Book Reviews / Critique

Book Reviews

Destructive Mass Movements in High Mountains: Hazard and Management

By G.H. Eisbacher and J.J. Clague
Geological Survey of Canada Paper 84-16
Geological Survey of Canada, Ottawa
230 p., 1984; $20 ($24 outside Canada), paper

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Much of Dr. G.H. Eisbacher's geological experience was acquired in North America, primarily during his many years with the Geological Survey of Canada in Vancouver. His deep interest and knowledge of things connected with the alpine landscape is, however, unmistakably Austrian. Thus, he has ideal qualifications for the mission which he has chosen in preparing this book: to collect experience with mountain hazards accumulated by the ancient populations of the Alps and make some of it accessible to North American readers.

The book has two parts. The first 68 pages is a monograph on the subject of slope hazards in high mountains; their description, prediction, avoidance and control. The much larger second part ("Appendix") is a collection of 137 case histories of landslide accidents from Switzerland, Austria, northern Italy and eastern France, preceded by a concise summary of the geology and climate of the Alps.

The brevity of the case histories is misleading. Apart from occasional amusing bits of folklore, the writing style is spartan: every sentence conveys important information. The reader's mind almost longs for the rest usually afforded by a "padding" of meaningless words. Nevertheless, the case histories are brief and obviously the authors' intention was to provide a broad coverage, even at the expense of limited depth. Some 450 references are provided, mostly European.

The case histories offer a glimpse of the fourth dimension of slope hazards science. Many of the localities have a documented history of landslide activity more than 2,000 years long. In Western Canada, we have typically only the forty or fifty years covered by aerial photography or at best some 100 years of fragmentary historical records.

Thanks to this expanded time frame, the book offers many first-hand descriptions of the course of events during major landslides. Albert Heim's statement quoted on page 203: "Great rockslides commence slowly and make themselves known weeks or at least days in advance..."— is supported by vivid descriptions of the precursory signs appearing before major slides such as at Piuro (Case A35), Motto d'Arbino (A112) and many others. Acceptance of even well-recognized major hazards seems widespread, relying on the timely interpretation of the appropriate warning signs (e.g. A113).

Most of the great alpine rockslides are described with some new insights — Elm, Goldau, Flims, Granier, Vaiont. The illustrations consist of many excellent original photographs and small, somewhat schematic sketches. Several reproductions of old drawings are of interest (e.g. Figure 109).

Even an experienced geologist cannot remain unimpressed by the variety and complexity of landslide scenarios described with the authority of eyewitness documentation. Rockslide masses loading unconsolidated deposits trigger delayed failures and debris flows which then lead to damming of rivers and consequent debris floods. Glaciers cause icefall catastrophes on advance and outburst floods on retreat. The relationship between slope creep (Sackung) and debris flow appears ubiquitous. All this takes place amongst the populous villages and manicured pastures of the Alps.

The human responses and defences against the hazards are cursorily described but fascinating in their variety, from burning the supposed perpetrator of a glacial outburst at the stake (A47) to construction of rockfall berms (A113) and drainage of subglacial water by tunnels (A101).

The most important message of the book is that landslide hazards are a principal element of life in high mountains, which imposes overriding control on the use of the land. The fact that we have only just begun to realize this in Canada is due to the sparseness of our population, not to a lack of landslides!

The first part of the book is written against a Canadian background, with few case histories. It is connected to the Appendix only by unwieldy numerical cross-referencing. This makes the first part rather dry reading and the reader would do well to turn to it only after a generous browsing of the case histories. The chapter "Slope Movements on Volcanoes" has no counterpart in the Appendix.

One interesting fact in the case histories is the enormous scale of many storm-related debris flow events (cf. Figures 276, 279 and 283). One basin in Austria is said to have yielded 40 x 10^6 m^3 of debris in 180 years, i.e. 250,000 m^3 per year on average (A70). Another in Italy (A92) produced 14 x 10^6 m^3 in a single event! Many cases in the order of one million m^3 are described from various geological settings both inside and outside the Pleistocene ice cover limits. The largest debris flow unrelated to a glacier ever described in Canada was 75,000 m^3 (Nasmith, 1972, p. 20). This apparent paradox remains unexplained.

The case histories are arranged chronologically, although geographic organization would be more meaningful. Despite this, the book will be an excelllent guide to any engineering geologist fortunate enough to be able to travel in Europe. The quality of the production is very good and the price very reasonable. The book's lessons, learned the hard way by the Europeans, are of course priceless.

References

Nasmith, H., 1972, Engineering geology of the Southern Cordillera of British Columbia, Excursion guidebook: 24th International Geological Congress, Montreal, Quebec, 34 p.

Conodonts of the Middle Ordovician Table Head Formation, Western Newfoundland

By Svend Sandbergh Stouge
Fossils and Strata No. 16
Universitätsforlaget, Oslo
Distributed in North America by
Columbia University Press, New York
145 p., 1984; $30.00 US, paper

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This volume is a comprehensive taxonomic treatment of conodonts recovered from the Table Head Group of western Newfoundland, a unit that was deposited on the eastern margin of North America at about the time of the Taconic Orogeny. The distribution of the conodonts recovered is used to make paleoecological interpretations and three main biofacies are recognized. In addition, the volume provides detailed information on ten measured sections, an assessment of their lithostratigraphic correlation and the nature of their depositional environments. The volume represents the results of a doctoral thesis completed by the author at Memorial University of Newfoundland and, in the nature of such studies, it is an encyclopedic and discursive work.

An introductory section outlines previous work in the area and sets the geological scene. Subsequent sections deal in detail with the stratigraphy, lithostratigraphic correlation, and paleoenvironmental interpretation of the sections studied. It is a pity that the stratigraphic part does not take account of the revisions to the stratigraphy of the Table Head Group proposed by Klappa *et al.* (1980); instead, an entirely separate stratigraphic scheme is used. This detailed investigation of the strata from which the conodonts were obtained permits the author to examine closely the environmental effects on the distribution of conodont organisms in the early Middle Ordovician. Such a detailed treatment has great impact on paleoecologic and biostratigraphic interpretations.

A section dealing with the biostratigraphy of conodonts from the Table Head Group contains a valuable discussion of the phylogeny of early Middle Ordovician conodonts, particularly the genus *Histiodella*. Two phylozones, based on the development of *Histiodella*, and four additional assemblage zones are proposed. The strata of the Table Head Group probably represent rapid deposition in a short interval of time (the upper part of the Whiterockian Stage) and so the biostratigraphic treatment is at a highly detailed level. It remains to be seen whether these zones can be recognized in other areas with more condensed sequences.

The conclusions of the study have an impact on three main areas of Middle Ordovician stratigraphy and paleontology. First, in the field of biostratigraphy, where the definition of new biostratigraphic zones for the upper part of the Whiterockian Stage is of significance. The author also recognizes that the Lower-Middle Ordovician boundary is not coincident with the dolostone-limestone lithologic change (traditionally the St. George-Table Head group boundary). This is a situation now being recognized in many other areas of the Appalachians where the Lower-Middle Ordovician boundary is exposed in similar stratigraphic sequences. Second, the conclusions benefit the understanding of conodont taxonomy. A new family, two new genera and twenty new species are described. One of the latter, *Scolopodus oldstockensis* is named, not after a place called Oldstock, nor after an ancestral part of the lineage, but after a brand of beer particularly to the author's liking. Third, the study contributes to the understanding of the paleoecology of early Middle Ordovician conodonts. Three biofacies are recognized and divided into a number of sub-biofacies. These are partly a reflection of the fact that the Table Head Group was deposited near the boundary between two conodont faunal provinces and partly the result of local environmental shifts. Fluctuations of the provincial boundary cause substantial shifts in faunal content. These fluctuations are presumably in response to movements of major water masses. Local environmental changes also cause biofacies shifts within faunas from one particular province.

Technically, the volume is well produced with an attractive format and layout. The plates, however, are of variable quality as were those of the previous volume in this series (*Fossils and Strata No. 15*). The black backgrounds are somewhat grainy and the edges where the photographs were cut before mounting show through in many cases. As a result, although the plates are of acceptable quality, they do not meet the very high standards set by most earlier volumes in this series.

This volume is an important contribution to the understanding of Middle Ordovician stratigraphy in western Newfoundland and to the knowledge of early Middle Ordovician conodonts. It is of interest to those who work on conodonts, Ordovician stratigraphy and biostratigraphy, and on Appalachian geology. At $30.00 US, it is reasonably priced and should be on the shelves of most conodont workers.

Series such as *Fossils and Strata* provide an important medium for the publication of paleontological monographs which, because of their great length, are difficult to publish in normal research outlets. Such series do not attract many individual subscriptions and therefore rely heavily on library subscriptions. Significant advances in paleontology are made mainly through detailed studies such as this one and so preservation of the means of their publication is of vital importance. Paleontologists should make sure that this volume is on the shelves of their local library.

Modern Science and the Book of Genesis

By James W. Skehan
Science Compacts Number 1
National Science Teachers Association
1742 Connecticut Avenue, N.W.
Washington, DC 20009
30 p., 1986; $5.00 US, paper

Reviewed by Andrew D. Miall
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Teachers of science at every level and science professionals have experienced the need for relevant information on both science and theology in the current debate on whether creation science is true science or is religion disguised as science. *Modern Science and the Book of Genesis* by James W. Skehan, S.J., who has advanced degrees in geology and theology (Ph.D., Geology, Harvard University; and M. Div., Theology, Weston College) was prepared at the request of and published by NSTA.

It is a thoughtful and straightforward presentation of the views of "mainstream" theology to the effect that modern science and the teachings of the Bible are by no means in conflict. Anyone who feels personally challenged by creationist interpretations of earth history should read this booklet.

Biogeography: An Ecological and Evolutionary Approach, Fourth Edition

By C. Barry Cox and Peter D. Moore
Blackwell Scientific Publications, Palo Alto
272 p., 1985; $19.00 US, cloth

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Although most geologists inevitably think of biogeography solely in the context of continental drift, it has always been a broad, multidisciplinary subject which attempts both to document biotic distribution patterns and to arrive at an understanding of the various environmental, ecological and evolutionary processes that shape them. Thus, biogeography lies at the intersection of the geological, biological and environmental sciences and, in this book, the authors undertake the task of synthesizing its rather varied subject matter into an introductory review for a general scientific audience.

The first two chapters provide examples of biogeographic patterns and discuss the influence of physical environmental factors on biotic distribution. The emphasis here, and in the rest of the book, is very much on terrestrial ecosystems. Marine environments receive only a brief, superficial treatment and this is perhaps the book's major failing from the perspective of most invertebrate paleontologists. Chapter 3 presents an account of biological limiting factors. Competition is emphasized, although other processes, such as predation, are also included. However, the current debate over the importance of competition in community organization, which has occupied considerable space in the ecologic literature for almost a decade, is not mentioned. The following discussion of island biogeography in Chapter 4 is more balanced. An elementary, graphical treatment of MacArthur and Wilson's seminal equilibrium model is presented and due attention is paid to the various critiques of this theory which have been published in recent years. Speciation and adaptive radiations of colonists of remote islands are discussed using examples from the flora and fauna of the Hawaiian chain.

Most of the remainder of the book is devoted to historical biogeography and includes an overview of biogeographic changes through the Phanerozoic, with post-Jurassic terrestrial florae and faunae receiving most coverage. A brief, but impartial, review of the "dispersalist" and "vicariance" schools is presented but cladistic vicariance, perhaps the hottest topic in contemporary historical biogeography, is disposed of in a single page. Concluding chapters provide discussions of the biogeographic effects of the Pleistocene glaciation and of the impact of man on the biosphere. The latter is a varied compilation of topics which include the ecological effects of acid rain, the role of biogeographic theory in the design of national parks and conservation areas, and the possible influence of man on the late Pleistocene extinctions of large terrestrial mammals.

Overall, the book is concise and written in a clear and straightforward style. It provides an inexpensive introductory review suitable for use as background reading in undergraduate courses in paleoecology and evolutionary paleobiology.

New Views of an Old Planet: Continental Drift and the History of the Earth

By Tjeered H. van Andel
Cambridge University Press
324 p., 1985, $19.95 US, cloth

Reviewed by R.W. Hodder
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In this book, Professor van Andel of Stanford University makes a very personal selection of changes in climate, crustal stability, oceans, and life through geologic time to rationalize catastrophism and uniformitarianism as fast and slow perturbations in the pulse of an aging earth. This book is not a source of new data or of re-interpretation. Rather, it is an exceedingly clear and succinct summary of evidence and significance for such topics as seismic reflections indicating global change in sea level, asteroid impact on the Cretaceous-Tertiary boundary, late Permian extinctions, and even Darwin's 20-year delay in publishing *Origin of Species*. It also provides brief introduction to the use of the anthropogenic principle in reasoning back through time and to thought experiments where data are meagre. The book is a compilation of observations, a lot of ideas, plus philosophical commentary from an experienced and thoughtful observer who, as one of the founders of the Deep-Sea Drilling Project, has had ample opportunity to follow developments in geology and related disciplines over a protracted period of time.

By title and size, this book will probably be compared to other short summaries of plate tectonics such as *The New View of the Earth* (Uyeda, 1978), *Orogeny* (Miyashiro *et al.*, 1979) and perhaps even McPhee's (1981), *Basin and Range* which was aimed at a more general readership. Van Andel is not as timely as Uyeda, nor as factual as Miyashiro, and lacks the sense of discovery and wonder of McPhee. What van Andel has, however, is a critical eye for important cumulative evidence, interpretation at different scales from plankton to global and, a need to understand. He sums it up on page 296, as seeking "value beyond mere acquisition of facts, no matter how interesting. Inevitably, such a search for meaning is rather personal, but scholarship, after all, is a human enterprise". I recommend this book for thoughtful people who find science somewhat cold and mechanical and especially to students whose curiosity goes beyond their texts.

The book is very well produced in clear type with excellent line drawings underscored by good captions. There is a glossary and a very good index. References are not cited in the conventional way and there is no bibliography. Instead, there are suggestions for further reading at the end of each section. Several quotations from poems and prose at the beginnings of sections, and their accompanying dark and mystical plates are rather cryptic and their source has to be run down in an appendix. This is but a petty distraction in some very enjoyable and worthwhile reading.

Bone Hunters in Patagonia. Narrative of the Expedition

By J.B. Hatcher
Ox Bow Press, Woodbridge, Connecticut
221 p., 1985; $16.50 US, cloth

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Vertebrate paleontology is a subdiscipline that has been especially rich in brilliant, eccentric and often belligerent characters. Most remembered among these are, perhaps, Othniel C. Marsh (1831-1899) and Edward Drinker Cope (1840-1897), whose initial friendship degenerated into a feud so bitter and prolonged as to affect the entire geological community of their time. However, a list of others crowd after them into one's recollection — Gideon Algernon Mantell (1790-1852), who so filled his house with fossils that his family had to be moved into a hotel to make room for the collection; the very rich and very autocratic Henry Fairfield Osborn (1857-1935); the remarkable Ameghino brothers, Carlos (1865-1936) and Florentino (1854-1911), defending so stoutly the idea that the giant mammals originated in the Mesozoic, and man in the Tertiary, in South America; Friedrich Freiherr von Heune (1875-1969), whose eccentricities are remembered in Germany even more vividly than his achievements: the highly political Ferenc Nopcsa (1877-1933), who so nearly attained the throne of Albania; George Gaylord Simpson (1902-1984), one of the most percipient, but also one of the most prickly, of this century's paleontological thinkers — so many of them, and all so varied.

The name of John Bell Hatcher is less well known, perhaps, than these. Nevertheless, in a short life (1861-1904) bedevilled throughout and ended prematurely by illness, he achieved a great deal against heavy odds. Moreover, he was quite remarkably quarrelsome, quickly falling out with everyone with whom he was employed. Yet he retained sufficient affection and respect to be remembered by Osborn as a "truly rare and noble spirit" and by another associate, W.J. Holland, as "a most charming companion" (see Holland, 1901).

Hatcher was born in Virginia, where his father had a farm and worked part-time as a schoolteacher. He was a sickly child but a determined one. Since he desired a college education and there was no money for it at home, he worked as a coal-miner until he had raised enough to pay the fees — and, in the process, assembled a fine collection of fossil plants. This stimulated his interest in paleontology and when, after a brief spell at Grinnell College, Iowa, he moved to Yale University, he enrolled in classes in both geology and botany. Moreoever, his collection attracted the favourable attention of Marsh and, when Hatcher requested a job in fossil collecting "anywhere at any salary", he was promptly hired.

Hatcher was sent first to work in Kansas, under the direction of veteran fossil collector Charles Hazelius Sternberg (1850-1943). The association was brief: in his letters to Marsh, Hatcher was soon criticizing Sternberg's methods and requesting an independent project. This was granted and Marsh had no reason to regret the arrangement, for Hatcher was not only a careful but also a very energetic collector. He worked in the field not only in the summer but also — despite severe bouts of rheumatism — over several winters. During his years in Marsh's employment (1884-1892), Hatcher shipped back to Yale some 900 large boxes at vertebrate material, nearly all of them large and one weighing three tons! (Charles Schubert, quoted in Scott, 1904). His major find was the first North American discovery of Cretaceous mammals, in Wyoming in 1889; but many others were notable.

Nevertheless, the association with Marsh became increasingly uneasy; Marsh found it ever more difficult to find the financial support for Hatcher's collecting trips and Hatcher, despite his initial brave words, became ever more resentful when his pay arrived late. He was discharged by Marsh in 1893.

Fortunately, Marsh's letter of recommendation helped to secure for Hatcher immediate alternative employment as curator of paleontology at Princeton University. He was sent west immediately, along with a group of Princeton students, to collect fossil mammals. This venture went well and two further trips followed, in 1894 and 1895.

However, by then Hatcher was proposing to his superior, William Berryman Scott (1858-1947), the first of the expeditions that are the subject of this book — to South America, to obtain for Princeton an array of specimens of the remarkable Tertiary mammalian faunas that were being described by the Ameghino brothers. Unfortunately, though he gave the project his support, Scott was not able to help much with the funding for such a journey. Nevertheless, the money was gathered somehow and, on 29 February 1896, Hatcher and his brother-in-law Olof Petersen set off southward on a ship which Hatcher was to persistently misname the "S.S. Gallileo". Though mis-spelling it, Hatcher thought the name auspicious.

Hatcher's account of this expedition, and of his two subsequent ones to Patagonia, were published originally in 1903, in the first volume of the *Reports of the Princeton University expeditions to Patagonia, 1896-1899* — the only volume to appear in his lifetime. Because published in so expensive and formidable-seeming a series, it did not attain a wide readership; yet the story Hatcher tells is so remarkable a one, of scientific adventure under harsh conditions, that it deserves to be much better known. This re-publication of the account at low cost, and under a more appealing title, should serve to make Hatcher's achievements much better known.

Prospective readers should be warned, however, that they will not find the book easy reading. Hatcher had no fluency of style (p. 3-4 serve as example) and favoured long paragraphs; one runs to 3-1/2 pages! (p. 113-117). His habit of sometimes translating into English the Patagonian place-names (Punta Arenas becomes "Sandy Point", Puerto Deseado becomes "Point Desire") and sometimes leaving them unchanged (Santa Cruz does *not* become Holy Cross) is tiresome. Yet the story he tells is so remarkable that, despite these inadequacies, it holds one's attention.

The three expeditions receive a markedly disproportionate coverage. The first is described at leisure in 150 pages (p. 6-156). In contrast, the second is dealt with in thirty-six pages (p. 158-194) and the third in a mere twenty pages (p. 195-205). This disproportion reflects Hatcher's changing reactions. The initial, highly successful expedition is dealt with in loving detail, for it rewarded Hatcher amply and gave him a fascination for Patagonia that was never to be lost. The second, in contrast, brought a meagre paleontological reward and, for Hatcher, a frightening and prolonged illness; while the third was under a divided command that he resented bitterly and achieved only a paucity of significant discoveries. Indeed, in his excellent history of vertebrate paleontological discovery in South America, George Gaylord Simpson describes these later expeditions as "flatly failures" (1984, p. 119).

Simpson not only characterizes Hatcher as "austere to the point of self-sacrifice" (1984, p. 109) but also as "at times both aggressively antagonistic and eagerly self-centred" (*ibid.* p. 119-120). Perhaps these are characteristics to be expected and forgiven in one who was so often ill and who had through sheer determination overcome so many obstacles in following his chosen path. Whatever the reasons for them, these traits become very apparent to the reader as he follows Hatcher on his Patagonian wanderings.

Hatcher was not appreciative of the labours of his companions on the expeditions, nor did he treat them well. They were often left behind to wait, sometimes for several days, while Hatcher went off exploring: they might find themselves sent back by ship with the specimens to New York, to deal with all the problems that involved, while Hatcher stayed behind; and they could expect few tributes — and, indeed only a bare minimum of mentions — in his writings. Only A.E. Colburn, who nursed Hatcher through a serious illness on the second expedition, gains ungrudging praise (p. 189).

Hatcher was not an appreciative guest; for

example, after being entertained by the Governor of Santa Cruz Province and his wife, he wrote loftily:

> "While inwardly disgusted by the mode of life of the natives, which had in it so few elements of real comfort, yet we resigned ourselves to it with all the grace possible during the short time it was necessary to us to remain in Gallegos..."(p. 29).

He was also quite cold-blooded in his dealings with Patagonia's wild animals: his account of the shooting of his companion's dog (p. 186) is particularly unendearing.

Yet there is much in Hatcher to admire. He was remarkably tough, telling us enough about his problems for us to appreciate them fully, yet exhibiting little self-pity even when hit by serious illness or severe misfortunate. He was not easily daunted, indeed displaying a persistence which, as Simpson states (1984, p. 118), sometimes seems "in retrospect more maniacal than brave"; and his scientific attainments were considerable. He went to South America in part to test the Ameghinos' claim that its advanced mammals were contemporary with the dinosaurs; he found nothing to support that claim and much to disprove it. He brought back to Princeton, from the first expedition, an abundant and diverse fauna. If the two later expeditions were less fruitful, it was in part because Florentino Ameghino had been cautiously imprecise in giving details of his fossil localities to a stranger self-avowedly hostile to the Ameghinos' ideas.

Hatcher's return to Princeton from the third expedition was prefaced by a rather bad-tempered transfer of his field equipment to his undesired co-leader, Barnum Brown (1873-1963), and followed all too soon by a quarrel with Scott that led to Hatcher's resignation from the University in November, 1899.

He was not long in finding a third appointment, at the Carnegie Museum in Pittsburgh. His years there were fruitful in scientific publications but again uneasy in personal relationships. Nor were they long, for Hatcher died of typhoid fever on 3 July 1904, at the early age of 42. The posthumous tribute by Dr. William J. Holland, his colleague of the Museum merits quotation: that Hatcher was

> "in all probability the most successful collector in his chosen domain who has ever lived. Professor Hatcher and those who worked under him ... assembled more important vertebrate fossils than have ever been assembled by any other one man whose name is known in the records of paleontology."

John Bell Hatcher, that single-minded man, could have desired no better tribute; and this book, his one personal testament, should be read by all interested in the history of vertebrate paleontology.

References

Holland, W.J., 1904, John Bell Hatcher: Annals of the Carnegie Museum, v. 2, p. 597-604, part.

Scott, W.B., 1904, Memoir of John B. Hatcher: Geological Society of America, Bulletin, v. 16, p. 548-555, part.

Simpson, G.G., 1984, Discoverers of the Lost World: Yale University Press, New Haven, Connecticut, 222 p.

Volcanic Ash

By Grant Heiken and Kenneth Wohletz
University of California Press, Berkeley
246 p., 1985; $40.00 US, cloth

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This book is a reference and a guide to the characteristics of volcanic ash, and represents a greatly expanded compendium from an earlier effort produced by Grant Heiken in 1974, entitled *Volcanic Ash* and published as Smithsonian Contributions to Earth Sciences Number 12. This new volume, *Volcanic Ash*, is designed for use not only by geologists, but also by scientists in the fields of environmental studies, public health, engineering, aeronautics, agriculture, and atmospheric sciences, since the study of volcanic ash, especially when it is being erupted, touches all of these disciplines. The use of the book by non-geologists is enhanced by an excellent illustrated glossary of ash-related terms, as well as concise, up-to-date presentations on the formation of volcanic ash, classification of pyroclastic deposits and rocks, and a summary of the methods currently in use to analyze volcanic ash.

The main descriptive part of the text is organized according to how ash is generated (i.e. magmatic, phreatomagmatic, phreatic) and each ash type illustrated contains a detailed description of the ash, details of the site and the eruption (where applicable), comments on the formation of the ash, chemical analyses (where available), as well as several SEM photographs or photomicrographs illustrating the ash type being described. These sections represent both a collection of data from existing sources, as well as new work performed by the authors.

In addition to the descriptions of specific ash types, there is also a section which details a number of eruption sequences, showing the changes in ash type that may occur during an eruption, helping to place the material in the first part into a stratigraphic perspective. In addition, there is also a section on "Eruption Plumes and Distal Ash Falls" and on "Weathered and Metamorphosed Tuffs and Relict Pyroclastic Textures". The last section is probably of greatest interest to volcanologists working in Canada, yet it is the weakest portion of the book, with only a few examples of metamorphosed tuffs, not covering all of the various ash types, being shown.

The book is of greatest use to scientists working on fresh or only weakly metamorphosed or unconsolidated deposits. Although geologists working with older, more lithified sequences will still find much useful information in this book, they will be hampered by the author's reliance on SEM photographs, as opposed to photomicrographs, to illustrate the various ash types. However, it is in part the SEM photographs that make the book so useful to others. The section on "Eruption Sequences" will however, be invaluable in the study of older lithified sequences, particularly in facies studies. The book can also be used as a laboratory text in conjunction with the text *Pyroclastic Rocks* by R.V. Fisher and H.-U. Schmincke.

Despite its shortcomings with respect to metamorphosed and lithified ash deposits, this volume will serve as an important reference to scientists studying volcanic ash; and it is reasonably priced given its large format, attractive layout, and excellent reproduction of the many black-and-white photographs it contains. In fact, the next step may be for Canadian volcanologists to produce a similar volume which describes metamorphosed and lithified ash deposits as well, so that the material in this volume can be easily compared with the rocks many Canadian volcanologists commonly deal with.

Coal Geology and Coal Technology

Edited by C.R. Ward
Blackwell Scientific Publications, Palo Alto
345 p., 1984; $98 US, cloth; $54 US, paper

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In *Coal Geology and Coal Technology*, Colin Ward has assembled contributions from seven authors with expertise in the various fields of coal geology and technology. The book attempts to provide an overview of analytical methods applied to coal evaluation, coal geology and petrology, exploration, mining, processing and utilization. According to the preface, the book is aimed at senior students and professional geologists and there is clearly a need for such a book both as a University textbook and for those working in the coal industry. With four of the seven authors from Australia, the book, not surprisingly, has a distinctive Australian flavour, with a great many of the examples drawn from the Australian coal industry.

The book is divided into nine chapters which progress logically from a general introduction to chemical analysis and classification, petrology and petrography, utilization, geology, exploration, mining, preparation and marketing and environmental considerations. In the introduction, G.B. Barnsley and C.R. Ward, apart from a general introduction, present an interesting overview of the coal industry in the major producing countries (Canada is not a major producer) including such aspects as geology, history of development, reserves and ownership, production and utilization. In Chapter 2, "Chemical analysis and classification of coal", C.R. Ward presents the standard fare of coal analytical procedures (e.g. proximate and ultimate analysis, Grey-King, Fisher assay, etc.) drawing heavily from the American Society for Testing and Materials Standards (ASTM) and the British Standards. Ward presents a very comprehensive summary of the major coal classification schemes including the relatively straightforward ASTM and the bizarre "digit based" schemes of the International Coal Classification, Australian Standard Coal Classificiation and National Coal Classification of the United Kingdom. In Chapter 4, J.F. Cudmore gives a very comprehensive treatment of coal utilization. In this chapter, combustion, carbonization and coking, gasification and liquefaction are summarized together with the influence of coal properties and importance of coal handling on coal utilization.

Chapters 3, "Coal petrology and petrographic analysis", and 5, "Geology of coal" will undoubtedly be of the most interest to geologists but regrettably are the chapters I found most wanting in the book. In Chapter 3, A. Davis summarizes the megascopic and microscopic techniques and terminology as applied to coal and briefly outlines the applications of coal petrology. In the 38 pages that this chapter comprises, Davis does a credible job of introducing the complex terminology utilized in coal petrology but at the expense of being too technical for a general introduction to the subject. Coal petrology, being almost entirely a descriptive science, requires good photographs for effective documentation. Because of the quality of paper utilized in the book, the photographs which are so important to this chapter, have little contrast and are thus useless. J. Ferm, in Chapter 5, gives a general overview of coal geology terminology and a description of the main geological features of coal measures such as coal rolls, cleat, etc., which is followed by a brief summary of factors controlling peat accumulation. Most of this chapter deals with the "Allegheny model" and application of the model to coal deposits. Anyone who has read Ferm's or Horne's work knows the Allegheny model and, as excellent model as it may be, there exists considerable additional work that is worthy of mention but which is not considered in this chapter.

Chapter 6, "Coalfield exploration", and Chapter 7, "Coal mining geology", both written by C.R. Ward, are both descriptive and comprehensive. In Chapter 6, Ward reviews all the possible stages required in a coal exploration program from the legal aspects to the technical principles of the Density Log used in down-hole logging and calculation of reserves and resources. Chapter 7 reviews the main methods of coal winning and geological and economic considerations that must be evaluated. Included is a discussion of stability problems in open-cut and underground mines and such aspects as outbursts and methods of measuring subsurface stress patterns are included. Regrettably neither Chapter 6 or 7 includes methods of quantitative analysis nor are any case histories or specific examples provided.

In Chapter 8, the different methods of coal preparation are summarized and a very brief overview of marketing considerations is provided by G.E. Edwards. The best sections in this chapter is the discussion of "Assessment of properties for coal preparation" and "Size reduction and size separation" which provide not only a review of the processes, but also methods of evaluating or testing the product. This chapter is rounded out by a purely descriptive treatment of methods of cleaning by density separation, surface properties and dewatering, storage and blending, coal transport and marketing.

Chapter 9, "Coal and Environment" written by C.R. Longworth outlines the impact of mining on the environment, requirements of environmental impact studies and data collection. Included in the chapter is a discussion of water quality control and coal refuse disposal.

The overall content of *Coal Geology and Coal Technology* is excellent; no other book presently in print in English brings together so many aspects of coal geology and exploitation. The bringing together of seven authors with expertise in complementary areas has considerable merit in principle but in this book, has resulted in a very uneven treatment which may reflect a lack of editing or co-operation between the authors. Interestingly, the chapters written or co-authored by Ward are the most readable and comprehensive in the book. A major shortfall of the book is the lack of examples or case histories and absence of quantitative considerations. The references are strongly biased toward the Australian literature and some major works such as *Chemistry of Coal Utilization* edited by Elliot are notably missing. I found that in general the book fell in the crack between being too technical for the novice reader and not technical enough for the experienced coal geologist or technologist. One of the most disappointing aspects of the book is the poor reproduction of the photographs which is of particular importance to Chapter 3. The quality of line drawings is generally good and the number of typographical errors is not excessive. The binding of the copy of the book that I was given to review was of such poor quality that pages began to fall out before I reached page 250. Hopefully, the copy of the book I was given was an exception; possibly bound on a Friday afternoon or Monday morning?

In summary, *Coal Geology and Coal Technology* provides an overview of almost all major aspects of coal that are of interest to the geologist or coal technologist. The value of the book to the geologist is not in the chapters dealing with geology but rather in those chapters of more peripheral interest such as coal preparation and utilization. In fairness it must be noted that a mineral process engineer reviewing the book would likely suggest that the chapters on the geological aspects of coal are the best and the mineral processing sections the most lacking: such is the destiny of a multidisciplinary book. Even with its many shortcomings *Coal Geology and Coal Technology* is the best (and only) book on the market that covers the broad field of coal technology and geology. The book is too expensive to use as a text for undergraduate students but should be required reading and is a must buy for industry libraries.