



## IV. Agenda, or a collection of observations and researches, the results of which may serve as the foundation for a theory of the earth

M. De Saussure

To cite this article: M. De Saussure (1799) IV. Agenda, or a collection of observations and researches, the results of which may serve as the foundation for a theory of the earth , Philosophical Magazine Series 1, 5:18, 135-140, DOI: [10.1080/14786449908677129](https://doi.org/10.1080/14786449908677129)

To link to this article: <http://dx.doi.org/10.1080/14786449908677129>



Published online: 18 May 2009.



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loured scoria than when the former varieties exist; a speck of plumbago is now only found here and there, and that of the smallest size. When the quality of the metal is oxygenated (No. 4.), not only have the plates of carburet disappeared, but also the coally colour on the external surface of the scoria; what now attaches to the bars, is nearly of the same nature and colour as the lava emitted at the notch of the dam.

These criterions are infallible; for, as the fusibility or carbonation of the metal is promoted in a direct ratio to the comparative quantity of the coally principle present in the furnace, so in the same proportion will the vitrid crust encircling the working bars exhibit the presence of that principle in the furnace.

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IV. *Agenda, or a Collection of Observations and Researches, the Results of which may serve as the Foundation for a Theory of the Earth.* By M. DE SAUSSURE.

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CHAP. XXII.

*Errors to be avoided in Observations respecting Geology.*

1. **T**HERE are some errors into which people may readily fall when they have not had long experience in any given kind of observation, and against which it is of importance to put beginners at least on their guard.

2. One may be readily deceived in regard to the relative distances of remote objects. All the stars and planets appear to be at an equal distance from us. Distant mountains all appear to be in the same plain. Thus those which are situated very far behind the rest, seem to form one body with them; so that people believe they see continued and uninterrupted chains when there are really none, and where the mountains, on the contrary, are insulated.

The absolute distance of objects, even when not very remote, is equally difficult to be ascertained on high mountains,

tains, where the transparency of the air, and the absence of vapours, destroy the aerial perspective. I have often imagined that I had only two or three hundred steps to make in order to reach a summit, the distance of which from me was more than a league in a straight line.

3. There are a great many errors in regard to strata. Their great thickness may make one believe that there are none where they really exist. In the like manner, if the vertical strata, or those only very much inclined, present their planes to the eye of the observer, he will think he sees shapeless and indivisible masses; while, if their sections were seen, their divisions would readily be distinguished. A mountain then must be seen under aspects that intersect each other at right angles before we can pronounce that it is not divided by strata.

4. At other times accidental fissures, but produced however by a cause which is common to them, exhibit the appearance of strata when there are none; or when, if there are, their situation is very different from that of those strata. It is the internal tissue of the stone only which in many cases can determine whether the divisions observed are the interstices between strata or mere fissures; because the strata are constantly parallel to the internal laminæ, or schistous texture of the stone. Crystals, the lamellated texture of which may sometimes be confounded with a schistous texture, may afford an exception to this rule, by presenting laminæ perpendicular to the planes of the strata; but it is not difficult to distinguish them.

5. One may also form an erroneous opinion respecting the direction of a mountain, or of its strata, when the eye is not situated in their prolongation, or at least near it.

6. The apparent situation of the strata may also lead into an error. They appear horizontal even when they are very much inclined, and when they are not seen but in a section formed by a plane parallel to the common section of their planes with the horizon. It is impossible to judge of their inclination, and to measure it with certainty, but on a section perpendicular to the common section, which I have just mentioned.

6. A. The

6. A. The greatest error, however, is that which may be committed in regard to the super-position of strata. I have often seen novices in the study of mountains believe that one stratum reposed on another; one of granite, for example, on one of slate; because they found slate at the bottom of the mountain, and granite at the top; while the slate was only laid against the base of the mountain, and the granite, on the other hand, was sunk in the earth far below the slate. We must not then say, that a stratum is situated below another, but when we really see it extending itself below it.

7. And even when we distinctly see a rock placed above another, we must examine whether that which is uppermost does not occupy that situation accidentally; whether it has not slipped, or rolled down, from a more elevated mountain; and, in the last place, though they may be closely connected, one must examine whether their present situation is really the same in which they were formed, and whether they have not been reversed, and united accidentally in a situation contrary to that of their original formation.

8. One is frequently deceived, also, in regard to the nature of stones and of mountains. Though a well-accustomed eye may often judge at some, and even a considerable distance, of the kind of stone of which a mountain is composed, such judgment is however often erroneous: mountains of granite, or *gneiss*, tender and destructible, often assume, at a distance, the round form of secondary mountains; sometimes, also, mountains of calcareous stone, hard of their kind, and in strata either vertical or very much inclined, present the bold forms, the peaks, and sharp-angled indentations of the granite summits.

9. People are often deceived even on a near view. A stone may have a foreign covering of mica, for example, while the interior part is of a very different nature.

10. Effervescence with the nitrous acid is commonly considered as a certain character of calcareous stone; but this character may be deceptive, since barytes and magnesia effervesce also\*; and we must not consider it enough to touch

\* And, on the other hand, there are calcareous stones which do not effervesce.

a stone with the nitrous acid, or to let fall a drop of the acid on its surface, since the absorbing earth, whatever it is, may be only disseminated between argillaceous or siliceous particles. We must therefore immerse a fragment of the stone in a quantity of the acid sufficient to dissolve it entirely, if it be wholly soluble, and observe whether there remains any residuum that withstands solution.

11. The action of the air and of meteors often gives fossils appearances absolutely different from those which they had before they were subjected to it. We must not then be satisfied with a superficial examination: we must sound the rocks to the quick where the action of meteoric agents has not penetrated.

12. People are often deceived, also, in considering compound stones as simple stones, when the composition of them does not manifest itself on the first view, either on account of the smallness of their composing parts, or because some of these parts are each inclosed separately in a covering which conceals the interior of them. One may guard against this error by observing the fossil in the sun with strong magnifying glasses, after having moistened its surface with water or the nitrous acid, and still better by exposing it gradually to the flame of the blow-pipe.

13. People are often deceived in regard to crystallisation, either in the true form of the crystals, or, above all, in taking for real crystals parasite crystals, or such as have been formed in the moulds made by crystals of another kind. Thus we see crystals of quartz, petro-silex, and jasper, formed in the moulds made by calcareous crystals, and which have assumed the form of the latter.

14. In regard to errors occasioned by ignorance of the distinctive characters of fossils, and of the names proper for them, the only means of avoiding such errors is to study with care good authors; and, above all, collections formed, or at least arranged and titled, by able mineralogists.

15. But when the slightest doubt is entertained in regard to the denomination which ought to be given to any fossil, an exact description must be made either of its external characters or its most striking physical properties, such as weight  
and

and solubility \*. If this description is well drawn up, the error respecting the name may be rectified, and the observation will not be lost, as it would be were there any reason to suspect the justness of the denomination, and no means of correcting it by a description †.

16. When the characters of a fossil give it such a likeness to another that it is found near the limits which separate the genera or species of these two fossils, we must follow the example of Werner and his disciples, by marking that this fossil is intermediary, or forms a transition from the one species to the other. For if we should ascribe it exclusively to the genus A, without noting the characters which bring it near to the genus B, another observer, on seeing the same fossil, might refer it to the genus B, and no one could know which of them was deceived.

17. People are often deceived also by mixing opinion with observation, and giving the former for the latter; as when people assert, that they have seen vestiges of extinguished volcanoes, because they have seen black or porous stones, or stones of a prismatic form, without deigning to describe them with care, but by qualifying them merely as *lava* or *basaltes*.

18. In the last place, a very frequent source of error is, too great a confidence in the fidelity of one's memory, or in the justness of one's first observations. These two kinds of confidence go often hand in hand; and people cannot guard against the errors, which are the consequence of them, but by noting down, on the spot, all observations to which any importance is attached, especially if they are a little complex, and carry away specimens, with their characters carefully marked upon them, of the objects that are the subject of

\* Hardness, refrangibility, electricity, &c. H.

† A person now dead, who in his time was considered as a mineralogist, wrote to me that he had found marine shells in granite. I begged him to give me an exact description of the stone which he called *granite*. He did so; but I perceived that the stone was a free-stone or sand-stone, and the specimens he afterwards sent me proved that I was not deceived. We may here recollect Recupero's pyrites of *Ætna*. The errors of this kind, arising from false denominations, are innumerable; for an exact knowledge of mineral substances is more difficult to be obtained, and more rare, than is generally imagined.—Note of the AUTHOR.

these observations; for it is not specimens of rare objects merely that should be collected. The end, indeed, of the geological observer is, not to form a cabinet of curiosities, but he must carry away fragments of things apparently the most common, when an exact determination of their nature may be interesting to theory. People may thus employ, with advantage, the means of confirming or rectifying their first observations, and of making profound researches and comparisons impossible to be made on the spot \*.

[To be continued.]

*V. Observations on Animal Electricity, and particularly that called Spontaneous. By J. J. HEMMER.*

[Concluded from Page 7.]

IN a letter, dated June 21, 1787, which I received from M. De Saussure, he confesses that he had not made any farther experiments on animal electricity; and that he did not know whether any had been made by others. As I was convinced, however, that a complete knowledge of that electricity which is produced in the human body by the friction of the clothes, as well as spontaneously, might be of great

\* We think it our duty to subjoin here some advice to travellers in regard to the questions which they may ask in the different towns.

Whence do they procure the materials proper for building; such as lime, plaster, tiles, slate, stones of different kinds, and sand? Do they burn turf or coal; and where are they found? Where do they procure their potter's clay, fuller's earth, the clay used for refining sugar, their whetstones and millstones? To observe with what the streets are paved; of what stone the steps of stairs are formed; marks for boundaries, &c.; and to learn from what place they are brought. To ascertain whether wells or the foundation of houses are dug; and whether there are in the neighbourhood any ravines or precipices. These questions will serve to facilitate the means of observing the nature of the ground, by pointing out the natural or artificial excavations that may exist in the neighbourhood, or which ought to be visited. For the same reason it is proper to examine the shores of rivers. It will be of use also to take a general view of the country from the tops of towers and of the highest steeples. It will be of some importance also to enquire, in the country, whether the inhabitants make use of lime, marl, plaster, coal, earth, or turf-ashes, for manuring their land; and from what places these substances are procured. C.  
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