numerical methods are developed from one fundamental base—the theory of interpolation polynomials." Such a foundation is rather proper in one-dimensional situations, cf. the elegant little book by Wendroff, [3]. In more than one dimension the claim is somewhat overstated. You will need much more than interpolation polynomial theory to conquer a given partial differential equation.

The brisk treatment means that the authors often give their own opinions in practical matters without supporting evidence. For example, on page 36 the following statement appears: "It is enough to say here that the application of Galerkin's method to first order equations is never worth the effort."

There are a few questionable statements in the book. The worst one appears in Section 1.4, pp. 5–6, on why and how boundary conditions must be specified. For example, for $\Delta u = 0$ in a two-dimensional region, since there are 4 derivatives involved, formal integration gives 4 unknown functions! Happily, if the region is rectangular, there are 4 sides and so we can specify the correct number of conditions! Woe if you were to solve the problem in a triangle or a pentagon or a disc! For the heat equation it is only by convention that one specifies initial time conditions (in addition to spatial boundary conditions). Final time conditions would be equally appropriate, it appears!

For the interested reader, I will record that I also found statements that I quarrel with on the following pages: 30, 49, 52, 55, 77, 97, 100–107, 117. Happily, most of these statements can be taken as starting-points for constructive discussions. Most likely, the authors have evidence which they do not present in this brief volume.

The practical hints given seem mostly to pertain to problems which require only low-accuracy solutions, say 5–10 percent relative error in multidimensional situations. A scientist who desires to illustrate her/his theory by compelling numerical examples might well heed different advice.

Having thus said that the book contains statements that merit reflection, for novice and expert alike, I point out that it is indeed a brisk and to the point introduction to numerical methods in partial differential equations. Most major classes of methods are treated in some detail. The "how-to" is explained with detailed examples, and the authors share their wealth of knowledge in practical evaluation of the methods. This volume should serve at least as an introduction to its stated purpose, "...to supply the inexperienced scientist or engineer with the fundamental concepts required to achieve this objective (to obtain a relevant numerical solution efficiently and accurately)".

L. B. W.

1. L. Lapidus & G. F. Pinder, *Numerical Solution of Partial Differential Equations in Science and Engineering*, Wiley, New York, 1982.

2. D. V. von Rosenberg, *Methods for the Numerical Solution of Partial Differential Equations*, Gerald L. Farrar and Associates, Inc., Tulsa, 1969.

3. B. Wendroff, *First Principles of Numerical Analysis*, Addison-Wesley, Reading, Mass., 1969.

7[65R20, 76B05].—H. Schippers, *Multiple Grid Methods for Equations of the Second Kind with Applications in Fluid Mechanics*, Mathematical Centre Tracts 163, Mathematisch Centrum, Amsterdam, 1983. iii + 133 pp., 24 cm. Price $6.00.

This Mathematical Centre Tract has been based on the author's Ph.D. Thesis at Delft University of Technology (with Professor Wesseling). It provides a well-written introduction into theoretical and practical aspects of the use of multigrid methods for the numerical solution of Fredholm integral equations of the second kind. Furthermore, it presents interesting applications to problems in fluid dynamics: the computation of the double layer distribution representing a potential flow around an airfoil, and the computation of the periodic flow generated by an infinite disk performing rotational oscillations.

After introductory remarks and a survey of the compactness results on sequences of approximations to Fredholm operators, the multigrid approach is introduced and asymptotic results about contraction rates, convergence and number of operations are derived and experimentally verified. Then a code is presented (in Algol 68) for the solution of Fredholm integral equations of the second kind. The approximations may be piecewise linear and trapezoidal rule, or cubic spline and Simpson's rule. A tolerance for the remaining discretization error may be specified and the code attempts to choose the finest grid accordingly. In numerical examples the code proves superior to Atkinson's IESIMP.

The second half of the monograph deals with two applications in fluid dynamics. First, the multigrid approach is applied to the numerical solution of the customary collocation system for a piecewise constant doublet distribution along the boundary. A clever analysis of many theoretical and algorithmic details leads to convergence results for the doublet distribution and its derivative and to contraction rates of various multigrid processes. The application to both noncirculatory and circulatory potential flows around Karman-Trefftz airfoils is demonstrated; the circulatory flows require a special type of smoothing and convergence cannot be established in a vicinity of the trailing edge.

A particularly interesting application to the computation of the periodic solution of a parabolic equation with periodic initial conditions concludes the treatise, which constitutes a welcome contribution to the multigrid literature.

H. J. S.

8[10A25, 10-04].—JOHN BRILLHART, D. H. LEHMER, J. L. SELFRIDGE, BRYANT TUCKERMAN & S. S. WAGSTAFF, JR., *Factorizations of* $b^n \pm 1$, $b = 2, 3, 5, 6, 7, 10, 11, 12$ *up to high powers*, Contemporary Mathematics, Vol. 22, Amer. Math. Soc., Providence, R.I., 1983, lxvii + 178 pp., 25 cm. Price $22.00.

The purpose of this volume is to present several tables of factorizations of integers of the form $b^n \pm 1$. The first set of four tables gives the complete (with a few exceptions) factorization of all integers of the form $2^n - 1$, $2^n + 1$, $10^n - 1$, $10^n + 1$ for values of n up to 250, 238, 82, and 72, respectively. A second, larger set of tables presents factorizations of $b^n \pm 1$ for all $n \leqslant m$, where the values of b and m are set out in the table below.

N	m	N	m
$2^n \pm 1$	1200	$7^n \pm 1$	180
$3^n \pm 1$	330	$10^n \pm 1$	150
$5^n \pm 1$	210	$11^n \pm 1$	135
$6^n \pm 1$	195	$12^n \pm 1$	135