noting that her untimely death almost coincided with the conference. The succeeding paper, by Sutton and Watson ("Questions for the future"), is a brief exposition of the history of research on the Lewisian complex and a sentient consideration of the problems posed by the Lewisian in the context of continental structure and growth. Two review papers follow, Park and Tarney on the Lewisian as a whole, with emphasis on the mainland, and Fettes and Mendum on the Outer Hebrides. In addition to discussion, the former presents new cross sections illustrating mainland Lewisian history, and the latter gives the first modern review of the Outer Hebrides and provides an excellent summary of recent research.

Next is a group of papers on the origin of granulites. First, the problem of the origin of the extreme depletion of large-ion lithophile elements of the granulites is considered, with an emphasis on models that involve depletion at a primary magmatic stage. Next, the adjacent amphibolite facies gneisses of the Gruinard district are treated in detail, and new data are presented. Three theoretical and observational papers on the granulite facies metamorphism complete the group; estimates of peak pressure and temperature vary about 20 percent.

A series of more specific papers follows, first on the geochemistry of marbles (one paper) and then on structural matters, mostly connected with Proterozoic shear zones (five papers). The next three papers, on geophysical matters, form a welcome addition to Lewisian studies; they discuss physical properties of the gneisses, crustal seismic reflection profiling, and paleomagnetism. The Lewisian section ends with a detailed discussion of the deep-seated Proterozoic dyke swarm.

The final group of papers are valuable comparative studies; the reviews of the Yilgarn Block and of the high-pressure granulites of Enderby Land are particularly instructive.

Altogether there is a wealth of information in this volume on the "high grade terrains" of the title. It is not, however, a textbook; the papers are not fully informative to the nonexpert on several major matters, notably the gray gneisses (the Laxford complex) and their relationship to the granulites. The "evolution" of the title is not accompanied by new geochronology or new insights into old geochronology; there is no systematic discussion of isotopic tracers except in the papers co-authored by Tarney. There still seem to be terminological problems; time is rather naively treated on occasion, and some rewriting of history may be noticed. Nevertheless, this book does justice to its famous subject: most of the many hundreds of papers on this 5000 square kilometers are included in the reference lists. It will be a very useful addition to library resources on crustal structure for the next decade, and then a fourth Lewisian conference will be required.

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## Model Landforms

**Experimental Fluvial Geomorphology.** Stanley A. Schumm, M. Paul Mosley, and William E. Weaver. Wiley-Interscience, New York, 1987. xiv, 413 pp., illus. $49.95.

Nearly two decades ago, Judge R. H. Kroninger, in ruling on the effects of logging in a California watershed, noted that numerous expert witnesses in geology and engineering presented conclusions that were "hopelessly irreconcilable on such critical questions as how much and how far solid particles will be moved by any given flow of surface water." The witnesses "were able to agree only that sediment will not be transported upstream" (*State of California, Marin County*, v. *E. Righetti* et al., 1969). To students of rivers the words sting even today. For however hyperbolized the ruling may have been, it reminds us of a painful truth: we still do not fully understand complex, nonlinear fluvial systems with their internal thresholds and their evolutions that span geologic time.

Our excuses seem legitimate. The fluvial system consists of hundreds of major components in its drainage basins, conveyance channels, and alluvial fans or deltas and certainly many times that number of feedback loops. Like all good reductionists we have studied the subsystems, often to good effect, but are at a loss when we try to put the system back together. Those who have traditionally attempted to understand the whole system, primarily field geomorphologists interested in landscape evolution, have been confounded by incomplete records of fluvial responses to perturbations, or by superposition of responses, and have never traced a signal—say, a wave of erosion due to base-level lowering—throughout a natural river to its headwaters.

It is joyful news, then, when a book is born into a discipline so desperately in need of answers. Here under one cover are the products of 18 years of experimental investigations into the fluvial system by the archdruid of the technique and his students. The experimental apparatuses employed are the rainfall-erosion facility (REF), a 138-square-meter sandbox with overhead sprinklers, and two tilting flumes. A typical REF experiment involves establishing a planar, sloping sand surface that is subject to some intensity of simulated rainfall from the sprinklers and documenting the evolution of the drainage net, the water and sediment yields, and so on. A typical flume experiment entails establishing a narrow ditch through the bed material and documenting the evolution of the channel pattern and sediment discharge, subject to various initial and boundary conditions. The objective of the experiments always is to "provide an insight into landform evolution and dynamics," not to provide quantitative predictions, because the models are not dynamically similar to nature. They are "simply considered to be small landforms."

Those who have followed the journal literature in this area will recognize many of the experiments. Parker and Mosley's tests of the Glock model for drainage network evolution are here, along with Parker and Harvey's experiments that led to the concepts of episodic behavior and complex response. Here also are the flume experiments on channel planform as a function of slope, water discharge, and sediment type that underlie Schumm's oft-reproduced classification diagram of alluvial channels. Gardner and Shepard's studies of entrenched bedrock meanders (in a cohesive clay and sand substrate) and the more recent studies of flume-channel response to local deformation of the bed (effected by jacking up the middle section of the flume) and alluvial fan morphology and dynamics round out the treatment. This presentation of previously published material is not necessarily redundant. The whole body of work now can be seen in toto and in much greater detail. In addition, each topic is placed in context by concise summaries of other work, especially field and theoretical studies. The resulting collection is not a treatise on experimental fluvial geomorphology, as its title implies, but more a peripatetic autobiography of sorts for the senior author. But it is a testimony to his breadth that the title fits at all.

This is a useful book, one that would please Judge Kroninger. It demonstrates an underused methodology for understanding teleconnections within the fluvial system, and it presents the basic experiments that have led to several important theories of landform behavior. But you must believe that the results from these "small landforms" can be applied to the world at large.

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