turning its back on Algol 60, and the interest in maintaining this library was rapidly waning. What remains fifteen years later is this manual printed from one-alphabet lineprinter output, and it does not at all look palatable now.

The book under review is the manual of a straightforward conversion of the complete NUMAL library into C. The book contains a diskette with all source code of routines and example programs.

Nearly all NUMAL procedures and their example programs have been converted into ANSI C, and all routine descriptions (purpose of the routine, specification of the parameters, information about the solution method) are now meeting modern standards of typesetting and readability. Owing to the availability of typesetting for mathematical formulas, the descriptions of purpose and method of many routines could actually be supplemented with further explanations that were (for NUMAL) only available in the referenced literature. The typesetting and rewriting of formulas is not perfect and errors occur (which probably do not trouble the reader much), but is a big improvement compared with the NUMAL manual. There is no new extension, algorithms have not been replaced or modified reflecting recent achievements, and the choice of parameters is still the choice that was found useful when employing Algol 60. C utilities are used for imitating the Algol dynamic memory management.

It is difficult to assess the usefulness of this work. One could say that the work was hardly called for, and the programming style in use for Algol 60 procedures twenty years ago by some contributors of the NUMAL library is probably not adhered by them any more. Experienced C programmers might find that the Algol 60 style of making and using arrays is error prone when applied to C implementations. What (relative) merits does this collection have compared with the set of routines known as Numerical Recipes, or compared with well-known libraries for which efforts are continuing to improve methods, the performance on new architectures, the ease of use for users that do not have a PhD in numerical analysis, and the attractive presentation of the computed results?

As can be perceived from the Introduction, the author appreciates the NUMAL-like setup of a library with very technical routines and accessible auxiliaries because of its possibilities for developing new research software using the library modules as building blocks. Also, students could be entertained with assignments to modify example programs in order to provoke some listed error exit of a routine, or they could learn by studying the implementations. This justification for the book is not very pretentious. However, the book is also a tribute to a group of pioneers in numerical software.

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35[01A70, 33-XX, 33C45, 41-XX, 41A55]—*Approximation and Computation: A festschrift in honor of Walter Gautschi*, R. V. M. Zahar (Editor), International Series of Numerical Mathematics, Vol. 119, Birkhäuser, Boston, 1994, xlvi+591 pp., 24 cm, $98.00

Nearly twelve months after the actual event, an International Symposium was held at Purdue University in December 1993 to celebrate the 65th birthday of

Walter Gautschi. About 80 delegates from many parts of the world attended this Symposium and over thirty papers were presented. This volume, the 119th in the ISNM series, is a commemorative issue in Walter's honour and comprises nearly all the papers that were given at the Symposium, together with a few more which were subsequently submitted.

During his distinguished career, Walter has worked principally in four areas of mathematics. These are: (1) Approximation theory, (2) Orthogonal polynomials, (3) Quadrature and (4) Special functions. A list of the thirty-eight papers to be found in this volume, classified according to these areas, appears at the conclusion of this review. Each paper has been refereed and, although Walter has written papers in English, French, German and Italian, every paper in this volume is written in English. But there is more to this volume than just a collection of papers and a photograph of Walter. There is a "Foreword" from John Rice, Head of the Department of Computer Sciences at Purdue, where Walter has spent about half his life. This is followed by an "Introduction" written by R. V. M. Zahar who was the first of Walter's seven Ph.D. students and who has done such a superb job of editing this volume. In his "Introduction", Zahar has given a brief review of each paper and the classification of the papers into the four subject areas is due to him.

However, for this reviewer, the *pièce de résistance* of the volume is Walter's 20-page "Reflections and Recollections", followed by a list of his publications. The latter makes interesting reading; 150 articles are given ranging from books to chapters in books, papers in refereed journals, Conference Proceedings, translations and a miscellaneous collection labelled "other". It is a most impressive record of mathematical activity which started in 1951 and continues unabated to this day (there are four articles in the "to appear" category). Under one item of the "other" category, one reads that Walter has had 97 book reviews published in *Mathematics of Computation* and no less than 450 reviews of technical articles and books published in *Mathematical Reviews*! As further evidence of his mathematical activity, John Rice remarks in his "Foreword", that Walter has served a total of 76 years on the editorial boards of various mathematical journals with the last nine years as Editor-in-Chief of *Mathematics of Computation.* This journal alone receives more than one paper each working day of the year and each has to be considered in some way by Walter. But a list of publications gives only an outline of anyone's career; Walter has added substance to this outline in his twenty autobiographical pages.

He starts out by saying that he had "no intention to give a talk" at the Symposium but "only after persistent persuasion" did he agree to give "an informal personal talk reflecting on my career". Persistence has been well rewarded, for the result is a fascinating account of the first half of Walter's life, his family background, his undergraduate years and the postgraduate years which set him on the mathematical track he has followed ever since. As a student at the University of Basel he worked for two years as Professor Ostrowski's assistant. What a marvellous mathematical training that must have been for a young man! His own first excursion into research was on a variant of a *graphical* method for solving ordinary differential equations which was published in 1951. In 1954, Walter was given a two-year travelling fellowship. The first year was spent in Rome, where he worked at Professor Picone's Institute for Computational Mathematics. The second year was spent at Aiken's Computation Laboratory at Harvard, where he worked on the Mark III computer, "a massive electronic computer with magnetic drum storage and lots of vacuum tubes which had a tendency to blow out every so often".

The programming was in basic machine language. What nostalgia this evokes, and one wonders how many people, now under the age of 60, have had the doubtful pleasure of having to write programmes this way but, in the pre-Fortran, pre-Algol days, there was no alternative. After Harvard, Walter went to the National Bureau of Standards in Washington, D.C., and while there contributed two Chapters to Abramowitz & Stegun's, "Handbook of Mathematical Functions".

After Washington, there followed a few years at Oak Ridge, Tennessee, where Walter worked with Alston Householder's group. Here he became fascinated by J. C. P. Miller's backward recurrence algorithm for the computation of Bessel functions and this led to his work on the minimal solution of three-term recurrence relations. It was also at this time that his interest in orthogonal polynomials and Gaussian quadrature began. For this we owe a debt of gratitude to an unknown Chemist who asked Walter how to construct Gauss quadrature rules associated with the weight function $w(x) = 4/(\pi^2+\ln^2((1+x)/(1-x)))$ on the interval $(-1, 1)$. One is reminded of that other Chemist, Mendelieff, who asked Markoff how large the derivative of a polynomial, of a given degree, could become on the interval $[-1, 1]$. Perhaps we should all pay more attention to questions posed by our colleagues in Chemistry. Walter's thirty years or so at Purdue are, however, covered in a mere $2\frac{1}{2}$ pages. There is a need for a sequel covering those years, although his contribution to de Branges' proof of the Bieberbach conjecture has been well documented.

Although the list of thirty-eight papers is appended, I will say no more of them here. This volume has been very well produced and its Editor is to be congratulated on a magnificent tome which should be in every Numerical Analyst's library. To assist the reader, there is both a comprehensive Subject Index and an Author Index listing every reference given in the papers. Not surprisingly, but very fittingly, the list of references under the name of "Gautschi W." has substantially more entries than that of any other author.

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36[11Txx, 94A60, 94B60]—*Introduction to finite fields and their applications*, 2nd ed., by Rudolf Lidl and Harald Niederreiter, Cambridge Univ. Press, Cambridge, 1994, xii+416 pp., $23\frac{1}{2}$ cm, \$44.95

This is the second edition of the well-known 1986 text by Lidl and Niederreiter. The latter is, in turn, based on their 1983 monograph in volume 20 of the Encyclopedia of Mathematics and its Applications.

The second edition hardly differs from the first one: the authors have updated the bibliography and have extended their historical and bibliographical notes. The main text remains unaltered: a discussion of the theory of finite fields with some applications to coding theory and cryptography. The approach is easygoing, with a student reader in mind: the algebraic prerequisites are minimal and each chapter contains a lot of exercises.

The book contains ten chapters. The first one contains a rather general algebraic introduction. Chapters 2 and 3 contain the basic theory. Chapters 4, 5, 6 and 7 are devoted to factorization algorithms for polynomials, exponential sums, linear recurrences and designs, respectively. Chapters 8 and 9 contain the applications to coding theory and cryptography. Finally, Chapter 10 contains some tables of finite fields and irreducible polynomials over finite fields.

The authors introduce Gaussian sums, linearized polynomials etc., but they do not discuss the deeper properties of finite fields and polynomial equations over finite fields. They do not even state the main consequences of the work of P. Deligne or even A. Weil, on varieties over finite fields. This is a pity, but perhaps understandable, since a full discussion of their results in a book of this sort seems quite difficult.

On the other hand, many of the recent results on finite field theory obtained by researchers in computational number theory and computer algebra are quite accessible and can easily be explained to anyone aware of the contents of Chapters 2 and 3 of this book. The authors have not included these new results in their second edition, but have left the book as it was: an easygoing introduction to the theory of finite fields.

R.S.