thus would have been the only permanent river and, moreover, the only freshwater source in the area southeast of the lake.

Lying in one of the least known parts of Africa, the Kalambo Falls area is but sparsely inhabited by either man or animal. However, it lies in one of the crossroads of eastern Africa, in the Tanganyika-Nyasa corridor between Lakes Tanganyika and Malawi. We have here something like an hourglass constriction, connecting northeast Africa and the interior of southern Africa.

When this site was first discovered it was thought that its inhabitants had been a group of prehistoric lake dwellers. That interpretation was abandoned following the detailed investigation in 1959 and 1963, which showed that the deposits were largely fluviatile in origin. There is abundant evidence for this—alignment of the pebbles in the deposits, tree trunks (in the older deposits) with their heads pointing downstream, and the numerous channel cuttings and aggradation of sediments. Having once accepted the reports that this was a lakeside occupation, with all that that means for prehistoric adaptation to environment, one finds it a wrench to adjust one's thinking to a riverine situation. Fortunate is the archeologist who can correct his interpretations in the course of the fieldwork, and credit is certainly due to Clark and his associates for their masterly presentation of the evidence supporting the new line. Fundamentally, in the mind of this reviewer at least, the whole prehistoric occupation revolved about the proximity of the water at the Kalambo Falls site.

As Kleindienst points out, because of the work of the water in ancient times, none of the sediments and deposits from the key site A could be duplicated in exact detail at the other three locales. In order to get their correlations, the investigators had to do some involved sleuthing, based on lithology, organic remains, carbon-14 dating, elevation, and artifact contexts. With regard to the geology, it is curious that the standard Munsell color chart was not used here.

Probably the single most interesting bit of research involves the paleoclimatological aspect. E. M. van Zinderen Bakker discovered from his pollen studies that there were considerable changes in vegetation at the site during the Pleistocene. The results of his work are presented graphically in fig. 17, in which he illustrates the striking similarities between Woldstedt's temperature curve for the last 70,000 years in Europe (the Last Glaciation) and the results he obtained at Kalambo Falls. One could argue that the graph for Kalambo Falls shows more dots off the curve than on it, indicating a certain amount of supposition, but we have no reason to believe the situation was other than as Bakker depicts it.

After having been conditioned to the traditional chronological divisions, the "Earlier," "Middle," and "Later" Stone Ages, which Clark helped propagate in his book *The Prehistory of Southern Africa* (see table 3 there), published 10 years before the present work, we find these terms conspicuous by their absence in the report on Kalambo Falls. Actually, Clark used this nomenclature in connection with Kalambo Falls through the middle '60's. Heavy doubts concerning the inflexible nature of this arbitrary framework were raised in the Wenner-Gren Foundation for Anthropological Research symposium on Africa in 1965 (see *Background to Evolution in Africa*, 1967, edited by Walter W. Bishop and Clark). Regardless of the merits of abandoning a given system of nomenclature, the fact is that discarding something already fossilized in the literature takes a little time to get used to.

The archeologist who is trained neither as a botanist nor as a geologist will probably get most use out of appendix K. This appendix gives us a welcome summation of the finds from localities A, B, C, and D at Kalambo Falls by archeological horizons. Appendix J will also be frequently referred to by researchers. It is a detailed summary of the radiocarbon dates for the archeological industries.

As Clark says, admitting all of the lacks in the record at the Kalambo Falls site, the unaccounted-for gaps in the chronological record, and the problems in the archeology and geology, it is transparently evident that here we have the most complete record available for this span of time in sub-Saharan Africa. As a backdrop to the forthcoming publications on the same site, Clark and his associates have demonstrated the kind of habitat and the biome against which were interplayed man and his culture. Actually, Clark might be accused of being a kind of "environmental determinist," which were once almost fighting words. Writing on Kalambo Falls in the *Scientific American* in 1958, Clark suggested that by the end of the Pleistocene, about 10,000 years ago, the stream of human progress had shifted out of Africa to the Near East and Europe. By then, lower Africa had become a "backwater" because life in Africa was "easy" compared with the rigors offered by the elements in the newer parts of the occupied world. We do not know if Clark will dwell on this theme in the other books on Kalambo Falls, but it is something that goes vastly beyond our present reach.

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Island Faunas

Mammals in Hawaii. A Synopsis and Notational Bibliography. P. QUENTIN TOMICH. Bishop Museum Press, Honolulu, 1969. viii + 240 pp., illus. $5. Bernice P. Bishop Museum Special Publication 57.

Like most remote lands, the Hawaiian Islands possess a sparse fauna of endemic mammals. Aside from a rich variety of whales and dolphins (17 species) in the surrounding waters, the indigenous mammals include only a species of monk seal and a subspecies of the hoary bat, both of which presumably reached here under their own powers. But the list of other mammals that have populated the area now includes 26 exotic species of eight orders. Here indeed is a natural laboratory for studying the ecology of introduced forms, and this volume provides a firm foundation on which to build.

Polynesian settlers, possibly as early as the 2nd century A.D., brought with them the pig, dog, and Polynesian rat. Following Captain James Cook's first arrival in 1778, European explorers and traders introduced cats, dogs, and mice and other rodents, many of which later assumed considerable economic and public health importance. With the development of agriculture, the mongoose and two species of bats (which failed to survive) were imported for the control of pests. Interest in sport hunting led to the introduction of such ungulates as the axis and mule deer, pronghorn, and mouflon. At various times the wallaby, rabbit, and guinea pig were released or escaped. There now are 19 free-ranging, established terrestrial species, including (in both feral and domestic states) the horse, donkey, sheep, goat, cow, and water buffalo, that reached the islands through the agency of man.

The mammals are discussed species by species, with the taxonomic, historical, and biological data that are available. These are scanty in some cases, plentiful in others. Attention is given to interactions between species, changes in habits, responses to and effects on the new environment, and economic significance. There follows a section on "Some perspectives in Hawaiian mammalogy," dealing with such special topics as Hawaiian names for mammals, mammals in crafts and art, whales and dolphins, biological aspects of the rodents, diseases and parasites, current introductions, the fate of Kahoolawe, and the Leeward archipelago. It is surprising that, despite the limited fauna and the general lack of interest in it until recent years, the author has assembled in the last section a bibliography of 86 pages with 771 annotated references bearing on the subject. An adequate index completes this interesting and informative volume, published in observance of the 80th anniversary of the founding of the Bernice P. Bishop Museum in 1889.

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Sedimentary Compounds

Organic Geochemistry. Methods and Results. G. EGLINTON and M. T. J. MURPHY, Eds. Springer-Verlag, New York, 1969. xxiv + 828 pp., illus. $49.

Sedimentary rocks contain the earth's largest pool of organic compounds; 1 percent of a typical sediment consists of an immensely complex assemblage of compounds that reflect both earlier life and the slow but powerful chemical reactions in the subsurface. Organic geochemistry is the study of this material and the interpretation of its structure in terms of the processes that shaped it.

The size of the present book, the number of contributors, and the quality of the papers mirror the present state and the healthy growth of the field. Organic geochemistry has grown under three different stimuli: academic curiosity, petroleum research, and preparation for extraterrestrial sampling. Yet only two of the 31 chapters have been contributed by scientists in the oil industry. A large fraction of the industrial effort during a quarter century remains classified and lost to science.

The papers fall into four groups: on methods, on geological processes, on inventory of compounds, and on specific geological situations. The methods section emphasizes the modern tools, especially mass spectrometry. Some chapters could be more effective; the short section on gas chromatography is too elementary, with only two pages on geochemical use. Some statements are painfully misleading: "Pesticide grade solvents are contamination free" (p. 77).

The section on geological processes should be valuable for chemists entering the field; I regret that the vital chapter "Organic matter in sediments" was not expanded beyond a brief outline and five references. The inventory of compounds and the analysis of geological situations reflect the uneven penetration of the field by modern techniques; these are applied to small molecules but have had little impact on the study of humic acids, coal, and kerogen. The imbalance is great; we are ignorant about the structures of most sedimentary organic compounds.

Organic reactions in sediments are incredibly complex. A single biochemical may be converted into many thousands of different compounds. We will not understand the origin of oil, coal, and kerogen until we understand the reactions that occur in sediments. Yet, a single chapter of the book discusses some possible reactions, and the excellent subject index has no entries for equilibrium, mechanism, radical, or reaction.

We miss some subjects that might be covered in a future addition to this book: history and development of thoughts, areas of controversy, pitfalls in research and interpretation (meteorites!), trends and needs for future growth, links and contrasts between inorganic and organic geochemistry, and *applications*. Organic geochemistry does have applications, most obviously in petroleum exploration, and also in oceanography, public health, and pollution research, a subject that need not have been covered by a tendentious poem, as it is in this book.

On the whole this is an excellent book, a good reflection of the state of the art, in spite of three years' production time, and useful to students and specialists; but not an imaginative outlook into the future, and with a price tag that may limit the market.

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A Solid

Physics of Ice. Proceedings of an international symposium, Munich, Sept. 1968. NIKOLAUS RIEHL, BERNHARD BULLEMER, and HERMANN ENGELHARDT, Eds. Plenum, New York, 1969. xx + 644 pp., illus. $25.

Gränicher, in his review "Problems of the physics of ice," the first of the 56 papers in this volume, relates a story about the visit of a distinguished American scientist to his laboratory in Zurich. The visitor expressed astonishment that Gränicher had chosen to study ice, a substance about which surely everything is known. This volume effectively dispels that notion; it also catalogs in detail much of the recent work on the structure and properties of ice, and it emphasizes by means of several review articles the importance of achieving a thorough understanding of ice.

A group of eight papers covers the crystal structure and growth of ice. These papers remind us that ordinary ice I is only one of at least ten solid forms of H_2O. The others include the high pressure ices (II through IX) and the metastable cubic ice and vitreous ice that can be formed by condensing water vapor at low temperatures. Whalley, Hamilton, Kamb, Rabideau, and others summarize the structural conclusions that have emerged from their studies of x-ray and neutron diffraction, infrared and Raman spectroscopy, nuclear magnetic resonance, and dielectric and thermodynamic measurements. In all ices studied to date, each molecule is hydrogen bonded to four near (2.75 to 2.87 Å) neighbors. Within the limits of the measurements, individual H_2O molecules are not deformed from their dimensions in the vapor, though hydrogen bonds in some of the ices are deformed considerably from the nearly linear O-H. . .O bond in ice I. In ice IX the departure from linearity is as great as 15 degrees. The greater compactness of the high pressure ices is the result of the closer approach of non-hydrogen-bonded neighbors; this is achieved in most cases through the bending of hydrogen bonds. The ices differ in the degree of order of the orientations of the molecules. In ices II, VIII, and IX, the orientations have a long-range order, whereas in ices I, III, V, VI, VII, and cubic ice they are disordered.

A total of 21 papers are grouped under the headings Electrical Properties and Diffusion and Relaxation Phe-