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Man-Land Relationships of Acheulian Hunter-Gatherers

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TOOLMAKING TRADITIONS OF THE EARLY AND MIDDLE PLEISTOCENE

The primary record of prehistoric man during the long span of mid-Pleistocene time is provided by stone artifacts. The earliest standardized toolmaking tradition known today is represented among the middle and upper strata of Bed II at Olduvai Gorge (M.D. Leakey, 1967). The most notable implements, which are replicated in considerable numbers, are hand-axes. These are made from large flakes or pebbles, on which a significant portion of the circumference has been trimmed from two surfaces to produce a sharp edge. Trimming usually extends far back from the edges of such tools and often covers most or all of both opposed surfaces. As a consequence, hand-axes are frequently known as "bifaces" (= two-faced implements). Generally, when a hand-axe is viewed in plan, one end will be relatively pointed (see Fig. 66, [1 and 2]), while the other (called the "butt") may be rounded and sometimes completely unworked. Most hand-axes are easily recognized as man-made artifacts, and have therefore been subject to uncontrolled collecting for almost a century. For better or for worse these implements have become the index fossil of the Lower Paleolithic of Europe, and of the Earlier Stone Ages of Africa and India. It is, in fact, common to speak of "hand-axe industries," almost all of which are generally grouped within the Acheulian "culture" or—better—industrial tradition.

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It is not hard to imagine how gradual change through time in the extent to which a stone knapper modified a pebble or large flake would have led to the development of hand-axes by populations whose ancestors had made simpler Oldowan "choppers" and "chopping tools" on pebbles. In fact, there are pieces from Sterkfontein which could be regarded either as particularly elaborate chopping tools or as very crude hand-axes (R.G. Klein, unpublished). In this sense, the Acheulian can be considered a logical outgrowth of the Oldowan. While Oldowan toolmakers simply modified the circumference of pebbles in their efforts to produce a tool, Acheulian craftsmen usually completely transformed pebbles, chunks, or large flakes so that it is now often impossible to determine on what kind or shape of object a finished hand-axe was made. In addition to hand-axes, distinguished generally by being more or less pointed at one end, Acheulian knappers also made another basic kind of biface, called a "cleaver" (Fig. 66, [8]). The essential element here is an axe-like straight edge at the end where a point might be expected on a hand-axe. The major use of hand-axes and cleavers appears to have been as mattocks and flensers for removing hide, cutting ligaments, parceling meat, and removing flesh from the bone or hide of large game (J. D. Clark, 1960). Hand-axes could be used specifically to pierce hide, while cleavers were more suited for general chopping purposes or for hacking through or prying apart the joints of large animals.

The chips or flakes trimmed from bifacial tools were commonly detached by striking the rock face, from an angle, with a suitable stone "hammer" or a piece of bone or wood. The latter provides a "soft" hammer particularly useful for the fine trimming of cutting edges. Some of the intact or battered, shapeless stones at Acheulian sites probably pertain to such hammer-stones, or may have been otherwise employed as missiles or as general chopping and pounding equipment. The diverse flakes, formed as a by-product of biface preparation, were frequently employed as tools, with or without a little edge-trimming or retouch. Depending on their shape, flakes could be held in the hand and used as a scraper (see "side-scraper," Fig. 66, [7]) or chisel (see "end-scraper," Fig. 66, [6] to remove meat from hide or bone. Notching a flake (Fig. 66, [4]) can also produce a notch or hook of possible use for trimming hide or wood. Whether stone tools were also used to secure vegetable food is quite uncertain.

The Acheulian of East Africa ranges in time from Olduvai middle Bed II, perhaps 500,000 or even 1 million years ago,[1] to about 60,000 B.P. at

1. The single K/Ar date from upper Bed II (0.5 million years) is unacceptable since sample provenance is uncertain (R. L. Hay, personal communication), while the 1.1-million-year date from lower Bed II may represent a contaminated sample from Bed V (Hay, comments on Evernden and Curtis, 1965).

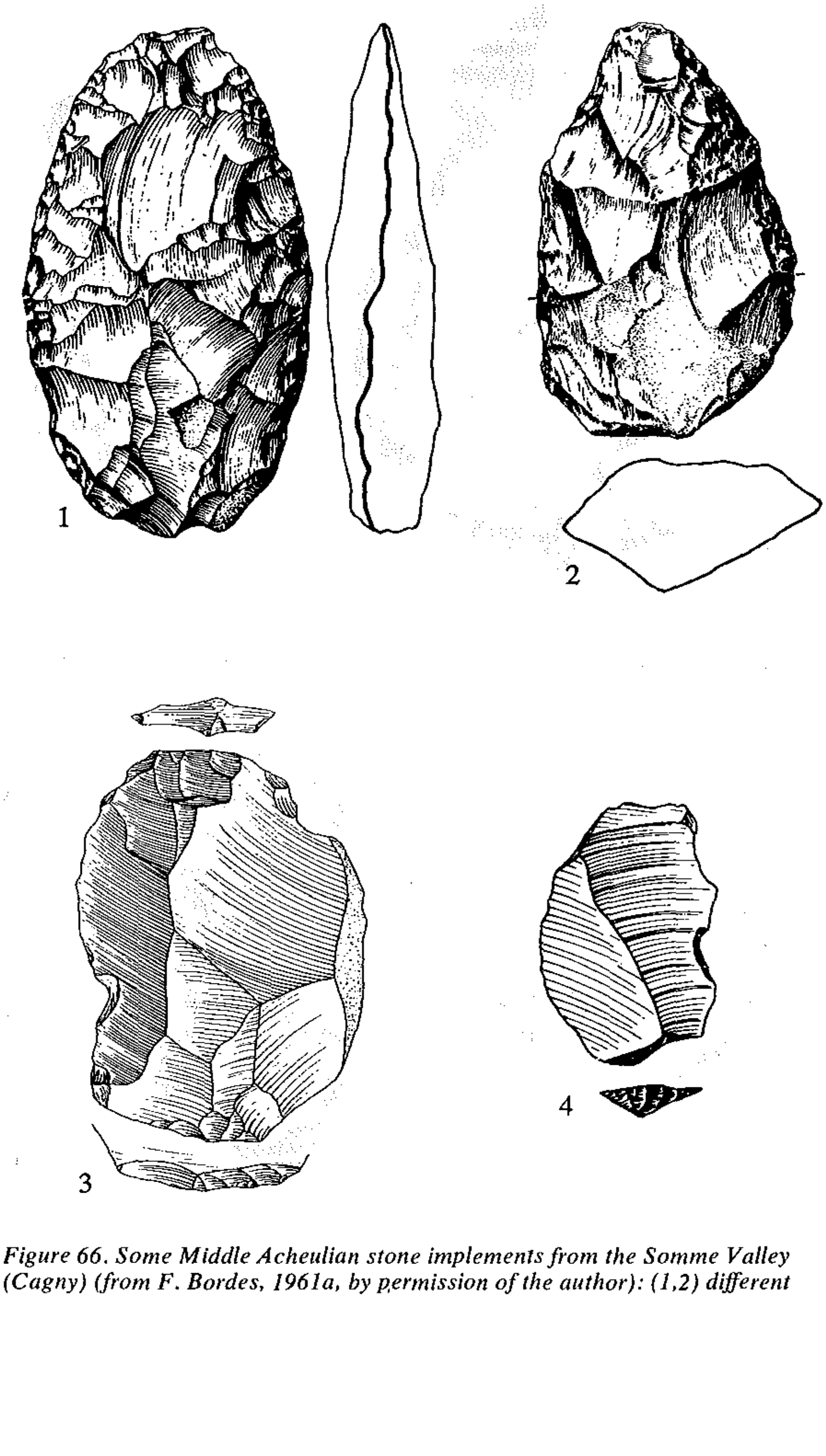
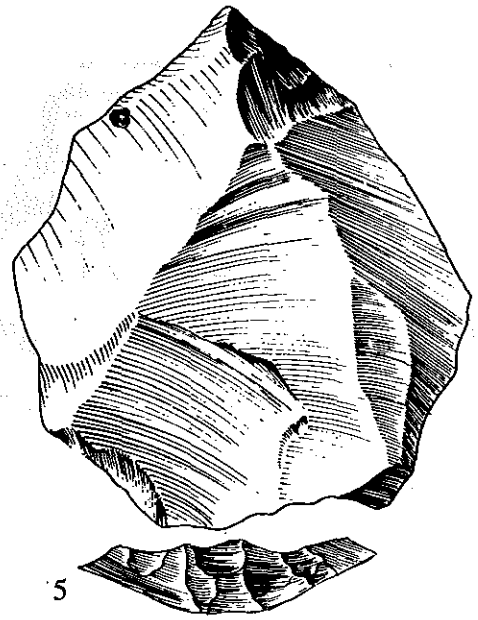


Figure 66. Some Middle Acheulian stone implements from the Somme Valley (Cagny) (from F. Bordes, 1961a, by permission of the author): (1,2) different



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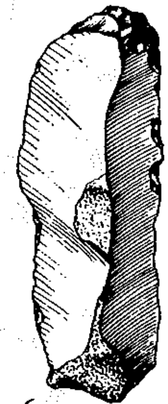

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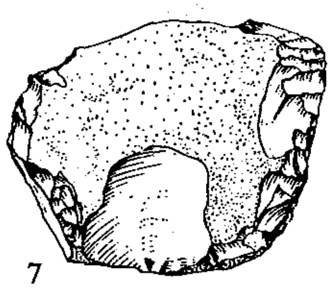

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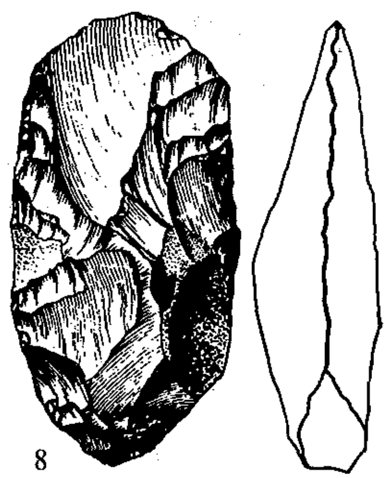

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bifaces or "hand-axes," (3) flake, (4) notched flake, (5) core, (6) end-scraper, (7) side-scraper, (8) cleaver. (Reduced to one-half natural size.)

Kalambo Falls J. D. Clark, 1969). In Europe the Acheulian is first recorded from Elster-age deposits and lasted through the Eem Interglacial. To be sure, there are developments through time. Bifacial tools tended to become more sophisticated and were frequently characterized by fine symmetry in plan and cross-section. At some point in time the soft-hammer technique was also invented. Nonetheless, hand-axes with unprepared butts or with irregular and assymetrical shapes continued to be made in all Acheulian workshops, often side by side with handsome, blade-thin pieces. Frequently the absence of attractive bifaces was a result of the absence of suitable raw material: extremely hard rock may only fracture under very heavy blows, while the fractures of many rocks with geometrical jointing or fracture lines cannot be fully controlled by the workman.

Consequently, the presence or absence of refined bifaces is *not necessarily* a reflection of temporal development. On the other hand, one trend that does seem to have been more or less universal within the Acheulian was an increasing emphasis on flakes as time passed. Eventually, an elaborate variety of tools came to be made of flakes. This increasing reliance on flakes led to an increased sophistication in the techniques whereby flakes were produced. In the earlier Oldowan, most flakes, whether used or not, were probably simply by-products of the manufacture of other tools. Already in the late Oldowan and early Acheulian, however, flakes had come to be specially produced from pieces that we call "cores" (Fig. 66, [5]). Cores were used principally for the production of flakes, and whether or not an "exhausted" core was later used as a tool was in most cases incidental to its initial purpose. In the middle and later Acheulian, a major innovation was the preparation of a core in such a way that the size and shape of a flake struck from it were predetermined (see Fig. 66, [3] for a flake struck from a prepared core of "Levallois" type). Sophisticated prepared-core techniques were particularly prominent in Europe during the later Middle Pleistocene and thereafter, but were also present in Africa.

In general, then, there is evidence to suggest that the Acheulian changed through time. At this stage in our knowledge, however, it would be dangerous to generalize on this any further. Thus, while Howell (1966), Bordes (1968), and Collins (1969) believe that they can trace the detailed evolution of the Acheulian in Europe, Isaac (1968b, 1969) has so far been able to distinguish only two main stages of the Acheulian in East Africa.

The almost incredible time-span of 500,000 years or more for the Acheulian industries is matched by a distribution over three continents, from South Africa to England, and from Morocco to India. Apparent stylistic elements, such as biface size or shape, e.g., almond, pear, twisted, lanceolate, ovate, etc., remain enigmatic in terms of interpretation, and no systematic variation through either space or time has yet been demonstrated. Possible functional attributes, such as the frequency and diversity of flake tools, also show more variation among contemporaneous or sequential occupations in one area than on an interregional basis. As a result, it is difficult to subdivide the geographic continuum of Acheulian industries. Regional variants appear to be present in northwestern Europe, where typical cleavers are very rare, and on the Indian subcontinent, where non-Acheulian components are prominent (see below). But throughout Africa, Spain, and the Near East there is an amazing continuity of traditions.

The Acheulian is not the sole industrial tradition of the mid-Pleistocene. Oldowan craftsmanship was still practiced at Olduvai, throughout the deposition of Bed II, and Mary Leakey (1967) assumes the coexistence of two distinct industrial traditions with a limited, but nonetheless discernible, degree of contact with one another. It is just as possible, however, that assemblages both with hand-axes and without them were left by people of the same culture. Similar precursors of Oldowan type, possibly also representing archaic survivals, are recorded in the Sterkfontein and Vaal valleys (see chapter 25, and Mason, 1963) as well as in western Morocco (Biberson, 1961b). Of a rather different nature are the non-Acheulian traditions evident along the peripheries of Acheulian distribution in Europe and Asia (Fig. 67). So, for example, the Elster-age Buda industry of Vertésszöllös, near Budapest, has a very low proportion of shaped tools, and even these are rather unimpressive (see Kretzoi and Vertes, 1965; also Howell, 1966). Apart from a good number of small, well-flaked, scraper-like flakes, there are many small choppers and chopping tools, pieces on which trimming was much less extensive than on hand-axes and cleavers. Of comparable or greater age are possibly similar industries in Czechoslovakia (Stranska) and southern France (Vallonnet). Hand-axes and cleavers are also absent from the important, Holstein-age Clactonian industry and its Saale-age offshoots in western Europe (see Howell, 1966; and Collins, 1969). Here the emphasis is on flake-tools, many of them originally produced by smashing pebbles against large rocks. Chopping tools are of less and less importance.

Equally significant are the non-Acheulian industries of eastern and southern Asia (see Movius, 1943, 1948, 1955; Heekeren, 1957). These are now known from northwest India (Soan), central Burma (Anyathian), northern (and southern?) China (Choukoutienian), Malaya (Tampanian), and Java (Patjitanian). These industries are characterized principally by choppers and chopping tools. Choppers have cutting edges flaked from one side (direction) only, while the edges of chopping tools are struck from two sides (directions). One or more edges may be worked, and an occasional example even approaches a hand-axe in its general appearance. No purpose would be served by calling these artifacts hand-axes, however, since they are clearly part of another spectrum of artifactual variability than that containing the true hand-axes of contemporary Europe and Africa. In addition to choppers and chopping tools, the non-Acheulian industries of Asia were characterized by a variety of other large tools (e.g., pieces called "hand-adzes") and by flake tools. Geological evidence suggests that the general chopper/chopping-tool tradition characterized eastern and southeastern (and possibly central) Asia during the early and middle Pleistocene, persisting well into the late Pleistocene.

The origins of the Eurasiatic chopping-tool traditions is quite obscure, as are their mutual interrelationships. Equally enigmatic is the nature of interaction between contiguous populations practicing Acheulian and non-Acheulian industrial traditions, and there is the possibility that in some cases Acheulian and non-Acheulian assemblages may have been left behind by one and the same people doing different things at different sites. A crucial study area will be the Indian subcontinent, where both traditions overlap. In the Narmada Valley, where both are found together, chopper-chopping tools are found only in a stratigraphic context older than the Acheulian (A. Khatri, personal communication). In fact the Indian Acheulian seems relatively late and may well have displaced an older chopping-tool tradition.

FOSSIL REMAINS OF MID-PLEISTOCENE MEN

A number of localities have produced early and middle Pleistocene strata with human fossils, some of them associated with artifacts of either the hand-axe or chopping-tool traditions. These fossils are best referred to the genus ***Homo,*** and they appear to represent the general stock ancestral to modern man. However, variability is so great that, with the rather sporadic and incomplete fossil record, more questions are raised than are answered. Certainly the evidence does not warrant the mass of generic names that has been applied to each fossil, nor does it support a generic distinction from later human types (see Howell, 1960). But even the differences among some contemporary fossils is so great that subspecific or specific distinctions may be necessary. So, for example, the Elster-age hominines from Heidelberg and Vertésszöllös are more advanced than those from Ternifine or Java. However, we should expect at least as much geographical variation among early or mid-Pleistocene men as among populations of modern man. For this reason a number of authors prefer to place all fossils of Lower Pleistocene age into a single taxon, *Homo erectus* (see Howell, 1960). *Homo sapiens,* as represented at Swanscombe and Steinheim, appears to have developed out of *Homo erectus* at or near the beginning of the Middle Pleistocene. It is of course possible that the *sapiens* threshold was crossed earlier in some places than in others, perhaps earliest of all in Europe, as appears to be suggested by the remarkable *sapiens*-like fragment from Vertésszöllös.

Some of the more important localities with early hominid remains can be listed here (see Fig. 67) in stratigraphic order, with their identification—often tentative—and, in quotation marks, their superfluous generic or descriptive names:

A. Early Lower Pleistocene
   a) Olduvai; upper Bed II. *Homo* cf. *erectus* ("Chellean Man") and one or more australopithecines.
   b) Swartkrans. *Homo erectus* ("Telanthropus") (see Clarke *et al.,* 1969) and *Australopithecus robustus.*
   c) Sangiran and Modjokerto, Java; Djetis fauna. *Homo* cf. *erectus* ("Meganthropus palaeojavanicus") and *Homo erectus* ("Pithecanthropus") (see Tobias and Koenigswald, 1964).

B. Late Lower Pleistocene
   a) Heidelberg-Mauer, Germany. *Homo cf. erectus* ("Palaeanthropus"), of post-Cromerian but pre-Elster age (see Howell, 1960).
   b) Vertésszöllös, Hungary. *Homo* cf. *sapiens* of Elster age (see Kretzoi and Vertes, 1965).
   c) Ternifine, Algeria. *Homo erectus* ("Atlanthropus") see Howell, 1960).
   d) Koro Toro, Chad. *Homo* cf. *erectus* ("Tchadanthropus"), a poorly preserved fossil of uncertain age (see Tobias, 1968).
   e) Sangiran and Trinil, Java; Trinil fauna. *Homo erectus* ("Pithecanthropus") (see Koenigswald, 1949, 1968).

C. Uncertain, early to mid-Pleistocene
   a) Olduvai; Bed IV. *Homo erectus* (see Leakey, Tobias, and Isaac, 1967).
   b) Choukoutien I, near Peking, China. *Homo erectus* ("Sinanthropus Pekinensis") of Holstein age or from an earlier interglacial or interstadial (see Chang, 1968; Kahlke, 1968).
   c) Lantian, China. *Homo erectus* ("Sinanthropus lantianensis"), of Holstein age or more probably from an earlier interglacial (see Kahlke, 1968).

D. Early Middle Pleistocene
   a) Swanscombe, England. *Homo* cf. *sapiens* of late Holstein age (see Howell, 1960).
   b) Steinheim, Germany. *Homo* cf. *sapiens* of late Holstein age (see Howell, 1960).
   c) Montmaurin, France. *Homo* cf. *sapiens* of late Holstein or Riss interstadial age (see Howell, 1960).

E. Late Middle Pleistocene
   a) Rabat and Sidi Abderrahman (Littorina Cave), Morocco. *Homo* cf. *sapiens,* of early post-Tyrrhenian I age (see Howell, 1960; Biberson, 1961a, 1961b).
   b) Lower Omo Basin, Ethiopia; Kibish Formation, Member I (130,000 B.P.?). *Homo sapiens* (Butzer, Day and Leakey, 1969; Butzer, Brown and Thurber, 1970).

Omitted from this list are the primitive *Homo sapiens* from Kanjera and Kanam (see Tobias, 1968) on the shores of Lake Victoria. Although originally supposed to be of early or mid-Pleistocene age, they may well be early Upper Pleistocene.

A survey of these fossils—of their specific attributes and localities as well as their industrial associations—shows that few biological generalizations can be made for the carriers of the different tools. The Acheulian at Swanscombe is associated with a proto-*sapiens* fossil, while *Homo erectus* appears to be related to the earlier hand-axe industries of Olduvai and Ternifine. The nonbiface industries of Europe may possibly have been associated with proto-*sapiens* types, while at least the earlier chopper/chopping-tool industries of eastern Asia were clearly the work of *Homo erectus*. On the other hand, it is also possible to infer that, during the early Pleistocene, *Homo erectus* made Acheulian artifacts in Africa and Europe as well as non-Acheulian (chopper/chopping tool) artifacts in eastern Asia. In mid-Pleistocene times, early *Homo sapiens* continued the Acheulian tradition in Europe and Africa, and there is as yet no compelling reason to suppose that the makers of the mid-Pleistocene variants of the Asian chopper/chopping-tool tradition were not also members of the modern species. At the moment, there simply are too few human remains in suitable archeological contexts to resolve the problem of the biological identity—if any—of the Acheulian craftsmen.

FURTHER EVIDENCE OF ACHEULIAN TECHNOLOGY

Many Acheulian sites have provided cultural items other than stone tools.

In addition to stone, bone and wood were widely employed for artifactual purposes. Although comparatively rare, worked bone and wood have usually been found at well-excavated sites that do favor bone preservation. In the Elster-age Acheulian occupation horizons of Torralba and Ambrona, there are substantial quantities of bone with clear evidence both of deliberate fashioning and trimming and of use, such as scratches, polish, and wear (Biberson and Aguirre, 1965). In particular, the persistent patterns of bone-splitting have been duplicated by modern experiments, using hand-axes and fresh elephant bone. The Torralba evidence shows that long bones and ribs of various larger animals were deliberately fractured longitudinally down the center. The resulting fragments were often flaked by use of a hammer, producing some tool types analogous in shape to picks, hand-axes, or cleavers. Other implements find no analogies among stone artifact assemblages and may have had functions not duplicated by any stone tools. It seems that bone-working at Torralba and Ambrona was a consequence of the local scarcity of good raw material for stone implements. However, worked bone has also been found on the Acheulian living-floors of Bed II at Olduvai Gorge (M. D. Leakey, 1967).

An increasing number of wood implements has come to light in recent years, although wood preservation is usually poor from early and mid-Pleistocene time ranges. Perhaps the most interesting collection was made at Torralba, where several pieces of pine wood with various shapes show clear evidence of cut marks, trimming, or sharpening. The pointed pieces are suggestive of offensive weapons. More convincing evidence of wooden spears is available from the Eem-age site of Lehringen, where a 2-meter spear, made of yew, was found between the ribs of an elephant. It is quite possible that the meager record of offensive weapons is a result of the widespread use of wooden implements such as spears, clubs, or throwing-sticks. Wooden sticks or bone fragments may also have been used to dig for roots or bulbs of wild vegetables, and a number of obliquely truncated and pointed sticks from the early Würm site of Kalambo Falls, Zambia, probably belong in this category.

The use of fire is already recorded by charred bone at Vertésszöllös (Kretzoi and Vertes, 1965), by several good hearths at a cave near St. Estève in southeastern France, and by charcoal fragments, carbon, and charred bone at Torralba (Howell, 1966), each of these sites dating from the Elster. The early use of controlled fire through much of middle latitude Eurasia is further suggested by abundant hearths at Choukoutien (Holstein age or earlier) (see Oakley, 1961). This practice seems to have spread slowly into warmer latitudes, and may possibly have remained unknown in Africa until late Pleistocene times (J. D. Clark, 1960). Whether or not mid-Pleistocene man knew how to use fire as a hunting device remains unknown.

Other technological information is provided by structures commonly interpreted as simple shelters. Already in Bed I at Olduvai Gorge there is a circle of loosely piled lava blocks which appears to have been artificially constructed (M. D. Leakey, 1967). A similar interpretation must be given to a linear arrangement of elephant bones and rocks at Ambrona (Howell, 1966), and stone circles from Acheulian sites in Nubia and Syria also suggest structures. More impressive are arrangements from the Holstein-age (early Tyrrhenian I), Acheulian site of Terra Amata, at Nice (de Lumley, 1967, 1969a). A number of structures, interpreted as huts, are indicated by: *(a)* imprints of a series of stakes, each averaging about 8 cm. in diameter, that were driven into sand to form the walls of a shelter; *(b)* lines of stones, paralleling the stake imprints, and occasionally stacked one on the other, apparently to brace the walls of the shelter; and *(c)* impressions of thick posts along the central axis of the structures. Floor plans range from 8 to 15 m. in length and 4 to 6 m. in width, and the oval floors are covered with organic matter, ash, artifacts, and waste flakes. A similar but less convincing structure is indicated within the nearby Lazaret cave, apparently occupied during late Riss time (de Lumley, 1969b). In a later time range, ca. 60,000 B.P., a rough arc of intentionally placed stones at Kalambo Falls, Zambia, may also have formed the base of a wind shelter (J. D. Clark, 1960). From this fragmentary evidence, it nonetheless seems abundantly clear that mid-Pleistocene men knew how to construct windbreaks and other crude shelters in open situations as well as within caves. The fact that such structures are not represented at all sites suggests that they were only assembled when weather made them necessary and, possibly, where longer periods of occupation were contemplated.

The sum total of Acheulian technology is simple and perhaps rudimentary, but the available data serves to show how biased and unrepresentative stone tools are as an index of prehistoric culture.

ACHEULIAN CULTURE VERSUS TECHNOCOMPLEX

Comprehensive studies of the European Lower Paleolithic or of the African Earlier Stone Age invariably emphasize the low degree of systematic cultural differentiation in mid-Pleistocene assemblages. Isaac, in particular, has shown that there are few apparent long-term trends of change in the Acheulian of East Africa (Isaac, 1968b, 1969). Instead, the great variability of samples that are close together in time shows that these long-term trends account for an insignificant part of the over-all diversity of Acheulian craft norms. A similar case could be made for geographical variation, namely, that variation within one ecologically defined region is at least as prominent as variability between regions or even continents.

In view of the apparent homogeneity of Acheulian artifact assemblages through time and space, one may ask to what extent the Acheulian was *a* culture or culture complex. As Bowman (1971) points out, many archeologists have explicitly or implicitly defined a "culture" as an assemblage of material objects (so, for example, Childe, 1956, p. 123). In fact, Grahame Clark (1957, p. 169) feels that criteria reflecting choice or style are more reliable for defining prehistoric cultures than criteria influenced by ecological or economic factors. If this view were accepted, then the Acheulian could be identified as *a* culture that persisted over 500,000 years and spanned two and a half continents (Bowman, 1971). In terms of our contemporary understanding of the stability and dispersal of identity-conscious sociocultural groups, this would, of course, be absurd. The problem remains to find a reasonable interpretation for the apparent homogeneity of Acheulian industries. Two approaches appear profitable in this regard.

It is quite possible that different groups with Acheulian traits did in fact have specific ecological adaptations, and that their sociocultural patterns varied far more than their tool inventory. Unfortunately, the only statistically significant sample of Acheulian manifestations is that of the stone industries. Existing tool classifications emphasize—almost exclusively—form and style, rather than function (Bowman, 1971). It may be that a functionally oriented typology of artifact assemblages will provide more relevant insights into Acheulian tool-kits, reflecting on subsistence patterns, ecological adaptations, or dietary habits. However, until a successful functional typology has in fact been devised, it must remain questionable whether tangible data of this kind will be forthcoming.

The problem of Acheulian "identity" may also be approached by analogy from modern ethnological information (Isaac, 1968b, also 1968a). It appears that among low-density populations of hunter-gatherers, individual "patrilocal" bands tend to show marked, if trivial, cultural idiosyncrasy, while larger groupings into tribes or linguistic groups are often arbitrary and seldom meaningful (see Owen, 1965). As a result, the bands, on the one hand, and the "culture-area," on the other, seem to be the only useful cultural taxa. Isaac (1968b) suggests that this pattern may have close analogies with the Acheulian artifact assemblages, as there are no recognizable entities between the taxonomic level of the individual camp-site occurrence and that of the industrial complex. In such hunter-gatherer societies, there may also be an adaptive continuity of idiosyncratic male culture and locality-specific lore, with the dispersal and recombination of women into scattered bands favoring a continual diffusion and reinforcement mechanism for basic cultural and technological traits (Owen, 1965). Again, it seems that such a system of cultural transmission should have a high inertia against radical change. In this way an adequately adapted body of technological and socioeconomic traditions might be maintained over wide areas during a period of perhaps a half million years. Such stability must, of course, also be viewed within the perspective of less evolved brains and relatively specialized ecological-economic relationships that is suggested by the paleontological and archeological evidence (Isaac, 1968b).

Perhaps the concept of the technocomplex, introduced by D. L. Clark (1968, ch. 8), offers the most viable approach to the technical and the adaptive manifestations of the Acheulians. The technocomplex embraces a huge system of loosely related culture groups, cultures, assemblages and artifact types. The sociocultural basis of such a system could be completely heterogeneous in terms of social organizations, languages, and the like, although it would inevitably contain small homogeneous units of cultural status. The technocomplex represents "the partly independent arrival of diverse developing culture systems at the same general equilibrium format based on a similar economic strategy, operating in similar environments, with a similar technology and similar past trajectories" (Clarke, 1968, p. 355). Thus heterogeneity is broadly constrained by both the organizational format and the operational ecosystem. The technocomplex does not mask the variable composition of the Acheulian tool-kit that suggests the practice of several discrete activities, each requiring a special set of tools (J. D. Clark, 1960). Similarly it does not assume a single socio-organizational pattern or undirectional cultural development. In fact, the technocomplex offers an ideal framework for considering the evidence for the increasing complexity of mid-Pleistocene hominid behavior.

INFERENCES ABOUT SUBSISTENCE AND SETTLEMENT PATTERNS

Wherever bone has been preserved, the archeological inventory of Acheulian sites suggests that large mammals provided an important, if not the major, food source. Almost all of the mammalian bone is disarticulated, broken, or battered, and sometimes reduced to small splinters, so that there can be little question that the animals were butchered and used for food. Numbers of individuals indicate that certain genera are heavily represented, as for example, elephant at Torralba and Ambrona (Howell, 1966), baboon at Olorgesailie in the Kenya Rift (Isaac, 1968a). A wide spectrum of large animals was hunted, however, including such diverse forms as hippo, horse, bovids, pigs, elephant, and rhino at Olorgesailie, as well as wolf and a large lion at Ambrona. Furthermore, the hunting bag was not limited to large mammals: rodent, bird, and reptile bones are commonly present including crocodile at Olorgesailie and a weasel at Ambrona. Whether some of these animals were scavenged from animal kills is difficult to decide, but the great bulk was certainly killed by man. The general impression obtains that all forms of protein available with given hunting techniques were utilized. Sporadically, as in the case of the one baboon concentration at Olorgesailie, a whole troop was probably ambushed and killed on a fortuitous occasion (Isaac, 1968a). In other instances, such as at Torralba and Ambrona, a long-term concentration on elephant hunting is apparent, possibly reflecting on a successful local hunting adaptation or on the exceptionally high meat yield per effort expended.

The nature of Acheulian hunting techniques is still imperfectly understood. Evidence from both Olduvai Gorge and Torralba-Ambrona suggests that animals were frequently driven into swamps or onto boggy grounds, so reducing their mobility and making individual kills possible. Fire may possibly have been used to drive animals for this purpose, but no empirical evidence is available to that effect. Bola stones, attached to hide ropes, may also have been used to bring down running animals: the stone would be hurled between the animal's legs, so that the rope would wrap itself around the limbs. Some of the many unbattered stones found in and around occupation floors may well have been used for this purpose. Nighttime attacks by large groups of hunters armed with spears, clubs, and heavy stones may also have been used to ambush sleeping animals (see Isaac, 1968a). With only flimsy weapons available, it seems unlikely that large animals like the elephant, rhino, or hippo would ever have been confronted directly. However, the possible use of vegetable poisons – such as those known to the modern Bushman – would have lent new potency to a spear-point.

Next to nothing is known about the extent to which wild vegetable foods – such as berries, fruits, nuts, stems, roots or bulbs – were exploited. The empirical evidence is simply not preserved except in exceptional cases, e.g., various fruits at Kalambo Falls. However, modern hunting groups depend for most of their subsistence on sources other than meat and, except in subarctic environments, mammal hunting provides only 20 to 40 per cent of the diet (Lee and DeVore, 1968, chap. 4). Hunting, as opposed to vegetable-gathering, would probably have become increasingly important as populations migrated out of the tropics into areas with a cold season, where plant foods are scarce for at least part of the year.

The demography of mid-Pleistocene hunter-gatherers is obviously beyond the possibilities of reconstruction. Nonetheless, the matter deserves thought, since even a speculative consideration based on modern analogies has its value. Thus, unspecialized hunter-gatherers typically aggregate in local groups or bands of 25 to 50 persons, with over-all population density seldom exceeding 4 to 100 persons per 1000 square kilometers (see Lee and DeVore, 1968). Disease, malnutrition, and possibly infanticide would provide obvious mechanisms of population control, and severe ecological reverses once in a generation or in every century would cut back the population level drastically. Lee and DeVore (1968, p. 11) suggest that the most successful long-term situation would be a population stabilized at 20 to 30 per cent of the carrying capacity. Such data is compatible with the rather fragmentary archeological record (see Howell and Clark, 1963; Howell, 1966; Isaac, 1968a). For example, Acheulian hunter-gatherers at Olorgesailie apparently lived in groups varying in size from 4 to 30 adults, the smaller groups possibly reflecting temporary splitting of relatively stable bands with 20 or 30 adults (Isaac, 1968a).

Acheulian living sites take the form of areal tool and bone concentrations that record both the toolmaking and meat-eating activities of man. Some parts of such "cultural floors" were primarily used for tool-flaking, others for the dismemberment and efficient use of animal game for food. Various foci of archeological concentration may suggest that a band reoccupied a site on several occasions, or that several groups may have temporarily occupied it together. In either case the lack of appreciable thickness to such cultural floors seems to indicate that sites were only ephemeral camps, possibly in a seasonal movement within a hunting territory.

> Some of these sites can have been no more than stopping places for consuming a single large food animal. Others, however, provide signs of deliberate and more prolonged occupation and are believed to represent butchery sites where a number of animals, on more than one occasion, were killed, cut up, and eaten, or where a seasonal crop of vegetable foods determined a stay of several days (J. D. Clark, 1960, p. 314).

Such sites appear to qualify as ephemeral settlements. Nonetheless, the evidence for simple shelters, some built within caves, suggests that at least a few settlements had greater permanence and were intended for the duration of several weeks or even months. The Lazaret cave shelter may possibly have been occupied between mid-November and mid-April, judging by bones of 5-month-old ibex (born in spring, killed in autumn) and of marmot (available only after the winter hibernation) (de Lumley, 1969b). On the other hand, pollen recovered from human coprolites included *Genista* and some other plants, indicating that one or more of the Terra Amata sites was occupied for an uncertain length of time during late spring or early summer (de Lumley, 1967, 1969a). Such inferences involve a number of questionable assumptions although, in general, sites with obvious advantages, such as suitable shelter, water, and accessible game, should have favored longer occupation.

The mobility and range of Acheulian hunter-gatherers is difficult to assess. At Torralba and Ambrona, some rocks used for tool manufacture were brought in from distances tens of kilometers away, while at Olorgesailie the absence of many types of exotic rocks suggests a more restricted range. Modern hunter-gathering groups do, however, move about a great deal, and each local group is associated with a home base or camp and a geographical range—although such groups do not function as closed social systems (Lee and DeVore, 1968, p. 11). As a result of this mobility, personal property would need to be kept at a minimum. At the same time, the nature of the food supply restricts the size of the living groups, since large concentrations of population would rapidly exhaust local food resources. Since food supplies vary from region to region with the season or year, local groups probably did not ordinarily maintain exclusive rights to resources (see Lee and De Vore, 1968).

In their culture-ecological model of "elemental man," Watson and Watson (1969, ch. 5) illustrate how social organization, subsistence, and ecology operate as interacting factors for people at the level of Acheulian hunter-gatherers.Several sociocultural phenomena appear to have been particularly significant: *(a)* The development of a complex language as a prerequisite to effective social organization and the transmission of knowledge. *(b)* The development of family structures and social institutions as a means of securing internal cohesiveness, by formalizing and extending patterns of sharing and cooperation. In fact, economic success and survival depend on the cooperative activity of every individual and family within a group. *(c)* The development of culturally determined food preferences, as groups develop tastes for only certain foods—primarily meat—without fully exploiting every possible food source. In this way, despite more efficient social patterns and improved tool techniques, Acheulian man may have been supported in smaller numbers in a given area than australopithecines were, since populations could only increase to the limits of the preferred rather than the possible food supply.

MAN-LAND RELATIONSHIPS

The distribution of artifactual sites and human fossils documents the fairly rapid dispersal of man during the early Pleistocene. Vallonnet, in southeastern France, indicates human occupancy in Europe during the youngest pre-Cromerian cold phase (de Lumley *et al.*, 1963),[2] while the earliest hominines of Java are certainly no younger (see Koenigswald, 1968). This picture of the primary dispersal of mankind seems completed by the close of the Lower Pleistocene, when man occupied much or most of Africa, the warmer and temperate zones of Europe, as well as southern, southeastern, and eastern Asia (see Fig. 67). It remains impossible to reconstruct the routes and stages of this dispersal in any meaningful detail, and a possible ecological motivation or influence must remain entirely speculative. Man could enter Asia by the rather ancient isthmus of Suez and cross to Java dry-shod during a glacial regression, and he may have first reached Europe via western Asia.[3]

On the African continent, Acheulian sites (see distribution maps in J. D. Clark, 1967) are

> most concentrated in regions which today are grass and park savanna in East and South Africa and are invariably within easy distance of water or of places where it is evident that water would be available under a slightly increased rainfall. Lakes, pans, swamps, permanent and seasonal watercourses, springs, and deep water in limestone caves were all favored camping places. There is no evidence that the earlier Acheulian populations occupied country that is today arid or often waterless, on the one hand, or evergreen forest on the other. During the later stage, however, the populations spread into the semi-arid and arid regions of (Somalia and southern Africa) as well as establishing themselves in the Sahara. At the same time they made inroads on the peripheral parts of the Congo Basin into country that is today . . . savanna . . . and penetrated along corridors into the forest itself opened by its recession from the main interfluves (Howell and Clark, 1963, p. 525–26).

In Asia, Acheulian industries have not yet been found north of the mountain barrier formed by the Caucasus, the Elburz, the Hindu Kush, and the Himalayas, and it is possible that the cold plains or steppes of

2. The sea-level stratigraphy of Vallonnet is inconclusive, but the late Villafranchian fauna, with *Elephas meridionalis, Equus stenonis, Euctenoceros senezensis, Histrix refossa* and *Crocuta perrieri*, is no younger than Cromerian (see Kurtén, 1968). The available evidence of frost-fractured rock may allow a tentative correlation with a cold phase such as the Menapian.

3. The Bosporus-Dardanelles would be reduced to a river during a glacial regression (see Pfannenstiel, 1944) and could have been forded far more easily than the Straits of Tunis or Gibraltar, both of which are very deep (thresholds at −324 m. and about −250 m. respectively) and subject to complex currents. The faunal isolation of the Mediterranean islands since early Pleistocene times, as well as the absence of Paleolithic archeology from all but Sicily—and there of late Pleistocene age (see Vaufrey, 1928, 1929)—rules out land bridges anywhere in the Mediterranean Sea. However, stylistic similarities between the Acheulian of Spain and of Morocco suggest that the restriction of the Acheulian to western Europe may not be fortuitous. Consequently, accidental or deliberate crossing of the Straits of Gibraltar by light craft during the Elster must be considered as a definite possibility.

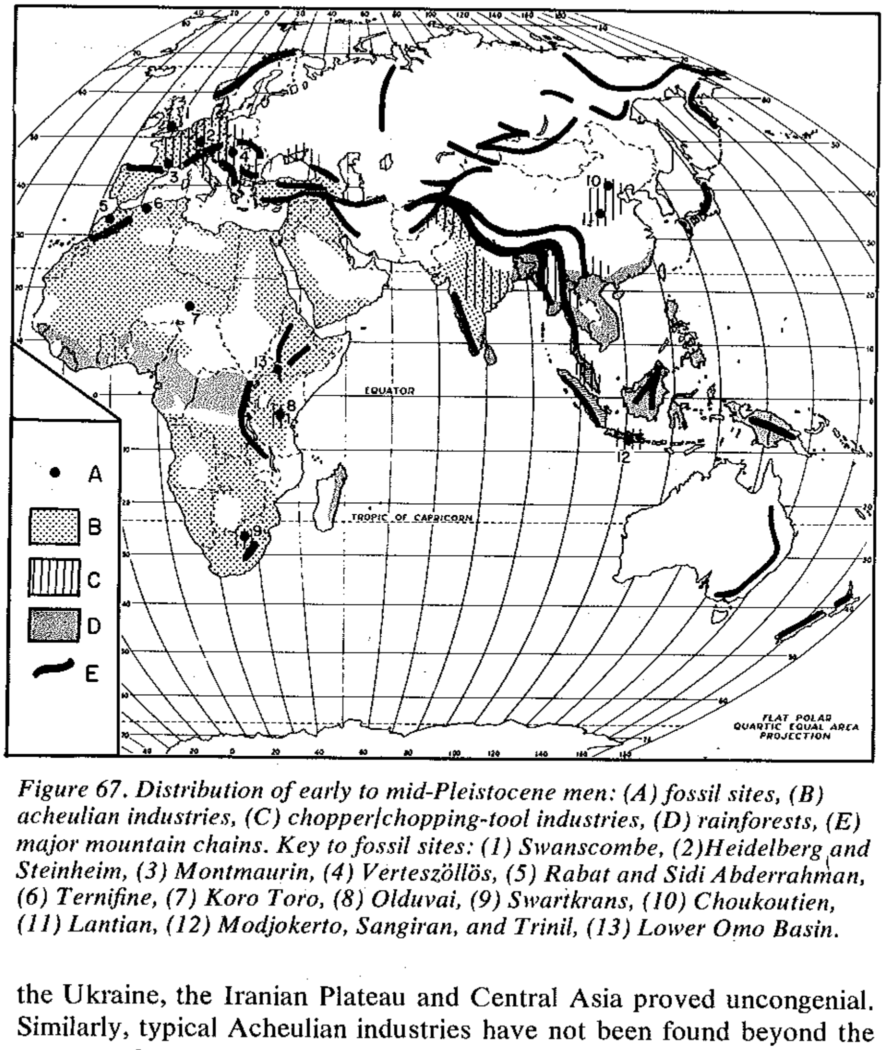

Figure 67. Distribution of early to mid-Pleistocene men: (A) fossil sites, (B) acheulian industries, (C) chopper/chopping-tool industries, (D) rainforests, (E) major mountain chains. Key to fossil sites: (1) Swanscombe, (2) Heidelberg and Steinheim, (3) Montmaurin, (4) Vérteszöllös, (5) Rabat and Sidi Abderrahman, (6) Ternifine, (7) Koro Toro, (8) Olduvai, (9) Swartkrans, (10) Choukoutien, (11) Lantian, (12) Modjokerto, Sangiran, and Trinil, (13) Lower Omo Basin.

the Ukraine, the Iranian Plateau and Central Asia proved uncongenial. Similarly, typical Acheulian industries have not been found beyond the monsoon forests of East Pakistan and the India-Burma border.[4] In India and West Pakistan, Acheulian sites are found along the river valleys of the Himalaya foothills and across the open hill and plateau country of the Deccan, in what are now semiarid or subhumid environments, not unlike those of tropical Africa. On the other hand, the Acheulian sites of western Asia are found in settings analogous to those of northern Africa.

The situation is somewhat different in Europe (see distribution maps

4. Movius, in discussion to Collins (1969), does not accept the Patjitanian of Java as Acheulian, despite the presence of hand-axes.

in Collins, 1969) where the Acheulian is prominent in what were cold and open environments during the glacial stages. Occupation at Torralba and Ambrona was contemporary with an alpine grassland in Elster times, while the majority of the English, French, Italian, and German sites were situated amid the loess steppes or grasslands of the Saale Glacial, a time when open vegetation appears to have reached the Mediterranean shores. In fact, the only sites that must be linked with woodland environments are those of Holstein age, when Acheulian settlement was concentrated in northern France and southern England. Even here it might be argued that open woodlands were selected,[5] and a case could be made for an almost general regression of settlement.

There can be little question that Acheulian populations favored country with open rather than closed vegetation. This finds a ready explanation in their subsistence-base of big-game hunting, which would be optimal in grassland or savanna environments (see ch. 10). It is also hardly fortuitous that riverine, lakeshore, or spring settings, often with local development of thickets or fringing forest, were typically selected at the level of the mesohabitat. This is the sum total of the ecological adaptation of the Acheulian technocomplex. Beyond this limited degree of specialization, divergences become discernible. In particular, there was apparently no settlement on the colder plains of Asia, despite successful adaptation to equally severe environments in western Europe during the Elster and Saale Glacials. The Holstein adaptation of Acheulian populations to woodland environments in northwestern Europe may be another case in point. These examples suggest an increasing diversification of regional adaptation through time, especially along the peripheries of Acheulian settlement.

Whether or not the environmental changes evident in the geological record exerted an influence on ecological adaptations is difficult to establish, at least until a typology of functional attributes has been devised and applied to Acheulian assemblages from diverse contexts. It is reasonable to postulate that the economic structure of society would be upset by environmental change, so that readjustment might be necessary (see J. D. Clark, 1958, p. 2). This may well have been the case in western Europe, where rather sweeping shifts of vegetation accompanied the alternation of glacial and interglacial climates, in a circumscribed area bounded on three sides by open seas. Change through time was less significant but nonethless important in northern Africa, though

5. But the detailed palynological evidence (see West, 1968, with references) certainly does not support the extreme formulation of "open country with pine woodlands" (Collins, 1969, Fig. 2).

less so in the eastern and southern parts of that continent. Tropical Africa is far more diversified at the level of meso-environments than is Europe, and the absence of major barriers suggests that prehistoric groups could adjust their range more easily than their subsistence base in response to environmental change. It is even more tenuous to suggest cultural speed-ups in Africa during "interpluvials" (see Clark, 1960), particularly when mid-Pleistocene stratigraphy is not understood. It is theoretically plausible, however, that pluvial climates would facilitate population movement, gene flow, and cultural contacts in the semiarid and subhumid tropics, while dry phases would favor isolation, restrict gene flow, and favor cultural specialization (Clark, 1960).

Acheulian hunter-gatherers lacked the technology and numbers to modify their environment in any significant way. Lack of specialization in hunting techniques precludes any significant modification of the fauna. However, the use of fire as a possible device for hunting or regeneration of food plants requires attention. West and McBurney (1954) found evidence of a sudden appearance of pioneer weed plants in the Acheulian cultural layer of the Holstein-age pollen profile of Hoxne, Suffolk. This suggests forest burning with subsequent recolonization by lower, light-loving plants and ultimately tree species. Deliberate burning by man or an accidental forest fire may have been responsible. Certainly the ethnological, historical, and archeological work of Sauer (1944, 1947) and Stewart (1956) make it impossible to ignore the potential effects of the burning of the vegetative cover by man. It is improbable, however, that any appreciable, large-scale influence was exerted on the natural vegetation during the course of the early and middle Pleistocene.

All the evidence suggests, in agreement with the model of "elemental man" (Watson and Watson, 1969, p. 83), that the Acheulian hunter-gatherer lived in ecologic balance with the natural environment, affecting it in ways and degrees no different from other large animals. Despite his improved social organization and technology, he was by no means always the dominant member of his ecological community, and he was hardly so successful as to push out other large predators. The physical environment set the problems; man's solutions to these problems did not yet disrupt the ecological balance of the system, and population numbers were controlled by the basic food supply (Watson and Watson, 1969, p. 83). Nonetheless Acheulian man was a successful hunter, no less successful than other large predators. Not all groups were under constant ecological pressure, and many modern hunting populations show a remarkable lack of concern about the problem of finding food, actually working short hours while exploiting abundant food resources (Lee and DeVore, 1968, p. 6, and chs. 4, 5, 9). Almost certainly Acheulian man enjoyed better health, a more balanced diet, and more leisure than most agricultural populations do today.

AN EXAMPLE OF AN ACHEULIAN LIVING SITE: TORRALBA, SPAIN

The early Acheulian site of Torralba is located 156 km. northeast of Madrid at an elevation of 1,115 m. Originally studied by the Marqués de Cerralbo from 1907 to 1911, the site was nearly completely excavated by F. C. Howell and L. G. Freeman from 1961 to 1963 (see Howell, 1966). In the following discussion the geology and paleogeography is based on Butzer (1965), the paleontology on E. Aguirre (unpublished), the palynology on F. Florschütz and J. Menéndez-Amor (unpublished).

The geographical setting consists of a broad, steep-sided valley incised into a limestone plateau. The lower part of the valley cuts into impermeable strata of gypsum and siltstone, so that springs are frequently found at the base of the porous and permeable limestone bedrock above. A spring of this kind almost certainly existed at the site during the time of occupation. Running water is now available in a local stream at 500 m. distance, and was certainly once accessible in nearby torrents at 300 m. during most of the year. The topography itself is such that the steep slopes accompanying the valley margins would have impeded free passage of some animal species from the valley to the uplands. Furthermore, this valley represents one of the few low level passes joining Old Castile to the north of the central sierras, and New Castile to the south (Fig. 68). Torralba is therefore located along what may have been a seasonal migratory route for larger game moving northward in the late spring, southward in the late summer. Also of significance is the absence of surface water on the limestone plateau as a result of very rapid percolation. This means that man and animals have at all times been required to obtain water in the valleys.

The geologic setting of the Torralba site, and its twin at nearby Ambrona, is within a river terrace at 40 m. above the local stream, part of the headwaters of the Jalón, a major tributary of the Ebro. The stratigraphic column of this 40-meter terrace deposit is listed as the "Lower Complex" of Fig. 69. The over-all climate was both cooler and relatively moister than today's, although subject to repeated oscillations. Human occupation is first recorded here during a cold interval. Subsequently conditions were temperate but then once more reverted to a cold climate. Occupation is no longer recorded during a later warm oscillation. Geomorphic phenomena include evidence of considerable frost-weathering, solifluction (partly as a result of soil frost, partly due to lubrication of clayey beds), and valley alluviation. Most of the occupation levels are found in a series of intercalated slope deposits and stream

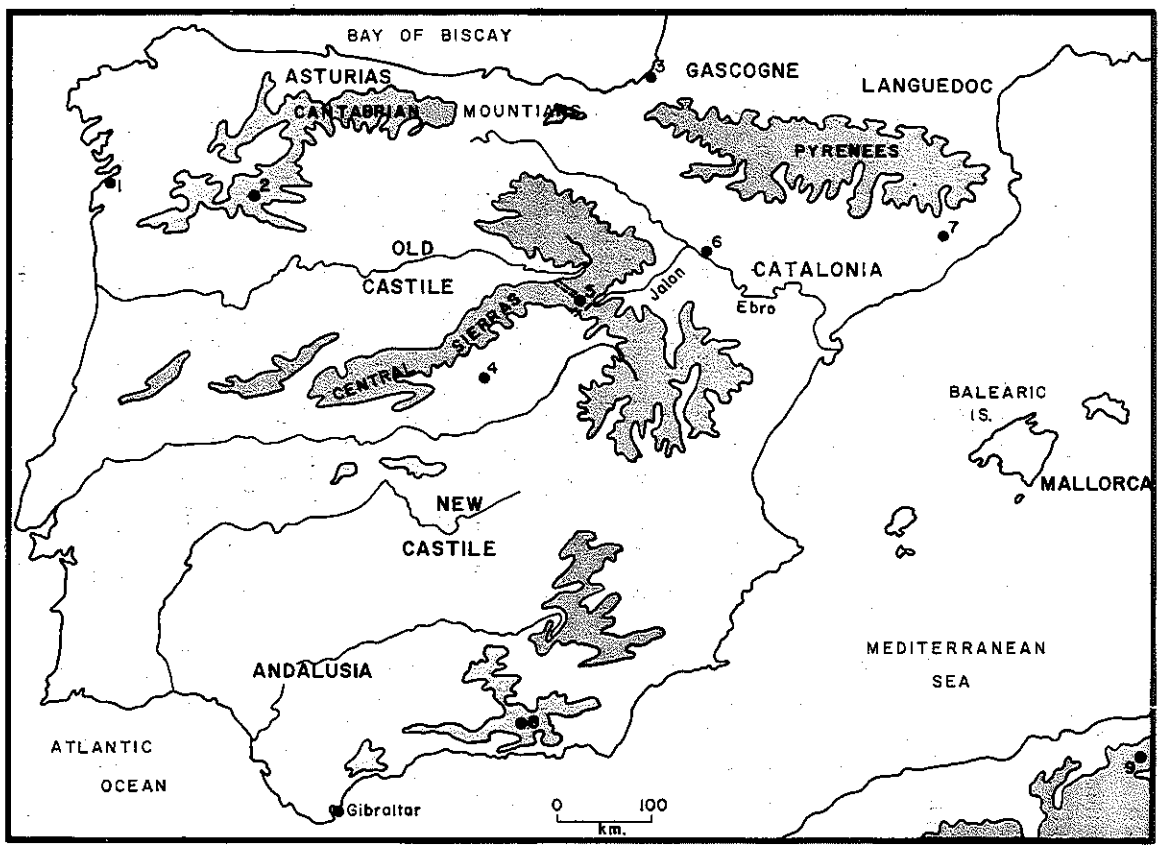

Figure 68. The Iberian Peninsula. Areas over 1,000 m. elevation shaded. (1) Vigo, (2) Laguna de las Sanguijuelas, (3) Biarritz, (4) Madrid, (5) location of Torralba and Ambrona with route of low-level pass, (6) Zaragoza, (7) Moya, (8) Sierra Nevada, (9) Jurjura Mountains, (Topography modified after Prentice-Hall World Atlas [2nd ed.], by permission of Geographischer Verlag Ed. Hölzel, Vienna.)

alluvia. One major cultural level is found within and on top of a stratum of coarse, subrounded, frost-weathered gravel (Bed IIb) which mantles the upland surfaces and hillsides of the area. Stone rings and garlands found at the Torralba site indicate significant soil-frost phenomena. All in all, the geomorphic record suggests a marginal periglacial environment with some evidence of accelerated fluvial activity. The latter includes well-rounded, coarse gravel in the stream bed deposits, considerable spring activity, widespread fine valley alluviation on the floodplain peripheries, and typical colluvail deposits.

Four major alluvial terraces were observed in the upper Jalón and Henares valleys, the second of which is equivalent to the mixed alluvial-slope deposit sequence at Torralba and Ambrona (see Gladfelter, 1971). Evidence of significant frost-weathering and some frost-heaving is limited to the second terrace. Similarly, evidence of subsequent, intensive reddish soil development is confined to the second terrace, whereas the next younger terrace was less intensively weathered. Instead, it may contain derived red sediments of the older soil at its base. This fossil red soil, stratigraphically fixed in the time interval separating the second and third terraces, is distinctive, particularly as developed *in situ* on the sediments at Torralba and Ambrona. External correlation with the equally striking rotlehm found developed on the "high terrace" of several Catalonian coastal streams is permissible. The Catalonian rotlehm is contemporary with the Tyrrhenian I or Holstein (Butzer, 1964a). A younger interglacial, presumably the Eem, is recorded by swamp marls at the base of the valley floor. These beds record a warm, dry climate as indicated by abundant grass and 10 to 15 per cent *Castanea* pollen—although the chestnut is now absent from the Spanish sierras. Above and below this marl are sandy fills, the lower with frost-weathered gravel, the upper with pollen suggesting a cool grassland environment. Thus the Torralba "Lower Complex" can be correlated with a pre-Holstein cold phase.

Palynological work corroborates the geomorphologic evidence. Corresponding to the cool, moist phases are pollen spectra with 10–60 per cent pine pollen, and a high proportion of grasses and some sedges. During the moist, temperate oscillations, pine pollen attains over 75 per cent, frequently with sedges accounting for most of the remainder of the spectrum. In conjunction with the geomorphology this suggests that the cold phases were characterized by seasonally inundated grasslands or swamps in the valley, and by a high-altitude grassland on the uplands with some open pine scrub or parkland in areas of broken ground. Much bare soil was probably exposed here with an incomplete mat of lower vegetation, including some *Artemisia*. During the more temperate

PLEISTOCENE STRATIGRAPHY AT TORRALBA & AMBRONA (SORIA), SPAIN

UNIT	SEDIMENT	THICKNESS (cm) TORRALBA	THICKNESS (cm) AMBRONA	ASSOCIATED PROCESSES	CLIMATIC INFERENCES	MAMMAL FAUNA	HUMAN OCCUPATION TORRALBA	HUMAN OCCUPATION AMBRONA	TENTATIVE CORRELATION
	IV. Reddish colluvium	120	200	Soil colluviation with local fan alluviation at valley margins	(Human interference)				Historical
				EROSION					
UPPER COMPLEX	III. Fine dark alluvium	80		Valley alluviation	Moist, temperate				Middle Holocene
	II. Coarse brown alluvium	70		Alluviation at valley margins by lateral tributaries; tufa deposits locally.	Cool, moist		Upper Paleolithic (surface traces)		Würm Glacial
	I. Reddish colluvium	125		Some solifluction initially.					
				EROSION					
MIDDLE COMPLEX	II. Yellowish sands	10		Colluviation and valley alluviation, following intensive frost-weathering. Slumping of subsurface, lubricated Keuper silts producing faulting at both sites. Some solifluction.	Cold, moist				Riss Glacial Complex
	I. d. Reddish colluvium	55							
	I. c. Reddish alluvium	60							
	I. b. Reddish colluvium	30							
	I. a. Cryoclastic detritus	20							
				EROSION					
PEDO-GENESIS	Terra fusca soil developed on Lower Complex IV and V exclusively. B	160	150		Warm seasonally very moist				Great (Holsteinian) Interglacial (= Tyrrhenian I stage)
	Bc	10	35						
	Ca	10-20	10-60						
				EROSION					
LOWER COMPLEX	V. d. Coarse reddish alluvium	165	95	Shallow alluviation at valley margins by lateral tributaries.	Very cold		Hiatus	Early Middle Acheulian Occupation	Stadial (Late Elster)
	V. c. Fine reddish alluvium		85						
	V. b. C-gravels		60						
	V. a. Gritty marl		90					Hiatus	Interstadial
	IV. b. Gray marl	150	200	Valley back swamps filled with homogeneous fine silts from sluggish flood waters; pseudo-gley conditions indicated by limonitic Fe-horizons.	Moist, temperate		Early Middle Acheulian Occupation	Early Middle Acheulian Occupation	Stadial
	IV. a. Marl with channel beds		220	Valley flood-plaining dominated by very fine alluviation, but with coarse, moderate cryoclastic channel beds locally.	Moist, cool				
				EROSION					
	III. b. B-gravel	–	15	Coarse valley alluviation with reduced soil frost.	Moist, cool				
	III. a. Upper gray colluvium	80	80	Fine valley alluviation with some solifluction.	Cold, moist				
				EROSION & CONGELIFLUCTION					Interstadial
	II. d. Sandy marl	90	150	Fine valley filling.	Moist, temperate				Stadial
	II. c. Lower gray colluvium	100	?	Well-stratified gritty sands with intercalated gravels. Valley alluviation.	Cold, moist				
	II. b. A-gravel	30	60	Coarse cryoclastic gravels on slopes, partly calcrete, partly interbedded with grey silts. Some congelifluction.	Cold, moist				
	II. a. Light sand	70+	300	Fine valley filling of homogeneous sands, partly silty at top.	Cool, moist		Sterile		
				EROSION					Interstadial ?
	I. Red colluvium	400+	?40	Medium, highly cryoclastic detritus at base of slopes.	Very cold				Stadial
	O. Redeposited Keuper (several phases)	100+	200+	Congelifluction and earth flows of lubricated clays, silts and marls.	Moist, cold.				

Figure 69. Stratigraphic columns of Torralba and Ambrona.

phases, pine woodlands dominated the uplands while open country in the valley was reduced to a few sedge swamps. A fringe of deciduous trees accompanied the stream throughout this period. Macrobotanical remains confirm that Scot's pine *(Pinus silvestris)* was the dominant tree type, although a few pieces of hardwood have also been identified. The cold intervals represented a transitional forest-steppe or grassland environment such as found above the tree line at about 2,000 m. in the central sierras today (see Welten, 1954). This suggests a depression of the altitudinal vegetation belts by at least 900 m. Modern January averages lie at about +2° C., July averages at 19° C. The January means must have been at the very least 5° to 6° C. lower in Elster times in order to account for the significance of frost action.

The abundant mammalian fauna is limited in terms of species. The inventory of the 1961–63 excavations is dominated by elephant, with at least 30 and possibly as many as 55 individuals represented, exclusively of a grassland-adapted variety of *Elephas antiquus* (Aguirre, 1969). Next in importance is a primitive horse (*Equus caballus torralbae*), with at least 26 individuals. Deer, primarily red deer (*Cervus elaphus*) but including also fallow deer (a large form of *Dama* cf. *clactonia*) and roe deer (*Capreolus* sp.), are represented by at least 25 individuals, the aurochs (*Bos primigenius*) by at least 10, the steppe rhinoceros (*Dicerorhinus hemitoechus*) by at least 6, and unidentified carnivores by 4. The faunal list of the contemporary occupation at Ambrona further includes a big lion, the wolf (*Canis lupus*), a weasel, a mouse, a hare, a cercopithecoid monkey (*Macaca* sp.), two species of duck, grouse, various falcons or kites, a lizard, and a toad. Although some of these animals are considered as woodland or indifferent forms, the majority of the individuals represented are grassland-specific. This is in keeping with the pollen evidence.

In overview, the regional environment was that of a high-altitude grassland or forest-steppe during the cold phases, a subboreal woodland with open, swampy lowlands during the more temperate oscillations. The local setting of the site at the time of Acheulian occupation was a stony footslope located at the side of broad, grassy valley with local sedge swamps. Some stunted pine scrub may have been found in sheltered draws, with grasses and herbs also characteristic of the uplands.

Turning to the cultural inventory, a great variety of stone implements and waste chips, as well as deliberately worked wood, bone, and tusk tips are interspersed with butchered faunal remains. A few distinct occupation levels with articulated or semiarticulated elephant bones were found, almost completely undisturbed by subsequent sedimentation. In other horizons, disarticulated remains of several species occur in association, suggesting a certain amount of derivation by slope wash or solifluction. Nevertheless, the distribution of disjunct associations or true "floors" through a vertical column exceeding 3.5 m. at Torralba and 6.5 m. at Ambrona indicates the repeated use of both sites for kill or butchering purposes during a protracted period of many millennia. Most of the fauna shows distinct evidence of butchery practices, and there is an unusually high frequency of juvenile animals. There can be little doubt that, with a few possible exceptions, all of the animals were killed by man. They were eaten more or less where killed, and the bones were dismembered and in part scattered considerably. Bones with marrow were frequently cracked and split open. No traces of shelters or the like have been found, and it is possible that Torralba served repeatedly as an ephemeral camp-settlement of a few days duration.

The stone implements include numerous flake tools of several kinds (especially scrapers of different sorts) and bifacial tools, including cleavers and hand-axes. These are specifically adapted for butchering purposes. Raw material was provided by quartzite, flint, and limestone, most of which was either available locally in the stream gravel or within a few kilometers distance. Bone fragments and elephant tusk tips with traces of cutting and purposeful trimming, as well as worked wood, have been found. Some of the wood may belong to weapons, others may have been used as pointed tools. Several pieces of charcoal, charred wood, much carbon, as well as charred bone have been found, suggesting human control of fire even though there is no direct evidence of hearths. In default of preserved vegetable foods, it would seem that hunting was the mainstay of the economy, with elephants representing over four-fifths of the total meat obtained. This was probably a matter of deliberate selection, partly dictated by the facility of hunting proboscidians in the often swampy terrain of a narrow, steep-sided valley.

In retrospect, the small or moderate sized, simple hunting group or groups that occasionally preyed on migrating herds of herbivores on the swampy river floodplain at Torralba are probably quite characteristic of the Acheulian hunter-gatherers. Seasonal abundance of animals was assured each spring and autumn as the herds moved between their winter grazing grounds, in the cool, open woodlands of southern Spain, to their summer habitats in the colder grasslands of the northern plains and plateaus. Man was only one of the many elements of the biological environment.

NOTES

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