Book Review / Critique

Book Reviews

A Guide to the Geological Features of Edmonton, Alberta

by M.A. Roed, *Geo-analysis Ltd., Box 173, Station A, Ottawa, Ontario K1N 8Y2, 26 p., 1978*
$3.00 + $.50 handling charge.

Reviewed by W.H. Mathews
Department of Geological Sciences
University of British Columbia
Vancouver, B.C. V6T 1W5

The first comment that can be made about this novel booklet is that it has been misnamed: a title such as "A layman's introduction to the geology of Edmonton" would have much more appropriately described its contents. It is clearly written for a non-professional audience. Moreover, it is hardly a "guide", at least in the sense of leading the reader from place to place to view geological features; indeed its 8" × 11½" (216 × 280 mm) format discourages any thought of stuffing it into a pocket to help on a tour around the town. Finally much of what it describes lies below the surface, unaccessible to the tourist.

The factual material presented in the text is accurate and the interpretations sound, the untrained reader will not be misinformed by this publication. The writing is clear and concise and sentence structure is simple. Technical terms are few, introduced well, and their use is also covered in a glossary. Comprehension by the layman should not pose a problem. Two-dimensional and block diagrams support the text as do three pages of photographs.

Appeal is made to a wide variety of readers by treating not only geological history but also covering past mineral production – gold and coal – as well as groundwater and localities of interest to the rock hound and the fossil collector. Maps are provided showing the location of buried valleys, the extent of coal mining, the oil and gas fields, and places attractive to rock hounds, but alas the small scale of these maps makes it impossible to pinpoint specific sites of interest.

Conclusions are offered, for the most part without explanation as to how they are reached, and many of the topics are touched on only briefly. It may be hoped that even the passing mention of some item may whet the curiosity of the reader and, with the help of the bibliography – a dozen references to pertinent technical papers – he may choose to delve further into the subject. There remains the danger, however, that reader is 'turned off' by this approach.

Whether the booklet meets the favor of the public is something only future sales will tell. We can but wish the author-publisher finds success in this endeavour

MS received November 3, 1978

Reflection Seismology: A Tool for Energy Resource Exploration

By Kenneth H. Waters
John Wiley and Sons, 377 p., 1978.
$28.00

Reviewed by R.F. Mereu
Department of Geophysics
University of Western Ontario
London, Ontario N6A 5B7

This book is an excellent reference textbook which brings the reader up to date on the state of the art of the subject of reflection seismology. This method is the most powerful and widely used tool we have for delineating subsurface structures for the exploration of our energy resources such as oil, gas and coal. If the earth were composed of perfectly elastic homogeneous flat-lying layers of rock, the method could be implemented with as little effort as the echo sounding techniques used to determine water depths in seas. Unfortunately in the real earth, the degree of resolution required to map the structures of interest is extremely difficult to attain. The high frequency signals which are necessary for high resolution are rapidly attenuated and scattered by an earth which is inhomogeneous and anelastic. The detected reflected energy is usually made up of wavelengths which are much longer than the thicknesses of the rock layers of interest. Frequently there is insufficient contrast in the physical properties of the different sedimentary sections such that the signal to noise ratio is very small. Because of the great technical difficulties which have to be overcome before meaningful results can be

obtained, a great deal of research has gone into the method. Much of the progress made to date is described in this book and is a direct result of the tremendous advances made in solid-state electronics and computer technology in recent years.

This book will be an asset to the libraries of geophysicists, geologists and other earth scientists concerned with the energy problem. The text is written in a style that is easy to read such that scientists who are not familiar with the subject will have no difficulty understanding the material presented. The mathematics is kept at an elementary level. However, this is supplemented with excellent references to the literature for those who wish more details on the theory and methods. The descriptions and discussions of many of the topics coupled with a wealth of contemporary, technical and practical information will mean that the book offers much to both experts in the field as well as non-experts. The text is permeated with excellent diagrams and illustrations. This book will also be an excellent reference source for numerous university geology and geophysics undergraduate and graduate courses. One drawback from a teaching point of view is that it is not the kind of textbook that provides problems, exercises or computer programs.

There are 12 chapters of which the first seven are devoted to explaining the principle of the method, the sources, the receivers, the data gathering, and the data processing techniques. The vibroseis system which uses a controlled source is detailed and emphasized. Chapters 8 to 11 are devoted to the problems of resolution, diffraction, near-surface corrections and interpretation. The section on resolution is particularly well done. The last chapter brings the reader up to date on some of the new and promising tools in the making. Some of these are shear waves, three-dimensional analysis and seismic holography. At the end of each chapter there is a very useful summary and conclusion. An occasional appendix is also inserted to supplement some of the sections in the text.

MS received November 29, 1978

Seismic Stratigraphy – Applications to Hydrocarbon Exploration

Edited by Charles E. Payton
American Association of Petroleum Geologists, Tulsa, Oklahoma, U.S.A. 516 p., 1977.
AAPG and SEPM members U.S. $18.00, others U.S. $24.00

Reviewed by D.C. Umpleby
Geological Survey of Canada
Bedford Institute of Oceanography
P.O. Box 1006
Dartmouth, Nova Scotia B2Y 4A2

This book, Memoir 26 of the series published by the American Association of Petroleum Geologists, consists of 14 chapters arranged in three sections. It provides in an excellent manner, a balance between the mathematical and physical treatment of modern reflection seismic interpretation and current geological concepts of basin evolution and sediment deposition. It is especially valuable to the increasing number of earth scientists and explorationists who are concerned with unravelling the geology of the lesser-known offshore areas. In such areas, non-conventional methods must be used because of the lack of detailed stratigraphic data. Using techniques that are carefully explained in this book, reflection seismic profiles can be made to yield much more information. In short, this book describes a fresh approach to seismic interpretation.

Section 1 outlines fundamental principles of interpretation and consists of two chapters. The first chapter, by R.E. Sheriff, describes how and why seismic data are processed so that noise, as far as possible, is eliminated and interpretational ambiguities are minimized. An appendix to this chapter includes definitions of some technical terms in a format similar to his Encyclopedic Dictionary of Exploration Geophysics (1973, Society of Exploration Geophysicists). The second chapter, by A.R. Gregory, provides a lucid description of the physical properties of rocks and the significance of these properties in reflection seismic data processing and interpretation.

The second section consists of seven chapters describing how seismic reflection records are qualitatively interpreted using up-to-date stratigraphic and sedimentological concepts. The longest chapter in this section consists of an 11-part series written mainly by explorationists of the Exxon Group, who describe a new approach to seismic interpretation called seismic stratigraphy.

The basic assumption made is that seismic profiles record stratigraphic or chronostratigraphic depositional events so that chronostratigraphic correlations follow seismic reflections. Thus the attitudes of correlated seismic markers can be used to describe the depositional history of an area. Procedures for converting seismic profiles to chronostratigraphic sections and charts showing relative changes in sea level are carefully described and the procedure by which this chronostratigraphic section is used to summarize the geological evolution of a sedimentary basin is outlined. Thus phenomena associated with cyclic sedimentation and changes in sea-level are illustrated. The correspondence between sea-level changes and time is contentious but forms the basis of obtaining a geological history from a seismic profile.

The remainder of Chapter 3 describes and illustrates criteria which enable depositional facies to be recognized from the pattern of reflections. The terminology and reflection parameters used to analyze facies are clearly described, well-illustrated by both line drawings and actual seismic records and listed in a useful glossary.

Chapters 4 to 6 show how seismic stratigraphy and seismic facies analysis are used to analyze seismic reflection profiles in a variety of sedimentary basins containing sequences of diverse age, lithology and depositional settings. Included are well-known areas (Gulf Coast, Denver Basin) as well as frontier areas (offshore West Africa), and facies analysis of clastic and carbonate regimes.

Chapter 7 by M.T. Taner and R.E. Sheriff evaluates the effectiveness of seismic parameters in facies analysis and gives a timely account of the direct detection of hydrocrbons. This chapter contains examples of recently-

developed coloured sections in which differences in relative strength, phase coherence, frequency and apparent polarity are indicated by different hues to facilitate interpretation. M. Dobrin in Chapter 8 shows how seismic interpretation strategies, especially seismic facies analysis can be used to explore for stratigraphic traps. He provides many informative case studies. In the last chapter of section 2 (Chapter 9), H.C. Sieck and G.H. Self explain the use of high-resolution seismic methods, a technique the authors prefer to call continuous acoustic profiling or high resolution acoustics.

The final section, "Stratigraphic Models from Seismic Data", describes techniques and provides examples of modelling in which the seismic response of geological contacts is constructed. In the first two chapters, the theoretical seismic signatures of a variety of facies relationships, such as the interfingering of sand and shale sequences, are given. In the third chapter, theoretical seismic profiles are presented using, as examples, facies changes in the basal Pennsylvanian of part of the Anadarko Basin. The final chapter, by M.W. Schramm *et al.*, include examples of modelling both the seismic response of various types of lithologic change and the conversion of lithologic changes to seismic signatures. The authors use examples from the Gulf Coast where seismic modelling techniques have been used successfully. However, they make it clear that these techniques could have universal application.

In general, Memoir 26 is a collection of papers previously published in bulletins of the American Association of Petroleum Geologists. This memoir can, therefore, be regarded as a second edition and should be error-free. An exception is that in my copy, Figure 4 on p. 358 is reversed. The book is very well illustrated, though with some duplication of figures, and contains an excellent, comprehensive index. As the title suggests, the book will be of most value to industry explorationists, though no practicing geologist or geophysicist can afford not to have it, especially so since the price is only $18.00 or 3.5 cents per page to AAPG members.

MS received December 4, 1978

Marine Evaporites: Lecture Notes for Short Course No.4

Edited by Walter E. Dean and B. Charlotte Schreiber
Society of Economic Paleontologists and Mineralogists, 88 p., 1978.
$6.00

Reviewed by Alan C. Kendall
Amoco Canada Petroleum Company Ltd.
444-7 Avenue S.W.
Calgary, Alberta T2P 0Y2

Review of short course notes is difficult because they are neither fish nor fowl. Their prime purpose is as an accompaniment to the course and deficiencies in the text may be more than counterbalanced by excellence of the oral presentation. Nevertheless, these notes are offered to the public and presumably are deemed capable of standing alone.

The notes are divided into nine sections or chapters, the first of which, by B.C. Schreiber, outlines the major structural settings of evaporites. Its brevity and the lack of examples make it the least satisfactory of the chapters. Most of the next chapter, "Evaporites of Coastal Sabkhas" by D.J. Shearman, is a repetition of his excellent University of Calgary Notes but, excepting a new section upon halite, the literature quoted is all pre-1971. The only recent sabkha discussed is that in Abu Dhabi which could lead to erroneous impressions that all sabkhas are similar or that all ancient deposits were formed in this sabkha type. In contrast, "Environments of Subaqueous Gypsum Deposition" by B.C. Schreiber is up-to-date, excellently presented and alone is worth the price of the book. In it the myriad structures and textures exhibited by gypsum are detailed. No serious student of evaporites can afford to ignore it.

Sections 4 to 7 deal with evaporite geochemistry (written by W.E. Dean with one chapter by O.B. Raup and R.J. Hite). Although coverage is adequate, the lack of any new emphasis or insight is disappointing. Much of the material has been included in review papers elsewhere.

Roy Nurmi's chapter on uses of well logs in evaporite successions is welcome but, rather oddly, includes a discussion of aeolian sandstones and omits one upon the use of well logs in native sulphur evaluation. The last, but far from concluding chapter, "Depositional Environments of Evaporite Deposits" by G.M. Friedman, too briefly describes features of continental sabkhas, playas, sea-marginal sabkhas and pools. The absence of figures in this chapter is striking. A bias against "deep" water evaporites is also evident.

There is a need for a book that deals with the many facets of evaporite sedimentology – a subject that has expanded considerably in the last decade. Unfortunately these notes do not fill this gap satisfactorily. One looks in vain for any reason why evaporite rocks are worthy of our interest and economic considerations are simply ignored. The vitality and excitement of evaporite research at the present time – with desiccating ocean basins, the structural implications of major salt deposits at ocean margins, and the often heated disputes between "shallow" and "deep" water advocates – all this is rarely, or is but dimly shown. However, my own prejudiced view is that the absence of any section upon diagenesis is the major flaw of the short course. How the geochemistry or the environmental reconstruction of ancient evaporites can be discussed without detailing their penchants for change is a position difficult to defend.

Whereas I feel an opportunity has been missed, it must also be said that these notes represent a most useful and convenient compilation of information. At $6 the book is a definite bargain and is recommended to all that would know more about these most peculiar of sedimentary rocks.

MS received October 31, 1978

The Ecology of Fossils

Edited by W.S. McKerrow
Gerald Duckworth and Company Ltd., London, U.K. 384 pages, 1978
£14.00 (about $30.00)

Reviewed by Alan Logan
Department of Geology
University of New Brunswick
Saint John, N.B. E2L 4L5

Splendidly edited by Stuart McKerrow, this book presents paleontology in an exciting new way. The emphasis is visual – it is an atlas of reconstructions of the life habits of over 1000 species from 125 communities throughout the geological record, graphically illustrated by artist Elizabeth Winson. Each community diagram shows the water column, a block of sea floor and, beneath, a block of sedimentary rock showing both bedding plane and vertical section views. Biotas are displayed either as nekton or plankton above the sea floor or as benthos living on or within the sediments of the sea floor.

The communities are almost all based on fossil associations found in rocks of the British Isles. McKerrow is the author of the two introductory chapters and the Precambrian section and has collaborated with L.R.M. Cocks on the important Cambrian, Ordovician and Silurian sections. The Devonian section is written by R. Goldring, the Carboniferous and Permian by W.H.C. Ramsbottom, the Triassic and Jurassic by B.M. Sellwood, the Cretaceous by W.J. Kennedy and the Cenozoic and Present Day by J. Taylor. A glossary of terms and a short reference list complete the volume. Each section is dealt with in a similar way – the global paleogeography and zonal scheme precedes the subsequent concise descriptions and illustrations of the various communities found in the British Isles in rocks of that period. The descriptions focus on such factors as biotic associations, feeding relationships, substrate control, depth, temperature and salinity. While some artistic license has obviously been taken with extinct forms (look for the hypothetical reconstruction of the conodont animal in the Devonian section) the community reconstructions appear realistic and the authors have avoided the temptation to overcrowd the sea floor by squeezing in every possible community member.

North American readers may be a little dismayed with the almost total emphasis on British examples but, as the editor points out, most marine fossil communities throughout the world have some close parallel with a community illustrated in the book. Because of the variation in the degree of sophistication reached for paleo-community reconstructions throughout the geological column, certain chapters are noticeably shorter than others. Also, the marine Triassic, so familiar to North American biostratigraphers, is given scant treatment because of its scarcity in Britain. Another small criticism is the absence of a subtidal rocky shore community in the Present Day section. This would have been useful for comparison with the Jurassic and Cretaceous hardground communities illustrated in the volume.

Typographic errors are remarkably few, but one that lingers on the mind rather pleasurably is the "new" Carboniferous stage, the "Manurian" (for Namurian, of course), presumably reserved for beds dominated by coprolites.

In summary, this book will excite the imagination of paleontology students everywhere. Animals and plants are shown as they once might have lived, instead of inanimate pieces of stone. It is the best book of its kind to come on the market for many years and I hail it with enthusiasm.

MS received November 13, 1978

Short Course in Trace Fossil Concepts

Edited by P.B. Basan
Society of Economic Paleontologists and Mineralogists, 201 pages, 1978.
$6.00 (Soft Cover)

Reviewed by S.G. Pemberton
Department of Geology
University of Georgia
Athens, Georgia 30602

Prior to the 1978 National Meeting of the SEPM in Oklahoma City a one day shortcourse was offered on general concepts dealing with ichnology. Six of the leading authorities on the subject presented a series of lectures dealing with the application of trace fossil concepts and data to a variety of geological problems. The SEPM published in this volume the set of lecture notes, as edited by P.B. Basan.

The first three chapters serve as an introduction to the known uses of trace fossils in sedimentology and paleontology. P.B. Basan reviewed the present classificational systems used to characterize trace fossils as well as highlighting the unique properties displayed by these structures. J.D. Howard presented a well-written view of trace fossils as primary sedimentological structures and illustrates their value in determining depth, rates of deposition or erosion, and sediment consistency. Throughout the chapter Howard stressed the inherent link between these biogenic sedimentary structures and physical sedimentary structures in interpreting the dynamic depositional environment. The succeeding chapter presents data on the behavioral and ecological implications of trace fossils, by R.W. Frey. When viewed as the ethological response of an organism to its environment, trace fossils can provide a wealth of environmental information. Frey draws upon specific examples to illustrate the importance of trace fossils in the interpretation of such factors as: substrate characteristics, aeration, depositional history and facies analyses. In addition he points out that in most cases trace fossils represent the only clue to the soft-bodied

component of a fossil community and as such must not be overlooked by the geologist when conducting a faunal survey of a rock unit.

Chapter four by J.E. Warme and E.J. McHuron, is an excellent review of marine borers and their significance. This chapter is well illustrated and all major groups of macroboring organisms are represented. Of particular interest is the way in which Warme and McHuron provide data on the identification of borers on the basis of their borings. A useful section on borings as paleobiological and sedimentological tools is included also. The chapter concludes with an excellent review of the literature, which contains most of the major references on the subject.

Perhaps the most useful chapter in the book is that on the recognition of trace fossils in cores, by C.K. Chamberlain. More and more petroleum industry geologists are recognizing the importance of trace fossils, when used in conjunction with other paleontologic, petrologic, and sedimentologic data, in paleoenvironmental reconstructions. However, because the petroleum industry employs cores as its basic sample unit the identification of specific trace fossils becomes difficult if not impossible. Chamberlain presents a well illustrated conceptual view of the configuration of a wide variety of trace fossils that are commonly encountered in core samples.

The final chapter of the book concerns the use of trace fossils in recognizing depositional environments, by A. Seilacher. The chapter contains notes on Seilacher's now-classic paleobathymetric zonation of trace fossils as well as information on the evolutionary history of shallow and deep water trace fossil communities and the distinction between terrestrial, non-marine, and marine trace fossil assemblages. Seilacher effectively draws on his vast experience with trace fossils and augments his comments with many specific examples.

In general, I can find little wrong with this book; it is well written and well illustrated, and obvious care has been taken to ensure that the many photographs are carefully reproduced. There exists some duplication of references which may have been avoided if there had been one listing instead of six; however, the excellent coverage of the literature is one of the highlights of the book. Copies should certainly be in the collection of most paleontologists, sedimentologists and field-oriented geologists. The fact that it was intended for the non-specialist coupled with its low price makes it attractive as a supplemental source for both undergraduate and graduate courses in paleontology and sedimentology.

MS received November 21, 1978

Geochemistry of Elements in the Supergene Zone

by A.I. Perel'man
John Wiley and Sons, 266 p., 1978
$37.50

Reviewed by Ward Chesworth
Department of Land Resource Science
University of Guelph
Guelph, Ontario N1G 2W1

Geochemists in Russia have always displayed a greater interest in the geochemistry of the outer parts of the earth's crust than most geochemists in the Anglophone world particularly in regard to those processes that produce one of our most fundamental geological resources, the soil. Professor Perel'man is a recognized expert in this field. He has written several texts concerned with the geochemistry of the supergene zone, the latter being defined as the upper part of the solid earth where atmosphere, hydrosphere, biosphere and lithosphere all interact in a variety of complex ways, ultimately to produce the environment we live in.

This book deals with 28 elements that migrate in the atmosphere and in water. A first section is concerned with the principles of geochemistry in the supergene zone, a second part with aerial migrants and a third with the aqueous ones. Important elements missing from the book and to be dealt with in a later volume are Al, Ti, Fe, Mn, Cu and Zn amongst others.

On the whole I found the book dull and uninspiring. It takes an essentially static view of geochemistry seeking to characterize the behaviour of elements in terms of various geochemical indexes. One such, the clarke (Fersman's "new constant of the universe") according to Perel'man "explains many aspects of the behaviour of an element in the supergene zone." Of course it does nothing of the sort, it is merely a number, the average content of an element in the lithosphere. It does not explain anything and it is not even a constant in practical terms, for hasn't Denis Shaw said in one of his more lucid, philosophical moments "la teneur moyenne d'un element . . . dans la lithosphere augmente continuellement et tend vers une limite asymptotique."

The one useful concept hidden away in the verbiage is Polynov's idea of landscape geochemistry. Do specific landscapes exist, comparable to petrogenetic and metallogenic provinces? If so how do they form and what do they tell us about our environment? A great deal of work needs to be done in this area not only because of its intrinsic interest but also for purposes of environmental planning.

In my own mind I kept comparing the book unfavorably with Garrels, MacKenzie and Hunt's *Man's Contributions to Natural Chemical Cycles* which deals with the geochemistry of the same zone but in a dynamic physical-chemical-biological way in terms of processes. In short, Perel'man's book is an old fashioned, static approach to the subject, and if I had not been given a copy, I would not have bought one.

MS received September 22, 1978

The Chemistry of the Atmosphere and Oceans

By Heinrich D. Holland
Wiley-Interscience, 351 pages, 1978
$24.95

Reviewed by Robert C. Cooke
Department of Geography
Dalhousie University
Halifax, Nova Scotia B3J 4J1

The subject of this book is vast, complicated, incompletely examined, and of great practical and theoretical importance. Dr. Holland has obviously taken great pains to assess each of a very large number of geochemical, oceanographic and meteorological papers both absolutely and relatively, and has been able to describe the chemistries of many diverse systems with a lucid and scholarly style.
The book should be in every earth scientists' library if only to be used as a reference for key papers. The text has the tight, factual style of a man who knows how to write good science, to criticise constructively, and to suggest new approaches to old problems.
For example, the flux of matter as a function of reaction and erosion rates in rivers and oceans is described with considerable clarity, while the use of descriptive differential equations is highly illustrative and an excellent example of the power of a simple but appropriate mathematics. This is a volume of learned discourse that will generate ideas and new work and should be read several times. Although somewhat dated in a few topics that are changing rapidly, the treatment of each section is generally thorough and complete. The sections are also laced with unequivocal and demonstrable statements that make fine exam questions. This is an excellent volume for the exceptional undergrad, good graduate students and lively faculty.

MS received December 4, 1978

Atlas of the Textural Patterns of Basalts and their Genetic Significance

By S.S. Augustithis
Elsevier Scientific Publishing Company, 323 p., 1978.
U.S. $73.95 (Dfl 170.00)

Reviewed by L.D. Ayres
Department of Earth Sciences
University of Manitoba
Winnipeg, Manitoba R3T 2N2

For many years the main thrust of igneous petrology has been geochemistry and geochemical modelling. Detailed microscopic observations, particularly those of more than routine nature, have been generally neglected. As a consequence, much important, petrographic data that could be a useful adjunct to the geochemical data has not been used to its fullest extent. The present book, which is a companion volume to the author's earlier atlas of granitic textures (1973), is an attempt to rectify this deficiency.

The present work comprises two parts: an initial text of 100 pages divided into 34 chapters, followed by an illustration section consisting of 604 figures, 547 of which are photomicrographs. I found the constant flipping back and forth from text to illustrations somewhat annoying, but other readers may like the uninterrupted text presentation.

Some 350 references are cited, but less than 10 per cent of these are post-1970. Many important references, particularly relating to interpretation of microscopic textures, have not been cited.

Most photomicrographs are clear and sharp, and because only three photographs are shown on most of the large, 21 x 30 cm pages, the petrographic detail is readily observed.
The captions are adequate but somewhat repetitious.

According to my dictionary, an atlas should be a systematic treatment of a subject, in this case basaltic textures Unfortunately this is not done in the present book. No attempt is made to distinguish between the textures of tholeiitic, calc-alkalic, alkalic, and ultra-alkalic basalts. Glass textures, particularly alteration phenomena are not shown. Vertical textural variations through pillows, flows, and lava lakes are not illustrated although such sections would best show the relationship between many of the textures. Most importantly, subaqueous basalts, which are the dominant form of Cenozoic and older volcanism are largely neglected, being illustrated by only five examples.

Although most major mineral phases are illustrated (nepheline and aegirine are neglected), the material is not well balanced. For example, about 20 per cent of the text and 86 photomicrographs are devoted to ultramafic and mafic nodules. As these nodules are not an essential part of the basalt flows, most of this space could have been used for amplification of other textures.

The text consists of four sections: general features and structures (4 chapters, 10 pages), nodules (2 chapters, 19 pages), primary and secondary textures (18 chapters, 40 pages), and classification, crystallization, chemistry, and origin (10 chapters, 31 pages). The textural chapters are largely descriptive. In discussing the genetic significance of the textures, the author tends to present his own viewpoint and does not offer alternative explanations Because the origin of many of the textures is poorly understood, this sort of presentation detracts from the general usefulness of the atlas.

Many North American petrographers will disagree with the author's interpretation of some of the textural features, particularly the late stage development of some phenocrysts (tecoblasts) and the intergrowth textures. However, in support of his interpretations, the author points out many petrographic details that do not always fit the more commonly accepted North American ideas. Obviously much is still to be learned about crystallization in basalts, and petrography has a major contribution to make here.

The final section is incomplete and the conclusions reflect the author's textural interpretations. They do not always agree with experimental data. For example, the author believes that most basaltic magma is generated in the lower gabbroic crust above the Moho. In oceanic regions basaltic

magma is thus generated at only a few kilometers depth.

The author is obviously not writing in his native language. The text is cumberson with numerous grammatical and spelling errors. Some of the spelling errors recur several times and are not typographical errors. The petrographic terms should have been defined, possibly by inclusions of a glossary.

Well balanced, unbiased petrographic atlases are needed. Unfortunately this book does not fit the bill. Better selection of material to avoid repetition, provide better balance, and give comparative data is needed for a good atlas. Many of the photomicrographs are useful, but the book is not worth the high cost.

MS received November 30, 1978.

Books Received

An Introduction to X-ray Crystallography
by M.M. Woolfson, Cambridge University Press, 1978, 380 p., $10.95.
A paperback version of the 1970 hardcover publication. ". . . an elementary text which will serve either the undergraduate student or the postgraduate student . . . there has been no attempt to compete in depth with specialized textbooks . . ." (From the Preface).

The Earth's Changing Surface
by M.J. Bradshaw, A.J. Abbot, A.P. Gaersthorpe, John Wiley, 1978, $14.95. Geomorphology, with emphasis on current surface processes and internal processes. British, but it has varied examples. Suitable for high-school use.

Recent Advances in Geomathematics
edited by D.F. Merriam, Pergamon Press, 1978, 233 p. A collection of papers dealing with physical and chemical properties of sediments, cartography, polarity reversals, shape analysis, stratigraphy and texture simulation, all involving quantitative, computer based techniques.

Quantitative Techniques for the Analysis of Sediments
edited by D.F. Merriam, Pergamon Press, 1976, 174 p. ". . . sedimentologists were among the first in the earth sciences to use numbers in their analysis . . ." (From the Preface). This volume reports on recent endeavors by sedimentologists in the use of quantitative methods.

Principles of Physical Geology (Third Edition)
by A. Holmes and D.L. Holmes, John Wiley, 1978, 730 p., $24.95.
An updated and abbreviated version of a classic. The photos, though varied, are poorly reproduced. But the writing is as fluent and as impressive as ever and the coverage of earth science unparalleled – nostalgia for older geologists, and an example for us all of how to present geology in an interesting way.