this subject, describes an impressive collection of applications of variants of augmented Lagrangian methods in nonlinear mechanics.

The book begins with a review of fundamental concepts of continuum mechanics including basic concepts of Sobolev spaces, existence theorems, and the characterization of solutions to weak or variational formulations of nonlinear initial and boundary value problems. Some of the basic equations of quasi-static viscoplasticity, elasto-viscoplasticity, and finite elasticity are given in a second chapter. Then the augmented Lagrangian methods for the solution of variational problems are presented and discussed in considerable depth in Chapter 3. The remaining chapters concern specific algorithms applying the augmented Lagrangian methods to various problem classes.

Chapter 4 is particularly interesting as it applies these methods to viscoplasticity and elasto-viscoplasticity problems with small strains. Limit load analysis is covered in Chapter 5 and two-dimensional flow of incompressible viscoplastic fluids is covered in Chapter 6. Chapter 7 is devoted to problems of finite elastic deformation. Emphasis is given to finite element discretizations and iterative solution methods based on augmented Lagrangian formulations. Included in this chapter are also some problems of contact. In Chapter 8, the final chapter in this work, large-displacement behavior of flexible rods is discussed. This work includes the solutions of dynamical problems.

The book is well written, laid out in a readable style, and the major algorithms are set out in a tabular-box format in the text. The book provides, at the same time, an excellent introduction and a text to augmented Lagrangian methods as well as a reference to researchers and engineers looking for powerful numerical methods to treat nonlinear problems in mechanics. This book is an important contribution to the field.

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3[65N38, 65R20, 65L10, 45E10].—Michael A. Golberg (Editor), *Numerical Solution of Integral Equations*, Mathematical Concepts and Methods in Science and Engineering, Vol. 42, Plenum Press, New York, 1990, xiii + 417 pp., $23\frac{1}{2}$ cm. Price $75.00.

This book consists of eight interesting survey papers on current topics in the numerical treatment of integral equations. Combined, these papers cover a vast area. All of them are well organized, clearly written and easy to follow. If a theorem is given without a proof, a suitable reference is supplied for the interested reader. Each paper contains a long reference list which is very useful for further study. I note with satisfaction that the book has an index, something which cannot always be taken for granted in collections of this type.

The following list of chapter headings gives an indication of the contents of this volume:

1. K. E. Atkinson: A survey of boundary integral equation methods for the numerical solution of Laplace's equation in three dimensions.
2. I. H. Sloan: Superconvergence.

3. M. A. Golberg: Perturbed projection methods for various classes of operator and integral equations.
4. G. Miel: Numerical solution on parallel processors of two-point boundary value problems of astrodynamics.
5. M. A. Golberg: Introduction to the numerical solution of Cauchy singular integral equations.
6. D. Elliott: Convergence theorems for singular integral equations.
7. E. O. Tuck: Planing surfaces.
8. R. S. Anderssen and F. R. de Hoog: Abel integral equations.

In Chapter 1 we find an integral equation reformulation of Laplace's equation. Both direct and indirect boundary element methods are presented and the cases of smooth and piecewise smooth boundaries are dealt with. Numerical solutions are derived by using both global (i.e., when the solution is expressed as a linear combination of some selected basis functions that interpolate globally) and local methods. In most cases a large system of equations is obtained, and the author discusses different approaches for solving this system.

Chapter 2 is devoted to superconvergence, i.e., the phenomenon that the order of convergence for certain functionals of the solution to an integral or a differential equation is higher than for the solution itself. As an example, the accuracy of the solution at the knots may be higher than at other points. The author discusses collocation, Galerkin's and Kantorovich's methods, and presents examples.

Chapter 3 deals with perturbed projection methods. Here, too, we encounter the Kantorovich method as well as the collocation and Galerkin methods. The author also discusses the influence of discretization errors.

In Chapter 4 we encounter a treatment of two-point boundary value problems for ordinary differential equations using a reformulation to an equivalent problem of solving a Hammerstein integral equation. The author gives a lucid presentation of the solution of corresponding operator equations in Banach spaces. Some interesting applications to the movement of space vehicles are described, and an implementation on parallel computers is treated.

Chapter 5 gives a thorough discussion of Cauchy singular integral equations, in particular, the important generalized airfoil equation. We encounter the Galerkin method as well as collocation and quadrature methods.

In Chapter 6 the same class of equations is treated as in the preceding chapter. The author gives an interesting theory for the convergence of important classes of numerical methods.

Chapter 7 deals with the planing equation which is important in ship hydrodynamics. The author reports on problems and progress in this area.

Chapter 8 gives a fairly complete treatment of the theory and the applications of Abel's equation. Although this equation is special, it is important for the applications in many fields. Solutions may be written in analytic form, but there are numerical pitfalls associated with these solutions. The authors discuss these difficulties and give methods for avoiding them. They point out that one is not always interested in the solution itself but rather a functional having the solution as an argument. The latter problem is often better conditioned than the task of determining the solution itself, a fact which may be utilized in the numerical treatment. This important observation is often valid for other ill-conditioned problems, besides the task of solving Abel equations.

The book is strongly recommended for those working in the theory or the applications of integral equations. Thus it should be suitable for graduate students in science or engineering as well as for their teachers.

F. S.

4[01A55, 01A70, 68-03].—MICHAEL LINDGREN, *Glory and Failure: The Difference Engines of Johann Müller, Charles Babbage and Georg and Edvard Scheutz*, The MIT Press, Cambridge, MA, 1990, 414 pp., 26 cm. Price $45.00.

As the result of exhaustive, painstaking research, this copiously annotated, well-illustrated book presents a detailed social and technical analysis of the first attempts to mechanize the production of numerical tables.

The book is divided into two parts. The first begins with a survey of the most celebrated numerical tables published before 1830. This is followed by the history and technology of the difference engines (so designated by Charles Babbage) and accompanied by biographical sketches of their inventors. The first of these men, Johann Müller, invented in 1784 a printing tabulating machine 37 years before Babbage first considered such a device. Müller and his machine, which was never built, have been almost completely ignored by previous historians. In contrast, the lives and inventions of Charles Babbage, Georg Scheutz and his son Edvard have been well documented in the existing literature, which is referenced in an appended bibliography of nearly 400 sources.

The second part contains a detailed comparison of Babbage's Difference Engine No. 1, as planned but never completed, with the third difference engine of the Scheutzes. Babbage's failure to fully implement his plans is attributed to his perfectionism and his initial limited knowledge of engineering. Despite their achievement of completing three operational difference engines, Georg and Edvard Scheutz failed to attain commercial success because of the mathematical limitations of their machines and the limited market for machine-computed and typeset tables. In the Epilogue the assertion is made that if the Scheutzes had been more attuned to market forces and had concentrated on building ordinary calculating machines, their fortunes would have been assured.

In an appendix the author describes his rediscovery in 1979 of the first Scheutz engine, which had been stored away in its case and forgotten among the collections in the Nordic Museum in Stockholm for nearly a century. Details of the restoration of this machine preparatory to its display are included by the author, who participated in that task.

Apart from a number of typographical errors resulting in misspellings, this reader has detected only one significant error, which arose from the confusion of James Glaisher with his son James Whitbread Lee Glaisher, to whom all relevant references in the text should have been made. This error of identification extends to the index of persons, where (on page 411) the dates given for the son are actually those of the father. The correct chronological entry should read (1848–1928).

This carefully written, scholarly book is an impressive addition to the MIT Press series on the History of Computing. It will be rewarding for all those