meaning to his. In an interesting addendum to the early modern material, Westman suggests that Pauli's work on these pictorial archetypes may have been stimulated in part by the visualization crisis in modern physics.

Fludd thought Kepler was a numerologist, albeit a mistaken one, and since Fludd was one himself he attempted to straighten Kepler out on the matter. Judith Field finds in her essay, however that Kepler knew he was not in that tradition. Kepler had opted for *numeri numerati* (counted numbers) over *numeri numerantes* (counting numbers), thus for geometry over arithmetic in music, astrology, and astronomy. He saw himself as heir to Plato, Euclid, Ptolemy, and Proclus rather than Pythagoras, Boethius, Iamblicus, and Porphyry. Since many historians have also seen Kepler as something of a numerologist in his search for "the music of the spheres," Field's work is a significant clarification.

A number of the essays mention epistemology, and, although no author quite makes the point explicit, as a whole the collection presents considerable evidence for an epistemological crisis during the 16th and 17th centuries. What can one know, and how can one know it? Through what human faculties is knowledge to be obtained? Or, since both the senses and the intellect are subject to error, should one rely solely on divine illumination? Mulligan in " 'Reason,' 'right reason,' and 'revelation' in mid-seventeenth-century England" has found that these questions cut across all fields—religion and politics as well as the study of nature. Almost everyone called for the use of "right reason," by which each one meant his own idiosyncratic mix of "reason" and "revelation," with none to decide which "right reason" was really "right." No one knew, and one must be very sensitive to that point in any search for "occult and scientific mentalities" in the Renaissance and early modern period. As Richard Westfall notes in his essay on Newton's alchemy, "A different standard of rationality in the seventeenth century may have encouraged Newton to open himself to the influence of a tradition that appears to us almost as the antithesis of reason" (p. 332). No single factor seems to divide the principal actors in the drama as we would wish, and it may be that we have not yet asked quite the right questions on any of these issues regarding the origins of modern science.

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Fluvial Sedimentology

Modern and Ancient Fluvial Systems. J. D. COLLINSON AND J. LEWIN, Eds. Blackwell Scientific, Palo Alto, Calif., 1983. viii, 575 pp., illus. Paper, $56. International Association of Sedimentologists Special Publication no. 6. From a conference, Keele, England, Sept. 1981.

This book incorporates 44 of the papers presented at the second international conference on fluvial sedimentology. The editors have endeavored to select papers representative of the overall balance of the meeting and have organized them into four sections that reflect the interdisciplinary range of topics discussed—hydrodynamics and bedforms, present-day channel processes, facies models, and economic aspects.

In the first group, M. R. Leeder and J. R. L. Allen present two thoughtful syntheses of flow dynamics, lag and bedform genesis. Two additional papers summarize new experimental data. Papers concerning modern channels provide numerous largely descriptive views of erosional and depositional processes and products. The focus of study has shifted from the well-known meandering channel to examples of very coarse-grained and very fine grained fluvial systems. Channel segments located in proglacial or glacially influenced terranes receive the most attention. However, the sedimentary dynamics of large, humid-climate, and tropical streams remain little described. Perhaps of greatest general interest is a paper by D. G. Smith on anastomosed fluvial deposits. Anastomosed systems have been popularized by sedimentologists only in the past few years, though their basic features were discussed nearly 20 years ago by S. A. Schumm. The greatest number of papers focuses on the analysis of ancient alluvial sequences. Most of these papers are primarily descriptive but do illustrate the ways in which paleoflow and bedform dynamics can be inferred from preserved sedimentary structures and other features. A few papers, notably that of P. F. Friend, discuss broader concepts of the stratigraphy of fluvial deposits. The remaining papers provide good examples of the way interpretation and mapping of ancient fluvial deposits aid the understanding and prediction of mineral resources, including gold, uranium, coal, and petroleum.

Modern and Ancient Fluvial Systems is an overview of current research directions for the nonspecialist and contains many papers that will be of interest to the specialist in terrestrial depositional environments. However, in comparing this book with its predecessor (Canadian Society of Petroleum Geologists Memoir 5, 1977), which resulted from the first fluvial conference, I find myself somewhat let down. Whereas the first volume teemed with thought-provoking concepts and attempts at synthesis and generalization, this volume seems to reflect a period of retrenchment and of return to the relatively safe task of description, preferably at a highly localized and detailed level, with little attempt to integrate the observations into the larger context of the fluvial system or basin studied. Thus assessment of the significance of the models and concepts presented is left to the reader. It may well be that, as Collinson and Lewin propose in their introduction, "many case histories will be a better basis for interpretation of new examples." However, my expectation is that the third volume, when it is published, will contain citations of more papers in the first volume than in this one.

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The Erosion of Shorelines

CRC Handbook of Coastal Processes and Erosion. PAUL D. KOMAR, Ed. CRC Press, Boca Raton, Fla., 1983. xii, 305 pp., illus. $70. CRC Series in Marine Science.

The objective of this book is "to provide a state-of-the-art presentation of the science of coastal erosion processes," apparently for an audience of coastal geologists and geomorphologists. Judged against this stated objective the book is a success.

There are 14 chapters, including four by Komar. The 14 authors include a representative cross-section of American coastal geologists and geomorphologists, as well as a coastal engineer, a meteorologist, and two overseas authors with American experience. The introductory chapter, by Komar, qualitatively summarizes what has been described mathematically about coastal processes. Following chapters cover topics that range from edge waves (Holman) to barrier islands (Nummedal) to erosion statistics (Dolan, Hayden, and May). For the reader desiring to follow up a topic, there are bibliographies, many of them excellent, at the ends of the chapters.

Sea level rises so slowly on ocean beaches that a research career is not long

enough to isolate and observe the effects from the field. However, lake level changes significantly on the Great Lakes over five- to 10-year periods, providing an outdoor laboratory model of the slower and noisier ocean process. Hands summarizes his extensive experience with beach profile changes on Lake Michigan during times of changing lake level. He found that longshore bars moved shoreward as lake level rose (1969–1976) and that shore erosion lags the change in lake level by two to three years. Erosion in response to a rise in lake level depends on the selection of the seaward limit of sediment motion, which Hands relates to a wave height having an expected recurrence interval of five years. Hands concludes that confirmation of this approach for ocean shores is lacking, and is not likely, because of the difficulty of measuring small, slow changes.

Among possible solutions to beach erosion, the one most favored by regulatory agencies with coastal responsibilities is nourishment of the beach by sand from outside sources. Dean reviews the subject, stressing that the effectiveness of nourishment depends to a large extent on the longshore length of the beach being nourished. Where this length must be small, terminal groins or a groin field are needed. Terminal groins are more likely to be effective at sites where the breaking wave crests parallel the shoreline.

Since this is called a handbook, one looks for tables of useful data. They are to be found primarily in the chapter by Dolan *et al.*, which tabulates rates of shore erosion along U.S. coasts by state for major water bodies and by landform for geographic regions. The accompanying text states that erosion now is occurring along 79 percent of the Atlantic coast, 63 percent of the Gulf coast, and 30 percent of the Pacific coast including Alaska (these percentages are not derivable from the tables). The tables suggest that about 69 percent of the weighted Gulf coast erosion is in Louisiana, associated with subsidence and erosion of the Mississippi Delta. The statistics given for Alaska in the tables represent only a small part of the total Alaskan coast, so presumably the low frequency of Pacific coast erosion is not overweighted by the very long Alaskan shore.

Useful data on worldwide cliff erosion are found in the tables in a chapter by Sunamura. The subject of cliff erosion and platform development was of interest in the early days of this field, but it no longer attracts much attention among American workers. Sunamura's chapter is a good general starting point for a renewed look at this subject. In the following chapter Kuhn and Shepard provide a qualitative supplement for the cliffs of San Diego County.

Granted the strengths of the chapters described above, the book remains a collection of papers rather than a cohesive treatise. The cross references between chapters are few and unspecific. Symbols describing shore profiles and sea level rise change from chapter to chapter and even within the same chapter. Terminology in the book is often imprecise. The term "littoral drift" is used to describe both the sand-transporting process (longshore transport) and the sand itself, occasionally with both meanings in the same paragraph. The term "morphodynamics" is undefined. Nongeologists will be surprised to learn, if they figure it out at all, that a "regressive" shoreline is not eroding but accreting. "Regression," "transgression," "morphodynamics," and "longshore transport" are not included in the brief index.

Edge waves receive attention, though detection of their presence requires a detailed field study and some faith. On the other hand, solitons developed from the decomposition of shoaling waves are easily seen and are shown (but not identified) in at least five photographs in the book. These more substantial phenomena fail to arouse curiosity, but the will-o'-the-wisp edge waves continue to fascinate.

This book is well suited for use as a supplemental reference in courses on coastal processes, marine geology, and coastal engineering. It will fill a gap in the libraries of most coastal specialists with geologic or engineering interests and stand as a good summary of present activity in the field. The price will inhibit wider use.

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Anatomy and Behavior

Adaptations for Foraging in Nonhuman Primates. Contributions to an Organismal Biology of Prosimians, Monkeys, and Apes. PETER S. RODMAN and JOHN G. H. CANT, Eds. Columbia University Press, New York, 1984. x, 351 pp., illus. $35; paper, $18.50. Based on a symposium, 1980.

The 13 papers in this book illustrate a number of approaches to answering questions concerning how anatomy and behavior related to it affect foraging strategies.

Two of the contributions deal with morphological features involved in processing food. Kay addresses the question of which features might be used to infer the foraging behavior of extinct primates. He presents evidence that 60 percent of the diet of most primates is made up of either insects, fruit, or leaves. As many as 90 percent of the species have diets consisting mainly of fruit and leaves or fruit and insects. None feed exclusively on leaves and insects. Because of the difficulty of catching a large number of insects and of digesting leaf material, highly insectivorous primates are usually small and highly folivorous ones are large. Kay has found that there is a significant correlation between the shearing crest morphology of molar teeth and dietary propensities. Insect and leaf eaters have similar molar morphology, but this morphology differs from that of primates that feed mainly on fruit. Since primates with leaf and insect diets can be distinguished by body size, the type of diet of fossil primates can be determined. Kay also explains how such features as enamel thickness, incisor wear, and incisor structure can be used to infer aspects of the diet.

Milton presents evidence that certain features of gut morphology, food passage rates, and body size may play an important role in determining the types of foods a given primate species finds most suitable. Smaller species tend to pass food through their guts more rapidly than larger species, and modifications of proportions of the gut tract allow plant feeders (especially those that eat mainly leaves) to have slower food passage rates.

Both these papers illustrate that morphological features related to feeding are quite conservative and place constraints on the diet of a species. Waser, who has compared the foraging and ranging behavior of two closely related primates (*Cercocebus albigena* and *C. galeritus*) living in radically different habitats, reports that these species have adopted different patterns of ranging and of intergroup and intragroup dispersal to obtain diets that are extremely similar in composition (proportions of different types of foods) and in short-term diversity (number and proportions of different foods eaten per month).

In his contribution Post, drawing examples from his study of yellow baboons in Kenya, stresses that the foraging decisions a baboon troop makes at one point in time (for example, upon leaving its sleeping groves) will affect and constrain