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Book Reviews / Critique

Book Reviews

Quaternary Paleoclimatology — Methods of Paleoclimatic Reconstruction

By R.S. Bradley
Allen and Unwin, Inc., Winchester
472 p., 1985; $50.00 US, cloth;
$24.95 US, paper

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The opening sentence intimates that "*Quaternary Paleoclimatology* is intended as an introduction to methods used in reconstructing past climates from proxy data series", and it is clear that the book is designed for the use of both advanced students in the Quaternary Sciences and professionals in the several related disciplines that either generate or use paleoclimatic reconstructions. Professor Bradley has succeeded notably in this formidable task and his superb book will immediately take the leading place in the literature of the subject, far out-distancing existing volumes. He makes the point in the Preface that such a vast and complex opus might have been attempted by a team of specialists, but he has proved conclusively that one author with a comprehensive and up-to-date grasp of the field, can carry off this formidable task successfully. It has an excellent balance of treatment, depth, and critical rigour — features invariably lacking from the usual multi-authored reviews that clutter library shelves.

After two introductory chapters, on "Paleoclimatic Reconstruction" and "Climate and Its Variations", detailed accounts are provided, of the bases and selected results of all the relevant dating methods, ice core investigations, the marine sedimentary record, non-marine geological and biological evidence, pollen analysis, dendroclimatology, and historical data. The concluding chapter is a thoughtful and stimulating essay on the current status and future directions of paleoclimatology — a discipline that is developing rapidly in both its theoretical and applied dimensions. A thorough bibliography of over 1,000 references provides the reader with appropriate entries into the literature, up to 1982.

One of the several strengths of the treatment is that both the principles and the methods of a particular technique (e.g. ^{14}C-dating, lichenometry) are set out clearly and comprehensively so that the investigator using the results of such analyses can be completely aware of both the potentials and the limitations of the method. The author does not hesitate to call attention to the insecure foundations of certain methods (lichenometry) or the often overlooked limitations of others (pollen analysis). But this rigour is applied fairly, and always balanced by a final assessment of the realistic potential of the methods.

With one or two exceptions — Figure 5.4 baffles me, and the caption of Figure 6.16 should be more informative — the illustrations are most effective. Professor Bradley's style is admirably clear and consistent, and the text is virtually free of typographic errors. This sensibly priced compendium is an item essential to the library of every investigator, teacher and student of Quaternary Studies. It will undoubtedly become the core text for university courses in the subject, and it is likely that it will appear in several translations and that in several years Professor Bradley will be prevailed upon to produce a second edition as the field moves on. Ray Bradley deserves our thanks and congratulations for a magnificient achievement.

Sedimentology: Recent Developments and Applied Aspects

Edited by P.J. Brenchley and B.P.J. Williams
Blackwell Scientific Publications, Palo Alto
320 p., 1985; $60.00 US, cloth;
$31.00 US, paper

Reviewed by Andrew D. Miall
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Many sedimentologists will remember the influential, thought-provoking book *Evolving concepts in sedimentology*, put together by Bob Ginsburg in 1973 as a tribute to Francis Pettijohn. This excellent book has similar aims, and should be required reading of any sedimentary geologist attempting to keep abreast of developments in our exploding discipline.

The book had its genesis at a special 21st anniversary "coming of age" meeting of the British Sedimentological Research Group (BSRG) at the University of Liverpool in 1982. The history of development of North Sea oil has coincided almost exactly with the life span of BSRG and has contributed enormously to the growth of the discipline in that country. The increasing importance of sedimentary ore deposits has also had a major impact. The British "school" is therefore a considerable force to be reckoned with, as epitomized by the enormously successful textbook *Sedimentary Environments and Facies*, edited by Harold Reading, a Second Edition of which is breathlessly awaited at the time of writing.

At the BSRG 1982 meeting selected reviewers were invited to provide surveys of progress in areas of particular interest to British sedimentologists. Not all facies and environments are covered. For example there are no discussions of alluvial, lacustrine or coastal clastics (except in the context of North Sea hydrocarbon fields), and little mention of evaporites and deep water carbonates. But the twelve papers in the book cover a great deal of ground, and demonstrate the enormous distances we have travelled during the lifetime of BSRG. Work up to 1983 is

generally well-covered, with a few 1984 references included, and very little has appeared since to render these reviews out-of-date.

The first paper, by J.R.L. Allen, deals with selected topics in the area of fluid mechanics and clastic sedimentary processes. Some of Allen's elegant and instantly recognizable diagrams are used to illustrate the structure of vortices and streaks in turbulent flow, and the structure of the leading portion of turbidity currents. The review is selective, Allen himself having shown how large this subject has become in his two-volume tome, *Sedimentary Structures: their character and physical basis*.

Facies models and sedimentary environments are covered in six papers. The first, by R. Anderton, contains an excellent discussion of the theory and practice of facies analysis, including some useful ideas for field and laboratory procedures. The paper concludes with a historical summary that attempts to trace the main developments in sedimentological thought since the word was first coined in the 1930's. I.N. McCave's brief survey of recent shelf clastic sediments is probably the least satisfying paper in the book, focussing as it does on modern environments, particularly those in the North Sea. Much of the current excitement in this area is being generated by such workers as Walker, Swift and Bourgeois in studies of ancient shelf sediments in North America. The next paper, by D.A.V. Stow, covers deep-sea clastics, and manages to convey an impression of complexity and variability about this environment, while summarizing current knowledge in a series of useful block diagrams and vertical profile models. J.K. Leggett's paper, dealing with deep-sea pelagic sediments and paleooceanography is a tour de force that draws on the wealth of DSDP data accumulated during the last decade. By now it is a cliché that DSDP opened up a whole new world, but if anybody needed convincing of the range of new insights gained and of entire new subdisciplines developed as a result of this project, this is the paper to read. Fascinating ideas about the linkages between climate, sea level, plate tectonics, oceanic circulation, global geochemical trends and even paleomagnetism and mantle behaviour are starting to emerge. All of these are ably summarized in this paper.

R.J. Suthren reviews volcaniclastic sediments, a subject I know little about and will therefore pass over. The concluding article in this section is a thorough review of shallow marine carbonate facies and facies models by M.E. Tucker.

The next section of the book is entitled "Diagenesis", and contains two papers, one by J.A.D. Dickson on shallow-marine carbonates, and one by S.D. Burly, J.D. Kantorowicz and B. Waugh on clastic diagenesis. Both are illustrated with a set of beautiful colour photomicrographs. Dickson's paper focusses on methods of petrographic investigation, including staining, cathodoluminescence, and the use of ultrathin sections. Burley *et al.* review the wide range of laboratory techniques now available for diagenesis studies and discuss diagenetic models.

The final section of the book contains three papers on economic and applied aspects. H. Clemmey emphasizes the importance of sediment-hosted ore deposits and reviews the use of basin analysis methods in explaining their origins. H.D. Johnson and D.J. Stewart provide a lengthy review of North Sea oil and gas development and the role clastic sedimentology has played in this enterprise. The paper is illustrated by numerous examples taken from oil company files and, as a sedimentologist, I found it particularly satisfying to see how vital this subject has become at all levels of exploration and exploitation of the many subtle traps in the North Sea area, from initial wildcat drilling to detailed reservoir engineering studies. Much the same message is conveyed by T.P. Burchette and S.R. Britton in their analysis of a Cretaceous carbonate-hosted hydrocarbon play in the Middle East.

Research specialists will find the papers in their particular areas useful as surveys of recent literature from a British perspective. Those most likely to benefit from this book are academics, like myself, who are required to keep abreast of a broad range of subjects in order to teach effectively. The book is well produced, the errors are few and the price not too steep.

The Physiography of Southern Ontario, Third Edition

By L.J. Chapman and D.F. Putnam
Ontario Geological Survey, Toronto
270 p., 1984; $20.00, cloth

Reviewed by A.V. Jopling
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The Third Edition of *The Physiography of Southern Ontario* has been printed in revised and updated form by the Ontario Geological Survey as part of an Ontario Bicentennial Project. The revision was carried out by Chapman in collaboration with the staff of the Survey (Putnam died in 1977). Since 1951, Chapman and Putnam's *magnum opus* has served as a major reference work for geographers, geologists, engineers, planners and environmentalists in Ontario, and it has proved especially valuable for secondary school teachers and their students. Further, amateur naturalists interested in the landscape and geology of Southern Ontario have benefited greatly from its storehouse of information.

The volume was originally intended to provide a reference framework for the mapping, description and classification of Southern Ontario soils, but over the years it has served many other practical purposes. Thus it has been used in a general exploratory context for the location of sand, gravel and clay deposits, and for the location of groundwater supplies and the routing of highways (one gravel contractor, on being introduced to Dr. Putnam, is reported to have exclaimed "Happy to meet you, sir, I made half a million out of your book!"). More recently, Chapman and Putnam's data have proved useful in groundwater pollution studies.

The volume concentrates on a synthesis of regional geomorphology, surficial geology, rural land use and agriculture, but it also includes climatological/hydrological data together with some population statistics from the 1981 Canadian census. The emphasis is placed on landforms and land use as interpreted through bedrock geology (Precambrian and Paleozoic) and the constructional landforms of the Pleistocene. The Second Edition (1967) identifies 52 physiographic subdivisions in Southern Ontario, and the Third Edition incorporates another three based on Chapman's (1975) research in the Georgian Bay-Ottawa Valley areas.

The essential flavour of the earlier Editions has been retained in the Third Edition, but the latter includes a new wall-sized map drawn to a scale of 1:600 000. The original maps drawn at a scale of 1 inch to 4 miles are still available. The first part of the volume (as per the original format) is devoted to the "Bedrock" of Southern Ontario, the second to "Glacial Geology", the third to "Surface Features", the fourth to "Physiography", and the fifth takes the form of a "Summary". The same general headings/subheadings are used in the Third Edition, but the subheadings are printed in bolder type. The volume emphasizes morphology at the expense of stratigraphy and chronology, and it therefore lacks the specialized stratigraphic analyses found in the technical bulletins of the Ontario Geological Survey. Nevertheless the volume provides a succinct overview of the glacial geology of Southern Ontario with emphasis on Wisconsinian events.

This quality publication is attractively bound and the 86 photographs printed in sepia tone add lustre and interest to the text. In the preface to the publication the Director of the Ontario Geological Survey takes pleasure in commending the Third Edition to the reader; this reviewer does likewise. This impressive piece of work, written in a lucid and readable style, ranks as one of the classics of Canadian geomorphology.

Field and Theory: Lectures in Geocryology

Edited by Michael Church and Olav Slaymaker
University of British Columbia Press
229 p., 1985; $32.00, cloth

Reviewed by Hugh M. French
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Geocryology is the study of perennially frozen ground (permafrost) and the associated cold climate (i.e. cryogenic) conditions at the earth's surface. The Soviet Union, Canada, Alaska and the People's Republic of China, by virtue of their large areas underlain by permafrost, are the countries where geocryological studies are most fundamental. In Canada, rapid growth of permafrost science and engineering, together with related fields such as periglacial geomorphology, has occurred in the last 30 years. Today, Canada is regarded as a leader in many aspects of geocryology. At the same time, it is not exaggeration to state that the present situation owes much to the work of J. Ross Mackay. Awarded the Governor General's Northern Science Medal in 1984, and other prestigious academic honours previously, this outstanding geomorphologist has devoted the majority of his professional career to an understanding of the periglacial geomorphology and permafrost conditions of the Western Canadian Arctic. Although most well known for his research upon pingos in the Mackenzie Delta — conical ice-cored hills which occur and persist only in permafrost — he has also conducted a range of unique and sophisticated long-term studies including active layer movement, thermal contraction cracking, patterned ground and the history of permafrost and ground ice.

The present volume is a collection of essays resulting from a lecture series organized to commemorate his retirement from the Department of Geography at the University of British Columbia in 1981. It was there that he conducted a teaching career for over 30 years. The authors include some of the most eminent and internationally recognized authorities in the field of geocryology, and several former doctoral students. Collectively, they bear witness to the high esteem with which J. Ross Mackay is universally regarded. An introductory chapter by W.H. Mathews, his colleague and friend in the Geology Department at U.B.C., provides a personal insight into the working characteristics of the man. Then, papers by A. Jahn and A. Rapp, two of the more senior periglacial geomorphologists from Europe, stress the value of the quantitative, long-term field experimentation approach used by Mackay. The magnitude and frequency of geomorphic events is also stressed by B.B. Fitzharris in the context of avalanche hazards in New Zealand. Three papers follow which illustrate the theoretical and laboratory approach to permafrost studies: L.W. Gold discusses the ice factor in frozen ground from a geotechnical viewpoint, M.W. Smith provides a review of soil freezing theory, and S.I. Outcalt presents yet another numerical simulation model, this time for ice segregation. Two further contributions are by N.R. Morgenstern who summarizes recent work at the University of Alberta upon the deformation of ice-rich permafrost, and N.N. Romanovskij who presents ideas upon ice wedge classification and mapping approaches in the U.S.S.R. A final chapter is provided by A.L. Washburn who summarizes current problems and gaps in periglacial geomorphology. All are easy to read, although a good knowledge of physics and mathematics is necessary to fully understand several of the papers.

This is a book for the permafrost sophisticate and not necessarily the undergraduate student. The latter will merely see a number of rather unconnected essays. The student will read them primarily because of their authors' reputations, and because each chapter has definite intrinsic value, but rarely will the student comprehend why the volume is like it is. On the other hand, all permafrost sophisticates will have this volume in their collections. As the editors state in a brief introduction, the papers highlight the dichotomy between the realities facing field research in some of the harshest and most inhospitable environments of the world, and the inevitable limitations to science which are the result, and the laboratory and theoretical approach which provides control but often lacks the field test. Very few scientists have managed to bridge this gap as successfully as Mackay.

The volume is attractively presented and in general the editors have done a good job of melding what must have been a highly variable and wide-ranging series of lectures. However, there are the inevitable typographical errors, and several more serious weaknesses which detract from the usefulness of the book. Some of the more obvious include the inversion of Figure 4.4, the difficulty of comprehension of Figure 9.4 (not helped by the second paragraph of the previous page), and the omission of certain key references in Chapter 10. A more complete, accurate and up-to-date bibliography of Mackay and his work is also required since the bibliography supplied by Mathews is unsatisfactory and cannot be used as a reference source.

Hopefully, this volume will not be the only tribute to J. Ross Mackay. Of wider appeal might be a volume of essays each reviewing the current understanding of those aspects of geocryology where Mackay has made a major contribution: one thinks of frost mounds in general, thermal contraction cracking, active layer processes and patterned ground, and field instrumentation techniques. The entire role of geocryology in Canada, and its implications for Man, also need to be emphasized in such a volume. No doubt, all this will come; in the meantime, this volume is just one reminder that J. Ross Mackay continues to conduct frontier research in the same rigorous, exacting and outstanding manner as ever.

James Hector, Explorer

By Bruce Haig
"Following Historic Trails" Series
Alberta Historical Resources Foundation
102-8th Avenue S.E.
Calgary, Alberta T2G 0K6
51 p., 1983; $7.95, paper

Reviewed by William A.S. Sarjeant
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The name of Sir James Hector (1834–1907) is perhaps better known in New Zealand than in Canada, for the Scottish-born scientist was to spend the greater part of his career in that country, successively as Geologist to the Province of Otago (1861–1865), as first Director of the New Zealand Geological Survey (1865–1885) and as Chancellor of the University of New Zealand, Wellington (1885–1903).

Nevertheless, he is important also in the geographical and scientific exploration of our own country, having served as naturalist and geologist to the Palliser Expedition into the Canadian west from 1857 to 1860. As the author notes:

> "...Hector's geological observations and sketches became the basis of the first complete description and explanation of Canada's geological structure west of the Great Lakes. They also threw new light on the various stages of the earth's development and examined the comparative ages of rock and soil formations."(p. 6)

This little work presents in abbreviated form the day-to-day record of Hector's exploratory journey through the Rocky Mountains, along with sketched maps showing his route and many photographs, reproduced quite attractively in sepia. Certainly it will facilitate the adventurings of anyone interested in retracing the steps of the Palliser expedition's participants. Moreover, it deserves to be in the library of anyone interested in the history either of the explorations of our country or of its study by geologists, as giving a lucid and attractive picture of James Hector's own journeyings.

Proterozoic Geology: Selected Papers from an International Symposium

Edited by L.G. Medaris, Jr., C.W. Byers, D.M. Mickelson and W.C. Shanks
Geological Society of America Memoir 161, Boulder
318 p., 1983; $49.00 US, cloth

Reviewed by R.M. Easton
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Unimaginatively titled, this volume is a collection of 23 selected papers from an International Symposium on Proterozoic Geology held 18-21 May 1981 in Madison, Wisconsin. The volume is divided into five main sections: "Tectonics", "Magmatism and Metamorphism", "Mineral Deposits", "Life and the Oceans", and "Glaciation". The section on Tectonics (7 papers; 3 pro-plate tectonics, 1 non-uniformitarian; 3 non-plate tectonics) accounts for about one-third of the volume; Magmatism and Metamorphism (4 papers) and Mineral Deposits (5 papers) about one-sixth of the volume each; and the others (7 papers), the remainder. The editors provide a brief (1½ pages) overview of the volume. A companion volume, Memoir 160, includes papers on the Proterozoic Geology of the Lake Superior Region also presented at this symposium.

As is common in collections of papers of this type, the quality of the papers is uneven — some are excellent, others are simply a rephrasing of material already presented elsewhere. These problems are compounded by the fact that the volume contains two main categories of papers: (1) relatively short, timely (as of 1981) contributions designed to spur discussion on controversial topics in Precambrian geology (e.g. papers by Windley ("A Tectonic Review of the Proterozoic"); Kimberley ("Constraints on Genetic Modelling of Proterozoic Iron Formations"); and Cloud ("Aspects of Proterozoic Biogeology"); and (2) long review and summary papers on specific aspects of Proterozoic Geology (e.g. Anderson ("Proterozoic Anorogenic Granite Plutonism of North America"); Sawkins ("Tectonic Controls on the Time-Space Distribution of Some Proterozoic Metal Deposits"); and Harland ("The Proterozoic Glacial Record")). Papers of the first type are beginning to show their age, and would have probably been better presented as a more timely collection, for example, a series in a format such as Geoscience Canada. The second type is still useful, and would provide good supplementary material to any class at the senior undergraduate level or graduate level on Proterozoic Geology.

Since this is one of the few recent volumes on Proterozoic geology, some readers might consider it useful as a possible text on the subject. Unfortunately, the editors do not seem to address the book toward any particular audience. For example, although some of the papers in the Tectonics section are concise and well-written, little new material is presented here with regard to the debate on the nature of tectonic styles in the Proterozoic. Some of the review articles would be useful as textbook material on Precambrian geology, but the treatment of any one subject area is often incomplete, and the book is not properly balanced to be useful as a text. The discussion-type articles are useful, but again, coverage is unbalanced, and would have been better presented in a separate, more timely, format, particularly one that would have allowed for Comment and Reply. In addition, it is not clear how the papers were selected: was it on the basis of subject matter, theme, or simply by which authors met the required deadline for manuscript submission? This problem is not entirely the editors' fault, it is more a reflection of the problem of attempting to discuss two billion years of earth history as a comprehensive, and supposedly uniform package. The volume is also atypical of the GSA Memoir series, which previously has tended to publish either single author, comprehensive studies on a particular geologic subject or area; or collections of rather lengthy articles related to a specific area or field of geologic study. Volumes similar to this one have previously been published as GSA Special Papers.

If you do purchase this volume, do not buy it for the paper in your speciality, but rather, for those outside your area of interest. I found the papers on Proterozoic glaciation and biogeology to be more pertinent and interesting than some of those on Proterozoic tectonics and mineral deposits although the latter are my research interests. The volume is well-produced, contains few typographical errors, and figures are clear and legible. At $49 US, it is not a book I could recommend to all Precambrian geologists. Certainly, every library should have a copy, and, anyone who teaches Precambrian geology should try to obtain this volume simply because of the number of useful review articles (eight) in the volume. As a textbook for Proterozoic geology, the Second Edition of *Evolving Continents* by B.F. Windley is far superior, but could be easily supplemented with material from this volume. In summary, it is worth reading through many of the papers in this book, but it does not need to be on every Proterozoic geologist's bookshelf.

Early Proterozoic Geology of the Great Lakes Region

Edited by L.G. Medaris, Jr.
Geological Society of America Memoir 160, Boulder
142 p., 1983; $28.00 US, cloth

Reviewed by R.M. Easton
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This volume is a collection of nine papers relating to the Penokean Orogeny in the Great Lakes Region presented at a session held in conjunction with an International Symposium on Proterozoic Geology held 18-21 May 1981 in Madison, Wisconsin. It is a companion volume to Memoir 161, also resulting from the same symposium, but Memoir 160 suffers few of the flaws of that volume. To a large extent, this simply reflects the more restricted subject matter of the papers in Memoir 160. They deal strictly with the Penokean Orogeny, and as such, can delve into their subject matter in some depth. In addition, it is clear that this volume will be of most interest to geologists working in the Great Lakes Region, or learning more about that enigmatic orogeny known as the Penokean.

The first three papers of the volume deal in general with the tectonic development of the Penokean fold belt as well as tectonostratigraphic relationships within the belt. Emphasis in these papers is on models of how the foldbelt developed, and its tectonic regime, more so than on the geology of the region. This is the only real flaw of the volume — it assumes a fair knowledge of the geology of the area. This may be acceptable for workers in the region, but for foreign readers it might prove a hindrance.

Three additional papers deal with Lower Proterozoic sedimentary rocks in the Great Lakes region, and provide both rock descriptions as well as tectonic interpretation related to these sedimentary sequences. One paper deals with tectonic and deformational style in the foldbelt. The two other papers in the volume deal with the geochemistry of Penokean and post-Penokean volcanic rocks in the region, again with emphasis on the genesis and possible tectonic settings of the volcanic suites. The volume is well laid out, contains few typographical errors, and most figures in the volume are clear and informative.

In summary, at $28 US this volume is a good buy for anyone working in the Great Lakes region or interested in the Penokean Orogeny. The only flaw with the book is its emphasis on orogenic history and tectonic setting relative to geologic descriptions. Extensive reference lists for each of the papers serve to minimize this deficiency. This book is also a useful addition to any geological library.

Mechanics Of Sediment Transport

Edited by B. Mutlu Sumer and A. Muller
A.A. Balkema, Amsterdam
285 p., 1983; $45.00 US, cloth

Reviewed by Robert W. Dalrymple
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Civil engineers and sedimentologists share an active interest in the subject of sediment transport, affecting as it does many engineering projects and sedimentary rock attributes. Consequently, it was with anticipation that I began to read this collection of 36 short papers (average length 7.1 pages) presented by engineers at the 1982 European Mechanics Committee Meeting. These papers, which provide a snapshot of the "state-of-the-art" and direction of sediment transport research in Europe (all but four of the papers are by European workers) as of 1982-83, are subdivided into six subject groups: visualization of flow structure (5 papers); behaviour of single particles (6 papers); bedform generation and migration (9 papers); suspended sediment transport (5 papers); transport in steep, gravel channels (4 papers); and a miscellaneous section (7 papers) which contains four papers dealing with sediment transport by waves. The diversity of subject matter and approach (from highly theoretical to experimental and empirical) will ensure that there is something of interest for most process-oriented sedimentologists.

For this reviewer, one of the highlights was the section on flow visualization. Recent technological advances now allow the three-dimensional structure of turbulence, and the behaviour of large numbers of real sediment grains to be visualized as never before. A review article by Grass, and the research papers by Browand *et al.* on particle motion under incipient motion conditions, and by Müller and Gyr on flow structure in the separation zone behind bedforms, were particularly interesting. After this look at real-life flow, many of the subsequent theoretical and numerical modelling papers dealing with particle behaviour, bedform genesis, and sediment transport seemed artificial to varying degrees, although they are becoming more realistic (and, thus, much more complex!) with the common trend toward the introduction of turbulent velocity fluctuations, and, to a lesser extent, non-uniform grain sizes, into the analyses. Examples include the use of numerical simulations to explain ripple genesis from random particle motions (Tsujimoto and Nakagawa), and to model suspended and bedload transport (Barndorff-Nielsen *et al.*; Bechteler and Färber). Although the predictive power of the models is improving, it is evident, nevertheless, that they have a long way to go before they can accurately mimic nature.

In the midst of the highly complex mathematics (including one differential equation 6 lines long!), several of the experimental papers are refreshingly semi-practical: Fredsøe, in a review paper, and van Rijn, illustrate how bedform dimensions change with flow strength, grain size and the amount of suspended load; Petković and Bouvard show how turbulence reduces mean particle settling velocities by up to 30% relative to those in still water; and Deigaard demonstrates that downcurrent size sorting can generate size distributions with multiple, straight-line segments (on probability paper). In addition, Wan reports all too briefly on hyperconcentrated floods (suspended sediment concentrations reaching 35% by volume!) in the Yellow River, and Bayazit, in a review article, discusses how flow and sediment movement in steep, gravel-bed streams does not conform to the rules established for deeper, sand-bed rivers.

While I found much that was of geological relevance (although possibly not of immediate use), I came away frustrated by the uninformative abstracts, the unfinished state of much of the research described, and the tunnel vision of the majority of the authors. Many of the research papers are preliminary, progress reports, in which a new idea or approach is introduced, or the first of a series of experiments is described, without elaboration as to the broader implications, and with only limited testing against experimental or field data. One's interest is constantly whetted but never satisfied. More significantly, however, the papers are woefully under-referenced (12.5 references per paper), show serious inbreeding (referencing oneself or colleagues at one's own institute), and fail almost completely to cite the sizeable body of relevant sedimentological literature. By way of examples: Celik, and Bechteler and Schrimpf both discuss the vertical distribution of suspended sediment, but use unrelated approaches and have only one reference in common; and Ribberink, in a series of sophisticated flume experiments, "discovers" that avalanching on dune lee faces causes the coarser particles to be concentrated near the base of the bed, something geologists have known for decades! Despite these negative comments, and, indeed, because of the latter one, I recommend that process-oriented earth scientists scan the book (which their local engineering department should buy), so that we do not fall into the same isolationist trap. The rest of the earth science community can safely ignore this book.

The Techniques of Modern Structural Geology Volume 1: Strain Analysis

By John G. Ramsay and Martin I. Huber
Academic Press, London
307 p., 1983; $55.00 US, cloth;
$28.00 US, paper

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Geology textbooks used to come with attractive, but flimsy, slip-covers that concealed plain inner covers. Nowadays publishers skip the slip-covers and concentrate on decorative covers. In terms of eye-appeal Ramsay and Huber's book, in a 21 × 30 cm format, would rank high. The cover displays an intricate fold pattern in shades of orange with large blue and white lettering. I tossed the book on my coffee table to get the reaction of the cocktail circuit (after all, not everyone is a structural geologist). One medically-minded person mistook the cover pattern for an electro-cardiogram, another thought the book was a sequel to a Hans Selye work on stress management and a third, an interior decorator, suggested the book did not match the decor of the room.

But you can't judge a book by its cover so what's inside? A glance at the contents indicates this is not your run-of-the-mill book. The text is divided into two columns and the book contains numerous excellent sketches and photographs; the latter, mostly two per page, extend right to the margin of the paper. The book is divided not into chapters, but 14 "sessions". Why "sessions"? Well, this is not the sort of book that one reads passively in bed. It is a do-it-yourself work book — a combination theoretical text and laboratory manual. The authors explain their approach in the "Preface". At the beginning of each session a specific topic or problem is enunciated. This is followed by background material including mathematical formulae. Next, problems and experiments are posed that the student must solve. Then comes "Answers and Comments" in which the authors discuss the techniques and the answers to the problems. The problems and experiments are based on actual geological examples rather than contrived and unrealistic situations. Each session contains a second set of problems for the advanced student or to be tackled during "a second round".

Session 1 deals with the changes in lengths and angles that occur during deformation. The first practical problem involves demonstrating these changes by means of a pack of cards held in a box and with specific values of shear strain produced by shaped end pieces or "formers". The carpenter skills of the stu-

dent are put to the test as one has to manufacture the box and formers! The strain ellipse is introduced in Session 2. Use is made of the card deck and box to demonstrate distortion and rotation and the concept of displacement gradient and homogeneous and heterogenous strain. The formation of extension fissures in shear zones is described and beautifully illustrated. Heterogeneous strain is discussed in Session 3. The concept of strain compatibility is nicely explained. Practical problems include the construction of finite strain trajectories and the calculation of displacement in shear zones. Session 4 examines the geometric properties of different types of displacement and the resulting displacement vector fields. The session also includes a graphical representation of the strain ellipse fields and their geological significance. A photograph of a geologic example of each field is given. In a short note the authors dismiss Sanders' classical "movement direction" concept.

The next four sessions set out practical ways of measuring strain from initially circular or elliptical markers, lines, the centre to centre technique, and angles. Session 7 briefly describes deformation mechanisms and strain partitioning amongst them. These four sessions could stand, in themselves, as a separate publication.

Session 9, titled "Orientation Analysis", deals with projections, the relationship between lines and planes in space and so on. Although the topic is fundamental to structural geology, it is adequately dealt with in virtually all introductory structural geology texts and could well have been omitted from the book.

The next two sessions treat strain in three dimensions. Session 10 indicates methods of describing lines and planes in space, classifies strain ellipsoids and discusses the nature and origin of planar fabrics in some detail. Session 11 reviews features in deformed rocks that are useful for the determination of strain in two and three dimensions and summarizes the methods whereby two-dimensional strains can be used to establish the strain ellipsoid. The Helvitic nappes of Switzerland are given as a field example of strain in three dimensions. The shapes of ellipses in the XY plane are shown on a map and those on the XZ plane on a vertical section.

The last three sessions deal with an aspect of progressive deformation. Session 12 covers the principles of progressive displacement and progressive deformation. As in the rest of the book the material is presented verbally, by formulae, by graphs and by photographs. The photographs of folded boudins and stretched folds are superb. The measurement of progressive deformation in extension veins and pressure shadows is discussed in Sessions 13 and 14, respectively. The casual reader might consider that these structures are trivial phenomena but a perusal of the text soon dispels this notion.

Mathematical proofs for the basic formulae used in the sessions are set out in the appendices. These include strain parameters, strains from displacement, displacements from strain and changes of lengths and angles in strained bodies.

At the end of each session is a list of key words and their definitions. This serves as a summary and also as a quick reference for review. There is also a list of a half-dozen or so key references with a brief account of the importance of each. Some are from the previous century. A source list of recommended reading is given at the end of the book.

Readers who are familiar with Ramsay's (1967) *Folding and Fracturing of Rocks* will find many familiar diagrams and photographs. *Strain Analysis* however is not a mere rehash of this older book. Rather, it is a lucid and up-to-date account of one of the most actively investigated aspects of structural geology. It is an excellent text for a senior undergraduate course. Any field geologist working in deformed terrain ought to have a copy of *Strain Analysis*. Most of the Precambrian rocks of the Canadian Shield are deformed yet much of the mapping was done, and is still being done, by geologists who are unfamiliar with the principles of strain analysis. If I were marooned on a desert island (with plenty of exposures of deformed rocks) and could take only one geology book, I would choose *Strain Analysis* (along with a selection of nets, card decks, a card deck box, formers, a computer, drafting materials, etc.). This book will be the definitive work on strain for many years. Buy a copy before it is sold out.

Interregional Unconformities and Hydrocarbon Accumulation

Edited by J.S. Schlee
American Association Petroleum Geologists Memoir 36, Tulsa
184 p., 1984; $18.00 US (AAPG members), $24.00 US (non-members), cloth

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Peter Vail and his seismic team at Exxon started a revolution in stratigraphic methods in 1975 with the appearance of their charts of global sea-level change. The scope of their proposals was breathtaking, and it has become popular to compare all newly described stratigraphic sequences to the "Vail curves" to see how well they fit: do the pattern of local changes in water depth and the age of unconformities "fit" the global pattern documented by the seismic method? Any experienced stratigrapher will recognize the obvious dangers in such an approach. It is all too easy to interpret incomplete or imprecise data in terms of a preconceived model, and this interpretation then imperceptibly becomes part of the data base for the model itself. The danger is particularly acute in the case of the Vail curves because none of the raw data on which they are based has been published, and we are forced to accept them on faith. This has not prevented the rapid, uncritical acceptance of the curves as a new standard of geologic time, for example in *A geologic time scale*, compiled by W.B. Harland and his co-workers (see *Geoscience Canada* review, v. 10, p. 217-218).

It is therefore particularly interesting to see new data compilations such as the one reviewed here. The data themselves are interesting enough, as they permit us some reasonably independant critical evaluations of the Vail models. More important is the insight the book offers us into the health of stratigraphy as a science. Are stratigraphers still a group of tough-nosed, sceptical professionals, or have we become a bunch of panting puppies scampering blindly after the nearest bouncing ball? The book is moderately reassuring on this point.

In his foreword, John Schlee, the editor, explains that the book grew out of two conferences held in 1980 and 1981 to evaluate the Vail method. Eight of the twelve papers in the book consist of detailed regional stratigraphic studies. Most of these are more or less rigorous analyses of various types of regional lithostratigraphic, biostratigraphic or seismic data (or combinations thereof), and most show considerable local variations in the ages of stratigraphic sequences and the ages of the bounding unconformities. In most of these papers the regional results are plotted against the appropriate Vail curve, and the results are mixed, to say the least. Some of the unconformities coincide, others do not. Some can be traced throughout the study area, others appear to be more local in extent. It is difficult to see how a global model could ever be built from fussy, detailed data such as these and, of course, the Vail model was not. It was constructed from seismic data, and we should remember that the seismic method can rarely detect any stratigraphic unit thinner than at least several metres. Vail's global view was his most important contribution, but I still find the lack of published supporting data most worrisome. How many generalizations and over-simplifications are hidden in those bland, professionally-illustrated and most convincingly written Exxon publications?

Vail's own contribution to this book, co-authored with Hardenbol and Todd, does nothing to reassure one in this regard. The paper presents an updating of their interpre-

tative method, with a discussion of three different types of unconformity, and a typically brief description of a new, revised, eustatic sea level chart for the Jurassic. The authors have finally recognized a problem that has been nagging away at some of us for a considerable time: the validity of facies interpretations relating to coastal onlap made solely from seismic data. So called "seismic facies" cannot readily discriminate between the deposits of transgressing shorelines and the onlap of submarine fan, alluvial or other facies. Vail's instantaneous regressions have given way to a modified version that explains the peaks of their familiar sawtooth curves as the product of alluvial fill continuing to onlap an unconformity after sea level has reached its maximum elevation and begun to fall. This new idea may explain some of the sawtooth peaks, but it is, once again, presented as a universal model, with no supporting data.

More worrisome is the continued assumption of chronostratigraphic precision in the dating and correlation of their seismic sections. Nowhere is there any discussion of possible ranges of error and, to make matters worse, their Jurassic chart is based on a time scale published nine years ago (by Van Hinte). The compilation by Harland and his co-workers, referred to above, indicates that Van Hinte's ages are too young by as much as 20 million years. Their revised chart contains many subtle changes from the 1977 version published in AAPG Memoir 26. Vail and his co-workers state that "by more careful age dating, we have discovered that the unconformities we previously placed at the base of the Sinemurian, Callovian, Oxfordian, Kimmeridgian, and Valanginian are all older and occur within or at the base of the late portion of the preceding age." Changes of several million years are blithely presented, with the addition of several new unconformities and a modification of the "global cycle" code numbers. None of the raw data are given. None of this can matter much for the Exxon team who, presumably, all use the same time scale. However, it becomes important when other geologists, using different biostratigraphic methods and different time scales, employ the Vail curves as a standard for comparison. The possibilities of error and miscorrelation abound. Yet Vail *et al.* claim that "interpretations based on lithofacies and biostratigraphy could be misleading" and that "the analysis of stratigraphy based on depositional sequences is the most accurate approach for interpreting geologic age, depositional environment, lithofacies and paleogeography". Talk about the tail wagging the dog!

In fascinating contrast is the preceding paper in the book. M.A. Koming sets out to reexamine the Pitman (1978) method of calculating sea-level fluctuations due to changing mid-ocean ridge volumes. Pitman was able to confirm some of the broad trends in the Vail curves by calculating global average spreading rates from the documented Late Jurassic to Recent history of the world's oceans. Koming discusses the numerous problems with this method, and her rigorous analysis of possible errors brings a refreshing dose of reality to a serious subject that has rapidly been descending to the level of a gee-whiz Scientific American spectacular.

Another interesting paper is that by R.K. Matthews, who points out the potential value of oxygen isotope data as an indicator of sea water volume and climate change. He argues that present evidence can be interpreted in terms of an Antarctic continental ice sheet in the early Tertiary, and that rapid, probably glacio-eustatic sea-level changes are indicated at several times in the earlier geologic record back to 100 Ma.

Serious stratigraphers will find this book essential reading. It is heavy going, because of the wealth of data and tightly constructed argument (except in the paper by you know who). What about the "hydrocarbon accumulations" mentioned in the title? That was obviously put in just to assure quick sales to AAPG members (like the trick of putting sexy covers on dull paperbacks). Pay no attention.

The CSPG has now joined AAPG and GSA in publishing all their journals and memoirs in the new large format, and so far CSPG is making a much better job than AAPG of adapting illustrations and general layout to the larger page. Most of the papers in this memoir are spoiled by poorly drafted figures (inappropriate line weights, lettering much too large), many of which could have been printed at half their published size if they had been drawn properly. Apart from this fault it is a well-produced book, and quite reasonably priced.

Late Quaternary Environments of the Soviet Union

Edited by A.A. Velichko
(English Language Edition edited by H.E. Wright, Jr. and C.W. Barnosky)
University of Minnesota Press
327 p., 1984; $45.00 US, cloth

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The 1981 INQUA Congress in Moscow, USSR, focussed the attention of the Quaternary research community on the Soviet Union. Previously, knowledge of Soviet Quaternary research was poor in North America, and dissemination of the available information proceeded slowly, especially among unilingual English-speaking researchers. Consequently, there was a need for a comprehensive volume summarizing the various aspects of Quaternary work in the USSR. The present volume answers this need by providing an outline of the status of Soviet Quaternary work. The emphasis is on reconstructions, climatic models, and broad regional correlations. The objectives, then, to provide the reader with a framework of events, and to illustrate the concepts which are developing and those already developed, are largely satisfied. The volume is divided into an introductory section, with contributions from both the Soviet and American editors, and nine sections composed of 30 chapters. The introduction written by Wright, Jr., and Barnosky serves as an overview of the volume's contents, and enables the reader not intimately familiar with Soviet Quaternary studies to relate the events discussed in subsequent chapters to each other. This is important, as there is relatively little integration between chapters and sections of the volume. The introduction by Velichko also attempts to integrate the volume's contents into a regional framework. The correlation table provided in this introduction is especially useful, and the reader will probably refer to it frequently during perusal of the volume.

The volume begins with discussions of continental and mountain glaciation. The timing and extent of the Scandinavian ice sheet events during the last 125,000 years, the extent of ice sheets and lakes in Western Siberia, and glaciation in the Caucasus and Kamchatka mountains are discussed. The ongoing controversy concerning the existence and extent of the Kara Sea ice sheet is of particular interest. Sections dealing with permafrost and loess, fossil soils, and periglacial landforms include stratigraphic correlation of these features and sediments, but provide little information on dynamics and

sedimentary processes which has not already been published in English. Vegetation history and faunal populations are considered in separate sections. The records are primarily interpreted in terms of climatic fluctuations. Broad correlations across the Soviet Union are presented for several periods from the last interglacial to the Holocene. While these correlations provide a general framework for the interpretation of vegetational and faunal history, their utility is limited by limited chronological control. The section on Inland Sea Basins includes the evolution of 13 marine basins bordering the USSR, including the Caspian Sea, Black Sea, White Sea, and the Sea of Japan, based on faunal and geomorphological data. This section contains much new information, and illustrates the potential for paleobasin reconstruction. Paleoclimatic reconstructions, utilizing floral and faunal data, are presented in a separate section. Integration between this section and the section dealing with vegetational history would have greatly improved the volume. The volume concludes with a brief section discussing human migrations, and Mesolithic and Neolithic cultures.

Notwithstanding the criticisms offered here, *Late Quaternary Environments of the Soviet Union* represents the most comprehensive, convenient, and readable treatise dealing with Soviet Quaternary studies available. The editors are to be congratulated for the promptness of the volume's appearance. We recommend *Quaternary Environments of the Soviet Union* as a valuable reference work for all researchers and institutions concerned with Quaternary research.

Jurassic-Cretaceous Biochronology and Paleogeography of North America

Edited by Gerd E.G. Westermann
Geological Association of Canada
Special Paper 27, Toronto
315 p., 1984; $30.00 (GAC members),
$36.00 (non-members), cloth

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An English colleague complained to me some years ago that access to the literature on the North American Mesozoic was difficult by virtue of the scarcity of comprehensive reports, and would we please do something about it. Whether or not this was true at the time, it is not now, largely thanks to the publication of USGS Professional Paper 1062 by R.W. Imlay (1980), CSPG Memoir 9 in 1984, and the present volume.

This volume derives from a Symposium held in honour of R.W. Imlay and J.A. Jeletzky at the 3rd North American Paleontological Convention in Montreal in 1982. There are a total of 15 papers, including an insightful summary paper by Westermann, regional reviews covering most of North America, and localized reports on the Grand Banks, Portugal, the Gulf of Mexico and Caribbean, and various parts of Mexico. Western and Arctic Canada and U.S.A. get the most attention. Some of the reports are summaries, reviews or syntheses of earlier work, others are entirely new. There is in all of them a wealth of new information, many specimens are illustrated for the first time, and some new species are described. The graphics and plate quality are excellent, and few typos catch the eye.

The first paper, by Imlay, is a well-illustrated summary of his previous extensive publications on the Jurassic ammonite biostratigraphy and paleogeography (without considering plate movements) of North America. It has been brought up-to-date since publication of his masterpiece in 1980, but the careful reader will notice some variance of taxonomic opinion between this report and others by Callomon and Taylor *et al.*

The only two papers on the Atlantic margin, by Exton and Gradstein, and by Ascoli, Poag and Remane, are also the only two concerned essentially with micropaleontology. They are biostratigraphic, covering the Early Jurassic, and the Jurassic-Cretaceous boundary interval, respectively. Reports on the Gulf of Mexico-Caribbean region by Scott, and on east-central Mexico by Longoria, are essentially tectonic/basin-analysis studies, treating paleontologic data only incidentally. These four reports present sometimes conflicting hypotheses on the origins of the Atlantic, Caribbean and Central America areas.

Local paleogeographic studies, documented by extensive citation of relevant molluscan faunas, are those by Alencaster on southern Mexico (late Jurassic through Cretaceous), and by Cobban and Hook on part of Western Interior U.S.A. (mid-Cretaceous). The report on the Cretaceous Interior seaway of North America by Kauffman is characteristically comprehensive.

Short, essentially taxonomic papers are those by Buitron on Late Jurassic bivalves and gastropods from central Mexico, and by Westermann, Corona and Carrasco on mid-Jurassic ammonites from southern Mexico.

Mesozoic ammonite workers have been concerned with biogeographic provincialism since late in the last century. A report by Callomon is a review of the problems posed by the western and Arctic Canadian and American, Late Bajocian and younger Jurassic ammonites in this regard, and presents many proposals for correlations of the various faunas he delineates. The experience that this author brings to bear on some taxonomic questions makes this report particularly useful for North American ammonite workers.

In a short, comprehensive summary, Taylor, Callomon, Hall, Smith, Tipper and Westermann point out the paleobiogeographic affinities of Jurassic ammonites from each of the tectonic terranes of western North America and discuss the limits they pose on plate movements. In common with other papers by Tipper, Callomon and Jeletzky, which also touch on these questions, they conclude that Jurassic ammonite faunas of western Cordilleran terranes, while they may be allochthonous at least in part, are not necessarily far-travelled, and that all are of North American affinity. While statements of this sort are useful for placing controls on paleomagnetic and other models of plate movement, none of these authors considers the various other factors influencing paleobiogeographic distributions, such as climatic modification and animal migration patterns due to longshore currents, that might have been particularly important on the ancient western margins of North America.

A long and detailed account by Jeletzky discusses the ammonites and bivalves of the Jurassic/Cretaceous boundary beds of western and Arctic Canada, primarily their contribution to resolving long-standing questions of correlation between the Tethyan and Boreal realms. Comments by A. Zeiss following this paper detail certain opposing arguments, namely that the Early Berriasian of the Tethyan Realm is equivalent with the Late Volgian of the Boreal, whereas Jeletzky correlated the Late Tithonian with the Early Ryasanian. Interested workers should be aware of recent Jurassic Subcommission initiatives to resolve these questions through multi-taxial approaches, principally involving microfossils and palynomorphs.

Most Mesozoic biogeographic syntheses deal with ammonites. Would that micropaleontologists and palynologists take a cue and provide biogeographic summaries of their own groups at each zonal level to test the applicability of the ammonite provinces.