REVIEWS.

A Text-book of Mineralogy, with an extended treatise on Crystallography and Physical Mineralogy. By Edward Salisbury Dana. New Edition, entirely re-written and enlarged. Large 8vo, 593 pp., over 1,000 figs., and a coloured plate. New York and London, 1898.

Prof. E. S. Dana's text-book of Mineralogy in scope occupies an intermediate position between elementary books in which little or no attempt is made to deal adequately with the crystallographic and optical branches of the subject, and such a work of reference as Dana's *System of Mineralogy*. The want of such a text-book in English has of late years been increasingly felt owing to the advances made in the science, especially in crystallographic and optical methods of investigation. This new edition has been entirely re-written and brought up to date, and should go a long way towards satisfying this want. The first part of the book, occupying 144 pages, is devoted to crystallography. According to the degree of symmetry they exhibit, crystals are divided into the now-accepted thirty-two groups. These are classified under the six systems, the group in each system possessing the highest degree of symmetry being called the normal group. In the introductory articles is a brief account of molecular networks or point systems, according to which these groups receive their theoretical explanation. This subject has been engaging the attention of mineralogists so much of late that we are inclined to regret that the author has not felt able to devote more space to its consideration. An intelligible summary in English of this subject, similar to that given by Groth in the last edition of his *Physikalische Krystallographie* would be very desirable at the present time.

The second part of the book, dealing with physical mineralogy, occupies 94 pages, and is mainly taken up with the optical characters of crystals. A useful feature in this as in other parts of the book is the list, at the end of each main section, of references to important papers on the subject discussed in the section. In the articles treating of optical instruments and methods, mention might have been made of the Dick microscope which has proved so eminently serviceable in the optical examination of minerals.

The whole subject of the optical properties of crystals is very fully treated, and it is shown how these can be deduced from the index-ellipsoid or indicatrix of Fletcher, the axes of which are proportional to constants capable of direct measurement, viz. the refractive indices α, β, γ, where $\alpha < \beta < \gamma$.

It is, therefore, all the more puzzling to find a later article headed "Axes of elasticity," in which it is stated that "these axes of elasticity are of great convenience in describing the optical properties of crystals, *and it is hence necessary to make frequent use of them.*" These, in fact, are the axes which, under the new name of "ether-axes," the author uses in the descriptive part of the book. He mentions, it is true, that these axes of elasticity "have the direction of the three ellipsoidal axes" (the axes of the indicatrix), but he does not clearly point out to the student that it is the a (a)-axis of the indicatrix which corresponds to the a (𝔞)-axis of elasticity and so on, and accordingly that old formulæ, expressed in the language of elasticity, can be at once translated into the language of the indicatrix by substituting 'axis of indicatrix' for 'axis of elasticity,' *e.g.*, a positive biaxial crystal is one in which the c (γ)-axis of the indicatrix as well as the c (𝔠)-axis of elasticity is the acute bisectrix. To the mineralogist the fact is of little concern that, regarded as an axis of the indicatrix, the c-axis is the greatest, whereas regarded as an axis of elasticity it is the least. The axes of elasticity most often employed are not those of Fresnel's ellipsoid of elasticity, which is identical in form with the indicatrix, but of its polar reciprocal. They are usually denoted by the letters 𝔞, 𝔟, 𝔠, where $\mathfrak{a} > \mathfrak{b} > \mathfrak{c}$, whereas the axes of the indicatrix being proportional to the refractive indices are generally denoted by a, β, γ where $\alpha < \beta < \gamma$. It is probably on this account, and to obviate the necessity of altering the lettering of old diagrams, &c., that the author has elected to retain the old axes of elasticity under their new name of ether-axes. We cannot help thinking that this is quite a needless complication, which might have been avoided by denoting the axes of the indicatrix by the letters 𝔞, 𝔟, 𝔠. The result of this would be that old formulæ and diagrams, illustrating the relation of the crystallographic to the light-axes, would need no alteration: it would be only necessary to remember, when any question might arise as to their relative magnitude, that in the case of the indicatrix $\mathfrak{a} < \mathfrak{b} < \mathfrak{c}$.

To the third part of the book, treating of Chemical Mineralogy, only thirty pages are devoted. The elementary principles of chemistry, as applied to minerals, are briefly but clearly explained, and reference is made to the periodic law. The subject of isomorphism and the con-

nection between chemical composition and crystalline form receives rather brief treatment. A short account is given of the blowpipe examination of minerals, but for this and kindred subjects the reader is referred to Brush's *Manual of Determinative Mineralogy*, a new edition of which, under the editorship of Prof. Penfield, has just appeared.

The fourth part of the book, on descriptive mineralogy, is "essentially an abridgment of the Sixth Edition of Dana's *System of Mineralogy*," as prepared by the author. In the case of the more important minerals, however, useful paragraphs have been added in which are given the distinguishing characters which serve to separate the species from others with which it might be confounded.

At the end of the book are appendices, one treating of the drawing of crystals and of projections, and the other containing tables of minerals, arranged according to crystal system, specific gravity, &c., which should be very serviceable for determinative purposes.

The book is not altogether free from printer's errors. In the preface the Oxford professor of mineralogy is referred to as Prof. Miers of Cambridge, on pp. 28 and 31 some of the indices of the faces are incorrect, on p. 158 the heavy liquid methylene iodide is referred to as methyl iodide, a very different substance.

As an excellent text-book of Mineralogy, and the only one in English containing a full treatment of the crystallographic and optical principles of the science according to the most recent methods of investigation, the book should meet with wide acceptance. G. T. P.

Geology for Beginners. By W. W. Watts, M.A., F.G.S., Assistant-Professor in Geology at the Mason University College, Birmingham. 8vo, 352 pp., 310 figs. London, 1898.

This excellent little text-book of geology forms one of Macmillan's Elementary Science Series. Although intended for use in preparation for the elementary stages of the Science and Art examination, it has none of the objectionable features of the ordinary cram-book.

The treatment is necessarily of an elementary character, but for its size the book contains a really marvellous amount of information arranged in admirable fashion to meet the needs of the student.

The general "plan of work" as set forth by the author in the first chapter explains well the excellent mode of treatment adopted and the general aim of the book. First, common rocks are pulled to pieces, and studied at home. Then are noted their mode of occurrence and appear-

ance in the field. After which the various geological changes taking place at the present time are explained, so that the student may duly appreciate the way in which rivers carve out their valleys and seas tear down their cliffs, and deposit the relics, in the one case in deltas and river basins, and in the other on the sea-bed. From the study of what is actually occurring at the present day the student is then taught to deduce what has happened in the past and to "find out how the rocks succeed one another, and what points in the history of life or geography each one yields." At the end of the book, after the different geological systems have been described, is an instructive and interesting chapter on the origin of landscape, and finally a rather short chapter on economic geology.

A prominent feature of the book is the number and excellence of the illustrations. As is well known, the author, as secretary to a British Association Committee, has been zealous in directing the attention of geologists to the advisability of collecting and preserving photographic records of interesting geological features. The number of reproductions of such photographs taken by various observers, which adorn the pages of his book, seem to show that the author has begun to reap some advantage from his labours. Many of the other illustrations have been taken from Zittel's *Grundzüge der Paläontologie.*

The book appears to be remarkably free from printer's errors. The following are a few points we have noted to which exception may be taken. The granite figured on p. 9 is not a very typical example of granitic structure. The chemical composition of a felspar is not very well expressed by the statement on p. 36, that it is "a compound of two substances, known respectively as silicate of potash and silicate of alumina." On p. 122, trimetric is used instead of the more usual orthorhombic. On p. 126, magnetite is described as crystallising in dodecahedra, whereas if only one habit of the crystals is mentioned octohedra are far more common. On page 130, chlorite is referred to the hexagonal system. On p. 168, tachylyte is spelt 'tachylite.'

These, however, are but very minor points, and do not seriously detract from the value of a book which, in our opinion, is by far the best elementary treatise on geology which has appeared within recent years.

G. T. P.

Manual of Determinative Mineralogy, with an introduction on Blowpipe Analysis. By George J. Brush. Revised and enlarged with entirely new tables for the identification of minerals by Samuel L. Penfield.

New York (John Wiley and Sons), London (Chapman and Hall, Ld., 1898). Large 8vo, 312 pp., 375 figs.

The first edition of this book, by Prof. G. J. Brush, appeared in 1874, and the present is the 15th edition. This fact alone testifies to the great popularity of the work.

In 1896, a first instalment of the present edition was issued, with the introductory chapters entirely re-written by Professor Penfield, but with the old tables, and was reviewed in this Magazine (vol. xi. 219). The work now re-appears in a complete form, as a new book, with the determinative tables revised, and with a new chapter of 84 pages on the Physical Properties of Minerals. This chapter is the simplest and most intelligible summary of the principles of crystallography that has yet been given to the elementary student, and is a very noteworthy feature of the book; especially satisfactory are the diagrams by which the symmetry of the 32 crystalline types are illustrated and the order of their symmetry axes depicted.

In the very complete tables for the determination of mineral species which constitute the latter half of the book, the following classification is adopted:—I. Minerals with metallic lustre; II. Minerals without metallic lustre. Within each of these classes the species are grouped by their fusibility. In class I. the fusible minerals are further distinguished by blowpipe reactions as arsenic, selenium, tellurium and antimony compounds, and sulphides, while the infusible minerals include iron and manganese compounds. In class II. the fusible compounds include (1) those which yield globules of silver, lead, bismuth, antimony and copper; (2) the iron compounds, which become magnetic; (3) certain arsenates, phosphates, borates, silicates, and salts of the alkali, and alkali-earth metals. The infusible compounds comprise the remainder.

Practically all the known species are included in these tables, but the more common are printed in conspicuous type. It is stated in the preface that all the tests have been carefully verified, and many have been devised specially for the present work. The real value of the book can only be ascertained by its practical use. We may confidently expect that it will be found to fulfil all the requirements of the student.

Should Professor Penfield feel able to include a chapter on the optical examination of crystals in a future edition without increasing the book to an inordinate size, it will become a complete handbook, with the aid of which a skilful student should be able to identify any known mineral, including even the rarer species.

The Boy Mineral Collectors. By Jay G. Kelley, M.E. 362 pp. (Philadelphia : J. B. Lippencott Company, 1899).

This is a story, in conversational form, of the doings of two boys while on a visit to their mining uncle in Colorado. Instead of profitably spending their time in collecting minerals in the open, they spend most of it talking in the library. There are popular chapters on " Metals of great value," in which vanadium is quoted at 2,240 dollars per pound ; " A lesson on pearls and rubies " ; " A chat on silver and diamonds," &c. Information on any one subject is much scattered, and is not always quite accurate ; the names of minerals are sometimes incorrectly spelt. As a story the book is a failure.