tion of the type locality, the general distribution, references to illustrations, and general notes are given. All the descriptions are in English, and written in a correct but very simplified style, so that anyone can easily understand them. Latin descriptions find no place in this admirable work, which is designed to be useful to the multitude rather than to the botanist alone.

In the first volume the Cactaceæ are divided into the three tribes Pereskieæ, Opuntieæ, and Cereæ. The tribe Pereskieæ contains only the single genus *Pereskia*, of which nineteen species are described. The Opuntieæ are divided into seven genera, of which *Opuntia* is the largest, containing 240 species; the other genera have only one or a few species in each. These two tribes fill the first volume, and the Cereæ, which comprise the bulk of the order, are being dealt with in the remaining volumes. The first portion of the Cereæ is accounted for in the present volume, where the plants that are commonly known by the generic title of *Cereus* are described and illustrated.

It has long been recognised that different species of *Cereus* produced different types of flower, and since, in other natural orders, differences in floral structure are recognised as being of generic value, some botanists have founded genera upon some of the different floral types found among Cerei. These genera have not hitherto found much favour among botanists or horticulturists, because the plants, when not in flower, often present a great similarity to one another. The authors of "The Cactaceæ," however, have accepted the view that a difference in floral characters should constitute a generic distinction; they have had this view constantly in mind, and carried it to a logical conclusion, so that they have divided the old genus *Cereus* into no fewer than forty-seven genera, containing 275 species. Twenty of the genera are proposed for the first time in this volume. Whilst there can be little doubt that the plants which have been placed in the genera *Heliocereus*, *Aporocactus*, *Cleistocactus*, etc., should be separated from *Cereus*, it may be questioned whether those placed in the genera *Dendrocereus*, *Harrisia*, *Acanthocereus*, etc., should be held to constitute more than sectional groups under *Cereus*. This, however, is a matter of opinion, and time alone will show if the numerous genera maintained in this work will be generally accepted. Whether they are accepted or not, their adoption in "The Cactaceæ" in no way invalidates the usefulness of that splendid work. The reviewer has had considerable experience in the use of existing monographs, and has found "The Cactaceæ" very far in advance of them;

it can be recommended with confidence to students.

The only noticeable fault in the work is the rather serious one that exceptions are always neglected in the keys. This, however, is a fault appertaining to most botanical works, and invariably leads the novice astray. For example, should a novice desire to find out, by means of the key given on p. 1 of vol. ii., the subtribe in which the authors place the globose, spineless plant cultivated under the name *Echinocactus* (and *Anhalonium*) *Williamsii*, no place for it will be found. The only spineless plants mentioned in that key belong to the subtribe *Epiphyllanæ*, which have flat, many-jointed stems. This fault is so easily remedied by including exceptions and variable characters again and again under the headings of different parts of the key that perhaps the authors will endeavour to correct this defect in the continuation of their work. They are to be congratulated heartily upon the manner in which they have so far carried out their very difficult task of evolving order out of the very confused synonymy found in other works upon this group of plants.

N. E. BROWN.

A Study in Geo-chemistry.

The Enrichment of Ore Deposits. By W. H. Emmons. (Bulletin 625. United States Geological Survey: Department of the Interior.) Pp. 530. (Washington: Government Printing Office, 1917.)

UNDER the above modest guise the United States Geological Survey has published a volume of the greatest value to the student of ore deposition, which may fairly claim to rank as one of the most interesting of recent contributions to this very difficult branch of economic geology. The author points out that two phases in the formation of economically important ore deposits require independent investigation, namely, the formation of the primary ore deposits and the subsequent modifications which the more superficial portions in many cases undergo.

The present work is devoted exclusively to a comprehensive investigation of the second of these phases, the genesis of the primary ore deposits being considered indirectly only. The author reviews successively the conditions that make for enrichment, such as amount of rainfall, surface contours, permeability of the rocks, the nature of the underground circulation of water, and in particular the oxidation of sulphide deposits. He lays very great stress upon the last-named, and ascribes the solution of the various minerals

affected almost exclusively to the action of sulphuric acid produced by the oxidation of sulphuretted ores. This thesis is developed in detail in a series of chapters devoted to the chemistry of enrichment, in which the conditions of solution and precipitation, so far as the more important metals are concerned, are worked out in full detail. This section is an admirable contribution to geochemistry, and will well repay careful study. It is perhaps possible that the author pins his faith somewhat too exclusively to the action of sulphuric acid and somewhat underrates the possible effect of other solvents. In part this may be due to the fact that he has confined his studies to the North American continent and to the chemical changes that characterise the temperate zones; thus it is significant that the word "lateritisation" is not even once mentioned, and that this phenomenon, which has played an important part in the secondary modification of certain ore deposits in tropical and sub-tropical regions, is here quite disregarded.

Each of the more important metals is then considered in detail; the principal ores of each, their solubilities and mode of occurrence, are discussed, and the influence of enrichment is illustrated by descriptions of a number of representative deposits of each metal; finally, the non-metallic or gangue minerals are treated in the same way. It will be obvious, even from this brief sketch, that the author has done his work with great thoroughness, and it is easy to foresee that this volume will remain for a long time the standard text-book (for such it really is) on the subject.

It need scarcely be said that there are a number of highly contentious points upon which it would be hopeless to expect any general agreement amongst geologists. Perhaps the phrase to which most will take exception is a statement on p. 15: "Many of the rich deposits of gold are primary." It is not too much to say that the exact opposite of this will be more in accord with the experience of most students of the subject, and that the statement, "None of the rich deposits of gold are primary," would meet with far more general acceptance. A gold deposit that has not undergone secondary enrichment is quite exceptional, and many examples where such enrichment has assumed a scale of great importance are familiar to all economic geologists, e.g. the Witwatersrand and in Western Australia.

Far more difficult and more debatable is the question whether the author has drawn rightly the line of demarcation between the phenomena that ought and those that ought not to be included in the list of secondary enrichment. There are

numerous cases where material too poor to be economically workable (which the author, following Ransome, designates as "protore") has been enriched until it is worth working and thus becomes a true ore. Few will object to the inclusion amongst cases of secondary enrichment of those protores that have been converted into ores by the addition of valuable mineral matter, as, for example, the monzonite copper ores of Bingham, Utah, Ely, Nevada, etc.; it is, however, far more doubtful whether the term can fairly be applied to deposits which have been enriched by the leaching out or dissolving away of gangue material. Thus the important deposits of brown hæmatite of Santander, Spain, have been derived from ferriferous dolomite, containing only some 3 per cent. of iron, by the solution of the carbonates of lime and magnesia. It would probably be more correct to designate these as primary deposits than to look upon them as enriched protore. Many writers classify them as "residual deposits." Obviously, if Mr. Emmons carried his method to its logical conclusion, he would include also clastic deposits, seeing that these are the result of the concentration or mechanical enrichment of mineral deposits that will in many cases have been protores.

It is interesting to note that the author has confined his attention to secondary enrichment, and makes no specific reference to secondary impoverishment as such; necessarily he discusses the phenomenon as antecedent to enrichment, but there are certain cases in which the subject deserves attention for its own sake.

Perhaps reference to such controversial points as the above will serve better than anything else to bring out the difficulties of the subject that Mr. Emmons has so ably dealt with in this volume, and both he and the United States Geological Survey are to be congratulated upon this important contribution to the study of the phenomena of ore deposition.

H. LOUIS.

Our Bookshelf.

The Elements of Theoretical and Descriptive Astronomy. By C. J. White. Eighth edition, revised by P. P. Blackburn. Pp. xi+309+ix plates. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1920.) 17s. 6d. net.

THIS book is something of a curiosity, if only because it has reached an eighth edition. The first edition was published in 1869 for the benefit of the students of the U.S. Naval Academy. It was an elementary primer giving the simple geometrical facts of astronomy. So far as can be