secondary schools has but few ardent supporters.

In teaching chemistry in graded and secondary schools would it not be more profitable to spend the time in the laboratory on pure descriptive chemistry, and could not the time spent on abstract chemical theory more profitably be spent emphasizing the relations expressed in the phrase 'The Chemistry of Daily Life'?

Francis Gano Benedict.

SCIENTIFIC BOOKS.

Chemical Analyses of Igneous Rocks Published from 1884 to 1900, with a critical discussion of the character and use of analyses. By Henry Stephens Washington. United States Geological Survey, Professional Paper No. 14. Washington, Government Printing Office. 1903. Pp. 495.

In the first two or three decades of the last century, rocks, in contradistinction to the individually well-defined minerals, were regarded merely as aggregates of minerals in presumably fortuitous combinations and lacking in that definiteness or constancy of composition which would justify their study as a whole. As time went on, however, the chemical aspect of petrography gradually attracted more attention, its great importance being first clearly recognized by Abrich, who in 1841 pointed out the necessity for a knowledge of the chemical composition of rocks in dealing with the problems of their origin and mutual relations as well as for their satisfactory classification and proper nomenclature.

Bunsen's well-known hypothesis that all igneous rocks might be considered as mixtures in various proportions of two supposed original or normal magmas—the trachytic and the pyroxenic—gave a marked stimulus to the study of their chemical composition. But with the abandonment of this view, which broke down under the weight of the evidence accumulated to test it and with the introduction of the microscope as a means of petrographical study in the early seventies, analyses lost much of their interest, being, as Dr. Washington observes, 'inserted perfunctorily in petrographical writings, in obedience to custom, as ornamental embellishments, while the chief efforts of the petrographer were devoted to the elucidation of the purely mineralogical and textural characters of the rocks described.'

During the past ten years, however, the chemical composition of rocks has again attracted much attention—more especially on account of its important bearing on the theoretical side of petrography—the crystallographic and optical properties of the constituent minerals and the details of structure no longer being the only subjects of investigation. The chemical composition of an igneous rock is now recognized as distinctly the most important fact which can be learned concerning it, and the one which is of the greatest value in dealing with the great questions of origin and genetic relations, as well as affording the most reliable basis for classification.

For the study of the chemical composition of rocks, the tables of analyses collected by Roth and which were issued at intervals from 1861 to 1884, have up to the present been the great storehouse of information. They present in tabular form and with certain critical notes practically all the rock analyses which had been published up to the year 1884. Since this latter year, however, a great number of analyses have appeared, in widely scattered journals, proceedings and reports, showing a marked improvement in quality as compared with the old analyses.

In the present volume Dr. Washington has collected all the analyses which have been published during the seventeen years from 1883 to 1900, and has presented them excellently arranged according to the quantitative system of classification recently proposed by him in conjunction with Iddings, Pirsson and Cross, together with full references and with critical notes when required, the whole being introduced by an admirable series of chapters dealing with the character of rock analyses and their bearing on rock classification. The vol-

ume thus extends the work begun by Roth and brings it down to the year 1900, while appendices which will be issued from time to time will serve to keep the work up to date. It is, however, much more valuable than Roth's tables in that the analytical work embraced by it is of a better average quality than the older analytical work and because the analyses collected are not all thrown together irrespective of quality, but are divided into two classes; the 'Superior Analyses,' which judged by the various criteria discussed are believed to be correct, and 'Inferior Analyses,' which are of such a character that deductions based upon them must be regarded as erroneous.

The number of analyses published during the seventeen years in question and which are thus included in Dr. Washington's book is no less than 2,881. These are rated as 'excellent,' 'good,' 'fair,' 'poor,' 'bad.' The three first divisions being grouped as superior analyses are thus worthy of use in petrographical discussion, while the 'poor' and 'bad' analyses are classed as inferior analyses and are considered to be of little or no value. The superior analysis constitutes 64.70 per cent. of the whole, and the inferior analysis, 35.30 per cent.; 'in other words, more than one third of all the analyses which have been made in the seventeen years included by the collection are not worthy of use for general purposes and a very large part of them are useful for no purpose at all.'

As Dr. Washington points out, petrographers have hitherto not been by any means sufficiently exacting in the standard required in rock analyses. The fact has not generally been recognized that the complete and adequate analysis of a rock is one of the most complex and, in some respects, one of the most difficult problems of analytical science, far beyond the capabilities of a novice and demanding not only chemical knowledge and manipulative skill, but often the exercise of considerable judgment derived from experience in solving the perplexing problems which may present themselves. A very large proportion of all the analyses which can be classed as 'excellent' are the work of the chemists of the United States Geological Survey, which shows the preeminent position which they hold in this branch of the science, while the analyses that are now being made by the Geological Survey of New South Wales are of almost equally high standard.

In the case of each of the superior analyses, Dr. Washington has calculated the *norm*, which represents in the aggregate a colossal amount of labor, but the results well repay the labor expended to attain them, for all the rock analyses in recent years are thus placed in their proper position in the quantitative system and the suitability of this system of classification is demonstrated. The exact rating and relative value of each analysis is also given. The book may thus be regarded as a sequel to the 'Quantitative Classification of Igneous Rocks' which was reviewed in SCIENCE last February. It tests and illustrates in the most elaborate manner the classification therein proposed. One of the most valuable and interesting portions of the work is that dealing with the errors which are likely to vitiate rock analysis, and how they may be avoided, as well as the methods of judging of and testing the accuracy of an analysis when it has been made.

The book is one of the most important contributions to petrography which has been made for many years, and petrographers are deeply indebted to Dr. Washington for the wide lines on which his book is based and the thoroughness with which it is elaborated. It is a work which gives to the chemical aspects of petrography a new significance.

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DISCUSSION AND CORRESPONDENCE.

STATEMENTS REGARDING EXCHANGES OFFERED BY THE ALLEGHENY OBSERVATORY LIBRARY.

WHILE engaged in rearranging and classifying the books and pamphlets of the Allegheny Observatory library we found that many of our important files of the publications of other observatories and scientific societies were broken and incomplete, but that, on the other hand, we possessed many dupli-