

WOMAN THE GATHERER

EDITED BY FRANCES DAHLBERG

New Haven and London
Yale University Press

1981

2 WOMEN AS SHAPERS OF THE HUMAN ADAPTATION Adrienne L. Zihman

Fossil discoveries in Africa provide evidence that the earliest hominids lived on the savannas as long as 3.5 million years ago, that they were about the size of chimpanzees with somewhat larger brains, that they walked upright, and that they began making stone tools about two million years ago. What was their social organization like? From bones and teeth we can deduce much about locomotion and diet, but it is more difficult to reconstruct sharing habits, reproductive behavior and mating patterns, how the young were socialized, and the roles of males and females in all these activities.

The most popular reconstruction of early human social behavior is summarized in the phrase "man the hunter." In this hypothesis, meat eating initiated man's separation from the apes. Males provided the meat, presumed to be the main item in early hominid diet, by inventing stone tools and weapons for hunting. Thus males played the major economic role, were protectors of females and young, and controlled the mating process. In this view of things, females fade into a strictly reproductive and passive role—a pattern of behavior inconsistent with that of other primates or of modern gathering and hunting peoples. In fact, the obsession with hunting has long prevented anthropologists from taking a good look at the probable role of women in shaping the human adaptation.

Evolutionary success is reproductive success, which of

course makes women's contribution both critical and central. In this chapter, I take a close look at women's and men's roles in influencing early human evolution, using an interpretive framework constructed with detailed knowledge of primate behavior, especially that of our closest living relatives, the chimpanzees, and of the behavior of gathering and hunting peoples. Their life-styles are much nearer to the ancestral one than are the urban hierarchies used by so many anthropologists to "explain" human evolution and behavior. Much of my argument will be based on anatomy, in particular the examination of "sexual dimorphism." Specific female-male differences, detectable in the fossil record, offer clues to the behavior and sex roles of our ancestors who lived millions of years ago and left no other historical record than their own bones and teeth and footprints.

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Historical Background: Darwin to E. O. Wilson

Our notions of women's and men's roles in prehistory derive in part from currently perceived differences in status of the sexes. Popular pictures drawn of the past are too often little more than backward projections of cultural sex stereotypes onto humans who lived more than a million years ago. Themes of male aggression, dominance, and hunting have long pervaded reconstructions of early human social life; and this has led to a belief that present-day inequality of the sexes has its roots in an ancient life-style and in inherent biological differences between the sexes.

These views, which this chapter questions, may be better appreciated by noting their historical development. Male concern with male dominance in studies of humans and animals has been integral to past theories of human origins, human nature, and human evolution (Haraway 1978a,b). Beginning with Darwin's discussion of human evolution, the theme of male dominance and female passivity and the use of tools as weapons has run through thinking about evolution. The emphasis on hunting, as with male dominance, is an outcome of

male bias, however unconscious it may be, and this bias pervades even studies of primate behavior. In Darwin's case, given the values of Western society, especially Victorian England, and the nature of available evidence, his emphasis on males is not surprising. Even so, facts or concepts without the proper theoretical framework are useless, as is well illustrated by E. O. Wilson (1975). His "new synthesis" in *Sociobiology* presents some concepts that are intrinsically pro female (e.g., his ideas on kin and sexual selection). Yet he concludes with a century-old view of human evolution and sex roles that is more like an "old synthetic."

Darwin and Sexual Selection

Darwin and Huxley, over one hundred years ago, first brought human evolution into the scientific realm (Washburn 1968a). Darwin provided the mechanism of natural selection to explain evolutionary change. Though he did not comment on human origins in *The Origin of Species* (1859), his closing paragraph indicates that he believed natural selection could "throw light" on the subject. Huxley picked up on the theme soon after and, in his essays on *Evidence as to Man's Place in Nature* (1863), showed how man is, anatomically, closely related to the African apes. Darwin later (1871) built upon Huxley's thesis and offered a behavioral model for human origins; he maintained that evolution occurred in Africa with the human line emerging as the "third ape," differing from gorillas and chimpanzees, and being characterized by bipedalism and tool using, and small canine ("fighting") teeth.

Progressive on the one hand, Darwin split from the scientific orthodoxy of his time in holding that species were not immutable but changed with time through natural selection. But on the other hand, the traditional constraints of Victorian England are apparent in *The Descent of Man and Selection in Relation to Sex*, published in 1871. In this work, Darwin pointed out that sexual selection, as an aspect of natural selection, could explain human secondary sexual characteristics (sexual dimorphism). But there is a curious discrepancy in

his argument. When describing the process of sexual selection among all animals save the human species, he not only describes competition among males for females but also stresses the importance of female choice. The secondary sexual characteristics of the males, such as bright coloration, fine plumage, or special vocal qualities, are seen as important to the extent that they are attractive to females:

The females are most excited by, or prefer pairing with, the more ornamented males, or those which are the best songsters, or play the best antics. . . . Thus the more vigorous females, which are the first to breed, will have the choice of many males. [1871:573]

However, when Darwin approaches the discussion of sexual selection among humans, male choice is now assumed, and it is female beauty which is seen as attracting the male. In accounting for this presumed reversal, he writes:

Man is more powerful in body and mind than woman, and in the savage state he keeps her in a far more abject stage of bondage than does the male of any other animal; therefore it is not surprising that he should have gained the power of selection. [1871:901]

Darwin was aware of the inconsistency and it worried him. He therefore went on to consider the possibility that female selectivity in choosing mates occurred among our progenitors. Without direct evidence of the sexual practices of the past, he looked to travelers' anecdotes concerning non-Western peoples for evidence as to whether "primitive" women might not exercise somewhat more sexual initiative than the Victorian ladies of his day. He concludes with a cautious affirmative: ". . . for in utterly barbarous tribes the women have more power in choosing, rejecting, and tempting their lovers, or of afterwards changing their husbands, than might have been expected" (1871:901).

One Hundred Years Later

The framework of human evolution Darwin set forth is still utilized, and his approach to female choice is very much in

evidence one hundred years later. A centennial volume, *Descent of Man and Selection in Relation to Sex 1871-1971*, edited by Bernard Campbell (1972), commemorates Darwin's work and contains eleven articles on sexual selection and human evolution. Interpretations range from the articles by Trivers and Selander, which discuss the role of female choice, to those of Fox and Crook, which neglect it. Most of the subject matter of Trivers's and Selander's articles is birds and insects; Crook and Fox deal with primates and humans—as if the closer we approach the human condition, the less is female choice confronted and dealt with directly.

Both Crook and Fox carry on the theme that men have gained the power of selection. Crook, for example, in his discussion of human behavior, notes the role of the secondary sexual characteristics of young women that make them attractive to young men: "Hairlessness, voice tone, complexion and girlish behavior all have a childlike character that . . . appear to lower the probability of a male aggressive response or to appease if one is present" (1972:372). This approach is similar to the part of Darwin's argument that stresses female beauty as a lure to males. Thus male choice is assumed, in the face of all the evidence of female choice in other species, so that it follows "logically" that females had only a passive role in forming uniquely human cultural practices.

Fox develops this view in approaching human kinship systems. Following the structural male-behavior anthropological approach developed by Lévi-Strauss (1949), Fox views human intelligence as an outgrowth of male behavior and male-male interaction, whereas females are merely objects of exchange between men. Hence, females have had little role in the development of human kinship systems. Fox goes so far as to say that "it is the role of women as labor and as objects of exchange that is important. This control of women by the older, dominant males is probably the clue to all human kinship systems" (1972:313).

Campbell's book perpetuates and compounds Darwin's difficulty with male versus female choice (Zihlman 1974). The

relatively insignificant role historically given to human females in mating might help explain why neither Darwin nor Campbell (nor E. O. Wilson) could fully integrate sexual selection and the descent of "man" and why the view that males control females still pervades reconstructions of human evolution.

Primate Behavior and the Dominant Male

From the earliest studies of primate behavior, selectivity in observation and bias in sampling and interpretation are apparent. For instance, Zuckerman (1932) concluded from a limited study of hamadryas baboons in the London zoo that the sexual bond is the cohesive mechanism of primate societies (see Haraway 1978b for an extensive discussion). In short-term field studies later, human observers considered the dominance hierarchies and aggression of male baboons, twice the size of the smaller females, as prominent features of primate societies (DeVore 1963). The centrality of savanna baboon adult males in mating (DeVore 1965), controlling group movement, maintaining social order, forming hierarchies, and acting as protectors becomes a basis for extrapolating to human societies, even though Rowell (1966, 1967) reported that baboons in forest environments behaved quite differently. Drawing from the baboon example, Kummer writes in *Primate Societies*:

Man's latent or overt inclinations for dominance hierarchies, closed groups and discrimination against outsiders, suggest that he approached the baboon type of society, at least at one stage of his evolution. In many respects the hamadryas baboon's society of closely coordinated family units is a better model of human social structure than that of the chimps. [1971:152]

Dominance behavior—and its function and transmission in monkey and ape groups—has entailed a number of assumptions: that it is a major determinant in structuring social relationships within multimale/multifemale primate societies; that it equates with successful aggressive encounters; that it is a determinant of reproductive success; and that it is passed on

genetically (implying a link to the Y chromosome) from one generation of males to the next.

However, dominance behavior is insufficient to describe the complexity and variability of nonhuman primate social behavior (Gartlan 1968). There may be little correlation between high rank and reproductive success of males, and dominance behavior may have little adaptive significance (Rowell 1974). "Dominance" is more correlated with length of tenure in a social group than with winning fights, and reproductive success correlates with living to maturity (Lancaster 1978).

Furthermore, a different picture of dominance acquisition emerges from data collected on monkeys and apes during long-term studies that considered the entire life cycle of individuals of both sexes of all ages. Such studies have shown the centrality of the mother rather than of males in determining the dominance status of offspring (Sade 1972). Kin relations, including physical closeness and intense social interaction, are an important factor in social organization, and for monkeys and apes "kin" consists of a mother and her offspring, as well as the siblings of a common mother.

Paternity is unknown among nonhuman primates, nor can human observers "know" paternity from watching social interaction, especially in multimale/multifemale social groups. Since "adoption" is relatively rare among primate groups, kin relations are also genetic relations. Dominance rank of both male and female offspring is influenced by the status of the mother (Koyama 1967; Sade 1967; Eaton 1976). Further, in many primate societies, this female core provides the principal social continuity of the group. It is noteworthy that these important facts about primate societies and female centrality have been minimized.

The Ubiquitous Hunting Model

The theme of male dominance and male centrality extends into interpretations of the economic and social life of early human society through the emphasis on hunting. The inven-

tion of hunting as the major economic and technological pursuit is credited with the consequent human departure from the ape forebears and with producing the essential "human" traits—intelligence, manual skill, toolmaking, tool using, sociability. Hunting is assumed to have been in practice for 99 percent of human history, thus providing "the master behavior pattern of the human species" (Laughlin 1968:304).

Robert Ardrey's *African Genesis* is an early, popular version of the hunting hypothesis (1961). (A later book, in 1976, was titled *The Hunting Hypothesis*.) According to Ardrey, our forebears were killer apes who wiped out their peaceful vegetarian brothers (he uses the Cain and Abel analogy) and so passed on to us all those nasty but successful human traits that we know so well today from genocidal wars and nuclear weapons. In fact, Ardrey's ideas are rooted in those of Raymond Dart (1955, 1957), the discoverer of *Australopithecus*. Dart, who was trained in England, was no doubt influenced by Darwin and Huxley, and the thread runs through from the founder to the present.

Tiger (1969) and Tiger and Fox (1971), in their popularizations of hunting, emphasize "male bonding" (the buddy system) as the focal point of human evolution. In their view, predatory aggression is genetically wired into our (male) nature (Zihlman 1973). Desmond Morris (1967), on the other hand, stresses the sexual bonds between males and females but still accepts the central role of males in hunting.

These popularizations and innumerable other versions tend to dismiss the facts: women and children constitute at least 75 percent of human society; women are the primary socializers; the human diet is omnivorous, not carnivorous; and meat and other protein can be obtained in numerous ways besides hunting. If one ignores these considerations, it becomes "logical" to draw analogies between early human groups and the social carnivores like lions and wolves (Schaller and Lowther 1969; Peters and Mech 1975; Thompson 1975; King 1976). Hominids and carnivores seem to have in common cooperative hunting for food, sharing of meat, divi-

sion of labor, large home range, and long dependency of the young. But in all these features, carnivores and humans are also fundamentally different.

Carnivores have specialized for millions of years in preying upon a few species. Unlike carnivores, humans prey on almost any species, of any size, and rely not on canine teeth, less on strength and speed, and more on technology and planning. Sharing among carnivores has been greatly overrated. Lion cubs often eat last and do die of starvation (Schaller 1972). Wolves and hunting dogs regurgitate part of their meal for the young. Adult hyenas do not share but merely tolerate others eating alongside (Kruuk 1972). The orderly distribution of foods, both plant and animal, among human societies is a complex social mechanism, totally different from "sharing" among carnivores (Washburn and DeVore 1961).

Similarly, "cooperation" among carnivores merely means that several individuals hunt at the same time—a far cry from human cooperation involving language and self-identification as a group member. Female lions do all the killing for sharing with young. Some carnivores, such as lions, do have a long period of dependency (two to three years) before they master the skills of predation, but mothers cache rather than carry their young and have multiple rather than single births. Critically, unlike carnivores, human mothers continue to feed their dependent young for years after they are weaned, even when nursing and carrying other offspring, and maintain close emotional ties throughout life. Overall, the comparison of early hominids with carnivores is superficial, misleading, and essentially an extension of the "hunting hypothesis."

Sociobiology: "New Synthesis," Old Biases

Whether or not E. O. Wilson's *Sociobiology* (1975) is, as he claims, "the new synthesis," his view of human behavior is male-oriented all the way. Sociobiology attempts to explain the evolution of social systems, from insects to humans. The concept of natural selection is expanded to encompass the notions of "inclusive fitness" and "kin selection," as mecha-

nisms to explain mating strategies and relative reproductive success. But at the same time, Wilson's *Sociobiology* uncritically emphasizes male dominance, male fitness, and male reproductive success (Kleiman 1977). To Wilson, dominance is the essence of reproductive success:

In the language of sociobiology, to dominate is to possess priority of access to the necessities of life and reproduction. . . . With rare exceptions, the aggressively superior animal displaces the subordinate from food, from mates, and from nest sites. It only remains to be established that this power actually raises the genetic fitness of the animals possessing it. On this point the evidence is completely clear. [1975:287]

Expanding this concept to primate societies, Wilson says that "the reproductive advantages conferred by dominance are preserved even in the most complex societies" (p. 288). And the leitmotif is sounded again fourteen chapters later: "What we can conclude with some degree of confidence is that primitive man lived in small territorial groups within which males were dominant over females" (p. 567). Finally, all the "objective" considerations and "new syntheses" lead, like a Sherlock Holmes solution, to the good old hunting hypothesis, in sociobiological garb: "By the time *Australopithecus* . . . had begun to feed on large mammals, group hunting almost certainly had become advantageous and even necessary" (1975:567).

The concepts of parental investment and mate choice, pillars on which sociobiology is founded, are never in this book applied to female mammals or primates. Though Wilson mentions that maternal care is prolonged in higher primates and humans, and that social relationships are to some extent matrilineal, these facts play no essential role in his theoretical formulation of human societies today or yesterday. The intellectual tradition of Wilson's emphasis on male reproductive success appears as a barrier to his employing sociobiological concepts of maternal investment, female choice, and mechanisms of sexual and kin selection, which he applies so impres-

sively to ant and wasp societies, for incorporating women into human evolution.

Thus male-oriented reconstructions wherein males play the main economic (hunting) and reproductive (mate choice) roles have dominated the last one hundred years of discussions on human evolution. The "old model" built around weapons, hunting by males, and meat eating, in which women play no economic role, may be viewed as an extension of Darwin's ideas which emphasize the loss of large canine teeth for fighting and their replacement by weapons for protection: the dominating males thereby gain control of mate selection.

The Interpretation of Evidence

Any serious reconstruction of the past must "fit" within a growing body of data on living apes and gathering-hunting peoples, the hominid fossil record, genetic relationships of living species, as well as concepts in evolutionary biology. The human species has only one evolutionary history, and reconstructing that pathway must integrate this wide range of information from the genetic to the behavioral level, from millions of years ago to the present.

Evidence of the Past

The fossils, as well as associated tools and animal bones, and the ancient environmental setting, provide information from which we can directly deduce something about body size, motor capabilities, habitat, available food, potential predators, and circumstances of death of our earliest ancestors. To go beyond this evidence, to formulate the social aspects of life, requires supporting studies of closely related species, particularly the apes and gathering-hunting peoples (see Goodall 1968; Gale 1970; Bicchieri 1972; Teleki 1974; Lee and DeVore 1976; see also chapters 1 and 3, this volume).

Studies of anatomy, behavior, and especially protein structure and DNA indicate that chimpanzees, gorillas, and humans apparently diverged from a common ancestor as re-

cently as five or six million years ago (King and Wilson 1975; Sarich and Cronin 1976). The oldest well-documented fossils come from Laetoli, Tanzania, and are about 3.5 million years old (M. D. Leakey et al. 1976; M. D. Leakey and Hay 1979). Other material, particularly pelvic and limb bones, comes from two sites—Hadar, Ethiopia, and Sterkfontein Cave, South Africa—which are over 2.5 million years old (Howell 1978). These sites in the savannas of eastern and southern Africa have yielded an abundance of fossil hominids, mostly jaws and teeth, though a dozen or so skulls have been found, and almost all parts of the skeleton.

The fossil evidence indicates that the earliest hominids were small, about the size of pygmy chimpanzees (thirty-two to thirty-five kilograms) (Zihlman 1979). Their pelvises and feet were constructed for walking in an upright position; the legs were not much longer than those of chimpanzees, and the arms were much shorter. Overall their body build was distinct from chimpanzees in spite of similar body weight. Their teeth were also distinct: small canines and large cheek teeth, with thick enamel and extensive wear. Cranial capacity ranged from 430 to 530 cubic centimeters, larger than the chimpanzee average of 390 cubic centimeters.

Fossil footprints indicate that the hominids of 3.5 million years ago could no longer use the great toe for grasping, as monkeys and apes can. Their tree-climbing ability was thereby reduced, and, more importantly, infant hominids could not effectively cling to their mother's hair. Though the pelvis was redesigned to orient the muscles for bipedal locomotion, brain size was still small and birth would not have been difficult (Leutenegger 1974).

Stone tools and "campsites" are not found in an archaeological context dated older than two million years—over one million years *after* the appearance of the hominids. By this time the tools are found in association with hominids, or with animal bones, or with both, particularly on the "living floors" at Olduvai Gorge (M. D. Leakey 1971). At such sites, sealed by subsequent deposits and undisturbed by water ac-

tion, stones and bones remained as they were left, until unearthed by archaeologists. Plant remains and organic tools, on the other hand, preserve less readily, and we must therefore recognize that the paleontological and archaeological records are biased in the evidence they preserve. The importance of plants and organic tools cannot be dismissed in our reconstruction.

The Evolutionary Framework

In a court of law, some evidence is thought to be so clear that "it speaks for itself" (*res ipsa loquitur*), but in anthropology an analytical framework is needed for the interpretation of data. That framework is evolution. Evolution is and has been a continuous process, whether or not the record of the past reflects this precisely. It is in the recombination of existing behavioral elements that a new way of life is initiated; this demonstrates that evolution is also change. Often the fossil evidence appears discontinuous, but there must have been *behavioral continuity* during all phases of human evolution. For example, stone tools were not invented "out of the blue" without a prior tradition of perhaps several million years of tool using, whether of organic materials that do not leave traces, or of stone so little modified that the ensuing "tools" are not recognizable by archaeologists. The regular use of organic, and later stone, tools was a key aspect of the early hominids' adaptation.

Furthermore, continuity in evolution assumes an integrated way of life, and to appreciate that fully it is necessary to explore interrelated patterns, which include social, technological, economic, and ultimately ideological features. So, in reconstructing dietary patterns, for instance, it is not sufficient to know the kind of food eaten and with which tools it was obtained. Equally important would be the group members who obtained the food, how they learned its location, what motor patterns had to be mastered, and through what social networks the food was shared. And determining how all of this contributes to reproductive success is essential.

An evolutionary approach requires a consideration of the mechanism of natural selection, which in its broader application includes kin and sexual selection. In formulating natural selection, Darwin observed that a species is composed of individuals with varying abilities to survive and reproduce in a particular environment. Thus a population's "gene pool" represents those individuals producing the most surviving offspring; natural selection, then, measures this differential reproduction and survival. The "fitness" of individuals can be defined by their comparative success in contributing genes to succeeding generations. "Inclusive fitness," a term particularly applicable to social species like primates, takes into account not only reproductive strategies but also social behavior that contributes to the survival of the young: parental investment and kin investment (Hamilton 1964; Alexander 1974).

In primates, each sex contributes the same number of genes to a new individual, but the sexes do *not* contribute *equally* to its prenatal or postnatal survival. The more time and energy a mother invests in each of her offspring, the fewer offspring she can produce in a lifetime. Trivers (1972) proposes that the sex investing the most energy in its offspring is the sex that chooses its mates and thus influences the gene flow into the next generation: this is the principle of sexual selection.

Kin investment includes parental investment as well as time and energy devoted toward the survival of related individuals. In primate societies, "kin" engage in a great deal of social interaction, and, because adoption is infrequent, kin are also genetically related. Therefore, by contributing to the survival of kin with whom genes are shared, both females and males may influence evolution through kin selection, whether or not they mate and produce their own offspring.

Reproduction: A Female View

Although two sexes are essential for mammalian reproduction, the degree of involvement in rearing the offspring varies widely among species. Most discussions of primate reproduc-

tion have been male-oriented, considering only the sex act, in which the male makes his contribution; but for females this is only the beginning. Reproductive success involves the female in a greater investment of time and energy—ovulating, gestating, nursing, feeding, carrying, and establishing lifelong social ties.

The evolutionary roots of women's role in reproduction lie in mammalian and primate patterns. Primate mothers are a special kind of mammal: there is a long gestation, relative to body size, and a long period during which the infant nurses and develops physically and socially. Rather than make nests or have dens, as is the case for almost all other mammals, primate mothers carry their babies on their bodies until the young are weaned; the infants cling to their mother's hair with well-developed grasping hands and feet. Thus monkey and ape mothers with dependent young retain their ability to move around the environment at will, but at the price of increased physical stress and strain and energy output. The prolonged physical closeness between mother and offspring results in enduring social and emotional attachments; these are essential for observational learning by the young from their mothers and hence for the transmission of behaviors and information vital to individual survival and to perpetuation of the group and the species.

This mobility of primate mothers, the prolonged physical contacts, and the lasting emotional ties continued and were elaborated among early hominids. Contrary to many reconstructions of early human social life that picture women burdened with young, sitting back at camp waiting for the hunter's return, hominid mothers must have been moving actively around the environment, getting food and carrying infants while doing so. To postulate that early human females were sedentary denies their primate heritage as well as evolutionary continuity, and implies that their behavior has no counterpart among all female monkeys and apes and women in gathering societies today. In fact, there are no such sedentary females in gathering and hunting societies.

From the beginning of human evolution, because young hominids had lost their grasping feet and could not cling, the burden of holding on shifted to the mothers. Hence, females took a more *active* role in the generation of mother-infant attachments: mothers acted as initiators of attachment as well as perpetuators of it. With upright posture and hands no longer needed for locomotion, the mother developed a new way of carrying her infant, a way that ensured her own mobility without jeopardizing the mother-infant contact and relationship. The first tools, as many have suggested, may have been invented by mothers to carry their offspring who could not cling or walk. Such a "tool" is a unique development among primates, and to the mother it meant that physical mobility was not impaired and that she could search for, obtain, and carry food while carrying a dependent infant. This flexibility of being able to engage in a wide range of activities depended upon the initial invention of a sling/container.

Parental investment is an integral part of reproductive success. Maternal investment of early hominid mothers increased in terms of both time and energy from that exhibited in our female ape ancestors. Hominid young were born helpless and matured slowly. In close physical contact to their mothers, they learned about the physical environment, how to make tools, and developed social bonds that endured for life. The time and energy spent in carrying and caring for long-dependent offspring were even more extensive than among the ape forebears because mothers were usually caring for weaned, but still dependent, offspring while continuing to nurse younger infants. In a hominid mother's lifetime she may have had five or six children, a maximum estimated from the !Kung San average (about five) (Howell 1979) and chimpanzee populations. Unlike men, who invest less in each offspring, and hence can have more, women are confined to these few.

According to sociobiological theory, this heavy maternal investment should mean that females were choosing their mates. And precisely because of the burden of long-

dependent offspring, females must have selected sociable males, willing to share food and protect them and their offspring. This turns around the traditional picture of human reproduction, where the dominant males pick suitable females, who do their best to remain attractive and thereby be assured of having a mate, food, protection, and offspring.

Women's Role in Subsistence

In the early 1960s, studies among the !Kung San of the Kalahari gatherer-hunters in southern Africa revealed women's major economic role in obtaining and sharing food through gathering activities.

Richard Lee documented in some detail the economics of hunting and gathering (1965, 1968a) to show that in some cultures at least females are not as dependent as it might seem from the perspective of Western industrialized society. In 1966, Lee, with Irven DeVore, organized the conference on hunting/gathering societies referred to earlier in this book, to present new data and to relate them to reconstructing human evolution. The subsequent volume was titled *Man the Hunter* (1968a) in spite of the statement in the editors' introduction that "it was generally agreed to use the term hunters as a convenient shorthand, despite the fact that the majority of peoples considered subsisted primarily on resources *other than meat*—mainly wild plants and fish" (1968b:4; emphasis in the original). The information presented in this misnamed volume, as well as in related studies appearing later, provided the basis for questioning the hunting model and for expanding our understanding of women's roles and for proposing alternative views of sex roles in human evolution (Linton 1971; Gale 1970; Martin and Voorhies 1975; Tanner and Zihlman 1976).

Lee and DeVore, commenting on the applicability of the findings on women's gathering activities to human evolution, noted:

Vegetable foods . . . were always available to early man and . . . easily exploited by even the simplest of technologies. . . . Early



Figure 2.1. A !Kung woman living in the Kalahari in southern Africa today illustrates the role of women in reproduction and production. She carries her three-year-old child and is also seven months pregnant. As she returns from a day in the bush, she brings along her digging stick and the food she has gathered to be shared with her kin. Photograph courtesy of Richard B. Lee.

women would not have remained idle during the Pleistocene and . . . plant foods . . . so important in the diet of inland hunter-gatherers today would have played a similar role in the diet of early peoples. [1968b:7]

But concerning the actual recovery of such information, Lee astutely says: "The !Kung have a very substantial subsistence base largely made up of vegetable foods and small animals, but . . . there would be *almost a total loss* of this evidence to the archaeologists" (Lee 1968b:344; emphasis in original). This phenomenon would hold equally for all gatherer-hunter groups. These studies show the importance of women in these groups as an economic force, as they must have been in the past, though the evidence for this role would leave little or no trace in a record of the past.

Gathering and Reproductive Success: The Alternative Model

I argue here, as I have elsewhere, that gathering and not hunting was the initial food-getting behavior that distinguished ape from human. This was an innovation whereby human females used tools to obtain food for themselves, as well as to sustain their young through the long period of dependency, walked long distances, and carried food bipedally on the African savannas (Tanner and Zihlman 1976; Zihlman and Tanner 1978). From the beginning of the human adaptation, a woman's role encompassed reproductive, economic, and social components. Furthermore, rather than a leading force, hunting must have emerged late in human evolutionary history from a technological and social base in gathering (Zihlman 1978a).

Gathering as a subsistence technique, not hunting, combines behavioral elements that existed in the prehuman ape ancestor (chapter 1, this volume). At first the tools would have been modified only slightly, a simple digging tool or a crude container, but through evolutionary time, the manufacture of

these tools and the skill for using them became refined. (Among peoples today, digging tools appear simply made, but are often fire-hardened and regularly sharpened with stone tools.) Implements for collecting termites by chimpanzees, and presumably by the hominid ancestors, may have been the basis for developing digging sticks. Containers must also have been an early invention making it possible to transport food to a safe spot for leisurely consumption and sharing. A modified container could act as a baby sling, or vice versa, as the kaross does among Kalahari San women. With the use of tools, sufficient food could be collected and transported to permit sharing with offspring and perhaps others. A nomadic way of life, in which female mobility was critical, was facilitated by bipedal locomotion, permitting long-distance walking even while carrying infants, food, and tools.

Children raised in the gathering way of life remained dependent on adults until they could walk long distances, master the skills of collecting and processing food with the use of tools, and acquire sufficient knowledge of the social and physical environments. Presumably, a young hominid with a more prolonged developmental period needed at least five years to master the art of chimpanzee "termiteing" or "ant dipping" with tools (McGrew 1977), and this in part accounted for delayed maturation already expressed among early hominids (Mann 1975). Further, the ability to walk long distances bipedally does not develop until children acquire the body build of adults, thereby decreasing oxygen consumption and increasing stamina. A hominid child's survival depended upon its mother's ability to carry it great distances for several years, her skill in finding and gathering food, using tools, her ability to space infants, to feed her weaned offspring, and to maintain social ties with the group (Zihlman 1978b).

The importance of the gathering technique is that it involves tools for collecting a quantity of food that can be carried elsewhere for consumption and sharing. This technique is a departure from the ape's way of plucking and eating food

"on the spot" with each weaned animal foraging for itself. The food obtained requires manipulation by tools for extraction, carrying, or preparation. The type of foods may have been mostly plants, which require less energy or risk of failure than predation or hunting. However, the gathering technique can also be applied to protein sources in "small packages," such as insects, other small invertebrates, reptiles, small animals, and shellfish (Marshall 1976; Tanaka 1976; Meehan 1977a,b).

Continuous with the ancestral ape pattern, though adding a new dimension through recombining existing elements, the hominid diet was omnivorous and included predation on small animals, as among chimpanzees. The frequency of chimpanzee meat-eating varies by habitat (McGrew et al. 1979; Nishida 1979), and the technique of capture or utilization does not require tools. The savanna environment into which the early hominids moved has now, as it did then, considerable biomass of large ungulates (Bourlière 1963). Due to this greater availability of potential prey, meat consumption of early hominids is likely to have increased compared to the forest-living ape ancestors. Particularly, newborn and young ungulates hiding in the grass while their mothers grazed would have been easily captured. Early hominid women could have obtained small or young animals by capturing them with only bare hands, as has been reported among women in gathering societies today (Shostak 1976). However, because meat may require a high output of energy for an unpredictable return, it seems unlikely that hominid mothers and infants living two to four million years ago depended for their survival on meat, whether obtained from their own efforts, or the efforts of others.

Role of Males in Reproduction and Subsistence

Males in human evolution are traditionally depicted as the primary food getters, protectors of females and young, dominant to females, and in control of the mating process through choosing females as their lifelong partners. Such a

picture fits with twentieth-century Western society but less well with the information on sexual behavior and mate choice, food sharing, and social behavior among chimpanzees. The view presented here suggests that a departure from the behavioral pattern of the ancestral male ape is the incorporation of early hominid males into social groups of their own "kin." Males, unburdened by young and so even wider ranging than many females, may have obtained the unpredictable meat by pursuing small animals more frequently than females with young were able to do, and they may have assumed an important role in protecting the group, although group protection included means other than male fortitude (Tanner and Zihlman 1976).

Males also gathered food, although probably in early evolution little more than for themselves. After all, a male infant was carried by his mother as she gathered and would learn this way of life while growing up. Through his efforts in sharing food with his mother and siblings, aiding in group protection, and carrying and playing with young, a male increased the likelihood that his kin would reach adulthood. Males contributed to the survival of the species through kin selection.

Because maternal investment was high, females were choosing precisely those males who were friendly, nurturing, tool-using, and willing to share food. Chosen males then contributed to the gene pool by investing in their kin, usually but not necessarily in their own offspring, and were integrated into the food-sharing and social network. These male behaviors would have been advantageous in a system where the males probably could not know who their offspring were. In a "pair bond" situation, there is greater confidence in identifying paternity and hence in direct paternal investment in a particular offspring. Widespread social nurturing by males would appear more likely in contexts of polygamous matings and would be a significant factor in the survival of the young.

This view of male, as well as female, roles recognizes the contribution of male nurturing of young, as well as the criti-

cal role of a female's economic behavior as integral to her reproductive success. The supposed specialization of sex roles—females as nurturers and males as economic providers—ignores the potential flexibility of behavior of both sexes and sets up a social system too rigid for utilizing opportunistically the range of food sources on the savanna. Both sexes must have been able to care for young, protect themselves from predators, make and use tools, and freely move about the environment in order to exploit available resources widely distributed through space and time. It is this range of behaviors—the overall behavioral flexibility of both sexes—that may have been the *primary* ingredient of the early hominids' success in the savanna environment.

Sexual Dimorphism and the Division of Labor

The basis for arguing that there were very different economic and reproductive roles for each sex has been tied to the physical differences between women and men. Among nonhuman primates and humans, males are usually larger in body size; and size is often equated with dominance and, by extension, with strength and "power of selection" of mates. Very different behaviors are thus assumed to have existed between the sexes. Among nonhuman primates, sex differences in body and canine size were thought to be correlated primarily with ground living and with the ability of males to protect the social group (DeVore 1963; Crook and Gartlan 1966; Leibowitz 1978). DeVore maintained that an increase in dominance behavior is accompanied by increased development of features equipping males for fighting (e.g., body and canine size), resulting in extreme sexual dimorphism in some species.

Linking male dominance behavior and larger body size to their role in predator defense and terrestrial living was assumed valid for human evolution (Tiger 1969). Sexual dimorphism conjures up the image of big, strong, dominant men as hunters of large beasts and protectors of small, fragile women and helpless children from the dangers of the savanna environment. So the evolution of sexual dimorphism

has been assumed to account for the enhancement of men's hunting activities and, by extension, for a division of labor; or, the reverse has also been assumed—that the evolution of hunting would select for sexual dimorphism. Mating strategies whereby a male chooses a dependent female as a pair-bonded mate followed as part of the hunting premise (Washburn and Lancaster 1968; Tiger 1969; Tiger and Fox 1971).

Discussions of sexual dimorphism and the division of labor in reconstructions of human evolution must be grounded in the actual expression of sexual dimorphism in living apes and humans and its behavioral correlates, if any. With this basis one can then turn to the fossil record. This section attempts to clarify how sexual dimorphism is expressed in apes and modern humans and what can be pieced together from the early hominids' bones and teeth. Behavioral correlates to sexual dimorphism where they can be demonstrated will be discussed. Sexual dimorphism as it relates to an early division of labor and to the hominids' mating system can then be assessed in this light.

Sexual dimorphism is the phenotypic expression of *morphological* variation in male and female types of the same species (di = two, morph = form). (Sexual dimorphism does *not* apply to the behavioral correlates that may be associated with it.) Besides reproductive anatomy, male and female nonhuman primates vary in nonsexual characters such as body weight and muscular development, overall size expressed in head, body, and tail dimensions, coat and hair color and markings, and canine tooth length, as well as in maturational, seasonal, or periodic morphological changes associated with reproduction, such as sexual skin changes (Crook 1972). The pelvis and related birth canal in females, body size and weight, and canine tooth size are the most consistent characters, though not the only ones, in which sexual dimorphism is expressed among primates. Size of canine teeth is the best single indicator of sex for most species (Garn et al. 1966). For fossil species, bones and teeth are the only

preserved indicators of sexual dimorphism. Body size must be reconstructed only from these pieces, and in turn the size differences, if bimodal, are assumed to represent two sexes. Finally, hypotheses are made about behaviors that may correlate with the supposed degree of sexual dimorphism.

Studies of living humans and of nonhuman primate species show that sexual dimorphism in canine and body size, head proportions, body weight and proportions involves a mosaic of characters and constitutes a distinct pattern in all species of apes and some species of monkeys (Zihlman 1976; Grand 1978; Janszen and Zihlman 1979). Sexually dimorphic features such as body size and weight, canine tooth size, or pelvic proportions do not all correlate with the same behaviors across species. For example, confusion about the behavioral correlates of sexual dimorphism has derived from attempts to infer mating patterns from a particular morphological feature such as body length (e.g., Alexander et al. 1979). In this way, researchers are making hit-and-miss attempts to draw causal generalizations out of the many diverse and complex variables which are involved in each species' way of life (Janszen 1978). Not only is sexual dimorphism inappropriately reduced to a single trait, but this approach also fails to view sex differences as expressions of *different* strategies adopted by *each sex* in accordance with its particular life history.

I focus here on body size and weight and canine size among living humans and apes because these are the forms of sexual dimorphism we can derive from the fossil record. Body weight in two species of chimpanzees and humans, for example, may be moderately different between the sexes, yet degree of sex difference in social behavior and in other morphological features of each species varies. In humans, women have about 84 percent of male body weight among a rain forest horticultural group and in savanna hunter-gatherers (Truswell and Hansen 1976; Chagnon and Hames 1979). A similar percentage is found in pygmy chimpanzees (*Pan paniscus*) (80 percent) and common chimpanzees (84 percent)

(Zihlman 1976; Cramer and Zihlman 1978). Moderate body weight sex differences may or may not correlate with size differences in other anatomical features such as cranial capacity, long bone lengths, or robusticity or joint size. In humans and in common chimpanzees (*P. troglodytes*) there are sex differences in all these traits, whereas no sex differences in pygmy chimpanzees exist for these traits.

Canine size, also, is a very interesting trait in primates for the study of sexual dimorphism and is directly preserved in the hominid fossil record. In monkeys and apes, canine size often shows marked variation between the sexes and, for a group of thirty-five species of monkeys and apes, correlates with body size dimorphism (correlation coefficient $r = 0.76$). Body size dimorphism is apparently influenced by more factors than is canine size and is therefore more variable (Leutenegger and Kelly 1977). Factors that seem to influence selection on canine size include predator defense, extent of social role differentiation between the sexes, and visibility within the habitat. Selective pressures on body size relate to predator defense and avoidance, territorial availability, food availability, diet, habitat and locomotion, and social role differentiation (Leutenegger and Kelly 1977).

Canine size dimorphism does correlate with social role differentiation among living monkeys and apes, so small canine size and the absence of dimorphism in this trait among early hominids may offer clues to their social behavior. In monkeys and apes, absolute as well as relative canine size differences between the sexes do correlate with sociability but not with mating pattern per se. For example, female monkeys in multifemale/one-male groups have the smallest canines relative to body size, and females who live in pairs, the largest (Harvey et al. 1978a,b). In a small-bodied ape, the gibbon, large canine teeth exist in both females and males; gibbons live in small family groups of one adult female, an adult male, and their subadult offspring; there is high intolerance among adults, even between the male and female pair. The offspring are expelled when they approach adulthood. Competition for

food does exist among members of the family group, related to their small home range. The suggested function for large canines in the adult female is her effective competition for food with the adult male (Ellefson 1968).

Standing in contrast to this example are pygmy chimpanzees (*P. paniscus*). Canine teeth are relatively small for both sexes, though slightly larger for males (Johanson 1974). Both females and males are quite social; they live in mixed groups of males and females of about twenty individuals (Kuroda 1979). This is quite different from common chimpanzees (*P. troglodytes*, with moderate body size and canine size dimorphism), where females tend to forage with their offspring and males travel in company of other males (Wrangham 1979), behaviors considered to reflect less sociability and greater social differentiation (i.e., male-male competition) than occurs in the closely related pygmy chimpanzees. There is then a correlation between canine size and social organization that reflects the patterns of actual social interaction between individuals. Frequency and intensity of interaction, competition, and relations among classes of individuals are reflected in canine morphology.

In turning to the fossil record and the problem of sexual dimorphism of now extinct species, it is essential to discover, from fossil fragments of bones and teeth, the range of body size that can be reconstructed from this evidence. The fossil bones of three million years ago indicate a size range among individuals, and one explanation for this variability may be sexual dimorphism (Johanson and White 1979). If so, body size dimorphism was probably no more than moderate (as in both species of chimpanzees and humans), though could have been extreme, as in gorilla and orangutan. The evidence is not yet clear. However, the early hominids of two million years ago show no dimorphism in canine size. Moderate to extreme body size differences, in combination with no functional difference in canine size, may have been a pattern unlike that found in living apes or modern humans. From estimates of body weight, Leutenegger (1977) argues that both

species of early hominids (*Australopithecus africanus* and *A. robustus*) were dimorphic and therefore that their mating systems were probably polygynous. This may not have been the situation, given the example of the two chimpanzee species, both with moderate body weight dimorphism but with different social organizations.

Canine tooth size may be more helpful in inferring social behavior. The fact that they are small and nondimorphic among early hominids could reflect greater sociability among individuals, between males and females, females and females, and a reduction of male-male competition and aggression, similar to, and even an extension of, that found among pygmy chimpanzees. This behavioral interpretation of an anatomical character fits with two hypotheses presented in this chapter and discussed by others regarding early human social life: (1) Food sharing has long been considered a new and integral part of economic and social life of the human species (Washburn and DeVore 1961; Tanner and Zihlman 1976; Isaac 1978). Decreasing competition and other changes in male-male interaction would be expressed in sharing food between males and females and intense social interaction among kin and community members. (2) With regard to kin investment by males, females preferred as sexual partners those males who were more social and less aggressive toward them and who contributed to the welfare of their own kin group (Tanner and Zihlman 1976; Zihlman 1978a). Both hypotheses are more recently borne out by studies on sharing patterns and sexual behavior of pygmy and common chimpanzees. Common chimpanzee females apparently avoid mating with males aggressive toward them (Sugiyama 1973; McGinnis 1973), and among pygmy chimpanzees a high degree of food sharing is closely interwoven with copulation (Savage and Bakeman 1978).

The increased sociability of early hominid males toward their kin and other social group members may be expressed anatomically in the small size of their canine teeth. In addition

to the social function of canine teeth, other selective pressures could also be operating to reduce canine teeth in both sexes of early hominids. Because one correlate of marked canine dimorphism is antipredator behavior, among early hominids tool using for predator defense might have replaced large canines in males, assuming that early hominids inherited large canines from their ape ancestor. In fact, there is evidence to suggest that these ancestral apes' canine teeth were not much larger than those of pygmy chimpanzees (Zihlman et al. 1978). Another function of natural selection for reduction of canines in both sexes may have been to increase the effectiveness of the food-grinding mechanism for processing large quantities of tough, gritty foods.

In summary, size and weight differences between the sexes no doubt existed in the early hominids, though such differences have yet to be delineated in any but the most general way. Absence of canine dimorphism, a diagnostic primate character for social behavior, may safely be interpreted to indicate frequent and relatively nonaggressive social interaction between males and females. This by no means suggests "monogamy" or "polygyny" in mating strategies or an absence of aggression. The function of sexually dimorphic characters is not always apparent and in fact may not exist for all characters (Caspari 1978). For example, because degree of body size and weight dimorphism varies so widely among human populations—and in part can be attributed to nutritional differences (Tobias 1975)—the possibility must be considered that variation in such characters may not have direct behavioral significance (contra Alexander et al. 1979).

There is no specific character in male or female physique in ancient or modern humans that can be interpreted to signify that only males must hunt and females gather. Considerations regarding child care and the limitations it imposes on females are another variable and a factor distinct from physical strength per se. A division of labor probably evolved late in human evolution and has never been absolute. Sexual di-

morphism is not sufficient to conclude the necessity of a division of labor by sex, of a particular mating pattern, or of nurturing behavior confined to one sex.

The Relation of Gathering to Hunting

A major assumption with significant impact on the interpretation of the division of labor of early hominids centers upon the emergence of hunting and gathering together. Recent emphasis has been placed on the sharing of both plant and animal resources, a "mixed" economy, in which women gather and men hunt (Isaac 1978; Lancaster 1978; R. E. F. Leakey and Lewin 1978). These "newer" views of early hominid behavior attempt to integrate females into human evolution and into the social and economic systems by emphasizing gathering and the division of labor by sex. This is merely a *superimposition of gathering onto the traditional hunting model*. If hunting and gathering did arise simultaneously in the distant past, or hunting before gathering, then a system in which males hunted and females gathered probably would have been the main way to divide the labor. When viewed in this way, the division of labor and sex roles related to subsistence seem very deterministic, thereby reinforcing the supposed biological base for very different roles between the sexes. This minimizes the unique and central contribution of women, not only to economics, but also to reproduction, and undermines the behavioral flexibility of both sexes. Even within a feminist perspective, "man the hunter" and male dominance unfortunately can prevail as the unifying framework of human behavior, past and present (e.g., Friedl 1975, 1978).

What is the evidence that hunting arose early? or later? My conclusions that hunting arose relatively late in evolution and grew out of the technological and social bases in gathering derive from archaeological and paleontological evidence, or its absence, from behavior of living peoples, from the anatomy and ecology of early hominids, and from the principles of evolutionary continuity and "recombination." Mod-

ern gatherer-hunters represent an integrated adaptation of gathering with hunting and a highly developed technology, such as bow and poisoned arrows, and may not extend beyond the last one hundred thousand years, as opposed to the three or four million years I am discussing here. We cannot assume a division of labor such as occurs in living peoples to apply automatically to the ancient past.

Before proceeding to the evidence, it is important to define "hunting" properly. Much of the debate about its origin might be eliminated by making proper distinctions among a variety of behaviors. The term is often used interchangeably with carnivore killing for food (by tooth and claw), chimpanzee predatory behavior (by use of hands), killing with tools, scavenging, butchering, taking big game or small, acting alone or in groups. These are all ways of obtaining meat, but they differ markedly in the behaviors and technology involved and in what members of society carry out the behavior. For example, butchering requires good cutting tools, makes available for sharing a meat source of large animals that cannot be torn limb from limb with hands or teeth, and is easily performed by either females or males. The comparison of carnivore with human hunting confuses rather than clarifies because it is a mixture of behavioral, technical, and dietary analogies with no consistent evolutionary or genetic framework. Human hunting, as we know it, is a composite of behaviors: stalking, pursuing, bringing down, killing, and butchering, and various tools are tied in with some parts. Each part may have developed prior to the crystallization of the whole pattern. And depending on the prey and the environment and the social organization of the "predators," these behaviors may vary radically.

There are difficulties in interpreting the archaeological evidence on hunting origins; questions remain concerning (1) the appearance of stone tools and their continuity with prior tools, (2) the meaning of bone accumulations and their association with stone tools, and (3) the behavioral/technical means for killing large animals and the frequency of such kills.

There is ample evidence that the hominids were on the scene for almost two million years prior to the appearance of stone tools and butchering sites (Zihlman 1978a); as has been remarked, however, organic tools and plant remains do not preserve as readily as stones and bones. Chimpanzee tool use suggests that a long period of organic tool using could have preceded the invention of tools made of stone (Lancaster 1968; Teleki 1974). And organic tools in the beginning were more likely to have been digging types. It is not difficult to imagine the step necessary to develop a digging tool from a probing type of grass stem or twig as used by chimpanzees (see chapter 1, this volume).

Of the stone tools that first appeared about two million years ago, many are simple "choppers" and are not extensively modified. Early choppers may have been preceded by earlier use of unmodified flakes or cores to improve the manufacture of tools from organic materials. This suggestion arises from the fact that tools similar to these early choppers are still used today. Among the !Kung San, women carry a stone "chopper" to sharpen their digging sticks (Marshall 1976), and choppers continue to be used among Australian Aborigines, whose technology is largely based upon organic tools manufactured with stone tools (Mulvany 1975; Hayden 1977). The use of materials of one type to make/process materials of another involves a number of conceptual connections and a "sophistication" regarding tool use and manufacture further supported by the rapid changes in tool types, including the bifaces, which occurred by 1.5 million years ago.

In the archaeological and paleontological records, concentrations of fragmented bones have been interpreted as tools and as evidence of hunting. Dart (1957) and Ardrey (1961) treated the large number of bones at Makapansgat Cave in the Transvaal of South Africa as evidence of toolmaking, hunting, and meat eating by early hominids. Dart suggested that early man had fashioned tools out of the bones, teeth, and horns of the animals they had killed and eaten. Washburn (1957) long ago questioned this evidence; he in-

terpreted the bone accumulations as hyena meals, and recent studies (Shipman and Phillips-Conroy 1977) confirm his suspicion. Bones may accumulate by natural processes, such as water action that selectively deposits them some distance away depending on density and shape, and by carnivore scavenging (Brain 1970; Behrensmeier 1976). Bone accumulations once considered hominid meals can be explained by mechanisms more plausible than hunting. Even when stone tools do occur with animal bones, careful study must establish whether or not the association is fortuitous.

Evidence of tools used in connection with meat comes from several sites dated between 1.6 and 1.8 million years ago (Isaac et al. 1971; M. D. Leakey 1971). Although hominids may have butchered the hippo and elephants at these sites, there is little evidence that they actually killed them. The animals were uncovered in what were once ancient swamps, where they could have become mired, a suggestion made by Mary Leakey and illustrated in modern swamps today (Johnson et al. 1977). The archaeological finds are important, however, because they indicate that hominids had "discovered" small sharp flake tools, which would have enabled them to cut up and share large animals more efficiently, presumably, than tearing them apart with hands or teeth. Even so, the butchering sites indicate less efficient utilization of the meat than occurs later. Furthermore, butchering, as opposed to chasing after an animal, could as easily have been done by women with children as by men. The association of these tools with animal bones by no means proves "the hunting hypothesis."

The anatomy of the hominids themselves is another line of evidence that points to the importance of plant foods. For their body size, early hominids had relatively large teeth which show a great deal of wear and chipping. Markings on the fossil skulls and jawbones indicate well-developed muscles for grinding food, a chewing mechanism typical of omnivores and herbivores (Crompton and Hiimäe 1969; DuBrul 1977). Thus the anatomy suggests a high proportion of gritty and

tough material in the diet. The kinds of food that need extensive processing in the mouth are the tougher vegetable foods, some fruits and nuts, or foods found on or under the ground. It may be no coincidence that the chronic disorders today associated with a diet high in fat and animal protein suggest that one composed principally of vegetables rich in dietary fiber represents better the "natural" condition of the species (Mendeloff 1977).

Finally, the combined evidence suggests that the early hominid diet can be best described as omnivorous: meat would be included but would be of less importance than the popular hunting hypothesis proclaims. As yet no explanation for the origin of hunting takes into account evolutionary continuity: there is no simple extension from chimpanzee-like predation (catching small animals without tools) to throwing at, trapping, driving, or stalking and killing animals of all sizes with the use of tools. Further, any explanation must take into account the archaeological evidence, or lack of it. All components—*anatomical, social, technical, ecological*—of hunting must be delineated; until then the development of hunting cannot be reconstructed step by step as it must have emerged in evolution.

Questions remain regarding the emergence of hunting, but the gap narrows when we recognize the continuity and similarities between gathering and hunting. Gathering may have laid the social and technological foundations for the emergence of hunting. For example, behaviors attributed to hunting can as easily be explained by gathering: long-distance walking, use of tools, sharing resources, large home range, home base, low population density, detailed knowledge of the environment, and cognitive mapping. Sharing patterns established between mothers and offspring continued into adulthood and expanded to include other adult males and nonrelated individuals. Actual hunting probably built upon these existing sharing patterns. Individuals engaged in obtaining raw materials for tools or pursuing unpredictable game could gather for themselves while traveling, and if they

did not succeed in the capture they would be assured of shared food gained from others' effort.

Technology of hunting could have developed from tools initially invented for gathering activities and plant food preparation. As aspects of evolutionary continuity, wooden spears and, later, hafted tools, fishing nets, and the like may have developed from digging sticks or "bags" for collecting and carrying, in the same way that digging sticks may have emerged from an ape's termiting stick. Tools invented for food preparation, such as those used to pound and pulverize tough plant foods or to cut up large fruits and vegetables for consumption and sharing, may have been the basis for inventing stone tools for cutting up animals or pounding meat prior to eating. One might also make a case for hunting as a specialized form of gathering—"gathering" small reptiles, conies, rodents, and so on, and building on this to go after small and young herbivores, and on to larger herbivores. The interrelation of gathering with the later emergence of hunting must have expanded considerably the feeding and foraging strategies of the early hominids for utilizing an ever wider range of dispersed and varied food types, both plant and animal; this in turn would contribute to reproductive success of those individuals and social groups so engaged.

A firm foundation in a gathering way of life would then have enabled the hominids' successful exploitation of more extreme habitats as they moved out of the tropical areas of Africa and Asia into the temperate regions, where plants were not available year around. The hominids of half a million years ago living in the temperate climates must have utilized a great deal of meat (Butzer 1977). However, there are few clues in the archaeological record of how frequently and by what means the animals were killed. Initially, it may have been close-range killing with a digging type of tool that could knock out a small animal; later, more effective tools for close-range killing of medium-sized to large animals would have been used. Such killing might be contrasted with predation—killing of smaller animals by hand—and the distinction

between the two indicates a higher level of social, technical, economic, and cognitive organization.

Conclusions

In the origin of the human way of life, women's roles in feeding, carrying, and caring for their nursing and weaned young were critical for species survival. Men's roles also were geared to investing time and energy in the next generation, for their own offspring as well as their "kin." The female contribution to reproductive success included an active role in production and subsistence. Gathering and preparing food with tools made it possible for the early hominids, especially the mothers, to exploit the abundant savanna resources: it was a new feeding pattern in a new environment for obtaining, transporting, and preparing foods to share. Foods obtained in this way, which are mostly although not exclusively plant, require less energy than going after mobile animals, an important consideration for a female with dependent young.

At the earliest stages of human evolution, a pronounced division of labor by sex is unlikely, though there was probably a tendency for males, or even females without young, to range in groups more widely for food than those mothers with young. In this way, resources could be efficiently utilized over a wide area. Males became more involved in the survival and well-being of their kin, and so contributed to the gene pool through kin selection and by being chosen as mates for females who preferred more social, food-sharing, nurturing males. Hunting, emerging later and utilizing male mobility and female information "banks" and gathering as security, further provided means for exploiting more effectively another food source of moderate-to-large-sized animals. This in turn provided the basis for developing wider sharing networks that included non-kin. This broader definition of both women's and men's roles in this long time frame gives us greater insight into the development of the division of labor

by sex, and hunting in relation to gathering, and the complementarity of the nurturing roles of both sexes.

The flexibility of the human adaptation over the long haul allowed exploitation of a wide variety of plant, animal, and fish species, through the invention of tools and new behavioral patterns. Ultimately, the success of human reproduction means producing and socializing offspring that not only survive but also in turn have offspring of their own. Women's critical contribution to shaping the human adaptation must be integrated into an evolutionary picture in order to explore their interrelation with men's roles. If we are to advance our understanding of sex roles in prehistory, which in turn may further understanding of the sexes today, we must ask questions in ways not previously asked, and most importantly we must break away from the traditional "man the hunter" formulation. Only then can we begin to redress the imbalance of history and embark on new avenues of research to broaden our insights into human behavior.

Acknowledgments

For comments and discussion, I thank Catherine Borchert, Meg Conkey, Karen Janszen, and Jerry Lowenstein. For the photograph, I thank Richard Lee. I acknowledge research support from the Wenner-Gren Foundation for Anthropological Research and the Faculty Research Committee, University of California, Santa Cruz.

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