

## BOOK REVIEWS

### Classic text on small-scale structures

Wilson, G. 1982. *Introduction to Small-scale Geological Structures* (in collaboration with Cosgrove, J. W.). George Allen & Unwin, London. 128 pp. Price: hardcover £10.00; softcover £4.95.

Many structural geologists, particularly if trained in Britain, consider the structural analysis of deformed rocks as central to their discipline. It is therefore a paradox to admit that few if any of the standard textbooks on structural geology deal satisfactorily with this aspect of the subject. Indeed, while the modern approach to structural geology tends to experiment and mathematical analysis, it is the older texts such as C. K. Leith's *Structural Geology*, first published in 1923, which perhaps have more to offer the field geologist interested in the tectonic significance of small-scale structures. The publication of Gilbert Wilson's *Introduction to Small-scale Geological Structures* is therefore timely, following as it does a classic tradition in structural geology. It provides a broad survey of the various types of small-scale structures developed in deformed rocks, based in large measure on the well-known and oft-quoted paper originally published in 1961 by the author in the *Annals of the Geological Society of Belgium*.

The approach to small-scale structures is briefly surveyed in an introductory chapter to the book. This is followed by a short chapter dealing with stress and the mechanics of rock deformation, which is adequate for its purpose. The next chapter introduces the concept of structural symmetry as a prelude to describing the geometrical elements of cylindrical folds. In concentrating on such a concept, the text shows its age, for structural geology is now much more concerned with the detailed anatomy of deformed rocks, as described throughout the rest of the book, rather than such an abstract concept. This introductory part of the book concludes with a chapter on structure and stratigraphic succession.

The remainder of the book deals with particular types of small-scale structure, chapter by chapter, each dealing with mode of origin, nature of occurrence and structural significance on a larger scale, illustrated with field examples and historical references to the literature.

Brittle structures such as tension gashes and kink-bands are considered first. The following chapter deals with cleavage and schistosity in general, distinguishing between the different types of fracture cleavage, strain-slip or crenulation cleavage, flow or slaty cleavage, and schistosity, according to the British terminology. This chapter concludes with a detailed description of the structural relationships which are developed *vis-à-vis* bedding wherever cleavage forms as an axial-planar structure in folded rocks.

The next two chapters are devoted to a more detailed description of fracture cleavage, strain-slip cleavage and flow cleavage. While fracture cleavage is considered as a morphological variant to flow cleavage in more competent rocks, its association with fault-zones is also stressed. The nature and origin of strain-slip cleavage are briefly considered. The strain resulting in the development of flow cleavage is discussed in some detail, along with other topics of a more diverse nature generally coming under the heading of linear structures associated with cleavage and schistosity.

The nature of boudinage, and its association in the field with fold-structures and thrust-zones, is the subject of the next chapter. This is followed by a discussion on drag-folds and their relationship to differential movements. Here, again, the text shows its age as most 'drag-folds' would now be viewed, rightly or wrongly, as essentially the result of buckling mechanisms. This section of the book ends with a useful description of mullion and rodding structures, often lacking in other texts.

The final section of the book deals with the superposition of small-scale structures as the result of repeated deformation. The field evidence for such superposition is seen in the folding of early cleavages along with bedding, while the development of interference patterns as the result of refolding is alluded to briefly. Any more detailed description of the complex structural forms which develop in response to such deformation is evidently considered as beyond the scope of the present book. Instead, the author ends his treatment of small-scale

structures by discussing how such structures may be related on a larger scale to one another in the tectonic pattern of different regions with which he is particularly familiar. In conclusion, the author stresses the important contribution made by stratigraphic mapping in any region of structural complexity to the full understanding of its geological history. I would agree.

Although the text is somewhat dated, it benefits greatly not only from the author's wide experience in the field, on which he draws extensively, but also from his broad knowledge of the European and American literature. Indeed, the text is almost a commentary on the published literature, illuminated by his own field observations. There can be little doubt that the present strength of structural geology in Great Britain has emanated from Imperial College, and it was Gilbert Wilson who did much to influence the present generation of structural geologists through his teaching and research. This book is therefore a fitting testimony to his enthusiastic interest in structural geology over the years.

John L. Roberts

### Reading geology

Skinner, B. J. (editor) 1982. *Earth's History, Structure and Materials*. (Readings from *American Scientist*), William Kaufmann Inc., Los Altos, California. 183 pp.

At first glance this book appears to be a further publication in the series 'Readings' from *Scientific American*. Closer inspection of the title and style of presentation reveals, however, that it belongs to a series of readings under the general title 'Earth and its Inhabitants' which were previously published in the journal *American Scientist*. This journal and the Readings are little known in the U.K., but may be well-known elsewhere.

The series contains seven volumes of which the present volume is said to cover the Earth's evolution, geological time, plate tectonics, drifting continents and special features such as chains of volcanoes. The book contains sixteen articles divided into four sections.

#### I. *Earth as a Planet.*

(1) J. W. Head, Wood, C. A. & Mutch, T. A. Geological evolution of the Terrestrial Planets (1977).

#### II. *Geologic Time and How it is Determined.*

(2) H. Faul. A History of Geologic Time (1978).

(3) A. E. J. Engel. Time and the Earth (1969).

(4) R. L. Fleischer. Where do Nuclear Tracks Lead? (1979).

(5) I. Friedman & Trembour, F. W. Obsidian: the Dating Stone (1978).

(6) E. K. Ralph and Michael, H. N. Twenty-five years of Radiocarbon Dating (1974).

#### III. *Plate Tectonics and Drifting Continents.*

(7) D. P. McKenzie. Plate Tectonics and Sea-Floor Spreading (1972).

(8) W. A. Nierenberg. The Deep Sea Drilling Project after Ten Years (1978).

(9) R. K. Bambach, Scotese, C. R. & Ziegler, A. M. Before Pangea: the Geographies of the Palaeozoic World (1980).

(10) B. D. Marsh. Island Arc Volcanism (1979).

(11) G. B. Dalrymple, Silver, E. A. & Jackson, E. D. Origin of the Hawaiian Islands (1973).

#### IV. *Igneous Activity.*

(12) C. L. Rosenfield. Observations on the Mount St. Helens Eruption (1980).

(13) J. C. Moore. Mechanisms of Formation of Pillow Lava (1975).

(14) J. R. Heirtzler, Taylor, P. T., Ballard, R. D. & Houghton, R. L. A visit to the New England Sea-Mounts (1977).

(15) G. Heiken. Pyroclastic Flow Deposits (1979).

(16) D. Hunter. The Bushveld Complex and Its Remarkable Rocks (1978).

The contents thus demonstrate that there is no general theme for the book, each title being a stand-alone article. There is a general introduction to the book and a brief statement of the main topic of each

article which are given by the editor at the start of the book. Unlike *Scientific American* compilations there is no general introduction by either the editor or the authors to the different sections or individual articles. Such introductory passages would have been useful to fetch the reader up to date briefly, as in the case of D. P. Mackenzie's article which is now ten years old and covers the plate tectonic model without a mention of triple points.

A considerable variation in the style and level of writing is present. Some articles assumed virtually no background knowledge and defined every technical term used. Others, however, did require a fair background in order to fully appreciate the article. There is also a mixture in that some authors present the articles as general reviews for a wide audience and at times general philosophical comments upon Man's place in the world or somewhat condescending statements such as "A team of imaginative and clever geologists and geochronologists . . ." are found in articles such as that of Engel's. Other articles are however presented in a style more typical of normal research papers with a considerable reference list. This perhaps indicates that there is not a strong editorial control on authors in the original publication. This is strengthened by the fact that even the simple presentation of a reference list varies between articles. Some present them by reference to the author's name while others simply refer to the articles in a numerical fashion.

The book is well illustrated, often in striking colours, and there are also good reproductions of colour photographs, which will probably attract the interested layman. Even though the book is modestly priced, the geological student and professional will probably be put off by the variation in style mentioned above and niggled by the lack of editorial consistency which extends as far as the irregular use of both imperial and metric units in the same article.

D. Robinson

### Learning about the earth

Press, F. & Siever, R. 1982. *Earth* (3rd edition). Freeman, New York, 613 pp., 614 figs. Price: hardcover £18.50; softcover £9.95.

It is often said that American textbooks on geology at the introductory level are less suitable for the British student because of their emphasis on American examples. While I think that the importance of this aspect of a textbook is probably exaggerated, there is no doubt that the usefulness of many American textbooks to the British student would be greatly increased by the inclusion of some more familiar examples—especially in relation to surface processes and other topics where topographic expression is significant. An instructive comparison may be made with our own much-loved *Physical Geology* by Arthur Holmes. Of the first 30 photographs in Holmes' book, less than half are of British examples, the remainder being drawn widely from the rest of the world. Apart from this disadvantage however, there is much to recommend the best American introductory textbooks, because apart from their comparative cheapness, they approach the problem of learning Geology with a professionalism which is sadly lacking in many of our own books (the *Open University* texts being a notable exception).

*Earth*, by Frank Press and Raymond Siever, is one of the best examples of its kind. It is aimed specifically at the very large number of North American college students who have little or no previous experience of college science courses and who are taking an introductory course in geology which, for the large majority, will be their only encounter with the study of the earth. The book is intended to make the subject interesting and easy to learn and, I should judge, largely succeeds.

The book is divided into three parts: I. The Evolution of the Earth and how we study it (a short, introductory, section); II. The Skin of the Earth: surface processes and III. The Body of the Earth: internal processes. There are 22 chapters in all, each of which is intended to be self-contained and may be read out of context. There is a short summary at the end of each chapter, together with some exercises and a selected bibliography (there are no references in the text). A useful feature for the student is the summarization of certain key collations of information in the form of 'boxes', outlined in colour, containing some descriptive material together with figures or tables. These appear at intervals throughout the book and provide convenient focal points for the learner. The abundant diagrams are mostly of excellent quality and there are many photographs. There is a valuable glossary at the end of the book followed by an index which could be much improved by a

greater use of cross-referencing. To take two examples at random: *monocline* and *salination*, which are both defined in the glossary, are listed in the index under 'folding' and 'streams', respectively, but are not listed separately.

Structural geologists might find the chapter on 'Deformation of the Earth's Crust' rather disappointing in its scant coverage of folding and faulting, and in its omission of cleavage, minor structures and other topics beloved of British structural geologists. However, there is a particularly good chapter on plate tectonics and, on the whole, structural geology is well integrated with geotectonics. The way in which deformation is treated offers an interesting contrast to the classical approach of description followed by interpretation. Plate tectonics is described first (in Chapter 19) giving a framework into which structure can be fitted. The chapter on deformation (Chapter 20) opens with a general discussion of how rocks deform, introducing the concepts of brittle and ductile behaviour and the effects of varying confining pressure and temperature. Only then is the geometry of folds and faults described.

Although only four years have elapsed since the publication of the last edition of *Earth*, the authors have taken advantage of a number of recent advances in knowledge to update the book. The chapter on the planets contains new material, including several excellent photographs, from the Voyager spacecraft missions to Jupiter and Saturn. Full use has also been made of the recent eruption of Mt. St. Helens. Other new material includes the Molnar and Tappanier interpretation of the tectonics of Asia, and a recent reconstruction of mid-Ordovician palaeo-continents to illustrate pre-Mesozoic continental drift.

The main structure of the book (i.e. chapter headings, order, etc.) remains substantially the same, but the table of contents has been improved by the addition of synopses of the contents of each chapter. The book is shorter (616 pp. instead of 649), mainly because of the more effective use of space—and this despite a larger print size. The colour has been improved from dark to lighter brown which gives a better contrast with the black. Unfortunately, for some reason, the quality of the photographs seems to have suffered slightly. There is much evidence of minor re-organisation of material to provide a more logical 'flow' to the work. A good example of the many improvements in layout is the section illustrating the break-up of Pangaea, where figures illustrating the five stages now lie together on two facing pages where they can be easily compared.

These changes both in material and in layout have resulted in a much improved textbook which, at under £10 softback, is excellent value for a student wishing a good general introduction to physical geology.

R. G. Park

### Ancient environments

Hallam, A. 1981. *Facies Interpretation and the Stratigraphic Record*. Freeman, Oxford, 316 pp., 116 line-drawings. Price: hardcover £10.95.

For many years students have regarded stratigraphy as a long drag up the stratigraphic column with accompanying countless incomprehensible lists of local formation names and fossils. This was complemented by accounts of correlation problems, particularly biostratigraphic, and the establishment of a stratigraphic hierarchy. Whilst stratigraphy can be regarded as the framework on which many other studies can be hung, it can also be regarded as a synthesis of the stratigraphic record leading to an interpretation of environments through time.

In order to re-establish the teaching of stratigraphy as a core course in Universities after the fragmentation of some aspects into courses such as sedimentology and palaeoecology, it became necessary to present the subject in a more inspiring manner. This is what Professor Hallam sets out to achieve in this book and he attempts to stimulate his readers by selecting a series of major topics in earth history and discussing them with reference to a variety of environments of different ages. The book is aimed primarily at advanced undergraduates, but others, like myself, should find it an interesting approach and value the up-to-date overview presented of some major topics in global geology. Should the reader find a topic of such interest as to merit further reading, or so controversial as to require an examination of the original paper, there is a clear and extensive (approximately 500) reference list. The book is well illustrated though most of the diagrams have been re-drawn from other published works.

In his preface the author states why he has used the term 'facies