

Historiam lapidum singulari figurâ insignium, quos in sua provinciâ nasci comperit ; expectare iussit.

19. Maxillæ piscis fragmentum lapideum cum adnatis *Bufo*nitibus. Garvordix inventum.

20. *Glossopetra* exigua cum mandibulæ fragmento lapideo adnato. Faringdon.

At vero ad metam inopinatò pervenimus, jam nihil amplius adjiciendi est locus : & te forsan diutiùs quam par est, hoc uno argumento detinui ; quamvis gratissimum esse jamdudum comperi. Vale (vir Ornatissime) amicorum quacunque terrarum non immemor.

Oxonii, 20 Aprilis,
1693.

IV. *The Extract of a Letter from Mr. Anthony Van Leuwenhoek, S. R. S. to the R. Soc. containing several Observations on Cinnabar and Gunpowder.*

HAVING with the greatest niceness examined native *Cinnabar*, I could discover therein nothing worthy noting; wherefore I gave it a very strong Fire, upon which it soon began to move, many small Particles separating themselves from the rest, till they had crept into a cooler place ; and notwithstanding the great Weight of the *Cinnabar*, yet several considerable Particles as big as Pins Heads rose up from the Fire, and got into cooler places. When the Heat was encreas'd, the *Cinnabar* began to evaporate, a black Smoak arising, made up of
small

Small Globules : Examining this *Cinnabar* when cold, I found therein several six-sided Figures, such as is represented No. 1. *A*, of which some were very regular, others not ; they were of different sizes, some of the bigness of a small Sand, others an hundred times less ; some were of the *Fig. B.* shaped like an Equilateral Triangle with the Three Points cut off. I never found any of these Figures in the *Cinnabar*, till it had been exposed to a strong Fire, which separated them from it, notwithstanding which it still retained its red Colour, only was somewhat browner.

Some part of the *Cinnabar* that lay next to the fire appeared as *CD* ; some Particles also were like *E*, others like *F*, and some with several Points and solid Angles, as *GH*. Besides these Figures, there was a blackish matter, which like Smoak had been separated from the *Cinnabar*, where I found a great number of exceeding small Globules of *Quicksilver*, and admired at the great quantity thereof contained in the *Cinnabar* : Amongst these Globules lay some, which I judged to be Salt Particles ; but for their extreme minuteness I could not discern their Figure.

When I burnt the *Cinnabar* in the open Air, there arose a Flame very like that of *Brimstone* ; but upon examination I could not find that the inflammable parts thereof were true *Brimstone*. Then I caused the Flowers of *Brimstone* to arise, which I viewed, and found, amongst several irregular parts, some Globules transparent like Oil ; and the higher they rose from the Fire, the smaller were these Globules, till in the end they became undistinguishable. The Volatile parts of *Cinnabar* could not be driven very high, tho' with a great Fire, whereas those of *Brimstone* were raised much higher with a small Heat. I observed in the *Brimstone* several Salt-Particles, constituted, as I guess'd, of many small united Globules. For I suppose they were raised in a round

Figure, which subsiding shoots into Angles, especially if they meet with any Moisture.

Powdering some *Cinnabar*, I exposed it to the Fire as before, and found therein six-sided Figures, with some triangular ones, whereof some had one, others more Angles broken off; with other differing Figures with one acute Angle, but there were no Squares or Oblongs. I often found amongst them a considerable quantity of Oil, with some transparent parts which I took for Salts; this Oil lay farthest from the Fire: and I judged the Flame which I sometimes observed, might be from the burning of these Oily parts.

I then poured Rain-water on some of this *Cinnabar* that had been raised by the Fire without flaming; and when it had stood in the Air till part was evaporated, I found a great number of Salt Particles of a longish Figure, as are represented N^o 2. *I*. And tho' some of these were bigger, yet I judged them to be formed of the smaller ones united together. Amongst the rest some were pyramidal, constituted on a six-sided Basis, and ending in a point like little Diamonds. There were Salts of some other Figures, as Oblongs, &c. So that no estimate can be made of these Salts. It is true Rain-Water affords a Salt, but it is in so small a quantity as not to be considered in this Experiment.

Then I poured Rain-water on beaten *Cinnabar*, and after some Weeks settling, and in part evaporated, I found therein an inconceivable number of Salt Particles, of which I could not discern the Figures they were so small, my best Microscope shewing them no bigger than a Sand appears to the Naked Eye; only I fancied some were Sexangular. Boiling some of this Water, and evaporating part of it, the aforementioned Salts were to be seen in greater quantity; some of the largest are represented, magnified, N^o 2. *K. L. L.*

Having

Having therefore thought that the Salt Particles which were raised up by the force of the Fire, must necessarily be of a Spherical Figure, as being softned and melted by the Heat, I was willing to be satisfy'd herein; and remembring some Remarks I had formerly made on Gun-powder, I took several clean Glafs Vials from 3 to 6 Inches long, these I heated to dry them, and rarify the Air, and then put therein one or more of the largest Corns of *Gunpowder*, and closed them up to exclude the common Air, and placed them in so great a Heat that the Powder took Fire, filling the Glafs with a white Smoak, some of the Cole and Brimstone sticking to the sides; but putting in more Corns, they were carried up much higher, so that I could very distinctly discern the Brimstone from the Nitre; for it lay so thick in some places, as to exhibit a yellow colour, and might, by a good Microscope be seen moving circularly in the white Smoak, which was the *Nitre*; tho the Particles thereof were very small, which, when moving, appeared perfect Spheres, which leisurely subsided to the bottom of the Glafs: Wherefore I laid the Glafs along, that the Particles of the *Nitre* might be distinct from those of the Coal and Brimstone; and then I found those Particles which before seemed Globular, were, when fixed on the sides of the Glafs, all shot into six-sided Salts. Some were like N^o. 3. *M. N.* with others irregular as O, and some of these ended pyramidally like little Diamonds. Some of the Salt peter Particles which lay mixt with the others were long and slender, and looked like little bundles of Arrows.

Besides the forementioned parts, I observed a Moisture in the upper part of the Glafs upon the first firing of the Powder, which I guess'd might come from the *Nitre*, and therefore shall call it Oyl of *Nitre*, tho' possibly there might be some Oyl of *Sulphur* mixt therewith; for further Satisfaction I put some refined

Nitre

Nitre by it self in a Glass, leaving a small hole in the top to prevent its bursting, and gave it so great a heat, that the *Nitre boyled*, and found in the upper part of the Glass a very transparent fluid matter, or Oyl, which at another time was curdled together in irregular Figures, and stuck to the Glass.

Not fully satisfied herewith, I repeated the Experiments with the powder, and immediately after its blowing up, I viewed the Glass with a Microscope, and could then discern the very suddain change or shooting of the Globular Particles of the *Nitre* into Sexangular Salts, and that all at once. The number of these Salt-Peter Particles afforded by one Corn of Powder, is inconceivably great, besides those of the Sulphur and Coal. These were best seen when I fired but one Corn; for when there were more fired, the greater quantity of *Nitre* blew up so much of the Sulphur and Coal, that the change and shooting of the Salts could not be so well seen. If I fired the Powder with Heat from below, the Coal and Sulphur would be blown up; but if with Heat from above, but few Particles of the Coal, and yet fewer of the Sulphur would be forced up.

Next I fired one, two, and three Corns of Powder in several closed Glasses, and suffering them to cool, I opened them (some after 4 or 5 days) and found always compressed Air therein, which flew forcibly out. That I might know the quantity of this generated Air, I opened some of them after such a manner, that the Air contained therein issued into a Bolt-head with a narrow Neck, which was filled with Water, which, as the Air rushed in, was forced out; by which Experiment I found the Air compressed eight times what it was before; or, which is the same thing, when at liberty took up eight times the room it did before.

Not fully satisfied herewith, I put one Corn of Powder in a Glafs, and closing it up with a very small hole only at the narrow end, which end I placed under the Water in the glafs Vessel as before, and firing the Powder, so great a quantity of Air was thereby generated, as forced out 160 Grains of Water. Now 13 Corns of Powder weigh but one Grain; wherefore multiplying 160 by 13, which makes 2080, we find that Gunpowder fired expands it self 2080 times, or takes up so many times the Space it did before.

I observed likewise that the Glafs wherein the Powder was fired would be always filled half full of Water immediately after the Explosion, the reason of which I conceived to be the great rarefaction of the Air, by the Heat of the Fire and stroke of the Powder, which upon cooling takes up less Space, and the Water enters in to fill up the rest to prevent a Vacuity.

From this last Observation, I concluded that a Bullet cannot be shot with so great a Force out of a very long Canon, or other Gun, as out of one something shorter: And discoursing since with a certain Commander upon this Subject, he told me he was once present when upon a Wager a Cannon of 14 Foot threw a Ball much farther than one of 18 Foot.

As to the Reason, how so great a quantity of Air comes to be generated, tho' I thought of several Solutions, yet I could not satisfy my self; I sometimes thought that the Particles of the Air were by the violent motion broken and comminuted into smaller, and so between each Particle a much finer Substance might be placed, but this did not answer so great an Expansion. Upon the whole, I concluded that the greatest Improvement that can be made in shooting, is, if possible, so to order the matter, that all, or the greatest part of the Powder be fired at once; and when this is effected, a much less quantity will serve than is now used.

To examine yet farther this matter of new-made Air, I took one Grain weight of Crabs Eyes, to which I poured Wine Vinegar, and in 4 hours as much Air was generated as filled the space of 44 Grains of Water; and 3 Grains of Crabs-Eyes produced about three times as much. This new-made Air kept its Expansion for 12 hours that I observed it, whence it appears to have been true Air.

V. *The Description of the American Tomineius, or Humming Bird, communicated by Nehemiah Grew, M. D. and Fellow of the Royal Society.*

There is in most parts of *America* a Bird called by the *English* the *Hum-Bird*, by the *Spaniard* *Tomineius*. He is of a most excellent shining green Color, and very resplendent; the Colour doth something resemble some of our *English* *Drakes-heads*. It doth inhabit in some of the colder parts of *America*, as well as in the hotter. It is the least of all Birds that I have seen there or in *England*; her Leg and Foot together is but half an Inch, the other parts answerable, the Trunk of her Body not an Inch. I did weigh one (in those parts) as soon as ever it was kill'd, whose Weight was the tenth part of an Ounce *Avoirdupoize*, which I take to be about the Weight of a Coined Six-pence. And I have weighed here in *England* a *Tit-mouse* (which I take to be the least Bird here) and it weighed above Two Shillings, and some Half a Crown. I saw one of their Nests made of Cotton-Wool, in form and bigness of the
Thumb

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