arches and stacks, ramparts, ramps, potholes, solution pools, tafoni (hollows or cavities in rock), and honeycombs. Notches are potentially useful as paleo-sea level indicators, but their interpretation as such requires careful understanding of their mode of origin, which includes chemical solution, mechanical erosion (wave action, abrasion), and/or bio-erosion. While most notches lie at or above mean sea level, some also lie below. The wide vertical distribution suggests considerable variability in wave energies and tidal ranges. Sea caves, arches and stacks form in weaker rocks, the erosion of which is often controlled by planar elements, such as bedding planes and fractures. Coastal tafoni often develop on arkose or sandstone, usually above the spray zone, whereas honeycombs, with a cell-like structure, form within the spray zone, above HWL. Their worldwide distribution is tabulated.

The last chapter examines the impacts of anthropogenic activity on rocky coasts. After a brief survey of different types of protective engineering structures, the consequences of these on cliffed coasts are examined. Sea walls are subjected to scouring at their base. Rigid sea walls may further enhance bedrock lowering. Basal scouring may ultimately undermine the stability of the structure. Engineering works, such as breakwaters or jetties, may interrupt littoral drift, depriving the downdrift side of sediment. If this causes depletion of beach materials in front of a cliff, an intensification of cliff erosion is likely. Construction of dams or reservoirs, and also beach mining all tend to reduce the sediment supply to the coast. Cliff slope instability is promoted by construction of buildings and roads too close to the cliff edge, a common problem in places like California. Removal of the natural vegetation cover is another destabilizing factor. Cliff erosion, especially where associated with Type-A platforms, is likely to increase with rising sea level. Using a simple mathematical model, Sunamura estimates up to a doubling of the recession rate for a small Pacific volcanic island, by the year 2100.

In contrast to most previous descriptive accounts of rock coastal landforms, this book presents a more quantitative treatment supported by laboratory experiments and field observations. This viewpoint provides a much better understanding of the dynamic forces, both attacking and resisting, that shape rocky coasts. As such, the book makes a valuable contribution to coastal geomorphology. A few minor points could have been improved. Parameters on Figs. 7.5–7.7 could have been defined in the captions. The title is also somewhat misleading, in that "rocky" is essentially equated with "cliffed". The author's definition of a rocky coast is one that is "cliffed and yet composed of consolidated material irrespective of its hardness", including soft, cohesive, but *unconsolidated* materials, such as clay, sand, pyroclastics (see Appendix Two). While the latter materials may well form cliffs, they are not usually described as "rocky".

Vivien Gornitz
Columbia University and
Goddard Institute for Space Studies
New York, NY

Coarse-Grained Deltas, edited by Albina Colella and David B. Prior, 1990, Blackwell Scientific Publ., Oxford, etc., 357p, 392 figs. (pounds sterling 40.–). (Spec. Publ. 10, International Association of Sedimentologists). ISBN 0-632-02894-7.

This is a symposium volume consisting of 19 articles by 29 authors. It arose largely as the product of the First International Workshop on Fan Deltas that was held in 1988, sponsored by the University of Calabria, Italy. Coastal specialists will be interested in this volume because it deals in some detail with deltas mainly of the Gilbert type and vastly different in many respects from the classical muddy deltas familiar to students of the Mississippi, Nile, Po, Danube, etc.

The delta concept and its various classifications are treated by W. Nemec (Bergen) and a new and original system for alluvial deltas is presented by G. Postma (Utrecht). For students of ancient deltas it is essential to try to avoid generic definitions because, although the regional forcing conditions are a legitimate criterion for categorizing modern deltas, when we have to face up to limited data and the regional inferences involved in analyzing any ancient geological examples, assumptions and subjective judgments tend to mount up. Criteria based on purely sedimentologic data offer a more secure procedure. This is especially true because ancient deltas are often long-lived and vary in form and characteristics through time. This volume focuses on sand-to-gravel grain sizes combined with steep slopes at the delta face. The marine or non-marine settings are not considered to be particularly relevant, nor are the alluvial features.

Postma's approach is to designate (a) architectural characteristics and (b) sedimentary facies; the feeder (distributory) system is significant, as are the basinal water depths and the sediment diffusion modes. Various combinations of these criteria generate twelve "prototype deltas". His feeders are grouped into four types: (A) Extremely steep-gradient (up to 30°), gravel dominated, often ephemeral and seasonal, such as high-latitude, fjord situations; (B) Reduced slope, sand-gravel, in mobile bed-load channels, typical of sandurs; (C) Moderate slope, sand-gravel in stabilized channels (vegetated banks), as in fjord heads and some mountain lakes; (D) Low-gradient, fine suspensions (mud), prograding, bird-foot style.

Postma's system proceeds from these four feeder categories to consider two water-depth conditions, shallow and deep, but subdivides "shallow" into two, a very shallow "Hjulstrom-type" and a little deeper "classic Gilbert-type"; these are principally restricted to A and B feeders. His deep-water deltas include some Gilbert type (A and B), but also include C and D in his "Mouth Bar type" (which includes his category 11 (delta-fed submarine ramp) and 12 (delta-fed thalweg and lobe system). Time will tell how Postma's scheme is accepted, but it seems like a serviceable methodology.

The sediment "diffusion" modes, noted above, are treated in considerable detail in another chapter by W. Nemec. The gravity-driven categories proved to be of considerable interest to this reviewer (R.W.F.) whose doctoral thesis, submitted in 1940, was dedicated to this subject, an almost unheard-of topic half a century ago. Nemec identifies progressively: creep, slide, slump, flow (plastic), flow (fluidal) and fall. The slide-to-slump stage is mainly a coherent transfer that mimics Alpine gravity tectonics ("Pumpelly's Law"). Fluidal flow and free fall result in total loss of coherence, followed by forcing according to grain size and density.

The rest of the volume consists mainly of regional case studies, which contribute most valuable input to the general theme. Two environmentally contrasting types of region receive unusual attention: (a) high-latitude settings of seasonal postglacial sedimentation (fjords, margins and heads), and (b) low-latitude, tectonically active settings, also strongly seasonal. High slope-angles, high-energy "overload" alluvial feeding, and highly pulsatory sedimentation is characteristic of both. As a result, in the history of interpretation of ancient deposits, some tectonic semi-arid situations have formerly been misread as postglacial and vice versa.

Prior and Bornhold illuminate some Holocene fjord examples from British Columbia with side-scan sonar imagery supplemented with subbottom profiles and sampling. An alluvial delta in the same region is analyzed by Bornhold and Prior. An isostatically emergent fjord-head example is provided by the Alta delta in northernmost Norway (Conner *et al.*). Pleistocene fan deltas are considered, from Ontario (Martini) and Poland (Mastalerz), and an extraordinary lava-fed Gilbert-type delta from Antarctica is described by Porebski and Gradzinski.

Turning now to the semi-arid or Mediterranean settings, mostly with tectonic input, there are several cases from Spain (Dabrio, Bardaji *et al.*, van der Straaten, Garcia-Mondejar), others from the rift margins of the Gulf of Suez, Red Sea (Gawthorpe and Colella) and Dead Sea (Bowman). A wave-dominated example in the Taranto embayment, Italy, is well described by Massari and Parea. An active fault setting in S.W. Turkey is presented by Kazanci. An example from Korea displays foresets up to 150 m high, again suggesting a highly dynamic control (Hwang and Chough). In the whole volume the only paper that approaches geographically the original Lake Bonneville, Utah, setting of Gilbert's classic studies is a short treatment of an early Tertiary intermontane basin in Colorado (Flores).

For sea-level specialists it is interesting to find that eustatic control (in Vail's first-, second- and third-order cycles) is treated in some detail (the Spanish examples by Bardaji *et al.* and by Dabrio).

The volume is well printed and illustrated, being remarkably free from errors, showing the hand of dedicated editors. It has a "soft" but serviceable and sturdy binding. References are copious, paper by paper, and there is an excellent overall index which will make this paper an invaluable research tool.

Rhodes W. Fairbridge
Columbia University
New York, NY