effort at abstraction. All in all it makes for interesting reading.

Merrill's significant extension of Scarf's algorithm is hidden in section 6.3, "fixed points of upper semicontinuous point-to-set mappings", and deserves a much more prominent place (it isn't even mentioned in the index, which is far too short and selective). Furthermore, there is no description of any of the several new algorithms developed since the mid-70s which now dominate the field; all that is offered is a list of references. This is difficult to justify, and greatly lessens the value of the book to current researchers.

For beginners, my advice is to look first at the attractive review article of Allgower and Georg [1], which is fairly up-to-date and discusses the implementation and efficiency of complementary pivoting algorithms as well as covering nicely much of the book's early material.

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(This review was written while the author was at Waterford Regional Technical College)

"FINITE FIELDS" (Encyclopaedia of Mathematics and its Applications, Volume 20)

By *Rudolf Lidl and Harald Niederreiter*

Published by *Addison-Wesley*, Reading Mass, 1983, Stg £57.80, pp. xx + 755. ISBN 0-201-13519-1

Recently, before breakfast one morning, I received a telephone call from a former student of mine who is now teaching at a Regional Technical College. He wanted to know if a certain polynomial of degree 16 was irreducible over GF(2). This question was motivated by a project one of his students was hoping to carry out in coding theory. For me, this incident epitomises the sudden rush of interest from many sides in the classical theory of finite fields.

It is difficult to know where to begin describing the book in hand. Perhaps some raw statistics may serve to convey something of the scope of this massive work. It has 755 (+ xx) pages in all handsomely bound. There is a comprehensive bibliography of 160 pages of detailed references to finite fields from ABDULLAEV, I, through LAFFEY, T.J. to ZSIGMONDY, K. The author index has 15 pages of entries and there are 21 pages of very useful tables relating to such topics as irreducibility of specific polynomials over fields of small order. In addition there are 634 carefully worded exercises ranging from the pretty:

Let F be a field; if F* is cyclic show that F is finite,

through the purely routine

Factor $x^5 + 3x^4 + 2x^3 - 6x^2 + 5$ over $\mathbb{F}_{17}$

to the difficult, of which there are many.

There are two features of this book that I particularly welcome. All sections, especially those introducing new or difficult material, are explained and clarified by an astonishing number of thoroughly worked examples of varying levels of difficulty. This means that although the book is pitched at a reasonably advanced level it is very suitable for students or those wishing to learn the subject for the first time. The second notable feature is that each chapter is followed by a section of pleasantly readable notes running to twenty pages of text in the case of some chapters. These notes give the historical background and significance of the results proved in the chapter as well as detailed references to the bibliography.

Chapters 1-3 give the standard information on algebraic foundations, structure of finite fields and polynomials over finite fields, carefully presented. The section on the various algorithms for finding the roots of linearised polynomials is particularly readable. Chapter 4 is concerned with the factorisation of polynomials over "small" and "large" finite fields. Chapter 5 on Exponential Sums takes us into the applications of finite fields in number theory and Chapter 6 gives a very thorough treatment of equations over finite fields. Chapter 7 on Permutation Polynomials gives us further algebraic background for what one suspects is the meat of the book - the many unlikely and exciting applications of the theory of finite fields - linear recurring sequences, linear codes in general, cyclic codes in particular, finite geometries and various aspects of combinatorics such as block designs and latin squares. In the section on finite geometries there is some delightful material on the connection between the theorems of Desargues and Pappus via Wedderburn's Theorem. Overall, the range and scope of the material presented is almost overwhelming.

Any reservations? Well, it is almost churlish to mention them but any book of this length is unlikely to please everyone in every detail. Though there seem to be remarkably few misprints, the language reads a little strangely at times. For example, on page 17 we read "An element c ∈ R is called a prime element if it is no unit ..." and on page 18 "... the ring R/(C) consists only of one element and is no field". Overall perhaps the book is a bit too clinical with little emphasis on the beauty and elegance of the theory of finite fields. Maybe this is the price to be paid for a definitive work on the subject.

"Finite Fields" is a must for all libraries and, despite its price, probably essential for anyone with a serious interest in algebra. Lidl and Niederreiter have written a superlative book which is likely to be regarded as the last word on finite fields for many years to come.

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