

(1906)

I. *A Letter from Mr Anthony van Leeuwenhoek, F. R. S. concerning the Figures of the Salts of Crystal.*

ABout the end of last *March* the *Heer Peter Valkenier* made me a Visit again, and brought with him several Crystals that were still joyned to some pieces of the Rock, and were very remarkable; among the rest, the said Gentleman had one about as big as my Fist, which look'd like several small Flint-stones joyn'd together; they seem'd to be united by very Transparent Particles, which one might call Wild Crystal: And when I view'd the so nam'd Crystal Particles, of which the largest prominent Points seem'd no bigger thro the Microscope than a large Grain of Sand, many of 'em appear'd to me to be Hexangular, like the Mountain Crystal.

The said Gentleman told me farther, that in *Switzerland* there were found some of the highest Mountains, where the great and small Stones were almost mix'd or united with the wild Crystal, which Mountains are therefore call'd by the Inhabitants *Nagelfelsen*, which is as much as to say, the Nail Mountains or Rocks, by reason of the great number of prominent points in the same.

He very obligingly press'd me to take some of these Stones, so joyned as is above mentioned, in order to make my observations concerning 'em, which I did accordingly, and with a Key struck off 4 or 5 small Flint Stones from the great piece; in doing which, several of the so nam'd wild Crystal Particles came off together.

II

I placed the said Crystal Particles before a Microscope, and observed that each of them was almost of a different figure, tho' most of them run into an hexangular point of several sizes; in the breaking them from one another the sides assumed particular figures, which looked as if they were composed of nothing but long Particles, all of them as bright and transparent as any Crystal, save only in those parts where they were joyned to the Stones. The Crystal Particles lay very thick upon one another, and they were so small that 100 and more were not equal to our Crystal Particles; among others, I observed some Crystal Particles no bigger than a coarse grain of Sand, the which were composed of 100 other smaller Particles, all very transparent, and appearing thro' the Glass like a little Mountain of Crystal, which was a very agreeable spectacle.

I saw likewise several Crystal Particles, which, instead of ending in one hexangular point like others, consisted of several sharp ones, some of which were very different both in length and thickness from the rest, which confirm'd my opinion, that they were coagulated out of long Particles.

I observed, that where the little Flint Stones had not lain very close to one another, the void space, as it appeared to the naked eye, had also been filled with the said Crystal Matter; but when I came to view them more narrowly, I could perceive that those Crystal parts were indeed united to the little Flint Stones, but that there were several small Cavities between them; from whence I concluded, that the Flint Stones lying so upon one another, as we now find 'em, a fluid Crystalline Matter, out of which all the Crystals were coagulated, had insinuated it self between those Flint Stones; and where those Stones were not so closely joyned, there did not happen to be enough of that Crystalline Matter to fill up the vacant space.

I have thought fit to represent two of the so-named Crystal Particles, (as they appeared to me thro' my Microscope)

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whose superficies ended in such points as I have before mention'd.

Fig. 1. A B C D E F shews you one of the said Crystal Particles, wherein you may observe at A B C, and partly also between D F how it had been joyn'd, and how also it had been broken off from other Crystal Particles ; between D E F is that part from whence proceeds several prominent points, which the Painter has describ'd to the best of his power.

Fig. 2. G H I K L M N Represents a larger Particle of Crystal which had been joyn'd to another Particle lying by it ; as in G H I K O is shown that part that had not been united, and in which, as far as it is possible, the several prominent Points are describ'd by L M N G O. In handling these foremention'd Crystal Particles, I found that they were separated from one another with very little trouble ; to make a further proof of the softness thereof, I plac'd a Particle of it no bigger than a grain of Sand upon a Plate, and then pressing it with my Thumb Nail, it burst into a thousand small pieces, which seem'd the stranger to me, because we know generally how hard the Mountain Crystal is.

From this Experiment, I imagin'd, that what we call wild Crystal is mostly Salt, if perhaps it be not all so.

To make a further tryal thereof, I took a piece of the said Crystal about the bigness of a Pea, which I broke off from a Flint Stone, and laid it upon a Silver-Smith's Wood Coal, and put it into a glowing heat, and then threw it into some clean Rain-Water, whereby it was immediately dissolv'd into white Powder ; but viewing the same with my Microscope, I saw that there remain'd some Particles still as big as a grain of Sand.

The small quantity of Water in which the Crystal lay, that was no more than could be contain'd in a little Thimble, having stood about a quarter of an hour, I observ'd that the superficies of it was cover'd with a thin Scum, of which taking a small part, (as I did again when the said
Scum

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Scum was grown thicker, after the space of 3 or 4 hours) and placing the same before a Microscope, I saw, that besides several small Particles, of which for the most part the Scum was compos'd, there lay an unspeakable Number of Salt Particles, and those of very different figures, in somuch, that they are not to be described: Some of 'em were Long, Quadrangular and Hexangular Figures, appearing all of 'em to be solid Cubical Bodies; their longest sides were parallel to one another; and when I view'd these Coagulated Salts, some of which lay upon the Superficies of the Water, as others were sunk to the bottom, I observ'd that they were not only grown larger, but that each of 'em was encompass'd with several Circles or Circumferences.

Moreover, where the Water was exhald, there lay such an unspeakable number of small Salt Particles, that they did in a manner escape the sight, insomuch, that in some of 'em it was impossible to discover any figure; and of some that were yet smaller, there was nothing more to be seen in them than an exceeding slenderness and length; just as if one saw with the naked Eye very small Particles or Threads of Wool: From which Observation I suppos'd, that in case I had put the Water a little thicker together, instead of spreading it upon the Glass as thin as it was possible, the Coagulation of the Salt Particles would have been thicker and larger: I concluded too, that most of those very slender and long Particles were of the same figure as the larger. In short, the Salt Particles were so exceeding numerous, that it is inconcievable by any body but such as have had a sight of 'em.

When a great many of those very Transparent, and as it were Crystalline Salt Particles were become dry, their Transparency or Brightness did in a manner vanish, and they were chang'd to Opake Bodies, in which one could not perceive the least Transparency, but they appear'd to be a white Matter.

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This Discovery made me imagine, that whereas one of these foremention'd Particles, whilst it had any moisture about it, was always increasing, by a Confluence or Coagulation of unspeakably small Salt Particles, all of 'em so firmly united to one another, that they seem'd to be so many Crystals ; so when that same moisture was wholly exhal'd, the Coagulated Particles were presently separated from each other ; yet the Dissolution was not so efficacious as to deprive them of the figure which they had, but only of their strict Conjunction : So that instead of being one Transparent Body, they were turn'd into several Bodies, that did not admit the Light, but appear'd white to our Eyes. And I imagin'd likewise, that when the Water was exhal'd at last, those very small Salt Particles, whose figures, by reason of their smallness, had altogether escap'd my sight, were not Coagulated upon the great Salt Particles, and so were depriv'd of their Transparency ; whereas the Transparent Salt Particles that were more thinly Coagulated did preserve their Transparency, but they were but very few.

After that the abovemention'd Water had stood several days upon the so nam'd wild Crystal, which I had thrown into it glowing hot, I put a very small part of it upon a clean Glass, and plac'd the Water so, that there came but very little Air to it, and then I could perceive but a very little Coagulation of the Salt Particles ; but, placing the same Water in the Air, I saw that there were a great many Salt Particles coagulated. In short, there was such an inconceivable Number of exceeding small Salt Particles in a little quantity of Water that lay within the compass of a Pea, that it is impossible to make any man believe it.

I took moreover, some of the Salt Particles that lay upon the Superficies of the Water, after that it had stood about eight days, and observ'd at the same time, that they were not only coagulated much larger together, with very neat and smooth sides and superficies, but also that they were
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I have thought good to give you a Sample of some few of the Salt Particles that were coagulated in that Water, in which the glowing Crystal was quenched, that you may better conceive the Figures of them.

Fig. 3. Shows you between P and Q a little Figure of a Salt, in which such a Salt Particle lay, that according to all appearance was at first coagulated, and afterwards arrived at that bigness when the Water was quite exhaled.

By Fig. 4. between R and S is another Salt Particle described, having likewise within it a Coagulated Salt Particle, which at R. has two right Angles, and at S. an acute one, both the long sides thereof running Parallel, and at equal distance from each other; of these Figures there were a great many.

Fig. 5. T. U. shows you an Hexangular Figure, wherein also lay a smaller of the same shape, the which inclosed Figure was very thick.

By Fig. 6. between W. and X. is represented a Salt Particle, whose superficies made an exact square; Of these Figures I met with very few, especially where the Water had lain thick.

Fig. 7. Y. Z. describes a Figure, the like of which, I did discover an exceeding number, altho the same were very thin.

Fig. 8. shows also between A. and B. another Salt Particle, of which there were an unspeakable number coagulated in the Water.

Having made a great many Experiments in the last mentioned Water till it was quite exhaled, and having also poured new Water twice upon the so named wild Crystal, I saw with great surprize, that each time there was a Coagulation of new Salts upon the superficies of the Water; but most of them so very small, that they appeared thro the Microscope no bigger than a Grain of Sand to the naked Eye, and yet I could perceive the Figures of them very clear, and the more, because they were all of them
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very transparent ; and whereas a great many Salt Particles are so soft, that in moist Weather they are dissolv'd into a Watry Vapour, these were so hard and so dry likewise, as if they had been the Salts of Chalk ; and if one shook the Glass in which they were, they came off from it, especially those Salt Particles that were pretty large.

After these Observations I took another View, by the help of a Microscope, of several pieces of my Mountain or Rock Crystal, just as I had broke it off from the Stone, in which I had formerly discover'd, amongst others, some such figures as are describ'd in Fig. 5. between T U ; and now observing again an Hexangular piece of Crystal which ended also in a point of the like shape, I discover'd in the same several pointed blue small Crystals, as you see in Fig. 9. between C and D. They were of several sizes, and some of them a finer blue than the rest.

I also discover'd in another piece of Crystal much the like Figure, but none of them were blue, some of which were as transparent as Crystal, and the others again as dark as if they had been nothing but a blackish Earth ; some of them lay much deeper in the Crystal than the others.

I had one piece of Crystal, in which I counted above 30 little blue Figures, such as are describ'd by Fig. 9. and some of them so very small, that they appear'd no larger thro a Microscope than a grain of course of Sand to the naked Eye ; and as far as I could judge of 'em, they were most of them Hexangular ; but I observ'd, that some of them were not so perfect and regular as the rest, one point of them being bigger than the others, as they are describ'd in Fig. 10. between E F.

I saw also one little Figure lying, that was exactly of equal sides, but the fore-sides thereof ran obliquely, and the superficies of the same did also consist of an exact quadrilateral Figure ; it was moreover as bright as Crystal, appearing just like one of those Diamonds of the ordinary sort, which we call thick Stones.

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Is it not extremely surprizing to see the abovemention'd Figures incorporated in such a hard matter ? Some of them lying near the superficies of the Crystal, and some of 'em much deeper.

I have a piece of Rock Crystal that is Hexangular, and ending in an Hexangular point ; it is about a Finger thick, and an Inch long ; upon one side of it one could discover with the naked Eye little cavities or holes, about the largeness of half a Nail, the which cavities seem'd, for the most part, to be fill'd with an Earthy matter ; but when I plac'd the said Crystal before my Microscope, my opinion of it was, that while the said Crystal was growing or coagulating, several small Insects running about upon it, were irretiated or imprisoned therein ; the rather because that some other Particles lay yet deeper in the Crystal, and so they were altogether shut up in the same. The Bodies of these Insects or Worms were composed of very small and slender Circles, or Ring-like parts, as I have observed frequently in such *Animalcula*.

I placed the said piece of Crystal before a Microscope, and caused the Painter to draw a small part of one of these seeming Insects that lay pretty deep in the Chrystal, as you may see in Fig. 11. G H I K.

I could see no further of this Part, because the ends thereof, viz. G and I, were cover'd with other such like Particles ; and this was also the largest Body that I could discover amongst them, for the other Particles were broke into much smaller bits and pieces. Amongst all those that I observed, there was but one Particle that ended in a point, and that I judged to be a part of the Tail, as I guessed that another had been a Head ; I saw also two small Particles that had been alike green, and so were several other little pieces of Insects.

I had two pieces of Crystal, of which the smallest was above an inch thick and Hexangular, wherein I discover'd seven long Particles, the largest of which was no thicker than

than the Hair of a Mans Head; they were of a dark grey colour, and had at one end several thinner Particles, or little Fibres branching out; some others were much finer than the single Hair, and some of them of exceeding fineness.

In another and thicker Crystal, I saw above five and twenty more such long Particles; and notwithstanding that I broke that Crystal into pieces, to discover of what Matter these Particles were composed, yet I could not succeed therein. I saw indeed that one of 'em had a sort of a Cavity in it, and was round, another flat without any hollowness, and in another piece of the broken Crystal I could perceive a Triangular long Particle that was hollow; this last was very visible, because one end of it lay opposed to my sight. I saw also another very plainly that was Triangular likewise, two sides of which were a third part broader than the other; but I was not very sure that it was hollow: I saw also another long Particle that was Quadrilateral, of which the two opposite sides were twice as broad as the other two; and forasmuch, as I was well assured, that it could never have been any Hair or Particles of Wool, nor had I ever seen any Vegetable that had produc'd such fine slender Parts, I could not come to any conclusion what for a substance it was, and much less how they could come into the Crystal, in which they lay across or athwart one another.

I have observ'd before, that when I plac'd such Rock Crystal over the Fire, it burst into a great many pieces; from whence I infer'd, that in the same there must be shut up either some Vapour, or else Particles of Salt, that occasion'd its breaking into so many pieces; to discover which, I put into a little Glass several pieces of such broken Crystal; and observ'd that by the Fire a very little Moisture and Salt was drawn off from the same; but when I threw some of those pieces of Crystal, as glowing hot as I could make them, into Water, I could not discover, as I had
done

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done in others, any Salt Particles Coagulated upon the Superficies of the Water.

However, I took some more pieces of Crystal, and plac'd 'em upon a Wood Coal, and the small remainder thereof, which the Heat had not forc'd to fly away, I threw into some clean Rain Water; and tho I could discover no Salt Particles upon the superficies thereof, yet I took several times some of the said Water, and pour'd it upon the cleanest Glasses I could get; and after that it had stood some time both in moist and dry Weather, I view'd it often, and always perceiv'd, that there lay a great many Salt Particles of different figures coagulated, but could not discover the exact figure of the most of 'em, because the Water did not exhale; but I supposed that there were Salts of two kinds therein, *viz.* the Salts that were already coagulated, and other Salts that surrounded the aforementioned coagulated Salts.

I view'd these Salt Particles in the afternoon, in clear Weather, in the month of *April*; and next day in the morning about 6 a Clock perceiv'd them to be surrounded with so many seeming Water Particles, that one would be amazed to see it.

Amongst the said Salt Particles, when I had a very clear view of them, I observ'd some of them of the same figure with the Crystals, to wit, Hexangular; and just as our Rock Crystal is of an Hexangular figure, ending in points of the same shape, so likewise had these coagulated Salt Particles two Hexangular points, as they are describ'd by Fig. 12. between L and M.

I imagin'd to my self, that in case the Rock Crystal in its Coagulation had lain in such a position, as not to be united at both ends, but only in the middle, they would then have been compos'd of two Hexangular points, as we see in *Salt Petre*, which in coagulating in the Water, and fixing one of its sides to any other substance, is not only Hexangular, but the ends thereof, which run into a point, are

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are not Hexangular like Crystals, but oftentimes of the form of a Chiffle.

I saw a little Particle of Crystal, which tho very small, I could perceive to be of a Triangular shape, two Angles of it being a little larger than the third, as is represented in Fig. 13. between N and O.

I saw also some Salt Figures like Fig. 8. between A and B, but they had a thickness in 'em which was visible to the Eye, besides a great many other irregular Salt Particles, which were so very numerous in a small quantity of Water, that I was astonisht at it.

I caused the Water, that almost always surrounds the Salt Particles, to exhale leisurely by the warmth of a Candle, and then I could discover a great many coagulated small Salts without any visible figure.

II. *A Register of the Weather for the year 1692, kept at Oates in Essex. By Mr John Locke.*

I Herewith send you the Copy of my Register of the Weather, from the 9th of Decemb. 1691. to the end of the year 1692. It is fit I explain a little to you some things in the Table, for the better understanding of it.

The first Column, having D at the top, contains the day of the month.

That with H, the hour of the day, which beginning from one of the clock in the morning, I count round in one continued series to 24, which is 12 a clock at night.

The Column *Ther* is that of the Thermoscope, which was a sealed one, whereof you will find a larger account hereafter.

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Fig: 1.

