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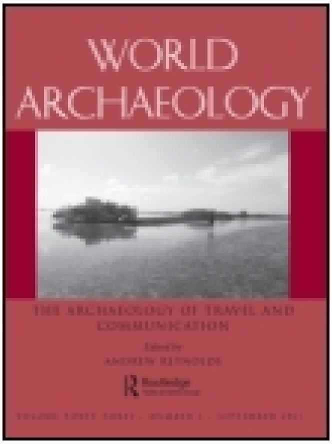

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The diet of early man: aspects of archaeological evidence from lower and middle Pleistocene sites in Africa

Glynn Isaac

The habit of creating concentrated patches of food refuse and abandoned artefacts is amongst the basic features of behaviour that distinguish the human animal from other primates. The habit has created a trail of litter that leads back through the Pleistocene and can provide an extremely important source of evidence regarding the evolution of human behaviour. Systematic archaeological study of the long-term features of this garbage record is still in its infancy and yet it is already apparent that it is far from being a trivial pursuit.

Suppositions regarding the diet and subsistence activity of early men figure large in numerous writings that also treat broader questions regarding the qualities of human nature. For example Ardrey (1961) saw in the allegedly predatory behaviour of early hominids the origins of violent behaviour patterns that continue to be apparent in modern societies; Morris (1967) argues that many distinctive features of human behaviour and biology have arisen as a consequence of an evolutionary pathway that involved predation and led to important parallels with the biology of other social carnivores Amongst others Washburn and Lancaster (1968) have stressed the importance of hunting in creating the selection pressures that have directed human evolution towards brain expansion and effective linguistic communication. Tiger (1969) argues that the widespread phenomenon of male bonding in human societies has its origin in social arrangements that were adaptive for early men that lived by hunting. The vegetable component of human diet has received less dramatic attention in discussion of human nature and human evolution, but recently a phase of seed-eating specialization has been suggested as having played a critical role in the differentiation of hominids (Jolly 1970). This stock of examples is by no means exhaustive, but it serves to illustrate the interest in the feeding habits of early men and to indicate some of the implications that the findings of Pleistocene archaeologists have for anthropology.

While a number of general reviews of human evolution, including that of Howell (1965), do treat the topic of subsistence in general terms, they are not of a character where the relationships between evidence, the process of inference and legitimate conclusions could be critically discussed. What is attempted here is a brief, critical examination of the available stock of information and of the methods by which it can be evaluated. Special attention is given to the African evidence with which the author is most familiar.

1 *Comparative considerations*

In many evolutionary studies a first approximation of the historical problem of change can best be obtained from comparative considerations made prior to scrutiny of the fossil evidence. Amongst extant primates the human species is peculiar for the strength of its tendency to incorporate animal protein in its diet. We are, however, dealing with a difference in degree since it is now known from field studies that few of the anthropoid primates are exclusively vegetarians, while very few if any recent human communities are exclusively carnivorous.

The published symposium on 'Man the Hunter' includes a number of ethnographic essays on non-agricultural subsistence patterns (Lee and DeVore 1968). It emerges that terms such as 'hunters' or 'carnivores' should probably only be applied to recent representatives of the human species with qualifications. The small available sample of studies from Africa and Australia suggest that in the tropics and warm temperate regions the meat component of diet may often have been appreciably less than 50%. The data also imply possible latitudinal gradation in which the importance of meat and fish increases from equator to pole, with arctic and sub-arctic peoples as much as 80–90% dependent on protein foods.

The occurrence of opportunistic hunting amongst baboons, chimpanzees and other anthropoids can probably be taken to indicate that this is a generalized anthropoid trait shared by an ancestral stock even prior to the evolutionary divergence of the hominids. Since we know that this tendency has been intensified in man, it is clearly worth attempting to determine the history of changes leading to the increased carnivorous proclivities that distinguish the species. However, in pursuing this evolutionary study it would seem wise to bear in mind the great variation found in ethnography. It seems likely that the evolution of human behaviour has involved not simply increasing intensity of predation but the unusual development of a flexible system of joint dependence on plant and animal food. Among many recent human communities the retention of gathered food as a major dietary component, constituted an 'insurance policy' that rendered hunting possible under marginal conditions. This ecological strategy made non-agricultural man unique amongst the large predators and appears to have depended on differentiation in the subsistence activities of the two sexes, probably partly genetically determined.

Comparison of extant human subsistence behaviour with primate behaviour in general reveals another set of contrasts which are functionally related to sexual division of labour and joint dependence on both hunting and gathering – namely the distinctive human practices of food sharing and the occupation of home bases. Repeated transport of food back to specific localities results in the localized accumulation of refuse which is what has made archaeological study of prehistoric life possible. However, as we trace the archaeological record back through time there must come a point where the integrated hunting, food-sharing and home base pattern first appears, perhaps with only low intensity.

Studies of the early development of occupation sites in relation to their content of food refuse is clearly one of the important contributions that archaeology can make to the understanding of human evolution. Localities suitable for such studies have only recently come to light, but given suitable orientation of investigations it seems entirely possible that the evolution of these important aspects of human socio-economic behaviour can be worked out.

2 *Traces, preservation factors, and other variables*

Archaeological study of Pleistocene diet is a little like navigating in the vicinity of an iceberg: more than four-fifths of what is of interest is not visible. We do have some positive evidence of foodstuffs eaten but only in the form of certain minor by-products of a complex vanished system. Fig. 8 attempts to define the gross structure of the system as a flow diagram leading from an input of food to a residue of potential traces. Lines of evidence other than archaeological traces of food refuse and faeces do exist; for example, the morphology and wear patterns of hominid teeth; settlement patterns in relation to palaeo-ecology; artefacts with known functions in relation to subsistence. However, for the Early Pleistocene these are often ambiguous in their implications.

Fig. 8 shows that the extent to which diet is documented in an archaeological record is affected by selective factors at two main stages in the chain. First, *feeding habits* exercise a determining influence through (i) localization or dispersal of feeding activity; and (ii) the character of the food, especially the proportion and character of its durable refuse. Only the second of these two sub-factors is widely recognized. The normal primate type of dispersed foraging that does not involve transport of foodstuff and food-sharing at a central locale would *not* be conducive to the formation of an archaeological record even when durable wastes were involved. For example the absence of Lower and Middle Pleistocene shell middens could equally well be caused by the habit of consuming shellfish on the collection sites as by absence of sea foods from diet.

Differences in the ways in which carcasses of different sizes are treated provides another example of the effect of particular feeding habits on the formation of an archaeological record of diet. Smallish animals are likely to be carried back to camp whole; generally only selected parts of medium size animals would have been transported. This will

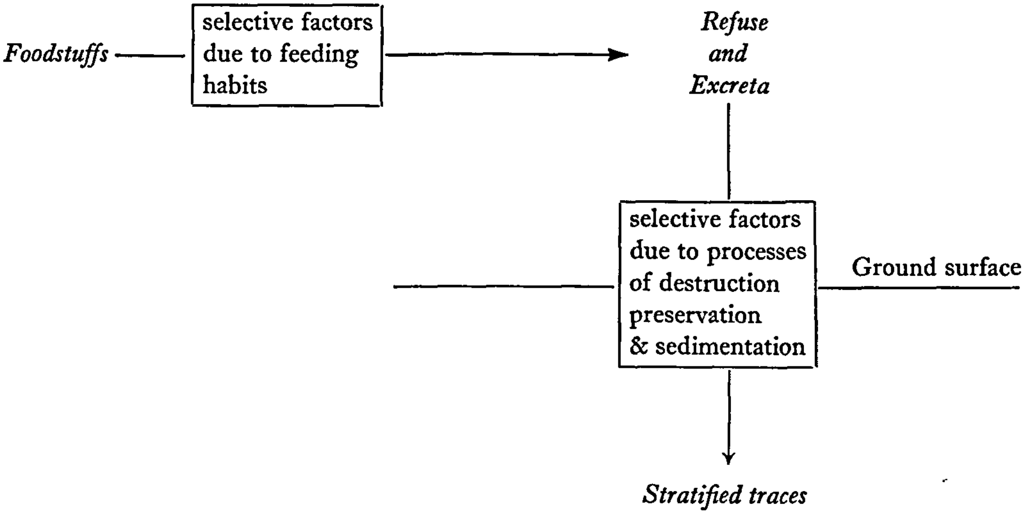


Fig. 8 The formation of an archaeological record of diet shown as a flow diagram. Interpretation should proceed in steps taken in reverse order

distort the bone refuse, but in a way that is often detectable. However, in the case of very large beasts, the bones are so heavy that if anything is moved, it consists only of meat, so that its consumption at a remote home base would be archaeologically invisible. Fortunately for archaeology, other aspects of human behaviour probably often led to moving a camp site temporarily to the site of abundance—and such camps can be obvious archaeological sites. Perkins and Daly (1968) have coined the term '*schlepp* factor' for the way in which the composition of bone refuse is distorted by differences in transportability.

Schaller and Lowther (1969) have raised another notable point relevant to the reliability of the bone record formed during early phases of hominid adaptation to life as a diurnal, social carnivore. They suggest that the practice of accumulating bone at a home base would endanger the occupants by attracting nocturnal predators. Fortunately for archaeology, man's tendency to drop litter appears to have deep roots, and despite this hazard, bone refuse occurs at apparently domestic sites of almost 2 million years ago. In tracing the record further back, the factor of predator danger may need to be taken into account.

Secondly, *preservative factors* exert a controlling influence on what parts of the refuse and excreta that accrue do survive to be studied as palaeo-anthropological documents. The most durable class of macroscopic food remains are of course vertebrate bones and mollusc shells. These survive in good condition in numerous Pleistocene sediments of all ages and constitute the great bulk of the positive dietary evidence of prehistoric archaeology. Careful study of bone refuse can lead to deductions concerning hunting and butchery practices, feeding habits and season of occupation.

Even where chemico-physical bone preservation conditions are ostensibly good, dispersal and destruction by scavengers may obscure or bias the record. Some current studies of the processes involved in the formation of fossil assemblages ('taphonomy') are of value in assessing this potential bias (eg. Brain 1967, Isaac 1967a). Figs. 9*a* and *b* are graphic excerpts from two such studies illustrating respectively relative destructability of body parts and the power of scavengers to disperse bone.

Given the great relative durability of bone, it can be seen that the archaeological record is liable to exaggerate the carnivorous proclivities of early men, unless deliberate steps are taken to counter the bias. Since macroscopic plant food refuse survives in small quantities only at one or two pertinent sites such as Choukoutien (Black 1933, Movius 1948) and Kalambo Falls (Clark 1969), more devious strategies for assessment will be required, as discussed below. Even where traces of plant foods do survive, such as hackberries at Choukoutien, and *Syzygium* fruits and *Borassus* palm nuts on Acheulian floors at Kalambo, it is very hard at present to gauge the dietary importance of these foodstuffs.

Even where feeding habits have led to the accumulation of refuse of which an interpretable proportion appears to be preserved, other variables also need to be assessed. Notably it is necessary to form some estimate of the numbers of hominids and the duration of time involved in refuse accumulation. Only at Terra Amata has any great precision yet been achieved in this direction and elsewhere we have to be content with assessments of orders of magnitude. Little systematic writing has been devoted to the matter, but it is probably widely assumed that crude proportional relations exist as follows: (*a*) Area of site $\propto$ number of occupants (see Cooke and Heizer 1965, Isaac 1969); (*b*) number of

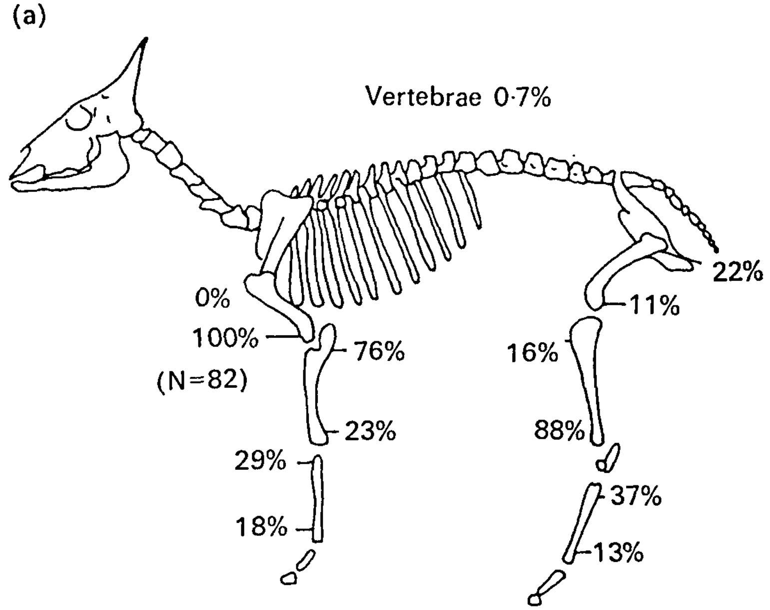


Figure 9a Diagrammatic representation of a goat skeleton showing the great variation found in the relative frequency with which skeletal parts were preserved. (Modified after Brain 1967: fig. 1.) Percentage values are relative to the minimum number of individuals involved as indicated by the most abundant part, the distal ends of humeri. The data were drawn from analysis of a collection of 2,373 specimens collected from the vicinity of 8 Hottentot villages

artefacts ∝ number of occupants and duration of occupation. Using these rough and ready assumptions we may perhaps start to sift available and incoming data by classifying sites according to size and by using the ratio of bone refuse to artefacts as a crude index of the abundance of meat in diet.

Some sites involving high intensities of occupation and low relative abundances of bone refuse may be those where diet consisted principally of gathered foods. This is one possible, if unsatisfactory, way of attempting to get around the non-preservation of vegetable refuse. Alternatives are of the greatest importance, and perhaps the most promising line of investigation of prehistoric diet that has not yet been extensively pursued is the analysis of chemical residues on occupation sites, given the extreme sensitivity of chromatographic techniques and the demonstrated persistence of a range of organic substances through geologic time.

3 *Artefacts and subsistence activities*

Stone artefacts are the commonest fossils that have any bearing on human evolution and yet, despite the fact that a good deal more than 90% of the extensive literature on the 'Lower Palaeolithic' deals exclusively with artefacts, virtually nothing is firmly established about the way in which they functioned in the ecology and economy of their makers

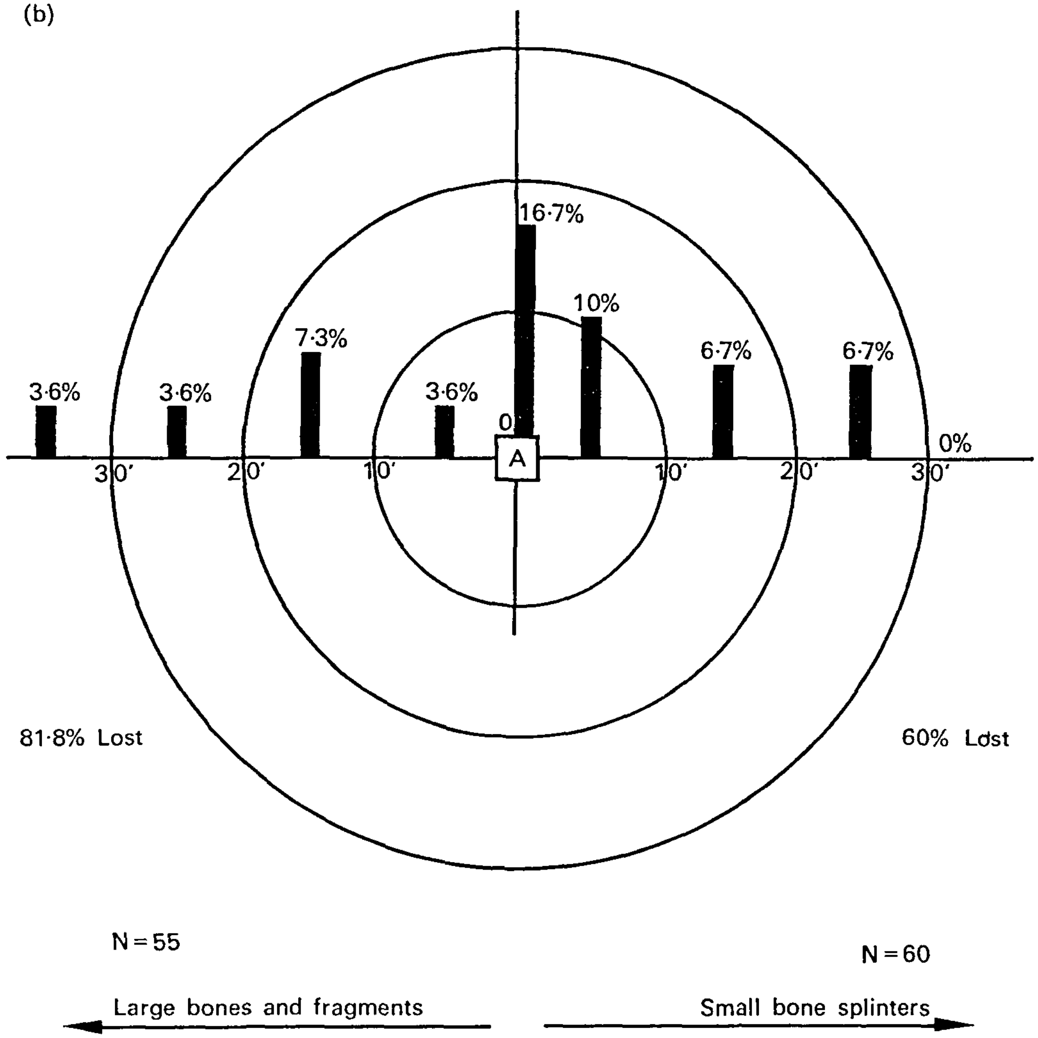


Figure 9b Experimental observation of the ability of scavengers to disperse and destroy bone in modern African savannah at Olorgesailie. 55 large (> 5cm.) and 60 small pieces of domestic bone refuse were dumped in a one-yard square at A over a two-month period. The diagram shows what proportion of each size category was recovered six months later. The percentage recovery is shown for each of the concentric zones drawn in the figure (after Isaac 1967: fig. 4)

(Isaac 1969: 12). It is probably true that cutting tools and simple weapons such as clubs and staves are an essential part of hominid adaptation to a partially carnivorous subsistence but adequate cutting edges are provided by a wide range of flakes and core tools and as yet we gain little additional information regarding economy from the diversity of forms common on most sites.

Some endeavours have been made to translate the results of elaborate quantitative analysis of stone artefacts assemblages into functional terms (e.g. Binford and Binford 1966), though such attempts have been largely confined to Upper Pleistocene assemblages with their greater specificity of tool design and the approximation of forms to known ethnographic categories. Eventually the combination of such analyses with use-damage studies may bring stone artefact morphology to the point of contribution to our understanding of subsistence. Items such as cores, cobbles and manuports with signs of battering caused by use in pounding bone or vegetable foods are likely to be quite as informative as conventional shaped tools.

Richard Lee has pointed out in discussion that containers – baskets or animal membrane bags – are a very basic human invention, without which the division of labour between hunting males and female gatherers could not have arisen. Unfortunately no examples have yet been recovered from really ancient sites. Two sequences of behavioural evolution suggest themselves: either the use of containers preceded and hence facilitated the development of extensive foodsharing, and the organization of social life round the institution of a home base; or the home base institution may have developed in conjunction with the transport and sharing of meat only, which does not require a container. Initially plant and insect foods would still have been foraged by each individual for himself in the manner of most non-human primates. Subsequently the invention of carrying equipment would have made it possible to diversify the adaptive potential of food-sharing by the inclusion of dispersed vegetable foods. Archaeology may eventually be able to resolve this question, but either sequence would be compatible with present evidence, though the second seems more likely.

4 *Variation among sites*

Undisturbed Pleistocene open air sites are commonly referred to one of three main categories: occupation floors, kill (butchery) sites or workshop sites. These terms are reasonably well understood but have seldom been closely defined. Fig. 10 illustrates their meaning in relation to variations in the proportion of bone refuse to discarded stone artefacts. More subtle site classificatory schemes that take artefact character into account are discussed, for example, by Binford and Binford (1966) and Hole and Flannery (1967).

Since stone and bone are the most durable traces of early Pleistocene behaviour, this classificatory scheme forms a convenient frame of reference for attempts to scan available archaeological and palaeontological data for patterns. In general, the diagonal defined by increasing artefact and bone densities represents increasing intensity of occupation. At one extreme, very low density sites which may be single occupation transit camps have only rarely been excavated; sites with abundant stone and bone have attracted more attention. These are liable to be regarded as home-base camp sites that were occupied for some length of time or were reoccupied at intervals. Situated on either side of the diagonal in fig. 10 are other classes of site. Occurrences with a relative abundance of bone and a paucity of stone are interpreted as 'kill' or butchery sites, especially where the bones of a single large mammal are involved (Clark and Haynes 1969). However, in tracing the record back towards the beginning of the Pleistocene, it must be remembered that low artefact to bone proportions could also result from hominid behaviour patterns in which stone-tool manufacture played a lesser part. Other, complex factors can also lead to great variation in this regard (cf. White and Peterson 1969).

Figure 10a

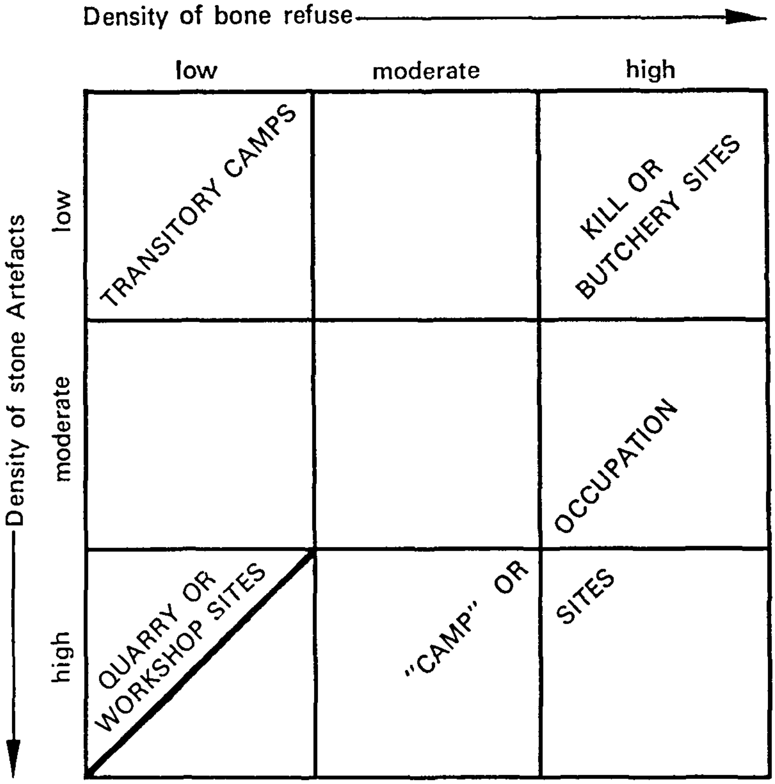
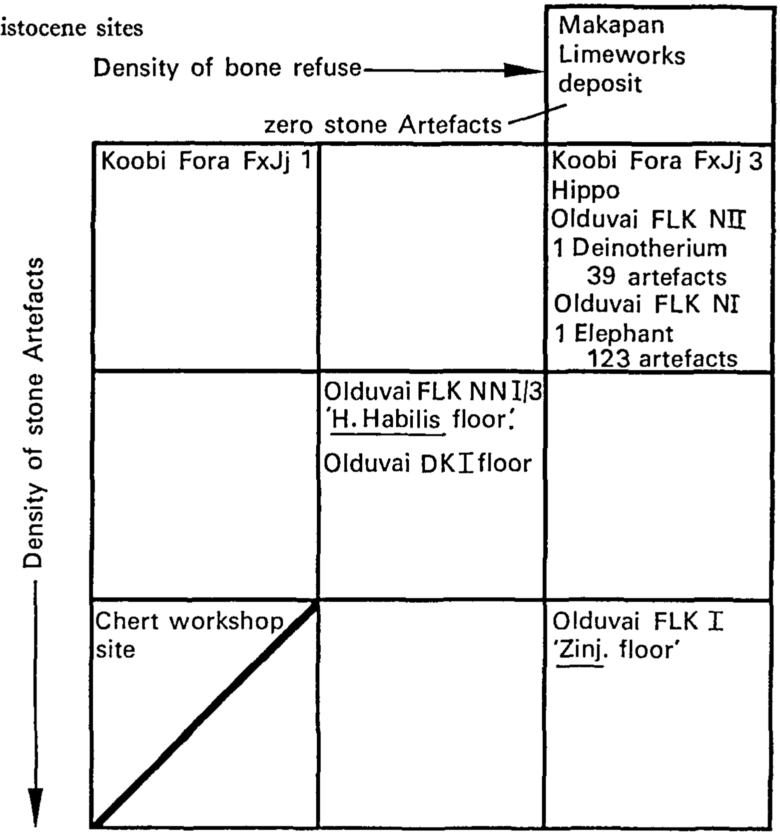
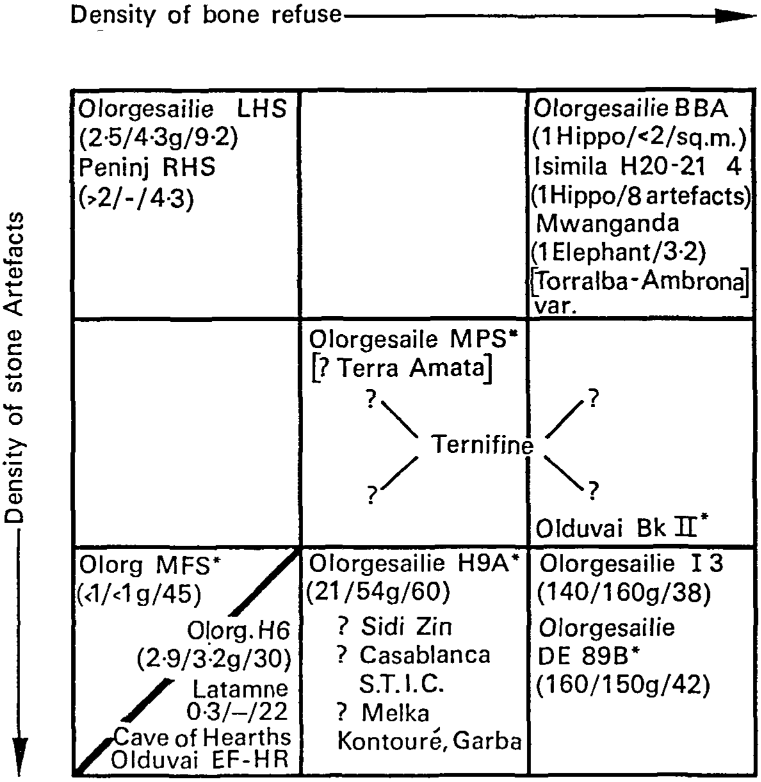


Figure 10b Lower Pleistocene sites



		Makapan Limeworks deposit
Koobi Fora FxJj 1		Koobi Fora FxJj 3 Hippo Olduvai FLK NII 1 Deinotherium 39 artefacts Olduvai FLK NI 1 Elephant 123 artefacts
	Olduvai FLK NN I/3 'H. Habilis floor' Olduvai DK I floor	
Chert workshop site		Olduvai FLK I 'Zinj. floor'

Figure 10c Acheulian and related industries associated with bone refuse



Olorgesailie LHS (2·5/4·3g/9·2) Peninj RHS (>2/-/4·3)		Olorgesailie BBA (1 Hippo/<2/sq.m.) Isimila H20-21 4 (1 Hippo/8 artefacts) Mwanganda (1 Elephant/3·2) [Torralba-Ambrona] var.
	Olorgesaile MPS* [? Terra Amata] ? Ternifine ?	? ? Olduvai Bk II*
Olorg MFS* (<1/<1g/45) Olorg. H6 (2·9/3·2g/30) Latamne 0·3/–/22 Cave of Hearths Olduvai EF-HR	Olorgesailie H9A* (21/54g/60) ? Sidi Zin ? Casablanca S.T.I.C. ? Melka Kontouré, Garba	Olorgesailie I 3 (140/160g/38) Olorgesailie DE 89B* (160/150g/42)

Sites with favourable conditions of preservation and yet with small quantities of bone relative to abundant artefacts have commonly been regarded as workshop sites. However, the settlement patterns and distance from stone outcrops sometimes indicate that stone working cannot have been the primary function of the site. In these cases it is possible either that gathered foods formed a major component of diet or that the flensing of carcasses was carried out at kill sites resulting in a minimum importation of bones.

Following this potentially depressing review of factors which may distort the archaeological record of subsistence, it is necessary to ask whether the record is after all worth considering. Given that the history of subsistence is significant for understanding human evolution, and that refuse and excreta are the firmest documents likely to be available, continual research does seem essential, and research in turn requires the review of existing knowledge and the formulation of questions. The lasting contribution of archaeology in the matter is likely to come through the demonstration of pattern amongst numbers of carefully investigated instances chosen for their individual promise. Since feeding and preservation factors will vary from case to case, in a large sample we may be able to assess the overall preservation bias, and hence reconstruct something of the realities of original subsistence patterns. Meanwhile it is clearly unwise to base important evolutionary interpretations on selected cases that happen to suit a particular interpretation.

In order to tackle the evolutionary questions already raised, it is necessary to scan the archaeological record for signs of systematic change through time with regard to the following:

1 The gross abundance of bone on sites.
2 The gross and relative abundance of bone and artefacts.
3 The range and relative proportions of different animal species represented in refuse.

The review of evidence which follows makes use of the interpretation of Pleistocene chronology previously discussed by the author (1969). Available K/Ar dates and palaeomagnetic data indicate an age of circa 2·7 million years for the inception of major glaciation and hence of the Pleistocene according to many definitions. An estimate of 1·4 – 1 million years is more tentatively put forward as the age of the arbitrary boundary between Lower and Middle Pleistocene time-stratigraphic units in East Africa. Discussion of the connotations of the culture-stratigraphic terms 'Oldowan' and 'Acheulian' as used here, is contained in the same paper.

5 *Evidence from the Tertiary*

The date of the evolutionary divergence of hominids and pongids remains a controversial question and there is certainly no direct evidence as to the diet of Pliocene hominids, or of Miocene hominids if such there were. The claim made for a significant association in the Late Miocene of an alleged hominid, *Ramapithecus* (*Kenyapithecus*) *wickeri*, with traces of tool use and the breaking of marrow bones are intriguing but require fuller documentation before they can be incorporated as evidence in any discussions (Leakey 1968).

6 *Evidence from the Lower Pleistocene*

From Africa, a series of undoubted hominid fossils spans the time from Late Pliocene (*c.* 3·5 million years) on through the entire Pleistocene. Archaeological evidence of tools and food refuse is well established from about 2 million years onward and current investigations at the Omo and the East Rudolf area are probing into earlier periods.

The only two sets of occurrences of Lower Pleistocene age that have yet been extensively investigated from a palaeo-dietary point of view are the occupation sites at Olduvai Gorge, Beds I and Lower Bed II, and the Makapansgat limeworks deposit.

At Olduvai, Dr Mary D. Leakey has carried out careful excavation and thorough analysis on an unprecedented scale. The monograph in which she reports on her work is in process of publication by the Cambridge University Press. When available, it will be a highly important source book for palaeoanthropology. The comments made here regarding the Olduvai evidence are based primarily on preliminary reviews (Leakey, L.S.B. 1960, 1961, 1963a and b; Leakey, M.D. 1967), on information acquired during visits to Olduvai and on numerous discussions with Drs L. S. B. and M. D. Leakey.

The australopithecine bearing breccias at Makapansgat have come to be regarded as important sources of evidence regarding the evolution of human diet and behaviour. (See for example Dart 1957a and b; Ardrey 1961; Tobias 1967; Howell 1965; Clark, J. G. D. 1969; Wolberg 1970.) However, through no fault of the investigators the situation is far from satisfactory; the site was largely destroyed by quarrying and the vast bone sample on which dietary and tool usage hypotheses are based, was obtained largely from the discard dumps of miners. Details of stratigraphic and archaeological context are consequently a matter in part of reconstruction and conjecture. If the australopithecines whose bones occur in the breccia were solely responsible for the accumulation of the bones then they were indeed, as Dart and Ardrey have contended, very effective carnivores. If as seems likely, they were not the sole, or even the principal cause of accumulation, then it is hard to assess directly the extent to which meat figured in their diet. Pending further studies such as those of Brain (1970) at Swartkrans, the evidence must be set aside as ambiguous.

The evidence for osteodontokeratic tool use is similarly inconclusive. The data set out by Dart and elaborated by Ardrey and Tobias proves conclusively the existence of an assemblage showing a high degree of selectivity in body part representation. The tool and weapon hypothesis was eminently reasonable when first set out, but as fig. 9*a* shows, subsequent research has demonstrated that natural and midden bone assemblages normally involve highly selective patterns of preservation and destruction of different body parts in circumstances where tool use can be ruled out as an explanation (Lubbock 1865; Washburn 1957; Brain 1967; Isaac 1967a). Certain depressed fracture, breakage and damage patterns and the jamming of bones into one another, remain as potential evidence of hominid activity, but much more systematic data are necessary regarding natural bone accumulations before decisions can be made even with regard to these features.

While the Makapansgat data do not offer satisfactory *proof* of australopithecine diet and behaviour patterns, the *supposition* that the *A. africanus* was partially carnivorous and a tool user remains eminently reasonable.

The situation at Olduvai is very different. Active hominid involvement in the accumulation of concentrated patches of bone is attested not only by the occasional presence of hominid bones amongst the others, but by the presence of numerous artefacts and artificially introduced stones. It seems certain that hominids were the prime agency creating these concentrations. The sites document a behaviour complex that is fundamentally human: tool manufacture, a partly carnivorous diet achieved by hunting and/or scavenging, and the practice of bringing meat back to a home base for sharing amongst the members of a social group. In contrast to Makapan, the problem at Olduvai camp sites is not to determine how many of the bones were introduced by non-hominid agencies, but how many may have been removed by scavengers.

Fig. 10*b* shows that Oldowan sites from the Lower Pleistocene at Olduvai (Bed I and Lower Bed II) cover almost the full classificatory range defined in fig. 10*a*. Occurrences such as the 'Zinjanthropus' level at FLK I, the DK I floor and some levels at FLK N I involve moderately high densities of both stone artefacts and bone, and therefore rank as occupation floors or camp sites. Others, such as FLK N I level 6 or FLK N II, consist of numerous bones from single carcasses (an Elephant and a *Deinotherium* respectively) and comparatively few artefacts or other bones. These can fairly be described as butchery sites (cf. Clark and Haynes 1969: 405). To complete the range, one recently discovered site in Lower Bed II was close to a contemporary chert outcrop, and has prodigious quantities of debitage with a minimum of other occupation refuse. This must be the oldest known quarry and workshop site.

Detailed consideration of the quantitative evidence for meat diet must await the appearance of Dr M. D. Leakey's monograph; however, certain features are already apparent in relation to the criteria listed in section 4:

1 Bone is at least moderately abundant on some of the Olduvai Bed I and Lower Bed II sites. How densities compare with those from the majority of Middle Pleistocene sites, remains to be determined.

2 Stone artefacts appear to be noticeably less abundant than on later sites. Compare the maximum figure of 2,659 artefacts at FLK I (Zinj) with 7,223 at BK II (M. D. Leakey 1967) or with 5–6,000 artefacts on several comparable but somewhat smaller excavated areas at Olorgesailie (Isaac 1968a: 257). The artefact to bone ratio is probably generally lower on Oldowan sites.

3 The full size range of African fauna is found in association with Lower Pleistocene Oldowan industries, but medium size antelopes and pigs preponderate numerically as they do in the fauna itself. The remains of the largest animals such as pachyderms, giraffe or buffalo, though certainly present, may be less frequent than on later sites. There is no way of telling whether the butchered elephant and *Deinotherium* carcasses at FLK N were killed or found dead. The Olduvai evidence documents an established behavioural and dietary situation that had become distinctively human by virtue of the importance of meat.

4 There are as yet no reported instances of specialized or selective accumulations of large numbers of a single species such as the *Pelorovis* herd at BK II or the numerous baboons at Olorgesailie DE/89 (see below).

Reptile, frog, bird and rodent bones appear to be better represented in Bed I than in any African Middle Pleistocene site yet reported. This may partly reflect the lakeside site preference pattern and the excellent preservation conditions. At FLK N I concentrated patches of rodent and other microfaunal bones have been found. These do not closely resemble available samples of owl pellets and some may be residues from human faeces: if so, this would demonstrate that early hominids tapped the rich protein resources of the microfauna – a practice not unknown amongst more recent peoples in arid terrain.

The only site with numerous artefacts and very low bone density is the chert quarry site already mentioned. The absence of other such sites might be used as an argument against periodic or seasonal spells of dependence on plant food, but as yet the sample of sites is too small for this to have much force.

In summary, the available evidence shows clearly that a wide range of meat foods figured in Lower Pleistocene hominid diet at Olduvai and that the quantities involved were substantial. There is at present no real way to assess the relative proportions of the total diet that accrued from gathering, hunting and scavenging. All three were probably important activities. The observations of Schaller and Lowther (1969) suggest that scavenging may only be feasible as a sole means of subsistence seasonally or in particularly favourable areas.

Research is proceeding in two areas where apparently earlier traces of hominids are preserved – namely the Omo delta (Arambourg and Coppens 1967; Bonnefille *et al.* 1970; Howell 1968), and East Rudolf (R. E. Leakey *et al.* 1970) At the Omo, hominid fossils are moderately abundant while artefacts are extremely rare, and nothing that can be called an occupation floor has yet come to light (Howell and Coppens pers. comm.). In the East Rudolf (Koobi Fora) area, artefact occurrences have been located in direct association with a tuff dated at 2·61 ±0·26 m.y. At Richard Leakey's invitation the author has commenced intensive archaeological investigation; the results of the initial excavation and survey work in 1970 suggest that at least one stratified scatter of artefacts and broken-up bone can be regarded as a low density occupation floor (Site KBS or FxJj1). Surface indications imply that a hippopotamus butchery site may also be present (FxJj3). If these preliminary results are confirmed by further work, then the Koobi Fora Formation will provide a backward extension of the known time range of the basic hominid behavioural complex of meat eating, tool making and the occupation of home bases.

7 *Evidence from the Middle Pleistocene*

Most Middle Pleistocene artefact occurrences in Africa can be assigned to the category 'Acheulian' *sensu lato* (see discussion in Howell and Clark 1963; Leakey, M. D. 1967; Isaac 1969). Fig. 10*c* depicts evidence for this period from a series of sites with a broad geographic range covering much of Africa and extending into Eurasia, where site complexes such as Torralba-Ambrona (Howell 1966), Terra Amata (de Lumley 1969) and Latamne (J. D. Clark 1966, 1967 and 1969b) provide comparable evidence for the Eurasiatic Acheulian. For the sake of comparison these sites are indicated on the chart in parentheses. Choukoutien, Vértesszöllös and Lehringen are important contemporary non-Acheulian sites with bone refuse, but they are not shown.

At present the various Olorgesailie sites comprise the largest single corpus of associations between Acheulian industries and bone refuse. Investigations at Olorgesailie were begun in 1942 by Louis and Mary Leakey (L. S. B. Leakey 1952), and continued by Posnansky (1959) and Isaac (1966a and b, 1968a). A comprehensive report has been compiled as a thesis and though unpublished, is available (Isaac 1968b). A monograph is in preparation. Unfortunately at two of the other major site complexes in Africa, Kalambo and Isimila, bone is scarcely preserved owing to unfavourable geochemical conditions (Howell and Clark 1963). Olduvai Gorge Bed IV can be expected to provide much critical evidence when current studies by Dr M. D. Leakey have been completed. The studies of Melka Kontouré also are still incomplete (Chavaillon 1967). Quantitative data are available only for Olorgesailie, the Natron sites (Isaac 1967b), some of the butchery sites (Clark and Haynes 1969), Torralba-Ambrona (Howell 1966, Freeman and Butzer 1966) and Latamne (J. D. Clark 1966, 1967, 1969b). The chart indicates these quantities as densities of bone by fragment number, and weight if available, and of artefacts by number, per square metre. Probable relative positions have been guessed for other important published sites even when quantitative data are not available. This is clearly unsatisfactory, but has been done to illustrate ways of thinking about the existing data and to stress the advantages of securing quantitative data in future. Fig. 10*c* makes it clear that there is wide variation with regard both to the gross and relative abundance of bone on Acheulian sites. At some there is spectacular evidence of success in hunting.

The Torralba and Ambrona elephant butchery grounds are by far the most impressive of such sites, but the *Pelorovis* remains at Olduvai BK II (Leakey 1957) and the mass of baboon bones at Olorgesailie DE/89 B are also notable in this regard. However, even when allowance has been made for distortions due to scavengers and poor preservation, it does appear that most Acheulian sites contain comparatively modest amounts of bone. Some, such as Latamne, Olorgesailie H/6, and the Cave of Hearths, contain only minor amounts of bone in spite of apparent favourable conditions for preservation.

If the spectrum of variation in bone abundance is confirmed by further research, it might indicate that the great variation also seen in the meat component of the diet of recent non-agricultural peoples has in fact been a consistent pattern throughout much of human evolution. Modern variation can be related within one culture to seasonal factors and to opportunism, and between cultures to technological and eco-geographic factors. Presumably the Middle Pleistocene variation was scarcely less complex.

Returning to the specific points set out in Section 4:

1 Despite the great range of variation, the maximum values for gross densities of stone artefacts, and possibly also of bone refuse are apparently higher than in the Lower Pleistocene.

2 The full size range of African macro-fauna is represented on Acheulian sites, the medium size bovids and the equids being usually preponderant. No African sites yet document extensive exploitation of micro-fauna, but this might be a consequence of poor preservation. Rodent remains are numerous in the rich faunal assemblages of the non-Acheulian, Middle Pleistocene site of Vértesszöllös (Vértes 1966).

3 Sites such as Ternifine, Sidi Zin, Casablanca S.T.I.C., Olorgesailie H/9 A and I 3, and the Cave of Hearths show a fairly generalized bag of species, but as already mentioned, two African sites and one European site are notable for the concentrated remains of one or a few species. These occurrences, detailed below, are of special interest for the light they throw on hunting methods and socio-economic organization; they are also the oldest cases for which scavenging can definitely be ruled out as the source of the meat and bone.

(*a*) At Olduvai BK II erosion and excavation exposed a transect across a broad channel (Leakey, L. S. B. 1957; Leakey, M. D. pers. comm.). Occupation in the vicinity was probably recurrent and abundant artefacts and broken-up bones are distributed through the channel fill deposits. One bed of clay appears to represent a backwater or swamp and in it were found partially articulated remains of a number of ungulates, especially the extinct large bovid *Pelorovis*. In one case the lower extremities of all four limbs were found standing upright while the upper part of the carcass had been removed. The conformation of the remains and the presence of broken-up bones of the same forms in the refuse is strongly suggestive of drives on one or more occasion, of ungulate groups into the morass where they could be killed and butchered.

(*b*) At Olorgesailie one major site, DE/89 horizon B, contained the comminuted remains of at least 40–50 adult and 13 or more juvenile baboons of the extinct robust species *Simopithecus oswaldi*. More than a thousand identifiable teeth and bones, plus 15 kilograms of bone splinters lay amongst a super-abundance of handaxes and other artefacts. (Isaac 1968a and b; 1969).

(*c*) At Torralba and Ambrona in central Spain there are preserved at several horizons stratified relicts of former swampy valley floor surfaces. These must frequently have been dotted with dismembered animal carcasses and the sparse artefactual refuse of the Acheulian men who butchered them (Howell 1965, 1966; Freeman and Butzer 1966). Elephants predominate, but rhinoceros and various large ungulates are also represented. It seems probable that this was an area where animals could comparatively easily be waylaid and driven into swampy ground to facilitate killing and butchering, perhaps during seasonal migrations.

The remains at each of these three sites appear to indicate effective hunting practices that involved comparatively large groups of men in drives or in encircling movements. BK II and Torralba are probably of broadly similar age (early Middle Pleistocene); being somewhat older than Olorgesailie DE/89, they are the oldest positively documented cases of co-operative hunting. The elephant and hippo carcasses at FLK N I and II may conceivably have been scavenged rather than killed.

It is not clear whether the use of group hunting techniques was a new development and whether it led to meat becoming an abundant dietary staple during the Middle Pleistocene. The Olorgesailie and Olduvai instances may well document only occasional opportunism. The Torralba evidence clearly indicates regular repetition, but even this may have been of a seasonal character. It is of interest that this site complex, which is by far the most spectacular known instance of hunting success in the Middle Pleistocene, was occupied under cold temperate conditions.

The greatest resolution of behavioural detail yet achieved in the study of a Middle Pleistocene site is modestly claimed in a preliminary report on Terra Amata, a locality in France, near Nice (de Lumley 1969). Eleven superimposed levels separated from each other by thin drifts of sand, are thought to represent brief spring occupations in 11 successive years. Bone remains document deer as the major quarry, followed by elephant, boar, ibex, rhino and aurochs. Rabbits and other rodents are represented. Small numbers of marine shells and fish bones are present. Fossil human faeces were found, but only the presence in them of pollen indicating spring occupancy is reported so far.

8 *Comparisons between the Middle and Upper Pleistocene*

Studies of African Upper Pleistocene material have tended to retain culture-historic and technical preoccupations; consequently we have no corpus of Middle and Later Stone Age sites excavated in the manner of Olduvai, Olorgesailie, Isimila or Kalambo. Various current research projects are geared towards rectifying this deficiency, but meanwhile some points of interest can already be discerned:

1 Most African Upper Pleistocene and Holocene sites that have been excavated are cave sites. The abundance of bone varies but is in general probably low by European Upper Palaeolithic standards.

2 At least two open air L.S.A. sites are now known where the absolute densities of bone and artefacts far exceed the known African Lower and Middle Pleistocene range. Neither is published. Recent excavation by C. M. Nelson, on a late Kenya Wilton site near Longs Drift in the Eastern Rift Valley, revealed a bone and artefact accumulation

where the estimated maximum density approaches 50,000 items per cubic metre (see Isaac *et al.* unpublished 1970). This value may be higher than any Lower Palaeolithic values from Africa by a full order of magnitude; though photographs and descriptions suggest that some of the floors at Vértesszöllös in Hungary may show comparable high densities (Vértes 1966). Preliminary descriptions of the Gwisho Springs sites in Zambia indicate similar very high densities (Gable 1965, Fagan and Van Noten 1966, Fagan pers. comm.). These higher densities are probably due to more sedentary habits rather than radical changes in hunting efficiency and diet.

3 Shell middens and evidence of communities that were extensively dependent on aquatic foods are of wide occurrence in the Late Pleistocene and Holocene, but corresponding traces are unknown from Lower and Middle Pleistocene deposits. Fish and frog bones do occur on some African sites (e.g. Olduvai and Olorgesailie), but it is not always clear whether they derive from food refuse or are natural components of the waterside sediments. Minor quantities of fish bones and shell are reported as dietary traces at the Acheulian site of Terra Amata in France, but they do not appear to have been important gathered foods in spite of the proximity of the sea (de Lumley 1969). Similarly, in spite of the proximity of many stratified Acheulian sites to former shore lines at Casablanca, there is no evidence of any shell middens (Biberson 1961). The available evidence seems to indicate that during the Upper Pleistocene the range of human subsistence patterns was expanded amongst other things by localised extensive exploitation of aquatic resources. In cold temperate and sub-arctic Eurasia, hunters may well have reached new levels of predatory efficacy and dependence on meat, while in much of the tropics, more generalized subsistence patterns persisted.

9 *Geography and Settlement patterns*

Gross geographic distributions clearly do not give very precise palaeo-economic indications. In Africa, known Lower and early Middle Pleistocene sites are confined to relatively dry regions, where subsistence by hunting and/or gathering is feasible, to judge by the contemporary examples of the Bushmen and Hadza. The distribution of late Middle Pleistocene Acheulian industries covers all of the African grasslands, savannahs and much of the woodland, but not extensively forested areas. This again is at least consistent with the variable, generalized hunting-gathering pattern envisaged for this time span in the tropics and warm temperate areas.

Various patterns are also beginning to emerge with regard to preferred locations for Pleistocene camps; for example, the Oldowan camps in Bed I and Lower II were all in lakeside flood plain situations, while Acheulian camps are generally away from the lake shores and along the courses of seasonal streams. When these patterns are known in more detail, they may help to correct the distortions due to excessive reliance on the bone refuse record, by indicating the various eco-types that communities consistently sought to exploit. Considerable micro-environmental diversity is already apparent: for instance, the Olduvai and Natron basins included salt and fresh water bodies, lake-side flood plains arid steppe, stream courses presumably with riverine bush, and forest clad volcanic mountains.

Conclusion

This review has been concerned almost exclusively with direct archaeological evidence for hominid diet, partly because, incomplete though it may be, this is likely always to be the most definite class of evidence available, and partly because the evidence has in recent years sometimes been abused. Various points with regard to human evolution and human nature have been backed by citation of *selected* items of archaeological evidence, whereas in spite of its manifest imperfections, the implications of the whole corpus of archaeological data ought to have been considered.

Given the initial evolutionary proposition that man is descended from an ancestral stock that was much less extensively carnivorous, questions can fairly be asked as to whether archaeology documents initial stages in the evolutionary shift. This is not yet entirely clear, but available data suggests that at the outset of the known archaeological record, *circa* two million years ago, at least some hominids had a significant meat component in their diet. Investigations of the evolutionary antecedents of this situation should be fascinating, but localities have only recently been found where such studies can even be attempted.

Two recent studies of human evolution by B. Campbell (1966) and J. Pfeiffer (1969) suggested that the Lower Pleistocene could be characterized as a small game hunting phase while during the Middle Pleistocene a big game hunting phase led to the acceleration of mental, linguistic and social evolution. This is probably an over-simplification. Even during the Lower Pleistocene, the bones of big game animals are to be found in hominid refuse, though there may have been an increase in the proportion of large quarry during the Middle Pleistocene. Equally, while it is true that the first indications of effective co-operative hunting on a large scale are of Middle Pleistocene age, the sample of sites from the Lower Pleistocene is so small that the absence of a known instance is of uncertain significance.

The view is presented here that in Africa, which may well be representative of tropical and warm temperate regions in general, hunting has seldom if ever been 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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Abstract

Isaac, G. Ll.

The diet of early man: aspects of archaeological evidence from lower and middle Pleistocene sites in Africa

Evidence for Palaeolithic diet is critically reviewed, especially that from African sites. Methods of evaluating it, and some of the resulting socio-economic conclusions, are examined. Hominids, although their ancestral stock was largely vegetarian, have evolved so as to include more protein in their diet; its importance has varied, apparently increasing by latitudinal gradations from equator to pole. Flexible joint dependence on animal and plant foods, establishment of home bases, food sharing, and differentiation of the subsistence activities of the sexes, together constitute an integrated behavioural complex already partly established some two million years ago. Large animals are certainly represented in Lower Pleistocene food refuse; they become commoner in the Middle Pleistocene, when evidence for effective co-operative large-scale hunting also first occurs. Other Middle and Late Pleistocene developments, some dependent on the increased geographic range of hominid settlement, are briefly reviewed. In Africa, hominid subsistence was probably broadly based throughout the Pleistocene.