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STRATIGRAPHY AND PALEONTOLOGY OF PLIOCENE AND PLEISTOCENE LOCALITIES WEST OF LAKE TURKANA, KENYA

John M. Harris, Frank H. Brown, and Meave G. Leakey

Natural History Museum of Los Angeles County • 900 Exposition Boulevard • Los Angeles, California 90007

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STRATIGRAPHY AND PALEONTOLOGY OF PLIOCENE AND PLEISTOCENE LOCALITIES WEST OF LAKE TURKANA, KENYA

John M. Harris,[1] Frank H. Brown,[2] and Meave G. Leakey[3]

ABSTRACT. A cumulative thickness of 730 m of lacustrine, fluviatile, and terrestrial sediments exposed near the northwest shoreline of Lake Turkana documents the western margin of the Lake Turkana basin during the late Pliocene and early Pleistocene. These strata constitute the Nachukui Formation, which is named in this paper and subdivided into eight members. The distribution of sedimentary facies within the Nachukui Formation suggests that, as today, the Labur and Murua Rith ranges formed the western margin of the basin and were drained by eastward-flowing rivers that fed into the forerunner of the present lake or a major river system. Twenty-three of the tuffs observed in the formation have been previously recognized from sequences preserved at Koobi Fora and in the lower Omo Valley and permit correlation between these three localities.

Forty-seven fossiliferous sites from West Turkana have yielded more than 1000 specimens of 93 mammalian species, including important *Homo erectus* and *Australopithecus boisei* material that has been reported previously. The larger fossil mammals described in this paper constitute 10 time-successive assemblages that augment information about faunal and environmental change from elsewhere in the basin.

INTRODUCTION

The Lake Turkana basin, which forms part of the eastern Rift Valley system of East Africa, is located at the western edge of the border between Kenya and Ethiopia. It has proved a prolific source of Miocene, Pliocene, and Pleistocene fossils that have contributed much to the understanding of the tempo and mode of evolution of terrestrial African faunas. Within the basin, several geographically discrete areas have at different times been investigated by different research projects (Fig. 1). Pliocene and Pleistocene assemblages of fossil vertebrates and invertebrates from the lower Omo Valley of Ethiopia, to the north of the present lake, were originally documented by Arambourg (1943, 1947) and were later (1967–1974) intensively investigated by participants in the joint French/American International Omo Research Project (Coppens et al., 1976; Coppens and Howell, 1985). The lengthy stratigraphic succession in the lower Omo Valley of southwestern Ethiopia has in consequence provided a framework of radiometric dates and paleomagnetic data from which to calibrate and interpret faunal change both in the basin and farther afield. The Koobi Fora region, on the northeastern shore of the lake, has been investigated by participants in the Koobi Fora Research Project under the aegis of the National Museums of Kenya since 1968 (Leakey and Leakey, 1978). This region contains a less continuous Pliocene and Pleistocene succession than that documented in the lower Omo Valley, but it both supplements our understanding of the time-sequential regional assemblages of fossil vertebrates and invertebrates in the Lake Turkana Basin, and provides faunal samples from intervals that are either unrecorded or only poorly documented in the latter. The abundant hominid remains (Leakey and Leakey, 1978) have received much attention and some of the other fossil mammals have been described in monographic detail (Harris, 1983). Monographic treatment of the rest of the Koobi Fora fossil material is currently in progress. The localities of Kanapoi, Ekora, and Lothagam to the southwest of the lake have yet to be dated precisely but have yielded assemblages with potential to resolve and document faunal change in the late Miocene and early Pliocene (Patterson et al., 1970; Behrensmeyer, 1976; Smart, 1976; Cooke and Ewer, 1971; Hooijer and Patterson, 1972; Hooijer and Maglio, 1974; Maglio, 1970).

Exposures on the west side of Lake Turkana had previously yielded an early Miocene fauna (Madden, 1972), a Miocene freshwater whale (Mead, 1975), a Cretaceous dinosaur humerus (Arambourg and Wolff, 1969), and fragmentary vertebrate fossils thought to be late Pleistocene or Holocene in age. The region received renewed attention at the beginning of the present decade as an outgrowth of field programs of the Koobi Fora Research Project. The West Turkana Re-

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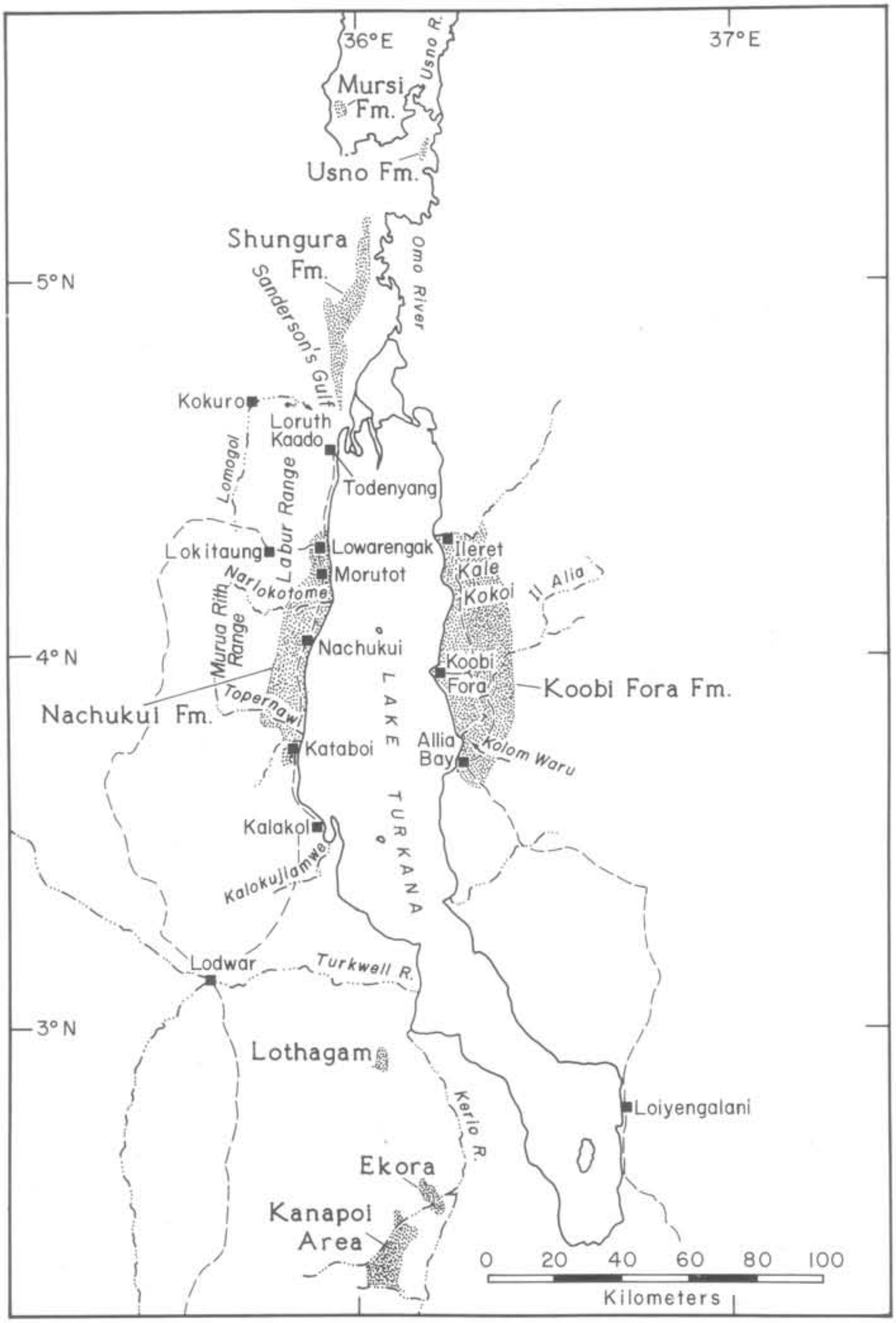


Figure 1. Map of Lake Turkana Basin showing the distribution of the major Plio-Pleistocene fossiliferous localities (West Turkana, Shungura, Mursi, Usno, Koobi Fora, Kanapoi, Ekora, and Lothagam). Shaded areas represent Plio-Pleistocene outcrops. Dashed lines represent roads.

search Project, as it has now become known, is part of the field and research programs of the National Museums of Kenya.

Late in 1980, personnel from the National Museums of Kenya surveyed exposures of the West Turkana region that lay between the settlements of Kalakol (formerly Ferguson's Gulf) and Lowarengak and located sites that contained Pliocene and Pleistocene mammalian fossils and stone tools. These localities were briefly revisited by part of the original team accompanied by two of us (JMH, FHB) in the summer of 1981 to evaluate the age and diversity of the surface fossils and to seek tuffs for correlation and dating purposes. A further two-week field reconnaissance in the summer of 1982 laid the basis for preliminary estimates of the biostratigraphy and chronostratigraphy of this new area (Harris and Brown, 1985). Large-scale aerial photographic coverage of the region was obtained in 1983 and intensive fieldwork to document the geology and paleontology was initiated in 1984.

One of the objectives of the West Turkana Research Project was to seek additional material relevant to the investigation of early human origins. The subsequent recovery of a virtually complete *Homo erectus* skeleton (Brown et al., 1985) and an early robust australopithecine cranium (Walker et al., 1986) has already been reported. Descriptions of other new hominid material are in progress. The purpose of this paper is to provide additional information on the stratigraphy and paleontology of the Pliocene and Pleistocene strata exposed in this region so that the previously reported hominid specimens can be viewed in terms of their overall chronostratigraphic and biostratigraphic context. Monographic treatment of the Pliocene and Pleistocene fossil assemblages will be provided elsewhere.

GEOGRAPHIC SETTING

The region investigated lies between the settlements of Kalakol to the south and Lowarengak to the north (see Fig. 1), and is largely contained within a strip of land about 10 km wide between the shore of Lake Turkana and low mountains, the Labur and Murua Rith ranges, formed from strata of Miocene or earlier age to the west. Other exposures lie north of the Labur (sometimes spelled "Lapurr") Range near the spring of Loruth Kaado, approximately halfway between the police posts of Kokuro and Todenyang, and also in small patches to the south as far as Kalojujiamwe (Fig. 1). The region is delineated by latitudes 3°35′N and 4°30′N and longitudes 35°40′E and 35°55′E. The elevation of the Pliocene and Pleistocene sediments ranges from about 372 m (the level of Lake Turkana) to 540 m. The top of the Labur Range is the local high point, and rises to 1457 m.

All rivers in the region are ephemeral and drain from west to east. Most arise from the east edge of the Labur and Murua Rith ranges although the larger rivers (the Lagas Topernawi, Kataboi, Kokiselei, and Nariokotome) originate within these ranges. The Lomogol, which rises west of the Labur Range, flows directly northward for most of its course, but turns east at Kokuro to debouch into Sanderson's Gulf. Much of the area is covered by upper Pleistocene and Recent alluvium, but there are many exposures of Pliocene and Pleistocene sediments that crop out along stream courses near the lake or in low hills farther from the lake.

STRATIGRAPHY

Several short articles documenting local sections in the vicinity of fossil hominid remains have been published (Harris and Brown, 1985; Brown et al., 1985; Walker et al., 1986). It was possible to discuss these sections in regional terms because correlations with the Shungura Formation in the lower Omo Valley and with the Koobi Fora Formation east of the lake were established through chemical analysis of volcanic ash layers within the local sections. No generalized account of the stratigraphy of the deposits has been reported previously, nor has a formal stratigraphic nomenclature been established. We here provide a formal stratigraphic scheme for the region.

Even though precise correlations can be made with both the Shungura and Koobi Fora formations, a new formational name for the geographically separate outcrops along the western side of the lake is justified. Some stratigraphic units from west of Lake Turkana correlate with strata of the Koobi Fora Formation that are absent from the Shungura Formation, whereas others correlate with strata of the Shungura Formation that are absent from the Koobi Fora region. Moreover, a separate name will permit other workers to clearly convey their intent to discuss the fauna, facies, strata, etc. of this particular subregion of the Turkana Basin.

Because lithologic contrasts are extreme in this region, one must opt whether to follow the precedent set for the Shungura and Koobi Fora formations by using volcanic ash layers as marker horizons to define named stratigraphic intervals, or to emphasize observed major changes in sedimentary facies. New units are defined here such that correlation with other established stratigraphic units in the basin is straightforward and precise, hence the earlier precedent is followed, although this is not wholly satisfactory for the geology of this particular part of the basin. It must also be decided whether names applied to subdivisions of the strata should be those applied to other strata exposed elsewhere in the region, or if a new system of subdivisions should be established referring specifically to the strata exposed in the immediate area. A hybrid between the two might be preferable, permitting some members that are lithologically well defined to extend from one formation into another but defining new members where necessary to reflect the unequal development of particular lithologies from one part of the basin to another. Here the third option is followed, defining some new members but retaining other member names that had been previously defined elsewhere.

The widely dispersed nature of the exposures west of Lake Turkana, precludes defining the strata of this region in a single type section. However, each of the members of the formation, as proposed below, can be defined in a single section, and each of these individual sections can be linked by volcanic ash layers. The stratotype of the formation is the composite stratotype of the eight constituent members of the formation.

There are few permanent settlements or prominent topographic features in the region. For this reason discussion of the stratigraphy is made with reference to the unpaved major road linking Kalakol (formerly Ferguson's Gulf) at the south of the area with Lowarengak to the north, and to the ephemeral rivers (lagas) draining eastward into Lake Turkana.

NACHUKUI FORMATION

The name Nachukui Formation is proposed for poorly consolidated sandstones, siltstones, claystones, and conglomerates exposed west of Lake Turkana between 3°20′N and 4°20′N latitude that rest disconformably on, or are in fault contact with, Miocene volcanic rocks and intercalated sediments and/or on Precambrian gneisses. The aggregate thickness of these strata is on the order of 730 m, comparable to that of the Shungura Formation (de Heinzelin, 1983), and of the Koobi Fora Formation (Brown and Feibel, 1986). There is no satisfactory name for the entire region of exposures west of Lake


Type Section of Members
A: Lonyumun and Kataboi
B: Lomekwi
C: Lokalalei
D: Kalochoro
E: Kaitio, Natoo and Nariokotome
Fault. Ball on downthrown side
Contact
Alluvial cover
Natoo and Nariokotome Members
Kalochoro and Kaitio Members
Lomekwi and Lokalalei Members
Lonyumun and Kataboi Members
Miocene Basalts
LOWARENGAK
Lowarengak
503
Nakitokonon
508
Lokitoinyala
771,772
773
766
769
Natoo
not mapped
764
Lokapetemoi
2972
2957
Nariokotome
785
786
784
791
779
775
Kaitio
514
777
780
Nachukui
1847
1848
1849
3022
NACHUKUI
Naiyena Engol
Kalochoro
Kalokodo
741
Kokiselei
737
740
738
Kangaki
739
2614
2615
2934
not mapped
Lokalalei
2674
Lomekwi
2709
2662
729
2657
2654
2652
2635
Kangatukuseo
2860
Topernawi
2604
Kataboi
KATABOI
532
2594
2597, 2598
0
10 km
LAKE TURKANA

Turkana, save Turkana itself, but this name has been applied to both Cretaceous and Miocene sediments in the area, and is not available. Consequently the formation is named for an ephemeral stream, the Laga Nachukui, in the vicinity of which outcrops typical of the upper half of the formation are found. The type area of the Nachukui Formation lies west of Lake Turkana, and east of the Labur and Murua Rith ranges (Fig. 1). Exposures of Pliocene and Pleistocene strata immediately to the north of this range near the spring of Loruth Kaado are considered by us to be part of the Nachukui Formation, but are treated separately in this paper. The Nachukui Formation is divided into eight members on the basis of volcanic ash layers of distinctive chemical composition. In ascending stratigraphic order, these members are the Lonyumun, Kataboi, Lomekwi, Lokalalei, Kalochoro, Kaitio, and Nariokotome members. Locations of the type sections of these members are shown on Figure 2.

Tuffs have been used to subdivide the Nachukui Formation into members because they are the only lithologic units that can be recognized with a high degree of confidence wherever they occur in the area. In fact it would be more correct to say that it was possible to create the Nachukui Formation from its constituent members because of the presence of the tuffs. As several tuffs must be newly named here, the sequence of ash layers is discussed before giving descriptions of the members of the Nachukui Formation.

TUFFS OF THE NACHUKUI FORMATION

Much of our understanding of stratigraphic relations between the Shungura, Koobi Fora, and Nachukui formations results from geochemical study of the glass fraction of volcanic ash layers interbedded within these deposits. The gross character of a particular ash layer may change markedly from one area to another within the region—a tuff may be be present as a thick channel fill at one locality, but as a thin air-fall deposit at another. Hence one cannot use lithologic characters as a basis for correlation over large areas. The correlations achieved thus far between the three formations rest on compositional data on 1040 glass separates that have been organized into approximately 120 distinct chemical types. Not all tuffs have been found in all areas, and each area has a number of ash layers present only locally. In part this reflects localized deposition and erosion expected in terrestrial settings, and signals that diastems must abound in all sections. Other tuffs, however, are much more widespread, and it is usually possible to place the more geographically restricted tuffs within a reasonably narrow stratigraphic interval with respect to these. In a few cases, however, tuffs of distinctive chemical composition have been collected and analyzed from sections that cannot be related to any of the widespread tuffs. As a result it is not possible to arrange all of the ash layers into a single ordered sequence, although with enough analyses in enough local sections this is theoretically possible, provided sections linking all ash samples are somewhere preserved in the basin.

Below we summarize information on 43 tuffs within the Nachukui Formation known to be of distinctive chemical composition, or stratigraphically distinct from one another. Some of these are confined to the Nachukui Formation, but others correlate with tuffs exposed elsewhere in the Lake Turkana Basin. For many of tuffs of this latter group two designations already exist—one for tuffs in the Shungura Formation, the other for tuffs in the Koobi Fora Formation. The tuffs of the Shungura Formation have been referred to by an alphanumeric system (de Heinzelin, 1983) rather than names, because the type area of the Shungura Formation has few locally named geographic features that could be used in naming tuffs. This system has been criticized because it does not follow the International Stratigraphic Guide, but for the Shungura Formation the system has proven extremely practical because the designation of the tuff immediately indicates its stratigraphic level. Thus one need not memorize a sequence of names. It seems senseless to name every distinct tuff unless it has been used for stratigraphic subdivision, correlates with an unnamed tuff known elsewhere in the basin, or has been dated. In deference to the "Guide," and for the sake of uniformity, those tuffs that meet any of the above criteria will be referred to by a name in this paper. If a tuff has been previously named from the Koobi Fora region, that name will be employed here. If no prior name (as opposed to an alphanumeric designation) exists for a tuff it is newly named here. If a tuff has a prior alphanumeric designation, the designation of the Shungura Formation correlative of the named tuff is placed in parentheses immediately following the name throughout the text. Thus Lokochot Tuff (= A) implies that Tuff A of the Shungura Formation is considered correlative with the Lokochot Tuff of the Koobi Fora and Nachukui formations. The tuffs are discussed below in stratigraphic order from the base of the formation upward utilizing the member names stated above. The analyses in Table 1 are arranged stratigraphically insofar as possible, with analyses of the youngest ash layers at the top of the table. Most of the sample locations are shown on Figure 2; a generalized sequence of tephra layers is shown in Figure 3 for reference. Lithologic descriptions of the members are given in the following section.

Only one volcanic ash layer is known from the Lonyumun Member of the Nachukui Formation (K82-721; Table 1). It is 0.5 m thick, lenticular, and lies about 3 m below the Moiti Tuff in a siltstone section exposed in a small ephemeral stream 8 km south of the town of Kataboi.

Seven tuffs are known from the Kataboi Member, five of which correlate with ash layers known elsewhere in the Turkana Basin, or at more distant locales. The Moiti Tuff was defined by Cerling and Brown (1982), and marks the base of

←

Figure 2. Schematic map of the Nachukui Formation west of Lake Turkana, Kenya. Localities of type sections of members of the formation are shown, as are locations of analyzed tephra samples from the region. Sample numbers are given on the figure without the prefix that designates the year of collection.

Table 1. **Compositional data on tuffs of the Nachukui Formation with comparative analyses from the Koobi Fora (KF) and Shungura formations.**

Sample #	Fe_2O_3	CaO	K_2O	Ba	Mn	Nb	Rb	Sr	Ti	Y	Zn	Zr	Location
						Tuffs of the Nariokotome Member							
Kale Tuff													
K81-508	3.00	0.18	2.9	<10	950	99	90	<5	1028	79	153	866	Nakitokonon
K80-143	3.01	0.22	2.5	<10	973	104	94	<5	1080	79	153	874	Area 7, KF
Upper Nariokotome Tuff													
K82-773	4.00	0.22	3.4	376	1510	108	87	<5	1495	91	201	1002	Natoo
Middle Nariokotome Tuff													
K82-772	3.85	0.22	3.1	364	1165	123	89	5	1518	104	221	1081	Natoo
Lower Nariokotome Tuff													
K82-771	4.80	0.18	4.1	87	1892	109	95	26	1770	99	240	1023	Natoo
						Tuffs of the Natoo Member							
Unnamed tuff													
K82-769	6.09	0.30	2.7	813	2095	128	79	19	1970	105	166	1134	Natoo
Naito Tuff													
K82-764	5.17	0.24	2.8	622	1714	109	80	14	1654	97	249	1005	Lokapetamoi
ETH329	5.39	0.27	3.3	682	1705	120	81	18	2094	109	240	1101	Naito, Omo
Chari Tuff (= L)													
K82-786	2.90	0.19	2.9	225	696	99	105	6	1105	100	193	1074	Kaitio
77-23	2.81	0.18	3.3	223	564	103	102	5	1093	102	190	1085	Area 1, KF
TEC76-L	2.70	0.18	4.4	225	518	102	107	7	1056	101	183	1106	Kalam; Omo
Unamed tuff													
K82-785	3.20	0.19	3.1	203	762	114	110	<5	1172	110	213	1155	Kaitio
Unnamed tuff													
K84-2972	1.31	0.29	3.9	1059	488	79	123	203	1440	70	96	302	Nariokotome
Koobi Fora Tuff													
K84-1888	5.01	0.17	2.8	<10	1829	225	142	<5	1886	117	258	1484	Loruth Kaado
K85-2274	5.06	0.19	2.9	<10	1859	239	136	<5	1881	132	276	1665	Area 103, KF
Lower Koobi Fora Tuff													
K84-2957	5.15	0.28	2.5	75	1454	139	108	<5	2054	106	224	1104	Nariokotome
K80-163	5.00	0.37	2.1	35	1485	142	108	12	2064	99	215	1096	Area 103, KF
						Tuffs of the Kaitio Member							
Unnamed tuff													
K82-784	6.40	0.19	2.3	<10	2534	312	172	<5	2217	156	353	1994	Kaitio
Morutot Tuff (= J-4)													
K82-766	2.95	0.34	4.2	216	701	147	91	<5	1049	110	201	1005	Natoo
K81-503	2.85	0.33	4.9	168	853	160	97	<5	1049	117	211	1013	Lowarengak
ANU83-32	2.73	0.34	4.9	193	721	153	95	<5	1462	111	207	1022	Area 131, KF
228-3	3.31	0.43	3.5	262	816	141	84	<5	1321	102	196	1176	Ilgwa, Omo
Orange Tuff													
K82-791	2.10	0.40	3.3	<10	421	84	159	10	708	70	90	481	Nachukui
K80-237	2.18	0.46	4.6	39	457	80	145	6	1002	68	83	543	Area 107, KF
Malbe Tuff (= H-4)													
K81-514	4.76	0.91	2.5	51	1858	158	99	20	3240	99	210	1121	Nachukui
K80-225	4.70	0.38	3.0	61	1897	139	103	<5	3353	82	194	996	Area 112, KF
76-H4B	4.78	0.34	4.3	253	1934	152	119	16	3067	95	212	1082	Shungura, Omo
KBS Tuff (= H-2)													
K82-775	3.05	0.18	3.3	27	869	196	172	<5	1178	129	227	1233	Kaitio
77-17	3.09	0.23	3.2	30	843	194	165	7	1297	129	253	1239	Area 105, KF
76-H2B	3.00	0.17	3.8	89	825	191	174	7	1205	131	230	1319	Shungura, Omo

Table 1. Continued.

Sample #	Fe_2O_3	CaO	K_2O	Ba	Mn	Nb	Rb	Sr	Ti	Y	Zn	Zr	Location
					Tuffs of the Kalochoro Member								
Kangaki Tuff													
K82-739	3.60	0.16	2.3	11	1523	204	170	<5	1318	104	209	1535	Kangaki
Unnamed Tuff													
K82-738	6.19	0.19	1.7	54	2512	226	226	69	1175	134	260	1632	Kangaki
K82-741	6.32	0.18	1.1	<10	1805	250	80	<5	1116	151	262	1689	Kokiselei
Unnamed Tuff													
K82-740	4.75	0.20	1.5	<10	1736	192	104	<5	1796	110	216	1423	Kokiselei
K82-737	4.70	0.21	2.1	19	1681	198	81	<5	1858	111	223	1449	Kokiselei
Unnamed Tuff													
K84-1849	6.18	0.22	1.4	<10	2260	407	72	8	1446	236	393	3007	Kalochoro
Ekalalei Tuff (= F-1)													
K85-2614	4.75	0.21	1.2	<10	1772	203	117	<5	1807	119	217	1479	Lokalalei
K86-3022	4.43				1711	196	90	<5		108		1409	Nachukui
ETH-228	4.67	0.21	1.9	12	1606	188	73	11	1593	104	215	1377	Shungura, Omo
Kalochoro Tuff (= F)													
ET-51	4.63	0.18	2.0	<10	1514	169	95	<5	1537	129	272	1394	Shungura, Omo
K84-1848	4.57	0.19	1.6	<10	1517	179	107	<5	1781	134	273	1476	Kalochoro
ET-53	4.77	0.18	1.8	<10	1542	192	91	<5	1469	146	272	1638	Shungura, Omo
					Tuffs of the Lokalalei Member								
Unnamed tuff													
K82-780	2.36	0.29	2.4	509	1290	109	112	10	1913	82	140	854	Kaitio
Nalukuwoi Tuff (= E-4)													
K82-779	4.30	0.19	2.0	<10	1447	152	103	<5	1504	111	223	1213	Kaitio
K85-2662	4.36	0.22	1.1	<10	1478	150	93	<5	1516	114	215	1237	Lomekwi
ET-103	4.67	0.16	2.6	<10	1583	147	104	<5	2001	105	206	1246	Shungura, Omo
Unnamed tuff													
K82-777	4.95	0.19	2.0	16	1706	147	83	<5	2145	101	210	1185	Kaitio
Kokiselei Tuff (= E)													
K85-2615	6.10	0.22	1.2	29	2406	172	107	<5	2249	130	261	1359	Lokalalei
ET-45	6.11	0.20	1.5	<10	2402	168	72	<5	2276	128	279	1338	Shungura, Omo
Unnamed tuff													
K82-729	5.90	0.13	1.1	<10	2058	354	109	<5	1368	214	362	2813	Lomekwi
Unnamed tuff													
K85-2654	3.13	0.37	1.8	117	1559	74	65	12	3213	64	136	557	Lomekwi
Lokalalei Tuff (= D)													
K84-2934	3.45	0.19	1.8	<10	1337	179	151	<5	1333	102	178	1414	Lokalalei
K82-2635	3.12	0.14	1.5	<10	1429	171	117	5	1708	99	168	1332	Kangatukuseo
ET-35	3.15	0.12	3.7	<10	1240	174	154	<5	1304	95	165	1321	Shungura, Omo
80-275	3.58	0.15	1.7	<10	1388	169	159	<5	1384	95	201	1233	Area 207, KF
K82-2657	3.41	0.19	2.2	<10	1327	161	140	<5	1579	88	153	1169	Lomekwi
					Tuffs of the Lomekwi Member								
Unnamed tuff													
K85-2652	2.69	0.19	1.8	10	1301	101	90	<5	2141	74	134	816	Lomekwi
Emekwi Tuff (= C-9)													
K82-2674	5.19	0.22	1.2	<10	1834	193	116	<5	1871	112	261	1382	Lokalalei
ET-77	5.11	0.18	2.0	<10	1782	197	80	<5	1847	114	249	1417	Shungura, Omo
Waru Tuff													
K85-2604	5.28	0.25	1.9	<10	1674	109	109	<5	1945	120	209	1006	Topernawi
K82-1372	5.29	0.23	2.0	11	1640	106	125	<5	1819	116	206	972	Area 207, KF

Table 1. Continued.

Sample #	Fe_2O_3	CaO	K_2O	Ba	Mn	Nb	Rb	Sr	Ti	Y	Zn	Zr	Location
Unnamed tuff													
K82-750	3.59	0.11	3.0	10	990	206	243	<5	907	147	314	1666	Loruth Kaado
Tulu Bor-β Tuff (= Bβ)													
K85-2598	1.66	0.35	3.3	177	459	81	118	7	940	59	76	381	Nasechebun
K80-177	1.56	0.31	3.3	134	392	85	115	5	962	63	73	386	Area 117, KF
ET-89	1.62	0.29	3.5	114	372	85	132	6	874	64	73	367	Shungura, Omo
Tulu Bor-α Tuff (= Bα)													
K85-2597	1.39	0.49	3.4	413	278	75	121	27	1214	55	55	283	Nasechebun
K81-479	1.37	0.47	4.3	399	248	72	114	22	1196	52	59	266	Area 250, KF
Tuff Bα	1.41	0.55	3.2	416	283	75	148	33	1364	55	55	288	Shungura, Omo
Tuffs of the Kataboi Member													
Kaado Tuff													
K84-1874	2.53	0.32	3.5	18	984	94	70	<5	1814	70	128	816	Loruth Kaado
K84-1584	2.68	0.23	3.0	38	1170	97	62	6	2095	73	178	796	Area 117, KF
Lokochot Tuff (= A)													
K81-532	3.59	0.18	2.8	103	806	146	127	5	1209	133	244	1369	Nasechebun
K80-291	3.51	0.18	3.3	121	809	146	126	<5	1233	135	233	1360	Area 250, KF
Tuff A	3.70	0.21	3.1	109	828	153	132	7	1285	140	255	1419	Shungura, Omo
Loruth Tuff													
K82-746	2.87	0.44	3.9	19	598	87	150	16	1407	69	132	683	Loruth Kaado
K81-481	2.91	0.36	3.1	<10	572	78	146	<5	1086	68	131	673	Area 250, KF
Unnamed tuff													
K85-2860	3.32	0.18	2.4	893	898	108	80	33	1634	94	132	833	Topernawi
Unnamed tuff													
K82-742	4.40	0.21	2.5	<10	1533	161	143	<5	1581	110	204	1136	Loruth Kaado
Topernawi Tuff													
K85-2709	2.81	0.20	3.3	<10	828	139	158	<5	1118	99	142	918	Lomekwi
K85-2726	2.45	0.46	3.9	137	1092	101	118	8	2194	71	123	778	Area 254, KF
Moiti Tuff													
K85-2594	2.80	0.24	3.0	395	695	117	95	11	1186	112	227	1058	Nasechebun
K81-602	2.70	0.18	4.2	401	618	122	97	<5	1063	114	235	1099	Area 260, KF
Tuff of the Lonyumun Member													
Unnamed Tuff													
K82-721	4.26	0.30	2.0	14	1296	115	89	<5	1627	95	174	1030	S of Kataboi

the Kataboi Member. It is an extremely widespread ash layer, known from the Koobi Fora and Nachukui formations in the Turkana Basin, from the deep sea in the Gulf of Aden (Sarna-Wojcicki et al., 1985), the Somali Basin (unpublished data), and the region between North Horr and Loiyengalani on the western edge of the Chalbi Desert (Brown et al., in prep.). A similar ash has been reported in the upper part of the Omo River valley by W[olde]-Gabriel and Aronson (1987), where it is much thicker than in the Turkana Basin. In the Nachukui Formation, the Moiti Tuff is discontinuously exposed from Topernawi southward to Kalokujiamwe. It has been dated at 4.10 ± 0.07 Ma by McDougall (1985).

A thick sandstone between Laga Topernawi and the upper course of the northern branch of Lomekwi contains a tuffaceous band 3–5 m above its base with pumice clasts up to 10 cm in maximum dimension. This tuff is here named the Topernawi Tuff, with its type locality in the Lomekwi drainage (sample K86-2709; Fig. 2). It is probable that this tuff correlates with a tuff that demonstrably lies between the Moiti and Lokochot (= A) tuffs of the Koobi Fora Formation in Area 254 of the Koobi Fora region. There it consists of a coarse ash with well-developed current cross-bedding, and is obviously reworked. K/Ar determinations on this tuff are consistent with its position, and will be reported elsewhere (Feibel, Brown, and McDougall, in prep.) along with supporting data.

Two tuffs (K82-742 and K85-2860) are known only from the Nachukui Formation, and are not named here. K82-742 is a lenticular tuff that lies about 10 m below the Lokochot Tuff (= A) at Loruth Kaado. K85-2860 is a sample of a lenticular tuff known only where it fills a channel to a depth of 7.8 m in exposures between the Laga Kataboi and the Laga Topernawi. There it lies 9 m below the Lokochot Tuff (= A), but disappears laterally. The relative order of these two tephra layers is not known with certainty.

A second section of Loruth Kaado includes a vitric tuff (K82-746) 0.5 m thick which lies 2 m below the Lokochot Tuff (= A). It correlates with a tuff (K81-481) exposed in Area 250 at Koobi Fora where it lies 4 m below the Lokochot Tuff (= A). This tuff is here named the Loruth Tuff; the type locality is the exposure at Loruth Kaado.

The Lokochot Tuff (= A) was defined by Cerling and Brown (1982) in the Koobi Fora Formation. It was described in that paper, and it was also demonstrated that Tuff A of the Shungura Formation is its lateral equivalent. Subsequently it was found that the Lokochot Tuff (= A) is present in deep-sea sediments of the Gulf of Aden (Sarna-Wojcicki et al., 1985), and in Pliocene exposures located south of Lothagam (Brown et al., 1985). In the Nachukui Formation the Lokochot Tuff (= A) is discontinuously exposed from Kokiselei to Nasechebun (see Table 1).

Below the Tulu Bor Tuff (= B) at Loruth Kaado is a vitric tuff (K84-1874) 12 m thick, which we name here the Kaado Tuff, after the type locality at Loruth Kaado. It is separated from the Tulu Bor Tuff by 2.7 m of olive-gray claystone. Compositionally it is very similar to a tuff (K83-1584) exposed in an isolated section in Area 117 at Koobi Fora, and correlation between these two units is probable. This is the highest volcanic ash layer known in the Kataboi Member of the Nachukui Formation.

Six tephra layers are known from the Lomekwi Member. The lowest two of these are the two types of Tulu Bor Tuff (= B) designated α-Tulu Bor (= Bα) and β-Tulu Bor (= Bβ) tuffs by Cerling and Brown (1982), where it was also shown that the Tulu Bor tuffs (= B) correlate with Tuffs B-α and B-β of the Shungura Formation. Comparative analyses are given in Table 1. In the Nachukui Formation the Tulu Bor Tuffs are known from Loruth Kaado, and from exposures between Lomekwi and Nasechebun. The β-Tulu Bor Tuff has been correlated with the Sidi Hakoma Tuff of the Hadar Formation in Ethiopia by Brown (1982), and has been identified in deep-sea sediments of the Gulf of Aden (Sarna-Wojcicki et al., 1985). An unnamed tuff (K82-750) exposed at Loruth Kaado lies about 2 m above the Tulu Bor Tuff there. This is its only known occurrence.

A fine sand section on the south bank of the laga Topernawi 5 km west of the road contains a tuffaceous interval, glass shards from which (K85-2604) are compositionally identical to those from a tuff (K82-1372) cropping out in Area 207 of the Koobi Fora region (Brown and Feibel, 1986). This tuff lies 5 m stratigraphically above the base of the Allia Tuff, and is here named the Waru Tuff, after Kolom Waru, a small stream in the Allia Bay region at Koobi Fora. In its type section the Waru Tuff is 8–10 cm thick, unbedded, and composed predominantly of flat and bubble-junction shards.

The Emekwi Tuff (= C-9), newly named here (see below), is exposed only in the southern branch of the Laga Lokalalei, where it is a medium to dark gray vitric tuff 1 m thick with small-scale cross-laminations (sample K82-2674). It rapidly

NACHUKUI FORMATION

Member	Tuff
NARIOKOTOME MEMBER	vvvvvvvvvv---KALE TUFF
	vvvvvvvvvv---UPPER NARIOKOTOME TUFF
	vvvvvvvvvv---MIDDLE NARIOKOTOME TUFF
	vvvvvvvvvv---LOWER NARIOKOTOME TUFF
NATOO MEMBER	vvvvvvvvvv---K82-769
	vvvvvvvvvv---NAITO TUFF (=L-3)
	vvvvvvvvvv---CHARI TUFF (=L)
	vvvvvvvvvv---K82-785
	vvvvvvvvvv---K84-2792
	vvvvvvvvvv---KOOBI FORA TUFF
	vvvvvvvvvv---LOWER KOOBI FORA TUFF
KAITIO MEMBER	vvvvvvvvvv---K82-784
	vvvvvvvvvv---MORUTOT TUFF (=J-4)
	vvvvvvvvvv---ORANGE TUFF
	vvvvvvvvvv---MALBE TUFF (=H-4)
	vvvvvvvvvv---KBS TUFF (= H-2)
KALOCHORO MEMBER	vvvvvvvvvv---KANGAKI TUFF
	vvvvvvvvvv---K82-738
	vvvvvvvvvv---K82-737
	vvvvvvvvvv---K84-1849
	vvvvvvvvvv---EKALALEI TUFF (=F-1)
	vvvvvvvvvv---KALOCHORO TUFF (=F)
LOKALALEI MEMBER	vvvvvvvvvv---K82-780
	vvvvvvvvvv---NALUKUWOI TUFF (=E-4)
	vvvvvvvvvv---K82-777
	vvvvvvvvvv---KOKISELEI TUFF (=E)
	vvvvvvvvvv---K82-729
	vvvvvvvvvv---K85-2654
	vvvvvvvvvv---LOKALALEI TUFF (= D)
LOMEKWI MEMBER	vvvvvvvvvv---K85-2652
	vvvvvvvvvv---EMEKWI TUFF (=C-9)
	vvvvvvvvvv---WARU TUFF
	vvvvvvvvvv---K82-750
	vvvvvvvvvv---β-TULU BOR TUFF (=Bβ)
	vvvvvvvvvv---α-TULU BOR TUFF (=Bα)
KATABOI MEMBER	vvvvvvvvvv---KAADO TUFF
	vvvvvvvvvv---LOKOCHOT TUFF (=A)
	vvvvvvvvvv---LORUTH TUFF
	vvvvvvvvvv---K85-2860
	vvvvvvvvvv---K82-742
	vvvvvvvvvv---TOPERNAWI TUFF
	vvvvvvvvvv---MOITI TUFF
LONYUMUN MEMBER	vvvvvvvvvv---K82-721

Figure 3. Schematic section through the Nachukui Formation showing the sequence of analyzed tuffs.

thins laterally to 30 cm. There is little question that it correlates with one of the tuffs of Submember C-9 of the Shungura Formation (see Table 1). Five meters above it, along the southern branch of the Laga Lokalalei lies another thin unnamed tuff of distinctive composition (K85-2652) that is widely exposed near the top of the section at Lomekwi. This latter tuff lies 4 m below the Lokalalei Tuff (= D) along Laga Lokalalei.

At exposures adjacent to the Lokalalei drainage there is a 30-cm-thick vitric tuff that crops out discontinuously as far south as the Laga Kangatukuseo. It is quite variable in gross character. At Lokalalei it was deposited over a dark brown claystone, and is massive. At Lomekwi it was deposited and redeposited over an interval of about 6 m of section in channels commonly with *Etheria* at the base. There it contains lenses of pumice gravel with clasts up to 20 cm in diameter. This tuff is compositionally indistinguishable from Tuff D of the Shungura Formation, and is here named the Lokalalei Tuff (= D). Partial chemical analyses of this tuff have been published previously by Harris and Brown (1985). It also correlates with the informally designated "upper Burgi Tuff" of Cerling and Brown (1982), and the name Lokalalei Tuff should now be applied to that tuff (see Table 1). The best age estimate for this tuff based on K/Ar determinations is 2.52 ± 0.05 Ma (Brown et al., 1985). Nine meters above the Lokalalei Tuff at Lomekwi is an unnamed vitric tuff 0.7 m thick that is known only from this locality (sample K85-2654).

About 18 m above the Lokalalei Tuff at Lokalalei is another vitric tuff composed of distinctive dark gray glass shards. This tuff is compositionally indistinguishable from Tuff E of the Shungura Formation, and is here named the Kokiselei Tuff (= E). The Kokiselei Tuff is discontinuously exposed from Kaitio to Lomekwi in the Nachukui Formation.

Above the Kokiselei Tuff along the Laga Kaitio near the lake there are three tuffs (samples K82-777, -779, and -780; Table 1) that lie 7 m, 15 m, and 22 m, respectively, above the Kokiselei Tuff (= E) in the upper Lokalalei Member. K82-779 (the middle one of the three) correlates with a tuff in Submember E-4 of the Shungura Formation, and is here named the Nalukuwoi Tuff, after the laga of that name immediately south of Laga Kaitio. The Nalukuwoi Tuff is also known from the northern part of the Lomekwi drainage (sample K85-2662). The other two tuffs are not named as they are known only from this locality.

Six tephra layers are known from the Kalochoro Member. The lowest of these is the Kalochoro Tuff (= F). This tuff is 1.4–1.7 m thick, and contains pumice clasts up to 3 cm in diameter. It is compositionally indistinguishable from Tuff F of the Shungura Formation. Its reference locality in the Nachukui Formation is the exposure along the Laga Kalochoro, but it is also exposed on the north bank of the Laga Nachukui at the road crossing. Tuff F of the Shungura Formation has been dated at 2.35 ± 0.05 Ma by Brown et al. (1985).

Approximately 4 m above the Kalochoro Tuff on the south bank of the Laga Nachukui is another tuff that is compositionally very similar to the Kalochoro Tuff, but distinct. This tuff correlates with Tuff F-1 of the Shungura Formation, and is here named the Ekalalei Tuff (= F-1). The type locality is taken as the section at Lokalalei where the type section of the Lokalalei Member was measured (see Fig. 8).

About 8 m above the Kalochoro Tuff at its type locality is another tuff (K84-1849). This tuff is lenticular, and its thickness ranges from 0 to 5.5 m where exposed along the Laga Kalochoro. There it is small-scale cross-laminated and contains abundant calcified root casts. A possible correlate is found at Lokalalei; this tephra layer remains unnamed.

Three other tuffs belong to the Kalochoro Member, only the uppermost of which is named. These tuffs are exposed only along the Lagas Kalochoro and Kangaki. Analyses are given in Table 1 (see uppermost tuffs of Kalochoro Member). The uppermost is here named the Kangaki Tuff. It contains pumice clasts that may prove datable. The type locality of this tuff is along the Laga Kangaki, where it is a very pale gray, fine-grained tuff 2.4 m thick (see Fig. 2).

Five tuffs are known from the Kaitio Member, four of which correlate with tephra layers elsewhere in the basin. The KBS (= H-2) and Malbe (= H-4) Tuffs are well known, and need little discussion (see Cerling and Brown, 1982). In most exposures in the Nachukui Formation they are altered to clay. The KBS (= H-2) and Malbe (= H-4) tuffs are very securely dated at 1.88 ± 0.02, and 1.87 ± 0.02 Ma by McDougall (1985).

The Orange Tuff has been referred to informally as such since Bowen discovered it in Area 131 at Koobi Fora. In subsequent work it was identified in Area 107 at Koobi Fora, and also exists in the upper part of the Nachukui drainage in the Nachukui Formation (K82-791). We here formally name it the Orange Tuff because in its type area (Area 131, Koobi Fora) it is orange.

A thick tuff (5 m) is well exposed at Nanyangakipi, at Lowarengak, and at Natoo, and is very useful as a mapping unit in this area. This tuff is composed of coarse bubble junction and striated glass shards, and at Nanyangakipi it contains occasional pumice clasts up to 8 cm in diameter. It is compositionally similar to Tuff J-4 of the Shungura Formation, and is here named the Morutot Tuff (= J-4), with the type area specified as Nanyangakipi. Pumices whose chemical composition match that of the Morutot Tuff (= J-4) (Brown and Feibel, 1985) have been dated at 1.65 ± 0.02 by McDougall et al. (1985).

The highest tuff assigned to the Kaitio Member is an unnamed tuff (K82-784) that lies only 5 m below the Lower Koobi Fora Tuff along the Laga Kaitio. It is only 10 cm thick, and appears massive. It is known only from this exposure and from exposures along the Laga Kalochoro.

The basal tuff of the Natoo Member is the Lower Koobi Fora Tuff, defined by Brown and Feibel (1985). Six additional tuffs have been analyzed from the Natoo Member, only two of which are known elsewhere in the Turkana Basin. The lowest of these is likely the Koobi Fora Tuff (see Brown and Feibel, 1985), and is known only from Loruth Kaado in low outcrops east of the road there.

An unnamed, but very distinctive tuff (K84-2972) is locally useful from Nariokotome to Kalochoro where it outcrops discontinuously. It lies 7 m above the Lower Koobi Fora Tuff at the road crossing on the Laga Nariokotome. There it is 1.3 m thick and contains sparse mollusks near its base. It is essentially the same composition as the Tulu Bor Tuff, with which it could be confused in the absence of analyses of other tuffs related stratigraphically to it, or other information concerning its age. K82-735 is a sample of an unnamed vitric tuff that lies 35 m below the Chari Tuff in exposures along Laga Kaitio. It is 5 cm thick and known only from this locality.

The Chari Tuff (= L) is well known; a definitive description was given by Cerling and Brown (1982). It is known to correlate with Tuff L of the Shungura Formation, and thus far has only been identified at two localities in the Nachukui Formation—along the Laga Nariokotome and along the Laga Kaitio. In the latter locality it contains pumice clasts to 20 cm although the ash layer itself is only 10 cm thick. The Chari Tuff has been very securely dated at 1.39 ± 0.01 Ma by McDougall (1985).

The Naito Tuff (L-3), named here, is the highest tuff known from the Kaitio Member. It correlates with a tuff that lies 9 m above Tuff L in the Shungura Formation, and has been ascribed to Submember L-3 of the Shungura Formation by de Heinzelin (1983). The type locality is taken as Naito, a regional name for low hills about 3 km NNW of Namaruputh in Ethiopia near the southern extent of the Shungura Formation. In the Nachukui Formation it is thus far known only as a very pure ash layer 20 cm thick at Lokapetamoi where it lies 3 m below the Lower Nariokotome Tuff (see below).

On the south bank of Nariokotome, 0.5 km west of the road crossing, there is a cliff which exposes a siltstone sequence that contains two tuffs in a section about 10 m thick called the Nariokotome Tuff complex. The basal tuff in this sequence is named the Lower Nariokotome Tuff. It is 24 cm thick, poorly consolidated, composed of bubble-junction and bubble-wall shards, contains rounded pumice clasts up to 20 cm in diameter, and grades upward from very coarse grained ash to fine-grained ash. Locally it is a very useful marker bed. Along Laga Natoo the Nariokotome Tuff Complex is only 7 m thick, but here three thin vitric tuffs are found in sequence. The central tuff is here named the Middle Nariokotome Tuff. It is 8 cm thick, but otherwise similar to the Lower Nariokotome Tuff. A third vitric tuff lies at the top of the complex, is again similar to the two underlying tuffs in overall aspect, but is 10 cm thick, and is here named the Upper Nariokotome Tuff. These tuffs are compositionally only slightly distinct from one another, but sufficiently so that they cannot be confused if only one is present. The sediments which intervene between the tuffs are tuffaceous fine sandstones and siltstones that are distinctly laminated and contain fish bones and carbonate concretions. Near the divide between the northern branch of Laga Nachukui and Laga Nariokotome, the Lower Nariokotome Tuff occurs in a conglomeratic section where it contains accretionary lapilli 5 mm in diameter throughout its 1-m thickness. The Lower Nariokotome Tuff has been dated at 1.33 ± 0.05 Ma; K/Ar measurements are reported in Brown et al. (1985).

At Kaieri Akak and at Nakitokonon, strata assigned to the Nariokotome Member are also present. At both localities exposures are poor, but both contain a tuff which correlates with a tuff that lies stratigraphically above the Silbo Tuff of the Koobi Fora Formation in the Ileret Area. This tuff is named the Kale Tuff after the large plain north of Koobi Fora Area 7, which is its type area. Although the Kale Tuff has not been dated, it should be only slightly younger than the Silbo Tuff. The Silbo Tuff has been dated at 0.74 ± 0.01 Ma by McDougall (1985).

Correlations from the Nachukui Formation to the Shungura and Koobi Fora formations (Fig. 4) provide a reasonably tight framework in which to interpret the vertebrate faunas from the three formations. The correlations are also useful in comparing lithostratigraphic differences from narrow temporal intervals which is necessary for paleogeographic reconstructions.

DESCRIPTIONS OF MEMBERS

Lonyumun Member

The Lonyumun Member of the Nachukui Formation comprises those sediments that lie below the basal contact of the Moiti Tuff. This member is best exposed in the southern part of the region west of Lake Turkana in the Nasechebun drainage south of Kataboi. Other excellent exposures lie near the contact with Miocene volcanic rocks in the northern part of the region. The member as defined is stratigraphically equivalent to the Lonyumun Member of the Koobi Fora Formation (Brown and Feibel, 1986), hence that name is retained. In its reference section in the Nachukui Formation it is 91 m thick (Fig. 5).

The Lonyumun Member is lithologically very similar to its counterpart in the Koobi Fora Formation, but is somewhat thicker west of the lake. The basal contact is only locally seen, but at the Nasechebun drainage the member rests on basalt. The lowest part of the section consists of dark brown to pale olive laminated claystones that contain ostracods and mollusks. Sparse interbeds of sandstone a few centimeters thick are normally limonite-stained, and contain both fish bones and ostracods. Diatomites occur higher in the section near the top of the member, but are also locally present much lower in the section. In the exposures along Laga Lomekwi, limonite-stained volcanic conglomerates with weathered clasts interfinger with the claystones and diatomites near the base of the section. The upper contact of the Lonyumun Member is marked by a thin altered tuff in the upper part of the northern branch of the Laga Lomekwi. As no fresh glass remains, this altered tuff could not be chemically compared to the type Moiti Tuff of the Koobi Fora Formation but its correlation is believed to be secure. Where the Moiti Tuff crops out in the Topernawi drainage and south of Kataboi, it has been positively correlated with that from the type locality at Koobi Fora.

Other small exposures of the Lonyumun Member are found along the mountain front as far south as the Laga Kalokujiamwe. The member may extend much farther south, however, because strata of the Muruongori Formation (Powers,

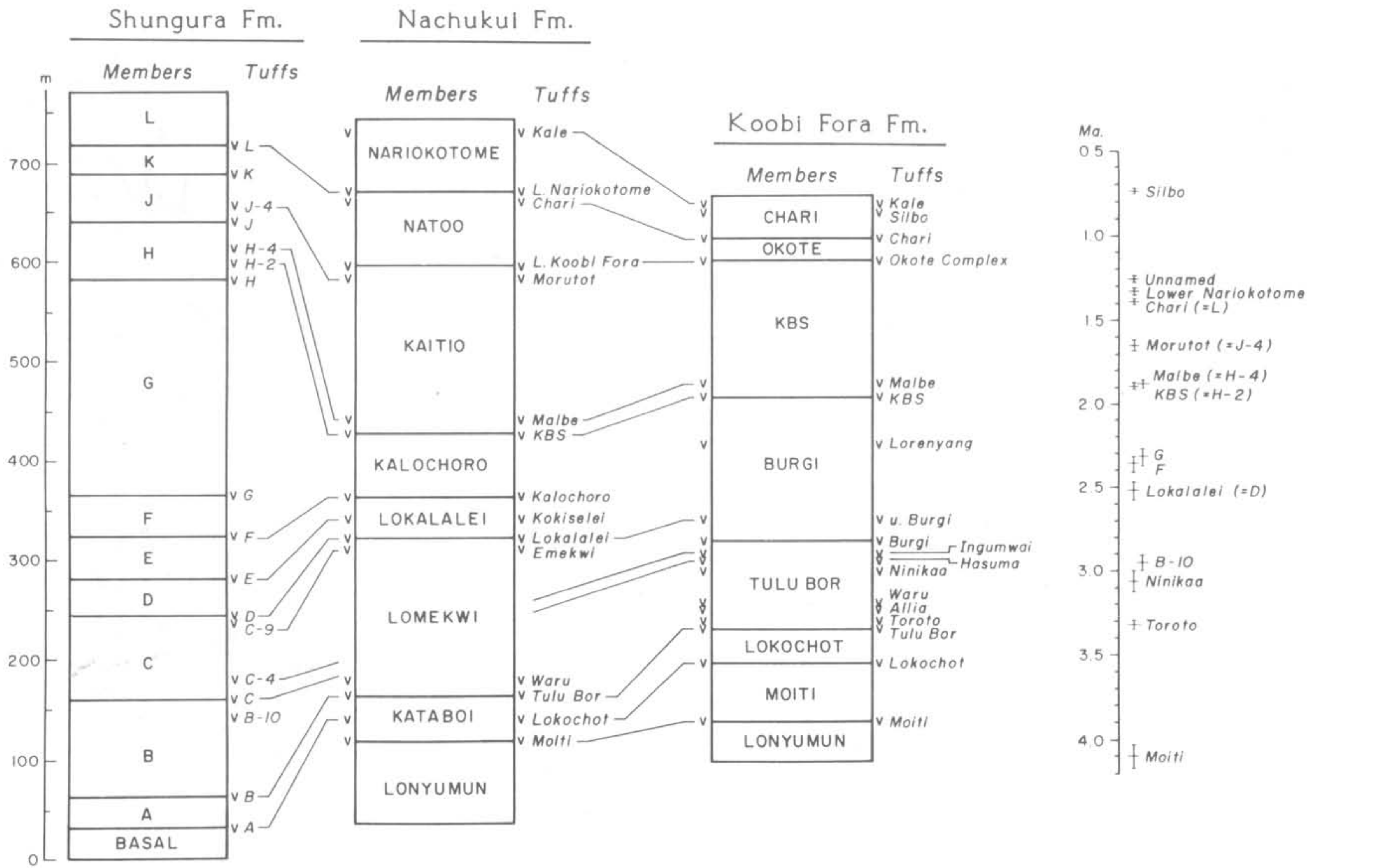


Figure 4. Correlation diagram for the Shungura, Nachukui, and Koobi Fora formations. Note that the scale on the left, calibrating the thickness of these units, is unrelated to the time scale on the right.

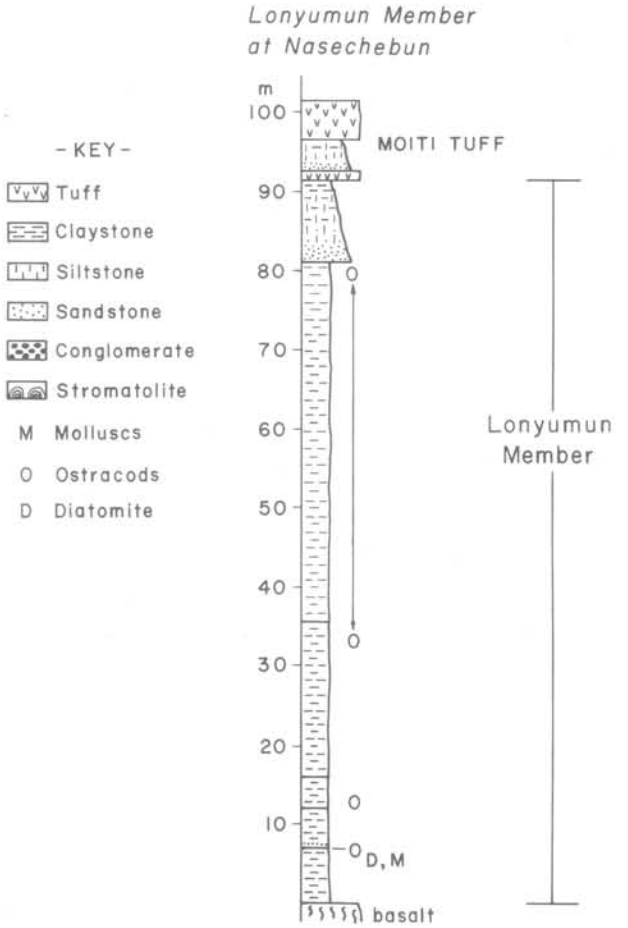


Figure 5. Type section of the Lonyumun Member at the Laga Nasechebun. In this and other stratigraphic sections, E = *Etheria;* the key is common also to Figures 6–12.

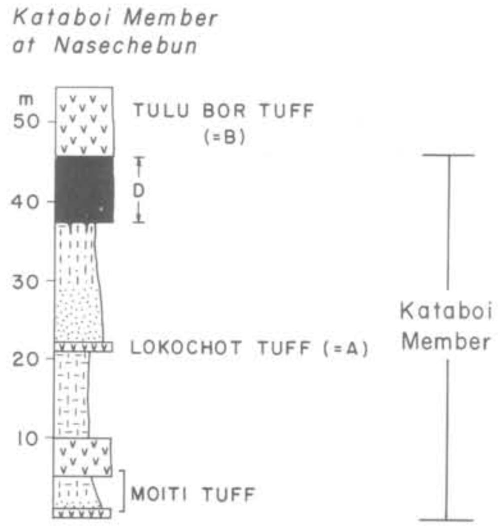


Figure 6. Type section of the Kataboi Member at the Laga Nasechebun.

1980) of the Lothagam area, some 50 km to the south, are lithologically very similar and of approximately the same age. Similar sediments are also present near the base of the section at Loruth Kaado.

The upper age limit of the Lonyumun Member is well established by K/Ar ages on the Moiti Tuff at 4.10 ± 0.07 Ma (Brown et al., 1985). The lower limit is less secure. In the Koobi Fora region the Lonyumun Member overlies basalt flows at Karsa that have been dated at 4.35 ± 0.05 Ma by McDougall (1985). The Lonyumun Member is considerably thicker in the Nachukui Formation, and may extend to earlier times, but probably does not exceed 5 Ma in age.

Kataboi Member

The Kataboi Member (Fig. 6) of the Nachukui Formation is defined here as those strata which lie between the basal contact of the Moiti Tuff and the basal contact of the Tulu Bor Tuff (= B). This member is best exposed near the Laga Kataboi and in the upper part of the Lomekwi drainage, but also crops out as far south as Kalokujiamwe. It correlates with the Basal Member and Member A of the Shungura Formation and with the Moiti and Lokochot members of the Koobi Fora Formation. Where the Lokochot Tuff (= A) is present, the Kataboi Member may be divided into a lower and upper part. The lower Kataboi Member is equivalent to the Moiti Member of the Koobi Fora Formation, and the upper Kataboi Member is equivalent to the Lokochot Member of the Koobi Fora Formation and to Member A of the Shungura Formation. In its type section the Kataboi Member is 45.6 m thick, but near Kataboi and along the Laga Lomekwi it is about 55 m thick.

In its type section, the lowest 35 m of the Kataboi Member consist of upward-fining cycles beginning with medium- to coarse-grained trough cross-bedded sandstones, grading through fine sandstones to siltstones and silty claystones, the latter with slickensides and dish-shaped fractures. Calcite nodules are commonly present about 1.5 m to 2 m below the top of each cyclic unit. The Lokochot Tuff (= A) lies about 22 m above the base of the member, and at Kataboi contains accretionary lapilli up to 8 mm in diameter. The upper 12 m of the Kataboi Member consists of laminated or massive diatomite with well-preserved diatoms and freshwater sponge spicules. Fish bones and chelonian fragments are common in this interval, and mammalian fossils are sparsely present but very well preserved.

Along the Laga Kalokujiamwe, strata above the Moiti Tuff are attributed to the Kataboi Member, but as there is no overlying tuff, they may also be partly equivalent to the Lomekwi Member. The section there consists predominantly of well-sorted sandstones which contain two volcanic cobble conglomerate beds in the upper part.

Near the mountain front between the Topernawi and the northern branch of the Laga Lomekwi, the Kataboi Member is well exposed and is about 50 m thick. The Lokochot Tuff (= A) is absent in these exposures, but the Topernawi Tuff (see section on volcanic ash layers) is present as a tuffaceous band 3–5 m above the base of a thick sandstone (16 m). Below the tuff, this sandstone contains dispersed ostracods and mollusks, that are overlain by 7 m of siltstone with dish-

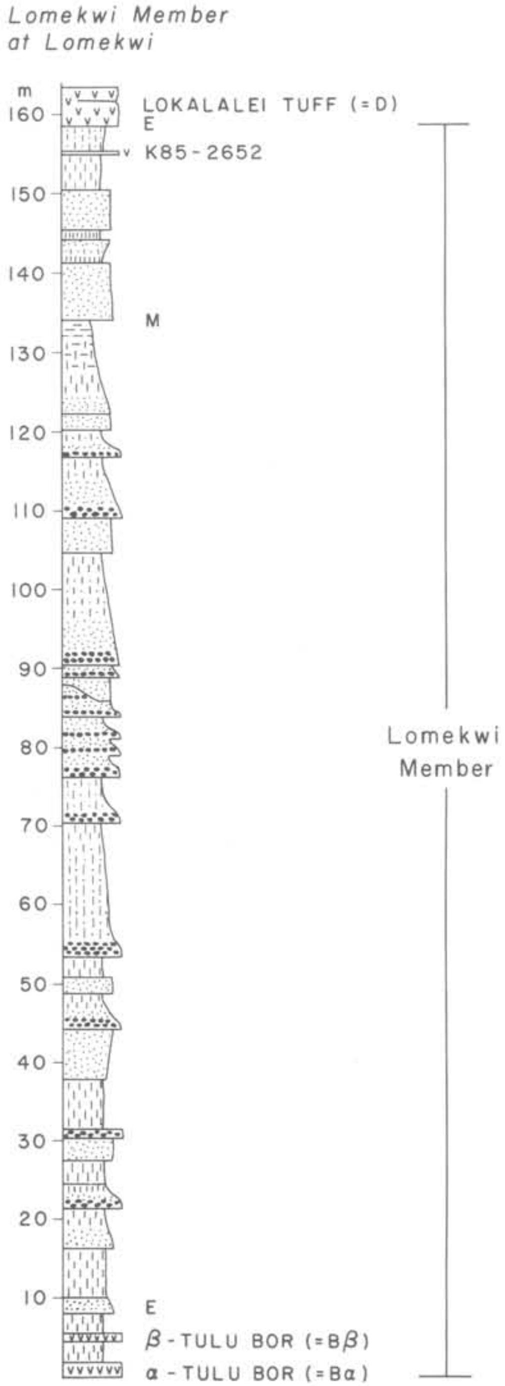


Figure 7. Type section of the Lomekwi Member at the Laga Lomekwi.

shaped fractures at the top. The sandstone is overlain by a volcanic clast conglomerate (10 m), and then a further 6 m of sandstone with a mollusk-packed layer about 2 m above its base in which the gastropod *Cleopatra* is dominant. Six meters below the base of the Tulu Bor Tuff (= B), there is a very distinctive diatomaceous interval with well-preserved diatoms, abundant fish bones and sparse, but well-preserved, mammalian bones. The unit grades upward into sandy siltstones immediately below the Tulu Bor Tuff. This diatomaceous sequence is correlated with the diatomites in the upper part of the type section of the Kataboi Member and is very continuous in this area. It can also be correlated with diatomites in the upper part of the Lokochot Member of the Koobi Fora Formation.

The Kataboi Member spans the time range from the Moiti Tuff (4.10 ± 0.07 Ma) to the Tulu Bor Tuff (= B), the age of which is estimated to be 3.36 ± 0.04 Ma (Feibel et al., in press).

Lomekwi Member

The Lomekwi Member (Fig. 7) is defined here as those strata between the basal contact of the Tulu Bor Tuff (= B) and the basal contact of the Lokalalei Tuff (= D; see next section). Exposures in the southern branch of the Laga Lomekwi represent the only continuous section through this member, but it is also exposed as far north as the Laga Kokiselei and extends southward about 15 km south of Kataboi. It is stratigraphically equivalent to Members B and C of the Shungura Formation, and to all of the Tulu Bor Member and the lowest part of the Burgi Member of the Koobi Fora Formation. The type section of the Lomekwi Member is 158.5 m thick.

The Lomekwi Member illustrates well one of the problems with stratigraphic description in this region. In order to measure the type section it was necessary to investigate a strip of outcrops nearly 5 km in east–west extent. Hence, what is recorded as a vertical section does not reflect the succession of lithologies at any one geographic point but includes lateral variations as well. Normally this is of little consequence, but near the margin of a basin lithologic changes occur over rather short lateral distances and, in this particular instance, sandstones are replaced by conglomerates in the western part of the outcrop (toward the mountains).

At the base of the Lomekwi Member, the Tulu Bor Tuff (= B) crops out in two successive bands, separated by 2.5 m of reddish-brown siltstone. The two bands correspond compositionally to the α-Tulu Bor Tuff (= Bα) and the β-Tulu Bor Tuff (= Bβ), respectively. These tuffs are exceptionally well exposed in the upper part of the Laga Lomekwi, where associated sediments interfinger with volcanic pebble conglomerates.

Strata of the Lomekwi Member fall into two sharply contrasted lithologic associations. One consists of volcanic clast conglomerates 0.2 to 4 m thick and massive, poorly sorted sandy siltstones that are usually reddish-brown. The other consists of quartz-rich sandstones grading upward into siltstones and silty claystones with vertical prismatic structure at the top. In one case, the section coarsens upward from very fine sandstone to coarse sandstone with a concomitant increase in the size of trough cross-bedding from about 10 cm scale in the lower part to 50 cm in the upper part. Mammalian fossils occur in both of these associations. The African freshwater oyster *Etheria* is found associated only with the quartz sandstones at the bottoms of the upward fining cycles, either as isolated broken valves or as well-preserved bioherms with the individuals in growth position. The molluscan assemblages containing a new species of the gastropod *Potadoma* (Williamson, 1985) derive from a sandstone 23 m above the base of the member.

Within the Lomekwi Member are three tuffs that are useful for local and regional correlation. The Waru Tuff is exposed along the south bank of the Laga Topernawi west of the road crossing. It is interpreted as an air-fall ash layer that was deposited in an extensive but short-lived lake. In the Nachukui Formation, the sediments enclosing the Waru Tuff are rich in sponge spicules and diatoms. The Emekwi Tuff (= C-9), is exposed in the southern branch of the Laga Lokalalei. A thin unnamed tuff 10 m above the Emekwi Tuff (= C-9) and 8 m below the Lokalalei Tuff is widely exposed near the top of the section along the Laga Lomekwi.

The Lomekwi Member spans the temporal interval from the Tulu Bor Tuff (3.36 Ma) to the Lokalalei Tuff (= D). The Lokalalei Tuff (= D) has been dated at 2.52 ± 0.05 Ma (Brown et al., 1985). Additional unpublished potassium-argon age measurements on the Lokalalei Tuff (= D) have confirmed this age.

Lokalalei Member

The Lokalalei Member is defined as all strata which lie between the base of the Lokalalei Tuff (= D) and the Kalochoro Tuff (= F). The type section is located along the northern branch of the Laga Lokalalei (Fig. 8), but there the Kalochoro Tuff is absent, and the section is drawn through to the Ekalalei Tuff (= F-1). The top of the member is taken as the top of a distinctive mollusk-rich conglomerate about 3 m below the Ekalalei Tuff (= F-1) to avoid duplication of section. In several exposures the Ekalalei Tuff (= F-1) is known to lie 4 m below the Kalochoro Tuff (= F), both in the Nachukui Formation and in the Shungura Formation. Other outcrops of the Lokalalei Member exist in the Nanyangakipi, Kalochoro, Kaitio, Kokiselei, Lomekwi, and Kangatukuseo drainages. It is stratigraphically equivalent to Members D and E of the Shungura Formation and, where the Kokiselei Tuff (= E) crops out, can be divided into upper and lower parts, equivalent to Member D and Member E, respectively. The only known correlative strata in the Koobi Fora region east of the lake belong to the lower Burgi Member exposed along Il Ingumwai; these consist of about 10 m of fluvial deposits. In its type section at Lokalalei, the member is 38 m thick.

Strata of the Lokalalei Member consist predominantly of fine-grained sandstones and siltstones. The sandstones are poorly consolidated, either laminated or cross-laminated, and commonly contain calcite concretions. The uppermost part of the member consists of a poorly sorted, structureless, silty claystone with occasional volcanic pebble conglomerate lenses, one of which is packed with shells of the small gastropod *Melanoides*.

The Lokalalei Member was deposited between 2.52 ± 0.05 Ma (the age of the Lokalalei Tuff (= D)) and 2.35 ± 0.05 Ma ago (the age of the Kalochoro Tuff (= F)).

Kalochoro Member

The Kalochoro Member is defined as those strata that lie between the base of the Kalochoro Tuff and the base of the KBS Tuff (= H-2). The type section of the Kalochoro Member (Fig. 8) is located in the Laga Kalochoro, about 5 km west of the road crossing, where the member is 78 m thick. This section lies west of a major fault that separates strata of the Nariokotome Member from those of the upper part of the Lokalalei Member. The Kalochoro Member correlates with Members F, G, and the lower part of Member H of the Shungura Formation, and with all but the lowest part of the Burgi Member of the Koobi Fora Formation.

The Kalochoro Member is divisible into three parts, a lower part (40 m) of upward-fining cyclic deposits with two prominent volcanic ash beds, a middle portion (27 m) consisting predominantly of laminated claystones and siltstones, and an upper part (20 m) dominated by sandstone, but with minor interbedded volcanic pebble conglomerates. The upward-fining cycles of the lower part are similar to those of the Kataboi and Lomekwi members, and need little elaboration.

The laminated siltstones and claystones of the middle part range from medium brown to olive-gray, contain fish bones and fish scales along bedding planes, and jarosite, gypsum, and Fe-Mn oxide coatings along fractures. Limonite-stained bands 1–3 cm thick within the siltstones commonly contain ostracods. This part of the section is best exposed in the Kalochoro, Kokiselei, and Kangaki drainages.

The upper sandstones of the Kalochoro Member are predominantly medium- to fine-grained with parallel lamination or small-scale cross-lamination. Mammalian fossils are sparse, but fish bones are reasonably common. The trace fossil *Piscichnus,* interpreted as fossil fish nests (Feibel, 1987), is found on ripple-marked bedding planes near the top of the lowest sandstone in this sequence. A 10-cm-thick band of well-indurated dolomite occurs about 7 m above the base of the upper sands in the type section, and contains very chalky mammalian bone.

Kaitio Member

Strata between the KBS Tuff (= H-2) and the Lower Koobi Fora Tuff along the Laga Kaitio (the type section) are defined as the Kaitio Member. There the member is 169 m thick (Fig. 9). The Kaitio Member correlates with parts of Members H and J of the Shungura Formation, and with the KBS Member and the lowest part of the Okote Member of the Koobi Fora Formation. Most of the Kaitio Member is also exposed at the Laga Nanyangakipi, about 15 km to the north.

Most strata of the Kaitio Member are laminated siltstones, claystones, and fine sandstones. Both the claystones and siltstones contain dispersed ostracod impressions and there is a 15-cm-thick layer with abundant bivalves and gastropods 115 m above the base. At Laga Nanyangakipi there is an ostracod-packed sandstone 13 m above the presumed correlative of this mollusk-bearing layer. Gypsum is common along fractures in the claystones of the lower half of this sequence.

Twelve meters below the top of the Kaitio Member there is a sharp transition to coarser sediment, beginning with deposition of a sequence of three fine sandstones fining up-

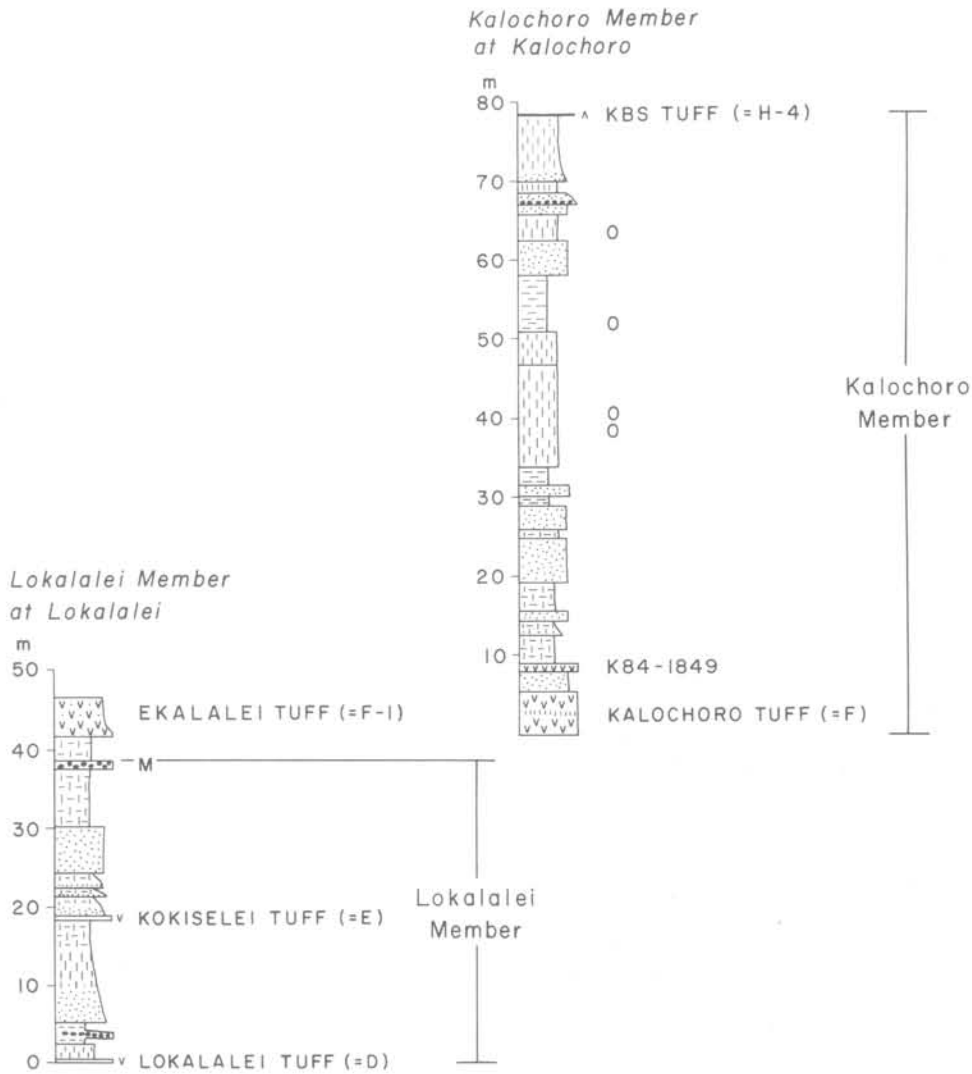


Figure 8. Type sections of the Lokalalei Member at the Laga Lokalalei and the Kalochoro Member at the Laga Kalochoro.

ward to siltstones in a packet 7.5 m thick. The sandstones are pale yellowish-gray and laminated or cross-laminated. The siltstones are pale brown and have pronounced vertical structure. These are overlain by a vitric tuff, 10 cm thick, itself capped by a medium brown clayey siltstone with slickensides, dish-shaped fractures, and calcite nodules. The top of the member consists of fine sandstones with siltstone interbeds that contain abundant ostracods.

The Kaitio Member is also exposed in a strip of prominent outcrops located about 8 km west of the lake and extending from Nariokotome to Kokiselei but, in this area, it is difficult to differentiate from the overlying Natoo Member. The Kaitio Member in these exposures is only about 60 m thick and is comprised of sandstones, thin (0.1–0.6 m) mollusk-packed sandstones and conglomerates, and volcanic clast conglomerates. The dominant mollusks in this sequence are *Cleopatra* and *Melanoides*. The base of the mollusk-packed sandstones sometimes contains well-preserved examples of the trace fossil *Pelecypodichnus* (bivalve burrows), with the burrows filled with gastropod shells. Molds of open, articulated *Mutela* valves are found on the surface of these sandstones. Some of the sandstones in this part of the section are uncemented and these often contain exceptionally well preserved fossils of large mammals. Mammalian fossils also occur in cemented sandstones and conglomerates. The mollusk-packed sandstones and conglomerates are sufficiently well cemented by sparry calcite to produce bold cliffs where streams cut through the strata. North of Kalochoro and south of Kokiselei, the mollusk-packed sandstones are replaced by well-developed stromatolite layers. This lithologic association continues upward through the Natoo Member which is about 40 m thick in this area.

Strata of the Kaitio Member range in age from 1.88 ± 0.02 Ma (the age of the KBS Tuff (= H-2); McDougall, 1985),

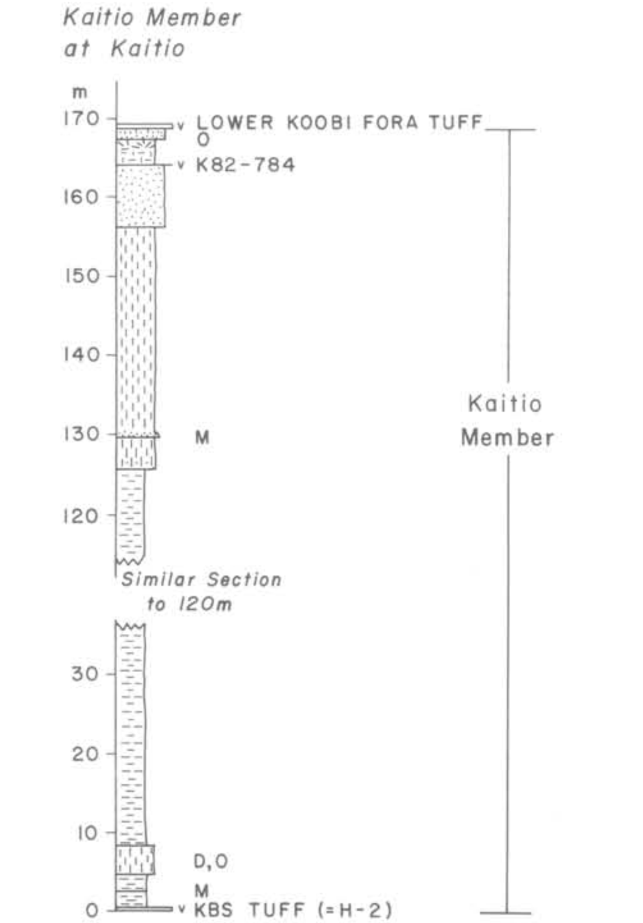


Figure 9. Type section of the Kaitio Member at the Laga Kaitio.

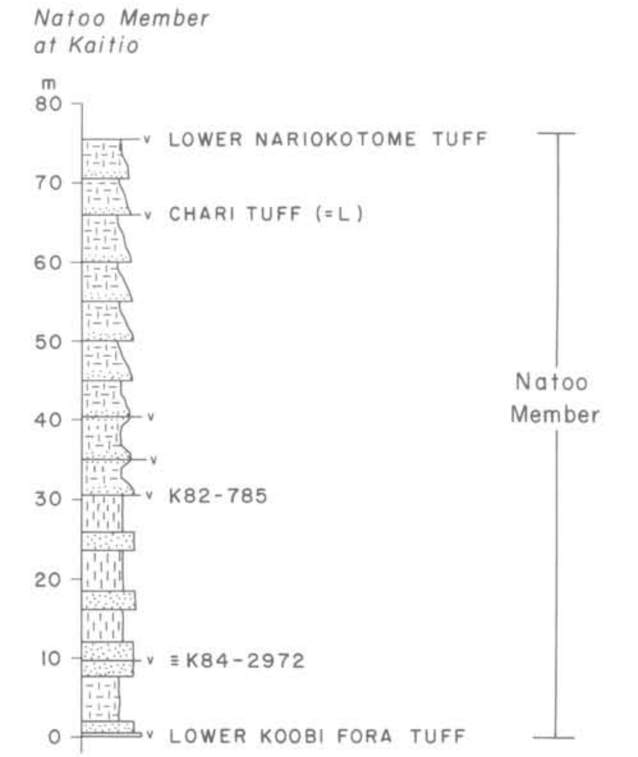


Figure 10. Type section of the Natoo Member at the Laga Kaitio.

to about 1.6 Ma, the approximate age of the Lower Koobi Fora Tuff (McDougall et al., 1985; Brown and Feibel, 1985).

Natoo Member

Strata between the basal contact of the Lower Koobi Fora Tuff and the basal contact of the Lower Nariokotome Tuff are named the Natoo Member (Fig. 10). The type section is located in the Kaitio drainage, but this name has been used for the underlying member, so the member is named for another small ephemeral stream north of Nariokotome where it is also exposed. The member is exposed in every ephemeral stream from Kalochoro to Kaieri Akak. In the type section, the Natoo Member is 75.5 m thick. It correlates with the upper part of Member J, with Member K, and with the lower part of Member L of the Shungura Formation, and with most of the Okote Member of the Koobi Fora Formation.

The style of sedimentation which began near the top of the Kaitio Member continues into the Natoo Member, which is composed of pale yellowish-brown sandstones grading upward into pale brown siltstones totalling 13 cycles with an average thickness of 5.8 m. An unnamed very pale yellow vitric tuff (0.3 m) that contains mollusk shells and ostracods occurs 9.5 m above the base of the member. Between 30 and 40 m above the base of the member occurs a triplet of medium- to fine-grained vitric tuffs, each of which is less than 10 cm in thickness, and each of which is situated at or near the base of an upward-fining cycle. The Chari Tuff (= L) occurs 9 m below the top of the member. Mammalian fossils are scarce in this member, but fossils of fish (*Hydrocynus, Sindacharax, Labeo,* Dasyatidae, etc.) are abundant, especially in the lower half of the member.

In exposures north of the Nariokotome drainage, the base of the Morutot Tuff was mapped as the base of the Natoo Member. The Morutot Tuff is well exposed at Nanyangakipi, at Lowarengak, and at Natoo. This tuff lies slightly lower in the section than the Lower Koobi Fora Tuff, but for mapping purposes the error in position is small.

At Lowarengak a thin stromatolite bed occurs just above the base of the Natoo Member. At Nanyangakipi the lower 30 m of this member is exposed and consists of fine sandstones with a thin (30-cm) volcanic pebble conglomerate 22 m above the base, a 5-cm-thick conglomerate with molds of gastropod shells 4 m above that, and a 50-cm tuffaceous fine sandstone at the top of the section.

The Natoo Member ranges in age from approximately 1.6 Ma (the age of the Lower Koobi Fora Tuff) to 1.33 ± 0.05 Ma (the age of the Lower Nariokotome Tuff; see Brown et al., 1985). The member includes the Chari Tuff that has been very securely dated at 1.39 ± 0.01 Ma by McDougall (1985).

Nariokotome Member

Strata which lie above the basal contact of the Lower Nariokotome Tuff, but below Holocene strata which discon-

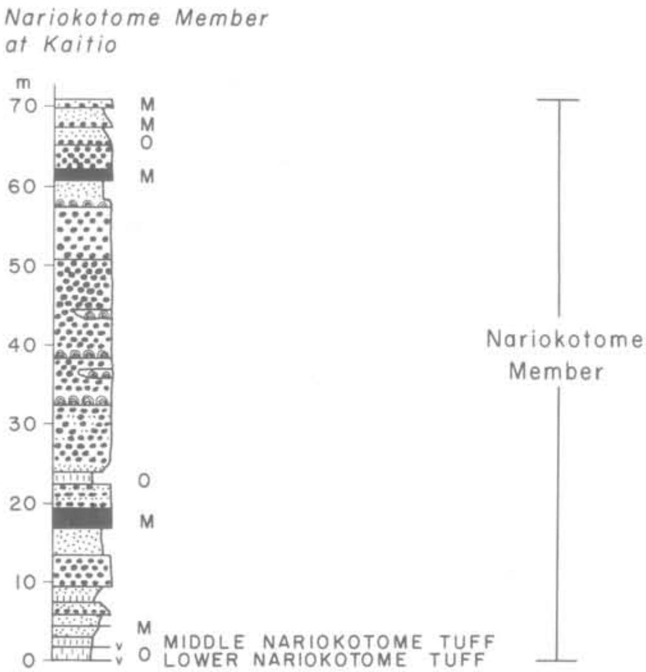


Figure 11. Type section of the Nariokotome Member at the Laga Kaitio.

formably or unconformably overlie the Pliocene and Pleistocene strata of the Lomekwi Formation, are designated the Nariokotome Member. The type section is located in the Laga Kaitio; the name of the member is taken from the name of the basal tuff of the member. In the type section, this member is 70.4 m thick (Fig. 11), but other strata located at Nakitokonon and Kaieri Akak are also included in this member, and its composite thickness may be somewhat greater.

The base of the Nariokotome Member marks a distinct change in sediment type from fine-grained sands and silts to strata dominated by volcanic clast conglomerates and coarse-grained sandstones. Here again the effect of geographic position cannot be ignored because sections of the Nariokotome Member lie somewhat nearer the mountains than do those of the underlying Kaitio and Natoo members in which, as noted above, conglomerates grade laterally into finer sediments.

Strata of the Nariokotome Member are depicted graphically in Figure 11, where the dominance of conglomerates is apparent. The transition between the fine- and coarse-grained strata takes place in the lowest 6 m of the Nariokotome Member. The Lower and Middle Nariokotome tuffs are present in the section at Kaitio, but the Upper Nariokotome Tuff is absent. Between these two tuffs is a fine-grained section that contains an ostracod-rich oolite bed about 1 m thick. The section above the Middle Nariokotome Tuff begins with a thin sandstone that contains well-preserved mammalian footprints, and is followed by 1.5 m of sandstone rich in ostracods and the gastropods *Cleopatra* and *Melanoides*. Above these, volcanic pebble conglomerates appear in the section and the associated fine sediments are poorly sorted sandy siltstones. Aside from a few mollusk-bearing layers, well-developed stromatolites provide the most useful marker beds in this member.

Individual stromatolites are normally 10–20 cm in diameter, but range up to 1 m. Those beds composed of stromatolites vary from 0.1 to 1.0 m in thickness. The core around which the stromatolites form is normally a basalt pebble or cobble, but a few surround mollusk shells. The base of most beds is composed of oncolites 5–10 cm in diameter, but these give way above to laterally continuous pavements of larger stromatolites that have a polygonal outline in horizontal section because individual heads fail to join laterally in most cases. The planar vertical boundaries between the individual stromatolites are usually marked with curvilinear subparallel grooves that are believed to be invertebrate borings. *Etheria* is occasionally found associated with the stromatolites, either attached to the surface, or partially covered by algal carbonate. The bivalve *Caelatura* is found in the vertical planes which separate individual stromatolites; the only other mollusk noted was a small gastropod.

On the divide between the headwaters of the Laga Nachukui and the lower course of the Laga Nariokotome, the Nariokotome Member consists solely of volcanic pebble conglomerates and associated poorly sorted sandstones and siltstones. Carbonate concretionary layers are present near the tops of some of the siltstones.

Along Kaieri Akak and Laga Nakitokonon, strata assigned to the Nariokotome Member are also present. Although exposures are poor at both localities, the Kale Tuff is present in both places. The associated strata at Nakitokonon are laminated siltstones and claystones. At Kaieri Akak, the section consists of fine sandstone and siltstone, and contains a mollusk bed in which *Pseudobovaria* (bivalve) and *Mutela* are dominant 5 m above the Kale Tuff. These bivalves belong to endemic species recorded from the Chari Member of the Koobi Fora Formation (P. Williamson, pers. comm.). Thus these occurrences extend the known geographic range of the phyletic endemic isolate that Williamson recorded at Ileret (Molluscan Range Zone 10 of Williamson, 1982). More recently this distinctive molluscan assemblage has been documented from Submember L-9 of the Shungura Formation (P. Williamson, pers. comm.).

Strata assigned to the Nariokotome Member range in age from about 1.3 Ma (the age of the Lower Nariokotome Tuff) to about 0.7 Ma. The upper age limit is based on the occurrence of the Kale Tuff in the sections at Kaieri Akak and Nakitokonon. The Kale Tuff is known to underlie the Silbo Tuff of the Koobi Fora Formation, and this latter tuff has been dated at 0.74 ± 0.01 Ma by McDougall (1985).

LORUTH KAADO AREA

This fossil-bearing area was first mentioned by Champion (1937) and was later the subject of a brief study by de Heinzelin (1983). The area is located at the north end of the Labur Range (Fig. 12), and the Plio-Pleistocene strata exposed there are here assigned to the Lomekwi Formation. The stratig-

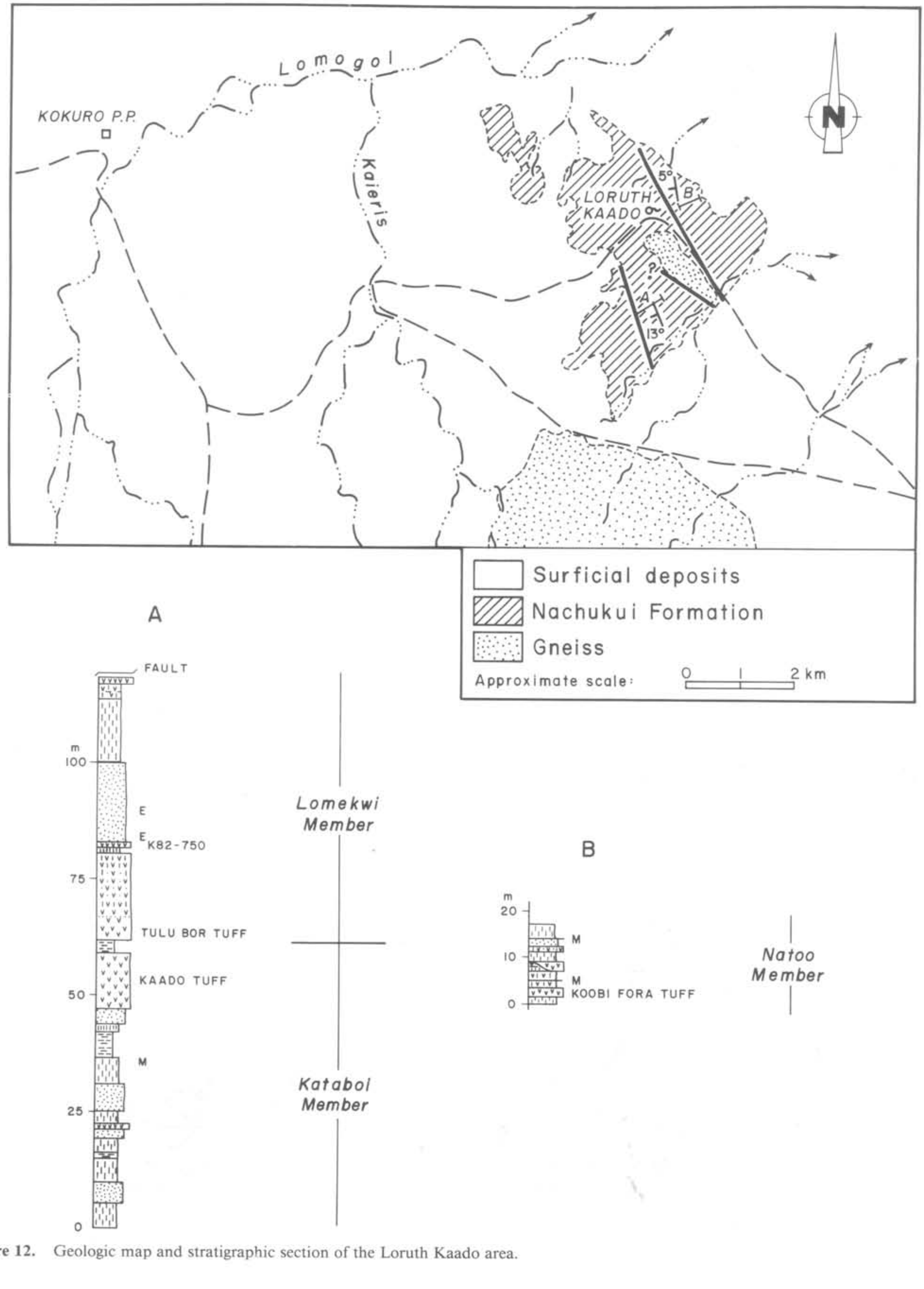


Figure 12. Geologic map and stratigraphic section of the Loruth Kaado area.

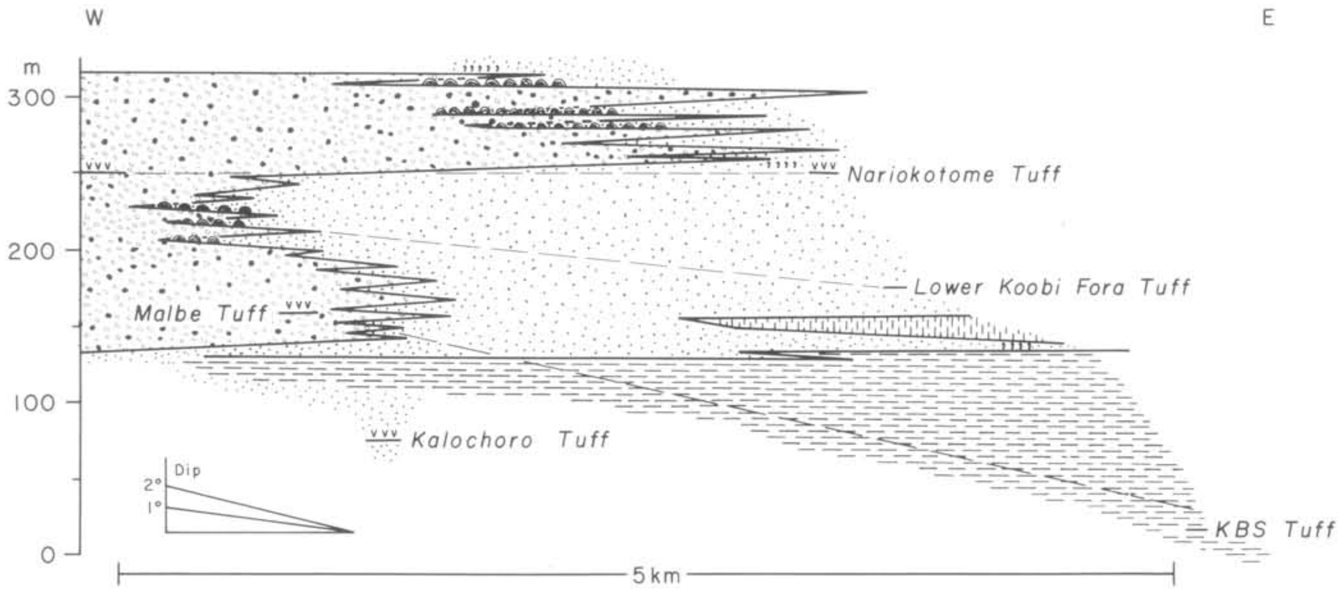


Figure 13. Facies diagram for the upper part of the Nachukui Formation in the area between the Lagas Kalochoro and Nariokotome.

raphy of this area is incompletely known, but a brief description of some of the principal outcrops is given here.

Fossil sites LK I and LK II are located near Loruth Kaado itself, where the stratigraphic section is as shown in Figure 12. Deposition began with diatomites and claystones typical of the Lonyumun Member of the Koobi Fora and Lomekwi formations, followed by fluvial sediments which contain tuffs identified as belonging to the Kataboi Member at other localities, and a shell bed in which the gastropod *Bellamya* is dominant. The section overlying the Tulu Bor Tuff (= B) belongs to the lowest part of the Lomekwi Member, and consists of fluvial deposits. These are very similar to the fluvial section in the lower part of Member B of the Shungura Formation with which they correlate.

Minor conglomerates above the Tulu Bor Tuff consist solely of volcanic clasts. This is remarkable because today gneisses with quartz veins and Cretaceous quartz-bearing conglomerates are exposed only a few kilometers south and west of the outcrops of the Nachukui Formation. In addition, surficial deposits in the area are rich in quartz. By contrast, conglomerates of younger deposits (Natoo Member, see below) at Loruth Kaado contain abundant quartz pebbles. It is believed that this difference in clast composition reflects uplift of the Labur Range, and exposure of the quartz-bearing older strata. The timing of uplift is thus constrained to lie between that represented by the middle Lomekwi Member and that represented by the Natoo Member—roughly between 2.5 and 1.7 Ma ago.

Fossil site LK III lies east of a major fault that separates the older section to the west from the younger section to the east. These sediments are about 20 m thick, fine-grained (mainly siltstones), and contain a tuffaceous sequence that includes amongst other tuffs, the Koobi Fora Tuff (see Table 1). The section also includes thin mollusk-bearing conglomerates that contain both quartz and volcanic pebbles.

The fossil sites LK IV and LK V were visited by only one of us (JMH) and were not investigated geologically.

DISCUSSION

As discussed above, there are very marked lithologic changes over short distances in this region. Figure 13 is a schematic (but controlled) facies diagram for the upper part of the Nachukui Formation in the region between Kalochoro and Nariokotome. In this figure measurements were taken from the base of the Lower Nariokotome Tuff and plotted in their respective positions on an east–west transect. The thin dashed lines represent constant time lines or nearly so.

At the time the Kalochoro Tuff (= F) was deposited (ca. 2.3 Ma) this area was dominated by a large river with its characteristic upward-fining cycles. For this part of the section variation in thickness and lithology is rather small—the section resembling that of the Shungura Formation. Although not shown on Figure 13, this condition also obtained eastward along the Kaitio drainage in deposits of the upper Lokalalei Member and in the easternmost part of the Nanyangakipi drainage.

Slightly before deposition of the KBS Tuff (= H-2) about 2 million years ago, the situation had changed, and to the east claystones were deposited in a deep lake while to the west sandstones were deposited along high-energy shorelines, with distal alluvial conglomerates interfingering from still farther west. Slight structural movement might have been associated with this change, resulting in a dip of about 2° to the east on sediments deposited prior to the lacustrine claystones. This condition persisted for perhaps 0.3 Ma, after which there was a change to deposition on a broad alluvial plain. Basinward the deposits are characterized by rather thin, fine-grained, upward-fining cycles. Stromatolites occur along the western edge of this plain, presumably formed in

Table 2. Statigraphic positions of West Turkana vertebrate fossil sites.

Locality	Horizon	Member
Kaitio I (KI1)*	Above Nariokotome Tuff	Nariokotome
Kaitio II (KI2)	Above Okote Tuff	Natoo
Kaitio III (KI3)	Above Kokiselei Tuff	Kalochoro?
Kalochoro I (KL1)	Below Chari Tuff	Natoo
Kalochoro II (KL2)	Below Chari Tuff	Natoo
Kalochoro III (KL3)	Below Okote Tuff	Kaitio
Kalochoro IV (KL4)	Below KBS Tuff	Kalochoro
Kalochoro V (KL5)	Below Nariokotome Tuff	Natoo
Kalochoro VI (KL6)	Below Okote Tuff	Kaitio
Kalakodo (KK)	Below KBS Tuff	Kalochoro
Kangaki I (KG1)	Below KBS Tuff	Kalochoro
Kangaki II (KG2)	Below KBS Tuff	Kalochoro
Kangatakuseo I (KU1)	Below Lokalalei Tuff	upper Lomekwi
Kangatukuseo II (KU2)	Below and just above Lokalalei Tuff	upper Lomekwi/Lokalalei
Kangatukuseo III (KU3)	Below Lokalalei Tuff	upper Lomekwi
Kokiselei I (KS1)	Below Okote Tuff	Kaitio
Kokiselei II (KS2)	Below Okote Tuff	Kaitio
Lomekwi I (LO1)	Below Lokalalei Tuff	upper Lomekwi
Lomekwi II (LO2)	Below Lokalalei Tuff	upper Lomekwi
Lomekwi III (LO3)	Below Lokalalei Tuff	upper Lomekwi
Lomekwi IV (LO4)	Just above Tulu Bor Tuff	lower Lomekwi
Lomekwi V (LO5)	Just above Tulu Bor Tuff	lower Lomekwi
Lomekwi VI (LO6)	Just below Tulu Bor Tuff	Kataboi
Lomekwi VII (LO7)	Above Lokalalei Tuff	Lokalalei
Lomekwi VIII (LO8)	Above Lokalalei Tuff	Lokalalei
Lomekwi IX (LO9)	Below Emekwi Tuff	middle Lomekwi
Lomekwi X (LO10)	Below Emekwi Tuff	middle Lomekwi
Lokalalei I (LA1)	Just above Kalochoro Tuff	Kalochoro
Loruth Kaado I (LK1)	Just below Tulu Bor Tuff	Kataboi
Loruth Kaado II (LK2)	Below Tulu Bor Tuff	Kataboi
Loruth Kaado III (LK3)	Above Okote Tuff	Natoo
Loruth Kaado IV (LK4)	Below Okote Tuff	Kaitio
Loruth Kaado V (LK5)	Indet.	Indet.
Nachukui I (NC1)	Above Chari Tuff	Nariokotome
Nachukui II (NC2)	Above Chari Tuff	Nariokotome
Nachukui III (NC3)	Above Chari Tuff	Nariokotome
Nasechebun I (NS1)	Below Tulu Bor Tuff	Kataboi
Nanyangakipi (NN)	Below/above Okote Tuff	Kaitio and Natoo
Nariokotome I (NK1)	Galana Boi Beds	
Nariokotome II (NK2)	Below Chari Tuff	Natoo
Nariokotome III (NK3)	Below Chari Tuff	Natoo
Nariokotome IV (NK4)	Below Chari Tuff	Natoo
Natoo (NT)	Below Chari Tuff	Natoo
Naiyena Engol I (NY1)	Below Okote Tuff	Kaitio
Naiyena Engol II (NY2)	Below Okote Tuff	Kaitio
Naiyena Engol III (NY3)	Below Okote Tuff	Kaitio
Naiyena Engol IV (NY4)	Below Okote Tuff	Kaitio

* Abbreviations in parentheses.

more or less permanent, but short-lived, shallow lakes at the junction with alluvial fans entering from the west. Mammalian footprints have been noted at several levels in this interval, but mammalian fossils are sparse. Fossils of fish are, however, rather abundant. Several thin volcanic ash layers were deposited in this interval at Kaitio but are thus far unknown elsewhere. Small-scale ripple marks commonly occur in the top of the Lower Nariokotome Tuff. Overall, it appears that deposition during this interval took place in very shallow water on broad flats that were periodically exposed subaerially. Whether or not the ancestral Omo River contributed sediment to this system is not clear at present. It is possible that from ca. 1.7 Ma until the late Pleistocene the Omo River may have flowed westward into the Nile drainage much of the time. Overbank sediments may still have been introduced into the Turkana Basin and, for short periods, the river may have returned as well.

About the time the Nariokotome Tuff Complex was deposited (ca. 1.3 Ma), there was a major shift of the alluvial fans to the east or northeast. The ensuing deposits were clearly deposited by braided streams at no great distance from a lakeshore because shoreline sands with mollusks and ostracods continue to interfinger with the gravels, and stromatolites continue to form.

A curious and unexplained feature of the Nachukui Formation stratigraphy is the progressively northward displacement of the southern limit of exposure as the strata become younger. For example the Moiti Tuff (4.1 Ma) is known as far south as Kalokujiamwe, where it contains pumice; the Tulu Bor Tuff (= B; ca. 3.3 Ma) is known to extend only a few kilometers south of Kataboi, and the southern limit of the Lokalalei Tuff (= D; 2.5 Ma) is Kangatukuseo. The progression continues until at least 0.7 Ma, for the Kale Tuff of approximately this age is not found south of Nakitokonon. If the observed southernmost exposures of various tuffs are plotted against time, the result is nearly linear, and the rate of northward displacement amounts to about 30 km/Ma. This could be explained by differentially greater uplift in the southern part of the region with consequent erosion of strata that formerly extended that far. Alternatively it is possible that the observed limit of deposition is approximately the same as the actual original limit of deposition. If this is the case, then some other explanation for the displacement must be found. It is probably not coincidental that a similar distribution of strata is seen at Koobi Fora, with the youngest deposits confined to the northern part of the region.

SYSTEMATIC DESCRIPTION

More than 1000 specimens representing more than 90 fossil mammal species have been recovered from the Plio-Pleistocene portion of the West Turkana succession. Most of the specimens were not *in situ* and were collected during the course of surface prospecting although a few were recovered by excavation or, in the case of microfauna, by sieving. Some specimens of *Equus* sp., *Phacochoerus aethiopicus,* and *Metridiochoerus compactus* were encountered on the surface of Pliocene exposures and must have been derived from younger strata (Galana Boi Beds) that formerly overlay such older sediments but were subsequently eroded. It is our considered opinion, however, that the majority of surface specimens were not far removed from their original site (or level) of preservation.

A policy to collect all specimens that were potentially identifiable to species was conscientiously followed but no attempt was made to collect isolated bovid limb bones and some larger (hippo, elephant) specimens still await retrieval from the field. The location of all collected specimens was marked on aerial photographs and recorded (in duplicate) in field notebooks; the photographs and notebooks are now deposited in the archives of the National Museums of Kenya in Nairobi.

The Plio-Pleistocene strata exposed west of Lake Turkana document the western margin of the Lake Turkana Basin. As expected, the recovered mammalian fossils are closely comparable to others from strata of equivalent age elsewhere in the basin although differences in both composition and proportions of the faunas vary between different places in the basin even at time-equivalent horizons. Although the West Turkana succession extends from below the Lokochot Tuff (= A) to above the Chari Tuff (= L), parts of the succession equivalent to Shungura Members E and F are either missing from the West Turkana sequence or are unfossiliferous. This lacuna permits the West Turkana fossil assemblages to be considered in terms of an older and a younger suite—these are listed separately in summary Tables 2 and 3. The descriptions provided in the following part of this paper are intended as a preliminary account of the larger mammalian fossils represented in the succession, with justification for the identifications that have been made. Monographic treatment will be deferred until further collecting has been undertaken. The lower vertebrates (fish, chelonians, crocodilians), birds, hominids, and micromammals (rodents, lagomorphs) are not treated in this paper but are listed in Table 4.

SITE DESIGNATIONS

In all, 47 sites have yielded identifiable mammalian remains (Fig. 14). These have been given names and are referred to by an abbreviated site designation consisting of two letters and a number (e.g., LO3). In most instances the letters represent an abbreviation of the name of the closest river to the site, whereas the number refers to the order of discovery of sites along that drainage (e.g., LO3 was the third site located on the Lomekwi drainage). The exceptions are the Loruth Kaado sites in the far north of the area (LK1–5, named after the Loruth Kaado spring). This labelling system replaces the site numbering system (Localities I–VII) employed in the preliminary report by Harris and Brown (1985).

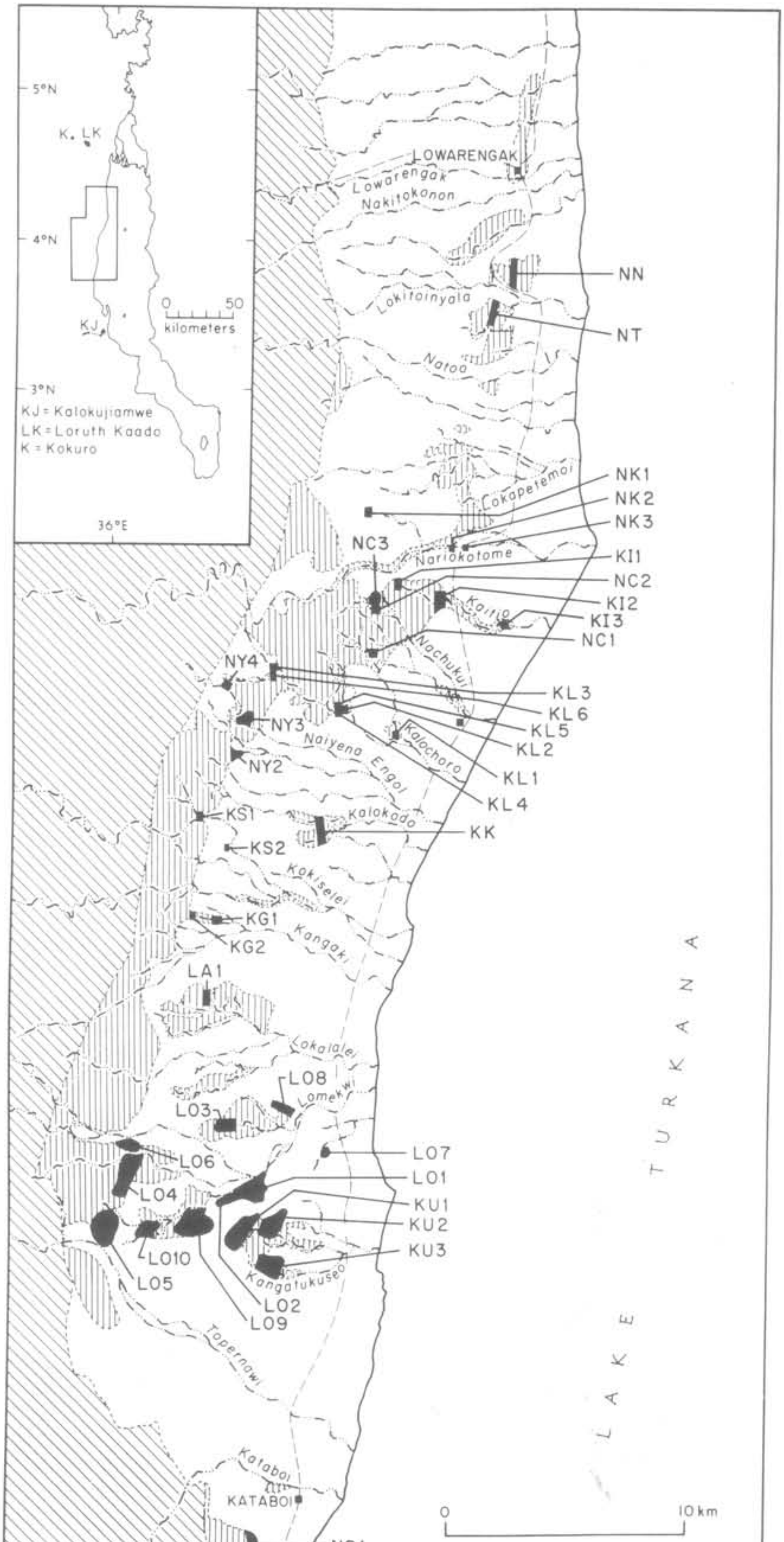
FOSSIL MATERIALS AND METHODS

The fossil material from West Turkana is housed in the collections of the National Museums of Kenya in Nairobi, where it is catalogued with the prefix KNM-WT. For economy of space the full prefix has frequently been omitted or abbreviated to WT in the descriptive portions of this paper.

Specimens from Koobi Fora, referred to in the faunal descriptions, are also housed in the National Museums of Kenya, where they are catalogued with the prefix KNM-ER. Reference has been made by one of us (MGL) to South African fossil primates from Sterkfontein (STS) and Swartkrans (SK)

→

Figure 14. Map of the Plio-Pleistocene fossiliferous sites west of Lake Turkana (indicated by solid shading); for site abbreviations refer to Table 2. Unlabelled black squares represent settlements. Vertical shading denotes exposures of the Nachukui Formation. Diagonal shading represents Miocene and older rocks.


5°N
K. LK
4°N
0 50
kilometers
KJ
3°N
KJ = Kalokujiamwe
LK = Loruth Kaado
K = Kokuro
36°E
LOWARENGAK
Lowarengak
Nakitokonon
NN
Lokitoinyala
NT
Natoo
Lokapetemoi
NK1
NK2
NK3
NC3
Nariokotome
KI1
NC2
KI2
Kaitio
KI3
NC1
Nachukui
NY4
KL3
KL6
KL5
KL2
KL1
KL4
NY3
Naiyena Engol
Kalochoro
NY2
KS1
Kalokodo
KK
KS2
Kokiselei
KG1
KG2
Kangaki
LA1
Lokalalei
L08
Lomekwi
L03
L07
L06
L01
L04
KU1
KU2
KU3
L010
L05
Kangatukuseo
L02
L09
Topernawi
Kataboi
KATABOI
NS1
0
10 km
LAKE TURKANA

in the collections of the Transvaal Museum, Pretoria, and to others from Makapansgat (M.) in the collections of the Bernard Price Institute of Paleontology, Johannesburg.

The descriptions of fossil material provided hereafter employ standard anatomical nomenclature. Elephantid teeth were measured using the parameters defined by Beden (1983). Measurements of suid teeth are those defined by Harris and White (1979:102–103). Length and width measurements of equid and bovid teeth were taken at the occlusal surface. Those of other fossil mammals were taken at the base of the tooth crown.

ABBREVIATIONS

The following abbreviations are used in the lists of specimens and tables of measurements:

ant: anterior
ap: anteroposterior (mesiodistal) length
artic: articular facet
assoc: associated
dist: distal
dv: dorsoventral (measurement)
e: estimated (measurement)
ext: external
for: foramen
frag(s): fragment(s)
h/c: horn core
ht: height
hyp: hypolophid width
indet.: indeterminate
int: intermediate (list of specimens)
int: internal (measurement)
juv: juvenile
L: left
lat: lateral
lt: length
Ma: million years
max: maximum (measurement)
max: maxilla (list of specimens)
mc: metacarpal
md: mandible
med: median
met: width at metaloph
mt: metatarsal
n/c: naviculocuboid trochlea (width at)
no.: number
occ: occipital
pc: postcranial
premax: premaxilla
prot: width at protoloph(id)
prox: proximal
R: right
tc: tuber calcis
tib: tibial trochlea
tr: transverse (= buccolingual for teeth)
+: maximum measurement on incomplete specimen
−: measurement obtained slightly larger than true measurement
( ): estimated measurement
*: estimated measurement

Order Primates

Family Cercopithecidae

Subfamily Cercopithecinae Gray, 1821

Theropithecus Geoffroy, 1843

Theropithecus brumpti (Arambourg, 1947)

Figures 15–17

This species is known only from the northern part of the Lake Turkana Basin, having previously been reported from the Pliocene parts of the successions at Koobi Fora (Leakey and Leakey, 1978) and Omo (Eck, 1976). Its recovery from the Pliocene strata west of Lake Turkana therefore comes as no surprise. The West Turkana specimens of *T. brumpti* are from stratigraphic levels dated between 2.5 and 3.4 Ma. Those from Koobi Fora are of similar age (Lokochot, Tulu Bor, and lower Burgi members). In the Omo Shungura sequence, *T. brumpti* has been confidently identified at slightly younger horizons (Members C.6–G.12, 2.0–2.6 Ma); it has been less certainly identified at still younger (G.12–13, ca. 2.0 Ma) and older (B.10–C.6, 2.49–2.69 Ma) horizons (Eck and Jablonski, in press). The uncertainty in identification arises because these authors were unable to distinguish isolated molars of *T. brumpti* from those of other members of the genus and because of the similarity of the *T. brumpti* mandible to that of *T. quadratirostris* (Iwamoto, 1982).

A total of 46 specimens has so far been recovered from seven sites in the Lomekwi Member. The West Turkana specimens are mostly fragments of cranium and mandible although one reasonably complete cranium was recovered. There were very few associated cranial and postcranial elements. The material is typical of *Theropithecus brumpti* as described by Eck and Jablonski (1987). The mandibular fragments are distinctive by virtue of their deep fossae and rugose mental ridges. The cranium, WT 16828, has the characteristic long and flat but rather narrow muzzle dorsum, sharply defined maxillary ridges, deeply excavated maxillary fossa, broad flaring zygomatics, deep and robust zygomatic arches, "bow-shaped" superior margin of the supraorbital tori with a deeply excavated depression above the interorbital region, and strongly developed sagittal and nuchal crests. The zygomatics are particularly striking, extending more superiorly and laterally than on any of the crania described from the Omo Valley. The development of the zygomatics in this species appears to be somewhat variable; some specimens from the Omo succession have very little flare while others approach the condition of the West Turkana specimen. There is evidence for considerable sexual dimorphism in the size of the males and females; one specimen—WT 16747, an adult

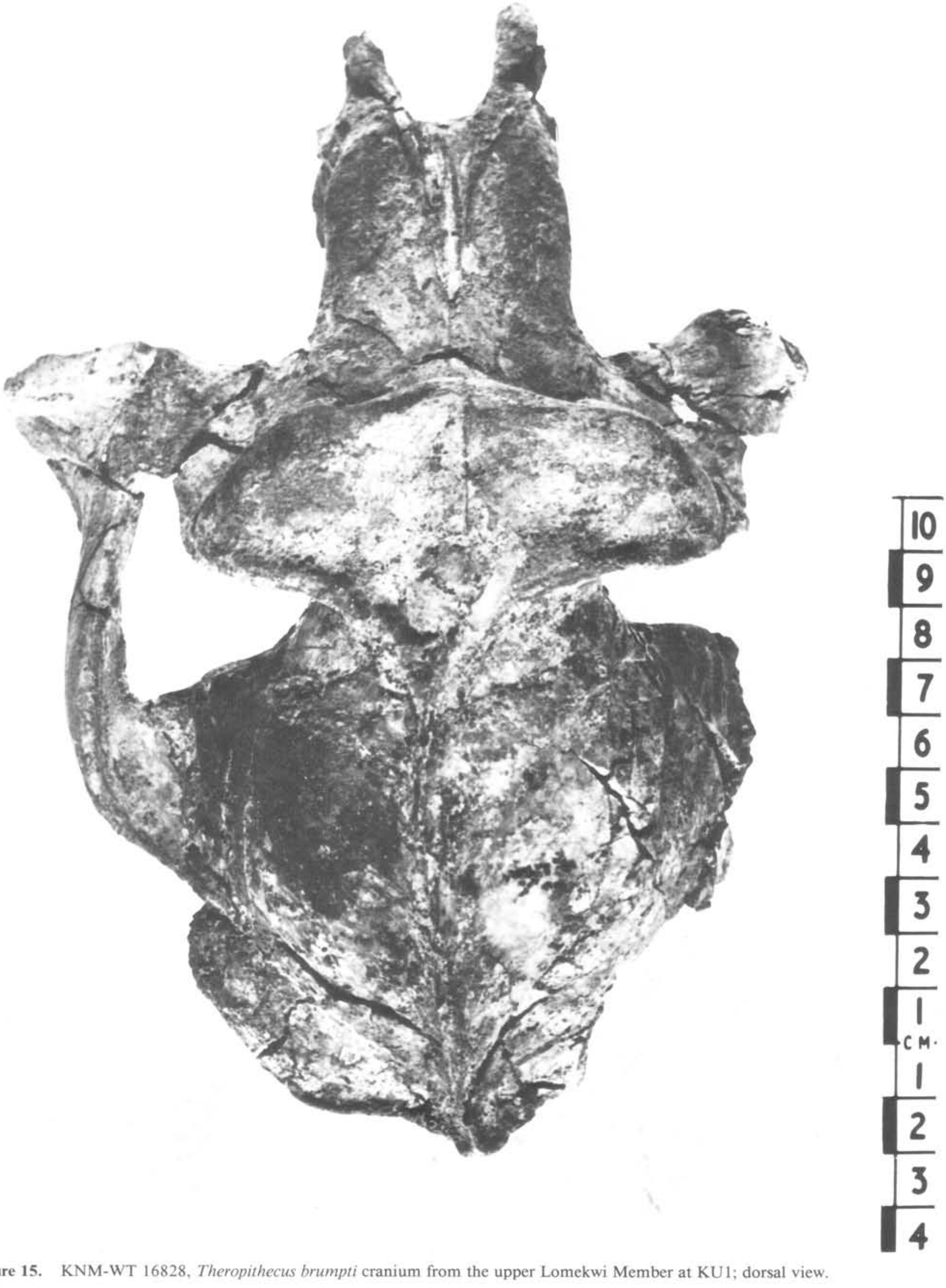


Figure 15. KNM-WT 16828, *Theropithecus brumpti* cranium from the upper Lomekwi Member at KU1; dorsal view.

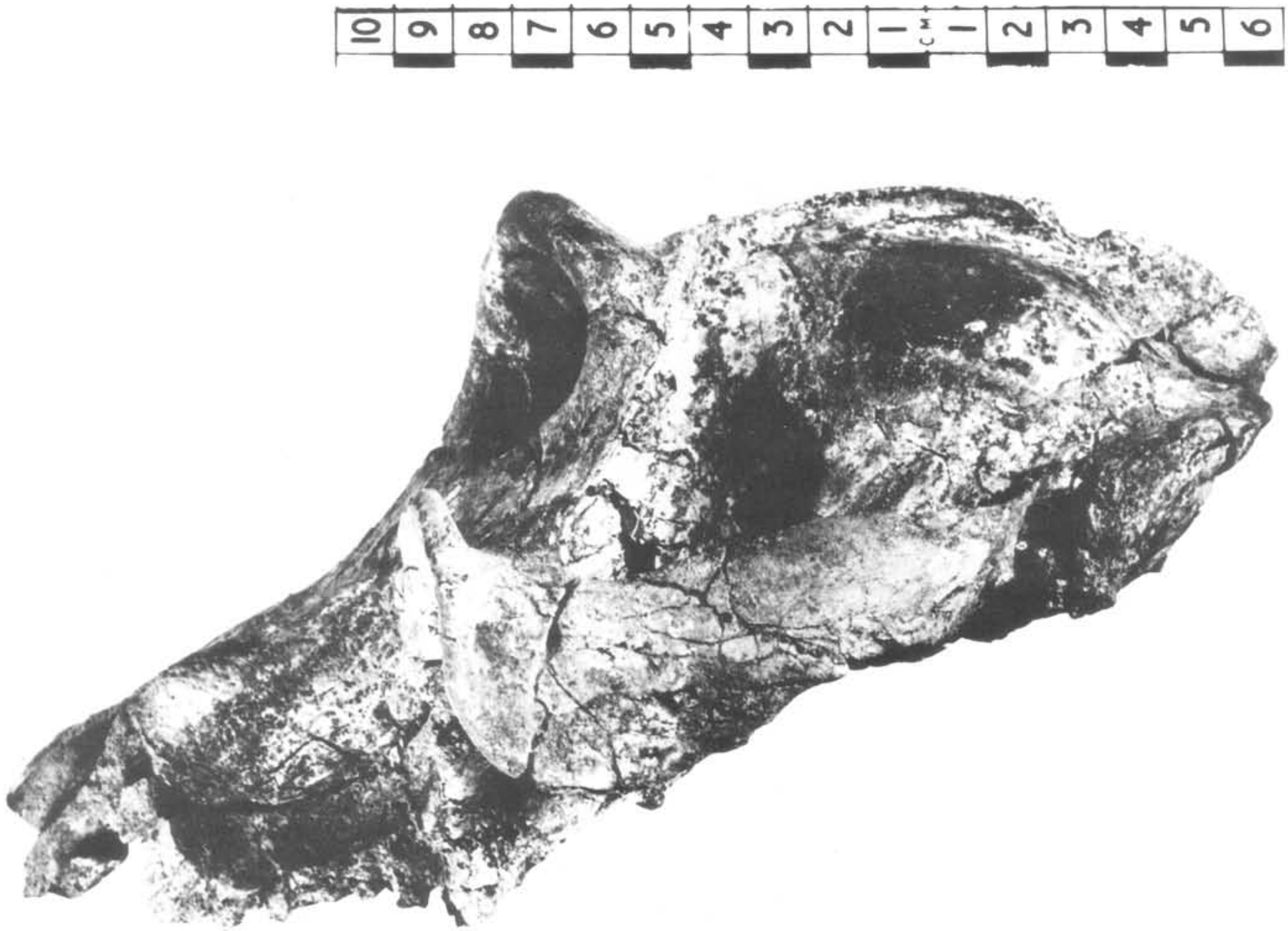


Figure 16. KNM-WT 16828, *Theropithecus brumpti* cranium; left lateral view.

female edentulous symphysis—is very much smaller than any of the male specimens while an adult female cranium (KNM-ER 1564) and mandible (KNM-ER 3023) from Koobi Fora are also significantly smaller than any of the other *T. brumpti* specimens. Jablonski (1986) has found considerable sexual dimorphism in several species of *Theropithecus.*

In their recent discussion of the crania of *Theropithecus* species, Eck and Jablonski (1984) have proposed that two species formerly placed in *Papio, P. baringensis* (Leakey, 1969) and *P. quadratirostris* (Iwamoto, 1982) be transferred to *Theropithecus.* They also propose that *T. baringensis* from the Chemeron Formation near Lake Baringo, Kenya, *T. quadrirostratus* from the Omo Usno Formation and *T. brumpti* from the Omo Shungura Formation form a phyletic lineage from strata of about 4 Ma, 3.4–3.3 Ma and 2.8–2.0 Ma, respectively. This theory may be correct but the age of the earliest species in the lineage is uncertain. *Theropithecus baringensis* is known only from site JM 90/91 in the Chemeron Formation. The problems relating to the age of this site were discussed by Birchette (1982), who concluded that it is older than 2 Ma, younger than 5.4 Ma, and probably younger than 4 Ma.

Eck and Jablonski (1984) note that, whereas the crania of the three species are distinctive, the mandibles of *T. brumpti* and *T. baringensis* are very similar and they predict that, when found, the mandible of *T. quadratirostris* will be difficult to distinguish from those of the other two species. The mandibles reported here from LO4 and LO5 are of about the same age as Omo specimens of *T. quadratirostris* and may represent the first mandibles of this species to be recovered. Attribution of the mandibles to *T. brumpti* is tentative, pending the recovery of crania from these localities.

Theropithecus oswaldi (Andrews, 1916)

Theropithecus oswaldi, one of the most common cercopithecines in the fossil record, is represented at many East African localities dated to between a little less than 1 and approximately 2 Ma. At Koobi Fora this species has been recovered from the upper part of the succession (upper Burgi, KBS, and Okote members). In the Omo Valley it occurs in Shungura members E.3 (2.4 Ma) to G.14 (2.0 Ma) but has not been recorded from higher in the sequence. Eck (1987) attributes

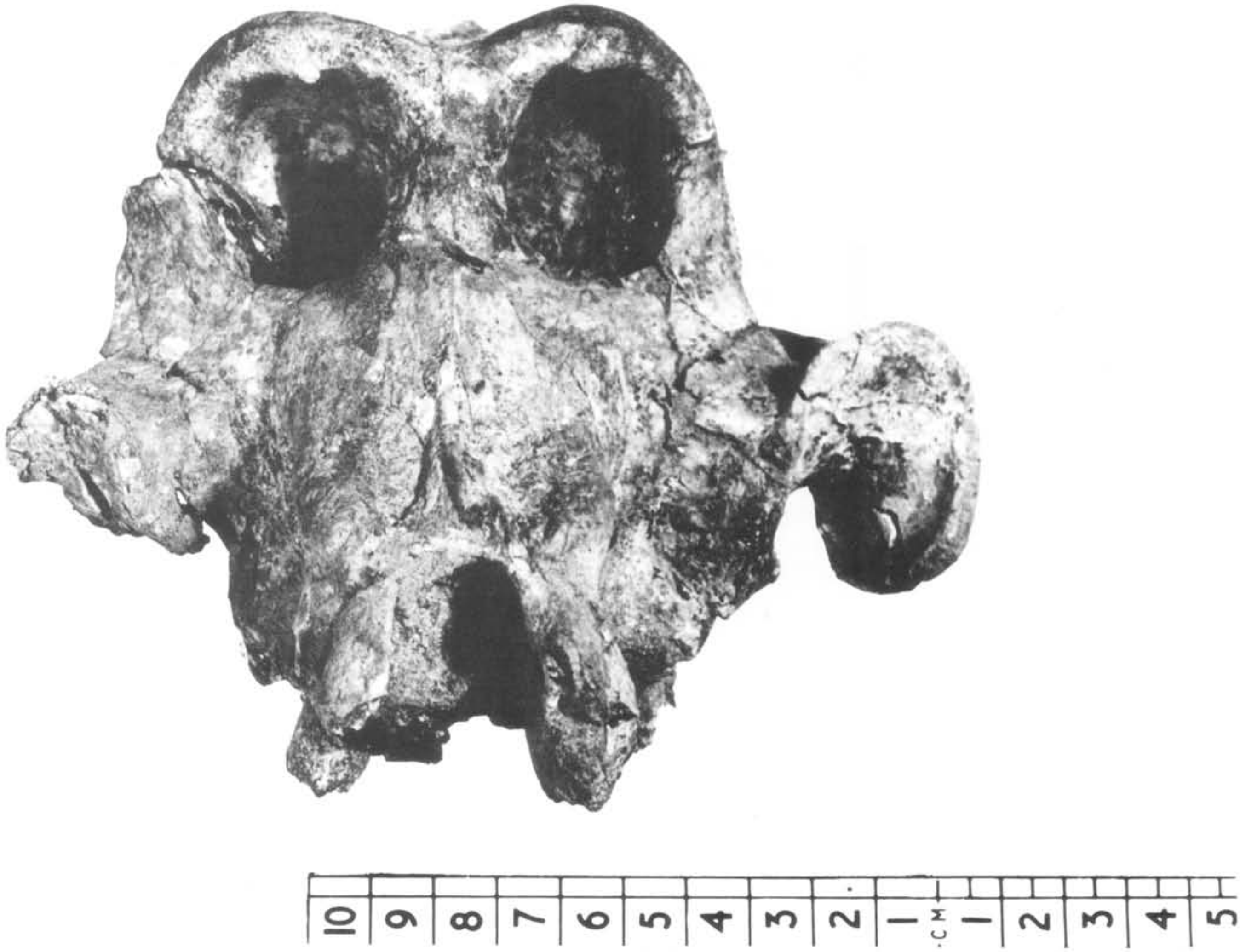


Figure 17. KNM-WT 16828, *Theropithecus brumpti* cranium; anterior view.

its absence from the upper Shungura succession to an inability to identify the small sample of very fragmentary specimens from this part of the sequence.

The relatively few (10) specimens of *Theropithecus oswaldi* from West Turkana add nothing to the morphological information available for specimens of this species from other localities (Jolly, 1972; Szalay and Delson, 1979; Leakey and Leakey, 1973).

In the Shungura succession, *T. oswaldi* co-occurs with *T. brumpti* between E.3 and G.12 (i.e., between 2.4 and 2.0 Ma). However, this interval is either undocumented or unfossiliferous at West Turkana and Koobi Fora, and the two species are not recorded together at these two localities.

Theropithecus species indeterminate

An upper right canine, 17405 from KS1, cannot be more positively identified to species.

Parapapio Jones, 1937

Parapapio ado (Hopwood, 1936)

Parapapio is common in South Africa where four species have been recognized (Freedman, 1957) but rare in East Africa where hitherto only one species, *P. ado,* has been described. A single specimen of this species, WT 16752, a fairly well preserved male mandible lacking the canine and ascending rami, was recovered from the lower Lomekwi Member at LO4. The specimen is similar to mandibles of this species documented from Laetoli (Leakey and Delson, 1987) but is rather smaller than the three male mandibles recovered from the latter locality. The teeth are within the size range recorded for the Laetoli specimens.

Parapapio ado is also represented at Koobi Fora by a single specimen—KNM-ER 3122—a fragment of right mandible with M_{2-3} from Area 106, but has not yet been recorded from the lower Omo Valley.

Identification of fragmentary specimens of *Parapapio* and

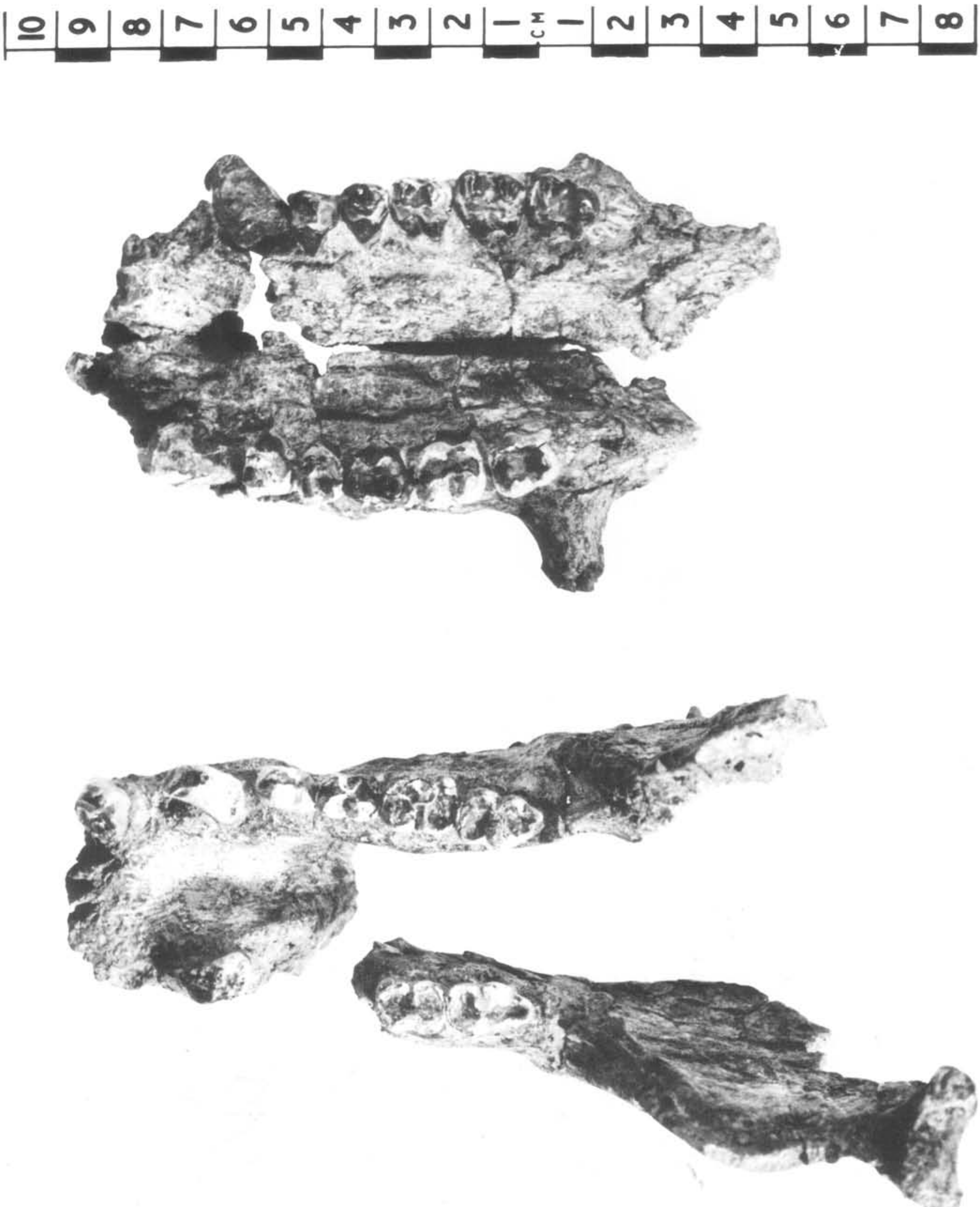


Figure 18. KNM-WT 16287, *Paracolobus mutiwa* mandible and maxilla from the upper Lomekwi Member at LO1; occlusal view.

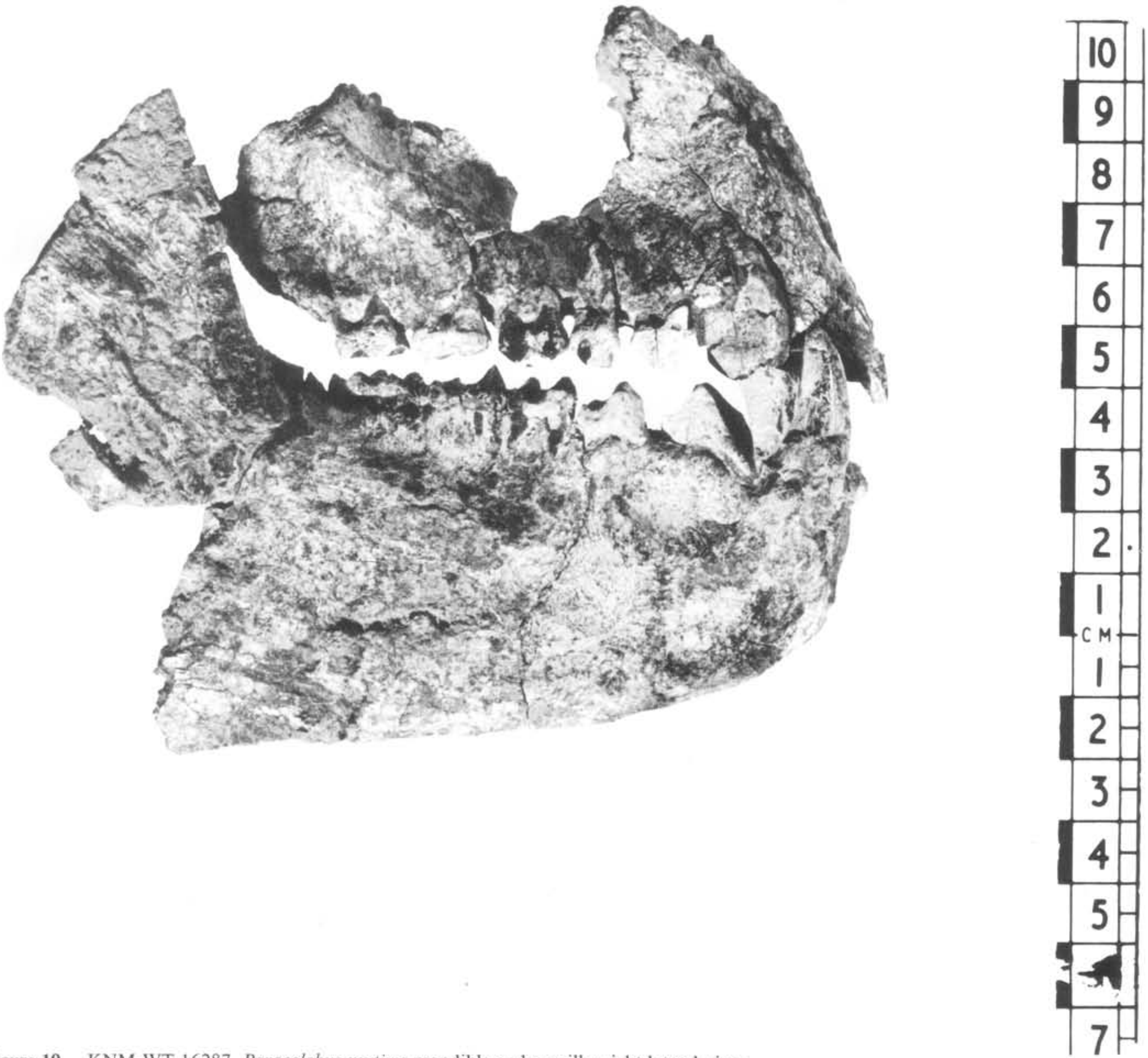


Figure 19. KNM-WT 16287, *Paracolobus mutiwa* mandible and maxilla; right lateral view.

Papio is difficult because the principal diagnostic characters separating these two genera pertain to the lateral profile of the muzzle dorsum and the presence or absence of fossae in the maxilla.

Parapapio whitei Broom, 1940

Parapapio cf. *P. whitei*

Two specimens are provisionally assigned to this species. WT 16751 is a left mandible with M_{1-3} from LO4 in the lower part of the Lomekwi Member and WT 16869 is a left M_3 from KU2 in the upper part of the same member. Measurements of M_2 and M_3 of 16751 are close in length to those of *Parapapio whitei* from Makapansgat (Maier, 1970) and from Sterkfontein (Freedman, 1957) but the West Turkana M_2 is narrower.

This is the first reported occurrence in East Africa of *P. whitei,* the largest of the *Parapapio* species recognized from South Africa. A large papionin, *Dinopithecus ingens,* which may be better assigned to *Papio* (Delson, 1982), has been recovered from Swartkrans and Schurweberg in South Africa, but its teeth are considerably larger than the West Turkana specimens. In East Africa a large papionin, similar in size to *D. ingens,* has been recognized at Laetoli (Leakey and Delson, 1987) and assigned to cf. *Papio* sp. Only one specimen of a comparably large papionin has been recovered from similarly

Figure 20. KNM-WT 16287, *Paracolobus mutiwa* mandible; left lateral view.

ancient strata at Koobi Fora: KNM-ER 7728, an unerupted molar from Area 260/261. However, from higher in the Koobi Fora succession (upper Burgi, KBS, and Okote members), a number of specimens of a papionin close in size to modern representatives of the genus *Papio* have been recovered. Some of these specimens have distinct maxillary or mandibular fossae but others lack such fossae, suggesting that both *Papio* and *Parapapio* may be represented in this interval. Eck (1976) reported *Papio* sp. from the Omo Usno Formation and from Members A–G, J, and K of the Shungura Formation (i.e., an interval spanning 1.2–3.5 Ma). These specimens, which are mainly isolated teeth, may also conceivably include representatives of both genera. However, Eck and Jablonski (1984) suggested that *Papio* may not be present anywhere in the fossil record; some specimens previously assigned to this genus belong in *Theropithecus* while others belong in *Dinopithecus*. Resolution of this quandary must await the availability of more complete material from appropriate time intervals.

Subfamily Colobinae Blyth, 1875

Paracolobus R. Leakey, 1969

Paracolobus mutiwa M. Leakey, 1982

Figures 18–20

Paracolobus mutiwa, the largest of the Plio-Pleistocene colobines, is rather poorly known. It is represented by two specimens from the upper Burgi Member at Koobi Fora (ca. 2 Ma). In the lower Omo Valley *P. mutiwa* has been recognized from Shungura Members C, F, and G, whereas isolated teeth have been identified with less certainty from Members B through G (Leakey, 1985). The type species of the genus, *Paracolobus chemeroni* Leakey, 1969, is known from only

Theropithecus brumpti (Arambourg, 1947)

Material referred KNM-WT	Specimen	Site
16753	female md (LI_1–P_3, RP_{3-4}, RM_2)	LO1
16754	chipped LM^2	LO5
16756	L$\underline{P}$	LO1
16801	R md frag (M_1)	LO1
16802	frag LM_3	LO1
16803	R md frag (M_{2-3})	LO1
16805	cranial frags (LM^3, RM^{2-3})	LO1
16806	md (LP_3, LM_{2-3}, RM_{2-3})	LO1
16808	md and postcranial frags	LO1
17421	male R$\underline{C}$ frag	LO1
17420	LM_2	LO1
17571	female md (RP_4–M_2, LP_3)	LO1
17569	female md (M_{1-3})	LO1
16739	molar frag	LO4
16740	lower molar frag	LO4
16742	juvenile md frag	LO4
16746	L md (M_{1-3})	LO4
16747	female md symphysis	LO4
16748	R$\underline{C}$	LO4
16749	male md (LP_3–M_2)	LO4
16750	md frags (LM_{2-3}, roots RM_2)	LO4
16754	juvenile cranial frags	LO4
16887	female max & md frags (L$\underline{P}$, LM^{2-3}, RM_{2-3})	LO5
16888	female max frags (LP^3–M^3, RP^4–M^1, roots RM^3)	LO5
16894	R max frag (M^{2-3})	LO5
16895	R md frag (P_3)	LO5
16896	broken molar	LO5
16897	L /C	LO5
16898	L M_2	LO5
16899	R M^2	LO5
16900	lower molar frag	LO5
17553	md frags	LO5
17554	md frags	LO5
17555	md	LO5
16864	md frag (M_3), M frag	LO9
17422	lower M frag	LO9
17560	md and prox ulna	LO9
16862	L max (P^3, M^{1-2}), R max (P^{3-4}, M^{2-3}), temporal frag	LO10
16863	md frags (RP_{3-4}, RM_3 frag, LP_4, LM_1, LM_3)	LO10
16828	cranium & postcranial elements	KU1
16867	lower M frag	KU1
16890	LP_3	KU1
16865	RM_3 frag and M frag	KU2
16870	md frag ($M_{2/3}$), prox humerus	KU2
16871	R max (M^2)	KU2
16872	LM_3 frag	KU2

Theropithecus brumpti cranial measurements
WT 16828

Length glabella to inion	137.0
Width postorbital constriction	52.0
Bizygomatic width	~153.0
Depth orbit	32.4
Width orbit	32.0
Interorbital width	20.2
Max external width across orbital process of zygomatic	102.5
Max external width across zygomatic processes	87.0
Max width across maxillary ridges	47.5
Length nasals	81.0

Theropithecus brumpti dental measurements

		16862	16899	16808
$\underline{C}$	ap	–	–	23.3
	tr	–	–	12.7
P^3	ap	8.5		
	tr	9.3		
P^4	ap	9.2		
	tr	10.0		
M^1	ap	14.0		
	tr	12.2		
M^2	ap	16.5	16.3	
	tr	14.5	14.0	
M^3	ap	17.5		
	tr	14.2		

Theropithecus brumpti dental measurements (continued)

		16746	16750	16749	16753	16801	16808	17420	17553
I_2	ap				7.7				
	tr				6.0				
/C	ap				5.3		17.0−		
	tr				8.6+		11.0−		
P_3	ap				8.0+				
	tr				6.7				
P_4	ap			8.4	9.5		9.8		
	tr			7.5	7.5		10.0+		
M_1	ap	11.5				14.0			
	tr	8.8				10.2			
M_2	ap	14.2			15.0			16.5	
	tr	11.3+			11.2			12.8	
M_3	ap	18.5	19.3				22.0		21.0
	tr	11.5	13.5				24.3		22.2
		16863	16888	16894	16897	16898	17571	17560	
/C	ap				15.5				
	tr				8.0				
P_3	ap	13.0		9.0			9.5		
	tr	8.5		5.0			7.2		
P_4	ap	10.5					9.5		
	tr	8.7					8.0		
M_1	ap		13.5			12.5	13.5		
	tr		12.8			9.0	9.5+		
M_2	ap						16.0	16.0	
	tr						11.5	12.0	
M_3	ap	20.6							
	tr	14.0							

Theropithecus oswaldi (Andrews, 1916)

Material referred KNM-WT	Specimen	Site
14650	L md (M_3)	KG1
14659	female md (L & R P_4; roots L & R P_3, M_1)	KG1
14655	R /C	KL3
14658	female md (L & R M_{2-3})	
14663	R & L tibiae frags, prox L femur, dist R femur	KL3 KL1
14665	RM^3	KL5
14666	female assoc teeth (L /C, LP_3, LM_1, LM_3, RP_3)	KL5
17403	edent md frag	NC1
14660	R md (M_{2-3})	NC2
17435	partial cranium	NY2

Theropithecus oswaldi dental measurements

		14665	17435	14650	14659	14655	14666
M^3	ap	18.5	18.5				
	tr	14.0	12.5				
/C	ap					15.3+	
	tr					9.8+	
P_4	ap				10.0−		
	tr				8.3		
M_3	ap			17.5			22.0
	tr			12.0			13.0+

Theropithecus sp. indet.

Material referred KNM-WT	Specimen	Site
17405	R$\underline{C}$	KS1

Primate specimen lists and measurements (continued).

Parapapio ado (Hopwood, 1936)

Material referred

KNM-WT	Specimen	Site
16752	male md (LP_3–M_3, RI_2–M_2) and I^2	LO4

Parapapio ado lower dentition measurements

		WT 16752	Laetoli *P. ado* mean	range
I_1	ap	4.5	4.87	4.5–5.1
	tr	6.4	4.78	3.8–5.3
I_2	ap	5.0	5.3	
	tr	7.1	4.62	3.4–5.9
/C	ap	5.9		
	tr	(10.0)		
P_3	ap	14.5	11.5	
	tr	5.5	5.4	5.0–5.8
P_4	ap	6.0	7.08	5.8–8.5
	tr	5.6	5.82	5.1–6.5
M_1	ap	(8.5)	9.07	7.7–10.3
	tr	(6.0)	6.98	6.3–7.9
M_2	ap	(9.2)	10.82	9.6–12.5
	tr			
M_3	ap	(12.5)	13.85	12.5–15.3
	tr	8.2	8.92	7.8–10.8

Parapapio whitei Broom, 1940

Parapapio cf. *whitei*

Material referred

KNM-WT	Specimen	Site
16751	L md (M_{1-3})	LO4
16869	LM_3	KU2

Measurements of the lower molars of *Parapapio whitei* and *Dinopithecus ingens* from South Africa and of *Parapapio* cf. *whitei* from West Turkana

M_2	ap	tr	tr/ap × 100
Parapapio whitei			
Makapansgat			
M.3062+	12.4	10.6	85
M.3072+	13.2	10.8	82
Sterkfontein			
STS 533*	12.2	10.9	89
STS 359*	12.3	10.4	85
STS 563*	13.0	10.6	82
STS 352*	12.5	10.8	86
STS 370A*	13.4	10.5	78
Dinopithecus ingens			
Swartkrans			
SK 401*	16.2	13.1	80
SK 455*	16.2	13.0	80
SK 628A–B*	16.2	13.0	80
SK 432*	16.2	12.7	78
Parapapio cf. *whitei*			
West Turkana			
WT 16751	12.6	11.5	91

M_2	ap	tr	tr/ap × 100
Parapapio whitei			
Makapansgat			
M.3062+	17.5	11.6	66
M.3072+	16.1	11.0	68
Sterkfontein			
STS 342*	16.5	11.1	67
STS 533*	15.5	11.1	71
STS 359*	16.5	11.1	73
STS 352*	16.5	10.8	65
Dinopithecus ingens			
Swartkrans			
SK 455*	22.7	13.7	62
SK 404*	21.5	13.6	63
SK 422*	22.3	12.8	57
SK 492*	21.5	14.5	67
SK 428*	20.0	13.0	65
SK 470*	20.0	12.6	63
Parapapio cf. *whitei*			
West Turkana			
WT 16751	17.2	11.7	68
WT 16869	17.2	12.3	71

* From Freedman, 1957.
\+ From Maier, 1970.

Paracolobus R. Leakey, 1969
Paracolobus mutiwa M. Leakey, 1982

Material referred

KNM-WT	Specimen	Site
16827	cranial & postcranial frags	LO1

Paracolobus mutiwa dental measurements

WT 16827		Upper	Lower
I2	ap	7.8	4.0+
	tr	7.5	6.3
C	ap	17.5	13.3
	tr	11.6	9.8
P3	ap	10.0	13.5+
	tr		10.0
P4	ap	9.0	10.5
	tr	10.8	8.0
M1	ap	11.8	12.5−
	tr	11.0	8.2
M2	ap	13.3	13.5
	tr	12.3	10.5
M3	ap	13.0	15.5
	tr	12.3	10.2

Cercopithecidae gen. & sp. indet.

Cercopithecidae indet. (large)

Material referred

KNM-WT	Specimen	Site
16738	prox R humerus, prox R femur	LO4
16877	dist L humerus	LO5
16878	dist femur	LO5
16879	R calcaneum, head femur	LO5
16880	L calcaneum	LO5
16881	dist femur	LO5
16884	femur frags, prox tibia, innominate	LO5
16886	postcranial frags	LO5
16868	prox R humerus	KU2
16873	prox R ulna, L radius	KU1
16874	L humerus	KU1
16875	R tibia	KU1

Cercopithecidae indet. (medium)

Material referred

KNM-WT	Specimen	Site
16883	humerus	LO5
16891	prox R humerus, prox R ulna	LO5
16892	prox L ulna	LO5
16893	prox L ulna	LO5
16737	dist humerus shaft	LO3
16860	R femur shaft	LO3
16861	dist femur	LO3
16755	dist tibia	LO1
16876	weathered calcaneum	KU1

Ceropithecidae (small)

Material referred

KNM-WT	Specimen	Site
16736	prox & dist R humerus, prox R ulna	LO4
16807	dist L femur, dist L scapula	LO1
16866	prox R radius	KU2

Cercopithecidae indet.

Material referred

KNM-WT	Specimen	Site
16744	RI^2	LO4
16741	broken LI_2	LO4
16885	juv md frag	LO5
14657	R /C & postcranial frags	NK1 (GB)
16743	prox L radius	LO4
16882	prox R ulna	LO5
17407	L astragalus	LO5
16889	phalanx	KL1
17399	prox L femur	NY2
17402	L /C	NY2
17404	prox & dist L femur	NY2

one specimen from site JM 90/91 in the Chemeron Formation, a site of uncertain age as mentioned earlier.

The single specimen of *P. mutiwa* from West Turkana, 16827—cranial and postcranial fragments from LO1 in the upper part of the Lomekwi Member—adds significantly to our knowledge of this species. Hitherto, the most complete specimen of this species was the holotype, a fragment of maxilla associated with pieces of the frontal and temporal from Koobi Fora (Leakey, 1985). The West Turkana specimen includes a palate (lacking RI^1 and LI^{1-2}), a mandible (lacking much of the right ramus, a portion of the right body, and the incisors), various skull fragments, and a number of postcranial elements including a complete right and left astragalus, left calcaneum, an almost complete left humerus, distal right humerus, right and left innominates, and fragments of other limb bones including the proximal right femur, right ulna, distal right and left scapula, and right humerus plus hand and foot bones and vertebrae.

The holotype (and only) specimen of *Paracolobus chemeroni* includes much of the postcranial skeleton, part of which has been described in detail by Birchette (1982). As noted by Leakey (1985), *P. mutiwa* differs from *P. chemeroni* by having a more pronounced snout with a postcanine fossa and a wider malar region. The West Turkana specimen documents additional differences from *P. chemeroni.* The premolars (especially P_3) are relatively larger, and although the mandibular ramus is wide anteroposteriorly at the level of M_3 it narrows towards the condyle. The mandible, as noted on specimens from the Omo (Leakey, 1985), has a distinct oblique ridge on the medial face just posterior and inferior to M_3—a feature which also separates this species from those of *Rhinocolobus.* In the upper and lower dentitions the molars display greater wear than the anterior teeth. The postcranial elements also differ in relative size, suggesting that the limbs of *P. chemeroni* were relatively longer than in *P. mutiwa;* the humerus is shorter than that of *P. chemeroni,* the astragalus is of similar or slightly smaller size, and the calcaneum is distinctly smaller. The West Turkana specimen is still only partially prepared but additional morphological differences from *P. chemeroni* are apparent in the glenoid fossa of the scapula and in the innominate.

The West Turkana specimen is the most complete specimen of *P. mutiwa* yet recovered and provides the first positively identified I^2, upper canines and postcranial remains of this species. The holotype specimen is a female maxilla which is considerably smaller than the male from West Turkana, suggesting significant sexual dimorphism. Initial observations support the original attribution of this species to the genus *Paracolobus* but more detailed studies of the postcranial skeleton are required to confirm this.

Cercopithecidae genus and species indeterminate

A number of isolated cercopithecid postcranial specimens and other fragmentary material cannot be identified to genus or even subfamily without further study. The postcranial remains are mainly of large and medium-sized individuals. Most of them probably represent skeletal elements of *Theropithecus brumpti* though four specimens from the upper part of the succession may belong to *T. oswaldi.*

Order Carnivora

Family Canidae

Canis Linn., 1758

This genus, to which the extant species of jackals belong, made its first appearance in Africa during the Pliocene. Jackals are not uncommon in Africa during the Plio-Pleistocene although other canids are rare.

Canis mesomelas Schreber, 1775

This species, the side-striped jackal, is today found in eastern and southern Africa where it principally inhabits *Acacia* and *Commiphora* woodlands and thickets (Kingdon, 1977). It is the only extant jackal recorded in the fossil record. The extinct subspecies *C. m. latirostris* is recorded from Bed I at Olduvai (Petter, 1973) while from South Africa the extinct subspecies *C. m. pappos* is known from Sterkfontein, Swartkrans, and Kromdraai (Ewer, 1956).

Canis cf. *C. mesomelas*

Two specimens from West Turkana compare closely to *C. mesomelas.* WT 14664, a relatively complete right mandible lacking the condyle and part of the ramus, was recovered from the Kalochoro Member at KG2. The incisors and P_4 are missing and the molars are worn. WT 14988, a proximal right humerus, was recovered from the Natoo Member at KL1. *Canis* cf. *mesomelas* occurs at Koobi Fora where five specimens are known from horizons above and below the KBS Tuff.

Living canids are a very homogeneous group with few skeletal and dental differences. The extant East African jackals, *C. adustus, C. aureus,* and *C. mesomelas,* are therefore difficult to identify to species even from complete skeletons. The specimens from West Turkana and Koobi Fora are tentatively referred to *C. mesomelas* largely because of their similarity to specimens from Olduvai Gorge that have been attributed to *C. mesomelas.*

Lycaon Brookes, 1827

Lycaon pictus, the extant wild dog, has been recorded from woodlands and grasslands throughout much of sub-Saharan Africa although in many areas it is now rare or absent. Little is known of the evolution of this genus which has previously been recognized only at Elandsfontein in South Africa (Hendey, 1974). Recently Turner (1986) has argued that the large Olduvai dog, *Canis africanus,* described by Pohle (1928) was actually a species of *Lycaon,* but the cranium and mandible subsequently recovered from Olduvai in 1974 confirm the original attribution to *Canis.* The upper first molar of *C.*

africanus has a divided basin to accommodate the lower carnassial talonid, which has both a hypoconid and an entoconid. The M^1 of *Lycaon,* in contrast, has a single basin and the lower carnassial talonid has only a hypoconid.

cf. *Lycaon* sp.

The anterior portion of a lower right M^1, WT 14994, from the Kalochoro Member at KK, is significantly larger than that of any species of jackal but is smaller than the large dog *Canis africanus* from Olduvai (Pohle, 1928). The West Turkana molar fragment may also be distinguished from *C. africanus* by the large metaconid. The preserved portion of the tooth matches that of *Lycaon pictus* but it is only tentatively referred to *Lycaon* because of its incomplete nature. The trigonid length of the WT 14994 is 14.3 mm (paraconid length (6.0 mm) plus protoconid length (8.4 mm)). An edentulous mandible of a similar sized canid was recovered from Koobi Fora (KNM-ER 878).

Family Viverridae

Mungos Geoffroy & Cuvier, 1795

This genus was recognized at Olduvai where three species were documented (Petter, 1973). The single extant species, *Mungos mungo* (the banded mongoose), is widely distributed in sub-Saharan Africa where it exploits a variety of habitats including savanna, woodland, and gallery forest (Kingdon, 1977).

Mungos dietrichi Petter, 1963

Two West Turkana specimens have been recovered from the middle portion of the Lomekwi Member at LO9. WT 17575, comprising right and left mandibles and maxillae, is the first record of an associated upper and lower dentition of this species. WT 16834 is a right mandible with P_2 and alveoli for P_3–M_2. Although the West Turkana specimens may be at least half a million years older than those from Olduvai Bed I (Petter, 1973), they are dentally similar. This genus has not been recovered from Koobi Fora.

Civettictus Pocock, 1915

The African civet, *Civettictus civetta,* the only extant African representative of this genus, is widespread throughout a variety of habitats in sub-Saharan Africa. It is the largest viverrid found in East Africa today.

cf. *Civettictus* sp.

A partial palate of a large viverrid was recovered from the middle portion of the Lomekwi Member at LO10. The specimen approximates the size of the extant *C. civetta* and preserves the left third incisor, canine, and first premolar, and alveoli for the left P^{2-4} and left and right I^{1-2}. The specimen differs from *Pseudocivetta ingens,* described from Olduvai Bed I (Petter, 1973), by its smaller but higher crowned P^1. The alveoli for P^{2-4} indicate narrow teeth, thereby contrasting with the typically broad teeth of *Pseudocivetta.* Two crania of a large viverrid have been recovered from Koobi Fora but these and several isolated teeth almost certainly represent *Pseudocivetta ingens.* The West Turkana specimen is too fragmentary to refer to species but it may represent the first fossil record of the genus *Civettictus.*

Family Hyaenidae

Crocuta Kaup, 1828

Crocuta crocuta, the spotted hyaena, occurs throughout much of sub-Saharan Africa. The earliest record of *Crocuta* from this region is at Kakesio, a site in Tanzania that is older than 4 million years (J. Barry, pers. comm.). An early *Crocuta* also occurs at Laetoli (Barry, 1987) and in the Chemeron Formation of the Tugen Hills sequence (Hill et al., 1985). These early forms are not the same species as the extant *C. crocuta.*

Crocuta crocuta Erxleben, 1777

The spotted hyaena is common in Plio-Pleistocene assemblages from Koobi Fora, Olduvai (Petter, 1973) and South Africa (Kurten, 1956). The oldest Koobi Fora specimen is from the upper Burgi Member. Two rather fragmentary specimens from West Turkana appear to represent the extant species. WT 14995 is a right mandible fragment from the Kalochoro Member at KG1. WT 14989 is a right mandible fragment from the Nariokotome Member at NC1.

Crocuta new species

Five mandibular specimens from the lower and middle parts of the Lomekwi Member (LO4, LO5, LO10) are from individuals that were considerably larger than the extant spotted hyaena. The mandibles are massive and have deep symphyses, large canines, and very large broad premolars. P_3 is particularly large and approximately the same length as P_4, in contrast to the condition in *C. crocuta.* The premolars are also rather high crowned and the posterior portion of P_4 is enlarged. M_1 appears to have been relatively long and narrow but in the West Turkana specimens this tooth is not well preserved.

The specimens are all from the interval between the Tulu Bor Tuff (= B) and the Waru Tuff. No similar specimens have been recovered from Koobi Fora, Olduvai, Laetoli, or from the Transvaal cave deposits in South Africa.

cf. *Crocuta* species indeterminate

Also from the lower part of the Lomekwi Member (LO5) are three fragmentary hyaenid specimens that do not seem to belong to the new *Crocuta* species: 16847, a left upper canine crown; 16848 a right upper canine; and 16853, a right mandible fragment with P_3. It is possible that these are related to an early species of *Crocuta* from Laetoli reported by Barry (1987).

The early evolution in Africa of the genus *Crocuta* is not well understood and good specimens are required to distinguish between the recognized taxa. Several small specimens from Laetoli were interpreted by Barry (1987) to retain a number of primitive characters and to perhaps represent an early species of *Crocuta.* The P_3 of the Laetoli form is "not greatly enlarged relative to the other premolars and lacks the small anterior cingulum seen in most *C. crocuta.*" Only one West Turkana specimen, WT 16853, preserves this diagnostic tooth; it resembles the Laetoli P_3 in being small and in lacking the anterior cingulum—although this might be partially obscured by damage to the tooth. WT 16853 is close in size to LAET 149 from Laetoli, which has a length of 16.3 mm and a width of 17.2 mm, but is smaller than the mean of the Laetoli sample (length = 17.2 mm from five specimens, width = 12.3 mm from four specimens). It is clear that more complete material from West Turkana is required to determine the relationship, if any, between the three specimens reported above and the Laetoli species.

Hyaena Brisson, 1762

Two species of this genus occur in Africa today. *Hyaena hyaena,* the striped hyaena, is found in eastern and northern Africa and is well represented in the Pleistocene fossil record, whereas *H. brunnea,* the brown hyaena, is restricted to southern Africa. An early species, *H. abronia,* from Langebaanweg differs from the extant striped hyaena by several primitive characters and may have been ancestral to the extant species (Hendey, 1974).

Hyaena hyaena (Linn., 1758)

Four specimens attributable to this extant species have been recovered from West Turkana: WT 17573, associated mandible and maxilla fragments from the upper Lomekwi Member at LO1; WT 14991, a left mandible from the Kalochoro Member at KG1; and two specimens from the Kaitio Member—WT 17938, a left metacarpal IV from NY2, and WT 17434, a right mandible from NY4.

Hyaena hyaena is well represented at Koobi Fora by two complete skulls from the upper Burgi Member (KNM-ER 1548 and 3766) and other specimens from the KBS and Okote members. Although showing some similarities to the primitive *H. abronia* from Langebaanweg, the Koobi Fora crania are clearly more advanced and belong to the extant species. *Hyaena hyaena* is also recorded from Olduvai Gorge Beds I and II (Petter, 1973) and from Makapansgat in the Transvaal (Toerien, 1952; Ewer, 1967).

Hyaenidae genus indeterminate

16855 from the upper Lomekwi Member at KU1, part of a mandible associated with tooth fragments and a phalanx, is too fragmentary to permit identification to genus.

Family Felidae

Dinofelis Zdansky, 1924

The genus *Dinofelis,* the false sabretooth, was originally founded upon a species, *D. abeli,* from North China (Zdansky, 1924). Subsequently Hemmer (1965) demonstrated that *Therailurus* Piveteau, 1948, was a synonym of *Dinofelis.* Hemmer considered that the European *D. diastema* was ancestral to the African *D. barlowi* that in turn gave rise to *D. piveteaui,* the last species in the lineage. Hendey (1974) has recorded *D. diastema* from Langebaanweg, which comprises the earliest record of the genus in Africa, and Barry (1987) has recognized the genus at Laetoli. The genus is well known from later Plio-Pleistocene deposits in both southern and eastern Africa. Ewer (1967) had described both *D. barlowi* and *D. piveteaui* from the Transvaal and Cooke (in litt.) has described some very complete cranial and postcranial specimens from Bolt's Farm. In East Africa a very complete but undescribed specimen of *D. piveteaui* has been recovered from Kanam East and a number of specimens of both species are known from the Turkana Basin (Leakey, M.G., 1976; Howell and Petter, 1976).

Dinofelis cf. *D. barlowi*

Two specimens have been recovered from the middle part of the Lomekwi Member at LO10—WT 16832, an edentulous left mandible, and WT 16846, a right upper canine. This fragmentary material is not diagnostic to species but the specimens are referred to the earlier African taxon on the basis of their age (below the Emekwi Tuff). *Dinofelis barlowi* is represented by over a dozen specimens at Koobi Fora where it occurs in the upper Burgi Member. The better West Turkana specimen, WT 16832, is very similar to KNM-ER 3880 from Koobi Fora Area 129.

Homotherium Fabrini, 1890

Homotherium, the great scimitar cat, was founded on the Villafranchian species *H. nestianus* from Europe (Fabrini, 1890). The holotype is not well preserved but a more complete skull from Perrier, Italy (de Bonis, 1976), provides good morphological detail. *Homotherium nestianus* is very similar to a second European species *H. sainzelli* (= *H. crenatidens*), which is known from a particularly well preserved skull and skeleton (Ballesio, 1963). De Bonis (1976) considered that the differences, which include the larger size, more reduced P_3, longer diastema between P_3 and P_4, and less well developed P_4 of *H. nestianus,* were sufficient to warrant retention of both species.

Homotherium problematicus (Collings, 1972)

Figures 21–23

Three specimens from West Turkana are attributable to this species: WT 16881, a right ulna from the lower Lomekwi Member at LO4; WT 16826, cranial and postcranial fragments from the upper Lomekwi Member at KU2; and WT 17436, a juvenile edentulous cranium from the Kaitio Member at NY3. The latter is the best preserved cranium of this genus yet reported from sub-Saharan Africa. All the teeth were missing, except for the unerupted permanent canines which remain in their crypts, but some incisors were subsequently recovered by sieving. The cranium was recovered

Figure 21. KNM-WT 17436, *Homotherium problematicus* cranium from the Kaitio Member at NY3; dorsal view.

in pieces, revealing parts of the anterior and posterior edges of the canines, which are serrated. WT 16826, a very broken juvenile skeleton with its epiphyses unfused, provides many details of the postcranial morphology of this large sabretooth cat. The fragments recovered include the distal left scapula with glenoid process and spine, diaphyses of the humeri and left ulna, portions of both femora, parts of both fibulae, a proximal tibia fragment, left scaphoid, left cuboid, left astragalus, left metacarpal I, left metatarsals III and IV, three distal metapodials, four proximal and two terminal phalanges, plus rib and vertebrae fragments.

Homotherium problematicus, described from a squashed and incomplete cranium from Makapansgat in South Africa (Collings, 1972), was incorrectly referred to the genus *Megantereon* (Hendey, 1974). Collings et al. (1976) later reassigned this specimen to *H.* cf. *H. nestianus.* The East African *Homotherium* specimens almost certainly belong to the same species as the specimen from Makapansgat, and the new West Turkana cranium (17436) indicates that this species is not *H. nestianus.* Characters that distinguish the East African species from the European species include the following: the snout is significantly shorter relative to the length of the

Carnivore specimen lists and measurements.

Canis cf. *mesomelas*

Material referred

KNM-WT	Specimen	Site
14664	R md (/C–P_3, M_{1-2})	KG2
14988	prox R humerus	KL1

Canis cf. *mesomelas* dental measurements

		14664
/C	ap	7.5+
	tr	5.8
P_1	ap	–
	tr	3.0+
P_2	ap	8.6
	tr	3.8
P_3	ap	9.0
	tr	3.8
M_1	ap	17.2+
	tr	7.0+
M_2	ap	8.8
	tr	6.0

Mungos dietrichi Petter, 1973

Material referred

KNM-WT	Specimen	Site
16834	R md (P_2, alveoli P_3–M_4)	LO9
17575	L max (P^3–M^2), R max (P^3–M^1)	
	L md (P_4–M_2), R md (/C, P_2, P_4–M_2)	LO9

Mungos dietrichi dental measurements

		16834	17575
P^3	ap		5.0
	tr		3.9
P^4	ap		6.2
	tr		6.5
M^1	ap		4.8
	tr		7.5
M^2	ap		3.2
	tr		5.4
/C	ap		3.0
	tr		4.0
P_2	ap	4.4	
	tr	2.3	
P_4	ap		6.0
	tr		3.7
M_1	ap		5.8
	tr		3.7
M_2	ap		5.2
	tr		3.5

cf. *Civettictus* sp.

Material referred

KNM-WT	Specimen	Site
16852	L max frag (LI^3–P^2)	LO10

Carnivore specimen lists and measurements (continued).

cf. *Civettictus* sp. dental measurements

		16852
I^3	ap	4.6
	tr	4.1+
$\underline{C}$	ap	5.7+
	tr	–
P^3	ap	4.9
	tr	3.5

Crocuta crocuta Erxleben, 1777

Material referred

KNM-WT	Specimen	Site
14989	R md frag (root /C)	NC1
14995	R md (P_{3-4} roots /C, P_2, M_1)	KG1

Crocuta crocuta dental measurements

		14995
P_3	ap	20.5+
	tr ant	15.0+
	tr post	15.5–
P_4	ap	21.9–
	tr ant	13.9–
	tr post	14.4–

Crocuta new species

Material referred

KNM-WT	Specimen	Site
16843	L md (M_1)	LO4
16845	R md (P_2, alveoli /C, I_{2-3}	LO5
16849	R md (P_{2-4})	LO5
16851	L md (P_{2-3}, roots P_4–M_1)	LO10
17408	R md frag & R m/c III	LO5

Crocuta new species dental measurements

		16843	16849	16851
P_2	ap		17.4	17.2–
	tr ant		12.8	–
	tr post		14.3	11.8
P_3	ap		24.1	21.7–
	tr ant		18.0	15.7
	tr post		16.7	15.3
P_4	ap		24.0	
	tr ant		15.8	
	tr post		15.7	
M_1	ap	29.5+		
	tr ant	12.0		
	tr post	13.2		

cf. *Crocuta* sp. indet.

Material referred

KNM-WT	Specimen	Site
16847	L $\underline{C}$	LO5
16848	R $\underline{C}$	LO5
16853	R md (P_3)	LO5

Carnivore specimen lists and measurements (continued).

Crocuta sp. indet. dental measurements

		16847	16848	16853
$\underline{C}$	ap	16.0	17.0	
	tr	13.0	13.0	
P_3	ap			16.5−
	tr ant			11.5
	tr post			—

Hyaena hyaena (Linn., 1758)

Material referred

KNM-WT	Specimen	Site
14991	L md (P_2–M_2)	KG1
17398	L m/c IV	NY2
17434	R md (P_3–M_1)	NY4
17573	L & R max frags (I^3, P^4) & md frags	LO1

Hyaena hyaena dental measurements

		17434	14991	17573
I^3	ap			9.5
	tr			8.0
P_2	tr		7.7+	
P_3	ap		18.0+	
	tr ant		10.3	
	tr post		10.3+	
P_4	ap	21.3	18.5+	
	tr ant	10.5	9.6	
	tr post	11.0	10.4+	
M_1	ap	24.0	21.2+	
	tr ant	11.5	9.6	
	tr post	10.0	9.0+	

Dinofelis cf. *barlowi*

Material referred

KNM-WT	Specimen	Site
16832	edentulous L md	LO10
16846	R $\underline{C}$	LO10

Homotherium problematicus (Collings, 1972)

Material referred

KNM-WT	Specimen	Site
16826	cranial and postcranial frags	KU2
17436	juv. edentulous cranium	NY3
16881	R ulna	LO4

Homotherium problematicus cranial measurements

	17436
Length cranium (ant border foramen magnum to ant I^1 alveolus)	~250+
Bizygomatic breadth	~180
Height nasal aperture	31
Width across postorbital processes	91
Width postorbital constriction	64
Max width across external border of condyules	62
Max height condyle	29.5
Width calvarium	86.5
Width snout anterior to infraorbital foramen	77
Length diastema post border C/ alveolus to ant border P^3 alveolus	8.5
Length ant border C/ to post border carnassial	~92
Length ant border P^3 to post border carnassial	~61

Carnivore specimen lists and measurements (continued).

Homotherium problematicus dental measurements

		16826	17436
I^1	ap	9.4	
	tr	8.5+	
I^2	ap	9.7	12.0
	tr	10.5+	11.0+
P^3	ap	11.5	
	tr	5.9	
I_1	ap	6.2	
	tr	4.8	

Carnivora gen. & sp. indet.

Material referred

KNM-WT	Specimen	Site
14568	L dI (Canidae?)	KL1
14990	dist m/p	KG1
14992	L humerus frag (Viverridae?)	KK
14993	L M/t IV (*Dinofelis*?)	LK1
16833	dist M/c V	LO4
16835	R ulna	LO5
16838	dist R radius	LO4
16839	prox R radius (*Crocuta*?)	LO4
16850	dist L humerus (Viverridae?)	KU2
16856	prox R ulna (*Crocuta crocuta*?)	LO10
17406	R astragalus (*Crocuta* sp. indet.?)	LO5

braincase and it is relatively wide; the orbit is less clearly defined because both the frontal and zygomatic postorbital processes are small; the foramen magnum is relatively large; P_3 is less reduced and is double-rooted. The relative immaturity of the West Turkana cranium may account for some but not all of these differences. The earliest *Homotherium* specimens from Koobi Fora are from the Lokochot and Tulu Bor members and several have come from the upper Burgi and KBS members.

Felidae genus indeterminate

Cranial and postcranial fragments of an immature felid (16859) have been recovered from the upper Lomekwi Member at KU1 but cannot be allocated to genus.

Carnivora Indeterminate

Additional carnivore material, mainly isolated postcranial elements, cannot be more positively identified at present.

Order Proboscidea

Family Deinotheriidae

Deinotherium Kaup, 1829

Deinotherium bozasi Arambourg, 1934

Deinothere enamel is sufficiently distinctive that even small fragments suffice for identification. Indeed 11 of the 12 deino-

Figure 22. KNM-WT 17436, *Homotherium problematicus* cranium; ventral view.

there specimens recovered from West Turkana comprise only fragments of enamel although one complete upper second molar (WT 16721) was recovered from KU2. Only a single deinothere species has been recognized from the Plio-Pleistocene of East Africa, founded on material described originally from the Omo succession (Arambourg, 1934). The one complete tooth from West Turkana is of comparable size to others from the Lake Turkana basin. The youngest specimen, 14986 from NN, is of similar age to the youngest occurrence of this species at Koobi Fora.

Family Elephantidae

Both *Elephas* and *Loxodonta* species have been recovered from the West Turkana localities. *Elephas recki* is the commonest elephant, and is represented by *E. recki brumpti* in the lower part of the sequence and *E. recki shungurensis* in

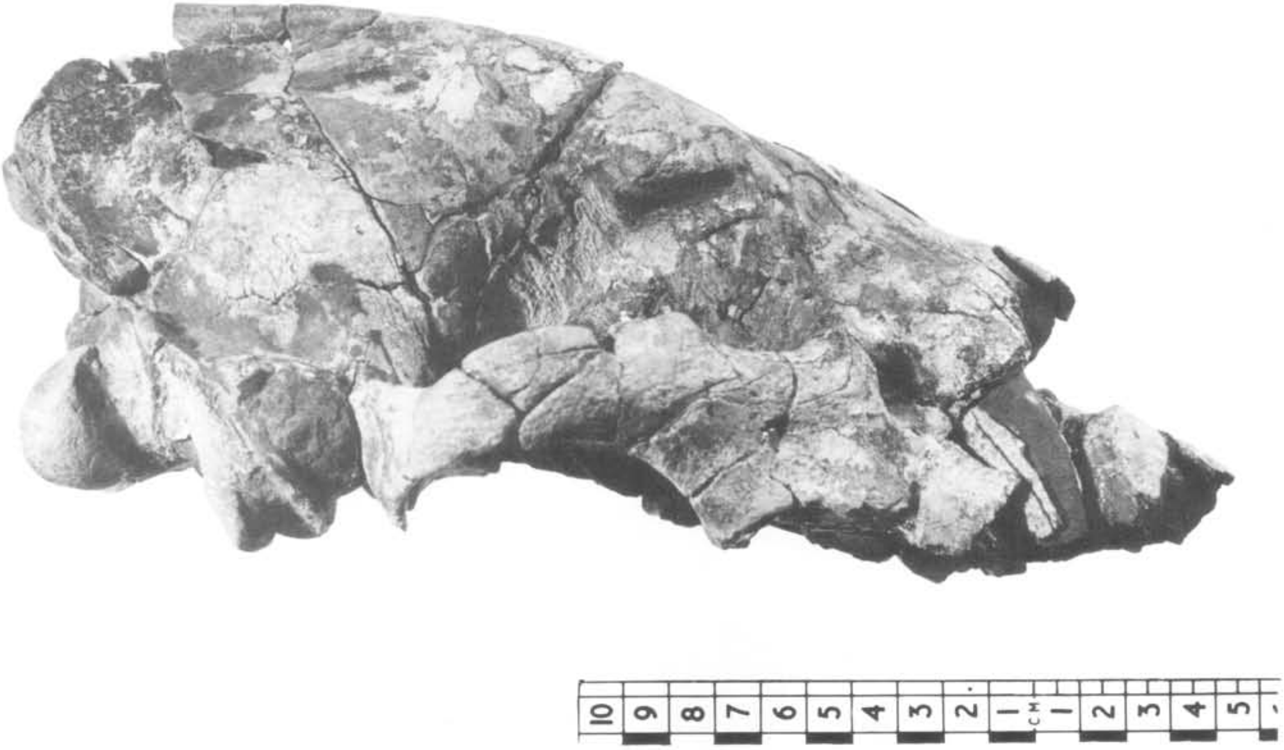


Figure 23. KNM-WT 17436; *Homotherium problematicus* cranium, right lateral view.

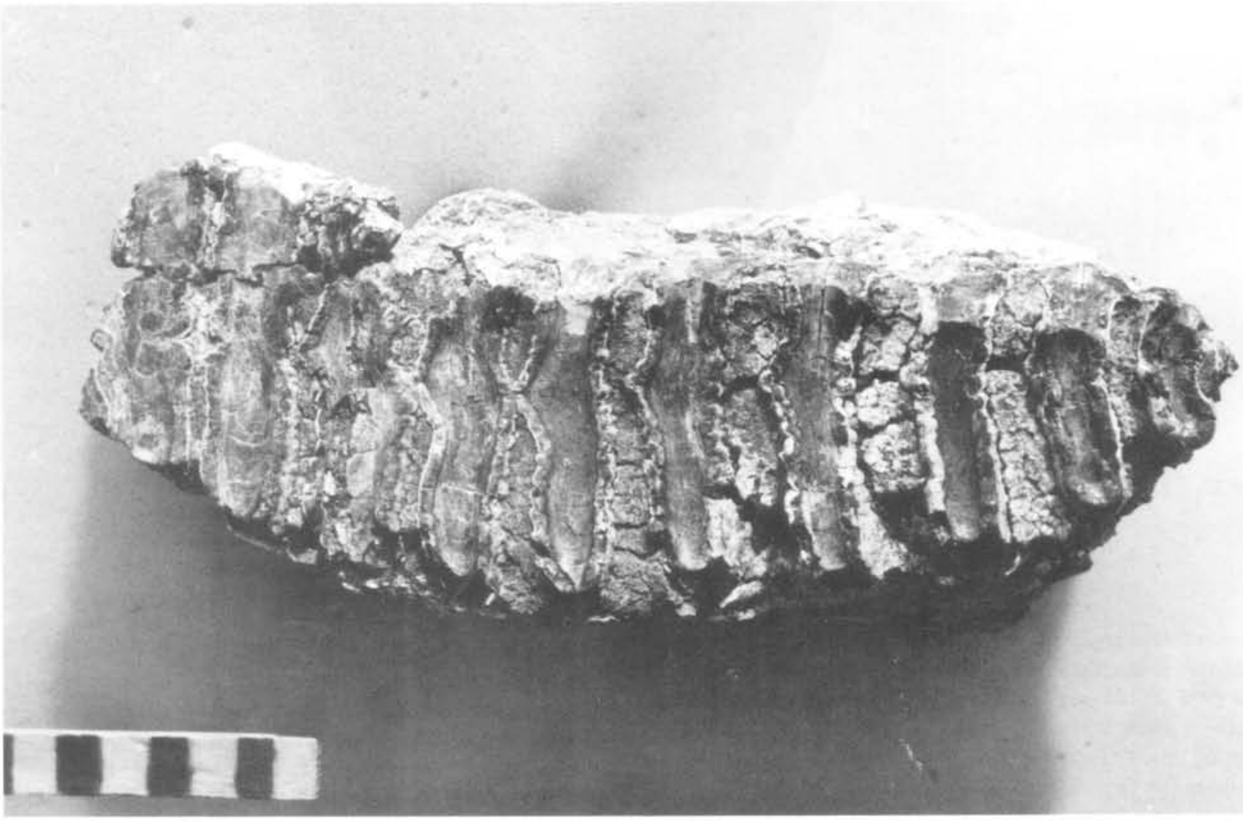


Figure 24. KNM-WT 16830, *Loxodonta adaurora* RM^3 from the lower Lomekwi Member at LO5; occlusal view.

Figure 25. KNM-WT 16470, *Loxodonta adaurora* RM_3 fragment from the lower Lomekwi Member at LO4; occlusal view.

the middle part. A few specimens of more progressive subspecies have been recovered from the upper portion. *Loxodonta* is rarer but is represented by three species—*L. adaurora* and *L. exoptata* in the lower portion of the sequence and an unnamed species of *Loxodonta* in the upper.

Loxodonta Cuvier & St. Hilaire, 1825

Loxodonta adaurora Maglio, 1970

Figures 24, 25

Erected by Maglio in 1970, this species was subsequently interpreted by Beden (1983) to be divisible into two subspecies on the basis of material from Koobi Fora. *Loxodonta adaurora adaurora,* the type subspecies, occurs in strata older than 3 Ma while a more progressive subspecies, *L. adaurora kararae,* was recognized from the latest Pliocene. All the identifiable material of this species so far recovered from West Turkana belongs to the nominate subspecies.

Four specimens have been collected from the lower part of the sequence: WT 14540, a posterior fragment of LM_3 from LK1; 16470, a fragment of right mandible with the posterior half of M_3 from LO4; 16830, a fragment of right maxilla with M^3 from LO5; and 16594, a fragment of left M^3 also from LO5. The first specimen is from the Kataboi Member and the other three from the lower part of the Lomekwi Member. The teeth of this species are characterized by thick enamel and widely spaced plates.

Loxodonta exoptata (Dietrich, 1941)

Figure 26

Loxodonta exoptata is a progressive loxodont that may have evolved from *L. adaurora* and forms part of the lineage leading to the extant African elephant (Beden, 1983). It was first recognized by Dietrich from the area now called Laetoli but has subsequently been identified at several localities in the northern part of the eastern Rift Valley. Only one specimen of this species has been recovered from West Turkana—WT 16458, a right maxilla fragment with M^3 from LO4 in the lower part of the Lomekwi Member. This tooth is in an advanced state of wear. Of its nine plates, the first four are heavily worn while the last two have yet to come into occlusion. The tooth has relatively thick enamel and prominent anterior and posterior pillars which, in mid-wear, impart a "lozenge"-shape typical of the plates of the extant African elephant. The plates are fairly widely separated with only four plates in the anterior 10 cm of the tooth.

Loxodonta sp.

WT 17470 comprises molar fragments from NY3 in the Kaitio Member. These have much thicker enamel and more

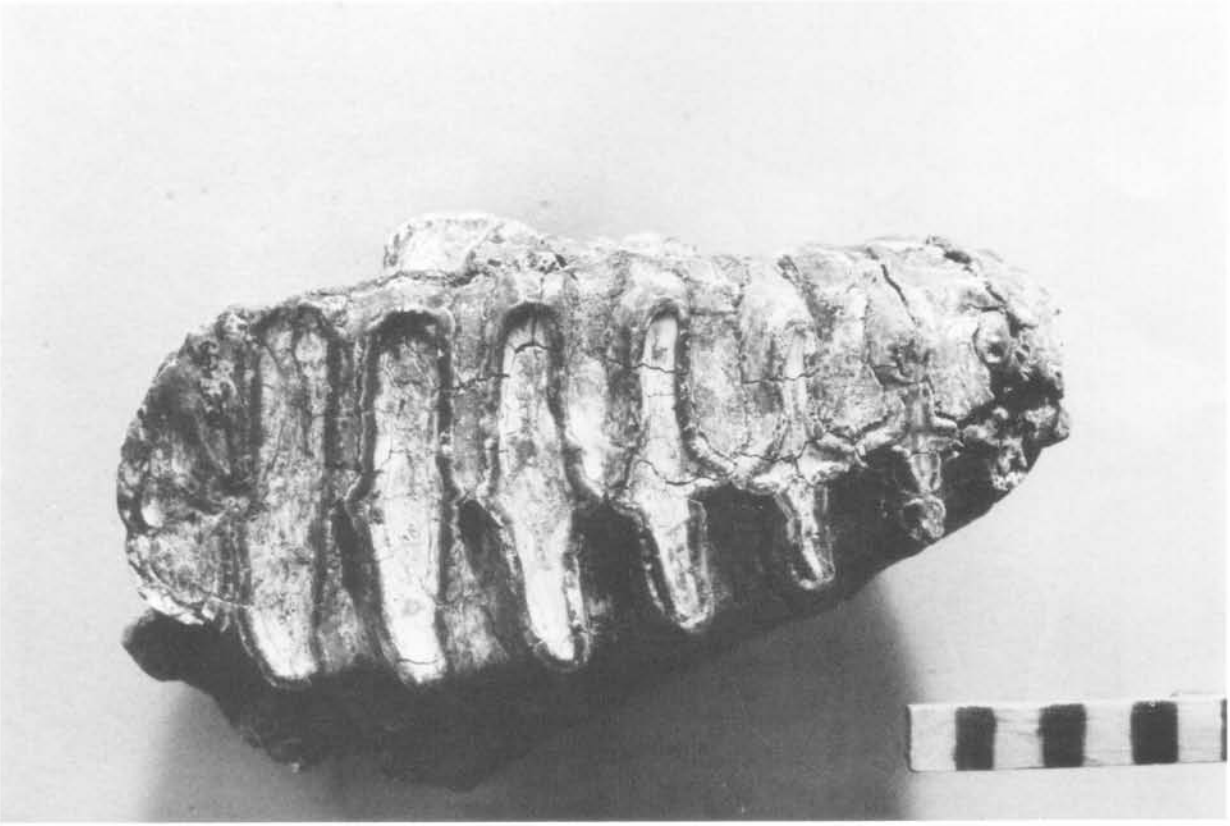


Figure 26. KNM-WT 16458, *Loxodonta exoptata* RM[3] from the lower Lomekwi Member at LO4; occlusal view.

widely spaced lophs than specimens of *Elephas recki* so far recovered from anywhere in the West Turkana sequence. The thick enamel (4.4 mm) and diamond-shaped occlusal surfaces on worn plate fragments suggest the specimen is a loxodont but the specimen is too incomplete for further identification or for meaningful measurements to be taken.

Elephas Linn., 1735

Elephas recki Dietrich, 1915

Maglio (1970, 1973) recognized four successive evolutionary stages in this species. Beden (1980, 1983) later identified five stages (and three variants of one of these) and formally interpreted them as subspecies of *Elephas recki*. Four of these subspecies have been recognized in the West Turkana sequence.

Elephas recki brumpti Beden, 1980

Figures 27, 28

This is the most primitive subspecies in the lineage and has been recovered from four sites in the lower portion of the Lomekwi Member and from LO3 in the upper part of this member. Teeth of *E. recki brumpti* may be distinguished from those of *L. adaurora* by having thinner and more crenulated enamel on the plates, and by the more numerous and more closely spaced plates. Although the plates are separated by median pillars, when worn these form simple rounded sinuses rather than contributing to the lozenge-shaped wear pattern characteristic of plates of the more progressive *Loxodonta* species.

Elephas recki shungurensis Beden, 1980

Figures 29, 30

This subspecies is represented in the upper part of the Lomekwi Member (eight specimens), the Lokalalei Member (one specimen), and the Kalochoro Member (four specimens). Molars of *E. recki shungurensis* can be distinguished from those of *E. recki brumpti* by their greater number of plates and thinner and more crenulated enamel.

Elephas recki cf. *ileretensis* Beden, 1980

Figure 31

Only two specimens of this subspecies are known from West Turkana: WT 14539, a right M[3] from KL6 and WT 17497,

Figure 27. KNM-WT 16387, *Elephas recki brumpti* palate with LM^{2-3} and RM^3 from the middle Lomekwi Member at LO9; occlusal view.

left and right M^3 fragments from NY2, both from the Kaitio Member. The taxonomic assignment is made primarily on stratigraphic provenance but the teeth are clearly more progressive (in terms of number of plates, enamel thickness, etc.) than those from lower in the succession.

Elephas recki recki Dietrich, 1915

Figure 32

This subspecies is represented by three specimens from the Nariokotome Member (the uppermost fossiliferous portion of the Pleistocene strata): WT 14503, a mandible (with left and right M_{2-3}) from NC1; 14538, a left M_2 fragment from NC1; and 14983, also a left M_2 fragment, from NC1. Though none of the teeth is directly comparable with those of *E. recki* cf. *ileretensis,* the specimens from NC2 have thinner enamel, seem to be more hypsodont, and have plates that are more closely spaced.

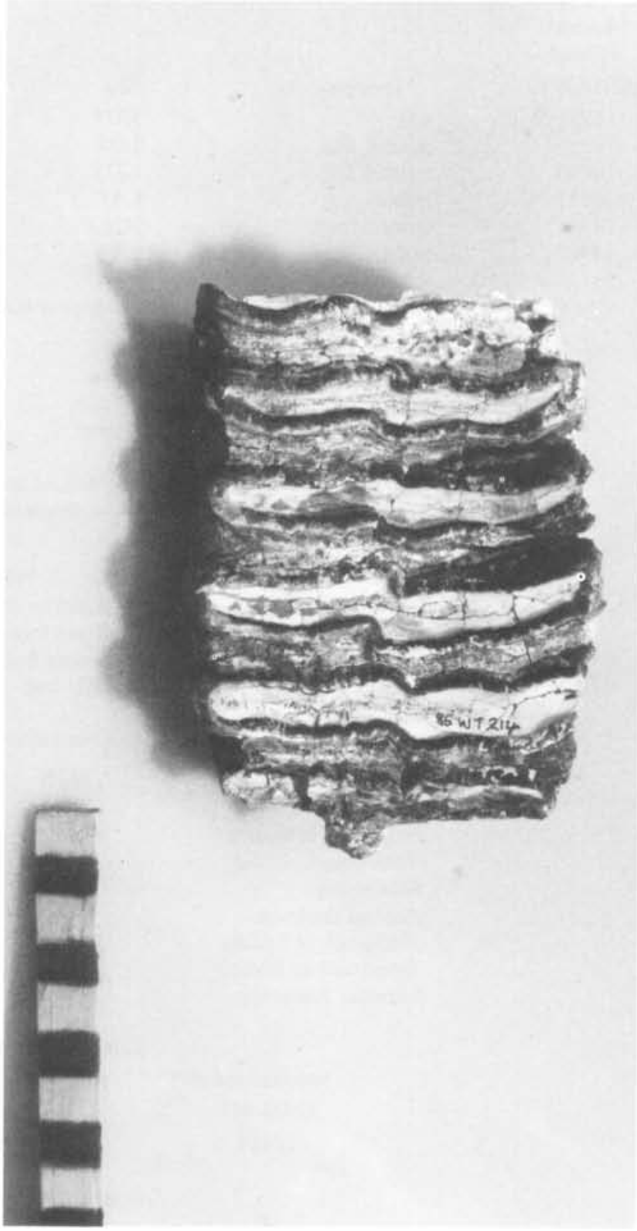


Figure 28. KNM-WT 16009, *Elephas recki brumpti* LM^3 fragment from the lower Lomekwi Member at LO5; occlusal view.

Order Perissodactyla

Family Equidae

Hipparion De Christol, 1832

Most of the *Hipparion* material from West Turkana comprises isolated teeth and these seem to belong to three species

Deinotherium bozasi Arambourg, 1934

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16721	LM^2	KU2	16592	indet tooth frags	LO9
16593	enamel frag	LO5	14984	enamel frag	KG
16590	enamel frag	KU1	16723	enamel frag	KU1
16591	enamel frag	LA1	16724	molar frag	LO3
14986	enamel frags	NN	16722	molar frags	LO9
14987	enamel frags	LK1	16589	molar frags (RM^{1-2})	LO2

Deinotherium bozasi dental measurements

	16721
LM^2 ap	111
prot	111
met	100

Loxodonta Cuvier & St. Hilaire, 1825
Loxodonta adaurora Maglio, 1970

Material referred KNM-WT	Specimen	Site
14540	posterior fragment LM_3	LK1
16470	R md frag (post 1/2 M_3)	LO4
16830	R max frag (M^3)	LO5
16594	LM^3 frag	LO5

Loxodonta adaurora dental measurements

	14540	16470	16830	16594
No. plates	–2	–5	x10x	5–
No. plates in wear	–1	–5	10	5–
Total length	–65	–115	263	100–
Max width	—	80	94	78+
Enamel thickness	4.5	5.3	5.2	4.5
Frequency of folding	0	1–2	1–2	1–2
Amplitude of folding	0	1	1	1
Laminar frequency	—	4.5	4.5	4.5

Loxodonta exoptata (Dietrich, 1941)

Material referred KNM-WT	Specimen	Site
16458	R max frag (M^3)	LO4

Loxodonta exoptata dental measurements

	16458
No. plates	9
No. plates in wear	7
Total length of tooth	223 mm
Length of wear surface	182 mm
Maximum width	91 mm
Enamel thickness	3.6 mm
Frequency of folding	2
Amplitude of folding	2
Laminar frequency	4

Loxodonta sp.

Material referred KNM-WT	Specimen	Site
17470	molar frags	NY3

Elephas recki Dietrich, 1915

Elephas recki brumpti Beden, 1980

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16457	R & L M^3 & M^2 frag	LO10	16012	LM_1 frag	LO5
16456	RM^3 frag	LO3	16013	L max frag (P^4)	LO4
16008	RM^2	LO4	16455	RM^3 frag	LO9
16010	L$M^{1/2}$ frag & RM^3 frags	LO5	16011	LM_3 frag	LO4
16007	R$M^{2?}$ frag	LO5	16387	max (R & L M^3) & md frags (R & LM_3)	LO9
16009	LM_3 frags	LO5	16629	L max frag (M^1)	LO3

Elephas recki brumpti dental measurements

	P^4	M^1	M^2				M^3	
	16013	16629	16457	16008	16007	16387	16457	16456
No. plates	–4–	6–	–3	–9	–7–	–5	–11	6–
Plates in wear	4	1	3	7	7	5	–4	3
Total length	74+	102+	70+	152+	147+	100	216	149+
Max width	—	57	—	70	84	81	89	92
Height	—	82	—	70+	—	—	102	120
Enamel thickness	2.9	3.9	4.0	2.5	3.4	3.0	4.2	4.1
Frequency of folding	3–4	—	3–4	3–4	3–4	—	1–2	2–3
Laminar frequency	—	5.5	—	5–6	5–6	6?	4.5	3.5–4.5

	M^3			M_1	M_3		
	16455	16387	16010	16012	16009	16011	16387
No. plates	–7	8–	10	–6	10	–6	9–
Plates in wear	5	4	4	6	9	–5	—
Total length	105+	204+	177+	101+	217	103+	—
Max width	78	91	83	69	92	64	—
Height	—	—	94+	—	—	73+	—
Enamel thickness	3.8	4.0	2.8	3.2	3.6	2.8	—
Frequency of folding	—	2	3	4	2–3	2–3	—
Laminar frequency	6	4	5	6	5	6	6

Elephas recki shungurensis Beden, 1980

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16169	R md frag (M_{2-3})	LO3			
16680	M_3 and M^3 frags	KU3	16230	RM_3 frag	LO3
16679	RM^3	KU2	16233	LM^1	LO8
16678	L & R M^3 frags	KU1	14494	md frags (L & RM_3)	KK
16234	R md frag (M_{2-3})	LO2	14537	M_2 & M_3 frags	KG1
16232	LM_3 frag	LO1	14985	RP^4 frag	KG
16231	RM_1	LO3	15007	astragalus	KK

Elephas recki shungurensis dental measurements

	P^4	M^1	M^3		M_1	M_3				
	14985	16233	16679	16678	16231	14537	16169	16232	16230	16234
No. plates	–5	10	13	11–	8	–7–	–12	–5	–8	8–
Plates in wear	–4	1	5	4	6	2	—	–4	—	8
Total length	—	117	238	205+	122	—	210+	98	154+	—
Max width	60	59	81	91	58	77	—	86	75	79+
Max height	—	59	133	129	69+	82	—	—	105	103+
Enamel thickness	2.0	2.4	3.6	3.1	3.3	3.1	—	3.1	—	3.5
Frequency of folding	3–4	5	4	—	4–5	2–3	—	3	—	3–4
Laminar frequency	—	9	6	5.5	7	6	6	6	5.5	5.5

(14494: M_3: laminar frequency = 5)

Probiscidean specimen lists and measurements (continued).

Elephas recki cf. *ileretensis* Beden, 1980

Material referred

KNM-WT	Specimen	Site
14539	RM^3	KL6
17497	L & RM^3 frags	NY2

Elephas recki cf. *ileretensis* dental measurements

	M^3
	14539
No. plates	x16x
Plates in wear	11
Total length	274
Max width	88
Max height	132
Enamel thickness	3.8
Frequency of folding	3
Laminar frequency	6

Elephas recki recki Dietrich, 1915

Material referred

KNM-WT	Specimen	Site
14503	R & L md (M_{2-3})	NC1
14538	LM_2 frag	NC1
14983	LM_2 frag	NC1

Elephas recki recki dental measurements

	M_2		M_3
	14538	14503	14503
No. plates	–7–	–7	–13
Plates in wear	–6	–7	—
Max length	114+	200	·245+
Max width	65	77	142
Max height	82	—	—
Enamel thickness	2.4	2.4	
Frequency of folding	5	4–5	
Laminar frequency	6–7	6	5.5

Elephantidae indet.

Material referred

KNM-WT	Specimen	Site
16014	$dP^{2?}$	LO4
16267	$dP_{2?}$ frag	LO4

that were described by Eisenmann (1983) from horizons of equivalent age at Koobi Fora. Only one species—*Hipparion hasumense*—is recognized from the early part of the West Turkana sequence. The synonymy and diagnosis of this species, and the description of material from the early portion of the Koobi Fora sequence, are given in Eisenmann (1983).

Hipparion hasumense Eisenmann, 1983

A total of 36 specimens of this species has been recovered from sites in the Kataboi and Lomekwi members. The teeth may be distinguished from others occurring later in the succession on the bases of the molars being appreciably smaller than the premolars, of the apically tapering exostylids that are not always visible unless the tooth is at least moderately worn, and of the presence of deep vestibular grooves in the premolars.

Hooijer and Churcher (1985) recognized two species of *Hipparion* in the lower part of the Omo Shungura Formation (Members B through G)—a small form that they compare to *H. sitifense* and a larger species which they did not name. Eisenmann (1985) concurred but pointed out that the real (North African) representatives of *H. sitifense* had primitive lower teeth that are not documented from the Omo sequence. Neither set of authors referred to the previously published Koobi Fora material. Hooijer and Churcher did not provide measurements of the teeth that they discussed. Eisenmann did not provide specific identifications for the Omo teeth listed in her tables, which were measured at a height 2 cm above their bases (the measurements of the West Turkana specimens were taken at their occlusal surfaces). It seems likely that at least some of the West Turkana specimens here identified as *H. hasumense* are conspecific with *Hipparion* sp. as recognized from the Omo succession but more detailed evaluation must await the collection of more complete material.

Hipparion ethiopicum (Joleaud, 1933)

Eisenmann (1983) discussed the difficulties of interpreting the type material listed for this taxon by Joleaud (1933) and her reasons for provisionally assigning the Koobi Fora material to *Hipparion* cf. *ethiopicum.* With the possible exception of two specimens discussed in a later section, all the West Turkana hipparion teeth from strata that postdate the Kalochoro Tuff (= F) seem attributable to the same taxon. Hooijer and Churcher (1985) interpreted this form as a subspecies of *Hipparion libycum.*

Hipparion cf. *H. ethiopicum*

Figure 33

The 11 specimens attributed to this species represent the dominant hipparion in the later part of the sequence (Kalochoro through Natoo members). The teeth may be distinguished from those found lower in the succession by their elongate protocones, by the premolars being of similar size to the molars, by the small vestibular grooves, and by the ectostylids becoming visible at least shortly after wear. Whether or not this sample represents more than one species, and the appropriateness of the name adopted, must await the retrieval and study of more complete material.

Hipparion cornelianum (Van Hoepen, 1930)

WT 17524, from KS1 in the Kaitio Member, consists of portions of a male cranium including parts of both sides of the premaxilla, a right maxilla fragment with P^2, P^4, and M^1, and portions of the cranial vault. I^1 and I^2 are large teeth. I^3 is greatly reduced and set laterally to and behind I^2. I^3 is separated from the canine (the crown of the right canine is partially preserved, the left canine is represented only by a root) by a short diastema. The specimen from Koobi Fora attributed to this species by Eisenmann (1983) is immature and there is no sign of the third incisor, but the West Turkana specimen fits the diagnosis provided by Eisenmann and the cheek tooth morphology is closely comparable to the Koobi Fora specimen. A second specimen, WT 17528, a left premaxilla fragment with I^{1-2} from KS1, would, from the configuration of the incisors, appear conspecific with WT 17524.

Although the two specimens from KS1 fit the description of the premaxilla of *H. cornelianum* they also represent the only hipparion premaxillae recovered from West Turkana and conceivably belong to *H.* cf. *ethiopicum.* As Eisenmann (1985) points out, symphyses from Olduvai attributed to *H.* cf. *ethiopicum* by Hooijer (1975a) include examples with and without reduced third incisors. While it serves some purpose to refer to examples with progressive (reduced) incisors by name, additional material is needed to establish to which of several evolving hipparion lineages the specimens belong.

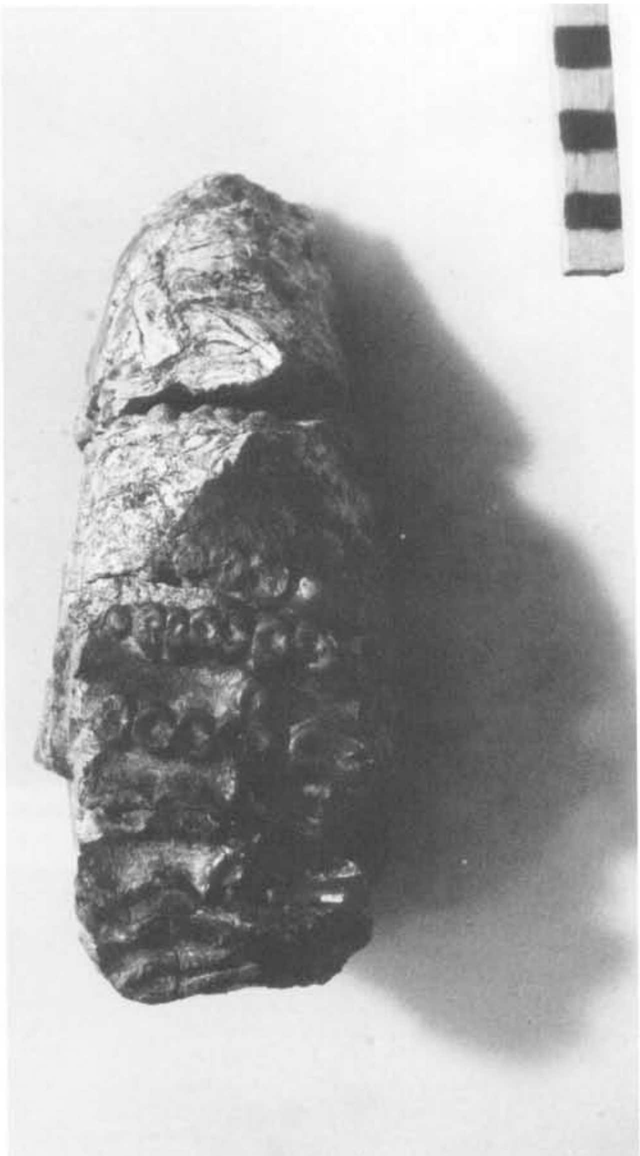


Figure 29. KNM-WT 16679, *Elephas recki shungurensis* RM^3 from the upper Lomekwi Member at KU2; occlusal view.

Equus Linn., 1758

Nearly all the *Equus* specimens recovered from West Turkana consist of isolated teeth. While these are readily distinguishable from cheek teeth of *Hipparion,* their attribution to

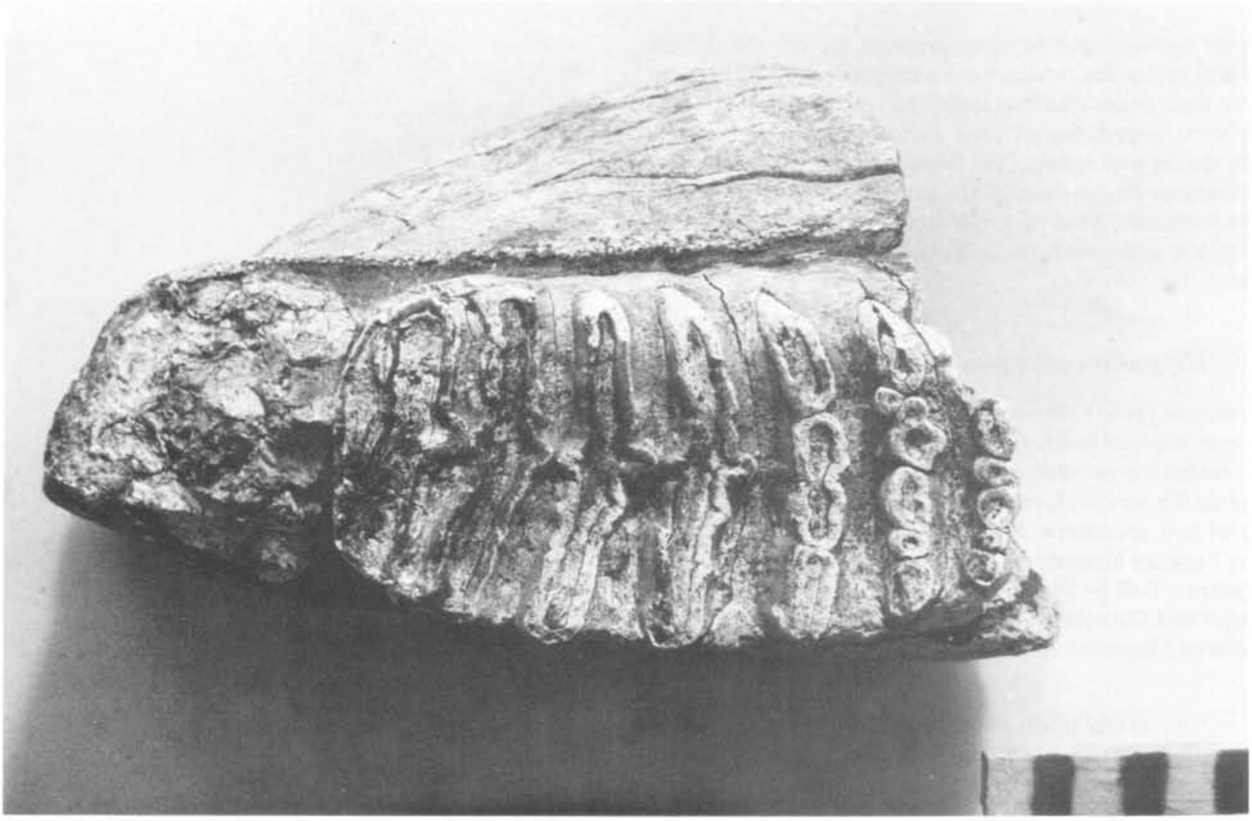


Figure 30. KNM-WT 16234, *Elephas recki shungurensis* right mandible fragment (RM_{2-3}) from the upper Lomekwi Member at LO2; occlusal view.

Figure 31. KNM-WT 14539, *Elephas recki ileretensis* RM^3 from the Kaitio Member at KL6; occlusal view.

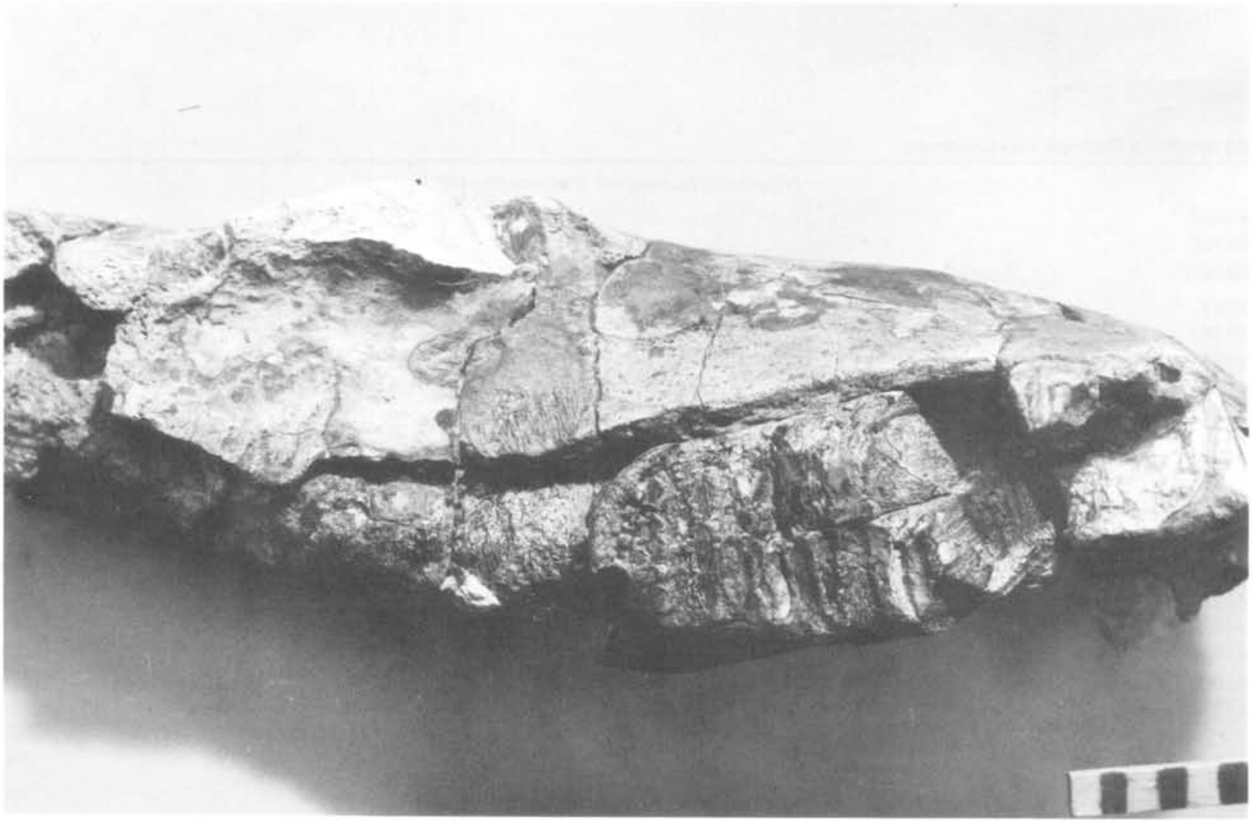


Figure 32. KNM-WT 14503A, *Elephas recki recki* right mandible fragment (M_{1-3}) from the Nariokotome Member at NC1; occlusal view.

Figure 33. KNM-WT 14545, *Hipparion* cf. *H. ethiopicum* right mandible fragment (P_4–M_3) from the Kalochoro Member at KK; occlusal view.

Hipparion hasumense Eisenmann, 1983

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16084	LM_3	LO4	16109	$LP^{3/4}$	LO5
16114	RM_3	KU2	16100	$RP^{3/4}$	LO4
16093	LM_3	LO4	16091	$LP^{3/4}$ frag	LO4
16087	RM_{1-3}	LO4	16116	LP^2	KU2
16102	$RM_{1/2}$ frag	LO2	16127	$LM^{1/2}$	LO4
16124	LM_3, $L\underline{M}$ frag	KU2	14543	$RM^{1/2}$ frag	LK2
16121	$RM_{1/2}$	NS1	16085	$RM^{1/2}$ frag, $RM_{1/2}$ frag	LO4
16101	LM_{2-3}	LO9	16098	RM^3	LO4
16086	$RM_{1/2}$	LO4	16125	RM^3	LO5
16108	LP_2	LO5	16106	$RM^{1/2}$	LO1
16105	$LP_{3/4}$	LO2	16090	$RM^{1/2}$	LO6
16126	RP_3, RP_4	LO4	16096	$RM^{1/2}$	LO4
16104	RM_2, RM_3, $LM_{1/2}$	LO5	16099	LM^{1-3}	LO10
16097	LMd frag (P_{3-4})	LO10	16089	$R\underline{M}$ frag	LO4
16107	$LP_{3/4}$	LO5	16103	$RP_{3/4}$ germ	LO5
16117	L md frag ($P_{2-3?}$)	LO10	16115	lat m/p	KU2
16092	$LP_{3/4}$	LO4	16123	R astragalus	LO5
16095	$RP^{3/4}$	LO4	16113	$RM_{1/2}$	NS1

Hipparion hasumense dental measurements

		16084	16114	16093	16101	16104	16087	16126	16108	16124
P_2	ap								31.7	
	tr								15.0	
P_3	ap							26.2		
	tr							19.4		
P_4	ap							28.3		
	tr							16.5		
M_1	ap									
	tr						14.8			
M_2	ap				24.9	25.6	22.9			
	tr				15.3	14.4	16.3			
M_3	ap	26.9	25.1	26.1+	28.5	30.3	—			24.6
	tr	11.4	11.7	13.0	12.9	14.9	14.2			12.3

		16086	16121	16102	16105	16107	16092	16103
$P_{3/4}$	ap				25.4	30.9	28.5	30.6
	tr				15.2	15.8	17.2	15.7
$M_{1/2}$	ap	22.6	25.2	—				
	tr	16.3	11.3	11.9				

		16095	16109	16100	16091	16116	16127	14543	16106
P^2	ap					31.5			
	tr					23.0			
$P^{3/4}$	ap	28.2	29.3+	32.3	30.1				
	tr	28.7	29.3	24.6					
$M^{1/2}$	ap						25.5	25.8	23.0
	tr						24.3	—	21.4

Hipparion hasumense dental measurements (continued)

		16085	16098	16125	16096	16090	16099	16124
$P^{3/4}$	ap		29.0					
	tr		22.7					
$M^{1/2}$	ap	24.6		23.9	27.0	21.9		24.0
	tr	—		19.7	23.3	17.7		
M^1	ap						26.2	
	tr						24.4	
M^2	ap						23.9	
	tr						24.8	
M^3	ap						24.6	
	tr						22.4	

Astragalus	16123
lat lt	53
med lt	59
tib tr	48
n/c tr	44
dv	38

Hipparion cf. *ethiopicum*

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16119	$LM_{1/2}$	LA1	14542	molar frags ($RP^{3/4}$, $RM^{1/2}$), RI	KL4
14544	$RM_{1/2}$	KG1	16051	$RM^{1/2}$	KL1
16110	$LM_{1/2}$ frag	LA1	16111	$LM^{1/2}$ frag	LA1
16112	$LM_{1/2}$ frag	LA1	17449	incisors	NY4
14545	R md frag (P_4–M_3)	KK	17526	$LP_{3/4}$	KS1
16120	RP^2	LA1			

Hipparion cf. *ethiopicum* dental measurements

		14545	17526	16119	14544	16120	14542	16051
P^2	ap					30.2+		
	tr					23.2		
$P^{3/4}$	ap						25.9	
	tr						25.2	
$M^{1/2}$	ap						23.1	21.0
	tr						—	18.1
P_4	ap	23.8						
	tr	15.6						
M_1	ap	24.2						
	tr	13.1						
M_2	ap	23.5						
	tr	13.2						
M_3	ap	24.2						
	tr	11.4						
$M_{3/4}$	ap		28.1					
	tr		19.0					
$M_{1/2}$	ap			20.7	22.8			
	tr			12.8	13.4			

Hipparion cornelianum (Van Hoepen, 1930)

Material referred KNM-WT	Specimen	Site
17524	male cranial frags	KS1
17528	L premax frag (I^{1-2})	KS1

Hipparion cornelianum dental measurements

		WT 17524
P^2	ap	26.9+
	tr	22.0
P^4	ap	23.9
	tr	23.5
M^1	ap	23.3
	tr	23.3

Equus sp. indet.

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
14686	L md frag (P_3–M_3)	KK	14668	RP^2 frag	NC1
14689	R md (P_3–M_3)	KL3	14688	$RP^{3/4}$	KL1
14684	R md frag (P_3–M_1)	NC1	16054	$RP^{3/4}$	KL1
16057	$LM_{1/2}$	KL1	14690	$RM^{1/2}$	KL1
14669	$LM_{1/2}$	KI1	14691	$RM^{1/2}$	KL3
16079	LM_3 & int phalanx	KL1	14694	LM^3 frag	LK3
14670	$LP_{1/2}$	KL1	14744	LP^2	NC1
14666	LM_3	NC1	14692	$\underline{M}$ frag	KK
16059	LM_2	KL1	16058	$\underline{M}$ frag	KL1
14677	LM_3	NC1	14685	$\underline{M}$ frag	NK3
14674	$RM_{1/2}$	NC1	14682	R max frag ($M^{1/2}$) & enamel frags	KK
14676	$LP_{3/4}$	KK	16078	LM^3	KL1
14665	RP_2	NC3	14675	premax frag (RI^{2-3}, LI^2)	KG1
14681	assoc $RP_{3/4}$, LM^3, $RP^{3/4}$, enamel frags	NC1	17426	LP^3–M^3, RP^2, RP^4–M^3	NY4
16094	LM^3	LA1	17454	RM^3	KL1
14679	RP^2, $RM^{1/2}$, $LP^{3/4}$, LM^3	KK	17461	$LP_{3/4}$	KL1
14673	RM^3	KG	17477	L md frag (M_{2-3})	NY2
14693	assoc LP^3, $LM^{1/2}$ & p/c elements	KL1	17499	$LP^{3/4}$	NC1

Equus sp. dental measurements

		14686	14689	14684	16079	16059	14666	14677	17477
P_2	ap	36.4	32.1						
	tr	18.2	16.6						
P_3	ap	32.2	31.8	28.7					
	tr	19.8	16.4	21.9					
P_4	ap	31.6	28.4	27.6					
	tr	18.9	14.3	21.6					
M_1	ap	27.2	29.7	24.0					
	tr	18.1	14.4	19.8					
M_2	ap	27.9	30.6			34.4		28.2	25.9+
	tr	16.8	12.3			13.7		12.2	14.7
M_3	ap	32.3			35.6		33.3		33.3
	tr	15.4			12.1		14.5		15.2

		14676	14665	16057	14670	14669	14674	14681	17460
$P_{3/4}$	ap	34.2	32.2+					29.8	28.1
	tr	18.5	14.4+					19.2	15.6
$M_{1/2}$	ap			23.5	29.0	31.0	26.0		
	tr			16.1		14.5	15.5		

Equid specimen lists and measurements (continued).

Equus sp. dental measurements (continued)

		14668	17426	17454	17499	16078	14744	14673	16094	14694
P^2	ap		40.7				40.7			
	tr		24.6				25.0			
P^3	ap		30.2		30.7					
	tr	28.3	27.4		26.6					
P^4	ap		30.2							
	tr		28.4							
M^1	ap		25.9							
	tr		25.8							
M^2	ap		27.4							
	tr		27.0							
M^3	ap		26.7	27.1		23.0		26.0	26.5	26.1
	tr		23.3	22.4		20.5		28.4	22.8	22.8
		14682	16054	14688	14679	14681	14690	14691	14693	
P^2	ap				40.7					
	tr				28.0					
$P^{3/4}$	ap	29.2	31.9	27.4	29.7	29.7	24.8			
	tr	—	—	25.9	31.1	—	25.4			
$M^{1/2}$	ap	23.1			23.2	25.8		23.9	26.3	
	tr	—			—	25.4		23.8	26.8	
M^3	ap				29.6					
	tr				28.4					

Equidae indet.

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16088	dist R radius	LO8	14671	R dist tibia	KL3
14683	dist R radius	KL1	14687	dist L tibia	KK
16048	terminal phalanx	KL1	17453	cranial frag	KL1
14678	proximal phalanx	NN	17459	radius frags	KL1

species of *Equus* that have been previously recognized from elsewhere in the Lake Turkana Basin is a task which will be deferred until more complete material is available for study.

Equus species indeterminate

Figure 34

The 36 *Equus* specimens from the Kalochoro, Kaitio, Natoo, and Nariokotome members appear to represent only a single species, though which one is open to question. The common *Equus* species from Koobi Fora was *E. koobiforensis* according to Eisenmann (1983), but the relationship of the latter to *E. olduwayensis* has yet to be clarified. Hooijer and Churcher (1985) attributed all the *Equus* specimens from the Omo succession to *E. oldowayensis.* Eisenmann (1985), wary of the great variation in size and proportions of postcranial material referred to the latter taxon, instead identified *Equus numidicus* and *E. stenonis vireti* from Shungura Member G and Grevy's zebra (*E. grevyi*) from the upper part of Member L. Unfortunately neither Eisenmann nor Hooijer and Churcher attempted comparisons of the Omo material with that from Koobi Fora.

Equidae Indeterminate

In addition to the specimens described above there are a number of postcranial elements that have not at present been identified to genus.

Family Rhinocerotidae

The two extant genera of African rhinos are represented in the West Turkana sequence. Of the two, the remains of *Diceros* are less common and are indistinguishable from representatives of the extant species.

Diceros Gray, 1821

Diceros bicornis (Linn., 1758)

The extant black rhinoceros is a conservative species that appeared as long ago as 3.5 Ma in the Upper Laetolil Beds

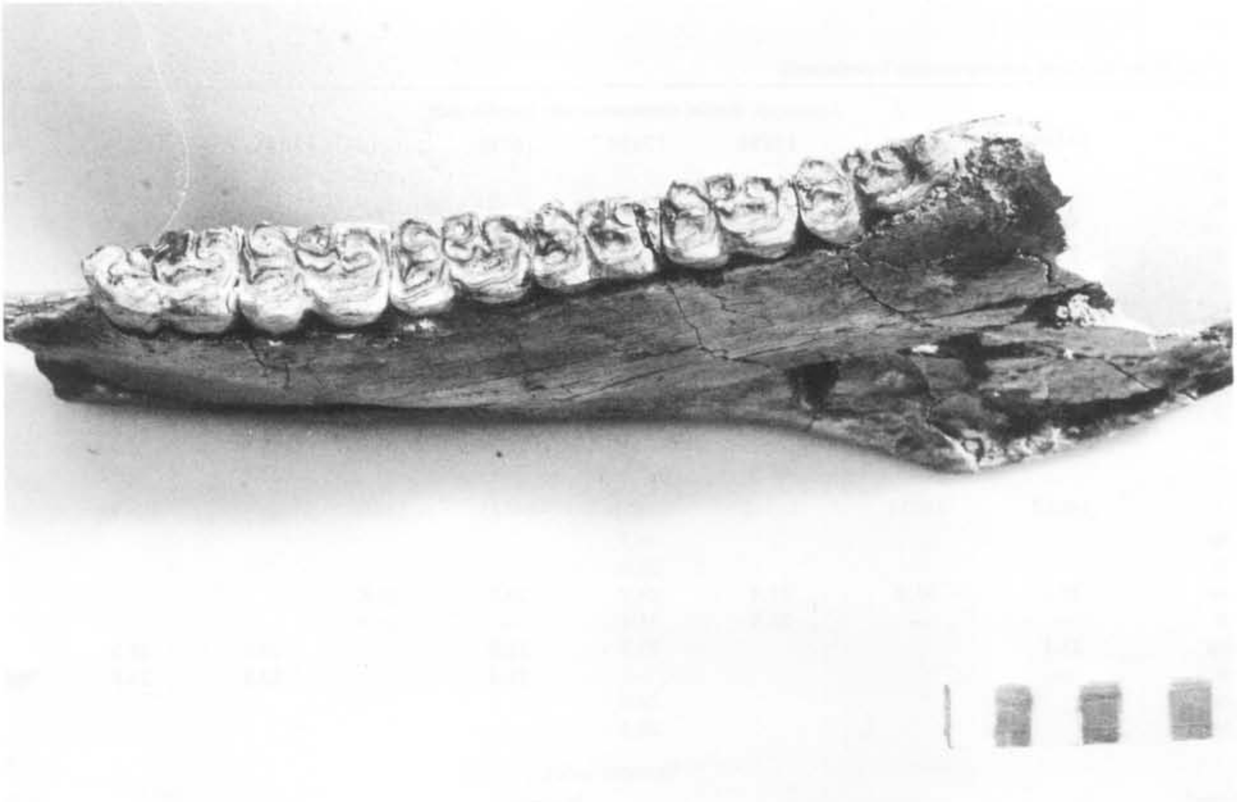


Figure 34. KNM-WT 14686, *Equus* sp. indet. left mandible fragment (P_2–M_3) from the Kalochoro Member at KK; occlusal view.

(Guerin, 1987). *Diceros bicornis* has been retrieved only from the upper Burgi and KBS members of the Koobi Fora Formation (Harris, 1983:139) but in the Shungura succession is represented in the Mursi and Usno formations and in all members of the Shungura Formation except Member E (Guerin, 1985; Hooijer and Churcher, 1985).

The black rhino is represented at West Turkana in the Lomekwi, Kaitio, and Nariokotome members. The 10 specimens include the occipital region of a cranium (WT 16731) from LO3, the proximal portion of a third metacarpal (WT 14501) from NC2, and eight other isolated teeth or partial dentitions. The occiput has a width of 205 mm at the mastoid processes. The width of the occipital condyles is 120 mm and the height of the nuchal crest above the basioccipital is 199 mm. The proximal articulation of the third metacarpal is 56 mm wide.

Ceratotherium Gray, 1867

Ceratotherium simum (Burchell, 1817)

Two species of *Ceratotherium* occur in the Pliocene and Pleistocene assemblages from the Lake Turkana Basin. *Ceratotherium praecox* Hooijer & Patterson, 1972, was founded on material from Lothagam and Kanapoi to the southwest of Lake Turkana and has been subsequently recognized in strata older than 3 Ma at Langebaanweg in South Africa (Hooijer, 1972), at Hadar in Ethiopia (Guerin, 1985), at Koobi Fora (Harris, 1983:131–132) and in the Tugen Hills sequence (Hill et al., 1985) in Kenya, and Laetoli in Tanzania (Guerin, 1987). *Ceratotherium praecox* was replaced by an extinct subspecies of the extant white rhino—*C. simum germanoafricanum*—at about 3 Ma and the latter in turn gave rise to *C. simum simum* at about 2 Ma (Guerin, 1985). In the Omo succession, *C. praecox* is recognized only from the Mursi Formation (Hooijer and Churcher, 1985) while *C. simum* was the common rhino throughout the Shungura sequence.

The upper teeth of specimens of this genus are relatively more hypsodont than those of *Diceros,* are more elongate anteroposteriorly and proportionately less wide, have more obliquely placed lophs, sinuous ectolophs, and have medifossettes formed by the union of crotchet and crista. The lower teeth of *Ceratotherium* tend to be taller than those of *Diceros* (the mandibular ramus is correspondingly deeper to accommodate them), and have lophids that, at least in little worn specimens, are more obliquely aligned. The cranium of *Ceratotherium* is more elongate, larger, and the occiput

Rhinocerotid specimen lists and measurements.

Diceros bicornis (Linn., 1758)

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16727	RM^2, RM^3	LO10	14498	R md frag (RP_{2-4}, RM_3)	LK4
16728	LM^3	LO4	16732	lower teeth (RP_{3-4}, RM_3, LM_1)	LO5
16725	LP^3	LO5	16731	occiput	LO3
16726	LP^4	LO3	16730	lower teeth frags (RM_1, RM_2)	LO10
16729	RP^2 frag	LO10	14501	prox L mc III	NC2

Diceros bicornis dental measurements

		16729	16727	16728	16725	16726			14498	16730	16732
P^2	ap ext	33.1					P_2	ap	27.9		
	met	32.7						prot	17.7		
P^3	ap ext				40.5			hyp	21.3		
	ap int				40.0		P_3	ap	40.2		44.9
	prot				59.1			prot	24.7		29.3
	met				49.6			hyp	30.0		31.7
P^4	ap ext					44.4	P_4	ap	44.2		45.0
	ap int					39.8		prot	30.0		25.8
	prot					57.2		hyp	34.9		27.5
	met					53.0	M_1	ap			50.2
M^2	ap ext		61.1					prot			28.5
	ap int		53.4					hyp			31.2
	prot		69.9				M_3	ap	49.8	55.0	53.0
	met		56.5					prot	33.4	37.3	31.8
M^3	ap ext		61.5	66.5				hyp	30.0		28.5
	ap int		62.8	66.1							
	tr		51.1	60.4							

Ceratotherium simum (Burchell, 1817)

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16734	cranial frags (LP^4–M^3)	LO3	16548	LP^4	LO5
17169	md (LP_2–M_3, RP_3–M_3)	LO3	16709	RM^1 frag	LO3
16585	R md frags (P_2–M_2)	LO4	16716	RdP^2 frag	LO4
14502	R md (P_3–M_3)	LK4	16715	$\underline{M}$ frags	LO4
16718	R max frag (M^{2-3})	LO10	16547	LM_1 frag	LO4
16720	juv maxilla (RdP^3–M^1)	LO3	16546	RP frag	LO4
16586	associated teeth (R & L P^4–M^2)	LO5	16549	RP_2	LO3
16596	L md frags (M_{1-3})	LO3	16597	RdP_{2-4} frags	LO4
14496	L md frags (dP_{2-4})	KL6	17464	RM^1	NY3
14495	L astragalus	KL6	17503	RM_3	NC1
14500	prox R int III	KI1	17512	LP^3 frag	KS1
16717	LP^3	LO4	17513	cranial frags	NY3

Ceratotherium simum dental measurements

		16586	16718	16720	16734	16717	16548	17464
dP^3	ap ext			40.2				
	ap int			36.8				
	prot			46.2				
	met			45.9				
dP^4	ap ext			45.2				
	ap int			43.9				
	prot			53.2				
	met			51.6				
P^3	ap ext					44.4		
	ap int					34.4		
	prot					43.5		
	met					39.7+		
P^4	ap ext	45.9					52.0	
	ap int	34.5					43.8	
	prot	44.3					52.6	
	met	35.1					47.7	
M^1	ap ext	53.1		58.8				65.5
	ap int	48.8		41.7				55.8
	prot	43.4		44.1				54.1
	met	45.8		35.1				36.6
M^2	ap ext	55.5			54.9			
	ap int	61.3			51.7			
	prot	50.3	64.1		67.2			
	met	56.8	53.2		58.2			
M^3	ap ext		71.1		72.0			
	ap int		56.4		57.4			
	tr		54.6		47.3			

		14502	16596	17169	16585	14496	16547	16549	16597
dP_1	ap			20.8					
	tr			11.5					
dP_2	ap					32.9			
	prot					17.6			
	hyp					19.5			
dP_3	ap					41.6			
	prot					21.8			
	hyp					23.3			33.7
dP_4	ap			45.0		45.3			55.1
	prot			32.6		24.5			33.1
	hyp			31.7		24.2			35.8
P_2	ap			34.3				27.1	
	prot			21.3				20.0	
	hyp			19.4				19.5	
P_3	ap	37.6		40.0					
	prot	28.5		24.6					
	hyp	26.5		25.2					
P_4	ap	48.8		45.3					
	prot	28.9		25.7					
	hyp	27.4		29.1					
M_1	ap	41.4	41.5	46.1	41.6		—		
	prot	29.4	31.2	27.7	27.8		28.6		
	hyp	26.9	—	29.3	28.6		—		
M_2	ap	49.7	50.3	55.9					
	prot	30.2	—	27.0					
	hyp	32.0	34.2	26.1					
M_3	ap	59.8							
	prot	28.0+							

Ceratotherium postcranial measurements

Prox MT III	14500	Astragalus	14495
prox ap	46	lat lt	96
prox tr	55	med lt	100
		tib tr	103
		n/c tr	100
		dv	72

slopes backwards and upwards from the occipital condyles rather than being vertically oriented as in *Diceros.*

Twenty-four specimens of *Ceratotherium simum* have been recovered from 10 sites west of Lake Turkana; 16 are from the Lomekwi Member, seven from the Kaitio Member, and one from the Nariokotome Member.

Rhinocerotidae Indeterminate

Several incomplete upper premolars are too fragmentary for identification to genus. These include WT 14497 from LK1, 16509 from LO4, and 14499 from NC1.

It is interesting that the 37 rhino specimens were recovered from only 12 sites. Only two specimens were from sites (KI1, LK1) in the eastern edge of the region and only one specimen was from a site (KS1) which associated faunal evidence suggests was close to a major body of water. Fossil representatives of the two rhino genera thus appear to have shared a similar habitat preference.

Order Artiodactyla

Family Suidae

Notochoerus Broom, 1925

Notochoerus teeth are common from the lower and middle portions of the West Turkana succession. Two species are present—*N. euilus* in the lower portion and *N. scotti* in the middle. They are not always easy to distinguish on the basis of incomplete tooth fragments but *N. euilus* has only four major pairs of pillars in the upper and lower third molars whereas *N. scotti* has five or more. *Notochoerus scotti* teeth also tend to be larger, wider, and taller. It seems probable that *N. scotti* was derived from *N. euilus* but a few teeth with identical morphology to that of *N. euilus,* although rather smaller in size, are documented from the middle part of the Shungura succession (Harris and White, 1979). This morph has not so far been recognized at West Turkana sites.

Notochoerus euilus (Hopwood, 1926)

This was the most common East African suid species during the interval 3–3.5 Ma. Diagnosis, description, and comparative measurements for specimens from various East African localities appear in Harris and White (1979) and a detailed description of Koobi Fora material in Harris (1983:222–228).

A total of 61 specimens of *N. euilus* have been recovered from six West Turkana sites, three in the upper Kataboi Member, two in the lower Lomekwi Member, and one in the middle Lomekwi Member. The most complete specimen is a partial cranium (WT 16647) from LO4 but the zygomatic arches are incomplete and it is not evident whether these originally bore the knob-like protuberances that characterize male specimens of this species. A second, originally more complete skull from the same locality was observed in 1981 but had been broken up into small pieces, presumably by local people or their domestic animals, before collecting began in 1984. Most of the remaining specimens comprise jaw fragments and isolated (partial) teeth that are comparable in size and morphology to material from other sites of similar age.

Notochoerus scotti (Leakey, 1943)

Originally identified on the basis of specimens from the Omo Shungura Formation, this species is the common notochoere in the Lake Turkana Basin during the interval 2–3 Ma. A synonymy, diagnosis, and comprehensive description of material from known localities is provided in Harris and White (1979) and a detailed description of Koobi Fora specimens in Harris (1983:228–233).

Notochoerus scotti is the common suid in the upper part of the Lomekwi Member (24 specimens), and persists to the Kalochoro (11 specimens) and Kaitio members (two specimens). Five specimens have been recovered from LO9 in the upper part of the lower Lomekwi Member, and single specimens are known also from somewhat older horizons in LO10 and LO5 where they co-occur with the more common *N. euilus.* Three specimens from the upper part of the Lomekwi Member, WT 16253 (LM_3 fragment from LO2), 16278 (LM_3 fragment from LO1), and 16259 (left mandible fragments with P_4–M_3 from KU2), seem definitely to be *N. scotti* rather than *N. euilus* but appear smaller and appreciably more gracile than other representatives of the more progressive species.

Metridiochoerus Hopwood, 1926

This genus, from which the extant warthog is descended, made its initial appearance in Africa about 3 Ma. Four species of *Metridiochoerus* are present in the West Turkana sequence.

Metridiochoerus andrewsi occurs in the lower and middle part of the sequence, *M. compactus* in the upper part, and *M. modestus* and *M. hopwoodi* in the middle and upper portions. The genus is common only in the upper part of the succession.

Metridiochoerus andrewsi Hopwood, 1926

This is the common metridiochoere species at East African localities dated between 3 and 1.5 Ma and provided the stock from which the other recognized species derived. The crania are strongly sexually dimorphic with male specimens being larger and possessing large and protuberant zygomatic knobs. Representatives of the species exhibit a progressive increase in size, and in height and complexity of the third molar, through time. For synonymy, diagnosis, description, and measurements of specimens from various African localities see Harris and White (1979).

Twenty specimens assigned to *Metridiochoerus andrewsi* have been recovered from 14 localities in the Lomekwi, Lokalalei, Kalochoro, and Kaitio members, the species thus having a comparable temporal distribution to specimens of this species from Omo and Koobi Fora. Most of the specimens comprise isolated teeth, the third molars displaying an increase in size and height upwards through the succession. Two crania have been collected. WT 16595 from KU1 is not fully mature; the upper second molars are in wear but the third molars are still erupting. Its right zygomatic arch is sufficiently well preserved to retain the zygomatic knob typical of males of the species. Perhaps because of its relative immaturity, but probably because of its greater geologic age, the KU2 cranium does not show the great lateral expansion of the palate in the vicinity of the canine alveoli that is a distinctive feature of cranium WT 14743 from KL3. The KU2 skull has suffered some dorsoventral compression but was originally proportionately less elongate and less elevated in the cranial vault than the later specimen. The cranial vault between the orbits is concave in the earlier skull but flatter and broader in the later.

Metridiochoerus hopwoodi (Leakey, 1958)

Representatives of this species are of similar size to the more progressive examples of *M. andrewsi* but are distinguished by their narrower molars and by the symmetry of the molar crown elements (particularly in the lower molars). For synonymy, diagnosis, description, and measurements of specimens from various East African localities see Harris and White (1979).

The West Turkana sample of *Metridiochoerus hopwoodi* consists of four isolated lower third molars from the Kaitio Member and an upper canine from the Nariokotome Member. The four third molars attributed to this species are larger and proportionately longer and narrower than specimens assigned to *M. andrewsi,* and have pillars that are arranged symmetrically throughout the length of the tooth. The left upper canine, WT 17052 from NC2, is not that of *M. compactus,* is too large to belong to *M. modestus,* and was collected from a horizon that postdates the last known occurrence of *M. andrewsi.*

Metridiochoerus modestus (Van Hoepen & Van Hoepen, 1932)

The teeth of this species are as small as, or smaller than, the earliest representatives of *M. andrewsi* but have not been recorded from horizons predating Shungura Member G. The teeth retain a typical metridiochoere crown morphology although it seems likely that this species, or one very similar to it, gave rise to the earliest representatives of the genus *Phacochoerus.* For synonymy, diagnosis, description, and measurements of specimens from various East African localities see Harris and White (1979).

As elsewhere, this small species is rare at West Turkana and specimens are restricted to horizons younger than 2 Ma. The six specimens from West Turkana are from NY2 and NY3 in the Kaitio Member and NC1 in the Nariokotome Member.

Metridiochoerus compactus (Van Hoepen & Van Hoepen, 1932)

This is the largest and most derived species of the genus. It makes its initial appearance about 1.6 Ma and persists thereafter as one of the two common suids of the early and middle Pleistocene of Africa. Its third molars are extremely hypsodont and the canines are very distinctive. The very large upper canine, which has a core of cellular osteodentine, extends laterally from its alveolus while the massive lower canine rises forward and upward. For synonymy, diagnosis, description, and measurements of representatives from various African localities see Harris and White (1979).

Metridiochoerus compactus is the commonest suid in the upper portion of the West Turkana sequence. Thirty-four specimens have been recovered from two sites in the Kaitio Member, five sites in the Natoo Member, and two sites in the Nariokotome Member. The one partial cranium, WT 16168 from KL1, has canine alveoli that illustrate the characteristic lateral alignment of the upper tusks and one lower tusk has been recovered from NY2. Most of the material comprises isolated teeth or tooth fragments that display the characteristic crown pattern and distinctive hypsodonty of this species.

Kolpochoerus Van Hoepen & Van Hoepen, 1932

Although the name *Mesochoerus* was formerly in widespread use, *Kolpochoerus* is the correct generic name for this suid genus that, together with *Metridiochoerus,* migrated into Africa during the late Pliocene and thereafter became a prominent constituent of African early and middle Pleistocene assemblages. In their revision of the Plio-Pleistocene African Suidae, Harris and White (1979) recognized only two kolpochoere species—*K. limnetes,* the common form that presumably also provided the ancestral stock for the extant giant forest hog (*Hylochoerus*), and the bush pig-like *K. majus.* Although isolated teeth of what other authors recognize as *K. afarensis, K. limnetes, K. olduvaiensis,* and *K. paiciae* could be construed as part of a single evolving lineage, it is probable that Harris and White's (1979) interpretation represents an oversimplification of the phylogeny. However, in the absence of adequately complete cranial material, we have not attempted to subdivide the "*Kolpochoerus limnetes*" material from West Turkana.

Kolpochoerus limnetes (Hopwood, 1926)

Kolpochoeres are represented throughout all but the very lowest part (Lonyumun Member) of the West Turkana sequence but are usually less abundant than *Notochoerus* specimens in the lower and middle part of the sequence and than *M. compactus* in the upper portion. The West Turkana sample comprises a total of 51 specimens from 18 sites, the greatest quantity of specimens coming from the upper Lomekwi, Kalochoro, and Natoo members. The third molars show a progressive increase in size, length, and complexity through the succession but it is probable that those specimens from the Kaitio and superjacent members represent the derived East African species *K. olduvaiensis.*

Kolpochoerus majus (Hopwood, 1934)

Although this species was formerly referred to the bush pig genus *Potamochoerus,* Harris and White (1979) drew attention to its greater similarity to *Kolpochoerus* representatives. The small *K. majus* has hitherto been known only from localities with strata of early and middle Pleistocene age when the contrast in size between representatives of this species and those of *K.* "*limnetes*" was readily apparent. A left lower third molar from KU2 in the upper Lomekwi Member is here identified as *K. majus* and, if this interpretation is correct, represents the earliest known specimen of this taxon. The tooth from KU2 is appreciably smaller than other *Kolpochoerus* specimens from this locality but is larger than bush pig third molars from earlier in the succession.

Kolpochoerus majus is known from two other specimens, an adult mandible (WT 14533) and a juvenile mandible (WT 14957), both from NC2 in the Nariokotome Member. The mandibles show typical kolpochoere inflation of the ramus lateral to M_{1-2} and have their greatest constriction between the canine and the anterior premolar.

Nyanzachoerus Leakey, 1958

This genus, with large premolars and simple brachyodont molars, was present in East Africa during all but the latest portion of the Pliocene. Of the three recognized species, the small *N. tulotus* seems restricted to the early part of the Pliocene while the larger *N. kanamensis* was present for much of the remainder of the epoch, perhaps giving rise to the short-lived *N. jaegeri* which in turn might have been ancestral to *Notochoerus euilus.* Only one species, *N. kanamensis,* is here recognized from the succession west of Lake Turkana.

Nyanzachoerus kanamensis Leakey, 1958

This species is known from a handful of specimens from the Kataboi and lower Lomekwi members. There is some variation in tooth size but most of the specimens are incomplete and the sample is insufficient to gauge if more than one species is represented.

Potamochoerus Gray, 1854

Potamochoerus sp.

Small, simple bunodont teeth similar to those of the extant bush pig have been recovered from a number of Pliocene and Pleistocene localities in eastern Africa. Many of these were attributed to the extant bush pig species (*P. porcus*) by Harris and White (1979) but Cooke (1978) identified those from Hadar as an early, primitive species of *Kolpochoerus* (*K. afarensis*), in part because of the kolpochoere-like alignment of the zygomatic arches of a male cranium from that site.

Three specimens of small potamochoere teeth have been retrieved from LO4 in the lower part of the Lomekwi Member and one specimen has been collected from LK4 in the Kaitio Member. The modern bush pig is known from the Galana Boi sediments cropping out at NK4.

Suidae genus and species indeterminate

There are a dozen or so specimens, mainly deciduous dentitions or tusks, that cannot presently be assigned with certainty to genus or species.

Family Hippopotamidae

Hippos are frequently among the most common fossils at Plio-Pleistocene localities in eastern Africa but are often disregarded by collecting parties, in part because of their large size (with ensuing difficulties of transportation and storage) and in part because of long-standing problems of diagnosis and identification of representatives of this family. Existing diagnoses rely heavily on arrangements of elements (particularly the lacrimal bone) of the facial region of the cranium and on the number and arrangement of incisors on the premaxilla and mandibular symphysis, whereas it is the upper and lower cheek teeth that are most commonly encountered in the field. Nevertheless, a relatively straightforward record seems to be emerging from the West Turkana sequence. Low in the succession there is a large and hypsodont form which appears to be closely related to *Hippopotamus kaisensis.* This is replaced by a smaller and more brachyodont form—*Hexaprotodon protamphibius* which persists to the Kalochoro Member. Higher in the sequence are found representatives of *Hexaprotodon karumensis, Hippopotamus gorgops,* and

Notochoerus euilus (Hopwood, 1926)

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16647	partial cranium (LM$^{1-3}$, RM$^{2-3}$)	LO4	16494	md frags (LP$_3$–M$_3$, RM$_{2-3}$)	LO4
16361	L md frag (M$_2$)	LO5	16440	LM^3 frag	LO4
16370	R md frag (M$_3$)	LO5	16432	L md frag (M$_3$)	LO4
16357	L md frag (M$_3$)	LO5	16445	R md frag (M$_2$)	LO4
16364	LM$_3$ frag	LO5	16441	M^3 frag	LO4
16367	L md frag (M$_{2-3}$), RM$_3$ frag	LO5	16491	LM^3	LO4
16359	?R M$_2$ frag	LO5	16448	LP^4, LM^3 frag	LO4
16356	RM$_3$ frag	LO5	16431	R & L M^3 frags	LO4
16284	RM$_3$ frags	LO5	16439	L & R M^3 frags	LO4
16283	L md frag (M$_3$)	LO5	16489	L md frag (M$_3$)	LO4
16369	RM$_3$	LO5	14532	LM^3	LK1
16362	RM$_3$ frag	LO5	16493	R max frag (M^3)	LO4
16360	L md frag (P$_4$–M$_1$)	LO5	16449	RM^3, LM^3 frag	LO4
16368	LM^3	LO5	16492	LM^3 frag	LO4
16366	LM^3 frag	LO5	14530	M$_3$ frag	LK1
16286	R max frag (P^4–M^1)	LO5	16434	RM$_3$ frags	LO5
16285	LM^3 frag	LO5	16446	M frags	LO4
16365	R max frag (M^3)	LO5	16436	M$_3$ frags	LO4
16355	LM^3 frag	LO5	16435	M frags	LO4
16358	LM^3 frag	LO5	16442	RM$_3$ frags	LO4
14519	L md frag (P$_3$–M$_3$)	LK1	16438	RM^2 frag	LO4
14527	R $\underline{C}$ frag	LK1	16194	M frags	NS1
14529	$\underline{C}$ frags	LK1	16443	$\underline{M}$ frag	LO4
14526	LP$_{2-3}$	LK1	16437	L M$_2$ frags	LO4
16444	RM$_3$ frag	LO4	16190	LM$_2$	LO10
16428	LM$_3$ frag	LO4	16191	LM$_1$	LO10
16490	RM$_3$, LM$_3$ frag	LO4	16192	LP^4	LO10
16450	R md frag (M$_3$)	LO4	16199	LP^4, LM^1, RM^1	LO6
16487	R md frag (M$_{1-3}$)	LO4	16429	RM^2	LO4
16488	R md frag (M$_3$)	LO4	16447	L md frag (M$_{1-2}$)	LO4
16430	RM$_3$ frag	LO4			

Notochoerus euilus dental measurements

		16192	16199	16429	14532	16449	16448	16441	16268			16368	16647
P^4	ap	13.3	13.9				14.8		14.0				
	tr	14.4	15.2				16.8		15.1				
M^1	ap		27.2										
	tr		21.4										
M^2	ap			28.9						M^2	ap		28.5
	tr			22.5							tr		25.6
M^3	ap				71.7	83.4		—		M^3	ap	65.9	80.2
	tr				30.7+	28.6+		39.1			tr	26.2	36.8

		14526	14519	16191	16437	16445	16494	16490	16488
P$_2$	ap	18.0							
	tr	10.1							
P$_3$	ap	20.0	20.5						
	tr	12.3	13.7						
P$_4$	ap		18.5						
	tr		15.5						
M$_1$	ap		21.8	31.2					
	tr		15.2	20.6					
M$_2$	ap		33.1		—	29.7			
	tr		22.5		23.9	19.9			
M$_3$	ap		84.5				85.1	80.5	—
	tr		31.7				25.0	26.6	24.6

Notochoerus euilus dental measurements (continued)

		16487	16450	16491	16360	16369	16356	16361	16370	16367	14689	16447
M_1	ap				22.1							22.0
	tr				14.4							14.0
M_2	ap	28.5										—
	tr	20.3+										15.9
M_3	ap	—	72.6	75.2		71.6	—	72.5*	82.3	—	—	
	tr	25.6	24.7+	—		26.5	25.2	—	25.1	25.4	30.9	

Notochoerus scotti (Leakey, 1943)

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16257	RM_3 frags	KU2	16210	RM_3 frag	KU3
16260	LM_3 frag	KU2	16202	LM_3 frag	KU1
16256	juv md frags with R & L M_1 & RM_2	KU2	16258	R & L M^3 frags	KU1
16363	RM^3	LO5	16187	R md frags (M_{2-3})	KU1
16203	RM^2	LO9	16198	RM_3 frag	LA1
16204	L md frag (M_3)	LO9	16188	R max frag (M^3)	KU1
16201	LM^3 frag	LO10	16195	RM^2, RM^3 frags	KU1
16209	LM_3 frag	LO9	16189	RM^2 frag	KU1
16206	RM^2 frag	LO9	16255	RM_3 frag	KU2
16207	RM_3 frag	LO9	16200	RM_3 frags	LA1
16211	M_3 frags	LO1	16197	LM^3 frag	LA1
16214	RM_3 frag	LO3	14871	R & L md frags (M_3)	KK
16212	RM_3 frag	LO1	16259	L md frags (P_4–M_3)	KU2
16213	RM_3 frag	LO1	14872	LM^3	KG
16193	L md frag (M_{1-3})	LO3	14877	RM_3 frag	KG
16254	RM_3 frag	LO3	14875	LM^3 frag	KG1
16251	LM_3 frag	LO1	14876	RP^4, RM^3 frags	KG
16253	LM_3 frag	LO2	14873	P_4, M_3 frags	KG1
16278	LM_3 frag	LO1	14874	RM^1, M^2 frag	KG1
16186	R md frag (M_3)	KU2	17517	L md frag (M_3)	KS1
16196	L md frags (M_3)	LO3	17518	M^3 frag	KS1
16208	LM^3	KU2			

Notochoerus scotti dental measurements

		16259	14871	16193	16256
P_4	ap	14.7			
	tr	11.7			
M_1	ap	—		21.9+	
	tr	12.1		14.3+	
M_2	ap	23.4		27.0	30.8
	tr	16.2		21.3	17.5
M_3	ap	76.5+	80.5	95.0	
	tr	—	26.4	22.8+	

		16203	16363	16208	16195	14872	14876	14874
P^4	ap						15.0	
	tr						14.1	
M^1	ap				18.4+			23.5
	tr				24.3			20.7+
M^2	ap	34.0						
	tr	24.3						
M^3	ap		95.0	93.4	—	99.7	104.3+	
	tr		36.3	32.4	28.7	29.2		

Metridiochoerus andrewsi Hopwood, 1926

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16282	R md frag (P_4–M_3)	LO4	14743	cranium (LM^3, RP^4–M^3)	KL3
16281	RM_3 frag	LO4	14652	md (R & L M_{2-3})	KL3
16205	M_3 frag	LO9	14541	cranial frags (L & R M^3)	KL6
16595	cranium with R & L P^3–M^3	KU1	17450	R md frag (P_4–M_3)	NY4
16276	md frags (RM_2, LM_3)	KU2	17452	LM_3 frags	NY3
16279	LM_3 frag	LO8	17485	LC	NY2
16273	$LP_{3/4}$	LO3	17496	LM_3 frag	NY2
14646	LM_3 frag	KK	17525	LM^3	KS1
16280	LM_3 frag	LA1	17527	RC	KS1
16275	LM_3 frags	LA1	17529	RC	KS1

Metridiochoerus andrewsi cranial measurements

	16595 (M)	14743 (M?)	14541 (F?)
Max preserved length skull	385+	590+	
Width palate at canines	138(e)	207	
Width palate between M^3	40	56	
Width cranium at M^3	79	106	
Bizygomatic breadth (posterior)	175		
Bizygomatic breadth (anterior)	204		
Width at post orbits	127	183	
Width occipital condyles	63	—	81
Ht occiput above for magnum	97	165	145
Width nuchal crest	106(e)	155	154

Metridiochoerus andrewsi dental measurements

		16596	14743	14541			16282	16281	16276	16273	14646	14652	17450
P^3	ap	10.9				ap				15.4			
	tr	10.5				tr				9.6			
P^4	ap	12.7	14.0		P_4	ap	12.3						13.5
	tr	13.6	15.9			tr	9.9+						10.7
M^1	ap	19.2	19.2		M_1	ap	16.1		18.0*				18.2
	tr	18.4	18.4			tr	13.7		—				—
M^2	ap	23.0	19.1	22.9	M_2	ap	19.4		23.7			26.1	27.2
	tr	23.7	21.0	22.8		tr	18.2		—			19.3	19.6
M^3	ap	44.6	56.7	63.5	M_3		42.8	—	52.3		—	61.7	58.0
	tr	—	23.4	25.7			20.8	21.3	19.4		19.3	21.7	18.4+

Metridiochoerus hopwoodi (Leakey, 1958)

Material referred KNM-WT	Specimen	Site
16465	LM_3	KL3
14638	RM_3	KL4
14649	RM_3 frag	LK4
14635	RM_3	LK4
17502	L $\underline{C}$	NC2

Metridiochoerus hopwoodi dental measurements

		14635	14638
M_3	ap	68.0+	67.4+
	tr	17.2	20.6
	ht	51.6	47.5

Metriodiochoerus modestus (Van Hoepen & Van Hoepen, 1932)

Material referred

KNM-WT	Specimen	Site
14640	R max frag (M^3)	NC1
14641	RM^3	NC1
14639	L md frag (M_3)	NC1
17446	R max frag (M^3)	NY3
17429	L md (dP_2–M_1)	NY2
17433	L md (M_3) & R md (M_{2-3})	NY3

Metridiochoerus modestus dental measurements

		17429	17433	14639			14640	14641	17446
dP_3	ap	10.3							
	tr	5.2							
dP_4	ap	23.3							
	tr	11.8*							
M_1	ap	24.9							
	tr	—							
M_2	ap		18.4						
	tr		12.7						
M_3	ap		47.8	50.9	M^3	ap	34.8+	41.8	40.7
	tr		13.7	12.1		tr	15.7	12.4	117.7
	ht			49.4		ht		36.5	

Metridiochoerus compactus (Van Hoepen & Van Hoepen, 1932)

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
14914	RM_2	LK3	14903	RM_3 frag	NC1
14918	M_3 frag	LK3	14911	RM_2	KL1
14896	M^3 frag	LK3	16071	L md frag (M_3)	KL1
14904	M_3 frags	KL1	16070	R & L md frags (M_3)	KL1
14902	LM_3 frag	LK3	14912	L max frag (M^2)	KL1
14910	M_3 frags	KL2	16053	LM^3	KL1
14897	LM_3 frag	KL2	16049	RM^2	KL1
14637	LM^1	KL6	16065	$\underline{C}$ frags	KL1
14916	LM_3 frag	NK2	16168	partial cranium (LP^4–M^3, RM^{1-3})	KL1
14647	R md frag (M_1)	NY	14905	L md frag (M_3)	NC1
14909	RdP_4	NC2	14907	RM_3 frag	NC2
14648	L md frag (M_{1-2})	KL6	14906	LM_3 frag	NC1
14913	RM_3 frag	KL5	14915	R md frag (M_3)	NC1
14908	LM_2	KL1	17448	M^3 frag	KL1
14901	LM_3 frag	KL1	17487	L C	NY2
14899	L max frag (dP^4)	KL1	17507	R md frag (M_3)	NC1
14898	RM_3 frag	KL1	17509	LM^3 frag	NC1

Metridiochoerus compactus dental measurements

		16168	16053	16049	14912	14637	17059	14889
dP^4	ap							19.5
	tr							14.7
P^4	ap	8.7						
	tr	10.0						
M^1	ap	19.1				24.9		
	tr	18.0				22.8		
M^2	ap	33.9		—	38.0			
	tr	19.2		25.8	17.7			
M^3	ap		70.5					
	tr		24.5					
	ht		75.1				74.0	

Suid specimen lists and measurements (continued).

Kolpochoerus limnetes (Hopwood, 1926) (continued)

		14909	14686	14908	14911	14914	14903	16071	16070	14915
dP_4	ap	25.7e								
	tr	10.5								
M_1	ap		18.8							
	tr		13.6							
M_2	ap		26.6	29.0	19.6	—				
	tr		17.9	19.0	18.3	17.4				
M_3	ap						—	84.3	96.4	85.5
	tr						16.8	20.2e	22.1	—
	ht									62.1+

Kolpochoerus limnetes (Hopwood, 1926)

Material referred KNM-WT	Specimen	Site
16020	LM^3	LO8
16016	LM md frag (M_{2-3}) & R md frag (M_3)	LO8
14959	LC	KK
16170	md symphysis (roots I's & CC's, LP_3)	KU1
16217	md frags (I's, C's, RP_{3-4}, LP_4–M_1, L & R M_3)	KU1
16021	LM^3 talonid	LO1
15998	R max frag (dP^3–M^1)	LO1
16024	C frag & R & L M_3 frags	LO1
16252	RP_4 frag	LO2
16023	R md frag (dP_{3-4})	KU2
15999	L md frag (P_3–M_3)	KU2
16017	upper tooth frags (L & R M^2, LM^3)	KU2
16015	upper tooth frags (RdP^3, M^3 talon)	KU2
16026	lower tooth frags (RP_2, RP_4, RM_1, RM_3 frag)	KU2
16019	RM_3	LA1
16022	LM^3 talon	LA1
16171	RM_3 frag	LA1
14963	RM_2	KL4
14966	R & L md frags (LM_3)	KK
14965	L md frag (M_3)	KL3
16067	L md frag (M_{2-3})	KL1
16066	R & L max frags (M^3)	KL1
16055	molar frags	KL1
16080	R md frag (M_3)	KL1
16072	L md frags (M_{1-3})	KL1
16073	md symphysis	KL1
14964	L max frag (P^3–M^2)	NC2
14968	L max frag (M^2)	NY
14956	R & L max frags (M^{2-3}) & md frag (M_{2-3})	LK4
14960	L md frag (P_3–M_3) & R md frag (P_4–M_3)	KL6
14958	L md frag (edent)	NC1
14967	LM_3 frag	KL2
14961	M_3 frag	NC1
14962	L max frag (M^2)	NC1
17428	L md (M_{2-3})	KL1
17455	L max frag (dP^3–M^1)	KL1
17469	RM_2 frag	NY3
17473	L md frag (M_2)	NY2
17475	L md frag (P_4–M_2)	NY3
17484	RM^3 frag	NK3
17488	LM^3 frag	NY2
17492	M frag	NY2
17514	cranium	NY3
17516	LM^3	KS1
17523	R md frags (P_4–M_1, M_3)	KS1
17532	juv md frags (dP_4)	KS1
17533	md frags	KS1
17534	cranial frags	KS1
17542	cranium	NY2
17544	R max frags (M^{1-2})	KS1
16215	LM^3	LO5

Kolpochoerus limnetes dental measurements

		17455	15998	16017	17534	16015	16066	14968	14962
dP^3	ap	15.2	18.3			14.9			
	tr	12.9	12.8			10.3			
dP^4	ap	17.3	20.0						
	tr	15.8	19.9						
M^1	ap	21.7	24.0						
	tr	18.0	22.7						
M^2	ap			23.7				25.2	29.9
	tr			21.4				22.5	22.8
M^3	ap			49.2	50.3		68.7		
	tr			24.1	22.7		27.0		

Kolpochoerus limnetes dental measurements (continued)

		14956	14964	17516	16020	16215
P^3	ap		14.7			
	tr		12.6			
P^4	ap		16.3			
	tr		17.8			
M^1	ap		21.9			
	tr		21.3			
M^2	ap	23.9	31.3			
	tr	22.5	26.3			
M^3	ap	58.1		61.1	46.8	44.8
	tr	25.8		29.1	23.8	22.8

		16170	16016	16252	16217	16026	16019	15999	14966
P_2	ap					12.1			
	tr					6.2			
P_3	ap	13.8			16.8				
	tr	8.0			8.8+				
P_4	ap			—	17.7	19.8		16.4	
	tr			12.8	13.9	—		13.0	
M_1	ap					18.4		18.4	
	tr					12.5		15.4	
M_2	ap		23.5					22.7	
	tr		18.7					16.4	
M_3	ap		54.0		50.6	48.7+	50.1	46.9	54.2
	tr		21.6		22.7	20.6	21.0	19.1	22.6

		14963	14960	14956	16067	16080	16072	17428	17473	17475	17533
P_4	ap		16.2							15.3	
	tr		13.5							13.6	
M_1	ap		17.6					17.3			
	tr		13.8					16.3		23.9	
M_2	ap	35.1	24.5	24.5	25.1		30.1	23.8	27.9	19.1	
	tr	22.7	18.4	—	—		22.0	19.6	17.8		
M_3	ap		60.2	53+	72.7	74.5	73.3	67.4			65.1
	tr		22.3	22.3	24.4	26.2	25.8	23.7			26.9

Kolpochoerus majus (Hopwood, 1934)

Material referred

KNM-WT	Specimen	Site
14533	R md frag (P_4–M_3) & L md frag (P_2–M_2)	NC1
14957	juv md (RI, –C, dP_4–M_1; LI, –C, dP_2–M_2)	NC1
16018	LM_3	KU2

Kolpochoerus majus dental measurements

		14957	14533	16018
dP_3	ap	13.5		
	tr	7.2		
dP_4	ap	23.9		
	tr	12.2		
P_2	ap		9.6	
	tr		5.8	
P_3	ap		15.2	
	tr		11.0	
P_4	ap		18.2	
	tr		13.8	
M_1	ap	22.8	19.1	
	tr	14.2	16.9	
M_2	ap	26.0	25.0	
	tr	14.0+	20.7	
M_3	ap		47.3	38.2
	tr		25.8	20.8

Nyanzachoerus Leakey, 1958
Nyanzachoerus kanamensis Leakey, 1958

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16216	molar & premolar enamel frags	LO5	16268	L max frag (M^{2-3})	NS1
16266	RM^3 frags	LO6	16270	LP_3, LM_3, RP_3, RM_3 frag	LO4
16433	R max frag (M^1)	LO4	16025	RM_3 frag	LO5
14528	LM_1	LK2			

Nyanzachoerus kanamensis dental measurements

		16268	16433	14528	16270
M^1	ap		22.3		
	tr		16.5		
M^3	ap	55.3			
	tr	33.8			
P_3	ap				20.2
	tr				17.4
M_1	ap			30.5	
	tr			20.0	
M_3	ap				53.2
	tr				22.1

Potamochoerus sp(p).

Material referred KNM-WT	Specimen	Site
16221	RM^2	LO4
16264	RM_3	LO4
16263	LM^2 frag, LM^3, LM_2, LM_3	LO4
14562	L max frag (dP^3–M^1)	LK4
15002	L md (M_{2-3})	NK4

Potamochoerus sp. dental measurements

		14562	16261	16263	16264	15002
dP^3	ap	17.2				
	tr	12.4				
dP^4	ap	16.7				
	tr	13.0+				
M^1	ap	17.0				
	tr	15.2				
M^2	ap		22.0			
	tr		20.5	16.1+		
M^3	ap			29.5+		
	tr			—		
M_2	ap			21.7		21.1
	tr			16.2		18.1
M_3	ap			36.4	32.6	35.8
	tr			19.6	16.3	19.0

Suidae gen. & sp. indet.

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
14531	R max frag (dP^{3-4})	LK2	17540	RC frag	KS1
16262	L max frag (dP^4)	LO4	16274	C tip	LO4
16265	L max frag (dP^4)	LO4	14644	C frags	LK3
16269	LdP^4 frag	LO10	14636	$\underline{C}$	NN
14900	RM_1	KL1	14651	$\underline{C}$ (*Met. hopwoodi*?)	NC1
16023	R md frag (dP_{3-4})	KU2	14653	$\underline{C}$	KL3
14642	L md frag (dP_{3-4})	KL3	14643	$\overline{C}$	KL3

Figure 35. KNM-WT 16588, *Hexaprotodon protamphibius* cranium from upper Lomekwi Member at LO1; dorsal view.

Figure 36. KNM-WT 16588, *Hexaprotodon protamphibius* cranium; occlusal view.

Hip. aethiopicus. In the youngest fossiliferous part of the Pleistocene sequence (NC1) the extant hippo *Hip. amphibius* occurs.

Hexaprotodon Falconer & Cautley, 1836

Hexaprotodon protamphibius (Arambourg, 1944)

Figures 35, 36

This species was originally recognized from the Omo Shungura Formation by Arambourg (1943), who treated the Shungura material in some detail in a subsequent publication (Arambourg, 1947). As described by Coryndon (1978), the Shungura sequence documents an evolutionary trend in this species whereby the hexaprotodont incisors of the early representatives become tetraprotodont higher in the succession.

Twenty-five specimens of *Hex. protamphibius* have been collected from nine sites in the Lomekwi, Lokalalei, and Kalochoro members. Early specimens of this taxon from the Omo Shungura Formation have hexaprotodont mandibles but those West Turkana specimens in which symphyses are preserved are all tetraprotodont. The teeth are smaller and lower crowned than *Hippopotamus* teeth from the lower part of the West Turkana sequence. The upper molars show four well-developed trefoils but the lowers have the entocoonid reduced to an anteromedially directed pillar. The posterior lobe of the metaconid and anterior lobe of the hypoconid are elongated to meet in the midline, the diagonal ridge thus produced preventing the protoconid from contacting the entoconid. The lower third and fourth premolars may have prominent additional cusps medial to the protoconid; these are not discernible on the West Turkana *Hip.* cf. *kaisensis* premolars because of wear, but were present in one of two specimens described from Kaiso (Cooke and Coryndon, 1970). The canines are smaller and less prominently ribbed than those of *Hippopotamus* species; there is a prominent groove on the medial surface but there is not a (less) prominent groove on the lateral surface as in *Hip. kaisensis.*

Only one relatively complete cranium has been recovered—WT 16588 from LO1 in the upper Lomekwi Member. The midline of the cranial vault is almost horizontal but

Hexaprotodon protamphibius (Arambourg, 1944)

Material referred KNM-WT	Specimen	Site
16382	LC frag	LO4
16383	L dC frag	LO4
16380	R max frag (d$\underline{C}$, RdP^2–M^1)	LO4
16381	RdP$_4$	LO4
16379	assoc teeth (L & R D$\underline{C}$, RdP^2, L & RdP^4)	LO4
16377	RM$_3$	LO5
16376	RP^1	LO10
16372	dI	LO9
16373	RP^3	LO10
16371	Rd$\underline{C}$	LO5
16378	LM$_3$	LO8
16385	LdC	LO1
16384	R max frag (dP$^{3-4}$)	LO1
16419	juv L md frag (LdC, dP$_4$–M$_1$)	LO8
16375	LM$_2$	KU1
16374	LM$_1$	KU2
16588	cranium (LM$^{2-3}$, RM$^{1-3}$), atlas, axis	LO1
14745	L & R max frags (M$^{1-3}$)	KK
14749	L max frags (P^4–M^3)	KK
14752	L max frag (P^4)	KK
14750	L & R max frags (LP^4–M^3, RP^3–M^1)	KK
14751	RM$_3$	KK
14747	assoc teeth (I, C frag, LP$_3$–M$_3$, RP$_4$–M$_1$)	KK
14748	L md (M$_{1-3}$) R $\underline{C}$	KK
14746	L md (M$_{2-3}$)	KK

Hexaprotodon protamphibius cranial measurements

	16588
Max length skull (premax–occ condyles)	595
Max width at premax	214
Max width at canine alveoli	310
Bizygomatic width	335
Mastoid width	227
Occ condyle width	126
Width postorbital processes	257
Midline length nuchal crest–premax	570
Length ant premax to ant orbit	350

Hexaprotodon protamphibius dental measurements

		16380	16384	16374	16380	16376	
P^1	ap					17.7	
	tr					12.1	
dP^2	ap	23.3		25.3			
	tr	15.5		14.1			
dP^3	ap	34.8	30.5				
	tr	22.2	19.3				
dP^4	ap	38.0	33.7	33.4			
	tr	29.0	25.9	25.2			
M^1	ap				44.5		
	tr				35.3		
		14745	14749	14752	14750	16373	16588
P^3	ap				28.8	30.5	31.2
	tr				18.8	21.5	19.2
P^4	ap		—	27.1	28.0		27.0
	tr		27.2	28.0	24.6		22.5+
M^1	ap	42.6	42.8		37.6		33.6
	tr	33.4	37.6		32.0		29.6
M^2	ap		41.2		—		39.9
	tr		—		41.5		41.1
M^2	ap	37.3	49.8		45.8		43.6
	tr	45.6	43.3		43.1		42.3

Hexaprotodon protamphibius dental measurements (continued)

		16381	16419	16377	16378	16375	16374	14747	14751	14748	14746
dP_4	ap	40.2+									
	tr	22.5	24.6								
P_3	ap							31.9			
	tr							19.2			
P_4	ap							32.0			
	tr							21.2			
M_1	ap		—				37.9	—			
	tr		29.3				22.7	24.5			
M_2	ap					49.2		52.7		40.3	
	tr					31.3		30.0		30.8	32.7
M_3	ap			61.7	64.9			69.7	73.0		63.8
	tr			30.5	34.3			32.4	33.1		30.5

		16371	14748	16385	16419	16383	16382
dC/	ap	11.2					
	tr	13.1					
	ht	60+					
C/	ap		31.2				
	tr		50.1				
/dC	ap			20.0	26.7		
	tr			16.1	16.9		
/C	ap					38.7	54.6
	tr					—	—

Hexaprotodon protamphibius postcranial measurements (WT 16588)

Atlas		Axis	
Max width	252	Width atlas facets	123+
Max height	109	Length centrum–odontoid	118
Width occ facets	134	Length spine	125
Width axis facets	142	Max height	152

Hexaprotodon karumensis Coryndon, 1977

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
14504	edentulous mandible	LK3	14511	intermediate phalanx	KL1
14518	frag L md (P_3–M_3)	KL6	14970	R unciform	NK1
14509	L$\underline{C}$ frag	LK4	17467	R astragalus	NY3
14505	R md frag (M_3)	LK3	17478	L C	NY2
14979	RM_3	KI2	17490	$\underline{C}$	NY2
14506	assoc teeth (RC, P^{3-4}, M^{2-3})	LK4	17520	max frags ($\underline{C}$, RdP^4–M^3, LM^{1-3})	KS1
14973	R$\underline{C}$ frag	KL1	17539	C frags, LP_3, LM_1, RM_2	KS1
14969	R$\underline{C}$	KL3	17443	$LM_{1/2}$	KS1
14971	L astragalus	KL1			

Hippopotamid specimen lists and measurements (continued).

Hexaprotodon karumensis dental measurements

		14506	17520			14518	14505	17539
P^3	ap	36.8		$3P_3$	ap	44.4		48.6
	tr	24.4				25.7		34.8
P^4	ap	25.2	(d) 46.0	P_4	ap	43.5		—
	tr	28.2			tr	31.5		
M^1	ap		53.2	M_1	ap	48.6		68.2
	tr		54.3		tr	38.2		49.7
M^2	ap	52.0	55.1	M_2	ap	60.5		80.1
	tr	54.3	60.6		tr	45.4		53.2
M^3	ap	56.0	64.0	M_3	ap	87.7	62.7	
	tr	52.4	63.5		tr	45.7	49.2	

		14509	14506	14973	14969	17490	17520		17478
C/	ap	23.1	24.2	19.2	33.5	31.0	41.5	/C ap	39.9
	tr	32.4	33.8	32.2	38+	25.2	51.6	tr	25.0

Hexaprotodon karumensis postcranial measurements

Astragalus	14971	17467
lat lt	—	105
med lt	101	92
tib tr	—	92
n/c tr	79	78
dv	64	63

Int phalanx		14511
lt		52
prox	ap	31
	tr	48
dist	ap	24
	tr	44

Unciform	14970
max lt	86
max tr	51
max ht	33

Hippopotamus kaisensis Hopwood, 1926

Hippopotamus cf. *H. kaisensis*

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
14512	RM_1	LK1			
14514	LM_3	LK1	14513	RC frag	LK1
14515	associated lower teeth (R & LC, RP_3–M_3, LM_3)	LK1	14510	intermediate phalanx	LK1
16386	immature L md ($DI_{1,3}$, C, dP_3–M_1)	LO6	17456	R max frags (dP^3–M^1)	NS1

Hippopotamus cf. *H. kaisensis* dental measurements

		14512	14514	14515	16306	14513	16386	17456
dP_3	ap				25.3			
	tr				12.5			
dP_4	ap				44.5			
	tr				25.6			
P_3	ap			35.2				
	tr			21.3				
P_4	ap			37.2				
	tr			27.6				
M_1	ap	40.7		41.1	43.6			
	tr	28.0		—	30.1			
M_2	ap			59.8				
	tr			35.2				
M_3	ap		—	73.4				
	tr		51.1	38.4				
/C	ap			56.1		68.7		
	tr			47.6		49.2		
	lt			285+				
/dC	ap						20.0	
	tr						16.8	
dP^3	ap							31.4
	tr							20.6
dP^4	ap							37.5
	tr							31.4
M^1	ap							45.3
	tr							38.3

Hippopotamus cf. *H. kaisensis* intermediate phalanx measurements

		14510
Length		39
prox	ap	29
	tr	3
dist	ap	24
	tr	43

Hippopotamus gorgops Dietrich, 1928

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
14516	L md frag (P_4–M_2) & L $\underline{C}$	KL6	17458	L C frag	NY3
14982	R md frag (M_{2-3})	NC1	17474	C frag	NY2
14977	RM^2	NC2	17498	RM_3	NC1
14507	R max frag (P^4, M^3)	LK3	17531	R astragalus	KS1
14517	R astragalus	KL6	17536	R C	KS1
14975	L C	NC1	17444	LM_1	KS1
17438	L semilunar	KL1	17419	molar frags	KS1

Hippopotamus gorgops dental measurements

		14507	14516			14516	14982	14975	17458	17498	17536
P^4	ap	—		P_4	ap	40.7					
	tr	36.4			tr	—					
M^1	ap	46.4e		M_1	ap	42.3					
	tr	48.2e			tr	33.8					
M^2	ap	51.6e		M_2	ap	54.1	56.2			79.5	
	tr	57.4e			tr	44.3	43.1			42.8	
M^3	ap	61.1		M_3	ap		73.1				
	tr	60.0			tr		45.7				
C/	ap		41.2	/C	ap			58.8	77.1		85.8
	tr		54.1		tr			48.8	54.4		52.5

Hippopotamus gorgops astragalus measurements

	14517	17531
lat lt	121	132
med lt	112	123
tib tr	108	129
n/c tr	99	120
dv	86	95

Hippopotamus aethiopicus Coryndon & Coppens, 1977

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16082	R md frag (M_{2-3})	KL1	16062	RI_1	KL1
14978	RM^1	KL1	?14974	I_1 & $\underline{C}$	NC1
14980	LM^2	KL1	14976	L astragalus, prox L radius, tuber calcis, prox phalanx	NN
16061	RM^3	KL1			
?14972	RC	NK2	17451	R max frag (dP^4–M^1), P_3	KL1
?14508	RI	LK4	17462	LM_3, I, cranial frags	KL1
?14981	LC frag	NN	17506	L md frag (dP_3–M_1)	KI2

Hippopotamus aethiopicus dental measurements

		16082	17462			14978	14980	16061	17451
				dP^4	ap				31.6
					tr				25.0
				M^1	ap	33.6			32.5
					tr	31.2			27.2
M$_2$	ap	33.4		M^2	ap		40.4		
	tr	27.3			tr		35.7		
M$_3$	ap	52.2	48.8	M^3	ap			34.6	
	tr	27.3	28.2		tr			31.4	

		16062	14508	14972	14981	16082			14974
I$_1$	ap	8.8	14.4			18.9	I^1	ap	24.2
	tr	7.3	12.6			16.5		tr	23.2
I$_2$	ap					10.2			
	tr					11.3			
/C	ap			26.8	20.2		C/	ap	28.3
	tr			22.5	14.6			tr	24.3

Hippopotamus aethiopicus postcranial measurements (WT 14976)

Astragalus		Prox phalanx		Radius		Calcaneum	
lat lt	82	lt	57	prox ap	39	tc tr	44
med lt	69	prox ap	27	tr	67	dv	52
tib tr	57	tr	37				
n/c tr	63	dist ap	17				
dv	47	tr	30				

Hippopotamus amphibius Linn., 1758

Material referred

KNM-WT	Specimen	Site
17504	R maxilla (C, P^2–M^3)	NC1

Hippopotamus amphibius dental measurements (WT 17054)

$\underline{C}$	ap	30.7	M^1	ap	44.4e
	tr	45.8		tr	42.4e
P^2	ap	37.8	M^2	ap	51.6
	tr	32.1		tr	48.5
P^4	ap	31.7e	M^3	ap	54.2e
	tr	35.6e		tr	49.5

Hippopotamidae indet.

Material referred

KNM-WT	Specimen	Site
17415	M^1 or dP^4	KS1

ascends slightly from above the anterior tip of the nasals to the nuchal crest. The orbits are elevated slightly above the cranial vault and located posterior to the tooth row. The upper incisors are lateral to each other rather than being oriented anteroposteriorly. In the LO1 cranium, the left first molar and left and right first premolars were shed and their alveoli resorbed. The canines have been lost but were relatively small. The bullae are relatively large and inflated. The lacrimals are broad and concave and occupy an area immediately in front of the orbits.

Hexaprotodon karumensis Coryndon, 1977

This species was founded on material from the east side of Lake Turkana. It was almost certainly descended from *Hex. protamphibius* and, despite a progressive but apparently gradual increase in size, retains the gracile postcranium characteristic of the latter. Derived representatives of this species (including the type) continue the trend for reduction in number of incisors and display a diprotodont arrangement.

Seventeen specimens of *Hex. karumensis* have been collected from 11 sites in the Kaitio and Natoo members. Specimens of this species are larger than *Hex. protamphibius* but have a similar cusp arrangement on their lower molars (i.e., entoconid reduced and metaconid linked to hypoconid). Those lower premolars collected lack additional lateral cusps adjacent to the main cusp. The species is characterized by small canines and, in its most progressive form, a diprotodont arrangement of the lower incisors (seen only on WT 14504 from LK3 in the Natoo Member). *Hexaprotodon karumensis* may be differentiated from the other large contemporaneous hippo by its smaller canines, lower crowned cheek teeth, the transverse cusp arrangement, and by the more slender limb material (for West Turkana specimens postcranial comparison is limited to the astragalus).

Hippopotamus Linn., 1758

Hippopotamus kaisensis Hopwood, 1926

This species was first described by Hopwood (1926) on the basis of lower teeth and postcranial remains from Kaiso. Additional Kaiso material was described by Cooke and Coryndon (1970) who emended the diagnosis accordingly. Other fossil material from the several isolated sites that together constitute the locality of Kaiso suggests derivation from strata that range in age from equivalent to Shungura Member B to equivalent to Shungura Member G (Harris and White, 1979). Some of the material from the lower part of the West Turkana sequence must, from the strongly ribbed nature of the lower canine, belong to the genus *Hippopotamus*. The West Turkana cheek teeth associated with this type of canine are of similar, though slightly smaller, size to specimens allocated to *Hip. kaisensis* by Cooke and Coryndon (1970).

Hippopotamus cf. *H. kaisensis*

Five of the seven specimens attributable to this species were recovered from LK1 (upper Kataboi Member) in the Loruth Kaado area. The teeth are hypsodont with four well-developed trefoils on the lower molars. The lower canine is immense with strongly ribbed enamel. An immature mandible from the upper Kataboi Member at LO6 (WT 16386) has a first molar that is a little larger and appreciably taller than other hippo material recovered from the upper reaches of the Laga Lomekwi. This is assigned to *Hip. kaisensis* also, as are juvenile maxilla fragments (WT 17456) from NS1.

Hippopotamus gorgops Dietrich, 1928

This species was first recognized from Olduvai Gorge (Dietrich, 1928) where it is common throughout the succession (Coryndon, 1978). It had a widespread distribution, occurring as a relatively infrequent constituent of Pleistocene assemblages from Omo and Koobi Fora and is documented from Cornelia in South Africa (Coryndon, 1978).

Fourteen specimens attributed to *Hip. gorgops* have been recovered from eight sites in the Kaitio, Natoo, and Nariokotome members. This species has teeth of comparable size to *Hex. karumensis* but has four well-developed trefoils in both upper and lower molars and the teeth are proportionately higher crowned. The upper molars are bilobed, the anterior and posterior pairs of pillars being separated by a deep valley. The upper and lower canines are much larger and more strongly ribbed than those of *Hex. karumensis* and the astragalus is larger and broader.

Hippopotamus aethiopicus Coryndon & Coppens, 1975

This pygmy species was recognized from the upper part of the Omo Shungura sequence by Coryndon and Coppens (1975) and occurs also in the KBS and superjacent members of the Koobi Fora Formation. Thirteen specimens of *Hip. aethiopicus* were collected from six sites in the Kaitio, Natoo, and Nariokotome members.

Restricted to the upper portion of the sequence, this pygmy form is unmistakable by virtue of its much smaller size than the two contemporaneous hippo species. The teeth, for their size, have tall crowns. The incisor arrangement is tetraprotodont.

Hippopotamus amphibius Linn., 1758

The extant hippo is presently represented by a single specimen: WT 17504, a right maxilla ($\underline{C}$, P^2–M^3) from NC1 in the Nariokotome Member. The specimen has not yet been completely prepared but the teeth are well enough exposed to permit this identification. The molar teeth are smaller than those of either *Hip. gorgops* or *Hex. karumensis* but larger than those of *Hip. aethiopicus*. The molar cusps are widely separated at their apices but in full contact at their bases, and arranged in anterior and posterior pairs (as in *Hippopotamus*) rather than with a diagonal transverse link (as in *Hexaprotodon*). The upper second premolar is triangular. The upper fourth premolar is bicuspid with a large (outer) paracone and smaller (inner) protocone. The canine is comparable in size to that of an extant male hippo. It is similar also in size to that of a male *Hex. karumensis* but much smaller than typical *Hip. gorgops*.

Family Camelidae

Camelus Linn., 1758

Camelus sp.

Camels were present but rare in the East African Plio-Pleistocene, specimens having been recovered from Omo (Grattard et al., 1976), Koobi Fora, Marsabit Road (Gentry and Gentry, 1969), Laetoli (the oldest specimen—Harris, 1987a), and Olduvai Bed II (the youngest specimen—Gentry and Gentry, 1969). There is no evidence to suggest that more than one species is represented. It is intermediate in size between the extant bactrian and dromedary and, on the basis of a mandible from Koobi Fora, belongs to the genus *Camelus*.

Only one camel specimen—WT 16454, comprising right and left mandible fragments from KU1 in the upper Lomekwi Member—is known from West Turkana. The mandible is badly shattered but portions represented include fragments of the anterior part of the symphysis, fragments of the posterior portion of the symphysis, and fragments of the left and right rami with third molars and the coronoid processes.

The incisors have typical camelid bilobate (flanged) crowns, though those of the first incisor are worn down almost past that level. Both canines lack most of their crowns but have large and massive roots, as does the P_2 whose caniniform crown is comparatively fragile. The lower molars have triangular outer cusps but a relatively flat lingual surface deformed only by the goat fold, a stylid at the rear of the metaconid, and slightly outbowed ribs.

The posterior border of the symphysis lies behind the alveolus for the second premolar. The mandibular ramus was shallow, and the ascending ramus (as preserved) gracile.

Camel measurements.

Camelus sp. (WT 16454) dental measurements

I_1	ap	13.5	P_2	ap	16.1
	tr	17.4		tr	—
I_2	ap	12.1	M_1	ap	34.3
	tr	15.9		tr	25.5
I_3	ap	10.2	M_2	ap	42.2
	tr	13.3		tr	28.5
/C	ap	22.2	M_3	ap	59.0
	tr	15.9		tr	24.3

Family Giraffidae

Subfamily Giraffinae Zittel, 1893

Giraffa Brisson, 1756

Giraffa sp(p).

At least three fossil giraffine species have been documented previously from the Lake Turkana Basin. The small *Giraffa stillei* (Dietrich, 1942), previously referred to as *G. pygmaeus* from Koobi Fora (Harris, 1976) and including at least part of the material described from Omo as *G. gracilis* by Arambourg (1947), is present throughout much of the Plio-Pleistocene succession. The large *Giraffa jumae* Leakey, 1965, has a similar temporal distribution. A third species, intermediate in size, with ossicones oriented at a different angle from those of *G. jumae,* and incorrectly attributed to *G. gracilis* by Harris (1976), first appears in the middle part of the Shungura sequence and persists at later horizons in the Pliocene and early Pleistocene parts of the Omo and Koobi Fora sequences. However, much of the giraffid material recovered from the Lake Turkana Basin is too incomplete for confident identification to the species level.

In the West Turkana sample giraffines are represented by three ossicones, eight dental specimens, and a few postcranial elements from 10 sites in the Lomekwi, Kalochoro, Natoo, and Nariokotome members. A fragmentary ossicone from LO5 in the lower Lomekwi Member, WT 16227, is probably a right ossicone. If so, the surface bone from much of the posterior surface is missing. The ossicone has a large basal sinus and is compressed anteroposteriorly at its proximal end. It tapers rapidly above its base but then more gradually to terminate in a rugose knob. The terminal knob and the uneroded surfaces of the proximal portion are sculpted by deep longitudinal grooves and ridges.

Ossicones WT 14523A (right) and 14523B from NC1 in the Nariokotome Member have, in contrast, a much smoother outer cortex and a more pronounced terminal knob. There are small patches of secondary bone apposition. The specimens are too large to belong to *G. stillei* (Dietrich, 1942). They probably represent either *G. jumae* Leakey, 1965, or the extant *G. camelopardalis,* but which is difficult to judge.

Upper teeth are known only from NC2 in the Nariokotome Member and could belong to either *G. jumae* or *G. camelopardalis.* Lower teeth, currently known only from the Lomekwi and Kalochoro members, exhibit little morphological variation other than size; the latter increases up the sequence. Perhaps the mandible fragment WT 16223 from LA1 in the Kalochoro Member belongs to the giraffine species documented from Omo and Koobi Fora that is intermediate in size between *G. stillei* and *G. jumae.* The magnum WT 16224 from KU1 in the upper Lomekwi Member is smaller than WT 14521 from NC1 in the Nariokotome Member.

Subfamily Sivatheriinae Zittel, 1893

Sivatherium Falconer & Cautley, 1835

Sivatherium maurusium (Pomel, 1892)

Sivatheres were present but usually uncommon at many of the known Pliocene and Pleistocene localities of sub-Saharan Africa. Only one Plio-Pleistocene *Sivatherium* species has been recognized from East Africa. This displayed considerable variation in ossicone morphology (Harris, 1974) and underwent progressive reduction in the length of the metapodials.

Only five sivathere specimens have so far been recovered from West Turkana: WT 17472, upper molar and premolar fragments from NS1; WT 16222, a left lower third molar from LO3; WT 16221, a right lower first or second molar from KU2; WT 14522, a right mandible fragment (dP_3–M_1) from KK; and WT 16584, associated upper and lower teeth and postcranial elements from KL1. The partial skeleton from KL1 is the second most complete specimen from the Lake Turkana Basin, a slightly more complete skeleton being known from Koobi Fora Area 131. All the West Turkana material falls within the limits of size variation exhibited by other specimens previously assigned to this species.

Family Bovidae

The bovids are the commonest terrestrial fossils recovered from the West Turkana succession. Over 30 species have been recognized on the basis of their cranial or horn core morphology. Dentitions and isolated teeth are usually iden-

Giraffa Brisson, 1756
Giraffa sp(p).

Material referred KNM-WT	Specimen	Site
14520	RP^4, LM^1, LM^2	NC2
14521	R magnum	NC1
14523	R & L ossicones	NC1
16223	R md frag (M_{2-3})	LA1
16225	R astragalus	LO1
16226	R md frag (M_{1-3})	KU1
16224	R magnum, LM_3 frag & enamel frags	KU1
16228	LP_4 frag	LO3
16218	RM_3	LO9
16219	LM_3 frag	LO4
16220	RP_4 frag	LO4
16227	R ossicone	LO5
17437	R mc, int. phalanx & humerus frags	KL1

Giraffa sp(p). dental measurements

		16219	16220	16228	16218	16224	16226	16223			14520
P_4	ap		—	—							
	tr		18.3	20.7+							
M_1	ap						28.5*		P^4	ap	23.9
	tr						20.4			tr	29.1
M_2	ap						28.4	24.5	M^1	ap	27.8
	tr						21.4	17.3		tr	33.9
M_3	ap	38.7+			43.7	41.0	39.5	34.2	M^2	ap	29.3
	tr	21.3			22.5		21.1	17.4		tr	35.6

Giraffa sp(p). ossicone measurements

	16227	14523A	14523B
prox ap	67		
tr	96		
dist ap	36	39	37
tr	45	49	41
length	178	204	

Giraffa sp(p). postcranial measurements

	Magnum 14224A	Magnum 14521
max lt	63	66
max width	61	69
max height	35	39

	Astragalus 16625
lat lt	101
med lt	87
tib tr	72
n/c tr	62
depth	59

	Metacarpal 17437	Intermediate phalanx 17437
Length	610	52
prox ap	55	33
tr	77	45
distap	47	27
tr	74	42

Sivatherium maurusium (Pomel, 1892)

Material referred KNM-WT	Specimen	Site
16222	LM_3	LO3
16221	$RM_{1/2}$	KU2
14522	R md frag (DP_3–M_1)	KK
16584	cranial & postcranial frags	KL1
17472	upper molar & premolar frags	NS1

Sivatherium maurusium dental measurements

	14522	16221	16222	16584		
dP_3 ap	23.6				P^3 ap	34.8
tr	16.3				tr	
dP_4 ap	51.4				P^4 ap	36.2
tr	24.5				tr	40.4
P_4 ap				40.6	M^1 ap	
tr				27.1	tr	
M_1 ap	42.0			45.4	M^2 ap	51.9
tr	33.3*			31.3	tr	49.3
M_2 ap		45.2		50.6	M^3 ap	46.2
tr		39.5		32.5	tr	44.7
M_3 ap			65.0	62.2		
tr			33.0	30.3		

Sivatherium maurusium postcranial measurements (WT 16584)

	Scaphoid		Semilunar		Cuneiform	
	R	L	R	L	R	L
ap	67	69	58	59	59	60
tr	38	39	41	39	35	37
ant ht	45	45	47	50	45	48

	Unciform		Magnum		Terminal phalanx		
	R	L	R	L	RR	RL	LR
ap	58	—	68	66	87	87	—
tr	50	—	53	51	53	51	51
ant ht	32	32	28	30	40	42	42

	Metacarpal		Proximal phalanx			Intermediate phalanx		
	R	L	RR	RL	LR	RR	RL	LR
Length	283	—	112	107	106	58	58	57
prox ap	62	63	48	49	49	43	46	41
tr	90	91	49	48	51	49	51	47
dist ap	51	52	32	33	33	47	50	46
tr	99	100	49	51	49	50	47	47

	Calcaneum		Astragalus			Naviculocuboid		
	R	L		R	L		R	L
Length	—	179	lat lt	94	90	lt	67	79
artic tr	—	70	med lt	80	80	tr	83	81
dv	74	76	tib tr	65	67	dv	43	46
tc tr	—	48	n/c t	64	64			
dv	—	44	dv	54	55			

	Metatarsal		Prox phalanx			Int phalanx		Distal phalanx		
	R	L	RR	RL	LR	RR	LR	RR	RL	LR
Length	345+	—	104	106	105	53	53	80	76	79
prox ap	56+	69	47	46	45	35	37	49	48	50
tr	74	72	45	44	44	41	41	35	34	35
dist ap	51	49	28	28	28	39	41			
tr	87	89	41	42	41	38	38			

tifiable only to tribal level. Isolated postcranial elements, which are even more difficult to identify, were not collected.

Tribe Tragelaphini

Tragelaphus Blainville, 1816

Tragelaphus nakuae Arambourg, 1941

Figure 37

This species was first described from the Omo Shungura Formation (Arambourg, 1941), where it is abundant from Member B through lower Member G and persists into Member H (Gentry, 1985). It occurs also at Koobi Fora in the interval represented by the Moiti through the KBS members but has not yet been recorded outside the Lake Turkana basin.

Tragelaphus nakuae is represented in the West Turkana sample by 22 specimens from nine sites in the Kataboi, Lomekwi, Lokalalei, Kalochoro, and Kaitio members. The most complete specimen so far recovered from West Turkana comprises a calvaria with proximal horn cores (WT 16681) from KU2 in the upper part of the Lomekwi Member. Only

Figure 37. KNM-WT 16681, *Tragelaphus nakuae* calvarium and proximal horn cores from the upper Lomekwi Member at KU2; anterior view.

Figure 38. KNM-WT 14534, *Tragelaphus strepsiceros* calvarium and horn cores from the Kaitio Member at KL6; anterior view.

the posterior portion of the orbits is preserved but the dorsal surface of the cranial vault extends anteriorly to the nasal–frontal suture. The deep supraorbital foramina are located midway between the top of the orbital rims and the midline. The cranial vault is slightly constricted behind the orbits before expanding at the horn core bases. Behind the horn cores the cranial vault is proportionately shorter than in *T. strepsiceros* and the dorsal surface is excavated into a concave basin between the supratemporal ridges laterally and between the horn core pedicels and the nuchal crest anteroposteriorly. The posterior portion of the parietals is swollen to form the massive transverse crest typical of this species. There is only a faint median ridge on the occiput, which is proportionately taller and less wide than in the *T. strepsiceros* specimens from higher in the sequence. The paroccipital processes and occipital condyles are incompletely preserved in WT 16681 but virtually complete (and the processes short and massive) in WT 16511 from LO4 in the lower Lomekwi Member.

Behind and above the orbits, the horn cores extend backward, outward, and upward. They are nearly oval in transverse section at their base though a short anterior, a dorsal, and a longer posteroventral surface may be distinguished. The right horn core spirals clockwise when viewed from the distalmost preserved portion, so that the posterodorsal corner at the base becomes the posteroventral. The horn cores have begun to curve medially at their preserved extremities but the distal portions are missing.

In both the Shungura and Koobi Fora successions, the horn cores of *T. nakuae* underwent a distinct change in shape through time. The West Turkana material is too incomplete to document a comparable change in this succession.

Tragelaphus strepsiceros (Pallas, 1766)

Figure 38

The oldest record of the extant greater kudu in the Lake Turkana basin is in the lower part of Shungura Member G, where it is rare (Gentry, 1985). It does not occur at Koobi Fora below strata equivalent to upper Shungura Member G but is a common constituent in the younger local faunas from that locality. At Koobi Fora, as at Olduvai, two subspecies

Tragelaphus nakuae Arambourg, 1941

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16681	calvaria and prox h/c's	KU2	16502	R md frag (P_3–M_3)	LO5
16511	incomplete calvaria lacking h/c's	LO4	16504	R md frag (M_3)	LO4
16884	partial R h/c	KU2	16506	R md frag (P_4–M_3)	KU2
16682	h/c frag	KU2	17471	LM^3	NS1
16598	distal h/c frag	LO8	16497	R md frag (M_{2-3})	KU2
16683	h/c frag	LO4	16499	L md frag (M_{1-2})	LO5
16510	h/c frag	LA1	16495	M_2	LO5
14883	h/c frag	NT	16496	RP^3, RM^{2-3}, RM_3 frag	LA1
14884	h/c frag	LK1	16501	LM^3	LO4
14892	h/c frag	LK2	16498	LM^2	LO8
16503	R md frag (M_{2-3})	LO5	16500	R max frag (M^{2-3})	LO5

T. nakuae cranial measurements

	16681	16511
Width post. orbits	164	
Max width base h/c's	154	
Base L h/c ap	52	
tr	68	
Base R h/c ap	46	
tr	77	
Width at mastoid	149	143
Height occiput above foramen magnum	73	74
Width occipital condyles	—	81
Width post. tuberosities	4	
Width ant. tuberosities	29	

T. nakuae dentitions

		16506	16502	16504	16503	16497	16499	16495
P_2	ap		11.6					
	tr		6.6					
P_3	ap	15.0						
	tr	9.2						
P_4	ap	16.4	18.1					
	tr	11.4	10.6					
M_1	ap		19.4				20.4	
	tr	13.5	14.3				12.7	
M_2	ap	25.3	25.1		25.8	23.2	22.2	25.4
	tr	15.6	15.6		13.5		14.9	16.2
M_3	ap	33.5	34.3	32.8	33.5	31.9		
	tr	14.3	14.2		12.5			

		16496	16501	16498	17471
P^3	ap	15.2			
	tr	14.5			
M^2	ap	30.1		28.8	
	tr	21.9		21.5	
M^3	ap	29.0	26.0		23.2
	tr	20.0	19.1		

Tragelaphine speicmen lists and measurements (continued).

Tragelaphus strepsiceros (Pallas, 1766)

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
14534	calvaria with h/c's	KL6	14735B	L md frag (M_2)	LK4
14880	female cranium (RM^3)	KG	16064	R md frag (P_3)	KL1
14882	calvaria with prox L and part R h/c	KL2	17424	max frag (L & R M^{2-3})	NY3
14885	prox R h/c	KL3	17546	R max (M^{1-3})	NY2
14893	prox R h/c	KL3	17551	L md (dP_3)	NY3
14888	h/c frags	KL6	17457	R & L h/c frags	NY3
14881	h/c frag	KL2	17465	h/c frag	NY3
14895	h/c frag	KL6	17466	L h/c frag	NY3
14886	h/c frag	KL6	17468	h/c frags	NY3
17430	juv R h/c	NY2	17476	L md frag (P_{3-4})	NY2
17445	prox R h/c	NY3	17481	R h/c frag	NY2
14894	R md (dP_4–M_2)	KL6	17482	$LM^{1/2}$	NY2
14887	R md (M_{1-3})	KK	17493	R & L h/c frags	NY2
14891	LM^3	KL3	17494	max (RM^{1-3}, LM^{2-3})	NY3
14879	RM^2, LM^2, LM^3	LK4	17495	frontlet & h/c frags	NY2

T. strepsiceros cranial measurements

	14534	14882	17445
Width post. orbits	149		
Max width base h/c's	123		
Base L h/c ap	63		
tr	50		
Base R h/c ap	63		65
tr	49		59
Width at mastoid	137	141	
Height occiput above foramen magnum	57	67	
Width occipital condyles	74	85	
Width post. tuberosity	59		
Width ant. tuberosity	35		

T. strepsiceros dental measurements

		14984	14887	14735A	16064	17476·	17491	17551
dP_3	ap							13.9
	tr							7.5
dP_4	ap	26.2						
	tr	11.9						
P_3	ap				15.7	15.3		
	tr				8.4	8.6		
P_4	ap					16.8		
	tr					10.1		
M_1	ap	21.2	17.8+					
	tr	10.8	10.9					
M_2	ap	23.5*	23.6	20.6				
	tr	10.6	11.4	13.6				
M_3	ap						34.4	
	tr		11.9				13.7	

		14879	14891	17424	17494	17546
M^1	ap					19.5+
	tr				19.6	15.6
M^2	ap	23.5		24.6	25.1	24.2
	tr	18.5		20.5	19.6	13.0
M^3	ap	16.3	22.9	25.6	25.6	21.6+
	tr	12.8	13.8	16.5	15.0	12.5

Tragelaphus gaudreyi/robbinsi

Material referred KNM-WT	Specimen	Site
16505	prox L h/c	LO8

Tragelaphus scriptus (Pallas, 1766)

Material referred

KNM-WT	Specimen	Site
14878	R md (P_4–M_3)	NC1
14890	R md frags (roots DP_4, M_1, M_2)	KL6
16415	R md frag (M_3)	LO3

Tragelaphus/Taurotragus

Material referred

KNM-WT	Specimen	Site
14623	RdP_4	NC1

Tragelaphus imberbis/scriptus

Material referred

KNM-WT	Specimen	Site
16473	max frags (RM^{2-3}, LM^{1-2})	LO5

Tragelaphini dental measurements

	14878	14890	16415	14623		16473
P_2 (roots) ap	6.9				M^1 ap	14.4
tr	3.8				tr	14.1
P_3 (roots) ap	9.9				M^2 ap	17.0
tr	5.1				tr	15.7
P_4 ap	12.3			26.0	M^3 ap	20.3
tr	6.5			14.6	tr	14.0
M_1 ap	14.2	17.2				
tr	7.9	7.1				
M_2 ap	16.3	18.6				
tr	8.8					
M_3 ap			21.4			
tr	8.9*		7.9			

of greater kudu occur in strata older than 2 Ma but the extinct subspecies, *T. strepsiceros maryanus* (Leakey, 1965), characterized by anteroposteriorly compressed horn cores, has not yet been recovered from West Turkana. Both greater and lesser kudu occur east of Lake Turkana today.

Thirty specimens of *Tragelaphus strepsiceros* have been recovered from nine West Turkana sites: two specimens have been recovered from the Kalochoro Member, three from the Natoo Member, and the rest from the Kaitio Member. The best West Turkana specimen is WT 14534, a calvaria with horn cores from KL6 in the Kaitio Member. It differs from *T. nakuae* by lacking the transverse bar at the rear of the parietals, by the less massive and proportionately wider but less elevated occiput, and by the different shape of the horn cores. The horn cores are more uprightly inserted, less dorsoventrally compressed, and ascend outward and backward in a helical spiral and with greater torsion, completing one full revolution between the base and the tip. The torsion is in the same direction as in *T. nakuae* (clockwise upward in the right horn core). A well-developed keel arises from the anteromedial edge of the horn core base, with a less strong keel extending from the posteromedial edge.

A poorly preserved female cranium (WT 14882 from KG in the Kalochoro Member), a little larger in size than the extant female lesser kudu, may also be of this species.

Tragelaphini genera and species indeterminate

WT 16505 is a proximal left horn core fragment from LO8 in the Lokalalei Member. It is greatly eroded and no measurements are possible. It has comparable torsion and angle of insertion to *T. strepsiceros* specimens from younger portions of the section but is more gracile. It could conceivably represent *T. gaudreyi* (P. Thomas, 1884), recorded from sediments of comparable age in the lower Omo valley (Gentry, 1985) or a new species of *Tragelaphus* described from Kanapoi (Smart, in litt.).

WT 16473, fragments of maxilla (RM^{2-3} and LM^{1-2}) from LO5 in the lower Lomekwi Member has teeth of identical size and morphology to a lesser kudu (*T. imberbis* Blyth) or a large bushbuck (*T. scriptus* (Pallas)).

Three tragelaphine mandibles—WT 16415, a right mandible fragment (M_3) from LO3 in the upper Lomekwi Member; WT 14890, right mandible fragment (M_{1-2}) from KL6 in the Kaitio Member; and WT 14878, right mandible (P_4–M_3) from NC1 in the Nariokotome Member—are morphologically identical and of similar size to those of a large bushbuck (*T. scriptus*).

WT 14623 is a very large tragelaphine RP_4 from NC1 in the Nariokotome Member and may represent either a very large greater kudu or eland.

Tribe Bovini

At least three distinct bovine species occur in the West Turkana assemblages—a species of *Ugandax* in the lower part of the succession, at least one species of *Pelorovis* in the upper part of the succession, and a form close to the modern cape buffalo in the youngest assemblage from the Nachukui Formation. Although the teeth are very similar, *Pelorovis* teeth have "pinched" lobes on the inner surface of the upper teeth and outer surface of the lower molars, whereas those of *Ugandax* have a more smoothly rounded profile although the "pinching," a typically bovine characteristic, is present to a limited degree. The "pinching" in some *Pelorovis* specimens—particularly mandible WT 14630 and upper molars 14628 and 14631—is sufficiently developed to impart a "ribbed" effect on the lobe surface.

Syncerus caffer (Sparrman, 1779)
Syncerus cf. *S. caffer*

WT 14621 from NC2 in the Nariokotome Member is a partial right horn core of a small buffalo that is closely comparable in shape to that of *S. caffer*. The horn core, which has a small basal sinus, is flattened dorsoventrally and gradually tapers distally from the base. The horn core extends outward and slightly downward from the base, rising upward in its distal portion (which is less dorsoventrally compressed); there is slight anticlockwise torsion in the preserved portion of the horn core. The distal portion is more elevated dorsally and is more rounded than the proximal portion. The tip (and probably the distal third) of the horn core is missing but this probably rose to be elevated some distance above the level of the basal boss. More than 19 cm long, the horn core measures 72+ × 39 mm in its proximal portion.

A fragment of a lower right M_2, WT 14622, from the same locality may represent the same taxon. This is 15.4 mm wide.

The only *Syncerus* material identified from the Shungura Formation is an extinct species comparable to *S. acoelotus*. The Nachukui sites in the Nariokotome Member are, however, equivalent stratigraphically to high in Member L—a level that was not intensively sampled by the International Omo Expedition. An undescribed specimen closely comparable to the extant cape buffalo was, however, retrieved from the late Pleistocene to Holocene strata at Kalam in the lower Omo Valley by the International Omo Expedition. Cape buffalo were present in the south part of the Lake Turkana Basin in historic times but are not found there today; they do, however, still occur in the lower part of the Omo River drainage.

Ugandax Cooke & Coryndon, 1970

This genus was originally interpreted as hippotragine by its authors but was subsequently determined to be a bovine. The type species is from Kaiso in Uganda and a different species is known from Hadar in Ethiopia. Undescribed material from the lower part of the Koobi Fora sequence appears to represent yet another species to which specimens from the lower part of the West Turkana sequence apparently belong.

Ugandax new species

Eleven specimens attributed to this taxon were collected from seven sites in the Lomekwi, Lokalalei, and Kalochoro members. WT 16185 from KU2 in the upper Lomekwi Member consists of a horn core fragment and associated maxilla fragment with RM^{2-3}. The portion of horn core is dorsoventrally compressed and lacks much of one surface (the inferior?) but is evidently hollow at its base where a basal sinus is well developed. The surface bone is weathered but suggestive of a smooth (or at most longitudinally ridged) surface. The fragment measures 74 mm anteroposteriorly in its proximal portion and more than 38 mm dorsoventrally.

A partial calvaria with proximal horn cores—WT 16508 from LO8 in the Lokalalei Member—has suffered much dorsoventral compression. The horn cores, which arise well behind the orbit, are dorsoventrally flattened, curving backward and outward at their base but converging medially in their distal portion in a manner closely comparable to a calvaria (KNM-ER 230) from the lower part of the Koobi Fora sequence. As preserved, the West Turkana calvaria is broadest at the rear of the orbits. Though concave in the midline, the frontal roof is domed on either side in front of the horn cores. The parietal vault is very short, and the temporal fossa is deep and elongate anteroposteriorly. The occiput must have been crushed dorsoventrally for, as preserved, the top of the foramen magnum is almost contiguous with the nuchal crest. The mastoids and anterior part of the basioccipital have been eroded away. The paroccipital processes are very short and conical. The fragments of horn core show no appreciable torsion.

Pelorovis Reck, 1928

This genus was originally erected for a large species of bovine from Olduvai Gorge. Subsequent collecting at Koobi Fora indicated that two *Pelorovis* species, a large and a small, coexisted in East Africa during the early Pleistocene. The smaller species, currently unnamed pending description of more complete material from Koobi Fora, has now been recognized also from West Turkana.

Pelorovis new species

Right and left horn cores, WT 17519 from NY3 in the Kaitio Member, belong to a small species of *Pelorovis* recorded from the upper portion of the Koobi Fora Formation. Dorsoventrally compressed, these horn cores extended outward and slightly backward in their proximal portions, curving round to converge anteriorly in their distal portion. There is slight anticlockwise torsion (in the right horn core). The distal third of each horn core is missing. The proximal portion of the right horn core measures 107 × 77 mm, that of the left 108 × 76 mm.

Pelorovis species indeterminate

A horn core fragment and some partial dentitions appear to belong to *Pelorovis* but may not be assigned with certainty to *Pelorovis oldowayensis* or the new, smaller species.

WT 14624 from KL6 in the Kaitio Member is a small fragment of the middle section of a right horn core. About 17 cm long, it measures 67 × 53 mm at its proximal end.

Bovine mandible fragments and teeth that probably belong to *Pelorovis* are known from KI1, KL3, KL6, KS1, and NY2 in the Kaitio Member and KL1 and KL5 in the Natoo Member. Three mandibular fragments, 14634 from KL4 in the Kaitio Member and 14627 and 14696 from KG1 in the Kalochoro Member are a little smaller than the other *Pelorovis* specimens but are from slightly older horizons.

Two large left bovine astragali (14632 and 14633) from KL1 in the Natoo Member probably belong to *Pelorovis* also.

Tribe Reduncini

Kobus A. Smith, 1840

Kobus ellipsiprymnus (Ogilby, 1833)

A proximal left horn core, WT 14727 from NC1 in the Nariokotome Member, is attributed to the extant waterbuck on the basis of similar size and morphology. It is slightly compressed mediolaterally, but less so than in *Kobus sigmoidalis* and is appreciably larger than most specimens of *K. kob*. Although some bone is missing from the lateral surface, this was apparently flattened originally. The specimen is ornamented with longitudinal ridges and there is a very faint indication of transverse ribbing. At its proximal extremity the specimen measures 52 mm (ap) × 50 mm (tr). A few specimens of this species have been retrieved from the KBS Member in the Koobi Fora succession. Waterbucks were formerly present in the south part of the Lake Turkana Basin in historic times and were recorded as present on the east side of the lake by Stewart and Stewart (1963); they still persist today in the vicinity of the Omo River.

Kobus leche Gray, 1850

A proximal right horn core, WT 14730 from NC3 in the Nariokotome Member, is of comparable shape, compression, and ornamentation to those of *K. sigmoidalis* but arises more laterally from its base. It is ornamented by longitudinal ridges and transverse ribs and its basal diameters are 44 mm × 35 mm. Horn cores of similar shape and orientation, but varying greatly in size, have been collected from the upper Burgi, KBS, and Okote members in the Koobi Fora succession.

Kobus kob (Erxleben, 1777)

Kobus cf. *K. kob*

Horn cores very similar to those of the extant kob have been reported from the higher part of the Shungura sequence (Members J–L) by Gentry (1985). The species is represented also in the Koobi Fora succession, first occurring in significant numbers in the KBS Member and becoming the common reduncine in the Okote Member. In the West Turkana succession, kobs have been recovered from only two sites (KL1 and NT) in the Natoo Member.

The West Turkana kob horn cores are small and relatively short and stout. They are massive and only slightly mediolaterally compressed in their proximal portion—a feature that serves to distinguish them from other reduncines in this part of the succession—but become circular in transverse section distally. The horn cores arise behind the orbits and diverge outwards as they extend backward. Their anterior surface is ornamented by faint to moderately developed transverse ridges.

Kobus sigmoidalis Arambourg, 1941

This species is a prominent constituent of assemblages from the lower part of the Shungura sequence where it is particularly abundant in Members D through G (Gentry, 1985). *Kobus sigmoidalis* is similarly the commonest reduncine from Koobi Fora in the upper Burgi and KBS members. It is of comparable size to the extant waterbuck, compared to which it has similarly shaped, though much more laterally compressed, horn cores.

This is one of the most frequently encountered species in the middle portion of the West Turkana sequence, with nine specimens documented from the upper Lomekwi Member and seven from the Lokalalei Member. Isolated specimens are known also from LO4 and LO9 (in the lower and middle portions, respectively, of the Lomekwi Member), and perhaps from LK3 in the Natoo Member, though this might instead be a fragment of lechwe horn core. The best specimen is a cranium with associated horn cores, WT 16674 from KU2, but portions of the base of the horn cores are missing so these may not be fitted to the cranium. The horn cores arise behind the orbit and, if complete, which none of the West Turkana specimens are, would be slightly S-shaped in lateral view (hence the name). The horn cores diverge outwards as they extend backward and then upward with slight clockwise torsion (in the right horn core) and probably forwardly recurved at the tip, though none is preserved in the West Turkana sample. The horn core is mediolaterally compressed at the base with a flattened lateral surface in the proximal portion. Distally the horn core is almost circular in transverse section. Ornamentation is principally of lon-

Syncerus cf. *caffer*

Material referred KNM-WT	Specimen	Site
14621	partial R h/c	NC2
14622	RM_2 frag	NC1

Ugandax new species

Material referred KNM-WT	Specimen	Site
16185	h/c frag & max frag (RM^{2-3})	KU2
16180	LM^{2-3}	LO9
16183	L $\underline{M}$ frag	LO9
16181	R $\underline{M}$ frag	LO9
16184	L md frag (M_{1-3})	LO3
16175	LM_2	LO4
16176	L md frag (dP_4–M_2)	LO5
14946A	L max frag (M^{2-3})	KK
16152	RM^1	LO4
16182	RP_4	LO9
16508	partial calvaria with prox h/c's	LO8

Ugandax new species cranial measurements

	16508
Width post. orbits	164
Width base h/c's	154
L h/c ap	42
tr	69
Width occipital condyles	89
Width post. tuberosity	46

Ugandax new species dental measurements

		16182	16184	16176	16175
P_4	ap	16.5			
	tr	10.5			
M_1	ap		23.2	25.2	
	tr		16.8	11.6	
M_2	ap		26.7	28.5	32.1
	tr		17.1		
M_3	ap		32.7		
	tr		16.7		

		16180	16183	16181	14946A	16152
M^1	ap			28.1+	22.2	25.4
	tr				17.1	
M^2	ap	36.0	29.2		22.2	
	tr	24.9			14.2	
M^3	ap	32.7				
	tr	20.5				

Pelorovis new species

Material referred KNM-WT	Specimen	Site
17519	R & L h/c's	NY3
17537	R md (M_{1-2})	KS1

Pelorovis sp.

Material referred KNM-WT	Specimen	Site
14624	h/c frag	KL6
14629	L md (P_3–M_2)	KL6
14889	R md frag (M_{1-2})	KL6
14625	L md frag (M_3)	KL3
14630	R md (P_4–M_3)	KL6
14626	RM_1 frags	KI2
16050	L $\underline{M}$ frag	KL1
14631	R $\underline{M}$ frag	KL5
14628	L $\underline{M}$ frag	KL5
17480	LM_3	NY2
14634	R md frag (RM_{1-2})	KL4
14627	R max frag (P^3–M^2)	KG
14696	L md frag (P_{3-4})	KG1
14632	L astragalus	KL1
14633	L astragalus & lunate	KL1

Pelorovis sp. dental measurements

		14629	14630	14625	14889	14634	14696	17480	17537			14627
P_3	ap	15.3				22.6+	19.2	45.4	37.8	P^3	ap	15.3
	tr	11.9					11.4	17.8	17.3		tr	14.4
P_4	ap	16.3	20.6			25.1+	20.2		36.7	P^4	ap	14.9
	tr	13.8				16.8	14.6		15.5		tr	15.4
M_1	ap	22.9	26.6		25.8					M^1	ap	22.0
	tr	17.4	16.8		12.6						tr	20.7
M_2	ap	29.0	28.9		28.8					M^2	ap	29.0
	tr	18.2	16.3								tr	22.5
M_3	ap		38.2	45.9								
	tr		15.3	17.2								

Bovini astragalus measurements

	14633	14632
lat lt	75	73
med lt	72	71
tib tr	50	49
n/c tr	49	50
depth	44	43

gitudinal grooves and ridges but transverse ribbing is superimposed on the anterior surface of some horn cores.

Kobus aff. *sigmoidalis/ellipsiprymnus*

A number of horn cores from Kokiselei (KS1) are clearly closely related to waterbucks but are appreciably larger. Isolated horn cores of similar size and shape are known from the eastern side of the lake (e.g., KNM-ER 4999). The Kokiselei specimens are at present unprepared and are covered with concretionary matrix. They vary appreciably in size and possibly represent more than one species.

The best preserved specimen (WT 17414) has a frontlet of comparable morphology to that of *K. ellipsiprymnus.* The base of the right horn core is greatly swollen but tapers rapidly distally. The horn core has a flattened lateral surface, deep longitudinal grooves and ridges, and a slight indication of transverse ribbing on the anterior surface. The horn core curves backwards, upwards, and outwards at its base, just as in *K. ellipsiprymnus,* and, though incomplete, the curvature is such as to suggest that the middle portions of the horn cores were parallel to one another.

WT 17413 may be an admixture of three or more individuals. One portion, a proximal right horn core, is rather longer than WT 17414 and tapers less rapidly distally; this, however, may be an artifact of its larger size and of individual variation. A proximal left horn core with the same accession number appears even more massive at its base. Fragments of the middle portion of the horn core seem to be virtually straight. WT 17412 constitutes fragments of a large *Kobus*-like horn core of comparable size to the fragments constituting WT 17413.

WT 17411 is only the base of a left horn core but is clearly a large *Kobus.* WT 17410 is a smaller specimen, less massively inflated at its base than 17414 but otherwise similar in shape. WT 17409 is a collection of horn core fragments, probably of *Kobus* (smaller end of size range) and may represent more than one individual.

Kobus oricornis Gentry, 1985

This species was recently described by Gentry (1985) from the Shungura Formation where it is evidently restricted to Member B. The species is also known from the early part of the Koobi Fora Formation where, as at West Turkana, it persists in horizons that postdate Shungura B. So far only isolated horn cores have been recovered from the West Turkana localities.

A total of 10 specimens has been recorded from six localities in the Kataboi and Lomekwi members. The most complete representative of this species is a left horn core, WT 16617, from LO5. The horn core rises above and behind the orbit and ascends steeply upward in a virtually straight line. It is almost circular in transverse section but slightly flattened anteroposteriorly though to a lesser extent than in *Kobus* sp. A (see below). The horn core, which must have been very long, tapers only gradually toward its distal extremity. Its surface is relatively smooth but there may be some longitudinal ridging.

Kobus sp. A

Figures 39–41

This taxon is represented by two specimens from the lower part of the Lomekwi Member (LO4, LO5) and eight from the upper portion (LO1, KU1, KU2). The best preserved horn core is from the lower Lomekwi Member (WT 16612

Figure 39. KNM-WT 16612, *Kobus* sp. A right horn core from the lower Lomekwi Member at LO4; anterior view.

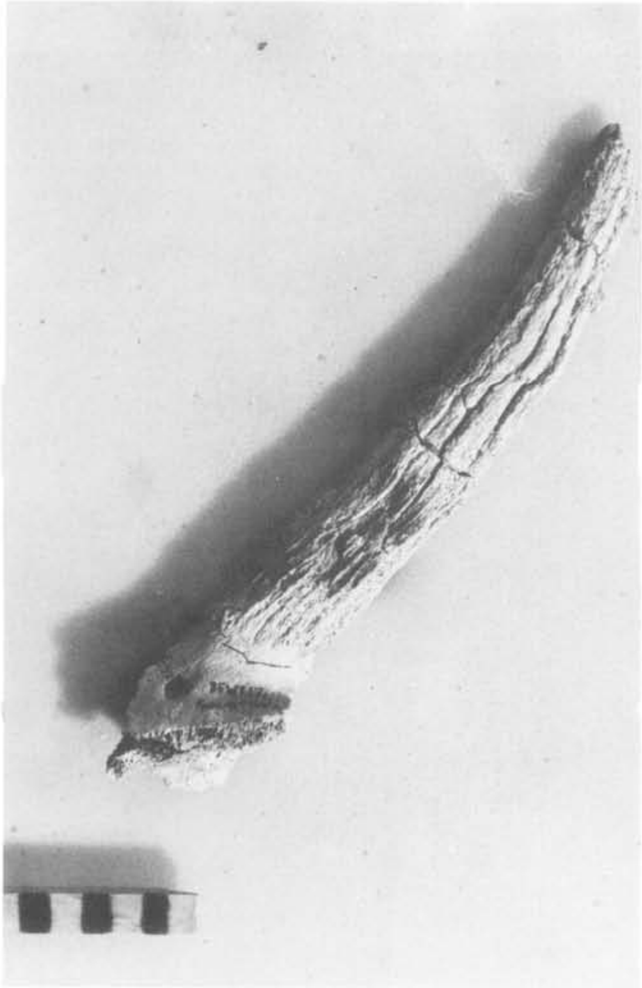


Figure 40. KNM-WT 16612, *Kobus* sp. A right horn core; medial view.

from LO4) and is also one of the smallest representatives. One specimen of comparable small size has been recovered slightly higher in the sequence (WT 16614 from KU2) although this might be an immature individual. The remaining specimens are appreciably larger, possibly representing a different species. The most complete individual is WT 16587 from LO1 which includes a mandible and associated postcranial elements.

WT 16612, a right horn core, originates immediately behind the orbit. There is a small postcornual fossa below the posterolateral edge of the horn core base. The horn rises backwards, upwards, and outwards, diverging continuously from the base but having the concave profile characteristic of the reduncines and thereby differing in this feature from horn cores attributed to *K. oricornis*. The horn core is compressed anteroposteriorly (which in effect, because of the horn core orientation, is dorsoventrally in the proximal portion). The compression is more marked in the proximal portion. It is thus similar to, though more pronounced than, *K. oricornis* in this feature, which distinguishes these two species from *K. sigmoidalis* and *K. ancystrocera*. Longitudinal ridges and furrows provide ornamentation on the proximal portion of the anterior surface but are even more prominent on the posterior surface.

Kobus sp. B

Four horn cores from the middle and upper part of the Lomekwi Member are superficially similar to those of *K. sigmoidalis* but are larger and lack the sigmoid curvature typical of the latter. These horn cores, here identified as *Kobus* sp. B, are slightly compressed mediolaterally at the base, curve upward, outward, and backward proximally but then curve inward distally, the curvature being uniform and with no flexure. There must have been slight clockwise torsion in the right horn core (the most complete specimen—WT 16660, a left horn core from KU2—shows slight anticlockwise torsion). The ornamentation consists of prominent longitudinal

Figure 41. KNM-WT 16612, *Kobus* sp. A right horn core; lateral view.

furrowing, particularly in the proximal portion of the anterior surface and on the posterior surface.

Kobus sp. C

Figures 42–44

Three horn cores, the best specimen of which is WT 16608 from LO3 in the upper Lomekwi Member, share a combination of characters shown by other taxa and seem to deserve a separate identity. WT 16608 is anteroposteriorly flattened (like *Kobus* sp. A) but the curvature of the horn core is comparable to *Kobus* sp. B. The anteroposterior compression and well-developed transverse ridges serve to distinguish it from the latter, even though it is of comparable size. Distal horn core fragments from KU2 (WT 16665) and from LO8 in the Lokalalei Member (WT 16662A) also appear to belong to this species.

Kobus sp. D

Figures 45–47

This specimen consists of a single right horn core, WT 16607, from KU2 in the upper Lomekwi Member. The horn core is rather kob-like but more widely divergent. It has transverse ribbing on the anterior surface (like *Kobus* sp. E) but is mediolaterally compressed with a flattened lateral surface (though this compression is less than in *K. sigmoidalis* or *K. leche*). The horn core is short, relatively massive, and oval in transverse section (long axis oriented anteromedially–posterolaterally). It curves backwards, upwards, and outwards but begins to recurve forward in its distal portion, and the posterior surface bears prominent longitudinal grooves. The specimen has an anteroposterior measurement of 50 mm at its base, a transverse measurement of 42 mm, and was more than 160 mm long.

Another specimen apparently belonging to the same species is WT 16613, right and left horn core fragments from a slightly older horizon at LO9, which, together with WT 16607, are virtually identical to an unnamed *Kobus* species from the lower portion of the Koobi Fora sequence (i.e., KNM-ER 1606 from Area 202). The horn cores from West Turkana, especially WT 16607, might be slightly more divergent. WT 16613 is more complete distally than 16607 and recurves forward towards its tip.

Kobus species indeterminate

Two specimens are assigned to this category. WT 16660, a proximal right(?) horn core from KU2 in the upper Lomekwi Member, is virtually straight but is ornamented by deep and closely spaced longitudinal grooves with faint transverse ribbing on the anterior surface. It differs from *Kobus oricornis* specimens by virtue of its smaller size (ap 36 mm, tr 34 mm, lt 130+ mm) and by its more prominent ornamentation.

WT 16659, another proximal horn core fragment associated with WT 16660 at KU2, is only 7 cm long. The ornamentation is identical to that of WT 16660 but the specimen shows a slightly greater distal taper. It measures ap 35 mm, tr 35 mm.

Menelikia Arambourg, 1941

Menelikia lyrocera Arambourg, 1941

Figure 48

This species has been previously documented from the Koobi Fora and Shungura sequences. A "typical" form with long lyrate horn cores occurs in the middle part of the Shungura sequence but is subsequently replaced by a form with short

Figure 42. KNM-WT 16608, *Kobus* sp. C left horn core from the upper Lomekwi Member of LO3; anterior view.

lyrate horns (Shungura upper Member G, upper Burgi Member), which in turn is replaced by a form with short, straighter horn cores (Shungura Members H–K and KBS Member). Gentry (1985) considers these to be part of a single evolving lineage. The majority of the West Turkana specimens derive from sites equivalent in age to the lower part of Shungura Member G and, when preserved beyond their basal portion, are of "typical" aspect.

Sixteen specimens attributable to *M. lyrocera* have been recovered from West Turkana, 14 from the Kalochoro Member (KG1, KK, LA1), one from the subjacent Lokalalei Member (LO8), and a proximal horn core of comparable morphology from KL1 in the Natoo Member. These horn cores arise behind the orbit and are swollen at their base with an oval transverse section (long axis oriented anteromedially–posterolaterally). The horn cores taper rapidly from their base but more gradually in their distal portion. The horn core curves backward and outward in its proximal portion, curving more strongly outward in its medial portion, and recurving backward and upward in its distal portion; the overall effect is of a wide lyrate shape. There is distinct anticlockwise torsion in the right horn core. The main ornamentation is of longitudinal ridges and furrows though transverse ribbing may be superimposed on the massive basal portions. There is considerable variation among individual horn cores, some appearing shorter and more massive while others are longer and more slender.

A lower right third molar associated with horn core WT 14940 and a large reduncine mandible, both from KK, may possibly be representative of this species.

Menelikia sp. (cf. Gentry, 1985)

Figures 49, 51

From lower in the succession come horn cores with mediolateral compression comparable to that found in *Kobus sigmoidalis* but with the shape and torsion suggestive of the stock from which the "typical" *Menelikia lyrocera* horn cores could have derived. Similar specimens were recorded from the lower portion of the Shungura sequence by Gentry (1985) who referred them to an unnamed species of *Menelikia*.

Seven horn cores of *Menelikia* sp. were collected from the upper part of the Lomekwi Member (LO1, KU2) and two from the Lokalalei Member (LO7, LO8). These horn cores arise immediately behind the orbit and are greatly compressed at their base, the long axis of the oval transverse section thus formed running anteromedially–posterolaterally. The horn cores ascend upward and outward and then

Figure 43. KNM-WT 16608, *Kobus* sp. C left horn core; lateral view.

Figure 44. KNM-WT 16608, *Kobus* sp. C left horn core; ventral view.

backward, but toward the end of their proximal third they taper rapidly while undergoing a nearly quarter circle turn (anticlockwise torsion in the right horn core), after which they diverge more laterally. From this point they taper gradually toward their distal extremity though none of the specimens has its tip preserved. All horn cores of this taxon show erosion of the surface. Though relatively smooth, there is longitudinal ridging and some specimens show faint transverse ribbing.

These horn cores appear to be a derived form of another species assigned to *Menelikia* (Harris, in litt.) from the early portion of the Koobi Fora sequence (Area 250). These in turn can be derived from a species that C.L. Smart (in litt.) identified as "*Antidorcas*" sp. from Lothagam.

Reduncini genus and species indeterminate

A number of reduncine partial dentitions and isolated teeth have been recovered from West Turkana sites. These cannot be identified beyond the tribal level but can be divided into three discrete size groups each of which is distributed throughout the succession.

Tribe Hippotragini

Hippotragus Sundevall, 1846

Hippotragus gigas Leakey, 1965

A proximal right horn core, WT 17486 from NY2 in the Kaitio Member, is a small representative of *H. gigas* of comparable size to specimens from Koobi Fora. The horn core, which is mediolaterally compressed so that it is oval in transverse section, is inserted uprightly above the orbit and ascends upward then curves progressively backward. It tapers only gradually in its proximal two-thirds but more markedly in its distal portion. The tip of the horn core is missing. There is no surface ornamentation to the horn core other than

Figure 45. KNM-WT 16607, *Kobus* sp. D right horn core from the upper Lomekwi Member at KU2; anterior view.

Figure 46. KNM-WT 16613, *Kobus* sp. D left horn core from the middle Lomekwi Member at LO9; anterior view.

shallow and faint longitudinal grooves. In its proximal portion the horn core measures 51 mm × 43 mm.

Oryx Blainville, 1816

Oryx sp.

One specimen from LO1 in the upper Lomekwi Member, a proximal left horn core WT 16178, belongs to an oryx-like hippotragine. This horn core fragment, which has a circular transverse section, is superficially similar to other incomplete specimens attributed to *Kobus oricornis*. Unlike specimens of the latter species, however, WT 16178 has a moderately large basal sinus but lacks the slight anteroposterior compression in its proximal portion. Its anteroposterior and transverse diameters each measure 38 mm. A species of *Oryx* is represented by horn cores from Shungura Members C and G and from the upper Burgi and KBS members. The scarcity of fossil *Oryx* in the Lake Turkana Basin is in marked contrast to their abundance there today.

Hippotragini genus and species indeterminate

The sole hippotragine dentition comprises a right mandibular ramus fragment with M_{2-3} from LO5 in the lower part of the Lomekwi Member. The teeth have rounded lobes and small goat folds but may be distinguished from alcelaphine teeth by the presence of small external pillars. M_2 measures 25.7 mm × 12.6 mm and M_3 32.5 mm × 10.9 mm.

Tribe Alcelaphini

Damaliscus Sclater & Thomas, 1894

Damaliscus sp(p).

A total of 11 *Damaliscus* horn cores has been retrieved from eight sites in the Lomekwi, Kaitio, and Natoo members. These horn cores were inserted immediately above and behind the orbits. Their base is mediolaterally compressed and

Kobus ellipsiprymnus (Ogilby, 1833)

Material referred

KNM-WT	Specimen	Site
14727	prox L h/c	NC1

Kobus cf. *K. leche* Gray, 1850

Material referred

KNM-WT	Specimen	Site
14730	prox R h/c	NC3

Kobus cf. *kob*

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16069	prox R & L h/c's	KL1	14729	prox R h/c	KL1
14734	prox L h/c	KL1	14724	frag L h/c	NT
14728	prox L h/c	KL1	14698	dist h/c frag	KL1
16075	dist h/c	KL1	14726	dist h/c	KL1

Kobus cf. *kob* horn core measurements

	16069	14729		16069	14734	14721
R h/c ap	51	44	L h/c ap	52	41	39
tr	42	37	tr	44	37	38

Kobus sigmoidalis Arambourg, 1941

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16675	prox R h/c	LO4	16667	prox L h/c	LO8
16469	L h/c & prox R h/c	LO1	16460	prox R h/c	KU3
16672	R h/c	LO1	16466	R & L h/c frags	LO7
16459C	prox R h/c	KU2	16662	prox L h/c	LO8
16459	prox L & R h/c's	KU2	16669	R h/c	LO8
16671	R h/c frags	LO1	16650	prox R & L h/c's	LO8
16670	prox R h/c	LO8	16668	prox L h/c & R h/c frag	LO8
16464	prox L h/c & R h/c frags	KU2	14732	L h/c frag	LK3
16674	cranium with R & L h/c's	KU2	16673	R h/c frag	LO9
16676	R h/c & prox L h/c	KU3			

Kobus sigmoidalis horn core measurements

	16675	16672	16459A	16459	16670	16676	16460	16669	16674
R h/c ap	46	53	51	46	54	51	48	55	50
tr	35	35	40	35	38	41	34	37	42
lt						240+			270+

	16459	16464	16677	16676	16466	16650	16668
L h/c ap	42	40	45	46	44	48	50
tr	36	34	30	39	31	34	40

Kobus sigmoidalis dental measurements

		16674R
dP^4	ap	13.1
	tr	12.6+
M^1	ap	18.0
	tr	13.7
M^2	ap	19.6
	tr	14.5
M^3	ap	19.3
	tr	11.7

Kobus aff. *sigmoidalis/ellipsiprymnus*

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
17409	h/c frags	KS1	17412	h/c frags	KS1
17410	prox L h/c	KS1	17413	h/c frags	KS1
17411	prox L h/c	KS1	17414	frontlet & prox R h/c	KS1

Kobus ellipsiprymnus/sigmoidalis horn core measurements

	17414	17413	17412	17409
R h/c ap	77	86	67	60
tr	64	59+	64	55

	17410	17411	17413	17412
L h/c ap	67	69	86	66
tr	50	60	72	58

Kobus oricornis Gentry, 1985

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16617	L h/c	LO5	16653	prox L h/c	LO1
16610	prox L h/c	NS1	16651	prox R & L h/c's	KU2
16602	prox R h/c	LO4	16652	L? h/c frags	LO1
16604	prox L h/c	LO3	16661	prox R h/c	LO1
16606	prox L h/c frag	KU2	16666	prox L h/c	LO1

Kobus oricornis horn core measurements

	16617	16610	16604	1653	16606	16666	16652	16678
L h/c ap	40	41	40	39	42	39	—	44
tr	45	50	45	36	42	40	44	50
lt	190+						270+	

	16602	16661
R h/c ap	40	39
tr	44	42

Kobus sp. A

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16612	R h/c	LO4	16663	prox R h/c	LO1
16664	prox R h/c	LO5	16657	prox L h/c	LO1
16614	frontlet with R & L h/c's	KU2	16601	L h/c frags	KU1
16605	prox L h/c	KU1	16587	L h/c, frags R h/c, L md (P_4–M_3) & associated pc frags	LO1

Kobus sp. A horn core measurements

	16612	16663	16614
R h/c ap	35		34
tr	42	44	43
lt	205+		255+

	16605	16601	16657	16664	16616	16587
L h/c ap	49	50	43	38	32	51
tr	61	54	54	46	39	58
lt					225+	

Kobus sp. A dental measurements

		16587
P_4	ap	13.3
	tr	8.8
M_1	ap	16.0
	tr	—
M_2	ap	19.9
	tr	11.8
M_3	ap	26.1
	tr	10.3

Kobus sp. B

Material referred

KNM-WT	Specimen	Site
16660	L h/c	KU2
16615	prox R h/c frag	LO2
16603	prox L h/c frag	(KU2)
16611	R h/c frags	LO9

Kobus sp. B horn core measurements

	16600	16603
L h/c ap	49	49
tr	45	42
lt	360+	

Kobus sp. C

Material referred

KNM-WT	Specimen	Site
16608	L h/c	LO3
16665	dist h/c frags & assoc md frag (RM_3)	KU2
16662A	dist h/c frag	LO8

Kobus sp. C horn core and dental measurements

	16608		16665
L h/c ap	46	M_3 ap	24.1
tr	52	tr	10.3
lt	330+		

Kobus sp. D

Material referred

KNM-WT	Specimen	Site
16607	R h/c	KU2
16613	R & L h/c frags	LO9

Kobus sp. indet.

Material referred

KNM-WT	Specimen	Site
16660	prox h/c (R?)	KU2
16659	prox h/c	KU2

Menelikia lyrocera Arambourg, 1941

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
14939	frontlet with h/c's	KK	14940	calvaria frag with L h/c	KK
16068	prox L h/c	KL1	14947	dist h/c frag	KG
14946	R & prox L h/c's	KK	14945	prox L h/c	KG
14951	prox R h/c	KK	14948	dist h/c frag	KG
14950	R & L h/c frags	KK	14952	L h/c	KG1
14949	L h/c frags	KK	14954	R & L h/c frags	KG
16420	prox R h/c	LA1	16247	prox R h/c	LO8
14953	prox R & L h/c's	KK	14719	weathered h/c	KG1

Menelikia lyrocera horn core measurements

		16247	14953	14942	16420	14939	14950	14946		
R h/c	ap	43	45	56	46	52	59	54		
	tr	43	40	46	43	40		45		
	lt			250+		250+		245+		
		14952	14945	14940	14953	14942	14949	14939	16068	14946
L h/c	ap	50	48	58	43	55	45	53	52	48
	tr	48	39+	52	42	46	43	45	40	43
	lt			230+						

Menelikia lyrocera dental measurements

		14955	14940A
M_1	ap	18.4	
	tr	9.7	
M_2	ap	22.4	
	tr	9.5	
M_3	ap		28.7
	tr		11.6

Menelikia sp. (cf. Gentry, 1985)

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16465	R & L h/c's	LO1	16654	prox R h/c	LO8
16468	L h/c	LO1	16658	R h/c frags	KU2
16463	L h/c frag	LO7	16461	prox R h/c	KU2
16467	prox L & R h/c's	LO1	16609	prox L & R h/c's	LO1
16462	L h/c	LO1			

Menelikia sp. horn core measurements

		16465	16467	16658	16609
R h/c	ap	55	51	50+	54
	tr	43	39	39	42

		16465	16468	16467	16462
L h/c	ap	55	43	47	53
	tr	45	42	39	39
	lt	250+	295+		

Reduncini large size group

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
14955	R md (P_4–M_3)	KK	14720	R md (dP_2–M_2)	LK1
14695	L md (P_3–M_3)	LK1	16165	R md frag (M_{2-3})	LO1
16148	L md frag (M_{1-3})	KU1	14699	LM_3 frag	NC1

Reduncini large dentition measurements

		14720	14695	16148	16165
dP_2	ap	9.0			
	tr	5.2			
dP_3	ap	14.0			
	tr	7.1			
dP_4	ap	22.2			
	tr	9.6			
P_3	ap		12.9		
	tr		8.6		
P_4	ap		12.8		
	tr		9.7		
M_1	ap	20.8	19.0		
	tr	9.1	13.3		
M_2	ap		24.1	25.5	21.9
	tr		14.0	14.9	12.9
M_3	ap		30.1	34.1	32.5
	tr		11.8	14.1	11.6

Reduncini medium size group

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
14731	L max frag (dP^4–M^2)	NC1	16135	L md frag (M_{1-3})	LO5
16128	L max frag (M$^{2-3}$)	LO5	14714	L md (M_{1-3})	KL3
16143	RM^2, RM^3 frag	LO1	14725	L md frag (M_{2-3})	KL2
14723	L max frag (M$^{2-3}$)	KK	14718	R md frag (P_3–M_2)	KG1
16144	LM^2	LO1	16132	R md frag (M_{1-3})	KU2
16137	LP^4–M^1	LO9	16151	R md frag (M_1, M_3)	LO1
16142	L max frag (P^4–M^1)	LO1	14741	R md frag (M_{2-3})	KG
16129	$\underline{M}$ frags	KU3	16141	L md frag (M_2)	LO2
14712	LM^2	KI2	14697	LM_2	NC1
16130	RM^1, LM^2, LM^3	LA1	16149	L md frag (dP_4–M_3)	KU1
16136	R md frag (M_3)	KU2	16146	R md frag (M_3)	LO9
16395B	L md frag (P_{3-4})	LO5	14711	L md frag (M_{2-3})	KG1
14721	R md frag (P_3–M_1)	KK	14737	RM_2 frag	KL6
14736	R md frag (M_3)	KG	14739	RM_2 frag	KK
16140	L md frag (P_4, M_3)	LO4	16167	RM frag	LA1
16164	L md frag (M_3)	LO1	16147	LM_{1-3}	LA1
16145	R md frag (M_{1-3})	LO1	14739B	LM_3 frag	KK
14717	L md frag (M_3)	KL6	17505	RM_2	KI2
16133	L md frag (M_{2-3})	LO9	17538	R md (M_{1-3})	KS1

Reduncini medium dentition measurements

		16137	16143	16128	14731	14723	16144	16142	14742	16130
dP^4	ap				15.2					
	tr				14.8					
P^4	ap	12.3						12.5		
	tr	13.5						12.8		
M^1	ap	18.4			16.4			16.2		
	tr	16.4			16.8			15.8		
M^2	ap		20.0	19.0	21.9	19.2	19.7		20.5	19.2
	tr		13.7	16.8	16.6	16.3	14.5		16.2	12.9
M^3	ap		—	22.2		22.0				17.4
	tr		15.1	14.5		14.7				11.8

		16145	14721	16395B	16136	16133	14717	16164	16140	14718	14725	14714	16135
P_3	ap		11.0	11.4									
	tr		9.0	7.9									
P_4	ap		13.4	11.1					13.0	13.3			
	tr		8.8	8.4					7.0	8.8			
M_1	ap	15.2								14.1		17.5	16.4
	tr	10.5								11.8		13.0	8.2
M_2	ap	18.5								18.9	21.2	19.1	19.0
	tr	11.5								11.4	11.0	14.7	8.2
M_3	ap	26.6			25.3	26.7	27.1	24.6	24.5		25.1	27.0	24.8
	tr	10.6			10.7	10.8	10.3	9.3+	9.5		9.4	10.9	7.8

		14711	16141	14741	16151	16132	14697	16149	16146	16147	14735B	17505	17530
P_4	ap												
	tr												
M_1	ap					13.7		18.6		19.3			
	tr					10.2		9.7		9.3			
M_2	ap	21.6	19.0	19.3		17.4	22.6	20.7		21.5		19.6	21.7
	tr	9.0	9.4	11.3		10.7	10.6	9.2		9.7		8.0	11.5
M_3	ap	—		30.6	26.2	27.5		25.5	27.7	—	—		
	tr	8.7		11.7	10.1	11.0		8.3	11.2	9.7	12.9		

Reduncini small size group

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16139	$LM^{1/2}$	LO4	16131	L md frag (M_3)	KU2
14738	$LM^{1/2}$	NC2	14733	$LM_{1/2}$	KL6
14715	L md (M_{2-3})	KG2	16138	L md frag (M_2)	LO5
16150	R md frag (M_{1-2})	LO1	16173	md frags (LdP_{2-4}, RdP_3–M_1)	LO5
14722	R md frag (M_{2-3})	KL1	17521	R md frag (M_2)	KS1
16134	RM_3 frag	LO4			

Small reduncine dentition measurements

		14738	16139			16173L	17173R
M^1		14.6		dP_2	ap	4.8	
		11.2			tr	3.0	
M^2	ap		17.7	dP_3	ap	10.7	11.2
	tr		12.8		tr	5.6	5.2
	ap			dP_4	ap	20.7	19.2
	tr				tr	7.2	6.7

		14715	16150	14722	16131	14733	16138	17521
M_1	ap		13.4					
	tr		9.9					
M_2	ap	16.4	16.8	15.1		16.4	16.5+	12.3
	tr	7.6	10.1	9.7		7.8	7.5	7.1
M_3	ap	19.0		21.6	23.2			
	tr	6.7		8.7	7.2			

is irregularly oval in transverse section, with the posterolateral corner projecting farther posteriorly. The horn core ornamentation varies from smooth to longitudinal ridging and two specimens, WT 16422 and 16421 from LO1 in the upper part of the Lomekwi Member, have prominent transverse ridges on their anterior surface. The horn cores ascend upward and slightly outward in their proximal third, then curve backward, and probably recurve upward toward their distal extremity. The horn cores possess large basal sinuses. It is conceivable that more than one species is represented among the specimens grouped here although this cannot be confirmed on the material currently available. The sample falls within the range of variation exhibited by a new unnamed species of *Damaliscus* from the upper part of the Koobi Fora Formation.

Parmularius Sclater & Thomas, 1894

Parmularius sp.

WT 16623, right and left horn cores from LO5 in the lower part of the Lomekwi Member, are superficially similar to those of *Aepyceros shungurae.* These horn cores are elongate and slender and have a large basal sinus. Although of comparable size and shape to *A. shungurae,* they have only a faint lyrate curvature and lack the transverse ribbing typical of many impala horn cores. The horn cores are mediolaterally compressed at their base and are almost triangular in transverse section because of the posterolaterally protruding expansion of the horn core base (very similar to that seen in species of *Damaliscus*). Although not attached to a frontlet, the horn cores appear to have curved upward and slightly outward proximally, curving posteriorly in their distal portion. The horn cores are much more slender than those attributed to *Damaliscus* and are not dissimilar in shape to those of *Damaliscus agelaius* or *Parmularius altidens.*

The left horn core measures 40 mm × 35 mm at its base and would have been longer than 210 mm.

Connochaetes Lichtenstein, 1814

Connochaetes new species

Figures 51–56

The most complete specimen is WT 14525, a calvaria with horn cores from KL3 in the Kaitio Member. The supraorbital and postorbital regions are very broad and closely comparable in shape to those of a more complete cranium of similar geologic age from Koobi Fora (KNM-ER 287). The orbital region constitutes the widest portion of the cranium. Behind

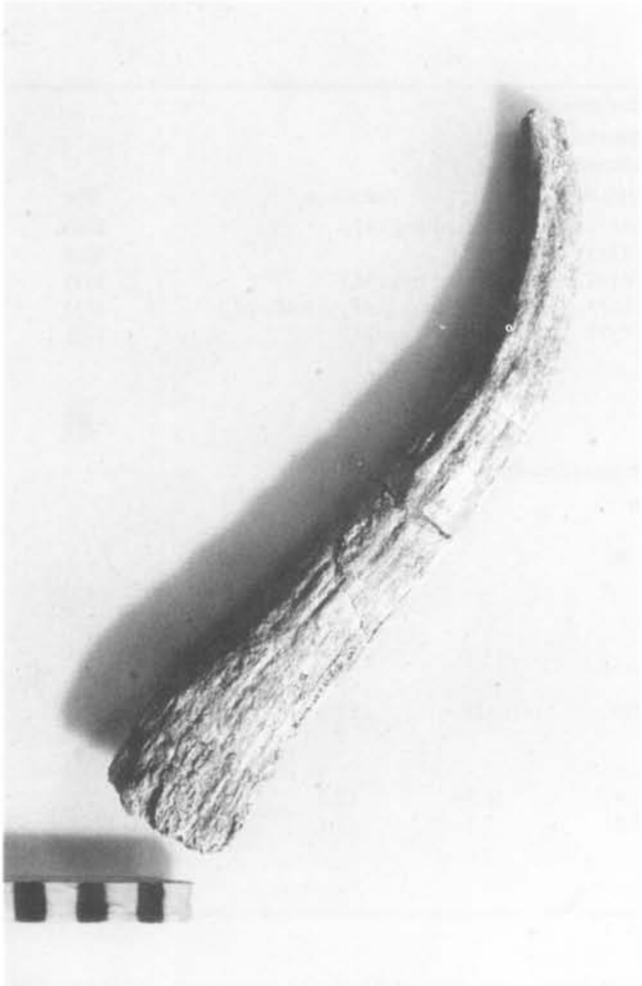


Figure 47. KNM-WT 16613, *Kobus* sp. D left horn core; lateral view.

the orbits the frontal is constricted as it extends posteriorly toward the horn core bases. The dorsal surface of the cranial vault in the parietal region is even narrower and slopes downward to the nuchal crest. The occipital region is identical to that of the Koobi Fora cranium but less well preserved. Only the basioccipital is preserved on the ventral surface of the specimen (i.e., the paroccipital processes are broken off at their bases and the auditory bullae are missing).

The horn cores are broad at their base and oval in transverse section with the longest axis directed mediolaterally. They rise backward and upward in their proximal portion and a distinct keel is produced on the medial surface, with a slight concavity immediately behind the keel. The horn core is then flexed laterally with slight anticlockwise torsion on the right horn core. At this point the horn core is oval, flattened dorsoventrally, in transverse section, and with a slight keel on the posterior margin. The distal third of the horn core curves upward to terminate in a pointed tip and is more nearly rounded in transverse section though slightly flattened mediolaterally. The horns are generally more slender than those of the Koobi Fora specimen but are clearly conspecific. Perhaps the West Turkana specimen is a female.

WT 16060, a frontlet with a proximal left horn core from KL1 in the Natoo Member, appears to be an immature *Connochaetes*. The horn core, arising just behind the orbit, is dorsoventrally flattened and curves backward and outward in the plane of the cranial vault. The tip of the horn core is missing but at the point of breakage the horn core appears to begin an upward curve. Another specimen from KL1—WT 17510—though fragmentary confirms the presence of *Connochaetes* new species at this locality.

Two specimens of *Connochaetes* were recorded from Shungura Member G (Gentry, 1985) but these lack keels and may represent a different species.

Connochaetes sp.

Two proximal horn cores have been collected from KU2 in the upper Lomekwi Member, WT 16427, a proximal right horn core, and 16424, a proximal left horn core. These differ from *Connochaetes* new species from later in the West Turkana sequence and from Koobi Fora because they extend directly outward from their base rather than, as in the younger specimens, extending backward and then outward. Although their basal diameter is comparable, or slightly smaller, than the specimen from KL3, the proximal (outwardly directed) portion of the KU2 horn cores is considerably more robust. Though incomplete, they too show slight torsion (again, clockwise in the right horn core) and appear to flex upward distally.

Alcelaphini Teeth

The West Turkana alcelaphine dentitions may be subdivided into three size groups. The largest size group, 21 specimens representing all members except the Lonyumun, Kataboi, and upper Lomekwi, includes teeth that are larger than those of the extant wildebeest and are of comparable size to those of the large extinct alcelaphine *Megalotragus* van Hoepen, 1932. The medium size group, 32 specimens from the Lomekwi and all younger members, are teeth of comparable size to those of the extant wildebeest and conceivably represent extinct *Connochaetes* species. The small size group includes some specimens that possessed lower second premolars and others that, like most alcelaphines, had lost this tooth. Some of the small size group (46 specimens from the Lomekwi, Kalochoro, Kaitio, Natoo, and Nariokotome members) probably belonged to species of *Parmularius*.

Aepyceros Sundevall, 1747

Impalas are among the commonest bovids from the West Turkana sequence. Three relatively easily distinguishable forms are recognized here; an unnamed species of *Aepyceros* from the upper Kataboi Member at Loruth Kaado; *Aepyceros shungurae* from elsewhere in the lower portion of the succession and *A.* cf. *melampus* in the upper portion. All three species have lyrate horn cores that arise immediately above

Figure 48. KNM-WT 14939, *Menelikia lyrocera* frontlet with horn cores from the Kalochoro Member at KK; anterior view.

and behind the orbits and are inserted on pedicels that have extensive basal sinuses, are compressed mediolaterally in their basal portion, have their anterior surfaces ornamented with transverse ridges, and have a postcornual fossa located at the posterolateral corner of the pedicel.

The features of the horn cores here used to separate the two common species—length, thickness, and degree of divergence and of lyration—are, as pointed out by Gentry (1985), all characters that display great regional variation in modern impalas and were therefore not used in his diagnosis of *A. shungurae* from the Omo succession. Nevertheless they conveniently serve to distinguish the morphs from the upper and lower portions of the West Turkana sequence. In the larger Omo sample studied by Gentry, he arbitrarily assigns all specimens from upper Member G and older horizons to *A. shungurae* (Gentry, 1985:173). At Koobi Fora and in the West Turkana succession there is an appreciable gap in the fossiliferous sequence immediately underlying strata equivalent to Shungura Member G and at both localities this gap, perhaps fortuitously, coincides with differences seen in the morphology of the *Aepyceros* horn cores.

Aepyceros melampus (Lichtenstein, 1812)

Aepyceros cf. *A. melampus*

The extant impala, or a form very closely similar to it, is known from 23 specimens from 10 sites in the Kalochoro and superjacent members but is particular abundant in the Kaitio Member. The oldest recognized specimen is from LA1. In these specimens, which tend to be larger than those of *A. shungurae,* the horn cores are relatively more transversely oriented and diverge more widely in their proximal portion, resulting in a more exaggerated lyrate shape. The horn cores are usually longer, stouter, and more robust than those found lower in the succession. Impalas were reported to be living near Lokori, southwest of Lake Turkana in the Kerio Valley, nearly two decades ago by Coe (1972) and were documented on Kulal, to the southeast of the lake, by Stewart and Stewart (1963) but are not usually seen elsewhere in the Lake Turkana Basin.

Aepyceros shungurae Gentry, 1985

Aepyceros shungurae is represented by 58 specimens from the Lomekwi, and Lokalalei members, but is particularly abundant at LO4 and LO5 in the lower part of the Lomekwi Member. This species, common in the lower portion of the Shungura sequence, has horn cores that are smaller and more gracile than the extant species. The base of the horn core has an oval transverse section that is aligned anteromedially–posterolaterally. The horn core rises upward, backward, and outward from the base in its proximal third but is far less laterally divergent than the later or modern form. The horn core then curves medially so that the middle third of the

Figure 49. KNM-WT 16465, *Menelikia* sp. frontlet with right and left horn cores from the upper Lomekwi Member at LO1; anterior view.

Figure 50. KNM-WT 16465, *Menelikia* sp. left horn core; lateral view.

horn core is oriented more or less parallel with its fellow. The distal third of the horn core curves upward and slightly inward so that the overall shape of the horn core is a narrow lyrate one. Transverse ridges are variably developed on the anterior surface in all but the distal fourth of the horn core. The posterior surface is ornamented by longitudinal ridges and grooves. There is slight clockwise torsion upward in the right horn core.

Aepyceros sp.

Left horn core WT 14932, from LK1 in the Kaito Member, is considerably larger than the slightly younger specimens of *A. shungurae* from Lomekwi Member localities. In this, and other specimens from LK1 and LK2, the long axis of the horn core base is more transversely oriented and diverges more laterally and less posteriorly from the base. These specimens bear a closer resemblance to *A. melampus* than to *A. shungurae* but are perhaps even closer in size and morphology to an as yet unnamed species of *Aepyceros* from Lothagam. They are evidently not closely related to a new species of *Aepyceros* described by Gentry (1985:183) from the Omo Mursi Formation and from Karmosit in Kenya.

Tribe Antilopini

Antidorcas Sundevall, 1847

Antidorcas recki (Schwartz, 1932)

Antidorcas, the genus that includes the extant South African springbok, is represented at West Turkana by six horn cores from the Lomekwi, Kalochoro, and Kaitio members. These, like others known from Olduvai and Koobi Fora, vary considerably in shape. WT 16249, a proximal right horn core from LO9 in the Lomekwi Member, is quite broad at its base, has distinct anticlockwise torsion, and the tip, though missing, conceivably curved upward in its distal portion. Four specimens—WT 14605, 14604, 14616, and 14617—from the Kalochoro Member are more mediolaterally compressed and show less torsion. WT 14612 from KL3 in the Kaitio Member is by far the broadest and there is a slight keel on its medial surface. A number of incomplete dentitions from the Lomekwi and Kalochoro members are attributed

Figure 51. KNM-WT 14525, *Connochaetes* new species calvarium and left horn core from the Kaitio Member at KL3; dorsal view.

Figure 52. KNM-WT 14525, *Connochaetes* new species calvarium and left horn core; left lateral view.

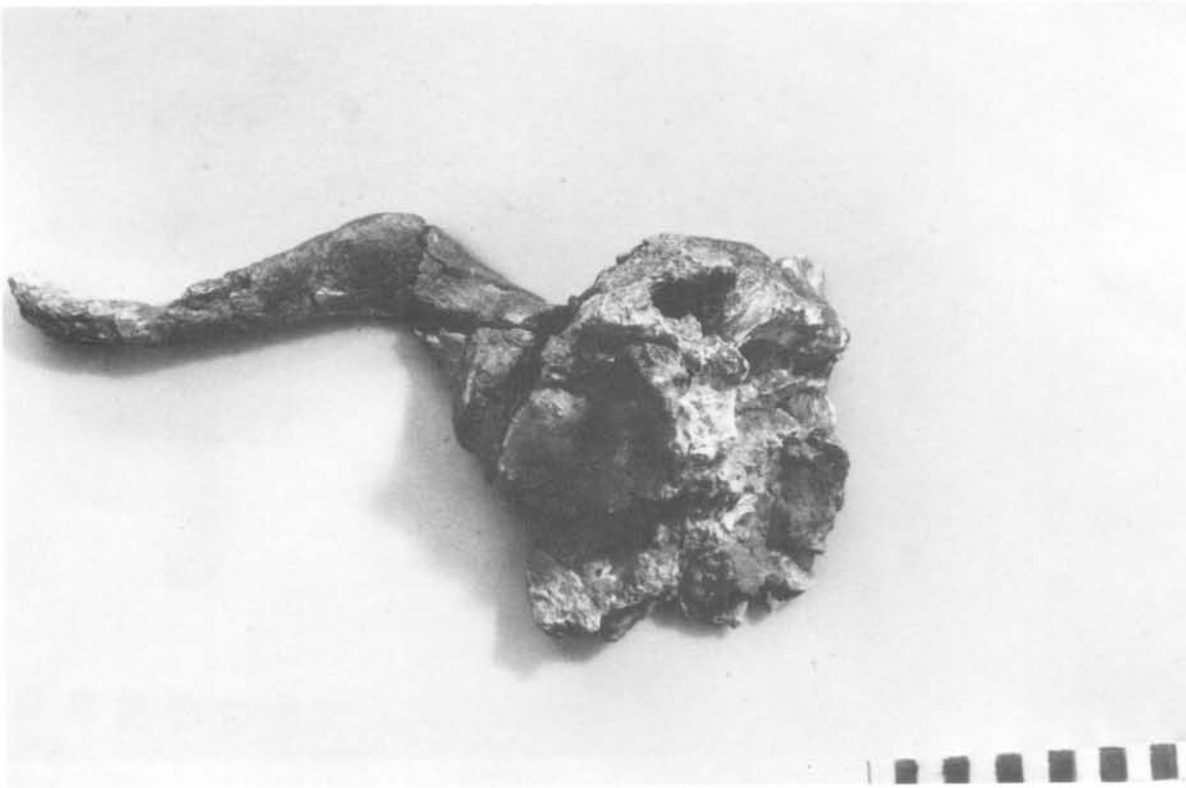


Figure 53. KNM-WT 14525, *Connochaetes* new species calvarium and left horn core; ventral view.

Figure 54. KNM-WT 14525, *Connochaetes* new species right horn core; anterior view.

Figure 55. KNM-WT 14525, *Connochaetes* new species right horn core; dorsal view.

Figure 56. KNM-WT 14525, *Connochaetes* new species right horn core; posterior view.

Damaliscus Sclater & Thomas, 1894
Damaliscus sp(p).

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16421	prox R h/c	LO1	16426	prox R h/c	LO5
16422	prox & distal R h/c	LO1	14602	prox L h/c	LK3
16425	prox R h/c	LO4	17417	prox R h/c	NY3
16423	prox R h/c	LO1	17416	R & L h/c frags	KS1
14572	prox R h/c	KL6	17447	frontlet with prox h/c's	NY3
16599	prox R h/c	LO3			

Damaliscus sp. horn core measurements

	16421	16422	16423	16425	16426	14572	14602	16599
Prox R h/c ap	53	50+	52	54	57	59	50	39+
tr	41	41	38	47	44	48	45	40

Parmularius Sclater & Thomas, 1894
Parmularius sp.

Material referred

KNM-WT	Specimen	Site
16623	R & L h/c's	LO5

Connochaetes new species

Material referred

KNM-WT	Specimen	Site
14525	calvaria with h/c's	KL3
16060	frontlet with prox L h/c	KL1
17510	h/c frags	KL1

Connochaetes new species cranial measurements

	14525	16060
Width post orbits	172*	
Width h/c bases	170	
Width mastoids	125	
Height occiput to top of foramen magnum	46	
Height occiput to bottom of foramen magnum	76	
Width occipital condyles	87	
Width post. tuberosity	39	
Width ant. tuberosity	29	
R h/c ap		
tr		
length		
L h/c ap		29
tr		40
length		

Connochaetes sp.

Material referred

KNM-WT	Specimen	Site
16424	proximal L h/c	KU2
16427	proximal R h/c	KU2

Connochaetes sp. horn core measurements

	16424	16427
R h/c ap	50	
tr	60	
L h/c ap		35+
tr		53+

cf. *Megalotragus* sp.

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
14586	LM^3	KL6	14580	LM$_3$	LK5
16560	RM$^{2-3}$	LO5	16599	RM$_{2?}$	LA1
16172	LM^3	LO4	14667	RM$_2$	KL2
16576	LM$^{3?}$	LO5	16574	R md frags (M$_{2-3}$)	LO9
16588	RM^3	LO5	16654A	L md frag (dP$_4$)	LO8
14582	RM^2	KL1	17432	R md frag (P$_4$–M$_3$)	NY3
16485	RP$^{3-4}$ (max frag)	LO4	17508	LM^2	NC1
16575	LM$^{1/2}$	LO4	17515	L md frag (M$_{2-3}$)	KS2
16577	RP^4, RM$^{2-3}$, LP^3	LO4	17545	R max frag (dP^4–M^1)	NY3
14575	R md frag (dP$_4$–M$_2$)	LK3	17441	RP$_4$, LM$^?$	KS1
14598	R md frag (M$_{1-3}$)	KL1			

cf. *Megalotragus* sp. dental measurements

		14575	14598	14580	17515	16559	14667	16574	16554A	17432	17441
dP$_4$	ap	25.3							30.6		
	tr	11.6							9.9		
P$_4$	ap									16.3	20.3
	tr									8.8	16.1
M$_1$	ap		19.3							21.2	
	tr		14.0							12.0	
M$_2$	ap	29.3	26.8		32.8	27.7	27.5	28.2		31.6	
	tr	11.8	16.1		12.6	11.3	13.0	10.7		14.1	
M$_3$	ap		43.9	42.1	39.1					42.7	
	tr		15.8	13.9	11.7			9.6		13.5	

		14586	16560	16172	16576	16558	14584	16485	16575	16577			17508	17545
P^3	ap							13.5			P^4	ap		19.6
	tr							11.7		12.2		tr		(13.6)
P^4	ap							14.2		14.3	M^1	ap		22.9
	tr									13.6		tr		12.7
M^2	ap		27.8				29.1		28.5	25.9	M^2	ap	31.8	
	tr		19.7				19.0			19.2		tr	20.7	
M^3	ap	30.0	23.8	26.0	23.9	27.9				26.4				
	tr	16.2	12.8	17.6	16.9	19.8				18.1				

Alcelaphini medium-sized teeth

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
14595	RM frag	KL3	16579	R & L M$_2$, M$_3$	LO1
14585	RM^3	KL6	16565	R md frag (M$_{1-3}$)	LO5
16581	LM$^{3?}$	LO5	16578	M frags	LO10
14579	RM^2	KL1	14601	L md (P$_4$–M$_2$)	KL6
14593	RM^2	NC1	16555	R md frag (P$_{3-4}$)	LO5
16561	RM^3	LO5	16571	LM$^{1-2}$, LM$_{1-2}$, RM$_{2-3}$	LA1
16564	L max frag (M$^{1-3}$)	LO9	16570	L md frag (P$_4$–M$_2$)	LO5
16567	LP^4–M^3	LO4	16582	L md frag (M$_{2-3}$)	LO5
16563	L max frag (P^2–M^2)	LO5	14588	RM$_1$	NK1
14589	RM^2	KG	14581	RM$_2$	LK1
16562	LM^3	LO5	16568	L md frag (P$_3$–M$_2$)	LO5
14582	RM^1, RM$_1$	KL1	16166	RM$_3$	LO9
14576	RM^3	NC1	17483	LM$_1$	NY2
16577C	LM$_3$ frag	LO4	17489	LM$_3$	NY2
16556	R md frag (P$_4$–M$_3$)	LO5	17522	RM$_3$	KS1
16557	R md frag (M$_{1-2}$)	LO9	17439	LM$_3$	KS1

Medium Alcelaphini dental measurements

		16556	16557	16579	16565	14601	16555	16570	16582
P_3	ap			11.2			11.0		
	tr			7.0					
P_4	ap	12.2				15.1	15.0		
	tr					8.4	9.5		
M_1	ap	16.4			22.1	18.4		16.3	
	tr	11.2			11.7	11.3		12.2	
M_2	ap	21.8	24.3	26.3	26.8	23.3		23.0	22.4
	tr	12.9	12.8	13.9	11.3	12.2		12.8	13.5
M_3	ap	34.4	35.4	34.5	31.9				34.7
	tr	14.0	13.0	12.9	10.6				13.8

		16571	16568	14588	14581	16577C	16582A	16166	17482	17489	17522	17439
P_3	ap		10.2									
P_4	ap		13.4									
	tr		7.4									
M_1	ap	20.5	19.5				18.2		19.1			
	tr	9.0	8.9				9.0		9.0			
M_2	ap	22.5	23.7	22.4	24.2							
	tr	7.7	11.7	11.8	11.5							
M_3	ap							34.0			29.1	37.9
	tr					11.5		13.0		10.4	10.8	13.9

		16563	16567	16564	16571	16561	14576	16562	14582B	14589	14593	14579
P^2	ap	8.5										
	tr	6.7										
P^3	ap	11.5										
	tr	10.5										
P^4	ap	13.4	11.2									
	tr	13.1	12.2									
M^1	ap	15.3	16.9	16.8				22.7				
	tr	15.0	15.0	17.7				14.3				
M^2	ap	23.4	24.1	25.0	21.5				20.4	21.8	26.5	23.5
	tr	17.9	15.6	19.3	14.6				12.5	13.6	18.4	17.2
M^3	ap		23.9	30.6		28.1	22.7					
	tr		13.7	16.5+		17.5	13.5					

Alcelaphini small-sized teeth

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16478	LM^2	LA1	14591	L md frag (M_3)	KL6
16580	LM^2, RM^{2-3}	LO4	14573	L md frag (M_2)	KL1
16553	R max frag (M^{2-3})	KU2	14583	RM_3	KL3
16482	LM^1, LM_1	KU3	14574	R md frag (dP_3–M_2)	KL6
16566	RM^3	LO4	16481	L md frag (M_{1-2})	KU2
16572	LM^2	LO1	16552	R md frag (P_4–M_3)	KU1
14592	R max frag (P^4–M^3)	KI3	14597	LM_1	KK
14590	L max frag (P^2–M^3)	KK	14587	R md (P_3–M_3)	KK
16484	RM^1, LM^3	KU1	16477	L md frag (M_3)	LO5
16551	LM^3	LO3	16476	R md frag (M_3)	LO5
16486	LM^3	LO4	16475	R md frag (P_3–M_2)	LO5
16483	RM^1	KU1	16554	L md frag (P_3–M_3)	KU1
14578	LM^3	NC1	14596	RM_3	KK
16479	L md frag (M_{1-2})	LO5	14594	md & max frags (LM_{1-3}) LM^3, RM^3	KK
16573	L md frag (M_{1-2})	LO3		RM^3 different individual	
14600	L md frag (M_{1-3})	LK1	16471	R & L md frags (P_4–M_1)	LO10
14577	RM_3	LK3	16472	L md frag (P_4–M_3)	LO9
14599	RM_2	LK3	16550	RM^3, LM_3	LO5

Alcelaphini small-sized teeth (continued)

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16389	LM^3	KU1	16406	R md frag (M_3)	LO9
16409	RM^2	LO9	16453	RM_2	LO5
14935	R md frag (M_{2-3})	KK	16412	L md frags (P_4, M_3)	LA1
16388	L md frag (M_3)	LO5	14934	L md frags (P_4–M_2)	KG1
16407	R md frag (P_4–M_2)	LO9	16606C	R md frag (M_3)	KU2
16410	R md frag (M_3)	LO9			

Small Alcelaphini dental measurements

		16550	16472	16471	14594	14596	16554	16475	14476	16477	14587	14597
P_3	ap						11.7				8.5	
	tr						7.6				4.8	
P_4	ap		8.0	10.9			13.7				10.5	
	tr		5.8	6.1			8.5				6.3	
M_1	ap		11.7	15.7	10.6		15.7	16.6			13.9+	17.1
	tr		7.0	8.4	7.4		10.4	7.6			9.1	7.0
M_2	ap		16.1		12.9+		20.2	20.0			19.0	
	tr		8.9		8.6		10.7	7.6			9.5	
M_3	ap	21.9	22.3		22.3	23.4	24.7		25.4	26.2	22.2	
	tr	8.7	8.2		8.5	7.6	9.9		9.7	9.7	7.7	

		16552	16481	16482	14574	14583	14573	14600	16573	16479	14599	14577
dP_3	ap				11.0							
	tr				5.2							
dP_4	ap				20.3							
	tr				8.0							
P_3	ap											
	tr											
P_4	ap											
	tr											
M_1	ap	15.6	18.4	17.2	18.6			19.8	19.0	19.5		
	tr	9.3	8.6	8.4	7.5			9.8	8.4	8.6		
M_2	ap	19.0					22.2	22.6	21.0	21.2	22.8	
	tr	9.0	8.3				8.8	9.0	8.0	8.3	9.8	
M_3	ap	20.6+				28.4		26.0				28.9
	tr	7.7				10.1		8.3				9.4

		14935	16388	16407	16410	16406	16453	16412	14934	16606C
P_4	ap			7.9				12.1	7.8	
	tr			4.8				7.9	5.4	
M_1	ap			12.7					9.5	
	tr								7.5	
M_2	ap						16.9		13.7	
	tr	7.5		6.9			9.3		7.8	
M_3	ap	19.2	21.4		22.8	19.6				22.7
	tr	7.1	7.5		7.8	7.1		8.6		6.7

to this taxon on the basis of their small size, square upper molars with V-shaped backward-pointing internal cusps, and comparably shaped lower molars.

Gazella Blainville, 1816

Three gazelle species are represented in the West Turkana sequence by horn cores. The largest has horn cores of similar size and shape to the extant Grant's gazelle and was hitherto unrecorded from the Lake Turkana Basin. The two smaller species are both known from Koobi Fora although only one, *G. praethomsoni,* was previously recorded from the Omo succession.

Gazella granti Brooke, 1872

Gazella cf. *G. granti*

Figure 57

Three horn cores, one from the upper Kataboi Member (LK1) and two from the upper Lomekwi Member (LO1), bear a

Aepyceros melampus (Lichtenstein, 1812)

Aepyceros cf. *A. melampus*

Material referred KNM-WT	Specimen	Site
16627	R & L h/c frags	LA1
14931	R h/c frag	KL1
14920	dist R h/c frag	KL1
14921	R h/c frag	KL1
14927	prox R h/c	KL6
14929	R & L h/c frags	KI3
14919	dist L h/c frag	NC1
14928	prox R h/c	NC1
17479	R & L h/c frags	NY2
17501	h/c frag	NC1
17535	juv L h/c	NY2
17541	cranium & h/c's	NY3
17431	cranium & h/c frags	NY2
16413	LM_2	LA1
14938	R md frag (M_3)	KG1
14936	R md frag (M_{1-3})	KL1
16414	LM^{2-3}	LA1
14879	R max frag (dP^4–M^1)	LK4
17548	LM^2	NY2
17549	L md frag (dP_3–M_1)	NY2
17552	RM_1	NY3
17440	LM_3	KS1
14922	R h/c frag	KK

Aepyceros cf. *A. melampus* horn core measurements

	16627	14927	14921	14931	14929	14928
R h/c ap	35	41	33	35	33	36
tr	35	35	21	28	25	30

	14929	17429	17535
L h/c ap	36	39	27
tr	37	33	21

Aepyceros cf. *A. melampus* dental measurements

	14936	14938	17549	16413	17752	17740
dP_3 ap			9.2			
tr						
dP_4 ap			18.6			
tr			6.1			
M_1 ap			15.7		16.4	
tr			6.5		7.8	
M_2 ap	14.4			17.1		
tr	8.5			7.4		
M_3 ap	25.2	20.5				26.5
tr	9.2	7.9				(9.9)

	16414	17548	14879	17431
dP^4 ap			14.5	
tr			10.3	
M^1 ap			17.1	12.7+
tr			9.6	
M^2 ap	17.1	16.5		17.2
tr	10.6	9.2		12.7
M^3 ap	16.9			17.7
tr				10.7

Aepyceros shungurae Gentry, 1985

Material referred KNM-WT	Specimen	Site
16630	R h/c	LO4
16641	L h/c	LO4
16620	R h/c	LO4
16514	prox R h/c	LO4
16515	prox L h/c	LO4
16518	prox R h/c	LO4
16637	L & R h/c frags	LO4
16619	prox R h/c	LO4
16624	prox L h/c	LO4
16621	L h/c frags	LO4
16625	juv prox L h/c	LO9
16632	prox R h/c	LO9
16633	prox L h/c	LO9
16242	prox R & L h/c's	LO4
16629	prox L h/c	LO9
16644	L h/c frags	LO5
16638	R h/c frags	LO5
16636	L h/c	LO5
16516	R h/c	LO4
16626	prox R h/c	LO5
16631	prox L h/c	LO5
16643	prox R h/c	LO4
16642	prox R h/c	LO4
16635	R & L h/c frags	LO5
16645	prox L h/c	LO5
?16639	prox R h/c	LO5
16646	R h/c frags	LO5
16648	R h/c frags	LO5
16649	R h/c frags	LO10
16512	prox R h/c	LO3
?16517	R h/c frag	LO3
16513	R h/c	LO1
16634	juv R h/c	KU1

Aepyceros shungurae Gentry, 1985 (continued)

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16622	juv R h/c	KU2	16401	L md frag (dP_4–M_2)	KU1
16640	L h/c frag	LO8	16411	L md frag (M_{2-3})	LO4
16246	prox R h/c	LO4	16408	RM_1	LO9
16405A	prox R h/c	LO5	16404	L md frag (M_{2-3})	LO5
16396	R md frag (M_{2-3})	LO4	16416	LM_3 frag	LO4
16402	L md frag (M_1–M_3)	LO5	16394	max frags (LP^4–M^2, RM_{2-3}) & md frags (LP_4–M_2), (RM_3)	LO5
16400	*R md frag (M_3)*	*LO4*	16390	max frags (R & LM's)	KU3
16452	LM_2	LO4	16418	LM^3	LO4
16399B	RM_2	LO10	16393	L max frag (M^{2-3})	LO5
16392	R md frag (M_{1-2})	KU2	16417	RM^{2-3}	LO4
16391	R md frag (M_{2-3})	LO5	*16395A*	*R max frag (M^{2-3})*	*LO5*
16403	*L md frag (M_{1-3})*	*LO5*	16581B	LM	LO5
16451	R md frag (P_2–M_2)	LO5			

Aepyceros shungurae horn core measurements

	16648	16639	16645	16643	16653	16626	16516	16636	16638	16620	16630	16514
R h/c ap	37	34	36	32	32	33	33	32	31	37	35	29
tr	34	28	32+	29	31	30	21	27	26	30	28	23
lt											240+	

	16518	16642	16637	16619	16624	16632	16242	16426	16512	16634	16622	16405A
R h/c ap	32	35	34	33	38	38	27	24	36	25	29	33
tr	26	33	32	28	34	35	25	23	31	18	19	32

	16646	16653	16631	16636	16644	16630	16515	16637	16621	16625	16633	16629	16242
L h/c ap	32	34	32	30	34	32	30	35	39	25	40	32	28
tr	31	33	28	28	30	30	31	31	31	25	35	29	22
lt						270+							

Aepyceros shungurae dental measurements

		16451	16403	16391	16402	16396	16411	16399	16394
P_2	ap	4.9							
	tr								
P_3	ap	8.8							
	tr	4.6							
P_4	ap	8.9							9.6
	tr	5.3							
M_1	ap	12.8			14.5				14.0
	tr	7.1			6.6				
M_2	ap	15.2	14.5	15.3	16.7	15.8	17.5	18.5	16.3
	tr	7.2	8.0	8.5	6.1	8.2	8.0	6.9	8.2
M_3	ap		19.2	21.5					22.8
	tr		7.3	8.0					7.1

		16401	16408	16404	16392	16452			16394	16390	16393	16395	16417	16418
dP_4	ap	17.4					P^4	ap	10.4					
	tr	6.4						tr	8.2					
M_1	ap	15.8	13.2		14.3		M^1	ap	14.3					
	tr	6.3	6.8		7.0			tr	10.7					
M_2	ap				17.1	15.4	M^2	ap	16.9	16.8	16.4	17.2	18.2	
	tr				7.4	7.5		tr	11.3	10.3	12.1	11.9	11.3	
				17.0			M^3	ap	17.0		18.6	15.5		19.2
				8.1				tr	9.8		11.4	9.7		10.8

Impala specimen lists and measurements (continued).

Aepyceros sp.

Material referred KNM-WT	Specimen	Site
14932	L h/c	LK1
14930	L h/c frag	LK2
14926	R h/c frag	LK1
14937	R md (M_3)	LK1

Aepyceros sp. horn core measurements

	14932
L h/c ap	40
tr	34

Aepyceros sp. dental measurements

	14937
M_3 tr	8.0

Antilopine specimen lists and measurements.

Antidorcas recki (Schwartz, 1932)

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
14605	R & L h/c's	KK	16250	L max (P^3–M^3)	LO3
14616	R h/c	KG1	16243	R md frag (P_4–M_2)	KU1
14604	prox R h/c	KG1	16235	L md frag (M_{2-3})	LO4
14617	prox L h/c	KG2	16236	L md frag (M_2)	LO9
16249	prox R h/c	LO9	14619	R md frag (dP_4–M_1)	KG
14612	prox L h/c	KL3			

Antidorcas recki horn core measurements

	14605	14616	14604	14617	16249	14612
R h/c ap	27	25			24	
tr	17	17			19	
lt	10	12				
L h/c ap	28		21	29		28
tr	17		11	17		24

Antidorcas recki dental measurements

	14619	16243	16235	16236		16250
dP_4 ap	14.3				P_3 ap	7.4
tr	4.8				tr	7.5
P_4 ap		6.2			P_4 ap	6.9
tr					tr	7.8
M_1 ap	11.4	9.9			M^1 ap	9.7
tr	4.6				tr	10.8
M_2 ap		11.9	9.9	11.8	M^2 ap	11.8
tr		6.9	6.4	5.3	tr	10.5
M_3 ap			15.4		M^3 ap	15.0
tr			6.1		tr	9.4

Gazella Blainville, 1816
Gazella granti Brooke
Gazella cf. *granti*

Material referred KNM-WT	Specimen	Site
14620	L h/c	LK1
16244	prox L h/c	LO1
16240	prox R h/c	LO1

Gazella cf. *granti* horn core measurements

		14620	16244	16240
L h/c	ap	46	46	
	tr	29	28	
	lt	250+		
R h/c	ap			53
	tr			31

Gazella janenschi Dietrich, 1950

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
14613	L h/c	KL3	16237	prox L h/c	LO6
16238	prox L h/c	LO5	14567	prox R h/c	KL2
16245	prox L h/c	LO9	16271	distal h/c frags	KU2

Gazella janenschi horn core measurements

		14613	16238	16245	16237	14567
L h/c	ap	23	21	24	26	
	tr	20	17	23	24	
	lt	80+				
R h/c	ap					24
	tr					22

Gazella praethomsoni Arambourg, 1947

Material referred KNM-WT	Specimen	Site
16074	L h/c	KL1
16272	prox L h/c	LA1
16076	prox R h/c	KL1
14614	female R h/c	KK
14610	female prox R h/c	KG

Gazella praethomsoni horn core measurements

		16074	16076	16272	14614	14610
L h/c	ap	27	26	24		16
	tr	20	16	16		12
	lt	140+				
R h/c	ap				14	
	tr				11	
	lt				72+	

Gazella sp. indet.

Material referred KNM-WT	Specimen	Site	Material referred KNM-WT	Specimen	Site
16248	L md (P_3–M_2)	KU2	16056	L md (P_3–M_2)	KL1
14609	L md frag (M_2)	KG1	14933	R md frag (dP_{3-4})	NK1
14611	L md frag (M_{1-2})	KL1	14923	L md frag (M_{1-3})	KG1
14618	L md frag (M_{1-3})	KG	14924	L max frag (M^{1-3})	KL1
14603	L md frag (M_2)	KL5	16399A	LM^2	LO10
14606	LM_3 frag	KK	17425	L md (P_3–M_3)	NY4
16405	max frags (LP^2–M^3, RM^2)	LO5	17550	LM	NY4
16398	md & max frags (LP_3–M_3, RP^4–M^1)	LO4			

Gazella sp. indet. dental measurements

		16248	14609	14611	14618	14603	14933	14923	16056	17425	16398
dP_3	ap						10.2				
	tr						6.1				
dP_4	ap	12.0					15.5				
	tr	5.5									
P_3	ap	6.8									
	tr	3.2							8.1	8.4	
P_4	ap								5.3	5.1	
	tr								9.9	9.1	9.6
M_1	ap	11.8	12.8		12.2			11.1	6.1	5.5	5.5
	tr	5.9	6.5	7.6	6.5			6.8	11.5	11.8	12.3
M_2	ap	14.9		16.8	14.5	15.2		11.8	7.2	7.4	7.5
	tr	6.1		6.3	6.4	7.7		8.1		14.7	15.3
M_3	ap				19.8			20.5		7.5	7.4
	tr				5.6			7.8		20.2	

		16405	14924	16399A	
P^2	ap		6.6		
	tr		7.9		
P^3	ap		7.3		
	tr				
P^4	ap		8.9		
	tr		10.0		
M^1	ap		11.3	10.9	
	tr		12.7	11.6	
M^2	ap		14.5	14.1	16.3
	tr		12.2	12.4	11.2
M^3	ap			17.0	
	tr		10.0	11.7	

striking resemblance to those of the extant *Gazella granti.* The horn core, arising immediately above the orbit, is mediolaterally compressed and is D-shaped in basal transverse section with a flattened lateral surface. Almost vertically inserted, the horn core rises upward and backward, tapering gradually. There is no surface ornamentation other than longitudinal grooves. A horn core of similar size and shape and attributed to *G. granti* has been recorded from the somewhat older Lower Laetolil Beds (Harris, 1987b).

Gazella janenschi Dietrich, 1950

Six specimens of *G. janenschi* have been recovered from six sites in the Lomekwi, Kaitio, and Natoo members. The horn cores of this species are much smaller and broader than those of *Gazella* cf. *G. granti,* but still have a D-shaped base in transverse section. Arising immediately above the orbit, the horn core curves backward and outward. The surface is smoother than that of *G. granti* but shows some longitudinal grooving. *Gazella janenschi* was originally described from Laetoli but is also known from undescribed specimens in the Koobi Fora sequence.

Gazella praethomsoni Arambourg, 1947

Five specimens that can be attributed to *G. praethomsoni* have been recovered from three sites in the Kalochoro Member and from KL1 in the Natoo Member. Horn cores of this species are of comparable or slightly larger size than those of *G. janenschi* and are longer but more mediolaterally flattened (though less so than in *G.* cf. *granti*). They curve backward, diverging outward toward the tip. The species was originally described from the Omo sequence and occurred also in the Koobi Fora succession.

Gazella species indeterminate

Fifteen partial dentitions or isolated teeth attributable to *Gazella* species have been recovered from 10 West Turkana sites (representing the Lomekwi, Kalochoro, Kaitio, and Nariokotome members) but cannot be more precisely identified.

Tribe Caprini

Three different kinds of horn core are tentatively assigned to the Caprini but cannot at present be more precisely identified.

Caprini genus indeterminate species A

Figure 58

This form is represented by WT 16241, a frontlet with proximal horn cores from LO7 in the Lokalalei Member, and WT 14615, proximal right and left horn cores from NC2 in

Figure 57. KNM-WT 16420, *Gazella* cf. *granti* left horn core from the Kataboi Member at LK1 (left), and KNM-WT 16244, proximal left horn core (center) and KNM-WT 16240 proximal right horn core (right), both from the upper Lomekwi Member at LO1; lateral view.

Figure 58. KNM-WT 16421, Caprini gen. indet. sp. A frontlet with proximal horn cores from the Lokalalei Member at LO7; anterior view.

the Nariokotome Member. Separated by a broad U-shaped depression of the frontal, the horn cores have shallow basal sinuses and are mediolaterally compressed at their base. The shape, orientation, and curvature of the horn cores are very similar to the condition in *Menelikia lyrocera,* the horn cores curving upward and outward with slight anticlockwise torsion in the right horn core. The lateral surface of the proximal portion of the horn core is flattened. The horn core is ornamented by longitudinal grooves with faint indications of transverse ribbing. It is perhaps possible that the specimens are merely very small variants of *M. lyrocera* but more probable that they represent a species of caprine.

Caprini genus indeterminate species B

Figures 59, 60

WT 14566, a proximal right horn core from KI2 in the Kaitio Member, is dorsoventrally flattened with a flat ventral surface, contributing to a D-shaped transverse section. Anterior to the base of the horn core, the frontal bone above the brain case bears very large sinuses—a feature seen in caprines and duikers. The horn extends backward, and slightly upward and outward, and is hollow in the proximal portion preserved, suggesting a very deep basal sinus. The horns were separated by only a short distance because the medial base of the horn core pedicel is formed by the intrafrontal suture whereas the frontal–parietal suture adjoins the posterior base of the pedicel. While the specimen could belong to either group, its size and the rarity of duikers in the fossil record suggest that a caprine identification is more plausible. At its base the horn core measures 16 mm × 27 mm.

Caprini genus indeterminate species C

Figures 61, 62

A third caprine is represented by two specimens. The most complete is WT 14941, a frontlet with horn cores from NC1

Caprine specimen lists and measurements.

Caprini gen. indet. sp. A

Material referred

KNM-WT	Specimen	Site
16241	frontlet with prox h/c's	LO7
14615	prox R & L h/c's	NC2

Caprini gen. & sp. indet. A horn core measurements

		16241	14615
Width			
base h/c's		102	
R h/c	ap	43	36
	tr	32	31
L h/c	ap	46	35
	tr	34	31

Caprini gen. indet. sp. B

Material referred

KNM-WT	Specimen	Site
14566	prox R h/c	KI2

Caprini gen. indet. sp. C

Material referred

KNM-WT	Specimen	Site
14941	frontlet with h/c's	NC1
16239	prox R(?) h/c	LO9

Caprini gen. indet. sp. C horn core measurements

		14941	16239
R h/c	ap	47	26
	tr	63	47
	lt		110+
L h/c	ap	45	
	tr	56	
	lt	250+	

Caprini gen. & sp. indet.

Material referred

KNM-WT	Specimen	Site
17547	R md (P_4–M_3)	KL1
17548	LM_2	NY2

Caprini gen. & sp. indet. dental measurements

		17547	17548
P_4	ap	11.3	
	tr	5.8	
M_1	ap	12.0	
	tr	7.2	
M_2	ap	14.0	17.4
	tr	8.0	7.4
M_3	ap	17.3+	
	tr	8.4	

in the Nariokotome Member. The horn cores arise behind the orbit, curving outward in their proximal portion, and recurving inward at their tip. The lyrate curvature is similar to that seen in *Menelikia lyrocera* but, unlike those of *Menelikia,* these horn cores are dorsoventrally flattened. Distinct transverse ribs are present in the proximal two thirds of the horn core. Between the horn cores, the frontals are concave but the interfrontal suture is produced into a ridge, thus contrasting with the condition seen in *M. lyrocera* and Caprini A.

A second specimen, WT 16239, a proximal right(?) horn core from LO9 in the Lomekwi Member, is smaller and even more dorsoventrally compressed. The horn core is weathered and no transverse ribbing can be discerned.

Caprini genus and species indeterminate

Two caprine dental specimens—WT 17547, a right mandible (P_4–M_3) from KL1, and WT 17548, a left M_2 from NY2—may not be assigned to any of the three taxa listed above.

DISCUSSION

BIOSTRATIGRAPHY

The mammalian fossils from the 47 fossiliferous sites from west of Lake Turkana can be grouped into 10 discrete assemblages on the basis of their stratigraphic position and faunal composition. Their stratigraphic level may be evaluated with reference to major tuffs in the sequence (see Table 2), many of which crop out also in the Koobi Fora and/or the Shungura sequences. Changes in faunal composition, involving sequential replacement of *Elephas recki* subspecies and of *Hipparion, Theropithecus,* hippopotamid, and bovid species, help to define and distinguish intervals of time represented in the sequence. Except at two Loruth Kaado localities (LK1 and LK2), the older assemblages are restricted to the southern half of the region and the younger ones to the northern half. A major change in the composition of the local faunas occurs half way through the sequence coincident with the migration of *Equus* into sub-Saharan Africa. The distribution of taxa in the lower portion of the sequence is given in Table 3 and that in the upper part of the sequence in Table 4

Upper Kataboi Member Assemblage (Table 3: 1)

The samples from LK1, LK2, LO6, and NS1 were collected below the Tulu Bor Tuff but high in the Kataboi Member. The assemblage includes *Homotherium problematicus, Deinotherium bozasi, Loxodonta adaurora, Hipparion hasumense, Nyanzachoerus kanamensis, Notochoerus euilus, Sivatherium maurusium, Tragelaphus nakuae, Kobus oricornis,* and *Gazella* aff. *G. granti. Hippopotamus* cf. *H. kaisensis* and the large *Aepyceros* sp. are apparently restricted to this unit.

Figure 59. KNM-WT 14566, Caprini gen. indet. sp. B proximal right horn core from the Kaitio Member at KI2; anterior view.

Figure 60. KNM-WT 14566, Caprini gen. indet. sp. B proximal right horn core; lateral view.

The upper Kataboi Member assemblage, from below the Tulu Bor Tuff, is younger than the assemblages recovered from the Mursi Formation in the Omo Valley and from the Moiti Member at Koobi Fora, but stratigraphically and chronologically equivalent to those from the Lokochot Member at Koobi Fora and to Shungura Member A.

Lomekwi Member Assemblages

Three distinct and sequential assemblages have been recovered from the lower, middle, and upper parts respectively of the Lomekwi Member. The youngest assemblage is underlain by the Emekwi Tuff (= C9) but unfortunately the discontinuous nature of the outcrops, their low relief, low angle of dip, and the absence of conspicuous marker horizons, do not permit more precise stratigraphic definition of the other two.

Lower Lomekwi Member Assemblage (Table 3: 2)

The interval of section exposed in the upper reaches of the Laga Lomekwi at localities LO4–5 represents strata immediately below and above the Tulu Bor Tuff. LO4 and LO5 are abundantly fossiliferous, most of the specimens coming from just above the Tulu Bor Tuff, i.e., from the lowest part of the Lomekwi Member. Several undescribed hominid specimens are known from this interval (Harris and Brown, 1985). *Theropithecus brumpti* is the common cercopithecoid and persists through the older part of the succession but *Parapapio ado* and *Parapapio* cf. *whitei* are also recorded from

Figure 61. KNM-WT 14941, Caprini gen. indet. sp. C frontlet with left and proximal right horn cores from the Nariokotome Member at NC1; anterior view.

Figure 62. KNM-WT 14941, Caprini gen. indet. sp. C frontlet; left lateral view.

this interval. Two *Crocuta* species occur, one of which is found also in the middle part of the member. *Elephas recki brumpti* makes its first appearance west of Lake Turkana in this assemblage, *Loxodonta adaurora* its last, and *Loxodonta exoptata* is apparently restricted to this interval of section. Both rhinos, *Diceros bicornis* and *Ceratotherium praecox,* occur for the first time in the Nachukui Formation. *Notochoerus euilus* is the commonest suid but one specimen of *Not. scotti* was recovered from LO5 and representatives of *Nyanzachoerus, Kolpochoerus, Potamochoerus,* and *Metridiochoerus* also occur at both sites. *Hexaprotodon protamphibius* is the common hippo, evidently replacing *Hippopotamus* cf. *H. kaisensis* known from the Kataboi Member. *Giraffa* sp. occurs for the first time in the sequence. Of the bovids, the alcelaphines and particularly the extinct impala *Aepyceros shungurae* predominate, the latter making its first appearance in the sequence along with *Tragelaphus* cf. *scriptus, Ugandax* sp., *Kobus sigmoidalis, Kobus* sp. A, *Megalotragus* sp., *Parmularius* sp., *Antidorcas recki,* and *Gazella* cf. *G. janenschi.*

The lower Lomekwi Member assemblage may be stratigraphically and temporally correlated with those from horizons just above the Tulu Bor Tuff in the Tulu Bor Member at Koobi Fora and the lower part of Member B of the Shungura Formation.

Middle Lomekwi Member Assemblage (Table 3: 3)

The mammalian fossils from localities LO9 and LO10 occur stratigraphically higher in the succession than those from LO4–5. Many of the taxa from this interval persist from lower levels. *Notochoerus euilus* makes its last appearance in this interval, as does *Crocuta* new species. The sabretoothed *Dinofelis* cf. *D. barlowi* and the viverrids *Mungos dietrichi* and cf. *Civettictus* sp. are known only from this member. Making their first appearance west of Lake Turkana are *Kobus* spp. B and D and Caprini sp. C. *Notochoerus scotti* is the common

Table 3. Fossil mammals from the lower part of the succession. X denotes species present.

	Assemblages*				
	1	2	3	4	5
Theropithecus brumpti		X	X	X	
Cercopithecidae large		X		X	
Cercopithecidae medium		X		X	
Cercopithecidae small		X		X	
Cercopithecidae indet.		X			
Parapapio ado		X			
Parapapio cf. *whitei*		X		X	
Paracolobus mutiwa				X	
Australopithecus boisei				X	
Hominidae indet.		X		X	
Crocuta new species		X	X		
cf. *Crocuta* sp.		X			
Hyaena hyaena				X	
Hyaenidae indet.				X	
Homotherium problematicus	X			X	
Dinofelis cf. *barlowi*			X		
Felidae				X	
Mungos dietrichi			X		
cf. *Civettictus* sp.			X		
Carnivora indet.		X	X	X	
Deinotherium bozasi	X	X	X	X	
Loxodonta adaurora	X	X			
Loxodonta exoptata		X			
Elephas recki brumpti		X	X	X	
E. recki shungurensis				X	X
Elephantidae indet.		X			
Hipparion hasumensis	X	X	X	X	
Equidae indet.					X
Ceratotherium sp.		X	X	X	
Diceros bicornis		X	X	X	
Rhinocerotidae indet.	X	X			
Notochoerus euilis	X	X	X		
Not. scotti		X	X	X	
Nyanzachoerus kanamensis	X	X			
Kolpochoerus limnetes		X		X	X
Kolpochoerus majus				X	
Potamochoerus sp.		X			
Metridiochoerus andrewsi		X	X	X	X
Suidae indet.	X	X	X	X	
Hippopotamus cf. *kaisensis*	X				
Hexaprotodon protamphibius		X	X	X	
Camelus sp.				X	
Sivatherium maurusium	X			X	
Giraffa sp.		X	X	X	
Tragelaphus nakuae	X	X		X	X
Tragelaphus sp. (kudu)					X
Tragelaphus scriptus		X		X	
Ugandax sp.?		X	X	X	X
Oryx sp.				X	
Hippotragini indet.		X			
Kobus sigmoidalis		X	X	X	X
Kobus oricornis	X	X		X	
Kobus sp. A		X		X	
Kobus sp. B			X	X	
Kobus sp. C				X	X
Kobus sp. D			X	X	
Kobus sp. indet.				X	
Menelikia lyrocera					X
Menelikia sp.				X	X
Reduncini large	X			X	
Reduncini medium		X	X	X	
Reduncini small		X		X	
Connochaetes sp. A				X	
Damaliscus sp.		X		X	
Parmularius sp.		X			
Alcelaphini large		X	X		X
Alcelaphini medium	X	X	X	X	
Alcelaphini small		X	X	X	
Aepyceros shungurae		X	X	X	X
Aepyceros sp.	X				
Antidorcas recki		X	X	X	
Gazella aff. *granti*	X			X	
Gazella cf. *janenschi*		X	X	X	
Gazella sp. indet.		X	X	X	
Caprini sp. A					X
Caprini sp. C			X		

* Members (Sites): 1 Kataboi (NS1, LK1, LK2, LO6); 2 lower Lomekwi (LO4, LO5); 3 middle Lomekwi (LO9, LO10); 4 upper Lomekwi (LO1, LO2, LO3, KU1, KU2, KU3); 5 Lokalalei (KU2, LO7, LO8).

suid while alcelaphines and tragelaphines outnumber the other bovid tribes.

The middle Lomekwi Member assemblages is of equivalent age to those from the upper part of Shungura Member B and from horizons between the Allia and Hasuma tuffs in the Tulu Bor Member at Koobi Fora.

Upper Lomekwi Member Assemblage (Table 3: 4)

Sites LO1, LO2, and KU1–3 are from an area that incorporates the middle reaches of the Laga Lomekwi and the upper part of the Kangatukuseo drainage; these samples are all of similar age and are from the upper part of the Lomekwi Member. Making their initial appearance west of Lake Turkana in this interval are *Australopithecus boisei* (Walker et al., 1986), *Hyaena hyaena, Elephas recki shungurensis, Kolpochoerus majus, Kobus* sp. C, and *Menelikia* sp. Appearing for the last time in the Nachukui Formation are *Theropithecus* cf. *T. brumpti, Parapapio* cf. *P. whitei, Hipparion hasumense, Kobus oricornis, Kobus* spp. A, B, and D, and *Gazella* cf. *G. granti.* Evidently restricted to the upper part of the Nachukui Formation are *Paracolobus mutiwa, Camelus* sp., *Oryx* sp., and *Connochaetes* sp. *Notochoerus scotti* is the common suid and for the first time in the succession the reduncines become numerically more abundant than the alcelaphines or tragelaphines. LO3, on a northern branch of the Laga Lomekwi, is of similar age but is possibly slightly

Table 4. Fossil vertebrates from the upper part of the succession. X denotes species present.

	Assemblages*				
	6	7	8	9	Galana Boi
Siluriformes			X		
Myliobatiformes			X		
Cyprinidae			X		
Characidae			X		
Pisces			X		
Crocodylus sp.	X				
Euthecodon brumpti	X		X	X	
Crocodylidae		X		X	
Trionyx sp.		X	X		
Aves	X	X	X		
Tatera		X			
Hystrix sp.		X	X		X
Thryonomys sp.		X			X
Lagomorpha			X		
Theropithecus oswaldi	X	X	X	X	
Theropithecus sp.		X			
Papio sp.					X
Cercopithecidae indet.		X			X
Australopithecus boisei		X			
Homo habilis	X				
Homo erectus			X	X	
Canis cf. *mesomelas*	X		X		
cf. *Lycaon* sp.	X				
Crocuta crocuta	X			X	
Hyaena hyaena	X	X			
Homotherium problematicus		X			
Carnivora indet.			X		
Deinotherium bozasi	X	X			
Loxodonta sp.		X			
Elephas recki shungurensis	X				
Elephas recki ileretensis		X			
Elephas recki recki				X	
Hipparion cornelianum		X			
Hipparion ethiopicum	X	X	X		
Equus sp.	X	X	X	X	
Equidae indet.	X	X	X		X
Diceros bicornis		X		X	
Ceratotherium simum		X	X	X	
Rhinocerotidae gen. indet.				X	
Notochoerus scotti	X	X			
Kolpochoerus limnetes	X	X	X	X	
Kolpochoerus majus				X	
Metridiochoerus andrewsi	X	X			
Metridiochoerus hopwoodi		X		X	
Metridiochoerus modestus		X		X	
Metridiochoerus compactus		X	X	X	
Potamochoerus porcus		X			X
Phacochoerus aethiopicus					X
Hexaprotodon protamphibius	X				
Hexaprotodon karumensis		X	X	X	
Hippopotamus gorgops		X	X	X	
Hippopotamus aethiopicus		X	X	X	
Hippopotamus amphibius				X	
Sivatherium maurusium	X		X		
Giraffa cf. *camelopardalis*				X	
Giraffa sp.	X		X		
Tragelaphus strepsiceros	X	X	X	X	
Tragelaphus scriptus		X		X	
Tragelaphus nakuae	X				
Tragelaphini sp.				X	
Syncerus cf. *caffer*				X	
Syncerus sp.	X	X			
Pelorovis new species		X	X		
Pelorovis sp.	X	X	X		
Hippotragus gigas		X	X		
Kobus ellipsiprymnus				X	
Kobus sigmoidalis			X		
Kobus ellip/sigm		X			
Kobus kob			X		
Kobus leche				X	
Menelikia lyrocera	X		X		
Reduncini large	X			X	
Reduncini medium	X	X	X	X	
Reduncini small	X	X	X	X	
Megalotragus sp.	X	X	X	X	
Connochaetes new species		X	X		
Damaliscus sp.		X	X		
Medium alcelaphini	X	X	X	X	
Small alcelaphini	X	X	X	X	
Aepyceros melampus	X	X	X	X	
Antidorcas recki	X	X			
Gazella janenschi		X	X		
Gazella praethomsoni	X		X		
Gazella sp.	X	X	X		
Caprini sp. A				X	
Caprini sp. B		X			
Caprini sp. C				X	
Caprini gen. indet.			X		

* Members (Sites): 6 Kalochoro (KK, KG, LA1); 7 Kaitio (KL3, KL4, KL6, LK4, NY2–4, KS1–2, NN); 8 Natoo (NT, LK3, KL1–2, KL5, NK2, KI2); 9 Nariokotome (KI1, NC1–3). The Galana Boi Formation consists of Holocene lacustrine and fluviatile sediments.

older than other sites in the upper Lomekwi Member as indicated by the presence of *E. recki brumpti* as well as *E. recki shungurensis*.

The upper Lomekwi Member assemblage is chronologically equivalent to assemblages from Shungura Member C and to those from the youngest portion of the Tulu Bor Member (between the Hasuma and Burgi tuffs) at Koobi Fora.

Lokalalei Member Assemblage (Table 3: 5)

Sites LO7 and LO8 are in the lower reaches of the Laga Lomekwi and represent levels that lie within the Lokalalei

Member. The reduncine bovid *Menelikia lyrocera* makes its first appearance west of Lake Turkana at this level, perhaps having evolved from *Menelikia* sp., which makes its last appearance in this interval. Caprini sp. A also makes its initial appearance. Appearing for the last time in the sequence are *Tragelaphus nakuae, Kobus* sp. C, and *Aepyceros shungurae.* The sample size of this assemblage is small. Reduncine bovids predominate and the only suid present is *Kolpochoerus limnetes.*

Because of the discontinuity of exposures in the lower reaches of the Laga Lomekwi and the lack of extensive marker horizons, the stratigraphic placement of the Lokalalei Member assemblage is less precise than that of the others. The member is confined between the Lokalalei Tuff (= D) and Kalochoro Tuff (= F) and the assemblage is therefore temporally equivalent to Shungura Members D or E. At Koobi Fora the sequence equivalent to Shungura Members D, E, F, and the lower portion of Member G is either missing or unfossiliferous.

Kalochoro Member Assemblage (Table 4: 6)

The fossiliferous horizons of localities LA1, KK, and KG1–2 lie above the Kalochoro Tuff (= F) in the Kalochoro Member. A significant change in faunal composition is encountered in this interval. The genus *Equus* occurs for the first time in the West Turkana succession. *Theropithecus* is represented by *T. oswaldi* instead of *T. brumpti* that is found at earlier horizons while, similarly, *Hipparion ethiopicum* replaces *H. hasumense.* These faunas are also the youngest in which *Elephas recki shungurensis* and the hippo *Hexaprotodon protamphibius* appear. A jackal (*Canis* cf. *C. mesomelas*) and the spotted hyaena *Crocuta crocuta* occur for the first time west of Lake Turkana while a larger canid (cf. *Lycaon* sp.) is known only from this interval. *Menelikia lyrocera* is common and has long lyrate horn cores that are similar to those from the middle portions of the Omo Shungura succession and which contrast with the shorter lyrate horn cores occurring in the upper Burgi Member of the Koobi Fora succession. At this point in the West Turkana succession a form similar to the extant impala replaces *A. shungurae, Ugandax* sp. occurs for the last time, and *Pelorovis* sp. and *Gazella praethomsoni* make their initial appearance. *Tragelaphus nakuae* is represented at LA1 and constitutes the last occurrence of this species in the West Turkana succession, whereas the greater kudu *Tragelaphus strepsiceros* occurs for the first time in KG1; it is conceivable that LA1 slightly predates KG1 but the tragelaphine samples are small and both species occur together at later horizons in the Koobi Fora and Shungura formations. The proportion of alcelaphines in the assemblage increases over that found in the subjacent assemblage but reduncines continue as the commonest bovids and *Notochoerus scotti* is the commonest suid. One hominid (*Homo habilis*) cranial fragment has been recovered from this interval.

The presence of *Equus* and of *Tragelaphus strepsiceros* in this assemblage signifies temporal equivalence with Shungura Member G rather than Member F. The presence of the long and lyrate-horned morph of *Menelikia lyrocera* suggests that the Kalochoro Member assemblage predates the assemblages from the upper portion of the Burgi Member at Koobi Fora (the *Mesochoerus limnetes* Zone of Maglio (1972) or *Notochoerus scotti* Zone of Harris (1983:fig. 1.10) or Zone D of Harris (1985). The closest correlation is thus with the lower part of Shungura Member G.

Kaitio Member Assemblage (Table 4:7)

Localities KL3–4, KL6, LK4, NY2–4, KSI–2, NN, and NT lie between the Malbe Tuff (= H4) and Okote Tuff, and some are prolifically fossiliferous. Three *Metridiochoerus* species—*M. hopwoodi, M. modestus,* and *M. compactus*—and three hippo species—*Hexaprotodon karumensis, Hippopotamus gorgops,* and *Hip. aethiopicus*—make their initial appearance in the succession as does *Connochaetes* new species. Last occurrences include *Homotherium problematicus, Deinotherium bozasi, Notochoerus scotti,* and *Metridiochoerus andrewsi.* Elephants are uncommon at these localities but specimens of *Elephas recki ileretensis* and of an undetermined species of *Loxodonta* have been recovered. These two taxa and *Hipparion cornelianum, Pelorovis* new species, *Hippotragus gigas,* and Caprini sp. B make their only appearance west of Lake Turkana in this unit. Tragelaphines and alcelaphines are the commonest bovids from this interval except at KS1 where reduncines predominate. *Australopithecus boisei* specimens have also been recovered from sites in this unit.

The Kaitio Member assemblage is temporally equivalent to the abundantly fossiliferous KBS Member from Koobi Fora (= Zone E of Harris, 1985; *Metridiochoerus andrewsi* Zone of Maglio, 1972 and Harris, 1983) and to the less well known assemblages from Shungura Member H and the lower part of Shungura Member J.

Natoo Member Assemblage (Table 4: 8)

There is a further group of localities from the northern half of the region that have yielded mammalian fossils from horizons between the Okote and Nariokotome tuffs. These include KL1–2, KL5, LK3, and NK3 which has yielded specimens of *Homo erectus* (Brown et al., 1985). *Kobus* cf. *K. kob* occurs for the first time in the West Turkana succession. Making their last appearance in this unit are the giraffids *Sivatherium maurusium* and *Giraffa* sp., and the bovids *Kobus sigmoidalis, Menelikia lyrocera, Connochaetes* new species, *Parmularius* sp., *Gazella* cf. *G. janenschi,* and *G. praethomsoni.* The commonest suid is the large and hypsodont *Metridiochoerus compactus,* known previously in the succession from a couple of specimens high in the sequence at KL6. Alcelaphines are the commonest bovids from this interval.

The Natoo Member assemblage correlates with that from the Okote Member at Koobi Fora (= Zone F of Harris (1985); *Metridiochoerus compactus* Zone of Harris (1983) or *Loxodonta africana* Zone of Maglio (1972) and with assemblages from upper Member J, Member K, and perhaps the lowest part of Member L, from the Shungura succession.

Nariokotome Member Assemblage (Table 4: 9)

The youngest fossil mammals from the Nachukui Formation are from NC1–3 at the head of the Laga Nachukui in the Nariokotome Member. Making their first appearance in this member are the most progressive subspecies of the *Elephas recki* lineage—*Elephas recki recki*—and the extant (or closely comparable) species *Hippopotamus amphibius, Giraffa* cf. *G. camelopardalis, Kobus ellipsiprymnus,* and *Syncerus* cf. *S. caffer. Metridiochoerus compactus* is again the most common suid while alcelaphines and reduncines predominate among the bovids.

The Nariokotome Member assemblage comes from above the Nariokotome Tuff complex, which postdates the base of Shungura Member L. and the Chari Member at Koobi Fora. This assemblage is thus correlative with, or younger than, the rather sparse assemblages from the youngest portions of the Shungura and Koobi Fora formations.

PALEOENVIRONMENTAL IMPLICATIONS

As at Koobi Fora and in the lower Omo Valley, the West Turkana region evidently supported a larger and more diverse suite of mammals during the Plio-Pleistocene than it does today. The current paucity of endemic mammals is in part due to the less favorable (more arid) climate and in part to human influence, particularly the intemperate overgrazing by domestic stock during historic times. Most constituents of the late Pliocene assemblages from the West Turkana region occurred contemporaneously elsewhere in the northern part of the Lake Turkana Basin and many were more widely distributed. At West Turkana, as at Omo and Koobi Fora, a major change in the prevailing faunal composition was encountered about 2 million years ago, coincident with the immigration of *Equus* into the region. This change, which was by no means instantaneous, saw replacement of the *Theropithecus, Hipparion,* hippo, and bovid species which previously predominated in the region by more progressive representatives of their families, resulting accordingly in a different early Pleistocene suite of mammals.

So far only relatively small samples have been retrieved from the West Turkana localities and many species are represented by a mere handful of specimens from any one site. Continued collecting might thus dramatically affect the proportions of faunal elements represented at individual sites and hence the preliminary paleoenvironmental reconstructions attempted below. In regional terms, however, the faunas from West Turkana, Koobi Fora, and the lower Omo Valley are broadly comparable in chronologically equivalent portions of their sequences.

The bovids, which represent more than 40% of the total sample collected from west Turkana and more than 40% of the mammalian species recognized from the sequence, provide interesting indications of the environmental conditions that prevailed throughout much of the succession. Such interpretation was attempted on the assumption that extinct members of the bovid tribes shared similar habitat preferences to those of their extant counterparts. For purposes of preliminary interpretation it was assumed that tragelaphines and *Aepyceros* species represented woodland or forest edge, bovines represented woodland or grassland, reduncines suggested wet grassland (grassland with standing bodies of water), and alcelaphines, antilopines, and caprines were indicative of open arid grassland and/or scrub (see Table 7).

Williamson (1985) recorded the occurrence of the prosobranch gastropod *Potadoma* in the West Turkana succession from a horizon a short distance above the Tulu Bor Tuff (lower Lomekwi Member) and interpreted this, and the occurrence of the anacardiacean tree *Antrocaryon,* at correlative horizons in the Usno and Shungura formations of the lower Omo Valley, as evidence of a short-lived expansion of rain forest during this interval in the Lake Turkana Basin. The sparse mammalian faunas from horizons predating the Tulu Bor Tuff do not provide unequivocal indication of environmental conditions that prevailed during the accumulation of the Kataboi Member, but some environmental change is suggested by the change in impala and hippo species at the Tulu Bor marker horizon. As seen from Table 7, the bovids from the lower Lomekwi Member, in which the widespread rain forest supposedly occurred, comprise a mixture of woodland and forest edge species (tragelaphines, bovines, and impalas) with a lesser proportion of open drier savanna species (alcelaphines, antilopines, and caprines).

Using the information available at the end of the second (1985) collecting season, two cycles of change in the prevailing habitats could be inferred. In the lower third of the section, the upper Kataboi Member and lower and middle portions of the Lomekwi Member, one might infer from the proportions of represented bovid tribes a progressive reduction in woodland with a corresponding increase in open dry grassland. In the middle third of the section, the upper Lomekwi Member and the Lokalalei and Kalochoro members, a predominance of wet grassland seemed to be indicated with relatively minor proportions of woodland and arid grassland. This cycle was repeated in the upper third of the section with woodland predominating in the Kaitio Member, arid grassland in the Natoo Member, and with an increase in the proportion of wet grassland in the uppermost part of the fossiliferous succession—the Nariokotome Member. A possible explanation of such observations would be that the inferred habitat changes reflected cyclic climatic change (two or perhaps three phases of progressive increase in rainfall) and/or repetition of tectonic modification of the Lake Turkana basin that affected the areal extent of the proto-Lake Turkana.

As summarized by Van Zinderen Bakker and Mercer (1986: 227), the worldwide climatic cooling encountered at 2.5 Ma had far-reaching effects on the paleoecology of Africa, establishing the Sahara desert, and modifying the closed forests and woodlands of East Africa into savanna and grasslands. The paleoenvironmental change, suggested by the different proportions of bovid tribes represented in the upper part of the Lomekwi Member (from above the Emekwi Tuff (= C9) dated at just over 2.5 Ma) from those encountered earlier in the succession, might be construed as a local manifestation of this major climatic event.

Table 5. Distribution of West Turkana fossil mammals by site.

Site	BOV	GIR	SUI	HIP	EQU	RHI	DEI	ELE	CAR	PRI	HOM	SUM
NS1	2	1	2	1	2						8	
LK1	10		6	5		1	1	1	1		25	
LK2	1		2		1						4	
LO4	45	2	40	5	14	8		7	4	15	3	143
LO5	65	1	23	2	7	5	1	4	6	26	2	142
LO6	2		2	1	1							6
LO9	27	1	6	1	1		2	2	2	3		45
LO10	5		5	2	3	4		1	5	2		27
KU1	12	2	8	1	2			1	3	7		36
KU2	32	1	16	1	4		1	1	1	7	1	65
KU3	5		1					1				7
LO1	35	1	8	3	1			1	1	16	1	67
LO2	2		2		2		1	1				8
LO3	10	2	5			8	1	5		3	1	35
LO7	3											3
LO8	16		3	2	1			1				23
LA1	15	1	8		6		1					31
KK	25	1	4	8	7			2	2			49
KG1	22	6			3		1	2	3	2	1	40
KG2	2								1			3
KL3	11		7	1	3				2			24
KL6	20		4	3		2		1				30
LK4	4		4	3		2						13
NY2	16		8	3	1			1	2	3	1	35
NY3	16		6	2		2		1				27
NY4	2		1		2							5
KS1	14		12	8	3	1				1	1	40
KS2	1											1
NN	2		1	2	1		1					7
NT	2											2
KL1	30	2	24	11	17	1			2	2		89
KL2	6		4									10
KL5	3		1							2		6
LK3	6		5	3	1							15
NK3			1	2	1						2	6
NC1	16	2	14	5	8	2		3	1	1		52
NC2	2	1	4	1		1				2		11
NC3	1				1							2
KI1					1							1
KI2	4		2									6
KI3	1											1
KL4	1		2		1							4
NK1	3			1								4
NK2			1	1								2
NY1	2											2
Total	499	24	240	80	95	37	10	36	34	94	13	1162

BOV = Bovidae, GIR = Giraffidae, SUI = Suidae, HIP = Hippopotamidae, EQU = Equidae, RHI = Rhinocerotidae, DEI = Deinotheriidae, ELE = Elephantidae, CAR = Carnivora, PRI = non-hominid primates, HOM = Hominidae.

The last 2 million years have been characterized by 21 marine oxygen isotope stages which alternated from colder to warmer conditions, increasing in frequency and amplitude during the Pleistocene to culminate in full glacial/interglacial cycles. However, during the interval 1.9–1 Ma, the climatic fluctuations did not result in a gradual deterioration of climate but rather contributed to a "standstill" of climatic conditions (Van Zinderen Bakker and Mercer, 1986:229). Harris (1983:315) interpreted changes in the early Pleistocene mammal assemblages from Koobi Fora as representing response to a progressive decrease in humidity that was periodically interrupted by more humid intervals; similar climatic oscillations have been inferred from the paleofloras from Olduvai Gorge (Bonnefille, 1979). It is interesting that during this interval, "cool" maxima are documented from deep-sea cores in the Atlantic (Van Donk, 1976) and Pacific oceans (Shackleton and Opdyke, 1976) at times coincident with eruption of the KBS and Okote tuffs which, in turn, fortuitously define

Table 6. Distribution of West Turkana fossil mammal specimens by member.

Site	BOV	GIR	SUI	HIP	EQU	RHI	DEI	ELE	CAR	PRI	HOM	SUM
Kataboi Member												
NS1	2	1	2	1	2							8
LK1	10		6	5		1	1	1	1			25
LK2	1		2		1							4
LO6	2		2	1	1							6
Total	15	1	12	7	4	1	1	1	1	0	0	43
Lower Lomekwi Member												
LO4	45	2	40	5	14	8		7	4	15	3	143
LO5	65	1	23	2	7	5	1	4	6	26	2	142
Total	110	3	63	7	21	13	1	11	10	41	5	285
Middle Lomekwi Member												
LO9	27	1	6	1	1		2	2	2	3		45
LO10	5		5	2	3	4		1	5	2		27
Total	32	1	11	3	4	4	2	3	7	5	0	72
Upper Lomekwi Member												
KU1	12	2	8	1	2			1	3	7		36
KU2	32	1	16	1	4		1	1	1	7	1	65
KU3	5		1					1				7
LO1	35	1	8	3	1			1	1	16	1	67
LO2	2		2		2		1	1				8
LO3	10	2	5			8	1	5		3	1	35
Total	96	6	40	5	9	8	3	10	5	33	3	218
Lokalalei Member												
LO7	3											3
LO8	16		3	2	1			1				23
Total	19	0	3	2	1	0	0	1	0	0	0	26
Kalochoro Member												
LA1	15	1	8		6		1					31
KK	25	1	4	8	7			2	2			49
KG1	22	6			3		1	2	3	2	1	40
KG2	2								1			3
KI3	1											1
KL4	1		2		1							4
Total	66	8	14	8	17	0	2	4	6	2	1	128
Kaitio Member												
KL3	11		7	1	3					2		24
KL6	20		4	3		2		1				30
LK4	4		4	3		2						13
NY2	16		8	3	1			1	2	3	1	35
NY3	16		6	2		2		1				27
NY4	2		1		2							5
KS1	14		12	8	3	1				1	1	40
KS2	1											1
NY2	2											2
Total	86	0	42	20	9	7	0	3	2	6	2	177
Natoo Member												
NN	2		1	2	1		1					7
NT	2											2
KL1	30	2	24	11	17	1				2	2	89
KL2	6		4									10
KL5	3		1							2		6
LK3	6		5	3	1							15
NK3			1	2	1					2		6

Table 6. Continued.

Site	BOV	GIR	SUI	HIP	EQU	RHI	DEI	ELE	CAR	PRI	HOM	SUM
KI2	4		2									6
NK2			1	1								2
Total	53	2	37	21	20	1	1	0	2	4	2	143
Nariokotome Member												
NC1	16	2	14	5	8	2		3	1	1		52
NC2	2	1	4	1		1				2		11
NC3	1				1							2
KI1					1							1
Total	19	3	18	6	10	3	0	3	1	3	0	66

BOV = Bovidae, GIR = Giraffidae, SUI = Suidae, HIP = Hippopotamidae, EQU = Equidae, RHI = Rhinocerotidae, DEI = Deinotheriidae, ELE = Elephantidae, CAR = Carnivora, PRI = non-hominid primates, HOM = Hominidae.

changes in composition of the faunas from the Lake Turkana Basin. It is possible that the observed faunal change reflects worldwide but minor climatic fluctuation. It is likely, however, that tectonic modification of the Lake Turkana Basin, particularly as this would have affected the hydrographic configuration of the region, also contributed to the nature of the changes observed in the faunas.

As summarized by Harris (1983:313–315), various other lines of evidence indicate that during the Pliocene and early Pleistocene the Lake Turkana basin was cooler and more humid than it is at present, but that there was a progressive decrease in humidity from the earlier to the later parts of the succession. Progressive increase in hypsodonty in the teeth of the *Elephas recki* lineage, members of the *Notochoerus, Kolpochoerus,* and *Metridiochoerus* lineages, and perhaps, though less well documented, in long-lived hippo and rhino species, could conceivably be construed as reactions to change in available dietary resources imposed by increasing aridity. Cerling (1979:276–280) identified a major environmental change at the junction of the upper Burgi and KBS members in the Koobi Fora succession (more or less equivalent to the Kalochoro and Kaitio members west of Lake Turkana), but the changes seen in the West Turkana faunas seem at least in part to anticipate the change interpreted from the strata to the east of the lake. Although the composition of a fossil assemblage is influenced by prevailing climatic conditions, it is also influenced by the nature of the available habitats. This point was brought home by the discovery in 1986 of KS1, an abundantly fossiliferous locality in the Kaitio Member. At KS1 reduncines were the commonest bovids, in contrast to other sites from this member where tragelaphines predominated. An explanation for the differential distribution of bovid tribes within this and other members was provided by investigation of the facies from which the bovids were recovered.

Today the western margin of the Lake Turkana basin is formed by the Labur and Murua Rith ranges. These provide the catchment for small ephemeral streams that drain eastward into Lake Turkana. These low western mountains are also cut through by several larger but still ephemeral rivers (the Lagas Kataboi, Topernawi, Kokiselei, Nariokotome) that have sources still farther to the west. Examination of the facies represented in the West Turkana succession, and particularly the river channel and lake margin deposits, suggests similar distribution of depositional environments along the western margin of the basin during the Plio-Pleistocene but with the ephemeral rivers sometimes draining into a major permanent river (the proto-Omo) rather than a lake.

Were the temperature cooler and/or the climate more humid at that time, as seems to be indicated by palynological and other evidence from elsewhere in the basin, the westerly hills might have been clothed with denser vegetation than that of today and thus capable of supporting the tragelaphine and impala populations preserved in the fossiliferous sequence. Given such a scenario one might predict that, regardless of their position in the stratigraphic sequence, those localities closest to the ranges that formed the western basin margin would be characterized by a predominance of tragelaphines and impalas. Alcelaphines and antilopines, on the other hand, representing more open grassland conditions, would constitute a greater proportion in the faunas from localities farther to the east (near the lake margin or on the Omo floodplain, depending on the time interval sampled). One might further expect to preferentially encounter the water-frequenting reduncines at those localities adjacent to the courses of the larger eastward-draining rivers (which during the Plio-Pleistocene could conceivably have been permanent rather than ephemeral). Such predictions are indeed borne out by analysis of the depositional facies from which the bovid samples were retrieved.

The observed distribution of bovid tribes sampled from the West Turkana fossil localities agrees very closely with predictions based on the existing geographic framework but entailing a (slightly) more humid environment. Such close agreement in turn suggests that the climatic changes represented in the time interval under consideration did not have a profound effect on either habitat or fauna. This is not entirely unexpected because the West Turkana region formed

Table 7. Distribution of West Turkana bovid specimens by tribe, member, and locality.

Site	TRAG + AEP	BOV	RED	ALC + ANT + C	HIP	Total
Kataboi Member						
NS1	1		1			2
LK1	4		2	3		9
LK2	2					2
LO6				2		2
Total	7	0	3	5	0	15
Percent	47	0	20	33	0	100
Lower Lomekwi Member						
LO4	26	2	6	12		46
LO5	25	1	7	24	1	58
Total	51	3	13	36	1	104
Percent	49	3	12	35	1	100
Middle Lomekwi Member						
LO9	5	4	6	13		28
LO10	2			3		5
Total	7	4	6	16	0	33
Percent	21	12	18	48	0	100
Upper Lomekwi Member						
KU1	2		4	6		12
KU2	7	1	18	7		33
KU3	1		3	1		5
LO1	1		22	8	1	32
LO3	3	1	2	4		10
Total	14	2	51	26	1	94
Percent	15	2	54	28	1	100
Lokalalei Member						
LO7			2	1		3
LO8	4	1	9	1		15
Total	4	1	11	2	0	18
Percent	22	6	61	11	0	100
Kalochoro Member						
LA1	5		4	5		14
KK	2	2	12	9		25
KG1	2	2	10	9		23
KG2			1	1		2
KI3		1		1		2
KL4		1				1
Total	9	6	27	25	0	67
Percent	13	9	40	37	0	100
Kaitio Member						
KL3	3	1	1	5		10
KL6	7	4	3	6		20
LK4				1		1
NY2	12	1		3	1	17
NY3	10	1		5		16
NY4		2				2
KS1	1	1	8	4		14
KS2				1		1
NY1						0
Total	33	10	12	25	1	81
Percent	41	12	15	31	1	100

Table 7. Continued.

Site	TRAG + AEP	BOV	RED	ALC + ANT + C	HIP	Total
Natoo Member						
NT	1		1			2
KL1	5	3	9	13		30
KL2	2		1	2		5
KL5		2		1		3
LK3	1			4		5
NK3						0
KI2		1	2	1		4
Total	9	6	3	21	0	49
Percent	19	12	27	44	0	100
Nariokotome Member						
NC1	5	1	4	5		15
NC2		1	1	1		3
NC3			1			1
Total	5	2	6	6	0	19
Percent	26	11	32	32	0	100

TRAG = Tragelaphini, AEP = *Aepyceros* spp., BOV = Bovini, RED = Reduncini, ALC = Alcelaphini, ANT = Antilopini, C = Caprini, HIP = Hippotragini.

a narrow corridor flanked on one side by low mountain ranges and on the other by a large permanent river or lake. In essence, it was a narrow closed enclave protected from the more drastic effect of increasing aridity encountered in the more open country to the east of the basin.

The distribution of the small sample of rhinos appears to agree with the above interpretation of habitat distribution. Thirty-five of the 37 rhino specimens were collected from 10 sites in the western part of the region and only one of these specimens was from a locality (KS1) adjacent to a major fluvial system. It would seem that both genera of rhinos preferred the woodland/thicketed habitats interpreted for the western margin of the basin rather than the more open and/or better watered grassland at the periphery of the lake or on the Omo River floodplain. On the basis of the small equid samples currently available, this habitat preference seems to have been shared by the hipparions whereas the equines are more abundant at sites indicative of more open grassland.

Unfortunately the interval of time represented by Shungura Members C through F is largely unrepresented by fossiliferous strata in the Koobi Fora region while faunal samples from this interval from both the Omo and West Turkana are from strata that accumulated close to major river systems. The effects of minor climatic fluctuation would be less readily felt in localities adjacent to major permanent river systems and the "mid Shungura" samples may thus be atypical in terms of the assemblages present elsewhere in the basin, but not represented by fossils, during this time interval.

SUMMARY

Upper Pliocene and lower Pleistocene strata exposed west of Lake Turkana between the settlements of Kalakol (to the south) and Lowarengak (to the north) form part of the western edge of the Lake Turkana Basin. These lacustrine, fluviatile, and terrestrial sediments have been assigned to the Nachukui Formation, which as been subdivided into eight sequential members. The older members crop out to the south of the area, the younger members are restricted to the northern part. The Nachukui Formation may be correlated with the Shungura and Usno formations in the lower Omo Valley, and with the Koobi Fora Formation to the east of the lake, by the tuffs and mammalian fossils that occur within the respective sequences.

During the Plio-Pleistocene, as today, the western margin of the basin was formed by low mountain ranges drained by small, eastward-flowing rivers. These sometimes fed into a lake (the predecessor of the present Lake Turkana) and sometimes into a large, southward-flowing river (the forerunner of the Omo River). Different facies of the Nachukui Formation document the former distribution of the lake margin and/or floodplain of the Omo River.

Plio-Pleistocene strata are also exposed to the north of the area near the Loruth Kaado spring, approximately midway between the police posts of Kokuro and Todenyang. These outcrops have been only briefly surveyed but are known to contain strata equivalent in age to the Lonyumun, Kataboi, Kaitio, and Natoo members of the Nachukui Formation.

More than 1000 mammalian fossils have been recovered from the Nachukui Formation and the Loruth Kaado exposures. The faunal list numbers more than 90 species, most of which have been previously documented from the Lake Turkana Basin but including primate, carnivore, hippo, and bovid taxa that are either new or new to the region. The monkey, hominid, and carnivore samples include specimens that add important information about previously known species. The faunal samples constitute nine time-successive assemblages, one per member except for the Lomekwi Member which has three and the Lonyumun Member which has not yet yielded mammalian fossils; these are treated as informal zones. All may be correlated with assemblages from other parts of the basin but those from the Kataboi and Lokalalei members are not well documented from West Turkana while that from the Nariokotome Member is perhaps younger than other faunal samples recovered from the Koobi Fora and Shungura formations.

The overall composition of the assemblages is suggestive of environmental conditions that were cooler and/or more humid than those characterizing the region today. Minor climatic fluctuations are suggested by the apparently cyclic changes observed in the bovid tribes represented in different intervals of the succession. Although such changes can be related to worldwide climatic conditions, they might also be at least in part explained as the product of local tectonic activity which affected the basinal drainage regime.

A major change in the represented primate, equid, hippo, and bovid species is encountered in the Kalochoro and Kaitio members. This change, which is documented also in the Koobi Fora, Shungura, and Olduvai successions, has been elsewhere interpreted as the result of increased aridity with the concomitant spread of savanna grassland in which alcelaphine bovids and the newly immigrant *Equus* species predominated. Because of the geographic setting of the West Turkana locality—a narrow corridor bounded to the west by low mountains and to the east by a large lake or major permanent river—it seems probable that any such climatic changes had only minor effect on the locally available habitats.

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NOTE ADDED IN PROOF

Further field work in 1988 located three new sites: Lokapetamoi I (LP1) and Nabaleta Akoit I (NA1) in the Natoo Member and Nachukui IV (NC4) in the Nariokotome Member. Additional specimens were recovered from other previously known sites. Table 4 (p. 118) has been updated to include all new West Turkana stratigraphic records.

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