

Encyclopedia of Human Evolution and Prehistory

Second edition

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Garland Publishing, Inc.
A member of the Taylor & Francis Group
New York & London, 2000

Africa, East

A tropical region of distinctive topography and climate, extending from the Western Rift highlands (ca. 28–32° E longitude) to the Indian Ocean, between the north and south 15th parallels. This land is occupied by the nations of Ethiopia, Djibouti, Somalia, Uganda, Kenya, Tanzania, Rwanda, Burundi, and Malawi, together with northern Mozambique and the thin slice of easternmost Zaire that lies within the Western Rift. The dominant element in the geography of the African Plateau in this region is the East African Rift system, a chain of updomed highlands transected by enormous, volcanically active pull-apart grabens. The environment of the region is regulated by prevailing dry westerlies, punctuated by highly seasonal monsoonal rains. Ecosystems are mostly open woodlands, gallery forests, and grassland, with thorn brush and xeric shrubland in the rain-shadowed rift-valley basins. Higher precipitation on the isolated heights of rift highlands and volcanic massifs, on the other hand, support bamboo and deciduous rain forest, succeeded at the highest elevations by evergreen cloud forests and altiplano (equatorial-alpine) zones. A strip of deciduous forest also marks the narrow coastal plain.

The rift valleys of East Africa are characterized by heavily mineralized alkaline groundwater, subsiding closed basins, and active volcanism and fault movement. These combine in

conditions that are close to ideal for the accumulation, preservation, and later exposure of archaeological and paleontological remains. Mid-Miocene and younger paleoanthropological sites are therefore densely concentrated along the north-to-south strip that corresponds to the Eastern or Gregory Rift system from Afar to central Tanzania; other sites occur more sparsely in the Western Rift.

It must be noted, however, that climate and geological conditions were different in the Early Miocene, when the Kenya Dome was still rising and rifts had not developed. The earliest Miocene faunas are forest-adapted associations that were preserved in great volcanic massifs which built up on the flanks of the dome, including Tinderet, Kisingiri, Elgon, and Napak. After the dome ruptured, vulcanism and sedimentation shifted into the newly opened grabens, which lay in the rain shadow of the rift escarpments and were, in sharp contrast to the Early Miocene mountainsides, more arid than any other part of the landscape. The geological evolution of East Africa, in other words, distorted the paleoclimatic history: prior to 17 Ma, the fossil record is dominated by forest-adapted faunas from volcanic highlands, while after 14 Ma virtually all of the sample is from the rift basins, the driest part of the region. In the 17-to-14-Ma interval, both "highland" and "lowland" ecofaunas can be distinguished.

History of Paleoanthropological Discovery in East Africa

Fossil mammals and stone tools were known in East Africa for many years before significant primate remains were recovered. Probably the earliest collections were Plio-Pleistocene mammal fossils sent to Paris in 1902 from Count Teleki's exploration of the Lake Rudolf (Turkana) Basin, although these lay unknown until the French paleontologist Camille Arambourg came upon the unopened crates many years later. Arambourg's 1934 follow-up expedition also discovered Miocene fossils at Muruarot and Cretaceous dinosaurs at Lokitaung. The earliest known report of fossil mammals was in 1910, when G.R. Chesnaye, who was prospecting the Miocene formations around Lake Victoria for placer gold, sent word to the local authorities of fossil mammals he had found, first at Koru and shortly thereafter at Karungu. The famously unfortunate Mr. Piggott (who was eaten by crocodiles on his return trip) was sent out to collect at Karungu the following year by the district commissioner, C.W. Hopley. Piggott's collection survived to become the first fossil mammal fauna to be scientifically described from sub-Saharan Africa, prompting a full geological study by F. Oswald in 1911–1912. On his way out, Oswald found Plio-Pleistocene fossils, including the type of *Theropithecus oswaldi*, the first fossil primate from East Africa, at Kanjera (properly Kanjira) near the scene of Piggott's disaster. During the years 1912–1914, Hopley caused fossiliferous limestones on Rusinga Island to be mined for cement without noticing abundant bones of the deinotherium, which had previously been named after him from nearby Karungu. It fell to Dr. H.L. Gordon, investigating his property at Koru in 1926, to discover the first hominoid remains from East Africa. These were assigned to the new genus and species

East African tuff horizons (*K-Ar dates, Ma)	Western Rift	West Turkana	East Turkana	Shungura, Omo	Awash, Hadar	Gulf of Aden
Kale		=====	== () ==	.	.	.
Silbo		.	== () ==	.	.	.
Gele		.	== () ==	.	.	.
Nariokotome		== () ==
Natoo		== () ==	.	=L-3=	.	.
Chari		=====	== () ==	=L=	.	=====
L.Koobi Fora	=Kagusa=	=====	== () ==	.	.	.
Okote		.	== () ==	=J-7=	.	.
Morutot		=====	== () ==	=J-4=	.	.
Orange Tuff		.	== () ==	=====	.	.
Malbe		=====	== () ==	=H-4=	.	.
KBS	=Hohwa=	=====	== () ==	=H-2=	.	.
Kangaki		== () ==
Tuff G		.	.	== () ==	=?BKT-3=	.
Ekalalei		== () ==	.	=F-1=	.	.
Kalochoro		== () ==	.	=F=	.	.
Nalukuwoi		== () ==	.	=E-4=	.	.
Koikiselei		== () ==	.	=E=	.	.
Lokalalei		== () ==	=====	=D=	.	.
Burgi		.	== () ==	.	.	.
Emekwi		== () ==	.	=C-9=	.	.
Ingumwai		=====	== () ==	=C-4=	.	.
Hasuma		.	== () ==	=C=	.	.
Bouroukie BKT-2		.	.	.	== () ==	.
Tuff B-10		.	.	== () ==	.	.
Ninikaa		.	== () ==	.	=?BKT-1=	.
Kada Hadar KHT		.	.	.	== () ==	.
Triple Tuff-4		.	.	.	== () ==	.
Waru		== () ==	=====	.	.	.
Allia		.	== () ==	.	.	.
Toroto		.	== () ==	.	.	.
Tulu Bor-b		=====	== () ==	=B;U10=	=SHT=	=====
Kaado		=====	== () ==	.	.	.
Lokochot	*3.40	Kyampanga	== () ==	=A=	.	=====
Loruth		=====	== () ==	.	.	.
Lomugol	=Warwire=	== () ==	.	.	=Sagantole=	=====
Topernawi		== () ==	=====	.	.	.
Cindery Tuff		.	.	.	== () ==	.
Moiti		=====	== () ==	=U-1=	=VT-1=	=====
Gaala VTCf		.	.	.	== () ==	.

Tephrostratigraphic framework for Western Rift, Turkana, and Afar basins. The preferred nomenclature and dating for each tuff sheet are given at the left, with the type area indicated by parentheses. Commonly used alternative names in other basins are also shown (note that Sidi Hakoma Tuff or SHT in Hadar is called Maka Tuff in the Middle Awash Valley). Asterisks indicate radiometrically determined ages; other ages are interpolated from the dated horizons and from paleomagnetic reversals, according to estimated depositional rates. The identity of the tuff sheets in different basins has been determined by chemical-petrological fingerprinting. Sources: Western Rift—M. Pickford, et al., 1991, C. r. séances Acad. Sci. Paris, II, 313; West Turkana—J. M. Harris et al., 1988, Los Angeles County Museum, Contributions in Science, no. 399; East Turkana (Koobi Fora)—C. Feibel et al., 1989, Am. J. Phys. Anthropol., 78; Omo Shungura, Usno, etc.—B. Haileab and F. H. Brown, 1992, J. Hum. Evol., 22; Afar Basin (Middle Awash, Hadar)—R. C. Walter, 1994, Geology, 22. Gulf of Aden (from deep-sea cores)—A. M. Sarna-Wojcicki et al., 1985, Nature, 313.

Proconsul africanus by British paleontologist A.T. Hopwood after he and Louis Leakey found numerous additional specimens at Koru and on Rusinga Island in 1931–1932. Leakey also revisited Kanjera and nearby Kanam at the end of the 1932 season and chanced to find modern burials in the fossil beds that he long held to be evidence for the antiquity of *Homo*. The skull cap from the Middle Pleistocene Kanjera deposits understandably caused much less of a stir than the mandible published as *Homo kanamensis* from the Lower Pliocene levels at Kanam.

The earliest report of stone tools associated with fossils may have been that of a lepidopterist named Kartwinkler, who described artifacts from Olduvai Gorge in 1911 (the story that he found the gorge by falling into it while chasing butterflies may be apocryphal). The collection made by German paleontologist H. Reck in 1913 (which included another rather sensationally misinterpreted human burial) led Louis Leakey and Swedish archaeologist L. Kohl-Larsen to mount separate expeditions to the region in 1931. Both

workers, as it happened, collected teeth of *Australopithecus afarensis* at Lactoli, which, although misdiagnosed at the time, were the first early hominin specimens to be found in East Africa. Kohl-Larsen also opened the Mumba Cave site (Tanzania), expanding on Leakey's discovery of a Paleolithic occupation at Gamble's Cave a few years before. In his 1919 monograph on the Rift Valley of Kenya, American geologist J.W. Gregory described abundant handaxes at Ol Gaselik, now known as Ologresailie, a site that was not relocated until Louis and Mary Leakey found it again in 1942.

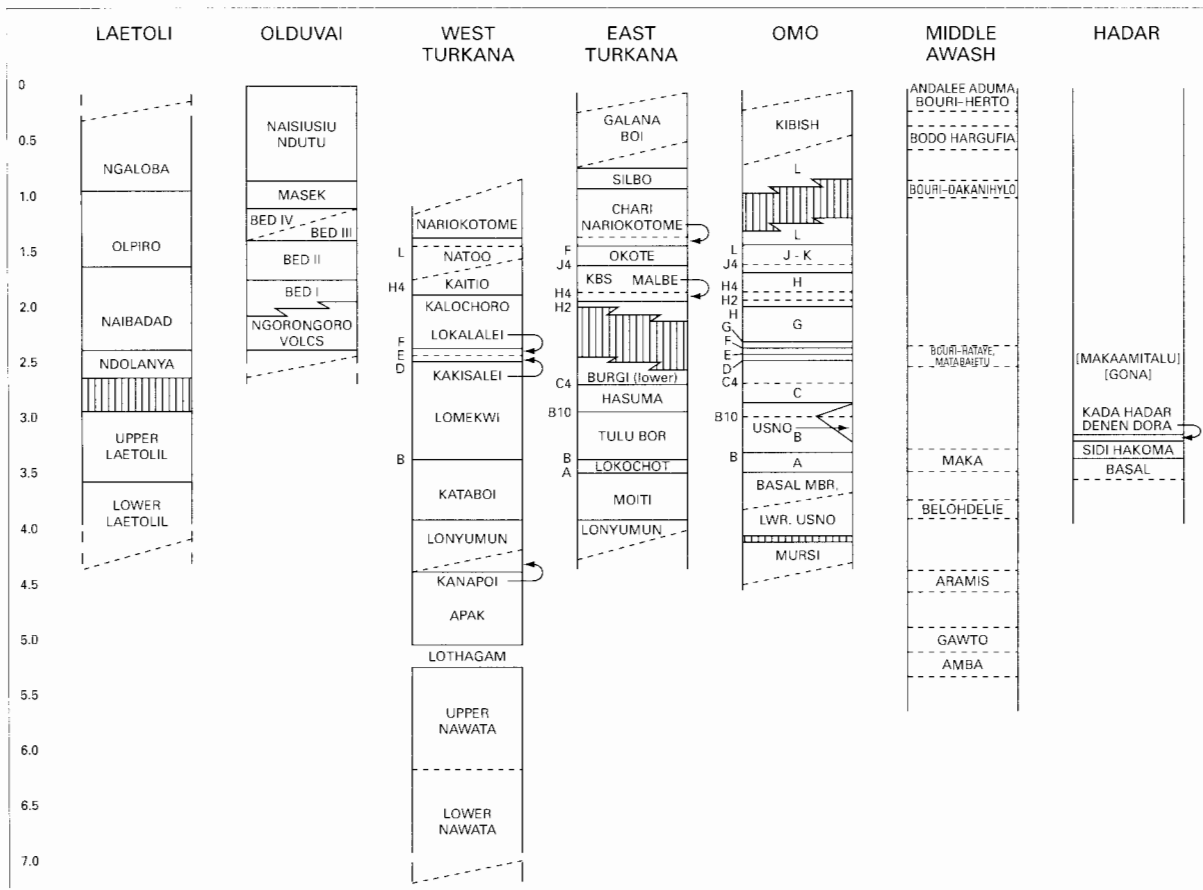
The 1930s through 1950s saw a focus on Asian and South African discoveries of *Homo erectus* and *Australopithecus*, respectively. However, the Leakeys persisted in eastern Africa, working at Olduvai, Ologresailie, Kariandusi, Hyrax Hill, and other Pleistocene sites, as well as developing the Miocene primate record at Koru, Songhor, Maboko, and, above all, Rusinga. Their work was joined at various times by colleagues including Dorothea Bate, J. Desmond Clark, W.E. LeGros Clark, F. Clark Howell, Sonia Cole, and the geologists P.E.

Kent and R.M. Shackleton. During this period, the 1947 Wendell Phillips expedition, guided by H.B.S. Cooke, enlarged on Arambourg's pioneering work in the Turkana Basin with the discovery of remains from Lothidok now classified as *Kamoyapithecus*, which are dated to the late Oligocene and are thus the oldest known hominoid. In the late 1950s, W.W. "Bill" Bishop began work in Uganda on the Kanam-aged Kaiso beds of Lake Albert and the Early Miocene of Napak. In August 1959, however, the discovery of the robust australopith *Zinjanthropus* (now *Paranthropus*) *boisei* at Olduvai marked the beginning of the modern era of well-funded interdisciplinary research, which has raised East Africa to the preeminent place in human evolutionary studies that it now holds.

The number of known paleontological and archaeological sites in eastern Africa began to expand dramatically in the 1960s. Many of these discoveries came when researchers initially involved with the Leakeys began to look farther afield. During this decade, a generation of doctoral candidates in geology and paleontology were introduced to East Africa under the supervision of Leakey (Cambridge), Bishop and L.C. King (Bedford College, London), R.J.G. Savage (Bristol), Howell, J.D. Clark, G.I. Isaac, and G.H. Curtis (Chicago and Berkeley), and Bryan Patterson (Harvard). French students were also active under the guidance of Yves Coppens. The primary areas of new discoveries were the northern Turkana Basin (Omo Valley and Koobi Fora), where teams

under Coppens, Howell, Isaac, and R.E. Leakey developed a tremendously significant Plio-Pleistocene section; the comparably productive Afar region of Ethiopia, explored by groups led by J. Kalb, D.C. Johanson, and J.D. Clark; and the Miocene-Pliocene sequences exposed in the Central Kenya Rift west of Lakes Baringo and Hanningron, which was studied intensively, first by students directed by Bishop and King and later by a successor group under D.R. Pilbeam. B. Patterson's expedition into the desolate region between the Tugen Hills and Lake Turkana located Kanapoi, Lothagam, Ekora, and Loperot. Archaeological work also went forward under Isaac's direction at Peninj, Ologresailie, Eyasi, and Nakuru.

Since 1980, research has been productive in all parts of East Africa. Aside from important new discoveries from previously known areas such as Rusinga, Maboko, Chemeron, Kanapoi, and the Afar, material also came from new or neglected areas. West Turkana Plio-Pleistocene sites were developed by A. Walker and R.E. Leakey, and new Miocene sites at the southern end of the lake (Buluk, Kajong, Locherangan, Kalodirr) and in the Samburu Escarpment (Nachola) were also reported, the last by a Japanese team led by H. Ishida. Several locations with hominin remains and Acheulean tools were described by French workers in Djibouti, while exploration in Ethiopia uncovered promising sites outside the Afar at Gona, Kesem-Kebeba, Burji, Fejej, and Konso. In the Western Rift, knowledge of Miocene,



Correlation of major Miocene-Pleistocene sequences in East Africa. The units are dated according to radiometric ages on included lavas and tuffs. Some of the tuffs (indicated by letters to the left of the columns) have been traced over wide areas according to their trace element chemistry and mineral content, and by their relationship to paleontological and paleomagnetic data (see also accompanying table of tuffs and tephrostratigraphy).

Pliocene, and Pleistocene beds of the Lake Albert Basin and the Kazinga Channel was greatly expanded by American and French teams, respectively, and tephrostratigraphic analysis linked many of the index tuffs across huge distances from Uganda through the Turkana and Awash basins to the Red Sea. Another round of work on the Chiwondo beds brought the first hominin fossils to light in Malawi; new Mio-Pliocene fossil beds were reported from Manonga Valley in central Tanzania; and an Italian team recovered a fauna with a partial *Homo cf. erectus* skull at Buia in Eritrea (marginally within North Africa here), dated to ca. 1 Ma.

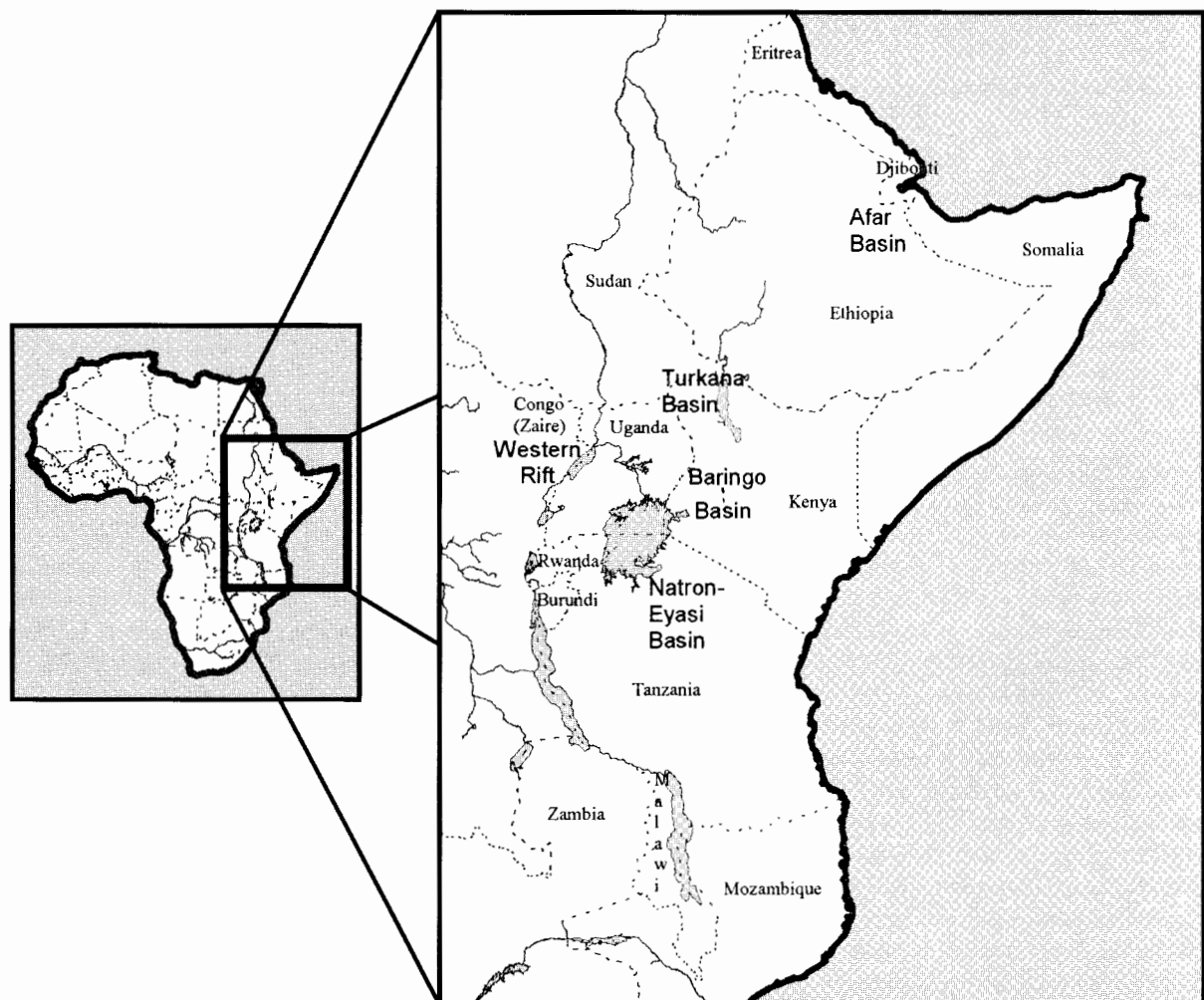
East Africa is central to several key themes in paleoanthropology, among which are the early history of hominoid diversity and adaptation, the origin of the human lineage, and the evolution of culture and human intelligence. These themes are chronologically sequential and depend on data coming mainly from the Miocene, Pliocene, and Pleistocene, respectively.

The Fossil Record

EVOLUTION OF HOMINOIDEA

Afro-Arabia in the Miocene is accepted by most workers as the center of diversity for the Catarrhini, including the

endemic archaic catarrhines, victoriapithecines, and proconsulids; Afro-Eurasian taxa (colobines, cercopithecines, kenyapithecines, and hominines); and possible ancestors for extra-African lineages such as pliopithecids, dryopithecines, oreopithecines, hylobatids, and pongines. Documentation, however, is confined to the Miocene of East Africa with the exceptions of scanty remains from Namibia and the east coast of Arabia. Because of the Early Miocene bias toward tropical highland samples, the earliest part of the known record, from 23 to 17 Ma, is dominated by a wide diversity of small-to-medium-sized, presumably arboreal, archaic catarrhines (*Dendropithecus*, *Micropithecus*, *Kalepithecus* and *Limnopithecus*, loosely lumped as the “*Dendropithecus*-group”) and proconsulids, such as *Kamoyapithecus*, *Proconsul*, and *Rangwapithecus*, in assemblages known from Lothidok, Koru, Songhor, Napak, Rusinga, Mfwangano, and ancillary sites. Monkeys and lorisooids are rare at these localities. The fact that catarrhines were also evolving in other ecosystems “out of sight” is signaled by a group of sites in the rift valley of northern Kenya dating to 17.5 Ma or slightly younger, including Buluk, Kajong, Locherangan, Loperot, Muruarot, and Kalodirr, which preserve a mammal fauna clearly more adapted to open

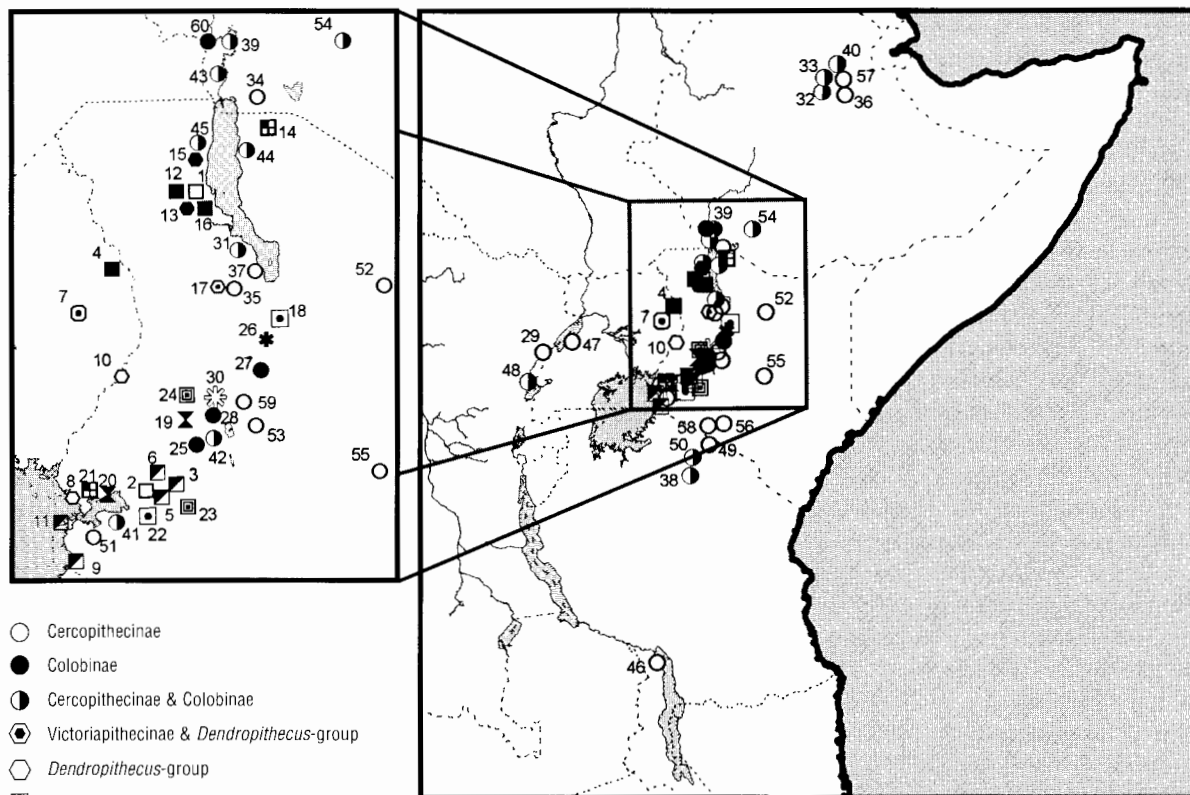


The major depositional basins and geographic regions (and countries) within East Africa, each of which is the subject of a separate entry.

conditions. In these sites, the earliest hominid, *Afropithecus*, as well as the probably “*Dendropithecus*-like” *Turkanapithecus* and *Simiolus* and the victoriapithecine monkey ?*Prohylobates*, are found with open-country bovinds, giraffids, and suids, while proconsulids are rare. Mammal faunas of similar aspect and age have been found in coastal-plain sites in Namibia (Sperrgebiet, Auchas), Tunisia (Jebel Mrhila), Libya (Jebel Zelten), Egypt (Moghara), Israel (Rotem), and Arabia (Hadruk), the latter with the kenyapithecine *Heliopithecus*, indicating that seasonally drier environments were widespread at lower elevations by this time. The Ugandan ?highland site of Moroto, with *Afropithecus*-like (kenyapithecine) fossils, may be of similar age or slightly younger.

Between 15 and 13 Ma, sampled environments were all open woodland, if not drier. Fossil mammal assemblages from Maboko Island and Fort Ternan in western Kenya were very like those of main-rift sites in central and northern Kenya such as Muruyur, Alengerr, Lothidok-Esha, and Na-

chola. In all of these sites, the kenyapithecine *Kenyapithecus* is the dominant hominoid, while early cercopithecids and the last proconsulids are much more rare (although *Victoriapithecus* is known from hundreds of specimens at the main Maboko horizons, by far the most common primate anywhere in the African Miocene). Unfortunately, the later Miocene history of hominoids in Africa is nearly unknown. Numerous fossil mammal faunas have been sampled from the time interval between 13 Ma and ca. 6 Ma, in both East and North Africa, without recovering any significant hominine remains (although monkeys are reasonably represented). Single teeth from the lower Ngotota Formation (ca. 12 Ma) and the Lukeino Formation (ca. 6 Ma) and a partial maxilla from the Samburu Hills (ca. 9 Ma) are still incompletely analyzed and hard to place phylogenetically, but they may represent rare traces of the Hominae or even the Homini during the Late Miocene. The fact that all of these later Miocene mammal faunas appear to represent intensely seasonal and



Main localities in East Africa yielding fossil non-hominin primates. Symbols indicate age and included primates, while numbers represent site names (in approximate chronological order), as follows: 1, Lothidok Hill; 2, Meswa Bridge; 3, Mteitei Valley; 4, Moroto; 5, Koru; 6, Songhor; 7, Napak; 8, Angulo; 9, Karungu; 10, Bukwa; 11, Rusinga, Mfwangano; 12, Moruarot; 13, Kalodir; 14, Buluk; 15, Locherangan; 16, Esha Hill; 17, Loperot; 18, Nachola; 19, Kipsaramon; 20, Maboko; 21, Ombo, Bur-Siala, Majiwa, Kaloma; 22, Nyakach; 23, Fort Ternan; 24, Ngorora; 25, Ngeringerowa; 26, Samburu; 27, Nakali; 28, Mpesida; 29, Ongoliba; 30, Lukeino; 31, Lothagam; 32, Kuseralee; 33, Aramis, Maka, Matabaietu, Andalee; 34, Fejej; 35, Kanapoi; 36, Belohdelie; 37, Ekora; 38, Laetoli; 39, Omo Usno; 40, Hadar, Gona; 41, Kanam East; 42, Chemeron JM 90/91; 43, Omo Shungura; 44, Koobi Fora; 45, Nachukui (West Turkana); 46, Chiwondo Beds; 47, Kaiso Village; 48, Senga-5; 49, Peninj; 50, Olduvai Gorge; 51, Kanjera; 52, Marsabit; 53, Chesowanja; 54, Konso; 55, Nyeri; 56, Olgorgesailie; 57, Bodo, Dawatoli, Hargufia; 58, Lainyamok; 59, Kapthurin; 60, Omo Kibish.

open, not to say grasslands, environments suggests that most of the story of hominine evolution in Afro-Arabia during the Middle to Late Miocene may have been hidden in the trees.

EVOLUTION OF HOMININS AND CONTEMPORARY CERCOPTHECIDS

As well as the oldest known hominids, East Africa has yielded the oldest remains of the human lineage recognized to date. A partial mandible from the lower part of the Apak Member of the Nachukui Formation at Lothagam (previously 1C, now dated just younger than 5 Ma), although still the subject of taxonomic debate, is the best candidate for the earliest known hominin.

The earliest identified hominin is *Ardipithecus ramidus*, known by fragmentary dental, cranial, and postcranial remains from the Aramis region in the Middle Awash of Ethiopia dated ca. 4.4 Ma. *Australopithecus anamensis* from Kanapoi and the lowest levels of the Koobi Fora sequence (and perhaps Tabarin, in the Tugen Hills) is slightly younger, at ca. 4.2–3.9 Ma. All East African hominins dating to the interval between 3.8 and 2.8 Ma are currently assigned to a single species, *Australopithecus afarensis*, and derive primarily from two regions: Laetoli, near Olduvai Gorge, and Hadar in the Awash drainage. The period 2.8–2 Ma is poor in fossil remains of hominins in East Africa, although extensive fossil beds of this age are found throughout the Turkana Basin, in the Gona region adjacent to Hadar in Ethiopia, and in the Chemeron Formation at Baringo. The hominins recovered to date suggest that the earliest members of the genus *Homo*, as well as the robust australopithecids (*Paranthropus*), may have emerged during this interval, represented in material classified as cf. *Homo rudolfensis* from Chemeron, the Makaamitalu region at Hadar, and the Chiwondo beds of Malawi and rare specimens of *P. aethiopicus* from West Turkana and the lower levels of the Shungura sequence.

At the same time as this flowering of the human lineage, there was an even greater radiation of cercopithecoid monkeys in eastern Africa. The dominant cercopithecine was *Theropithecus*, which appears to have split early into two lineages that can be recognized as subgenera. *T.* (*Theropithecus*) first appears in uppermost Lothagam sediments, in the Middle Awash sequence, and at Hadar, between 4 and 3 Ma, where it is represented by *T.* (*T.*) *oswaldi darti*. This is succeeded in the lower Shungura Formation and elsewhere by the subspecies *T.* (*T.*) *oswaldi*, which remained rare during the Pliocene but flourished in the Pleistocene. *T.* (*Omopithecus*) was initially common, as was *T.* (*O.*) *brumpti*, in the Turkana Basin later Pliocene and may have been preceded by ?*T.* (*O.*) *baringensis* in the Tugen Hills and Koobi Fora regions ca. 3 Ma, but this clade appears to have become extinct before the end of the Pliocene. Other cercopithecines were rare, with only *Papio* (*Dinopithecus*) *quadratirostris* even moderately well represented, in the Shungura between 3.2 and 2 Ma. The colobines were represented by a still greater diversity of taxa over the Late Pliocene, especially around the Turkana Basin. *Rhinocolobus*, a large form (comparable to the largest modern baboons) known also at Hadar, seems to have been surprisingly arboreal for its size. Several species of

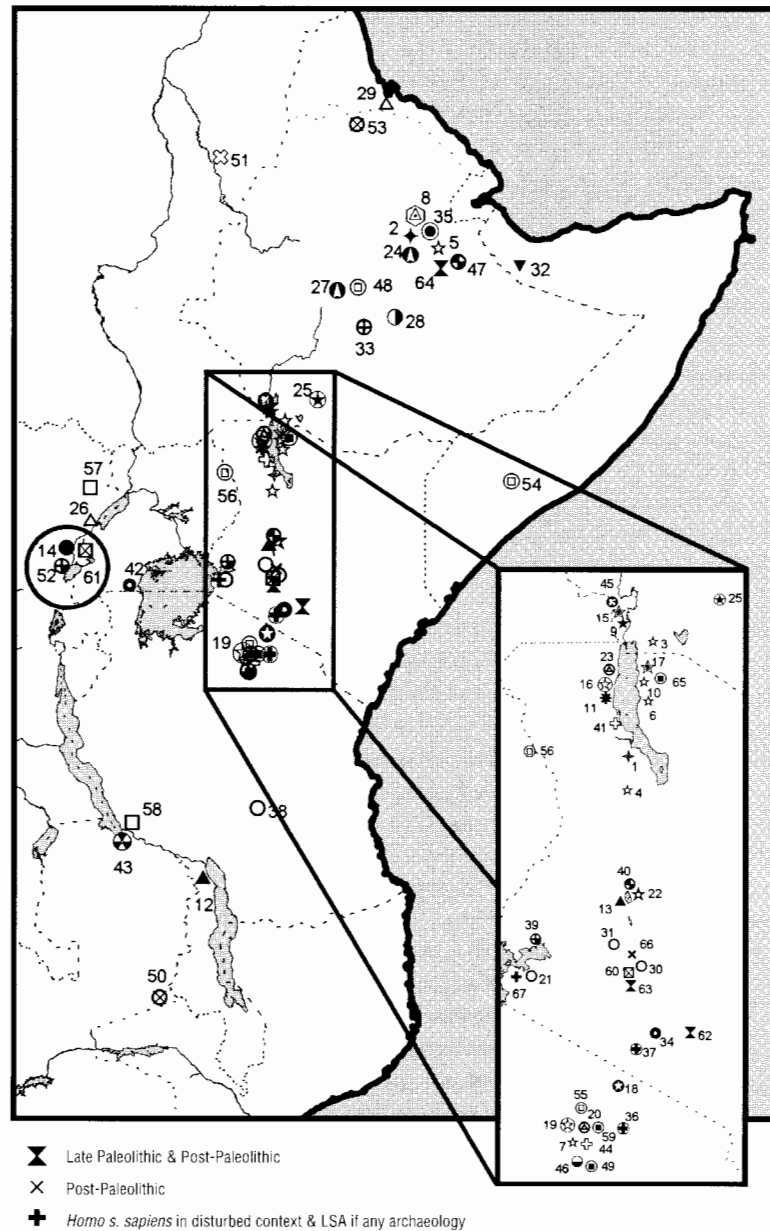
Paracolobus overlapped the range of modern *Papio* at Laetoli, Chemeron, and Turkana sites, apparently with mixed arboreal and terrestrial adaptations. The slightly smaller *Cercopithecoides* was represented at Koobi Fora and later Olduvai by two extremely terrestrial species. Rare specimens indicate the presence at many sites of one or more species comparable in size to living *Colobus*, while the enigmatic form known as Colobine species A was intermediate in size and terrestrial adaptations. Several of these taxa persisted into the earliest Pleistocene before becoming extinct. Unfortunately, there is as yet no evidence of the evolutionary history of the African apes.

Evolution of Human Culture and Modern Morphology

East Africa yields evidence that relates progressive changes in human toolmaking to human morphological evolution throughout the known time range of the genus *Homo*. Of particular interest are the 1990s discoveries of artifacts predating 2 Ma at several localities, the oldest being the Gona sites at ca. 2.6–2.5 Ma and the Lokalelei sites at West Turkana dating to 2.35 Ma. These artifacts, which overlap the known time range of *H. rudolfensis*, consist of simple flakes and pebble cores with a few removals, often made on lava cobbles. Some researchers argue that these constitute an Omo or “pre-Oldowan” stage of Mode 1 tool manufacture and reflect only minimal conceptual abilities consistent with a brain size not far removed from that of a chimpanzee, combined with a specialized manual dexterity. Others see these tools as reflecting the full range of cognitive capabilities seen in later Oldowan materials. In any case, the sites contain tools and cutmarked bones that are the earliest known signs of a new adaptation for both food procurement and land-use strategies by hominins in Africa. While human agency has been claimed for *eoliths* (to use a term denoting rocks with shapes or arrangements suggesting artificial modification) from equally ancient sites in many regions of the world, including France and Siberia, those in East Africa are distinguished by their systematic manufacture, their abundance relative to unmodified rocks, their fresh condition, and their location in fine-grained (low-energy) deposits well dated by potassium-argon and associated mammalian fossils. Indeed, there is little question as to their authenticity as human artifacts, and while the oldest artifacts in southern Africa are estimated to be slightly younger, from the base of Member 5 at Sterkfontein (close to 2 Ma), no inarguable evidence of human cultural activity occurs outside of Africa before 1.4 Ma.

The Oldowan (originally, Chellean) industries of East Africa, typified by simple flakes and chipped cobbles without other tools, are actually quite widespread, not only at Olduvai Gorge but also in the Turkana Basin, from levels with dates and faunas indicating ages between 2 and ca. 1.8 Ma, which is also the approximate time range of *Homo habilis* (but overlaps with both *H. rudolfensis* and *H. erectus*). Following this, a transition is seen in stratified sequences at Olduvai, Koobi Fora, Shungura, and Melka Kontouté, through a “mixed” interval to the typical Acheulean industry with bifaces, especially handaxes. Tools of this type, which have been found by the thousands at Olduvai upper Bed II through Bed IV,

- ✦ cf. *Australopithecus*
- ◆ *Ardipithecus*
- ☆ *Australopithecus*
- * ? *Australopithecus* & *Paranthropus*
- ★ *Paranthropus*
- ⊙ *Paranthropus*, Oldowan & Acheulean
- ☆ *Paranthropus* & Acheulean
- ⊙ *Australopithecus*, cf. *Homo sp.* & Oldowan
- Oldowan
- ▲ cf. *Homo rudolfensis*
- ⊙ *Paranthropus*, *Homo habilis* (or *H. rudolfensis*) & Oldowan
- Acheulean
- ☆ *Paranthropus*, *Homo habilis* (&/or *H. rudolfensis*), *H. erectus*, Oldowan & Acheulean
- ⊙ *Paranthropus*, *Homo erectus* & Acheulean
- ⊙ *Homo habilis* (&/or *H. rudolfensis*), *H. erectus*, Oldowan & Acheulean
- ⊙ *Homo erectus* & Acheulean
- △ cf. *Homo erectus*
- ⊙ Oldowan, Acheulean & ?MSA
- ⊙ early "archaic *Homo sapiens*" & Acheulean
- ⊙ early "archaic *Homo sapiens*" Acheulean & MSA
- ⊙ early "archaic *Homo sapiens*" & Sangoan
- ⊙ MSA
- ⊙ "archaic *Homo sapiens*," Acheulean, MSA, & early blade technology
- ⊙ late "archaic *Homo sapiens*"
- ⊙ Acheulean & MSA
- ⊙ Acheulean, MSA & early blade technology
- ⊙ MSA & early blade technology
- ⊙ late "archaic *Homo sapiens*" & MSA
- ⊙ late "archaic *Homo sapiens*," early *H. s. sapiens* & MSA
- ⊙ ?early *Homo s. sapiens* & MSA
- ⊙ early *Homo s. sapiens*
- ⊙ *Homo s. sapiens*, MSA & LSA
- ⊙ MSA & LSA
- ⊙ MSA, LSA & Post-Paleolithic
- ▼ Late Paleolithic & ?Acheulean
- LSA
- ⊙ LSA & Post-Paleolithic



Main localities in East Africa yielding fossil hominins and Paleolithic archaeological remains. Symbols indicate age and included primates, while numbers represent site names (in approximate chronological order), as follows: 1, Lothagam; 2, Aramis; 3, Fejej; 4, Kanapoi; 5, Belohdelie, Maka; 6, Allia Bay; 7, Laetoli; 8, Hadar, Gona, Makaamitalu; 9, Omo Shungura older than 2.1 Ma; 10, Koobi Fora older than 2.1 Ma; 11, Nachukui (West Turkana) older than 2.1 Ma; 12, Uraba (Chiwondo); 13, Chemeron JM 85; 14, Senga-5; 15, Omo Shungura between 2.1–1.3 Ma; 16, Nachukui (West Turkana) between 2.1–1.6 Ma; 17, Koobi Fora between 2.1–1.3 Ma; 18, Peninj; 19, Olduvai Gorge Beds I-II (lower); 20, Olduvai Gorge Beds II (upper)-Masek; 21, Kanjera (main); 22, Chesowanja; 23, Nachukui (West Turkana) between 1.6–1.3 Ma; 24, Middle Awash horizons between 2–.07 Ma; 25, Konso; 26, Nyabusosi; 27, Melka Kontouré (earlier horizons); 28, Gadeb; 29, Buia; 30, Kariandusi; 31, Kilombe; 32, Hargeisa; 33, Gademotta; 34, Ologresailie; 35, Bodo, Hargufia, Meadura, Andalee; 36, Lake Ndutu; 37, Lainyamok; 38, Isimila; 39, Muguruk; 40, Kapthurin; 41, Eliye Springs; 42, Sango Bay; 43, Kalambo Falls (earlier horizons); 44, Ngaloba (Laetoli); 45, Omo Kibish; 46, Eyasi; 47, Diré-Dawa (Porc-Epic); 48, Melka Kontouré (later horizons); 49, Mumba; 50, Kalembo; 51, Singa; 52, Katanda; 53, Gobedra Rock Shelter; 54, GoGoshis Qabe; 55, Apis Rock; 56, Magosi; 57, Matupi; 58, Kalambo Falls (later horizons); 59, Olduvai Gorge Ndutu-Naisiusiu Beds; 60, Gamble's Cave; 61, Ishango; 62, Lukenya Hill; 63, Nderit Drift; 64, Laga Oda; 65, Koobi Fora (later horizons); 66, Hyrax Hill; 67, Kanam, Kanjera (Leakey ?surface collections). Circle indicates 14, 52 and 61 essentially at same point, nearest to 52. Note that several other sets of points (2, 5, 24, 35; 9, 15; 10, 17, 65; 11, 16, 23; 19, 20, 59; 27, 48; 43, 58) are also effectively or actually coincident.

Ologresailie, Kariandusi, Melka Kontouré, and at Bouri and Bodo in the Awash Valley, are comparable to those that have long been known from the Thames and Somme valleys in Europe. In East Africa, however, they can be dated in faunal and geological contexts to range in age from levels more than twice as old as those in Europe (i.e., 1.6 Ma or older) up to ca. 0.5 Ma, the general age of the European examples. This is ap-

proximately the same age range as the remains of *erectus*-grade humans in Africa, some of which may be classified as *Homo ergaster*; the youngest Acheulean assemblages may be associated with "archaic *Homo sapiens*" (= *H. heidelbergensis*), as at Bodo or Lake Ndutu. Acheulean sites are often (but not exclusively) located in stream channels, in contrast to the more usual location of Oldowan sites on or near lakeshores.

They also exhibit more careful work to prepare symmetrical bifacial tools, greater transport of raw materials (up to 11 km at Olduvai), repeated use of hammerstones resulting in spheroids, and more complex butchery of large animals, possibly implying earlier access to carcasses and thus a more successful defense mechanism against large predators. Contemporaneous with the biface industry, other sites with choppers and cleavers but without bifaces have been called "Developed Oldowan." In East Africa, as in southern Africa, evidence for controlled fire may first appear ca. 1.4–1.3 Ma at Chesowanja and FxJj 50 in Kenya. A wide variety of relatively modern cercopithecoid and loroid primates are found in Pleistocene sites, especially the large *Theropithecus oswaldi leakeyi*, which may have reached nearly 100 kg in mass and were probably hunted by Acheulean peoples, as at Olorgesailie.

In the Kapthurin Formation at Baringo, a late Acheulean industry contains large prismatic blades manufactured on blade cores similar to those from the Pre-Aurignacian of North Africa and the Levant. At the end of the Acheulean, ca. 300–200 Ka, a transitional, or Sangoan, period based on artifacts from Sango Bay in Uganda is evidenced in East Africa. It is characterized by sophisticated smaller handaxes and the introduction of prepared-core techniques, with picks and core axes. The Sangoan time interval is marked by indications of aridity in East Africa and the elimination from the fossil fauna of the few remaining mammalian taxa, including *Elephas*, which are not presently extant in Africa.

The Sangoan is succeeded by a variant of the MSA (Middle Stone Age), once termed "Kenya Stillbay," which occupies most of the rest of the Middle Pleistocene. By 200 Ka, at sites in Ethiopia such as Gademotta and Kukuleti, artifacts of true MSA technology with blades and highly standardized bifacial and unifacial points trimmed for hafting, together with Levallois and discoidal-core technologies, entirely replaced the Early Paleolithic tool forms. After ca. 80 Ka, toward the end of the MSA, these industries also include backed crescents and microliths. At the Katanda MSA sites in Zaire, even older barbed bone points were associated with fish remains that suggest seasonal hunting of large catfish, and in South Africa at Blombos Cave, MSA levels also yielded both bone points and fish remains. After 40 Ka, East Africa produced a microlithic (mode 5) industry at sites like Matupi Cave in eastern Zaire, Mumba Cave in Tanzania, Twilight Cave in Kenya, and Isbango (Zaire) in contrast to the contemporaneous mode 4 industries of early Upper Paleolithic of Europe and the final MSA (mode 3) of South Africa. Both Mumba and Twilight caves have also yielded ostrich-eggshell beads dated to before 40 Ka.

The relationship of Middle and Late Pleistocene lithic industries to the human fossil record in East Africa is unclear. Specimens referred to the transitional grade of "archaic *Homo sapiens*," however, are generally found together with either Late Acheulean tools at Bodo, Ethiopia, and Ndotu, Tanzania, or with Sangoan tools at Eyasi and Kabwe, Tanzania. Both transitional and modern archaic forms are usually associated with MSA technology. This late Middle and early Late Pleistocene technology, although reminiscent to some extent of that in Europe at the same time, is not associated with human remains that could be called Neanderthal-like. On the contrary, from

ca. 130 Ka onward, the human fossil remains in sites such as Mumba Cave (Tanzania), and Omo Kibish (skull 1) and Porc-Épic (Ethiopia) exhibit dental reduction, and in the case of Kibish angulation of the cranial base, a higher and more rounded cranial vault profile, and a reduction in prognathism, which is consistent with a minimal definition of *H. sapiens sapiens*.

Evolution of Modern Cultures in East Africa

Between 35 and 25 Ka, a Later Stone Age culture with microlithic debitage and some backed bladelets is found at several sites (Mumba, Nasera, Twilight Cave) in association with ostrich-eggshell beads. At Ishango, Uganda, on Lake Rutanzige (Edward), remains have been found of modern people with a very robust but tall and slender physique, associated with numerous small bone harpoons and microlithic debitage, as well as with a bone haft marked with incisions that may indicate an understanding of doubling, an early form of multiplication. Remains of deep-water-lake fishes suggest the presence of boats and nets. Other rich sites of this period with numerous backed bladelets are the lower levels at Lukenya Hill in Kenya and Kisesse rockshelter in Tanzania. A fragmentary cranium from Lukenya Hill is comparable in frontal profile to several of the Ishango fossils. The earliest rock art in Tanzania could well date to this period.

During the Pleistocene-Holocene transition, a period of extreme aridity (corresponding to the cold-dry maximum of the final glacial phase) ca. 18 Ka may have reduced human population in the rift valleys, with all but the deepest rift lakes dried to ephemeral pools. One site dating to this period is Buvuma Island in Lake Victoria, Uganda. Following this arid interval, several sites such as Gamble's Cave and Nderit Drift in Kenya and Gobedra rockshelter near Axum in Ethiopia were occupied by people who left assemblages of large blades. In Kenya, these industries are known as the Eburran and contain many "Upper Paleolithic" tool types. At other sites in most East African countries—for instance, Laga Oda rockshelter in Ethiopia, QoQoshis Qabe in Somalia, and Lukenya Hill and Nasera in Kenya, microlithic industries of pointed backed bladelets and crescents are prevalent. By 10 Ka, most regions are characterized by microlithic technology. It is likely that these latest Paleolithic hunters were responsible for the rich corpus of rock art in Tanzania. Around the Lake Turkana Basin, the high lake shorelines dating to the Early Holocene have yielded not only microlithic industries and ostrich-eggshell beads but also numerous small bone harpoons and the abundant remains of fish, hippopotamus, and crocodile.

A succession of wet and dry intervals between 9.5 and 5.5 Ka apparently promoted interchanges and possibly migrations between east Africa and the Sahara region. By ca. 5 Ka (3000 BCE) remains of domesticated cattle, sheep, and goats, all nonindigenous species, are known from northern Kenya, and there is some evidence for semipermanent settlement and the intensive use of cereals. Agriculture, based on local plants such as millet, teff, and ensete, may have been independently developed in Ethiopia, but by the late 1990s the only evidence for this dated to between 2000 and 0 BCE.

The earliest state-level society in the region is the state of Axum in northern Ethiopia, whose origins date to ca. 500 BC and reflect strong influences from South Arabia. Historical inscriptions from Meroitic sites in Central Sudan indicate that the Nubian-Egyptian civilization had established trading and military outposts in the same region as far back as 1200 BC. Contact with Arabia was also important in the establishment of later East African states, such as those of the Swahili coast. The nature of this contact, however, and the extent to which it merged with already existing indigenous complex cultural systems, is the subject of several archaeological and historical investigations.

See also Acheulean; Afar Basin; Africa; Africa, North; Africa, Southern; Arambourg, Camille; Asia, Western; Australopithecus; Baringo Basin/Tugen Hills; Cercopithecinae; Clark, J. Desmond; Colobinae; "Dendropithecus-Group"; Early Paleolithic; Hominidae; Homininae; Hominoidea; Homo; Kenyapithecinae; Late Paleolithic; Later Stone Age; Leakey, Louis Seymour Bazett; Leakey, Mary Douglas; Middle Awash; Middle Paleolithic; Middle Stone Age; Modern Human Origins; Natron-Eyasi Basin; Oldowan; Olduvai Gorge; Paranthropus; Proconsulidae; Rift Valley; Sangoan; Second Intermediate; Senga-5; Turkana Basin; Victoriapithecinae; Western Rift. [A.S.B., J.A.V.C., E.D.]

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