How Active Were Early Populations? Or Squeezing the Fossil Record

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When President Malina asked me to prepare a short presentation on the topic "How Active Were Early Populations?" my immediate response was, "Fine, we have been discussing classical Greece and Rome in my graduate history seminar this semester." When Bob indicated that it was early populations in the sense that anthropologists use the term, my reply was one of considerable hesitancy. Although I had taken coursework in the Department of Anthropology as a young faculty member at the University of California, the overwhelming amount had been in social and cultural anthropology not in physical anthropology. To make matters worse, my doctoral training was in history, not biological science; hence, I was very tempted to decline our President's invitation.

However, anthropology is an academic discipline that embraces an extremely wide and varied range of courses—wider by far than the discipline of physical education. In spite of this diversity there seems to be more that holds anthropologists together than drives them apart. This is not to suggest that there are not tensions within the field; paleoanthropologists, for example, almost certainly have far more in common with paleontologists than they do with folklorists. Yet when dealing with a range of questions at an archeological site, it is not enough to reconstruct the physical evidence; it is also necessary to know what kinds of culturally driven practices the individual and the group engaged in. Perhaps more than any other group of academicians, anthropologists are likely to appreciate and utilize a multidisciplinary approach.

As we physical educators grapple with some of the dilemmas confronting our own field, we would do well to realize, as do anthropologists, that human beings are biosocial animals. If we wish to advance the field of physical education scientifically and theoretically we need to give greater attention to this fact. The questions that the field in general should seek to answer are, in the final analysis, biosocial questions. This does not mean of course that physical educators do not have to pursue rather specialized lines in their research and teaching. Indeed they do! However, it would benefit us all if we could be more familiar with the major tenets of relevant specialties outside our own or, at the very least, be more sensitive to and supportive of the work of our colleagues in other subdisciplinary specializations. To facilitate this we need to be more open to each other's endeavors; more departments of physical education need to embrace high-quality research across the biosocial spectrum.

Anthropologists in general tend to be accustomed to looking at the world in ways that will facilitate the broader perspective. Perhaps this is why they are often rather pleasant and interesting people. On my own campus, the Department of Anthropology is divided into six subdisciplinary areas at the undergraduate and graduate levels: physical anthropology, medical anthropology, archaeology, folklore, social and cultural anthropology, and linguistic anthropology. Additional coursework is offered in theory and method, area studies (e.g., Afro-American Ethnography, People and Cultures of the Himalayas), and quantitative and computer methods in anthropology. (It should be noted that these designations are fairly similar to those defining the section editors for *The American Anthropologist*.)

This configuration—ranging from biological to social considerations, with the addition of some relevant "applied" work—is not all that different from what one might or should find in a physical education department. It was largely because I endorse Brooks' (1981) contention that physical education is both cross-disciplinary and interdisciplinary, and that anthropology is in some ways a successful model for what we might become, that I decided to attempt the present challenge. We might all derive benefit from concentrating on those things that could bring us together rather than lamenting about what drives us apart. So, with the caveat that I am neither a physical anthropologist nor a physiologist but an historian of physical education and sport, I will try to say a few useful words about "How Active Were Early Populations?"

Questions about his relationship to the rest of the animal kingdom have intrigued humankind for centuries. The publication of Darwin's *On the Origin of Species* (1859) and especially his *The Descent of Man* (1871) cast traditional notions of humanity's possible relationship to other mammals, especially the great apes, in a new light. Whereas in 1871 the fossil record of human evolution was almost nonexistent, by the 1970s a variety of field and laboratory techniques such as radiocarbon dating and computerized gas chromography had made it possible for scientists to accumulate and interpret a remarkable amount of the fossil record bearing on human ancestry.

Although much of what we know about early hominid populations is derived from the fossil record, comparisons with contemporary pongid populations have also been the source of useful speculation about early humankind. In his influential text, *The Fossil Evidence for Human Evolution: An Introduction to the Study of Paleoanthropology,* Clarke (1978) observed, "The muscular anatomy of men and apes is astonishingly alike, even down to some of the smaller details of attachments of many of the individual muscles." The structure and disposition of the visceral organs and the basic morphology of the brain show important similarities; and metabolic processes, serological reactions, chromosome patterns, and blood groups show a similar striking complex of resemblances (pp. 1-4).

While unambiguous information about the early stages of human divergence from the ape line is absent from the fossil record, there is broad agreement that *Homo sapiens* evolved from a common ancestor, *Australopithecus afarensis*. In January 1979 Donald Johanson (Johanson & Edey, 1981) announced to the world his discovery of "Lucy" (scientific name—*Australopithecus afarensis*) at the Hadar site in Ethiopia's Rift Valley. The first find in 1973 had been a complete knee joint from a soil layer dated at over 3 million years old. This effectively pushed back the previously held history of human walking by more than a million years. The 52 major skeletal elements recovered made it possible to reconstruct something like 80% of the Lucy skeleton. Moreover, remains of an additional nine adults and four juveniles also have been found at the Hadar site. From this and comparable evidence anthropologists have concluded that the body form had achieved successful adaptations long before a fully human brain had evolved. Reconstructions of the long bones, rib cage, and shoulder girdle, for example, show remarkable similarities with modern skeletal structure.

The Hadar hominids provided anthropologists with several pieces of information that are important in trying to reconstruct the record of human evolution. Although disagreement continues, potassium–argon dating put the finds at between 3.5 and 3.8 million years old. The body form is almost entirely human with upright walking structures well established. While small in stature (1.2 to 1.5 meters in height), the *afarensis* appear to have been sturdy and strong. The hand and foot bones were robust and show evidence of having been well muscled. Lucy's pelvis (the find is held to be that of a female creature) had not yet evolved to allow the birth of a large-brained infant, however. The teeth were largely human in pattern but showed identifiable connections with ape ancestors. (They retain the *diastema,* the gap between incisors and canines; Gowlett, 1984; Johanson & Edey, 1981).

Although there is not complete agreement among anthropologists and paleontologists, the family *Hominidae* (the term used to describe all the representatives of the human family) dates back about 3 million years. Raymond Dart gave the name *Australopithecus* (Southern ape) to the early humanlike remains that were found in Southern Africa in 1924. Louis Leakey discovered other specimens with unusual characteristics at Olduvai Gorge in Tanzania in 1960. These were dated at about 1.8 million years. He called them *Homo habilis*; however, some scientists have claimed this type is an evolved form of *Australopithecus* and not a new genus. *Homo erectus* finds, whose average cranial capacity ranges from 600 cc to 750 cc, date from 1.5 million years ago, and *Homo sapiens*, with a cranial capacity ranging from 600 cc to 2,000 cc, is placed at about half a million years ago (Gowlett, 1984; Kelso, 1970; Potts, 1987).

Methods of dating fossil remains have been revolutionized in the last 20 to 30 years. For the main periods of human evolution, the Pliocene (roughly 5.0 to 1.6 million years ago) and the Pleistocene (roughly 1.6 to 10,000 years ago), several interlocking methods of dating fossil remains have been devised (e.g., the potassium–argon method, which is based on the rate of decay of argon gas in volcanic rocks; the Pliocene deep sea cores method, which depends on the polar direction of magnetic particles in rocks and sediments at the time they were laid down; and the method whereby changes are observed in the amino acids in bone and teeth of fossil remains; Gowlett, 1984).

Anthropologists also rely on archaeological evidence to date and reconstruct the past. Technically archaeology begins with the first preserved evidence of cultural activities, or about 2.5 million years ago, and extends to about 10,000 years ago. The Pliocene and Pleistocene together account for about 99% of the archaeological record. That portion of human history that has been dominated by animal and crop management began about 10,000 years ago and accounts for less than 1%. Little trace has been left of whatever modest settlements early prehistoric humankind may have established and inhabited, although evidence of fire dates to 1.5 million years ago, and archaeologists have made a number of intriguing deductions from charred fossil bones. The majority of evidence has been destroyed by chemical decomposition, physical abrasion, and other processes, but large quantities of stone tools have been recovered enabling anthropologists to make important determinations about what types of activities it was possible for early humankind to engage in. For example, it has been determined that stone choppers and scrapers, the earliest types of tools, were entirely suitable for altering wood, meat, and bone.

By the time that *Homo erectus* had appeared about 1.5 million years ago, a new tool—the hand axe or bi-face—had been perfected. As hand-axe industries endured for over a million years, it is reasonable to believe this tool was extremely useful and efficient. Simple in design, the typical hand axe (known for the site in northern France that gave the industry its name, St. Achuel) was symmetrical with two faces and sharply worked edges. Such tools may be made today by skilled knappers (stone workers) and have been found to be as effective as steel blades for butchering carcasses (Gowlett, 1984, pp. 60-84).

Because successful behavior leads to successful adaptation, it is generally held that "the key to understanding the evolution of man is a knowledge of those types of behaviors of which early man was capable" (Mann, 1971, p. 167). The evolution of hominids during the middle Pleistocene (roughly 1 million to 200,000 years ago) was a continuation of an adaptation based on a culture that probably originated with the Australopithecines. By the middle Pleistocene, culture—that is, habits acquired as a member of a community—performed a role in adaptation much as it does for modern humankind. Both fossil and archaeological evidence suggest that hunting and gathering, the kind of adaptation that still characterizes many modern groups, was well established by the middle Pleistocene. Studies of contemporary groups have shown that a hunting and gathering existence depends on a fairly well-established culture with food sharing, band foraging movements, and at least some special grouping (Potts, 1987; Tooby & DeVore, 1987).

The further one pushes the evolutionary record back into the past, the more difficult it is to define, understand, and interpret culture. Most of what anthropologists know about early humankind must be inferred from fossil and archaeological evidence or modeled upon primate behavior or upon theoretical mathematical constructions such as optimal foraging behavior, compression hypothesis, and niche behavior models (Winterhalder, 1981). Therefore, analogies with and extrapolations from modern hunter–gatherer societies and from humanity's closest relatives among the primates, especially gorillas and chimpanzees, have been used to construct theories about human activities. In their recently edited *Hunter–Gather Foraging Strategies* Winterhalder and Smith (1981) set forth a number of theories and strategies based on a variety of uses of archaeological and ethnographic analyses. The general strategy of the papers included is to examine "dynamic interactions and the evaluation of potential strategies in regard to resource concentration, predictability, breadth, time spent, and net energy intake" (p. vii).

The obtaining of nonproduced foodstuffs and resources—that is, those not cultivated or husbanded by humans—is referred to as foraging. Foraging may include trapping, netting, snaring, gathering, and hunting. The word hunting implies direct and immediate involvement in capturing or killing animal prey. In general, strategies that are flexible are likely to be the best for ensuring survival and evolution. Changes in season and climate, fluctuations in resources, difficulties in harvesting, intra- and interspecific competitors, and other factors will influence availability of sources, the group's needs and choices, and strategies for obtaining the needed or desired resources. Optimal foraging strategies would maximize energy intake/energy expenditure ratios in favor of the forager. Such cost-benefit considerations have a distinct bearing on the matter of how active an individual or group would need to be to subsist.

The nutritional quality of what is foraged needs to be taken into account, as do questions about environment (both physical and social) and other factors that might affect foraging behaviors, for example, sexual division of labor. Schoener (1971) has divided foraging into four decision sets: (a) the items the forager will consume from those available, (b) the condition of the spatial environment and the location in which the forager will seek food resources, (c) the times when foraging will occur, and (d) the circumstances under which foragers will form groups for the purpose of pursuing food resources (pp. 177-179). Additional factors that influence the optimal diet include: (a) Is the forager a generalist or specialist? (b) Is the environment "patchy" (heterogeneous) or "uniform" (homogeneous)? (c) What is the structural use relationship between the organism and its environment? and (d) What are the relationships between time spent searching and time spent pursuing, capturing, and eating prey (Limp & Reidhead, 1979; Lyman, 1979; Schoener, 1971)?

Considerable recent work in evolutionary ecology has focused on attempts to predict group size and structure. Winterhalder (1981) suggests that the following items condition group size and structure: (a) Efficiency and effectiveness of individual foragers is increased up to a point by aggregation; (b) groups may form in response to food concentration for reasons that have no effect on efficiency of individual foragers; and (c) group formation may hinder individual foraging but may offer other compensatory effects (p. 30). Theoretical models suggested by Gowlett (1984) place the typical hunter–gatherer band at from 25 to 30 individuals. These may occasionally aggregate with other bands to form groups of up to around 500 individuals, but normally there is limited overlap among ranges (pp. 64-65).

It is generally agreed that hunting and gathering had become an established way of life by the Acheulean Period (around 1.5 million to 150,000 years ago). The often-held assumption that early humankind led an unsettled, wandering life has now been called into question by evolutionary ecologists who point out that new-world hunting and gathering societies show that they can survive only if they have a systematic approach to the environment and operate within a well-defined territory. Detailed knowledge of the environment that will facilitate optimal foraging strategy—that is, the ability to exploit the environment in such a way that the maximum resources are extracted with the greatest economy of effort—is a necessary adaptive feature of successful populations. Following Braidwood (1960) and others, Butzer (1982) maintains that "the basic premise is a progression from unspecialized free-wandering bands to specialized hunter–gatherers with well-defined centrally based movements to agriculturalists with permanent settlements" (p. 234). For example, MacNeish (1972) has used this theoretical model to describe the archaeological record from Mexico's Tehuacan Valley during the last 10,000 years (Butzer, 1982).

Butzer (1982) has used surface artifacts, the remains of migratory birds and other fauna, soil layer analyses, rocks and minerals at sites and in the surrounding area, and a host of other items to develop a "seasonal mobility model" for Acheulian hunter–gatherers in mid-Pleistocene Spain. In the spring and autumn these hunters preyed on migrating herds that were forced to move through mountain passes. In summer and winter the hunters fanned out to temporary sites selected for accessibility to water, availability of flint and quartz to make tools, and location of animal resources. From models of resource concentration and mobility of these hunter–gatherers' subsistence settlement patterns Butzer also generalized that "groups probably will opt for a reasonably broad diet when possible, in order to reduce their dependence on the fluctuating productivity of a number of highly ranked resource types, as well as to optimize average food search time and harvest time" (p. 241; see also MacArthur & Pianka, 1966; Winterhalder, 1981). Although it was probably necessary to expend considerable energy obtaining needed resources under the least advantageous climatic, seasonal, and environmental circumstances, early populations appear to have made many adaptations that allowed them to obtain the necessary resources with relative ease.

Modern hunters and gatherers such as the Kalahari Bushmen and Australian aborigines live in small groups of around 30 people. Their social organization provides for flexible response to seasonal changes in resources, and population levels are controlled in accordance with the resources. Using Yellen's (1976) work on the Kalahari Bushmen, Butzer (1982) mapped two foraging itineraries of the Dobe group of bushmen. Their operational area of key resource concentrations had a mean radius of about 15 km. Each expedition of 18 days was spaced a month apart. On each of the 50-km trips ephemeral sites were occupied for an average of 3 to 4 days (Butzer, 1982, p. 239). In general, modern hunters and gatherers usually find it unnecessary to spend as much time each day obtaining their food as do modern subsistence farmers or as did agriculturalist societies that emerged around 10,000 years ago (see also, Festinger, 1983; Shackley, 1985).

In a recent text entitled *Using Environmental Archaeology* Shackley (1985) has "attempted to reconstruct, from their organic remains, something about different aspects of the lives of early people" (p. 9) focusing on hunting, eating, ailing, moving, and dying. Although there now is a considerable amount of what appears to be relevant fossil and archaeological evidence, interpreting it is still in the early stages. Much is known about the diet of modern hunter–gatherer communities; however, many problems remain in reading the archaeological record and trying to extrapolate from it and from what is known about modern populations. For example, the archaeological record is heavily biased in favor of animal foods because skeletal remains or horns of animals killed and eaten have a better chance of being preserved than do legumes. In recent years some useful work has been done that makes it possible to analyze plant food remains in paleofaeces. Hillman (1986) has written, "Many questions relating to past diet, past culinary practices, alimentary diseases, and ancient uses of medicines and drugs remain unresolved unless faecal remains are found on archaeological sites. To archaeologists, then, paleofaeces are pearls beyond price" (p. 99). Further work in this area is likely to aid anthropologists in their quest for understanding the activity patterns of early populations.

Anthropologists also now substantially reject the earlier belief that ancient hunter–gatherers lived almost exclusively on meat. It has been recognized that large quantities of animal bones may collect in caves and other sites for reasons that have little or nothing to do with hominoid practices. It is generally believed, for example, that Australopithecines were so small that they would have had difficulty killing large and dangerous animals. In fact it has been suggested that Australopithecines were probably more often the meals of large carnivores than they were killers of such animals. Most likely these very early hominid forms scavenged the kills of large carnivores and consumed fruits, grasses, seeds, grubs, and similar items. What kills they achieved were most likely small animals. Archaeological bone assemblages have also been studied for evidence of the relative dietary importance of various species of animals killed. Among the problems confronting the investigator is distinguishing consumed meat from available meat: What parts were used and what parts were discarded? For example, diets very high in lean meat were not efficient; hence, when such a diet was necessary there would be selective killing of the fattest animals and processing body parts that are rich in fat.

Because all animals must eat to live, obtaining food must occupy an important place in each day and account for a large portion of the activity that is done. Spurr (1983) reviewed the literature and discussed the "functional consequences of nutritional status . . . in terms of maximal oxygen consumption, physical work capacity, heart rate response to exercise, work productivity, and endurance at submaximal loads" (p. 1). Noting the difficulty of formulating universally acceptable definitions of physical fitness and physical work capacity (PWC), Spurr (1983) fixed on the "$\dot{V}O_2$max as an assessment of physical work capacity [and] a measure of functional (physiological) capacity [that] . . . has particular importance when related to nutritional status" (p. 3). A positive balance for the organism must be maintained between energy expended in the process of obtaining food and the nutritional value of the food. Climate, season, availability of animals and other usable foodstuffs, competition from other groups and with animals for the same resources, density of population, social organization, types of materials available for the construction of tools and weapons, and the level of technology of the population are among the factors that will have an influence on the energy that must be expended in getting food.

Because the archaeological evidence is so incomplete, great difficulty remains in determining precisely what strategies were used by early populations for obtaining food. It is a standard practice, therefore, to look to information that may be obtained from appropriate contemporary groups. In general, modern hunter–gatherers secure some portion of their protein from sources that are gathered rather than hunted (e.g., lizards, caterpillars, grubs). A study of the modern-day !Kung Bushmen of Botswana revealed that a sizable portion of the protein they consumed was obtained by gathering, and that only 37% of their diet was meat (Shackley, 1985, pp. 45-51). Lee (1968) found that modern !Kung maximized energy expenditure/food production efforts by concentrating on smaller and less swift animals, and that it took twice as long to produce 100 calories of food energy by hunting as by gathering. On the average, adults spent from 1 1/2 to 3 1/2 days a week in the quest for food, with seasonal fluctuations necessitating more or less energy expenditure (McElroy & Townsend, 1984, pp. 180-182). Modern hunting and gathering societies also exhibit sexual dimorphism in obtaining foodstuffs, with men tending to range farther away from the home base to hunt but actually contributing less to the total food supply than do women, who gather seeds, plant foods, grubs, and so on nearer the home base.

As long as early hominid populations remained small, competition from other species was limited, and environmental factors were favorable, it was probably only occasionally necessary to devote intense time and energy to obtaining resources. While early populations may have been active much of the day, it is unlikely that they were often obliged to engage in heavy aerobic exercise, at least for long durations (Bouchard, Thibault, & Jobin, 1981).

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