

BOOK REVIEWS

Structures are Fun

Davis, G. H. 1984. *Structural Geology of Rocks and Regions*. John Wiley & Sons, New York. Price £13.95.

This 1984 book is a latecomer for review. It is a comprehensive text-book of structural geology for non-specialists, and I presume its prime target is the university/college student in North America. By now, its success (or not) as an American course book will be decided. My own interest in reviewing the book is the insight into George H. Davis's view of structural geology.

Structural Geology of Rocks and Regions has 492 pages of large size, generously illustrated with photographs, diagrams and cartoons. It is divided into two main parts: I *Fundamentals* (Chapters 1–6), and II *Structures* (Chapters 7–12). This division allows principles, techniques and concepts to be treated first, and particular structures and associations to be dealt with later.

Chapter 1, Nature of Structural Geology, introduces the subject as the architecture of the Earth. Concepts of Detailed Structural Analysis such as distortion, slip, etc., are introduced in Chapter 2, and Davis employs some interesting 'models' such as air balloons, garden gates and pizzas to encourage readers to visualise these concepts. Descriptive Analysis (Chapter 3) provides a rigorous introduction to geological mapping techniques, and stereographic projection of data. In Chapter 4, Kinematic Analysis, displacements and strain are treated in greater detail. Chapter 5, Dynamic Analysis, follows, dealing with stress, rock mechanics, etc. Part I ends with Plate Tectonics (6) which provides some imaginative models to illustrate plate motions.

Part II, *Structures*, considers in sequence (7) Contacts, (8) Primary Structures, (9) Faults, (10) Joints, (11) Folds and (12) Cleavage, Foliation and Lineation. The first two provide a link with mapping techniques, but the last four are the more 'traditional' divisions of structural geology. Chapter 12 also includes passive folding, boudinage, shear zones and refolding in tectonites. Much of the content of these chapters is as expected in a comprehensive text book, but with Davis's personal touches, together with an emphasis on North American 'benchmarks' works. Since the content of Part II is the meat of structural geology, I found myself drawn to reviewing some parts in detail, as I am used to doing for scientific papers. As a result, my comments are specific rather than general. I suspect my principal criticisms have been made by many others, by now, and will be attended to in the next print.

In Chapter 9, faults are treated in sequential sections on thrusts, normal and strike-slip faults. The sections on thrusts and normal faults seem clear enough, but the presentation of strike-slip faulting is confused by introducing conjugate faulting here (p. 298). Conjugate faults are not unique to strike-slip zones, as the author says, but the diagram shows conjugate normal faults (Fig. 9.51). My more serious criticism of Fig. 9.51 is that it shows the relationship of conjugate faults to axes of strain, $\lambda_1, \lambda_2, \lambda_3$. The same diagram appears twice later, with axes labelled X, Y, Z in Fig. 9.62, and σ_1/Z , etc., in Fig. 9.64. In all these, but particularly the last, there is the strong message that stress and strain axes are parallel. Surely, one of the most important lessons of structural geology to be conveyed to students is that stress and finite strain axes, in general, are not the same? If Davis is just talking about the small increment of strain associated with faulting, he should not use the labels, X, Y, Z or λ normally used for finite strain. It is seriously misleading to suggest that fault pairs are conjugate to finite strain axes: the more so, that it is made three times in succession.

If this were not confusing enough, on the same page as the first illustration of faults conjugate to strain axes (p. 298), is one (Fig. 9.52) representing an 'initial' strain ellipse (A) with its conjugate fault pair, which is deformed by simple shear to a 'final' strain ellipse (B). I cannot understand this figure, nor an almost identical one (Fig. 10.33) for joints: I can only presume they are wrong, both in the sense of shear shown, and for the orientations of the deformed conjugate planes. Whether through error or intent, these figures convey the message that during simple shear the conjugate angle increases, but the fault pair remain symmetrical in the finite strain ellipse. This cannot be so for

simple-shear deformation because finite ellipse axes are not the same material lines as deformed earlier axes. It alarms me to see such confusion about strain in an undergraduate text-book. I hope the errors will be corrected for the next edition.

Other criticisms I have are minor in comparison. I do not understand why Fig. 11.54, illustrating schematic strain in a flexural slip fold, shows ellipses of equal shape but increasing size from hinge to limb, rather than ellipses of increasing axial ratio from zero at the hinge to a maximum on the limbs. This seems a rather poor way of illustrating strain in flexural slip.

I suspect readers will either love or hate the 'happy family' flavour which makes this book more personal than other structural text-books that I know. It was good to be reminded that books represent a huge investment of time and energy, and considerable forbearance of family and friends. Davis uses some unusual methods to illustrate geological processes. I wondered how much novelties like the 'geological' history of a pizza were part of the American way of teaching (in the beer-can mould) or Davis's individual approach. I found them refreshingly different and thought-provoking, but others might be irritated by these seemingly frivolous anecdotes.

Of all Davis's models and cartoons, one is so hilarious it deserves special mention. It is either a huge leg-pull, or an example of student acquiescence which I am certain we could not achieve from Manchester students! There, on p. 52, is a "human ladder" comprising three or four students stacked one above the other in the direction of dip, on a steep fault plane. This must surely be the most bizarre means of illustrating dip; why was the face of the poor soul at the bottom obscured from view?

I think this book is well-suited to the student market. It is very good value for money, considering its size and the number of lovely photographs. Whether there is too much for non-specialist structural geologists is a matter of opinion, but the emphasis on field geology and mapping techniques will be important for future survey and exploration geologists. They may be muddled on stress and strain, but they will surely have absorbed Davis's infectious enthusiasm for geological structures.

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Himalayan Thrusts

Saklani, P. S. (Editor) 1986. *Himalayan Thrusts and Associated Rocks*. Today & Tomorrow's Publishers, New Delhi. 290 pp. Price: \$65.

It can well be argued that thrusting was the principal structural mechanism responsible for the formation of the Himalayas. Thrusting controlled the obduction of ophiolites onto the continental margin in pre-collisional times, it took place during the collision of India and Eurasia causing repetition of rock units within the suture zone, it enabled the Indian plate to underthrust northwards, and it continued during post-collision times when delamination of the northern margin of India took place by major southward thrusting towards the continental foreland and finally it caused northward backthrusting. This book is concerned with the foreland-directed post-collisional thrusts.

One difficulty in following Himalayan literature is that much is published in a myriad of journals, many of which have limited circulation. Therefore edited books provide a useful service by bringing together groups of papers with a common theme. This is the fourth such book on Himalayan geology to be edited by Professor Saklani. It contains 15 papers, of which only three are on thrust tectonics, seven are concerned with an analysis of associated folds and with the petrography of rocks such as mylonites, gneisses, schists and phyllites, three deal with general Himalayan tectonic models, one describes Quaternary to Recent faults and another an experimental study of listric faults. Thus this is a very mixed bag. Six papers describe structures and rocks from Garhwal, two from Nepal, two from Kumaun and one from Himachal Pradesh. The main thrusts described