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Additional vertebrate remains from one of the Late Pleistocene—Holocene Kurnool Caves (Muchchatla Chintamanu Gavi) of South India

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Abstract

Additional remains of small mammals (rodents—*Hystrix sp., Bandicota* cf. *bengalensis, Millardia* cf. *kathleenae*, cf. *Rattus rattus*; *Lagomorph*—*Lepus* sp.) reptiles (*Python* sp. and serpentes indet., *Varanus* sp.), amphibian (cf. *Bufo melanostictus*) and aves (cf. *Gallus gallus*) are reported from deposits spanning the last ~20,000 yrs BP of Muchchatla Chintamanu Gavi (MCG). In the Late Pleistocene, the area around the Kurnool Caves had a very diverse fauna indicating the presence of wooded grassland, gallery forest and a well-watered landscape. In contrast, today the area is an arid shrubland and only a fraction of the Late Pleistocene vertebrate fauna has survived. The disappearance of several vertebrate taxa was probably due to a very arid phase of the Last Glacial Maxima (LGM). Excessive hunting by prehistoric man largely in Holocene time could have caused the demise of the mammals such as *Rhinoceros, Equus, Bubalus, Bos, Boselephas, Antilope* and *Gazella*.

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1. Introduction

Late Pleistocene—Holocene Kurnool Cave deposits of south India are well known for their lithic and bone artifacts of prehistoric man, and a diverse fauna (Newbold, 1844; Foote, 1884; Lydekker,1886b; Cammiade, 1927; Murty, 1974, 1975; Prasad and Yadagiri, 1986; Prasad, 1996). These caves are located around Betamcherla, a small town on the Hubli—Guntur meter gauge of South-Central Railway in the Kurnool District of Andhra Pradesh (Fig. 1A). Newbold (1844) was the first to report fossiliferous caves at Billa Surgam situated about 4.5 km southeast of Betamcherla. Subsequently, caves such as Yaganti, Yerrazari Gabbi, Sanyasyla Gavi, Krishnamma Kona Gavi were discovered by Foote (1884) and Cammiade (1927). Foote (1884, 1885) excavated three of the Billa Surgam caves and named them Charnel House Cave, Purgatory Cave and Cathedral Cave. These excavations yielded a great wealth of both archaeological (around 1700 specimens) and palaeontological (around 3000 specimens) much of which was systematically described by Lydekker (1886b).

Murty (1974, 1975) carried out a systematic excavation (G.L. Badam was part of the team in 1975) of Muchchatla Chintamanu Gavi (MCG) and recovered hundreds of stone and bone tools and faunal remains from three layers (Fig. 1B). Later, open air sites around these caves were also found to yield Upper Palaeolithic and Mesolithic fauna and lithics (Murty and Reddy, 1976; Reddy, 1980). Nambi and Murty (1983) discovered an Upper Palaeolithic fire place at MCG. The burnt clay coming from a depth of 165–185 cm from the surface at Trench E has yielded a thermoluminescence (TL) date of 17,390 yrs BP. Later, Gogte and Murty (1986) found that this date agrees fairly well with the electron spin resonance (ESR) dates of 19,224 yrs BP for B4 (165–180 cm); 16,686 yrs BP for B4 (150–165 cm) and 9498 yrs BP for B4 (120–135 cm). Gogte and Murty (1986) also got an ESR date of 5247 yrs BP for Trench F 1 (40–60 cm) and 893 yrs. BP for F 2 (20–40 cm). Radiocarbon dates provide a time frame of 23,000–10,000 yrs BP for the Upper Palaeolithic in the Kurnool District

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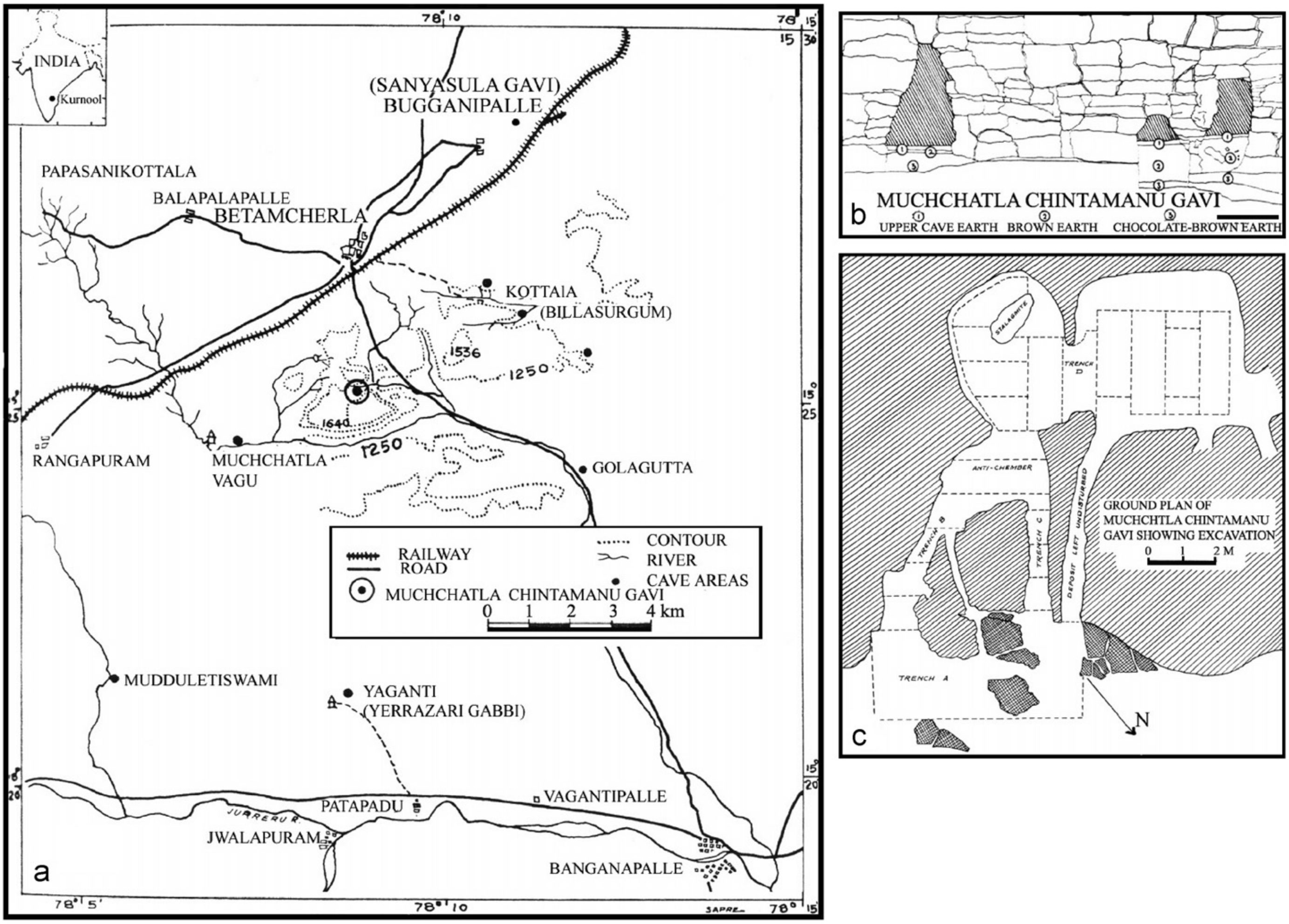

Fig. 1. The location map (A), the three passage openings and the three excavated layers (B) and the ground plan (C) of MCG.

of Andhra Pradesh (Agarwal and Kusumgar, 1975; Jacobson, 1979). Murty (1979) is of the opinion that 25,000 yrs BP separates Middle from Upper Palaeolithic based on a radiocarbon date of 24,300 yrs BP on charcoal samples from Nandipalley, Cuddapah District, Andhra Pradesh (Reddy and Sudarsen, 1978).

The small vertebrate specimens being reported here were excavated in the 1970s by Murty (1974, 1975). Along with these vertebrate remains, Murty (1974, 1975) recovered lithics comprising parallel sided, pointed, irregular blades, core implements and bone tools assignable to Upper Palaeolithic, and backed blades, bladelets and scrapers of Mesolithic culture. In the present paper we have attempted to identify the small vertebrate remains by describing them briefly. The overall palaeoecological and palaeoclimatological conditions of the Kurnool Cave region have been reviewed based on the new dates and additional faunal material.

2. Methodology

Murty (1974) systematically excavated MCG. About 15 cm layers of cave sediments were unearthed at a time, until the bedrock was reached. Trench A was laid at the mouth of the cave, Trenches B and C were in the entry passages, and Trench D inside the cave (Fig. 1C). The cave sediment has been divided into Layer 1 (upper cave earth), Layer 2 (brown earth) and Layer 3 chocolate-brown earth (Fig. 1B). Microvertebrates were photographed using a Leica Binocular Microscope. For Enamel Microstructure studies, *Hystrix* incisors were embedded in polyester resin. Based on the area of investigation, longitudinal and transverse sections were made (Fig. 2g–l). Sections were polished and etched with mild acid, 5% HCl and studied under the JEOL scanning electron microscope (SEM). The scheme proposed by Koenigswald and Clemens (1992) to study enamel microstructure has been followed. The murine dental terminology is from Musser and Newcomb (1983) (Fig. 3).

3. Preliminary identification and brief description of the microfaunal material

Class—Mammalia; Order—Rodentia; Family—Muridae; Subfamily—Murinae; Genus—*Rattus*; Species—Cf. *Rattus rattus*.

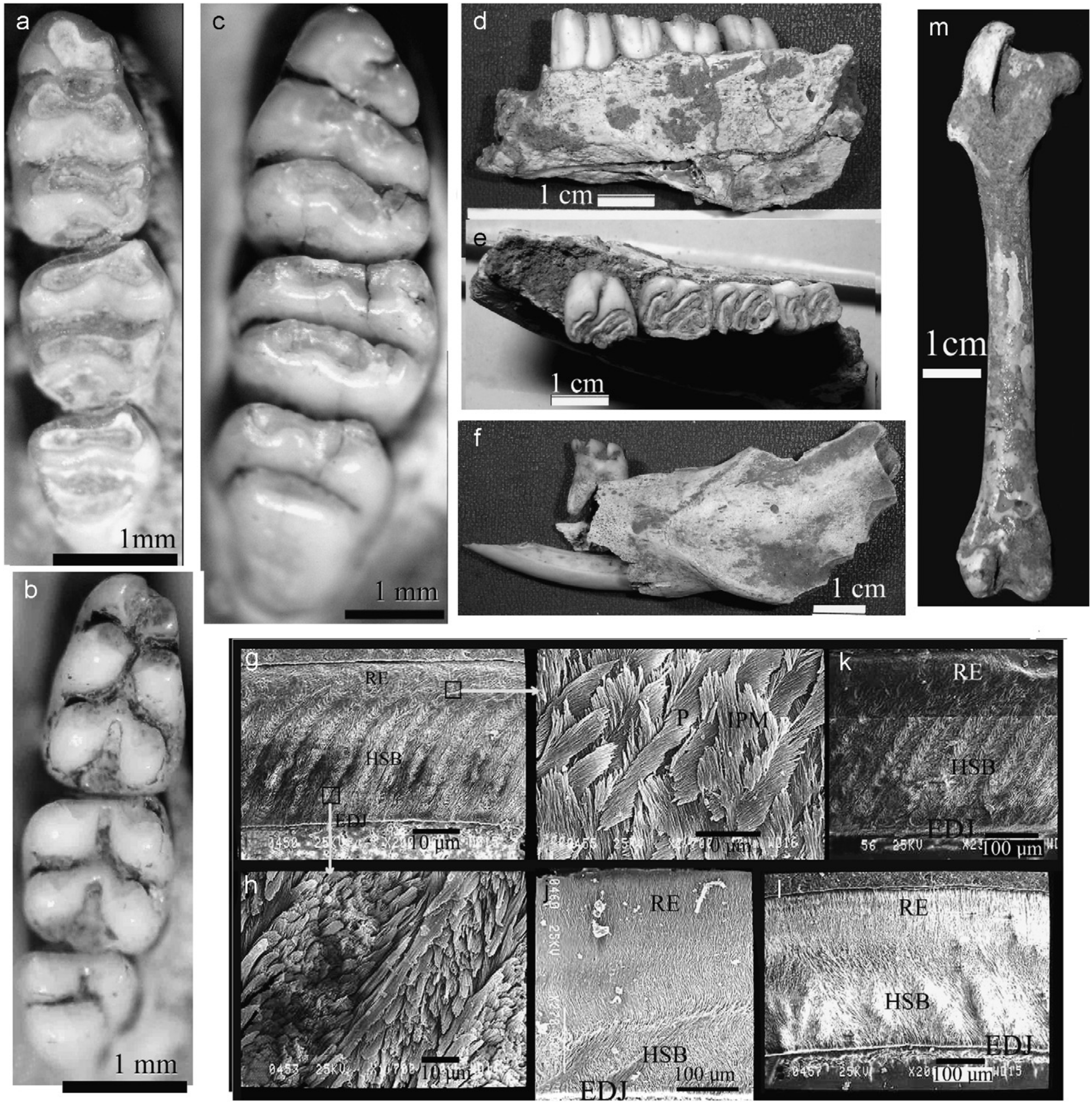

Fig. 2. (a) Occlusal view of *Rattus* cf. *R. rattus* $M_1M_2M_3$; (b), Occlusal view of *Millardia* cf. *kathleenae*. $M_1M_2M_3$; (c), Occlusal view of *Bandicota* cf. *bengalensis* $M_1M_2M_3$; (d) & (e) Lateral and Occlusal views of *Hystrix* sp. $P_3M_1M_2M_3$; (f) Lateral view of lower jaw of *Hystrix* sp.; (g) SEM micrograph of longitudinal section of upper incisor of Hystrix sp. (h) SEM micrograph of HSB as marked on (g); (i) SEM micrograph showing IPM and P as marked on (g); (j) SEM micrograph of transverse section of upper incisor of *Hystrix* sp. (k) SEM micrograph of longitudinal section of lower incisor of *Hystrix* sp. l, SEM micrograph of transverse section of lower incisor of *Hystrix* sp. m Left femur of *Lepus* sp. RE—Radial Enamel; EDJ—Enamel Dentine Junction; HSB—Hunter Schreger Band; IPM—Inter-Prismatic Matrix; P—Prism.

Referred material: Right lower jaw with M_1, M_2 and M_3 (A3-868) (Fig. 2a); Right lower jaw with M_2 and M_3 (A3-869). Locality and trench: MCG–A3. Horizon/level and age: 30–60 cm, ~ 5247 yrs. BP. Description: Moderately hypsodont molars, showing transverse laminae: M_1 anterolabial cusp much smaller than the anterolingual cusp, and the narrow lamina formed by these cusps is not attached to a relatively wider lamina comprising protoconid and metaconid. A very large posterior labial cusplet and posterior cingulum are present. M_1 is longer than wide, with three distinct transverse laminae. Anterolingual cusp is large and is anteriorly placed relative to the tiny

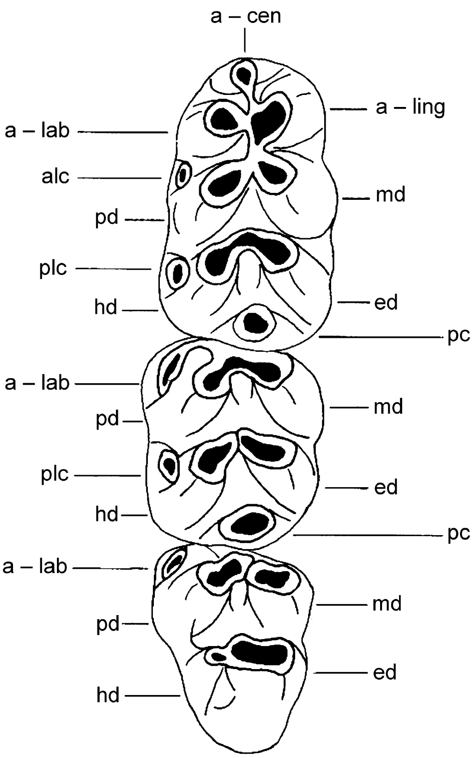

Fig. 3. Dental nomenclature of murine rodent lower molars (Musser and Newcomb 1983). Abbrevations: a-cen, anterocentral cusp; a-lab, anterolabial cusp; a-ling, anterolingual cusp; pd, protoconid; hd, hypoconid; md, metaconid; ed, entoconid; pc, posterior cingulum; alc, anterior labial cusplet; plc, posterior labial cusplet.

anterolabial cusp. Anterolingual and anterolabial cusps are joined. Metaconid is large, anteriorly placed and is joined to a large, posteriorly placed protoconid. Entoconid is large, anteriorly placed and is joined to a smaller, posteriorly placed hypoconid. A large posterior labial cusplet is attached to the hypoconid. Posterior cingulum is large, lense shaped and is medially placed behind the third lamina. M_2 is squarish. Anterolabial cusp is attached to protoconid. Protoconid and metaconid form the first lamina that is wider than the second lamina comprising entoconid and hypoconid. A large posterior labial cusplet is attached to the hypoconid. Posterior cingulum is long, narrow and is medially placed. M_3 is triangular in occlussal outline with first lamina comprising protoconid and metaconid. A small anterolabial cusp is attached to the protoconid. A large medially placed entoconid forms the last lamina.

The genus *Rattus* is a large group and comprises several subgenera (Musser and Newcomb, 1983). More specimens, including those of upper dentition, are in fact needed in order to make a detailed comparison. *Rattus* is considered to have diversified very recently under the influence of man. Its occurrence in the Upper Palaeolithic may reflect its original home in South Asia (see Neithammer, 1975 for similar views). *Rattus* was reported from the Late Pliocene Pinjor Formation of Upper Siwaliks (Gaur, 1984). Later, Musser (1987) opined that the specimen illustrated by Gaur (1984) probably belongs to *Millardia*.

Class—Mammalia; Order—Rodentia; Family—Muridae; Subfamily—Murinae Genus—*Millarida*; Species—*Millardia* cf. *kathleenae*.

Referred material: Right lower jaw with M_1, M_2 and M_3 (B2-396) (Fig. 2 b) and Left lower jaw with M_2 and M_3 (B2-397). Locality and trench: MCG–B2. Horizon/level and age: Layer one, ~ 893 yrs. BP (maximum). Description: Highly cuspidate (arcuate in shape) molars, anterolabial cusp is relatively smaller than the anterolingual cusp, the narrow lamina comprising anterolabial and anterolingual cusps is attached to a relatively wider lamina comprising protoconid and metaconid (anterolabial cusp–protoconid connection). Posterior labial cusplet is very small. M_1 is longer than wide, with three distinct transverse laminae. Anterolingual cusp is large and is anteriorly placed relative to the smaller anterolabial cusp. Anterolingual and anterolabial cusps are joined. Metaconid is large, anteriorly placed and is isolated from the large, posteriorly placed protoconid. Entoconid is large, anteriorly placed and is joined to a smaller posteriorly placed hypoconid. A very faint posterior labial cusplet is present anterior to the hypoconid. Posterior cingulum is large, semicircular in shape and is medially placed behind the third lamina. M_2 is squarish. Anterolabial cusp is very small and is attached to the protoconid. Protoconid and metaconid are joined by a very narrow ridge to form the first lamina. The second lamina comprises entoconid and hypoconid. Posterior cingulum is large semicircular and medially placed. M_3 is triangular in occlusal outline with first lamina comprising protoconid and metaconid. Anterolabial cusp is absent. A large medially placed entoconid forms the last lamina.

The genus *Millardia* is known from the Late Pliocene deposits of Siwaliks (Patnaik, 1997; Gupta and Prasad, 2001), Late Pleistocene deposits of Narmada Valley (Patnaik, 1995), and the Kurnool Caves (Lydekker, 1886b; see also Murty, 1975). *Millardia* is endemic to the Indian subcontinent and comprises three species, *Millardia kathleenae*, *Millardia meltada* and *M. gleadowi* (Agarwal, 1970). The present specimens are strikingly similar to the lower molars of *M. kathleenae* in size and morphology, in having cuspidate (arcuate) molars, large and connected anterolabial and anterolingual cusps, faint posterior labial cusplet and weakly connected cusps of transverse laminae.

Class—Mammalia; Order—Rodentia; Family—Muridae; Subfamily—Murinae; Genus—*Bandicota*; Species—*Bandicota* cf. *bengalensis*.

Referred material: Right lower jaw with M_1, M_2 and M_3 (A4-1064) (Fig. 2c). Locality and trench: MCG –A4. Horizon/level and age: Layer one, ~ 893 yrs BP (maximum). Description: Hypsodont molars, transverse laminae highly laminated, anterolabial cusp smaller than the anterolingual cusp, the lamina comprising anterolabial and anterolingual cusps is not attached to a relatively wider lamina comprising protoconid and metaconid. A very large posterior labial cusplet is present. Posterior cingulum is absent. M_1 is longer than wide, with three distinct transverse laminae. Anterolingual cusp is large and is anteriorly placed relative to the anterolabial cusp. Anterolingual and anterolabial cusps are joined. Metaconid is large, anteriorly placed and is joined to a large posteriorly placed protoconid. Entoconid is large anteriorly placed and is joined to a smaller, posteriorly placed hypoconid. A small anterior labial cusplet is present. A large posterior labial cusplet is attached to the hypoconid. Posterior cingulum is absent.

M$_2$ is wider than long. Anterolabial cusp is attached to protoconid. A strongly connected protoconid and metaconid form the first lamina that is almost equal in width to the second lamina comprising entoconid and hypoconid. A large posterior labial cusplet is attached to the hypoconid. Posterior cingulum is absent. M$_3$ is also wider than long, with first lamina comprising protoconid and metaconid. A small anterolabial cusp is attached to the protoconid. A large medially placed entoconid forms the last lamina.

Bandicota bengalensis is known from Late Pleistocene deposits of Kurnool Caves (Lydekker, 1886b) and Narmada Valley (Patnaik, 1995; Patnaik, et al., 1995). The oldest record of *Bandicota, Bandicota sivalensis* is from the Late Pliocene Siwalik (~2.5 Ma) deposits (Patnaik, 1997). *Bandicota indica*, *B. bengalensis* and *Nesokia indica* are highly specialized extant taxa with laminated molars (Misonne, 1969). *B. bengalensis* is smaller in size compared to *B. indica* and unlike *B. indica* usually stays away from human dwellings.

Class—Mammalia; Order—Rodentia; Family—Hystricidae; Subfamily—Hystricinae; Genus—*Hystrix*; Species—*Hystrix* sp. Referred material: Left lower jaw with P$_4$, M$_1$, M$_2$ and M$_3$ (B4-4323) (Fig. 2d). Right lower jaw with P$_4$ and M$_1$ (B4-4324), Right lower jaw with M$_1$ and M$_2$ (B4-4325). Locality and trench: MCG –B4.

Horizon/level and age: Layer 3, ~ 16,686 yrs. BP. There are several specimens that come from different trenches and levels. Referred material: Left lower jaw with P$_4$, M$_1$, M$_2$ and M$_3$ (B4-4323) (Fig. 2d). Right lower jaw with P$_4$ and M$_1$ (B4-4324), Right lower jaw with M$_1$ and M$_2$ (B4-4325). Locality and trench: MCG –B4. Horizon/level and age: Layer 3 (120–160 cm), ~ 16,686 yrs. BP. Referred material: Upper Left M$_1$ (B4-4328). Locality and trench: MCG –B4 Horizon/level and age: Layer 4 (180-200 cm), ~ 19,224 yrs. BP. Referred material: Left Lower jaw with P$_4$ and M$_3$ (B3-4328); two lower incisors (B3-4329-30); one isolated upper molar (B3-4331). Locality and trench: MCG –B4.

Horizon/level and age: Layer 3 (140–160 cm), ~ 16,686 yrs. BP. Referred material: 7 isolated molars (B4-120–126). Locality and trench: MCG –B4. Horizon/level and age: Layer 2 (40–60 cm), ~ 5,247 yrs. BP. Referred material: 1 incisor fragment and 23 isolated molars (B4-4771–4795). Locality and trench: MCG –B4. Horizon/level and age: Layer 3 (120–140 cm), ~ 16,686 yrs. BP. Referred material: One lower right jaw with P$_4$ (B4-112) and one lower left jaw with P4 (B4-113). Locality and trench: MCG –B4. Horizon/level and age: Upper debris (sub-recent). The dental remains recovered resemble most closely those of Hysrix indica. There is only one mandible with P$_4$–M$_3$ (B4-4323) preserved in our collection. The dimensions of its teeth (Fig. 2d) were compared with the dimensions of those of H. indica mandibles (Table 1). We found that the present dimensions fall very much within the range of H. indica. Hystrix sivalensis (Lydekker, 1884; Colbert, 1935) and H. cf. leucurus (Matthew, 1929; Black, 1972) are known from Upper Siwaliks (Black, 1972).

Table 1
Dimensions of mandibular teeth of *Hystrix* sp. and *H. indica*

Mandibular teeth	*Hystrix* sp. Mandible (B4-4323)	*Hystrix indica*	
		Mean	Range
P$_4$–M3L	36	34.2	32.0–36.3
P$_4$L	9.0	9.0	7.7–10.5
P$_4$W	6.0	6.7	6.0–7.8
M$_1$L	9.0	7.2	6.7–7.7
M$_1$W	6.5	6.8	6.2–7.3
M$_2$L	8.0	8.2	7.6–9.0
M$_2$W	6.0	7.0	6.6–7.5
M$_3$L	8.5	8.1	7.5–9.5
M$_3$W	7.0	6.4	5.5–7.4

Data of *H. indica* from Frenkel, (1970). L—length, W—width.

H. indica has a burrowing life-style or behavior and is specialized for digging. They are cave dwellers and gnaw bones lying in the caves. We investigated their incisors at the ultrastructure level in order to identify the enamel microstructure that makes these incisors strong and adapted to heavy use. Longitudinal sections of upper incisors show enamel dentine junction (EDJ), presence of multiserial hunter-schreger bands (HSB) and radial enamel (RE) (Fig. 2g). HSBs are inclined at an angle of around 70° anteriorly and are around 10 prisms thick (Fig. 2(h). The thick RE comprises prisms running towards the outer surface of the incisor at a very high angle to the interprismatic matrix (IPM) (Fig. 2i). Transverse section of upper incisor shows the presence of a very thick RE (Fig. 2j). Similarly, the longitudinal and transverse sections (Fig. 2k, l) of lower incisor show thick RE with prisms oriented anteriorly and towards the outer surface, and highly inclined multiserial HSBs (refer to Koenigswald and Clemens, 1992, for details regarding enamel microstructure terminology). A prism is composed of ribbon-like hydroxyapatite crystallites and apatite crystals offer more resistance to forces parallel to the long axis than to those parallel to shorter axes. Therefore, RE with parallel prisms oriented towards the tip of the incisor offer more resistance to abrasion. Thick RE in lower incisors has been considered to be functionally beneficial for digging and making burrows (Korvenkontio, 1934). Flynn et al. (1987) have observed that thick RE with low rod inclination and HSB with low band inclination in *Spalax* incisors indicates functional adaptation for digging. Our observations on *Hystrix* sp. incisors corroborate these findings.

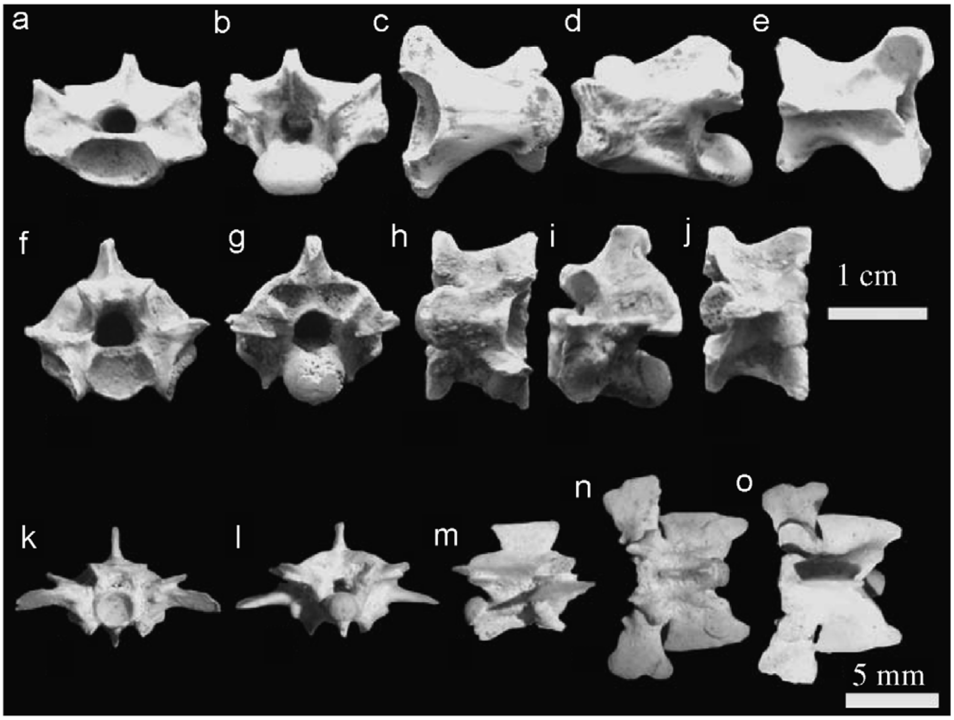

Fig. 4. *Varanus* sp., trunk vertebra, (a) anterior, (b) posterior, (c) ventral, (d) left lateral, (e) dorsal views. Python sp., trunk vertebra, (f) anterior, (g) posterior, (h) ventral, (i) left lateral, (j) dorsal views. Serpentes indeterminate trunk vertebra, (k) anterior, (l) posterior, (m) right lateral, (n) ventral, (o) dorsal views.

Class—Mammalia; Order—Lagomorpha; Family—Leporidae; Subfamily—Leporinae; Genus—*Lepus* ; Species—*Lepus* sp. Referred material: Left femur (B3-1486, Fig. 2(m). Locality and trench: MCG –B3. Horizon/level and age: Layer 2 (40–60 cm), ~5427 yrs BP. *Lepus nigricollis* is known from Kurnool Cave deposits and is also found today in the vicinity of these caves. *Lepus* in general has a worldwide distribution and is adapted to a wide range of climatic conditions. *L. nigricollis* in particular can thrive in desert to semi-arid conditions.

Class—Reptilia; Order—Squamata; Family—Varanidae; Genus—*Varanus*; Species—*Varanus* sp. indeterminate. Referred material: trunk vertebrae (A3-399 & 400, Fig. 4a–e). Locality and trench: MCG –A3. Horizon/level and age: Layer 1 (5–30 cm), sub-recent. Description: Extremity of the hypapophysis somewhat expanded and bearing two articular surfaces; ventral surface of centrum widened anteriorly and convex ventrally in cross-section; condyle strongly depressed, its articular surface facing mainly dorsally (Rage and Bailon, 2005). It displays a combination of characters that is characteristic of the group: vertebrae depressed; long axis of prezygapophyseal facet clearly oriented anteriorly but prezygapophyseal process directed more transversely (as shown by its preserved base); paradiapophyses blocky and lacking any trace of subdivision; posterior median notch in the neural arch absent. *Varanus sivalensis* is known from the Lower Pliocene Siwalik sediments of India (Lydekker, 1886a). *Varanus dracaena* has been reported from the Kurnool Caves (Lydekker, 1886b). *V. dracaena* can very well survive in dry conditions.

Class—Reptilia; Order—Serpentes; Family—Boidae; Genus—*Python*; Species—*Python* sp. Referred material: Trunk vertebrae (E2-4872-4877) (4872, Fig. 4f–j). Locality and trench: MCG –E2. Horizon/level and age: Layer 1 (20–40 cm), sub-recent. Description: vertebrae show a combination of features that is characteristic for this genus: haemal keel well defined by subcentral grooves or depressions that reach the cotyle, but only its posterior part projects below the centrum; neural arch markedly vaulted and upswept above the zygantrum; zygapophyseal facets weakly inclined; paracotylar foramina absent (see Rage and Bailon, 2005). *Python* vertebrae very similar to those of Python molurus are known from Siwalik sediments of Punjab, India (Lydekker, 1886a). *P. molurus* is known from the Kurnool Caves (Lydekker, 1886b).

Class—Reptilia; Order—Serpentes; Family and Genus—Indeterminate. Referred material: 22 Trunk vertebrae (E2-75-96) (E2-75-Fig. 42k–o). Locality and trench: MCG–E22. Horizon/level and age: surface find (sub-recent). Description: The vertebra is lightly built and very delicate. Length of centrum from cotylar rim to tip of condyle is 5 mm. Cotylar rim is circular. In anterior view the vertebra is much wider than high and relatively lightly built. The zygosphene is wide, moderately thick, and its roof is slightly arched dorsally. The neural canal is comparatively narrow. In dorsal view, the prezygapophyseal facets are elongate and oblique. The interzygapophyseal constriction is shallow. Anteriorly, the neural spine reaches the roof of the zygosphene. In lateral view, the vertebra is approximately as high as long.

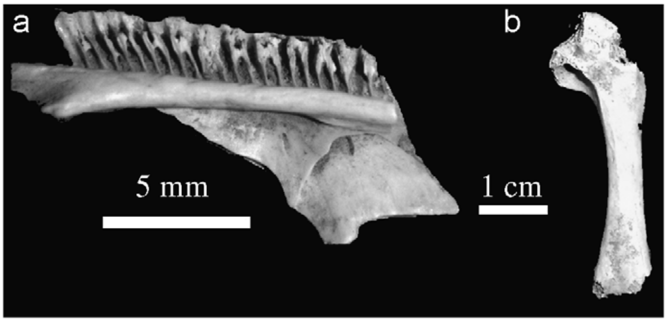

Fig. 5. (a) Lingual view maxilla of cf. *Bufo* and (b) Caudal view of left humerus of cf. *Gallus gallus*.

Class—Amphibia; Order—Anura; Family—Bufonidae; Genus—*Bufo* and species—cf. *Bufo melanostictus*. Referred material: maxilla fragment. Locality and trench: MCG –A7 (Fig. 5a). Horizon/level and age: Layer 1 (40–60 cm), ~ 5247 yrs. BP. Description: The labial surface is non-sculptured and the lingual part has the prominent dental gutter very similar to those seen in the recent toad *B. melanostictus*. All the 12 teeth are broken in the present specimen. *Bufo* cf. *melanostictus* has been recorded from the Kurnool Caves (Lydekker, 1886b).

Class—Aves; Order—Galliformes; Family; Phasianidae Genus—*Gallus*; Species—cf. *Gallus gallus*. Referred material: Left humerus (A4-1634, Fig. 5b); Locality and trench: MCG – A4. Horizon/level and age: Layer 1 (0–30 cm), sub-recent. Description: The proximal part of the humerus with a proximal margo caudalis, excavation under caput humeri, dorsally pointing processus supracondylaris very similar to that of jungle fowl (*G. gallus*).

4. Discussion

The composite Kurnool Cave fauna is very diverse and includes: Primates: *Presbytes entellus, Papio* sp. *Carnivora: Panthera tigris, Panthera pardus, Felis chaus, Felis rubiginosa, Hyaena crocuta, Viverra karnuliensis, Prionodon* sp. *Herpestes edwardi, Herpestes fuscus, Ursus labiatus*. Insectivora: *Sorex* sp. Chiroptera: *Taphozous saccolaemus, Phyllorhina diadema.* Rodentia*: Sciurus macrurus, Gerbillus indicus, B. indica, B. bengalensis, M. meltada, Mus platythrix, Golunda ellioti, Hystrix crassidens, Atherura karnulensis, Lagomorpha: Lepus* cf. *nigricollis Perissodactyla: Equus asinus, Rhinoceros karnulensis. Artiodactyla: Bos or Bubalus* sp*., Boselephas tragocamelus, Gazella banneti, Antilope cervicapra, Tetracerus quadricornis, Cervus aristotelis, Axis axis, (?) Cervus muntjac, Tragulus cf. leminna, Sus cristatus, Sus karnulensis*. Philodota: *Manis gigantean*. Reptilia: *Crocodylus* sp., *V. dracaena, P. molurus, Naia tripudians, Ptyas mucosus. Amphibia: Bufo* cf. *melanostictus*.

Based on this diverse assemblage, it has been invariably suggested that the area around Kurnool Caves was well watered, with lush forest in the late Pleistocene (Murty, 1975; Badam, 1979; Prasad, 1996). Prasad and Yadagiri (1979) suggested that occurrence of *Antilope, Gazella, Cervus, Ursus and Boselephas* indicate the presence of jungle spread on hill slopes, whereas *Bubalus* and *Bos* indicate the forested region broken up by streams with open expanses of grass. *Presbytes* (langurs) point towards the presence of forests, rocks and cliffs and *R. karnulensis* provides strong proof of presence of low forested hills, swamps with thick growth of grass (Badam, 1979; Prasad and Yadagiri, 1979; Prasad, 1996). The presence of *Tragulus meminna, T. quadricornis, S. cristatus, H. crassidens, L. nigricollis, F. chaus and V. karnulensis* indicate bush jungle around the rocky and hilly country of the Kurnool Cave region (Badam, 1979). The Late Pleistocene climate was probably warm and humid as indicated by the diverse faunal remains. In contrast the Kurnool Cave region today is a semi-arid country with dry deciduous type of vegetation and a very meager fauna comprising *H. indica, Viverricula indica, Hyaena hyaena, L. nigricollis, F. chaus, H. edwardi*, *Golunda* sp. *Mus* sp. *Bandicota* sp. and *Manis crassicaudata* (Murty, 1974).

Now the question arises: when and why did this drastic change take place? The well dated sediments of MCG may have the answer. Compared to the composite fauna of Kurnool Caves the fauna of MCG appears impoverished (Murty, 1975, Table 9; the present vertebrate data) and indicates a drastic decline in the diversity and number of mammalian taxa in the last 20,000 yrs. Large herbivores preferring swampy conditions such as *Rhinoceros* are absent altogether at MCG and occurrence of *Bubalus* (represented by three dental remains in the Layer 3) is also scanty. From the older layers (Layer 3) to the youngest one (Layer 1) one can observe a definite decrease in the number of specimens of *Equus, Presbytes, Bos, Boselephas, Antilope* and *Gazella*. Among the micromammals reported here, only *Hystrix* sp. and cf. *R. rattus* belong to the Late Pleistocene time bracket. The others come from the Holocene deposits. Hystrix sp. also occurs in the Holocene deposits. The frequency of faunal and cultural remains has also decreased substantially from Upper Palaeolithic to Mesolithic and Neolithic times (Murty, 1974, Table 1).

Based on palaeoclimatic data a hyper-arid condition has been observed from Last Glacial Maxima (LGM) ~ 18,000 to ~ 13,000 yrs BP (Pant, 2003). Such a dry climate might be due to low precipitation of summer monsoon and higher winter precipitation than that at present (Singh et al., 1990). Similar patterns of LGM climate have been shown by Sukumar et al. (1993) using δ^{13}C measurements in peat from Nilgiri Hills, southern India. The changes in vegetation type revealed from the δ^{13}C series correspond to a specific climate regime. Predominance of tropical grass type vegetation 20–16 ka BP clearly indicates a very arid phase during LGM as this type of vegetation grows favorably under low aridity and low soil moisture. This also points to a period of weak southwest summer monsoon during LGM. The change in climate and vegetation has adversely influenced the structure and composition of the montane ecosystem (Sukumar et al., 1995). Similar conditions of LGM have also been identified in the Central Narmada Valley (Patnaik et al., under revision).

After the Terminal Pleistocene arid phase, the warm and humid conditions of the early Holocene (Mesolithic ~8,000 to ~5,000 BP, Murty, 1985) helped mammals such as mouse deer (*T. meminna*), four horned antilope (*T. quadricornis*), the India Wild Boar (*S. cristatus*), porcupine (*H. crassidens*), Black Napped hare (*Lepus* cf. *nigricollis*), Jungle cat (*F. chaus*), Ox (*Bos* sp.), buffalo (*Bubalus* sp.), Nilgai (*B. tragocamelus*), Chital (*A. axis*), barking deer (*C. muntjac*), Sambar (*Cervus unicolor*), Chinkara (*Gazella gazelle*) and Pangolin (*M. gigantean*) to thrive again. Murine rodents such as *Bandicota* and *Millardia* are very well adapted to monsoonal conditions (Patnaik, 2003) and might have also migrated to this region in the Holocene. Recent report of molluscan species from MCG also indicates presence of wet and humid phase during the Mesolithic times in and around the Kurnool Caves (Deshpande-Mukherjee et. al., 2005).

Cynocephalus and *Hyaena* disappeared after the Pleistocene in India. *Atherura* and *Rhinoceros* are absent in peninsular India and are found in Assam (Prater, 1971). *Hippopotamus, Giraffa* and antilopes have also disappeared from India and are found in Africa today. Based on studies concerning evolution, distribution and migration of Kurnool Cave fauna, hypotheses regarding faunal links between India and Africa have been presented by various authors (Lydekker, 1886b; Badam, 1979, 1984). Lydekker (1886b) opined that Kurnool *Cynocephalus* and *Manis* are identical to their present day African counterparts. *Cynocephalus, Hyaena, Equus* and *Manis* may have migrated to Ethiopia from India (Lydekker, 1886b; Badam, 1979). But, at the moment we need more data in order to test these hypotheses.

5. Conclusions

It is highly probable that the arid phase of LGM caused the disintegration of gallery forests and swampy conditions, forcing populations of several large herbivores to either migrate or perish. During the warm and humid conditions of the Holocene, at least some of the mammals, reptiles and amphibians reoccupied the Kurnool Cave area. As evidenced from the bone and stone artifacts recovered from the Kurnool Caves, the early humans were highly specialized hunters and gatherers. Therefore, a drastic decline in the large and medium sized game animals during the Holocene due to excessive hunting by these early humans cannot be ruled out.

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