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X. *On Crystallography.* By M. HAUY. Translated from the last Paris Edition of his *Traité de Minéralogie**.

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Of the Synonymies employed in the following Treatise, and other Objects of Detail.

SYNONYMIES are as it were rallying points between the various authors who write upon one and the same natural science. I am fully aware how indispensable it is to attend to them, particularly in a work containing a certain number of new denominations. My greatest difficulty was to procure names, which in the German language correspond with those by which we designate the different mineral species. M. Leopold de Buch, a mineralogist of deserved celebrity, was kind enough, during his stay in Paris, to visit the cabinet of the School of Mines, and to arrange and ticket a collection of specimens, according to the method of the celebrated Werner.

The figures have been traced by the method of projections, supposing the points of view to be removed *ad infinitum*. The full lines represent the ridges situated in the part of the solid, which will be turned towards the observer if he sees it in the position to which the projection refers: the punctured lines represent the ridges situated in the opposite part, or that which an observer could not see, unless the solid was diaphanous.

In the figures relating to geometrical constructions, we have represented the diagonal and other lines as lying upon the faces of the solid, by suites of partial lines which leave small empty spaces between them: vide *mr*, *cm*, *cr*, (fig. 4,) Plate IX†, and *bg*, *ad*, *bf*, *fg*, *fs*, (fig. 9,) *ibid.*; and we have represented the axes and other lines which traverse the solid, as well as those which are external, so far as

* In compliance with the wishes of many of our scientific readers, we intend to present the public with a translation of the first volume of M. Haüy's celebrated work on Mineralogy, being that which contains his Crystallography. The Introduction was given in our last volume.

† Besides the usual *Numbers* on the plates, for reference in our own volumes, we shall preserve, on those which relate to Crystallography, M. Haüy's order of numeration, to prevent confusion.

it is concerned, by a series of partial lines, with intermediate points, vide *cg*, (fig. 9,) Plate IX., and *MR*, *CM*, *CR*, (fig. 4,) *ibid*. We should remark upon this same figure, that the upper parts of the lines *Ms*, *Ru*, which are situated in the space, are assemblages of partial lines interspersed with points, while their lower parts, applied upon the surface of the solid, are composed of partial lines without intermediate points. This distribution, for the happy idea of which we are indebted to M. Tremery, mining engineer, will assist the reader in finding his way in the assortment of lines with which projections are complicated, by enabling him to seize at the first glance the various functions of these lines.

In indicating the measures of angles relative to each variety of crystalline form, I shall not repeat those which, being common to it with other varieties formerly described, are already indicated by the latter. It will be easy to recognise them from the conformity of the letters, which upon the different figures designate the faces similarly situated.

GENERAL IDEA OF MINERALS.

The name of minerals has been given to bodies which, being placed on the surface or in the bowels of the terrestrial globe, are devoid of organization, and only present assemblages of similar molecules united to each other by a power called *affinity*.

Of this number are flints, rubies, diamonds, gold, silver, iron, &c. *Mineralogy* is the name of the science which makes us acquainted with all these different bodies.

The general classification of the bodies which the study of natural history embraces, considered on a grand scale, may be referred to two terms of comparison, which are life and spontaneous motion. From their union the distinctive character of animals is formed: plants live, and yet cannot move spontaneously: minerals are deprived of both faculties. Man, who is alone capable of studying Nature, towers above all the beings around him, in point of intelligence and reason.

The three grand classes of which we are about to treat, with the help of an ulterior and more comprehensive view,
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Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 2.

Fig. 1.

may be reduced to two ; one of which includes animals and vegetables under the common name of *organic beings*, and the other comprehends minerals, or *inorganic beings* *.

The manner in which the beings grow or are produced, which are comprised within these two great divisions, presents the most striking difference by which they can be distinguished. In animals and plants their growth takes place by the simultaneous development of all the parts of the individual, in consequence of the nourishment received by the organs destined to elaborate it. Every thing which contributes to the increase of volume is the effect of internal mechanism ; or, if new parts be formed externally, as in trees which send out branches and leaves, these parts are only productions of the peculiar substance of the individuals, which, assisted by the action of the nutritive juices, are developed in the same way. In minerals, on the contrary, the increase in volume takes place by an addition of new molecules, which are applied to the surface of the body, in such a way that every thing which existed at each period of growth, remaining fixed, presents on all sides a basis, as it were, for the materials which arrive for continuing the edifice. On

* We find in the bowels of the globe, earthy or metallic stones, the matter of which, by succeeding to organic bodies, such as shells, is modelled in the cavities which the latter had originally occupied. What is called *petrified wood* also presents an apparent conversion of an organic body into a mineral. Lastly, organic bodies which have undergone only slight alterations have been called *fossil shells* and *fossil wood*. Several modern authors, considering all bodies imbedded in the earth as in the regions of mineralogy, have substituted the word *fossil* for *mineral*, and some have applied the latter to metallic ores only. The same authors have denominated the science of fossils *oryctognosy*. We have thought it right to conform to the ancient language, because the expression *mineral*, by the side of *vegetable* and *animal*, makes us perceive more clearly the gradation of the three great collections of beings which have been denominated the *kingdoms of Nature*. We regard the study of fossils, properly so called, as an accessory so far as mineralogy is concerned, inasmuch as the consequences which we may derive from this study relative to the history of the globe rather spring from geology. We know besides, that fossils, at least those which have been primitively in the animal kingdom, have in another point of view occupied the attention of several celebrated zoologists, and among others Cuvier, who has, as it were, recomposed the bodies of animals of which we find no living analogies, and restored to modern science species of antiquity which seemed to have been for ever lost.

one hand, it is constantly the same being which merely passes to other dimensions ; on the other hand, it is always a new being in proportion to what it acquires.

We shall have an idea of the formation and increase of minerals, if, after having dissolved common salt in water, we observe what passes while the water is evaporated : we shall see small masses of salt deposited on the surface of the water, or upon the sides of the vessel which contains it, and increase in proportion as they attract new particles. In this case the figure of these masses is out of the question, and we confine ourselves to considering generally the method in which they are formed.

The molecules of stones, metals, &c., may for a time be suspended in a liquid. When this liquid afterwards abandons them successively, from whatever cause, they re-unite, in obedience to their mutual affinity, and produce solid masses*.

These molecules, of which the mineral is the aggregate, are imperceptible to our eyes, even with the assistance of the best optical instruments. But we cannot doubt that they have determinate forms, and that they are not similar in every species of mineral. We are even led to adopt this idea, by observations made upon a great number of minerals.

Let us continue to take as an example the salt already mentioned. If we cautiously strike a portion of this salt, we see it divided into fragments of a cubical form ; and on continuing the division, we shall have cubes successively smaller, until they are no longer visible without the microscope.

On the other hand chemistry, by analysing the salt in question, proves that it is composed of two different principles ; one of which is an acid called *muriatic acid*, and the other an alkali called *soda*. These two principles are com-

* The action of caloric, or heat, supplies the place of liquids in the formation of certain minerals ; when the molecules of the latter, which its interposition at first keeps separated, afterwards acquire, upon its retreat, the liberty of reuniting by virtue of their reciprocal affinity.

bined with each other in the salt, according to a certain proportion and a determinate arrangement. Each cube which we take from this salt is an aggregate, and the connection and arrangement of molecules is the same as in the whole mass. But the subdivision of the salt into cubes successively smaller, has necessarily its limits; and if we were possessed of organs and instruments of sufficient delicacy for pushing this division as far as it would go, we should even obtain cubes incapable of being subdivided without being analysed, *i. e.* without insulating the two principles, the junction of which constitutes the essence of the salt.

Hence we conclude, that we may consider in this salt (and the same may be said of all the minerals) molecules of two orders: the first, which we shall call *elementary molecules*, and which are in the present case, on one hand those of the acid, and on the other those of the soda; the second, to which we shall give the name of *integrant molecules*, and which are in the same case, the smallest cubes which can be obtained separately, without the nature of the salt being destroyed. The elementary molecules have doubtless regular and constant forms also for each species of acid, alkali, &c., and those of one species adapt themselves to those of the other, forming small compartments whence result the integrant molecules.

We shall suppose that these last molecules were similar to the solid ones procured from a mineral by dividing it mechanically. Of this we are not physically certain, since these molecules escape our observation from their extreme tenuity. But in the study of Nature we cannot act more wisely than to adopt this principle: *That things are to be considered precisely as they present themselves to our observation.* The ultimate perceptible results of the mechanical division of minerals, if they do not give us the figure of the true integrant molecules employed by Nature, represent them, at least with respect to us; nearly as the substances which chemists can no longer analyse further, are simple substances with respect to them, although in reality they may still be susceptible of decomposition.

It

It frequently happens that the cavity in which a mineral is formed contains other minerals of an anterior existence, which afterwards serve it as a support when its formation is completed. Frequently also the molecules of several minerals, suspended at the same time in one and the same liquid, produce cotemporaneous bodies. Hence the mutual adherence of several minerals; those kinds of penetrations, in virtue of which they are often as it were interwoven or dovetailed into each other; those mixtures of molecules of several different bodies; and all those sportive positions, all those varieties of conditions and aspects presented to the observation of the naturalist by a continual change of contrasts and shades.

Every mineralogical collection presents numerous examples of these accidental combinations; and although the chief object of the mineralogist is to classify bodies from considerations independent of their natural arrangement, it is nevertheless not a matter of indifference for him to know what are the other substances which adhere most usually to such and such species of stone or metal, and their indication should have a place in the history of the substance with which circumstances have associated them*. But the observation of masses frequently of stupendous size, in which the respective arrangement of the minerals results from an operation of Nature on a grand scale, is the object of a distinct science called *geology*, which cannot be studied except by travelling.

[To be continued.]

* The French word *gangue* has been applied to stony substances which accompany metallic veins, and *matrix* to substances which support, or contain imbedded in them, other stony substances, or of a nature not metallic. I thought it right to give an extension to the word *gangue*, by applying it indiscriminately to the supports or to the envelopes of a mineral, whatever be its nature. Thus, we say that such a variety of carbonated lime has a quartz for its *gangue*.