

PART I.—GENERAL FACTS AND THEORIES.

1. *Systems of Classification employed hitherto.*

Studies of individual deposits naturally involve speculations concerning their genesis, and many such monographs contain valuable data, which, for the more thoroughly examined mining districts, are so well established, and so comprehensive, as to invite a systematic arrangement and a genetic explanation. At first, only the form of ore-deposit was considered in such classifications; afterwards the barren surrounding medium was included. From this standpoint, unfortunately still taken by some purely empirical experts, the earth's crust is primarily divided into ore-bearing and barren rocks. It was especially the true veins, at one time the principal objects of mining, which gave rise to speculations and discussions having now only a historic interest. A. Werner was the first to frame a scientific theory. He distinguished between ore-deposits contemporaneous in origin with the enclosing rocks and those of subsequent formation, and proved once for all that veins are fissures filled with ore, thus furnishing the most important characteristic for the recognition of primary and secondary formations. As to the manner in which fissures have been filled, Werner's theory, based upon a comparatively limited field of observation, has, like many of his neptunistic views, failed to maintain itself, and this question remains still without a final answer.

Curiously enough, many systematizers reproached Werner for having introduced into his system a genetic principle, which they sought to eliminate, confining themselves to the form of deposit as a guide. Thus Waldenstein distinguished (a) tabular deposits (beds and veins); (b) stock-deposits, flat-lying or steeply inclined; and (c) scattered masses, such as nests and pockets.

Even Cotta, otherwise an earnest advocate of geological principles, classified ore-deposits according to their form and kind as beds, veins, and masses, adding a new and somewhat indefinite group of "impregnations." J. Grimm also followed in the main the old principles of classification, including in his system the eruptive ore-breccias which he had personally examined, and the tabular segregations of ore, and pronounced not only ore-beds but also certain bed-masses to be sedimentary formations. Dr. A. von Groddeck followed genetic principles already acquiring predominance. He distinguished—(a) original deposits, and (b) deposits of *débris* (placers). The former he subdivided into (1) those formed contemporaneously with the country-rock, and stratified (ore-beds, segregated beds, &c.) or massive; (2) those formed later (cavity-fillings, veins, cave-deposits, metamorphic deposits). He pronounced ore-beds to be sedimentary, and included in his system the cave-deposits and metamorphic deposits, without describing their occurrence in detail. He declared that his system, like all others, had only the purpose of arranging the material of observation conveniently for comprehensive study, and that the manifold products of nature could not be forced into a system of classification.

Groddeck's description of the series of forms of deposits is highly original. He presents a number of types, mainly characterized by the varying material of the deposits and its manifold combinations and transitions. Evidently there was before him the ideal of combining in a systematic representation the different standpoints from which the subject was to be viewed. At least, his personal, oral communication of his views, represented one standpoint by abscissæ, and the other by ordinates, so that the intersection would determine the type of the deposit. This is true enough, but it presupposes an exhaustive knowledge from both standpoints, which we, unfortunately, do not possess. My way of looking at the subject, as it appears from his expressions in a later publication, is incomprehensible to him. It seemed to him a sort of heresy to doubt the contemporaneous deposition of the ore of the manifold copper schists with the rock. This doubt need only continue until the chemical and physical possibility of such deposition should be shown.

Groddeck's system comprises, it is true, the metamorphic deposits, but without special definition or illustrative examples. In answer to a criticism of A. Stelzner's on this point, he replies that he has included in this class those deposits also which have been formed through alteration of rock material by the process which Stelzner had proposed to call metasomasis, but that the ore-masses thus originated cannot be regarded as separate deposits, because they are only incidental phenomena of the filling of cavities—in other words, he grants but subordinate rank to one of the clearest and most important genetic aids to classification, furnished by the occurrence of rocks transformed into ore. After conceding that deposit of *débris* should probably be included among stratified deposits, he restricts his system to four chief classes: (1) stratified or sedimentary deposits, (2) massive or eruptive deposits, (3) cavity fillings, (4) metamorphic and metasomatic deposits. This brings him essentially nearer my view, which groups the first two classes together, as contemporaneous with the country-rock in origin, with the reservation, however, that the contemporaneity indicated by the stratigraphy should be verified by other evidence.

While the work of J. Grimm comprises all useful deposits, that of Groddeck is confined to ore-deposits, although it would be practicable to classify salt, coal, and other beds under his system.

In England and America the subject has been variously viewed, considerations of practice being predominant, and stratification being regarded as the specially decisive factor. This conception appears, first, in the writings of J. D. Whitney, who divides mineral deposits primarily into (1) superficial, (2) stratified, and (3) unstratified. The stratified deposits are divided into (a) those in which the valuable mineral constitutes the mass of a bed, (b) those in which it is disseminated through sedimentary beds, and (c) those originally deposited from aqueous solution, but since metamorphosed. The unstratified deposits are again divided as irregular [subdivided into (a) masses of eruptive origin; (b) disseminated in eruptive rocks; (c) stock-work deposits; (d) contact-deposits; (e) fahlbands] and regular [subdivided as (f) segregated veins; (g) gash-veins; (h) true or fissure-veins].

We find here an explanation of the term "gash-veins," unfamiliar in Europe. Whitney says (*op. cit.* p. 225): "Segregated veins, which are peculiar to the altered crystalline, stratified, or meta-