Australopithecines and Predation

The Hunters or the Hunted? An Introduction to African Cave Taphonomy. C. K. BRAIN. University of Chicago Press, Chicago, 1981. x, 366 pp., illus. $35.

C. K. Brain's *The Hunters or the Hunted? An Introduction to African Cave Taphonomy* is a major contribution to the growing literature on vertebrate taphonomy and is of considerably wider interest than the title may suggest. It summarizes some 15 years of research directed at better understanding the deposits that first prompted much of the anthropological interest in vertebrate taphonomy: the australopithecine-bearing cave fills in southern Africa. In the 1950's Raymond Dart claimed that patterns of element representation and damage in the assemblage from Makapan cave testified to an "osteodontokeratic culture" created by predatory australopithecines, whose habits included internecine strife and murder. The "killer ape" hypothesis, forcefully articulated by Dart, was further popularized by Robert Ardrey's *African Genesis*.

However, at the time this view was promulgated very little was actually known about the effects of any bone-collecting or bone-modifying agents, human or animal, in creating patterns of damage or selective element representation in bone accumulations. In 1965, Brain began investigations intended to evaluate Dart's allegation that only hominids could produce the patterns of element representation and damage observed in the South African collections. He proceeded by first studying a variety of agents—humans, carnivores, other animals, even the weather—that act on remains of mammals in southern Africa today and then analyzing the cave assemblages in light of his findings. This kind of research on regularities in the formation of fossil deposits has come to be called taphonomy. Investigating relevant processes and their effects in present-day situations has proved an effective strategy for clarifying initially ambiguous patterns in the prehistoric materials themselves.

The structure of *The Hunters or the Hunted?* reflects this strategy. The first section reports Brain's observations on the effects of various present-day bone modifiers; the second applies these findings to analysis of the fossil deposits from the australopithecine sites. After a brief introduction of the problems and materials, Brain recounts experimental observations on the durability of skeletal elements, including observations of carnivore feeding and a study of food debris at Namibian Hottentot villages, the latter previously available only in hard-to-obtain publications. Since Brain pioneered controlled observations of skeletal element durability, this detailed account of his work in one source is especially useful to taphonomists.

Moving to the "food remains of primitive peoples," Brain summarizes analyses of four archeological faunal assemblages from rock-shelter sites in southern Africa, associated with Middle Stone Age to Later Stone Age artifacts. He also includes brief discussions of various archeologists' functional classification of sites, the role of animal foods in modern hunter-gatherer diets, and seasonality in human foraging behavior.

Readers expecting broadly applicable generalizations about human bone processing will find this chapter disappointing. Characteristic features of human bone accumulations are discussed in essentially qualitative terms, and few predictive statements are offered. Because Brain derives generalizations about species structure in archeological faunal assemblages solely from Middle and Later Stone Age sites in southern Africa, these are of limited use elsewhere. Cut marks and long-bone fragmentation patterns, two aspects of human assemblages discussed in considerable detail by other researchers, are mentioned only briefly. However, Brain's notes on distinctively human patterns of long-bone fragmentation accord well with Lewis Binford's reports on Eskimo bone-processing debris (summarized in *Bones: Ancient Men and Modern Myths*, Academic Press, 1981, pp. 51–181), and the material merits further comparative analysis.

Readers who are not archeologists should also be aware that many of the inferences about hunting by Lower Pleistocene hominids in eastern Africa, as well as Mary Leakey's site-classification scheme and the Speth-David seasonality model for Olduvai hominids, have recently been the subject of considerable criticism. These therefore should be treated with more caution than Brain's citations, doubtless written before some of these controversies reached print, might imply.

The next three chapters of this first section provide an unparalleled source of information on the behavior of three species of hyenas, leopards, black eagles, owls, and porcupines as bone collectors and modifiers. A number of these animals live or once lived outside of Africa, and this review will be of value to anyone investigating the formation of cave deposits in Eurasia, as well as in Africa.

The last chapter in this section, "Bone accumulations in southern African caves—a search for interpretive criteria," is a brief summary and evaluation of traces thought to be characteristic of different agents. Brain adds his observations to those of other researchers who have found spiral fractures, alleged by Dart to be solely the product of human agents, in assemblages produced by nonhuman agents. Perhaps because collection bias has clearly influenced the representation of skeletal elements in the Sterkfontein and Swartkrans Member 1 assemblages, Brain does not discuss carnivore versus human patterns of long-bone fragmentation, a promising criterion recently treated by Binford (*Bones*) and Gary Haynes (*Paleobiology* **6**, 341 [1980]). His consideration of cut marks and gnaw marks is likewise brief, and readers interested in a more detailed discussion of these features may wish to consult the recent work by Binford, Haynes, and others (H. T. Bunn, *Nature (London)* **291**, 574 [1981]; R. Potts and P. Shipman, *ibid.*, p. 577). Brain prefers to emphasize patterns of species representation, gross patterns of damage, and weathering as criteria for distinguishing assemblages created by carnivores, porcupines, and humans.

The second part of the book deals in great detail with the assemblages from the three Sterkfontein Valley sites. After an exhaustive summary and description of fossil species recovered from all the sites, Brain devotes one chapter each to Sterkfontein, Swartkrans, and Kromdraai, providing a history of activity at each site, a detailed description of its stratigraphy, and a summary of finds by species and element. From description he moves to analysis of element representation and modification in light of his modern observations; specially careful consideration is given to any individual specimens alleged by Dart or others to bear traces of australopithecine violence.

With the exception of the younger assemblage from Member 5 at Sterkfontein, Brain is "inclined to discount homi-

nid involvement in the bone accumulation process" in the australopithecine-bearing breccias at all three sites. He concludes that the patterns of species and element representation, as well as damage patterns, in the other assemblages are more likely to have been the result of carnivore predation, especially by large cats.

These chapters, supported by exhaustive tabulations in appendixes, will stand as the central references on the three Sterkfontein Valley hominid sites and their faunal assemblages, which number well over 18,000 pieces in the macrofaunal component alone. Brain's painstaking descriptions make this volume an invaluable source for paleoanthropologists and Quaternary paleontologists, as well as a model of taphonomic exposition.

After a brief chapter on the sites of Taung and Makapansgat, Brain turns to the main question his work sought to address: Who were the hunters and who the hunted? Recapitulating his argument for large carnivores, specifically cats, as the main agents of accumulation, he revises his previously published "leopard hypothesis." Arguing from element and species representation, damage patterns, the large average body size of primates in the deposits, and modern baboon behavior in the region, Brain formulates two linked hypotheses to explain the preponderance of primates (australopithecines and baboons) in the fossil accumulations at Sterkfontein Member 4, and their unusual abundance relative to bovids at Swartkrans Member 1 and Kromdraai B. He contends that (i) very large extinct cats, capable of handling prey bigger than those regularly taken by leopards, may have specialized in preying on australopithecines and baboons, which (ii) sheltered in the limestone caves and fissures during the colder winter months, as do modern baboons in the region. Although he proposes no means of further testing these hypotheses, Brain's close evaluation of the evidence should dampen whatever enthusiasm remains for the "killer ape" interpretation of the fossil assemblages.

The text is clearly written and lavishly illustrated; though some photographs are less clear than one might wish, most are sufficient to illustrate the features discussed in the text. Beyond percentage histograms, Brain employs no statistical characterizations or tests of his data, nor does he devote much space to building a set of generalizations of broader applicability. However, he presents his data in such profusion and detail, in both the text and an extensive appendix, that others so inclined can readily use the book as a data source.

Such close documentation makes *The Hunters or the Hunted?* a worthwhile and not overpriced addition to vertebrate taphonomists' working libraries. It is also a readable and often entertaining book that can be read profitably by those interested in early hominids and in how prehistorians move from lesser to greater understanding of the materials that time and the forces of nature have left them.

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Prices of Books

Average per-volume prices of books reviewed in *Science* 1977–1981. Data are for hard-cover books except where books were available only in paperback; books priced only in foreign currencies were excluded from the calculations. The average prices per page of the technical books in the natural sciences for the years covered were 6.8¢, 7.8¢, 8.6¢, 9.0¢, and 11.3¢.

Category	Price (dollars)				
	1977	1978	1979	1980	1981
All books	27.85	29.65	30.33	35.52	42.22
Technical books in the natural sciences	32.70	36.04	39.18	42.61	52.76

Aerospace Technology

The Origins of the Turbojet Revolution. EDWARD W. CONSTANT II. Johns Hopkins University Press, Baltimore, 1981. xvi, 321 pp., illus. $22.50. Johns Hopkins Studies in the History of Technology, New Series, No. 5.

In this book, Constant addresses one of the most important and least examined issues in the history of aerospace development: the origins of the gas turbine aircraft propulsion system. The result is an impressive and solid work of scholarship, drawing on a wide range of published and unpublished sources, combining detailed research with insightful analysis. It is certain to become a standard reference work on the subject.

Constant painstakingly traces the evolution of the turbine, going back to water turbines and hydraulic technology and advancing through the development of the revolutionary steam turbine for maritime propulsion and the first attempts at internal combustion gas turbine power plants. It is his contention that the gas turbine power plant—the turbojet—was at once the logical outgrowth of over two centuries of turbine development and a radical system dependent on the creative engineering of a few individuals operating on the frontier of the science of aerodynamics. As with the invention of the airplane itself, there is no one figure who is the "father" of the technology; rather there was a community of individuals, and the turbojet, which appeared in the late 1930's, was a multiple and independently derived invention in two nations, Great Britain and Germany.

Constant prefaces his work by proposing a heuristic model of technological change and provides an excellent table listing the numerous technologies and science specialties that came to bear on those who developed the turbojet. The "driver," in Constant's view, was the rapid advance of high-speed aerodynamic theory in the 1920's and 1930's, which led a small number of key individuals to radically revise their assumptions about the potential speed of aircraft. This in turn led them to investigate more suitable propulsion systems than the piston-engine–plus–propeller combination that had worked so well up to the 1930's. They recognized that with vast improvements in the efficiency of gas turbines (improvements made possible in part by these very discoveries in high-speed aerodynamics) a jet propulsion scheme could be applied to aircraft, enabling the envisioned increase in flight speeds to be attained. Between the piston-engine–propeller combination and the pure jet engine lay some complex devices, especially the turbosupercharger. The turbosupercharger was at once a help and a hindrance to advocates of jet propulsion. It required many of the same technologies as the later turbojet, but it was designed as a boost system to improve the efficiency of the piston-engine–propeller combination, and its success engendered resistance to the more radical pure jet concept. Constant's skillful weaving of the story of all these influences and paradoxes makes for exciting reading.