15[65-01].—GENE H. GOLUB & JAMES M. ORTEGA, *Scientific Computing and Differential Equations—An Introduction to Numerical Methods*, Academic Press, Boston, 1992, xi+337 pp., $23\frac{1}{2}$ cm. Price $49.95.

This is a revision of "An Introduction to Numerical Methods for Differential Equations" by J. M. Ortega and W. G. Poole, Jr., Pitman Publ., 1981. The new version has the subtitle "An Introduction to Numerical Methods", which emphasizes that this text uses the numerical treatment of differential equations as a vehicle for discussing fundamental topics of numerical mathematics.

This concept goes back to the preceding version; it has been strengthened by the amplification of some sections dealing with subjects other than differential equations, notably linear equations and least squares. As in the earlier version, one feels that the authors are really more at ease when dealing with systems of equations, eigenvalues, etc. rather than with the numerical treatment of differential equations. While the level of exposition is elementary in both areas, the text is appreciably more concise and definitive in its formulations in the algebraic sections than it is in the analytic ones. For example, ill-conditioning is not discussed in the context of initial value problems, where it is first met, but only with linear systems of equations; the discussion of roundoff effects is much more vague in differential equations than in algebraic problems, etc. The fundamental distinction between the numerical solution behavior for initial value problems as $h \to 0$ on a fixed finite interval, and as the interval length grows for a fixed small h, remains as vague as the criteria upon which a step-size control may be based and what they effect. On the other hand, there are excellent introductory expositions on the least squares problem and orthogonal polynomials, on projection methods, and on the direct and iterative methods for solving large sparse systems coming from partial differential equations, and the like. The weaknesses go back to the original version; it is a pity that they have not been eliminated in the revision.

On the other hand, it is a tribute to the authors of the original text that the first chapter "The World of Scientific Computing" needed very little updating except in the hardware section and in the treatment of visualization and symbolic computation. Also, the refreshingly original basic concept of the text has remained a challenge over the past ten years. The many exercises have remained a great asset.

Altogether, I would recommend the book as a text for an introductory course in numerical analysis (on the right level), but not as an introduction to scientific computation and differential equations. Thus, the inclusion of the subtitle in a quotation of the title appears to be necessary to avoid any misleading impression.

H. J. S.

16[65-02].—WILL LIGHT (Editor), *Advances in Numerical Analysis*, Vol. I: *Nonlinear Partial Differential Equations and Dynamical Systems*, Clarendon Press, Oxford, 1991, x+275 pp., 24cm. Price $52.00.

This book is the first of two planned volumes containing notes from a series of lectures delivered at the fourth Summer School in Numerical Analysis held at Lancaster University in 1990. It consists of six chapters, each corresponding to a short course of five lectures on a topic of current interest within numerical analysis of nonlinear partial differential equations and of dynamical systems. The intention of the editor appears to have been to create a semblance of one coherent treatise rather than a collection of independent contributions, and the various authors are not listed in the table of contents.

The first chapter, Finite Element Methods for Evolution Equations, by Lars B. Wahlbin, concerns mostly error analysis for linear parabolic equations and associated integro-differential equations with a memory term; it can be considered as introductory in the present context.

The second chapter, Finite Element Methods for Parabolic Free Boundary Problems, by R. H. Nochetto, treats the fixed-domain method for the Stefan problem. Approximations of the continuous problem by regularization and phase relaxation are described and used as motivation for the construction and analysis of discrete schemes based on finite elements in space and backward differencing in time. Much of the relevant material is in the form of exercises.

The third chapter, An Introduction to Spectral Methods for Partial Differential Equations, by A. Quarteroni, starts with reviewing basic properties of Fourier and Chebyshev expansions and corresponding discrete transforms, including fast ones. It proceeds with application to Galerkin and collocation methods for elliptic and parabolic boundary value problems, including the Navier-Stokes equations and ends with a section on domain decomposition methods.

The fourth chapter, Two topics in Nonlinear Stability, by J. M. Sanz-Serna, first defines stability for a linear problem as uniform well-posedness with respect to a discretization parameter, and then discusses generalizations to nonlinear problems. The second part is devoted to long-time behavior of discretized dynamical systems and of symplectic numerical integrators.

In the fifth chapter, Numerical Methods for Dynamical Systems, by Wolf-Jürgen Beyn, some of the topics covered concern numerical computation of invariant sets such as stationary points, periodic orbits and tori, the transition between these objects in parametrized systems, and the analysis of long-time behavior of time discrete trajectories.

The sixth and final chapter, The Theory and Numerics of Differential-Algebraic Equations, by Werner C. Rheinboldt, begins with three examples of applications of differential-algebraic equations and proceeds to discuss existence theory for implicit such equations, using techniques of modern differential geometry. The chapter closes with a section on numerical methods based on the notions developed.

The six chapters are somewhat different in style and degree of accessibility, with the contributions of Wahlbin, Sanz-Serna, and perhaps also Quarteroni, making for relatively easy reading. The topics of Nochetto's and Beyn's chapters, the two longest ones, are by their nature more difficult and require substantial efforts on the part of the reader, and Rheinboldt's presentation depends on a good familiarity with the language of algebraic geometry.

Together the contributions make for a very nice overview of important recent developments in numerical mathematics, and with the extensive lists of references the book should be a useful source of information.

V. T.