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# Book Reviews

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## Arctic Ordeal: the journal of John Richardson, surgeon-naturalist with Franklin, 1820–1822

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Edited by C. Stuart Houston, with illustrations by H. Albert Hochbaum and appendices by John W. Thomson and Walter O. Kupsch  
*McGill-Queen's University Press*  
383 p., 1984, \$29.95; cloth

Reviewed by William A.S. Sargeant  
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Because of the fascination attached to his disappearance during his quest for the Northwest Passage, the name of Sir John Franklin is a familiar one. (There is even a folksong about "Lord Franklin", making him the only explorer thus to be remembered.) On his third expedition to the Arctic, Franklin was on the very threshold of discovering the passage he sought when came the catastrophe that was to make his name so widely known.

Although that disaster has preserved Franklin's name for posterity, it has brought a forgetfulness of Franklin's two earlier expeditions; yet the second, in particular, deserves to be remembered. It was not a marine, but an overland journey of considerable extent, that took Franklin and his small party from York Factory on Hudson's Bay to Cumberland House, up the Saskatchewan River to Fort Carlton, across country to Green Lake and Ile-à-la-Crosse and on to Fort Chipewyan on Lake Athabasca; then to Fort Resolution and Fort Providence on Lake Athabasca, up the Yellowknife River to Fort Enterprise and down the Coppermine River to explore the coast of Coronation Gulf and Bathurst Inlet; up the Hood and Burnside Rivers and across country, back ultimately to Fort Providence. It was a journey that added a great deal to our knowledge, not only of the geography but also of the meteorology, geology and natural history of Arctic Canada; but it was also a tense drama of

courage and endurance under extremely harsh conditions, containing lurid episodes of murder and probable cannibalism. Of twenty men who set out, only nine returned.

One of those nine was the Scottish surgeon-naturalist Sir John Richardson (1787–1865), whose name is remembered by zoologists through the Prairie gopher, more properly Richardson's Ground Squirrel (*Spermophilus richardsonii*), and by botanists through the host of plants described by, or named after, him. Richardson's journal was consulted and sometimes quoted by Franklin (who had lost his own), along with those of George Back and the murdered midshipman Robert Hood, when writing the official account of the expedition. The three original journals, however, lay long unpublished. Hood's journal was rediscovered and edited for publication by Dr. C.S. Houston (*To The Arctic by Canoe*, McGill-Queen's University Press, Montreal, 1974); and Dr. Houston has now increased the indebtedness of scientists and geographers to him by editing for publication Richardson's own journal. Oddly enough, the entries in this journal commenced only just before Hood's were broken off; Richardson's journal begins on 21 August 1820, while Hood's ends on 13 September.

Richardson's journal thus recounts, in an informal and readable style, the events of the last year of the expedition, with its discoveries, dramas and tragedies. Though it gives daily details of the expedition's course and other specific information of interest only to specialists, these occupy only a small part of the record. Most of Richardson's writing is an informal, yet vivid, account of daily episodes and personalities, of small or large events or disasters; it breathes life into the dry pages of the official expedition record. Anyone interested in the history of northern exploration should read this work.

An attractive format makes reading easier. The book is further enhanced by a series of excellent maps and the skilful interpretative sketches of Albert Hochbaum. For those interested in the expedition's scientific achievements, there are appendices by Dr. C.S. Houston summarizing Richardson's

observations and discoveries of mammals, birds, plants and fish; a brief summary of Richardson's perceptive observations of lichens by Dr. John W. Thomson; and a searching analysis of Richardson's geological work by Dr. Walter O. Kupsch. In this, the observations of rock outcrops made by Richardson are meticulously recorded and compared, in tabular form, with modern interpretations of the same outcrops. His physiographical observations likewise receive careful attention. Kupsch's summing-up merits full quotation:

"Because his writings lack analytical thought, Richardson does not appear to have contributed to geological theory. Where he deals with the origin of geological substance(s), features or phenomena, he falls back to what he was taught or to what he had read about in the works of others. He did not introduce any new thought himself, perhaps, because he was not as comfortable with the science of geology as he was with zoology or botany. Behind all his observations is a fundamentally conservative and deeply religious mind, not amenable to the introduction of revolutionary or even novel thought. He was comfortable with the idea that his work had revealed the world to consist of parts that made 'a grand and harmonious whole, the production of infinite wisdom'."

All in all, this publication of Richardson's journal constitutes, not only an important addition to the literature of Arctic exploration, but also a particularly attractive one, for which editor and publisher deserve the highest praise.

(Modified from a version published in *Saskatchewan History*, v. 38, number 1, by permission of the Editor. The modifications constitute an extended discussion of Kupsch's geological Appendix.)

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## Brines and Evaporites

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By Peter Sonnenfeld  
*Academic Press, Inc.,*  
 613 p., 1984, \$75.00 US; cloth

Reviewed by Peter P. Hudec  
*Geology Department*  
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*Windsor, Ontario N9B 3P4*

The evaporites form some of the most important and least understood deposits in the geologic record. All practitioners of geology have needed to consult a reference about brines or evaporites at one time or another. Unfortunately, there was not one to consult — until now. Dr. Sonnenfeld has managed to assimilate and condense over 4000 references, many from obscure sources, to produce a reference book on the subject. Almost 2400 different references are quoted and listed in the Bibliography.

The book is divided into several sections. The first section deals with conditions leading to evaporation of the brines and discusses their physical and chemical properties. Several models of evaporite basin formation are presented and discussed. The second section deals with the precipitates. Marine and continental evaporites are discussed separately, and conditions of formation of the various more esoteric salts considered. The last section, which should more properly be an appendix, lists and describes the properties of various evaporitic minerals.

Evaporites contain a variety of accessory elements and radicals such as lithium, boron, ammonia, phosphates, etc. Their influence and significance on the formation of the evaporites is covered. The presence of clastics, especially clays and silts, and their significance in the history of the evaporite basin is highlighted. Clastics have been considered as evidence of the "freshening" of the basin. However, a suggestion is made that clastics can spread along the interface of a stratified brine system for long distances, and that clastics do not necessarily imply influx of fresh water into the basin.

Sedimentation, sedimentary features and structures are classed under "morphology" of evaporite deposits. Origin of features such as teepee structures peculiar to shallow water, sub-aerial conditions are discussed. Not to slight any subdiscipline, a section of interest to petroleum and economic geologists is given. Within it, the base metal behaviour under evaporitic conditions, and the relationship of brines and evaporites to ore deposits are discussed. Likewise, the common association of oil and gas fields with evaporitic basins is examined, and

some interesting new proposals dealing with the origin and migration of these hydrocarbons are given. The 20 pages devoted to this are far too short, but perhaps Dr. Sonnenfeld is planning to expand this topic in another book.

Post-depositional alterations of evaporites due to syngenetic and epigenetic brines form another section of the book. In the same way as "ordinary" sediments are subject to diagenetic changes, so the evaporites change in response to chemical disequilibrium brought about by the passing brines.

The book contains a wealth of information, and some interesting original diagrams. Every statement or contention is fully supported by field examples or by published references. The writing style does not make for light reading, and some of the material is organized in a strange fashion; however, this may be because Dr. Sonnenfeld tried to fit every available piece of information into a single volume. Even if the book does not include salt tectonics, leaching or collapse structures, *Brines and Evaporites* contains everything you ever wanted to know about evaporites, but did not know where to look.

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## Drumlins: a bibliography

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By John Menzies  
*Geo Books*  
 136 p., 1984, \$14.80 US; paper

Reviewed by John Shaw  
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*Queen's University*  
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I wonder if there is another topic in the Earth Sciences that has attracted as much attention as drumlins with so little understanding. For John Menzies, the compilation of this bibliography was obviously a labour of love. He is not the first to be fascinated by drumlins, nor will he be the last to be lured into the seemingly easy task of explaining them. This bibliography complements the thorough review of drumlins he wrote a few years ago. In addition to works that treat drumlins as a central issue, items are included that give only passing mention to drumlins, and discussions on small-scale flutings are included although these are probably not related genetically to drumlins.

Some items are annotated at length, others have brief notes, and some are presented without comment. It is not clear why some items were selected for lengthy annotation, but I imagine Dr. Menzies considers these to be benchmark papers.

There is a very useful theme index that makes interesting reading in itself. For example, there are 155 papers dealing with formative hypotheses on drumlin formation. It would be interesting to know just how many formative mechanisms have been proposed. Forty-nine papers mention stratified sediment in drumlins yet textbooks continue to describe drumlins as being composed of till!

The bibliography includes a brief synopsis of the history of ideas on drumlins and a short section on presently held views. A histogram of drumlin publications shows the heyday of drumlin publications was between 1975 and 1979, with a decline in recent years. I wonder if this marks the present trend away from academic and toward applied topics. If so, it is a pity.

It is interesting to see the great names of the Earth Sciences who tried their hand at the drumlin problem: Agassiz, Chamberlin, Charlesworth, W.M. Davis, Dawson, De Geer (who appears as De Greer), Fairchild, Flint, A. and J. Geike, G.K. Gilbert, Goldthwaite father and sons, Lundqvist father and son, Penck, Slater, Upham, J. Tuzo Wilson, and Woldstedt. Many continued their interest in glacial geomorphology, but one wonders for instance if Tuzo Wilson found in Continental Drift a more tractable problem than the explanation of drumlins.

The bibliography is salted with quotable quotes, but does not include the following by a first-year student of mine at the University of Alberta who was obviously highly impressed by Chorley's analogy on the shapes of drumlins and eggs: "Glaciers run down hill parallel throwing out drumlins in much the same manner as a hen lays an egg". I have been afraid to teach by analogy ever since.

In short, the bibliography is a gold mine for anyone wishing to do research on drumlins.

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## Earthfire

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By C. Rosenfeld and R. Cooke  
 MIT Press  
 155 p., 1982, \$9.95 US; paper

Reviewed by John Westgate  
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 Toronto, Ontario M5S 1A1

*Earthfire* is about the very recent eruptions of Mount St. Helens (MSH). Its senior author, Charles Rosenfeld, is a geomorphologist at Oregon State University and photo interpretation officer for the Oregon National Guard. He participated, therefore, in the many surveillance and photo missions across the MSH area after the initial eruption of late March 1980 — missions that were made using the Guard's Mohawk aircraft, equipped with thermal sensors and side-looking airborne radar (SLAR). Hence, Rosenfeld was in an unusually favourable position to observe and document the nature and chronology of geologic events associated with the eruptive activity of MSH. Indeed, he was flying around the volcano within 40 minutes of commencement of the plinian eruption of 18 May 1980!

"My own first glimpse of the mountain after the explosion came at 9:10 as John and I flew around to the west side for our initial passes. Our first objective was search and rescue, and we were trying to verify the condition of the two observation posts on Coldwater Ridge. The drama of the occasion and excitement of discovery can be sensed through much of the text, which is profusely illustrated with Rosenfeld's own photographs.

The book opens with a description of the cataclysmic events of 18 May 1980, including the precursory seismic and phreatic activity. These happenings are then placed in the perspective of the violent earlier history of MSH as revealed in the rock record and Indian folklore. Tephra was carried as far as northcentral Alberta during some of these earlier eruptions. A synopsis of the origin of volcanoes in light of the plate tectonics theory prefaces a review of the Cascade volcanoes, after which, the authors turn to the environmental consequences of the recent MSH eruption. The effect on the health of people in the fallout zone, local agriculture and forestry, and world climate are evaluated and some discussion is given to the issues of post-eruption ecological changes and erosional susceptibility within the highly devastated proximal region. The later, smaller-scale eruptions of MSH, the successive lava domes, and the topic of prediction form the salient themes of the last part of the book.

In this book the authors have found the middle-ground; they have written a text that is of interest and value to the earth sci-

entist, and, at the same time, is intelligible to the general public. It is a high quality production in all respects. If you want to promote the earth sciences in Canada, this is just the sort of text that should be in every high school library. Why not donate a copy to your local school. The price is right!

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## Facies Models, Second Edition

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Edited by R.G. Walker  
 Geoscience Canada Reprint Series No. 1  
 Geological Association of Canada  
 317 p., 1984, \$12.00; paper

Reviewed by M.P. Cecile  
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The Second Edition of *Facies Models* is a collection of nineteen short papers on facies models: facies sequence analysis; glacial, volcanoclastic, alluvial, fluvial, eolian, deltaic, barrier-island strand-plain, marine sand, turbidite, carbonate, carbonate-slope, reef and evaporite facies; subsurface facies analysis; trace fossil facies zonation; and seismic-stratigraphic facies models. The original objective of this series was to present "brief, well-written, concise articles outlining the techniques of rock interpretation, and the concepts and criterion for regional evaluation" that would be of "help to the *general purpose geologist*" (E. Dimroth, quoted in the Preface to the First Edition).

Judging by my own usage and the dog-eared condition of First Edition copies in the Geological Survey of Canada's Calgary library, this series is, in practice, meeting this objective.

The Second Edition is an expanded and revised version of the First Edition (1979) in which most of the repeated papers have been extensively rewritten and updated. In addition, many of the repeated papers have new co-authors who have added new insights and ideas to the subject matter. One paper, on eolian sands, has been completely replaced with a new text and author. Two papers, on iron formations, are not carried in the Second Edition; and two papers on evaporites have been combined in the Second Edition. The Second Edition has four new papers: "Improved Methods of Facies Sequence Analysis", "Glacial Facies", "Trace Fossil Facies Models", and "Subsurface Facies Analysis".

Nearly all the papers in the Second Edition are well-written and comprehensive and meet with Dimroth's objective, thus making it difficult to find fault with this series. I do,

however, have a few criticisms.

The first concerns the topic of facies sequence analysis which is treated both by Walker ("Facies Models") and Harper ("Improved Methods of Facies Sequence Analysis"). Walker relies on Harper to complete his brief discussion of the topic, but Harper's paper treats only an aspect of the analysis, and both Walker and Harper refer the reader back to the First Edition for the complete story. In the end, the reader does not get a "well-written and concise paper" outlining the techniques of this analysis. Furthermore, the reader should never have to refer back to the First Edition; the Second should replace the First not perpetuate it. A testimonial to the inadequacy of this Edition's treatment of facies sequence analysis is the recent publication in *Geoscience Canada* (v. 11, No. 4) of a paper by Harper, entitled "Facies Models Revisited: An Examination of Quantitative Methods". This method of facies analysis is becoming one of the more important tools of the modern sedimentologist-stratigrapher. Future editions of *Facies Models* should contain a single paper that reviews this topic thoroughly, and in a manner that is easily read and understood by the "general purpose geologist".

My second criticism is that the paper "Seismic-Stratigraphic Facies Models" by Davis is inadequate. It has a brief introduction and relies on three specific case histories to illustrate the principles of seismic-stratigraphic interpretation. The same paper in the First Edition, also written by Davis, has an excellent introduction and, as a result, is much better than the Second Edition version.

My third criticism is that one of the most important facies types (chert and shale) is not treated in this series. These fine-grained siliciclastic rocks are clearly one of the more abundant facies types in eugeoclines and foredeeps, and important facies types in many other basins, and they clearly deserve a chapter in any publication on facies types.

My final criticism concerns an editorial oversight in an otherwise well-edited series. Although the paper by Eyles and Miall is well-organized and comprehensive, it is marred by numerous overly complex sentences that leave the reader confused (e.g. p. 15, col. 3, lines 30-41). These sentences interrupt the flow of the text and seriously impair its readability.

These problems aside I would rate this book as an excellent and outstanding series that would make an excellent text for the working class stratigrapher-sedimentologist or graduate student. This is a world-class effort and Walker, his authors, and the Geological Association of Canada are to be commended. Not only that, for \$12 it's a real bargain.

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## An Introduction to Geophysical Exploration

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By P. Kearey & M. Brooks  
*Blackwell Scientific Publications Inc.*  
 296 p., 1984, \$21.00 US; paper

Reviewed by Dr. A. Easton Wren  
*Petrel Consultants Ltd.*  
 565, 800 — 6 Ave., S.W.  
 Calgary, Alberta T2P 3G3

In setting out the major topics to include in a textbook of this nature, most aspiring authors would be overwhelmed by the formidable range of subject matter and the seemingly impossible task of compiling a text that would be too lengthy or trivial. In this case, the authors have achieved a work of some merit, in keeping with the title, in keeping with their stated objectives in the preface and the result is a book of modest size. In confining the text to a basic introduction they have made some sacrifices and, in some instances, given more ink to certain aspects which appears to be more than generous with less than 300 pages to get the job done.

The "Preface" and "Introduction" (Chapter 1) set the tone by identifying the target audience and give a brief review of the basic geophysical methods in lay terms, emphasizing appropriately the problem of ambiguity in interpretation. The neophyte would welcome the elementary treatment and language to this point.

The contrast from Chapter 1 to Chapter 2 is dramatic and one which would cause the neophyte to think again. The chapter title is "Geophysical Data Processing", which is something of a misnomer since it discusses waveforms and transforms with some discussion on convolution and deconvolution. It is this reviewer's opinion that this chapter is out of place and if it is to be included in the text it should be as an Appendix. Most beginners without a background in filter theory would flounder here.

Chapter 3 ("Rock Properties, Ray Theory, Snell's Law") gets back on track with the basics of the elements of seismic surveying with a brief but excellent summary of seismic sources and recording systems.

Chapter 4 ("Seismic Reflection Surveying") is a mixed bag of principles and practice in acquisition, processing and interpretation. The section on field parameters is excellent. Seismic data processing could have been part of Chapter 2 but would be better as a separate chapter here. Migration is given a good but lengthy treatment. Similarly, interpretation should be handled as a separate chapter but most of the important aspects are covered, including reference to structural and strati-

graphic mapping, Exxon's seismic stratigraphy and modelling. The reference to the seismic wavelet is all too brief. The finale is a good review of shallow-water techniques.

The next chapter, "Refraction", is too theoretical and too lengthy for a book of this scope. The basics could have been included in Chapters 3 or 4. It is well-written and accurate but makes up almost 10% of the book.

The potential field methods, "Gravity" (Chapter 6) and "Magnetic Surveying" (Chapter 7) provide clear factual accounts of the basic principles and applications. While the material would be beneficial for seismologists it would appear to be overly theoretical for the target audience.

Chapters 8 and 9 cover the range of electrical and electromagnetic methods. While this reviewer has very limited experience in these areas the treatment appears similar to that given to the potential field methods. Most topics (resistivity, induced polarization, self potential, AFMAG, aero EM and telluric and magnetotelluric) are aptly covered but the treatment goes beyond the objectives stated at the beginning of the book.

Chapter 10 brings the reader back to reality with some references to the history of geophysics in the North Sea and a series of case histories from all the geophysical disciplines in several areas around the world.

In general, the book has some merit. It touches on almost everything, is well-illustrated and referenced. The major accomplishment is getting so much material between the covers. On the negative side, it alternates the simple with the complex and in places is overly theoretical for the target reader. My feeling is that the frustration I had reading this book is based on "too much squeezed into too little and the bias often in the wrong place". With some restructuring and cutting it would probably hit its target market.

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## Hurricanes, Storms and Tornadoes

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By D.V. Nalivkin  
 A.A. Balkema  
 605 p., 1983, \$26.50 US; cloth

Reviewed by M.E. Brookfield  
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This book is a translation of the 1969 Russian Edition, and is therefore out-of-date in terms of understanding of processes. However, the main value of the book is its summary of descriptions of unusual events.

The first part, "Hurricanes", contains chapters on tropical and non-tropical hurricanes, destructive and creative activity of hurricanes, atmospheric phenomena, transport of organisms, and planetary laws of propagation. It provides a useful summary of frequency, tracks and transport ability of hurricanes. Particularly interesting are comparisons of hurricane and ancient shelf deposits, and descriptions of objects transported long distances by hurricanes — for example coconuts and shells transported 1500 km from Haiti to North Carolina.

The second part, "Storms", generally follows the arrangement of the first part and includes descriptions of Central Asian deserts and dust storms.

The third part "Tornadoes and Vertical Vortices", has colourful descriptions of the effect of tornadoes: "...seasonal hired hands may not be familiar with tornadoes and often think they will 'blow over'. Actually it is they that are blown over and not the tornado". Of note are some of the things transported and deposited by tornadoes. If you ever have problems with layers of fossil fish in a supposed eolian sandstone, you may invoke "rain with fish" due to tornado transport. Also possible is rain with jellyfish, snails, frogs, earthworms, pebbles, etc.

The last part, "Geological Activity", is the least interesting, since more up-to-date and comprehensive studies are in many sedimentology texts. Also, perhaps because of the rarity of hurricanes, etc., this section seems mostly concerned with "normal" processes. It does, however, describe the variety of materials found in eolian deposits and how far they may be transported.

I found the descriptions of what happened during hurricanes, storms and tornadoes fascinating, and it made me think more about their effects in the geological record: no need now for floating ice to explain stones in lake clays! The book summarizes

scattered observations nicely and even has some appropriate poems by Pushkin, among others. As the author writes in his conclusion "Hurricanes, storms and tornadoes are phenomena that are very difficult to study and observe directly. Books are necessary."

The translation (by Dr. B.B. Bhattacharya) is good and the price modest. The book is worth having for library reference, or for yourself if you are terribly interested in storms, etc. It would make a good present for Lyellian Uniformitarians, if any can still be found lurking in the warrens of Canadian geoscience.

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## Krakatau 1883, the Volcanic Eruption and its Effects

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By Tom Simkin and Richard S. Fiske  
*Smithsonian Institution Press*  
 464 p., 1983, \$25.00 US, cloth;  
 \$15.00 US, paper

Reviewed by Maurice B. Lambert  
*Geological Survey of Canada*  
 588 Booth Street  
 Ottawa, Ontario, K1A 0E4

Krakatau, since its catastrophic eruption in 1883, has been the standard by which explosive volcanoes have been compared. Not only was it the earliest well-documented explosive eruption in historic time, but it produced worldwide effects that were not previously related to single volcanic events. The paroxysm and related events left over 36,000 fatalities, 165 villages destroyed, and another 132 villages damaged in Java and Sumatra.

The authors' purpose in writing this book was to (1) gather together, on the centennial of history's most famous eruption, descriptions of eyewitness accounts of the eruption and its effects, (2) translate the official 1885 report of R.D.M. Verbeek into English for the first time, and (3) present subsequent scientific interpretations of the eruption. Following an introduction, the book is divided into three main segments that admirably fulfil the authors' aims.

The introduction outlines the geographical setting and the historical and geological importance of Krakatau. The eruption is placed in the context of technological advancements of the time. Most importantly, the introduction gives a chronology of events related to Krakatau from the year 416 to October 1981. It is presented in tabular form (26 pages long) that lists time of event, type of event or report, reliability of data, and source of data. Of particular use is one column that gives a numerical code by which the reader can tell at a glance

which of 12 types of events occurred. This table is one of the most useful data and reference sources in the book. It is probably the most complete and detailed summary of events ever published.

The narrative section presents more than 90 accounts of the paroxysmal eruption, aftermath and distance descriptions. Many of these have not been published previously. Most accounts dwell on the heavy tephra fall, impenetrable darkness and destruction by tsunami and the loss of life. The accounts as a whole contain a considerable amount of repetition, which when read in succession become somewhat tedious. They are valuable, however, because they bring together a wealth of information from widely scattered sources and document timing of events. The authors have chosen the most reliable accounts, but also include short reports that illustrate man's uncanny ability to exaggerate and elaborate in a totally abhorrent manner. The descriptions of the aftermath focus on the thousands of corpses, obliteration of villages and vegetation, and transport of objects of enormous weight by sea waves. The accounts clearly indicate that the greatest devastation resulted from tsunami. Distance descriptions include sounds, sea waves, tidal disturbances and vast fields of floating pumice reported thousands of kilometres from the volcano, as well as atmospheric effects witnessed from New York, Hawaii, Ceylon and the United Kingdom up to 1886.

The central segment of the book devotes 108 pages to reproduction of most of Verbeek's Monograph. R.D.M. Verbeek was a 38-year-old mining engineer who mapped the geology of Krakatau three years before the eruption and was the official investigator for the Dutch East Indies Government immediately after the eruption. His 546-page Monograph (accompanied by an album of chromolithographic plates and an atlas of line drawings) describing the eruption and its effects was written in Dutch and published in 1885. Except for short reports of Verbeek's findings that were published in *Nature* in 1884 and 1886, the present volume provides the first English translation of the principal geological sections. It includes reproductions of the 25 coloured illustrations from Verbeek's album.

The narrative part of Verbeek's Monograph gives a detailed orderly description of the most important events leading up to and including the paroxysm of 26–28 August 1883. It helps to sort out the sequence of events and the accuracy and reliability of reports from many different areas. Verbeek's detailed discussion covers the geology of Krakatau, the regional geology of the Sunda Straits, and individual aspects of the eruption, including sections on causes and theoretical basis of the eruption, earth-

quakes, volumes and distribution of ejecta, collapsed volumes, atmospheric effects, meteorological and magnetic phenomena, and movements in the sea. Verbeek's largest chapter on the petrography of Krakatau is only briefly summarized in the present book, as are the results of his chemical investigations. The excerpts from the Monograph end with a reprinting of his reference citations and extensive footnotes.

The last major segment of the book presents a selection of scientific accounts and interpretations of the eruption. Thirteen geological papers trace the development of geological understanding about calderas, explosive volcanic eruptions and pyroclastic flows since the time of Verbeek from the 1888 English language account by J.W. Judd, the excellent scientific paper by Ch. E. Stehn (1929) documenting the eruption and development of Anak Krakatau, through excerpts from Howel Williams' classic 1941 Monograph on "Calderas and their Origin" (in which he establishes Krakatau as the type example of caldera collapse resulting from large-scale eruption of silicic magma from a shallow reservoir) to more recent (1981) interpretations by Self and Rampino, and the most recent activity and development of Anak Krakatau by A. Sudradjat of the Volcanological Survey of Indonesia. In spite of the large amount of data known about Krakatau, the authors point out that there are still a number of key questions that have not been satisfactorily answered, such as when and how the northern part of Karata Island collapsed and the generating mechanisms for sea waves. Modern petrochemical studies have yet to be undertaken.

Geologic papers are followed by papers that attempt to understand air and sea waves, including several interpretations that some distant sea waves may have been caused by air waves. Several reports on the unusual optical phenomena and extraordinary sunsets include the modern (1970) interpretation of mineralogist H.H. Lamb. The authors interject a short note on the El Chichón eruption (Mexico, 1982) that caused optical phenomena similar to Krakatau. Three brief discussions on relationship between volcanoes and climate include an early view by Benjamin Franklin in 1784, who linked cool temperatures to the 1783 eruption of Lakigigar volcano in Iceland, a correlation of the effect of volcanoes of the intensity of solar radiation by Abbott and Fowler in 1913, and a comparison of Krakatau with more recent eruptions by Mitchell in 1982. Finally, the book ends with two reviews written in 1929 detailing the return of flora and fauna to the island of Krakatau.

The book is well-illustrated, including

over 170 black-and-white photographs, engravings, line drawings and maps. Except for 3 reference maps, all maps, diagrams and photographs are reproduced directly from the original documents without modification and unretouched. Included are copies of original photographs of the 27 May 1883 eruption that have not been published previously. Although most maps are excellent, several are not entirely legible at the scale reproduced here. I assume the compilers chose to preserve authenticity at the expense of legibility. The book contains 48 colour photographs, including 25 from Verbeek's album, 11 reproduced from William Ashcroft's pastel sketches of unusual optical phenomena, and 12 photos of similar phenomena from more recent volcanoes (Agung, Mount St. Helens, El Chichón) and recent scenes taken near Krakatau and Sumatra, including the 1979 eruption.

Most eyewitness accounts are clearly written in non-technical language understandable by the lay person, yet not pedantic, and of equal fascination to the scientist. Throughout the book the authors interject short statements that introduce many accounts and remind the reader that interpretations must be judged in the context of the advancement of geological thought of the time. These comments provide a structure and continuity throughout the great mass of material presented.

The bibliography, although the authors claim it makes no pretense to be comprehensive, entails 472 entries that certainly include the most pertinent set of references to papers available in English. The index is sufficiently detailed to provide easy access to all topics the authors mention in the book.

This book presents the most complete collation of eyewitness accounts, scientific documentation and interpretation of Krakatau that has ever appeared in a single volume. It is of interest not only to geologists but to a wide range of disciplines, including biologists, botanists, archaeologists, oceanographers and atmospheric scientists. Undoubtedly, it is the most important secondary reference to date on all aspects of the Krakatau story. This highly subsidized publication is a bargain that shouldn't be missed.

## Silicified Silurian odontopleurid trilobites from the Mackenzie Mountains

By B.D.E. Chatterton and D.G. Perry  
*Palaeontographica Canadiana No. 1*  
*A paleontological series sponsored jointly by the Canadian Society of Petroleum Geologists and Geological Association of Canada, and administered by a Joint Committee on Paleontological Monographs. 126 p., 1983, \$21.00; paper*

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Canada has long been without a vehicle for the publication of paleontological monographs, and this publication is designed to fill that need. This publication, the first in a series, is, to quote its credo "a monograph series of major contributions to Canadian paleontology that is dominantly, but not exclusively, systematic in content".

The title page and its logo are handsome and eye-catching, the quality of the paper used is first class and should be durable, and its plates (numbering 36), which are readily comparable in quality to those of the current pace-setter, the *Journal of Paleontology*, are excellent. In fact, to me, the single most outstanding part of the paper is the profusion of richly illustrated taxa, which is as it should be in a monograph type of publication.

Trilobites, all silicified, collected primarily from five closely adjacent sections in the central Mackenzie Mountains from a near-basin margin setting, are incredibly prolific, and contain many other taxa in addition to the described odontopleurids. The ages of the trilobites range from upper Ordovician to early Ludlow.

The authors tie in lithofacies and biofacies to three "grand cycles" of transgressions and regressions, with the end of the final cycle being one of overall continuous shallowing. The study recognizes eleven distinct stratigraphic assemblages, which, because of sea level and lithofacies changes and of differing range zones of individual taxa, are unique.

A brief, but interesting part of the study incorporates modifications of the biomere concept. The writers postulate that during the transgressive phase of any one grand cycle, deep-water trilobites gradually move more and more onto the shelf region, displacing and causing the extinction of the pre-existing shelf/shallow-water dwelling "communities", finally establishing themselves as the shallow-water dwellers. During

the subsequent regression, the now shallow-water taxa move down onto the slope. They attempt to link the evolutionary lineages of *Leonaspsis*, *Odontopleura*, *Stelckaspis* and *Ceratocephala* to the biomere episodes. Their data are somewhat speculative, but are reasonably convincing. This part of the study is all the more interesting now that Palmer has recently reassessed and drawn back from his original view of the biomere.

Phylogenetic relationships of a number of genera and species are discussed, and the writers' new data permit them to substantially revise the evolutionary sequences of some taxa. It is interesting to note that although the gradualist view might be interpreted from the data presented, the writers make no attempt to enter into the gradualist/punctuated equilibria fray. This, in spite of excellent stratigraphic control, reasonable understanding of lateral lithofacies and biofacies changes, and an enormous amount of superb material, some including complete growth stages. Could this be a lesson to those who, with far fewer data, plunge headlong into the debate?

As is to be expected, "Systematic Paleontology" comprises the dominant portion of the publication. One new genus, one new subgenus and 29 new species are described in a total fauna of 10 genera and 36 species. Each genus receives a detailed and lengthy discussion and comparison, and species descriptions are, by virtue of such excellent and abundant material, detailed. As noted already, illustrations, including hand-drawn reconstructions in the body of the text, as well as photographic plates, are excellent.

This publication is important from the viewpoint of trilobite taxonomy and biogeography of the northern Cordillera and is a must for anyone working on, or interested in, Silurian trilobites. It is a worthy beginning to the Paleontological Monograph series.

As a final comment, it should be pointed out that because of the untimely death of Perry, Chatterton had to "carry the load" in the final stages of taxonomy and manuscript preparation. He is to be congratulated.

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## Principles of Sedimentary Basin Analysis

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By Andrew D. Miall  
 Springer-Verlag  
 490 p., 1984, \$52.00; cloth

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The text *Stratigraphy and Sedimentation* by Krumbein and Sloss (1963) has had an enormous influence on soft-rock geology. For over 20 years, it has been the only volume to take a broad overview of the relationship between stratigraphy, sedimentary environments, tectonics and basin development. The need for an up-to-date volume covering the same ground has been acute, and this need has been satisfied by Miall's *Principles of Sedimentary Basin Analysis*. The layout of both books is remarkably similar; Miall's is structured in terms of "increasing complexity of information". It begins with "Collecting the Data", and "Stratigraphic Correlation", sections which succinctly inform the reader how to do those things. The next section, "Facies Analysis", introduces the complexity of depositional environments; by using abundant examples, Miall steers the reader carefully through this somewhat more subjective topic, and it provides a good overview of how to go about making environmental interpretations. The following chapter, "Basin Mapping Methods", shows how stratigraphic and sedimentological data can be fitted into a broader, regional picture. Traditional mapping methods are discussed, along with conventional subsurface methods and seismic cross-sections. Regional changes in dispersal (paleocurrent analysis) and petrography are all built into the paleogeographic synthesis.

The scale of thinking enlarges with the next chapter, "Depositional Systems". Here, individual environments are linked into larger scale systems; for example, alluvial plains hundreds of kilometres long and wide are linked to their deltas. Inevitably, this leads to a much more generalized treatment of the subject, because Miall has built a large edifice on a huge amount of original literature. The original sources obviously cannot be discussed in detail in the book, and the reader may have to work a little harder to appreciate the details of the breadth of approach. The single page devoted to clastic shelves seems a little brief in view of their economic importance. The principles introduced earlier in the book are all used; depositional environ-

ments, correlation diagrams, stratigraphic maps and seismic-cross sections, and the chapter gives a good overall feeling for the type of synthesis required in many modern studies. The following chapter on "Burial History" is disappointingly short, but the following chapter, "Regional and Global Stratigraphic Cycles", is meaty. Miall develops Sloss' older ideas about cratonic cycles, introducing the methods of seismic stratigraphy, and relating them to sea level curves and stratigraphic sequences. The final chapter, of almost 100 pages, is devoted to "Sedimentation and Plate Tectonics". Basins are classified and related to global crustal motions at divergent, convergent and transform margins, and in cratonic settings. The coverage emphasizes generalities, but gives many worldwide examples to back up the principles and direct the reader to specific areas.

The book must be evaluated on the same grand scale as it is written — it is an excellent synthesis of a huge amount of diverse data. One may quibble with items here and there, but the overall synthesis is every bit as successful as that of Krumbein and Sloss 22 years ago. The style of writing is clear and direct, and the 387 illustrations are appropriate and well-reproduced. This book should be on the desk (not bookshelf) of all soft-rock geologists: paleontologists, stratigraphers, geomorphologists, sedimentologists and those involved in the search for hydrocarbons and minerals in sedimentary rocks.