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REVIEWS

Numerical and Physical Aspects of Aerodynamic Flows. Edited by T. CEBECI. Springer, 1982. 636 pp. DM 180.

This volume is based on research papers presented at the Symposium on Numerical and Physical Aspects of Aerodynamic Flows, at California State University, in 1981, and is dedicated to Mr Morton Cooper's service in the U.S. Office of Naval Research. Some revision of the papers was done between their presentation at the Symposium and this publication.

The presentation is divided into five parts, 1–5, on Numerical Fluid Dynamics, Interactive Steady Boundary Layers, Singularities in Unsteady Boundary Layers, Transonic Flows, and Experimental Fluid Dynamics respectively. Various types of introduction are given to each part.

Part 1, on Numerical Fluid Dynamics, has seven papers, all aimed in quite different directions. The introductory one by H. B. Keller, on continuation methods, contains some interesting remarks on these simple-looking methods particularly with regard to bifurcation and the use of arclength, or pseudo arclength, continuation. Examples noted are flow in a driven cavity and flow between rotating disks, but there is little helpful connection made with the rest of the papers. These are by Moretti (on initial and boundary conditions), Wu (hybrid procedures for general viscous flows), Ferziger (subgrid-scale modelling), Orszag & Patera (three-dimensional (3D) instability of plane channel flows), Roache (separated channel flows) and McDonald & Briley (3D Navier–Stokes results). Moretti's investigates how three numerical models cope with determining planar inviscid compressible fluid flow through a constricted channel. The steady-state comparisons are useful. Wu lists methods he has used on various problems, but without giving much detail, and some of the work appears to be the interactive boundary-layer approach in disguise. The results are nonetheless of interest. Likewise, Ferziger's survey of methods in subgrid-scale turbulence modelling, an important problem, is lacking in detail of the methods themselves, an omission which really inspires neither clarity nor confidence. Orszag & Patera's paper seems an admirably thoughtful contribution, on subcritical 3D instabilities, combining large computations and some analysis. The results are exciting and suggest an explanation at last of the experimentally observed instabilities in channel flows, although the analysis part is not a rational support for the secondary instability mechanism proposed, and once again computational detail is not exposed. Roache's work concerns channel flows whose streamwise lengthscales are proportional to the Reynolds number. The scalings and properties involved are well known already, but the numerical description here is presented clearly. McDonald & Briley consider some central points of 3D Navier–Stokes problems including mesh selection and splitting algorithms, the former acknowledging the processes of viscous–inviscid interaction in effect. Coarse-mesh results are given for flow through a square duct with a finite bend and for flow past a strut–endwall, or wing–body, junction. In both cases interactive theory would have helped in the mesh selection problems, I feel. The overall impression of Part 1 is one of great diversity rather than a general theme, of little novelty in fluid dynamics but much in numerical methods, as might be expected, and of a number of interesting computational results, standard and non-standard methods and concepts. The impact is lessened perhaps by having a number of excellent numerical studies assigned to subsequent parts of the volume.

Part 2, Interactive Steady Boundary Layers, quickly raises the fluid-dynamical content by means of the late Keith Stewartson's fascinating article. The master theoretician, discussing some recent studies in triple-deck theory, produces a most profound paper, in my opinion. Writing with that customary passion, joy and concern, he addresses trailing- and leading-edge separations, grossly separated motions, 3D motions, unsteady trailing edges and turbulence, pointing to central issues throughout. His comments on discontinuous transition/stall at the leading edge and on the Kirchhoff separated-flow solution in particular are illuminating and, while taking an opposing view about trailing-edge stall (see *J. Fluid Mech* **131** (1983), 219), I find the whole article exciting and stimulating. The subsequent papers also maintain a high standard. Burggraf & Duck present a spectral approach to triple-deck calculations, a powerful approach which is faster than finite-difference methods and accommodates flow reversal well. Significant separated-flow solutions are given. It is intriguing that solutions with large zones of reversed flow are still difficult to obtain: is this due more to numerical and/or physical instability, to subscales emerging, or perhaps to an impending unexpected change of character or to an unexpected finite breakdown of the solution? Next, Inger presents a 'non-asymptotic theory' of unseparated turbulent boundary-layer–shock-wave interactions. It is founded on Lighthill's approach of 1953, leading to the predominance of the inviscid rotational adjustment of the boundary layer. This produces reasonable comparisons with experiments, but the mechanism for separation, where the wall layer must be active, remains unclear. Rubin's review of marching procedures for parabolized Navier–Stokes equations is good, accommodating ideas from interactive theory and subsonic relaxation methods where necessary, comparing single- and multiple-sweeping techniques, and showing useful solutions. Davis & Werle (progress on interacting boundary-layer computations) address mainly the difficult problems of coordinate selection for interactive methods, a central difficulty which is pronounced for separated or blunt trailing-edge flows. Their techniques and results are full of interest. Melnik & Grossman then consider turbulent interaction at a wedge-shaped trailing edge. They conclude from a close analysis that neither weak nor conventional interaction is sufficient, and propose instead a strong-interaction account including normal pressure gradients. The avoidance of separation seems a crucial aspect.

Finally, Ragab & Nayfeh give comparisons between second-order triple-deck theory and interacting boundary layers, for flow over surface-mounted obstacles, including some separation. The general theme of Part 2 concerns the theoretical and practical importance of separation and turbulence. The interactive laminar-flow theory is now well established but requires more accurate numerical and analytical efforts to extend its range, whereas turbulent interactions still contain some mysteries. Part 2 addresses these tasks well.

Singularities in unsteady boundary layers are the concern of Part 3. The articles are by Cebeci, on unsteady separation, by Wang, on the controversy about unsteady separation, by Van Dommelen & Shen, on the genesis of separation, by Dwyer & Sherman, on characteristics of plane and 3D unsteady reversed boundary layers, by Williams (P. G.), on large-time computations at a rear stagnation point, by Barbi & Telionis, on form factors rear separation, and by Williams (J. C.), on semisimilar unsteady flow near a rear stagnation point. The introduction is by Cebeci. It is unfortunate for Part 3 that most of the content has been superseded since by Van Dommelen's finding of a finite-time singularity for the classical unsteady boundary-layer equations and by Sychev's finding of a logarithmic singularity in the steady downstream-moving wall and semi-similar unsteady-flow problems.

Part 4 is on transonic flows. There is a very useful, and sometimes humorous, introductory article by Ballhaus, Deiwert, Goorgian, Holst & Kutler, on advances and opportunities in computations, which surveys the status of steady inviscid, of unsteady inviscid and of viscous transonics. The benefit of improved computers as well as algorithms is made especially clear. Then Cheng's interesting paper reviews analytical methods for high- and low-aspect-ratio wings, amends previous authors' attempts, and presents a number of valuable solutions. Hafez adopts a perturbation analysis for flows with shocks, including effects of unsteadiness, three-dimensionality and wind-tunnel walls. Sears continues the theme with a study of the difficult problem of allowing for tunnel-wall interference. The remaining papers, on advances in the finite-volume method (Caughey & Jameson), on upper-surface-blow airfoils (Malmuth, Murphy, Shankar, Cole & Cumberbatch), on shock–boundary-layer interaction (Wai & Yoshihara), and on time-linearized unsteady-flow computations (Seebass & Fung), all deal in essence with improvements in computational approaches, using the various approximations available. Significant viscous effects are noted in some of the papers. Clearly from Part 4 the analysis, computations and experiments are in quite a strong and lively state on the whole, granted that the difficulties in handling shocks, and viscous effects, accurately, seem to remain.

Experimental fluid dynamics, in Part 5, is rich in variety and is given a good introduction by Roshko, who, among other things, categorizes experiments approximately as either data-collection or concept-seeking (or both). Ho studies the main non-stationary features of turbulent free shear layers and suggests certain theoretical possibilities with regard to vortex merging, local instability and subharmonic evolution. Johnson describes the use of laser anemometry in investigating shock-wave–turbulent-boundary-layer interaction and finds lack of agreement with numerical predictions based on Reynolds-averaged unsteady Navier–Stokes equations. Mehta, Shabaka & Bradshaw present experiments on streamwise vortices, or pairs, in turbulent boundary layers. These 3D motions occur typically near wing–body junctions, and are very complicated. Next, oscillating subsonic jets are discussed by Collins, Platzer, Lai & Simmons with a view to the increase in entrainment, while Taylor, Whitelaw & Yianneskis point out the benefits of laser-Doppler anemometry and water flow in their experiments on ducted flows. Investigations of airfoil stall for helicopters are described by Young, who discusses the unsteady development from unsteady small separations to strong vortex shedding. Finally, Parikh, Reynolds & Jayaraman's experiment on an unsteady turbulent boundary layer is aimed at both basic concepts and data collection, for the phenomenon of interaction with an unsteady free stream. All the experiments of Part 5 are of considerable interest, and in particular they pose challenging questions to theoreticians and computationalists.

What is perhaps insufficiently represented in, or is beyond the scope of, this volume is much new multistructured analysis, much 3D (e.g. vortex-sheet) research and linear or nonlinear stability considerations, among other things. Necessarily the volume tends to be a collection of individual items with little overall common theme other than the general concern with aerodynamics and the wide occurrence of viscous–inviscid interaction, separation, turbulence and zonal methods of solution. Necessarily some items are already out of date or have since been amended. Yet what is present is undoubtedly a solid body of serious research and information, with a splendid diversity, and rich in all kinds of interest, like aerodynamics itself. It will reward study and will provoke, and has provoked already, much further research.

F. T. Smith

Unsteady Viscous Flows. By D. P. TELIONIS. Springer, 1981. 408 pp. £20.85.

The standard graduate textbooks on fluid mechanics contain rather little material on unsteady viscous flows, as distinct from wave motions or turbulence: Schlichting's *Boundary Layer Theory* and Rosenhead's *Laminar Boundary Layers* each contain a single chapter on the subject, while Batchelor and Landau & Lifschitz have just one or two sections. I was delighted to receive this book, therefore, since, although limited to incompressible and mainly two-dimensional flows, it promised to be a complete monograph on the subject. In it we would be brought up to date on all the modern theoretical and experimental developments in unsteady boundary layers (for external and internal flows), in the development of unsteady separation and in unsteady separated flows past bluff bodies. This would be most timely, since the subject is currently one of vigorous research, both because of the development of new analytical and numerical techniques, and because of the wide range of applications in which interest has recently developed: unsteady aerodynamics (e.g. dynamic stall, or the hovering of insects), unsteady fluid loading on fixed bodies (e.g. wave action on marine structures), cardiovascular mechanics, etc.

For each topic selected for discussion I expected a clear statement of the current (in 1980) understanding of the physics of the flow and a thorough, critical review of the literature from which that understanding had been obtained. When I noticed that the book formed part of the Springer Series in Computational Physics, I realized that its greatest strength was likely to be on the numerical side, and I looked forward to learning what the best computational methods were, for particular problems, and why other methods were inferior. Reading the book in the light of these expectations, I have to confess to considerable disappointment, on two counts. First, the element of criticism is in general absent from the literature review: the author merely lists various techniques that have been used and some of the results obtained, without helping us to decide which is most accurate even when the results are mutually inconsistent. Secondly, the literature review is not thorough: not only are the broad subjects of internal flow and of hydrodynamic stability almost completely omitted, but important contributions to the chosen topics are also ignored.

The book has seven chapters. The first two, 'Basic Concepts' and 'Numerical Analysis', introduce the reader to some relevant mathematics of partial differential equations and, very usefully, provide explicit statements of several finite-difference schemes that have been used to solve the unsteady boundary-layer equations. Even here, however, the main weakness of the book becomes apparent: the author discusses various methods that have been used when regions of reversed flow arise, such as upwind differencing, zig–zag, and the 'Keller box', but he does not give us enough insight to be able to decide which scheme we should use in a particular problem.

In each of chapters 3–6 a particular class of unsteady flow is discussed: chapter 3 treats laminar flow started impulsively from rest, chapters 4 and 5 treat laminar oscillatory flow, 4 with zero mean and 5 with non-zero mean, and chapter 6 treats unsteady turbulent flow. Chapter 7 returns to laminar flow to discuss the topical subject of unsteady separation. Despite the numerical slant to the book, most of these chapters are unbalanced in favour of elementary analytical expansions of the boundary-layer equations, at the expense of (*a*) modern, difficult boundary-layer analysis, (*b*) critical comparisons of different numerical solutions of the boundary-layer and the full Navier–Stokes equations, and (*c*) qualitative or physical discussion of the flows.

A few examples will suffice to justify the above remarks. Section 3.5 concerns the impulsively-started semi-infinite flat plate, stating that Stewartson (1951) found an essential singularity in the solution of the boundary-layer equations, but failing completely to mention the rather complicated analysis with which Stewartson (1973) elucidated the structure of that singularity. On the plus side, the author does here give a clear discussion of three different numerical solutions, showing their (different) weaknesses and emphasizing, albeit implicitly, the need for several independent computations of any flow field before confidence can be placed in the results. In the section (3.8) discussing numerical results for impulsive flow past a circular cylinder, the author notes considerable discrepancies between the results of different researchers in the predicted time variation of the point of zero skin friction, and between prediction and experiment, but does not investigate them deeply enough for them to be understood and corrected. (Incidentally, the first time of zero skin friction is quoted as $t_s = 0.32$ in the text and in table 3.1, but seems to be around 0.2 in figure 3.14, suggesting some carelessness in the interpretation of other worker's non-dimensionalizations.) This section also contains a very confusing paragraph on how the author was surprised to find that t_s increases as Reynolds number *Re* decreases (i.e. kinematic viscosity ν increases), since the time scales with ν^{-1} in impulsively started flows. He appeared not to realize that it is the convective inertia terms that are responsible for flow reversal, and their influence is reduced as *Re* is decreased. Note that there is a similar but even more confusing paragraph in chapter 7, which I am sure contains misprints such as 'smaller *Re*' instead of 'larger *Re*'!

Chapter 4 deals with Stokes layers and steady streaming, is mainly analytical, and is unexceptionable. Chapter 5 considers oscillations about a non-zero mean flow, but only on a semi-infinite plane boundary, for which the boundary layer is quasi-steady near the leading edge (small x) and consists of a steady layer for the mean flow with a Stokes layer embedded in it at large x. The author unnecessarily limits himself to perturbation theory for small amplitude oscillations, whereas in fact the small- and large-x expansions work for any amplitude as long as the outer flow does not reverse. Moreover he nowhere considers reversing outer flows, although a critical numerical test of this reviewer's crude theory for them (Pedley 1976) would have been welcome. What is welcome is the demonstration of how the numerical solution of the boundary layer equations provides a good link between the analytical small- and large-x expansions, for small amplitude. Discussion of the results concentrates largely on the amplitude of the velocity maximum in the boundary layer and the phase of the skin friction, which leads that of the outer flow. It is a pity that the simple physical explanation of this phase lead does not come at the beginning of the chapter, to give point to the analysis. There is a brief but interesting section on the boundary layer on a plane under a travelling wave.

The main purpose of chapter 6 is to show how well numerical predictions of ensemble-averaged quantities (velocity profile, turbulence intensity, etc.), based on different turbulence models, agree with experiment, in order to decide which model is most appropriate. The intention is sound but unfortunately the outcome is again inconclusive.

Virtually all the boundary layers discussed in chapters 3–6 have pressure gradients that are given in advance and cannot be modified by the presence of the boundary layers themselves (a partial exception is the use of higher-order boundary-layer theory in chapter 3). But modern boundary-layer theory is interactive, the pressure gradient being undefined *a priori*, and solutions that fail to take account of that are unlikely to be widely applicable (see Smith 1982). In particular, only the very early stages of flow separation can be analysed non-interactively. Surely, then, we could expect some account of interactive boundary-layer theory and 'triple decks' in chapter 7, even allowing for the fact that much of the interesting work has been published since 1980. Instead, we are given a long discussion of the Goldstein singularity, and a survey of numerical solutions of the non-interactive equations, and of the Navier–Stokes equations, for small times after the impulsive start of a circular cylinder (as usual, the existence of discrepancies between different predictions is not used as grounds for rejecting one or the other). We are also given a welcome reference to the integration of the boundary-layer equations in Lagrangian coordinates by Van Dommelen & Shen (1980), a belated and oversimplified reference to Proudman & Johnson (1962) and a discussion of the development, in a finite time, of a singularity in the solution of the unsteady boundary-layer equations. However, the absence of interactive boundary-layer theory is what finally confirms the imbalance of this book.

I should add some comments about the style. References are listed chapter by chapter, without titles, and there is no author index at the end. The quality and clarity of the English is not high: e.g. 'Russian mathematicians have been by far the protagonists in this area' (p. 25) and 'in this effort and due to the neglect of the laminar shear stress, the calculations cannot be extended to the wall' (p. 244). Finally, three of the chapters end with the listing of complete computer programs. I imagine I am not alone in finding such listings peculiarly uninformative, and since the author does not tell us why (or even whether) these programs are the best available I cannot see why the bulk of the book has to be increased to include them.

T. J. PEDLEY

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Convective Transport and Instability Phenomena. Edited by J. ZIEREP and H. OERTEL. G. Braun (Karlsruhe), 1982. 577 pp. DM92.00.

The process of heat and solute transport by convective motion has long been recognized as being of crucial importance in understanding a wide range of physical phenomena. In particular, its role in the dynamics of oceans and atmospheres, of the Earth's core and of the solar interior has exercised the ingenuity of many. More recently there has been increasing interest in the effect of convection on smaller-scale problems, such as crystal growth and solidification. These typically involve not only buoyancy forces, but also interacting and competing factors such as the temperature dependence of surface tension, phase changes and latent heat release, non-isotropic crystal structure, etc. This book is designed to give an introduction, by way of the more classical aspects of convection theory, to these new fields. It is a compilation of specially written papers and, as always in such cases, the quality is rather uneven. The articles are divided into three main sections: Rayleigh–Bénard convection, including the transition to turbulence and double-diffusive effects; Marangoni convection (due to surface-tension variations) and related interfacial effects; and the interaction of convection with crystal growth and solidification. The style of the articles varies from that of a review of recent literature to a straight report on the author's own work. An unfortunate example of the latter, which lets down the rather high standards of the majority, is a paper which purports to calculate the dependence on the Prandtl number of the critical Rayleigh number for the onset of convection! (Lord Rayleigh himself knew that there is none.) On the other hand, I especially enjoyed two articles in the first section, one by Bergé, Dubois and Croquette on the new series of experiments carried out, mainly by workers with a background in crystal structure, to show the evolution of cellular convection towards turbulence as the Rayleigh number is increased, and the other by Linden on double-diffusive effects, reminding those of us that specialize in weakly nonlinear theory that it may have nothing to say about interesting finite-amplitude phenomena!

The second section, on interfacial effects, shows clearly how undeveloped the theory is compared with that for the classical Bénard problem. Most of the articles are devoted to a derivation of the governing equations and the determination of linear stability boundaries. Although experiments have shown many exciting nonlinear phenomena, including oscillatory motion and unusual convection planforms, there is no great amount of theory yet available. Linden's paper is particularly notable for its splendid series of photographs. The otherwise excellent review of interfacial effects by Velarde and Castillo is marred by the continued discussion of 'possible nonlinear instability' in the region between the stability boundaries given by normal-mode analysis (sufficient for instability) and the 'energy method' (a necessary condition). There are so many counter-examples to the proposition that the bifurcation is subcritical when these boundaries differ that it is irritating to see it repeated here. In contrast, two papers on combustion effects ignore linearized theory and concentrate instead on a discussion of turbulent transport, using closure methods and statistical techniques.

The third section, concerned mainly with the burgeoning technology of crystal growth (for example, in the semiconductor industry) is both the most tentative, in its use of classical convection theory, and the most exciting portion of the book. Glicksman and Huang's beautiful series of pictures of dendrites on a growing crystal, and the influence of the direction of gravity on their shape and size, present a tantalizing problem to the theoretician. The papers in this section are devoted almost entirely to experimental results, and are somewhat detached in spirit from the remainder of the book, but their inclusion is amply merited since the problems they describe are so important from an engineering point of view.

In summary, this book is an excellent work of reference, it is well printed from (uniform) typscript and is easy to read, and it should certainly be in the library of any department concerned with anything broader than the most abstruse theoretical aspects of convection theory.

MICHAEL PROCTOR

Hydrodynamics of the Equatorial Ocean. Proceedings of the 14th International Liège Colloquium on Ocean Hydrodynamics. Ed. by J. C. J. NIHOUL. Elsevier Oceanography Series, no. 36, Elsevier, 1983, 368 pp. $63.75 or Dfl 150.00.

The international Liège Colloquia make a popular and worthwhile contribution to the study of ocean hydrodynamics, and this well-produced volume comprises the proceedings of the fourteenth Colloquium. Inevitably, many articles are only of passing interest or will be better documented elsewhere, but there are many papers of lasting value. Equatorial oceans were the subject of this particular Colloquium, and the first part of the book is mainly concerned with the observational background. For instance, Merle gives a very useful summary of a careful and comprehensive study of seasonal variations in the upper ocean temperature structure of the equatorial Atlantic. Reverdin, Fieux, Gonella and Luyten find interesting information about the equatorial jet and equatorial waves by following buoy tracks in the Indian Ocean. Three papers deal with small-scale structure, and Gibson discusses the problems of interpreting turbulence measurements in the strong equatorial undercurrent and the controversies surrounding this topic.

The second half of the volume is mainly to do with mathematical modelling of equatorial and coastal currents. Busalacchi, Takeuchi and O'Brien use 18 years of wind data to drive a very simple model of the equatorial Pacific and show that a surprising amount of the interannual variability in sea-level response can be explained in this way. Kindle shows some interesting numerical results on Rossby-wave solitons, and there are two papers (Delecluse, Nihoul and Bah) showing geometrical effects on coastal waves and upwelling. Penhoat, Cane and Patton also study geometrical effects – islands and angled coastlines. Delecluse and Philander discuss the very interesting results of driving a three-dimensional equatorial ocean with simple wind systems and the notable asymmetries in response between the eastern and western boundaries. This study is particularly valuable because both dynamical and thermal effects are included. Mention should also be made of work on the effects of zonal currents on waves (Ripa and Marinone) and instabilities produced by such currents (Boyd and Christidis). To summarize, many interesting hydrodynamic processes at work in the equatorial ocean are dealt with in this useful book.

A. E. GILL

Solitons and Nonlinear Evolution Equations. By R. K. DODD, J. C. EILBECK, J. D. GIBBON and H. C. MORRIS. Academic, 1982. x+630 pp. £24.

The flow of books on solitons continues (see Miles, J. W., Review of 'Solitons and the Inverse Scattering Transform', by M. J. Ablowitz and H. Segur, *J. Fluid Mech.* **127** (1983), 564–566), and one now asks what special features each new offering contributes. Among several aims given for this book in its preface are: 'for the reader who has no prior knowledge of solitons and nonlinear wave equations... combine the ideas of soliton theory with a study of the physical origins of the nonlinear equations... treated the inverse scattering (spectral) transform with degree of rigour not usually attempted... appeal to both the research worker and graduate student in applied mathematics, engineering and theoretical physics.'

After a survey of the subject matter in chapter 1 the next four chapters deal with the scattering problem for the (linear) Schrödinger equation, its relation to the Korteweg–de Vries (KdV) equation, the inverse scattering method and the solutions it provides, and the physical context of the KdV equation. A similar set of three chapters deal with the ZS/AKNS (i.e. Zakharov–Shabat/Ablowitz–Kaup–Newell–Segur) set of equations and their associated partial differential equations, particularly the sine–Gordon and nonlinear Schrödinger (NLS) equations. The final chapters are on amplitude equations in unstable systems and numerical studies of solitons.

The authors do make a positive attempt to give a full development of the mathematics which is accessible to engineers and physicists as well as mathematicians. In some places the exposition is at a relatively elementary level, although elsewhere the background knowledge assumed is that of a graduate mathematician.

The nonlinear equations are set into perspective by one or more derivations for each equation showing the physical and mathematical approximations necessary. The diverse origins of the equations means that in some cases there is only a very brief discussion of the basic physics: however, the authors succeed in showing that there are common themes in the asymptotic methods leading to the KdV, NLS, etc. equations.

The book is written for use as a textbook, in the sense that it should be read and studied from beginning to end. If treated in this manner it can bring the reader near the level of current research. The first seven chapters all have a section of problems. However, a book of this size is likely to be used for reference, and for this purpose it is less than ideal. At many points the presentation depends heavily on earlier parts of the book, by back-references and the terminology used. Important results could have been summarized at the end of each chapter with benefit.

The book is printed from justified typescript produced by a word-processor. This has led to its being up-to-date (October 1982) with benefits to its substantial reference list, but there is a sprinkling of typographic errors and oversights, e.g. in chapter 8 there is an irritating reference to 'equations (6.?–??)'.

It is now almost 20 years since the 'soliton' concept arose. Its prototype, the solitary wave on water of finite depth, is a fluid entity. Readers of this journal with only this peripheral knowledge may wonder whether this book provides a good route to a wider appreciation of the subject. It does, for those people with a strong mathematical background who wish to master the subject. For others there is perhaps too much detail. The inverse scattering transform provides solutions for certain widely applicable partial differential equations for restricted classes of initial-value problems. Yet for many such problems it is often easier to compute solutions for particular cases than to carry through the analysis. Helpful comments on numerical methods are given in the final chapter. More useful, and involving less analysis, are the explicit exact solutions, e.g. for one or more solitons, which arise from the solution method. Fluid-dynamicists are familiar with the value of even a limited number of exact solutions. The discussion of many nonlinear equations that arise in fluid dynamics, as seen in a wider context, may well interest many readers.

In summary, this is an up-to-date text suitable for someone with a mathematical background wishing to master the subject. The book is less useful for reference than I expected.

D. H. PEREGRINE