Journal of Structural Geology, Vol. 7, No. 1, pp. 125 to 128, 1985
Pergamon Press Ltd. Printed in Great Britain

BOOK REVIEWS

Strain analysis: an introductory course

Ramsay, J. G. & Huber, M. I. 1984. *The Techniques of Modern Structural Geology, Volume* 1: *Strain Analysis*. Academic Press, London. 307 pp. Price: paperback £12.50.

This is the first of a planned three volume set of books, the first two aimed at undergraduate students, the third mainly at postgraduates. It is tempting to view these books as an updating of John Ramsay's *Folding and Fracturing of Rocks*. Whilst much of the material in volume 1 is covered in the earlier book, it is much more clearly presented for student use and is based on a question/answer format. Most readers will welcome the clear, up-to-date, well structured nature of this volume and the greater size and clarity of the illustrations. One is immediately impressed by the high quality of the photographs and line diagrams; more detailed examination shows them to be well chosen, carefully drafted and concisely described.

The book is organized into fourteen chapters or 'sessions', each designed to represent a unit of instruction (about 1 lecture and 3 hours laboratory practical). Each chapter is structured carefully, involving a short introduction, in which basic concepts and terminology are discussed, followed by a graded series of questions and answers, most of which are linked to simple practical methods of analysis. The chapters end with a glossary and annotated reference list. The whole organization of the book allows a great deal of self instruction and appraisal, and I suspect most structural geologists would benefit, as I did, from working through the examples. These are carefully thought out, accurate and well explained, although I found some a little contrived and would have liked to see more 'real' examples, even if the answers would necessarily have been less clear cut.

Chapters 1–3 are an introduction to displacement and strain, and make use of simple 'experiments' with card decks. The reader is introduced gradually to the concepts of simple shear and the strain ellipse. I was slightly irritated by the sign convention used for simple shear which, although internally consistent, is the opposite to that in normal use (e.g. Ramsay & Graham 1970) and necessitates a lot of −ve signs. These three chapters contain lots of very effective teaching material and set the general style and tenor of the book. However, I was left asking the question "can all geological structures be analysed in terms of simple shear?" Chapter 4 departs somewhat from the practical, 'try-it-and-see' approach, but is a very neat attempt to introduce vector fields and matrix representation of transformations, and generalizes some of the earlier discussion.

Chapters 5–8 are concerned with the main techniques of strain determination and represent good, 'state-of-the-art' reviews of existing methods. I was pleased to see the inclusion of Fry's centre-to-centre-method, but there was little discussion of the use of line orientations. Chapter 7 includes a brief mention of deformation mechanisms in connection with strain partitioning.

Chapter 9 is an introduction to stereographic projection. This gets a fairly brief treatment, but some of the examples are interesting. I feel that most courses in structural geology would need to devote more time to this topic, which is mainly introduced at this stage in the book to facilitate the treatment of three-dimensional strain in the following chapters.

Chapters 10 and 11 discuss three-dimensional strain and the presentation is more suitable for undergraduates than that in Ramsay (1967). I found these chapters struck a nice balance between presenting a full discussion with minimal mathematics and presenting simple examples of the applicability of the strain approach to field interpretation.

Chapters 12–14 discuss progressive deformation in general terms and its measurement using veins and pressure shadows. Again the treatment is clear and extremely well illustrated, but I still find it hard to conceive of the history of the Helvetic Alps being unraveled from a few pyrite grains and would have welcomed some more straightforward examples.

It is difficult to evaluate this book without reference to volume 2 (not yet published), since we are told this will deal with the application of much of the contents of volume 1. Both volumes will undoubtedly be judged with respect to Ramsay's earlier book, which had such an impact on the subject. The new books are aimed more obviously at the undergraduate student and I think they will be used widely by both student and teacher. The examples, diagrams and photographs will be utilized, in some form or other, in most structural geology courses. There are two areas where the book requires more careful evaluation.

Firstly, is the question/answer format a success? Overall I think it is, the authers achieve many of their objectives. The book is very readable, interesting and there is a reasonable flow between questions, answers and linking comment, although I did find I was constantly shifting backwards and forwards from question to answer. The questions are interesting and the answers accurate, but I would like to see more practical and realistic examples. The earlier chapters certainly allow the reader to become familiar with the basic concepts and geometry of strain without taxing his/her mathematical abilities more than necessary. For those who like their mathematics less diluted the appendices provide a good concise concentrate.

Secondly, does the book meet the needs of university courses and industry training? Here I think there are some serious imbalances. Initially I took the book for what it is; an introduction to strain analysis. Yet in reviewing it I cannot ignore the claim on the back cover that "the unique approach to the investigation of tectonic structures renders this book invaluable as a first substantial text for structural geology courses". I feel that as an introductory undergraduate textbook there are some obvious omissions, which volume 2 will be hard pressed to rectify. The most obvious is the lack of treatment of stress, surely as fundamental to the subject as strain. This is highlighted in chapter 9 where the reader is asked to "determine the principal stress directions", but nowhere in the book are these discussed. Even if one accepts the book purely as an introduction to strain analysis, there is still no discussion of rock rheology or deformation mechanisms. Thus the reader is asked to embark on a study of strain with little feel for how this might develop in rocks. The connection between computer cards and rocks needs to be explained—if it can! As for providing a training within industry, I feel a book on structural geology which has virtually no maps or cross-sections will have a somewhat limited appeal.

In summary this book by John Ramsay and Martin Huber is one which will be widely used by structural geologists and will have an influence on the teaching of the subject. It is a well produced and authoritative book in an area generally lacking such texts. I have some reservations about its marketing as an introductory textbook, and find the title "The Techniques of Modern Structural Geology" a little at odds with a book that is based firmly on the 19th century ideas of Mohr, Thompson, Tait and others.

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Ramsay, J. G. & Graham, R. H. 1970. Strain variation in shear belts. *Can. J. Earth. Sci.* 7, 786–813.

Benchmark papers on ductile strain

Stauffer, M. R. (editor) 1983. *Fabric of Ductile Strain* (Benchmark Papers in Geology, Volume 75) Hutchinson Ross, Pennsylvania. 400 pp. Price: hardcover US $48.00.

The series editor, R. W. Fairbridge, explains the philosophy behind the Benchmark Series, in a foreword: "to gather into single volumes the critical material needed to reconstruct the background of any and every major topic of our discipline". Each volume consists of reprinted articles selected by the volume editor to be of benchmark status, together with 'highlight' commentary. Volume 75, *Fabric of Ductile Strain* is edited by M. R. Stauffer of the University of Saskatchewan.