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Book Reviews / Critique

Book Reviews

Applied Geophysics for Geologists and Engineers: The Elements of Geophysical Prospecting

By D.H. Griffiths and R.F. King
Pergamon Press, 1981.

Reviewed by L. Mansinha
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In the decade and half since the publication of the first edition there have been significant developments in the practice of exploration geophysics. The changes have been mainly in instrumentation, firstly due to miniaturisation of analogue electronics and then due to the increasing sophistication of digital electronics. With the availability of powerful microprocessors and inexpensive memory chips, geophysical instrument design is presently continuing to evolve. Much of the change in recent years is beyond the scope of an introductory text such as this, except in so far as the techniques are affected by the available tools. Since the physical principles remain unchanged, the revisions and the rearrangements in the second edition reflect mostly a perception of change in the pattern of usage of the various geophysical methods.

The new edition begins with a section on seismology, followed by sections on electrical resitivity surveys and other electrical methods. Together, the two techniques most useful for shallow exploration occupy about half the book. The rest of the book is taken up by gravity, magnetic and other methods. SI units are now used throughout. The added textual material is accommodated with a larger page format. A new section with a set of 12 problems, together with the answers, has been added. The overall level of the text is not particularly taxing. However, the problem set is not elementary. Question 1, for example, asks the reader to choose from a set of geological models that one which is not inconsistent with a given unreversed refraction profile. It would have been preferable, in an introductory text, to build up to such a problem with a set of simpler exercises with complete data sets.

Overall the second edition is a definite improvement over the earlier version. The sections on seismic and electrical methods provide a good introduction to the topics. Still, the level is not demanding enough for the book to be considered an introductory text for a serious undergraduate geophysics program. It may be more suitable for the engineer and the geologist. However, inclusion of examples of successful (and unsuccessful) applications as case histories would have added to the dimension of the book in the two disciplines. The problem set at the end should have had more exercises. But shortcomings aside, the book has enough material presented in a lucid style for the book to be recommended for inclusion in institutional libraries.

Finally, a parochial note. Canada has a presence in the manufacture and export of state-of-the-art geophysical equipment for many of the exploration methods described in the book. Even though the book is produced in the U.K., passing reference to Canadian made equipment would not have been inappropriate.

MS received May 17, 1982.

Platinum-Group Elements: Mineralogy, Geology, Recovery

Edited by L.J. Cabri
Canadian Institute of Mining and Metallurgy
Special Volume 23, 267 p., 1981
$32 (Members), $40 (Others)

Reviewed by G. Springer
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Canada produces about 12 tons of platinum-group metals annually, with a value well over $100 million. This is approximately six per cent of current world production. In view of the importance of these metals, a book specifically devoted to their mineralogy and geology is most welcome, in particular as it gathers in one place data widely scattered over the literature.

The volume is a very practical reference book valuable to geologists and mineralogists engaged in mineral exploration and beneficiation. A chapter by A.D. Westland summarizes the inorganic chemistry of platinum-group elements. L.E. Berlincourt, H.H. Hummel and B.J. Skinner provide useful phase diagram information. The geochemistry of the platinum-group elements is reviewed by J.H. Crocket. Sample preparation techniques for bulk analysis and microscopic examination are described by L.J. Cabri and J.H.G. Laflamme. J.H. Crocket and L.J. Cabri give a review of mineralogical techniques of analysis and of assay procedure, including neutron activation. Three chapters of the book, comprising 113 out of a total of 267 pages, are devoted to minerals containing platinum-group elements. Two of these chapters are written by L.J. Cabri and deal with descriptions of named, and unnamed and poorly-defined species. Published electron-probe analyses were compiled

by L.J. Cabri and J.H.G. Laflamme. A.J. Naldrett gives an account, on a global scale, of ore deposits containing platinum-group elements. A final chapter by L.J. Cabri is devoted to the recovery of these elements from their ores in the various mining camps of the world.

The book is well written and well produced. Its technical content has been scrutinized by a panel of 18 reviewers. Much of the information is presented in form of easily readable tables and graphical illustrations. The references are complete up to 1979 with some 1980 additions. Excerpts are given from Russian and Chinese publications not readily accessible otherwise. The subject index is unusual in its detail.

By clearly outlining the present state of knowledge on the geological and mineralogical distribution of platinum-group elements the book will very likely spur new research on the field and is therefore laying the basis for its own eventual revision. In the meantime, however, it will remain an authoritative text for quite some years.

MS received May 6, 1982.

Crystallography - An Introduction for Earth Science (and Other Solid State) Students

By E.J.W. Whittaker
Pergamon Press, Oxford, 254 p. 1981
$28.20 (soft cover), $46.00 (hard cover)

Reviewed by F.C. Hawthorne
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This text is intended for undergraduate courses in morphological and X-ray crystallography. Part I begins with the relations between crystal faces and repeated cells, repeating patterns and primitive lattices, symmetry and stereographic projections. This leads into longer chapters on the morphology developed in each of the seven crystal systems (holosymmetric classes only), and on the 32 crystal classes themselves. In his preface, the author remarks on the importance of a thorough grounding in morphology to a full appreciation of symmetry in crystallography. In the furtherance of this, the author has departed from the traditional approach in several respects. The use of stereoscopic drawings to illustrate symmetry operations is particularly effective, and should reduce the problems traditionally associated with translational symmetry operations. The crystal systems are treated in the order orthorhombic, tetragonal, cubic, monoclinic, triclinic, hexagonal and trigonal. The rationale for this is obvious but I wonder if the advantages outweigh those of the traditional approach of gradually decreasing (or increasing) symmetry. In the section on the determination of crystal class, the 'etch pit' drawings are particularly appealing; however, no mention is made of the second harmonic generation method for determining the absence of a centre of inversion.

Part II of the book deals with X-ray crystallography, and by necessity follows the standard sequence of development through diffraction and the generation of X-rays, powder and single-crystal diffraction techniques, Bravais lattices and space groups, with short concluding chapters on crystal structure determination, electron diffraction and irregularities in crystals. The treatment of the Bravais lattices is much better than normal; however, I think that their fundamental importance to symmetry theory warrants complete introduction at an earlier stage than is done here. The core of an elementary course in X-ray crystallography is generally concerned with the theory, practice and practical applications of powder diffraction methods. It is here that this book is somewhat deficient. Most common methods are covered, and it is good to see the Guinier and Gandolfi methods included. However, considering its general importance particularly to non-crystallographers in geology, the powder diffractometer is not dealt with in sufficient detail. The same criticism applies to the section on the uses of powder diffraction; there are numerous petrologic applications of this technique, and even a whole chapter on this subject would not have been amiss. There is no mention of graphical solutions in the chapter on the interpretation of powder photographs. Single-crystal X-ray diffraction is treated, but only the rotation-oscillation methods are described; although this may provide a good introduction to the reciprocal lattice, this does not justify the ommission of the precession method, as it is undoubtedly the most widespread method in use today. The final chapters on electron diffraction and 'real' crystals are a welcome addition to the normal material covered in such a text.

At a more pragmatic level, the diagrams are strongly drawn and should reproduce well on overheads. The explanations of theoretical concepts are particularly clear but the text is rather brief on the more practical aspects of crystallography. In this regard, it complements other texts available in this area, and is a useful addition to the subject.

MS received April 12, 1982.

Volcanoes of the World

By T. Simkin, L. Siebert, L. McClelland, D. Bridge, C. Newhall and J.H. Latter
Hutchinson Ross Publishing Company, Stroudsburg, Pennsylvania, 232 p., 1981. Distributed by Van Nostrand Reinhold Co., 7625 Empire Drive, Florence, Kentucky 41042 U.S.A.
$25.70

Reviewed by M.B. Lambert
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This book presents computer-generated tables, containing data on volcanism that took place in the last 10,000 years organized into four parts: Regional Directory, Gazetteer, Chronology, and Bibliography.

A short introduction explains the main features of each part, methods of compilation, limitations of the data, and the system of cross-referencing between sets of tables. Six line drawings show distribution of volcanoes by latitude and by elevation, relate explosivity to the time intervals between eruptions and relate numbers of volcanoes to population and to the frequency of volcano reporting. The authors caution us in the use of the eruption statistics from this volume for defining trends of volcanism in historic time. They show that the apparent historic trends in volcanism relate to trends in reporting rather than to actual variations in volcanic activity. For example, the number of volcanoes reported correlate well with rate of population growth, great economic crises (world wars, depressions), increased public sensitivity following major, well publicized eruptions and major scientific programs.

A regional location map in the inside back cover provides a visual index to the volcanoes referred to in the tables. Although the map serves its purpose adequately, a larger map, such as that prepared by the same authors and produced by the World Data Centre-A, would be a welcome addition to this volume.

The Directory organizes 1,353 volcanoes by region and condenses geogra-

phic data, activity status, eruptive characteristics (20 characteristics are listed), known eruptive history, ages and methods by which prehistoric eruptions have been dated. The Gazetteer lists alphabetically all 5,342 names in the file and their synonyms and gives their relationship to each primary volcano and the morphologic type of that volcano. The Chronology section arranges all 5,564 eruptions (including unnamed volcanoes) in chronological sequence. The Bibliography arranges 709 source documents by region and chronology within each region. It allows the reader to find references on a specific volcano or group of volcanoes.

In general, the tabulation and organization of this volume are convenient to use. Cross-reference between sets of tables and the location map is accomplished by the use of volcano numbers. The first 2 digits of these numbers appear dictionary style on black marginal tabs (in the Directory) and the complete numbers appear in the right hand column of each section except in the Directory, where they appear in the central column. Although the authors state that the volcano numbers are convenient in the centre of the Directory tables, I found this awkward because the numbers are difficult to distinguish amongst several closely-spaced columns of numbers and because of its inconsistency with the other sections.

One of the key features, that make the tabulated information easily intelligible, is a listing of all abbreviations and codes used in the data tables in the inside front cover with references to sections of the text where each item is discussed in more detail. This feature, however, is not emphasized in the introduction and the user almost has to discover the usefulness for himself.

This book digests for the first time in a single volume an enormous amount of useful geographic, historic and volcanologic information on the world's volcanoes. It presents the first chronologic summary published in English. The data appear to be reasonably complete up to 1981. The Canadian reader will be pleased to see data on 20 volcanoes in Canada.

Although the book is of immense value to the specialist, it is also of interest to geologists studying ancient volcanic belts, in that it provides insight into location, sequence, and timing of volcanic events. The usefulness of this unique volume extends far beyond the scope of pure geology. It is a valuable source book for anyone interested in volcanism related to pure, applied or social sciences, including archeologists, historians, meteorologists and geophysicists. It stands in a class of its own as a practical source book of hard data on recent volcanism.

MS received May 18, 1982.

The Alaskan Shelf: Hydrographic, Sedimentary and Geochemical Environment

By G.D. Sharma
Springer-Verlag, 498 p., 1980
$29.80

Reviewed by James P.M. Syvitski
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The Alaskan Shelf represents 74% of the total area of U.S. continental shelves or 2,149,690 km^2. With an estimated 50 billion barrels of oil trapped under the Alaskan Shelf and one-fifth of that nation's commerical fisheries in the overlying waters, this volume is timely and of specific interest to sedimentologists, marine geochemists, and other scientists with need to understand and predict the fate of marine pollutants and oil spills.

The book is not intended as a review volume, although many key papers are referenced. Instead, the author has set out, over a decade, to sample suspended sediment and bottom surficial sediment over the entire Alaskan Shelf. The samples were analyzed in terms of grain size parameters (method not given) and major, minor and trace elements (atomic absorption techniques). The data are presented over ten chapters each representing a geographic subdivision (SE Alaska, NE Gulf of Alaska, Central Gulf of Alaska, Prince William Sound, Port Valdez, NW Gulf of Alaska, Cook Inlet, Bering Sea, Chukchi Sea and Beaufort Sea). Each subdivision is discussed in terms of: 1) on-land and sometimes off-shore "hard-rock" geology; 2) bathymetry; 3) hydrology; 4) hydrography; 5) sediments; 6) geochemistry; and 7) sediment source and transport. Two final chapters attempt to put the data in global perspective by addressing the textural and geochemical evolution, and by using a Q-mode factor analytical model to manipulate the data into broad facies.

The final product lies someplace between a data report and a scientific monograph where descriptive interpretation of contoured parameters is the normal mode of analysis. A drawback of this approach is highlighted in geographic subdivisions where contour maps are produced from sparse data (e.g., along a single sample line, NW Gulf of Alaska). The descriptive approach has resulted in copious illustrations (some 345). However, the many illustrations show examples of poor graphics and this reader was further frustrated by the shoddy reproduction by the printer (especially the numerous isodensity maps of suspended sediment concentration from satellite imagery). Some illustrations are provided with no interpretation (i.e., nearly all of the skewness and kurtosis figures).

The author has used few state-of-the-art sampling and monitoring techniques to back his sediment transport conclusions (such as high resolution seismic, side scan sonar, bottom photography or submersible observations, moored packages for the determination of residual bedload transport). Nor is there an adequate address of the question of whether a sample reprsents recent versus relict deposits. These and other shortcomings combine to cause some uncertainty in the conclusions drawn from some of the data.

However, the reader should remember the scope of the total geographic area and the problems of high latitude marine surveys. Sharma's text provides an excellent "broad brush" starting point for further detailed surveys. The similarities of the Alaskan Shelf to many of the Canadian shelf environments should make this book a good reference text for the Canadian marine community.

MS received April 20, 1982.

Paleoecology, Concepts and Applications

Robert Dodd and Robert J. Stanton, Jr.
John Wiley and Sons, 559 p., 1981
$39.95 U.S.

Reviewed by A.A. Petryk
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During the late 1950s to 1970s, analytical skills in taxonomy, population distribution, ranges, etc., were used increasingly to synthesize and integrate studies of large-scale integrated (eco)systems. As a result of these early efforts, the practice of inter-or multidisciplinary work, today, is virtually institutionalized. Recently, the U.S. National Sciences Foundation reorganized its Division of Earth Sciences to accommodate this interdisciplinary philosophy. In geology, we want to know what factors cause(d) things to happen, but more importantly why things happen(ed) as they do (or did). Moreover, because of major technological advances, we are analysing large-scale systems and developing global concepts in oceanography, tectonics, climatology and planetology. The computer has become an important tool in helping us make complex assessments based on a multiplicity of variables.

Dodd and Stanton's textbook deals with this mode of interdisciplinary conceptualization. It attempts to demonstrate, through numerous published examples, how apparently diverse biological, physical and chemical information and systems can be integrated into paleoecologic concepts and environmental reconstructions. As such, this book will encourage *specialists* to make more ambitious attempts to understand how ancient ecosystems functioned and evolved. The authors state in the preface that the book is intended for the specialist: mainly the advanced undergraduate or graduate student and the professional paleontologist. Anyone who has ever studied ecology can appreciate that paleoecology is best left to the interdisciplinary specialist or, preferably, to a multidisciplinary team of specialists (stratigraphers, paleontologists, sedimentologists, biogeochemists, mineralogists, etc.).

The stated objective of the textbook is to utilize the relationships of organisms in ancient ecosystems to determine paleoenvironments, their conditions and functions. The emphasis is placed on the importance of combining both paleontological and sedimentological concepts to solve the problem of determining ancient environments. This accent on the integration of paleontological and sedimentological concepts in the interpretation of paleoenvironments is decidedly practical. For this reason, this textbook will be useful to specialists in the hydrocarbon and mineral industries who often are faced with the problem of deciding whether certain sediments represent ancient shallow, medial or deep water sedimentary environments. The paleoecology discussed in this book concerns invertebrate faunas and oceanic realms.

The highly varied subject matter of paleoecology makes it difficult to organize a book on the subject, especially when one attempts to combine theory and practice into a single entity as Dodd and Stanton have done. The approach taken by these authors is as logical as it can possibly be in treating this subject. The organization of the book, as well as an explanation of the data and operational bases in paleoecology, are clearly explained in the introduction. The broad scope of the book is demonstrated in its 10 main chapters: 2) *Taxonomic uniformitarianism* (includes information mainly on the major invertebrate fossil groups but also on calcareous algae, land plants and vertebrates; 3) *Biogeochemistry* (includes information on skeletal mineralogy, trace chemistry, isotope techniques and organic biogeochemistry; 4) *Skeletal structure* (with information on growth mechanisms, foraminifers, anthozoans and molluscs; 5) *Adaptive functional morphology* (with examples from most invertebrate fossil groups and also from the algae, vascular plants and vertebrates; 6) *Trace fossils and the effects of organisms on sediments* (including information on classification, analysis, environmental interpretation and abundance); 7) *Fossils as sedimentary particles* (with discussions on skeletal condition, texture, differential preservation, orientation with examples of application, including storm deposits; 8) *Population paleoecology* (includes discussions on population growth, structure, size and variation, dispersion patterns, morphologic variation); 9) *Ecosystems and communities* (includes discussions of the community concept and community recognition, taxonomic - uniformitarian analysis, community structure analysis, diversity terminology and measures, causes and patterns, trophic structure and applications of the community in paleoenvironmental reconstruction); 10) *Paleobiogeography - the provincial level* (includes discussions on concepts, factors controlling geographic distribution of species, history of species ranges, defining provincial boundaries, modern and ancient biotic provinces); and 11) *Temporal patterns* (includes discussions on patterns, succession, environmental change and evolution).

An "applied" approach to paleoecology, rarely seen in textbooks, is set forth by the authors in their paleoecological analysis of the marine to non-marine Pliocene strata of the Kettleman Hills of the Coalinga Region of west-central California. Pertinent data, observations and analyses from the Kettleman Hills serve as examples of the principles discussed in most chapters.

Two very important factors not dealt with in the book are the importance of good taxonomy and fossil representation in paleoecologic studies. Although these factors may be taken for granted, we need to be reminded that they are basic limiting factors regarding the accuracy and also the credibility of any paleoecologic study. Of the numerous controversial paleoecologic concepts discussed and weighted by the authors, only certain ones are deemed realistic and applicable to problem solving.

The book is copiously illustrated with good line drawings and tables; photographic plates, however, are few. Of the vast terminology of paleoecology the terms biotope (paleobiotope), lithotope and biomere are omitted. The book, however, is clearly written and is a welcome reference work for geologists and specialists in academia, geologic surveys, industry or other organisations. This high-quality Wiley-Interscience publication is worthwhile having and should enjoy a relatively long "shelf-life".

MS received May 17, 1982.

Computer Applications in the Earth Sciences: An Update of the '70s

Edited by Daniel F. Merriam
Published by Plenum Press, 1981
$45.00

Reviewed by P.J. Lee
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Since the late 1950s, when computers became available to geologists, the demands for their use in geoscience problem-solving has increased. Applications such as geological model building, Monte Carlo simulations, statistical analysis, management of geological information systems, all complex operations, can be executed efficiently and quickly by computers. *Computer Applications in the Earth Sciences: An Update of the 70s* summarizes 20 years of advances in earth science computer applications.

International experts offer valuable comments and suggestions on computer use. Griffiths emphasizes that a geological model should have cause-effect relationships with sustained basis. McIntyre suggests that it is essential for students of geology who hope to survive in this fast-changing world to learn how to work at the interface between man and machine. In mineral-resource evaluation, Agterberg stresses the fact that the choice of variables and the interpretation of statistical results should be based as much as possible on geological concepts. Applications of remote-sensing to geology open a wide door for resource geolgists. Burns states there is a significant advance in quality control in data acquisition systems and computer processing in photointerpretation. Dobrin gives a lucid description on how seismic exploration techniques have been developed, and discusses their applications and limitations. The most spectacular development in seismic exploration has been the capability, under proper conditions, of detecting gas deposits on seismic record sections by making use of the fact that reflections from the top of gas-filled sands have a higher amplitude than those from water- or oil-filled sands. Geostatistics, developed by G. Matheron in France, provides a way to analyze spatial data and is one of the few significant accomplishments in mining geology. Petrologists have better understanding of the principles behind the various mixing models through computer applications. A completely generalized model capable of dealing with metamorphic reactions has been developed as stated by le Maitre and Miesch. There is a strong demand for research to bridge the gap between geological and decision analyses. As recommended by Harbough, "Mathematical geologists need to involve themselves to a greater degree in resource forecasting by providing guidance on a sustained basis". This comment is very encouraging. Seismic stratigraphy is one of the existing tools of stratigraphy, as described by Mann. A useful concept in paleoecological reconstructions is the ecolog described by Reyment, a union of physical and biological values. The greatest thrust, as described by Whitten, has been in the application of finite-element methods which seem destined to play an increasingly important role in structural geology research.

Most authors attempt to cover too many topics in their fields and leave little room for discussions of each application in detail. Predictions of future development are very vague, and specific guidelines for future research are not provided. The subject of the book is timely and much useful information is given.

A major shortfall of the book, however, is the total absence of discussion on quantitative basin analysis, an approach used by petroleum geologists to understand the evolution of sedimentary basins, by means of synthesis of various aspects such as plate tectonics, geothermal history, distribution of source rocks, maturation levels, distribution of reservoir rocks, trapping mechanisms, timing of deformation, etc. Quantification of raw data as well as geological relationships are important to petroleum geologists because such analyses aid in the understanding of basin evolution, in the development of new exploration concepts and in increasing of petroleum reserves.

In conclusion, this is a book for readers who are interested in reviews of computer applications in the earth sciences and also for statisticians who are interested in solving geological problems.

MS received May 18, 1982.

Colossal Cataract - The Geologic History of Niagara Falls

Edited by Irving H. Tesmer
State University of New York Press,
Albany, 219 p., 1981
$34.00 (Hard Cover); $9.95 (Paper Cover)

Reviewed by E.B. Freeman
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Colossal Cataract was written to provide "a popular, yet somewhat detailed, history of the geology of the Niagara River." And since one of the many fascinating statistics listed in Appendix C informs us that approximately 5 million visitors view the Falls each year, a large market for such a book is present.

To edit a series of scientific writings produced by seven different authors is an unenviable task - a task made especially difficult since each of us uses language differently. This difference is well illustrated in the collection of 'essays' assembled to form *Colossal Cataract*. Most are easy to read and will be of interest to those having had an introductory course in geology. Some parts are rather heavy going, and inevitably there is some overlap and repetition when two or three authors write on related subjects.

The books is divided into several parts. The first four chapters introduce the reader to general statistics about the river, a number of people who have reported on the Falls, the river's geologic history, the river's dynamics, and some thoughts on the future of the Falls. The last three chapters cover the detailed stratigraphy of the rocks exposed along the Niagara Gorge (29 pages of excellent photographs of features occurring in the rocks plus type section descriptions of particular value to the visiting geologist); followed by a very readable and well illustrated account of Silurian paleontology; and the depositional environments of, and fossil distribution within, the various rock units.

Probably the most used portion of the book will be the Appendices. Appendix A is a well illustrated 24 page road guide to important sites of geologic interest, a guide that many geologists will wish to follow. The road log is neatly broken into a 19 km trip on the U.S. side of the Gorge and a 22 km trip on the Canadian side. Appendix B briefly describes some nearby earth science museums worthy of

a visit, including of course the Schoellkopf Geological Museum. Appendix C provides the field trip leader to the Falls with the answers to all those questions asked about the river that you always wished you had the answers to. Lastly, Appendix D presents the log of the drill core obtained in 1969 from boring 109.5 m into the rock strata at the Falls. This log provides the thicknesses of each of the various rock formations present beneath the American Falls. Unfortunately this log is presented in Imperial Units only while the rest of the book uses Metric Units followed by Imperial Units in brackets - a more useful presentation for visiting geologists from overseas and most Canadian geologists.

Plentifully illustrated with 48 photographs and 24 line drawings/maps, *Colossal Cataract* also pours forth 127 references, a glossary listing 121 definitions, a comprehensive index, and a 65 x 70 cm colored map (printed on good quality paper able to withstand many foldings). The topographic base for the map appears to be of 1954 to 1963 vintage judging by the length of the International Flow Control Structure. The geology compilation is as of 1978. The geology is shown by rather bold colors, quite adequate to illustrate the general geology to a field trip group. The map scale is 1:24 000 (1 inch to 2000 feet). The omission of Bruce Sandford's 1969 paper on the Silurian of Southwestern Ontario in the Ontario Petroleum Institute Proceedings is disappointing. Use of this paper would have provided more detail for the Silurian paleography maps.

For nit pickers there is mention made of "horizontal Paleozoic" rocks on page 21 followed by a two page discourse pp. 58-59 on the dips and folds present in the area. And, "Lake Iroquois drained through the St. Lawrence River and then south through the Champlain Valley and Hudson River Valley into the Atlantic Ocean." (p. 48) will come as a surprise to all those, like myself, brought up to believe in the Rome outlet. It seems a shame to disturb the slumbers of A.P. Coleman and many others with such a statement.

It is unfortunate that several of the illustrations were apparently prepared for some other larger format, and only portions reduced to be used in this book. The result is difficult to read type (Index Map), cluttered linework (Fig. 4-2), and too great a reduction (Fig. 2-15). I also feel the paleographic maps (Figs. 2-2 to 2-5) would have been more readily understood by the layman had 10/20 per cent and 30/40 per cent solid screens been used for the two subdivisions of land areas to more readily separate them from the variety of marine sedimentation shown.

Colossal Cataract is a required companion for any field trip leader to the Niagara Gorge, and a good one-stop reference for university professor/student, or high school teacher studying the Gorge and its rocks. As such it is immensely useful. The general public, however, is still waiting for a popular history and guide to the Niagara River area.

MS received May 21, 1982.

The Cambridge Encyclopedia of Earth Sciences

David G. Smith, Editor-in-Chief
Prentice-Hall Canada Inc.
Cambridge University Press, 496 p., 1981
$35.00

Reviewed by P.M. Clifford
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In 1970, the Open University of England published *Understanding the Earth* - a multi-authored work that was conceived, assembled and published in nine months! This was due to, among other things, a clear intention on the part of the editors of that book. The *Encyclopedia* is very like the earlier book in many ways. The editor-in-chief, and most of the contributors are from the Open University; and the book "was conceived, written and published within less than three years." (Introduction). The longer elapsed time is due to the much more advanced level of treatment of material, together with a wider coverage of subject matter, as may befit an encyclopedia.

For those of us who frequently attempt to find a stimulating approach to the teaching of earth science, this book has much to commend it. It starts with a brief "History of the earth sciences" followed by a discussion of "The earth in space" - both chapters which set a scene for much of what follows.

Part 2, composed of seven chapters, treats the "Physics and chemistry of the earth". In these chapters, the various authors make explicit the intimate connections between geochemistry and geophysics via such matters as seismology, heat flow and petrogenesis. There is a mixture of dogma and current data (not always a compatible union), but the chapter to do with "Trace elements and isotope geochemistry" manages quite successfully.

Part 3 deals with "Crustal processes and evolution", set firmly in the context of plate tectonics. Chapters discuss processes at different kinds of plate margins; tectonics and sedimentation; and an attempt to summarize, in twenty-four pages, the history of the earth's crust - an attempt which was doomed from the start, but which represents a thoroughly laudable essay, offering some of the most provocative material in the book.

Part 4 - "Surface processes and environments" - can be thought of as the actualistic part of the book. It begins with chapters on the atmosphere, water and weather, and oceans; and so approaches the topics of weathering, and of sedimentary processes and environments. Finally, life and its evolution, and its intertwining with inorganic geology is handled with deftness, in a way which makes paleobiology far less daunting than so many stdents seem to find it.

Parts 5 and 6 - "Evaluation of earth resources and hazards" and "Extraterrestrial geology" offer brief but incisive treatment of such matters as remote sensing, economics of earth resources, geological hazards, and the geology (sic) of the Solar system.

Finally there are 11 pages of glossary and an extensive list of books suggested as further reading. Some of the readings listed are remarkably specialized, not at all the thing for the casual enthusiast for earth sciences.

The page format is over-size compared to most books; the print is pleasingly large and clear. The use of the English language is a treat, and much to be commended, in view of the thirty-two different people who wrote. But perhaps the greatest immediate pleasure is the wealth of plates, a great many of them multi-coloured; in particular, one must acknowledge the numerous diagrams prepared specifically for this book - they have been drafted with an acute eye for readability and are informative as well as attractive.

Any work with the title "Encyclopedia . . ." is really having its neck stuck out by its authors. Nowadays, any attempt to be exhaustive usually comes to an abrupt halt against the evergrowing mountain of publications, which has to be critically scanned and assimilated. Oxburgh implies as much in his foreword. As encyclopedias go, this must be regarded as a failure, simply because of the continuing rapid development of the subject it treats. But it is a highly commendable

failure, eminently readable, and, above all, thoroughly stimulating. Read it and enjoy!

MS received June 1, 1982.

The Geology of New Zealand

Edited by R.P. Suggate, G.R. Stevens and M.T. Te Punga
Government Printer, Private Bag, Wellington, N.Z., 2 volumes, 820 p., 1978
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In any book dealing with the geology of Canada, we would expect and get a lengthy exposition on the Precambrian. Our country depends in so many ways on the Shield and its minerals. The converse is true of New Zealand. There, the country has little in the way of recognizable old rocks, but much that is relatively new. Moreover, geology in New Zealand is an active business. Earthquakes are a common feature of some parts of the country; there are several live volcanoes; and, for students of landscape evolution, it would be hard to think of a place with more variety of processes and forms in a comparable area.

All this is evident when one reads this monumental production from officers of the New Zealand Geological Survey and their colleagues in various universities and industry. The initial impetus to write this book was in 1960, at about the time when the 1:250,000 geological map series was in production. Writing by committee, which this project involved, is a slow process, however; three Directors have seen this as part of their work. The publication date given in the books is 1978; I first saw it in the Government bookstore in Auckland early in 1980; and it has taken many months to read through it! Assuredly, it is not bedtime reading!

The overwhelming impression one gets from this work is the prolonged activity which has produced the geology we now see. The book is so organized as to emphasize this. Thus, we have an early section dealing with the Precambrian to Devonian rocks - all restricted to South Island - which comprise the *Early Geosynclinal Cycle*, terminated by the Tuhua Orogeny, effective from Late Silurian to Middle Devonian. From Carboniferous to Jurassic time, we have the development of the New Zealand Geosyncline. In this time were deposited most of the rocks of South Island, including those enormous volumes now designated as the Torlesse Supergroup (which is also extensive in North Island) and the Haast Schist Group. Both of these groups of rocks are severely deformed; the second is well metamorphosed for the most part; both are relatively barren of fossils and form a steady challenge to the geologist. The life of this geosyncline came to an end in the Rangitata Orogeny (? mid-Jurassic to early Cretaceous). All this is dealt with in Volume I. The remainder of the geologic history occupies Volume II, which is a strong indication of the continuing activity, referred to as the Late Mobile Phase. This activity comprised steady sedimentation, protracted and varied igneous activity, widespread and highly influential faulting, and had particular expression in the Kaikoura Orogeny, which began in the Miocene, and with which New Zealanders live today.

Accompanying this climb up the stratigraphic column are: an opening outline of the environment of New Zealand in the light of recent geophysical and oceanographic studies of the surrounding parts of the sea floor; a very enlightening chapter on "The fossil record and paleogeography"; an atlas of paleogeographic maps; five different indices, including one for the stratigraphic names, a boon to the non-Kiwi geologist; and a supplemental section referred to each chapter, as an attempt to bring the books as near up-to-date as possible.

The volumes are profusely illustrated with maps, line drawings and photographs. The photographs are perhaps too abundant, given that many are neither very clear nor very informative. This stricture does not apply to the numerous plates showing the fossils; their presentation is uniformly very good indeed. The endpapers provide a good relief and location map (front), and a stratigraphic table which correlates New Zealand nomenclature with standard international nomenclature (back).

One major disappointment is the lack of any concerted attempt to look at the geologic record in the context of plate tectonics. This is a startling omission, given the location of New Zealand at the junction - and a very peculiar one at that - of the Pacific and the Indo-Australian plates. A comprehensive attempt to remedy this omission would be very welcome.

Of great interest to geologists beyond New Zealand is the prolonged discussion on volcanic activity. The volcanoes of the North Island are mere newcomers compared to the enormous amounts of volcanic rock, largely pyroclastic, on which they sit, and they all form a very attractive subject for research, particularly as to their modes of activity and their connections with plate motions. There is also a detailed discussion of Quaternary sea-level fluctuations, and their effects as revealed in destructive and constructive features. The coastline areas are replete with terraces, raised beaches and the like, clearly a fruitful object of study. And then there is the matter of the Alpine Fault, one of the great transcurrent faults of this planet. This book tends to ascribe most of the motion to the Rangitata Orogeny, whereas recent papers tend to support the view that most motion is of late Eocene age or younger. In time, this problem will be fully resolved; but for the moment, a vast amount of data is contained in this book, which serves to emphasize just how difficult it can be to sort out movement histories on long-lived fractures.

All in all, this book accomplishes what it set out to do. Despite the lack of a modern interpretive stance, it provides a thoroughly comprehensive statement of the geology of New Zealand. It is not a book for every geologists shelves, especially at its price; but there are lots of good things in it, which will find a place in the work and thoughts of geologists the world over. It is a compliment to all those people who have had a part in the unravelling of New Zealand geology.

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