by a Britisher, and a few years later the Petersburg Rocket Institute was founded. Thousands of rockets were produced here for troops in the Caucasus. They were widely used in the Russian-Turkish War of 1828–1829, and later in the Balkans.

By midcentury, refinements in fuse design were evident. K. I. Konstantinov laid the groundwork for internal ballistics, empirical knowledge of powder formulations developed, and hydraulic presses capable of 40 tons had been built in France for the new Nikolaev Rocket Plant near Kiev. By the early 1900's, large rocket flares were being produced in quantity, and various wing and tubular stabilized rocket shapes had been tested. Large numbers of rocket flares were manufactured during World War I, although artillery had supplanted bombardment rockets in accuracy and range.

The author concludes with a summary of the history of Russian rocketry, and 16 detailed appendices complete the text. A bibliography and a name index are included.

The care with which Sokol'skii treats historical facts is evident. Statements such as "Until the middle of the 1840's Russian rocket engineering developed very slowly and the poor quality of rockets impeded their widespread use" are refreshingly candid. Russian weights and measures (*pud, sagene, verst,* and the like) are translated into pounds and yards whenever used.

The printing on the whole is clear, although in the review copy there are a few pages where the ink has run through the thin paper. Illustrations are crisp. The price of the book is most reasonable. A better title, however, might have been "A History of Russian Rocketry to 1918."

Highly recommended for students of history of technology, military ordnance, and Russian history and for all rocket engineers interested in learning how rockets were made in the time of their great-great-grandfathers.

F. C. DURANT, III
National Air and Space Museum, Smithsonian Institution, Washington, D. C.

Land near Water

River Plains and Sea Coasts. RICHARD J. RUSSELL. University of California Press, Berkeley, 1967. viii + 173 pp., illus. $8.75. Hitchcock Lectures, Berkeley, 1965.

This short book does not pretend to be a highly technical presentation; it is, rather, a simply and clearly written autobiographical account of the author's important contributions to geomorphology. Russell's research was directed to streams and alluvial morphology before 1956; since then he has been investigating seacoasts and beach processes.

The first half of the book is a lucid survey of the vast accomplishment of Russell, Fisk, and the Mississippi River group. These workers presented a most important challenge to the Davisian system and freed geomorphology from a too intensive preoccupation with erosion to the exclusion of deposition. Their work is certainly now an established part of geomorphology, and their conclusions, especially those dealing with the interaction of a stream with its own alluvium, have been successfully extended to many other streams. With a single unimportant exception, no reference is cited from publications later than 1960, for Russell had by that time become interested in coasts. It is a pity that he has not attempted to combine the important recent work on rivers with his own broad experiences; the results would have been welcome.

The second half of the book, dealing with coastal morphology, beach processes, and problems peculiar to tropical islands, is based on Russell's studies since 1956. The summary here given by Russell is particularly valuable, for the publications are scattered and the studies not generally as widely known as those on rivers. Again Russell's approach was to treat deposition and erosion as halves of a single picture, and he gives a particularly clear account of the many dangers of too naive interpretations of the "evidence" of various Quaternary stands of sea level.

Certainly not all of Russell's conclusions have won wide acceptance, but his contributions to geomorphology are enduring. His obvious love of fieldwork and the excitement of discovery are clearly revealed here; they are contagious. In an assigned reading list for a modern undergraduate course in geomorphology (physical geography) this small book may well be among the most valuable entries.

LAURENCE H. LATTMAN
Department of Geology and Geophysics, Pennsylvania State University, University Park

Quaternary Ecosystems

Quaternary Paleoecology. Vol. 7 of the Proceedings of the 7th Congress of the International Association for Quaternary Research, Aug.–Sept. 1965. E. J. CUSHING and H. E. WRIGHT, JR., Eds. Yale University Press, New Haven, Conn., 1967. viii + 433 pp., illus. $15.

A new look in paleoecology is exemplified by the varied contributions in this book. Imaginative studies of modern processes and modern biogeography are the basis for some illuminating interpretations of Quaternary biota and climate presented by contributors to the volume. Though much of the material relates to pollen chronology and stratigraphy, the topics are diverse, and include paleoecology based on evidence from mollusks, insects, seeds and other plant megafossils, C^{14}-C^{12} ratios in waters of different *p*H, chemical composition of clamshells, and modern pollen rain.

In geographic coverage the work focuses largely on eastern North America, but includes a smattering of studies from different parts of the world. Especially delightful reading is a discussion by Tsukada and Deevey of cyclicity in Mayan agricultural practices and the Mayan economy partly inferred from the pollen record. An example of their light touch is seen in their photograph of modern and ancient "pictographs" along the shores of Lake Guija, El Salvador (see opposite page).

Cushing and Wright's book might well have been entitled "Studies in Late Quaternary Ecology" because of the emphasis on the latter part of the Ice Age and because it is not strictly a book on principles of Ice Age ecology. However, some general papers on methodology and an intriguingly written introduction by the editors add a broad slant to the volume.

The book gives evidence that a good deal of face-lifting is going on in the methodology and ecological interpretation of the Quaternary plant record. An important tool long used in Europe, namely seed stratigraphy in close combination with pollen stratigraphy, is being tried with interesting results in the United States. Aside from the important matter of providing a basis for identifying species, which is not usually possible from pollen grains, plant megafossils such as seeds offer some assurance that the source plant was growing locally—a thing not certain from airborne pollen grains.

American workers are trying new

statistical methods; absolute numbers of pollen per unit of sediment, as is exemplified in chapters by M. B. Davis, Brush, and Whitehead, are useful in indicating real changes in abundances, especially when studied in connection with sedimentation rates (the old standard percentages tend to exaggerate the importance of changing ratios).

Another new American look that is being added to the old palynology inserts modern pollen-rain studies as an obviously important intermediary in linking fossil pollen assemblages with modern vegetation. It is now practically unfashionable in this country to publish a Quaternary pollen diagram without also providing comparative data on modern pollen rain.

An attribute of the book is the stratigraphic thoroughness with which most of the pollen sections are presented—a feature perhaps encouraged by the editors. Especially noteworthy is the format used by Cushing in his neat summary of late glacial and early postglacial pollen zones of Minnesota. Great attention is paid to tabulating the zone characteristics, C^{14} data, thickness, and geographic distribution of the zones, which makes Cushing's regional summary extremely useful.

A particularly important paper in this volume is Coope's summary of European fossil insects of the late Quaternary. He is able to draw amazingly precise determinations of paleoclimate based on relationships of the fossil records to modern biogeography and climate.

The late glacial pollen zones of Minnesota, with which the first third of the book is largely concerned, present certain ecological perplexities that are of special interest—for example, the association of arctic megafossils with pollen of hardwoods such as *Fraxinus* (ash). In the first recorded vegetation zone following deglaciation in northeastern Minnesota, tundra species are present, spruce is the dominant tree pollen, and nonarboreal pollen such as that of sedges is abundant. Cushing concludes that this zone represents a subarctic tundra.

During part of this interval (between about 12,500 and 11,500 years ago) a reasonably prominent peak (15 to 20 percent) of *Fraxinus* (and in some cases oak) pollen is a characteristic late glacial feature in the state. At Spider Creek the *Fraxinus* peak (including mainly *Fraxinus nigra* pollen) is associated with megafossils of such typical tundra species as *Vaccinium uliginosum* var. *alpinum, Rhododendron lapponicum, Salix herbacea,* and *Dryas integrifolia*—an anomaly that is bypassed by Watts's and Cushing's discussions of this zone.

Watts found the same arctic megafossils in the basal zone at nearby Weber lake, which also has a clear *Fraxinus* peak. Of the American ash species only *Fraxinus nigra* now overlaps the arctic species in range, but it does not do so in the midcontinent; the overlap occurs on the eastern seaboard in the vicinity of Anticosti Island and southern Labrador. It is of interest that some of the arctic species have amphi-Atlantic modern distributions. If the co-occurrence of these species in the late glacial of Minnesota can be taken to indicate that their geographic ranges overlapped, then the fossil association suggests a climate more maritime than that in the Great Lakes area today. With the enormous extent of glacial lakes covering much of central Canada at this time, the idea may not be entirely preposterous.

With appropriate caution, Cushing points out that in his opinion there is no reason to presume that modern ana-

Ancient and modern pictographs at water level (October 1950), Isla Igualtepeque, Lake Guija, El Salvador. A large Mayan archeological site on a hillside above the lake is probably Classic or Postclassic, but has not been systematically investigated. [From *Quaternary Paleoecology*]

logues of the late glacial floras exist today. Though one might assume that the ash and oak pollen blew into the area from forests lying to the south, the chapter by Brush concerning the late glacial of Iowa reveals no *Fraxinus* pollen at the sites she studied. The question of where the oak and ash source trees were growing during the late glacial is unresolved. The mystery is compounded by the fact that no late Quaternary megafossils of these trees have yet been found in the region.

In southern New England, a late glacial zone containing characteristic hardwood and pine peaks (pollen zone A-3) is opened to reinterpretation by Margaret B. Davis. She offers at least two alternatives for interpreting the "spruce-hardwood zone," which she feels might be of interstadial or of Valders glacial age. One hypothesis accepts all the fossil pollen at face value as originating locally; for this assemblage, Davis finds the nearest modern analogue to be pollen rain of southern Manitoba in the prairie-forest transition zone. She therefore suggests that the attendant late glacial climate in New England may have been more continental than today's climate.

Davis's second hypothesis dismisses the pine and hardwood pollen as having been blown in from "distant forests" and interprets the remaining pollen as representing a vegetation transitional between tundra and forest late in the Two Creeks interval or during the Valders readvance. Total frequency of hardwood pollen declines only slightly at the upper edge of this zone while conifer pollen increases, so Davis is not convinced that this switch indicates a cooling; but she thinks it may be only a successional development under a warming climate. If the only acceptable pollen elements are deemed to be spruce, fir, and nonarboreal pollen, then the assemblage probably compares favorably with any number of modern pollen-rain sites in northeastern Canada. In the end, we probably cannot worry too much about the ecological meaning of the spruce-hardwood zone of southern New England until we decide what part of it is local pollen, or until somebody pulls some plant megafossils out of that zone.

The irony of the first interpretation of late glacial spruce-hardwood zones discussed above is that if we accept all the observed fossil pollen and megafossils as coming from local sources both in southern New England and in Minnesota, we end up with the suggestion that the eastern seaboard late glacial climate was more continental than the present climate at about the same time that the Minnesota climate was more maritime or noncontinental in aspect.

The volume is beautifully printed, with elegant format and very few typographical errors. For any student of the Quaternary, it is a must.

ESTELLA LEOPOLD
Department of Biology,
University of Colorado, Boulder

Assessment of a Fossil Hominid

Olduvai Gorge. Vol. 2, The Cranium and Maxillary Dentition of *Australopithecus (Zinjanthropus) boisei*. P. V. TOBIAS. Cambridge University Press, New York, 1967. xvi + 264 pp., illus. $17.50.

This compendious monograph is devoted to a description of the best-preserved cranium and upper dentition of a member of the genus *Australopithecus* ever found. The format of the book and the careful use of precise terminology throughout are likely to make this work a model for all future treatments of ancient hominid crania, although I suspect the accomplishment will seldom be equaled. The photographic work of the 42 plates is of exceptionally high quality. Its impact, however, is slightly dulled by two plates of substandard pencil drawings and by the fact that there are only four plates comparing this find with any other organism.

As Tobias points out, although several crania of this group have been known for more than a quarter of a century none has been fully described before. W. E. LeGros Clark remarks in the foreword: "I do not suppose that any such meticulous and exhaustive description of a fossil hominid skull as is to be found in this monograph has ever before been made." The extent of this contribution to paleoanatomy is the more remarkable in that Tobias completed this impressive volume scarcely more than six years after the cranium, Olduvai hominid 5, was turned over to him for detailed analysis. Tobias's achievement is to be contrasted with the numerous cases in which discoverers of important hominid fossils have failed to produce analyses of their finds within reasonable periods of time.

Naturally, extensive monographic treatment of the sort Tobias has undertaken requires a reviewer to assess the final success of the projected aims. Basically, a single fossil find such as this cranium deserves compendious descriptive treatment to the extent that it represents a wholly novel taxon or is a much better-preserved specimen of a previously known species or genus. It is also essential that the describer set the find in its proper evolutionary or phyletic position.

There is no question that this cranium is remarkably complete and undistorted. However, the common tendency to feature each new hominid fossil as taxonomically distinct, and by so doing to overemphasize the uniqueness of the discovery, was exhibited in the original name given the find by Leakey: *Zinjanthropus boisei*. This discovery (Olduvai hominid 5) was made at site FLK 1, Olduvai Gorge, Tanzania, by Mary Leakey in July 1959. Its impact on the study of human origins dating from that year is well known to students of anthropogenesis. The cranium is remarkable not so much because it is unlike anything else but because of its completeness and its demonstrated age of about 1.75 million years. In fact, the degree of its taxonomic distinctiveness was immediately challenged, and in 1963 Louis Leakey himself reduced the generic name *Zinjanthropus* to subgeneric status under *Australopithecus*. Although Tobias retains this *nomen* as a subgenus in the title and throughout the greater part of this monograph, he finally remarks in his concluding discussion on its taxonomic status (p. 232):

> It may be inferred that *Zinjanthropus* is not even subgenerically distinct from *Australopithecus sensu stricto* or *Paranthropus*.