Gherardo of Cremona probably used the word sinus before Plato of Tivoli. As to the symbol for infinity ascribed to Wallis, a rather hasty examination of his Opera fails to show that he used the one mentioned, but he mayhave done so.

It is perhaps justifiable to revert to one point of criticism already mentioned, and to inquire whether Dr. White has used his talents to their best advantage in planning and executing such a work. There is an undoubted need for a good book on mathematical recreations arranged more systematically than any that has yet appeared; one that shall place the material in somewhat the order that a teacher or pupil may use it, and that shall rather carefully exhaust the available material in the large number of works on the subject. To write with no extensive knowledge of the best modern works on the subject, such as Ahrens's and Schubert's, and of such noteworthy older works as those of Bachet and Ozanam is to render impossible the accomplishment of such a labor.

It must be repeated, however, that the author makes no pretense to this sort of work, and it is only fair to say that he has given us a very readable book for a summer afternoon.

DAVID EUGENE SMITH.

Royal Society of London Catalogue of Scientific Papers 1800–1900. *Subject Index, Volume* I, *Pure Mathematics*. Cambridge, at the University Press, 1908. lviii + 666 pp. Price $6.75.

THIS is the first volume of a subject index which is to be published as "separate index-volumes for each of the seventeen sciences of the Schedules of the International Catalogue, viz., mathematics, mechanics, physics, chemistry, astronomy, meteorology, mineralogy, geology, geography, palaeontology, biology, botany, zoology, anatomy, anthropology, physiology, and bacteriology." The object is to bring this Index into close relation with the International Catalogue of Scientific Literature by adopting the same general method of classification and by indexing the papers of the whole of the nineteenth century, while the International Catalogue is devoted to the literature following this period. The present Index has also close contact with the well known Catalogue of Authors which is being issued by the Royal Society, and of which twelve large volumes (1800–1883) have been published, while those covering the period from 1884 to 1900 are in preparation.

As may be inferred from the title, the scope of the Index under review is not as extensive as that of the International Catalogue, since the former confines itself to periodic literature while the latter includes also the non-periodic publications. Notwithstanding this limitation, the preparation of such an Index for what has been called the historic century * is an enormous undertaking in view of the fact that the headings of articles are frequently too vague to admit of classification without a detailed examination of the contents of the articles. We are told in the preface that the present volume contains 38748 entries referring to 700 serials. Although these numbers may appear large, yet they are too small to imply a practically complete list of the papers which appeared during the period under consideration. In fact, about 950 journals devoting more or less space to mathematics were started during the nineteenth century and over 200 had their origin in the preceding century.†

One of the most important mathematical periodicals which does not appear in the list of serial publications used in preparing the present volume is the *Zeitschrift für mathematischen und naturwissenschaftlichen Unterricht*, founded by Hoffman in 1870. Among the American periodicals which have not been indexed, the *American Mathematical Monthly* is probably the best known, and I found only two of the early American mathematical periodicals mentioned by Hart, volume 2 of the Des Moines *Analyst*, in the given list of serial publications, viz., *The Mathematical Miscellany* (1836–39) and Runkle's *Mathematical Monthly* (1858–61). Some of these early periodicals were devoted entirely to problems and hence did not deserve a place in the list under consideration, but this is not true of all of them.

Although the number of entries and the number of serial publications used are not sufficiently large to justify the hope that the volume under review might contain a practically complete index of the mathematical papers appearing during the nineteenth century, they are large enough to inspire considerable confidence in the value of the Index. When it is remembered that Herr Valentin estimates the total number of mathematical articles as a little less than 100,000, a list of 38,748

* Cf. Günther, Cantor's Vorlesungen über Geschichte der Mathematik, vol. 4 (1908), p. 3.

† Felix Müller, *Jahresbericht der Deutschen Mathematiker-Vereinigung*, vol. 12 (1903), p. 439.

entries, with comparatively few repetitions and confined to the preceding century, is sufficiently extensive to include all the articles showing real advances. Even if this high ideal has not been entirely reached, as only about 750 articles appear to have been rejected on account of their lack of sufficient permanent interest to be entered, yet the present volume is extremely valuable and it is hard to see how any live mathematical scholar can afford to be without it.

For the greater part of the period covered, the volume under review contains the most complete subject catalogue extant. In fact, the only other work which can be compared with it is the well-known Répertoire bibliographique des sciences mathématiques, which was started with a view to covering the period from 1800 to 1890, but is still far from being complete. Since 1871 the *Jahrbuch über die Fortschritte der Mathematik* has been doing excellent service, and since 1893 the *Revue semestrielle des publications mathématiques* has made it much easier to keep in touch with recent literature, and the publication of separate volumes covering five-year periods has made the *Revue* very much more serviceable. Although such publications are very useful in looking up the total literature on a subject, they can scarcely be compared with a work of such a large scope as that of the volume under consideration.

A commendable feature of the extensive bibliographic undertaking of the Royal Society is that it tends to make it easier to keep in touch with progress in more than one of the large fields of scientific inquiry. If the subject catalogues of the various sciences form parts of the same set and are arranged according to the same general plan, it is very much easier to maintain the community of interests which ought to characterize scientific endeavor and which frequently tends towards mutual helpfulness. Even if this feature is not regarded as being of primary importance, it is far-reaching in its effects and seems to deserve more attention than it has been receiving during the recent period of very rapid development. Even in mathematics itself there is danger of estrangement, as Darboux pointed out in his recent address before the fourth international congress of mathematicians.*

When the volume under review is examined in detail there is considerable room for criticism. The classification is so minute as to demand an unusually large amount of mathemat-

* *Bulletin des Sciences Mathématiques*, vol. 32 (1908), p. 108.

ical knowledge on the part of the classifier, and it is not surprising to find that this demand was sometimes higher than his patience or knowledge could meet. Hence it is frequently necessary to look under several closely related headings to find the information that may be desired. The titles of the papers published after 1883 were made from the contents of the papers and not merely from their headings. This was also done as regards the earlier papers when the headings were too indefinite for the minute classification demanded by the general scheme.

As an instance where the heading is entirely misleading we may cite the papers by Cockle on a species of indeterminate analysis, which appeared in the *Cambridge and Dublin Mathematical Journal* (1851–53) under the title "Method of vanishing groups." Although they have nothing in common with what is now known as group theory, they are classed with this subject in the present volume. Bilenki's note on "permutants" is classed with permutations and substitutions instead of with the papers on matrices.

In the classification, the subjects are arranged under the registration numbers adopted by the International Catalogue, and a copy of Schedule A of this catalogue is made to serve as a table of contents of the volume, with references to the pages where the articles relating to the various subjects are indexed. In order to save repetition in printing, a number of sub-headings not contained in the International Catalogue, have been employed. These are printed in italics so that they can readily be distinguished from the regular headings of the catalogue. The list of periodicals which precedes the regular index includes not only the abbreviations used for each journal and the date when it was started, but also a statement as regards the British libraries in which it may be found and whether the library contains a complete or only an incomplete set.

Notwithstanding the imperfections to which attention has been called, the present work fills a great want which fully justifies the expenditure of the vast amount of labor involved in its production. It will doubtless contribute greatly towards progress in our science by making it much easier to become acquainted with everything that has been done along a certain line. Fortunately the price of the volume is sufficiently low to make it practicable for a large number of scholars to have it in their private libraries and thus use it to develop many thoughts which would otherwise make only a passing impression.

G. A. MILLER.