

REVIEWS.

An Introduction to the Study of Rocks. By L. Fletcher, Mineral Department, British Museum (Natural History). There are many ways in which a collection of rocks can be arranged, each carrying its own useful lesson. The chief types of rocks may be selected and so placed as to indicate their mutual relations as constituents of the earth's crust ; or they may be made to illustrate the various ages of the rocks, and the progressive changes that the earth went through during its growth ; or again the different products of each locality may be placed in close proximity so as to illustrate the mineral resources, age and character of the rocks at each locality ; or again, the collection may embrace the chief sorts of rocks and endeavour to give the history of each important class. But the chief interest of rocks to the mineralogist is as the habitat of minerals, and we suppose that this is the purpose which Mr. Fletcher had in view in writing this guide and in arranging the collection to which it refers.

But even with this comparatively limited object in view, the mineralogist no less than the petrologist finds his task a very difficult one, for no one character can be taken alone, and almost every set of characters when taken as a basis leads to one or more absurdities. Rocks are mineral aggregates and can be broken up mechanically into one or more mineral species, usually in combination with more or less matter which, though really complex, cannot be thus physically resolved ; minerals and amorphous matter can be formed in several different ways so that rocks may have many different kinds of origin. On going to the rock-mass itself, it is found to be a complex entity ; the simple "petrical individual" is very rarely to be met with, and it becomes necessary to confine attention to small portions of the rock at a time, and to name these if necessary, although in doing so it is well to notice their relations to the rest of the rock-mass both in structure and composition. The list and explanation given in this introduction of the chief "lithical" characters to be looked for will be found to be a most useful and exhaustive one. The "petrical" or larger features have also been treated with adequate justice. Aided by the knowledge thus acquired we are now prepared to enter upon a classification, remembering always that "the knowledge of a fragment is

merely an aid to the knowledge of the whole," for "a single mass may consist of more than one kind of rock," although such are, as a rule, merely varieties of the main type. Although the age of the rock may be an important character in indicating a particular phase in the earth's history, its chief function is in producing alterations in the rock, often of such import that two rocks initially identical may become totally unlike each other, or rocks originally quite different may eventually result in the same, *e.g.* the serpentines.

In endeavouring to hit upon the best basis for a classification it is found that mode of origin is the most reliable guide to the mineralogist, as well as to the geologist and petrographer; with the aid of it we are able at once to divide the sediments or aggregate rocks from the igneous group, and although when we carry this method to its logical issue we are often compelled to place in widely separated divisions one or two rocks which to ordinary methods of research are identical, this is better than such grouping as that of crystalline schists, which includes igneous rocks with flow-structure, dynamically metamorphosed rocks, products of contact-metamorphism, and possibly others to which all or several of these methods have contributed.

The classification to be adopted chooses the following chief types round which others may be grouped; the grouping of the igneous rocks will be found to be in the main a chemical one, and not widely different from that generally in use amongst geologists:—granite, syenite (including felspathoid rocks), diorite, gabbro (also including felspathoid rocks), and dunite. As subdivisions of these types are treated porphyritic, "mero-crystalline" (including semi-crystalline and crypto-crystalline varieties), and glassy types; and these forms are again divided by their minuter mineralogical variations. Then we have the gneisses and crystalline schists, the tuffs, sandstones and clays, the limestones and marls, and finally the coals.

The work will be found very useful to the student of classification, as he will find many of the old facts put strongly and often in quite a new light. Many of the chief difficulties are gone into very thoroughly, while the whole book is a conscientious attempt to make very clear to the mineralogist the nature and characters of the habitats of those minerals of which the bulk of the earth's crust is built up.

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C. F. Rammelsberg; *Handbuch der Mineralchemie*. Zweites Ergänzungsheft. Leipzig, 1895.

In this supplementary volume to the second edition of his invaluable

Handbook, the venerable Professor displays once more his marvellous industry, and brings together a critical summary of all the mineral analyses which have been published since the year 1886. As in the earlier volumes, the author confines himself to empirical formulæ, and dismisses, as too speculative for his handbook, the numerous recent attempts to establish structural formulæ for minerals. On the other hand, he adopts, for example in the arsenides, oxides, &c., such rational formulæ as seem to him most in accordance with the facts. With such compounds as the oxy-chlorides, the chlorine is not regarded as capable of replacing the oxygen, and similarly the radicle RCl or RCl_2 is assumed in the borates, carbonates, sulphates, phosphates and silicates.

In these matters the author confesses himself strongly conservative, and he entirely refuses to accept the newer views regarding the replacement of fluorine by hydroxyl in many so-called hydrated compounds.

Thus, in the case of topaz, he adheres to the formula $mAl_2SiO + nAl_2SiF_{10}$, and regards the water as indicating incipient decomposition.

Like the previous volumes, the book is one which is an absolutely indispensable work of reference to every Mineralogist.

Ostwald's Klassiker der exakten Wissenschaften, No. 75. Abhandlung über die Herleitung aller Krystallographischen Systeme mit ihren Unterabtheilungen aus einem einzigen Prinzipie, von Axel Gadolin, deutsch herausgegeben von P. Groth.

This excellent series of annotated German translations of classical papers in the various sciences, is now enriched by Professor Groth's edition of Gadolin's masterpiece. In this highly original memoir the author, without knowledge of the previous investigations of Hessel and of Bravais, proved in the year 1867, by an extremely simple and elegant method, that if the law of rational indices be accepted, then only 92 classes of crystals are possible, distinguished from each other by their characteristic symmetry.

At the present time when these conclusions are generally based upon structural theories, it is very suitable that the proof which is independent of any speculations regarding structure should be recalled to the minds of students of this subject.

Professor Groth's brief notes and the historical sketch by which they are preceded are excellently adapted to make the subject intelligible; particular attention may be drawn to the note on Chap. III., where an explanation is given of the modern conception of "composite" or "alternating" symmetry.