# Book reviews

**Paleoclimates and Their Modelling – With Special Reference to the Mesozoic Era.** 1994. J. R. L. Allen, B. J. Hoskins, B. W. Sellwood, R. A. Spicer, and P. J. Valdes, editors. Chapman and Hall, New York. 140 pp. ISBN 0-412-56330-4. Price: $59.95 US.

This book presents a series of papers that grew from a conference sponsored by the Royal Society attended by stratigraphers and climate modelers. There have been several such meetings in the past decade, but few have resulted in this kind of useful volume. The papers can be grouped into three categories: mostly modeling; mostly methods and geologic data; and mostly model-data comparisons.

*Mostly modeling:* Hoskins (Chapter 15) reviews the role of computer models in paleoclimate studies; the reader who is unfamiliar with computer models of paleoclimate might like to start with this chapter. Shackleton (Chapter 1) begins the book by sounding a note of caution. He remarks on how adequately GCMs (general circulation models) approximate the modern climate and that of the geologically recent past. Climates of the Plio-Pleistocene when we have the best information about geography and topography, and where the best climate-relevant data sets exist are not well modeled, so Shackleton suggests caution in the use and interpretation of climate models for Mesozoic and earlier times. Berger *et al.* (Chapter 6) presents an improved 2-dimensional climate model of the past 200 ky. The model considers the atmosphere, ocean mixed layer, sea ice, ice sheets and bedrock, and includes the variation of astronomic forcing, changes in albedo, $CO_2$ from paleo-records, and a water vapor feedback mechanism. Results closely approximate the $\delta^{18}O$ record of ice volume. This is a particularly good paper for the uninitiated to learn about the requirements necessary for a close approximation of climate change. Mitchell (Chapter 8) applies his GCM to questions of Holocene and late Pleistocene climates. This paper compares the author's results with that of other models. Inter-model comparisons are a valuable exercise that lets the reader judge which results may be more robust, common to several models, than others which may be model-dependent. Mitchell also touches on what is a growing controversy in paleoceanography, the low latitude SST (sea surface temperature) during the last glacial maximum. A long-used data set from the CLIMAP (CLIMate Mapping And Prediction) program suggests little or no change in SST for this interval, yet several GCM results suggest a 2 ° or greater cooling. (This discussion has been further fueled by new paleotemperature data based on the Sr/Ca ratios in shallow marine carbonate that suggest a several degree cooling of low latitude, glacial-age SSTs.) Parrish (Chapter 7) presents an historical overview of conceptual models of paleoclimate. Most of these models envision dominantly zonal climatic regimes like those of today. These models played an important role in the fixist *vs* mobilist controversy of the early and middle 20th century, as climate-sensitive facies were used as an independent test of continental reconstructions.

*Mostly methods and data:* Huntley (Chapter 2) presents a descriptive paper on the construction and use of response surfaces. This is a system that allows comparison of pollen data, commonly relative abundance or assemblage data, with model output, commonly temperature and precipitation calculations. The method, which arose from the COHMAP (COoperative Holocene MApping Project) project, plots pollen species abundance on a temperature (January and July) or temperature and precipitation field. The plot shows how species abundance varies with (responds to) the climatic variables quantified along the X- and Y-axes. Sellwood and Price (Chapter 3) review sedimentary facies as indicators of Mesozoic climate. This chapter is a nice review that 'rounds up the usual suspects'. Allen (Chapter 4) discusses terrestrial paleo indicators of direction and strength of winds. These indicators include the downwind decrease in the grain size of loess and ash, orientation of dunes and eolian cross bedding, and the fall direction of trees. Spicer *et al.* (Chapter 9) compile an overview of Cretaceous paleobotany, especially the geographic distribution of floral types. The authors note the urgent need for detailed and uniform descriptions of fossils from all localities, and suggest a multivariate analysis method for comparing paleobotanical assemblage data to paleoclimate information. This paper is much harder for the non-specialist to digest than most of the others because of the extensive use of the Latin names of

plant fossils. Hallam (Chapter 10) presents a good review of climate reconstructions of the Jurassic supercontinent based on information from facies and fossils. He notes the generally good agreement between geological paleoclimate indicators and computer models of Jurassic climate, assuming enhanced $CO_2$ levels. The Pangaean supercontinent is characterized by strong seasonality, enhanced monsoonal activity and perhaps orographically-related aridity. Ziegler *et al.* (Chapter 11) examine the phytogeography and climate of the Early Mesozoic. They review modern techniques of phytogeography and biome analysis. Biomes are climatically-related (temperature and precipitation) plant assemblages which, when plotted on paleogeographic maps, reveal the climate regime. This use of biomes seems to work well. I especially enjoyed the observation that the earth's climate zones remain fixed in latitude while the Jurassic continent moves south beneath them – opposite to the previously-held sense that the continents remained fixed and warming migrated north. Hallam (Chapter 16) summarizes the role of geological indicators in paleoclimatic studies and emphasizes the need for more/better paleobotanical information.

*Mostly model/data comparisons:* Wing and Greenwood (Chapter 5) examine the early Eocene paleoclimate of the North American Western Interior and review the paleobotany and paleozoology of the region. The early Eocene is the warmest time of the Cenozoic and approximating this global climate has presented quite a challenge to climate modelers. Climate models of the warm early Eocene suggest a pronounced seasonality with freezing winter temperatures in the Western Interior, whereas paleobotanical data admit little if any freezing, a contrast has become the subject of a data *vs* model debate in the past few years. This kind of dichotomy – an apparently clear difference between field data and model output – is much more important than merely a scientific argument because it leads to refinement of the GCMs and often to new fossil collections and understandings of the field data. Barron *et al.* (Chapter 12) uses computer models to examine the role of geography and $CO_2$ in determining Cretaceous climates. The authors employ the new generation of general circulation model housed at NCAR, the GENESIS model, to simulate climates of the Cretaceous. The GENESIS model is a significant improvement over the previously widely used CCM (community climate model) in that it is designed to account better for several climate-related factors like clouds, soils and vegetation cover, and snow/ice/sea ice. The GENESIS model is linked to a 50 m deep ocean that allows for oceanic heat transport. Prior work by Barron and his colleagues using the CCM had indicated that the geographic change in continental configuration between the present and the Cretaceous was an important factor in explaining the very warm Cretaceous climates. Application of the GENESIS model to the same question suggests that continental position is unimportant, and that a four to six fold increase in $CO_2$ is adequate to explain the Cretaceous climate regime. Calling on increased $CO_2$ to explain warmer climates is not new here, but the dismissal of paleogeography as being important is. The understanding that continental position can have an important, even dominant, effect on paleoclimate has become ingrained into the literature, so negating that concept is a significant result. This change is a further lesson for us about how careful we should be about accepting model results as paleoclimatic reality. Certainly when good coupled ocean-atmosphere general circulation climate models become feasible, we shall readjust other long-held concepts too. Valdes (Chapter 13) presents results from the U.K. Global Atmospheric Modelling Programme atmospheric general circulation model to examine late Jurassic climate. Among the model inputs are a $4 \times CO_2$ atmosphere and a fixed SST, so oceanic heat transport is minimal in the modeled scenario. The author admits that this is unlikely in a world dominated by one large continent and one large ocean, and notes that other models with different approaches to oceanic heat transport give different results. The model suggests a large seasonal range in continental temperatures, no severe winters at high latitudes, and generally equable climate. Kutzbach & Ziegler (Chapter 14) present a simulation of Late Permian climate as determined from model results and compare those results to Late Permian biomes. The authors use the CCM1 model of NCAR modified to include a 50 m deep ocean which allows for oceanic heat transport to be prescribed. Geography, topography, albedo, solar irradiance, orbital parameters, and $CO_2$ concentration ($\times 5$) are set. The climate of central Laurasia was modeled with and without large inland seas, which reduce the calculated seasonality by 50%. Otherwise the supercontinent shows extreme seasonality, about 60 °C, dry subtropical continental interiors, strong summer monsoons, and no permanent snowfields. Model output of temperature and precipitation were recast in terms of biomes and compared to the geologic record. The comparison of the model-predicted biomes and the paleontological record is gen-

erally good, with a few areas of uncertainty. The techniques used by these authors of modeling temperature and precipitation through the annual cycle, casting the results in terms of resulting expected vegetation, or biomes, and comparing them to the geologic record, is a classic example of how data-model comparisons further our understandings of paleoclimate.

*Summary:* This book is not for beginners in paleoclimatology, but is useful to those stratigraphers who may need to learn more about the use of models, or to climate modelers who interact with geologists. The chapters introducing the use of models, and providing cautions about interpretation of results, are good reading for someone who wants to understand the complexities of this business. As a some-time stratigrapher, I am more familiar with the methods of interpreting the fossil and rock record in terms of paleoclimate, but several of these chapters provide useful reviews and compilations. The real meat of the book is in the last group of four papers that, for different time periods, try to compare the results of computer models with the geologic data available for those times and regions. This interaction between stratigraphers and climate modelers is at the forefront of paleoclimate research today, and the joining these two methodologies is the most effective way to advance the science. This book could be the starting point for a graduate-level class or seminar on the subject of the combined use of geology and circulation modeling to understand past climates. Those working closely with the topics described above may want to have it on their shelves, others can find it in their library.

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**The Chironomidae: Biology and ecology of nonbiting midges.** 1995. P. Armitage, P. S. Cranston & L. C. V. Pinder (eds.). Chapman & Hall, New York. 572 pp. ISBN 0-412-45260-X. Price: $ 119.00 US.

With the development and successful application of quantitative models for paleotemperature and paleosalinity inference from fossil chironomid assemblages (Walker *et al.*, 1991a, 1991b, 1995; Wilson *et al.*, 1993; Levesque *et al.*, 1993), it would appear that chironomid paleoecology has come of age. Yet in the section 'Prognosis for future research' of his contributing chapter to this book, Ian Walker names the same three obstacles to further progress he identified already eight years ago (Walker, 1987): the fact that chironomid paleoecologists tend to work in isolation from other disciplines of paleoenvironmental reconstruction, the paucity of data on modern chironomid physiology, ecology, and community dynamics relevant to interpretation of the fossil spectra, and a taxonomical tradition failing to connect existing ecological information based on identification of the adult midges with often characteristic but unidentified fossil larval remains. Could it be that the field was waiting for a readily accessible compilation of a century of chironomid research to show the road towards a more integrated research effort? *The Chironomidae: Biology and ecology of non-biting midges* comes a long way in doing just that.

This book's handsome front cover is illustrated with an adult midge, a pupa, and, rather appropriately for chironomid paleoecologists, only part of a larva (actually, the complete life cycle starts on the back cover and passes around the spine to the front). Inside, the volume contains an introduction and 17 single-authored chapters arranged in three parts. The introductory chapter, by P. S. Cranston, effectively serves its role as an executive summary of the book's contents. Part One includes three chapters on chironomid morphology, systematics, and biogeography. In these we receive the basic information needed to recognize and identify Chironomidae: the animals we chose to study happen to be an insect group with enormous species richness both locally and regionally. Helpful information includes lists of major species catalogues for all biogeographical regions for which such works are available, and literature entries to published identification keys and guides (the book itself provides keys to the subfamily level only). Then follows Part Two with five chapters on the biology, ecology and behavior of the different life-history stages, and three chapters on population biology, secondary production, and community ecology. This part of the book deals with the study of Chironomidae for their own interest. I found each chapter to be a successful attempt to compile and review all the relevant literature, although due to the large number of species and their ecological diversity these compilations still often seem like a selective 'sampling' of the subject. A different author for each chapter results in many references being cited and discussed more than once in different contexts throughout the book, and points to the fact that much of our current knowledge still relies on a limited number of classic stud-

ies. Section Three assembles six chapters under the heading 'Interactions with Humans', describing how the Chironomidae interact with humans as sources of allergy, nuisance, and food; and how these diminutive insects can help humans to address issues of broad social and economic importance such as global change and water-resource management. The final chapter by W. P. Coffman should have been entitled 'Interactions with Scientists' rather than simply 'Conclusions'. It has a philosophical quality to it, as it tries to probe what it is about chironomids that lures scientists to their study yet at the same time scares them away from it. Coffman identifies the great species richness and abundance of the group, together with their worldwide distribution and extreme ecological diversity, as the organizing themes that 'played a major role in stimulating chironomid studies in the minds of the few, yet played an equally large part in discouraging their study in the minds of many' (p. 437). The book ends with a 90-page bibliography (an estimated 1800 references) and a 35-page combined subject and taxon index. I found the book to be well-organized and generally well-edited (there were a few instances, all of them in the same chapter, of unlisted references and erroneous years of publication). There is no glossary, but the introductory paragraphs to many chapters give definitions and explanations for basic terminology related to the particular subject, be it systematics, phylogenetics and cladistic analysis, phenology and life history characteristics, or classification of freshwater habitats. These sections, which could have been lifted straight out of an introductory entomology textbook, will be helpful for users of Part Three chapters to get the most out of Parts One and Two. An unfortunate exception is the chapter on production ecology, where we are referred to specialized literature for an explanation of methods used in estimating secondary production.

Ian Walker's chapter on the use of chironomids as biological indicators of past environmental change is one reason why this book is being reviewed for the *Journal of Paleolimnology*. Walker has quite a bit of progress to report since earlier reviews of chironomid paleoecology by himself (Walker, 1987) and Hofmann (1988). His discussion here of paleolimnological biomonitoring and the use of fossil chironomid analysis as a water-resource management tool forms a natural extension of the chapter by C. Lindegaard on chironomid-based classification of water-bodies and pollution assessment. Overlapping with Walker's treatment of the subject in *Freshwater Biomonitoring and Benthic Macroinvertebrates* (Rosenberg & Resh, 1993), it will be useful primarily to aquatic ecologists and managers as an introduction to how paleolimnology can help address environmental research problems that require a historical context for recent events. Walker then discusses chironomid paleoclimatology, a field that hinges on his own contributions. A definite plus is that he takes the opportunity offered by this book contribution to present and discuss the heretofore unpublished studies of Lawrenz (1975) and Boubée (1983). It is less fortunate that only three text pages are devoted to paleoclimate reconstruction. Compared to the exhaustive treatment of Chironomidae as sources of nuisance, allergies, and food in some of the other chapters, three pages is definitely a bit too concise. Certainly there would have been general interest among students of the Chironomidae in an introduction to the chronology and mechanisms of late-Glacial climatic change, and a more detailed account of the information chironomids have produced that other disciplines such as palynology were less able to. It would also have been useful to learn in broad lines exactly how a quantitative model for paleotemperature inference is developed, starting with 'extensive surface sample datasets for determining species' environmental requirements' (p. 420).

Whether chironomids are sensitive to (water) temperature directly, or respond to environmental cues that are only indirectly correlated with climate, has been a matter of intense debate fought out in part in the pages of this journal (Warwick, 1989; Walker & Matthewes, 1989; see also Hann *et al.*, 1992; Walker *et al.*, 1992). The controversy was essentially a culture clash between scientists trying to use chironomid species assemblages as a tool to reconstruct past climates and climatic change, and scientists trying to unravel the proximate causes that regulate their local occurrence in various aquatic habitats. Hopefully the success of chironomid paleoclimatology will benefit both camps of the controversy: the social relevance and urgency of global change research may create new opportunities and resources for invertebrate zoologists to study living chironomid populations and communities (in much the same way biodiversity issues have promoted interest in taxonomy), while the product of such studies may help remove at least one major obstacle for progress in chironomid paleoecology and improve the interpretation of patterns of change in fossil assemblages. This book, by providing a comprehensive overview of current knowledge on larval habitat choice, feeding behavior, population dynamics and community structure, will play its role in helping to design future research projects. Walker himself sug-

gests that part of a solution may come from examination of paleorecords of climatic scenarios other than the late-Glacial sequence, e.g. a long and sustained cooling instead of a two-step warming. Personally I see much potential in directed research (i.e. with the needs of paleoecologists in mind) into the modern biology and ecological tolerances of the key species that tend to play pivotal roles in the outcome of transfer-function based reconstructions. Awaiting such research, chironomid paleoecologists will find the chapters of Part Two in this book a trove of valuable information to help assess how aspects of phenology, spatial and temporal variability in chironomid density, abiotic factors in the environment and biotic interactions, all affect the way chironomid archives in lake sediments are formed. Besides the three obstacles to research progress mentioned above, Walker also calls for more work into the paleoecology of tropical Chironomidae. The dearth of basic information on faunistics and ecology from most tropical regions is also lamented on elsewhere in this book. Here I can only repeat Walker's invitation (p. 406) that tropical chironomid paleoecology 'represents a tremendous research opportunity, especially for graduate students seeking original avenues for research'.

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**Geomorphology and Sedimentology of Lakes and Reservoirs.** 1993. J. McManus and R. W. Duck (Eds). John Wiley and Sons, Ltd. West Sussex, New York. 278 pp. ISBN 0-471-93773-8. Price: $ 96.50 US.

The Geomorphology and Sedimentology of Lakes and Reservoirs is a collection of papers given at the sixth session of the British Geomorphological Research Group (BGRG) symposium series. The BGRG has established a strong tradition of highlighting existing and evolving research themes relevant to earth surface processes and the understanding of landscape history. This volume, edited by John McManus and Robert Duck – both from the department of Geography and Geology at the University of St. Andrews, Scotland – continues the tradition by bringing together research which focuses on the methodological and substantive issues of clastic and organic particulate matter delivered to, and deposited in, lakes and reservoirs.

The book is divided into 16 chapters, a series preface, a subject index and a geographical index of lakes and reservoirs mentioned in the text. Of the 40 or so lakes and reservoirs listed in the geographical index, the majority (>90%) are from the United Kingdom and thus 12 of the 15 substantive chapters reflect sediment delivery processes in a temperate mid-latitude zone of moderate relief. The other three chapters include examples from arid environments in Iran and the Dead Sea region as well as a high-relief alpine area of British Columbia, Canada.

Chapter 1 is a brief outline prepared by the editors. It details the usefulness of natural and artificial lakes as indicators of local, and possibly regional, climate and land-use change. A summary of the contributions to follow is included. John Dearing and Ian Foster use

Chapter 2 to illustrate the perspective of geomorphologists, as distinct from purely limnological or biological approaches, in using lake deposits to reconstruct land-use history. A distinction is made between river and hillslope derived clastic sediments, delivered to the lake via natural or human-induced surface erosion processes. The discussion focuses on functional and hypothetical relations between the contributing catchment and the rate of sediment accumulation in the outlet lake or reservoir. The authors also emphasize the importance of errors associated with establishing accumulation chronologies using $^{137}Cs$ and $^{210}Pb$ dating.

Chapter 4 (D. Walling and Q. He) and Chapter 5 (J. Rowan et al.) are devoted to the modelling and interpretation of radiocesium profiles in lake sediments. Recent inputs of Chernobyl-derived $^{134}Cs$ to sedimentary sequences are noted to be affected by bioturbation and remobilization. Chapter 6 (D. Butcher et al.), Chapter 7 (H. Al-Jibburi and J. McManus) and Chapter 8 (I. Owens and H. Slaymaker) illustrate the use of reservoir and lake surveys, along with modern sediment input data, in developing lake sediment budgets. The budget approach is shown to provide an ideal methodology for confirming both conceptual and quantitative models of sediment deposition and re-distribution in lakes.

The utility of pollen, diatoms, heavy metals, magnetic susceptibility and grain size information are discussed in Chapter 3 (S. Charlesworth and I. Foster), Chapter 11 (K. Edwards and G. Whittington) and Chapter 15 (J. Peakall). The benefits of analyzing multiple cores from lakes are highlighted and the importance of geochemical cycling, as interpreted from diatom composition (particularly the uptake of barium), is considered.

Seismic methods, including high resolution echo sounding, sub-bottom profiling and side scan sonar are discussed in Chapters 12 (S. Cronin et al.), 13 (P. Lowe) and 14 (R. Duck et al.). The remotely sensed data are compared to observed variations in sediment properties in cores demonstrating that useful calibrations between the two methods can be made. Seismic surveys allow for rapid, lake-wide, assessment of sedimentary characteristics particularly the occurrence of subaqueous slope failures and associated sediment redistribution.

In addition to these sub-themes, Chapter 9 (E. Toluie et al.) considers strategies for desiltation in a rapidly infilling reservoir in Iran. Chapter 10 (J. Marsh et al.) details an experimental study of particle tracers introduced into a reservoir via the main input stream. Lake dynamics and wind-current relations are modelled and compared to the tracer distribution. The final chapter in the book (Chapter 16 by I. Ried and L. Frostick) is a suitable conclusion to a collection which emphasizes modern rather than ancient lake deposits. In this chapter the authors consider a late Pleistocene sequence along the margins of the Dead Sea which records flash flood inputs to a well-laminated, high resolution, lacustrine sedimentary sequence. A recurrence interval of major floods of about 1000 years is interpreted thereby demonstrating the importance of long-term, high-resolution, sedimentary deposits. The book is well presented and illustrations are neat and legible. Photographs are restricted to two chapters and those showing seismic stratigraphy are of limited quality. However, there are a few instances where photographic evidence of the sedimentary sequence being examined would have benefited the conclusions. The only error I noted in my copy was the incorrect order of the subject and geographical indices. The collection may have benefited by including more discussion on sediment transport issues in lakes and a more comprehensive analysis of lacustrine sedimentology. However, the book brings together a useful mix of methodological and theoretical issues relating to the geomorphology of lake-catchment studies and therefore will make a valuable, although pricey, addition to anyone's library.

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**Late Quaternary Studies in Beringia and Beyond, 1950–1993: An Annotated Bibliography**. 1994, Alwynne B. Beaudoin and Frances D. Reintjes. Provincial Museum of Alberta, Edmonton, Alberta. 386 pp. ISSN 0707-2651; No. 35 (pbk). $14.95 (Can.).

In times of easy-access computerized library searches, publication of an annotated bibliography may seem a bit archaic. Such is not the case with the 35th publication of the Archaeological Survey Occasional Papers of the Provincial Museum of Alberta. Surprisingly, the format draws the reader along from abstract to abstract and from topic to topic. As the compilers admit, the volume is not meant to be exhaustive; rather it is a tool for obtaining a relatively comprehensive overview of

geological, archeological, and paleoecological studies across this vast region. This purpose is reflected in the book's origins as a background search for the Bridge of the Black Dragon Project, which examines late Pleistocene landscapes and human history of Heilongjiang, northeastern China. Participants in this program wanted to more thoroughly explore paleoenvironmental and prehistoric linkages between Heilongjiang (a possible source of human populations who eventually occupied and crossed the Bering Land Bridge) and other areas of northeastern Asia and northwestern North America. The results of their efforts, although focused on English language publications, will benefit other researchers interested in similar issues.

Beringia is defined as that region between the Lena River of Russia and the Mackenzie River of Canada. The 'Beyond' elements include western Siberia, northeastern China, northern Korea, Japan (with emphasis on Hokkaido), the offshore islands of the North Pacific Ocean, western British Columbia, and northwestern Washington. The temporal framework is between *c.* 50 000 to 10 000 years BP. Citations consist primarily of research papers, review articles, short notes, and conference abstracts, although a few references to popular articles are also included. Most of the listings were collected by reviewing personal collections and references cited therein. Bibliographies in the new references were then examined and so on. Abstracting journals and on-line services were used to supplement these efforts, but they were found to be too imprecise in spatial and/or temporal definitions to be especially useful. Eighty-eight key journals, listed in the book with accompanying call numbers, and several conference abstract volumes were systematically searched. In addition, a three page table of Latin and common names and Latin synonyms for fauna that occur in the abstracts should aid the nonspecialist in sorting through any taxonomic ambiguities. Indices of authors, geographic location, topic, and library location are equally helpful, especially for those who are just becoming familiar with the region and with those who have worked there.

The annotated bibliography begins with a section on Beringia as a whole and is followed by six sections oriented towards smaller geographic areas (east Beringia, west Beringia, continental shelf offshore islands, north China and Korea, Japan). Each geographic section is divided into six parts with the following emphases: general (articles and books with broad topical coverage); late Quaternary geology (surficial geology and stratigraphy, glacial history and geomorphology); late Quaternary paleoenvironments (reconstructions based on pollen, beetles, plant macrofossils, ostracods, and molluscs, climate history); late Quaternary palaeontology (terrestrial mammals, fish, marine mammals, and birds); archaeology and human history (sites, human dentition, genetics and migration); and modern biogeography (modern distributions and ecological requirements used to interpret fossil data). The volume concludes with a miscellaneous section that incorporates popular articles, reports and commentaries that are not tied to any specific region. Each entry includes full author and journal citation, verbatim copy of the published abstract, library call numbers, and key areas and topics.

As Beaudoin and Reintjes state, all citations on Beringia and neighboring regions are not included in this publication. Nonetheless, beginning students will welcome this bibliographic entry into the late Quaternary of Beringia, and regional experts will delight in unfamiliar papers and newly found citations. Although bibliographic compilations such as this one are immediately out of date as soon as the volume goes to press, the book's modest price and informative style make it a worthwhile investment for all interested in Quaternary studies.

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