



## XXVI. Remarks on the geological theory supported by James Smithson, Esq. in his paper on a saline substance from Mount Vesuvius

J.A. De Luc Esq. F.R.S. & c. & c.

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[P. 206] various parts of England. At length, after repeated attempts with Mr. E., had proved, that he could neither sufficiently explain, the already well known principles of Draining, or add any *new* one, as the too sanguine zeal of the President of the Board of Agriculture had imagined (see Communications to the Board, vol. i. pages lxi. and lxxvi.) and so persuaded the Legislature: in order to satisfy the condition annexed by the latter, to the *public Reward*, thus prematurely voted to Mr. E., the measure was adopted, of employing two or more young Men, to travel through the various districts in which Mr. E. had effected or attempted to make drainages, and from their own observations and study of the subject, and what they could draw from Mr. E. to furnish, in a degree at least, such a work on the subject, as the Legislature expected, as the result of the national liberality. Mr. John Johnstone, one of these young Men, very ably executed his task, and explained more fully than had previously been done, the principles and practices of this important art, in a Work prepared by him, but which is on almost all occasions (as in the present one by Mr. B. apparently) improperly ascribed to Mr. Elkington, Rep. ii. 372 Note.

[To be continued.]

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XXVI. *Remarks on the geological Theory supported by JAMES SMITHSON, Esq. in his Paper on a saline Substance from Mount Vesuvius.* By J. A. DE LUC, Esq. F.R.S. &c. &c.

Windsor, January 1814.

SIRS,—IN the number of your Magazine for last December, which contains my paper addressed to you, “On a Phenomenon of Mount St. Michael in Cornwall,” I have found a paper under the title: “On a saline Substance from Mount Vesuvius, by James Smithson, Esq.” intended to support a new geological system, thus introduced at the beginning of the paper. “It has long appeared to me, that when the *earth* is considered with attention, *innumerable circumstances* are perceived, which cannot but lead to the conclusion, that it has been once in a state of *general conflagration*. The existence in the skies of planetary bodies, which seem actually *burning*, and the appearance of *original fire* on our globe, I have conceived to be mutually corroborative of each other; and at the same time when *no answer* could be given to the most essential objections to the hypothesis, the *mass of facts* in favour of it fully justified, I thought, the inference that our *habitation* is *an extinct comet or sun.*”

Such is the system: and we must now consider what is that

that mass of facts that justify the hypothesis, of which it may be supposed the author adduces the most striking: he thus continues: "The mighty difficulties which formerly assailed this opinion, great modern discoveries have dissipated. Acquainted now, that the bases of alkalies and earths are metals eminently oxidable, we are no longer embarrassed either for the *pabulum* of the inflammation, or to account for the production of it. In the primary strata we behold the result of combustion: in them we see the oxide collected on the surface of the calcined mass, first melted by heat, then by its increase arresting further combination, and extinguishing the fires which had generated it, and in fine become solid and crystallized over the metallic ball. Every thing tells, that a large body of combustible matter remains inclosed within the stony envelope, of which volcanic eruptions are partial and small ascensions. Under this point of view, a high interest attaches itself to volcanoes and their ejections; they cease to be local phænomena; they become principal elements in the history of our globe; they connect its present with its former condition."

This surely is as new, as it is a grand system; but what is its foundation? The author tells it himself in the title of his paper; it is on a saline substance from Mount Vesuvius; and he informs us that it was sent to him from Naples, while he was at Florence in May 1794, with the request of ascertaining its nature; after which he thus continues: "The general examination which I made of it, showed that it was what at that time was called vitriolated tartar, and it was in consequence mentioned as such in an Italian publication soon after."

Then he gives the following particulars concerning the manner in which that substance had been found: "I was informed by a letter, that it had flowed out liquid from a small aperture in the cone of Vesuvius, which I apprehend to have happened in 1792 or 1793."

Thus we may judge, that the author has never observed himself Mount Vesuvius, and that he knows only by report a few of the phænomena of that volcano. He then proceeds to detail the chemical analysis which he had made of that saline substance; but as he is aware that so small and even so indirect a fact could not support his igneous system, he ventures on another ground, in which I shall now follow him, and afterwards return to volcanoes.

"In support (he says) of the igneous origin here attributed to our primitive strata, I will observe that, not only no crystal imbedded in them, such as quartz, garnet, tourmaline, &c. has been seen inclosing drops of water, but that none of the materials of the strata contain water in any state."

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The author appears not to be acquainted with such mountains formed of *primitive strata* as are those observed in the central ridge of the Alps, in which is found the *rock crystal*, of a *quartzeous nature*, and even the purest *quartz*; a fact directly contrary to his assertion: but the circumstances attending that *crystal*, and the *crystal* itself, indicate so incontestably its *aqueous origin* and that of the *strata* in which it is found, that I shall describe the most important of them.

At the time when I first travelled in the Alps, which was in 1744, *rock crystal* was employed, by cutting it, for various ornaments in houses, as lustres, sconces, and frames of various sorts, as may be seen in some ancient palaces.

Considering that the circumstances attending that *crystal* in the *strata* could lead to the natural history of the latter, and as living at Geneva near the Alps, my brother and myself resolved to visit the places whence that *crystal* came, and to converse with those on the spot whose profession it was to extract it, in order to be informed of the nature of their work.

After having travelled in many parts of the Alps, we generally found that *rock crystal* belonged to a certain class of *micaceous schistose strata*, with many circumstances attesting the *aqueous origin* of that *crystal*, and consequently of the *strata* themselves. The following was the information which we received.

A general fact is, that *rock crystal* is never found but in *cavities*, the sides of which all around are covered with its *prisms*. Those of the inhabitants of the Alps who made that *crystal* the object of their pursuits, commonly called *crystal-hunters*, knowing by the aspect of the *strata* those in which such *cavities* were likely to be found, and that they could not be discovered but in *abrupt sides* of the *rocks*, because the rubbish and grass cover the other parts, used a very hazardous method to find out those *cavities*. On the top of such abrupt sides in which they discovered their characters, they bored some holes in the solid rock at different places, for the following purpose. They fixed very solidly poles in these holes, and twisted round them a rope, at the one end of which hung a sort of basket: in this the most courageous of them was let down, allowing him a greater share of the adventure; while his associates, to whom he trusted his life, held the other end of the rope at the top.

As that man went down along the different parts of the rock, he struck it with a hammer, and by the different sound of the strokes he judged whether the rock was hollow. If there was no sensible difference in the sound, he did not think it worth while to open the *cavity*; but if the sound gave him the hope of finding a large *cavity*, then care was taken to secure him better, as he was to open it, and, entering it, to detach the *prisms*.

*Fragments* being only used for the common purposes, the man who entered these cavities broke with his hammer all the projecting *prisms* around it; and the quantity was sometimes so great, that the associates made much money from what they obtained in one of them. Such are the general circumstances concerning *rock crystal* found in that kind of *schistose strata*; but the particulars to which I now come, are no less important to the natural history of that mineral.

I shall mention as a first important circumstance, the *size* of some *prisms* which have been found. I have known two *prisms*, one of which was perfectly transparent, employed in a most beautiful work for the late Empress Queen, which *prism* was from 9 to 10 inches in diameter: the other, less transparent, was above one foot. I think I can now say with more certainty than the author has done for his hypothesis, that *such crystals have never been seen as the product of fusion*. But the character of true conclusions from the phenomena, is manifested by the coincidence of circumstances in the same object; and it is the case in the system of the *aqueous origin* of our *mineral strata*: a confirmation to which I now come.

As the men who followed this pursuit knew also that some curious travellers in the Alps paid them for the trouble of detaching parts of the crust covering the sides of the *cavities* with its *prisms*,—which crust, by naturalists of many countries, is called *druses*,—they carefully detached them; and we had the opportunity of purchasing many which are in our collection of minerals remaining at Geneva. Now, in these *druses*, many proofs are found that they were formed in *cavities* during the time that our continents constituted the *bed of the sea*, and that consequently these *cavities* were filled with *water*. That great geological fact, so contrary to the *igneous system* of the author, is demonstrated by the immense quantity of *marine exuviae* found in the *strata* commonly called *secondary*.

By the inspection of the *druses* that we have in our collection, it is impossible not to be convinced that the *prisms* have been formed, not only in *cavities* filled with *water*, but by a process in which each *prism* increased *successively* in *size* by new additions; and that they were as *shooting* at the same time in different directions from the same points. In one of these *druses* a large *prism*, in its increase of size, has enveloped a small one; they are both very transparent; and this phenomenon might be overlooked, did not the *small prism* project on one side of the other: but this circumstance directing the sight in the large *prism*, the small one is seen in it by the different refraction of the light. In another druse, by some change in the *successive* process of crystallization, a large *prism* has divided itself into small ones, like the branches of a tree.

It would be endless to describe further the phenomena of *druses*, all leading to the same conclusion : the various manners in which the *prisms* cross each other, divide and unite again. But there is a particular circumstance, which is exemplified in a process that we see going on, that of the *crystallization* of *salts* in *liquids*. Each *salt* has its particular character and shape ; and if a *liquid* hold in solution different *salts*, they crystallize separately in known circumstances, especially in different temperatures. Now there is a similar phenomenon in the *crystallization* of *rock crystal*, showing that in some of the *cavities* in which it has been formed, the liquid contained in solution other mineral substances, one in particular, whence have proceeded small crystals of *green shorls*, from which many *prisms* of *rock crystal* are made, unfit for any other use than that of variety in mineral collections.

These *green shorls* were at first supposed to be *mo-ses* that had grown in these cavities ; a supposition contradicted by its being impossible that *land vegetables* should grow in the sea ; but by observing these *shorls* with a magnifying glass, the mistake is soon discovered, by the *angular* form of their thread. We have a *prism* of rock crystal made almost opaque by these *shorls*, in which one of them having been destroyed, has left an angular hole from one side to the other, through which a horse-hair can pass.

I now come to the assertion of the author, *that none of the crystals has ever been seen inclosing drops of water*. This might be, without affording any argument against the *aqueous* origin, and for instance, of *rock crystal* ; for there is no reason *a priori*, that water should be inclosed in any of its *prisms*. However, the fact itself contradicts his assertion. It is natural to infer that he has not seen the case himself, since he never alludes to *rock crystal*, though so important to the natural history of the *primitive strata*. But I have seen many *prisms* of that crystal containing *water*, and there is one in our collection, the particulars of which I shall describe.

This prism is about two inches in diameter ; it is traversed by many small crystals of *green shorls*, between which a small quantity of *water* remained engaged during the increase of its size. That *water* is manifested by a *bubble of air*, which remained inclosed with the *water* retained also by the *shorls*. By inclining the *prism*, that *bubble* moves gradually from nearly one end to the other of the prism ; but as, according to the *shorls* that it meets in its way, its direction is determined, it does not follow the same course in every trial, except when the inclination of the *prism* happens to be the same and on the same side, and it shows thus the space which is occupied by the *inclosed water*.

Now, since the author says in favour of his *igneous system*, that *no crystal such as quartz has ever been seen inclosing drops of water*, which ought to be the case in that system; the contrary being the *fact*, is a peremptory proof against it.

I now come to the inferences which the author derives from the phenomena of *volcanoes*, making however this previous remark, that in this case again he has made himself no observations, nor even on Vesuvius, of which alone he speaks; for he says that he had received his information from a correspondent at Naples. But besides, the only fact on which he has built his whole system, is that *saline substance*, of which even the particulars that he relates are either not well expressed, or must proceed from a very inaccurate observer. I shall prove hereafter that this account is erroneous; but I must first state the nature of volcanoes, on which all their phenomena depend.

What are *volcanic eminences*? In what manner do they begin to be produced? How do they increase in height and extent? Fortunately the answer to these questions is obtained from a known event, transmitted to us by witnesses of the whole process, from beginning to end, in the formation of a new *volcanic eminence* between Naples and Puzzoli, which has retained the name of *Monte Nuovo* (new mount). I have given the whole account of the event from those witnesses, in p. 398 of the xith volume of my work, *Histoire de la Terre et de l'Homme*, of which account the following is a translation.

"In the night between the 29th and the 30th of September 1538, after two years of almost continual *earthquakes*, and especially after a day when the earth had been continually agitated, at last an *opening* was produced in a very fertile land; through which *opening* came out so much fire, and such a quantity of stones and cinders, that they produced a small mountain, now called *Monte Nuovo*; it destroyed many houses, fields, men and cattle, and buried under its materials the borough of Ripercola: it is about three miles in circumference, and its height is not much less than that of Mount Barbaro near it, which is estimated at a thousand steps; the ejections from that opening extended down to the sea. At the summit of this *mount* is still seen the mouth which ejected such a quantity of matter; which ejection however ceased very soon. The *Lago lucrino*, thus called from the *lucre* or profit resulting from an abundant fishery, was so much filled up by the matters thrown out of that opening, that it is now only a marsh covered with reeds."

From this known and well circumstantiated event, we are enabled to answer the above important questions concerning the formation of *volcanic cones*. A first explosion produces an *opening* in the *mineral strata* of the land; through that opening  
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come out successively *lavas* and *showers of cinders*, which by degrees produce an accumulation in the form of a *cone*; and the materials of such *mounts* are as distinct from the *original strata*, as iron is from wood.

The author has no real knowledge of the various *ejections* of Mount Vesuvius, since he derives his hypothesis from the specimen of a *saline substance* sent to him *from Naples*. But to conclude a system on that *specimen*, is the same as to decide the nature of all the *mineral strata* of an unknown country, from a *fragment of stone*. If he had known my geological work above mentioned, *Histoire de la Terre et de l'Homme*, he would have found in it, from the observations of my brother, such an exact description of all the *phænomena* of volcanoes, as must have superseded in his mind the erroneous information which he appears to have received from Naples.

Nobody, to my knowledge, has observed the various volcanic phenomena more thoroughly than my brother, not only of Vesuvius, but of Etna, and of the *volcanic* islands of Lipari, near Sicily. He has seen actual eruptions of Vesuvius, and followed the steps of new *lavas* flowing over old *lavas*. This progress continues as long as the new *lava* retains a sufficient heat to maintain its softness; but at a greater or smaller distance, though still *red hot*, it hardens and breaks; then the broken pieces, still propelled by the soft *lava*, rise in heaps at the extremity, and tumbling over one another, they produce a particular noise heard at a considerable distance. Such are the real characters of *lavas*, unknown to the author, who has never had the opportunity of observing them himself.

My brother has been no less attentive to the *saline* and *sulphureous* substances observed on the sides of Vesuvius. The author says he was informed *by a letter*, that the *saline substance* of which he had received a specimen, *had flowed liquid from a small aperture in the cone of Vesuvius*. I think he might have judged himself, that this was impossible. How could so small a quantity of matter, supposed to be in *igneous fusion*, preserve the heat that is supposed to make it *liquid*, while passing through a great thickness of old *lavas*, long reduced to the temperature of the air? This supposition, therefore, is absolutely improbable. My brother, who has carefully observed those substances that appear on the surface of the old *lavas* towards the top of Vesuvius, and has detached fragments of them preserved in our collection, has invariably found that they had been, and continued to be, produced in *crevices* which emit *fumes*: thus showing that these substances are a sort of *sublimation* which accumulates against the sides of the *crevices*, without any appearance of their having been ever in a *liquid state*.



With respect to the *nature* of *lavas*,—a most important point concerning all the volcanic phenomena, with which the author is totally unacquainted,—my brother has found in it all the characters of a *combustible* substance, which is *burning* before it comes out, and continuing to *burn* outside as long as it retains a sufficient heat. This combustion is shown by the *sulphureous smoke* that *lavas* emit all along their course. But that *smoke* is not the immediate product of the combustion; it proceeds from the decomposition of some *elastic fluids*, which, as long as they find no *vent*, are the cause of the ascent of *lavas* in the *cones*.

This circumstance is known to the inhabitants around Vesuvius; for, when they observe almost a cessation of the *smoke* issuing from its *crater*, they are in fearful expectation of the consequences, as it indicates that some *lava*, ascending in the channel, has cooled and hardened in it. The first consequence is *earthquakes*; and the next probable event, which is very dangerous, is the bursting of a *lava* from some other part of the cone. If that new lava flows over cultivated grounds, it sets on fire trees, vines, and even houses. But the new *lava* melting that which had stopped the channel, the *smoke* again issues from the *crater*, and these fatal effects cease.

The *showers of cinders* sometimes emitted from the craters of *volcanoes*, being an astonishing character of their operations, interested my brother very much, and he resolved to try whether it would be possible to observe it in the very *crater* of Vesuvius. At a time, therefore, when it was observed from Naples that such *showers* were frequently emitted, consisting of large *red-hot masses* mixed with smaller, always preceded by a *thundering* noise, and thrown up very high, which in the night appeared a most tremendous fire-work; my brother, taking notice of a favourable circumstance, that of a strong wind which repelled these ejections on one side of the *crater*, thought to avail himself of that opportunity. He therefore set out immediately from Naples, and ascended the *cone* on the side again-t which blew the wind.

Arrived at the top of the mount, he descended into the *crater*, and came as near the edge of the channel as he thought it prudent. At first he saw only some redness deep in the channel; but after a little time he heard the *thundering* noise; it began very deep; then it was heard to ascend at the same time that the *red matter* rose; and when its column arrived at a certain height, in a part of the channel which was wider, the *elastic fluid* that had pressed it so far upwards, burst through it, and a *shower* was produced. This being a remarkable phenomenon, not to be expected frequently with the favourable circumstance of a strong wind, my brother remained there a sufficient time to see it repeated with its various degrees.

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Desirous to know also in what state was the matter thus thrown up very high, and falling in *showers*, he followed with the sight some of the largest masses; and observing in what part of the *crater* they fell, he hastened there before another explosion: he found that they were come out very soft; for the largest, preserving longer their heat in their way through the air, were flattened like *cakes*; but the smaller masses, though still red-hot, had preserved their various forms.

It is from these *ejections*, carried out of the circumference of the crater in different directions by strong winds, that are formed the *slopes of loose cinders* which make the ascent to the *crater* very difficult, because they slide under the feet: those, therefore, who are not used to climb on all kinds of mountains, are obliged to employ some men, ready there for that purpose. These men have a belt, with a loop of string fixed to it, taken hold of by the people who could not ascend without help, who are thus dragged up.

But my brother, used to climb the slopes of *rubbish* in the Alps, which oppose the same difficulty as those of *cinders*, judging that on the slopes of *cinders* might be found all the kinds of *ejections* from the *crater* of Vesuvius, walked over them at different times in different directions, with expectation that they might lead to some knowledge both of the *depth* from which they proceeded, and of the kind of *mineral strata* through which they burst. He was not disappointed in that hope: for he found among the *cinders* large fragments of *granite*, *sienite*, of several kinds of *quartzeous stone*, and of *hard limestone*; all of which belonging to the lowermost known *strata*, indicate clearly that the substance of which *lava* is formed lies *under* those *strata*.

Thus, when the real phenomena are attentively studied, nothing is left for the work of imagination. Is it permitted in presence of common sense to form *general systems*, from particular phenomena? Had the author considered this, he could not have supposed that a particular *saline substance* found on the slope of Vesuvius could lead to conclude that the *internal part* of the globe shows it to be *an extinct sun or comet*; while the *ejections* of that *volcano* demonstrate that the *lava* is formed under known *mineral strata* in which no sign of *igneous* operation is discovered.

Another great fact, with which the author appears to be totally unacquainted, though I have described it with all its circumstances in the abovementioned work, *Histoire de la Terre et de l'Homme*, is this: On the surface of our continents rise many *volcanic eminences*, showing indubitable characters of having been produced on the *bed of the sea* before it became our *continents*.

That great geological fact of our *continents* having been formerly the *bed of the sea*, so contrary to the author's system, is

demonstrated, as I have already had occasion to mention, by the immense quantity of *marine exuvie* inclosed in the *secondary strata*. Now this character is found in the same countries as the *volcanic eminences* that are now the object, which I have particularly described, along the left bank of the Rhine, between Coblentz and Bonn, and in the country of Hessa. These *eminences* have all the characters of the actual *volcanoes*, and in particular of Vesuvius. In them and around them are seen not only *lavas* of different degrees of porosity and of mere *scoriæ*, which successively flowed over each other, but between them layers of *cinders* and an immense quantity of *pumice-stones*.

The *pumice-stones* are a known circumstance belonging to Vesuvius, but with a very remarkable character. It is not an ejection from the *crater*, or from any *known* part of that *volcano*; it rises from the *bottom of the sea*, in parts where the water is very hot. My brother had the opportunity of discovering that circumstance by a dog, who was fond of swimming by the side of his boat, and sometimes cried out as being scorched by the heat; and my brother actually found the water hot by plunging his hand into it. These are probably the places whence the *pumice-stones* come up from the bottom of the sea: they are found floating on the surface of the sea, as *pumice-stone* is specifically lighter than *salt water*.

Now this very important and known *volcanic product* is found around some *volcanic eminences* near the Rhine. I have seen very extensive beds of *pumice-stones* on the left bank of that river opposite to Coblentz; and in some places these beds of *pumice-stones* are intermixed with distinct beds of *cinders*, thrown up at some intervals from the *crater* of these *volcanoes*. But on this subject, as on the *aqueous origin* of our *mineral strata*, there are too many circumstances all to be mentioned here; I must therefore refer the author to my descriptions.

These are not the only remains of ancient *volcanoes* observed on our *continents*. In a new geological work which I have lately published, under the title of *Geological Travels through some Parts of France, Switzerland and Germany*, I have described in the northern parts of the latter country a multitude of *basaltic hills*, which evidently are *volcanic* from the nature of their substance; but they are particularly interesting, as they afford a new proof that some *lavas* come out from the *bottom of the sea*: these *lavas* from their nature, when meeting red-hot the water of the sea, were broken into the *prismatic* form of *basaltes*.

Of this effect my brother has seen an instance belonging to modern *volcanoes* on the coast of Sicily, near Catana. A *lava* having flowed from the side of Mount Etna down to the sea, the part which remained on the *land* retained the character of all *lavas*:

*lavas* ; but that part which entered the sea is seen, at the time of low-water, to be divided into the *prismatic* form which characterizes *basaltes*.

I hope, Sirs, that Mr. SMITHSON will read with interest in your Journal the statement of various geological facts which he had not had the opportunity of observing himself. He will thus understand, surely, that *geology* is too extensive a science for a general system being formed with any certainty, without having observed the different characters of the surface of the earth, not in one country only, but in many ; as in some countries the same phænomena are attended with others which may prevent mistakes. And with respect to information received from countries unknown to ourselves, he will also conceive that no reliance is to be placed on the observations of those whose accounts manifest that they have considered the phænomena with a mind prejudiced by some previous hypothesis to which they are bigoted.

I have the honour to be, Sirs,

Your most obedient servant,

To Messrs. Nicholson and Tilloch.

J. A. DE LUC.

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XXVII. *On the Phænomena of Sleep.* By a Correspondent.

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THE celebrated physiologist Dr. Whytt suggested that congestion of blood in the head was the immediate cause of sleep. Though this position was supported by a large induction of facts, it soon fell into disrepute, upon the discovery of congestion under circumstances no way analogous, as in lunacy, convulsions, insanity, and intoxication. Dr. Whytt's views however have lately been revived, and extended with some modifications to an ample explanation of all the phænomena. It is now ascertained that there is a congestion of blood in the head during sleep ; but that congestion alone is insufficient, a retarded circulation being also necessary. For this modification we are indebted to Dr. Park, the author of "An Inquiry into the Laws of Animal Life." From this work, which is a general outline of physiological science, the grounds upon which the phænomena of sleep may be explained are chiefly extracted. This writer reasons entirely on an inductive or analytical process: that which I shall use will be synthetic, applying his principles to a very minute statement of facts, and occasionally advancing ideas of my own.

Two important facts are established in this work; one relating to the connexion between the function of every organ and its circulation, and the other to the changes incidental to the circulation itself. The former shows that the faculty of feeling and the power