

VI. *Part of a Letter written to Signior Antonio Magliabechi, by Mr Anthony Van Leeuwen-hoek, F. R. S. concerning the Particles of Silver dissolved in Aqua Fortis, &c.*

Delft, March 12. 1705.

I Take the liberty to acquaint you, Honoured Sir, that I communicated to you some Months ago my Opinion concerning *Diamonds*; the sum of which was, that they do not grow bigger by lying in the Earth, but that their magnitude and figure is assumed at once, and at the very time of the coagulation or coalescence of the Particles which compose them.

I was the more confirmed in this my foregoing Opinion, by putting Silver (which I have done several times) into a Glas Tube, that was about the thickness of my Finger, and length of my Hand; upon which Silver I poured as much *Aqua Fortis*, as was sufficient to dissolve it.

I put this Glas Tube, which was a third part filled with *Aqua Fortis* impregnated with Silver, into a Pot filled with Sand, and placed it almost Horizontally, and so as that it might not stir any way, in hopes that I might the better observe, (after a few Days,) the coagulating Particles, subsiding to the bottom, all along the length of the Tube.

Having view'd this Glas Tube with a *Microscope*, I observed divers small long Particles coagulated, which I judged to be Particles of *Salt Petre*; for as I turn'd the Tube a little before my Eyes, and as gently as I could, I put those Particles into a little Motion, and thereby at once discover'd three sides of them, which I imagined to

be the half of those Bodies, and consequently that they were of an Hexangular Figure; they appeared also as clear as Chrystal.

I saw a few long Particles, some of which were inclining to a Red, others to a Peach Colour. I further observed exceeding small Particles, that had the figure of polish'd pointed *Diamonds*; others were coagulated more irregularly.

Hereupon I took a second Glass Tube, and proceeded therewith as I had done with the former, and let it lie longer, and put a little Fire under the Pot that was filled with Sand, to the end that I might cause the said Diamond-like Particles to coagulate more largely.

After that, I poured the said *Aqua Fortis* gently out of the Glass Tube, so as that the coagulated Particles might remain in it; and then I turned the Tube with the Orifice downwards, that all the moisture might drain out of it.

Having done thus, I view'd the Tube through a *Microscope*, and saw that there stuck a great number of Chrystalline Particles on the inside of the Glass, of which several were an hundred times bigger than those which I had observed in the first Glass; then I separated with a small Copper Wire the Particles that lay together, in order to distinguish them the better, and saw with great amazement the abovementioned Chrystalline Particles, lying together like a heap of *Diamonds*, all of 'em as it were of a Hexangular Figure, and having each of them two sharp Hexangular Points; they were of several Magnitudes, and in one place we saw them scatter'd, in another lying on a heap. In a word, it would have been impossible to have disposed any real *Diamonds* before the sight of our naked Eyes, after such a manner, as to exceed this Phœnomenon.

I could not then discover among these wonderful coagulated Silver Particles, that had assumed a Chrystalline Nature, any *Salt-Petre* Particles: I shew'd them to several

ral Gentlemen, who view'd them with great Attention ; among the rest there was a *Jeweler*, who seem'd to be struck Dumb at the sight, and said, that it would be impossible for any five Mouths to declare the Wonders that he had seen.

Now, to be more sure that the abovementioned coagulated Chrystalline Particles were real Silver, (tho I made no doubt of it my self) since *Salt Petre* and *Copperas*, from whence *Aqua Fortis* is Distilled, do never produce such Chrystals, at least in all Observations that ever I made of them ; I took some of those Chrystalline Particles, and laid them upon a piece of Wood-Coal, and with the flame of a Wax Candle, which I blew upon them, put them into such a Fusion, that they presently became round Globules, which Globules were plain visible Silver.

Hereupon I sent for a *Painter*, who in his Youth had also been a *Silversmith*, and caused him to view those Chrystalline Particles thro a *Microscope*, and when I had told him what it was that he had seen, he burst out into this Expresssion, *Good God ! What Wonders are these ?*

I made him draw one of those Silver Particles of the same size with those, whereof I had discover'd great multitudes in my first Observation ; see Fig. 1. between A and B.

As also another Chrystal Particle represented by Figure 2. C.D.

Figure 3. EFGH. shews you another Chrystalline Particle as it lay just opposite to the sight, wherein you might observe at EG the beginning of the slanting of the six sides which end in the points of F and H.

Fig. 4. IKLM is likewise a Silver Particle turn'd into Chrystal, in which one would imagine that one saw between K and M (as it is describ'd at N) a Quadrilateral plain or flatness, and that IN and NL, parts of the little Chrystal, were also flatish ; and this appears more visibly

still in Fig 5. where the **Quadrilateral flatness** is described by V between S and T, but you must suppose that the difference of this and the foregoing Figure is only caused by the Objects not being placed directly before the sight, so that one could only see them the shortest way ; for if you suppose that both the Divisions, as they are described by PSR and PTR, are those parts which are both of them placed in the middle of the Chrystal, and that from thence the Hexangular slantings which formed the point described by O and Q take their beginning, the flats which one supposes to see at PV and VR are only occasioned by the undermost parts, which upon the account of the Transparency of these Figures are seen thro' em, and so represents a flatness, which in reality does not exist : For let us imagine that *that* part of Fig. 5. represented by O, were placed next the sight, the divisions of that Figure described by PTS, and lying directly in the middle of the Chrystal, will then be the uppermost side, and PSR, which is likewise in the middle of the said Chrystal, will be the undermost.

For my further satisfaction of these appearances, I took an Hexangular piece of Rock Chrystal, and drew two streaks upon it with Ink ; one upon that part that lay uppermost, and the other upon the undermost part, and each of them equidistant from the Hexangular upper point of the said Chrystal ; and then laying it before my Eyes, in such a Position that the shortning of it appeared next the sight, the uppermost streak seemed to lie much further from the sight than the undermost, and so between both streaks was represented a Quadrilateral flatness.

Fig. 6. WXYZ, does likewise shew us a ChrySTALLINE Silver Particle, in which the parts that lie undermost WY make the Chrystal to appear quite otherwise than it really is: This last ChrySTALLINE Particle did not seem to be so well formed as many of the others ; for in that Hexangular Figure, of which one could see but three sides,

sides, the point WXY seems to be much larger than the opposite point WZY ; The occasion of which, as I suppose, was that the point WZY lay undermost, and near other Chrystalline Particles, whereas the point WXY lay uppermost, and consequently admitted more freely the coagulation of its Parts.

Fig. 7. ABCD represents another Chrystal, which appeared to be an uncommon Figure to the Eye of the *Painter*.

Fig. 8. ABCDEF is another Chrystalline Particle, wherein the Hexangular side CDE is very short, like that slanting part represented by EFABC, of which FAB runs into a much shorter point in proportion than the uppermost part does ; I observed a great many other such Chrystalline Figures. Now 'tis possible that these Chrystalline Figures, which are bent a little crooked, might be so shaped at the time of their coagulating by my moving the Glass, and laying it in such a posture as is before mentioned, and which was also probably the reason, that the pointed part FAB had assumed that form that is represented in Fig. 8.

I placed another Chrystalline Figure before the *Painter*, which was bigger than that represented by Fig. 5 ; two sides of which were encompassed with, or rather there were coagulated upon them abundance of exceeding small Chrystalline Particles lesser than those of Fig. 1. AB ; in these one could discover but one small point, so that 'twas impossible for the *Painter* to give us a full view of such very small Particles.

Not content with the aforementioned Observations, I took anew two other Glass Tubes, something larger than the former, into which also I poured *Aqua Fortis*, and then threw in some fine Silver ; whereupon I whelmed the Glass Tube upside down, and placed it in warm Sand, to the end that the *Aqua Fortis* should dissolve as much Silver as it was capable of ; and after that this *Aqua Fortis*,
thus

thus impregnated with Silver, had stood some few days, and the upper part was become very clear, I decanted the clear Water, and poured it off from the Silver (that still lay in it) into another Glass Tube; and turning the Orifice downwards, I kept it in that Position fourteen Days, almost always in warm Sand, in order to try whether the Chrystalline Particles would not by this means coagulate bigger, but I could not observe that they did; And as for the second Glass Tube, that fell out of the Sand in the Night and broke to pieces.

After this, I took a little of the *Aqua Fortis* that was impregnated with Silver, and having weaken'd it with common Rain Water, I put some of it upon a clean Glass, and spread it over the Glass as thin as I could; and then put upon the said Glass, a small Particle of red Copper no bigger than a Grain of Sand; and presently view'd it with my *Microscope*, and observ'd, that the Silver Particles were coagulated out of abundance of almost invisible Particles in the said Water; and tho' I view'd those Particles with a Glass that magnified them as much as possible, yet they were unconceivably small, that I could perceive nothing else, but that these slender Particles were made up of other Particles yet smaller; but tho' I observed them never so nicely, I could not discover their Figures, even after their coagulations.

Now as we see these small Chrystalline Particles (which are really Silver) coagulated into such exact pointed Hexangular Figures, just as if they were so many polish'd *Diamonds*, and that these Figures grew larger and larger; we cannot doubt but that those Chrystalline small Particles have the same form, even before they are obvious to our sight.

Now, let us compare the coagulated Silver Particles, which are all of 'em, as it were, changed into Hexangular Chrystalline Figures, with the pieces of Rock Chrystal, which are likewise all Hexangular, and we shall observe,
 that

that the first coagulations of the Rock Chryſtal are exceeding ſmall as they are congealed out of the Air; and from time to time, ſo long as that matter is in the Air, it preſerves the Figure which it had in the beginning, unleſs it be hindred by other Particles lying about it, as we may in ſome manner obſerve in the coagulated Silver Particles, which tho they have lain ſome Months within the Glaſs wherein they were coagulated, during a very Rainy Seaſon, yet I could not diſcover the leaſt alteration in them.

Now it ſeems very ſtrange, that moſt of the Rock Chryſtals are Hexangular, and end in an Hexangular point; and tho ſome of them are ſlanting and almoſt flat, where they are joined to the Rock, yet one end or point of them is likewiſe Hexangular; But when we ſee with our Eyes *Salt-Petre* diſſolved in Water, and united with it, and afterwards coagulating therein, we ſhall diſcover all the exceeding ſlender and long Particles thereof to be of an Hexangular Figure, excepting ſuch which coagulating in a heap together are irregular; and as the Chryſtals end in an Hexangular point, ſo the ends of theſe *Salt-Petre* Particles run into a flattish or *Beetle-like* Figure.

So we daily ſee in coagulated Sugars, that we call *Sugar Candy*, moſt of their Particles to be of a Quadrilateral Figure, of which two of the oppoſite ſides are often broader than the other two, and that the ends of them, when they don't ſtick to other Sugar Particles, run into a ſharper *Beetle-like* Figure.

In ſhort, we ſee that the coagulated Silver Particles appearing like Chryſtals are all of them Hexangular, and end in two ſharp points, and that the Rock Chryſtal is almoſt always of the ſame Figure; and moreover, that *Salt-Petre* does alſo coagulate into Hexangular Figures with a *Beetle-like* ſharp point; but why ſome coagulate one way, and others another, is a thing unconceivable in my Opinion, and which can no ways be accounted for.

I did

I did likewise put a little Gold into *Aqua Regia*, and placed the Tube, in which the said Water and Gold was, in warm Sand, to the end that as much Gold as was possible should be dissolved ; but I could observe no coagulations in it, but only in some Particles branching out, the Figures of which, by reason of their smallness, I could not perceive. But as to the mingled Salts, of which *Aqua Regia* is composed, *viz.* *Salt-Petre*, *Vitriol*, and *Sal Almoniac*, I saw abundance of their Salt Particles coagulated ; all which had the figures of exact square *Diamonds*, having two sharp and two obtuse Angles ; they were of different Magnitudes, some so small that they were hardly to be perceived with a *Microscope*, most of 'em as clear as *Chrystal*, excepting some very small Particles that lay upon them which had no transparency.

Fig. 9. Three of those *Diamonds* of several sizes are represented by ABC, DE and FG, in which we could perceive a thickness, and the *Painter* has described it accordingly : We saw likewise some few Oblong four-sided Figures, with two acute and two obtuse Angles, as in Fig. 10. HI.

I imagined that in the abovementioned Figures there was no Gold at all, because I scarce ever discover'd any such Figures in *Aqua Fortis* impregnated with Silver.

There lay moreover upon, and about the said *Diamonds*, long *Chrystalline* Figures, which I conclude were Particles of *Salt-Petre*.

