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The Ecology of Early Man in Southern Africa

The relationship between man and environment is traced through 3 million years of southern African prehistory.

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The systematic study of prehistory in southern Africa has been moving at an ever increasing pace since the early part of this century (*1*). It is widely appreciated that the first and, for many years, the only australopithecines came from the area (*2*), and the still commonly used subdivision of the sub-Saharan Stone Age into Earlier, Middle, and Later parts was devised originally on southern African materials (*3*). Yet, in recent years, spectacular discoveries of hominid fossils and artifacts in Plio-Pleistocene contexts in East Africa have tended to obscure the fact that prehistoric research in southern Africa continues, with many important new finds and advances in knowledge. The purpose of this article is to summarize this research, giving special emphasis to recently uncovered evidence for prehistoric relationships of man to environment. The time interval to be covered is the period between the mid-Miocene and the present, and the area is that which includes the modern political units of South Africa, Lesotho, Swaziland, South West Africa (Namibia), Botswana, Rhodesia, and southern Mozambique (Fig. 1).

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The Miocene

The Miocene lasted from approximately 23 million to 5 million years ago. In contrast to East Africa, southern Africa is relatively poor in fossiliferous, terrestrial Miocene localities. Until recently, the principal ones were found on the coast of South West Africa, south of Lüderitz. They provided small samples of mostly micromammal bones of probable early Miocene age (*4*). In early 1976, diamond prospectors in South West Africa uncovered a new and potentially far more important locality at Arrisdrift on the Orange River, approximately 30 kilometers from its mouth. The fossils lie in a coarse alluvial gravel immediately overlying bedrock and overlain by a series of finer, nonfossiliferous alluvial deposits. The fauna includes fish, reptiles, birds, and at least 15 species of mammals (*5*). The taxa identified so far suggest that the locality is of mid-Miocene age, perhaps broadly coeval with the Kenyan site of Fort Ternan, which has provided remains of *Ramapithecus*, believed by many to be the oldest known hominid. As yet, no primate remains have been found in the Arrisdrift assemblage, but the fauna suggests that the environment was wooded and well-watered, one in which primates probably would have prospered. Primate remains may yet be discovered in the enlarged faunal sample now being recovered.

The Early Pliocene

The early Pliocene lasted from approximately 5 million to 4 million years ago. Fossiliferous earlier Pliocene deposits are rare in southern Africa. Limited occurrences have been recorded at Kleinzee, not far south of the Orange River Mouth (*6*), and at Virginia in the northcentral Orange Free State (*7*), and there is a very rich locality at Langebaanweg (*8, 9*), roughly 105 km north of Cape Town. The fauna from the Varswater Formation at Langebaanweg includes invertebrates, fish, amphibians, reptiles, birds, and no less than 75 species of mammals. A minimum of 14 of the genera and all the species of larger mammals are now extinct. The archaic character of the assemblage is given emphasis by the presence of several essentially extra-African taxa, including a bear, a large wolverine, a possible raccoon, a basically Eurasian hyena, a peccary, and a boselaphine antelope whose closest living relative is found in India rather than in Africa. Several taxa that occur in the Varswater Formation are also known in East Africa, where they appear to have a potassium-argon age of roughly 5 million to 4 million years ago. In the absence of direct means of dating, this date stands as the best available estimate of the age of the Varswater fauna.

The faunal assemblage from the Varswater Formation is probably larger than the combined assemblages from all the contemporaneous East African localities, but it differs from those assemblages in that it contains no australopithecines (*10*). There is no apparent reason why australopithecine bones should not have been incorporated in the Langebaanweg deposits, most of which were probably laid down in or near a river discharging into the sea near the site.

Nor is it obvious that hominids could not have lived in the paleoenvironment sampled, which probably consisted mainly of open woodland on an estuarine or riverine floodplain. At this stage in the investigation of the site, it seems possible that hominids are absent simply because they were unable to extend their range so far south and west (32°58′S, 18°09′E) in this time period, either because there were insurmountable ecological barriers to the north and east or because general climatic conditions were unsuitable for them at this distance from the equator. In this regard, it is interesting that no australopithecines have been found farther north or south than 27°32′, the latitude south of the famous Taung site. I must add in caution, however, that investigators at Langebaanweg still usually uncover at least one previously unrecorded taxon each year. In addition, Langebaanweg, like many later sites in the same region, is poor in primate remains of every kind, the available sample consisting of only two or three possible cercopithecoid teeth.

Considering the possibility that hominids were absent or at least very rare in the ancient Langebaanweg environment, one feature of the fauna in general that becomes especially interesting is the very large number of carnivores. This large number is reflected both in the number of carnivore specimens and in the ratio of the number of different carnivore species to the number of probable prey species. Actual counts of individual carnivores and prey animals have yet to be made, but the frequencies of carnivore and prey taxa are reasonably well established. Thus, excluding the smaller taxa that probably fed mainly on insects, micromammals, or plants, there are 20 carnivore species in the Langebaanweg fauna. Similarly, apart from small prey such as small rodents and other micromammals, there are 27 potential prey species. Similar counts based on the large Middle Pleistocene faunal sample from Elandsfontein, only 10 km southeast of Langebaanweg, reveal 11 larger carnivore species and 32 prey species (*11*). For the extensively sampled Upper Pleistocene–Holocene sites of the region, the counts reveal 12 carnivore species and 32 prey species (*12, 13*). These data indicate that sometime between the early Pliocene and the mid-Pleistocene there was a substantial reduction in the diversity of carnivore species and, if anything, an increase in potential prey species. It seems likely that the decrease in carnivore taxa was at least in part due to the arrival and subsequent evolutionary success of meat-eating hominids.

Later Pliocene and Early Pleistocene

The later Pliocene and early Pleistocene lasted from approximately 3 million to 1 million years ago. The principal later Pliocene and early Pleistocene sites in southern Africa are the five well-known

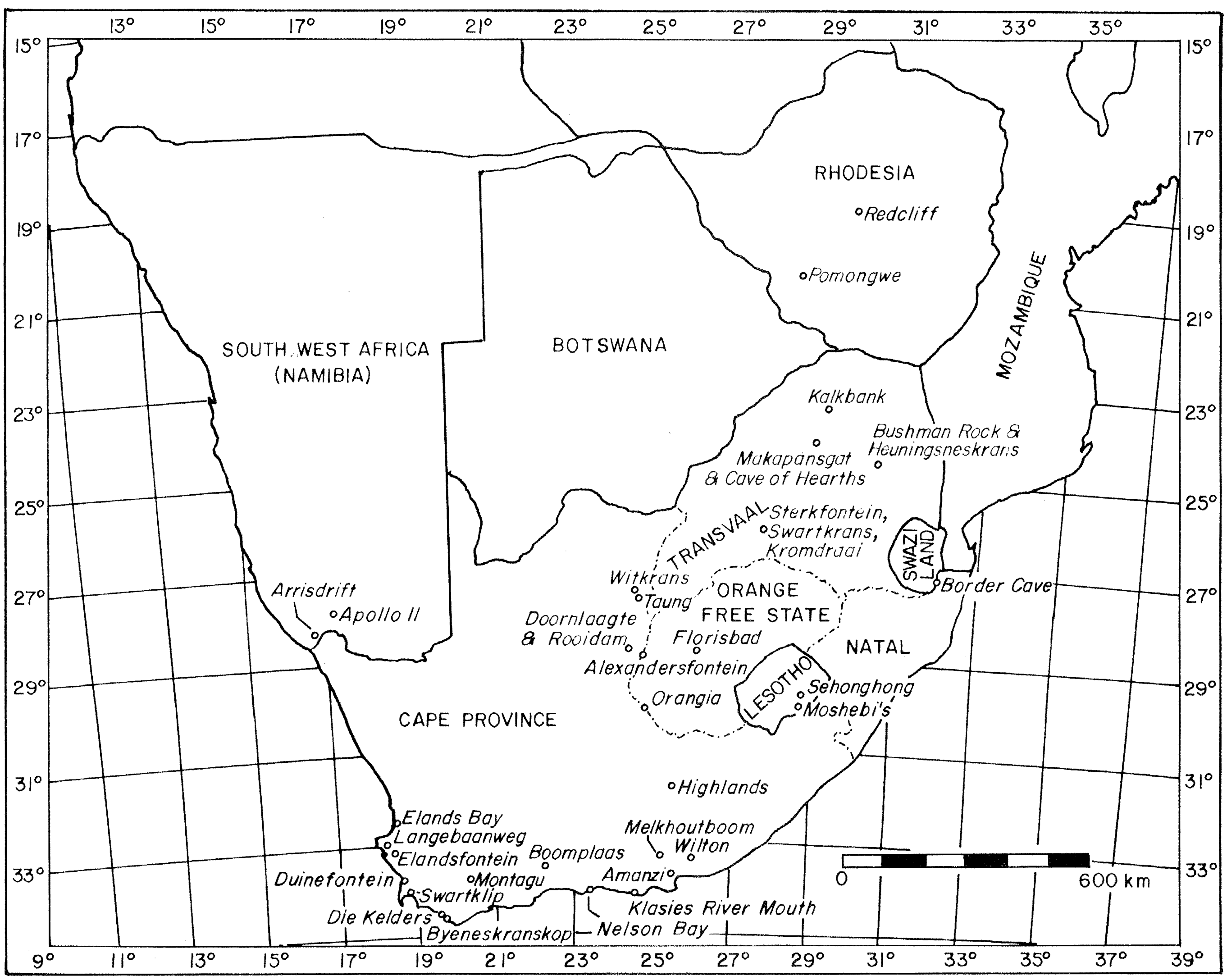

Fig. 1. Approximate locations of the principal sites mentioned in the text.

australopithecine caves—Taung in the northern Cape, and Sterkfontein, Swartkrans, Kromdraai, and Makapansgat in the Transvaal. These sites contain few of the archaic genera that have been found at Langebaanweg, but they contain several extant genera that are unknown at Langebaanweg. There is thus no doubt that the fossiliferous deposits at all five australopithecine sites postdate those of the Varswater Formation at Langebaanweg. Unfortunately, like Langebaanweg, the australopithecine sites have not yet provided material suitable for radiometric age determination, and a recent geomorphologic attempt to date them (*14*) has met with serious objections (*15*). As at Langebaanweg, the principal method of dating at the australopithecine sites consists of faunal comparisons with radiometrically dated sites in East Africa.

Faunal dating of the South African sites has always been difficult because of sampling problems, of possible confusion and mistakes in the identification and classification of fossils from various localities, and of the possibility that similar forms inhabited southern and eastern Africa at different times (or different forms at the same time). The dating is especially difficult now, however, because it has become clear that the sedimentary fills at each of the three most extensively sampled sites (Makapansgat, Sterkfontein, and Swartkrans) probably span hundreds of thousands of years. Within each fill, there are major sedimentary breaks representing long intervals during which there was no deposition (*16–24*). What this means is that the faunal samples from each site must be subdivided to obtain meaningful age estimates. To some extent, subdivision must be subjective since the samples were recovered largely from spoil heaps rather than directly from the separate stratigraphic units that are now recognized. Nonetheless, the most recent attempts at dating, based mainly on the bovid remains (*25, 26*), indicate fairly clearly that the remains of *Australopithecus africanus*, represented at Makapansgat and Sterkfontein, are between 2 million and 3 million years old. *Australopithecus robustus*, recorded at Swartkrans (*27*) and Kromdraai (*28, 29*), is probably between 1.8 million and 1 million years old, as are the fossils of early *Homo* found at both Swartkrans (*24*) and Sterkfontein (*21*). Only the holotype specimen of *A. africanus* from Taung remains especially difficult to date by faunal comparisons (*30*). In spite of this difficulty, there still exists an interesting parallel between the southern African pattern and the pattern that appears to characterize the Plio-Pleistocene deposits of the Lower Omo Basin (*31*). The earliest hominid remains found there, dated at approximately 3 million years ago, are similar or identical to those of *A. africanus*. This earliest form persisted until roughly 1.9 million years ago. Robust australopithecines (similar or identical to *A. boisei*) appear first in deposits that are about 2.1 million years old and were present for a million or more years thereafter. The earliest specimens assignable to *Homo* are dated to approximately 1.85 million years ago. A similar pattern may further characterize the East Turkana (formerly East Rudolf) succession, but problems of taxonomy and especially of dating intrude (*32*).

Earlier work at Makapansgat, Sterkfontein, Swartkrans, and Kromdraai suggested that the sediments incorporating australopithecine fossils recorded marked wet-dry fluctuations (*33*). The gracile australopithecine seemed to be present during drier times and the robust form during wetter ones. Such correlations suggested that the two forms may have differed with respect to environmental preferences and diet (*34*). More recent work (*17, 18*) indicates the probable existence of wetter and drier fluctuations, but reveals no definite correlation between precipitation and the presence of either type of australopithecine. In general, in the Transvaal both types of australopithecine appear to have inhabited areas whose environments were not very different from modern ones, with a mixture of grassveld and woodland that was never very arid or very humid. The associated faunal remains point essentially to the same conclusion (*35*). Only at Taung in the northern Cape may the australopithecine environment have been substantially different from the modern one. It was probably more mesic, and in fact, during the australopithecine period of occupation, may have resembled the environment of the Transvaal more than it did the historic environment of the northern Cape (*15*).

Work at the South African sites has disclosed relatively little information regarding australopithecine behavior. No confirmed stone artifacts have been found in association with *A. africanus*, and only a handful are known with *A. robustus* (*36*). Most of these artifacts come from Swartkrans, where they are also associated with early *Homo*. Typologically they may be comparable to the roughly contemporaneous Oldowan or Developed Oldowan A artifacts of Bed I and Lower Bed II at Olduvai Gorge, but a larger sample will be necessary for detailed conclusions.

Dart has argued strongly that, whether or not the australopithecines made stone tools, they did modify bones, teeth, and horns to make osteodontokeratic tools (*37*). His argument has been based on the nature of bone fractures, the presence of fragments that are jammed into other fragments, and striking differences between the observed numbers and the anatomically expected numbers of different bovid skeletal elements, as observed at Makapansgat. It is now clear that bones fractured by large carnivores in fact exhibit all the fracture patterns that Dart encountered (*38*) and that peculiar juxtapositions of bony elements in fact can result postdepositionally. Such strange juxtapositions have been observed at various sites where hominids were almost certainly not involved—for example, at Langebaanweg and in the late Pleistocene bone accumulation at Swartklip near Cape Town (*39*). It has also now been shown that the pattern of discrepancies in numbers that Dart observed among various skeletal elements probably is attributable mainly to the differing durability of various bones in the face of pre- and postdepositional destructive pressures (*40*). Conscious selection by australopithecines of some elements is not shown or implied; the Swartklip assemblage mentioned previously (*39*), for example, exhibits a closely similar pattern and was almost certainly accumulated by hyenas. Finally, it is probable that postdepositional events account for most, if not all, of the bashed and dented skulls that Dart (*41*) regarded as evidence for the hypothesis that the australopithecines used weapons against conspecifics and other animals (*42*).

The question of how bones reached the australopithecine sites remains unanswered. At the three most extensively investigated sites (Makapansgat, Sterkfontein, and Swartkrans), the bones accumulated mainly in portions of deep subterranean caverns that larger terrestrial vertebrates could have entered but not left. The bones thus must either have fallen or have been washed to their present positions, and the question becomes how they became concentrated around the openings of vertical shafts leading downward from the surface. It is possible the concentrators were leopards who had dragged their kills into trees to keep them from being stolen by other predators, particularly spotted hyenas (*43, 44*). In the ancient Sterkfontein-Swartkrans environment, the growth of suitably large trees was perhaps confined to cavern mouths by conditions of shelter and moisture.

In addition to leopards, other possible bone accumulators at the australopithecine sites were porcupines and hyenas. Both might have had dens in the small shelters that probably overhung the vertical shafts to the deep caverns below. Porcupines probably can be ruled out as the bone accumulators by the scarcity of obviously gnawed bones at each site. Hyenas are more likely to be the accumulators, especially since it has now been conclusively shown that they can and do accumulate substantial quantities of bones in and around their lairs (*45*). Furthermore, there is an interesting parallel between the Makapansgat bone assemblage and the Swartklip one, which was probably hyena-accumulated. At both sites, the ratio of postcranial to cranial remains increases with the body size of the species, and the postcranial remains of larger animals are mostly adult while the cranial remains are mainly juvenile. This pattern is very different from that which characterizes large, similarly analyzed archeological bone assemblages in southern Africa (*39, 46*). It perhaps reflects both an upper limit on the size of bones that hyenas can transport to dens and the likelihood that hyenas will destroy smaller and softer bones altogether. Unfortunately, published data are insufficient to permit a determination as to whether the other australopithecine bone accumulations resemble Makapansgat and Swartklip in this respect.

A further criterion that might be used to determine whether the australopithecine bone assemblages are the result of carnivore activity is the minimum number of carnivore individuals they contain (*47*). As a criterion, this rests on the assumption that carnivores probably prey or feed on other carnivores more frequently than early hominids did. The main difficulty here is in establishing how many carnivores to expect in a carnivore bone accumulation. The Swartklip site contained 22 percent carnivore individuals (46 out of 205 animals), while percentages of carnivores in nearby archeological sites of the same (late Pleistocene) age vary between 7 percent and 13 percent (on samples of from 100 to more than 400 individual animals minimum) (*39, 46*). The best available data for calculating the number of carnivore individuals in australopithecine assemblages come from Swartkrans (*24*) and Kromdraai B (*29*). The Swartkrans stratigraphic unit with *A. robustus* contains 40 carnivores out of 338 individual animals, or 12 percent. This figure is substantially lower than the one for Swartklip, but this may simply reflect interrelated differences in the carnivore responsible (leopard at Swartkrans, hyena at Swartklip) and in the prey species whose bones were found at the two sites. Whereas Swartklip has provided no remains of primates, *A. robustus* and terrestrial cercopithecoids each constitute 26 percent of the total number of individuals in the relevant Swartkrans assemblage. In specializing so heavily on terrestrial primates for its prey, the Swartkrans predator has masked what, in fact, was a very large number of carnivore individuals among its prey, if the kinds of animals represented at Swartklip are the only kinds considered. In this context, it is interesting that a later, probably mid-Pleistocene, unit at Swartkrans, containing bones derived from a minimum 258 individual animals, has fewer carnivores (8.5 percent) and many fewer primates (3 percent total). This reduced percentage of carnivores suggests that by this time a change may have taken place in the bone accumulator (from ?leopard to ?*Homo*). Kromdraai B, with 17 percent carnivores and 50 percent primates out of 86 individual animals, is more like the older than the younger unit at Swartkrans. This suggests that the agent of accumulation at Kromdraai B was the same as that in the older Swartkrans unit (?leopard).

If the robust australopithecines at Swartkrans and Kromdraai B were indeed carnivore prey, then the large number of their remains in the deposits may reflect relatively high population densities (*48*), for it seems unlikely that a carnivore would prey so heavily on a very rare animal. Furthermore, it seems possible that the relatively low proportion of adult individuals in the available *A. robustus* sample and the much higher proportion in the *A. africanus* one (*49*) reflect prey-size selection by predators (*48*). It is generally agreed that *A. robustus* adults were substantially larger than *A. africanus* ones.

Mid-Pleistocene

The mid-Pleistocene lasted from approximately 1 million years to 130,000 years ago. The principal mid-Pleistocene localities of southern Africa are numerous sites with handaxes (Fig. 2A), cleavers, and associated flake tools. The assemblages at these sites have been given various names (*50*), but are now generally grouped in the Acheulean Industrial Complex (*48*). Together with the Oldowan Industry, which is probably represented in the oldest stratigraphic unit at Swartkrans, the Acheulean Complex is often referred to as Earlier Stone Age.

Radiometric and paleomagnetic evidence indicates that the handaxes and cleavers that characterize the Acheulean Complex appeared in East Africa more than a million years ago (*51*). Since succeeding Middle Stone Age assemblages, lacking handaxes and cleavers, were present 180,000 years ago or somewhat earlier (*52*), the Acheulean in East Africa probably lasted a million years or more.

Like southern African australopithecine bones, southern African Acheulean artifacts must be dated mainly by faunal comparisons with dated sites in East Africa. On the whole, such comparisons suggest that the southern African Acheulean was broadly contemporaneous with the East African Acheulean, with a starting date prior to 1 million years ago and a terminal date more than 130,000 years ago (*53–67*). For the sake of convenience, I have used the term mid-Pleistocene for the probable time span of the Acheulean, although at best the Acheulean period coincides with only part of the mid-Pleistocene as recently formally defined (*68*). In this formal definition, the Lower-Middle Pleistocene boundary is placed at the beginning of the Brunhes Normal Polarity Epoch, approximately 700,000 years ago, and the Middle-Upper boundary, at the beginning of the Last Interglacial, approximately 130,000 years ago.

The number of sealed Acheulean sites in southern Africa is small, the artifact samples from both sealed and surface sites are often small and biased, and the dating of the sites relative to one another is usually problematic, so that it is difficult to determine whether significant changes occurred through time in the southern African Acheulean. It seems reasonable to suppose that there would have been a trend through time toward more finely made handaxes, perhaps involving a progressive decrease in relative thickness and an increase in the maximum number of trimming scars. This is a trend that may characterize the development of the Acheulean in East Africa (*51*). A progressive increase in relative handaxe breadth may characterize the Acheulean of the Transvaal (*56*) and may also be reflected in the stratified sequences at Rooidam in the northern Cape (*69*) and Montagu Cave in the southwestern Cape (*70*). Finally, it is possible that later Acheulean assemblages include a wider variety of tool types and that differences among Acheulean assemblages from different areas increased with time. However, such trends are not yet firmly established, and even the gross division of the Final Acheulean into the two broad types called Sangoan and Fauresmith is not yet clearly documented in terms of the typology and dating of the assemblages that have been assigned to the two (*71, 72*).

The overwhelming majority of known southern African Acheulean sites are surface localities whose dating depends upon presumed trends in artifact development. With this difficulty in mind, it is noteworthy that sites classified as Upper Acheulean are substantially more numerous than ones that are presumed to be earlier Acheulean (*73*). Supposed Upper Acheulean sites are also the earliest ones to appear in the drier, western areas of the subcontinent (*73*). Together, these facts suggest that population increase and adaptation to new environments characterized the long Acheulean time period.

Unfortunately, southern African sites have provided relatively little specific information about Acheulean behavior, except for the making of stone tools. With respect to site locations, southern African Acheuleans seem to have been quite eclectic. They camped on stream banks or on channel bars (*74*), on lake margins (*75, 76*), near springs (*77*), and in caves (*78*). Substantial accumulations of artifacts in both the caves and open-air sites suggest repeated and continued occupation. The repeated use of caves is perhaps explicable in terms of the shelter they afforded, but the factors dictating choice of open-air site locations remain less clear. Even when the large number of surface sites is considered, the only conclusion that emerges from an analysis of site locations is the trivial one that Acheulean peoples probably never camped very far from water. The problem of adequately sampling such long extinct settlement systems, in addition to the continuing problem of dating, may always prohibit more meaningful conclusions.

At present, there is little evidence for site modification by southern African Acheuleans. Large unmodified rocks found associated with Acheulean artifacts at Doornlaagte (*76*) may represent anvils, seats, or even remains of structural features, but it is possible that they were not humanly introduced (*67*). None of the known Acheulean sites contains well-defined hearths, and burnt bat guano at the base of the Cave of Hearths sequence may have been ignited naturally (*79*). Fires perhaps lit by Acheuleans may account for the high concentration of mineral ash in deposits at Montagu Cave (*48*), although the burned material may have been mainly plant food debris and bedding that was ignited accidentally (*80*).

Perhaps the aspect of Acheulean behavior that archeology can ultimately learn most about is subsistence. For the moment, however, information from southern Africa regarding subsistence is very limited. In most southern African Acheulean sites organic remains are not preserved, and unquestionable associations between bones and Acheulean artifacts are documented at only three sites—Pomongwe (*50, 58*), the Cave of Hearths (*56*), and Elandsfontein (*81*). The small faunal assemblages involved in each case suggest only that Acheulean peoples hunted or scavenged a wide variety of herbivores and generally avoided

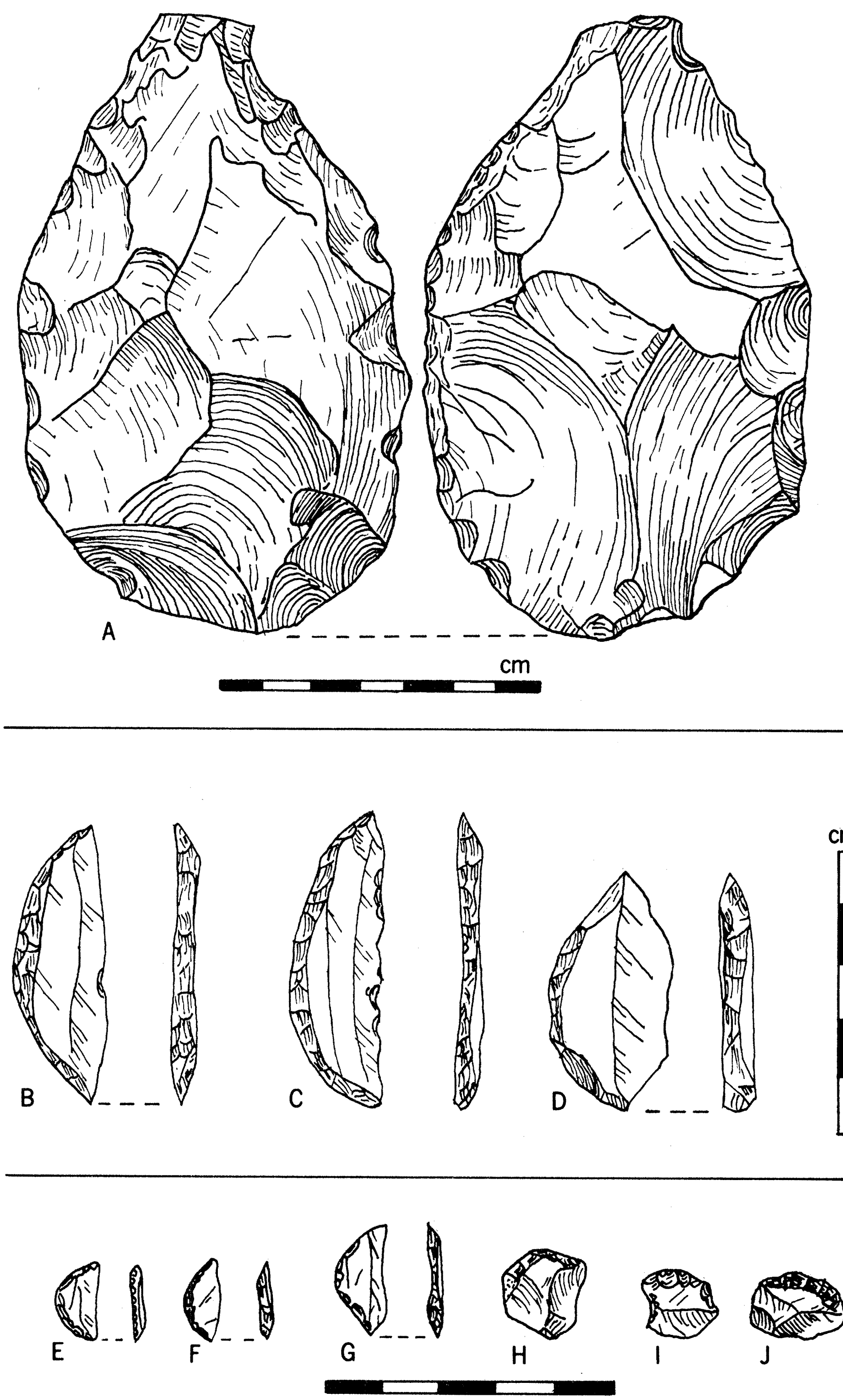

Fig. 2. (A) Acheulean handaxe from Amanzi Springs [after original in (*57*)]. (B–D) Middle Stone Age ("Howieson's Poort") segments from Nelson Bay Cave [after originals in (*99*)]. (E–J) Later Stone Age (Wilton) segments (E–G) and scrapers (H–J) from Nelson Bay Cave [after originals in (*99*)].

the larger carnivores, as did Stone Age peoples elsewhere. It may be assumed that they also relied to a considerable extent on plant foods.

Finally, it is obviously interesting to establish what the makers of Acheulean assemblages looked like. It is possible that a very early Acheulean population is represented by the recently recovered cranium and the few additional hominid fossils that occur at Sterkfontein in deposits overlying those that contain *A. africanus* (*21*). The pertinent fossils have been assigned to an early variety of *Homo*. The only hominid fossil (mandible SK 15) found in the post-*A. robustus* deposits at Swartkrans probably also belongs to an early Acheulean toolmaker and has been attributed to *Homo* cf. *erectus* (*24, 82*). Acheuleans from what was probably a later period are represented by a fragmentary juvenile mandible from the Cave of Hearths (*83*) and the famous Saldanha Skull from Elandsfontein (*84*), although the Acheulean association of the Saldanha Skull is only probable, not proven (*55*). Scanty though it is, the available evidence suggests that in southern Africa, as probably also in East and North Africa, the makers of Acheulean artifacts were archaic members of the evolving genus *Homo*.

Earlier Upper Pleistocene

The Earlier Upper Pleistocene lasted from approximately 130,000 to 40,000 years ago. The industries which succeed Acheulean ones in sub-Saharan Africa are most commonly called Middle Stone Age (MSA). They lack handaxes and cleavers and are characterized instead by a variety of flake tools, especially scrapers, points, and denticulates. As indicated previously, MSA industries appear to have been established in southern Africa at or before the beginning of the Last Interglacial, approximately 130,000 years ago. A growing number of carbon-14 determinations suggests that the latest MSA predates 40,000 years ago, the practical limit of carbon-14 dating as practiced by most laboratories (*85*).

Faunal remains accompany MSA artifacts at many sites throughout southern Africa (*86–95*). Taxonomically, all the reported faunas are overwhelmingly modern, with no more than three extinct genera (the giant buffalo, *Pelorovis*; the "giant hartebeest," *Megalotragus*; and the giant warthog, *Stylochoerus*) and a handful of extinct species in surviving genera (most prominently the "giant Cape horse," *Equus capensis*, and the springboks, *Antidorcas australis* and *Antidorcas bondi*). Three-toed horses (*Hipparion*), short-necked giraffids (*Sivatherium*), saber-tooth cats (*Megantereon*), giant baboons [*Theropithecus* (*Simopithecus*)], and other archaic forms that occur in Acheulean contexts are absent. Together with the stratigraphic superposition of MSA artifact assemblages over Acheulean ones at Pomongwe (*58*), the Cave of Hearths (*56*), Olieboompoort (*56*), and Montagu Cave (*70*), the faunal evidence indicates beyond all doubt that MSA industries are younger than Acheulean ones.

Studies on the MSA of southern Africa abound with the names of different industries that are said to succeed each other in time and space (*3, 50, 72, 96*). There is in fact little question that the demonstrable spatial and temporal variability in stone tool assemblages is greater for the MSA than for the Acheulean. This greater variability suggests that MSA peoples may have been better able to innovate in the face of spatially and temporally varying environmental conditions. A major innovation may be recorded by the appearance of well-made backed blades and segments (also called crescents and lunates—see Fig. 2, B to D) found in more or less the same stratigraphic position within MSA sequences scattered over much of southern Africa (*97–100*). Smaller tools of similar form made by much later peoples are known to have been mounted in various ways on wooden or bone handles or shafts, and it thus seems possible that the apparently sudden prominence of backed pieces in the later MSA reflects the development of a new method of hafting that spread over most of the subcontinent. Whether the spread of the method involved population movements or simply the diffusion of an idea might be determined from a knowledge of the temporal and spatial variability among the assemblages in which the backed elements occur. Unfortunately, the nature of this variability cannot be established, because the assemblages have not yet been systematically described in accordance with a standard typology. Also unknown for lack of the same kind of systematic description is the nature and extent of typological variability in the MSA assemblages that precede and follow the ones with prominent backed elements.

Middle Stone Age peoples in southern Africa occupied a wide variety of sites just as their Acheulean predecessors did. Cave occupations are especially well known, but there are also floodplain (*101, 102*), lakeside (*103, 104*), and spring (*105*) sites. There are numerous sites that seem to have been workshops located near sources of prized raw material, such as outcrops of indurated shale in the Orange Free State and northern Cape (*102*) and sites that seem to have been places where animals were killed (*106*). There is still only limited evidence for MSA site modification, but the evidence is more abundant than for Acheulean site modification. Thus, excavations at Orangia 1 uncovered a series of curvilinear arrangements of blocks and cobbles, in some cases lining the walls of shallow depressions (*102*). The excavator believes that the cobbles may have been anchors for windbreaks. The positions of windbreaks may also be indicated by a cobble alignment at the nearby site of Zeekoegat 27 (*102*) and by areas with especially high concentrations of cultural debris at the open-air site of Kalkbank in the Transvaal (*76*). Finally, it is clear that fire was used at several of the MSA sites, for example, at Montagu (*70*) and at Klasies River Mouth (*94*), where lenses of ash and charcoal are clearly ancient hearths.

The relatively substantial faunal information drawn from MSA sites suggests a common hunting pattern—MSA hunters preyed mainly on medium-to-large ungulates and generally avoided both the larger carnivores and the largest, most dangerous herbivores (rhinoceroses and elephants). The most detailed analyses of MSA faunas are my own for Klasies River Mouth (*59, 95*), Die Kelders (*59*), Duinefontein 2 (*60*), Border Cave (*92*), and Redcliff (*88*). In each of the long stratified sequences (all sites but Duinefontein 2), I have found that levels with historically important species alternate with ones characterized largely by historically rare or absent species. For example, at Redcliff in the Rhodesian Midlands, levels in the middle of the MSA sequence abound in the historically common tsessebe, hartebeest, blue wildebeest, Burchell's zebra, and warthog, while levels at the bottom and top are rich in springbok and blesbok. The last two species were absent from Rhodesia historically but were characteristic of the South African highveld to the south. I have hypothesized that these species extended their range northward to Redcliff and remained there in substantial numbers when the local vegetational setting more nearly approximated the highveld. More generally, for any site, I have supposed that levels with large numbers of historically absent or rare species reflect times of worldwide low temperatures and changed atmospheric circulation patterns documented for the southern African late Pleistocene on sedimentologic-geomorphic and palynological grounds (*104, 107*).

Perhaps the most interesting aspect of the MSA faunas that I have studied is the information they have provided on the long-term evolution of subsistence behavior. The MSA horizons of Klasies River Mouth contain abundant shells (*108*), numerous bones of seals and penguins, and occasional bones of fish and flying seabirds. The relevant Klasies levels probably span much of the Last Interglacial, beginning roughly 130,000 years ago, and for the moment, they contain the oldest known evidence in the world for the systematic use of aquatic resources. Since earlier (Acheulean) sites in similar shoreline settings in Europe and Africa so far lack such evidence, it is possible that the Klasies people in fact were among the first ever to take systematic advantage of aquatic foods. In any case, the Klasies data are interesting because they stand in contrast to data from later sites in the same habitat. Thus, at coastal caves such as Nelson Bay (*99, 109*) and Elands Bay (*110*), where the levels with marine food remains all postdate 12,000 years ago, amounts of seal and penguin comparable to those at Klasies are accompanied by substantial quantities of bones of fish and flying birds, which are lacking at Klasies. The implication is that fishing and fowling (for airborne birds) were probably beyond the technological capabilities of the Klasies people. And Klasies is not alone in this respect. Middle Stone Age levels that are the same age or perhaps somewhat younger at Die Kelders show the same general pattern, as do apparently some recently discovered open-air MSA shell middens on the southwest Cape coast (*111*). The precise time when active fishing and fowling came about in the Klasies–Die Kelders region may be impossible to establish since the relevant sites were probably located on the now submerged coastlines of the Last Glacial (after 75,000 years ago).

The Klasies and Die Kelders MSA sites also contrast with later ones regarding the terrestrial faunas they contain. Thus, at both Klasies and Die Kelders, the most common larger bovid is the eland, and suids (bushpig and warthog) are rare or absent. In clearly post-MSA levels at nearby sites in the same region, such as Nelson Bay Cave (*109*) and Byeneskranskop Cave (*112*), eland are relatively much less common and suids are much more common. Eland are among the least dangerous and suids among the most dangerous larger ungulates, and I have hypothesized that the commonness of eland and rarity of suids in the Klasies and Die Kelders MSA levels indicate that MSA peoples were less effective hunters than their successors. Unfortunately, my search for comparable evidence in other areas has been frustrated by the absence of either large MSA faunal assemblages, large post-MSA ones, or both.

Besides information on the evolution of subsistence strategies, the MSA faunas that I have studied contain information on animal and site usage as reflected in the quantities of different skeletal parts. The MSA levels of Die Kelders have provided extraordinary numbers of mole rat bones, but foot bones are relatively rare, especially in those levels where mole rats are present almost to the exclusion of other species (*46*). I have hypothesized that the Die Kelders people were as much or more interested in the fur than in the flesh of the mole rat and that the missing feet were removed from the site with the skins. Die Kelders is located in a microenvironment where mole rats have probably always been especially common, and the extraordinarily large quantities of mole rat bones in certain levels may reflect the past occurrence of specialized, short-term furtrapping occupations.

In every MSA assemblage I have examined, it has turned out that the larger the species is, the smaller the variety of body parts is by which the species is likely to be well represented. This phenomenon has been observed elsewhere in the world and has been called the schlepp effect (*113*). Essentially, it indicates that smaller animals were often returned to base camps intact, while larger ones were generally butchered where they were killed, and only certain parts were regularly brought home. The presence of the schlepp effect in the MSA also explains an interesting contrast in the numbers of large bovid (eland and/or buffalo) body parts between Duinefontein 2 and Klasies 1. Klasies 1 is a cave with a high ratio of artifacts to bones and numerous well-defined hearths. It was almost certainly a base camp, and it contains a relatively large number of fragmentary larger bovid limb bones and relatively few larger bovid vertebrae. In contrast, the open-air site of Duinefontein 2 contains relatively few limb bones and relatively many vertebrae. The relatively low ratio of artifacts to bones and the general nature of the Duinefontein 2 debris scatter suggests that Duinefontein 2 was a kill or butchery site from which the meat- and marrow-bearing limb bones were systematically removed.

Unfortunately, the physical appearance of southern African MSA peoples is no better established than that of their predecessors. The major problem is that much material that could be used diagnostically has been reported at sites where MSA cultural associations were not firmly established (*114*). On the other hand, only very fragmentary human remains have come from sites where MSA associations have been well documented (*115*). A mandible recently found at Border Cave is perhaps the most significant available human fossil with certain MSA associations. It comes from a level substantially older then 50,000 radiocarbon years and is apparently modern in every respect (*116*). However, additional and more complete material will be needed before extensive conclusions can be drawn from this. This is particularly true because published provenience data indicate that the best candidate for an actual MSA fossil among the less well-documented material is the Florisbad skull, which possesses distinctly primitive features, recalling the Saldanha and Broken Hill (Kabwe) (or Rhodesian Man) skulls (*84*). For the moment, it seems reasonable to conclude that the makers of MSA artifacts belonged to *Homo sapiens*, though not necessarily to the modern variety.

Later Upper Pleistocene and Holocene

The Later Upper Pleistocene and Holocene lasted from approximately 40,000 years ago to the present.

It is a curious and intriguing fact that most known southern African caves with stratified MSA assemblages appear to have been abandoned approximately at the end of the MSA and only reoccupied tens of thousands of years later (*117, 118*). Evidence of occupation following more or less directly after the latest MSA is available at no more than two or three known sites—most notably Border Cave in Natal (*63*) and Boomplaas Cave in the southern Cape (*119*). The reason for this is obscure, but it probably reflects important demographic shifts in response to changes in environment during the early-to-middle part of the Last Glacial.

Besides Border Cave and Boomplaas, a very early post-MSA industry may be represented at Heuningsneskrans Shelter in the eastern Transvaal. There are no MSA levels at Heuningsneskrans, but an early post-MSA age is implied by carbon-14 dates and extrapolated sedimentation rates (*120*). None of the three probable early post-MSA industries has yet been described in detail, and it is unclear whether the three share enough similarities with better known industries postdating 20,000 to 15,000 years ago to be grouped with them in a single Later Stone Age (LSA). For the sake of convenience, however, I am using this term to cover all post-MSA industries. Defined in this way, the LSA of southern Africa began sometime prior to 40,000 years ago and ended at various times, depending upon the place. On the north and east, especially in Rhodesia, the Transvaal, and the eastern Orange Free State, Natal, and the northern Cape, it came to an end with the arrival and dispersal of Bantu-speaking, Iron Age agriculturalists, beginning approximately at the time of Christ (*121*). On the south and west, especially in the southern and western Cape and the western Orange Free State, it continued later but was eventually brought to a halt by the spread of Europeans, mainly from the vicinity of Cape Town beginning in the latter half of the 17th century (*122*).

Later Stone Age industries postdating 20,000 to 22,000 years ago are fairly well known and show considerable change through time (*123*). Particularly well established is the widespread occurrence of macrolithic industries in the millennia preceding 10,000 to 8,000 years ago and their equally widespread replacement by microlithic successors thereafter. These microlithic industries, with their small convex scrapers and backed elements (Fig. 2, E to J) comprise the classic LSA Wilton Industrial Complex of southern Africa. Their widespread appearance between 10,000 and 8,000 years ago probably indicates the spread of an important innovation, such as the bow and arrow or at least a new kind of composite arrow with small backed elements inserted at the tip (*124, 125*).

It is not yet possible to document variability among the various macrolithic assemblages predating 10,000 to 8,000 years ago, but regional differences among subsequent, contemporaneous microlithic ones have been well established (*126–128*). Temporal changes also occur within the microlithic industries and have been especially well demonstrated in the southeastern Cape, where they probably reflect adjustments by Wilton peoples to changes in their natural, demographic, or cultural milieu (*129*).

Although raw materials other than stone were probably used for artifact manufacture in southern Africa as early as (or even earlier than) stone, there is little direct evidence for this prior to the LSA. Occasional bone points have been reported from MSA levels (*130*), but it is not until the LSA that such artifacts become really common. They are then often present in substantial numbers and accompanied by other apparently standardized tool types, for example, pieces called awls and spatulas. A further distinction between LSA and MSA sites is that LSA ones with appropriate preservational conditions almost always contain articles interpretable as ornaments and art objects. Such articles, besides being made of bone, are often made of molluscan shell and particularly ostrich eggshell. Small beads made of ostrich eggshell are ubiquitous in the LSA, and on the evidence from Border Cave (*63*), may have been manufactured from the start of the LSA, 38,000 or more years ago.

Later LSA sites also provide excellent evidence for the use of skin and sinew and of various plant materials for artifact manufacture. For example, the remarkable Wilton horizons of Melkhoutboom have provided pieces of cordage, netting, and matting made from sinews and plant fibers; small pieces of leather garments; cut or broken sections of reeds probably representing couplings or parts of arrow shafts; and numerous wooden objects—both shavings and finished products that seem to have been fire sticks, fire drills, points, pegs, and probable holders for stone bits (*118*). Although no stone artifacts were actually found in mounts at Melkhoutboom, many pieces do bear traces of the vegetal mastic by which they were attached to their hafts.

It is commonly assumed that LSA peoples are responsible for most of the rock paintings and engravings that are widespread in southern Africa (*131*), and direct associations between LSA artifacts and painted slabs have been reported at various sites in the southern Cape, most prominently at Klasies River Mouth Cave 5 (*132*) and Boomplaas (*133*). At Klasies, carbon-14 suggests an age of approximately 2300 years old for the two painted stones that were found; at Boomplaas, three stones are between 1900 and 1700 years old, and a fourth is approximately 6400 years old. However, the most spectacular discovery of painted stones is at Apollo 11 in South West Africa (*66, 134*), where seven fragments of slabs with painted animal figures are minimally 18,000 to 19,000 and maximally 25,500 to 27,500 radiocarbon years old. These paintings are among the oldest works of art known anywhere in the world.

Like their MSA and Acheulean predecessors, LSA peoples occupied a wide variety of sites—coastal and inland caves and open-air sites near rivers, springs, and marshes. Most sealed sites preserve well-defined fossil hearths and sometimes post molds (*135*), the latter suggesting that partitions or windbreaks were constructed. Artificially dug pits and depressions have been found at several sites, most prominently at Melkhoutboom (*118*) and Boomplaas (*119*), where they were used at least in part for the storage of fruits and seeds. Finally, at least beginning 14,000 to 12,000 years ago, LSA peoples often buried their dead in habitation sites, sometimes in relatively elaborate graves (*136*).

Faunal remains have been reported from many LSA sites, especially the more recent (Holocene) ones. The general pattern is very similar to that of the MSA—LSA peoples concentrated their hunting on various ungulates up to buffalo size and largely ignored or avoided the largest, most dangerous herbivores (rhinoceroses and elephants) and the larger carnivores. Once again, the most detailed available analyses of large faunal samples are my own, undertaken mainly for sites such as Byeneskranskop (*137*), Nelson Bay (*109, 137*), Boomplaas (*137*), and Elands Bay (*108, 137*) in the southern Cape. These analyses reveal some similarities and some differences between MSA and LSA faunas. The most obvious similarity is in body part counts, which show that the schlepp effect was present in the LSA in much the same way as it was in the MSA. The most striking differences are in species numbers, as already discussed above. Unlike MSA coastal sites, LSA ones contain a very large number of bones of fish and flying birds such as cormorants and gulls. At sites such as Swartrif midden (*138*), Nelson Bay (*99*), and Elands Bay (*110*) in the southern Cape, the LSA levels have even provided some of the artifacts that were probably used in procuring fish and birds. These include what were probably line sinkers and small bone slivers, intentionally sharpened at both ends to form gorges that could have been useful in either fishing or fowling. At least very recent LSA peoples also apparently constructed artificial intertidal fish traps, which are still preserved in some localities (*139*). There are also contrasts in the numbers of different terrestrial species (see above), which suggest to me that LSA peoples probably possessed the technological means (for example, snares and long-distance projectiles) to reduce the risk of hunting the more dangerous available prey species.

So far, it is only in the southern Cape that it is possible to talk about long-term changes in relative species numbers within the LSA. These changes do not suggest that definite technological advances were made, but they do indicate that LSA peoples had to cope with substantial long-term shifts in the nature of their basic resources. Thus, terminal Pleistocene LSA levels (predating 10,000 years ago) contain substantial quantities of bones from grazing ungulates such as wildebeest and springbok that have never been recorded locally in Holocene contexts (postdating 10,000 years ago). In contrast, Holocene LSA levels are characterized mainly by large numbers of such historically prominent browsers as grysbok, steenbok, bushbuck, and common duiker. The conclusion is inescapable that the late Pleistocene flora of the southern Cape included substantially more open grassland than the flora of the Holocene, which was dominated by bush, scrub, and fynbos. It is probable that adjustment to marked change in the flora during the transition from the Pleistocene to the Holocene was an important factor in the appearance of the Wilton Industry. Besides the technological changes implied by the appearance of new artifact types, cultural readaptation probably also involved important changes in demography and social organization, reflecting the very different habits of the principal prey species. Late Pleistocene hunter-gatherer bands, subsisting in large part on migratory, gregarious grazers, probably dispersed themselves more widely and occupied larger home ranges than their Holocene successors, who were forced to subsist to a much greater extent on nonmigratory, solitary browsers and perhaps also on plants (*118*).

During the transition from the Pleistocene to the Holocene in the southern Cape, the general change in environment was accompanied by the last appearance of two mammalian genera, the giant buffalo, *Pelorovis*, and the "giant hartebeest," *Megalotragus*, and of five or six species in surviving genera, most prominently the "giant Cape horse," *Equus capensis*, and the southern springbok, *Antidorcas australis* (*13*). The giant buffalo, "giant hartebeest," and "giant Cape horse" are also all known from earlier Upper Pleistocene contexts in the southern African interior, and it is possible that they survived there until roughly 10,000 years ago as well, although this remains to be demonstrated. At many earlier Upper Pleistocene sites, they are associated with yet another species that may have become extinct at the end of the Pleistocene, the hyperhypsodont springbok, *Antidorcas bondi*.

The causes of extinction remain unestablished, but I think it is significant that many of the animals that disappeared around 10,000 years ago in the southern Cape also became substantially less numerous during the last interval of similar environmental change, following 130,000 years ago. Such dimunition during environmental change suggests that a reduction in open grassland led to restriction in both the ranges and numbers of the animals that disappeared. But the fact that the animals survived the last period of similar environmental change indicates that this by itself is an insufficient explanation. What perhaps made the difference between continued existence and extinction 10,000 years ago was the presence of technologically more advanced hunters, as reflected in the contrasts between MSA and LSA faunas and artifact assemblages. The initial response of southern Cape LSA peoples to a reduction in the numbers of large grazers may have been to intensify their pursuit of those that were left. Only later, when this proved nonadaptive, did they perhaps turn their attention increasingly to various browsing creatures and monocotyledonous geophytic plants, both of which were probably substantially more numerous as a result of the environmental change.

The prehistoric inhabitants of southern Africa probably always relied to a large extent on plants as well as animals for their subsistence. However, it is only in the later stages of the LSA that there is substantial direct evidence for plant use (*140*). Similarly, although southern African hunter-gatherers probably always moved from place to place in response to seasonal changes in the distribution of resources, the earliest direct evidence for a seasonal round is again derived from the later stages of the LSA, particularly at Melkhoutboom, Nelson Bay, and Elands Bay Caves (*141*).

Since at least later LSA peoples (postdating 14,000 to 12,000 years ago) frequently buried their dead in occupation sites, their physical appearance is reasonably well known. Unquestionably, they were members of the modern subspecies (*Homo sapiens sapiens*), and, more specifically, they bore a strong resemblance to the historic "Bush-Hottentot" peoples of southern Africa to whom they were probably ancestral (*142*). The identity of earlier LSA peoples remains to be established, but it seems very likely that they were also members of *Homo sapiens sapiens*. Future research may well show that the origins of the LSA are in fact linked to the appearance of modern people in southern Africa in much the same way as the origins of the Upper Paleolithic are linked to the appearance of modern people in Western Europe.

Summary

It is not possible at present to demonstrate hominid occupation of southern Africa prior to the middle or late Pliocene, perhaps 3 million years ago. It may be the case that much, if not most, of the subcontinent was in fact uninhabited before that. The earliest hominid known to have lived in southern Africa is *Australopithecus africanus*. It was apparently replaced by *Homo* (?evolved into *Homo*) by 2 million years ago, at approximately the same time as *A. robustus* is first recorded locally. *Homo* and *A. robustus* then coexisted until perhaps 1 million years ago, after which *Homo* survived alone. There is no solid evidence that either of the southern African australopithecines made tools or accumulated bones. In fact, at the known sites, it now seems more likely that the bones, including those of the australopithecines themselves, were accumulated by carnivores.

The known archeological record of southern Africa begins 2 million to 1.5 million years ago and the oldest stone tools may belong to the Oldowan Industry. Far better documentation exists for the succeeding Acheulean Industrial Complex, which was present in southern Africa almost certainly before 1 million years ago and persisted with modifications probably until sometime between 300,000 and 130,000 years ago. Although it is known that Acheulean peoples made handaxes, cleavers, and other stone tools, very little else is known about the activities of Acheuleans in southern Africa. Far more is known about their Middle and Later Stone Age successors. Southern African MSA peoples were perhaps among the earliest anywhere to take systematic advantage of aquatic resources for their subsistence, although they apparently did so far less effectively than did the LSA peoples who followed them. There are also contrasts between the ways in which MSA and LSA peoples dealt with terrestrial prey and between the contents of MSA and LSA artifact assemblages. The LSA peoples, for example, seem to have made much more extensive use of bone as a raw material, and they were the first to manufacture articles that are clearly interpretable as ornaments or art objects. From an evolutionary perspective, the LSA may represent a quantum advance over the MSA, perhaps correlated with the replacement of an archaic human physical type by the modern one. However, this must remain only a working hypothesis until much more is learned about the earliest LSA, dating to 35,000 to 40,000 years ago or more, and until there are adequate samples of well-provenienced MSA and early LSA physical remains.

The later LSA, postdating 20,000 to 18,000 years ago, is reasonably well known. Later LSA peoples were probably at least partly responsible for the extinction of several large mammals in southern Africa about 10,000 years ago. By that date or shortly thereafter, at least some LSA peoples established basic hunting-gathering adaptations, which continued until the introduction and spread of agriculture and pastoralism, beginning roughly 2000 years ago. Thereafter, hunters and gatherers became progressively restricted in numbers and distribution, such that today only a very few exist, restricted to some of the most marginal environments of the subcontinent. It remains a major goal of southern African archeology to shed more light on the evolution and operation of hunting-gathering cultures during the vast time span when they covered all of southern Africa.

References and Notes

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11. See (*9*) for current Elandsfontein faunal list.
12. See (*13*) for an Upper Pleistocene faunal list for the Langebaanweg-Elandsfontein area. The excluded carnivore taxa for Langebaanweg, Elandsfontein, and the later sites were small viverrids and mustelids, *Otocyon* and *Proteles*. Prey species that were counted included all Primates, Tubulidentata, Proboscidea, Hyracoidea, Perissodactyla, Artiodactyla, and Lagomorpha, and excluded all Rodentia but *Hystrix* and *Bathyergus*.
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16. Relevant stratigraphic observations may be found in (*17–21*). Substantial temporal heterogeneity may also be inferred directly from the faunas of Swartkrans and Sterkfontein (*22–24*).
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18. ——, *S. Afr. J. Sci.* **72**, 136 (1976).
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25. E. S. Vrba (*23*, *26*) has recently completed systematic studies of the bovids from Sterkfontein, Swartkrans, and Kromdraai and is presently working on those from Makapansgat, previously described by L. H. Wells and H. B. S. Cooke [*Palaeontol. Afr.* **54**, 1 (1956)]. She has used recorded data regarding stratigraphic provenience, the nature of adhering matrix, the locations and contrasting contents of spoil heaps providing fossils, and taxonomy itself to isolate stratigraphically and temporally discrete subsamples of bovids within the temporally heterogeneous samples from Swartkrans and Sterkfontein. She has then compared the subsamples to stratigraphically and radiometrically controlled bovid faunas from Olduvai Gorge, East Turkana (formerly, East Rudolf), Omo, and other areas to establish the approximate ages of the hominids and artifacts with which the subsamples were associated. For the most part, her age estimates appear to be in agreement with those based on data from other taxa [see, for example, (*22*) and G. Petter, *Fossil Vertebr. Afr.* **3**, 43 (1973), on the carnivores. See H. B. S. Cooke and V. J. Maglio, in *Calibration of Hominoid Evolution*, W. W. Bishop and J. A. Miller, Eds. (Scottish Academic Press, Edinburgh, 1972), p. 303; V. J. Maglio, *Trans. Am. Philos. Soc.* **63** (No. 3), 1 (1973), on the pigs and elephants].
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27. It is now clear that the Swartkrans fill (Formation) consists of at least two and perhaps three major members (*18*, *24*). The one that contains remains of *A. robustus* and of Vrba's "Ska" fauna is the oldest, with a probable age of 2 million to 1.5 million years old (that is broadly equivalent to Upper Bed I and Lower Bed II at Olduvai Gorge). This oldest member also contains remains of early *Homo* and stone artifacts. The next oldest, with Vrba's "Earlier Skb" fauna, is perhaps a million years younger (broadly equivalent to Olduvai Bed IV or the mid-Pleistocene site of Elandsfontein in South Africa). It has provided no australopithecine fossils, but it does contain remains of *Homo* and artifacts that are probably Acheulean. Finally, there is apparently a younger unit (with Vrba's "Later Skb" fauna) of probable Upper Pleistocene age. It contains no hominid fossils and has uncertain (?Middle Stone Age) cultural associations.
28. Kromdraai consists of two adjacent sites, which were once thought to be the same age (*29*). Only site B has provided hominid remains and artifacts. The fossils belong to *A. robustus* (including the holotype), and there is a single undoubted stone flake. Vrba has suggested that site A (lacking both hominids and artifacts) is somewhat younger than the *A. robustus* stratigraphic unit at Swartkrans, while she thinks site B may be substantially younger, perhaps dating to no more than a few hundred thousand years ago. However, the bovid fauna of Kromdraai B is scanty, and an estimate that would make the australopithecines of the area perhaps the youngest known anywhere is not supported by data on nonbovid fossils [(*29*); Q. B. Hendey, *Ann. Transvaal Mus.* **28**, 99 (1973); L. Freedman and C. K. Brain, *Ann. Transvaal Mus.* **22**, 242 (1972)].
29. C. K. Brain, in *Paleoanthropology, Morphology and Paleoecology*, R. H. Tuttle, Ed. (Mouton, The Hague, 1975), p. 225.
30. The Taung fauna contains few bovids and relatively few taxa found at the other sites. In addition, most of the fauna apparently comes from below the level of the australopithecine skull. The age of the skull remains unclear, but the cercopithecoids [L. Freedman, *Palaeontol. Afr.* **13**, 109 (1970)] suggest that it may be substantially younger than the gracile australopithecines from Makapansgat and Sterkfontein [L. H. Wells, *S. Afr. Archaeol. Bull.* **24**, 93 (1969)]. On geomorphological evidence, it has been suggested that the Taung hominid may lie "closer to the Lower-Middle Pleistocene than to the Plio-Pleistocene boundary" (*15*), that is, closer to 0.7 million than to 1.8 million years ago. This would make the Taung specimen perhaps a million years younger than any other known *A. africanus*, a hypothesis that has prompted the speculation that it may be a member of the *A. robustus* lineage (*20*). Because we lack a detailed morphological description of the specimen and because the individual involved was a child, this speculation is difficult to evaluate at present.
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35. Vrba's work (*23*, *26*) shows that antilopine and alcelaphine antelopes are well represented throughout Sterkfontein, Swartkrans, and Kromdraai. Such representation indicates a general persistence of relatively open vegetational settings. Some fluctuations in antelope species frequencies do suggest environmental changes (settings always grassy, but sometimes more so), but again not any definite correlation of either type of australopithecine to a particular kind of vegetational setting.
36. There is only one artifact from Kromdraai B of which we are certain; most of the Swartkrans artifacts described by M. D. Leakey [*Nature (London)* **225**, 1222 (1970)] probably came from deposits postdating *A. robustus*.
37. R. A. Dart, in *Proceedings of the Third Pan-African Congress on Prehistory*, J. D. Clark, Ed. (Chatto & Windhus, London, 1957), p. 161; *Transvaal Mus. Mem.* **10**, 1 (1957).
38. P. Shipman and J. E. Phillips, *Curr. Anthropol.* **17**, 170 (1976); *Am. J. Phys. Anthropol.* **46**, 77 (1977).
39. R. G. Klein, *Quat. Res. (N.Y.)* **5**, 275 (1975).
40. C. K. Brain, *Sci. Pap. Namib Desert Res. Stn.* **32**, 1 (1967); *ibid.* **39**, 13 (1969).

R. A. Dart, *Am. J. Phys. Anthropol.* **7**, 1 (1949).

42. C. K. Brain, *Zool. Afr.* **7**, 379 (1972).
43. ——, *S. Afr. Mus. Assoc. Bull.* **9**, 127 (1968); *S. Afr. Archaeol. Bull.* **24**, 170 (1969). Feeding observations that Brain has made on large cats suggest that such cats can destroy virtually the entire postcranial skeleton of primates but do less damage to the more robust postcranial remains of bovids. There are numerous postcranial remains of bovids at Swartkrans, but the remains of *A. robustus* consist almost exclusively of cranial elements. One of these elements is a large piece of skull with two punctate depressions, the distance between which is such as to have been made by the canines of a leopard.
44. ——, *Nature (London)* **225**, 1112 (1970).
45. A. J. Sutcliffe, *ibid.* **227**, 1110 (1970); G. Mills, *Afr. Wildl.* **27**, 150 (1973).
46. R. G. Klein, paper presented at Burg-Wartenstein Symposium No. 69, Burg-Wartenstein, Austria, July 1976.
47. Yet an additional criterion is degree of bone fragmentation. C. K. Brain (*29*, *44*) has suggested that the degree of bone fragmentation will be greater in hominid than in carnivore sites, but in my experience in analyzing several large southern African later Pleistocene archeological and nonarcheological faunas, bone communition is usually a reflection of postdepositional factors, especially rate of sedimentation and intensity of occupation. Until postdepositional factors can be thoroughly controlled, I feel that degree of fragmentation should not be regarded as a reliable indicator of the agent that accumulated bones at a site.
48. H. J. Deacon, in *After the Australopithecines*, K. W. Butzer and G. Ll. Isaac, Eds. (Mouton, The Hague, 1975), p. 225.
49. P. V. Tobias, in *The Functional and Evolutionary Biology of Primates*, R. H. Tuttle, Ed. (Aldine, Chicago, 1972), p. 63; A. E. Mann, *Univ. P. Publ. Anthropol.* **1**, 1 (1975).
50. C. G. Sampson, *The Stone Age Archaeology of Southern Africa* (Academic Press, New York, 1974).
51. G. Ll. Isaac and G. Curtis, *Nature (London)* **249**, 624 (1974); G. Ll. Isaac, in *After the Aus-*

tralopithecines, K. W. Butzer and G. Ll. Isaac, Eds. (Mouton, The Hague, 1975), p. 495.

52. F. Wendorf, R. L. Laury, C. C. Albritton, R. Schild, C. V. Haynes, P. E. Damon, M. Shafqullah, R. Scarborough, *Science* **187**, 740 (1975).
53. At Cornelia in the northeastern Orange Free State, Acheulean artifacts underlie a level that contains an archaic fauna broadly similar to that of Olduvai Gorge Upper Beds II to IV [K. W. Butzer, J. D. Clark, H. B. S. Cooke, *Mem. Natl. Mus. (Bloemfontein)* **9**, 1 (1974)]. A comparable fauna accompanies bifaces in the stratigraphic units that immediately overlie the units with australopithecines at both Swartkrans and Sterkfontein. A similar fauna also occurs with Acheulean artifacts in the "Younger Gravels" of the Lower Vaal River [(*54*); H. B. S. Cooke, *Mem. Geol. Surv. S. Afr.* **35** (No. 3), 1 (1949); L. H. Wells, *S. Afr. J. Sci.* **60**, 91 (1964)] and is probably also contemporaneous with the numerous Acheulean artifacts found at Elandsfontein (also Hopefield or Saldanha) in the southwestern Cape [(R. Singer and J. R. Crawford, *J. R. Anthropol. Inst.* **88**, 11 (1958); K. W. Butzer, *S. Afr. J. Sci.* **69**, 234 (1973)]. On the basis of what is currently considered to be the age of Olduvai Upper Beds II to IV [M. D. Leakey, in *After the Australopithecines*, K. W. Butzer and G. Ll. Isaac, Eds. (Mouton, The Hague, 1975)], I feel that it is possible that some of the known southern African Acheulean sites are more than a million years old, and many, if not most of them are probably older than 400,000 years. Faunal evidence for an Acheulean site that may postdate Bed IV at Olduvai is limited to the Cave of Hearths, Transvaal (*54, 56*). The Acheulean fauna from this site appears to lack the archaic forms represented at Cornelia, Elandsfontein, and other sites, and to resemble closely the more modern fauna that accompanies succeeding Middle Stone Age industries at both the Cave of Hearths itself and at numerous other sites in southern Africa. However, the bone assemblage from the Cave of Hearths Acheulean levels is very small and highly fragmented, and it cannot be ruled out that sampling error, rather than a late date, accounts for the apparent absence of more archaic taxa.

    It is difficult to estimate the age of the latest Acheulean in southern Africa. Not very long ago, it was thought that the Acheulean persisted until 60,000 to 55,000 years ago, because there were finite carbon-14 dates in this range from Amanzi Springs, southern Cape (*57*) and Kalambo Falls, Zambia [J. D. Clark, *Kalambo Falls Prehistoric Site* (Univ. of Cambridge Press, Cambridge, 1969), vol. 1]. Essentially Acheulean assemblages referred to as Sangoan, Gwelan, and Charaman at Kalambo and at Pomongwe Cave in Rhodesia [(*58*); C. K. Cooke, *Arnoldia* (*Rhodesia*) **2** (No. 22), 1 (1966); *ibid*. **3** (No. 39), 1 (1968)] were associated with even later dates, that is, between 50,000 and 35,000 years ago. It now seems likely that the relevant Amanzi, Kalambo, and Pomongwe dates were all only conservative estimates, since a growing body of geological and paleontological evidence, supported by infinite radiocarbon measurements, indicates that the succeeding Middle Stone Age was probably established in southern Africa by the beginning of the Last Interglacial period, if not before [(*59–61*); for lists of relevant carbon-14 dates see (*62–66*)]. It now seems possible that a uranium series date of 167,000 ± 25,000 years on calcrete associated with what are probably late Acheulean (Fauresmith) artifacts at Rooidam, northern Cape [mimeographed addendum to (*67*)] is reasonable as a terminal date for the Acheulean, but even this may be only a conservative estimate.
54. H. B. S. Cooke, in *African Ecology and Human Evolution*, F. C. Howell and F. Bourlière, Eds. (Aldine, Chicago, 1964), p. 65.
55. R. G. Klein, *Nature (London)* **244**, 311 (1973).
56. R. J. Mason, *Prehistory of the Transvaal* (Witwatersrand Univ. Press, Johannesburg, 1962).
57. H. J. Deacon, *Ann. Cape Prov. Mus. Nat. Hist.* **8**, 89 (1970).

C. K. Cooke, *S. Afr. Archaeol. Bull.* **18**, 73 (1963).

59. R. G. Klein, *Science* **190**, 265 (1975).

______, *S. Afr. Archaeol. Bull.* **31**, 12 (1976).

61. K. W. Butzer, in preparation.
62. J. C. Vogel and P. B. Beaumont, *Nature (London)* **237**, 50 (1972); P. B. Beaumont and J. C. Vogel, *Afr. Stud.* **31**, 65 (1972).
63. P. B. Beaumont, *S. Afr. J. Sci.* **69**, 41 (1973).
64. R. G. Klein, *World Archaeol.* **5**, 249 (1974).
65. P. L. Carter and J. C. Vogel, *Man* **9**, 557 (1974).

W. E. Wendt, *S. Afr. Archaeol. Bull.* **31**, 5 (1976).

67. K. W. Butzer, *J. Archaeol. Sci.* **1**, 1 (1974).
68. ______, in *After the Australopithecines*, K. W. Butzer and G. Ll. Isaac, Eds. (Mouton, The Hague, 1975), p. 857.
69. G. J. Fock, *S. Afr. J. Sci.* **64**, 153 (1968).
70. C. M. Keller, *Quaternaria* **13**, 187 (1970); *Univ. Calif. Berkeley Publ. Anthropol. Rec.* **28**, 1 (1973).
71. J. D. Clark (*72*) suggests that the Sangoan was restricted to the more wooded areas of equatorial and southcentral Africa north of the Limpopo, while the Fauresmith occurred elsewhere in vegetational settings that were more open, as for example on the South African highveld. According to Clark, Sangoan assemblages are characterized by "small scraping and cutting tools and certain heavy duty equipment, notably steep scraping forms and crude pick-like tools" (p. 112). In contrast, Fauresmith assemblages are known "by handaxes and cleavers . . . often of quite small proportions" and by "a number of retouched scraper forms made on flakes often struck from specially prepared cores giving either thin, broad, Levallois flakes or long, blake-like forms" (p. 110).
72. J. D. Clark, *The Prehistory of Africa* (Thames & Hudson, London, 1970).
73. H. J. Deacon (*48*), based on data in J. D. Clark, Compiler, *Atlas of African Prehistory* (Univ. of Chicago Press, Chicago, 1967).
74. As suggested for example by various occurrences in the Vaal "Younger Gravels" [P. G. Söhnge, D. J. L. Visser, C. van Riet Lowe, *Mem. Geol. Surv. S. Afr.* **35** (1, 2), 1 (1937); C. van Riet Lowe, *S. Afr. Archaeol. Bull.* **7**, 135 (1952)].
75. As shown particularly clearly at Rooidam and Doornlaagte in the northern Cape (*67, 69, 76*).
76. R. J. Mason, *Occas. Pap. Archaeol. Res. Unit Univ. Witwatersrand* **1**, 1 (1967).
77. Notably Amanzi [(*57*); K. W. Butzer, *Quaternaria* **17**, 299 (1973)].
78. Besides Montagu (*70*) and the Cave of Hearths (*56*) mentioned previously, also Olieboompoort in the Transvaal (*56*), Wonderwerk in the northern Cape [B. D. Malan and L. H. Wells, *S. Afr. J. Sci.* **40**. 258 (1943)], and Pomongwe (*58*) and Bamb [A. L. Armstrong, *J. R. Anthropol. Inst.* **61**, 239 (1931)] in Rhodesia.
79. C. K. Brain, in *Background to Evolution in Africa*, W. W. Bishop and J. D. Clark, Eds. (Univ. of Chicago Press, Chicago, 1967), p. 285.
80. The former presence of substantial quantities of plant material in the Montagu Acheulean levels is suggested both by the large quantities of plant opal (from grasses) (*70*) and by the peculiar undulating lamination of the deposits [K. W. Butzer, *Univ. Calif. Berkeley Publ. Anthropol. Rec.* **28**, 89 (1973)].
81. R. Singer and J. J. Wymer, *S. Afr. Archaeol. Bull.* **91**, 63 (1968).
82. R. J. Clarke, F. C. Howell, C. K. Brain, *Nature (London)* **225**, 10 (1976).
83. P. V. Tobias, in *Evolution und Hominisation*, G. Kurth, Ed. (Fischer, Stuttgart, 1968), p. 176; *Am. J. Phys. Anthropol.* **34**, 335 (1971).
84. R. Singer, in *Hundert Jahre Neanderthaler*, G. H. R. von Koenigswald, Ed. (Kemink & Zoon, Utrecht, 1957), p. 52; G. P. Rightmire, *Nature (London)* **260**, 238 (1976).
85. Sources with pertinent carbon-14 dates are given in (*62–66*). Evidence that the southern African MSA dates back to at least the beginning of the Last Interglacial has come primarily through geological investigations at coastal caves in the southern Cape Province [(K. W. Butzer, *S. Afr. Archaeol. Bull.* **28**, 97 (1973)] and at Border Cave in Natal (______ and P. B. Beaumont, in preparation), and partially through paleontological investigations at the southern Cape open-air site of Duinefontein 2 (*60*).
86. The following sites are most important: (i) Apollo 11 [(*87*); F. Thackeray, "An analysis of fanual remains from Late Pleistocene and Holocene archaeological sites in southern South West Africa," thesis, University of Cape Town (1975)] in South West Africa; (ii) Pomongwe (*50, 58*) and Redcliff [(*88*); C. K. Brain and C. K. Cooke, *S. Afr. Archaeol. Bull.* **27**, 171 (1967)] in Rhodesia; (iii) site designated =gi [J. E. Yellen, *Botswana Notes Rec.* **3**, 276 (1971)] in Botswana; (iv) the Cave of Hearths (*56*), Kalkbank [(*56, 76*); R. G. Welbourne, "A study of prehistoric relationships between environment, animals, and man at one Earlier Stone Age site, one Middle Stone Age site, and eight Ion Age sites in the Vaal-Limpopo Basins" (thesis, University of the Witwatersrand (1971)], and Bushman Rock Shelter](*89*); C. K. Brain, *S. Afr. Archaeol. Bull.* **24**, 52 (1969)] in the Transvaal; (v) Florisbad (*54, 90*) and Vlakkraal [(*54*); L. H. Wells, H. B. S. Cooke, B. D. Malan, *Trans. R. Soc. S. Afr.* **29**, 203 (1942)] in the Orange Free State; (vi) Sehonghong (*65*) in Lesotho; (vii) Border Cave (*63, 91, 92*) in Natal; (viii) Witkrans (*93*) in the northern Cape; and (ix) Klasies River Mouth (*59, 64, 94, 95*), Die Kelders [(*59*); A. J. Tankard and F. R. Schweitzer, *S. Afr. J. Sci.* **70**, 365 (1974); in *Geoarchaeology*, D. A. Davidson and J. L. Shackley, Eds. (Duckworth, London, 1976), p. 298], and Duinefontein 2 [(J. Deacon, *S. Afr. Archaeol. Bull.* **31**, 21 (1976)] in the southern Cape.
87. W. E. Wendt, *Cimbebasia Ser. B* **2**, 1 (1972).
88. R. G. Klein, *Occas. Pap. Natl. Mus. Rhodesia*, in press.
89. A. W. Louw, *S. Afr. Archaeol. Bull.* **24**, 39 (1969).
90. A. C. Hoffman, *S. Afr. J. Sci.* **51**, 163 (1955).
91. H. B. S. Cooke, B. D. Malan, L. H. Wells, *Man* **45**, 6 (1945).
92. R. G. Klein, *S. Afr. Archaeol. Bull.*, in press.
93. J. D. Clark, *Am. Anthropol.* **73**, 1211 (1971).
94. J. J. Wymer and R. Singer, in *Man, Settlement and Urbanism*, P. J. Ucko, R. Tringham, G. W. Dimbleby, Eds. (Duckworth, London, 1972), p. 207; in preparation.

R. G. Klein, *S. Afr. Archaeol. Bull.* **31**, 75 (1976).

______, *ibid*. **25**, 127 (1970).

97. The relevant assemblages are variously known as Howieson's Poort, Magosian, Tshangula, Umguzan, Modderpoort, Epi-Pietersburg, and Final Middle Stone Age. Prominent sites where they occur include Redcliff and Tshangula in Rhodesia [C. K. Cooke, *Arnoldia (Rhodesia)* **7** (No. 4), 1 (1969)], the Cave of Hearths in the Transvaal (*56*); Apollo 11 in South West Africa (*66*); Moshebi's Shelter and other sites in Lesotho (*65, 98*); Border Cave in Natal (*63, 91*); and Nelson Bay (*99, 100*), Klasies River Mouth (*94*), and Montagu (*69*), among other sites in the southern Cape.
98. P. L. Carter, *Lesotho* **8**, 13 (1969).
99. R. G. Klein, *Palaeoecol. Afr.* **6**, 177 (1972).
100. T. P. Volman, in preparation.
101. Most prominently Orangia 1 in the Orange Free State (*102*).
102. C. G. Sampson, *Mem. Natl. Mus. (Bloemfontein)* **4**, 1 (1969).
103. For example, those recorded on the margins of Paleolake Alexandersfontein near Kimberley (*104*).
104. K. W. Butzer, G. J. Fock, R. Stuckenrath, A. Zilch, *Nature (London)* **243**, 328 (1973).
105. Most prominently Florisbad (*90*) in the Orange Free State.
106. Most clearly Duinefontein 2 in the southern Cape (*60*).
107. K. W. Butzer and D. M. Helgren, *Quat. Res. (N.Y.)* **2**, 143 (1972); ______, G. J. Fock, R. Stuckenrath, *J. Geol.* **81**, 341 (1973); K. W. Butzer, *Boreas* **2**, 1 (1973); E. M. van Zinderen Bakker and K. W. Butzer, *Soil Sci.* **116**, 236 (1973); K. W. Butzer, *Geosci. Man* **13**, 27 (1976).
108. E. Voigt, *S. Afr. J. Sci.* **69**, 306 (1973).
109. R. G. Klein, *Quat. Res. (N.Y.)* **2**, 135 (1972).
110. J. E. Parkington, *Afr. Stud.* **31**, 223 (1972); "Follow the San," thesis, University of Cambridge (1977).
111. G. Avery and R. G. Klein, in preparation.
112. R. G. Klein and F. R. Schweitzer, in preparation.
113. D. Perkins and P. Daly, *Sci. Am.* **219** (No. 11), 97 (1968).
114. Among the more prominent sites with possible MSA human remains are Cape Flats [M. R. Drennan, *J. R. Anthropol. Inst.* **59**, 429 (1929)], Peers Cave [A. Keith, *New Discoveries Relating to the Antiquity of Man* (Williams & Norgate, London, 1931)], Florisbad (*84*), Border Cave (*91*), Boskop [L. H. Wells, *Man* **58**, 158 (1959)], and Tuinplaats [R. Broom, *Illustrated London News*, 16 March 1929, p. 426].
115. Among sites with well-documented but very fragmentary MSA human remains are Die Kelders (R. G. Klein and F. R. Schweitzer, unpublished), Klasies River Mouth [R. Singer and P. Smith, *Am. J. Phys. Anthropol.* **31**, 256 (1969)], Witkrans (*93*), and Redcliff (R. G. Klein and C. K. Cooke, unpublished).
116. H. de Villiers, *S. Afr. J. Sci.* **72**, 212 (1976).
117. Examples of sites with substantial gaps in occupation following the MSA are Pomongwe in Rhodesia (*58*); the Cave of Hearths (*56*), Olieboompoort (*56*), and Bushman Rock (*89*) in the Transvaal; Pockenbank 1, Schlangen-

grotte, Bremen, Fackelträger, Zais, Zebrarivier, and other sites in South West Africa (*87*); Moshebi's Shelter in Lesotho (*98*); and Montagu (*69*), Nelson Bay (*99*), Highlands Shelter (*118*), Klasies River Mouth (*94*, *95*), and other sites in the southern Cape.
118. H. J. Deacon, *S. Afr. Archaeol. Soc. Monogr. Ser.* **1**, 1 (1976).
119. _____ and M. Brooker, *Ann. S. Afr. Mus.* **71**, 203 (1976); H. J. Deacon, in preparation.
120. J. C. Vogel and M. Marais, *Radiocarbon* **12**, 444 (1971); P. B. Beaumont, in preparation.
121. R. J. Mason, *J. S. Afr. Inst. Min. Metall.* **74**, 211 (1974); _____, M. Klapwijk, R. G. Welbourne, T. M. Evers, B. H. Sandelowsky, T. M. O'C. Maggs, *S. Afr. J. Sci.* **69**, 324 (1973); T. N. Huffman, *S. Afr. Archaeol. Bull.* **25**, 3 (1970).
122. Although Iron Age peoples never actually occupied the southern and western Cape in prehistoric times, their influence there seems to be indicated by the appearance of pottery and domestic stock there at the time of Christ or shortly thereafter, as shown at Die Kelders [F. R. Schweitzer, *S. Afr. Archaeol. Bull.* **29**, 75 (1974); "The ecology of post-Pleistocene peoples on the Gansbaai Coast, South-western Cape," thesis, University of Stellenbosch (1976)], Nelson Bay (R. R. Inskeep and R. G. Klein, in preparation), and Boomplaas (*119*). The early Cape herders-potters were not makers of iron tools and were apparently the ancestors of the local "Hottentot" peoples encountered by the first Europeans in the area. Genetically and linguistically, the Hottentots were more closely related to local hunting-gathering "Bushmen" than to Iron Age peoples. Both the Hottentots and Bushmen are regarded here as terminal LSA peoples. Perhaps future archeological study will provide the elucidation of the way in which they shared the landscape.
123. In the southern Cape, for example, the Robberg Industry, characterized by small carinate bladelet cores, appeared sometime between 21,000 and 18,000 years ago and lasted until perhaps 14,000 years ago (*118*). It was replaced by the Albany Industry, characterized by large amorphous scrapers and a general lack of microlithic tools. Sometime between 10,000 and 8,000 years ago, perhaps proceeding from west to east, the Albany Industry was in turn replaced by the Wilton Industry with its well-known small convex scrapers and segments. Much of southern Africa may turn out to be characterized by a similar sequence, but widespread distribution at present can only be demonstrated for the later, macrolithic to microlithic part of the succession—the Albany to Wilton of the southern Cape, the Earlier and Middle Smithfield to Later Smithfield of the northern Cape, Orange Free State, and Transvaal [as for example in (*56*)], and the Pomongwan to Matopan and Pfupian of Rhodesia [C. K. Cooke, R. Summers, K. R. Robinson, *Arnoldia (Rhodesia)* **2** (No. 12), 1 (1966)].
124. Radiocarbon evidence suggests that the microlithic industries of Wilton character did not appear everywhere simultaneously. Thus they seem to have been firmly established in southern South West Africa by 10,000 years ago (*66*), but may only have appeared in the south-central Cape about 8000 years ago (*64*, *109*) and in the southeastern Cape between 8000 and 7000 years ago (*118*). They may not have appeared over most of the South African interior plateau until 4500 years ago. There is little evidence for any human occupation of this enormous area between 9000 and 4500 years ago [J. Deacon, *S. Afr. Archaeol. Bull.* **28**, 3 (1974)]. The reasons are not entirely clear, but at least in the later part of this period (between approximately 6500 and 4500 years ago), the climate may simply have been too dry to support substantial human populations. After 4500 years ago, when the archeological record resumes, the industries involved are microlithic ones of the kind often known as Later Smithfield. Given the 4000 to 5000 years by which they postdate what are called the Earlier and Middle Smithfield Industries, there is obviously no reason to suppose a genetic connection (*125*). In fact, it may be the case that Later Smithfield peoples were derived from earlier Wilton ones living on the peripheries of the plateau between approximately 9000 and 4500 years ago (*118*).
125. H. J. Deacon, *S. Afr. Archaeol. Soc. Goodwin Ser.* **1**, 26 (1972).
126. For example, assemblages postdating 4500 years ago from the South African interior plateau are distinguished from those of the same age in the Cape Folded Mountains to the south by a paucity of segments and a variety of kinds of backed bladelets in their place. There are apparently also differences in scraper size and form. Examples of interior sites are the Highlands Shelter in the Karoo Cape Midlands (*118*) and Riversmead, Zaayfontein, and Blydefontein Shelters in the Orange River Drainage [C. G. Sampson, *Mem. Natl. Mus. (Bloemfontein)* **6**, 1 (1972)]. The most prominent sites in the Cape Folded Mountains are Wilton (*127*) and Melkhoutboom (*118*, *128*). Two separate, parallel traditions are perhaps involved—a Later Smithfield one in the interior and a Wilton one *sensu stricto* in the Cape Mountains. Since both segments and backed bladelets were certainly bits or inserts on wooden or bone handles, or shafts, one of the differences between the traditions may have been with respect to methods of hafting (*118*).
There were also regional differences in the relative numbers of backed elements and other tools (*125*). If, as is widely accepted, it is true that the backed elements were used to tip projectiles (principally arrows), a small number of backed elements might indicate restricted use of such weapons in hunting. In the Wilton of the southern Cape the number of backed elements occurring is relatively small, and the principal game animals appear to have been small, nongregarious browsing species. These are animals then that were probably more readily taken by snares and trap lines than by bow and arrow.
1 J. Deacon, *S. Afr. Archaeol. Bull.* **27**, 10 (1972).
128. H. J. Deacon, *Ann. Cape Prov. Mus. Nat. Hist.* **6**, 141 (1969).
129. Systematic, if subtle, shifts in modes of stone artifact manufacture characterize the long, parallel Wilton sequences of the Wilton name site (*127*) and Melkhoutboom (*118*). One such shift occurred shortly before 2000 years ago and is contemporaneous with an increase in freshwater mussel shell and a decrease in marine shell in the sites. It is also just prior to the local appearance of pottery and sheep [see (*122*)]. There is some evidence that the herders occupied the nearby coast earlier than the mountains in which Wilton and Melkhoutboom are located. It is therefore possible that the changes in mode of stone artifact manufacture and in the number of shells reflect adjustments by the late hunting-gathering inhabitants of Wilton and Melkhoutboom to a situation in which they could no longer include the coast in their seasonal round.
130. For example, at Klasies River Mouth (*94*).
131. C. K. Cooke, *Rock Art of Southern Africa* (Books of Africa, Cape Town, 1969); J. Rudner and I. Rudner, *The Hunter and His Art* (Struik, Cape Town, 1970); D. N. Lee and H. C. Woodhouse, *Art on the Rocks of Southern Africa* (Purnell, Cape Town, 1971).
132. R. Singer and J. Wymer, *Nature (London)* **224**, 508 (1969).
1 H. J. Deacon, J. Deacon, M. Brooker, *S. Afr. Archaeol. Bull.* **31**, 141 (1976).
134. W. E. Wendt. *Acta Praehist. Archaeol.* **5**, 1 (1975); *Bild Wiss.* **10**, 44 (1975).
135. For example in the Wilton deposits of Melkhoutboom (*118*) and the Albany levels of Nelson Bay (R. G. Klein, unpublished).
136. A particularly fine example has been found at Melkhoutboom, dug from a Wilton level dated to approximately 5900 years ago (*118*). The grave was a steep-sided vertical shaft, roughly 60 cm across, into which the body of a child had been placed with his hands on his knees in a squatting position. The shaft was capped by a 6-mm-thick layer of powdered red ochre and then by three large stones. Grave goods included three notched seashells and at least fourteen beads of gritty earth that apparently had been baked and formed into part of a necklace.
137. R. G. Klein, in preparation.
138. H. J. Deacon, *Koedoe* **13**, 37 (1970).
1 G. Avery, *S. Afr. Archaeol. Bull.* **30**, 105 (1975).
140. For example, in the Earlier Smithfield deposits of Kruger Cave [R. J. Mason, H. Friede, J. N. Pienaar, *S. Afr. J. Sci.* **70**, 375 (1974)] in the Transvaal; the Later Smithfield levels of Highlands Shelter (*118*) in the central Cape; in the Wilton levels of Melkhoutboom (*118*), of Scott's Cave [(*1* M. J. Wells, *S. Afr. Archaeol. Bull.* **20**, 79 (1965)], of Springs Shelter (*118*), and of de Hangen [J. E. Parkington and C. Poggenpoel, *ibid.* **28**, 3 (1971)] in the southern Cape; and in Mirabib Hill Shelter [B. H. Sandelowksy, *S. Afr. Archaeol. Soc. Goodwin Ser.* **2**, 65 (1974)] in South West Africa. The Melkhoutboom evidence for plant use is especially rich and shows that from at least 7000 years ago the inhabitants of the site were intensively taking advantage of the remarkable geophytic flora of the region. Corms of the genera *Watsonia*, *Hypoxis*, and *Moraea* were brought back by the inhabitants in huge quantities; thus it seems beyond question that these plants were staple foodstuffs. Besides debris of what probably were food plants, the Melkhoutboom Wilton levels have also provided remains of plants that were probably used for the manufacture of artifacts, arrow poisons, medicines, and vegetable oils.
141. Inflorescences of *Themeda* and *Helipterum* in the Melkhoutboom deposits indicate that Wilton peoples were certainly present in late spring and early summer. This is the time of year, perhaps extended through autumn, that would have been the best in which to take advantage of the primary food plants [various geophytes mentioned in (*140*)]. Winter would probably have been the poorest time of year, and it seems likely that the Wilton inhabitants of Melkhoutboom then moved to the coast, approximately 50 km away, where shellfish could have replaced plants as a reliable, collectable resource. Ratios of oxygen-16 to oxygen-18 of the last growth increments of shells from the Wilton middens of Nelson Bay indicate that the animals were collected only in the colder months [N. J. Shackleton, *Archaeometry* **15**, 133 (1973)] and therefore suggest that the coast was occupied only in winter. Marine shells in the Melkhoutboom Wilton deposits and ostrich eggshell fragments at Nelson Bay clearly point to contacts with coastal and inland environments, respectively. It is perhaps unlikely that Melkhoutboom and Nelson Bay were ever inhabited by the same people, but together the two sites provide nonetheless a reasonable case for a Wilton seasonal round, perhaps beginning between 8000 and 7000 years ago. A similar seasonal round—inland in summer, on the coast in winter—is suggested both by known seasonal variability in resources and by direct LSA archeological evidence in the Elands Bay Cave area (*110*).
142. G. P. Rightmire, *Am. Anthrop.* **77**, 28 (1975).
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