REVIEWS.

Synthèse du Rubis. Par E. Fremy, Membre de l'Institut, Directeur du Museum d'Histoire Naturelle. Paris (Vve. Ch. Dunod), 1891.

In this work M. Fremy gives the results of his laborious investigations on the artificial production of the ruby. As it was necessary to carry out many of the operations on a large scale, he originally associated himself with the late M. Feil, the eminent glass-maker; and in 1877 they were in a position to announce their first successful experiments. At that time M. Fremy used, as the raw materials for his synthesis, a mixture of alumina, red lead, and potassium bichromate. By calcination of this mixture, a lead aluminate is first formed, and this is then decomposed by the silica of the fire-clay crucible, with production of a fusible lead silicate and separation of alumina. The alumina appeared in brilliant red laminæ having the properties of the natural ruby, but always lamellar and friable, so as to be of no practical use.

After years of labour spent on attempts to improve the process, it was found impossible to obtain the alumina in large and thick crystals, and M. Fremy at length determined on a new departure in his researches. Assisted by M. Verneuil, he attempted to obtain the crystallised alumina by the aid of certain vapours, especially those of fluorides, and was ultimately rewarded by securing thick rhombohedral crystals. The materials usually employed in his later experiments were alumina, barium or calcium fluoride, and potassium bichromate. The colouring medium was in all cases potassium bichromate, the alumina being mixed with 3 or 4 per cent. of this salt. As it was essential that the alumina should be very pure, recourse was had to the calcination of ammonia alum, purified with great care. The best results were obtained by associating the alumina with more or less potassium carbonate; the presence of the alkali, though not absolutely necessary, facilitating the formation of the crystals. The mixture was exposed to prolonged calcination at about 1500°C., and the circulation of moist air through the crucible was found essential to the reactions. The moisture disengages hydrofluoric acid from the fluoride, and this appears to effect the isolation of the alumina which has combined with the alkali, or alkaline earth, and induces its crystallisation. Another mode of viewing the reaction is to assume that

an aluminium fluoride is slowly formed, and then decomposed under the influence of moist air, with formation of hydrofluoric acid and separation of free alumina. The red alumina appears to present all the physical characteristics of the natural ruby, and may be cut and polished as a gem, or used in the jewelling of watches.

M. Fremy's monograph is amply illustrated by a series of beautiful plates from photographs mostly taken by M. Dujardin. F. W. R.

Les Méthodes de Synthèse en Minéralogie. By Stanislas Meunier (Paris, 1891).

In this excellent work the methods of production are taken as the basis of the arrangement. The result has been to make the book for the most part far more readable and interesting than many other works on the same subject.

In the introduction the author gives a clear statement as to the services which mineral synthesis can render to science: (1) in enabling us to obtain types of simple composition of species, which in Nature consist of isomorphous groups; (2) in completing series of compounds of which all the possible terms are not realised in Nature; (3) in procuring perfect crystals of very rare species, or of species which are only met with in amorphous masses, so as to allow of the crystal measurement and complete chemical investigation of the mineral; (4) in elucidating the problem of the origin of minerals and rocks in Nature. The book is divided into three sections, dealing respectively with (1) the normal production of contemporaneous minerals in Nature; (2) accidental syntheses; (3) experimental or rational syntheses. In each section the three methods of production—by the igneous or dry way, by the mixed way (water heated under pressure), and by the wet way—are treated in turn. The first section contains a necessarily brief account of the mineral products which are actually in process of formation at the present time, as the result of volcanic action, deposition by thermal springs and salt lakes, weathering of rocks, etc. Only a rapid review of so vast a subject is given, but references to the more recent work on this subject are treated more fully, as e.g. the interesting description of the calcareous and siliceous formations in the Mammoth Springs, due to living algæ.

In the second section the accidental mineral syntheses which take place in foundries, etc., are described. A complete account is given of Daubrée's investigation of the different mineral species, including tetrahedrite and pyrites, which resulted from the action of the thermal waters of the

spring of Bourbonne les Bains upon the coins which had been cast in as votive offerings centuries before.

The arrangement of the third section, which forms the main portion of the book, is very systematic. It is divided like the others into three parts, dealing with processes in the dry, mixed, and wet way; and to each of these divisions five chapters are devoted, which treat respectively of methods of simple crystallisation, simple decomposition, conjugation, precipitation, and double decomposition.

Under the head of precipitation by gases in the dry way is a very interesting account of the author's own experiments on the synthesis of meteorites. His method consisted in reducing by hydrogen mixtures in different proportions of the chlorides of iron and nickel. The conclusion drawn from these experiments is that the most frequent types of meteorites do not result from fusion, but simply by way of concretion at the expense of vapours reacting one on the other. The same idea is extended to the breccias containing the native platinum of the Urals, and also to the Ovifak iron, except that in the latter case carbonic oxide and not hydrogen is supposed to have been the reducing agent.

Altogether it may be said that, although we already possess several books on mineral synthesis, including the well known work of Fouqué and Lévy, the thoroughly readable form into which the author has thrown the whole subject matter of the present volume, and the amount of recent work which he has introduced, render it a far from superfluous addition to the literature of the subject. G. T. P.