25[92–01].—R. BELLMAN, *Mathematical Methods in Medicine*, Series in Modern Applied Mathematics, Vol. 1, World Scientific Publishing Company, Singapore, 1983, xiv + 252 pp., $21\frac{1}{2}$ cm. Price $33.00 hardcover, $18.00 paperback.

From the many applications of mathematics to medicine the author covers a selection centered around pharmacokinetics and radiation biophysics. The book starts with one-dimensional compartment models in continuous and discrete time, multicompartment models and the related ordinary differential equations and matrix problems, problems of parameter identification, positivity and conservation laws (Ch. 1–4). Then follows a general introduction to computers and basic numerical methods (Ch. 5, 6). Ch. 7 and 8 introduce calculus of variations and control theory; Ch. 9 and 10, the theory of dynamic programming and related analytic and computational aspects. A short Chapter 12 treats scanning procedures and tumor detection, while Ch. 13 introduces radiation dosimetry and ends with new results of the author on scattering and transmission functions. Though much of the material is elementary and well known (also at 1978), one will find many interesting facts and views, in particular on those topics (Ch. 7–10) which are typically not presented in elementary biomathematics text books. On the other hand, the book as a whole has serious deficiencies.

1. The presentation is arbitrary, eclectic, and inconsistent (e.g., on p. 31 the problem of multiple eigenvalues and associated eigenvectors is suppressed, but on p. 26 matrix power series, and on p. 37, Stieltjes integrals, appear *en passant*. The transpose of the matrix is used on p. 36, the adjoint (w.r. to the usual inner product) is introduced on p. 49 and is "formed by the interchange of rows and columns". After the reader has just learned about round-off he is told that present (1978) large computers are far too small for most medical problems.

2. There are almost no examples or exercises, in particular no relation to real problems, real biological phenomena, real experiments or data.

3. The bibliography (the end of each chapter) refers almost exclusively to the author's own work or books edited by him.

The book has some merits as a complementary reference. It can be used for the training of medical students or young mathematicians only after careful preparation.

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26[94B05, 05B40, 20D08].—THOMAS M. THOMPSON, *From Error-Correcting Codes through Sphere Packings to Simple Groups*, The Carus Mathematical Monographs No. 21, The Mathematical Association of America, Washington, D. C., 1983, xiv + 228 pp., 19 cm. Price $21.00.

Undergraduate mathematics students may never see a theorem that was proved after their birth, prompting the question "Do people still do mathematics?" Moreover, one such student may have no idea how mathematicians work. Thompson's book is an excellent solution to this problem. Using extensive interviews, he has

traced Conway's discovery of three new simple groups [2] from Leech's work on sphere packings [4]. Leech's work was related to Golay's (23, 12) 3-error correcting code [3]. Thompson uses a hands-on approach, and assumes that the reader has had advanced calculus and a first course in algebra. The book is also unusually clear, because one of Thompson's main goals is to give the evolution of the mathematics.

It would be a lively choice for an upper level topics course. There are several interesting historical observations. Here are two facts that the reviewer did not know. It was Cocke [1], not Hamming or Golay, who found the infinite family of 1-error correcting codes over a general finite field $GF(q)$ (the so-called Hamming 1-codes). Bell Labs was able to patent (in 1951) Hamming's original (7, 4) 1-error correcting code. This led to a delay in its publication which caused a priority dispute.

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1. J. COCKE, "Lossless symbol coding with nonprimes," *IRE(IEEE) Trans. Inform. Theory*, v. 5, 1959, pp. 33–34.
2. J. CONWAY, "A perfect group of order 8,315,553,613,086,720,000 and the sporadic simple groups," *Proc. Nat. Acad. Sci. U.S.A.*, v. 61, 1968, pp. 398–400.
3. M. GOLAY, "Notes on digital coding," *Proc. IRE(IEEE)*, v. 37, 1949, p. 657.
4. J. LEECH, "Some sphere packings in higher space," *Canad. J. Math.*, v. 16, 1964, pp. 657–682.

27[65–01, 65–04].—WEBB MILLER, *The Engineering of Numerical Software*, Prentice-Hall Series in Computational Mathematics, Prentice-Hall, Englewood Cliffs, N. J., 1984, viii + 167 pp., $23\frac{1}{2}$ cm. Price $27.95.

This book is primarily a textbook suitable for the senior undergraduate or first-year graduate level. It ought to appeal to a greater audience, however: anyone likely to develop or use computer programs for serious scientific computation. Thus, it should interest engineers, mathematicians, and scientists, as well as computer scientists.

The author presents material related to the production and testing of numerical software that has never before been gathered together. In the Preface he states, "My goal is to present principles for writing numerical software. The ideal textbook about the production of numerical software remains to be written, but I hope that I have verified its worth and feasibility and hastened its arrival." I believe that the author has succeeded admirably in verifying worth and feasibility. While still not the ideal textbook, this book is a valuable first effort to organize and codify principles and concepts that have hitherto only been found scattered through the literature. The text is supplemented with exercises and programming assignments, some quite challenging, designed to enhance the reader's understanding of fundamental issues.

The book contains six chapters. Chapter 1 introduces terminology and illustrates concepts that will be used throughout the book. The distinction between similar terms, particularly those related to programming "mistakes" of various kinds, is sometimes subtle. Fortunately, examples in later chapters make the distinctions, and the reasons for them, understandable.