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FIRST RECORD OF *BOS NAMADICUS* FROM MIDDLE - LATE PLEISTOCENE DEPOSITS OF LOWER GODAVARI, NEAR SERVAIPET IN KARIMNAGAR DIST., ANDHRA PRADESH

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ABSTRACT

Bos namadicus is being reported for the first time from the Lower Godavari Valley. This discovery has an important bearing on palaeogeographical distribution of *Bos namadicus* in the peninsular river Valleys. Brief morphological descriptions of the peresent collection constitute a major part of the paper. However, taphonomical observations are the focal point of discussion which reveal that weathering and diagenesis are the main factors acting upon the bones from death to the fossil assemblage. Critical examination of these factors suggests that the fossils at Servaipet are probably autochthonous, and may belong to only one individual.

INTRODUCTION

Mesozoic vertebrate fossils from the Godavari Valley have been extensively studied (Jain and Roychowdhury, 1987). During the 1978 field season, a number of fossils belonging to *Bos namadicus* were discovered in the alluvium close to the right band of the Godavari near the village Servaipet (80°14′ E : 18°41′ N) in district Karimnagar of Andhra Pradesh (Figs. 1 and 2). Though quantitatively the assemblage is quite meagre, it represents well preserved post-cranial material which includes vertebrae, metapodials, carpal bones, etc.

The present paper attempts to study the morphology of these fossils and to make detailed taphonomic observations in order to understand the depositional history of the assemblage. The present study also intends to highlight the role of various natural forces acting upon the death assemblage either prior to burial or after fossilization.

SYSTEMATIC PALAEONTOLOGY

Class Mammalia LINN., 1758
Order Artiodactyla OWEM, 1847
Family Bovidae GRAY, 1821
Subfamily Bovinae GILL, 1872
Genus *Bos* LINN., 1758
Bos namadicus FALCONER, 1857

1859 *Bos namadicus*, Falconer, *Cat. Foss. Vert. Mus. As. Soc. Beng.*, p. 230.
1868 *Bos namadcus*, Falconer, *Pal. Mem., I*, p. 285.
1878 *Bos namadicus*, Lydekker, *Pal. Ind., (10) I*, p. 75.
1939 *Bos namadicus*, Pilgrim, *Pal. Ind., 26*, pp. 317-321.

Referred material: The new fossil material described has been deposited in the Palaeontological Collections of Deccan College, Postgraduate & Research Institute, Pune.

Catalogue No.	*Identification*	*Remarks*
SER/1/DC	Unciform, right	
SER/2/DC	Radius, right with a part of shaft of Ulna	Deformity in the shaft
SER/3/DC	Astragalus, left	
SER/4/DC	Metacarpal, left	
SER/5/DC	Ist phalanx	
SER/6/DC	Atals (vertebra)	Deformed
SER/7/DC	Radius, proximal, left	
SER/8/DC	Humerus, distal, right	
SER/9/DC	Axis (vertebra)	Deformed
SER/10/DC	IIIrd phalanx	
SER/11/DC	Ist phalanx	
SER/12/DC	Rib, cranial fragment	
SER/13/DC	Metatarsal, left	
SER/14/DC	Metacarpal, right	

DESCRIPTION:

1. Atlas vertebra (SER/6/DC; Pl. I, Fig. 1): The specimen is well preserved except for the ventral arch. Cranially the ventral articular surface is deep and U shaped which is characteristic of *Bos*. Caudally it bears a mildly depressed articular facet which articulates with the cranial facet of axis. The dorsal spine is prominent and raised. The transverse processes are very wide with depression near the arch. The neural canal is more or less oval in shape.

Measurements	*(in mm)*
Maximum width (along the transverse processes)	= 230
Length of right transverse process	= 151
Width of the caudal articular surface	= 147
Length from cranial articular surface to the caudal articular surface	= 150

2. Axis vertebra (SER/9/DC; Pl. I. Fig. 2) : The specimen has preserved only the body and the cranial end of the vertebra. The vertebra is slightly deformed which may be a post-mortem phenomena. The odon-

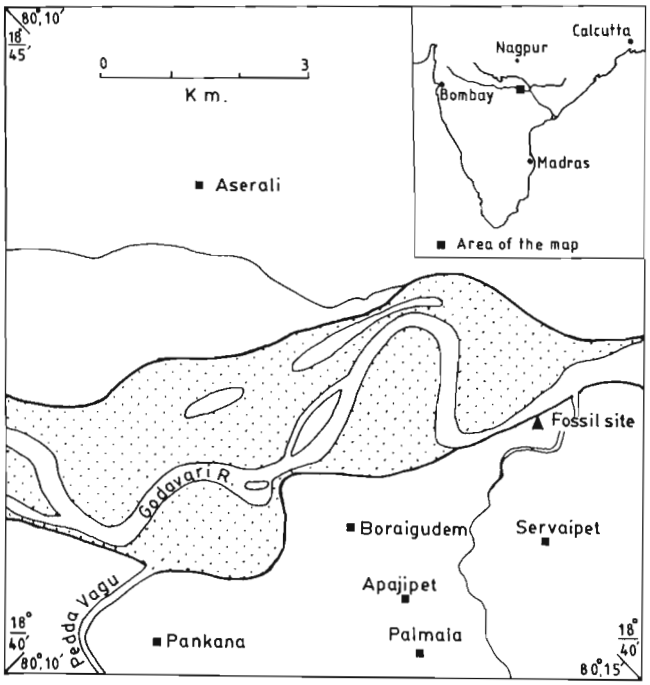

Fig. 1 Map (with inset map of India) showing the *Bos namadicus* fossil locality.

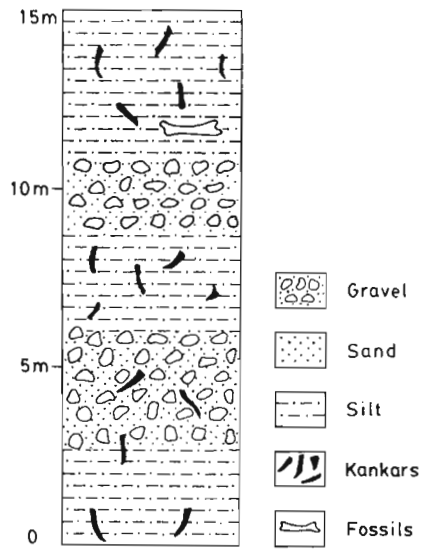

Fig. 2 Stratigraphic column of the fossil yielding section on the right bank of Godavari near Servaipet.

toid process is elongated and makes a right angle with the semicircular articular facet. On the ventral side the median ridge is prominently raised, with deep depression on its either sid

3. *Humerus* (SER/8/DC; Pl I, Fig. 4) : The specimen consists of only the distal part which is heavily encrusted with matrix. Distal epicondyles are intact, the medial one is larger than the lateral. The lateral epicondyle spreads laterally, while the medial one is almost straight. The olecranon fossa is deep, oval in shape and elongated medio-laterally. The coronoid fossa is shallow but elongated. The outline of the broken part of shaft at the distal end is oval.

Measurements	*(in mm)*
Width of the condyles	= 117
Length of Olecranon fossa	= 40
Width of coronoid fossa	= 54

4. *Radius,* right (SER/2/DC; Pl. I, Fig. 5) : The specimen is an intact and well preserved right radius except for a part of the coronoid process. However, the articular facet of the coronoid process is wide and deep. The distal extremity comprises complete medial, intermediate and lateral facets. The medial is more or less triangular in outline, whereas the intermediate is rectangular with deep cavities at the dorsal and ventral sides. The lateral facet which is fused with ulna is almost rectangular. On the dorsal side of the distal end two ridges are prominent which are oblique to the axis of the bone. The shaft of the specimen is crescent-shaped. Ulna which is represented by a partially preserved shaft is fused with the lateral edge of the radius. The interosseus space on the proximal side is wide.

Measurements	*(in mm)*
Maximum length of the specimen	= 360
Minimum thickness of the shaft	= 37
Minimum thickness of the distal end	= 51
Width of the distal end	= 97
Width of articular facet	= 85

5. *Radius,* Proximal, left (SER/7/DC; Pl. I, Fig. 3) : The specimen has preserved only the proximal end comprising a broken part of ulna. The medial and lateral cavities are more or less squarish in shape. The cavities are divided by a deep groove. The interosseous space is wide.

Measurements	*(in mm)*
Maximum width of the proximal end	= 113
Maximum width of the proximal articular facet	= 75

6. *Unciform*, right (SER/1/DC; Pl. I, Fig. 7) : This is a multifaceted triangular, well preserved bone. The dorsal surface of the specimen is flat and it articulates with the proximal end of metacarpal. The ventral side possesses three facets which articulate with unciform and lunate at the distal end of radius. The facets are depressed in the middle and have sharp ridges on the lateral ends.

7. *Rib fragment* (SER/12/DC; Pl. I, Fig. 6) : The specimen is a cranial end of the rib which has preserved the head, neck and the costal condyle. It is concavo-convex in cross section. Ventrally a deep groove is preserved.

8. *Metacarpal*, left (SER/4/DC; Pl. II, Fig. 2): The specimen is well preserved and complete. The proximal end has two articular facets divided by a deep fissure. The lateral facet is roughly squarish whereas the medial one is triangular. The shaft is plano-convex in cross-section with a shallow median groove running longitudinaly upto the distal end. Foramen nutricium is situated in the distal end of the median groove, at a distance of 18 mm from the distal end. The distal end has a pair of puley-like trochlea which are divided by a deep furrow. The sagittal ridges are sharp.

The distal end comprising the trochlea is horizontally cracked which appears to be a post depositional feature.

Measurements	(in mm)
Maximum length of the specimen	= 250
Width of the proximal end	= 75
Length of the proximal end	= 50
Width of the distal end	= 70
Length of the distal end	= 42
Width of the shaft (minimum)	= 35
Thickness of the shaft	= 35
Distance between the foramen nutricium and distal epiphysis	= 18

9. *Metacarpal*, right (SER/14/DC; Pl. II, Fig. 4) : The specimen is complete and well preserved. The shaft is ventrally flattend, and dorsally crescent shaped. The median groove runs dorsally upto the distal extremity and foramen nutricium is located 19 mm away from the epiphyseal end of distal extremity. The lateral facet at the proximal end is triangular while the medial one is squarish. The proximal articular surface is divided by a deep fissure. The distal extremity is characterized by two pulley - like trochlear ends which are divided by a deep furrow. The sagittal crests are sharp.

Measurements	(in mm)
Length of the specimen	= 260
Width at the proximal end	= 85
Length of the proximal end	= 50
Width of the distal end	= 78
Length of the distal end	= 41
Width of the shaft (minimum)	= 47
Thickness of the shaft (minimum)	= 31
Distance between the foramen nutricium and distal epiphyseal line	= 19

10. *Astragalus*, left (SER/3/DC; Pl. II, Fig. 1) : The specimen is compact and well preserved. Trochlear edges in the anterior side are straight unlike those of perissodactyls. The proximal trochlear ridges are separated by a deep groove which articulates with the distal end of the tibia and fibula. The reception for the lower border of tibia is deep and oval in shape. Facets for navicular and cuboid are prominent and round. The facet for the reception of calcaneum is well defined and rectangular, characteristic of ruminants.

Measurements	(in mm)
Maximum length of the lateral half	= 85
Length of the medial half	= 77
Depth of lateral half	= 44
Depth of medial half	= 48
Width of the distal end	= 58

11. *Metatarsal*, left (SER/13/DC; Pl. II, Fig. 3): The specimen is represented by a well preserved metatarsal with a fractured distal extremity. The epiphyseal region appears to have broken after the burial but it has preserved all the fractured edges to suggest that it belongs to metatarsal. The shaft is rectangular in cross-section and dorsally with deep median groove which runs all along the length, beyond foramen nutricium. The latter is situated at a distance of 19 mm from the distal end. The shaft has a shallow groove on the ventral side. The proximal articular surface has two rectangular facets which are divided by a deep groove. These facets fit with the distal end of centrotarsus. The distal exctremity is a pulley - like trocklea with sharp sagittal ridges divided by a deep furrow. These ridges articulate with the proximal concave facets of the Ist phalanx.

Measurements	(in mm)
Maximum Length of the specimen	= 253
Width of proximal end	= 69
Width of distal end	= 73
Thickness at distal end	= 39
Width of the shaft (minimum)	= 40
Thickness of the shaft (minimum)	= 42
Distance between foramen nutricium and the distal extremity (epiphyseal line)	= 19

12. *Ist Phalanx* (SER/5/DC; Pl. II, Fig. 6) : The specimen is complete and well preserved. The shaft is thick on the proximal end and tapers towards the distal end. The proximal end has two circular facets for distal trochlea of metapodial. These facets are divided by a shallow groove. The distal end preserves two trochlea-like articular facets for the proximal end of second phalanx.

Measurements	(in mm)
Maximum length of the phalanx	= 76
Width of the proximal end	= 42
Maximum length of distal end	= 39
Minimum width of shaft	= 35

13. *Ist Phalanx* (SER/11/DC; Pl. II, Fig. 5) : The specimen is a well preserved first phalanx. The shaft is thick at proximal end and tapers distally. The proximal articular surface for distal trochlea of metapodial is divided by a shallow groove. Articular facets of the distal end are well preserved, rounded with a shallow groove between them. The ventral side of the distal end is wider than the dorsal.

Measurements	(in mm)
Maximum length of the phalanx	= 72
Maximum width of the proximal end	= 38
Maximum length of the distal end	= 36
Minimum width of the diaphysis	= 36

14. *3rd Phalanx* (SER/10/DC; Pl. II, Fig. 7) : The specimen is a well preserved cloven bone. The proximal end has two articular facets for the distal end of second phalanx. This facet has two pointed projectios on the ventral and dorsal side, the latter one being prominent. The ventral surface is flat and pointed distally. The medial side of the phalanx makes a right angle with the ventral surface.

Measurements	(in mm)
Length of the dorsal surface	= 77
Maximum diagonal length of the sole	= 92
Middle width of the sole	= 24

DISCUSSION

Discovery of vertebrate fossils from Godavari Valley began with the first records of an elephant skull from Paithan (Oldham, 1868) and that of *Elephas antiquus* (*namadicus*) at Nandur - Madhameshwar by Pilgrim (1905). Since then several sites have been brought to light in the Central Godavari basin which have yielded a large number of vertebrate fossils and cultural material (Joshi *et al.*, 1966, 1978; Tripathi, 1967; Rajaguru & Badam, 1984; Badam, 1979, 1981 and Kumar, 1985). The fossils include those of *Bos namadicus, Equus namadicus, Hexaprotodon namadicus, Palaeoloxodon namadicus, Stegodon insignis, Elephas namadicus, Crocodylus* sp., etc. and have been found in the alluvial fills of late Pleistocene period dating from 32,000 B.P. In fact palaeontological and geomorphological dating has been supported by several C^{14} assays on fresh water shells and drift wood from the source region of the Godavari (Rajaguru & Badam, 1984).

The analysis of palaeontological material incorporated with geomorphological and archaeological observations have notably assisted in palaeoecological interpretations of the fossil sites in the Upper Godavari Valley. This has revealed that the large vertebrates had a wide geographical distribution that was controlled by local ecological factors even in semi-arid climate of late Pleistocene times. This supports the existence of several favourable ecological niches which sheltered animals like elephants, hippopotamii, turtles, several grazers like bovids and equids to thrive within certain geographical limits.

It is worthwhile to note that recently Sahni and Prasad (1984) have discovered *Potamochoerus theobaldi* Pilgrim, a suid of Upper Siwaliks, along with some bovid bones from the ossiferous gravels in Pranhita-Godavari Valley in Andhra Pradesh. The discovery is of great significance because so far the species had not been found beyond the Upper Siwalik formations of the Himalayan region. On the basis of this and associated finds Sahni and Prasad (1984) have designated the deposits as Middle to Upper Pleistocene.

Hitherto there was no record of any Pleistocene fossil from the Lower Godavari proper. Therefore, the recent discovery of the fossils of *Bos namadicus* near Servaipet (80°14′ E : 18°41′ N) on the right bank of the Godavari, though meagre, has a great bearing on the palaeogeographical distribution of *Bos namadicus* in the peninsular river valleys. However, it appears premature to deduce any palaeoecological inferences as the assemblage is scanty and probably derived from the individual of *Bos namadicus*. Degree of mineralisation, matrix association and surface texture also support this.

While studying the mode of preservation in the present fossil collection, weathering and diagenesis appear to have played a significant role as taphonomical factors. These factors influenced the death assemblage either prior to burial or after fossilization. Most of the long bones in the assemblage are complete except a few where the distal or proximal ends are broken (SER/8/DC - Pl. I : 4; SER/7/DC - Pl. I : 3). However, disintergration of epiphyseal region is not always associated with the age of the animal, as

all the fossils under study belong to an adult individual/individuals. Interestingly, some of the bones have even preserved the sharp ridges (SER/2/DC - Pl. I : 5; SER/7/DC - Pl. I : 3; SER/12/DC - Pl. I : 6 and SER/13/DC - Pl. II : 3). This suggests that abrasion by wind or water has not affected the specimens much, though the death assemblage has perhaps been preserved from attrition by fluvial activity. Perthotaxic and taphic factors between the death and fossil assemblages seem to have been very favourable. However, very little can be said about site erosion or sedimentary environment on the basis of the meagre collection. Most of the specimens show longitudinal (SER/14/DC - Pl. II : 4; SER/2/DC - Pl. I : 5; SER/7/DC - Pl. I : 3), horizontal (SER/14/DC - Pl. II : 4; SER/2/DC - Pl. I : 5 and SER/6/DC - Pl. I : 1) and mosaic (SER/6/DC - Pl. I : 1; SER/10/DC - Pl. II : 7) fractures. The fractures at times are considerably deep and distinctly post-depositional. It is of interest to note that small bones like unciform SER/1/DC - Pl. I : 7 and phalanges (SER/5/DC - Pl. II : 6; SER/11/DC - Pl. II : 5 and SER/10/DC - Pl. II : 7) are also preserved intact with long bones which probably rules out any possibility of much hydrodynamic sorting of the assemblage at Servaipet.

Taking into consideration the convention of Behrensmeyer (1975) and Shipman (1981), the sub-aerial weathering is attributed to the dry environment which dehydrates the organic contents of the bones, subsequently cracking and even splitting them prior to burial. Several features on the bones like flaking, cracking and pitting might also result due to trampling, water logging or carnivore activity. However, the determination of the length of exposure to subaerial agents is not possible for the present assemblage, though the fossils may have been exposed for a considerable period.

The post-burial preservation in the *Bos* assemblage shows that depositional load due to compaction of sediments have also probably distorted some of the bones (SER/6/DC - Pl. I : 1; SER/2/DC - Pl. I : 5). The impact of expansion and contraction of clays in the sediments must have caused breakage of several bones. However, Behrensmeyer (1975) suggests that broken bones from a pre-burial assemblage can remain intact and get preserved for fossilization. If some of the bones of the present assemblage (e.g. SER/4/DC - Pl. II : 2 and SER/14/DC - Pl. II : 4) broke up before burial (though there is no certainty about it) then the above contention of Behrensmeyer (1975) can hold good for the persent assemblage.

The foregoing discussion on taphonomic observations suggests that the present assemblage may be autochthonous as per the criteria proposed by Badam *et al.*, (1986) for Narmada fossil assemblage. It is possible, as indicated earlier, that all the bones belong to a single adult individual. Also, we suggest that perhaps the individual had some osteological deformity as reflected in radius (SER/2/DC - Pl. I : 5) and axis vertebra (SER/9/DC - Pl. I : 2). However, in the case of axis vertebra even the load of sediments may have deformed the bone to some extent.

On the whole the present discovery is important as it is the first of its kind from the lower reaches of the Godavari and throws interesting light on the mode of preservation and taphonomy of the material. The sedimentary context of the fossils at Servaipet may be attributed to the channel-fill mode of deposition. This is supported by the nature of preservation of these fossils as discussed above and points to autochthonous nature of deposition.

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EXPLANATION OF PLATES

PLATE I

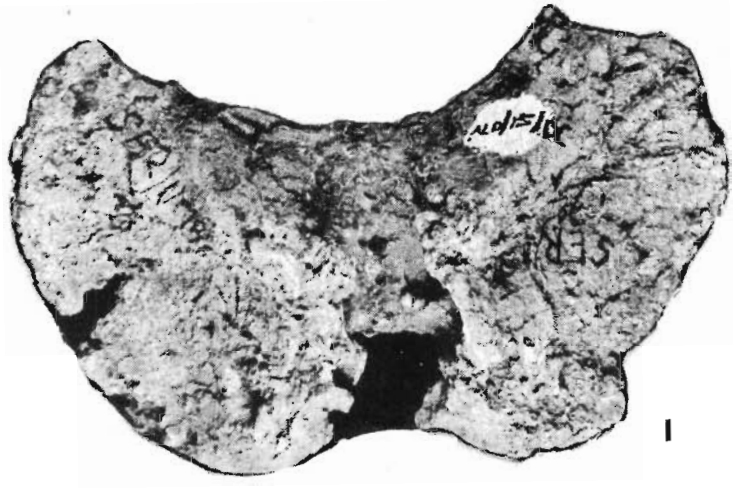
(Bos namadicus from Andhra Pradesh)

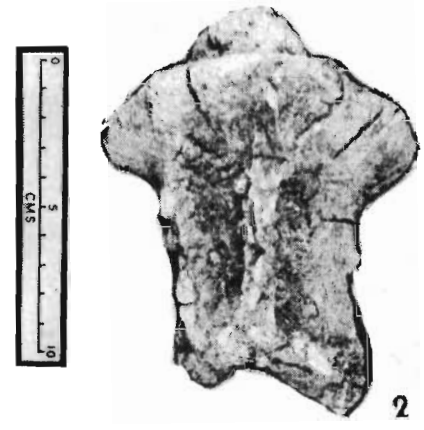
1. Atlas vertebra (SER/6/DC); showing mosaic fractures.
2. Axis vertebra (SER/9/DC); showing deformity in the odontoid process and in left ventral region; also sub-aerial weathering.
3. Radius (SER/7/DC) left, proximal fragment showing longitudinal and horizotal fractures.
4. Humerus (SER/8/DC) right, distal fragment exhibiting post-depositional fractures.
5. Radius (SER/2/DC) right, showing longitudinal fractures on the shaft and distortion in the shaft (a slight bend in the middle of the shaft).
6. Rib (SER/12/DC) fragment, exhibiting mosaic fractures on the cranial end and on the part of the body.
7. Unciform (SER/1/DC) right.

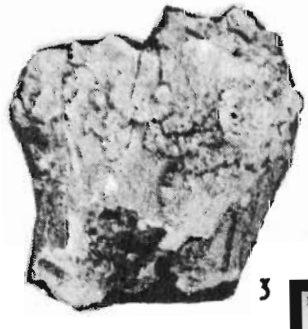
PLATE II

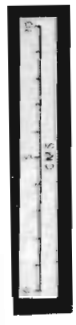
(Bos namadicus from Andhra Pradesh)

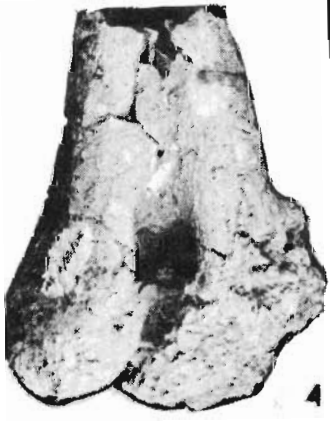
1. Astragalus (SER/3/DC), left, exhibiting superficial fractures due to sub-aerial weathering.
2. Metacarpal (SER/4/DC), left, exhibiting breakage in the distal end due to sedimant load.
3. Metatarsal (SER/13/DC), left, exhibiting sub-aerial weathering.
4. Metacarpal (SER/14/DC), right, showing logitudinal and horizontal fractures on the distal shaft and breakage in the distal end due to sediment load.
5. Ist Phalanx (SER/11/DC).
6. Ist Phalanx (SER/5/DC), showing shallow cracks due to sub-aerial weathering/trampling.
7. 3rd Phalanx (SER/10/DC), showing mosaic fractures in the distal region.

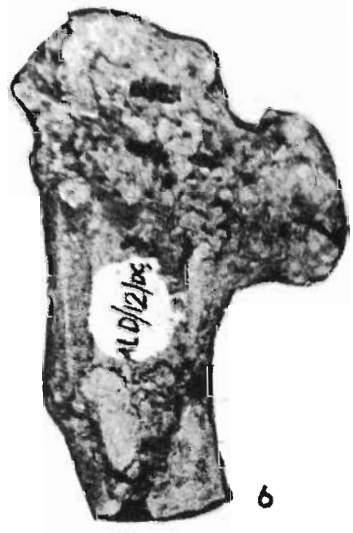


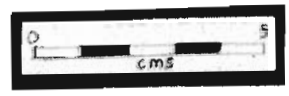












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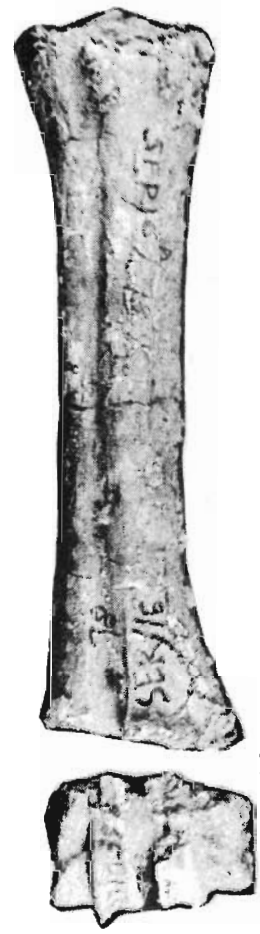

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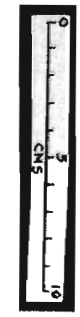

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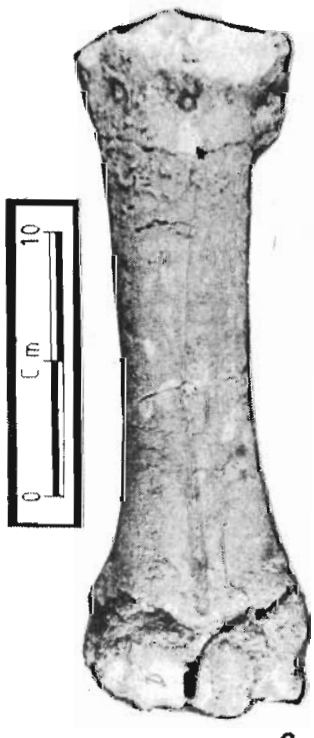

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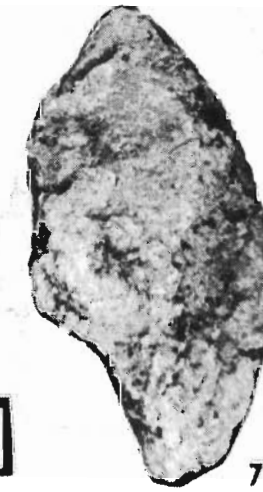

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