

must be professional mathematicians, since no one else can have the reserves of knowledge and the mastery of technique which are essential; and with these professional qualities they must combine a breadth of interest and a literary skill which very few professionals possess. Finally, they must be *honest*, and set themselves resolutely against any attempt to catch an audience by making their subject cheap.

In this respect the attitude of the authors is irreproachable. They do not pretend that their book is all easy arm-chair reading, or is likely to have a wide vogue among "tired business men". They know very well that mathematics is a serious and sometimes an exacting discipline, and that anyone who wishes to master even a little of it must be prepared to face a certain number of uncomfortable hours. They have done their best to smooth the path, and on the whole with remarkable success; but they realize, and warn their readers honestly, that no one can learn anything worth knowing about mathematics unless he has "a certain intellectual maturity and a willingness to do some thinking on his own". Very little *knowledge* is required; no more than could be learnt from any good high-school course.

I can think of quite a number of classes of readers for whom the book is just adapted: really clever schoolboys of fifteen, freshmen undergraduates of average mathematical ability, secondary school-masters, university lecturers in physics and engineering, even a minority of philosophers. All of them (except the first) will find difficulties somewhere, but a book on mathematics without difficulties would be worthless. Finally, even professionals (though they will naturally skip a lot) will find the book well worth reading. Few of them will really know more than seventy per cent of the contents, and each will probably pick out for special praise the parts with which he is least familiar.

To me, for example, the best chapter is Chapter 5, on topology. Here are Euler's formula for polyhedra, the 'five colour theorem', Jordan's theorem (for polygons), Brouwer's 'fixed point theorem', and many suggestions of further developments. The proof of Brouwer's theorem, in particular, is a model of what a mathematical proof should be. Next I put Chapter 7 (on maxima and minima, with strong emphasis on the geometrical side): Schwarz's 'triangle problem', Steiner's 'road problem', the isoperimetric property of the circle, Bernoulli's investigation of the brachistochrone, and much other attractive matter. Here, on the fringes of the calculus of variations, Prof. Courant is naturally at his best as an expositor. It is a pity that the famous 'ham sandwich' problem should be a little too difficult to include: the two-dimensional analogue is solved in Chapter 6 as an application of Bolzano's theorem.

It is natural that I should find the arithmetical and analytical chapters less entertaining, but I have no serious fault to find with the authors' choice of material. There might perhaps be a little more about logic and 'fancy' algebras. The calculus comes late, in Chapter 8, but that I welcome: it will be good for 'practically minded' readers to learn that 'calculus for engineers' is nowhere near the centre of mathematics.

The chapter which I find the least satisfying is Chapter 4, on projective geometry, based as it is, like the accounts in the school-books, on ratios of lengths and other obviously metrical concepts. The geometers will agree with me, but the difficulty is fundamental, and I do not suggest that the authors are

wrong in following (like Dresden before them) the course they take. The subject cannot be ignored but, treated really logically, in the manner of Veblen and Young or even of O'Hara and Ward, it becomes too bulky and formidable for a book like this. It is necessary to be rather illogical; but I think that the authors should have taken their readers a little further into their confidence, by the insertion of a few explanatory pages in which the difficulty is faced squarely. I would suggest this for the next edition: the explanations would demand great expository skill, but nothing which I should judge to be beyond the authors' powers.

I should add finally that the book is beautifully printed and the diagrams particularly well drawn.

G. H. HARDY.

ANALYSIS OF FOODS AND DRUGS

Aids to the Analysis of Foods and Drugs

By Dr. J. R. Nicholls. (Students' Aids Series.) Sixth edition. Pp. vii + 424. (London: Baillière, Tindall and Cox, 1942.) 10s.

THE sixth edition of this well-known book requires no introduction, and it is a pleasure to note that Dr. Nicholls, who was responsible for so much good work in his revision of the previous edition, has now become the recognized author. This edition, which has been increased in size by about one third, contains several new sections; in addition, previously existing sections have been extended and revised. Many references to recent original work recorded in *The Analyst* and elsewhere have been included, and these alone make the book of great value to the practising analyst. The great majority of the new sections have been added to the chapters dealing with food; drugs now occupy only about a tenth of the book, an even smaller proportion than formerly. One might almost suggest that they could be omitted altogether; the book could then be removed from the "aids" series and published in more pretentious form as a text-book on food analysis.

Dairy products occupy the first hundred pages of the book. The statement, which has persisted from an early edition, that the total solids of genuine milk rarely fall below 12.2 per cent, would appear to require further explanation. The new section on vitamins deals briefly with each, giving the structural formulæ and references to the better established methods of assay; a short table at the end of the section gives the international unit and the sources of the better known. The appendix at the end of the book has been extended to cover the Food and Drugs Act 1938, and gives a short summary of the more important points likely to affect the food and drug analyst. A list is also appended of some of the more important regulations and orders governing food which have been passed since the War.

In his preface, the author perpetuates the statement originally made in the preface to the first edition, that the book is not intended as a cram book for the examination of the Institute of Chemistry in food and drugs. It might equally well be said that the student, if he uses the book as a guide and follows up the many references given, will find in it an excellent basis for the theoretical knowledge he requires.

J. H. SINGER.