for the salary of such a clerk. I understand from Dr. Stiles that $1,200 would pay for the salary of a clerk. I would suggest, therefore, that ten of the leading Museums of the United States pay each $60 toward this expense and that $60 be paid by ten museums of Europe. Those in America to be the National Museum and those at Cambridge, Boston, New York, Brooklyn, Philadelphia, Pittsburgh, Chicago, Milwaukee, San Francisco. It would, of course, have to be recognized that this charge would be an annual one.

If the great museums of this country would thus voluntarily pay such a tax, the court of reference for questions of zoological nomenclature would become permanently established.

Chas. B. Davenport

SCIENTIFIC BOOKS

Igneous Rocks. By Joseph P. Iddings. Vol. I., Composition, Texture and Classification. 8vo, xi + 464 pages, 130 figures and two colored plates. New York, John Wiley & Sons. 1909.

It is not often that a work appears in the literature of any science which stands out so clearly from other corresponding works in respect to both its point of view and its intrinsic value that it must be accorded the rank of epoch making. But such is the fact in the writer's opinion concerning the volume by Professor Iddings which is the subject of this notice. Here is a treatise on igneous rocks which does not in the least pattern after the numerous works on the subject, but from the outset follows a new plan. The author has studied the igneous rock with the aid of modern developments in physics and chemistry and makes the understanding of composition and texture in the light of those developments the all-important thing.

The point of view of the author may be in a measure inferred from the order in which the properties of igneous rocks are presented, and the manner in which they are discussed in Part I., on Composition and Texture. The igneous rock is, of course, the product of the consolidation of a molten magma. The fundamental property which the rock shares with the magma from which it was derived is its chemical composition. Hence the work presents in Chapters I. and II. the characteristic facts as to the chemical composition of the rocks and of their constituent minerals. Groups of rock analyses are given and a full statement of the various devices used by petrographers to represent in diagrams the significance of the varying amounts of different components shown by analysis. Two colored plates represent many hundred analyses by means of diagrams of Iddings's own design.

A departure from the usual procedure in discussing the chemical composition of rock minerals is made by taking up the chemical elements known to occur in rocks and, considering them in groups of Mendeléeff's table, indicating the mineral into which they are likely to enter under the associations and restrictions of the case.

The fact that an igneous rock is derived from highly complex molten solution by crystallization is to the author abundant reason for insisting that the petrographer should understand the principles of physics and chemistry applicable to rock magmas and Chapter III. is devoted to this subject. Special attention is given to the properties of magmas as solutions, and to the chemical reactions which may take place under certain conditions in solutions, expressed in the terms of modern physical chemistry.

Following this general discussion is one in which the chemical reactions likely to take place in rock magmas under the conditions prevailing in the crustal zone of the earth are particularly considered. Taking the thirteen constituents which are prominent in most igneous rocks the controlling influence of relative chemical activity, strength of combination, affinity of certain elements for each other, and the effect of differing proportions of the elements, are considered in their bearing on the formation of observed rock minerals. To a large extent the reasons for the abundance of certain mineral molecules and the rarity of others containing the same substances are plain. The laws which control the common association of some minerals, the apparently antithetical relations of others, and the de-

velopment of rare combinations are discussed.

In Chapter V. Iddings gets at the meat of the matter as to the formation of the rock from the magma. The rock is formed by the separation of solid, liquid and gaseous substances from the magma, crystallization of minerals being the principal process. This change from the magmatic solution to the solid rock may take place in one or several periods, at one or several levels in the crust of the earth or at the surface. The conditions under which different stages of consolidation take place are constantly changing, not only from the circumstances of environment incident to eruption but from the changes connected with partial crystallization and various disturbances of chemical equilibrium. It is beyond the limits of this notice to review this important chapter in detail and an enumeration of the principal headings must suffice to show the method of treatment.

The separation of gases, liquids and solids is discussed. Under the latter the principal causes of separation are considered—such as the addition or loss of substances, lowering of temperature and changes of pressure. Saturation and supersaturation as influenced by changes in temperature, and the metastable and labile conditions of solutions, are treated in sections. Then comes the discussion of Number of Points of Separation, The Rate of Separation, The Effect of Viscosity on the Rate of Separation, Polymorphic Substances, The Order of Separation, Effect of Supersaturation on Order of Separation, Separation of Isomorphous Compounds, Zonal Structure and Eutectic Mixtures of More Than Two Compounds.

The author refers to the subject-matter of this chapter in these words:

> From the foregoing it appears that the solidification with crystallization of rock magmas must be an extremely intricate process, involving variable or irregular changes in temperature and pressure consequent on the movements of eruption, together with variations in composition chiefly through changes in gaseous components, and the possibilities of chemical reaction among the components with changing chemical equilibria, and the probabilities of supersaturation of the magma by different components to various degrees.

The origin of mineral composition of the rock having been discussed, there is taken up, in Chapter VI., the question of crystallization and resultant texture. Here again the treatment logically consists in showing the effect of a great range of changing or variable conditions in determining texture. After discussing the genesis of the formal relations of the parts of a rock Iddings describes the textures of igneous rocks under the divisions Crystallinity, Granularity and Fabric, using the terms which have recently been proposed[1] to supplement the inadequate terminology in current use. The illustrations used in this chapter are particularly good and tend to emphasize the desirability of greater precision and refinement in the description of igneous rock textures.

Differentiation of Rock Magmas is the subject of Chapter VII. The evidences of differentiation are first presented with regard to the visible relations of parts of a single rock mass on the one hand, and as exhibited by many relations which connect the various rocks of a petrographic province on the other. Having established by the citation of facts that the petrographer must recognize in various rock series or groups the products of differentiation from a parent magma, Iddings proceeds to the discussion of processes and hypotheses concerning them. It is notable that this discussion is sane and conservative. The author advocates no hypothesis or speculation without a plausible basis in the laws of physics and chemistry, which has sometimes been done by prominent leaders in the science. On the contrary, the conditions which have been operative on the magmatic solution at various stages of its history are examined to find influences which may have led to differentiation, of different degrees and kinds. The effects of changes in density, viscosity, molecular concentration and saturation, are discussed, to show that they may under certain circum-

[1] "The Texture of Igneous Rocks," by Cross, Iddings, Pirsson and Washington, *Jour. Geol.*, Vol. 14, 1906, pp. 692–707.

stances favor differentiation. Instances in nature which seem to be explainable by these processes are cited. Contemporaneous veins and pegmatic veins are considered by Iddings as resulting from differentiation and a hypothetical explanation for each is given. The facies of composition and texture exhibited by many igneous masses are examined in their relation to differentiation.

The solution of rock by liquid magma is considered, with the conclusion that evidences of this absorption within the zone available to our examination are rare. Hybrid or mixed rocks are given a brief mention, and a concise historical review of hypotheses of differentiation is given. In a short but interesting sketch of the course of magmatic eruption Iddings shows some of the phases or periods which may be supposed to favor magmatic differentiation.

The last chapter of Part I. is devoted to a description of the modes of occurrence of igneous rocks. Here the course of treatment naturally follows that of other treatises. Numerous excellent and new illustrations add greatly to the attractiveness of this chapter.

Part II. of the volume deals with "Nomenclature and Classification," truly a most difficult subject at the present time. On many sides one may hear expressions of extreme dissatisfaction with the existing condition of systematic petrography and its terminology. But we are in a perfectly natural, though most uncomfortable, stage in the evolution of the science. The man who understands the essence of the igneous rock, as presented by Iddings, can best comprehend that nomenclature and classification to-day are in confusion because it could not be otherwise.

Iddings first reviews the growth of the prevalent nomenclature and of the classifications it expresses. The facts are familiar to petrographers and they are presented by the author in a way to emphasize the conclusion that with such a history the existing confusion is simply the logical result.

In one chapter Iddings sketches the prevalent system—if system it can be called—under the term "Qualitative Mineralogical System." For the presentation of this system Iddings has recourse to the usual tabular scheme, inserting the names to be defined in their appropriate spaces. Then follows a definition of each name in terms of mineral composition and texture. These definitions are essentially as they may be found in the works of Rosenbusch and Zirkel, except the expression of genetic ideas attached by the former. These same names are used with similar signification by German, French, English, American and other petrographers in spite of more or less different bases of classification.

In the final chapter of the volume Iddings presents a statement of the "Quantitative Classification of Igneous Rocks" of which he is a co-author.[2] Here is given a criticism of the qualitative mineralogical system and a discussion of the available bases of classification, leading to the choice of chemical composition as the foundation of the quantitative system. This follows closely the original presentation of the system, but is accompanied by many references to facts brought out in earlier parts of the book.

Taken as a whole this volume leads directly to the quantitative system as the only one yet devised by means of which the petrographer may adequately and correctly express the relations of igneous rocks in regard to their absolute, determinable properties as objects. The discussion of the origin of mineral composition and texture is certainly thorough enough to demonstrate the author's deep interest in petrogenesis, but it also serves to show that the complexities, if not the uncertainties, of genetic relations render them unavailable as bases of a truly systematic classification of all igneous rocks.

The work is written from a standpoint occupied to some extent by other specialists, but which must henceforth be familiar ground to every petrographer worthy of the name. Not that one must agree with Iddings in all respects, but that the study and the scientific discussion of igneous rocks must be based on

[2] "Quantitative Classification of Igneous Rocks," by Cross, Iddings, Pirsson and Washington, The University of Chicago Press, 1903.

the fullest recognition of the extremely complex magmatic solutions from which they have come and of the varied conditions determining the characters of the rocks themselves, and not infrequently producing rocks of different mineral composition from a single magma.

This volume is a treatise on igneous rocks which is manifestly an unfettered expression of the author's understanding of them rather than a text-book. Yet it outlines so logically the view of these objects which the student should be made to understand that it may be used as the basis of instruction in all advanced courses.

The book appears in uniform style with "Rock Minerals" by the same author. The second volume, descriptive of known rocks, is in preparation, and will be awaited with interest and with the hope that the author may be successful in making his subject more attractive than is the case with existing literature of the kind. WHITMAN CROSS

Railroad Structures and Estimates. By J. W. ORRUCK, C.E. New York, John Wiley & Sons. 270 pages, 94 illustrations. $3 net.

Probably the primary purpose of this book is to furnish data for estimating the various parts of a railroad, and it contains a compilation of cost data which should prove of value to many a young engineer, not only in furnishing reasonable figures of costs, but also in stimulating him to secure similar figures for his own locality or from his own railroad. Costs vary from time to time and also locally, so that figures for estimates can not safely be swallowed whole either from this book or any other. A book of this sort then should find its best value in suggesting methods of cost estimation, and in analyzing the constituent parts of costs. This book is somewhat uneven from this standpoint, some chapters having the elements of cost well classified, while others are very general, as in the costs of tunnels where a short table of costs per lineal foot is quoted from Drinker's rather ancient treatise; while the estimates for turnouts are itemized, the cost of a split switch is given as $30 to $50; and similarly for laying and surfacing it, $30 to $50; a variation of considerable amount without special explanation to account for it. The criticism applies perhaps to the difficulty of the subject rather than to inferiority of treatment.

The compilation of cost data involves a knowledge of the structures or materials to be built or used; as a result a large share of the book is given to such descriptions, or sometimes practically specifications. There are given, also, a number of tables which seem hardly consistent with the general purpose of the book; among these are one "for putting in frogs and switches," others for "feet head and equivalent pressure in pounds per square inch," "friction of water in pipes," "friction of water in elbows"; also a table of "horsepower."

The chapter on buildings, covering eighty-eight pages, is quite largely given to descriptions, and these cover many classes of buildings; it has not quite the merit of a treatise and yet any one is likely to find there some thing he wants and which is worth while. In the estimates of this chapter, some are well analyzed and itemized, while some others are very general and with wide range of cost values, a freight shed with modern floors being estimated at 25 to 50 cents per square foot.

The chapter on Specifications and Contracts, covering thirty-one pages, is inadequate, and except for four pages on estimates, hardly in line with the apparent purpose of the book.

The book in its mechanical make-up has the general appearance and quality of the Wiley books on engineering, which means that it is satisfactory. The scope is indicated by the following Chapter Index:

I. Track Materials. II. Fences, gates, sign posts. III. Culverts. IV. Bridges. V. Buildings. VI. Water Stations. VII. Tanks. VIII. Specifications and Contracts. IX. Estimating Notes.

C. F. ALLEN

Neuere Ergebnisse auf dem Gebiete der Speziellen Eiweisschemie. PROF. EMIL ABDERHALDEN. Jena, Verlag v. Gustav Fischer.

"Die Neueren Ergebnisse auf dem Gebiete