

sound teaching of facts and the exact meaning of words, the theory can follow later with greater appreciation.

For such an early course Mr. Hadley's book is eminently suitable. The author's name is a sufficient guarantee of its soundness to those who know his other books. The illustrations are good and for the most part new, and the number of modern appliances described and explained is remarkable. Some attention has been given to the historical side; but among the great names which appear in the index in thick type we have been unable to find Kelvin, Clerk Maxwell, and J. J. Thomson, although wireless telegraphy and atomic structure are treated with some fulness.

*Hyper and Ornate Magic Squares, 15th and 16th Orders.* Constructed by Major J. C. Burnett. Pp. 36. (Grantham, Lincs.: The Author, Barkston, 1924.)

MAGIC SQUARES having certain properties were known to the ancients. In modern times they have been studied by mathematicians since Albrecht Dürer's celebrated magic square picture of 1514. A magic square of order  $n$  involves in its cells the first  $n^2$  natural numbers in such manner that the sum of the numbers in each row, column and diagonal is the same. Certain of these termed "pandiagonals" introduce the broken diagonals possessing the same additive property. If also every pair of numbers equidistant in a straight line from the centre have the constant sum  $n^2 + 1$ , the squares are further specified as associated or symmetrical. Squares are said to be doubly magic if the properties held show the numbers are replaced by their squares. Again, prime numbers exclusively and the knight's path, etc., have been introduced and the squares, to some extent, studied.

Major Burnett presents in his booklet examples of some of these of the 15th and 16th orders. The last square that he gives is doubly magic of the order 8. They will be of service to those who are interested in the subject. There is an extensive literature. Ahrens deals with it in Chaps. xii. and xiii. of his second volume ("Mathematische Unterhaltungen und Spiele," Bands I, II. B. G. Teubner, Leipzig, 1918), and at the end of the volume gives no fewer than 182 references. W. R. Rouse Ball ("Mathematical Recreations") gives an interesting account and many references. Squares which possess row and column properties without any restriction upon the magnitudes of the cell numbers have also been studied. The theory of these is fairly complete since it has been shown that a syzygetic scheme indicating ground forms and syzygies can be constructed. The allied theory of the Latin Square of Euler has also been connected with the theory of differential operations.

It is much to be desired that some competent person should take up (say) the bibliography of Ahrens and give a good account of the present state of knowledge concerning the various natures of magic squares. This will take time and will involve a book of a fair size; but it ought to be undertaken, because the subject is no longer isolated from other parts of mathematics. Several substantial links have been forged during the last thirty years, and without question others are in prospect.

P. A. M.

*Bristol Geology and Geography: for the Use of School Teachers and Others.* By Prof. Sidney H. Reynolds. Pp. 98. (Bristol and London: J. W. Arrowsmith, Ltd., 1924.) 2s. net.

BRISTOL is situated in a district rich in interest to the geologist and one which is well adapted to the study of physical geography. This little handbook has been produced by its author specially to meet the needs of teachers and students of geography and others whose interest in geology is only general. To this end the use of unfamiliar geological terms has been avoided, so far as possible, and, in addition, a glossary is provided.

The district described extends over a somewhat wider area than might be inferred from the title, and includes most parts of Gloucester and Somerset lying east of the Severn, up to within about 25 miles of Bristol, and takes in a little of Wiltshire. Prof. C. Lloyd Morgan's stimulating introduction to Reynolds' "Geological Excursion Handbook for the Bristol District," which outlines the historical and physical geology of the country surrounding Bristol, is reprinted in the book under notice.

Prof. Reynolds, after tabulating the geological strata and chief features of general interest in the district as a whole, proceeds to describe fourteen smaller physically or stratigraphically separable areas.

Detailed geological information, such as is given in the author's "Excursion Handbook," has, for the most part, been omitted, nor are there any references to previous literature. Prominence is given to the physical characteristics of each area, and the reader is assisted by a number of simple sketch maps and diagrams. A novel section of the book is that describing points of geological interest visible from a railway compartment to travellers in the vicinity of Bristol.

Prof. Reynolds' new handbook should serve its limited purpose very well, and may be recommended to visitors to Bristol, by whom it should be studied in conjunction with the geological model of the Bristol district on exhibition at the Museum there. "Bristol Geology and Geography," however, cannot, as its author points out, replace the "Excursion Handbook" as a guide in the field.

V. A. E.

*Flora of the Presidency of Madras.* By J. S. Gamble. Part 6: *Scrophulariaceæ* to *Plantaginaceæ*. (Published under the authority of the Secretary of State for India in Council.) Pp. ii+963-1160. (London: Adlard and Son and West Newman, Ltd., 1924.) 10s. net.

THE feature of the present contribution to the Madras flora is undoubtedly the account of the Acanthaceæ, which occupies more than a third of the entire part. To most workers this family has been one of considerable perplexity, which has not been lessened by the use some recent authors have made in the classification of the genera of minute pollen characters. It is just this that will make the field-worker of S. India, for whom indeed the flora is chiefly written, grateful to Mr. Gamble for giving him a clear analysis of the family which does not necessitate the use of a compound microscope. The excellent keys of some of the larger genera are also improved by the addition of rather full specific details.