dividual contributions in perspective relative to the broader topic. The editors of subsequent volumes in this series and in fact of similar proceedings would be well advised to follow this practice; the literature of turbulent flows involves a variety and scope which makes it difficult for an "outsider" to make proper assessments of new contributions, of problems calling for attention, etc. Thus the introductory remarks add significantly to the value of this volume.

The contributions in the first three chapters are equally divided between experiment and theory while the subject of the last two chapters restricts their contents to developments in theory and numberical methods. It is the nature of current turbulence research that few papers deal with both experiment and theory.

Workers in turbulence research and engineers responsible for applications involving turbulent flows will find this volume a valuable addition to their reference library and will anticipate subsequent volumes in the series.

Advances in Analysis of Geotechnical Instabilities. Edited by J. C. Thompson. University of Waterloo Press. 1978. Pages 230. Price $15.

REVIEWED BY J. W. RUDNICKI[8]

This volume collects five invited papers which were contributed during September, 1976, to October, 1977, for a symposium on geotechnical instabilities. A sixth article which is included, "The Application of Mechanics to Rock Engineering," by C. Fairhurst, is reprinted from the *Proceedings of the Third Symposium on Engineering Applications of Solid Mechanics.*

This latter article provides a good overview of the subject of this volume and would be an appropriate introduction although it appeared fifth in the actual arrangement of papers. Fairhurst suggests that progress in geomechanics design has been hampered by the difficulties presented by natural materials, but he emphasizes the usefulness of theoretical analysis as a basis for good design even when material properties are not precisely known. Improvements in prediction of tensile failure of rock which have been made using the Griffith approach to fracture are discussed as an example. Fracture mechanics has, however, developed far beyond the analysis of Griffith and these developments, although not discussed, could perhaps lead to comparable improvements. This example illustrates one disappointing aspect of the volume: With the exception of a paper by I. Vardoulakis ("Equilibrium Bifurcation of Granular Earth Bodies"), which applies a bifurcation analysis to study the development of shear bands in sand, the articles describe modifications of standard approaches to problems in geomechanics. However, in view of the motivation for the symposium, which Thompson states in the editor's preface is the inadequate understanding of the mechanics of instability in geotechnical materials, I had hoped for the description of more novel approaches. In spite of my disappointment over this one feature, I did find the problems and variety of approaches which were discussed to be very interesting. This volume will be of interest to workers in geotechnical engineering as well as to those in other areas of mechanics who wish an introduction to this field.

"Instability" is a term which can have many interpretations, even within the confines of mechanics, and the following short synopsis of articles in this volume indicates a variety of approaches:

The first article by G. Gudehus discusses the application of an approach often taken in classical soil mechanics design: the deformation at failure is assumed to occur along discrete sufaces and instability is identified with the limiting state of static equilibrium. H. Lippman also uses this interpretation of instability in his article on "translatory rock bursting" but, after reducing the problem to one dimension, he employs an elastic-plastic analysis to identify the limiting state of equilibrium. I. Vardoulakis considers instability as the development of zones of localized shear deformation. An article by R. H. Fakunding and others describes the geology of the Clarendon-Linden fault system in western New York and surface features (e.g., faults, joints, "popups") which appear to reflect some process of mechanical instability. Although this article contains much terminology from structural geology which may be unfamiliar to many readers, it does make clear the difficulties which are faced in interpreting field data and infering mechanical processes from observations of the end state. The final article entitled "Discontinuity Models of Problems in Geomechanics," by A. M. Starfield summarizes and critically reviews computer methods for predicting the response of jointed rock masses.

The article by Vardoulakis illustrates the improvements which can result from more detailed analysis. The point-of-view that localization of deformation can be explained as a bifurcation from homogeneous deformation, has recently proven to be very fruitful in studying this phenomenon in a variety of materials (see, for example, the review by J. R., Rice, "The Localization of Plastic Deformation," *Proceedings of the 14th International Congress of Theoretical and Applied Mechanics,* Edited by W. T. Koiter, Delft, North Holland, Vol. 1, 1976, p. 207). Vardoulakis finds that this approach yields predictions for the orientation of shear bands which are in much better agreement with his experimental observations than are the standard Coulomb or Roscoe predictions.

Fracture of Composite Materials. Edited by G. C. Sih and V. P. Tamuzs. Sijthoff and Noordhoff, Alphen aan den Rijn—The Netherlands. 1979, Pages xvi–413. Price $35.

REVIEWED BY C. W. SMITH[9]

This volume constitutes the *Proceedings of the First U.S.A.–U.S.S.R. Symposium on Fracture of Composite Materials* which was held at the Hotel Jūrmala, Riga, U.S.S.R., September 4–7, 1978. The purpose of the meeting was to assemble a small group of researchers "to review fundamentals, discuss problem areas and display the current developments" pertaining to the fracture characteristics of polyphase materials.

The volume includes a total of 33 technical papers, 16 of which described studies conducted within the U.S.S.R., and 17 papers dealt with research conducted in the U.S.A. and in Europe. The volume is divided into five sections which may be briefly summarized as follows:

Section I (*Microfracture*) contains papers on micro and macrocracks (Mileiko), dispersed fracture (Tamuzs) microcrack enlargement criteria (Kuksenko, Frolov, and Orlov), and fracture kinetics (Regel, Leksovskii, and Pozdnyakov) which involved both analytical and experimental approaches.

Section II (*Statistical and Analytical Methods*) deals with stochastic models of fracture (Bolotin), computer simulation of fracture processes (Kopyov, Ovchinsky, and Bilsagayev), failure analysis (Wu), failure prediction (Chou), and interface crack analysis (Dunders and Comninou).

Section III (*Fracture Analysis*) contains a variety of papers which include both analytical and experimental aspects. Fracture mechanics (Sih), interaction of cracks (Vanin), implication of experimental observations (Smith), failure modes (Tarnopolskiy), finite-element analysis (Herrmann and Braun), multiple fracture (Kelly), polymer reinforcement (Knauss and Mueller), and fracture test results

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(Wright, Welch, and Jollay), were described for a variety of polyphase materials.

Section IV (*Failure Analysis*) includes papers which focus upon criteria for predicting strength, fracture and/or failure of composite materials. Specifically, studies on strength criteria (Annin and Baev), failure of thin-walled structures under flexure (Nemirovsky), optimum design and strength (Obraztsov and Vasil'ev), fracture models (Rikards, Teters, and Upitis), influence of failure pecularities on strength (Perov, Skudra, Mashinskaja, and Bulavs), free edge induced failure analysis (Crossman), bone fracture (Knets), and fatigue life prediction (Parfeyev, Oldirev, Tamuzs) are presented.

Section V (*Experimental Methods*) contains papers on the experimentally behaviors in composite materials and various techniques for observing and testing them. Included are nondestructive study of damage (Latishenko, Matiss), test method development (Chamis), the nature of crack growth (Bunsell), optical methods (Rowlands and Stone), effect of high modulus fibers (Kalnin), interesting mechanical behaviors (Chiao), fracture characteristics (Lachman), and fracture initiation prediction (Mast, et al.).

The foregoing studies include both unidirectionally reinforced and crossply laminates and covered both common (glass-epoxy) and advanced (graphite-aluminum, etc.) materials as well as some more exotic (asbestos cement, bone tissue) of the polyphase materials.

Taken collectively, this volume presents a summary of current approaches and considerations involved in developing predictions of the failure by fracture and its associated mechanisms of a fairly wide variety of polyphase materials. Limitations and restrictions of the theories are noted and experimental methods are discussed and used to obtain results for comparison with analytical predictions. The volume should provide a window for viewing a "state of the art" in composite fracture (a developing but incomplete discipline) as seen collectively by the contributors. As such, it should be found of interest to workers in both composite materials and fracture mechanics.

Three-Dimensional Problems of the Mathematical Theory of Elasticity and Thermoelasticity. By V. D. Kupradze, T. G. Gegelia, M. O. Basheleishvili, and T. V. Burchuladze. Edited by V. D. Kupradze. North-Holland Publishing Co., New York. 1979. Pages 929. Price $158.50.

REVIEWED BY E. STERNBERG[10]

This voluminous tome is a translation into English of the 1976 second edition of a monograph originally published by the Tbilisi University Press in 1968. Although the individual contributions of the four authors involved are not identified, it is safe to surmise that the work of Kupradze, who also served as editor of the book, was predominant in determining its scope and character.

The present treatise is chiefly concerned with the classical linearized theory of homogeneous and isotropic elastic solids, elastostatic and elastodynamic considerations being given more or less equal attention. Further, a substantial amount of space is devoted to a linearized version of couple-stress theory for perfectly elastic, centrosymmetric-isotropic materials, as well as to linear thermoelasticity theory.

Notwithstanding its title, the book places relatively little emphasis on the treatment of specific physically important problems. Instead, the authors are heavily preoccupied with uniqueness and existence issues, and spend a major part part of their effort on the characterization of the relevant problem classes in terms of singular integral equations. Some background for this approach is supplied in preliminary chapters on basic singular solutions of the governing field equations, on the theory of singular integral equations, and on pertinent aspects of potential theory. Special mention should also be made of the three closing chapters, which pertain to contact problems for elastic media with inclusions, the use of generalized Fourier series, as well as to certain series and quadrature representations of solutions to half-space and quarter-space problems.

As ought to be apparent from the preceding all too cursory description, this is a rather unconventional treatise on elasticity theory, the choice of topics covered reflecting strongly the taste and bias of its authors. In particular, some readers—including the reviewer—may question whether couple-stress theory merits the emphasis it receives here.

There is also cause to wonder whether the authors have consistently achieved "the modern level of mathematical rigor" avowed in their preface. Indeed, the mathematical erudition affected in these pages is not always matched by an equal measure of conceptual clarity or genuine mathematical care.

A few examples drawn from the opening chapter on "Basic Concepts and Axiomatization" may serve to illustrate such misgivings. Here ordinary and couple-stresses are introduced (prior to any discussion of kinematics) through limit-definitions that are not made mathematically meaningful. The repeated allusions to molecules or particles seem neither helpful nor appropriate in the context of a continuum-mechanical exposition. In view of the authors' casualness in distinguishing material from spatial coordinates, their transition to the linearized theory will not bear scrutiny. Nor is the reader aided by the admonition (on p. 17) not to confuse the "vector of rigid rotation" with the "vector of internal rotation," despite the use of two different symbols, since both are defined as one-half the displacement-curl (see pp. 9, 16).

No credit is given to the translator of this volume, and not much credit is due in this connection. Sentences such as "One may have an infinite number of directions at each point of a medium" (p. 5), are apt to be attributable to faulty translation. So is the puzzling assertion (p. 2): "If the body . . . is deformed, . . . the parts of the body are no longer in mechanical equilibrium."

While this is hardly a treatise suitable for uninitiated students of elasticity theory, it renders accessible in English some valuable material of interest to specialists in this subject area.

Theoretical Kinematics. By D. Bottema and B. Roth. North-Holland Publishing Company, Amsterdam, New York, Oxford. 1979. Pages 558 + XIV. Price $87.75.

REVIEWED BY G. R. VELDKAMP[11]

This is a textbook in which kinematics is presented as a theory independent of any particular application, that is: as a fundamental science in its own right. The bulk of the book, 420 pages, is devoted to Euclidean kinematics of 3 and 2 dimensions. A characteristic feature of the treatment is the principle of starting with general concepts and problems and then specializing gradually to more simple cases. The first 22 pages of the text are accordingly written in terms of n-dimensional Euclidean space. The whole matter is in the main treated analytical accompanied by ample geometric interpretation. Synthetic reasoning however is not evaded in those places where it may contribute to a deeper understanding of the problem on hand. The mathematical tools are borrowed from elementary algebraic geometry, calculus, vector, and matrix algebra; mathematical concepts which

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