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FOSSIL RHINOCEROSES FROM HOPEFIELD, SOUTH AFRICA

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(With Plate XI)

INTRODUCTION

The fossil specimens of rhinoceroses recovered at the "Elandsfontein" site, Hopefield, Cape Province, belong to the two living species of Africa, viz., *Ceratotherium simum* (Burchell) and *Diceros bicornis* (L.) (Singer, 1954). Both are widely distributed in the African Pleistocene (see Hopwood and Hollyfield, 1954), and their distinguishing dental characters have been described by Cooke (1950). The purpose of the present publication is to place the Hopefield material on record.

The general age of the Hopefield fauna is considered to be early Upper Pleistocene, but it is probable that part of the fauna dates from the late Middle Pleistocene (Singer, 1957). In the material recorded below *Ceratotherium* is about four times less abundantly represented than is *Diceros*. The fact that the black rhinoceros was more common at the site than was the white species is in harmony with Hopwood's dictum: "Throughout the Lower and Middle Pleistocene the white rhinoceros (*Ceratotherium simum*) was common all over Africa, whereas the black species (*Diceros bicornis*) was rare: from the Upper Pleistocene onward the position was reversed" (Hopwood, 1954).

The Hopefield specimens, originally housed in the Anatomy Department, University of Cape Town, have now been transferred to the South African

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Museum, Cape Town. The specimens' numbers refer to the Hopefield collection catalogue.

Order PERISSODACTYLA Owen
Family RHINOCEROTIDAE Owen
Genus CERATOTHERIUM Gray

Ceratotherium simum (Burchell) subsp.

Only one out of the seven upper permanent teeth of the white rhinoceros thus far obtained from Hopefield is complete, viz., the crown of a left M^3 (3410A; pl. XI fig. c). It is worn down to the level of the entrance to the medisinus, about 25 mm from the crown base. The postsinus is not yet isolated as a fossette; the height of the worn crown at the antero-external angle is about 50 mm. The medifossette, closed off from the medisinus by the union of crochet and crista, forms an antero-posteriorly elongated oval. Like the medisinus, it is coated with a cement layer about 3 mm in thickness. The outer cement coating of the crown is lost except for a small basal portion anterior to the parastyle. The enamel is damaged antero-internally; the specimen is otherwise perfect.

In its distinguishing characters, such as the hypsodonty of the crown, the backward curvature of the internal portion of the protoloph, the presence of a cement investment, the absence of a marked paracone style, and the presence of a distinct medifossette the present fossil M^3 very closely resembles its homologue in the living white rhinoceros. The greatest (diagonal) length at the base is 90 mm, exclusive of cement. The greatest basal breadth, taken at right angles to the internal surface (protocone-hypocone), is 68 mm, again without cement. An M^3 of a recent *C. simum* in the S.A. Museum, Cape Town (S.A.M. 21379) measures 79 mm antero-posteriorly and 65 mm transversely at the base. However, these figures include the cement investment around the crown; the greatest length and breadth over the enamel at the crown base must have been about 5 mm less: 74 and 60 mm, respectively. Another M^3 of a recent white rhinoceros (from a skull preserved in the Albany Museum, Grahamstown) measures 85 mm antero-posteriorly and 69 mm transversely at the base, including cement. Thus, the fossil M^3 exceeds the recent in size. 6766: The buccal portion of a left upper molar, slightly worn (height of worn crown about 80 mm; antero-posterior length at base about 55 mm). The medifossette is closed. There is a small enamel projection from the crochet into the medisinus. The protoloph has broken off, but part of the metaloph remains, and it is directed obliquely backwards and inwards, as is characteristic of the upper molars of *C. simum*. The external cement coating

is missing, but that in the medifossette and the preserved part of the medisinus is present.

1828: A right upper molar, possibly M^2, the anterior and buccal surfaces of which are for the most part lost. Medisinus and postsinus are isolated from the margin of the crown, and possess a thick enamel investment. The anterior surface shows a deep vertical furrow flattening out at the base and marking off the protocone; this fold is occasionally seen in dentitions of recent white rhinoceros as well.

1827: A postero-buccal fragment of another right upper molar, probably M^3, broken off anteriorly in front of the medifossette, internally along the base of the medisinus, and lacking the internal portion of metaloph. Cement remains in the fossette and in the partially exposed postsinus. The height of the worn ectoloph is at least 80 mm.

1824: A central fragment of a right upper molar: the crista and the crochet have not united yet. The cement coat along the walls of the medisinus is 3 mm thick.

1829: A left premolar (P^2 or P^3), the ectoloph of which is unfortunately missing. The crown is worn down to a height of only 18 mm from the base lingually, and medi- as well as postsinus are isolated from the marginal enamel. Like the medifossette they are coated with cement. The protocone is marked off by two grooves. The antero-posterior diameter of the lingual half of the crown is only about 35 mm (not counting the marginal cement coating, which is lost in the present specimen); the buccal antero-posterior diameter of the crown was probably much greater.

1834: A small central fragment of an upper premolar or molar showing the cement-invested medifossette and part of the medisinus.

All the specimens recorded above definitely belong to *Ceratotherium simum*.

With the exception of the first mentioned specimen (3410A), it is impossible to give measurements that allow of a metrical comparison between the fossil and the recent teeth. It is, however, evident that the fossil material is at most subspecifically distinct, if at all, from the living species.

8610: A mandible with most of the teeth preserved; only the left P_2 is lost. The hypsodonty of the teeth, the presence of cement in their valleys and the great height of the ascending ramus prove it to belong to the extant species. The broken and partially reconstructed symphysial portion is wider, the mental foramina are less advanced in position and are larger than those in a black rhinoceros mandible. The coronoid process (preserved on the left side only) slopes backwards and the posterior medial projection of the condyle (for the postglenoid process of the squamosal) is rather large. In all visible characters the fossil mandible agrees with those of recent *C. simum*. The two valleys

of P_2 and P_3 are closed lingually and the anterior valley of M_1 is worn off, but those of P_4 and M_{2-3} are still open; M_3 is slightly worn. The fossil teeth agree well in dimensions with those of a mandible of recent *C. simum* (S.A.M. 21379) selected for comparison because its M_3 is in exactly the same very early of wear as that in the fossil mandible (table 1).

TABLE 1

Lengths of the lower teeth of *Ceratotherium simum* (in mm)

	Hopefield 8610	S. A. Museum 21379
P_2	32	35
P_3	39	39
P_4	47	47
M_1	—	—
M_2	*c.* 60	60
M_3	62	65

The mandible of the recent *C. simum*, the dental measurements of which are presented in table 1, has the premolars and the first and second molars more worn down than those in the Hopefield mandible. In P_4 both valleys are closed off from the margin, and M_1 has the only remaining valley (the posterior) reduced to a slit. In both mandibles the M_3 is so slightly worn that the enamel figures of the meta- and hypolophid are still separate. Therefore, it appears evident that in the recent jaw the eruption of the last molar is more delayed than is the case in the fossil jaw. The progressive retardation of the eruption of the last molar has also been observed among other rhinoceroses (Zeuner, 1934).

3110B: An isolated right M_3 somewhat more worn down than those in the above mentioned mandibles (the enamel figures of metalophid and hypolophid have just become confluent) (pl. XI, figs. d, e). It has a height of about 75 mm and an antero-posterior diameter of 68 mm, cement included. This specimen does not appear to exceed its recent homologue in size either.

1786: A fragment of the left ramus of the mandible with part of the symphysis. Although the teeth have broken off, the great depth of their alveoli and the position of the mental foramen show that the specimen belongs to the white rhinoceros.

Furthermore, there are some teeth of the milk dentition which are referred to the extant species, viz., a right DM^2 (1832), and a right and left DM^3 (1839, 1842 respectively), all evidently of the same individual. As the ectolophs of all the teeth are missing, no measurements can be taken. The pres-

ence of distinct medifossettes and of cement in the postfossettes indicate that the teeth belong to *C. simum.*

Genus DICEROS Gray

Diceros bicornis (L.) subsp.

This species, decidedly more common in the Hopefield fauna than is *Ceratotherium simum,* is represented, in the first place, by the greater part of the dorsal surface of a skull (8700), from the anterior end of the nasals almost up to the vertex. The sides of the fossil skull are very imperfect; the breadth of the nasals is 136 mm (130 mm is a recent young adult, S.A.M. 21380; 160 mm in a fully adult recent specimen, S.A.M. 21383), and the breadth of the brain case is at least 112 mm (110 mm and 126 mm in the above two recent S.A.M. skulls). Another large cranial fragment of the same fossil individual (8700) comprises the occipital condyles, the basioccipital and the left posterior zygomatic root. The subaural channel is almost closed below (as in the recent black rhinoceros); the posttympanic process is only 2 mm from the huge postglenoid process.

The full permanent dentition, P^2-M^3, is preserved. The lingual surfaces of the left P^3-M^2 and of the right P^2-M^3 are damaged, and the ectolophs of the right P^4-M^3 have broken off. All the teeth are well worn; the crochets are only slightly prominent, and there are no cristae. The crowns are low, proto- and metaloph are not projecting backwards lingually, and there is no crown cement. The fossil teeth agree closely with recent *Diceros bicornis* dentitions, and are within the limits of variation of the extant species (table 2).

8494: Another upper dentition, represented by P^2, P^4 and M^2, all from the left side, as well as many tooth fragments. The crowns are damaged posteromedially, and most of the lingual cingulum of P^4 is lost. There is no crista in any of the specimens; the crochet is bifid in P^4 but single in M^2.

3469: A right P^4, very much worn down but complete. The lingual cingulum is heavy, lowest at the entrance to the medisinus. The medisinus is very narrow medially but wide in the centre of the crown. There is a small crista that joins the crochet, cutting off a small medifossette. The postsinus is open behind because of the great amount of interproximal wear. There is no trace of cement.

1821 and 1823: Left P^2 and P^3 respectively, found together and belonging to the same individual. Although these teeth are somewhat damaged a few measurements can be taken (table 2). There is nothing to distinguish between these fossil teeth and their recent homologues.

TABLE 2

Measurements of upper teeth of *Diceros bicornis* (in mm)

		S. A. Museum		Hopefield				
		21383	21380	8700	8494	1821/23	3469	1809
DM^1	antero-posterior	—	—	—	—	—	—	—
	transverse	23	21	—	—	—	—	—
P^2	antero-posterior	32	29	31	*c.* 31	*c.* 28	—	—
	antero-transverse	44	33	36	40	—	—	—
	postero-transverse	50	38	40	41	36	—	—
P^3	antero-posterior	44	—	42	—	*c.* 36	—	—
	antero-transverse	—	—	55	—	46	—	—
	postero-transverse	60	—	—	—	*c.* 49	—	—
P^4	antero-posterior	51	*c.* 43	48	*c.* 46	—	—	—
	antero-transverse	67	59	—	—	—	56	—
	postero-transverse	66	—	60	*c.* 60	—	55	—
M^1	antero-posterior	53	46	52	—	—	—	—
	antero-transverse	69	55	—	—	—	—	—
	postero-transverse	66	51	—	—	—	—	—
M^2	antero-posterior	55	—	*c.* 55	53	—	—	—
	antero-transverse	70	58	—	—	—	—	—
	postero-transverse	63	—	—	62	—	—	—
M^3	antero-posterior	*c.* 53	—	49	—	—	—	—
	antero-transverse	*c.* 64	—	59	—	—	—	61
	length buccal surface	—	—	64	—	—	—	—

1809 and 1807: A right and a left M^{2-3} in situ in maxillary fragments, evidently of one and the same skull, which are too damaged for measurement except for the right M^3, the anterior breadth of which is within the range of variation of its recent homologue. In all visible characters these fossil specimens conform to those of the recent species.

This also pertains to the remaining upper permanent teeth, all too incomplete for measurement. These are: 1838, right P^3; 3411A, right P^3; 3369, left P^3; 1841, right P^4; 3901, left P^4; 5064, right M^1 or M^2; 7951 left M^2; 1833, right M^3; 1806, left M^{2-3}.

There is an abundance of mandibles of the black rhinoceros at Hopefield, including four almost entire mandibles that lack only the anterior premolars (8611, 8612, 8613, 8858). In 8611 and 8612 the symphysis is incomplete anteriorly, but in 8613 and 8858 the anterior projection of the symphysis with the rudimentary incisor alveoli is shown, just as in the recent *Diceros bicornis* mandibles. The last-mentioned fossil specimens also show the greater part of the coronoid process, which is missing in the others.

The fossil mandibles are indistinguishable from the recent. In some the molars are extensively worn down, whereas in others M_3 is only slightly worn. This accounts for the difference in overall length of the tooth series among the specimens; with advancing wear the tooth series tends to shorten

because of increasing interproximal wear. Comparative measurements are presented in table 3.

TABLE 3

Measurements of lower dentitions and mandibles of *Diceros bicornis* (in mm)

	S. A. Museum	Hopefield			
	21383	8611	8612	8613	8858
Length P_4-M_3	220	195	*c.* 195	200	190
Height of ramus at M_1	92	91	88	90	94

The following mandibular fragments are in the Hopefield collection: 3212A-D, left ramus with M_{2-3}, symphysis, right ascending ramus; 6238, right ascending ramus; 1845, right ramus, teeth broken off; 6159, right ramus with M_{1-3}; 1179, right ramus with M_{2-3}; 1790, left ramus with M_{1-2}; 1784, right ramus, teeth broken off; 1777, symphysis with right P_3; 6238B, right ramus with M_{1-2}; 1768, left ramus with M_{2-3}; 1798, left ramus, teeth broken off; 1787, right ramus with M_{1-3}; 1781, left ramus, teeth broken off; 1793, right ramus with M_2; 3947, left ramus with M_{2-3}; 1782, left ramus, teeth broken off; 1783, 1792, 1794, 1803, 1805, small ramus fragments with parts of teeth.

There are also parts of at least four upper milk dentitions of *Diceros bicornis* in the Hopefield collection, viz., 7950, right DM^{2-3}, slightly worn; 1836, left DM^2 and DM^3, unworn; 1844, left DM^4, slightly worn; 1837, anterior portion and lingual fragment of unworn crowns of DM^3.

TABLE 4

Measurements of DM^{2-4} of *Diceros bicornis* (in mm)

		Recent Leiden Museum cat. ost. b, c	Hopefield		
			7950	1836	1844
DM^2	greatest length ectoloph	40	42	41	—
	antero-transverse	—	35	35	—
	postero-transverse	40	39	38	—
DM^3	greatest length ectoloph	49	50	49	—
	antero-transverse	48	46	46	—
	postero-transverse	42	—	42	—
DM^4	greatest length ectoloph	55	—	—	56
	antero-transverse	48	—	—	45
	postero-transverse	44	—	—	40

The fossil upper milk molars (the measurements of which are given in

table 4) agree with those of the recent black rhinoceros. A peculiarity to be noticed among the fossil specimens is the strong development of the mesostyle in DM^2 of 7950. In DM^2 of 1836 there is no trace of a mesostyle. A well developed mesostyle is present in DM^2 of the recent Asiatic species of rhinoceros (Hooijer, 1946a), but it does not normally develop in the African forms. There is no difference whatsoever between the DM^3s of the two fossil milk dentitions 1836 and 7950 (pl. XI, figs. b, a, respectively). The occasional presence of a distinct mesostyle in DM^2 of the black rhinoceros may be considered an individual aberration.

1812: A reconstructed juvenile mandible (1811, 1820, 5032), broken off behind DM_4 on both sides. The full milk dentition is in situ; only the anterior portion of the left DM_3 is missing.

There are also the following fossil remains of milk dentitions: 1778, a left ramus of mandible with DM_{3-4}; 6098, a left ramus of mandible with DM_{2-3}, and DM_4 erupting; 3920, a left ramus of mandible with the roots of DM_{2-3}, and the anterior root of DM_4; 1819, a right DM_3; 1843, a left DM_3 (not belonging to 1819); 5300, a right DM_4; 3396, a broken right DM_3 or DM_4, and the ectoloph of a right DM_2.

The measurements that can be taken are recorded in table 5.

TABLE 5

Measurements of DM_{1-4} of *Diceros bicornis* (in mm)

		Recent Leiden Museum, cat. ost. e.	Hopefield				
			1812	1778	5300	1819	1843
DM_1	antero-posterior	19	20	—	—	—	—
	transverse	10	10	—	—	—	—
DM_2	antero-posterior	33	32	—	—	—	—
	transverse	18	17	—	—	—	—
DM_3	antero-posterior	41	42	—	—	—	43
	transverse	22	23	22	—	22	22
DM_4	antero-posterior	45	46	—	48	—	—
	transverse	25	25	—	26	—	—

Neither the white nor the black rhinoceros from Hopefield appears to be distinct from the forms now living. It is considered that the few differences found, such as the larger size of M^3 and the less delayed eruption of M_3 in the fossil white rhinoceros as compared with its modern counterpart, are not worthy of even subspecific distinction. However, the fact that there are differences should be borne in mind in the consideration of the dating of the fossil fauna (see also Ewer and Singer, 1956). Subfossil and fossil

remains of living species tend to be larger than their recent homologues (Hooijer, 1949, 1950).

Already in the early Pleistocene of Africa the white rhinoceros appears to have developed characteristics of the modern species: the milk teeth from the Early Pleistocene australopithecine site of Makapansgat, Transvaal, are only larger than the corresponding recent teeth and do not differ in structure (Hooijer, 1959). As shown by Zeuner (1934) *"Rhinoceros simus germano-africanus"* Hilzheimer (1925) from the Middle Pleistocene of Olduvai Gorge in East Africa is not more primitive than the extant form. Likewise, *"Serengeticeros efficax"* Dietrich (1942, 1945) from Serengeti, East Africa, is very close to, or identical with the living *Ceratotherium simum* (Arambourg, 1948). The black rhinoceros is likewise indistinguishable from the extant form, except for a tendency to be larger, already in Early Pleistocene times (Hooijer, 1959).

A further distinction between the fossil and the living *Ceratotherium* and *Diceros* may eventually be found in the proportional lengths of the limb segments. It has been shown (Hooijer, 1946b) that the Pleistocene *Rhinoceros sondaicus* from Java differs from the recent *Rhinoceros sondaicus* in the greater relative lengths of radius, tibia, and metapodials. Similar differences may well be found to exist between the Pleistocene and the recent African species of rhinoceros when sufficient postcranial material will have been recovered. Unfortunately, only a few entire limb bones of rhinoceroses have been collected at Hopefield as yet; the measurements of the postcranial material now in the collection are tabulated below.

In the opinion of Dietrich (1945) the postcranial skeleton of the white rhinoceros is indistinguishable from that of the black species, an opinion with which we agree. However, the bones of the white rhinoceros often show excess in size over the corresponding bones of the black rhinoceros. Although this may not constitute a specific character (Dietrich, l.c.) it is probable that some exceptionally large fossil bones do actually represent *Ceratotherium simum*. The bulk of the fossil bones, as in the case of the teeth, appear to represent the black rhinoceros.

In the following subdivisions of table 6, the measurements (in mm) of the Hopefield postcranial specimens are compared with those of recent *Diceros bicornis* (S.A.M. 21380) and *Ceratotherium simum* (S.A.M. 21379).

TABLE 6 (A-O)

Measurements of limb and foot bones of *Diceros* and *Ceratotherium*

A. Scapula	Hopefield		Recent	
			S.A.M.	S.A.M.
	1241	5137	21380	21379
Antero-posterior diameter of the collum scapulae	110	—	101	129
Antero-posterior diameter from tuber scapulae to posterior border of glenoid fossa	145	*c.* 142	128	158
Antero-posterior diameter of glenoid fossa	88	*c.* 98	84	106
Transverse diameter of glenoid fossa	81	—	80	98
Transverse diameter of the tuber scapulae	*c.* 46	44	47	60

C. Radius

	Right							
	4202	4384	4254	5169	8059*	3132 C	239	243*
Median length	342	—	—	—	—	—	330	330
Proximal breadth	103	117	104	103	—	—	100	97
Proximal antero-posterior diameter (medial side)	67	70	65	62	—	—	60	58
Minimum breadth of shaft	52	56	—	—	—	—	50	52
Breadth of distal articular surface	81	—	—	—	—	100	80	77
Distal antero-posterior diameter (medial side)	66	—	—	—	66	73	54	65

(* = Immature specimens)

B. Humerus	Hopefield								Recent	
	Right					Left				
	5000 B	5000 B	6042	635	3800	629	608	203	S.A.M. 21380	S.A.M. 21379
Length from caput to condylus medialis	—	—	—	—	—	—	—	—	345	410
Breadth across caput and posterior part of lateral tuberosity	—	—	—	—	—	—	—	—	160	188
Breadth at deltoid tuberosity	—	—	—	—	—	—	—	—	140	175
Smallest diameter of corpus	63	—	64	62	60	—	—	—	62	72
Distal breadth	143	—	—	145	159+	173	—	—	154	178
Breadth of trochlea	100	—	101	99	102	115	97	92	101	122
Antero-posterior diameter of condylus medialis	99	—	—	105	105	—	—	—	106	125
Antero-posterior diameter of condylus lateralis	105	—	—	9	117	121	—	—	102	114

Hopefield									Recent	
				Left						
236	262	3647	7885 A	259	240	5490	3807	5502	S.A.M. 21380	S.A.M. 21379
—	—	—	—	—	—	—	—	—	350	365
99	122	103	93	—	90	112	100	—	100	126
57	75	65	53	63	59	72	58	—	60	75
51	64	53	54	64	50	--	52	—	47	63
—	—	—	—	—	—	—	—	—	82	102
—	—	—	—	—	—	—	—	—	65	80

TABLE 6, Cont.

D. Ulna

	Hopefield						Recent	
	Right					Left		
	4379	3661	6764	4361	3810	7885 B	S.A.M. 21380	S.A.M. 21379
Maximum length	—	—	—	—	—	—	450	470
Length from proc. anconeus to extremity of olecranon	—	—	—	—	—	—	141	166
Breadth of semilunar notch	—	82+	97+	87+	—	74	88	112
Minimum antero-posterior diameter of shaft	51	—	54	—	37	33	35	54
Antero-posterior diameter of distal articular surface	—	—	—	—	51	—	61	63
Transverse diameter of distal articular surface	—	—	—	—	37	—	33	43

E. Scaphoid

	Hopefield										Recent	
	Right					Left						
	4143	5538	6565	2696 A	3587	3774	602	6489	2995	4239	3137	S.A.M. 21380	S.A.M. 21379
Vertical diameter (anteriorly)	51	50	52	56	64	58	56	58	55	67	59	54	58
Maximum diameter: distal surfaces	61	58	—	64	71	61	64	*c.* 62	61	76	76	62	78
Maximum A-P: proximal end	60	64	60	66	77	62	61	61	67	79	74	63	75

F. Lunar

	Hopefield				Recent	
	Right	Left			S.A.M.	S.A.M
	2696	5705	604	2588	21380	21379
Vertical diameter	51	*c.* 58	55	60	44	54
Transverse diameter	50	57	60	—	48	62
Maximum A-P diameter	67	77	77	80	64	75

G. Magnum

	Hopefield					Recent	
	Right	Left				S.A.M.	S.A.M.
	3675	3010	4269	2604	2136	21380	21379
Vertical diameter	83	—	—	—	—	77	85
Transverse diameter	48	59	54	60	56	44	57
Antero-posterior diameter	63	74	76	—	75	63	71

H. Unciform

	Hopefield												Recent	
	Right			Left									S.A.M.	S.A.M.
	4302	5638	3674	2594	1093	6047	3068	3135	4274	4123	3770	3219	2993	21380	21379
Vertical diameter	53	51	46	56	53	60	48	56	57	54	53	51	48	49	51
Transverse diameter	64	—	56	80	78	79	60	76	82	65	71	67	—	65	78
Antero-posterior diameter	91	96	82	108	—	107	89	101	103	—	105	86	—	84	100

TABLE 6, Cont.

J. Femur	Hopefield			Recent	
	Right	Left		S.A.M.	S.A.M.
	314	759	830	21380	21379
Length from caput to medial condyle	—	—	—	460	510
Proximal breadth over caput and trochanter major	—	—	—	195	226
Breadth across shaft and 3rd trochanter	—	—	—	141	157
Minimum transverse breadth of shaft	66	64	—	58	80
Antero-posterior diameter at the same level	50	50	—	55	59
Distal breadth across epicondyles	—	—	129	126	154
Distal breadth across condyles	—	—	114	113	130
Antero-posterior diameter of caput	—	—	—	87	108
Distal antero-posterior diameter (medial side)	—	—	164	164	192
Distal antero-posterior diameter (lateral side)	—	—	126	125	154
Antero-posterior diameter from middle of trochlea to inter-condyloid fossa	—	—	92	81	106
Length from trochanter major to base of 3rd trochanter	—	—	—	183	199

K. Tibia	Hopefield						Recent	
	Right			Left				
							S.A.M.	S.A.M.
	766	6858	4348	292	623	826	21380	21379
Length from intercondyloid eminence to median ridge of distal articular surface	340	—	—	336	358	—	334	352
Proximal breadth	113+	—	—	—	—	—	115	139
Proximal antero-posterior diameter	—	134	—	108+	112	—	120	145
Minimum breadth of shaft	54	54	—	55	57	—	54	66
Minimum antero-posterior diameter of shaft	51	42	—	48	52	—	44	61
Distal breadth	97	—	101	94	99	—	95	114
Distal antero-posterior diameter	66	—	77	67	72	—	97	86

TABLE 6, Cont.

I. Metacarpal

	II					III													IV					
	Hopefield			Recent		Hopefield										Recent			Hopefield			Recent		
	1296	3791	2656	S.A.M. 21380	S.A.M. 21379	6110	1327	1325	1341	1189	7886	1330	1335	1326	1336	1331	1350	S.A.M. 21380	S.A.M. 21379	1314	1337	5577	1312	S.A.M. 21380	S.A.M. 21379
Median length	153	152	162	148	160	171	172	175	162	169	—	175	169	158	157	173	—	166	173	146	152	126	—	135	145
Maximum length	159	159	166	152	165	182	186	190	176	—	—	187	178	—	167	180	—	178	187	153	161	135	—	143	152
Proximal end: Maximum A-P	43	42	50	36	44	49	53	51	51	51	—	48	48	—	48	54	—	51	55	—	45	43	—	44	51
„ „ : Maximum breadth	36	39	43	40	44	56	61	57	59	—	—	60	—	—	55	67	—	60	70	44	45	44	51	38	55
Mid-shaft: Maximum A-P	18	22	25	18	20	22	22	23	23	25	21	23	22	22	21	26	24	22	24	20	22	19	23	19	23
„ : Maximum breadth	35	37	41	31	40	46	45	45	45	54	45	48	42	42	44	55	—	45	56	31	35	35	45	30	40
Distal articular surface: Maximum A-P	38	40	45	38	43	41	45	43	42	49	—	44	40	39	40	52	52	41	48	35	38	35	—	34	43
„ „ „ : Maxium breadth	36	39	44	37	45	46	—	49	—	57	—	47	49	46	46	61	62	52	66	35	37	38	—	35	48

L. Astragalus

	Hopefield																												Recent	
	Right													Left															S.A.M.	S.A.M.
	3696	3555	3140	2942	4213	38	5497	3694	6645	6784	32	2947	3576	37	33	35	4458	5791	3928	3569	31	3693	3148	36	6847	3691	3007	34	3198	3692	3695	2934	4200	6404	3698	21380	21379
Medial height	72	70	65	78	—	—	66	81	68	*c.* 75	70	70	68	67	78	82	73	74	*c.* 77	78	66	75	80	78	74	74	70	77	75	68	78	*c.* 73	71	*c.* 68	74	68	84
Trochlea breadth	*c.* 80	77	75	—	—	75	70	86	72	*c.* 82	70	70	76	72	80	79	76	74	80	83	69	78	78	77	74	77	74	76	76	73	81	*c.* 75	70	71	73	72	77
Medial A-P diameter	58	—	52	57	56	52	49	61	50		53	48	—	50	57	55	54	57	60	*c.* 57	50	55	57	—	58	—	53	54	57	*c.* 52	59	—	53	48	*c.* 57	48	61

M. Calcaneum

	Hopefield																	Recent	
	Right									Left								S.A.M.	S.A.M.
	3729	3726	5875	119	146	3006	2696	6298	4171	118	3200	126	6395	8126	117	6651	6484	5836	123	6409	148	3566	21380	21379
Height	121	130	116	130	122	120	—	138	*c.* 117	120	127	—	117	134	134	120	121	—	124	*c.* 117	130	122	110	125
Minimum breadth corpus	38	45	35	—	32	35	31	46	35	36	37	34	31	48	41	34	45	34	—	35	39	36	31	46
Breadth over sustentaculum tali	71	78	65	67	*c.* 60	66	61	80	64	—	63	—	62	—	77	64	76	—	—	—	68	65	65	82
Antero-posterior diameter, same level	66	68	65	68	66	68	64	—	68	—	70	62	68	70	*c.* 67	69	65	60	73	*c.* 70	72	71	60	66

O. Metatarsal

	II											III											IV																					
	Hopefield									Recent		Hopefield									Recent		Hopefield																		Recent	
	5658	5542	1306	3790	1334	1347	1348	1349	1322	S.A.M. 21380	S.A.M. 21379	1353	1340	1339	3625	1302	3202	1343	1328	3174	S.A.M. 21380	S.A.M. 21379	1320	1333	1322	1319	1301	1308	1303	1305	1316	1289	1317	1329	1342	3139	1299	1399	1324	3177	S.A.M. 21380	S.A.M. 21379
Median length	134	155	152	—	—	137	156	150	151	135	148	158	168	146	160	171	—	165	161	—	152	160	143	136	138	133	142	136	130	139	127	—	128	139	149	136	145	133	145	—	127	132
Maximum length	142	161	169	161	—	146	161	156	161	141	152	162	173	152	162	174	—	170	168	—	157	167	150	143	148	140	150	141	137	145	135	—	132	144	157	141	156	142	150	—	137	138
Proximal end: Maximum A-P	37	39	41	—	38	—	40	39	42	33	49	51	45	40	46	48	46	43	—	46	45	47	51	—	40	40	38	38	—	37	41	45	39	45	44	45	42	40	—	40	40	47
„ „ : Maximum breadth	26	34	34	—	32	29	31	28	31	24	38	52	50	49	53	52	51	48	54	47	50	59	50	46	45	—	45	38	43	43	—	50	40	43	46	50	—	40	41	39	39	44
Mid-shaft: Maximum A-P	20	19	20	18	19	24	20	23	20	20	22	23	24	21	25	28	23	22	19	20	19	22	24	27	23	18	26	25	20	24	18	—	22	20	19	28	22	18	24	—	23	26
„ : Maximum breadth	24	35	35	34	32	29	31	27	29	22	30	47	41	41	46	46	41	40	45	38	40	51	31	31	24	32	25	27	35	26	29	—	25	31	35	30	32	30	27	—	26	35
Distal articular surface: Maximum A-P	34	39	37	40	—	39	37	37	39	35	42	45	42	36	—	51	—	39	41	—	40	46	44	41	36	32	35	—	37	35	34	—	—	36	38	40	38	34	36	—	34	41
„ „ „ : Maximum breadth	30	37	39	37	—	33	34	33	—	31	40	—	48	42	52	55	—	45	46	—	45	56	47	36	31	36	30	32	38	—	—	—	—	35	39	39	36	35	—	—	31	44

TABLE 6, Cont.

N. Cuneiform	Hopefield		Recent	
	Right	Left	S.A.M.	S.A.M.
	4282	4260	21380	21379
Vertical diameter	50	56	46	55
Distal breadth	40	59	40	58
Maximum A-P diameter	38	51	38	53

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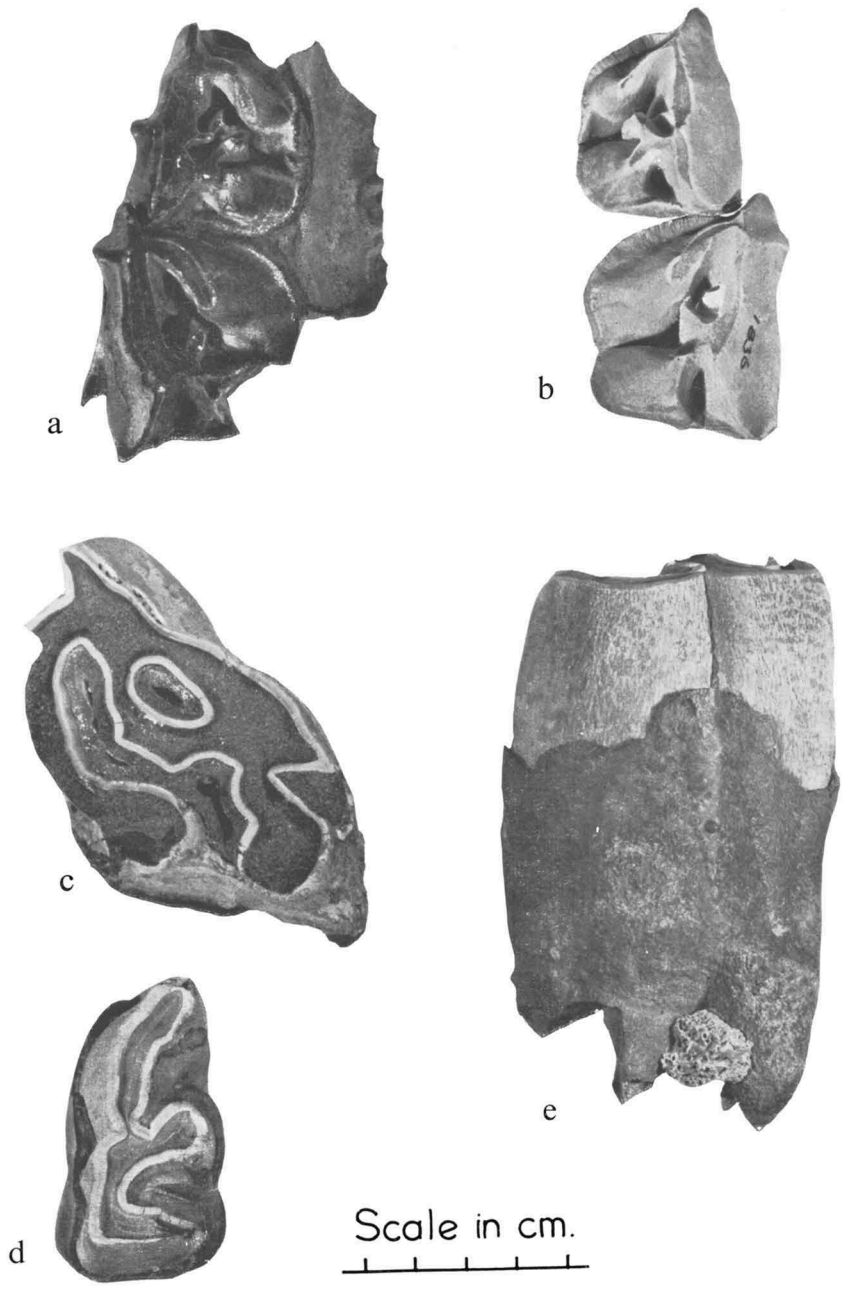
EXPLANATION OF PLATE XI

a-b, teeth of fossil *Diceros bicornis* from Hopefield; a, right DM^{2-3} (7950); b, left DM^2 and DM^3 (1836), crown views. c-e, teeth of fossil *Ceratotherium simum* from Hopefield, c, left M^3 (3410A), crown view; d-e, right M_3 (3410B); d, crown view; e, outer view. All figures 5/9 natural size.


a
b
c
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e
Scale in cm.