tempts to classify the bacteria. It will give us a sound foundation upon which to build our systematic groups. It will give us a simple and natural nomenclature in place of the unwieldy generic names in use at present, and will do away with the tendency so noticeable now to use trinomial or even quadrinomial names.

Besides pointing out the proper way to work out the classification of the bacteria the authors have set us an example of just how to go about the work by their careful study of the Coccaceæ. They collected 500 different strains of cocci from different sources and submitted each one to a series of eleven definite, and in most cases, quantitative tests. The frequency curve for each character was plotted, the modes determined, and these modes were taken as the bases for the establishment of the various groups. The eleven characters were chosen after due deliberation and while there may be a difference of opinion as to the relative value of these characters and others which might have been selected, yet we must agree with the authors when they say that the eleven tests chosen furnished sufficient information to warrant the recognition of the most important natural groups. A further study of the correlation of these characters seems to point to the fact that these systematic units are marked by the general association of a number of independent characteristics. Such an association can be explained, our authors say, only on the ground of relationship, therefore the classification which they have arrived at is a natural one, and one which meets the requirements of expressing the natural relationships of the different groups.

The authors find eight genera among the Coccaceæ, each of which they define and discuss. To the bacteriologist familiar with the earlier classifications some very striking and totally unexpected results appear. First of these is the importance of pigment production as brought out by this method. Hitherto it has been taken for granted that such an easily modifiable character as the production of pigment was scarcely even of varietal rank. But a study of chromogenesis by the biometrical method shows that the production of the various pigments is the property of certain well-defined types, and when we take into consideration the singularly perfect correlation between this property and the fermentation of the sugars, and with other characters, we must agree with the authors that it is really of genetic significance. Second, we find that the authors lay little stress on such characters as the shape and markings of colonies on gelatin or agar, the shape of the liquefaction in the gelatin stab, the luster or surface appearance of agar streaks, characters which we have been in the habit of considering important. They show that for the most part these characters are but the result of differences in general vigor of growth and in the rate of liquefaction of the gelatin. They summon sufficient evidence to support their position so that we are forced to agree with them. But they are careful to state that their conclusions apply only to the Coccaceæ and that some of these characters may be found important when other groups are studied.

The book closes with a summary of the genera and species of the Coccaceæ, an admirable key to these genera and species, and finally a complete bibliography and author and subject indexes.

While the work on the Coccaceæ is most admirably done and gives us a working basis for all future study of these forms, yet its real worth is not in its own intrinsic value, but in its immense suggestiveness for all future work in the classification of other groups of bacteria. We hope that this will be but the first of a long series of monographs dealing with other groups of the bacteria, all worked out along the lines which these authors have so well marked out for us.

F. P. GORHAM

BROWN UNIVERSITY

A Treatise on Gold and Silver. By WALTER R. CRANE, Ph.D. New York, John Wiley & Sons. 1908.

The preface states that "The object of this work with others of a series is to give a complete and accurate record of the development

of the mineral resources of the country and its influence on the various industrial activities throughout the United States," and that it "has been prepared with aid received from the Carnegie Institution of Washington, and is to form part of the Economic History of the United States, which is to be published by that Institution. . . . The work has been conducted under the supervision of Mr. Edward W. Parker" and its preparation "has occupied two years," etc., from January, 1906, to January, 1908.

Perhaps the value of such a contribution is enhanced by its character as a compilation, and this may give some excuse for the repetition of details under different heads. But the very semblance of statistical quality emphasizes the advantages which might have accrued from the presence of an adequate index or an expanded system of paragraphing. So very much of laboriously collected material has been itemized in the 720 pages, that thousands of entries would be necessary to properly catalogue them. This work has but 500 references in the index, and these are mostly equivalent to the titles of broad divisions of the text. There are typographical errors in proper names of the west, some displeasing errors in grammar and rhetoric and other literary blemishes, but these can all be corrected in later editions and are much less conspicuous than would be the case but for the heavy proportion of quotations, in which these defects do not appear.

There are seven chapters, covering various aspects of gold and silver. The first deals in a semi-philosophical way with precious metal mining as "a factor in the industrial growth of the United States," crediting this industry very largely with the development of civilizing influences, by the inception of agriculture, extension of transportation facilities, expansion of finance, stimulation of scientific enterprises, the upbuilding of mining schools and the general development of the mining industry.

The history of the discovery and growth of precious metal mining and metallurgy is then given in great detail, by geographic divisions, followed by a full chronologic treatment, covering the period from 1513 to 1906.

This portion of the work bears evidence of painstaking library research, and probably the results are, all considered, as satisfactory as could have been anticipated by this method alone. It is cause for regret that an institution of the prestige of the Carnegie should not have availed itself of the services of reviewers in all parts of the country in order to preserve an even balance throughout the record. It is no disparagement to the able young author to suggest this; for he has performed uncommonly well an arduous task, in assorting his material and condensing it as he has done. The general impress is correct, remarkably so, indeed. Very few false conclusions are expressed, although some errors are apparent, which need not here be specified.

Chapter III. treats of "Occurrence and Association of Gold and Silver." It opens with a professedly cursory review of current theories of ore deposition, which is a model of perspicuity and a striking example of self-restraint in the presentation of the current aspect of a much-involved series of problems. The summary of it all is the quotation from A. G. Lock, which puts the case in a nutshell.

Following is a general discussion of the variety of mineral occurrences, ending with a review of prejudiced notions and their injurious effects upon the mining industry.

Then come 120 pages of detailed descriptions of occurrence, arranged alphabetically by states. This chapter gathers a vast array of facts, wholly unclassified and largely repetitive, but often useful in this form. There has been here no attempt to arrange this material more specifically, or to trace connection between the minor areas. Many more pages are taken up with the occurrence, geographically, of gold in gravels.

Only ten pages (chapter IV.) are given to the geologic distribution of gold and silver, and this deficit must be regarded as a blemish. It is true that the presentation in this concise manner bears abundant evidence of the author's thorough acquaintance with the subject

and of his ability to condense. But some might prefer the relegation of the prolix chapters which precede, to a separate volume, giving opportunity for more adequate treatment of subjects which appear to be slighted over much.

Chapter V. has 130 pages devoted to Mining Gold and Silver Ores and Gravels. This is well put together and presents a very fair outline of methods of mining, being very largely a series of quotations from leading authorities, although in some parts the author exhibits his own qualifications by presenting well-digested material in his own words.

In chapter VI. a similar arrangement of authoritative quotations, edited and connected by appropriate remarks, makes a generalized review of about 80 pages.

Nearly 100 pages (as chapter VII.) are given to statistics of production, compiled by geographic areas, as usual. This work has been well performed. Six appendices follow in the form of tables, recapitulating in detail the statistical matter previously given, under practically equivalent headings. These crowd a vast amount of particular information into little more than 60 pages, but they are by no means as complete as they might have been made by seeking the aid of many local co-laborers. As a convenient hand-book for ready reference by busy practitioners, the statistics and much of the technical matter quoted may be in useful form, and probably the whole will fill a want among the untutored who require pre-digested nutriment. The abundant references, though lacking the personal factor which would ordinarily attest their authority, add greatly to the value of the work.

The compiler has rendered good service faithfully and conscientiously, according to a plan apparently dictated by others. Perhaps it is premature to express any opinion upon certain features which might be otherwise rated if one really knew the purpose of the Carnegie Institution in having prepared the series of texts of which ostensibly this is the forerunner. For instance, under the head of Extraction of Values, no mention is made of the flux smelting of gold and silver ores, concentrated in lead and copper menstrua. Although it is probable that this has been reserved for future volumes of the series, where the discussion may be more appropriate, there appears throughout the present volume a tendency to minimize the importance of the fact that the actual weight of silver annually extracted from placers and dry ores amounts to nearly four and one half times the weight of gold obtained from the same source. This is not an economic argument, to be sure, in favor of more generous treatment of the minor metal in a work purporting to deal with both. But the facts are that the weight of all silver extracted amounts to about fourteen times the weight of the gold, and that much more than three fourths of the total silver product (equal in value to one third of the gold product) is won by metallurgic processes designed primarily for the recovery of the silver. Moreover, the metallurgy of the baser ores, *per se,* is in many respects so distinctive that the collection of gold and silver therein is to be regarded properly as a separate industry. That is to say, the presence of the precious metals in ores limits and defines processes of treatment in such a manner as to make the grosser metals the real by-products.

Therefore, it would seem logical and profitable to discuss some methods to which little or no reference has been made in Dr. Crane's work.

Keeping always in mind the introductory words of this review, if it be fair to judge by them alone, the author appears to have compassed very well the task set by the Carnegie Institution. Probably no one else was better placed to perform this identical service by the means employed in executing it. One might prefer a different mode of treatment and the enlistment of others in the collaboration of data not readily accessible in print. But criticisms of this kind must not be permitted to obscure the patent fact that the writer appears to the very best advantage in those parts in which his subjects have given him more free scope for the exercise of his own abilities, and where dictates of modesty and

honor have not appeared to make rigid quotation essential. THEO. B. COMSTOCK

LOS ANGELES, CAL.,
January 15, 1909.

Ueber das Wesen der Mathematik. Rede gehalten am 11 Marz, 1908, in der öffentlichen Sitzung der k. Bayerischen Akademie der Wissenschaften. Von Dr. A. Voss, Professor der Mathematik in München. Pp. 98. Leipzig und Berlin, B. G. Teubner. 1908.

The numerous and valuable earlier publications of the author of the present address inspire confidence in his ability to treat such a general subject in a scholarly and helpful manner. The reader will find that this confidence has not been misplaced, for the address is not only replete with important suggestions in regard to fundamental questions in mathematics, but it also emphasizes those elements which point towards rapid progress in the near future and thus awaken a healthy optimism. It seems especially suited to widen the outlook and to arouse energizing enthusiasm on the part of the young mathematician who may fail to appreciate the dignity and the beauty of abstract thought.

The author begins his address by the statement that we are living in the epoch of natural sciences and technology, and he quotes approvingly the remarks of Galileo:

> True philosophy explains nature, but no one can understand her except those who have learnt the language and the symbols by means of which she speaks. This language is mathematics and the symbols are mathematical figures.

The bearing of mathematics just mentioned tends to explain why this subject is constantly taking deeper root in the educational systems of the world, notwithstanding the fact that it is "the most unpopular of all the sciences; it is a part of the essence of a true science to be unpopular."

The brief introductory remarks are followed by a rapid sketch of some fundamental facts in the history of mathematics. Beginning with the Egyptian work, written by Ahmes nearly four thousand years ago, which claims to give "Directions to obtain a knowledge of all dark things, all secrets contained in the things," our author considers the historical development of a number of fundamental mathematical concepts and symbols. He generally follows the "Prince of mathematical historians," Moritz Cantor. In one instance, however, he adopts a view which is not in accord with the most recent work of Cantor, viz., as regards the question of the origin of zero and the positional arithmetic. Ten years ago it was generally believed that these discoveries were due to the Hindus, while the most recent work of Cantor makes a Babylonian origin appear much more plausible.

As may be inferred from the heading of the address, emphasis is placed upon those mathematical concepts which border on the domain of philosophy. Among the questions which receive considerable attention are the following: definitions of mathematics, relations between mathematic and logic, the development of the concept of number, higher complex number systems and different points of view as regards ordinary complex numbers, different theories in regard to ordinary fractions and irrational numbers, continuity and limit, importance of the concept of function, and suggestions as to changes in the subject-matter to be used for instruction in secondary schools. The address is written in a popular style and should interest the man of general culture as well as the professional mathematician.

G. A. MILLER

UNIVERSITY OF ILLINOIS

SCIENTIFIC JOURNALS AND ARTICLES

The Journal of Experimental Zoology, Vol. VI., No. 1 (January, 1909), contains the following papers: "A Study of Growth in the Salamander, *Diemictylus viridescens,*" by Ada Springer. "Studies on Chromosomes—IV., The Accessory Chromosome in *Syromastes* and *Pyrrochoris,* with a Comparative Review of the Types of Sexual Differences of the Chromosomes," by Edmund B. Wilson. This paper is devoted to a reexamination of two forms heretofore studied by Gross. It shows that sex-production in these forms agrees in principle with that seen in other insects. In *Pyrrochoris* the spermatogonial number is 23