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## Book Reviews

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**Environmental Research in Support of Archaeological Investigations in the Yemen Arab Republic, 1982–1987.** Maurice J. Grolier, Robert Brinkmann, and Jeffrey A. Blakely, 1996, *The Wadi Al-Jubah Archaeological Project Volume 5*, published by the American Foundation for the Study of Man, Washington, D.C., xxxviii + 469 pp., \$85.00 (hardbound)

From 1982 through 1987, the American Foundation for the Study of Man (AFSU) conducted archaeological investigations on or near the ancient biblical spice routes in the Wadi al-Jubah area in east-central Yemen. Most of this volume is devoted to pedological and geomorphological research undertaken during the 1987 field season. The primary objective was to demonstrate how pre-Islamic and recent land use, especially flood (seil) irrigation farming, modified the environment of the study area.

The volume is organized in six parts, with each part containing one or more "articles." A gazetteer, glossary, and introduction precede Part I. The first article (Part I) is a brief summary of an interview with a sheik of the Baltarith tribe who provides a first-hand account of agricultural practices in the study area since the early 1900's.

Part II consists of six articles, three of which concentrate on landforms and soils resulting from seil irrigation. Maurice J. Grolier provides a detailed geomorphic inquiry into seil processes and seil irrigation farming in the al-Jadidah basin of Wadi al-Jubah. He notes that the archaeological evidence suggests a 1700-year gap between pre-Islamic seil irrigation and modern resettlement of the basin in the 19th century. Possible relations between the decay of ancient seil irrigation and changes in climate and the hydraulic geometries of wadis and irrigation canals are considered. However, the geomorphic and stratigraphic evidence does not indicate that abandonment of pre-Islamic agriculture was related to natural causes. Instead, Grolier argues that expansion of agriculture to ever higher interfluves, plus the gradual rise of the tilled surface above present-day Wadi beds, made the canal network unstable and led to its failure.

Grolier's essay sets the stage for the next article, "Pedological Characteristics of Anthrosols in the al-Jadidah Basin of Wadi al-Jubah, and Native Sediments in Wadi al-Ajwirah, Yemen Arab Republic," by Robert Brinkmann. Brinkmann's article is the largest component of the book and could easily stand alone. The purpose of his investigation was to determine the nature and extent of the pre-Islamic human alteration of the soil ecology. Most of the article consists of detailed descriptions of 12 soil profiles formed in anthropic cumulic Fluvents, buried Mollisols, naturally formed Fluvents, and irrigation channel deposits in the Wadi al-Jubah area. Each soil-profile description composes a section of the article and is accompanied by the results of physical and chemical laboratory analyses and interpretations of the data. Also, radiocarbon ages are presented for some soil profiles. Brinkmann concludes that the soil ecology underwent three major changes during the Holocene, two of which resulted from climatic fluctuations and one, the latest, from prehistoric agricultural activity. The period from ca. 10,000 to 6000–5000 B.P. was characterized by aridity and concomitant eolian and fluvial sedimentation punctuated by episodes of relatively moist conditions and associated soil (Mollisol) development. The modern arid climate was in place sometime between 6000 and 5000 B.P. Deposition of irrigation sediment and development of anthropic cumulic Fluvents began around 3300 B.P. and continued to at least ca. 2500–2400 B.P. The results of the chemical analyses indicate that the anthrosols formed under drier conditions compared to the early Holocene environment that favored the development of Mollisols in the region.

Brinkmann concludes his article with a list of recommendations for future pedological and geoarchaeological investigations. He emphasizes the need for archaeologists to explore the period covering the onset of grazing activity and the arrival of irrigation agriculture in the region. Such an approach is necessary to test the hypothesis that desertification was promoted by overgrazing around 6000 B.P. and that irrigation agriculture resulted from technological adaptations to a stressed food-production system. Brinkmann notes that clues to the cultural history of preirrigation residents are likely to be contained in the Mollisols beneath the agricultural deposits.

In the next article, Brinkmann briefly describes an attempt to use thermoluminescence (TL) dating to determine the absolute age of the pre-Islamic anthrosols in Wadi al-Jubah. Clarification of the time of formation of the anthrosols is needed to improve our understanding of the history of irrigation in the region. The TL dating, however, was unsuccessful. Brinkmann attributes the negative results to the grain size (sandy silts) of the samples.

Article 5, "Sites and Structures of Hujran al-Kanus (HK25), Yemen Arab Republic," is by Niki R. Clark and Jeffrey A. Blakely. Discovered in 1982, the Hujran al-Kanus sites and associated silt fields are among the best preserved ancient irrigation installations, ancient fields, and rural occupations in the project area. Clark and Blakely provide detailed site plans of irrigation structures, mound sites, and wells. Excellent photographs of the archaeological features accompany the site plans. However, the reader is left wondering about the age of the sites since no temporal information is given.

Maurice J. Grolier prepared the next article, "Plate Tectonics and Climate Modification and Disruption of Drainage in Southwestern Arabia and the al-Jadidah Basin, Wadi al-Jubah, Yemen Arab Republic." First, Grolier integrates a discussion of plate tectonics (continental drift) and uplift of the Arabian Shield and its Red Sea and Gulf of Aden margins with a description of past regional drainage changes in Yemen. Next, he considers the effects of Quaternary climatic change on stream flow in Wadi al-Jubah. Finally, Grolier describes the incipient capture of Wadi al-Jubah by a tributary of Wadi Mala in the al-Jadidah basin. He concludes that the 2000 m uplift of the Arabian Shield, which followed rifting in the Red Sea and Gulf of Aden structural depressions more than 13 million years ago, and the change in global and regional climate after the Climatic Optimum about 6000 years ago, "stand out as the two events, so far apart in time as they are, that conditioned and contributed most to the eventual development of seil agriculture in the Wadi al-Jubah basin." Grolier also stresses that stream capture threatens the modern seil irrigation agriculture in the southeastern part of the al-Jadidah basin.

The last article in Part II, "Late Pleistocene Mollisol and Cumulic Fluvents near Ibb, Yemen Arab Republic," is by Brinkmann and Abdu O. Ghaleb. Two buried Mollisols were examined in a roadcut south of Ibb. Bulk organic carbon from the upper and lower paleosol yielded radiocarbon ages of ca. 19,300 and 26,150 B.P., respectively. Brinkmann and Ghaleb compared some of the physical and chemical properties of these late Pleistocene paleosols with the properties of the Holocene-age Mollisols in the Wadi al-Jubah area.

Part III consists of three articles that focus on organic evidence related to the environment of Wadi al-Jubah. In the first article, Brian Hesse uses the faunal record from strata at Hajar ar-Rayhani to assess pastoral exploitation in Yemen during the Iron Age. Variations in the abundance of sheep, goats, cattle, and camel remains suggest that exploitation patterns oscillated during the period of occupation at the site. The next article is by William C. Overstreet and James C. Ritchie, presenting the results of pollen analyses on 12 sediment samples collected from the Wadi al-Jubah area. Unfortunately, the sediments yielded such low and erratic distributions of identifiable pollen that reliable statistical results were not obtained. The last "article" in Part III is actually a summarized species list for the botanical remains recovered at Hajar ar-Rayhani during the 1987 excavations. The list, which was prepared by Robert B. Stewart, supplements and expands on previous reports covering excavated botanical remains in the Wadi al-Jubah area.

Part IV consists of a brief article by Dan Rahimi that describes and interprets lithic artifacts discovered during 1987 reconnaissance of the Wadi al-Jubah area. Thirteen localities yielded lithic material, largely obsidian but including a small amount of flint.

Part V consists of two articles that describe sites that were found outside the project area. In the first

article, Jeffrey Blakely, Charles A. Vitaliano, and Robert Brinkmann focus on Kawlah al-Lajamah, a Bronze Age site consisting of at least 50 limestone structures. Most of the article is devoted to the compositional study of several morphologically diagnostic ceramic remains that are unlike any seen previously in the region. These ceramics are formed from a residual granitic clay, apparently tempered with sand, largely lacking in organic temper, and possessing relatively few heavy minerals. Blakely and his colleagues point out that this baseline data can be used for comparative purposes when examining morphologically nondiagnostic samples from Wadi al-Jubah and for comparison with the ceramics from subsequent periods.

The second article in Part V, "Pass on the High Road to az-Zahir, Yemen Arab Republic," is by William Overstreet and Maurice Grolier. Az-Zahir is one of a cluster of agricultural villages and homesteads that occupy a basin eroded in the roof of a granitic pluton that supports Jabal as-Sahh. The high road rises about 1300 m above the valley floor and was cut through a joint-controlled pass in the granite. The age of the road is unknown, and the authors raise some intriguing questions about its function. Why was a track that struggles up the steep escarpment a viable access route to Jabal as-Sahh when movement is easier along the bed of Wadi Najja? Was it a detour when routes in main wadis were flooded? Did the high road play a role in the overland spice trade during pre-Islamic time? All of these questions demand further research.

The final section of the volume, Part VI, also consists of two articles. In the first article, William Overstreet and Maurice Grolier provide a lengthy summary of the environmental aspects of the Wadi al-Jubah area. They integrate the results of the studies presented in the volume with information gleaned from previous investigations. A wide range of topics are covered in this article, including the regional geology and pedology, mineral resources, hydrology, irrigation systems, climate, cultural history, access routes, and modern and prehistoric plants and animals. Overstreet and Grolier close their article by addressing the causes for pre-Islamic abandonment of the al-Jadidah basin of Wadi al-Jubah. Environmental explanations most often offered for the demise and abandonment of the pre-Islamic irrigated agriculture are salinization of the soils, overthickening of the anthrosols, and climatic change (aridity). However, Overstreet and Grolier argue that there is no evidence suggesting that a single environmental factor contributed to the abandonment of the developed agricultural resources. Instead, they support Toplyn's (1988) theory that the pre-Islamic exodus from the al-Jadidah basin was caused primarily by political, commercial, and religious forces superimposed on persistent aridity.

The last article, "Recommendations for Further Environmental Studies," was prepared by Maurice Grolier and William Overstreet. They suggest that future archaeological investigations focus on the Holocene and late Pleistocene Mollisols in the Wadi al-Jubah region. Grolier and Overstreet provide strong arguments for geomorphological, sedimentological, palynological, paleontological, geochemical, and geochronological analyses in support of these investigations.

The book has some minor flaws. Specifically, there are a few typographical errors scattered through the volume. There are also problems with its organization. For example, Grolier's article on plate tectonics and climatic modification and disruption of drainage is in Part II, "Landforms and Soils Resulting from Seil Irrigation." Also, Overstreet and Grolier's comprehensive overview of the environmental setting and cultural history of Wadi al-Jubah was presented in the summary (Article 14) near the end of the volume. This background information sets the stage for the other articles and should have been placed in separate chapters at the beginning of the volume.

All in all, this book certainly is worth having in one's library. It is attractive and well written, and the graphics are excellent. I am especially pleased with Brinkmann's articles on the anthrosols and naturally occurring Mollisols in the project area. His use of diagrams to display the soils data is very effective, and the soil-profile descriptions provide the level of detail needed in a geoarchaeological investigation. This book will serve as an important resource for geoscientists and archaeologists working in Arabia and adjacent areas. According to Blakely (p. 4), the volume represents a multidisciplinary effort designed primarily to address questions raised by archaeologists. I think Blakely and his colleagues have succeeded in this task. They have also raised many new questions that must be resolved in order to interpret the archaeological record of Yemen, a region that has long been on the periphery of systematic interdisciplinary research.

## REFERENCES

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**Koobi Fora Research Project, Volume 5: Plio-Pleistocene Archaeology.**  
Glynn Ll. Isaac and Barbara Isaac (Editors), 1997, Oxford University Press, New York, xxxii + 596 pp., \$265.00 (hardbound).

Reviewing a monumental work such as this is both an honor and a pleasure. This is a great work, the culmination of many years of exciting, path-breaking field research and analysis by one of the true giants of contemporary paleoanthropology. But writing this review is also a cause for some sadness, for in 1985, with Glynn Isaac's untimely death, paleoanthropology lost one of its most stimulating and productive leaders, and many of us lost a friend. That this volume has appeared at all owes much to the untiring efforts of Barbara Isaac, who worked for more than a decade to pull together the many individual contributions that together make the volume an integrated and successful whole. Moreover, thanks largely to her efforts, the volume is current and timely, despite the gap of some 12 years between Glynn's death and its final publication.

I present this review in two principal sections, the first a very brief and somewhat personal view of the impact of Glynn's East African research on contemporary paleoanthropology, the second an equally brief chapter-by-chapter summary of the Koobi Fora volume.

For the most part, archaeology moves along rather slowly, with progress accumulating almost imperceptibly, bit by bit, over the years. Every once in a while, however, a scholar emerges whose creative energy and insight rapidly and profoundly transform a discipline, moving the entire enterprise to a new level of understanding and sophistication. Such was Glynn Isaac's impact on the archaeology of early hominids. Glynn's contributions permeate all levels of early hominid scholarship. He, of course, is well known for his stimulating ideas concerning the origins, deep within the Plio-Pleistocene, of central-place foraging, home bases, and food sharing. While Glynn's ideas about early hominid provisioning are still the subject of debate and disagreement, there is no doubt that paleoanthropology as a whole has benefited greatly from this discussion.

One of the important and enduring strengths of Glynn's work is the fact that he developed these theoretical ideas hand-in-hand with field research that was visionary in scale and scope, methodologically innovative, and meticulously carried out. For example, Glynn was one of the first paleoanthropologists to demonstrate the importance of looking beyond the contents of individual Plio-Pleistocene sites and site assemblages to the overarching pattern of settlement forms and functions across entire landscapes. In this regard, he also recognized the need to look not just at the obvious high-density artifact occurrences, but to explore the nature of the archaeological record between sites, an approach that he referred to as the "scatter-between-the-patches."

In addition, recognizing early on that the Plio-Pleistocene archaeological record was the complex cumulative product of both natural and hominid agents, Glynn became a major contributor to the development of taphonomy and the study of site formation processes. With the help of his students and

colleagues, he initiated a series of field and replicative experiments designed to elucidate such things as the effects of fluvial transport on the dispersal and orientation of stone tools and bones, the impact of hyenas and other carnivores on the nature and composition of animal remains, the relationship between raw material clast size and shape on the morphological properties of stone tool assemblages, the properties of stone-inflicted cutmarks and hammer impacts on bone that would provide incontrovertible proof of early hominid use of meat, and so forth.

Throughout his research, Glynn ardently supported the use of multiple working hypotheses, a practice that underscored his awareness of, and openness to, alternative ideas and explanations. In Glynn's own words, he viewed his work at Koobi Fora as "travelling, rather than arrival" (p. 10). Perhaps more than anything, Glynn saw the need to integrate the archaeological enterprise at many different scales, looking simultaneously at the record at micro- and macro-scales. Moreover, his view of an integrated approach to early hominid archaeology extended far beyond the narrow confines of archaeology itself, embracing scholarship and expertise in the geosciences, paleoecology, primate behavior, cognitive studies, nutrition, and beyond.

In the course of his research, Glynn transformed the field in other ways as well. He trained an impressive number of graduate students, many of whom are now leaders in their own right in African prehistory and paleoanthropology. He also pulled in outsiders, myself among them, to run seminars in the field at Koobi Fora with the explicit goal of exposing himself and his students to alternative perspectives and outlooks, and giving others an opportunity to see firsthand the archaeology of Koobi Fora. One of the special qualities that made Glynn so unusual and effective as a scholar was his marvelous ability to find the positive in others' work, students and colleagues alike, even when he had serious misgivings about their approach or conclusions. I experienced this firsthand. Many years ago, as a total neophyte in early hominid archaeology, I co-authored a paper with Dave Davis (1976) on the seasonality of occupations in Olduvai Gorge. At the time, I was totally naive about taphonomic issues (in fact I was not even aware of the term). Needless to say, we could have been crucified for that paper. At an SAA conference shortly after its publication, where I met Glynn for the first time, he took me aside and warmly complimented us for having pointed out the importance of site seasonality in the interpretation of early hominid activities. Only after underscoring the positive side of our contribution did he then indicate that he also had some "reservations" about the paper, noting in particular the potential taphonomic problems that we had not considered. In order that I might gain a better appreciation for the complex taphonomic history of faunal remains in early hominid sites, Glynn invited me to come to Koobi Fora and "see for myself." How could anyone possibly mind being criticized in such a positive and constructive way? I signed on and at the same time became very interested in taphonomy.

Obviously, much more can be said about the enduring contributions Glynn has made to archaeology and paleoanthropology but, given the space limitations here, I refer the reader to some of the appreciations published elsewhere by his friends and colleagues (e.g., Clark, 1986; Roe, 1989; Wood, 1986), and turn instead to a summary of the volume at hand. The present work is the fifth in a series of major synthetic volumes on Koobi Fora, a fossil-rich basin on the east side of Lake Turkana in northern Kenya. Koobi Fora is justly famous for the many Plio-Pleistocene hominid fossils that have been found there and, as this volume documents, it is equally remarkable for the wealth of archaeological remains that Glynn and his students and colleagues have brought to light. Volume 5 has ten major chapters, many of which are further subdivided into sections written by different authors or combinations of authors. In addition, most of the chapters are followed by extensive appendices, some of which contain detailed tabulations of data and supporting figures, maps, plans, and drawings, while others contain additional separately authored papers dealing with related topics. In all, contributions by twenty authors are presented (including a Foreword by J. Desmond Clark).

Chapter 1 (Introduction) by Glynn presents an historical narrative of the Koobi Fora archaeological project, which lasted from 1970 until 1979. In describing the early days of the research, Glynn notes the tremendous excitement surrounding the discovery in 1969 and 1970 of two archaeological sites (KBS or "Kay Behrensmeyer Site" and HAS or "Hippo and Artefact Site") in deposits that were initially dated to ca. 2.61 mya, some 0.7 mya earlier than the famous Bed I sites in Olduvai Gorge excavated by Mary Leakey. After a period of considerable controversy surrounding the chronology of the Koobi Fora For-

mation, the deposits were redated and it became apparent that KBS and HAS were in fact broadly contemporary with the Olduvai sites (i.e., ca. 1.8–1.9 mya).

In tracing the history of the project, Glynn quotes extensively from his original NSF proposals, allowing the reader to follow step-by-step the intellectual development of the research. It is clear from these proposals that his interest in home bases and food sharing was built into the overall research design right from the beginning, and KBS (viewed as a probable home base) and HAS (a probable butchering locale) were “lovingly” excavated to examine these settlement types in detail. Looking back at those early days of the project, Glynn notes “that the first round of research did not set out to *test*...[these] propositions...; rather it sought to document them” (p. 6, italics in original).

In 1973 Glynn and Jack Harris discovered the wealth of slightly younger (ca. 1.4–1.6 mya) archaeological occurrences along the Karari Escarpment, roughly 20–25 km to the east of the modern lake. With the discovery of these new sites, Glynn became increasingly interested in looking at early hominid land-use over the entire basin. The research also became increasingly problem-driven, examining a wide range of sites of different sizes and probable functions and in different paleoenvironmental contexts (e.g., floodplain, delta, basin margin). He also began to map the “scatters-between-the-patches,” both to establish that sites were, in fact, high-density clusters on the paleo-landscape and to learn more about hominid ranging patterns and land-use. In the latter half of the 1970s, large-scale excavations were undertaken at two important sites on the Karari, FxJj20 (which is actually a cluster of several adjacent loci) and FxJj50. Both of these sites were excellent candidates for home bases and both were well preserved. Many smaller sites, differing in content and context, were also examined. In addition, numerous more specialized studies were launched by Glynn and his doctoral students; these included replicative and experimental studies to determine how the Koobi Fora stone tools were produced and used; investigation of fluvial processes to better understand their impact on assemblages of stone tools and animal bones in deltaic, channel, and floodplain contexts; experimental and replicative studies to develop criteria for recognizing cutmarks, hammer impacts, and carnivore gnawing on animal bones, and for assessing the degree to which hominid and nonhominid agents had contributed to the formation of the fossil assemblages; refitting of both bones and lithics as a means of assessing site integrity, as well as a way of identifying selective transport of tools into or out of sites; and many others. These studies provided critical means for teasing apart and understanding the complex formational processes that gave rise to the archaeological record.

By 1977 Glynn and his students were also beginning to explore ways to falsify the home base-food sharing hypothesis, a process that was well underway before Binford and others began to challenge it. While the debate continues to this day, Glynn notes in concluding his Introduction that this volume would be “...devoted to a crisp presentation of information and it does not attempt to adjudicate or settle this dispute” (p. 10). I think this was an excellent decision. The data, analyses, and interpretations are presented in a theoretically informed way, and yet the discussion remains refreshingly free of polemic.

Chapter 2, by Isaac and Behrensmeyer, presents a synthesis of the stratigraphy, chronology, and paleoenvironmental context of the Koobi Fora sites. They approach these issues at three scales, a macro- or basin-wide-scale, an intermediate- or area-scale, and a micro- or site-level-scale. The Koobi Fora basin covers an area of nearly 2500 km<sup>2</sup>, extending from the shore of modern Lake Turkana on the west to prominent volcanic highlands bounding the basin on the east. Although there is still some uncertainty about the paleogeography of the basin, these authors favor a reconstruction in which a major, perhaps permanently flowing river (Ol Bakate) entered the basin through a gap in the volcanic highlands and then flowed west and south across the basin into the ancient lake. Numerous probably seasonal tributaries fed this main channel.

Archaeological remains come from two members of the Koobi Fora Formation. The earlier sites, particularly KBS and HAS, occur within the KBS Member, dated to between 1.8 and 1.9 mya; most of the younger Karari Escarpment sites are found within the overlying Okote Member, dated between 1.4 and 1.6 mya. A series of tuffs provide critical marker horizons and have also provided much of the direct chronological evidence.

The basin is divided into four principal research areas: Koobi Fora, named after a prominent spit of land that juts out from the east shore of the modern lake; Ileret, also near the lake but 40–50 km north

of Koobi Fora; Aberegaya Ridge, an area of dissected badlands to the northeast of Koobi Fora; and the Karari Escarpment, which extends northeast for about 20 km from Aberegaya Ridge to the basin margin. Lake-margin and deltaic deposits in the Koobi Fora and Ileret areas have produced extremely important fossil hominid remains, but the archaeological record in these areas is comparatively sparse. The KBS and HAS sites occur within alluvial delta-plain deposits in the Aberegaya Ridge area. FxJj20, FxJj50, and many other archaeological localities and sites on the Karari Escarpment occur in deposits associated with a broad alluvial floodplain traversed by tributary streams draining the local basin margins.

A variety of paleoenvironmental studies (e.g., sediments, fauna, molluscs, pollen, stable isotopes) spanning the archaeological interval represented at Koobi Fora point to fluctuating conditions that were becoming progressively drier though still generally better watered and more verdant than at present. Overall, however, the vegetation and climate were not dramatically different from what one finds there today. The landscape would have been dominated by savannas ranging from wooded grasslands to *Acacia-Commiphora* bushlands and scrub, with bushes and trees fringing the channels but with no extensive riverine forests. Appendices at the end of Chapter 2, written by Brown and Feibel, Behrens-meyer, and Findlater, present further details about the stratigraphy, sediments, and depositional environments at Koobi Fora.

In Chapters 3 and 4, Isaac and Harris, together with contributions by several other authors (Kaufulu, Herbich, K. Harris, Bunn, Kroll, Marshall), present detailed descriptions of each site excavated at Koobi Fora between 1970 and 1979. In all, 16 sites or site complexes are discussed. These site-by-site syntheses constitute final reports for each locale, providing baseline information on location, history of discovery and excavation, sampling strategies, stratigraphy and sediments, and reconstructed paleogeographic context, as well as summary data on site formation processes and the nature and composition of the stone tool and faunal assemblages. More in-depth discussions of the artifacts and animal bones, and inferred patterns of hominid activity, are deferred until later in the volume. An appendix by Bellomo and Kean presents evidence which suggests that at least one of several small, circular reddened patches found in the deposits at FxJj20 is the oxidized remains of a fire ignited by hominids some 1.6 mya.

Chapter 5 is actually four separate papers by Isaac, Harris, Kaufulu, and Schick on various facets of site formation processes. Isaac introduces the chapter, setting out the goals of these analyses, which are to identify and distinguish patterns resulting from the additive and subtractive actions of hominids from those produced by carnivores, geological, hydraulic, and soil-forming processes, and even the biases and distortions generated by archaeological recovery and recording. The complex actions and effects of these processes are recognized through studies of geological context, intrasite spatial analysis (including an ambitious program of refitting), and experimental and replicative work.

In the second contribution to this chapter, Kaufulu discusses the sedimentary contexts of the Koobi Fora sites, determining the paleo-landforms in which the sites formed (e.g., floodplain, levee, gravel bar), the probable depositional energy involved in their formation or transformation (i.e., low, intermediate or high energy), and the degree to which the sites have been rearranged, reworked, or transported by flowing water, bioturbation, pedogenesis, and other agents.

In the third section, Schick outlines several field and laboratory experiments that were designed to aid in the analysis of site formation processes. In the first of these, she determined the size-frequency distributions for the populations of flakes and debitage that were produced during the replication of three major Koobi Fora tool forms (flake scrapers, bifacial choppers, bifaces), and made using a variety of local raw materials (e.g., basalt, chert, ignimbrite). Interestingly, regardless of tool form or raw material, the distributions are strikingly similar. This result makes it possible to determine the degree to which an archaeological assemblage matches or deviates from the expected pattern, thereby providing a valuable tool for recognizing assemblages that have been selectively winnowed or transported by flowing water.

In another series of experiments, Schick determined the diameter of the apron of flaking debris that formed around a flint-knapper when the knapper did the flaking from a standing, kneeling, crouching, or sitting position. Regardless of position, most material fell within an area between about 50 cm and 120 cm in diameter. These results provide a useful framework for recognizing the loci of actual knapping events in the archaeological record.

Finally, Schick conducted a series of stream flow experiments designed to study the transport potential of stone tools and animal bones of different sizes and shapes, and to determine whether these items assumed preferred orientations as a result of fluvial disturbance. Some of these experiments were done using a flume, while others were conducted in modern ephemeral channels in the Koobi Fora basin chosen for their overall similarity to those that existed at or near the major archaeological sites in the Plio-Pleistocene. The combined results of these experiments play a major role in subsequent interpretations of the archaeological record.

In the final section of this chapter, Isaac, Harris, Kaufulu, and Schick combine their experimental results and insights to provide a compelling summary evaluation of the depositional context and degree of disturbance of each of the Koobi Fora archaeological sites. Not surprisingly, the most powerful discriminator of severe disturbance and bias is provided by the experimentally derived size-frequency distributions. The results outlined in this section provide a critical baseline for assessing the suitability of each archaeological locale for higher-level behavioral interpretations. Four sites stand out as exceptionally well preserved—FxJj1 (KBS), FxJj3 (HAS), FxJj20, and FxJj50. In terms of the overall integrity of their archaeological records, these sites are Koobi Fora's equivalents to the famous FLK-Zinj locality in Olduvai Gorge.

Chapter 6, by Isaac and Harris, presents a detailed analysis of the Koobi Fora stone tool assemblages. Lengthy appendices that accompany the chapter provide tool counts and metric data, as well as over 70 well-executed line-drawings of a representative sample of choppers, discoids, polyhedrons, flake scrapers, Acheulian tools, pounded pieces, and whole flakes. But Chapter 6 is much more than just a summary of lithic data. In it, the authors lay out three classes of information that they attempt to glean from these stone tools: (1) the minimum level of technological complexity attained by Plio-Pleistocene hominids; (2) aspects of activity patterning and land-use; and (3) "idiosyncratic lineages of cultural transmission."

They sought insights into level of technological complexity by examining the number of tool types, the number of steps required to produce these tools, the degree to which these types are standardized, and the nature and degree of variation among and between more or less contemporary assemblages. Their conclusions regarding this issue are interesting:

The artefact assemblages that have been recovered from the Koobi Fora Formation incorporate a very wide variety of shapes and forms. However, we would argue that most of the variation in shape is unsystematic and unstandardized and that consequently the intrinsic structure of the assemblages is rather simple.... We draw attention to this at the outset because, in reporting on the material, we will use several categories and attributes. Readers without firsthand experience of the material should be cautioned not to assume that complexity of the analytical system necessarily denotes complexity in the material culture system being analysed. (pp. 262–263)

They sought to understand the nature and spatial patterning of activities through the discovery of regularities in the relationship between tool morphology and aspects of site content and context (e.g., intrasite spatial patterning, faunal remains, paleoenvironment). This objective of their research was met with only "limited success." They found very few context-specific patterns or intersite differences in content that they could clearly relate to function. In hindsight, this is perhaps not surprising given their conclusion (and that of Toth in Chapter 7) that several of the formal tool types commonly recognized in Plio-Pleistocene studies (e.g., choppers, polyhedrons, discoids) all served essentially the same basic purpose, as cores for the production of simple, expedient, sharp-edged flakes. In other words, much of the functionally diagnostic information is carried by the unmodified flakes, and would be accessible primarily through microwear studies, not through the morphology of the tools. Unfortunately, the dominant raw material used by early hominids at Koobi Fora—basalt—is not amenable to use-wear analysis. The authors conclude that if activity facies do in fact exist, "they were sufficiently subtle to elude clear detection so far" (p. 299).

Finally, Isaac and Harris consider the Koobi Fora material from the perspective of distinct paleocultural traditions. In order to recognize such entities, they start with the null hypothesis that early hominid stone tool making was simple, and directed toward the expedient production of sharp-edged



flakes with the least investment of effort, except when the raw material had to be transported some distance to the place where it was to be used. They then present a logic for identifying patterning that would be indicative of such paleo-cultural entities.

If the assemblage includes standardized forms that either do not appear to be least-effort solutions to the problem of getting sharp edges or that appear to involve higher than minimum levels of skill and design, then one might wish to infer the existence of arbitrary idiosyncratic craft patterns of the kind that might be markers of a specific culture-tradition transmission system—that is to say, a palaeocultural entity of some sort. In our view, hypothesizing the existence of such entities automatically implies hypothesizing a higher than minimal level of stone-toolmaking capability. (p. 263)

In their subsequent analyses of the Koobi Fora stone tool assemblages, they find no convincing evidence until the early Acheulian, ca. 1.4–1.2 mya, of tool forms that appear to involve a level of craftsmanship that cannot easily be accommodated within their expectations for a least-effort technology. They then conclude with an interesting observation concerning the similarities shared by assemblages that are conventionally grouped together under the label “Oldowan.”

It should be clear that every locally applicable least-effort solution to the problem of extracting sharp edges from stone, has to be discovered and transmitted from generation to generation. The specific technological habits and morphological features of such simple stoneflaking systems can legitimately be identified and used as the basis for defining an industry with a formal name.... However, if the system is effectively a least-effort one then the recurrence of the defining features across time and space does not necessarily imply cultural continuity or affinity (i.e., participation in a particular network of cultural connections that was transmitting distinctive, idiosyncratic traditions). (p. 263)

In Chapter 7, Toth presents the results of an extensive series of replicative and experimental studies aimed at elucidating the nature of the raw materials used for the stone tools, the reduction patterns that were followed in producing the principal artifact forms, and the uses to which these tools may have been put. Most of the artifacts from Koobi Fora were made on waterworn pebbles and cobbles of basalt. Chert tools are present but rare. Average clast size in the channel deposits decreases with distance from the basin margins, and so too do the mean sizes of artifacts and the sizes of the largest tools. This patterning implies that early hominids generally selected their raw materials for tool-making from sources close at hand. There is some evidence, however, for transport over longer distances. At KBS, for example, raw materials and tools may have been carried in from several kilometers away, and in Area 103, near the modern lake, the presence of cutmarked bones points to transport of tools from distances in excess of 10 km. And as already noted, Toth suggests that many, perhaps most, of the choppers, polyhedrons, and discoids are cores for the production of flakes rather than tools in their own right.

Toth conducted a large number of reduction experiments in order to replicate the flake populations that were likely to have been generated by early hominids in the production of the principal tool forms represented in the Koobi Fora sites. In these experiments he documented the numbers of flakes that were generated, the proportions of flakes with residual cortex on their platforms and/or dorsal faces, and various metric characteristics such as length and thickness. These experimentally produced flake populations provide a baseline for comparison against the actual assemblages recovered from seven of the Koobi Fora archaeological sites. Major deviations from the expected population of flakes denote sites where fluvial disturbance is likely to have biased the lithic assemblage. When combined with systematic refitting studies, Toth's replicative experiments also show that early hominids not infrequently transported tools into, and away from, sites. In addition, the positioning of cortex remaining on the dorsal surfaces of flakes provide clear evidence that the Koobi Fora tool makers were preferentially right-handed.

Toth also conducted a series of experiments using replicated stone tools to cut, slice, saw, pound, and chop a variety of locally available materials. While these experiments do establish the feasibility of

using various tool forms for certain kinds of activities, microwear studies clearly provide a more direct and secure record of actual use. Unfortunately, in a study conducted by Keeley and included as an appendix to Chapter 7, only nine chert flakes from Koobi Fora yielded detectable traces of microwear. Nevertheless, those traces were sufficient to establish that early hominids butchered animals (also clearly demonstrated by cutmarks and hammer impact scars on bones), worked wood, and cut some sort of soft plant material. The emerging prominence of woodworking microwear on stone tools from all stages of the Paleolithic, now including the Oldowan, is one of the most intriguing, yet strangely underplayed, archaeological revelations of the past two decades, because it shows that archaic human technology included more than just stone tools.

The faunal remains from the Koobi Fora sites are documented by Bunn in Chapter 8. The bone assemblages are tabulated and evaluated site-by-site, providing a wealth of information on local paleoenvironments, site taphonomy, and early hominid subsistence behavior. Through studies of taxonomic diversity, prey sizes, body part frequencies, cutmarks, hammer impacts, bone fracture patterns, carnivore damage, and refitting of bone fragments, Bunn is able to show that many of the Koobi Fora sites were central places to which hominids transported selected carcass parts of many different species for further processing and consumption. The presence of the meatiest parts of smaller taxa indicates that hominids had early access to these animals, that is, before hyenas or other predators had totally consumed the carcasses. This is reasonably clear evidence of hunting. Accounting for the presence of the meaty parts of much larger species implies early access to these carcasses as well, but Bunn remains less certain as to whether these animals were procured by active (i.e., aggressive) scavenging or hunting. This remains one of the most fascinating and hotly contested issues in contemporary paleoanthropology, one that will undoubtedly generate many more increasingly fine-grained analyses and reanalyses of the Koobi Fora and Olduvai faunas.

An intriguing locality discussed by Bunn is GaJi5 located in Area 103 near the modern lake shore. Exposed at this locality, in deltaic lake-margin sediments dated to about 1.6 mya, are the fossilized bones from a variety of taxa, many of which retain indisputable cutmarks. However, there are no stone artifacts associated with these bones, and none have been found in adjoining outcrops. Geological studies of the area suggest that the nearest raw material sources would have been at least 10 km to 15 km away. This is one of the longest transport distances documented as yet for hominids of the early Pleistocene.

Chapter 9, by Kröll, looks at the intrasite spatial patterning of both bones and stone tools at eight of the major Koobi Fora sites. One of the goals of this chapter is to use the spatial patterning of material to help elucidate the complex formation processes—both hominid and nonhominid—that produced these sites. A second goal is to examine the nature and content of discrete activity areas within these sites, both to determine the function of the sites themselves and to better understand the spatial array of hominid activities over the landscape. Horizontal and vertical plots of refitted bones and stone tools play a major role in these analyses. Kröll concludes that most of the sites in her sample were only minimally disturbed by running water and bioturbation. Some site localities appear to have been revisited over time, creating superimposed horizons of artifacts and bones. Even where clusters appear to be contemporaneous, for example, at FxJj20E and FxJj50, infrequent refits between clusters suggest that they may have formed sequentially rather than simultaneously. The patterning at these sites leads Kröll to conclude that proximity to water and shade trees may have been key factors in determining where sites were located on the landscape, and where clusters of material accumulated within sites.

The final chapter was written by Derek Roe, who took on the formidable task of writing an overall summary and synthesis of the Koobi Fora archaeology project. Derek is to be congratulated for a job well done indeed. One can read Glynn's Introduction and Derek's concluding summary, and have a pretty good feel for what was accomplished, how and why it was done, and the manner in which the results of the project dovetail with broader problems and issues in contemporary paleoanthropology.

Despite the gap of some 12 years between Glynn's untimely death and final publication, the Koobi Fora volume is an up-to-date and extremely valuable contribution. That it is up-to-date is due largely to the ceaseless efforts of Barbara Isaac, with assistance over the years from friends and colleagues. Though many of the specific arguments and conclusions presented in this volume have already been

published elsewhere, taking some of the “shine of newness,” as Derek so aptly puts it, away from the truly innovative, if not revolutionary, methodological and theoretical contributions of the project, the volume nevertheless retains great value for several reasons. First, Glynn’s Introduction (Chapter 1) provides a fascinating and insightful overview of the evolution of his own thinking over the course of the Koobi Fora research, a synthesis that is unavailable elsewhere. Second, many of the arguments that have been published elsewhere are substantially updated here, and they are accompanied by complete tabulation of all of the relevant data upon which they were based. Journal articles often are frustratingly “thin” when it comes to data. Third, all of the sites, not just a select subset, are discussed and tabulated here, again with accompanying appendices that contain the basic data. Fourth, there are many maps, photos, diagrams, and figures that have never before been published. Finally, this is the only place where all of the various perspectives and analyses (e.g., geoarchaeological, taphonomic, experimental) that comprised the Koobi Fora research project are integrated within a single overarching framework.

In summary, this is far more than just another “good” book or another “useful” contribution. This is a monument in paleoanthropology, a classic, a window that has been skillfully and artfully opened by one of this century’s truly great archaeologists to reveal a fascinating part of our own early beginnings.

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**Smithsonian Institution Press, Exploring the Ancient World Series.** Jeremy A. Sabloff, Series Editor, 1996. **The First Cities.** Anthony P. Andrews, 1994, 176 pp. **The Ancient Astronomers.** Anthony F. Aveni, 1993, 176 pp. **The Aztec World.** Elizabeth Hill Boone, 1994, 160 pp. **Pyramids.** Flora Simmons Clancy, 1994, 160 pp. **Ancient Pueblo Peoples.** Linda S. Cordell, 1994, 176 pp. **Maya Civilization.** T. Patrick Culbert, 1993, 160 pp. **The Search for the First Americans.** David J. Meltzer, 176 pp. **People of the Andes.** James Richardson, 1994, 176 pp. \$19.95 each (clothbound).

These eight volumes, published jointly by St. Remy Press (Montreal) and Smithsonian Books, cover a variety of cultures around the world, but with focus on the New World in five of them. The volume by Anthony Aveni, published in 1993, deals with a global review of archaeoastronomy. As the leading expert on this topic for many years, Aveni provides a current overview that will serve as a valuable reference tool. Another thematic volume with a global perspective is Anthony Andrews’ *First Cities*, with syntheses of the development of urban centers in the Near East, Egypt, the Indus valley, China,

Mesoamerica (both Mexico and the Maya), and the Andes. As evidence of the rapid increase of archaeological information, some of these chapters already seem a bit dated just three years after publication. That is no criticism of the author, but illustrates how the reader must be able to judge such syntheses in the light of data pouring out of many of these regions. *Pyramids*, by Flora Clancy, also appeared in 1994. Unlike the multitude of overviews written on "The Pyramids," this book does justice to the practice of pyramid-building in several parts of the world, including Egypt. Thus, pyramidal or large monuments of similar architecture at Ur, in Indonesia, in the Maya area, at Teotihuacan, and at Tenochtitlan are all reviewed, in terms of their cultural setting, construction, and function. It is a bit curious that Monk's Mound at Cahokia, larger and more "pyramidal" than many structures featured in the book, is nowhere to be found. Clancy discusses, in several places, the mountain-pyramid metaphor, an example of which can be seen at La Venta (Mexico), in the Olmec pyramid that R.F. Heizer long ago recognized as symbolic of the volcanic Tuxtla Mountains.

The five volumes featuring the Americas deal largely, and rather predictably given the trends in other multivolume series on the ancient past, on the Aztec, Maya, Andean culture, and Pueblo cultures. Happily, there is a volume by David Meltzer, *Search for the First Americans*, that actually deals with hunting and gathering societies. I will return to Meltzer's book below. *The Aztec World*, by Elizabeth Boone, is well done and is a welcome antidote to other such overviews, such as *Aztecs: Reign of Blood and Splendor* (Time-Life Books, 1992, although it has better pictures) and *The Aztecs: Gods and Fate in Ancient Mexico* (Echoes of the Ancient World, 1985). James B. Richardson's *People of the Andes* (1994) is a well-integrated review of the development of high civilization in the Andean region. Its "companions" in the Time-Life series are entitled *The Search for El Dorado* (1994) and *Incas: Lords of Gold and Glory* (1992). Their emphases are on the splendiferous nature of Andean cultures, while Richardson's does a more interesting and satisfying treatment of their emergence and growth. The same track is followed in Linda Cordell's *Ancient Pueblo Peoples* (1994), as she examines the development of the sedentary agricultural societies of the American Southwest. This book, too, brings nonspecialists interested in the Southwest up to date on long-term projects that are providing exciting new information on the complexity of these societies. Curiously, she devotes far too much attention to Sandia Cave and Pendejo Cave in her treatment of the early peoples of the region; neither has contributed any new information to that period, but perhaps they are of interest in the historic sense. *Maya Civilization* (1993), by T. Patrick Culbert (author of several previous syntheses of the Maya), certainly wins hand-down over its major competitor, Time-Life's picture-book, *The Magnificent Maya*, also published in 1993. Though it is a more than adequate synthesis, it falls short of the books by Boone, Richardson, and Cordell in that we get a more or less standard treatment of the Maya, with little new data from the many recent research programs in the area and nothing on the emergence of Maya culture. A host of geomorphological and palynological studies since 1987 deal with the latter topic, albeit the more definitive ones appearing about the time of Culbert's publication.

All of these books are, to my mind, much better than similar treatments accorded these cultures in the Time-Life *Lost Civilizations* series, or others that have come out in recent years. While they are better, like their competitors, the Smithsonian books devote little to no attention to geoarchaeological issues, some of which must have been clearly important to their areas of interest. For example, Cordell mentions Ernst Antevs and the Altithermal, but no reference to the pioneering geoarchaeology done in the Southwest by C. Vance Haynes, or the more recent innovative work of Michael Waters. Andrews notes geoarchaeological factors that may have played a role in the decline of cities in the southern Indus Valley. Richardson does the best job, in these syntheses, by placing the rise of Andean culture in a landscape context that treats environmental change and provides data on glaciers and volcanoes; the other volumes would have benefited from such an introduction. None of these observations are made to criticize the authors; they had scant space in which to cover enormous topics. Still, though, geoarchaeology does not make it into most overviews of this sort.

For the geoarchaeologists, I have saved the best for last. David Meltzer has provided, in the first 128 pages of his book, *Search for the First Americans*, a timely discussion of the early migrations and the

development of Clovis. The last two brief chapters span 10,000 years from Folsom to the introduction of European disease.

Meltzer's treatment of Clovis (and earlier sites) is essentially a history of Paleoindian research, but it incorporates a variety of geoarchaeological data. This is particularly well done in his discussion of the routes of human migrations as well as their timing. And, of course, geoarchaeology was, and is, critical to the interpretation of localities where very early materials are found (e.g., Vance Haynes' work at Calico Hills and the importance of geology in the interpretation of Monte Verde). Meltzer does not give extensive examples in these cases, likely due to space constraints, but he does note important considerations (e.g., on p. 81) of where we should look for "pre-Clovis" sites, and of the technologies (in addition to geomorphology) that may be needed, such as geophysical remote sensing.

In Meltzer's review of Clovis and Folsom sites, there is little geoarchaeological interpretation offered, though there are discussions of the environment at the end of the Pleistocene. In reviewing post-Pleistocene cultures in selected areas of North America, Meltzer deals in some depth with the Altithermal, and provides a useful overview of his own research with early Holocene wells at the Mustang Springs site in west Texas. The rise and fall of lakes in the Great Basin are considered in terms of cultural change in that area. The human manipulation of the landscape is briefly noted in a review of Southwestern agriculture, and the emergence of agriculture (and the continuation of hunting and gathering) in the Eastern United States is structured in light of the region's diverse environments.

In sum, this is a very useful series, short on geoarchaeology, but convenient as references to major culture areas in various parts of the world.

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