

BOOK REVIEWS

Statistics for geologists

Cheaney, R. F. 1983. *Statistical Methods in Geology*. George Allen & Unwin, London. 169 pp. Price: paperback £5.95.

It is generally agreed that most geologists require some grounding in statistics, as many of the branches of the subject are now highly numerical and can produce vast quantities of data. However, the teaching of elementary statistics to undergraduate geology students is a task viewed with some trepidation by many lecturers, unless they are themselves specialist statisticians. The main problem encountered is that a proportion of the students is always somewhat wary of mathematics and, indeed, may have had little formal training in the subject beyond an elementary level at school. Similar problems might be encountered by more mature geologists who are attempting to come to grips with the subject for the first time. It is for this reason that elementary texts on statistics written for geologists by geologists are so welcome. The authors can recognize the limitations and forebodings of their audience, can cater for them, and can stimulate their interest by the inclusion of relevant geological examples. *Statistical Methods in Geology* by R. F. Cheaney is the latest text to join the small band of books of this type.

Chapter 1 deals with basic definitions, types of measurement and the graphical and mathematical methods of describing frequency distributions. Chapter 2 is a full description of the theory of hypothesis testing using calculations based on the binomial distribution. Chapter 3 covers the Kolmogorov-Smirnov test applied to comparing a sample with a theoretical distribution and with another sample. Chapter 4 deals with nominal scale statistics as represented on contingency tables and introduces the concept of degrees of freedom. Chapter 5 covers the Normal distribution, Student's *t*-test and confidence limits. Chapter 6 describes a number of tests applicable to ordinal scale data. Chapter 7 covers correlation and regression. Chapters 8 and 9 describe the statistical tests relevant to directional data. Chapter 10 outlines the method of constructing and testing hypotheses, and sampling procedures. Appendices provide additional exercises and brief résumés of matrix algebra and error theory.

The book is quite well written and assumes very little mathematical background. However, the style is rather too terse at times for easy comprehension, and more use could have been made of diagrams to illustrate difficult points. Little coverage is given to the theory of the techniques described, and the text concentrates on the procedures employed. It would have been advantageous if more guidance could have been given on which tests are the most applicable in given circumstances. A shortcoming of the book is that it appears to have been written for the field geologist dealing with a relatively small number of samples. Indeed, the author envisages that many statistical analyses will be performed in the field, a practice that may not be universally adopted. Consequently, perhaps undue emphasis has been placed on non-parametric tests at the expense of parametric tests. For example, Chapter 7 on correlation and regression is far too short and does not deal adequately with the topics. This is unfortunate for the reader who wishes to obtain some insight into the means of dealing with the vast quantities of ratio scale data produced, for example, by modern analytical equipment. A very welcome inclusion, not to be found in other books of this type, is a treatment of the statistical analysis of directional data in two and three dimensions. Although, of necessity, the most mathematically taxing section of the book, this will be of great use to structural geologists, sedimentologists and even prospective palaeomagnetists.

Although this new book will not displace other elementary texts on geological statistics, it is a valuable contribution and will provide useful background reading for those wishing to gain insight into the methods on which the book concentrates.

P. Kearey

Earthquakes and man

Gere, J. M. & Shah, H. C. 1984. *Terra Non Firma: Understanding and Preparing for Earthquakes*. Freeman, New York. 203 pp. Price: hardback £19.95; paperback £11.95.

As the title implies and the authors make clear, their considerable authority is applied to the writing of a simple popular account of earthquakes and associated phenomena, concentrating largely on the social and economic effects and avoiding theoretical treatment as far as possible. The causes and distribution of earthquakes are described against a background of elementary plate tectonics. Methods of recording and assessing magnitudes and intensities are briefly outlined. Related topics such as liquefaction hazards, the behaviour of tsunamis, attempts at earthquake prediction, engineering design, and self-protection in an emergency, are reviewed in separate chapters, but the treatment throughout is essentially qualitative. Naturally enough, the book concentrates on examples from plate boundaries and is slanted towards American experience. The more obscure rationale of the comparatively rare intraplate earthquakes, although mentioned, receives scant attention. Although the seismologist or earthquake engineer is unlikely to learn much of theoretical value from this unassuming and modestly priced book, he may well find it an attractive source of case histories, which are described in a lively and readable manner, and profusely illustrated.

I. E. Higginbottom

Unstrained grains through the looking glass

Adams, A. E., MacKenzie, W. S. & Guilford, C. 1984. *Atlas of Sedimentary Rocks under the Microscope*. Longman, Harlow, Essex. 104 pp., 217 colour plates. Price: softcover £9.95.

This atlas is the third in a series of books of photomicrographs intended as laboratory manuals for use mainly by undergraduates, teachers and amateur geologists. The book is divided into three principal divisions, namely terrigenous clastic rocks, carbonate rocks and other sedimentary rock groups, for example, cherts and evaporites.

Like all pictorial geology texts, those that contain a plethora of colour photomicrographs are aesthetically pleasing and simple to follow. In this respect the *Atlas of Sedimentary Rocks under the Microscope* does not fail to delight. It is set out in an acceptable and logical format, is easy to use and, at £9.95, should be well within the budget of most undergraduate students.

The terrigenous clastic and carbonate sections, which comprise nearly three-quarters of the Atlas, have introductory figures and tables on grain size, texture and classification which assist the reader in compartmentalizing the rock types illustrated. A two-column format is used throughout, the photomicrographs being arranged two or three to a page in the outer column. The photomicrographs are generally of high quality, although some of the plane-polarized light shots are too dark, particularly in the clastic rock section.

The carbonate section of the book is particularly strong and beautifully illustrated. Allochemical components of limestones (ooids, peloids, lithoclasts, intraclasts and pisoids) are well documented, as are a great number of bioclasts including molluscs, brachiopods, echinoderms, corals, bryozoans, arthropods and foraminifera. This latter component is particularly valuable for the recognition of fossils in thin section. Until now, bioclasts have been adequately described only in the expensive text of Horowitz & Potter (1971).

The above comments highlight the high-quality aspects of the *Atlas of Sedimentary Rocks*. As a clastic sedimentologist I was dismayed to

note the imbalance of presentation between clastics and carbonates and the omission of some major sedimentary rock clans. The bias of the first author to limestones is extremely apparent in that almost half the book deals with carbonate rocks, together with 97 out of 217 photomicrographs. Illustrative material on breccias and conglomerates is totally absent. Fine-grained clastic sediments (the claystones) are omitted because of their grain size—surely the undergraduate and/or amateur geologist is entitled to view at least one SEM shot of clay minerals or authigenic feldspar! Yet again, volcanoclastics are not treated in a sedimentary petrology book. All these factors lead to an overall imbalance of presentation of sedimentary rocks.

Another omission of some note is terrigenous clastic rock porosity. Limestone porosity is granted an introductory classification figure, four pages of text and 10 photomicrographs. Have the authors never heard of North Sea sandstone reservoir rocks? This major hydrocarbon-bearing province is famous for its terrigenous clastic reservoirs and associated varieties of porosity.

Finally as my 'banner' title proclaims there is little in the book for structural geologists. Unstrained grains are the order of the day, and although pressure-solution phenomena receive mention, in both the carbonate and clastic sections, illustrating them from the latter group of rocks with thin sections of italcolumite from Brazil is surely bizarre. Some of the litharenites figured in Part One of the book have undergone strain and low-grade metamorphism which is not commented on in the text. Likewise, the alignment of micas deformed by a crenulation cleavage (p. 14) is not considered worthy of remark.

In conclusion, despite its lack of balance, it must be stated that the book is of high quality considering its price and hence it should be of great use to those starting thin-section work on sedimentary rocks. The professional, however, might judge this atlas inferior to Scholle's (1978, 1979) memoirs on clastic and carbonate rocks which remain an excellent purchase at £36 for the pair.

REFERENCES

- Horowitz, H. S. & Potter, P. E. 1971. *Introductory Petrography of Fossils*. Springer, Berlin.
- Scholle, P. A. 1978. *A Color Illustrated Guide to Carbonate Rock Constituents, Textures, Cements, and Porosities*. American Association of Petroleum Geologists, Tulsa.
- Scholle, P. A. 1979. *A Color Illustrated Guide to Constituents, Textures, Cements, and Porosities of Sandstones and Associated Rocks*. American Association of Petroleum Geologists, Tulsa.

B. P. J. Williams

Rugged geology in difficult terrains

Holland, C. H. (editor) 1985. *Lower Palaeozoic of North-Western and West-Central Africa*. Wiley, Chichester, 512 pp. Price: hardback £69.00.

Having participated in the writing of the first two books in this series it is with sorrow that the reviewer notes from the Preface that this volume will be the last one of the series. Syntheses of the geology of vast areas such as this one are difficult to bring to fruition and it has taken in this case about a decade and a half. Where chapters have not been revised since 1975 this is a weakness but the information given in this carefully written, edited and published contribution to international geological communication is by no means ephemeral, and has not unduly suffered from delay. The publication is a fine, commendable synthesis of the Lower Palaeozoic geology of often difficult and remote regions. The excellent frontispiece of the late Henri Hollard in the bare, hot

landscape of the Anti-Atlas Mountains sets the scene perfectly—other areas will be contrastingly humid but the milieu generally will challenge and satisfy those who come to terms with it in the pursuit of geology (one is tempted to say 'real' geology).

Divided into four parts: Tunisia, Algeria, Morocco and lastly, west Africa and the western part of central Africa, it is immediately obvious that Tunisia is slim (3 pages), Algeria is larger (86 pages) while Morocco gets the most (246 pages) with west and west-central Africa second largest (160 pages). All parts are by French-speaking authors and reflect great contributions to the development of a vast region.

In Tunisia, the Lower Palaeozoic rocks do not crop out, so drill cores are the evidence and more is perhaps known than is here given, but the brief résumé is a welcome contribution. The maps in the Algerian section are often too detailed for reproduction at the given size but a lens will reveal much more detail than the naked eye can readily absorb; the reproduction in the copy reviewed does seem to be a little thin in places, but more ink might have resulted in blackening out of other details. This criticism is particularly apparent in Fig. 3 (pp. 8 and 9) but applies also elsewhere.

The maps and diagrams are often disappointing in their reproduction. Figure 6 showing isopachs of the Cambrian is a real disaster with 21 intended shades of white-grey-black which come out with at least four indistinguishable blacks.

The detailed Tables (I & II, pp. 14 and 15) are extremely useful and summarize the situation (or state of the art) but at some stratigraphical levels the absence of biostratigraphical data has led to the wise addition of question-marks in the Precambrian and Cambrian subdivisions. In the Ordovician system the situation for biostratigraphical zonation improves radically (e.g. Table 3) and in the Silurian system too the time-control is much improved (26 zones of graptolites are given for the Région du Nord, Table 4), but a word of caution on page 54 notes that "most of the published lists of graptolites are in need of revision, a task currently in progress".

In the section on Morocco the pages on the Precambrian-Cambrian Boundary and the Lower Cambrian are of special interest to the reviewer. The topic has been the subject of particular international interest in the last decade or so. In about 55 pages an excellent summary is given by the late H. Hollard but it suffers from the lack of correlation with strata of similar age in other parts of the world. The Moroccan outcrops are rich in fossils at some levels but the lack of diagnostic correlative fossils at critically significant horizons frustrates research in a way which leads to tentative conclusions. The general details from Morocco are of great benefit to have in English and much useful information is presented. The task is quite incomplete, however, and it was clearly a difficult one for Hollard, particularly in dealing with controversial papers by Choubert and incomplete research by Hupé. The half-tone photographs do no justice to the scenery and geology and Plates 3, 4, 5 and 6 are particularly poor. Having said that, it is only just to draw attention to the many excellent maps, diagrams and tables (e.g. Fig. 36) which brilliantly back up the text, especially in the Ordovician and Silurian sections. The whole is a mine of information to be used for decades to come.

In the final section on West Africa and part of Central Africa three very able field and laboratory geologists are the authors and they attempt in 160 pages to give a summary of 24 states as diverse as Chad, Sierra Leone, Mauritania and the Congo Republic. In this mammoth task they appear to the reviewer to have succeeded in producing an important work of reference to a very high standard. For interested Anglophones this must be required reading. The maps are clear and legible, the sections and diagrams excellent, the photographs are remarkable but not aesthetically satisfying. An esker 50 km long and 1 km in cross-section must be an awe-inspiring sight from the air. In their Conclusions the authors outline frankly the principal difficulties, in that research is not yet adequately developed, is geographically scattered and, excepting the Silurian sequence, fossils are exceptionally rare. References take up 18 pages and are an invaluable source of information about a widely scattered and obscure literature.

J. W. Cowie