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THE LATE MIOCENE LARGE MAMMAL FAUNA FROM THE NAMURUNGULE FORMATION, SAMBURU HILLS, NORTHERN KENYA

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ABSTRACT By the Japan-Kenya Expedition, more than 1145 late Miocene vertebrate fossils were collected from the Namurungule Formation in Samburu Hills, Northern Kenya in 1982.

These fossils are assigned to at least 29 taxa of which 21 are mammals, including Hominoid, *Tetralophodon,* two kinds of *Hipparion, Brachypotherium, Kenyapotamus,* and *Pachytragus.*

Quantitatively, the taxa of *Hipparion* are the most predominant. But gomphothere, bovid, rhinocerotid and giraffid fossils are approximately as common as each other at Namurungule. Suids, hippopotamids and carnivores seem to be uniformly rare as fossils at Samburu.

In this paper, 19 taxa of mammals are described and discussed briefly.

The Namurungule mammalian fauna is closer in age to Ngorora (c. 11 m.y.) than to Mpesida (7 m.y.) from Kenya, and this fauna is similar to the faunas of Samos and Pikermi (Vallesian).

It seems that the abundance of *Hipparion,* giraffids, rhinocerotids and bovids suggests a woodland to savannah environment at or near Namurungule during the upper Miocene. We find very little evidence to suggest that there was forest in the vicinity at the time of deposition.

INTRODUCTION

More than 1145 fossil vertebrate fossils were collected from the Namurungule Formation in 1982. These fossils are assigned to at least 29 taxa of which 21 are mammals. Many of the mammalian fossils consist of isolated teeth, footbones or broken long bones, which renders them somewhat difficult to analyse. However, enough is preserved for confident identification of many fragments at the generic level, while a few can be identified to the species level. The list of taxa so far identified is as follows:

			No. of Specimens
Pisces	Clariidae	*Clarias*	272
Ophidea		Indet.	2
Squamata	Varanidae	*Varanus*	1
Chelonia	Trionychidae	*Trionyx*	254
	Pelomedusidae	*Pelusios*	
	Testudinidae	*Testudo*	
Crocodylia	Crocodylidae	*Crocodylus*	189
Aves		Indet. wading bird	6
Mammalia	Hominoidea	nov. gen.	1
	Tubulidentata	*Oryctesopus* sp.	1
	Rodentia	*Paraphiomys* sp.	1
	Carnivora	*Percrocuta* sp.	1
		Ictitherium sp.	1
	Proboscidea	*Prodeinotherium* sp.	61
		Tetralophodon sp.	
	Equidae	*Hipparion primigenium*	177
		Hipparion sitifense	
	Chalicotheriidae	Indet.	1
	Rhinocerotidae	*Brachypotherium* sp.	46
		large sp. indet.	
	Suidae	*Nyanzachoerus* sp.	16
	Hippopotamidae	*Kenyapotamus* sp.	3
	Tragulidae	Indet.	1
	Giraffidae	*Palaeotragus* sp.	46
		large sp. indet.	
	Bovidae	*Miotragocerus* sp.	64
		Pachytragus sp. cf. *solignaci*	
		Palaeoreas sp.	
		Gazella sp.	
		Neotragini	

62.4% of the fossils collected are aquatic in their ecological affinities, reflecting the predominance of fully lacustrine sedimentary facies exposed in the Namurungule Formation. Many of the mammalian fossils were collected from channel deposits cut into shales (eg. site SH 22) or in fluvial conglomerate/mudstone alternations deposited near the edge of the basin (eg. locs. SH 11, 12, 13). Many fish, turtle and crocodile fossils were left in the field, so these figures also reflect a marked collecting bias towards mammalian fossils, which even so, comprised only 37.6% of the fossil remains collected in 1982.

Twenty one taxa of mammals have been recognised in the Namurungule Formation. Of these, nineteen are described in this report, while Rodentia and Hominoidea are the subject of separate reports. The authors were careful not to assign specific names to many of the taxa. This reflect three factors, a) the fragmentary nature of many of the fossils, b) the hope that future collections will result in better samples which may allow more confident identifications and c) the novelty of the fauna compared with other described East African fossil faunas.

Faunas from sites at different levels at Namurungule are essentially similar, and we consider it likely that the Namurungule Formation as a whole is yielding a fauna of restricted biostratigraphic range.

Sub-Saharan post-*Hipparion* faunas between 10.5 and 7 m.y. are very poorly known. In Kenya the sites of Ngeringerowa and Nakali have yielded fossils from this time period (Pickford 1981), but little has been formally described. Consequently, comparisons must be made with well known faunas from Eurasia, a factor which introduces uncertainty in analysis due to the tremendous geographic distances between the various sites.

Comparisons of the Namurungule mammalian fauna with older and younger faunas from Kenya indicate that the strata are probably closer in age to Ngorora (c. 11 m.y.) than to Mpesida (7 m.y.). (Bishop *et al.,* 1971; Pickford, this vol.). Comparisons with European faunas reveal several similarities at the generic level, with the faunas of Samos and Pikermi (Gentry, 1971). The Beglia fauna of Tunisia (Robinson, 1972) also yields a similar fauna. The Namurungule strata are thus broadly equivalent in age to Vallesian deposits of Europe.

The predominance of *Hipparion* fossils in the Samburu Hills mammal collection probably indicates two things. Firstly, *Hipparion* fossils are robust and seem to survive taphonomic processes from death to collection better than many other mammals. Secondly, *Hipparion* may have comprised a significant proportion of the large mammal population at the time of deposition of the strata. Gomphothere, bovid, rhinocerotid and giraffid fossils are approximately as common as each other at Namurungule. Suids, hippopotamids, and carnivores seem to be uniformly rare as fossils at Samburu.

The evidence is not clearcut, but it seems that the abundance of *Hipparion,* giraffids, rhinocerotids and bovids suggests a woodland to savannah environment at or near Namurungule during the upper Miocene. We find very little evidence to suggest that there was forest in the vicinity at the time of deposition.

The locality data, and geological and biostratigraphic context information are provided in separate reports published in this volume.

SYSTEMATIC DESCRIPTIONS

CLASS MAMMALIA
ORDER CARNIVORA
SUBORDER FISSIPEDA
Family Hyaenidae Gray, 1969
Genus *Percrocuta* Kretzoi, 1938

Percrocuta sp.

(Plate 1, fig. 1, 2)

Material . . . . . Fragment of right mandible with lower M_1 (KNM-SH 12408).
Locality . . . . . Samburu Hills (SH 34).
Horizon . . . . . Upper alternation, Namurungule Formation.

Description and Discussion

The tooth in the mandible is a worn carnassial. The occlusal surface of the tooth is heart shaped in occlusal view. The crown of the tooth is concave to the labial side, and the distal accessory cusp is small. There is no metaconid on the lingual side of the crown.

Measurements of the tooth are as follows: (mm)
Length of crown . . . . . ca. 26.5 (Reconstructed)
Breadth of crown 14.7
Height of crown 15.0
Height of mandible . . . . . 37.7 +

Material identified as Carnivora is represented by mandibles and lower teeth which undoubtedly belong to the family Hyaenidae judging from the cusp pattern of the cheek teeth.

Hyaenidae is divisible into two major groups termed the *Percrocuta* and *Hyaena* groups (Hendey, 1978). The body size of the *Percrocuta* group is larger than that of the *Hyaena* group.

The size of the carnassial tooth KNM-SH 12408 suggests that it belongs to the *Percrocuta* group. This inference is supported by the fact that the tooth has no metaconid.

The Namurungule lower carnassial assigned to *Percrocuta* is larger than that of *P. tobieni* Crusafont and Aguirre (1971).

Genus *Ictitherium* Wagner, 1848

Ictitherium sp.

(Plate 1, fig, 3, 4)

Material . . . . . Fragment of left mandible with P_2–M_1 (KNM-SH 12406).
Locality . . . . . Samburu Hills (SH 38).
Horizon . . . . . Upper alternation, Namurungule Formation.

Description and Discussion

In KNM SH 12406, the P_2 and M_1 are broken while P_3–P_4 are complete. The teeth are slender and narrow. P_3 and P_4 have accessory cusps anteriorly and posteriorly. P_4 has a distal cingulum. M_1 is a carnassial. There are two mental foramina below P_2 and P_3. There are no diastemata between the cheek teeth.

Measurements of the teeth are as follows: (mm)

	P_2	P_3	P_4	M_1
Length of crown		11.0	12.7	
Breadth of crown	4.3	5.5	6.3	6.0
Height of crown	4.1	8.2	9.0	7.1
Height of mandible	18.3		19.7	
	(P_2 – P_3)		(P_4 – M_1)	

The size of the cheek teeth of KNM-SH 12406 suggest that it belongs to the *Hyaena* as opposed to the *Percrocuta* group. The teeth are narrower than those usually seen in *Percrocuta* and the premolars possess accessory anterior and posterior cusps (Schmidt-Kittler, 1976). If the identification of this mandible as *Ictitherium* is correct, then this report provides the first record of the genus from Sub-Saharan Africa.

Hyaenidae, gen. et. sp. indet.

(Plate 1, fig. 5, 6)

Material . . . . . Fragment of right mandible with roots of C, P_1 and P_2 (KNM-SH 12407).
Locality . . . . . Samburu Hills (SH 25).
Horizon . . . . . Upper alternation, Namurungule Formation.

Description and Discussion

Among the carnivore fossils from Samburu is an edentulous anterior mandible fragment which we consider to represent a hyaenid. There is a big mental foramen below P_2. The cross section of the canine is oval and the symphysis of the mandible is long and curved. The specimen evidently represents a hyaenid, possibly compatible in size with the *Percrocuta* specimen described above.

Measurements of the specimen are as follows: (mm)

Dorso-ventral length of canine 26.3
Transversal breadth of canine. 17.8
Height of mandible below P_1 . . . . . 15.7
Height of mandible below P_2 . . . . . 20.1

ORDER PROBOSCIDEA
SUBORDER GOMPHOTHERIOIDEA
Family Gomphotheriidae Hay, 1922
Genus *Tetralophodon* Falconer et Cautley, 1857

Tetralophodon sp.

(Plate 2, fig. 1–8, Plate 3, fig. 1–8, Plate 4, fig. 1–5)

Material . . . . . Left and right upper M^2 (KNM-SH 12307), left upper M^1 (KNM-SH 12308), right upper M^1 (KNM-SH 12309), left upper P^4 (KNM-SH 12310), right upper P^4 (KNM-SH 12311), right upper P^3 (KNM-SH 12312), right lower P^2 (KNM-SH 12313), fragment of the left mandible with lower M_2 (KNM-SH 12373), right lower M_2 (KNM-SH 12380).

Locality . . . . . Samburu Hills (All specimens from SH 42 except 12373 and 12380 from loc. SH 33).

Horizon . . . . . Upper alternation, Namurungule Formation.

Description and Discussion

Specimens KNM-SH 12307–12313 represent one young individual. The cheek teeth are bunodont. The number of lophs in the intermediate molars (P4–M2) is four (tetralophodont). No cementum is preserved on the crowns, the enamel of which is thick. The hypocone has conules anteriorly and posteriorly which impart, in intermediate molars, a trefoil shape to the hypocone when viewed occlusally. The teeth (KNM-SH 12373 and 12380) belong to one adult individual. The symphysis of the mandible is long (longirostrine), and has an incisor alveolus (tetrabelodont).

Measurement of the crowns of the teeth are as follows: (mm)

	KNM-SH	Length	Breadth	Height	Thickness of enamel	LF
Left M^1	(12307)	148.4	81.1	58.0+	—	2.7
Right M^1	(12307)	147.3	83.8	50.0+	—	2.7
Left P^4	(12308)	106.3	61.8	47.5	4.2	3.8
Right P^4	(12309)	81.5+	62.2	36.5+	3.6	—
Left P^3	(12310)	56.3	48.9	28.1	3.3	3.6
Right P^3	(12311)	56.1	48.5	26.5	2.8	3.6
Right P^2	(12312)	37.3	36.7	10.9	3.3	5.3
Right P_2	(12313)	32.7	24.0+	17.3	2.5	6.1
Left M_2	(12373)	176.0	91.4	34.5	10.9	2.3
Right M_2	(12380)	118.1+	92.1	35.0	9.6	—

(LF = lamellar frequency)

The Samburu Hills gomphotheres are tetralophodont, longirostrine and probably tetrabelodont, (Tobien, 1973) particularly if the two individuals belong to the same species. The teeth appear to have no cementum, the molars are bunodont, the number of cones is low (4–6) the lamellar frequency ranges from 2.3 to 3.8, the talons and talonids are relatively simple; upper and lower tusks are circular in section, the intermediate molars have a secondary trefoil, the symphysis curves strongly downwards, and the molar enamel is thick (9.6–10.6 mm in M_2).

This combination of characters permits us to reject any assignment of these specimens to the genera *Palaeomastodon, Gomphotherium, Playbelodon, Choerolophodon, Anancus, Stegodibelodon* or *Primelephas.* Two genera of gomphotheres *Tetralophodon* and *Stegotetrabelodon* possess a number of these features listed above. Of these two, the Samburu Hills specimens are closest in overall morphology and size to *Tetralophodon.* Material assigned to *Stegotetrabelodon* does not permit many direct comparisons with the Samburu Hills specimens to be made. The little evidence available, including the loph number of intermediate molars, suggests that the Samburu specimens do not represent *Stegotetrabelodon* but are most likely to belong to *Tetralophodon* (see Alberdi, 1971). In view of the fact that the skull of specimens SH 12373 and 12380 is still *in situ* and will be collected next field season, it is best to await the recovery of additional specimens before attempting a specific identification.

SUBORDER DEINOTHERIOIDEA
Family Deinotheriidae Bonaparte, 1845
Genus *Prodeinotherium* Ehik, 1930

Prodeinotherium sp.

(Plate 5, fig. 1, 2)

Material . . . . . Left lower M_1 (KNM-SH 12304-C), left lower M_2 (KNM-SH 12304-A), left lower M_2 (KNM-SH 12304-B), right lower $M_{2 \text{ or } 3}$ (KNM-SH 12305-B), left lower M_2 (KNM-SH 12305-A), left upper $M^{2 \text{ or } 3}$ (KNM-SH 12306).

Locality . . . . . Samburu Hills (12304 is from SH 40, 12305 is from SH 20 and 12306 is from SH 26).

Horizon . . . . . Lower alternation and upper alternation, Namurungule Formation.

Description and Discussion

The cheek teeth (M_2 and M_3) are bilophodont, typical of the family Deinotheriidae. Two genera of deinotheres *Prodeinotherium* and *Deinotherium* are currently recognised in Africa (Harris, 1973). *Prodeinotherium* is generally considered to be smaller than *Deinotherium,* and possesses a number of primitive characters in the skull. Differences in the dentition are present but are generally of a minor nature, which renders specific identification of isolated teeth a matter of some uncertainty. The size of the cheek teeth does not always permit specific or even generic identifications to be made, since large specimens of *Prodeinotherium* are larger than small specimens of *Deinotherium.* The Samburu specimens fall into the size overlap range of the two genera.

The identification of this material as *Prodeinotherium* is based mainly on the presence, in the cheek teeth, of reduced posterior cingula (Harris, 1973). If this identification proves to be correct, then the Samburu deinotheres would represent a large species of *Prodeinotherium*. We feel that the recovery of skull or skeletal material is necessary before a definite identification can be made.

Measurements of the crowns of the teeth are as follows: (mm)

	KNM-SH	Length	Breadth	Height	Thickness of enamel
Left M_1	(12304-C)	57.0+	–	30.5+	3.0
Left M_2	(12304-A)	71.9	62.1	38.1	3.8
Left M_2	(12304-B)	74.6	68.5	39.2	4.1
Left M_2	(12305-A)	–	66.3	35.0	4.9
Right $M_{2 \text{ or } 3}$	(12305-B)	–	–	33.5	4.6
Left $M^{2 \text{ or } 3}$	(12306)	–	–	41.0+	5.5

ORDER PERISSODACTYLA
SUBORDER HIPPOMORPHA
Family Equidae Gray, 1921
Genus *Hipparion* de Christol, 1821

Hipparion primigenium (von Meyer), 1829

(Plate 5, fig. 3–15, Plate 6, fig. 1–4)

Material . . . . . .Right upper dP^2 (KNM-SH 12248, loc. SH 22), left upper P^3 (KNM-SH 12244 loc. SH 12), right upper P^3 (KNM-SH 12255 loc. SH 15), left upper $P^{3 \text{ or } 4}$ (KNM-SH 12205 loc. SH 11), right upper $P^{3 \text{ or } 4}$ (KNM-SH 12240 loc. SH 14), left upper $P^{3 \text{ or } 4}$ (KNM-SH 12245 loc. SH 9), right upper $P^{3 \text{ or } 4}$ (KNM-SH 12256 loc. SH 9), left upper $P^{3 \text{ or } 4}$ (KNM-SH 12258 loc. SH 12), left upper P^4 (KNM-SH 12202 loc. SH 25), right upper P^4 (KNM-SH 12204 loc. SH 25), right upper P^4 (KNM-SH 12257 loc. SH 9) left upper P^4 (KNM-SH 12271 loc. SH 11), right upper M^1 (KNM-SH 12239 loc. SH 5), left upper M^1 (KNM-SH 12241 loc. SH 16), left upper M^2 (KNM-SH 12242 loc. SH 9), left upper M^2 (KNM-SH 12246 loc. SH 21), left upper M^3 (KNM-SH 12243 loc. SH 41), left upper M^3 (KNM-SH 12247 loc. SH 12), fragment of the frontal (KNM-SH 12276 loc. SH 19), right mandible with lower P_2 (KNM-SH 12201 loc. SH 15), right mandible with lower P_2 and P_3 (KNM-SH 12269 loc. SH 12), right lower P_2 (KNM-SH 12264 loc. SH 11), left lower P_3 (KNM-SH 12249 loc. SH 25), left lower P_3 (KNM-SH 12250 loc. 12), right lower P_3 (KNM-SH 12253 loc. SH 15), left lower P_4 (KNM-SH 12262 loc. SH 12), left lower P_4 (KNM-SH 12259 loc. SH 25), right

lower $P_{3 \text{ or } 4}$ (KNM-SH 12265 loc. SH 12), left lower M_1 (KNM-SH 12252 loc. SH 16), left lower M_1 (KNM-SH 12261 loc. SH 12), right lower M_2 (KNM-SH 12251 loc. SH 12), left lower M_2 (KNM-SH 12254 loc. SH 15), right lower M_2 (KNM-SH 12263 loc. SH 9), left lower M_2 (KNM-SH 12266 loc. SH 9), left lower M_3 (KNM-SH 12260 loc. SH 13), right lower M_3 (KNM-SH 12267 loc. SH 12), right lower M_3 (KNM-SH 12268 loc. SH 9), left lower M_3 (KNM-SH 12270 loc. SH 14), left talus (KNM-SH 12278 loc. SH 12), proximal and distal end of right 3rd metacarpal (KNM-SH 12272 loc. SH 12), distal end of right 3rd metacarpal (KNM-SH 12274 loc. SH 11), distal end of 3rd basal phalange (KNM-SH 12277 loc. SH 14), proximal end of 3rd middle phalange (KNM-SH 12273 loc. SH 12).

Locality . . . . . .Samburu Hills (see above).

Horizon . . . . . .Lower alternation and upper alternation, Namurungule Formation.

Description

Upper cheek teeth: the cheek teeth are large and relatively hypsodont. The protocone is separated from the main part of the tooth. Various patterns of enamel folding can be seen in the sample. The enamel surrounding the prefossettes and postfossettes of the cheek teeth are characterised by abundant plication.

Lower cheek teeth: the cheek teeth in the collection are large and rarely possess an ectostylid, but commonly have protostylids and ptychostylids.

The limb bones are generally large, robust and broad.

Measurements of the specimens are as follows: (mm)

	KNM-SH	Length of crown	Breadth of crown	Height	Length of the protocone
Right dP^2	(12248)	27.0	19.1	53.5	6.6
Left P^3	(12244)	—	—	44.9	—
Right P^3	(12255)	28.2	28.1	52.9	7.3
Left $P^{3 \text{ or } 4}$	(12205)	27.3	26.3	48.2	8.6
Right $P^{3 \text{ or } 4}$	(12240)	—	24.1+	36.0	6.1
Left $P^{3 \text{ or } 4}$	(12245)	28.2	23.7	49.6	8.6
Right $P^{3 \text{ or } 4}$	(12256)	—	23.0	41.3	7.8
Left $P^{3 \text{ or } 4}$	(12258)	24.3	24.4	26.2	8.7
Left P^4	(12202)	25.7	—	51.1	—
Right P^4	(12204)	25.9	24.2	58.0	9.2
Right P^4	(12257)	25.8	23.6+	21.3	9.5
Left P^4	(12271)	26.5	23.6	66.7	8.4
Right M^1	(12239)	—	—	33.7	—
Left M^1	(12241)	—	—	52.3	—
Left M^2	(12242)	25.0	22.1	47.8	7.7
Left M^2	(12246)	23.0	22.4	37.7	7.6
Left M^3	(12243)	23.2	21.3	51.6	9.1
Left M^3	(12247)	26.1	20.5	42.7	9.0

	KNM-SH	Length of crown	Breadth of crown	Height
Right P_2	(12201)	32.8	16.5	36.3
Right P_2	(12269-A)	35.9	15.1	—
Right P_2	(12264)	—	13.1+	57.0
Right P_3	(12269-B)	—	16.2	—
Left P_3	(12249)	30.9	22.7	58.4
Left P_3	(12250)	—	15.6	61.0
Right P_3	(12253)	—	18.2+	48.9
Left P_4	(12262)	26.3+	14.6+	37.4
Left P_4	(12259)	25.5	15.4	36.9
Right $P_{3 \text{ or } 4}$	(12265)	—	12.0+	58.9
Left M_1	(12252)	25.3	15.5	49.0
Left M_1	(12261)	26.7	14.1	30.0
Right M_2	(12251)	—	12.1+	42.6
Left M_2	(12254)	26.3	13.2	53.5
Right M_2	(12263)	—	12.9+	37.3
Left M_2	(12266)	26.4	13.5	43.7
Left M_3	(12260)	28.6	11.7	52.0
Right M_3	(12267)	—	11.5+	42.1

Left Talus (KNM-SH 12278)

Greatest height 60.3

Greatest breadth 62.7

Length of the trochlea . . . . . 48.5+

KNM-SH	Right 3rd metacarpal (12272)	Right 3rd metacarpal (12274)	3rd basal phalange (12277)	3rd middle phalange (12273)
Breadth of the proximal end	44.0	44.0	41.2	—
Breadth of the body	31.9+	28.7	—	32.6
Breadth of the distal end	43.5+	—	—	37.0
Diameter of the proximal end	23.6	27.1	—	—
Diameter of the body	25.9	23.6	19.2	—
Diameter of the distal end	29.5	—	22.0	—

The dental dimensions of *Hipparion* molars from the Samburu Hills fall into two groups. The larger of these is closely comparable to samples collected from Nakali (Aguirre and Alberdi, 1974) (see accompanying table) and identified by them as *H. africanum.*

Hipparion sitifense Pomel, 1897

(Plate 6, fig. 5–12)

Material . . . . . Right upper M^2 (KNM-SH 12284 loc. SH 34), left upper $M^{1 \text{ or } 2}$ (KNM-SH 12285 loc. SH 34), left upper $M^{1 \text{ or } 2}$ (KNM-SH 12286 loc. SH 34), left upper $M^{1 \text{ or } 2}$ (KNM-SH 12302 loc. SH 20), right upper $M^{1 \text{ or } 2}$ (KNM-SH 12790 loc. SH 20), right upper M^3 (KNM-SH 12291 loc. SH 34), right lower M_1 (KNM-SH 12203 loc. SH 27), right lower M_2 (KNM-12283 loc. SH 9), right lower M_2 (KNM-SH 12290 loc. SH 9), left lower M_3 (KNM-SH 12287 loc. SH 8), left talus (KNM-SH 12280 loc. SH 24), left talus (KNM-SH 12281 loc. SH), right talus (KNM-SH 12295 loc. SH 24), right talus (KNM-SH 12297 loc. SH 28), right calcaneum (KNM-SH 12279 loc. SH 20), right navicular (KNM-SH 12282 loc. SH 20), right 3rd metacarpal (KNM-SH 12288 loc. SH 4), 3rd basal phalange (KNM-SH 12289 loc. SH 27), 3rd basal phalange (KNM-SH 12299 loc. SH 38), 3rd middle phalange (KNM-SH 12292 loc. SH 4), 3rd middle phalange (KNM-SH 12301 loc. SH 28).

Locality . . . . . Samburu Hills (see above).

Horizon . . . . . Lower alternation and upper alternation, Namurungule Formation.

Description and Discussion

Upper cheek teeth: the cheek teeth are small. The enamel surrounding the prefossettes and postfossettes of the cheek tooth are characterised by limited plication, but in other characteristics the teeth are similar to those of *H. primigenium.*

Lower cheek teeth: the cheek teeth are small, and have no ectostylid and no ptychostylid. Protostylids are very common in the sample under study.

The limb bones are slender and long.

Measurements of the materials are as follows: (mm)

	KNM-SH	Length of crown	Breadth of crown	Height	Length of the protocone
Right M^2	(12284)	19.9+	17.9+	31.3	6.5
Left $M^{1 \text{ or } 2}$	(12286)	20.9+	18.0+	34.3	6.7
Right $M^{1 \text{ or } 2}$	(12302)	19.5+	20.6	12.5	7.7
Right $M^{1 \text{ or } 2}$	(12790)	22.3+	17.1+	15.8	7.6
Right M^3	(12291)	20.9+	17.8+	35.8	5.4

	KNM-SH	Length of crown	Breadth of crown	Height
Right M_1	(12203)	22.4	14.2	12.1
Right M_2	(12283)	21.7	12.2	26.5
Right M_2	(12290)	—	11.4	14.5
Left M_3	(12287)	25.0	10.1	33.5

	KNM-SH	Greatest height	Greatest breadth	Length of the trochlea
Left talus	(12280)	51.4	45.4	47.7
Left talus	(12281)	51.3	45.0+	47.4+
Right talus	(12295)	51.4	47.3+	49.4+
Right talus	(12297)	—	48.0	—

	KNM-SH	Greatest length	Greatest breadth	Greatest diameter
Right calcaneum	(12279)	95.8	45.1	48.4

	KNM-SH	Greatest breadth
Right navicular	(12282)	34.5

KNM-SH	Right 3rd metacarpal (12288)	3rd basal phalange (12299)	3rd middle phalange (12292)	3rd middle phalange (12301)
Greatest length	216.5	58.0	34.9+	35.3
Breadth of the proximal end	36.9	37.9	34.1+	33.7+
Breadth of the body	26.5	27.4	31.2+	29.1+
Breadth of the distal end	37.5	30.2	30.6+	31.0
Diameter of the proximal end	29.3	28.2	20.5+	22.5
Diameter of the body	21.9	19.6	19.0	16.9
Diameter of the distal end	27.7	17.9	15.2+	17.2

Metric Comparison of Hipparion teeth from Nakali and Samburu Hills

The equid material so far collected at Samburu reveals that at least two taxa are present in the deposits. These are characterised by differences in size, limb proportions and dental features outlined above. The collection, though containing more than 170 specimens of which 79 are mentioned above, does not have any specimens complete enough to permit us to obtain a convincing idea of the affinities of the taxa. We are therefore obliged to use traditional nomenclature, and identify the large species as *H. primigenium* and the smaller one as *H. sitifense.* However, in the absence of skulls we cannot rule out the possibility that the large Samburu *Hipparion* may represent *H. turkanense* Hooijer and Maglio (1974).

		Nakali sample *H. africanum* (from Aguirre and Alberdi, 1974)	Samburu Hills *H. primigenium*	Samburu Hills *H. sitifense*
$P^{3 \text{ and/or } 4}$	(Length)	27.5 – 28.4	24.3 – 28.2	
	(Breadth)	26.0 – 27.5	23.0 – 28.1	
$M^{1 \text{ and/or } 2}$	(Length)	26.9 – 29.7	23.0 – 25.0	19.5+ – 23.3+
	(Breadth)	24.5	22.1 – 22.4	17.1+ – 20.6
P_2	(Length)	29.4 – 31.5	32.8 – 35.9	
	(Breadth)	14.0	13.1 – 16.5	
$P_{3 \text{ and/or } 4}$	(Length)	26.7 – 29.1	25.5 – 30.9	
	(Breadth)	16.6 – 18.0	12.0+ – 18.2	
$M_{1 \text{ and/or } 2}$	(Length)	25.0 – 30.0	25.3 – 26.7	21.17 – 22.4
	(Breadth)	13.2 – 14.1	12.1 – 15.5	11.4 – 14.2
M_3	(Length)	31.5	28.6	25.0
	(Breadth)	12.3	11.7 – 11.7	10.1

Family Chalicotheriidae Gill, 1872
Genus cf. *Ancylotherium* Gaudry, 1862

? Ancylotherium sp. indet.

(Plate 7, fig. 1)

Material . . . . . Basal phalange (KNM-SH 12138).
Locality . . . . . Samburu Hills (SH 14).
Horizon . . . . . Upper alternation, Namurungule Formation.

Description and Discussion

The only specimen of chalicothere in the collection is a lateral proximal phalange of the manus: Its dorsal proximal articular surface is rounded and overlaps the body of the phalanx both medially and laterally.

Measurements of the phalange are as follows: (mm)
Greatest length 53.1
Breadth of the proximal end 32.0
Breadth of the body. 26.1
Breadth of the distal end. 27.3
Diameter of the proximal end 27.3
Diameter of the body. 25.4
Diameter of the distal end. 19.7

Two subfamilies of chalicothere (Chalicotheriinae and Schizothersiinae) are recognised in Africa (Pickford, 1981). In the lower Miocene *Chalicotherium* is common (Butler, 1965) while in the Plio-Pleistocene the genus *Ancylotherium* is widespread but generally rare (Hooijer, 1975). In addition the genus *Chemositia* Pickford, was found in upper Miocene deposits at Mpesida.

It is clear from its morphology and size that the Samburu specimen does not represent *Chemositia.* On a basis of its size it is closer to *Chalicotherium rusingense* than to *Ancylotherium hennigi,* but morphologically it resembles the latter species in the shape and width of the distal trochlea, the swollen volar part of the shaft proximal to the distal trochlea, and in the degree of overlap of the proximal facet over the shaft. For these reasons we tentatively identify the specimen as *Ancylotherium* sp. It is appreciably smaller than any phalanges assigned to *A. hennigi.*

SUBORDER CERATOMORPHA
Family Rhinocerotidae Owen, 1845
Genus *Brachypotherium* Roger, 1904

Brachypotherium sp.

(Plate 7, fig. 2–5)

Material . . . . . Left lower P_3 (KNM-SH 12146 loc. SH 22), left lower M_2 (KNM-SH 12143 loc. SH 20), mandibular symphysis (KNM-SH 12174 A loc. SH 25).
Locality . . . . . Samburu Hills (see above).
Horizon . . . . . Lower alternation and upper alternation Namurungule Formation.

Description and Discussion

The available material consists of two lower cheek teeth and one edentulous mandible. P_3 (KNM-SH 12146) is heavily worn.

Measurements of the cheek teeth are as follows: (mm)

	KNM-SH	Length of crown	Breadth of crown	Height of crown	Thickness of enamel
Left P_3	(12146)	30.9	22.3	11.6	1.8
Left M_2	(12143)	50.5	26.5	21.3	2.8

In the lower cheek teeth the external groove is shallow but is more deeply indented than it is in *Brachypotherium heinzelini.* The buccal cingulum is well developed. The Samburu specimens are comparable in size to corresponding molars of *B. heinzelini,* and are smaller than those of *B. lewisi.* In view of the differences in depth of the external groove in molars from Samburu and typical *B. heinzelini,* and because the sample is small, we prefer to consider the identification of this species as indeterminate until better material is collected.

A mandibular symphysis in the collection (KNM-SH 12174) has two incisors of flattened oval cross section. A second mandible (KNM-SH 12175) is rather different in that it has no incisors, the symphysis is not so robust and not as recurved superiorly. The former we assign to *Brachypotherium* sp. since it is similar to a specimen from Ngorora (KNM-BN 554) identified as such on a basis of its dentition. KNM-SH 12174 is also similar to a symphyseal mandibular fragment with two incisor roots collected at Nakali (KNM-NA 142).

Rhinocerotidae gen. et sp. indet.

(Plate 8, fig. 1)

Material . . . . . Left lower molar (KNM-SH 12142 loc. SH 9), edentulous mandible (KNM-SH 12175 loc. SH 7).
Locality . . . . . Samburu Hills (see above).
Horizon . . . . . Lower alternation, Namurungule Formation.

Description and Discussion

A partial lower molar of a rhinocerotid in the collection is unusual in that it has large quantities of cementum preserved in the lingual and buccal valleys. The anterior crescentoid has a steeply oriented buccal cingulum on its anterior margin and the crown is moderately hypsodont.

It is possible that this specimen is related to the *Ceratotherium* lineage, but until better material is found we prefer to treat the tooth as an indeterminate rhinocerotid.

Measurements of the tooth are as follows: (mm)
Left lower molar (KNM-SH 12142)

Length of crown	—
Breadth of crown	22.4
Height of crown	42.5
Thickness of enamel	1.6

Aguirre and Guerin (1974) described an Iranothere from Nakali. They did not mention whether the specimens they studied possessed cementum, but Heissig (1972) described an Iranothere from Pakistan whose molars are heavily invested with cementum. It is possible that the lower molar described here belongs to an Iranotheriine such as *Caementodon* Heissig, but for the moment we cannot be sure since upper molars, which we don't have in the collection, would be more diagnostic.

The edentulous mandible (KNM-SH 12175) is relatively complete from M_3 to the anterior edge of the symphysis. There are no incisors, but rather a flattened pad-like area of bone, much as in *Paradiceros*. There are two large foramina on the inferior surface of the symphysis, and others below the P_2 on the lateral surface of the body. For the moment we are unable to assign this specimen to a genus.

ORDER ARTIODACTYLA
SUBORDER SUIFORMES
Family Suidae Gray, 1821
Genus *Nyanzachoerus* Leakey, 1958

Nyanzachoerus sp.

(Plate 8, fig. 2–5)

Material . . . . . Incisor (KNM-SH 12403 loc. SH 13), canine (KNM-SH 12401 loc. SH 25), right upper P^4 (KNM-SH 12419 loc. SH 23), left upper M^2 (KNM-SH 12418 loc. SH 23), upper $M^{2 \text{ or } 3}$ (KNM-SH 12400 loc. SH 11), lower M_1 (KNM-SH 12402 loc. SH 12), right lower M_2 (KNM-SH 12399 loc. SH 28), right lower M_2 (KNM-SH 12420 loc. SH 28).

Locality . . . . . Samburu Hills (see above).

Horizon . . . . . Lower alternation and upper alternation, Namurungule Formation.

Description and Discussion

Upper Dentition: The most diagnostic suid specimens in the Samburu collections are an upper P^4 (KNM-SH 12419) and an upper molar (KNM-SH 12418). The P^4 has a single labial cusp the buccal surface of which has a shallow valley running from crown tip to its root. The lingual cusp is as large as the buccal one. Enamel is moderately wrinkled and thick. These features indicate affinities with *Nyanzachoerus.* The molar is comprised of four main cusps and a median accessory cusplet. Enamel wrinkling is moderately complex and the tooth is low-crowned. It probably represents the same taxon as the P^4, in which case the species would be a primitive form of *Nyanzachoerus,* even more primitive than *N. tulotos* Cooke and Ewer (1972). Other teeth in the collection are either not particularly diagnostic or are rather worn. All specimens are however, compatible in size with the P^4 and the upper molar suggesting that only one species of suid is represented at Samburu.

Measurements of the materials are as follows: (mm)

	KNM-SH	Length of crown	Breadth of crown	Height	Thickness of enamel
Right P^4	(12419)	16.1	19.4	13.3	1.6
Left M^2	(12418)	23.7	20.8	11.0	0.7
$M^{2 \text{ or } 3}$	(12400)	21.0+	16.0+	16.5+	1.1
M_1	(12402)	15.0+	12.0+	8.0	0.7
Right M_2	(12399)	15.5+	20.0+	10.5+	1.4
Right M_2	(12420)	11.5+	20.3	10.0	1.2

	KNM-SH	Total length	Breadth	Diameter
Incisor	(12403)	24.3	6.5	6.1
Canine	(12401)	78.9	22.6	22.5

The degree of molar wrinkling and the index of hypsodonty resembles the few fragments of suid teeth from Nakali, which have yet to be described. They are more primitive than any of the taxa described by Cooke and Ewer, (1972) from Lothagam and Kanapoi.

Family Hippopotamidae Gray, 1821
Genus *Kenyapotamus* Pickford, 1983

Kenyapotamus sp.

(Plate 8, fig. 6–7)

Material ..... Fragment of tusk (upper canine) (KNM-SH 12430 loc. SH 12), left talus (KNM-SH 12422 loc. SH 24), two middle phalanges (KNM-SH 12429 C, D loc. SH 24).
Locality ..... Samburu Hills (see above).
Horizon ..... Lower alternation and upper alternation, Namurungule Formation.

Description and Discussion

A few specimens are assigned to *Kenyapotamus* on the basis of their similarity to material from Ngeringerowa (Pickford, 1983). The tusk fragment is similar in its enamel structure to KNM-BN 1353. The talus from Samburu is closely comparable to KNM-BN 1127.

Hippopotamid remains are scarce in the Samburu Hills, a puzzling feature of the sequence, since lacustrine and lake marginal sedimentary facies are very well represented. In virtually all sediments in Kenya deposited later than 7 m.y., hippopotamids are common. Prior to this they are rare. Pickford (1983) pointed out that sediments younger than 7 m.y. yield the genus *Hippopotamus* while those older than 7 m.y. have so far yielded only *Kenyapotamus.* The few fragments from Samburu cannot be assigned to a species with much confidence, although it is noted that they are comparable in size and morphology to *K. coryndoni.*

Measurements of the materials are as follows: (mm)

Left talus (KNM-SH 12422)

Length	49.0+
Width	37.0+
Height	29.5

Middle phalanges (KNM-SH 12429)

	C	D
Greatest length	31.5	31.5
Breadth of the proximal end	20.0	31.5
Breadth of the body	15.5	14.5
Breadth of the distal end	17.5	17.5
Diameter of the proximal end	16.5	15.0
Diameter of the body	10.5	9.5
Diameter of the distal end	12.0	11.0

SUBORDER RUMINANTIA
Family Tragulidae Milne-Edwards, 1864

Gen. et sp. indet.

(Plate 9, fig. 11)

Material ..... Left talus (KNM-SH 12370).
Locality ..... Samburu Hills, loc. SH 4.
Horizon ..... Upper alternation, Namurungule Formation.

Description and Discussion

Comparison of the slightly rolled talus (SH 12370) with a range of artiodactyl tali indicates that it is most similar to tali of *Dorcatherium songhorensis,* both in morphology and size. The length/width ratio is typical of Tragulidae, and differs from the usually wider tali of pecorans. The youngest known tragulid from Kenya other than this specimen is *Dorcatherium* cf. *pigotti* from Ngeringerowa. It is conceivable that SH 12370 represents the genus *Dorcatherium,* but we prefer to wait for the recovery of dental evidence before making a generic identification.

The specimen has the following dimensions:

KNM-SH 12370	Talus
Length	14.5
Breadth	7.7

Family Giraffidae Gray, 1821
Genus *Palaeotragus* Gaudry, 1821

Palaeotragus sp.

(Plate 8, fig. 8–11)

Material ..... Fragment of left upper molar (KNM-SH 12238 loc. SH 28), left lower P_2 (KNM-SH 12236 loc. SH 22), left lower P_3 (KNM-SH 12232 loc. SH 9), right lower P_4 (KNM-SH 12233 loc. SH 5), right lower P_4 (KNM-SH 12235 loc. SH 5), right lower M_2 (KNM-SH 12234 loc. SH 22), fragment of mandible with left and right lower M_3 (KNM-SH 12229 loc. SH 5).
Locality ..... Samburu Hills (see above).
Horizon ..... Lower alternation and upper alternation, Namurungule Formation.

Description and Discussion

The cheek teeth have the kind of rugose enamel typically developed in giraffid teeth. The occlusal shape of the P_4 is trapezoidal. The lower M_2 and M_3 have ectostylids. The teeth are slightly larger than their counterparts in *Palaeotragus primaevus,* but smaller than those of *P. germaini.* The paucity of material prevents a proper assessment of the slight discrepancy in size between the Samburu specimens and *P. primaevus.* Morphologically the two series of fossils appear to be similar, so , until better material is recovered, we assign the specimens to *Palaeotragus,* but leave the specific identification open.

Measurements of the crown of the cheek teeth are as follows: (mm)

	KNM-SH	Buccal length	Mesial breadth	Distal breadth	Height of crown
Left upper molar	(12238)	15.0+	—	—	15.0+
Left P_2	(12236)	20.0+	10.0+	—	19.0
Left P_3	(12232)	25.2	12.3	15.0	12.5
Right P_4	(12233)	22.5	14.0	17.6	11.0
Right M_2	(12235)	24.5	16.2	14.4	17.0
Left M_3	(12234)	29.0+	—	17.5+	17.5
Left M_3	(12229)	22.5+	—	16.4+	17.5+
Right M_3	(12229)	ca. 35.5	17.8	17.8	16.0

Giraffidae gen. et sp. indet. small-type

? Palaeotragus sp.

(Plate 9, fig. 1)

Material . . . . . The distal part of a left humerus (KNM-SH 12219 loc. SH 14), the distal part of a left radius (KNM-SH 12222 loc. SH 20), right talus (KNM-SH 12214 loc. SH 24), left talus (KNM-SH 12215 loc. SH 12), left talus (KNM-SH 12216 loc. SH 30), right talus (KNM-SH 12217 loc. SH 21), right talus (KNM-SH 12218 loc. SH 20), right navicular-cuboid (KNM-SH 12225 loc. SH 20), proximal end of a left 3rd–4th metatarsal (KNM-SH 12220 loc. SH 26), the proximal end of a right 3rd–4th metatarsal (KNM-SH 12221 loc. SH 20), the distal end of a metapodial (KNM-SH 12223 loc. SH 20).

Locality . . . . . Samburu Hills (see above).

Horizon . . . . . Lower alternation and upper alternation, Namurungule Formation.

Description and Discussion

A series of fossil giraffid bones from Samburu is comparable in size and morphology with material from Fort Ternan and Ngorora (Hamilton, 1978). The general aspect and size of the specimens leads us to assign the material tentatively to *Palaeotragus* sp.

Measurements of the materials are as follows: (mm)

	KNM-SH	Greatest height	Greatest breadth	Length of the trochlea
Right talus	(12214)	69.5	42.5+	39.0
Left talus	(12215)	55.3	36.8	33.5
Left talus	(12216)	62.4	40.5	38.2
Right talus	(12217)	60.0	45.3	39.4
Right talus	(12218)	49.5+	38.0+	33.5

Giraffidae gen. et sp. indet. large-type

? Samotherium sp.

(Plate 9, fig. 2, 3)

Material . . . . . The proximal part of a scapula (KNM-SH 12156 loc. SH 8), the distal part of a left humerus (KNM-SH 12153 loc. SH 9), the distal part of a right humerus (KNM-SH 12155 loc. SH 22), the distal part of a left humerus (KNM-SH 12158 loc. SH 26), the distal part of a right humerus (KNM-SH 12167 loc. SH 9), the distal part of a right femur (KNM-SH 12151 loc. SH 9), the distal part of a left femur (KNM-SH 12152 loc. SH 8), the proximal part of a femur (KNM-SH 12154 loc. SH 9), the olecranon process of an ulna (KNM-SH 12157 loc. SH 9), the proximal part of a radio-ulna (KNM-SH 12161 loc. SH 22), the distal part of a left radius (KNM-SH 12162 loc. SH 8), the distal part of a right calcaneum (KNM-SH 12165 loc. SH 25), a right talus (KNM-SH 12166 loc. SH 25), a right magnum (KNM-SH 12169 loc. SH 26), a right scaphoid (KNM-SH 12170 loc. SH 21), a right 3rd–4th metatarsal (KNM-SH 12172 loc. SH 39), the distal end of a 3rd–4th metapodial (KNM-SH 12159 loc. SH 26), the distal end of a 3rd–4th metapodial (KNM-SH 12163 loc. SH 30), the distal end of a 3rd–4th metapodial (KNM-SH 12164 loc. SH 16), the proximal part of a phalange (KNM-SH 12168 loc. SH 12).

Locality . . . . . Samburu Hills (see above).

Horizon . . . . . Lower alternation and upper alternation, Namurungule Formation.

Description and Discussion

Giraffid fossils are relatively common in the Samburu Hills (46 specimens) and represent two distinct sizes (18 small and 20 large specimens, remainder not assigned). Unfortunately all the dental remains collected belong to a small giraffid. In the absence of identifiable large teeth it is not possible to make a convincing identification of the large postcranial elements. A common feature of publications dealing with Miocene giraffids of Kenya is to assign large giraffid fossils to *Samotherium* sp. (Hamilton, 1978) despite the fact that no large giraffid teeth have been collected.

In the almost complete absence of cranial evidence, it is not profitable to attempt a more precise identification for the large giraffid limb bones from Samburu. However, it is noted that Aguirre and Leakey (1974) described a fragmentary molar and some postcranial elements from Nakali as *Samotherium*.

Measurements of the materials are as follows: (mm)

Right talus (KNM-SH 12166)	
Greatest height	101.0
Greatest breadth	68.0
Length of the trochlea	51.0+
Right 3rd–4th Metatarsal (KNM-SH 12170)	
Greatest length	421.0
Breadth of the proximal end	57.0
Breadth of the body	35.0
Breadth of the distal end	58.0
Diameter of the proximal end	57.0
Diameter of the body	40.0
Diameter of the distal end	49.5

Family Boidae Gray, 1821

Genus *Miotragocerus* Stramer, 1928

Miotragocerus sp.

(Plate 9, fig. 10)

Material . . . . . Fragment of horn core (KNM-SH 12318). Fragment of horn core (KNM-SH 12325) may belong here.

Locality . . . . . Samburu Hills (SH 20).

Horizon . . . . . Lower alternation and upper alternation, Namurungule Formation.

Description and Discussion

A single damaged right horn core is identified as *Miotragocerus*. It is curved and spiral with an anterior keel. The posterior part of the horn-core possesses a groove which curves upwards longitudinally so that it remains diametrically opposite the anterior keel. The tip and base are missing so it is difficult to orient the specimen. Its measurements are as follows:

	SH 12318
Greatest diameter at base of preserved part	44.0
Least diameter at base	31.9
Greatest diameter at 100 mm from base	32.5
Least diameter at 100 mm from base	22.2
Length of preserved part	182

A second fragment of horn core found nearby may be the tip of the horn of the same individual. It is nearly circular in section with a slightly flattened surface covering one third of the circumference. No dental elements can be assigned to this taxon, nor can postcranial elements, although the latter may be represented in the collection.

Thomas (1979) described *Miotragocerus cyrenaicus* from Sahabi, which in several features except size, is similar to the Samburu Hills specimen. The cross-sectional shape, rate of twisting and curvature, and position of grooves in the horn core seem to be similar in the two specimens. The Samburu Hills specimen is however, about 25% smaller than the Sahabi specimen.

Genus *Pachytragus* Schlosser, 1904

Pachytragus cf. *solignaci* Robinson, 1972

(Plate 9, fig. 4)

Material . . . . . Fragment of horn core (KNM-SH 12314 loc. SH 26), fragment of horn core (KNM-SH 12315 loc. SH 9), fragment of skull (KNM-SH 12316 loc. SH 20).

Locality . . . . . Samburu Hills (see above).

Horizon . . . . . Lower alternation, Namurungule Formation.

Description and Discussion

Two horn cores and a skull fragment resemble specimens of *Pachytragus* described by Robinson (1972). The horn cores are compressed oval in section and curve uniformly but gently backwards towards the tip. There is a minor twist towards the tip but the horn cores are essentially not spiral. The horn core swells above the pedicle which houses a sinus which extends a short distance into it. The back of the horn core is marked by a longitudinal groove which follows the concave curvature of the horn from its base to its tip.

Measurements of the horn cores are as follows:

	SH 12315	SH 12314
Antero-posterior diameter at base	48.2	c. 48
Medio-lateral diameter at base	31.6	c. 32
Antero-posterior diameter at 100 mm from base	c. 35	39.7
Medio-lateral diameter at 100 mm from base	19.5	21.5
Length of preserved parts	196	159

The skull fragment, KNM-SH 12316, is part of the left side of the frontal, lacking the horn core, but preserving the orbit, part of the basicranium (the basioccipital has a median groove) and the right auditory bulla. The midline is preserved, as is a supra-orbital foramen on the anterior root of the pedicle. The interfrontal suture is preserved, which shows that the intercornual distance was short (about 13 mm). The horns are situated directly above the orbits and are oriented on the frontal as in *P. solignaci.* The distal parts of the horn core roots are further apart than the anterior parts. No dental elements compatible in size with these horn cores have been found. A number of postcranial elements may belong to this taxon or to the similar sized *Miotragocerus* and *Palaeoreas.*

The Samburu material agrees in nearly all essential details with *Pachytragus solignaci* from Tunisia (Robinson, 1972). Metrically it falls at the lower end of the size range of *P. solignaci.* The material from Samburu seems compatible with a specimen from Ngorora tentatively assigned to this species by Thomas (1981).

Genus *Palaeoreas* Gaudry, 1861

Palaeoreas sp.

(Plate 9, fig. 5)

Material . . . . . Fragment of right horn core (KNM-SH 12328 loc. SH 9), fragment of right horn core (KNM-SH 12327 loc. SH 9), fragment of left horn core (KNM-SH 12326 loc. SH 31).
Locality . . . . . Samburu Hills (see above).
Horizon . . . . . Lower alternation and upper alternation, Namurungule Formation.

Description and Discussion

KNM-SH 12328 can be oriented since it retains part of the frontal. The horn core is nearly circular in section with a sharp posterior keel which curves from the base anticlockwise in the right horn core, the keel ending laterally at the base. A blunter keel starts from the anterior position near the base, spiralling anticlockwise towards the tip in the right horn core, keeping nearly diametrically opposite the rear keel. The horn core is not openly spiral. The specimen is rolled and abraded.

Specimens SH 12327 and 12326 are larger but have the same morphology as SH 12328.

These features closely recall the horn core morphology of *Palaeoreas lindermayeri* from Samos (Gentry, 1971).

Measurements of the horn cores are as follows:

	SH 12328	SH 12327	SH 12326
Antero-posterior diameter at base	26.4	35.0	32.0
Medio-lateral diameter at base	17.3	25.5	29.0

On the basis of the size of the unweathered specimens, the Samburu Hills specimens are compatible in size with *P. lindermayeri* (see Gentry 1971, Table 3) but without better material we hesitate to assign them to the same species.

Genus *Gazella* Blainville, 1816

Gazella sp.

(Plate 9, fig. 6–8)

Material . . . . . Fragment of left mandible with M_2 and M_3 (KNM-SH 12334 loc. SH

14), fragment of right mandible with M_3 (KNM-SH 12336 loc. SH 12), fragment of left horn core (KNM-SH 12319 loc. SH 25), fragment of left horn core (KNM-SH 12320 loc. SH 16), fragment of right horn core (KNM-SH 12321 loc. SH 12), fragment of left horn core (KNM-SH 12322 loc. SH 12), fragment of horn core (KNM-SH 12323 loc. SH 16), fragment of horn core (KNM-SH 12324 loc. SH 9), fragment of right horn core (KNM-SH 12317 loc. SH 12).

Locality . . . . . Samburu Hills (see above).

Horizon . . . . . Lower alternation and upper alternation, Namurungule Formation.

Description and Discussion

Several gazelline fossils, including horn cores and dental elements indicate the presence, in the Samburu deposits, of a species of *Gazella* slightly larger than *G. granti.* The horn cores have a flattened lateral surface and an evenly curved medial surface. A subcornual fossa is preserved near the disto-lateral surface of the base of the pedicle in four specimens. In two specimens there is a foramen at the base of the pedicle which connects with the interior surface of the orbit anteriorly. A number of unidentified bovid postcranial elements probably belong to the same species of gazelle as the cranial fragments.

The horn core measurements are as follows:

	SH 12321	SH 12320	SH 12319
Antero-posterior diameter at base	30.0	24.4	27.0
Medio-lateral diameter at base	19.8	20.2	20.6

Two mandible fragments may represent the same taxon as the gazelline horn cores.

KNM-SH 12334 and SH 12336 are left and right mandibles respectively. The former contains a fragment of M_2 and a damaged M_3. The lingual surface of the crown is virtually flat and the crown is narrow. The M_3 in KNM-SH 12336 is less damaged and reveals the presence of a very flat lingual wall and the medio-laterally compressed crown. There are no accessory pillars in the buccal valleys.

Measurements of the teeth are as follows: (mm)

	Length	Breadth
KNM-SH 12334 M_3	19.1	6.7
KNM-SH 12336 M_3	19.5	6.5

There are a number of postcranial elements which could belong to gazelles on a basis of their size and morphology. These include metapodials, numbers SH 12342, 12357, 12347, and 12345.

SUMMARY AND CONCLUSIONS

Twenty one mammalian taxa have been recognised from late Miocene deposits exposed in the Samburu Hills, northern Kenya. Because the deposits yield fossils from a time period which is poorly represented in Sub-Saharan Africa, many of the taxa are proving to be new to science. Our analyses are not yet complete, especially since we hope to improve the quality of the samples in subsequent field seasons. For this reason we have erred on the side of caution by not giving specific names to many of the taxa represented in our collections. Because of the paucity of comparative material of similar ages in East Africa, we have had to make comparisons with better

known faunas found north of the Sahara and southern Eurasia. With little doubt, some elements of the Samburu faunas compare reasonably well with faunas from sites such as Beglia, Sahabi, Pikermi and Samos, which indicate correlation with the Vallesian (= Pikermian) large mammal age of southern Europe.

The accompanying table provides lists of the faunas known from early upper Miocene sites in Kenya. There are broad similarities between all three, especially in the artiodactyl and equid faunas. However, since none of the faunas is very rich in diversity, there are many gaps which may be filled, as collecting proceeds in the future. It is hoped that future collections will not only provide a more refined sense of the biostratigraphy of the deposits, but will also enhance our understanding of the palaeoenvironments which we tentatively think may have been woodland to savannah.

Comparison of the early upper Miocene (10.5 – 7.5 my) faunas of Kenya

	Samburu Hills	Nakali	Ngerngerowa
Hominoidea gen. nov.	X		
Colobinae gen. nov.		X	X
Paraphiomys/Kanisamys sp.	X	X	
Mustelidae		X	
Percrocuta sp.	X		
Ictitherium sp.	X		
Hyperhyaena leakeyi		X	
Prodeinotherium/Deinotherium sp.	X	X	X
Tetralophodon sp.	X		
Choerolophodon/Anancus sp.		X	
Hipparion primigenium/africanum	X	X	X
Hipparion sitifense	X		
Chalicotheriidae	X		
Brachypotherium sp.	X		
Kenyatherium bishopi		X	
Rhinocerotidae gen. et sp. indet.	X	X	
Nyanzachoerus sp.	X	X	X
Kenyapotamus sp./*coryndoni*	X	X	X
Tragulidae	X		X
Palaeotragus sp.	X	X	X
?*Samotherium* sp./large giraffid	X	X	X
Miotragocerus sp.	X		
Pachytragus cf. *solignaci*	X		
Palaeoreas sp.	X		
Gazella sp.	X		
Neotragini	X		
Sivoreas eremita			X
?Hippotragini/?Reduncini			X
?*Antidorcas* sp.			X
Bovidae gen. et sp. indet.		X	
Number of Taxa	21	14	11

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Explanation of Plate 1

Percrocuta sp.

Fig. 1 Buccal view of the mandible (KNM-SH 12408) x 1

Fig. 2 Occlusal view of M_1 (KNM-SH 12408) x 1

Ictitherium sp.

Fig. 3 Buccal view of the mandible (KNM-SH 12406) x 1

Fig. 4 Occlusal view of the mandible (KNM-SH 12406) x 1

Hyaenidae gen. et sp. indet.

Fig. 5 Buccal view of the mandible (KNM-SH 12407) x 1

Fig. 6 Mesial view of the mandible (KNM-SH 12407) x 1

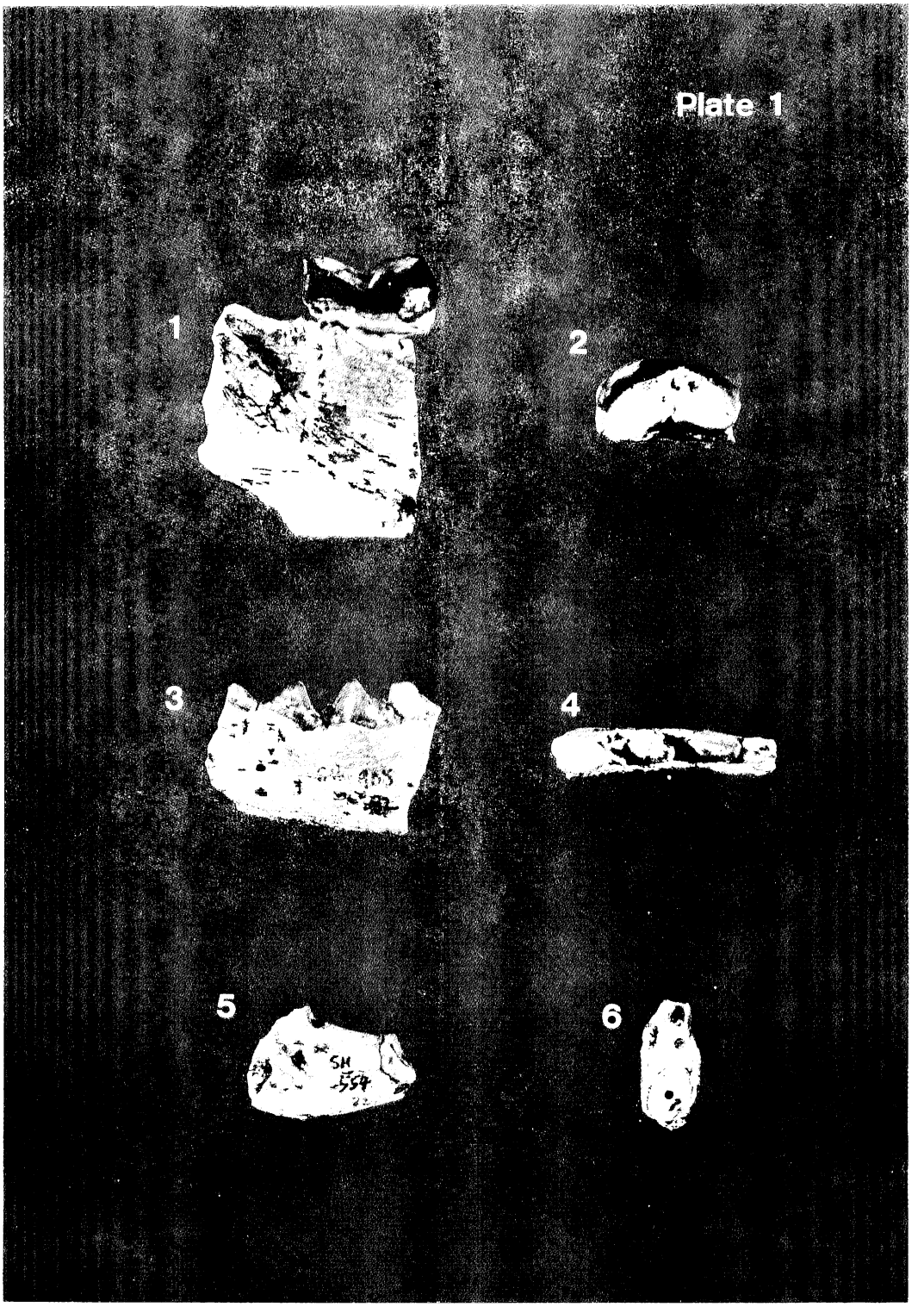
Plate 1
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Explanation of Plate 2

Tetralophodon sp.

Fig. 1 Occlusal view of the left M^2 (KNM-SH 12307-A) x 1/3
Fig. 2 Occlusal view of the right M^2 (KNM-SH 12307-B) x 1/3
Fig. 3 Buccal view of the left M^2 (KNM-SH 12307-A) x 1/3
Fig. 4 Buccal view of the right M^2 (KNM-SH 12307-B) x 1/3
Fig. 5 Occlusal view of the left M^1 (KNM-SH 12308) x 1/3
Fig. 6 Occlusal view of the right M^1 (KNM-SH 12309) x 1/3
Fig. 7 Buccal view of the left M^1 (KNM-SH 12308) x 1/3
Fig. 8 Buccal view of the right M^1 (KNM-SH 12309) x 1/3

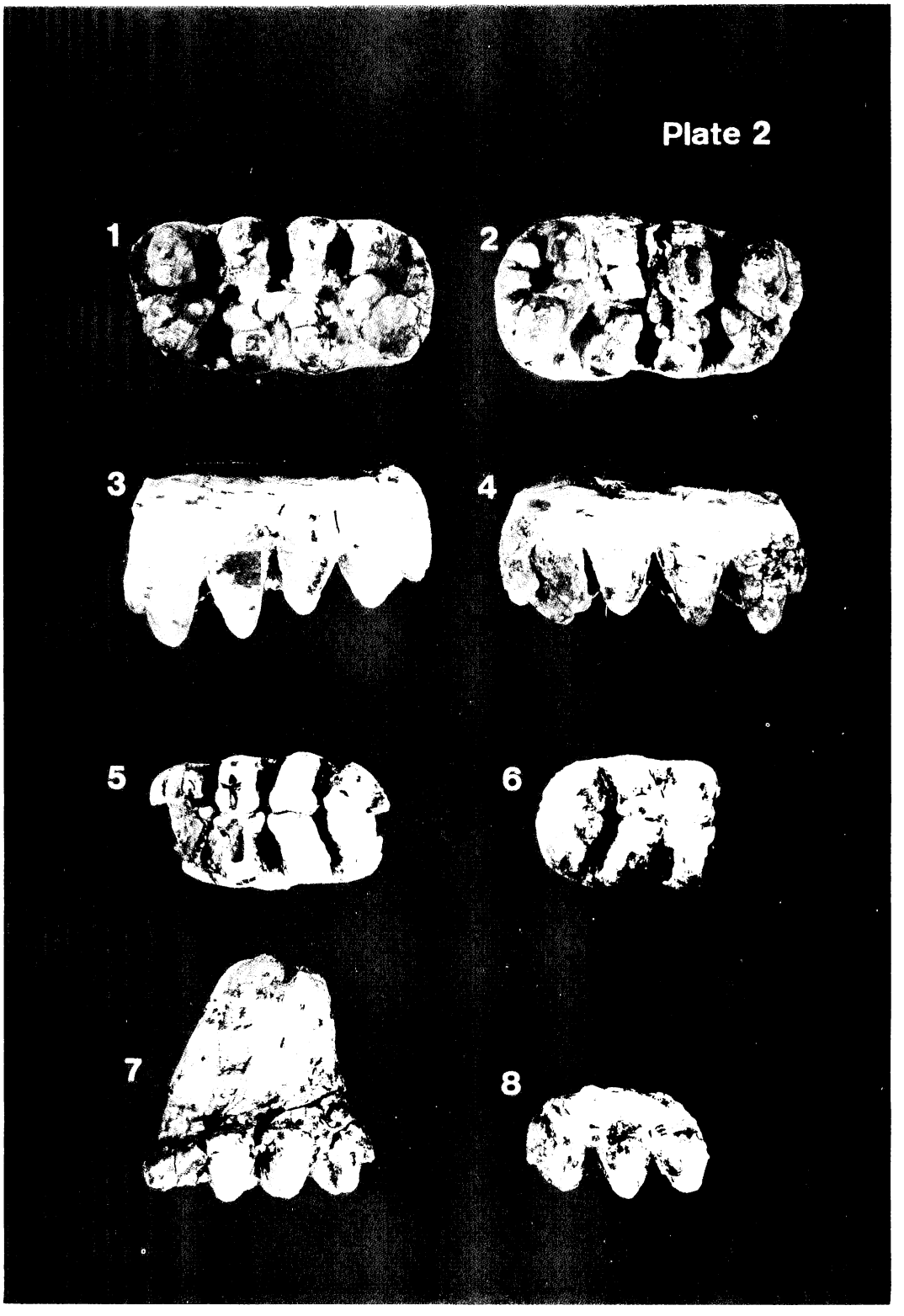
Plate 2
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Explanation of Plate 3

Tetraphodon sp.

Fig. 1 Occlusal view of the left P^4 (KNM-SH 12310) x 3
Fig. 2 Occlusal view of the right P^4 (KNM-SH 12311) x 3
Fig. 3 Buccal view of the left P^4 (KNM-SH 12310) x 3
Fig. 4 Buccal view of the right P^4 (KNM-SH 12311) x 3
Fig. 5 Occlusal view of the right P^3 (KNM-SH 12312) x 1
Fig. 6 Buccal view of the right P^3 (KNM-SH 12312) x 1
Fig. 7 Occlusal view of the right P^2 (KNM-SH 12313) x 1
Fig. 8 Buccal view of the right P^2 (KNM-SH 12313) x 1

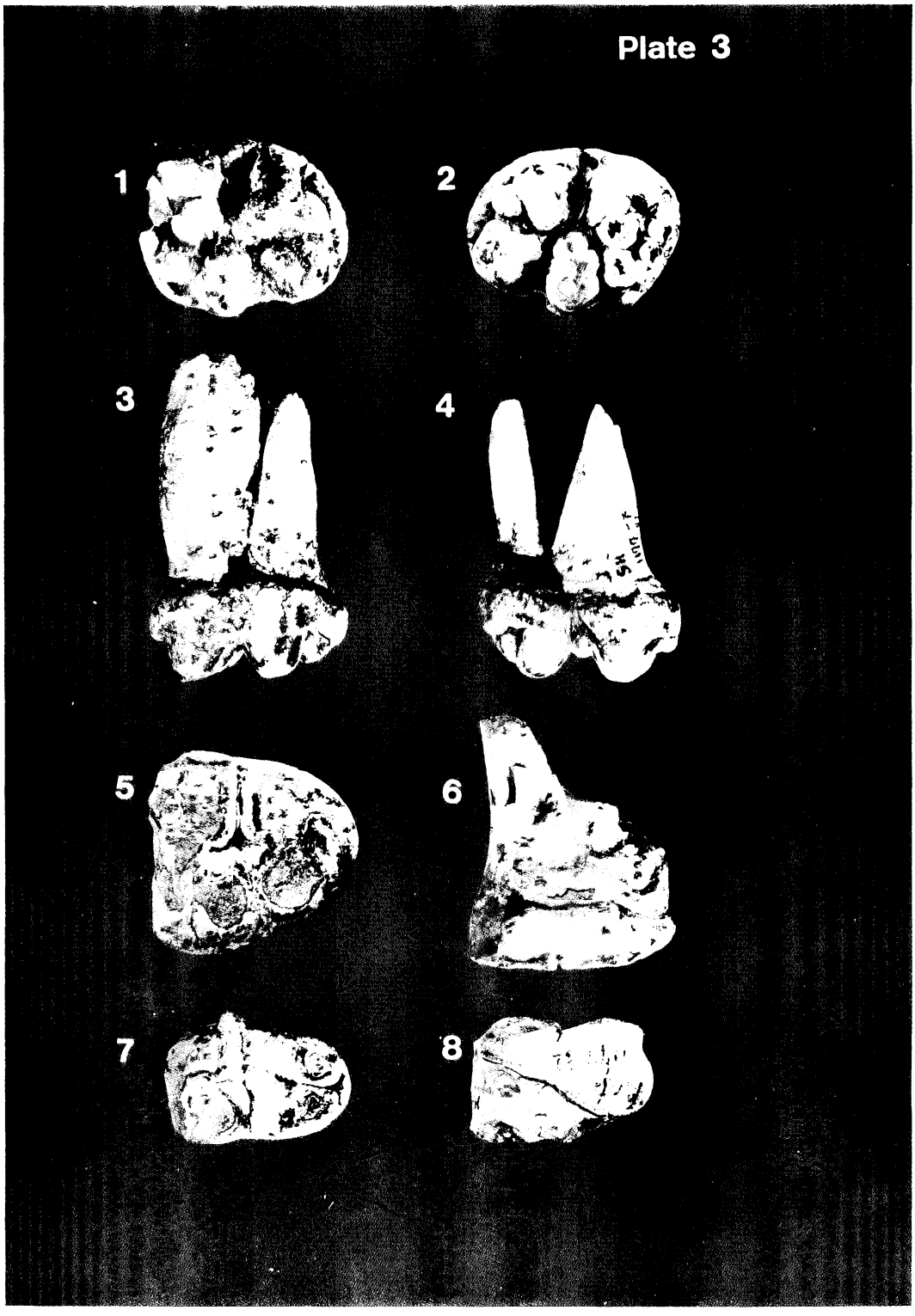
Plate 3
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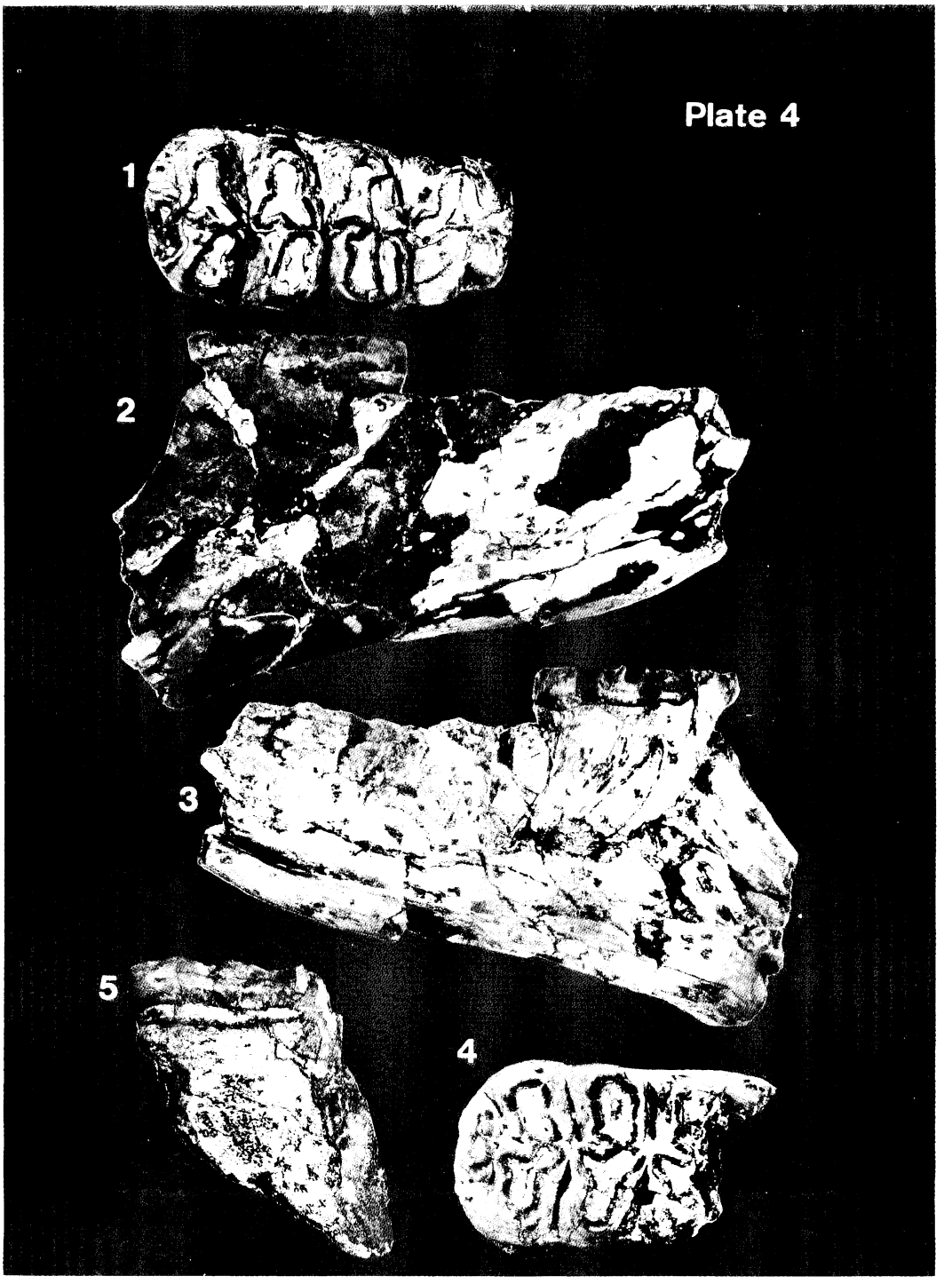
Explanation of Plate 4

Tetralophodon sp.

Fig. 1 Occlusal view of the left M_2 (KNM-SH 12373) x 1/3
Fig. 2 Buccal view of the left M_2 (KNM-SH 12373) x 1/5
Fig. 3 Lingual view of the left M_2 (KNM-SH 12373) x 1/5
Fig. 4 Occlusal view of the right M_2 (KNM-SH 12380) x 1/3
Fig. 5 Buccal view of the right M_2 (KNM-SH 12380) x 1/3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Explanation of Plate 5

Prodeinotherium sp.

Fig. 1 Occlusal view of the left $M_1 - M_2$ (KNM-SH 12304) x 1/2

Fig. 2 Buccal view of the left $M_1 - M_2$ (KNM-SH 12304) x 1/2

Hipparion primigenium (von Meyer), 1829

Fig. 3 Occlusal view of the right P^4 (KNM-SH 12204) x 1

Fig. 4 Occlusal view of the left $P^{3 \text{ or } 4}$ (KNM-SH 12245) x 1

Fig. 5 Occlusal view of the left P^4 (KNM-SH 12271) x 1

Fig. 6 Occlusal view of the left $P^{3 \text{ or } 4}$ (KNM-SH 12205) x 1

Fig. 7 Occlusal view of the right P^3 (KNM-SH 12255) x 1

Fig. 8 Occlusal view of the right P^4 (KNM-SH 12257) x 1

Fig. 9 Occlusal view of the left $P^{3 \text{ or } 4}$ (KNM-SH 12258) x 1

Fig. 10 Occlusal view of the left M_2 (KNM-SH 12266) x 1

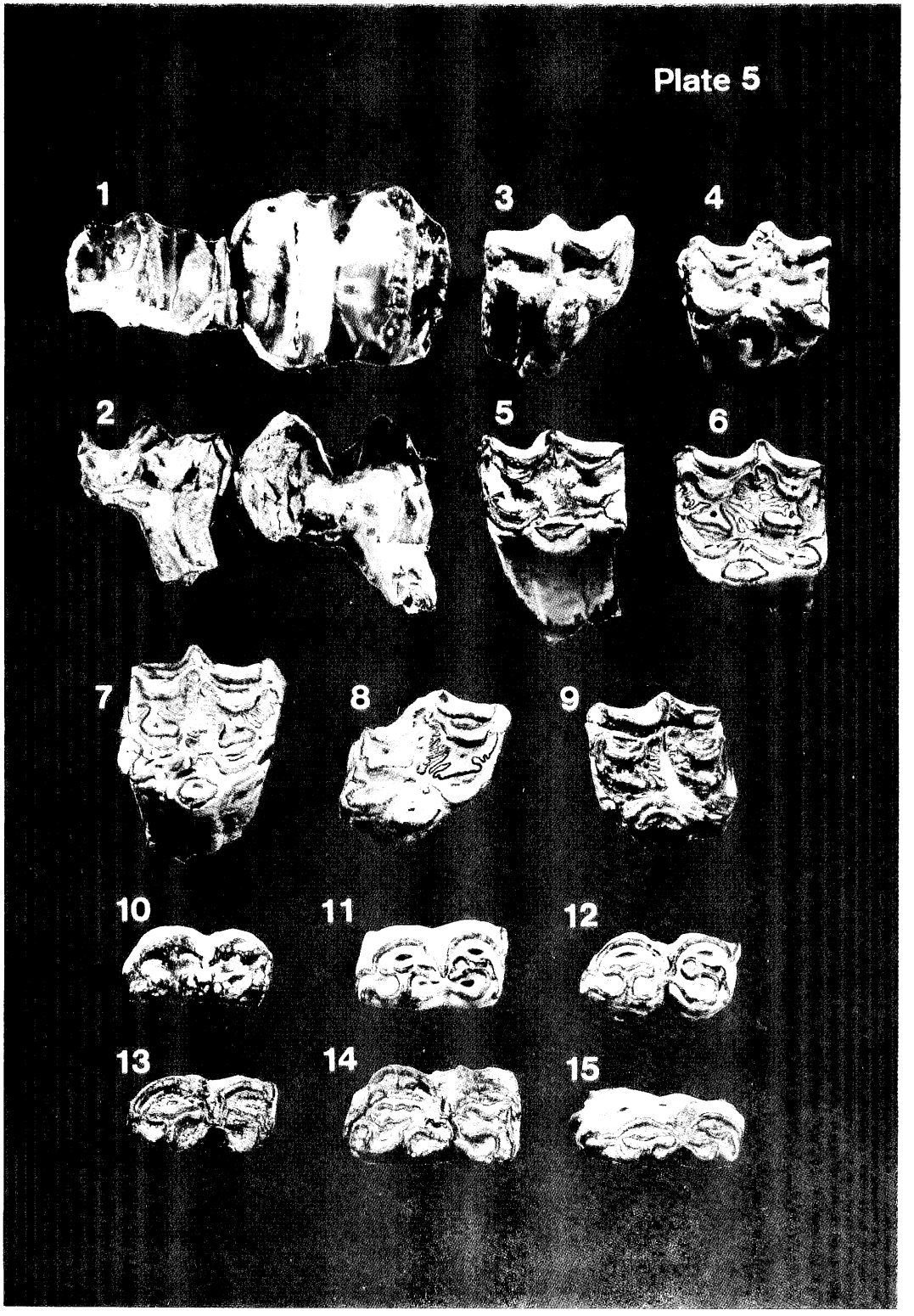
Fig. 11 Occlusal view of the left M_1 (KNM-SH 12252) x 1

Fig. 12 Occlusal view of the left M_2 (KNM-SH 12254) x 1

Fig. 13 Occlusal view of the left M_1 (KNM-SH 12261) x 1

Fig. 14 Occlusal view of the left P_3 (KNM-SH 12249) x 1

Fig. 15 Occlusal view of the left M_3 (KNM-SH 12260) x 1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Explanation of Plate 6

Hipparion primigenium (von Meyer), 1829

Fig. 1 Occlusal view of the right P_2 and P_3 (KNM-SH 12269) x 1
Fig. 2 Occlusal view of the right P_2 (KNM-SH 12201) x 1
Fig. 3 Dorsal view of the left talus (KNM-SH 12278) x 2/3
Fig. 4 Proximal view of the right 3rd metacarpal (KNM-SH 12272) x 1/3

Hipparion sitifense Pomel, 1897

Fig. 5 Occlusal view of the right $P^{3\ or\ 4}$ (KNM-SH 12790) x 1
Fig. 6 Occlusal view of the right $M^{1\ or\ 2}$ (KNM-SH 12302) x 1
Fig. 7 Occlusal view of the left M_3 (KNM-SH 12287) x 1
Fig. 8 Occlusal view of the right M_2 (KNM-SH 12283) x 1
Fig. 9 Occlusal view of the right M_1 (KNM-SH 12203) x 1
Fig. 10 Lateral view of the right calcaneum (KNM-SH 12279) x 2/3
Fig. 11 Dorsal view of the left talus (KNM-SH 12280) x 2/3
Fig. 12 Proximal view of the right 3rd metacarpal (KNM-SH 12288) x 1/3
Fig. 13 Proximal view of the 3rd basal phalanx (KNM-SH 12299) x 2/3

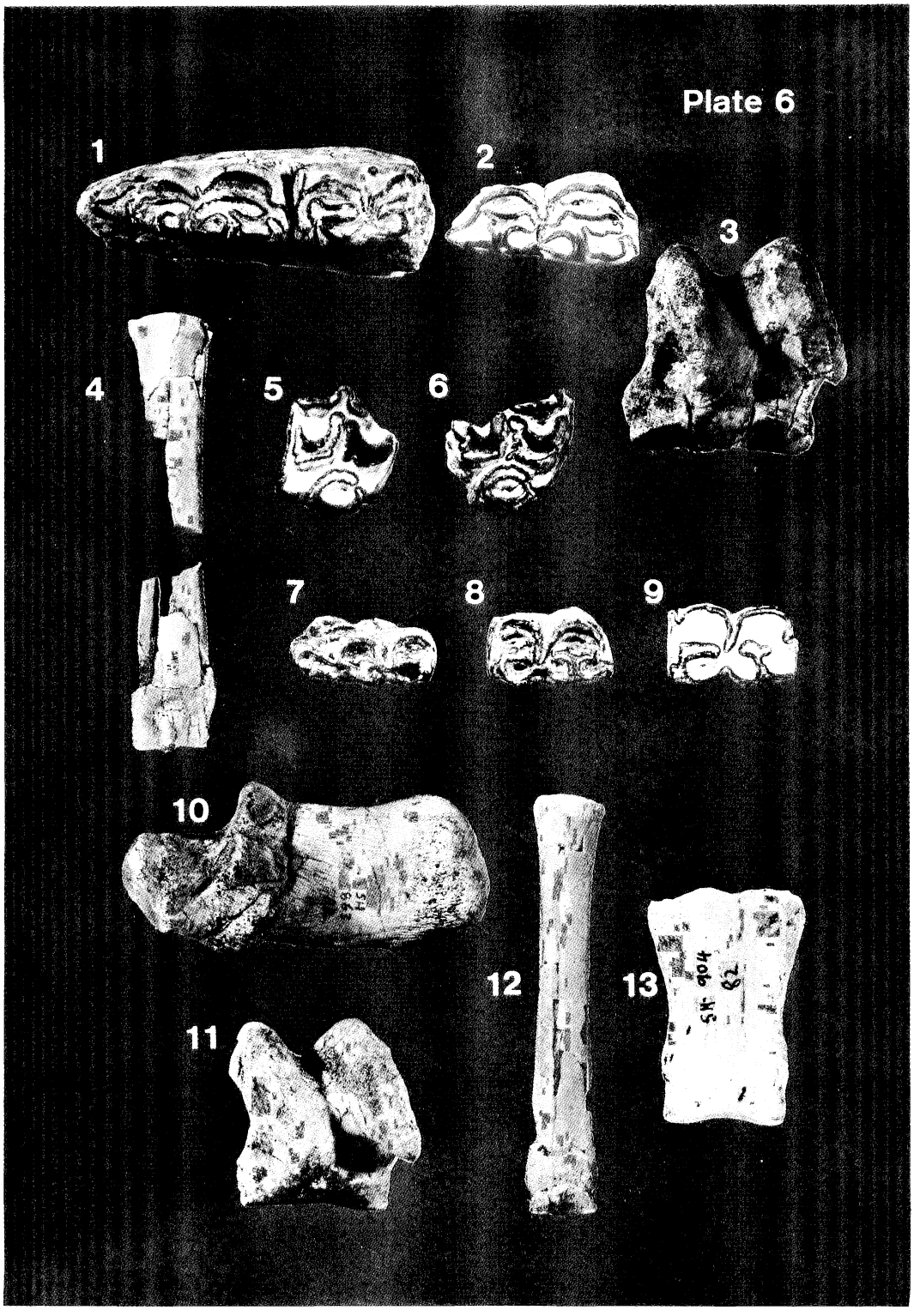
Plate 6
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Explanation of Plate 7

Ancylotherium sp.

Fig. 1 Proximal view of the basal phalanx (KNM-SH 12138) x 1/2

Brachypotherium sp.

Fig. 2 Occlusal view of the left M_2 (KNM-SH 12143) x 1

Fig. 3 Buccal view of the left M_2 (KNM-SH 12143) x 1

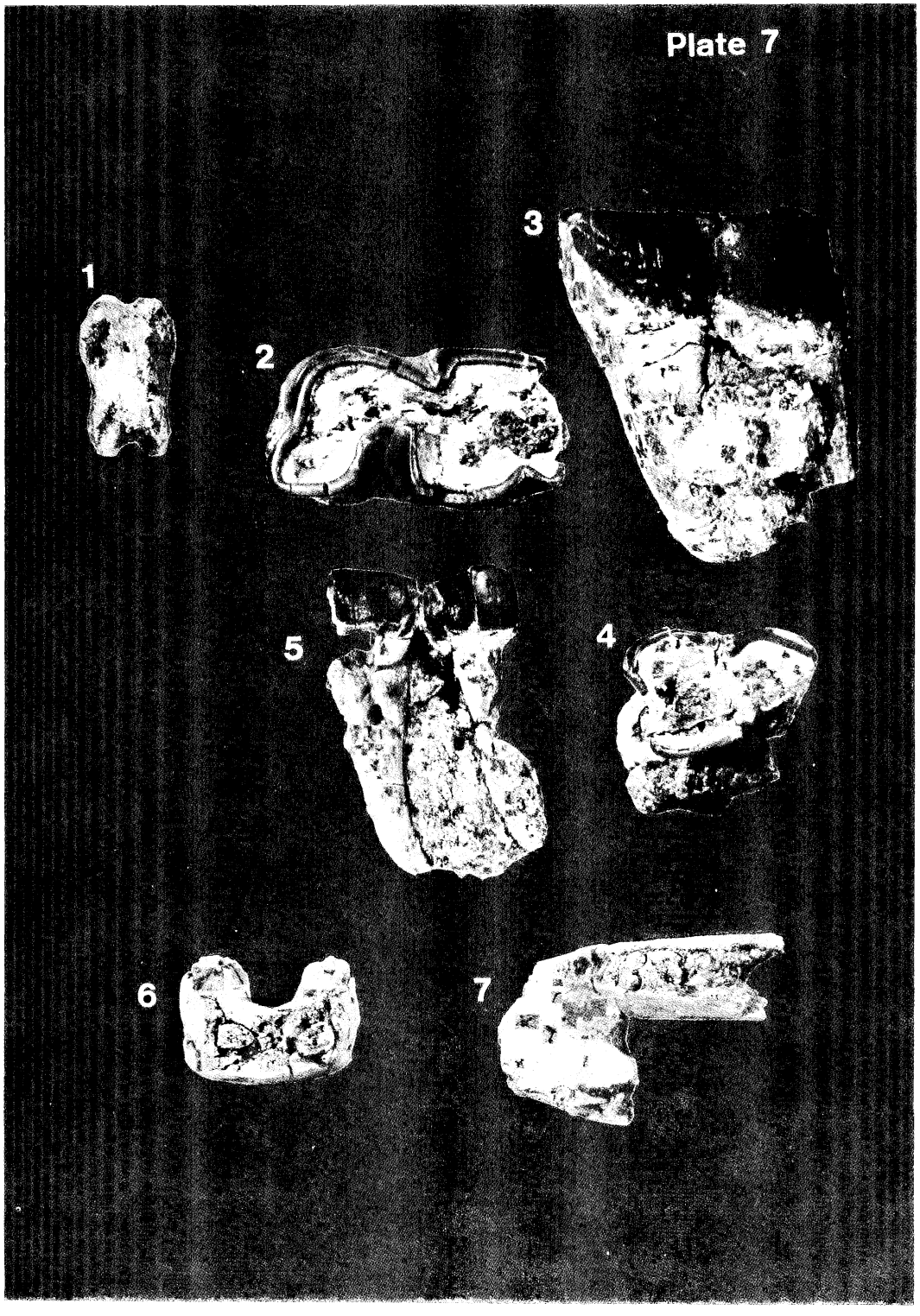
Fig. 4 Occlusal view of the left P_3 (KNM-SH 12146) x 1

Fig. 5 Buccal view of the left P_3 (KNM-SH 12146) x 1

Rhinocerotidae gen. et sp. indet.

Fig. 6 Mesial veiw of the mandible (KNM-SH 12174-A) x 1/3

Fig. 7 Occlusal view of the mandible (KNM-SH 12174-A) x 1/3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Explanation of Plate 8

Rhinocerotidae gen. et sp. indet.

Fig. 1 Lateral view of the fragment of the lower molar (KNM-SH 12142)

Nyanzachoerus sp.

Fig. 2 Occlusal view of the left M^2 (KNM-SH 12418) x 1

Fig. 3 Buccal view of the left M^2 (KNM-SH 12418) x 1

Fig. 4 Occlusal view of the right P^4 (KNM-SH 12419) x 1

Fig. 5 Buccal view of the right P^4 (KNM-SH 12419) x

Kenyapotamus sp.

Fig. 6 Lateral view of the tusk (KNM-SH 12430) x 1

Fig. 7 Dorsal view of the left talus (KNM-SH 12422) x 1

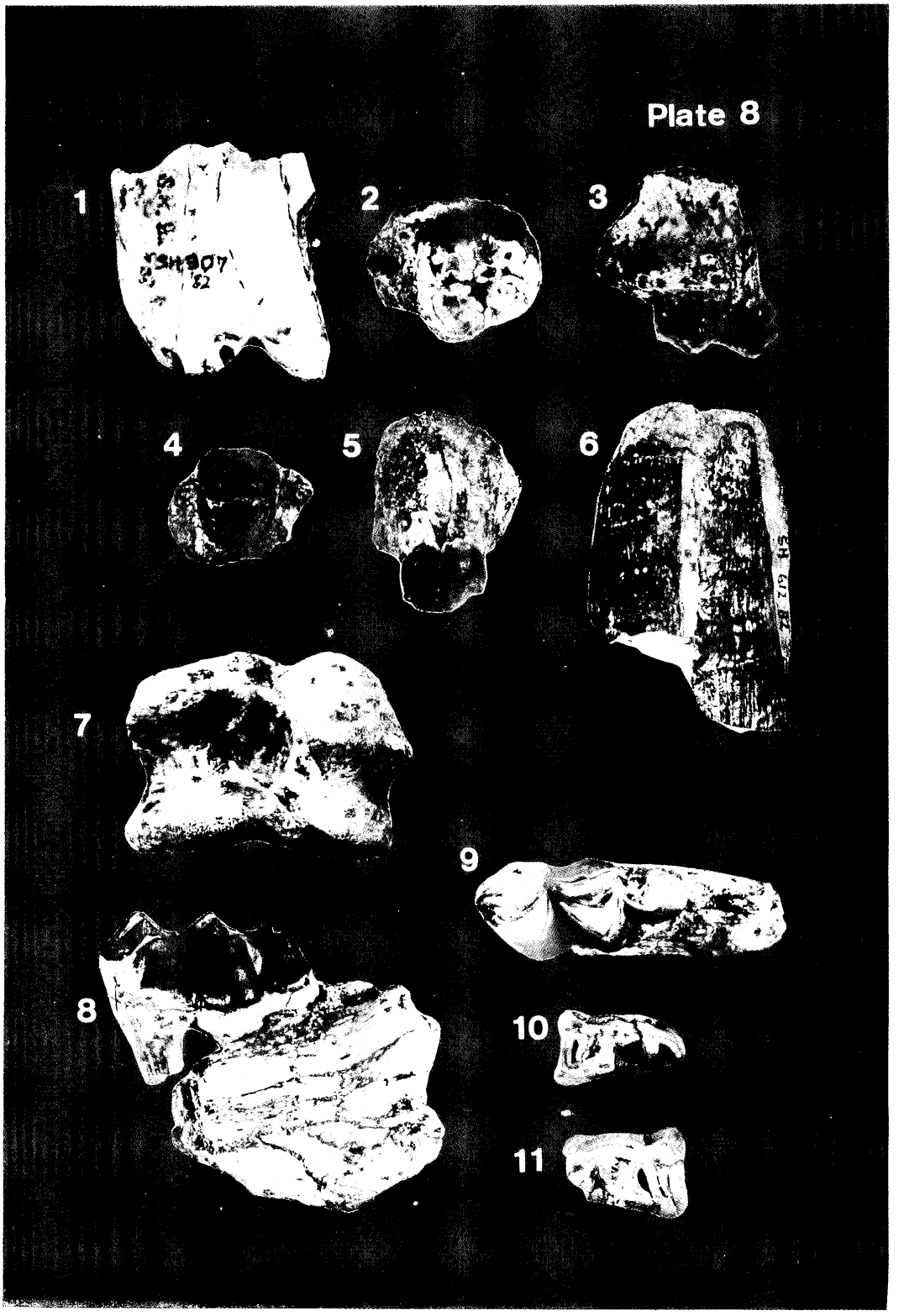
Palaeotragus sp.

Fig. 8 Lingual view of the fragment of the left mandible with M_3 (KNM-SH 12229) x 1

Fig. 9 Occlusal view of the left M_3 (KNM-SH 12229) x 1

Fig. 10 Occlusal view of the left P_3 (KNM-SH 12232) x 1

Fig. 11 Occlusal view of the right P_4 (KNM-SH 12233) x 1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Explanation of Plate 9

Giraffidae gen. et sp. indet. small-type
(? *Palaeotragus* sp.)

Fig. 1 Dorsal view of the left talus (KNM-SH 12215) x 1/2

Giraffidae gen. et sp. indet. large-type
(? *Samotherium* sp.)

Fig. 2 Dorsal view of the right talus (KNM-SH 12166) x 1/2

Fig. 3 Anterior view of the right metatasal (KNM-SH 12172) x 1/5

Pachytragus cf. *solignaci* Robinson, 1972

Fig. 4 Lateral view of the horncore (KNM-SH 12315) x 1/2

Palaeoreas sp.

Fig. 5 Lateral view of the horncore (KNM-SH 12328) x 1/2

Gazella sp.

Fig. 6 Lateral view of the horncore (KNM-SH 12317) x 1/2

Fig. 7 Occlusal view of the fragment of the right mandible with M_3 (KNM-SH 12336) x 1

Fig. 8 Lingual view of the fragment of the right mandible with M_3 (KNM-SH 12336) x 1

Fig. 9 Dorsal view of the right talus (KNM-SH 12368) x 2

Miotragocerus sp.

Fig. 10 Lateral view of the horncore (KNM-SH 12318) x 1/2

Tragulidae gen. et sp. indet.

Fig. 11 Dorsal view of the left talus (KNM-SH 12370) x 2

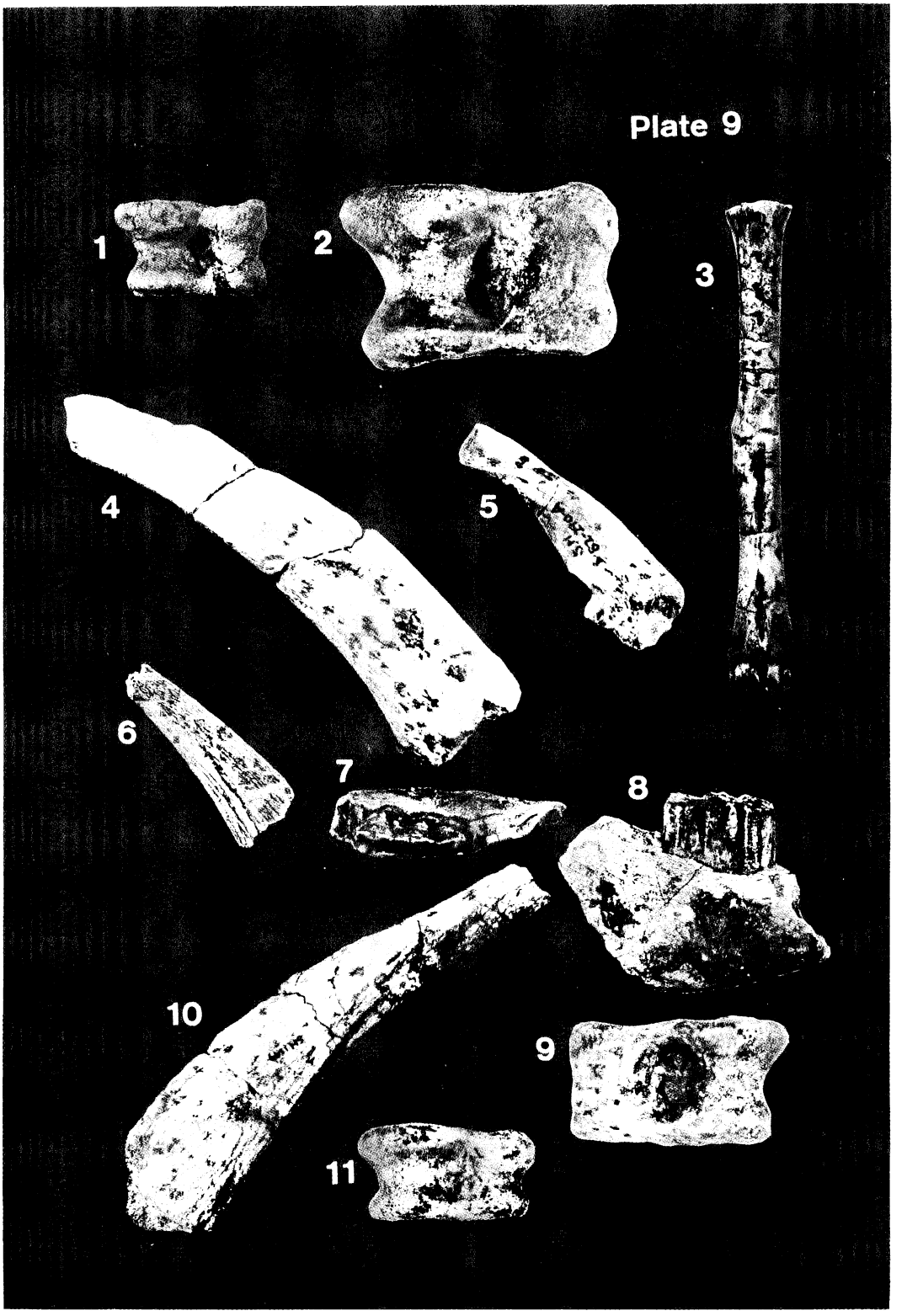
Plate 9
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