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Stress and Strain

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Geologic Time, but it is less specific in its focus, and as an even briefer treatment of an even vaster topic, inevitably it is more limited in scope and is deficient in depth. It is suitable only for a junior undergraduate readership. *Geologic Time*, some sections substantially reorganized compared to the first edition of 1968, is lucidly written, liberally laced with informative, simple illustrations, well bound, and reasonably priced. It should be required reading for students; it could be profitable reading for many practising geologists.

MS received January 6, 1977

History of the Earth Sciences during the Scientific and Industrial Revolutions with Special Emphasis on the Physical Geosciences

By D. H. Hall
Elsevier Scientific Publishing Co., 297 p., 1976.
Soft cover $19.95

Reviewed by W. A. S. Sarjeant
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The steadily increasing costs of printing, and in consequence of book prices, must inevitably cause changes in publication styles and methods. A deterioration in the quality of books may be an inevitable, though unwished-for, result.

Any assessment of the book here reviewed necessitates consideration of the fashion in which it has been produced. Only the 11 preliminary pages were typeset, all the rest are photographic reproductions of typescript. Unfortunately the pages have been over-reduced, so that the lettering is too thin and small and the pages too light, making the book very hard to read. This will unquestionably deter many readers.

Unfortunately, the book suffers also from inadequate editing and equally inadequate proof-reading. There is much duplication between sections (for example, the third paragraph of pages 96 and the last of page 98); some misspellings are consistent (e.g., "Edmund" for "Edmond Halley") and some clearly unintentional (e.g. "Ptolmaic", p. 101); and more major mistakes have also survived uncorrected (e.g., the nearly identical sentences on p. 60, the second quite incomprehensible!). Such inconsistencies as the citation of the same reference as "Crowther, 1960a" on page 92 and as "Crowther, J. G., 1960a" on page 93 should surely have been eliminated well ahead of publication. Other faults include wrong conjunctions (p. 12, "It is in fact doubtful that the pace of science could be halted "), tautology (p. 48, "Lunar geology and geophysics on the moon . . ."), faulty punctuation (e.g., near the foot of p. 86) and confused imagery: "Sometimes the thread is strong and continuous; at other times it diminishes in size and may even die out. If it dies out, it may reappear unexpectedly at another time or place" (p. 97). Prime responsibility for the elimination of such faults rests with the publishers and their readers. Since their survival into publication will inevitably reflect most heavily on the author, he deserves our sympathy.

Having successfully surmounted all these handicaps to reading and comprehension, one perceives that the title of the book is decidedly misleading. This is *not* a history of the earth sciences during the Scientific and Industrial Revolutions. Instead, it is a discursus on the philosophy of science as applied to the earth sciences, with a heavy overt reliance on the opinions of Crowther and Bernal. A history is indeed given of some aspects of geophysics, but that is all.

In this regard, the reference list is revealing. Of 123 works cited - a slim total for a work thus titled - the vast majority are either general works on the history and philosophy of science or works concerned with those aspects of geophysics. The author cites only six other references on the history of geology - the classic texts of Adams, Geikie and Zittel, plus three biographical works on Hutton - and only two on the history of geography. Was this, then, the extent of his reading?

The single aspect of the history of earth sciences that *is* thoroughly treated, the story of the development of the magnetic compass and its use, along with the pendulum, in determining the figure and structure of the earth - is handled well and interestingly. Other historical material is meagre indeed.

Do not, then, expect this work to fill out your knowledge of the general history of the earth sciences, for it will not do so. Do not expect to agree with all the author's judgements. I do not personally consider "geomagnetism, the first of the earth sciences" (p. 106) in point of time or in importance (and indeed it is an effect, not a science!). Nor do I believe that the oceans have yet been thoroughly explored, as the author claims on p. 46; their exploration is surely only beginning.

However, the author's reflections on the course of the development of science are controversial enough to be stimulating; some of his comments strike a responsive chord. When he comments (p. 13) that "a consideration of the history of his subject is rapidly becoming a necessary part of a scientist's education and professional development", one can wholeheartedly agree and wish that Canadian Universities in general were aware of this fact!

MS received December 21, 1976

Stress and Strain

By W. D. Means
Springer-Verlag, New York, Inc. 339 p., 1976
$14.80 paperbound

Reviewed by P. M. Clifford
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To understand structures, we still need clear descriptions and definitions, as of old. But nowadays structural geologists borrow freely from physicists, metallurgists and engineers, applying their ideas with some success. When we do this, however, we run into a language barrier, namely, *our* understanding of *their* concepts and mathematics. Means' book is designed to alleviate part of this bilingual problem. It provides an outline of the elementary notions of continuum mechanics, by considering

stress, strain, the Hookean and Newtonian versions of their relationships, and the implications for structural processes. In 27 brief chapters, he proceeds by small, simple steps. For example, it takes nine chapters to go from a definition of strain, via Mohr circle analysis of strain to tensor components of strain and their transformation to new co-ordinate systems. There is a similarly careful progress through stress. Though one needs to concentrate if ones' mathematics is rusty, none of it is particularly difficult. The book has been written with self-instruction in mind, so the manageable mathematics are particularly welcome.

The best pieces of explaining are for stress-fields and trajectories (ch. 12), strain fields and strain history (ch. 23, 24) and chapters 1 to 4 which set a standard of clarity not everywhere maintained, unfortunately. The development of tensor transformation formulae is one section difficult to follow, for instance. There, and elsewhere, symbol or sign changes, though explained, still can confuse the reader somewhat. A typical case is in chapter 15, where λ is used in the same sentence to refer to a principal axis of the strain ellipsoid, and to quadratic elongation, which is independent of a principal axis. There are sundry minor clerical errors, too.

Two things do stand out. First is Means' general insistence on precise definitions of terms. Any consistent and precise use of language is to be applauded these days! Many terms are taken from materials or engineering literature; they will make the geologist's use of that literature slightly easier. Then there are the numerous examples, and problems (with answers). Though these are not obviously useful in field studies, they have already encouraged clearer thought in students who are tempted to discuss processes, knowing only the final structure, and presuming its initial state.

We will wait a long time for continuum mechanics to become a routine part of the geologist's undergraduate training. Meantime, here is a useful stopgap, a convenient summary of several larger, more abstruse books. Parts of the book are at home in a first course in structural geology. A senior student, or a practicing geologist wanting to brush up on new developments will find it a useful companion and introduction to current literature in structural geology. There is a snag, however - $14.80! A bit much - but then, aren't most prices these days?

MS received February 4, 1977

Applications of Probability Graphs in Mineral Exploration

By Alastair J. Sinclair
Association of Exploration Geochemists Special Vol. No. 4. 95 p., 1976.
Price (soft cover only) $8
($6 to AEG Members)
Available from the Association of Exploration Geochemists
P.O. Box 523
Rexdale, Ontario M9W 5L4

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Firstly, I should state that I am not entirely a disinterested party in the welfare of this book due to my connections with the association that is marketing it as a special volume. However, I believe as a practicing geochemist who is interested in the application of statistics to the science I can attempt an objective review.

Sinclair's book is, as he himself states, more accurately described as a manual. The author has purposely avoided the theoretical background to probability plots and concentrated on demonstrating their application to mineral exploration problems, particularly in geophysics and geochemistry. Thus the book is well endowed with worked problems through which the author leads his reader from simple unimodal distributions to truncated and polymodal distributions.

Natural scientists, not only geologists, will find this book useful. In both experiments and surveys a population or area often has to be sampled; it is critical to be able to determine the underlying distribution of the data and determine if in fact the sample contains components from more than one distribution. Sinclair's book will assist scientists in the investigation of such problems in a simple and practical fashion which does not necessitate the use of a computer. Thus the manual will find special application in exploration offices remote from computer facilities.

To a geochemist the last two chapters are particularly interesting as they address everyday problems of exploration geochemistry. The estimation of thresholds is discussed in a full chapter and it is demonstrated, with examples, how the methods described can be used to improve the selection of threshold levels. In the final chapter the author discusses particular problems, such as where small data sets are encountered, or where data sets contain a high proportion of zero, or below detection level, data. This last chapter also contains several simple tips aimed at assisting the worker who is in the field.

My only criticism is the manner in which the cumulative probability plots are drawn, with the probability scale on the x-axis rather than the y-axis. However, even if one is used to seeing plots the other way around one can soon adjust to Sinclair's presentation.

To sum up, this book has much to recommend it as a practical manual which will assist many workers and students in gaining a better understanding of their data. The price is particularly gratifying and this puts the book within the reach of any geologist.

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