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Nicholas Toth and Kathy Schick
Co-Directors, Stone Age Institute
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STONE AGE INSTITUTE PUBLICATION SERIES

NUMBER 2

Series Editors Kathy Schick and Nicholas Toth

BREATHING LIFE INTO FOSSILS:

Taphonomic Studies in Honor of C.K. (Bob) Brain

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COVER CAPTIONS AND CREDITS.

Front cover, clockwise from top left.

Top left:
Artist's reconstruction of the depositional context of Swartkrans Cave, South Africa, with a leopard consuming a hominid carcass in a tree outside the cave: bones would subsequently wash into the cave and be incorporated in the breccia deposits. © 1985 Jay H. Matternes.

Top right: The Swartkrans cave deposits in South Africa, where excavations have yielded many hominids and other animal fossils. ©1985 David L. Brill.

Bottom right: Reconstruction of a hominid being carried by a leopard. © 1985 Jay H. Matternes.

Bottom left: Photograph of a leopard mandible and the skull cap of a hominid from Swartkrans, with the leopard's canines juxtaposed with puncture marks likely produced by a leopard carrying its hominid prey. © 1985 David L. Brill.

Center: Photo of Bob Brain holding a cast of a spotted hyena skull signed by all of the taphonomy conference participants. © 2004 Kathy Schick, Stone Age Institute.

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Published by the Stone Age Institute.
ISBN-10: 0-9792-2761-5
ISBN-13: 978-0-9792-2761-5

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ACKNOWLEDGEMENTS

The editors would like to thank a number of organizations and offices for their support of the conference that led to this volume. These include the Wenner-Gren Foundation for Anthropological Research, the Stone Age Institute and Friends of CRAFT, and the following offices of Indiana University: Vice President for Research and the University Graduate School, Office of the Chancellor, College of Arts and Sciences, and Office of International Programs. We would also like to extend special thanks to Charles Egeland, Melanie Everett, Leslie Harlacker, Jason Heaton, Anneliese Pickering, and Dietrich Stout for their valuable assistance during the conference. Funds for the production of this volume have been provided by the Stone Age Institute and Friends of CRAFT, Inc.

BREATHING LIFE INTO FOSSILS: TAPHONOMIC STUDIES IN HONOR OF C.K. (BOB) BRAIN

EDITED BY
TRAVIS RAYNE PICKERING, NICHOLAS TOTH AND KATHY SCHICK
STONE AGE INSTITUTE PRESS, 2007

CONTENTS

FOREWORD: IN APPRECIATION OF BOB BRAIN

Chapter 37 of the Old Testament Book of Ezekiel tells the story of its author being set in the midst of a valley full of dry moldering bones, which are eventually brought to life with God's breath. The secular world of paleontology does not have it so easy, but indeed our goal as historical scientists is to breathe life into long-dead bones. The disconnection between that aim (reconstructing the behavioral and ecological dynamics of prehistoric animals) and the static databanks for doing so (the paleontological and archaeological records) has long been recognized. This disjunction is most successfully overcome through the application of the principle of actualism. Lee Lyman's (1994: 69) comprehensive review of the articulation of actualism and taphonomy concludes that "[a]ctualistic research is presently perceived as the basis for most taphonomic…analysis and interpretation."

Even a cursory review of Bob Brain's research portfolio (see Rubidge, 2000), which spans 50+ years, reveals that this is certainly the case in his career. It is impossible to compartmentalize Bob as a person or as a scientist. An ostensible geologist (his 1957 doctorate was entitled *The Ape-Man-Bearing Cave Deposits of the Transvaal*), it is more appropriate to identify Bob as a consummate naturalist, in the best and most professional sense of that appellation. From research as seemingly disparate as studies on rotifer biology to reconstructions of the geomorphology of Pleistocene caves in the Sterkfontein Valley, all of Bob's work is united in a purpose that is ultimately behavioral.

In Chapter 1 of this volume, Bob recounts Raymond Dart's role in provoking him to enter into a sphere of research in which the fossil and living worlds converge, with observations made in the latter employed to breathe life into the bony residues of the former. As a result, Bob ushered the developing discipline of taphonomy into paleoanthropology, culminating in a new standard of scientific rigor in the field.

On a more specific level, Bob's actualistically grounded analyses of the fossil faunas from Swartkrans, Sterkfontein and Kromdraai caves toppled Dart's (e.g., 1957) hypothesis of australopithecines as "Killer Apes," the cannibalistic alpha predators of Pleistocene Africa. Bob's observations of modern primates being consumed by carnivores combined with his recognition of tooth marks on hominid fossils led him to construct an opposing model of australopithecines as being more commonly prey than predators (e.g., Brain, 1981, 1993a). Thus, began Bob's interest in predation as a major behavioral factor that conditioned not just human evolution, but the evolution of the very first animals, *c*. 600 million years ago.

Grappling productively with an overarching "grand theme"—predation, for instance—is a key reason why many "famous scientists" come to be venerated. But, it is also appropriate to fully understand the body of data generated by the "famous scientist" in service of posing and exploring the myriad of questions relevant to his "grand theme." To his great credit, such an appreciation comes easily in the case of Bob Brain. For example, his meticulous studies of carnivore feeding behavior, of the production of bone "pseudotools" through naturalistic processes, of the modification of actual bone tools through hominid digging and of the effects of burning on bones come readily to mind. Together, they create a much richer view of early hominids then them simply serving as the prey of large carnivores. Certainly *some* australopithecines were hapless victims (Figure 1); ac-

Figure 1. There is no other example from the fossil record that better documents the link between early hominids and carnivore feeding (and probable predation) than Bob Brain's observation of puncture holes in the juvenile hominid calotte (SK 54) from the Hanging Remnant of Swartkrans. The holes match exactly the spacing of the canine teeth of a fossil leopard mandible from the same deposit. Photograph by David Brill.

cordingly, predation probably influenced their social organization and perhaps other aspects of their biology. Verifying the causal links predicted on good theoretical grounds between predation pressure and socioecology is vexing even in modern higher primates (e.g., Zuberbühler and Jenny, 2002), which are observable—much-less in the fossil record, in which behavior can only be inferred (Pickering, 2005).

The beauty of Brain's approach to investigating his "grand theme" is that predation never became an exclusive fixation to him. Rather, it always was (and is) just that—a *theme* in the truest sense of the word. Predation is the great anchor of his work as evidenced by his consistent return to it time and time again. But, from that anchor the disparate lines of his work fan out in an interconnected web that, taken together, describe far-ranging aspects of prehistoric behavior.

An example illustrates both the agility with which Bob approaches paleoanthropology and his enviable ability to avoid the myopia that can often blemish a good but lesser scientist's standing. Figure 2 reproduces Bob's estimates of the minimum number of individuals (MNI) for some major taxonomic groups recovered from Members 1–3 of the Swartkrans Formation. As is apparent, the proportional representation of hominids drops markedly between the earliest formed Members 1 and 2 versus Member 3, a more recent Pleistocene deposit. Bob interpreted this shift as behaviorally significant, arguing that while predation had an important impact on the hominids in Members 1 and 2, the data suggest otherwise for the Member 3 hominids. Interestingly, while abundant *Australopithecus robustus* remains have been recovered from all three members, *Homo erectus* remains are much less common and do not occur at all in Member 3. The inference is that the recovered hominids represent, for the most part, victims of large carnivores. Thus, the paucity and eventual complete absence by Member 3 times of *H. erectus*, the presumptive direct ancestor of modern people, suggests the greater success of this species in avoiding predation. In addition to his taxonomically based conclusions, Bob documented the presence of burned bones in Member 3. His actualistic, chemical and histological analyses suggest that these fossils were heated in humanly controlled fires. Putting together these findings, Bob transcended the textbook caricature that each and every South African fauna was created exclusively by the feeding behavior of large carnivores. Instead, he cast a nuanced, sophisticated and (most importantly) testable hypothesis of broad-scale behavioral complexity through time at Swartkrans:

> "Taphonomic reconstructions at Swartkrans have emphasized the importance of feline predation on early hominids, at a stage when human influence on the natural environment was very slight, and when the balance of power lay with the cats. But the Swartkrans record also documents a technological innovation of immense importance: the management of fire, providing a measure of protection from nocturnal predators. In Member 3 at Swartkrans, a hint is discernable of a shift in the power balance towards hominids—the first in a series of technologically based triumphs that have established people as dominant animals on earth" (Brain, 1993b: 264).

In a wonderful display of magnanimity, Bob has encouraged and joined a new group of researchers at Swartkrans in testing this hypothesis through zooarchaeological and taphonomic analyses of Swartkrans fossils he recovered between 1979 and 1986. I am happy to be part of this group and we present some of our results on the Member 3 fauna in Chapter 13 of this volume (analyses of the Member 1 and 2 faunas are forthcoming and will be published elsewhere). This is just one of countless examples in which Bob has taken a genuine interest and tangible action in encouraging the work of others for the service of advancing our knowledge of Swartkrans, particularly, and our understanding of prehistoric life, generally. For this, a simple volume of papers in his honor does not suffice, but still, it does stand as an outward expression of our great gratitude. Bob sparked my interest in taphonomy when I first read his work as a student and has continued to foster it since we have become friends and collaborators. I am just one of a multitude of

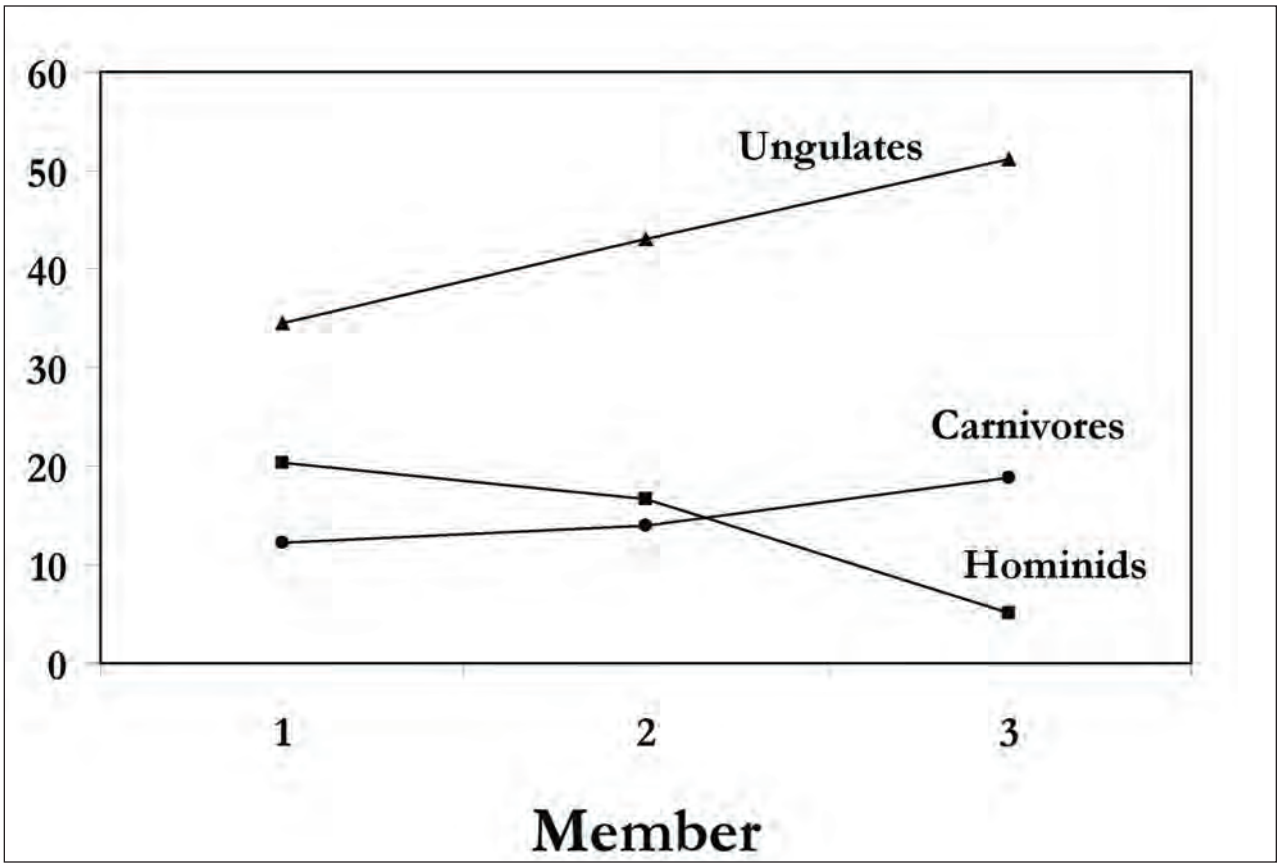

Figure 2. Percent representation of three major taxa (ungulates, carnivores, and hominids) based on the total minimum number of individuals (MNI) in the faunas of Swartkrans Members 1–3 (after Brain, 1993b: 263, Figure 8). Total MNI estimates for each member: Member 1 (Lower Bank) = 443; Member 2 = 114; Member 3 = 176 (Brain, 1993b).

researchers whom Bob taught that combining an interest in the living and fossil worlds is not only possible, but is also scientifically productive. We are all indebted.

31 May 2006
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INTRODUCTION

TRAVIS RAYNE PICKERING, KATHY SCHICK AND NICHOLAS TOTH

Taphonomy, the study of the processes leading to the fossilization of organic remains, is one of the most important avenues of inquiry in research into human origins. By carefully examining processes and patterns in the modern, observable world (actualistic studies), we are able to gain crucial insights that can be used in the data collection, analysis and interpretation of the prehistoric record. Such actualistic studies have grown tremendously in the past few decades, providing a wealth of information for use in paleoanthropological-research.

The conference *African Taphonomy: A Tribute to the Career of C.K. (Bob) Brain* was convened at the Stone Age Institute in Bloomington from April 29–30, 2004 to discuss the latest research and developments in taphonomy—a field introduced to African prehistorians in large part through the early work of C.K. (Bob) Brain. Brain's (1981) book *The Hunters or the Hunted?*, published after roughly 20 years of accumulated actualistic research, is still heralded as a classic treatise in human evolutionary studies. It was apparent from the conference presentations that Brain's work, as summarized in that book, continues to have a far-reaching and lasting impact. In honor of this legacy, we have collected in this volume 16 papers that emanated from the conference. As with Brain's own work, it is difficult to pigeonhole many of the chapters herein; most cross-cut various types of actualistic work. We have, however, made an effort to arrange the contributions into five broad themes.

The first set of papers includes two essays that discuss the influences on Brain's development as a scientist and his own subsequent impact on paleoanthropology. Chapter 1, by Bob Brain, presents the central storyline of the development of African cave taphonomy. The broad outline of that story will be familiar to many readers, but it is quite illuminating to read Brain's own take on the relevance of its various components. Especially valuable and inspiring are the dual themes of optimism and fun that run through his lively narrative. Science can and should be a pleasurable pursuit, one worthy of a lifetime's devotion, as in the case of Brain. Gary Haynes, in Chapter 2, a sociohistorical account of Brain's influence on the development of taphonomy in Paleoindian studies, stresses another aspect of Brain as a scientist and person. Haynes makes the point that we would all do well to use Brain's approach as a model in our own research:

> "He reviewed others' work, collected data, and spelled out his alternative interpretations with grace and tact… Brain's contribution to Paleoindian research went beyond merely providing examples of taphonomic studies to emulate. To his greatest credit, he also showed us how to stalwartly present a case without alienating colleagues and friends."

The remaining chapters are largely empirically based, but can still be crudely sub-divided. A group of papers by Naomi Cleghorn and Curtis Marean, Francis Thackeray, and Kathy Schick and colleagues deal ostensibly with mammalian carnivores as taphonomic agents—one of the major concentrations of Brain's research. Cleghorn and Marean (Chapter 3) discuss the growth of a general model for bone survival in zooarchaeological assemblages, with a special emphasis on carnivore destruction of skeletal elements. Their model separates bones into a low-survival set (elements that lack thick cortical bone) and a high-survival set (elements comprised predominately of thick cortical bone) and argues that because

of their resistance to complete destruction (through processes such a carnivore ravaging), the dense midshaft portions of limb bones are the most useful category of bone for reconstructing early hominid behavior. Thackeray's chapter (Chapter 4) also focuses on carnivore contributions to the formation of paleoanthropological bone assemblages and on limb bone shaft fragments. In particular, he explores the usefulness of mean limb bone shaft lengths and carnivore: ungulate ratios to assess the biotic agent(s) of bone accumulation at the important early hominid sites of Kromdraai, Swartkrans and Sterkfontein (South Africa). Schick and her colleagues (Chapter 5) present data on the bone assemblage from a modern striped hyena den they excavated in Jordan. The presentation is of particular relevance to the South African paleontological record since it is hypothesized that an extinct subspecies of striped hyena (*Hyaena hyaena makapani*) was a likely contributor of the Makapansgat Limeworks Grey Breccia fauna. This is the very fauna upon which Raymond Dart based his notion of the Osteodontokeratic Culture of *Australopithecus prometheus* (now *A. africanus*).

The third set of chapters, by Alan Walker, Martha Tappen and colleagues, Kay Behrensmeyer, Rob Blumenschine and colleagues, and Kathleen Kuman, explore site- or landscape-level issues in taphonomy and paleoanthropological assemblage formation. Walker's (Chapter 6) discussion of two Miocene sites on Rusinga Island (Kenya) deals with the most remote time period covered in the book and some of the most fascinating taphonomic circumstances known in primate paleontology. R114, which yielded the type specimen of *Proconsul heseloni*, is the site of large hollow tree that was ultimately infilled by matrix and bones, while the Kaswanga Primate Site is possibly an infilled carnivore burrow. Chapter 7, by Tappen and colleagues, describes taxonomic and taphonomic aspects of the important Pleistocene fauna from Dmanisi (Republic of Georgia), associated with the earliest securely dated hominids outside of Africa. The site is tantalizing taphonomically, with the authors' concluding preliminarily that it does not conform to the "plutonic ideals of human habitation sites, hyena dens, or mass death sites." Behrensmeyer's (Chapter 8) contribution returns to Africa, with a report on changes in skeletal part survival and bone surface modification in the Amboseli (Kenya) ecosystem over her 30 years of work there. She links many of the changes to a marked increase in the spotted hyena population and the decline of other large predators over the last decade, suggesting that such an inter-specific demographic in the past would have resulted in increased competition for carcasses and minimal opportunities for aggressive scavenging by early hominids. Landscape taphonomy is also the concern of Blumenschine and his colleagues. In Chapter 9, they present data from their Olduvai Landscape Paleoanthropology Project (Tanzania). In order to reconstruct landscape facets existing during Bed I and Lower Bed II times within the Olduvai Basin, the researchers have conducted modern taphonomic surveys in the Serengeti, along Lake Masek and the Lower Grumeti River. Especially fascinating is their study of crocodile taphonomy in these settings and its relevance for determining fine-scale landscape features. Kuman's chapter (Chapter 10) shifts focus from bones to stones and from East to South Africa, as she describes varying land use by hominids in the Stone Age. She concludes that nearly all of the earliest sites in South Africa are secondary deposits within karstic cavities, while actual occupation of caves occurred only much later, after 600,000 years ago. All other sites are open air and usually close to standing water. Kuman also elaborates on her current research on the late Acheulean and Middle Stone Age archaeology of the Mapungubwe National Park, in Limpopo Province (South Africa).

Two other papers, by Ron Clarke and Gail Krovitz and Pat Shipman, comprise the fourth section of this volume. Clarke (Chapter 11) provides taphonomic comparisons of three australopithecine skeletons from Sterkfontein (South Africa). The Little Foot (Stw 573) skeleton, from the Member 2 level at that site, is far more complete than the partial torsos from Member 4, Sts 14 and Stw 431, which each have only one partial limb preserved. Clarke concludes that Stw 573 was apparently mummified and buried before its bones separated, while the two Member 4 skeletons were probably ravaged by the same type of biotic actor, resulting in their similar degree and kind of incompleteness. Krovitz and Shipman (Chapter 12) provide methods for reconstructing the taphonomy of immature hominid crania, of particular relevance to the human fossil record, which has yielded many important specimens of juvenile status. Indeed, the authors then apply their methods to the cases of three such specimens, the Taung Child (*A. africanus*), Mojokerto (*Homo erectus*) and Herto BOU-VP-16/5 (*H. sapiens idaltu*).

The final four chapters are organized together because of their emphasis on hominids as taphonomic agents. Travis Pickering and his colleagues (Chapter 13) elaborate upon Brain's interpretation of early hominid behavior at Swartkrans Member 3 (South Africa) by presenting evidence of 163 fossil specimens bearing newly identified stone tool cutmarks and hammerstone percussion damage. Data presented on tooth marks indicate that carnivores contributed more predominantly than hominids to the formation of the Member 3 fauna, but hominids still appear to have been capable foragers. Based on the anatomical distribution of cutmarks, it is argued that hominids gained access to carcass parts usually defleshed early and entirely by carnivores before that happened. Although mostly a presentation of data on carcass modification by felids, the work of Manuel Domínguez-Rodrigo and his colleagues (Chapter 14) makes the point that hominid-induced bone damage is the preferred class of data upon which inferences of hominid behavior should be made. In response to previous models, they emphasize that the order of carnivore and hominid access to carcasses could be modeled more

specifically and usefully with a taxon-specific (felid versus hyenid) consideration of tooth mark frequencies, and present some useful steps in this direction. Henry Bunn's chapter (Chapter 15) is also concerned with inferring early hominid access to carcasses, but concentrates on the utility of his ethnoarchaeological observations of Hadza foragers (Tanzania) for doing this. He emphasizes that Hadza maximize their return rates by transporting to base camps essentially whole carcasses of zebra size and smaller animals. This makes sense when one considers that the sophisticated chopping (metal axes) and boiling technologies of these modern humans assure they can extract nutrients from skeletal parts that must have been difficult or impossible for Oldowan hominids to exploit. Tim White and Nicholas Toth (Chapter 16) close-out the volume by discussing the likelihood that feeding hominids modified bones with their teeth, as well as with stone tools. The chapter will serve as an important caution to taphonomists against automatically attributing every tooth mark observed in a fossil fauna to carnivores. The broader implication is that the usefulness of models of carnivore-hominid interaction that are dependent on tooth mark frequencies might be suspect.

Twenty-five years after the publication of the *Hunters or the Hunted?*, Bob Brain's masterwork, each of the chapters in this volume reflects the continuing and encompassing influence of the man and his work on the field of paleoanthropological taphonomy and its practitioners. Bob is still relevant and the research questions he posed and then so eloquently explored still resonate and inspire advancement in our understanding of human evolution.