they are informative and fit reasonably well with the emphasis on arctic paleoenvironments.

The main theme of the volume comes through most strongly in chapter 23, "Late Neogene Arctic Paleoceanography: Micropaleontology, Stable Isotopes, and Chronology," 77 pages, by Y. Herman, J. K. Osmond, and B. L. K. Somayajulu. Here is a thorough description and analysis of sediment cores taken from the Arctic Ocean. The mineralogical, chemical, biological, and textural data are presented individually, followed by an interpretive synthesis of the climatic history of the Arctic Basin. The authors conclude that perennial sea-ice cover first appeared in the Arctic only 0.9 Mya, as evidenced in the cores by changes in faunal abundances and oxygen-18 isotope ratios. Moreover, since that time, the Arctic Ocean experienced intervals of year-round ice cover (as presently observed), seasonal ice cover, and year-round open water. The latter intervals are associated with an isopycnal Arctic Ocean! If true, these scenarios pose extremely challenging problems for climatologists and oceanographers who would construct physical models for the Arctic during the Pleistocene. The following contribution, "Sediment Composition and Sedimentary Processes," by D. A. Darby, A. S. Naidu, T. C. Mowatt, and G. Jones, sheds further light on the difficulties and ambiguities of interpretations of sediment cores. For example, reduced abundance of some planktonic species in a given stratum might imply complete ice cover if light is taken to be the primary factor limiting biological productivity, whereas it might suggest increased density stratification in the water column if nutrient availability is all that counts. Darby et al. review the textural, mineralogical, geochemical, and magnetic properties of arctic sediment cores, concluding that sediments accumulate much more rapidly on abyssal plains than on ridge crests and slopes, and that significant amounts of sediment reach the former environments through turbidity flows that augment the ubiquitous ice rafting mechanism. They attribute the Plio-Pleistocene alternations between layers of coarse and fine grained deposits to variations in the relative importance of rafting by glacial ice and sea ice. They suggest that a definitive answer to the question: "When did the Arctic Ocean first support perennial sea ice?" awaits a chronostratigraphy with higher accuracy and resolution, and improved understanding of how the abundance of planktonic forams in arctic sediments depends on sedimentation rates, ice thickness, salinity of surface waters, and ocean circulation.

In summary, the book presents a current review, and a stimulating portrait, of regional, interdisciplinary scientific issues relevant not only to paleoclimatologists, but also to those who would model future global changes. As such, this volume is essential reading for arctic marine biologists, marine geologists, paleoclimatologists, and paleoceanographers, and should prove useful and interesting to a wider audience, including global climate modelers. The book can also serve as a useful reference in several subject areas, such as arctic biology and marine geology.—*Richard E. Moritz*

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**Floods: Hydrological, Sedimentological, and Geomorphological Implications.** K. Beven and P. Carlin, eds. 1989. 290 pp. $85.00. hardbound. John Wiley & Sons.

This book is a compilation of papers presented at a workshop held at the University of Lancaster in June 1988. The workshop was a joint meeting of the British Geomorphological Research Group and the British Hydrological Society and was organized by Keith Beven and Paul Carling. The workshop brought together scientific researchers with a common interest in the dynamics of fluvial floods and their effects on the landscape. The book is addressed to scientists from a variety of disciplines, such as hydrologists, hydraulic engineers, sedimentologists, and geomorphologists. It contains 16 papers (chapters) covering a mixture of theoretical and experimental research that aims to understand and quantify the hydrologic and hydraulic response of a basin to floods. Most of the papers in this volume deal with the problem of understanding floods and their interaction with the landscape; a few papers deal with the development of tools for the quantitative prediction of the effects of floods.

The book starts with an overview paper by the workshop organizers, P. Carling and K. Beven. The authors elaborate on the concept of effectiveness of

a flood event and the long-studied question of what events (in terms of frequency and magnitude) are the most effective in shaping up the landform. They also consider the prospects of developing predictive models for geomorphological systems and conclude that better understanding of hydrological processes is required before adequate models can be developed to cope with a variety of environments, basin scales, process thresholds, and sequences of extreme events. The rationale developed here ties together the papers that follow, and includes a fairly complete picture of the wide range of problems facing those investigating extreme floods, their occurrence, magnitude, frequency, and implications.

Chapter 2, "Storm Runoff Generation in Small Catchments in Relation to the Flood Response of Large Basins," is written by T. P. Burt. It presents a review of storm runoff mechanisms, sediment and solute production to streams, and flood runoff production to large basins. The findings of the paper emphasize that at the basin scale, the major controls of storm runoff generation are climate and soil, with topography important at the subcatchment scale and that both the partial area and variable source area models must be invoked, even in small basins, in order to relate stormflow production to sediment and solute delivery. The author points out that for a better understanding of sediment and solute delivery, several issues require further study, including patterns of soil erosion in relation to the characteristics and extent of variable source areas to the main channel system, and the use of distributed runoff models for studying linkages between tributaries and the larger drainage basin. This paper contains an extensive list of valuable references.

Chapter 3, "Flood Wave Attenuation Due to Channel and Floodplain Storage and Effects on Flood Frequency," is written by D. R. Archer. This paper draws attention to channel and floodplain storage as two factors affecting the flood frequency distribution. The author presents evidence of the nature of the control of these factors by the results of a study over a reach of the lower river Tees in northeast England where flood attenuation and the transformation of flood frequency over a common period were studied.

Chapter 4, "Physically Based Hydrological Models for Flood Computations," is written by S. Ambrus, L. Iritz, and A. Szollosi-Nagy. This paper presents some recently developed flood control models which are designed to work in an operational mode with limited data requirements and fast adaptation possibilities. The authors present numerical tests of these models for the Koros river basin in Hungary where these models currently form the hydrological support system for flood control.

In chapter 5, "Flood Frequency and Urban-Induced Channel Change: Some British Examples," C. R. Roberts points out that little systematic attempt has been made to link the magnitude of channel changes to the nature of the urban area or to establish the role played by floods of different frequency in the adjustment process. The paper presents a series of case studies which attempt to establish how the hydrological change has affected channel morphology in downstream reaches.

Chapter 6, "Hydraulics of Flood Channels," by D. W. Knight, highlights the complexity of the hydraulic behavior of flood channels. The geomorphological implications of this complexity (which results from the three-dimensional unsteady flow which may interact with the boundaries) are that care should be exercised when attempting to quantify the link between either surface erosion or deposition and the fluid flow. The paper expands on three topics: stage-discharge curves, in-bank flows, and out-of-bank flows.

Chapter 7, "Flow-Competence Evaluations of the Hydraulic Parameters of Floods: an Assessment of the Technique," is by P. D. Komar. The concept of flow competence refers to the limiting case of no sediment transport by flowing water. Flow competence has evolved into a measure of a current's sediment moving ability inferred from the largest particles transported under a given set of flow conditions. Assessment of competence has become a useful technique for the evaluation of extreme floods in still-active river systems. This chapter presents an overview of competence evaluations and comparisons of available formulae. The review indicates a number of deficiencies in our understanding and the author presents several issues which require further study.

Chapter 8, "Floods and Flood Sediments at River Confluences," by I. Reid, J. L. Best, and L. E. Frostick, examines confluences which are points of complex hydraulic adjustments in a drainage network and are prone to bank erosion and changing patterns of sedimentation. The authors conclude that confluences are important elements of the drainage network and are points at which flood flows are extremely complex.

Chapter 9, "Flood Effectiveness in River Basins: Progress in Britain in a Decade of Drought," by M. D. Newson, reviews research efforts in the last ten years and addresses the role of floods in developing the landscape. It demonstrates the value of a basin-wide determined and coordinated campaign by all relevant disciplines—particularly hydrologists and geomorphologists—to record the impacts of contemporary floods and to continuously review the impacts of historical floods. The author emphasizes that de-

spite a decade of drought in Britain, the knowledge of the geomorphological effectiveness of floods has been extended in the sense that we are now aware of the complexities of possible modes of response in the role of extreme process rates and their coupling with more moderate rates.

Chapter 10, "Magnitude and Frequency of Paleofloods," by V. R. Baker, reviews some recent research developments in paleofloods with emphasis on their use in flood frequency analysis. Distinction is made among three categories of paleoflood data: 1) regime-based paleoflow estimates; 2) paleocompetence studies; and 3) paleostage-based flow data (generated from stable boundary fluvial reaches characterized by the long-term preservation of slackwater deposits and paleostage indicators). This paper elaborates on the use of the most accurate paleostage-based flow data for flood frequency and magnitude analysis.

Chapter 11, "The Use of Soil Information in the Assessment of the Incidence and Magnitude of Historical Flood Events in Upland Britain," by R. F. Smith and J. Boardman, demonstrates how field investigations related to soil profile characteristics (such as relative maturity, presence of burried profiles and evidence truncation) may provide a useful evidence of the relative age of erosional and depositional features in a river valley. However, the authors point out that differentiation between closely spaced floods from soil information requires a more detailed knowledge of the chronology of soil development on river terraces than that presently existing.

Chapter 12, "The Yellow River (County Leitrim, Ireland) Flash Flood of June 1986," by P. Coxon, C. E. Coxon, and R. H. Thorn, describes the peat slides of the June 1986 event and examines the resulting geomorphological response of the river channel and its tributaries. The slope-area method and the boulder competence method were used for estimation of the flood discharge and the results were comparable, suggesting that the obtained estimates may be credible.

Chapter 13, "River Channel Changes in Response to Flooding in the Upper River Dee Catchment, Aberdeenshine, Over the Last 200 Years," by L. J. McEwen, focuses on river planform adjustment in response to flooding in the Upper River Dee basin. The author elaborates on the following questions: 1) What is the planform response to runoff events of varying magnitude and frequency? 2) Under what circumstances are rare floods geomorphologically significant? and 3) What impact may climatic fluctuations and land-use changes have had on rates of planform response, through changes in hydrological regime and sediment availability over the last 200 years?

Chapter 14, "Sedimentology and Paleohydrology of Holocene Flood Deposits in Front of a Jokulhdaup Glacier, South Ireland," by J. Maizels, examines the sedimentology of a series of deposits associated with catastrophic floods caused by subglacial volcanic eruptions at the above-mentioned site. The scope of the study was to assess the nature and dynamics of these floods, their magnitude and frequency, and their geomorphological significance in modifying the proglacial sandur environment. The author concluded that although major flood events have been relatively rare on that site, their effects still dominate the proglacial landscape.

Chapter 15, "Flood Deposits Present Within the Severn Main Terrace," by M. Dawson, describes and interprets a sedimentary horizon, thought to be of flood origin, present within a Devensian, paraglacial, terrace deposit and provides some general estimates of the flood magnitude.

Chapter 16, entitled "Floods in Fluvial Geomorphology," by J. Lewin, reviews some characteristics of the fluvial process model and puts forward some "unorthodox challenges" which suggest how the "orthodox" geomorphological model needs to be amplified and modified. The author emphasizes that the fluvial process model should not be taken as a universal world model for geomorphology and that the role of extreme floods is expected to vary geographically mainly because of the variation of the relative magnitude of extreme floods and the physiographics factors involved. He also suggests that sediments have to be considered more systematically.

Overall, the papers contained in this book are a healthy combination of theoretical and experimental studies (consisting of control laboratory experiments, dating techniques, field data interpretation, and historical data analysis) which aim to shed light on the hydrological, geomorphological, and sedimentological processes operating under extreme conditions. Although our understanding of these processes has considerably improved over the last twenty years, much work remains to be done before physically based predictive models are available for the relatively long time scales involved in sedimentology and geomorphology. Also, continuous research is needed for better understanding of the effects of geomorphology on the runoff production process, a necessary step for prediction of flood frequency characteristics from physical principles, and understanding of the spatial variability of runoff production at different scales.

*Floods: Hydrological, Sedimentological and Geomorphological Implications* constitutes a valuable reference for hydrologists, hydraulic engineers, geomorphologists, and sedimentologists. The effort of

the editors and workshop organizers in bringing together scientists from different disciplines for the common purpose of understanding the dynamics of fluvial floods and their effects on the landscape should be commended.—*Efi Foufoula-Georgiou*

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**Global Climate Change: Human and Natural Influences.** S. F. Singer, ed. 1989. 424 pp. $34.95. hardbound. Paragon House.

The stated purpose of this book is to examine three types of "environmental" problems. One category deals with purposeful modification of the physical environment, another with environmental impacts resulting from inadvertent human modification of the natural environment, and a third with external factors independent of human activities. The book title is *Global Climate Change,* though by its stated emphasis it could just as easily, and perhaps more germanely, have been titled *Global Environmental Change.*

In the overview, Singer broaches such varied subjects as acid rain and its link to forest dieback, weather and climate modification, and even asteroid impacts and species extinction. The first chapter, "Mechanisms of Climatic Change," written by Curt Covey, is intended to provide an overview of the physical mechanisms involved in climate changes. Unfortunately, providing an adequate review of such a complicated subject is a nearly impossible task considering the space constraints. Overall, a few important points are covered adequately. I take issue with a statement, found on p. 30, that human activities, such as deforestation and the addition of greenhouse gases to the atmosphere, could bring about ". . . within a generation or two, the warmest temperatures on earth since the Mesozoic Era." This view strikes me as a bit extreme, particularly in light of a second statement later on in this chapter where the author expresses the view that, ". . . reliable forecasts of the climate for the next several generations is beyond our current understanding."

The next two chapters, "Carbon Dioxide and Climate Changes," by William Kellogg, and "Response to W. W. Kellogg's Paper," by Hugh Ellsaesser, present alternate points of view regarding the current greenhouse gas controversy. Kellogg's chapter consists mostly of a distillation of material from earlier work by him and his collaborators, and represents the "consensus" view of the "greenhouse warming" debate. I found some typographical errors here; for example, on p. 41, the change in atmospheric carbon dioxide concentration under one particular "low-growth" scenario is given as going from 35 (rather than 350) to 400 ppmv. Figure 2-2 is labelled identically on both sides of the graph. I believe the left ordinate should have read "developed" nations. One problem with using older material for graphics, for instance figure 2-3, is that recent developments in this fast-paced field can call into question some of the assumptions used in the past, which are thus reflected in the graphs. In this particular figure, observed data ends about 1980, and "arctic" temperatures are projected to increase by about 7°C by around A.D. 2050. The graph shows extrapolated arctic temperatures increasing by 1°C by 1990, a "prediction" that is not borne out by observations over the subsequent (1980s) decade. Another shortcoming concerns the results of recent transient experiments with current versions of coupled atmosphere-ocean general circulation models (GCMs). Some of these have shown that, contrary to earlier expectations of enhanced temperature responses at high latitudes, it is *possible* that surface temperatures in some of these regions may in fact *cool,* at least initially. Such developments should throw up caution flags regarding our present ability to project the evolution of regional climates over the next several decades.

Ellsaesser's chapter, in reply, represents another view of the future. In particular, the author takes issue with what he calls "the cascade of inferences" derived from imperfect observations of climate variation and estimates of future climatic changes, and of the way in which such "value-added" judgements have dominated the projections of future climate scenarios. I found this format of alternating viewpoints among the real pluses of this book. I suppose the bottom-line message of this third chapter is that the subject of global change has seen a great deal of self-serving rhetoric, full of alarmist scenarios that are often backed by little hard data. The author also objects to the selective use of particular model projection features, while others may imply beneficial outcomes are often ignored.

Chapter 4, "Climate From a Modeling Point of View: In Reply to Comments by H. W. Ellsaesser," by Andrew Lacis, replies to some points raised by Ellsaesser regarding model accuracy. In this short chapter, some fine points of numerical climate modeling are touched upon. I found the author's as-