food supply. One significant result of such a division is an increase in the variety of foodstuffs consumed by the group. To generalize on the basis of many different ethnographic reports, the adult females of the society contribute the majority of the ‘gathered’ foods; such foods are mainly plant products but may include shell-fish, amphibians and small reptiles, eggs, insects and the like. The adult males usually, although not invariably, contribute most of the ‘hunted’ foodstuffs: the flesh of mammals, fishes, birds and so forth. Characteristically the males and females range in separate groups and each sex eventually brings back to a home base at least the surplus of its foraging.

Could this simple mechanism, a division of the subsistence effort, have initiated food-carrying by early hominids? One cannot dismiss out of hand the models that suggest safety from competitors or the need of nesting young as the initiating mechanisms for food-carrying. Nevertheless, neither model seems to me as plausible as one that has division of labour as the primary initiating mechanism. Even if no other argument favoured the model, we know for a fact that somewhere along the line in the evolution of human behaviour two patterns became established: food-sharing and a division of labour. If we include both patterns in our model of early hominid society, we will at least be parsimonious.

Other arguments can be advanced in favour of an early development of a division of labour. For example, the East African evidence shows that the proto-human foragers consumed meat from a far greater range of species and sizes of animals than are eaten by such living primates as the chimpanzee and the baboon. Among recent human hunter-gatherers the existence of a division of labour seems clearly related to the females being enumbered with children, a handicap that bars them from hunting or scavenging, activities that require speed, strength and adaptability. For the proto-humans too the incorporation of meat in the diet in significant quantities may well have been a key factor in the development not only of a division of labour but also of the organization of movements around a home base and the transport and sharing of food.

The model I propose for testing visualizes food-sharing as the behaviour central to a novel complex of adaptations that included as critical components hunting and/or scavenging, gathering and carrying. Speaking metaphorically, food-sharing provides the model with a kind of central platform. The adaptive system I visualize, however, could only have functioned through the use of tools and other equipment. For example, without the aid of a carrying device primates such as ourselves or our ancestors could not have transported from the field to the home base a sufficient amount of plant foods to be worth sharing. An object as uncomplicated as a back strap would have served the purpose, but some such item of equipment would have been mandatory. In fact, Richard Bochove of the University of Toronto has suggested that a carrying device was the basic invention that made human evolution possible.

What about stone tools? Our ancestors, like ourselves, could probably break up the body of a small animal, as chimpanzees do, with nothing but their hands and teeth. It is hard to visualize them or us, however, eating the meat of an elephant, a hippopotamus or some other large mammal without the aid of a cutting implement. As the archaeological evidence demonstrates abundantly, the proto-humans of East Africa not only knew how to produce such stone flakes by percussion but also found them so useful that they carried the raw materials needed to make the implements with them from place to place. Thus, whereas the existence of a carrying device required by the model remains hypothetical as far as archaeological evidence is concerned, the fact that tools were used and carried out is amply attested to.

In this connection it should be stressed that the archaeological evidence is also silent with regard to proto-human consumption of plant foods. Both the morphology and the patterns of wear observable on hominid teeth suggest such a plant component in the diet, and so does the weight of comparative data on subsistence patterns among living non-human primates and among non-farming human societies. Nevertheless, if positive evidence is to be found, we shall have to sharpen our ingenuity, perhaps by turning to organic geochemical analyses. It is clear that as long as we do not correct for the imbalance created by the durability of bone as compared with that of plant residues, studies of human evolution will tend to have a male bias.
in any exclusive sense the staff of hominid life. The archaeological record, such as it is, appears more readily compatible with models of human evolution that stress broadly based subsistence patterns rather than those involving intensive and voracious predation. Partial division of labour between male hunters and female gatherers constitutes an adaptive system that is unique to man and which should probably be more stressed as a feature of human evolution than mere predation. The archaeological evidence is at least consistent with the view that such an arrangement has been a prominent part of the behavioural milieu within which the last two million years of hominid development took place.

During the Middle and Late Pleistocene the geographic range of hominids was extended into cold-temperate and sub-arctic regions. This almost certainly led the hominids into new ecological conditions where protein foods had to be the dietary staples. The archaeological evidence for ensuing adjustments and considerations of the possible influences of more intensive hunting activity on the terminal phases of human behavioural evolution are clearly of the greatest importance but lie beyond the scope of this paper.

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This review draws on a wider range of sources than can be indicated in the bibliography [of the original paper] or text: I am especially grateful to researchers in Africa such as Mary Leakey, and to Berkeley colleagues such as J. Desmond Clark and S. L. Washburn for the frankness with which they have shared their information and ideas in discussions over the past few years. J. Desmond Clark read and gave advice on a first draft of the manuscript. Barbara Isaac has given extensive help and comment at all stages in the preparation of the paper.


The food-sharing behaviour of proto-human hominids

Over the past decade investigators of fossil man have discovered the remains of many ancient proto-humans in East Africa. Findings at Olduvai, Laetolil, Koobi Fora, the Omo valley and Hadar, to name some prominent locations, make it clear that between two and three million years ago a number of two-legged hominids, essentially human in form, inhabited this part of Africa. The palaeontologists who have unearthed the fossils report that they differ from modern mankind primarily in being small, in having relatively large jaws and teeth and in having brains that, although they are larger than those of apes of comparable body size, are rarely more than half the size of modern man’s.

The African discoveries have many implications for the student of human evolution. For example, one wonders to what extent the advanced hominids of two million years ago were ‘human’ in their behaviour. Which of modern man’s special capabilities did they share? What pressures of natural selection, in the time since they lived, led to the evolutionary elaboration of man’s mind and culture? These are questions that palaeontologists find difficult to answer because the evidence that bears on them is not anatomical. Archaeologists, by virtue of their experience in studying prehistoric behaviour patterns in general, can help to supply the answers.

It has long been realized that the human species is set apart from its closest living primate relatives far more by differences in behaviour than by differences in anatomy. Paradoxically, however, the study of human evolution has traditionally been dominated by work on the skeletal and comparative anatomy of fossil primates. Several new research movements in recent years, however, have begun to broaden the scope of direct evolutionary inquiry. One such movement involves investigations of the behaviour and ecology of living primates and of other mammals. The results of these observations can now be compared with quantitative data from another new area of study, namely the cultural ecology of human societies that support themselves without raising plants or animals: the few surviving hunter-gatherers of today. Another important new movement has involved the direct study of the ecological circumstances surrounding human evolutionary developments. Investigations of this kind have become possible because the strati-
As far as the model is concerned the key question is not whether collectable foods—fruits, nuts, tubers, greens and even insects—were eaten. It is whether these proto-humans carried such foods about. Lacking any evidence for the consumption of plant foods, I shall fall back on the argument that the system I visualize would have worked best if the mobile hunter-scavenger contribution of meat to the social group was balanced by the gatherer-carrier collection of high-grade plant foods. What is certain is that at some time during the past several million years just such a division of labour came to be a standard kind of behaviour among the ancestors of modern man.

A final cautionary word about the model: the reader may have noted that I have been careful about the use of the words ‘hunter’ and ‘hunting’. This is because we cannot judge how much of the meat taken by the proto-humans of East Africa came from opportunistic scavenging and how much was obtained by hunting. It is reasonable to assume that the carcasses of animals killed by carnivores and those of animals that had otherwise died or been disabled would always have provided active scavengers a certain amount of meat. For the present it seems less reasonable to assume that proto-humans, armed primitively if at all, would be particularly effective hunters. Attempts are now under way, notably by Elizabet Vrba of South Africa, to distinguish between assemblages of bones attributable to scavenging and assemblages attributable to hunting, but no findings from East Africa are yet available. For the present I am inclined to accept the verdict of J. Desmond Clark of the University of California at Berkeley and Lewis R. Binford of the University of New Mexico. In their view the earliest meat-eaters might have obtained the flesh of animals weighing up to 30 kg by deliberate hunting, but the flesh of larger animals was probably available only through scavenging.

**Tools as testimony**

Of course, the adaptive model I have advanced here reflects only a working hypothesis and not established fact. Nevertheless, there is sufficient evidence in its favour to justify looking further at its possible implications for the course of human evolution. For example, the model clearly implies that early tool-making hominids displayed certain patterns of behaviour that, among the patterns of behaviour of all primates, uniquely characterize our own species and set it apart from its closest living relatives, the great apes. Does this mean that the toolmaking hominids of 1.5 to 2 million years ago were in fact ‘human’?

I would surmise that it does not, and I have been at pains to characterize these East African pioneers as proto-humans. In summarizing the contrasts between living men and living apes I put high on the list language and the cultural phenomena that are dependent on it. We have no direct means of learning whether or not any of these early hominids had language. It is my suspicion, however, that the principal evolutionary changes in the hominid line leading to full humanity over the past 2 million years has been the great expansion of language and communica-

tion abilities, together with the cognitive and cultural capabilities integrally related to language. What is the evidence in support of this surmise?

One humble indicator of expanding mental capacities is the series of changes that appears in the most durable material record available to us: the stone tools. The earlier tools from the period under consideration here seem to me to show a simple and opportunistic range of forms that reflect no more than an uncomplicated empirical grasp of one skill: how to fracture stone by percussion in such a way as to obtain fragments with sharp edges. At that stage of toolmaking the maker imposed a minimum of culturally dictated forms on his artefacts. Stone tools as simple as these perform perfectly well the basic functions that support progress in the direction of becoming human, for example the shaping of a digging stick, a spear and a bark tray, or the butchering of an animal carcass.

The fact is that exactly such simple stone tools have been made and used ever since their first invention, right down to the present day. Archaeology also shows, however, that over the past several hundred thousand years some assemblages of stone tools began to reflect a greater cultural complexity on the part of their makers. The complexity is first shown in the imposition of more arbitrary tool forms; these changes were followed by increases in the number of such forms. There is a marked contrast between the pure opportunism apparent in the shapes of the earliest stone tools and the orderly array of forms that appear later in the Old Stone Age when each form is represented by numerous standardized examples in each assemblage of tools. The contrast strongly suggests that the first toolmakers lacked the highly developed mental and cultural abilities of more recent humans.

The evidence of the hominid fossils and the evidence of the artefacts together suggest that these early artisans were non-human hominids. I imagine that if we had a time machine and could visit a place such as the Kay Behrensmeier Site at the time of its original occupation, we would find hominids that were living in social groups much like those of other higher primates. The differences would be apparent only after prolonged observation. Perhaps at the start of each day we would observe a group splitting up as some of its members went off in one direction and some in another. All these subgroups would very probably feed intermittently as they moved about and encountered ubiquitous low-grade plant foods such as berries, but we might well observe that some of the higher-grade materials—large tubers or the launch of a scavenged carcass—were being reserved for group consumption when the foraging parties reconvened at their starting point.

To the observer in the time machine, behaviour of this kind, taken in context with the early hominids’ practice of making tools and equipment, would seem familiarly ‘human’. If, as I suppose, the hominids under observation communicated only as chimpanzees do or perhaps by means of very rudimentary proto-linguistic signals, then the observer might feel he was witnessing the activities of some kind of fascinating bipedal ape. When one is relying on archaeology to reconstruct proto-human life, one must strongly resist the temptation to project too much of ourselves into the past. As Jane B. Lancaster of the University of Oklahoma has
pointed out, the hominid life systems of two million years ago have no living counterparts.

Social advances
My model of early hominid adaptation can do more than indicate that the first toolmakers were culturally proto-human. It can also help to explain the dynamics of certain significant advances in the long course of mankind's development. For example, one can imagine that a hominid social organization involving some division of labour and a degree of food-sharing might well have been able to function even if it had communicative abilities little more advanced than those of living chimpanzees. In such a simple subsistence system, however, any group with members that were able not only to exchange food but also to exchange information would have gained a critical selective advantage over all the rest. Such a group's gatherers could report on scavenging or hunting opportunities they had observed, and its hunters could tell the gatherers about any plant foods they had encountered.

By the same token the fine adjustment of social relations, always a matter of importance among primates, becomes doubly important in a social system that involves food exchange. Language serves in modern human societies not only for the exchange of information but also as an instrument for social adjustment and even for the exchange of misinformation.

Food-sharing and the kinds of behaviour associated with it probably played an important part in the development of systems of reciprocal social obligations that characterize all the human societies we know about. Anthropological research shows that each human being in a group is ordinarily linked to many other members of the group by ties that are both social and economic. The French anthropologist Marcel Mauss, in a classic essay, 'The Gift', published in 1925, showed that social ties are usually reciprocal in the sense that whereas benefits from a relationship may initially pass in only one direction, there is an expectation of a future return of help in time of need. The formation and management of such ties calls for an ability to calculate complex chains of contingencies that reach far into the future. After food-sharing had become a part of proto-human behaviour the need for such an ability to plan and calculate must have provided an important part of the biological basis for the evolution of the human intellect.

The model may also help explain the development of human marriage arrangements. It assumes that in early proto-human populations the males and females divided subsistence labour between them so that each sex was preferentially tapping a different kind of food resource and then sharing within a social group some of what had been obtained. In such circumstances a mating system that involved at least one male in 'family' food procurement on behalf of each child-rearing female in the group would have a clear selective advantage over, for example, the chimpanzees' pattern of opportunistic relations between the sexes.

I have emphasized food-sharing as a principle that is central to an understanding of human evolution over the past two million years or so. I have also set forth archaeological evidence that food-sharing was an established kind of behaviour among early proto-humans. The notion is far from novel; it is implicit in many philosophical speculations and in many writings on palaeoanthropology. What is novel is that I have undertaken to make the hypothesis explicit so that it can be tested and revised.

Accounting for evolution
Thus the food-sharing hypothesis now joins other hypotheses that have been put forward to account for the course of human evolution. Each of these hypotheses tends to maintain that one or another innovation in proto-human behaviour was the critical driving force of change. For example, the argument has been advanced that tools were the 'prime movers'. Here the underlying implication is that in each successive generation the more capable individuals made better tools and thereby gained advantages that favoured the transmission of their genes through natural selection; it is supposed that these greater capabilities would later be applied in aspects of life other than technology. Another hypothesis regards hunting as being the driving force. Here the argument is that hunting requires intelligence, cunning, skilled neuromuscular coordination and, in the case of group hunting, cooperation. Among other suggested prime movers are such practices as carrying and gathering.

If we compare the food-sharing explanation with these alternative explanations we see that in fact food-sharing incorporates many aspects of each of the others. It will also be seen that in the food-sharing model the isolated elements are treated as being integral parts of a complex, flexible system. The model itself is probably an over-simplified version of what actually happened, but it seems sufficiently realistic to be worthy of testing through further archaeological and palaeoanthropological research.

Lastly, the food-sharing model can be seen to have interconnections with the physical implications of fossil hominid anatomy. For example, a prerequisite of food-sharing is the ability to carry things. This ability in turn is greatly facilitated by a habitual two-legged posture. As Gordon W. Hewes of the University of Colorado has pointed out, an important part of the initial evolutionary divergence of hominids from their primate relatives may have been the propensity and the ability to carry things about. To me it seems equally plausible that the physical selection pressures that promoted an increase in the size of the proto-human brain, thereby surely enhancing the hominid capacity for communication, are a consequence of the shift from individual foraging to food-sharing some two million years ago.
Comparing men and apes

What are the patterns of behaviour that set the species *Homo sapiens* apart from its best living primate relatives? It is not hard to draw up a list of such differences comparing human and ape behaviour and focusing attention not on the many traits the two have in common but on the contrasting features. In the list that follows I have drawn on recent field studies of the great apes (particularly the chimpanzee, *Pan troglodytes*) and on similar studies of the organization of living inter-gatherer societies. The list tends to emphasize the contrasts relating to the many subsistence adaptation, that is, the quest for food.

First, *Homo sapiens* is a two-legged primate who in moving from place to place habitually carries tools, food and other possessions either with his arms or in containers. This is not true of the great apes with regard to either posture or possessions.

Second, members of *Homo sapiens* societies communicate by means of spoken language: such verbal communication serves for the exchange of information about the past and the future and also for the regulation of many aspects of social relations. Apes communicate but they do not have language.

Third, in *Homo sapiens* societies the acquisition of food is a corporate responsibility at least in part. Among members of human social groupings of various sizes the levelling sharing of food is a characteristic form of behaviour: most commonly family groups are the crucial nodes in a network of food exchange. Food is exchanged between adults, and it is shared between adults and juveniles. The only similar behaviour observed among the great apes is seen when chimpanzees occasionally steal on meat. The chimpanzees' behaviour, however, falls far short of active sharing: I suggest it might better be termed tolerated scavenging. Vegetable foods,
which are the great apes' principal diet, are not shared and are almost invariably consumed by each individual on the spot.

Fourth, in human social groupings there exists at any given time what can be called a focus in space, or 'home base', such that individuals can move independently over the surrounding terrain and yet join up again. No such home base is evident in the social arrangements of the great apes.

Fifth, human hunter-gatherers tend to devote more time than other living primates to the acquisition of high-protein foodstuffs by hunting or fishing for animal prey. It should be noted that the distinction is one not of kind but of degree. Mounting evidence of predatory behaviour among great apes and monkeys suggests that the principal contrast between human beings and other living primates with respect to predation is that only human beings habitually feed on prey weighing more than about 15 kilograms.

The gathering activities of human hunter-gatherers include the collection of edible plants and small items of animal food (for example lizards, turtles, frogs, nestling birds and eggs). Characteristically a proportion of these foodstuffs is not consumed until the return to the home base. This behaviour is in marked contrast to what is observed among foraging great apes, which almost invariably feed at the spot where the food is acquired.

Fig. 11.2. Desolate landscape in the arid Kothi Fora district of Kenya is typical of the kind of eroded terrain where guilting exposes both bones and stone tools that were buried beneath sediments and volcanic ash more than a million years ago. Excavation in progress (centre) is exposing the hippopotamus bones and clusters of artifacts that had been partially buried by recent erosion and were found by Richard Leakey in 1969. The site is typical of the kind that includes the remains of a single animal and many tools manufactured on the spot.

Still another contrast with great-ape feeding behaviour is human hunter-gatherers' practice of subjecting many foodstuffs to preparation for consumption, by crushing, grinding, cutting and heating. Such practices are not observed among the great apes.

Human hunter-gatherers also make use of various kinds of equipment in the quest for food. The human society with perhaps the simplest equipment ever observed was the aboriginal society of Tasmania, a population of hunter-gatherers that was exterminated in the nineteenth century. The inventory of the Tasmanians' equipment included wood clubs, spears and digging sticks, cutting tools made of chipped stone that were used to shape the wood objects, and a variety of containers: trays, baskets and bags. The Tasmanians also had fire. Although such equipment is simple by our standards, it is far more complex than the kind of rudimentary tools that we now know living chimpanzees may collect and use in the wild, for example twigs and grass stems.

In addition to this lengthy list of subsistence-related behavioural contrasts between human hunter-gatherers and living primates there is an entire realm of other contrasts with respect to social organization. Although these important additional features fall largely outside the range of evidence to be considered here, they are vital in defining human patterns of behaviour. Among them is the propensity for the formation of long-term mating bonds between a male and one or more females. The bonds we call 'marriage' involve reciprocal economic ties, joint responsibility for aspects of child-rearing and restrictions on sexual access. Another such social contrast is evident in the distinctively human propensity to categorize fellow members of a group according to kinship and metaphors of kinship. Human beings regulate many social relations, mating included, according to complex rules involving kinship categories. Perhaps family ties of a kind exist among apes, but explicit categories and rules do not. These differences are emphasized by the virtual absence from observed ape behaviour of those distinctively human activities that are categorized somewhat vaguely as 'symbolic' and 'ritual'.

Listing the contrasts between human and non-human subsistence strategies is inevitably an exercise in over-simplification. As has been shown by contemporary field studies of various great apes and of human beings who, like the San (formerly miscalled Bushmen) of the Kalahari Desert still support themselves without farming, there is a far greater degree of similarity between the two subsistence strategies than had previously been recognized. For example, with regard to the behavioural repertoires involving meat-eating and tool-using, the differences between ape and man are differences of degree rather than of kind. Some scholars have even used the data to deny the existence of any fundamental differences between the human strategies and the non-human ones.

It is my view that significant differences remain. Let me cite what seem to me to be the two most important. First, whereas humans may feed as they forage just as apes do, apes do not regularly postpone food-consumption until they have returned to a home base, as human beings do. Second, human beings actively share some of the food they acquire. Apes do not, even though chimpanzees of the Gombe
least one factor is clear. The divergence took place long before the period when the oldest archaeological remains thus far discovered first appear. Archaeology, at least for the present, can make no contribution toward solving the puzzle of the split between ancestral ape and ancestral man.

As for the second puzzle, fossil evidence from East Africa shows that the divergence, regardless of when it took place, had given rise to 2 to 3 million years ago to populations of smallish two-legged hominids. The puzzle is how to identify the patterns of natural selection that transformed these proto-humans into humans. Archaeology has a major contribution to make in elucidating the second puzzle. Excavation of these proto-human sites has revealed evidence suggesting that 2 million years ago some elements that now distinguish man from apes were already part of a novel adaptive strategy. The indications are that a particularly important part of that strategy was food-sharing.

The archaeological research that has inspired the formulation of new hypotheses concerning human evolution began nearly 20 years ago when Mary Leakey and her husband Louis discovered the fossil skull he named Zinjanthropus at Olduvai Gorge in Tanzania. The excavations the Leakeys undertook at the site showed not only that stone tools were present in the same strata that held this fossil and other

![Diagram of East Africa showing prominent sites like Hadar, Melka Kunture, and Shungura.](image)

Fig. 11.3. Prominent sites in East Africa include (from north to south) Hadar, Melka Kunture and Shungura in Ethiopia, the Koobi Fora district to the east of Lake Turkana in Kenya, Chesowanja in Kenya, and Peninj. Olduvai Gorge and Laetolil in Tanzania. Dates for clusters of stone tools, some associated with animal bones, recovered at these sites range from 1 mya (Olduvai Upper Bed II) to 2.5 mya (Hadar upper beds). Some sites may be even older.

One complementary puzzle faces anyone who undertakes to examine the question of human origins. The first relates to evolutionary divergence. When did the human stock ancestral to the living apes diverge from the stock ancestral to man? What were the circumstances of the divergence? Over what geographical range did it take place? It is not yet established beyond doubt whether the divergence occurred a mere 5 to 6 million years ago, as Vincent M. Sarich of the University of California at Berkeley and others argue on biochemical grounds, or 15 to 20 million years ago, as many palaeontologists believe on the grounds of fossil evidence. At

![Table showing relative antiquity of selected sites in East Africa.](table)

Fig. 11.4. Relative antiquity of selected sites in East Africa is indicated in this table. Olduvai Gorge Beds I and II range from 1.8 to 1.0 mya. The Shungura sites in the Omo Valley are more than 2 million years old. Two Koobi Fora locales, the hippopotamus/artefact site (HAS) and the Kay Behrensmeyer site (KBS), are at least 1.6 million years old. Initial geological studies of the Koobi Fora sites suggested that they might be 2.5 million years old (dotted line). Only hominid fossils have been found in the lower beds at Hadar and at Laetolil.
hominid fossils but also that the discarded artefacts were associated with numerous broken-up animal bones. The Leakeys termed these concentrations of tools and bones 'living sites'. The work continued at Olduvai under Mary Leakey's direction, and in 1971 a major monograph was published that has made the Olduvai results available for comparative studies.

Other important opportunities for archaeological research of this kind have come to light in the Gregory Rift Valley, at places such as the Koobi Fora (formerly East Rudolf) region of northern Kenya, at Shungura in the Omo Valley of south-western Ethiopia and in the Hadar region of eastern Ethiopia. Current estimates of the age of these sites cover a span of time from about 3.2 million years ago to about 1.2 million.

Since 1970 I have been co-leader with Richard Leakey (the son of Mary and Louis Leakey) of a team working at Koobi Fora, a district that includes the north-eastern shore of Lake Turkana (the former Lake Rudolf). Our research on the geology, palaeontology and palaeoanthropology of the district involves the collaboration of colleagues from the National Museum of Kenya and from many other parts of the world. Work began in 1968 and had the help and encouragement of the Government of Kenya, the National Science Foundation and the National Geographic Society. Our investigations yielded archaeological evidence that corroborates and complements the earlier evidence from Olduvai Gorge. The combined data make it possible to see just how helpful archaeology can be in answering questions concerning human evolution.

At Koobi Fora, as at all the other East African sites, deposits of layered sediments, which accumulated long ago in the basins of Rift Valley lakes, are now being eroded by desert rainstorms and transient streams. As the sediments erode, the fossil bones are destroyed by weathering or a storm washes away stone and bone alike.

All field reconnaissance in East Africa progresses along essentially similar lines. The field teams search through the eroded terrain looking for exposed fossils and artefacts. In places where concentrations of fossil bone or promising archaeological indications appear on the surface the next step is excavation. The digging is done in part to uncover further specimens that are still in place in the layers of sediments and in part to gather exact information about the original stratigraphic location of the surface material. Most important of all, excavation allows the investigators to plot in detail the relative locations of the material that is unearthed. For example, if there are associations among fossils and between bones and stones, excavation will reveal these characteristics of the site.

The types of sites

The archaeological traces of proto-human life uncovered in this way may exhibit several different configurations. In some ancient layers we have found scatterings...
of sharp-edged broken stones even though there are no other stones in the sediments. The broken stones come in a range of forms but all are of the kind produced by deliberate percussion, so that we can classify them as undoubted artefacts. Such scatterings of artefacts are often found without bone being present in significant amounts. These I propose to designate sites of Type A.

In some instances a layer of sediment may include both artefacts and animal bones. Such bone-and-artefact occurrences fall into two categories. The first consists of artefacts associated with bones that represent the carcass of a single large animal; these sites are designated Type B. The second consists of artefacts associated with bones representing the remains of several different animal species; these sites are designated Type C.

The discovery of sites with these varied configurations in the sediments at Koobi Fora and Olдуvai provides evidence that when the sediments containing them were being deposited some 2.5 to 1.5 mya there was at least one kind of hominid in East Africa that habitually carried objects such as stones from one place to another and made sharp-edged tools by deliberately fracturing the stones it carried with it. How does this archaeological evidence match up with the hominid fossil record? The fossil evidence indicates that two and perhaps three species of bipedal hominids inhabited the area at this time, so that the question arises: Can the species responsible for the archaeological evidence be identified?

For the moment the best working hypothesis seems to be that those hominids that were directly ancestral to modern man were making the stone tools. These are the fossil forms of Early Pleistocene age, classified by most palaeontologists as an early species of the genus Homo. The question of whether or not contemporaneous hominid species of the genus Australopithecus also made tools must be set aside as a challenge to the ingenuity of future investigators. Here I shall simply discuss what we can discover about the activities of early toolmaking hominids without attempting to identify their taxonomic position (or positions).

Reading the evidence

As examples of the archaeological evidence indicative of early hominid patterns of subsistence and behaviour, consider our findings at two Koobi Fora excavations. The first is a locality catalogued as the hippopotamus/artefact site (HAS) because of the presence of fossilized hippopotamus bones and stone tools.

The site is 15 miles east of Lake Turkana. There in 1969 Richard Leakey discovered an erosion gully cutting into an ancient layer of volcanic ash known as the KBS Tuff. (KBS stands for Kay Behrensmeier Site; she, the geologist-palaeoecologist of our Koobi Fora research team, first identified the ash layer at a nearby outcrop.) The ash layer is the uppermost part of a sedimentary deposit known to geologists as the Lower Member of the Koobi Fora Formation; here the ash had filled in one of the many dry channels of an ancient delta. Leakey found many bones of a single hippopotamus carcass weathering out of the eroded ash surface, and stone artefacts lay among the bones.
J. W. K. Harris, J. Onyango-Abuje and I supervised an excavation that cut into an outcrop where the adjacent delta sediments had not yet been disturbed by erosion. Our digging revealed that the hippopotamus carcass had originally lain in a depression or puddle within an ancient delta channel. Among the hippopotamus bones and in the adjacent stream bank we recovered 119 chipped stones; most of them were small sharp flakes that, when they are held between the thumb and the fingers, make effective cutting implements. We also recovered chunks of stone with scars showing that flakes had been struck from them by percussion. In Palaeolithic tool classification these larger stones fall into the category of core tool or chopper. In addition our digging exposed a rounded river pebble that was battered at both ends; evidently it had been used as a hammer to strike flakes from the stone cores.

The sediments where we found these artefacts contain no stones larger than a pea. Thus it seems clear that the makers of the tools had carried the stones here from somewhere else. The association between the patch of artefacts and the hippopotamus bones further suggests that toolmakers came to the site carrying stones and hammered off the small sharp-edged flakes on the spot in order to cut meat from the hippopotamus carcass. We have no way of telling at present whether the toolmakers themselves killed the animal or only came on it dead. Given the low level of stone technology in evidence, I am inclined to suspect scavenging rather than hunting.

The HAS deposit was formed at least 1.6 million years ago. The archaeological evidence demonstrates that the behaviour of some hominids at that time differed from the behaviour of modern great apes in that these proto-humans not only made cutting tools but also ate meat from the carcasses of large animals. The hippopotamus/artefact site thus provides corroboration for evidence of similar behaviour just as long ago as that obtained from Mary Leakey's excavations at Olduvai Gorge.

This finding does not answer all our questions. Were these proto-humans roaming the landscape, foraging and hunting, in the way that a troop of baboons does today? Were they instead hunting like a pride of lions? Or did some other behavioural pattern prevail? Excavation of another bone-and-artefact association, only a kilometre away from the hippopotamus/artefact site, has allowed us to carry our inquiries further.
The second site had been located by Behrensmeyer in 1969. Erosion was uncovering artefacts, together with pieces of broken-up bone, at another outcrop of the same volcanic ash layer that contained the HAS artefacts and bones. With the assistance of John Barthelme of the University of California at Berkeley and others I began to excavate the site. The work soon revealed a scatter of several hundred stone tools in an area 16 m in diameter. They rested on an ancient ground surface that had been covered by layers of sand and silt. The concentration of artefacts exactly coincided with a scatter of fragmented bones. Enough of them, teeth in particular, were identifiable to demonstrate that parts of the remains of several animal species were present. John M. Harris of the Loise Leakey Memorial Institute in Nairobi recognized, among other species, hippopotamus, giraffe, pig, porcupine and such bovids as waterbuck, gazelle and what may be either hartebeest or wildebeest. It was this site that was designated KBS. The site obviously represented the second category of bone-and-artefact associations: tools in association with the remains of many different animal species.

Geological evidence collected by A. K. Behrensmeyer of Yale University and others shows that the KBS deposit had accumulated on the sandy bed of a stream that formed part of a small delta. At the time when the toolmakers used the stream bed, water had largely ceased to flow. Such a site was probably favoured as a focus of hominid activity for a number of reasons. First, as every beachgoer knows, sand is comfortable to sit and lie on. Second, by scooping a hole of no great depth in the sand of a stream bed one can usually find water. Third, the growth of trees and bushes in the sun-parched floodplains of East Africa is often densest along watercourses, so that shade and plant foods are available in these locations. It may also be that the proto-human toolmakers who left their discards here took shelter from predators by climbing trees and also spent their nights protected in this way.

Much of this is speculative, of course, but we have positive evidence that the objects at the KBS site did accumulate in the shade. The sandy silts that came to cover the discarded implements and fractured bones were deposited so gently that chips of stone small enough to be blown away by the wind were not disturbed. In the same silts are the impressions of many tree leaves. The species of tree has not yet been formally identified, but Jan Gilette of the Kenya National Herbarium notes that the impressions closely resemble the leaves of African wild fig trees.

Carrying stones and meat

As at the hippopotamus/artefact site, we have established the fact that stones larger than the size of a pea do not occur naturally closer to the Kay Behrensmeyer Site than a distance of 3 km. Thus we know that the stones we found at the site must have been carried at least that far. With the help of Frank Fitch and Ron Watkins of the University of London we are searching for the specific sources.

It does not seem likely that all the animals of the different species represented among the KBS bones could have been killed in a short interval of time at this one place. Both considerations encourage the advancement of a tentative hypothesis:
like the stones, the bones were carried in, presumably while there was still meat on them.

If this hypothesis can be accepted, the Kay Behrensmeier Site provides very early evidence for the transport of food as a proto-human attribute. Today the carrying of food strikes us as being commonplace but, as Sherwood Washburn of the University of California at Berkeley observed some years ago, such an action would strike a living ape as being novel and peculiar behaviour indeed. In short, if the hypothesis can be accepted, it suggests that by the time the KBS deposit was laid down various fundamental shifts had begun to take place in hominid social and ecological arrangements.

It should be noted that other early sites in this category are known in East Africa, so that the Kay Behrensmeier Site is by no means unique. A number of such sites have been excavated at Olduvai Gorge and reported by Mary Leakey. Of these the best preserved is the ‘Zinjanthropus’ site of Olduvai Bed I, which is about 1.7 million years old. Here too a dense patch of discarded artefacts coincides with a concentration of broken-up bones.

There is an even larger number of Type A sites (where concentrations of artefacts are found but bones are virtually or entirely absent). Some are at Koobi Fora; others are in the Omo Valley, where Harry V. Merrick of Yale University and Jean Chavaillon of the French National Centre for Scientific Research (CNRS) have recently uncovered sites of this kind in Members E and F of the Shungura Formation. The Omo sites represent the oldest securely dated artefact concentrations so far reported anywhere in the world: the tools were deposited some two million years ago.

One of the Olduvai sites in this category seems to have been a ‘factory’: a quarry where chert, an excellent tool material, was readily available for flaking. The other tool concentrations, with very few associated bones or none at all, may conceivably be interpreted as foci of hominid activity where for one reason or another large quantities of meat were not carried in. Until it is possible to distinguish between sites where bone was never present and sites where the bones have simply vanished because of such factors as decay, however, these deposits will remain difficult to interpret in terms of subsistence ecology.

What, in summary, do these East African archaeological studies teach us about the evolution of human behaviour? For one thing they provide unambiguous evidence that two million years ago some hominids in this part of Africa were carrying things around, for example stones. The same hominids were also making simple but effective cutting tools of stone and were at times active in the vicinity of large animal carcasses, presumably in order to get meat. The studies strongly suggest that the hominids carried animal bones (and meat) around and concentrated this portable food supply at certain places.

Model strategies

These archaeological facts and indications allow the construction of a theoretical model that shows how at least some aspects of early hominid social existence may have been organized. Critical to the validity of the model is the inference that the various clusters of remains we have uncovered reflect social and economic nodes in the lives of the toolmakers who left behind these ancient patches of litter. Because of the evidence suggestive of the transport of food to certain focal points, the first question that the model must confront is why early hominid social groups departed from the norm among living subhuman primates, whose social groups feed as they range. To put it another way, what ecological and evolutionary advantages are there in postponing some food consumption and transporting the food?

Several possible answers to this question have been advanced. For example, Adrienne Zihlman and Nancy Tanner of the University of California at Santa Cruz suggest that when the proto-humans acquired edible plants out on the open grasslands, away from the shelter of trees, it would have been advantageous for them to seize the plant products quickly and withdraw to places sheltered from menacing predators. Others have proposed that when the early hominids foraged, they left their young behind at ‘nest’ or ‘den’ sites (in the manner of birds, wild dogs and hyenas) and returned to these locales at intervals, bringing food with them to help feed and wean the young.

If we look to the recorded data concerning primitive human societies, a third possibility arises. Among extant and recently extinct primitive human societies the transport of food is associated with a division of labour. The society is divided by age and sex into classes that characteristically make different contributions to the total...