

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

interpretation' rather than 'facies analysis'. Hallam argues that the latter term is more appropriate to facies models of a restricted scale whereas he is dealing with a larger-scale synthesis. However, before discussing his seven major topics the author does consider it necessary to devote his first three chapters to facies and facies analysis.

In Chapter 1 the author introduces the concept of facies and outlines techniques of facies analysis and facies modelling. At this early stage in the book the author sets the critical tone that he adopts throughout, in that he questions uniformitarianism and asks "... to what extent is the present the key to the past?".

Chapters 2 and 3 cover sedimentary environments and facies—Chapter 2 continental and marginal marine facies and Chapter 3 marine environments and facies. Both chapters are well illustrated with sedimentary logs and accompanying reconstructed cross-sections and block diagrams. Hallam makes reference to the potential hazards of facies analysis and stresses the importance of relating facies in the stratigraphic record to logs of present day sediments. Unless a reader is familiar with sedimentary facies analysis it is vital to read these chapters before attempting the rest of the book.

The first major topic, 'Sedimentation and Tectonics' is the subject of Chapter 4. After a brief historical review of geosynclinal terminology this chapter examines sedimentation in relation to the main plate tectonic settings; that is, spreading-related, subduction-related, transform-fault-related/pull-apart basins and continental collision. For a discussion of the Wilson cycle the author chooses the Appalachians and compares them with the Mesozoic–Cenozoic belt from Oman to Cyprus. The section on cratonic basin subsidence is short but emphasises the role of stratigraphy in interpretation and the occurrence of petroleum, using the North Sea as an example.

'Ancient Epicontinental Seas' is the subject of Chapter 5 and one of the most thought provoking aspects illustrated in this chapter is the great extent of these seas and the absence of any modern analogue. Hallam examines the model for an epicontinental sea in terms of a negligible tidal range, stagnant basins and abnormally high salinities by choosing a wide variety of examples. Throughout, the author critically discusses models for various environments, putting forward more than one side of each argument.

In Chapter 6 the author discusses 'Eustatic Changes in Sea Level'. After introducing cyclic sedimentation and outlining the debate relating to eustatic changes in sea level as opposed to local tectonism Hallam discusses methods of determining the rises and falls in sea level. As an example the Jurassic is used, and an examination is made of the character of the rock sequence, the distribution of marine deposits and the use of seismic stratigraphy. From this information Hallam demonstrates the preparation of chronostratigraphic charts and regional sea-level curves. The chapter continues with an outline of the results of recent work on Phanerozoic changes in sea level emphasizing major events and how controversy can arise when biostratigraphic control is poor. An overview of the variation in sea level throughout the Phanerozoic is presented and the chapter concludes with a discussion of the causes of eustasy and some quantitative estimates of sea-level change.

'Phanerozoic Climates' is the subject of Chapter 7. After listing the climatic criteria the author examines the variation in climatic conditions from the Cambrian onwards. This is really a list of where evaporites, coals and tillites occur in a sequence and this, coupled with palaeomagnetic evidence, is used to fit various parts of the world into climatic zones. Most climatic changes in the stratigraphic record are related to plate motions, but the causes of polar ice caps and long term global climatic changes also receive some treatment.

The nature of the 'Mesozoic and Cenozoic Oceans' is discussed in Chapter 8 and much of the information presented here has resulted from deep-sea drilling. The chapter begins by examining the evidence for fluctuations in the calcite compensation depth (CCD) and continues by noting rates of sedimentation, hiatuses and the changes in ocean currents together with the origin and significance of siliceous and anoxic deposits. A model for cyclic changes in the ocean over the last 200 Ma is outlined and then a very critical appraisal is made of some of these concepts. The chapter is concluded with an examination of the Mediterranean evaporite basin but here again the author emphasises caution in accepting the published accounts and puts forward counter evidence. These differences of opinion serve to illustrate the limits of knowledge and could lead students into fruitful areas of research.

Whilst the rest of the book is devoted to the Phanerozoic, Chapter 9 deals with 'Precambrian Environments'. The author very briefly describes the techniques used to establish environments in the Precambrian in the absence of biostratigraphic control and discusses the uncertainties frequently encountered in deciding whether a facies belongs to a marine or non-marine environment. Hallam refers to Precambrian glaciations, the unreliability of stromatolites as palaeontological clocks and indicators of tidal ranges, and to the role played by facies analysis in establishing models of continental growth and evolution. Half the chapter is devoted to the evolution of the atmosphere, hydrosphere and biosphere.

Two major topics are covered in Chapter 10, 'Facies and the Phanerozoic Fossil Record'; these are mass extinctions and faunal provinces. The author provides a comprehensive account of the control of faunal provinces by climate and plate movement but also demonstrates how faunal provinces can be used to date oceanic closure.

This very readable book largely achieves what the author intended and should be a valuable addition to reading lists for advanced undergraduates. I thought the author's critical approach a healthy one to pass on and it should encourage students to reason and question. My main criticism of the book is that it is biased towards the Mesozoic and Cenozoic. Occasionally I was lost geographically and needed to consult an atlas—more maps would have helped. Because the book is designed primarily for undergraduates I would have also liked to have seen a short concluding chapter pointing the reader towards areas in which the author considers more work would be rewarding. The book is reasonably priced, but even so a cheap paperback edition would be worth considering.

*D. E. Roberts*