Geoscience Canada

Book Reviews / Critiques

Volume 12, numéro 2, june 1985

URI : https://id.erudit.org/iderudit/geocan12_2br01

Aller au sommaire du numéro

Éditeur(s)

The Geological Association of Canada

ISSN

0315-0941 (imprimé)
1911-4850 (numérique)

Découvrir la revue

Citer ce compte rendu

(1985). Compte rendu de [Book Reviews / Critiques]. *Geoscience Canada*, *12*(2), 76–82.

Book Reviews / Critique

Jan Veizer, *The Chemical Evolution of the Atmosphere and Oceans*
by H. D. Holland / 76

W. O. Kupsch*, Geology Emerging*
by Dederick C. Ward and Albert V. Carozzi / 77

William A. S. Sarjeant, *The Great Chain of History: William Buckland and the English School of Geology 1814-1849*
by Nicolaas A. Rupke / 77

Glynn N. Wright, *Introduction to the Petroleum Geology of the North Sea*
edited by K. W. Glennie / 79

Walter A. Glooschenko, *Lake Sediments and Environmental History - Studies in Paleolimnology and Paleoecology in Honour of Winifred Tutin*
edited by Elizabeth Y. Haworth and John W. G. Lund / 80

Emlyn H. Koster, *Modern and Ancient Fluvial Systems*
edited by J. D. Collinson and J. Lewin / 80

N. Eyles, *Scotland's Environment During the Past 30,000 Years*
by R. J. Price / 81

Rolf Ludvigsen, *Trilobites in British Stratigraphy*
by A. T. Thomas, R. M. Owens and A. W. A. Rushton / 82

Book Reviews

The Chemical Evolution of the Atmosphere and Oceans

By H.D. Holland
Princeton University Press
582 p., 1984, $75.00 cl., $24.50 pa.

Reviewed by Jan Veizer
Derry Laboratory, Department of Geology
University of Ottawa
Ottawa, Ontario, K1N 6N5

This book is a sequel to *The Chemistry of the Atmosphere and Oceans*, published in 1978. In contrast to the 1978 volume, which dealt largely with the present day (and to some extent Phanerozoic) steady-state, the new book deals with the questions of how and when the modern system evolved. In accord with such a mandate, the first chapter is an abbreviated and generalized discussion of the origin of the solar system. This is followed by three chapters dealing with theoretical scenarios prior to the oldest preserved rock record, that is, with the interval of 4.5 – 3.8 billion years ago. The analysed topics include inputs to the earliest atmosphere, rates of release and recycling of volatiles, and the chemistry of the early atmosphere and oceans. The overall proposition is that the bulk of the terrestrial atmosphere and hydrosphere was released by internal degassing coeval with, and subsequent to, formation of the core: the oxidation state of gases controlled by equilibria with basaltic magmas. The release of juvenile volatiles was faster on the early Earth, with recycling playing a progressively more prominent role in the aging planet. This early atmosphere was much less reducing (only trace quantities of CH_4 and NH_3) than it was previously believed from consideration of the origin of life. This belief was a consequence of experimental work which showed that the yield of organic compounds diminishes in less reducing environments. Furthermore, life had already originated and evolved during this stage. The chemistry of the oceans was probably similar to that of today.

The fourth chapter deals with acid-base balance, that is, the amount of volatiles (acids) required to titrate sediments (bases) throughout geologic history. The author concludes that the degree of titration of sediments is comparable throughout the whole geologic history, and this leads to actualistic interpretation of the nature of the atmosphere-hydrosphere system since 3.8 billion years ago. This, in Holland's view, is confirmed also by the carbonates and clays, which chemically show only minor variations during geologic history. The variations in isotopic composition of sediments are accepted, but the magnitudes and implications are consistently downplayed. It is some sections of these two chapters, and of chapter 8, which are amenable to alternative interpretations. The fact that the degree of titration is comparable throughout geologic history is a problem rather than a solution. The sedimentary cycle is approximately 65%-90% cannibalistic, and the bulk of the sedimentary mass was likely generated in the late Archean. This was, therefore, the time when the bulk of titration must have been accomplished and the supply of volatiles must have been, therefore, more proficient than during the subsequent geologic history. Alternatively, sediment titration is internally buffered by the rock itself, thus giving equal degree of titration. In such a case, the nature of the coeval atmosphere and hydrosphere would be of secondary importance. Contrary to assertions in the book, the analytical data for early Precambrian and Phanerozoic carbonates show clear differences in chemical and isotopic (e.g., Fe, Mn, $^{87}Sr/^{86}Sr$, $^{18}O/^{16}O$) composition, although the meaning of these observations is open to interpretation. Furthermore, the chemistry of polycomponent clastic sediments is, in my opinion, clearly dominated by provenance and they are not, therefore, a suitable indicator of the nature of the coeval atmosphere-hydrosphere system. Their relatively conservative chemistry throughout geologic history is probably a reflection of the high degree of cannibalistic recycling. Chemical changes are usually discernible only during reworking of first cycle clastics into mature polycycle sediments; such evolution was particularly evident during the late Archean – early Proterozoic time interval.

Chapters 7 and 8 deal with the perennial question of oxygen levels in the atmosphere-hydrosphere system during the Precambrian. The chapters review the evidence from paleosols, mineralogy of uranium-gold paleoplacers and chemistry of marine chemical sediments. Compared to the situation of a few years ago, the existence of some free oxygen since at least 2.7 billion years ago is considered likely, and the overall P_{O_2} is a consequence of supply and demand in a dynamic system. Thus, the thermodynamic arguments, with their absolutist consequences of an anoxygenic early milieu, are largely abandoned. I believe that this new, and generally accepted, dogma represents a significant conceptual advance. The discrepancy in selection of data (e.g., the previously discussed Mn, Fe in carbonates) is of minor significance for such understanding.

The last chapter deals with the composition of the Phanerozoic atmosphere and oceans. Due to the availability of data, and due to ubiquitous geologic record, this eon is treated in the most authoritative manner. Utilizing the mineralogy of evaporitic sequences, Holland shows that major element composition of seawater did not fluctuate widely. In contrast, isotopic composition did, as is clearly shown by the covariance of S and C isotopic curves. This covariance links C-O-S exogenic cycles in a redox balance. Data not available to Holland now confirm that Sr isotopes and Vail's "sea level" curves also track the S and C isotopic curves. This shows that tectonism is the forcing function of seawater chemistry on a time scale of $\geq 10^7$ years and that the terrestrial exogenic system is strongly buffered by interaction of many elemental cycles.

Technically, the book is written and illustrated well. However, compared to the first volume, it appears to have been produced in a more restrictive time frame. This results in misquotation of several references, incorrect cross-referencing of figures and text and incorrect citations.

Overall, despite some differing points of view, I think this is an excellent book and a must for anyone interested in the origin and evolution of the terrestrial atmosphere and hydrosphere. The book is recommended not only to geologists, but also to atmospheric scientists and oceanographers. For these, it can provide an appreciation of the geological perspective in dealing with widely discussed issues, such as the CO_2 greenhouse or acid rain.

Geology Emerging

By Dederick C. Ward and Albert V. Carozzi
Graduate School of Library and Information Science
University of Illinois
565 p., 1984, $35.00 US; paper

Reviewed by W.O. Kupsch
Department of Geological Sciences
University of Saskatchewan
Saskatoon, Saskatchewan S7N 0W0

The rather lengthy subtitle, which reads *A Catalog Illustrating the History of Geology (1500-1850) from a Collection in the Library of the University of Illinois at Urbana-Champaign*, may well have the effect of scaring potential readers away from *Geology Emerging*, a title that promises insights into the early developments of geology as a science. That would be a pity, indeed. The volume is more than a mere listing of old books on geology held by the University of Illinois and unlike, for instance, a telephone book, well worth reviewing and calling to the attention of all geologists having an appreciation for the history of their science.

In the early 1950s, the library of the University of Illinois began to acquire books important to the history of geology. The driving force behind this systematic program toward building perhaps *the* outstanding collection on the history of geology was Dr. George W. White, then head of the Department of Geology. Again, it was George White, together with his wife Mildred, who made *Geology Emerging* possible through their joint generosity toward its publication.

After the Acknowledgements and an "Introduction to the Catalog", the book devotes 29 pages to an "Introduction to the Collection". These pages inform the reader how the collection was built: "White's numerous visits to book dealers in North America and Europe for almost 30 years, and his extensive correspondence with them were instrumental in the acquisition of many of the titles." Also, they contain the authors' statement of purpose: "Our first task as historian of geology is to understand the man and his work in the context of his time, namely his training, his regionalism, his potential of observation, his preconceived ideas, his social and religious constraints."

The "Introduction to the Collection" then reviews the library holdings under the following headings: Lapidaries and Museum Catalogs; Mining and Metallurgy; Mineralogy and Petrology; Paleontology; Theories of the Earth; Seismology; Volcanology and the Origin of Basalt; Structural Geology; Hydrology; Engineering Geology; Marine Geology; Glaciology; Coal and Petroleum Exploration; The New World; and some unusual items not easily categorized. Under each of these headings is a short review of the pertinent literature in the period 1500-1850. Thus the reader is introduced to the writings of the philosophers, naturalists, geognocists, geologists and physical scientists of the time. Here are all the great writers of the past. Illinois' collection is so complete that few are not to be found. By reading this Introduction one becomes acquainted with the names that matter, particularly because they physically stand out on these pages, having been typeset in capital letters. Here are some of the most familiar: Theophrastus, Albertus Magnus, Aldrovandi, Gesner, Scheuchzer, Woodward, Buffon, Lamarck, Agricola, Lehmann, Werner, Hooke, Steno, Boyle, Wallerius, Jameson, Bergman, Hauy, Dana, Palissy, Beringer, Buckland, Cuvier, D'Orbigny, Descartes, Kircher, Leibniz, Arduino, Pallas, Hutton, Lyell, Humboldt, Dolomieu, Guettard, Faujas de Saint-Fond, Desmarest, Von Buch, Scrope, de la Beche, Sedgwick, Murchison, Conybeare, Omalius D'Halloy, Perrault, de Saussure, Playfair, Agassiz, Rogers, Maclure, Emmons, Eaton, Silliman, Schoolcraft, Hall, Hitchcock, Dana, Darwin.

Why list all these names here? It is not because name-dropping is a pastime I indulge in more than most, or because it is a case of hero-worshipping. It is merely recognition of the work of our predecessors, an acknowledgement of their contribution to the science of geology. Every geologist most likely will identify to at least some extent with those who grappled with the same problems that confront us in our own fields of research. As the authors of this book put it: "We believe that the history of geology is nothing more than a succession of different interpretations of the same phenomena and facts."

The catalogue itself comprises 2380 entries, arranged alphabetically. Each entry gives the name of the author (in full, with dates of birth and death for the first listing; surname only for following listings), the title of the work (usually in full; only excessively long titles are shortened by inserting ellipses), the place and year of the publication and the publisher. All this is in conformity with the Library of Congress format, as are the call numbers of the books in the University of Illinois' Library, which are also given.

The 107 illustrations are nearly all reproductions of the unique title pages, not of frontispieces or plates within a work, some of which are repeated in many books. The cover artwork shows part of the frontispiece of Dezallier D'argenville's *L'histoire naturelle eclaircie dans une de ses parties principales, l'oryctologie... 1755.* In the text the authors refer to this volume as having "the most spectacular illustration of fossils". I found this a gratifying remark, as it refers to the one book from my small personal collection which always lies on the desk in my study. It is there to be looked at and to remind viewers of the past. So is *Geology Emerging*.

The Great Chain of History: William Buckland and the English School of Geology 1814-1849

By Nicolaas A. Rupke
Clarendon Press
(distributed by Oxford)
335 p., 1983, $56.25

Reviewed by William A.S. Sarjeant
Department of Geological Sciences
University of Saskatchewan
Saskatoon, Saskatchewan S7N 0W0

The name of William Buckland is an honoured one in the history of geology and yet most geologists, if taxed, would find it hard to recall quite why it is thus honoured. They might remember, perhaps, that he was first Reader of Mineralogy at the University of Oxford and subsequently that University's first Professor of Geology. They might recall that, in his day, Buckland was rated an outstanding teacher. Possibly they might associate him with the foundation of the University Museum or remember that he was President of the Geological Society of London in 1824, when it gained its royal charter. Yet, as to his precise achievements in geology their ideas would be, in all probability, rather hazy.

It is easy to recall the reasons for fame of a scientist who, throughout his life, was associated with one specific line of investigation. It is much less easy to master in memory those of a scientist whose achievements were diverse. Instead, one tends to select the particular achievement that is readily memorable and forget about his others. Thus, in the case of Charles Darwin, most people remember the massive

achievement represented by his *Origin of Species by Means of Natural Selection* (1859); they forget his contributions to South American geology, to the elucidation of the climbing habits of plants and the fertilization of orchids, to our understanding of coral reef development and of the formation of soils by the action of earthworms.

William Buckland presents the particular problem that he was a scientific polymath among whose towering attainments no single one out-tops the others. In consequence, though his eminence in science is admitted, the reasons for that eminence tend not to be remembered clearly. Moreover, he has not been especially fortunate in his biographers. His son Frank's memoir is brief and was published rather obscurely in a late edition (1858) of his father's by then outdated Bridgewater Treatise on *Geology and Mineralogy*, while the belated biography of Buckland's daughter Mrs. Gordon (1894), light and pleasant reading, leaves much unrecorded and even more treated inadequately. Buckland has had no subsequent biographers and only his studies of bone-caves have attracted much attention in recent years. A wider-ranging assessment of William Buckland's achievements is long overdue.

This new work goes a long way toward providing such an assessment. It portrays Buckland at the height of his power and influence, when not only undergraduate students but also senior members of the University of Oxford crowded his lecture rooms (p. 64). This was in part because he was a superb teacher, with a mastery of vivid phrase and (more surprisingly, perhaps) a strong, sometimes rather crude sense of humour (p. 7); but there were other reasons also. First of all, during the period between about 1818 and 1835, Buckland was truly at the forefront of geological thought. Secondly and equally importantly, he had succeeded – or so many of his contemporaries felt – in linking geology with scripture and thus in finding for science a place within the framework of a University whose concerns hitherto had been essentially classical and theological. In so doing, as Rupke demonstrates very convincingly, Buckland brought into being a school of geology that was distinctly English.

Buckland's achievements within geology were indeed wide-ranging. He was, as Rupke states, "at the centre of English stratigraphy" (p. 128), producing a stratigraphical column for the British islands whose "Secondary" (Mesozoic) portion, at least, has stood the test of time. He strove to link English with foreign stratigraphy, believing – contrary to the opinion of such contemporaries as Greenough and Kidd – that it would be possible to establish a standard stratigraphy for the whole world. He was concerned also with landforms, studying in particular the great Axmouth landslip of 1839, writing on the work of rivers in the excavation of valleys and recording the occurrence of rain and ripple marks in ancient rocks.

Though their bones had been illustrated earlier without comprehension, it was Buckland who first recognized as a reptile, described and named one of the giant extinct creatures we now call "dinosaurs". He contributed significantly to early work on fossil marine reptiles and he described what is still the most primitive known pterodactyl, *Dimorphodon*. He wrote also on fossil fishes, ground sloths and elephants. When C.G. Ehrenberg demonstrated the importance of microfossils as rock-forming agents, Buckland was one of the first not only to hail, but also to apply, that work (p. 107).

Even more importantly, perhaps, it was Buckland who was the true pioneer of paleoecology. Not only did he describe for the first time fossil excreta and name them "coprolites", but also he demonstrated that they gave clues to the intestinal structure of the creatures that had produced them (p. 140). Not only did he perceive that bone accumulations in caves might be produced by scavengers but also he showed, by study of a living hyena, that the bones themselves furnished direct evidence of such an origin (pp. 33, 35). Not only did he recognize that fossil vertebrate footprints gave evidence of early life on land, but also he conducted experiments to show how they might have formed by setting tortoises walking on dough (p. 143-144). Not only did he note fossil tree stumps that had been preserved upright in the position of their growth, but also he understood the significance of seat earths, recognized that the plants of the Carboniferous bed had been colonizers of mudflats, and perceived that coals could be formed *in situ*.

Buckland was not always correct in his initial interpretations, but he was willing to accept new ideas provided that they were bolstered by good evidence. He had been the prime advocate of the idea that Noah's flood had formed the drift deposits so extensively to be seen in Europe; indeed, it was he who had defined "diluvium" and "alluvium" and formulated the threefold division into "antediluvial", and "diluvial" and "postdiluvial" (= alluvial) (p. 38). Yet, when Louis Agassiz came to Britain to promulgate his glacial theory, it was Buckland who became the prime convert to these revolutionary ideas (p. 99), seeing the Ice Age as the "grand key" to a whole range of problems to which his earlier idea of a huge tidal wave could provide no satisfactory answer (p. 96).

Concerning Buckland's success in bridging the gap between theology and geology, and in making the latter discipline respectable at Oxford, Rupke writes:

> "At one stroke Buckland brought into Oxford a theory of geology which asserted its own authority over successive periods of earth history, but which, in the form of diluvial geology, acknowledged the validity of textual evidence for the period of human history where the two subjects overlapped. In this context emphasis on the geological reality of the deluge was not just an affirmation of religious belief, but a demonstration of academic credibility. The weight of authority of Oxford's scholarly tradition was so great that failure by geology to corroborate the deluge, an event about which so much textual and testimonial evidence had been collected, would simply have discredited the new subject. In other words diluvial geology was modern geology presenting its credentials to a university where humanistic learning reigned supreme." (p. 58-59)

Whilst the concepts of diluvial geology were soon to become controversial and to be abandoned, their importance in enhancing the status of science in general and geology in particular can scarcely be overstressed. Though a tide of fundamentalist criticism was, as Rupke shows, later to rise against Buckland (p. 216-217), it was never to undermine the foundations he had laid for natural sciences in Oxford. Even when the publication of Darwin's theory caused a renewed and more bitter conflict between science and religion, those foundations were to remain unshaken.

The English school of geology, at whose centre Buckland stood (p. 128), was in many ways different in attitude and orientation from the earlier Scottish school, in which Hutton and Jameson were prominent and which was centred in Edinburgh. Scottish writers argued that geology and theology should be kept apart (p. 83); the English school found a bridge between them. Scottish geologists were concerned primarily with Paleozoic strata and, in particular, with the igneous and metamorphic rocks of the Precambrian; they were most interested in the processes by which rocks formed and the minerals which they contained. (Canadian geology, incidentally, is very definitely a growth from this Scottish stock.) The English geologists were presented with what is arguably the finest display of Secondary (Mesozoic) and Tertiary (Cenozoic) strata in small compass anywhere in the world. In consequence, as Rupke points out, "The study of fossils, rather than of minerals, had been a root cause of the success of English geology" (p. 182) with the consequence that "Buckland and his school were first and foremost historical geologists" (p. 190). The distinct character of this school was clearly recognized at the time of its existence, but has since been forgotten; Rupke does well to remind us of it. In contrast, the earlier primacy of Edinburgh, and the strength of the Scottish tradition that led through to

Lyell and uniformitarianism, has never slipped into the abyss of forgetfulness. Why this neglect of the English school? Could it be, perhaps, because Britain's foremost historian of geology in the late nineteenth century, Sir Archibald Geikie, was himself a Scot?

Buckland had no patience with humbug, even if propagated in the name of religion. When in Palermo, Sicily, he

> "visited a grotto supposed to contain the bones of Rosalia, the patron saint of the city. He immediately recognized that the bones were those of a goat rather than a woman, whereupon a scandalized clergy had the relics enclosed in a casket" (p. 68).

Of his wide range of interests and attainments outside the field of geology, only passing mention needs to be made here. Buckland was a strong advocate of scientific education outside universities, serving as first President of the British Association for the Advancement of Science (pp. 70, 242, etc.) and helping to found the School of Mines in London. He was a great believer in technological advances, serving as Chairman of the Oxford Gas, Light and Coke Company (p. 13). He demonstrated the use of mineral fertilisers on land and was concerned with land drainage, so effectively acting as publicist for science in agriculture that he was made an honorary member of the Agricultural Society (p. 274). His contributions to the design of London's sewerage system and to the development of its water supply were among the factors that gained for him honorary membership in the Institution of Civil Engineers (p. 274). He was a founder of the Zoological Society of London, kept many animals and was an adventurous eater of the meat of unusual creatures (such as crocodile!). His concern with archaeology was not confined to caves, but included also the excavation of barrows (p. 95). His interest in literature led him into correspondence with poets such as Southey and Tennyson and a personal friendship with novelist Wilkie Collins; indeed, there were few major figures in any field of Victorian endeavour who were not known personally to Buckland. In part as a consequence, in part because of his contemporary fame, no geologist has been so celebrated in verse and cartoon as was William Buckland.

Rupke expresses views that may scandalize some readers, though never without expressing excellent reasons for holding them. He believes that "The modern perspective of earth history owes little to Scottish geology" (p. 5) and that "The common notion that modern geology originated with uniformitarianism is a hindrance to the unencumbered study of the origin of the new geology" (*idem*). He notes also the belated appearance and artificial nature of "The Smith Cult", which has caused William Smith inappropriately to be placed on a high pedestal as "the Father of English Geology" (p. 191-192) – a title to which G.B. Greenough and James Parkinson can lay at least equal claim.

Rupke's decision to place the generic names of better-known fossils in Roman type is explained in his note "Citation", but this reader, at least, found this procedure irritating and, at times, confusing. (What was meant by "the mammalian didelphys" [p.186]: is there, then, a *non*-mammalian didelphys?). There are a few errors: German geologist Ami Boué (1794-1881) is miscalled "Aime Boué" (p. 126) and the genus of giant ground sloth first described by U.S. president Thomas Jefferson is misnamed "megalonix" (p. 132). Proofreading has been good in general, and I noted only three residual errors (on pages 17, 38 and 163). Rupke's writing style is lucid, especially considering the difficult concepts that he is striving to express, and his cross-referencing to sources is excellent.

All in all, this work constitutes a valuable reassessment of the contribution to the development of geology not just of Buckland himself, but also of the other English geologists of his period. May we hope that it will serve as prelude to a new, fuller biography of that extraordinarily talented scientist and to other studies of his scientific contemporaries?

Introduction to the Petroleum Geology of the North Sea

Edited by K.W. Glennie
Blackwell Scientific Publications
236 p., 1984, $31.00 US

Reviewed by Glynn N. Wright
Canadian Superior Oil Ltd
355-4th Avenue S.W.
Calgary, Alberta T2P 0J1

This paperback book is the outcome of courses arranged by JAPEC, a group sponsored by the Geological Society of London, the Petroleum Exploration Society of Great Britain and the Department of Geology at Imperial College, London. The publication concentrates on the UK section of the North Sea, and is full of information and ideas about exploration there. It is easy to read, stimulating and reports the results of the first twenty years of exploration. The diagrams, maps and sections are black and white, and most are very clear, although some maps would have been more useful with a latitude/longitude grid along each edge.

The book contains ten chapters by nine authors, including the editor, Ken Glennie. The writers are drawn from major oil companies, government, university and consulting organizations. Each chapter has a well documented list of selected references; the complete index includes groups of items (such as geographic locations, stratigraphic units, etc.). This organization has both positive and negative effects on the reader who is searching for an item.

After a historical first chapter, the book progresses from the structural framework of the region, via concise, but not dry, descriptions of the post-Permian periods and is completed by a chapter on source rocks and a summary of the hydrocarbon plays.

In the chapter "Petroleum Geology in North Sea Exploration, 1964-1983" the scene is viewed from economic, political, scientific and technical sides. Included are giant fields, like Groningen, discovered in 1959 with 86 trillion cubic feet (measurements include S.I. and the Imperial System), and Ekofisk, for example, with over a billion barrels. Field and play development is shown as it relates to seismic advances (processing and shooting), unit price, and government licensing.

Penetrating the pre-Lower Cretaceous offered another threshold, and gave rise to deeper plays, although the Carboniferous and Devonian are yet to be thoroughly evaluated. Geological dating and integration of palynopaleontological data and environmental data are discussed, as well as the technical drilling and completion problems in the deeper and more extreme environment of the northern North Sea. This approach gives the reader a feel for the factors considered in major exploration ventures.

Alternate explanations are often given for geological problems, which stimulates the reader and demands thought. Typical oil industry display techniques are used to advantage, including correlation of lithology (including source rocks) with gamma-sonic logs.

The section on the Jurassic is properly allotted more space than are other periods. The chapter on source rocks provides an overview of the analytical techniques and problems associated with quantifying the various data types, and is very well illustrated. It encourages an appropriate emphasis on understanding the timing of migration and the development of the potential traps.

The tremendous variety of geology in the region is amply illustrated and, of course, the contrast with Western Canada is enormous in terms of reservoir age and the significance of tectonics, including halotectonics. I was, however, moved to a wry smile with this sentence: "Appraisal of early discoveries has revealed that there is often

an element of stratigraphic trapping in prospects which were originally considered to be structurally closed". Surely that's the norm!

The book does what it sets out to do, and excels. However, I would have liked to see some more seismic illustrations.

Lake Sediments and Environmental History – Studies in Paleolimnology and Paleoecology in Honour of Winifred Tutin

Edited by Elizabeth Y. Haworth and John W.G. Lund
University of Minnesota Press
441 p., 1984, $55.00 US

Reviewed by Walter A. Glooschenko
Aquatic Ecology Division
National Water Research Institute
P.O. Box 5050
Burlington, Ontario L7R 4A6

Professor Winifred Tutin, to whom this book is dedicated, is a pioneer in the study of post-glacial vegetation history and lake developmental history. The book consists of 14 chapters dealing with various topics in paleolimnology and paleoecology written in her honour. Of the total, six chapters emphasize the role of pollen and plant macrofossils in elucidating lake histories, with other chapters dealing with topics of inorganic geochemistry of lake sediments, organic geochemistry, sedimentary indicators of environmental change, ^{210}Pb dating, radionuclides, paleomagnetism, algal remains in lake history interpretation and a chapter on ecological theory applied to lacustrine ecosystems. This latter chapter by E.S. Deevey, Jr., entitled "Stress, strain and stability of lacustrine ecosystems", is for me a highlight of the book, covering important processes that influence the developmental history of lakes with reference to modern ecological thought.

Another valuable chapter is the review of F. Oldfield and P.G. Appleby, "Empirical testing of ^{210}Pb-dating models for lake sediments". This important geochronological tool is available for determining the impact of human activities on lake history over the past 150 years. The chapter on paleomagnetism, by R. Thompson, discusses a technique rarely applied to lake sediments, but he unfortunately discusses little of its application to lake history interpretation. The paper by D.R. Engstrom and H.E. Wright, Jr., deals with chemical stratigraphy of lake sediments, reviewing mostly major elements, including Al, Na, K, Ca, Mg, Fe, Mn, P and Si along with their inherent biological interest. Unfortunately, contaminants such as trace metals are neglected in this chapter. The chapter by P.A. Cranwell makes use of organic geochemical techniques to determine the role of pentacyclic triterpenes as indicators of the input of organics from higher plant families into lakes. This new approach is of potential interest in evaluating changes in land use around lakes.

Eight chapters emphasize the use of pollen, algae, plant macrofossils and fungi in the paleoecology of lakes. Of these, one deals with North America (New Hampshire, USA) and the rest with Europe (mostly the British Isles and one from Denmark). These chapters will probably be of specific interest to people living in the regions of study, but present approaches of interest to all readers.

The book is well edited, with very few errors. It will interest scientists working in the disciplines of paleolimnology and Quaternary paleoecology. However, I feel that these fields now have arrived at a point where such individual approaches have reached a limit. When will we see multidisciplinary teams study lake sediments by incorporating inorganic and organic geochemistry, radionuclide dating, microfossils and macrofossils all on the *same* core in conjunction with classical, sedimentological interpretation? Otherwise, how can one evaluate the use of different or new approaches in the paleolimnological study of lakes?

Modern and Ancient Fluvial Systems

Edited by J.D. Collinson and J. Lewin
International Association of Sedimentologists
Special Publication 6
Blackwell Scientific Publications
575 p., 1983, $56.00 US ($42.00 US for IAS members)
£28.00 Br. (£21 Br. for IAS member); paper

Reviewed by Emlyn H. Koster
Alberta Geological Survey
Alberta Research Council
4445 Calgary Trail South
Edmonton, Alberta T6H 5R7

Calgary – 1977; Keele – 1981; Fort Collins – 1985: this is the schedule of venues for the opening trio of international conferences on fluvial sedimentology. The advent of these specialist conferences and their proceedings' volumes capture the progress in a popular, interdisciplinary field of Earth Science where, paradoxically, it often appears that as more is published, a greater number of questions are raised than are resolved. IAS Special Publication 6 is a valuable sample of the approximately 130 papers which were presented during a memorable week-long meeting held at the University of Keele, England, during September, 1981.

River systems have long attracted attention because, apart from their major role in denudation of uplifted terrains and as focal landscape elements, ancient alluvial deposits host fossil fuels and potentially yield much paleogeographic information. In fluvial sedimentology, the current effort is mostly toward broad-based, interpretative studies of ancient alluvium to determine intra- and extra-basinal controls on facies and overall architecture. Continuing to play an important role are investigations of present-day aggrading rivers with unaltered regimes, and experimental or theoretical work on channel-flow-sediment interactions. With hydraulic engineers, and to a lesser extent geomorphologists, having laid the foundation for modern fluvial sedimentology, the Keele meeting followed its Calgary forerunner by attempting to attract an interdisciplinary attendance; however, this aim proved difficult to achieve.

The UK and Canada/USA each contributed a third of the volume's 44 papers, the balance having authorship in eight other countries scattered from western Europe to South Africa to Singapore. Grant-supported work at academic institutions accounts for three-quarters of the papers which are grouped, inappropriately in some cases, into four sections as follows: Hydrodynamics and Bedforms (4 papers); Present-Day Channel Processes (17 papers); Facies Models (18 papers); Economic Aspects (5 papers). These follow an introductory review by the co-editors, who provide useful remarks on the shifts in research philosophy since Calgary '77. A list of organizations sponsoring the Keele conference, "at the front of the volume" according to this Introduction, was unfortunately omitted.

The first two sections are a miscellaneous assemblage of flume experiments, engineering studies, geologic consideration of extreme flood events, geomorphological studies of process in a wide variety of upland, inhabited and remote settings, and some Pleistocene facies studies. The paper on anastamosed fluvial deposits by D.G. Smith (Calgary) rightly belongs in the section on Facies Models, where B.R. Rust and A.S. Legun (Ottawa) describe other examples of the same fluvial style. Collectively, the review papers by M.R. Leeder (Leeds), J.R.L. Allen (Reading) and E.J. Hickin (Simon Fraser) are useful critical accounts of current knowledge on the hierarchy of spatial and temporal interactions between flow and sediment relevant to facies modelling in ancient alluvium.

The section entitled "Facies Models" is likely to be the crux of the book for most readers, although not all its papers satisfy the current, more stringent definition of this term. Here, the papers are loosely arranged according to sediment coarseness and relative downstream distance. Authored almost exclusively by university sedimentologists, they deal with a wide variety of fluvial styles in mostly post-Paleozoic strata, and constitute a useful group of detailed and well illustrated outcrop studies. The interaction of fluvial processes with other transport agents near base level is an important emerging topic discussed only in the papers of A.B. Hayward (British Petroleum), S.A. Okolo (Keele) and J.R. Graham (Dublin). The discussion paper by P.F. Friend (Cambridge) on deciphering the form and process of paleochannels would have been better placed next to this section's introductory paper by A.D. Miall (Toronto), which outlines the multidisciplinary approach necessary for basin-scale analysis of alluvial strata. The last section of the book, which should have also included the earlier paper by B.R. Turner (Newcastle) and M.K.G. Whateley (South Africa), contains subsurface and outcrop examples, mostly by industry personnel, of the facies context of coal, hydrocarbons, placer minerals and uranium mineralization.

In relation to the reprinted CSPG Memoir 5, which arose from the preceding conference in Calgary, this publication is higher priced (in the case of IAS members) and of lesser overall value in terms of the variety, quality and potential impact of its contents. On the other hand, given the diversity of modern *fluviology*, no volume of proceedings can reasonably be expected to represent all its facets. This book is an important record of a stimulating conference, and will inevitably find its way into the personal libraries of most sedimentologists worldwide, where it will be viewed as a recent chapter in the development of their field.

Scotland's Environment During the Past 30,000 Years

By R.J. Price
Scottish Academic Press
Distributed by Columbia University Press
224 p., 1983, $41.50 US

Reviewed by N. Eyles
Department of Geology
K. Bennett
Department of Botany
University of Toronto
Toronto, Ontario M5S 1A1

The author states in his introduction that he has attempted a synthesis of the results obtained by a variety of specialists whose work contributes to an understanding of paleoenvironments in Scotland. As such, this glossy, large-format book is a first effort to do so, and will generate wide interest. How successful is it?

Dr. Price starts well enough by establishing the characteristics of Scotland's present environment. A useful historical review of past notions of climatic change in Scotland is balanced against the most recent compilations established from North Atlantic Ocean cores. The relative paucity of the terrestrial record before 30,000 years ago and the subsequent growth of the last ice sheet is clearly shown – hence the title of the book. Chapters on ice sheet history show how little is known of the last British Ice Sheet and demonstrate the importance of continued computer modelling of its growth and dynamics. A large part of the book reviews the geomorphological evidence for the activity of the ice sheet and its later history, but the treatment given here is distinctly uninspired. Price's treatment of glacial erosion and sedimentation in Scotland shows no evidence of his previous experience with modern glaciers and their sedimentary and geomorphological products; the topic should surely be home ground, but no new insights into reconstructing the Scottish environment are in evidence. Moreover, nearly all of his source material is the work of J.B. Sissons and his students, and leads to unfavourable comparisons with the several books on the glacial and late-glacial history of Scotland by Sissons.

The discussion of past vegetation during the complex phase of interstadial and stadial climates recorded prior to final ice sheet disappearance is also extremely weak. Despite a large amount of published work on Scottish late-glacial pollen stratigraphy, there is only one page of text on past vegetation of the interstadial, and one page on stadial vegetation, together with, respectively, three and two thumbnail sketch pollen diagrams. The absence of a stratigraphy from all pollen diagrams in the book is a serious omission. The late-glacial sections contain a few lines of generalization (without references) and then a few paragraphs of selected quotation and topics. The classic account of Birks is omitted from the interstadial section, and his sites missing from the relevant figures. There is no overview of the nature of pollen and how it is employed in pollen stratigraphy, which will make these sections amorphous and confusing to the non-specialist.

The descriptions of post-glacial vegetation are longer, but none the better for that. The author appears to be convinced that the Godwin pollen zones are synchronous representations of climatic change (p. 184). It has long since been shown that, first, Godwin pollen zones cannot be recognized in most of Scotland, and second, even where they are recognizable, they are not synchronous.

The chapter on "the last five thousand years" is dominated by discussion of the Elm-decline and its possible association with Neolithic clearances. Most of this is not relevant to Scotland's environment. The author gives only one example of a possible anthropogenic influence in the vegetation at this time (Braeroddach Loch), and this is unconvincing because the description of changes mentioned in the text (p. 191) cannot be discerned in the accompanying pollen diagram (p. 192). The space would have been much better used with an account of the pine-decline that occurred about 4,000 years ago in the Highlands, and the associated spread of blanket peats. These were much more significant events in Scotland than the Elm-decline.

These criticisms, by reviewers familiar with the research areas summarized by Dr. Price, do not substantially devalue the worth of this book. It is the first attempt to bring a multidisciplinary approach to the presentation of Scottish environments over the last 30,000 years, and the author needs to be commended for his attempt.

The overall impression left after reading this book is that it is aimed at an exceptionally broad market, from the layman, the nephew at Christmas, to the researcher. Certainly everyone will find something of interest; for the researcher it could be a useful source book despite its shortcomings, and for the layman there are new perspectives offered by satellite photographs and by simple syntheses of a large and complex literature, but the high cost of the book will be a discouragement to most.

Trilobites in British Stratigraphy

By A.T. Thomas, R.M. Owens and A.W.A. Rushton
Geological Society of London, Special Report No. 16
Blackwell Scientific Publications
78 p., 1984, $17.50

Reviewed by Rolf Ludvigsen
Department of Geology
University of Toronto
Toronto, Ontario M5S 1A1

To the biostratigrapher, Britain has a special significance as home turf of all the Paleozoic systems, save the oldest and youngest (Vendian and Permian, respectively, both established in the USSR). These rocks and fossils were early investigated by a small group of gentlemen and professional geologists, including such stratigraphic tyros as William Buckland, Henry de la Beche, Charles Lyell, Adam Sedgwick and Roderick Murchison, who shared membership in that granddaddy of all earth science associations – the Geological Society of London.

Stratigraphy has always been a major preoccupation of the Geological Society of London and, since 1971, it has been sponsoring an important series of reports dealing with the stratigraphy and correlation of each of the geologic systems represented in Britain. With the publication of Special Report No. 15 (*A Correlation of Jurassic Rocks in the British Isles, Part Two*), the entire stratigraphic column from the Precambrian to the Quaternary had been covered in a concise and authoritative fashion. The series has now been continued under biologic headings, starting with No. 16 – *Trilobites in British Stratigraphy*.

In this report Thomas, Owens and Rushton, whose joint expertise spans most British trilobites, take an inventory of all of the species of trilobites that occur in Cambrian through Carboniferous strata in Britain and Ireland and discuss their stratigraphic distribution. Twenty-four figures show the vertical distribution of nearly a thousand species, more than half from the Ordovician, plotted against different stratigraphic schemes of either zones, stages or formations. These massive tabulations and their supporting discussions in the text facilitate access to the extensive and often complex British biostratigraphic publications dealing with trilobites. The data compilations alone are worth the cost of admission. I, for one, was surprised to discover that the graptolite zones of the Ordovician and Silurian are equally well characterized by trilobites.

The core of this report is the figures showing species ranges. These figures, however, do not include all of the species. Those taxa originally placed in open nomenclature are excluded from the figures because of the "varying usage by different authors of such terms as 'cf.' and 'aff'." (p. 3). This is a curious explanation. Even neophyte taxonomists can distinguish *confer* from *affinis*. This exclusion means that trilobites such as *Ceraurinella* aff. *magnilobata* (the most abundant trilobite in the Lower Stinchar Limestone of Scotland) and *Calymene* cf. *marginata* (abundant in Cautleyan zone 1 in England) do not appear in the range charts. Also excluded from the range charts are those species represented by a single specimen or at a single locality, because these species do not possess stratigraphic ranges. They are separately included in long annotated lists. Such species may not have ranges as such, but this is a trivial point of semantics because each certainly represents fossils collected at a locality. The simplest way of recording that occurrence is as a dot on a range chart. By separating the range and occurrence data between the charts, text and lists, the authors leave the task of reuniting this data to the reader.

A serious shortcoming of this report, at least to a non-British reader, is the absence of biostratigraphic syntheses and of correlation charts or, indeed, the lack of any figure which provides a broad overview of the distribution of British trilobites or of how they relate to overseas distributions. One figure does compare Cambrian zonal schemes of North America, Europe, Asia and Australia, but without any mention of British trilobites or British zones.

Thomas *et al.* state that this report is a summary of available knowledge of the stratigraphic distribution of British trilobites. This is not quite true. There is one dimension of the stratigraphy of trilobites that is barely touched – the spatial dimension. All of the charts show *vertical* distributions of trilobites. None of the twenty-four, however, is devoted to *lateral* distributions of trilobites in terms of biofacies or provinces. For example, the vertical distribution of the rich Wenlock trilobites faunas is well displayed in Figure 23. By contrast, the lateral differentiation is quickly passed over with the comment, "Thomas (1980) has shown that the distribution of Wenlock trilobites is related to lithofacies" (p. 54). Surely, the lateral segregation of Wenlock trilobites is potentially as significant as their vertical segregation. This unequal treatment is difficult to understand because the authors of Report No. 16 are responsible for a number of important papers on trilobite biofacies in British rocks. Biogeography fares no better. One looks in vain for any display of the strong provinciality among British Lower Cambrian trilobites. Acado-Baltic trilobites of England are shown cheek-by-jowl with Laurentian trilobites of Scotland on the same range chart, as if the provinciality was trivial and Iapetus Ocean closed.

There is a wealth of information on the distribution of British trilobites in this volume and it (and subsequent volumes) will certainly find ready use by paleontologists who occasionally need to assess the faunas of the type areas of the Cambrian, Ordovician, Silurian, Devonian and Carboniferous systems – and that means *all* Paleozoic biostratigraphers.