BOOK REVIEWS

LEDERMANN, W., *Introduction to the Theory of Finite Groups* (University Mathematical Texts, Oliver and Boyd, 5th edition, Edinburgh, 1964), x+174 pp., 10s. 6d.

The fifth edition of this well-known and popular textbook differs from the fourth edition of 1961 in a number of places in the last two chapters. The statement of the theorem (p. 143) on the generators of a subgroup of a finitely-generated free Abelian group has been strengthened slightly without requiring any change in the proof. There are other minor changes in the last two chapters and the theorem that a subgroup of a finitely-generated Abelian group is finitely generated has been added to the end of Chapter VI. Although *The Theory of Groups* by Marshall Hall (New York, 1959) is mentioned in a footnote in both the fourth and fifth editions, it still has not been added to the bibliography. The need for a new edition after only three years emphasises the book's popularity as the best short introduction to group theory available. C. J. SHADDOCK

NOBLE, B., *Numerical Methods, 2: Differences, Integration and Differential Equations* (Edinburgh, Oliver and Boyd, 1964) 215 pp., 12s. 6d.

This is the second volume of a two-volume presentation of numerical analysis at a level appropriate to an undergraduate course up to honours degree standard. The expectation engendered by the first volume (reviewed on p. 174 of the *Proceedings* for December 1964) that together these would provide a suitable textbook for such a course is amply fulfilled.

The opening chapter deals with the use of finite differences in numerical work, with no previous knowledge assumed, and the criteria for best polynomial approximations, in particular the minimax criterion. The least squares norm receives only a brief mention but the Chebyshev polynomials and their application to polynomial approximation are discussed. The following chapter is devoted to the interpolating polynomial in its various forms, due attention being given to truncation errors and the practical use of these formulae in both hand and automatic computation.

The author has avoided the symbolic method but in the opinion of the reviewer the treatment of numerical integration and differentiation would have been facilitated and enhanced by its use. There is no mention of the Euler-Maclaurin formula and the reference to Gaussian quadrature is perfunctory.

The multiplicity of superficially different methods for solving differential equations numerically and the variety of error sources, to which they are subject, including the phenomenon of instability in its diverse forms, makes this topic one which is not readily amenable to a systematic elementary treatment. The account given here is one which will be appreciated by those who have attempted this difficult task and will help greatly those who have to teach the subject. The account of numerical techniques for solving partial differential equations is brief and orthodox.

Relatively few printing errors have been detected at a first reading. The low price and high quality production associated with the University Mathematical Texts series is maintained in this timely contribution to the literature on numerical analysis by Dr Noble. JAMES FULTON

HUNTER, J., *Number Theory* (Oliver and Boyd, 1964), ix+149 pp., 10s. 6d.

This book, in the well-known University Mathematical Texts series, provides an introduction to elementary Number Theory. From the outset the relation of the subject-matter to algebraic theories is kept in mind. The first chapter, entitled " Number systems and algebraic structures," contains definitions of concepts such as group, ring, field and equivalence relation. These ideas are not developed far in their own right but the algebraic terminology is used where appropriate in later sections. Thus the elementary properties of congruences (mod m) are also expressed as results concerning the ring of residue classes (mod m), or when in particular m is a prime p, the field of p elements. Chapters 2 to 5 present the topics of divisibility and congruences traditional in an introductory text of this type, going as far as primitive roots and quadratic residues and including the Law of Quadratic Reciprocity, a theorem notorious for the variety of its proofs. Of these the reviewer would prefer a version making explicit use of a lattice-point argument; see for instance Hardy and Wright, *An Introduction to the Theory of Numbers*. However this is purely a personal preference for geometrical imagery! The last two chapters deal with the representation of integers by binary quadratic forms and with some diophantine equations. Naturally only an outline of these vast topics can be given at this level and in the space available. Another consequence, presumably, of the small size of the book is the sparseness of historical references. We are told on p. 133 that Diophantus of Alexandria lived in the third century A.D., but Mersenne and Fermat primes are merely named as such in exercises on p. 41 without further comment. However such details are easily accessible in more comprehensive books to which, it is to be hoped, readers of the present volume will be encouraged to progress. This remark prompts the reviewer's one serious criticism—the lack of a list of suggestions for further study. On p. 29 there is a reference, for a proof of the Prime Number Theorem, to Le Veque's two-volume treatise; later, mention is made of algebraic works by Ledermann and van der Waerden. But this is not enough and the gap should be filled as soon as possible in a further printing. There is a good supply of examples, very generously provided with hints for solution. Answers are also given.

Both the elegance of elementary Number Theory and its close relationship to algebra suggest that it should be part of the equipment of the modern teacher of Mathematics. The publication of a cheap and compact text on the subject is therefore timely and Dr. Hunter's book can be warmly welcomed. D. MONK

FLETCHER, T. J. (editor), *Some Lessons in Mathematics* (Cambridge University Press, 1964), xiii + 367 pp., 35s.

This book was written by a group of members of the Association of Teachers of Mathematics, largely during a " writing week ", and later edited by the group leader, Dr T. J. Fletcher. It must have been an extraordinary hard-working week, but also an extremely exciting and stimulating one—and the excitement and stimulation are clearly conveyed in the book. The chapter-headings indicate the wide variety of material discussed: binary systems; finite arithmetics and groups; numerical methods and flow charts; sets, logic and Boolean algebra; relations and graphs; linear programming; patterns and connections; convexity; geometry; vectors; matrices. Although there is a good deal of " straight " exposition and description, the most fascinating sections of the text are those in which more or less informal lessons are described, just as they might be conducted in the classroom. The method by which it was produced, and the style employed have produced a very unorthodox book full of fertile ideas, both mathematical and pedagogical, and, far more than any carefully-polished conventional text, it conveys very strikingly the impression of mathematics as a challenging and constantly developing subject. It should be in the hands of all who are concerned with the teaching of the " new mathematics ".

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