edition) a basic error estimate for the five-point operator, which he describes as extremely useful. Referring to this estimate, he then comments incorrectly (p. 254): "It also proves that the discretization error is proportional to h^2 so Richardson's 'deferred approach to the limit' method can be used effectively to improve the accuracy of the solution of the difference equations." He remarks (p. 255), somewhat misleadingly, that the requirement of the fourth derivatives of the solution to be bounded "...is not satisfied if, for example, the boundary contains corners with internal angles in excess of 180°."

The list of references for supplementary reading also reveals the author's lack of familiarity with recent developments.

In spite of the dominance today of the finite element method, particularly as concerns elliptic and parabolic problems, the reviewer feels that the finite difference method is still of sufficient importance to justify the publication of a textbook. Unfortunately, however, the present one must be considered severely outmoded.

V. T.

12[65N99].—Carlos A. Brebbia (Editor), *Topics in Boundary Element Research*, Volume I: *Basic Principles and Applications*, Springer-Verlag, New York, Heidelberg, 1984, xiii + 253 pp., $24\frac{1}{2}$ cm. Price $49.50.

This is the first volume in yet another series of publications on the boundary element method edited by Carlos Brebbia. In the Introduction to the Series, it is stated that the series was launched to satisfy an unfilled need, namely that which "exists for a serial publication in which the most recent advances in the method are documented in a more complete form than is usually the case in papers presented at conferences or scientific gatherings". Whether such a need actually existed is debatable in view of the fact that another series "Developments in Boundary Element Methods" edited by P. K. Banerjee et al., with somewhat similar goals, had been started, the first two volumes [1], [2] having been published in 1979 and 1982. Since then two more volumes have appeared [3], [4]. Several of the contributors to the present volume have also contributed to Banerjee's series.

In this volume, there are eleven chapters (three of which are co-authored by the editor) covering such topics as time-dependent problems, fluid mechanics, hydraulics, geomechanics, and plate bending as well as mathematical aspects of the boundary element method. Three chapters are devoted to the latter, the first of which is Chapter 0, entitled "Boundary Integral Formulations" written by the editor and J. J. Connor. This chapter is aptly numbered because there is very little in it of relevance to boundary element methods. Material which is relevant is presented in a more understandable fashion by other authors in later chapters. Much of the discussion in Chapter 0 is devoted to one-dimensional problems, and any mention of boundary integral formulations is through the weighted residual scheme, an approach which does nothing to simplify the derivation of integral equation formulations of boundary value problems, but much to confuse it. Moreover, the weighted residual scheme is an *approximate* method whereas the standard derivation, in which the fundamental solution of the equation in question is combined with a reciprocal theorem, is simply a reformulation of the problem, not an approximation to it. There seems to be nothing that can be accomplished using the weighted residual scheme that cannot be done in a more rigorous and straightforward manner using the standard approach. This chapter has only 10 references, all to publications (books and conference proceedings) by Brebbia.

Chapter 1, "A Review of the Theory" by M. A. Jaswon, is well-written, but it is rather mathematical in its approach and the book's intended audience of scientists and engineers will find it hard going. The third chapter devoted to mathematical aspects of the method is Chapter 10, "Trefftz Method" by I. Herrera. This chapter is exceedingly theoretical, and, in the reviewer's opinion, totally inappropriate for a publication of this nature, despite the editor's claim in the Preface that it "is written in a way the engineer can easily interpret". It appears to have little or no connection with the theory and application of boundary element methods described in the other chapters.

The remaining eight chapters are devoted to applications of the boundary element method. Transient problems in two space variables are discussed in Chapter 2, "Applications in Transient Heat Conduction" by H. L. G. Pina and J. L. M. Fernandes, and Chapter 3, "Fracture Mechanics Application in Thermoelastic States". In Chapter 2, the standard boundary integral formulation of the heat equation is derived in a rather confusing and long-winded fashion. Boundary element methods are described and two time-marching procedures are introduced and applied to a few test problems. Despite its title, much of Chapter 3 duplicates parts of Chapter 2. The notation is slightly different and, in contrast to Chapter 2, the correct fundamental solution is used, that of Chapter 2 having no fewer than two errors. When the discussion turns to thermoelastic problems it is very difficult to follow because some notation is not defined. Moreover, the reader unfamiliar with fracture mechanics will not be enlightened by the material presented in this chapter. Only 8 references are listed; one reference is omitted from the list and one appears in the list but not in the text.

Two chapters, Chapter 4, "Applications of Boundary Element Methods to Fluid Mechanics" by J. A. Liggett and P. L.-F. Liu, and Chapter 8, "Applications in Mining" by G. Beer and J. L. Meek, contain excellent reviews of their respective areas. In Chapter 4, the authors describe interesting applications of the method to porous media flow, free boundary and water wave problems, in addition to presenting a short history of the development and use of boundary methods in fluid mechanics. This chapter has a comprehensive list of 65 references. In Chapter 8, the authors give a very good description of the complexity of the problems arising in mining and discuss different formulations used in their analysis. Both direct and indirect boundary element methods are described, as well as a formulation known as the displacement discontinuity method which is of use when an excavation in a mine is considered to have negligible thickness. The combination of the boundary element method and the finite element method is discussed and several interesting examples of its use to solve some typical nonlinear mining problems are presented. This chapter has 69 references.

In Chapter 5, "Water Waves Analysis" by M. C. Au and the editor, the application of boundary element methods in the study of water waves diffraction and radiation problems involving fixed, free-floating or moored offshore structures is described. The main point made by the authors is that the boundary integral equation formulation of an exterior problem for Laplace's equation with a radiation type boundary condition at infinity can be simplified by imposing this boundary condition on a finite boundary sufficiently far from the structure. This idea is not new but was discussed and improved upon by Harten et al., in the mid-seventies (see [6] and references cited therein). What is not obvious from the Preface, and the chapter's introduction and conclusions is that problems which involve the Helmholtz equation are also discussed in this chapter. Moreover, no mention is made of the important "fictitious eigen-frequency problem" which can arise in the solution of exterior boundary value problems involving the Helmholtz equation. A number of numerical examples are provided, some of which involve the solution of the Helmholtz equation and the remainder Laplace's equation.

Chapter 6, "Interelement Continuity in the Boundary Element Method" by C. Patterson and M. A. Sheikh, is not only very poorly written but almost unintelligible in parts. The description of the boundary element method is the worst that this reviewer has seen in print and ought not to have been published.

Chapter 7, "Applications in Geomechanics" by W. S. Venturini and the editor, deals with the solution of geomechanical problems modelling rock and soil behavior using the boundary element method. Several examples are presented to illustrate the efficacy of the boundary element formulation and, whenever possible, results obtained using this method are compared with known theoretical solutions or solutions obtained using the finite element method. This chapter seems to draw heavily on material already published by the editor in publications which he has edited.

In Chapter 9, "Finite Deflection of Plates" by N. Kamiya and Y. Sawaki, the application of the boundary element method to solve finite deflection of elastic plates, shallow shells, and sandwich plates and shells is presented. Integral equation formulations based on the von Karman theory are described, as well as the so-called Berger approximation. Some numerical examples in which the Berger method is used are presented, and it is noted that this method gives "fairly good results" under certain specified limitations.

The volume is rather lavishly produced, being typeset and printed on thick glossy paper, and consequently it is exceedingly expensive. However, it contains more than its fair share of typographical errors, inaccuracies, and grammatical mistakes. Moreover, in contrast to the volumes edited by Banerjee et al., it is very carelessly compiled, and it is clear that little editing was done. The chapters have no common thread and no attempt has been made to relate them. Most of the chapters, including those co-authored by the editor, begin as if the boundary element method were never mentioned elsewhere in the book. Few of the key references are to papers published in refereed journals; most are to works appearing in conference proceedings, usually edited by Brebbia.

The series by Banerjee et al. [1]–[4] is to be recommended over this volume, as is the book by Banerjee and Butterfield [5]. This volume contributes little to the literature on the boundary element method that is not presented better elsewhere. If the editor is not more discriminating and more selective in the preparation of subsequent volumes, *caveat emptor*.

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1. *Developments in Boundary Element Methods*, Vol. 1, Edited by P. K. Banerjee and R. Butterfield, Elsevier, London, 1979.

2. *Developments in Boundary Element Methods*, Vol. 2, Edited by P. K. Banerjee and R. P. Shaw, Elsevier, London, 1982.

3. *Developments in Boundary Element Methods*, Vol. 3, Edited by P. K. Banerjee and S. Mukherjee, Elsevier, London, 1984.

4. *Developments in Boundary Element Methods*, Vol. 4, Edited by P. K. Banerjee and J. O. Watson, Elsevier, London, 1986.

5. P. K. BANERJEE & R. BUTTERFIELD, *Boundary Element Methods in Engineering Science*, McGraw-Hill, London, 1981.

6. A. HARTEN & S. EFRONY, "A partition technique for the solution of potential flow problems by integral equation methods," *J. Comput. Phys.*, v. 27, 1978, pp. 71–87.

13[76–02, 76–08].—EARLL M. MURMAN & SAUL S. ABARBANEL (Editors), *Progress and Supercomputing in Computational Fluid Dynamics*, Progress in Scientific Computing, Vol. 6, Birkhäuser, Boston, 1985, ix + 403 pp., 23 cm. Price $44.95.

This volume constitutes the proceedings of the U.S.–Israel Workshop entitled "The Impact of Supercomputers on the Next Decade of Computational Fluid Dynamics" held in Jerusalem, Israel, during the week of December 16, 1984. From the editors' preface the intent was to "...present to the community a sort of 'State of the CFD-Nation' report consisting of two elements: technical papers by leading researchers and an attempt to assess where the field is going".

Taken as a whole, the papers provide an excellent overview of the present status of computational fluid dynamics with particular emphasis on problems relevant to aerodynamics. The Euler and compressible and incompressible Navier-Stokes equations are considered. A variety of numerical algorithms and their vectorization properties are discussed, including explicit and implicit methods, multigrid and spectral methods. Finally, the important topics of prediction of transition and turbulence are presented. Reflecting the present emphasis in the community, most of the papers utilize finite difference approximations rather than finite elements.

One paper surveys the present status of supercomputer hardware and projects capabilities into the immediate future. Unfortunately, there is not a companion paper to speculate on the kind of software systems that the new supercomputers will require in order to be effective for computational fluid dynamics, but many authors did comment from their own perspective on what they considered necessary and desirable. In addition, these issues were discussed during panel sessions, and a summary of those discussions is given in the introductory paper by the editors.

With the expected explosive growth in raw computational power, the participants look forward to an exciting decade of discovery in computational fluid dynamics. However, the following statement from the editors' introduction indicates there is a clear understanding that such power alone is not sufficient: "It is important to understand that the powerful new supercomputers will only yield useful results if the mathematical and numerical analysis formulation is carefully done."

There follows a list of papers and authors included in the volume: