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CRYSTALLINE AGGREGATES.

247. The greater part of the specimens or masses of minerals that occur may be described as aggregations of imperfect crystals. Many specimens whose structure appears to the eye quite homogeneous, and destitute internally of distinct crystallization, can be shown to be composed of crystalline grains. Under the above head, consequently, are included all the remaining varieties of structure among minerals.

The individuals composing imperfectly crystallized individuals may be:

1. *Columns, or fibers*, in which case the structure is *columnar or fibrous*.
2. *Thin laminæ*, producing a *lamellar* structure.
3. *Grains*, constituting a *granular* structure.

248. Columnar and Fibrous Structure.—A mineral possesses a *columnar* structure when it is made up of slender columns, as some amphibole. When the individuals are flattened like a knife-blade, as in cyanite, the structure is said to be *bladed*.

The structure again is called *fibrous* when the mineral is made up of fibers, as in asbestus, also the satin spar variety of gypsum. The fibers may or may not be *separable*. There are many gradations between coarse columnar and fine fibrous structures. Fibrous minerals have often a silky luster.

The following are properly varieties of columnar or fibrous structure:

Reticulated: when the fibers or columns cross in various directions and produce an appearance having some resemblance to a net.

Stellated: when they radiate from a center in all directions and produce star-like forms. Ex. stilbite, wavellite.

Radiated, divergent: when the crystals radiate from a center without producing stellar forms. Ex. quartz, stibnite.

249. Lamellar Structure.—The structure of a mineral is *lamellar* when it consists of plates or leaves. The laminæ may be curved or straight, and thus give rise to the *curved* lamellar and *straight* lamellar structure. Ex. wollastonite (tabular spar), some varieties of gypsum, talc, etc. If the plates are approximately parallel about a common center the structure is said to be *concentric*. When the laminæ are thin and separable, the structure is said to be *foliaceous* or *foliated*. Mica is a striking example, and the term *micaceous* is often used to describe this kind of structure.

250. Granular Structure.—The particles in a granular structure differ much in size. When coarse, the mineral is described as *coarse-granular;* when fine, *fine-granular;* and if not distinguishable by the naked eye, the structure is termed *impalpable*. Examples of the first may be observed in granular crystalline limestone, sometimes called saccharoidal; of the second, in some varieties of hematite; of the last, in some kinds of sphalerite.

The above terms are indefinite, but from necessity, as there is every degree of fineness of structure among mineral species, from perfectly impalpable, through all possible shades, to the coarsest granular. The term *phanero-crystalline* has been used for varieties in which the grains are distinct, and *crypto-crystalline* for those in which they are not discernible, although an indistinct crystalline structure can be proved by the microscope.

Granular minerals, when easily crumbled in the fingers, are said to be *friable*.

251. Imitative Shapes.—The following are important terms used in describing the imitative forms of massive minerals.

Reniform: kidney-shaped. The structure may be radiating or concentric. Ex. hematite.

Botryoidal: consisting of a group of rounded prominences. The name is derived from the Greek *βότρυς, a bunch of grapes*. Ex. limonite, chalcedony, prehnite.

Mammillary: resembling the botryoidal, but composed of larger prominences. Ex. malachite.

Globular: spherical or nearly so; the globules may consist of radiating fibers or concentric coats. When attached, as they usually are, to the surface of a rock, they are described as *implanted globules*.

Nodular: in tuberose forms, or having irregular protuberances over the surface.

Amygdaloidal: almond-shaped, applied often to a rock (as diabase) containing almond-shaped or sub-globular nodules.

Coralloidal: like coral, or consisting of interlaced flexuous branchings of a white color, as in the variety of aragonite called *flos ferri*.

Dendritic: branching tree-like, as in crystallized gold. The term *dendrites* is used for similar forms even when not crystalline, as in the dendrites of manganese oxide, which form on surfaces of limestone or are inclosed in "moss-agates."

Mossy: like moss in form or appearance.

Filiform or *Capillary:* very slender and long, like a thread or hair; consists ordinarily of a succession of minute crystals. Ex. millerite.

Acicular: slender and rigid, like a needle. Ex. stibnite.

Reticulated: net-like. See Art. **248**.

Drusy: closely covered with minute implanted crystals. Ex. quartz.

Stalactitic: when the mineral occurs in pendent columns, cylinders, or elongated cones. Stalactites are produced by the percolation of water, holding mineral matter in solution, through the rocky roofs of caverns. The evaporation of the water produces a deposit of the mineral matter, and gradually forms a long pendent cylinder or cone. The internal structure may be imperfectly crystalline and granular, or may consist of fibers radiating from the central column, or there may be a broad cross-cleavage. The most familiar example of stalactites is afforded by calcite. Chalcedony, gibbsite, limonite, and some other species, also present stalactitic forms.

The term *amorphous* is used when a mineral has not only no crystalline form or imitative shape, but does not polarize the light even in its minute particles, and thus appears to be destitute wholly of a crystalline structure internally, as most opal. Such a structure is also called *colloid* or jelly-like, from the Greek κόλλα (see p. 6), for glue. The word amorphous is from ἀ *privative*, and μόρφη, shape.

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252. Pseudomorphous Crystals.—Every mineral species has, when distinctly crystallized, a definite and characteristic form. Occasionally, however, crystals are found that have the form, both as to angles and general habit, of a certain species, and yet differ from it entirely in chemical composition. Moreover, it is often noted in such cases that, though in outward form complete crystals, in internal structure they are granular, or waxy, and have no regular cleavage. Even if they are crystalline in structure the optical characters do not conform to those required by the symmetry of the faces.

Such crystals are called *pseudomorphs*, and their existence is explained by the assumption, often admitting of direct proof, that the original mineral has been changed into the new compound; or it has disappeared through some agency, and its place been taken by another chemical compound to which the form does not belong. In all these cases the new substance is said to be a *pseudomorph after* the original mineral.

Common illustrations of pseudomorphous crystals are afforded by malachite in the form of cuprite, limonite in the form of pyrite, barite in the form of quartz, etc. This subject is further discussed in the chapter on Chemical Mineralogy.

PART II. PHYSICAL MINERALOGY.

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253. The PHYSICAL CHARACTERS of minerals fall under the following heads:

I. Characters depending upon *Cohesion* and *Elasticity*—viz., cleavage, fracture, tenacity, hardness, elasticity, etc.

II. *Specific Gravity*, or the *Density* compared with that of water.

III. Characters depending upon *Light*—viz., color, luster, degree of transparency, special optical properties, etc.

IV. Characters depending upon *Heat*—viz., heat-conductivity, change of form and of optical characters with change of temperature, fusibility, etc.

V. Characters depending upon *Electricity* and *Magnetism*.

VI. Characters depending upon the action of the senses—viz., taste, odor, feel.

254. General Relation of Physical Characters to Molecular Structure.—It has been stated on pp. 5, 6 that the geometrical form of a crystallized mineral is the external evidence of the internal molecular structure. A full knowledge in regard to this structure, however, can only be obtained by the study of the various physical characters included in the classes enumerated above.

Of these characters, the specific gravity merely gives indication of the atomic mass of the elements present, and further, of the state of molecular aggregation. The first of these points is illustrated by the high specific gravity of compounds of lead; the second, by the distinction observed, for example, between carbon in the form of the diamond, with a specific gravity of 3·5, and the same chemical substance as the mineral graphite, with a specific gravity of only 2.

All the other characters (except the relatively unimportant ones of Class VI) in general vary according to the direction in the crystal; in other words, they have a definite orientation. For all of them it is true that *directions which are crystallographically identical have like physical characters.*

In regard to the converse proposition—viz., *that in all directions crystallographically dissimilar there may be a variation in the physical characters,* an important distinction is to be made. This proposition holds true for all crystals, so far as the characters of Class I are concerned; that is, those