



## FOSSIL ELEPHANTS FROM THE INDIAN SUB-CONTINENT AND THEIR TUSKS: A REVIEW

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### INTRODUCTION

Of the 350 and odd extinct and extant species of the Order Proboscidea, reported from all over the world during the last 175 years or so, nearly fifty have been discovered from the Indian subcontinent. These have been described and classified in various ways by Osborn (1921, 1936, 1942), Colbert (1935) Lydekker (1877, 1878, 1880), Maglio (1973), Chakravarti (1965), Simpson (1945), Madden (1983), and others from time to time. It will be interesting to know that the very first scientific discovery of vertebrate fossils in India was that of an elephant jaw discovered in the bed of the Omar (Umer) *nadi*, a tributary of the Narmada river near Narsinghpur in Madhya Pradesh (Spilsbury, 1833).

### ANCIENT BEGINNINGS

The beginning of the Order Proboscidea has been traced to some time in the late Paleocene when perhaps a single common ancestor produced two separate evolutionary lines, one of the sea-faring sirenians composed of the present-day dugongs and manatees or the sea-cows, and the other of proboscideans.

The earliest proboscideans are believed to have evolved during either late or early Eocene in Southern Algeria, and may be about fifty million years old. Such features from the few specimens discovered from these formations, as the high domed skull, nasal openings in the posterior, indications of trunk-like protuberances, enlarged upper incisors, reduced lower canines, etc. show their closeness to the latter day proboscideans. However, these were rather short animals with a height of hardly one meter or so. The presence of deep sub-maxillary fossa (pits or

depressions) separated this form from other early members of this Order. No names have been assigned to these fossils so far and these have also not been allotted to any family (West, 1983).

Other discoveries have been made from several stratigraphic horizons, the overall time frame of which varies from about fifty million years B.P. up to recent times, although a few authorities are of the view that some of these finds might also be belonging to the late Palaeocene nearly sixty million years B.P. Prominent among these horizons from Indian subcontinent are the Subathu Group or Formation of the Himalayas ranging in age from lower to middle Eocene, ( 50 to 30 m.y. B.P. ), the Bugti beds of N.E. Baluchistan and Sind which constitute the Fatehjang Zone, just below the lowest Siwalik horizon belonging to Upper Nari/Gaj age and the upper Manchhar belonging to upper Oligocene (28-2.5 m.y.B.P. approx.); the Salt Range of the Attock district of Punjab (Pakistan) containing the Chinji Stage of the Lower Siwaliks (middle Miocene 14 - 10 m.y. B.P. approx.), the Nagri and Dhok Pathan Stages of the Middle Siwalik ( upper Miocene : 10 – 5 m.y B.P. approx.); the Salt Range of the Jhelum district of Punjab (Pakistan) containing the Tatrot stage of upper Siwaliks (upper Pliocene : 5 to 2.6 m.y. B.P. approx.), the Pinjor Stage of the Siwalik hills of the Ambala district of Punjab (India), (uppermost Pliocene : 2.6 – 1.5 m.y. B.P. approx. ); the Potwar Plateau of the Outer Himalayas of Jammu, Himachal Pradesh and Punjab (India) having stages identical to the above; the Bokabil Formation of the Surma Group of Assam near Kumarghat, N. Tripura, belonging to Miocene, the Perim beds of the Perim Island in the Bay of Cambay (Khambhat) in Gujarat, which corresponds

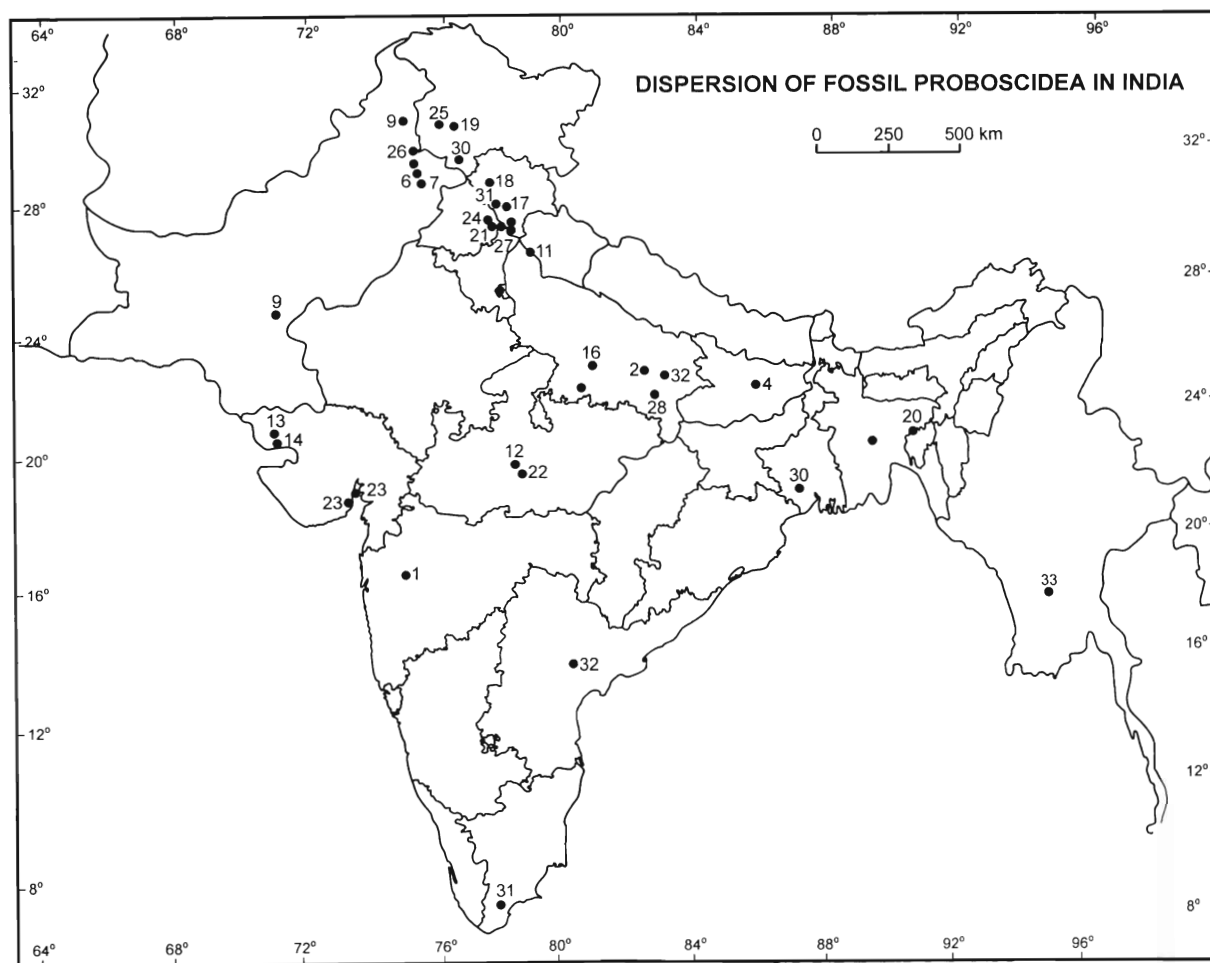


Fig. 1. Map showing dispersion of fossil proboscideans in India; see table 1.

to the Middle and Upper Siwalik beds; the Indo – Gangetic alluvium of Uttar Pradesh, Bihar and W. Bengal belonging to Pleistocene (1.8 to 0.01 m.y. B.P.); the Narmada and Godavari systems of Peninsular India broadly corresponding to the Pinjor Stage of the Siwalik, but perhaps belonging to upper Pleistocene; the Sayamalai area near Tirunelveli (upper Pleistocene) and lastly the Irrawady River System of Myanmar (Burma), which corresponds to the Middle and Upper Siwaliks. Fig. 1 gives a rough indication of these sites.

### TAXONOMIC DIFFERENTIATION

The taxonomic differentiation of the various extinct and the only extant Indian species *Elephas*

*maximus* Linn. 1758 or the common Indian elephant is made primarily on the basis of distinctive features of odontogeny (Gr. Odontos = teeth) or the structure of molars in the jaws. Thus the height and width of the crowns; presence, absence or modifications of the crestal cones, conelets, ridges or lophs, lophids and their numbers; plates or lamellae, talons; as also the presence or absence of enamel and cement, including the form of their folds and thickness and the positions of the skull, jaws and different bones also help in determining the status and placement in the order. Chakravarti (1965) regarded the structure of the grinding surface of molars as the most distinctive character separating various genera and species. In particular, he has stressed that the manner

**Table 1 : Index of Map showing locations and species discovered therefrom.**

1. **Ahmednagar, Maharashtra**  
*Stegodon insignis-ganesa*, Falconer & Cautley, 1845
2. **Allahabad/Naini/ Ganga bridge, Uttar Pradesh**  
*Hypselephas hysudricus*, Falconer & Cautley, 1845, 1846  
*Stegodon insignis-ganesa*, Falconer & Cautley, 1845  
*Stegodon namadicus*, Biswas & Dassanna, 1981
3. **Bankura, West Bengal**  
*Paledoxodon namadicus*, Falconer & Cautley, 1846
4. **Bhagalpur, Bihar**  
*Hypselephas hysudricus* Falconer & Cautley, 1845, 1846  
*Stegodon insignis-ganesa* Falconer & Cautley, 1845
5. **Cambay, Gujrat**  
*Deinotherium angustedens*, Koch, 1845  
*Anancus perimensis*, Falkner & Cautley, 1847
6. **Chinji Bungalow, Pakistan**  
*Trilophodon chinjiensis*, Pilgrim, 1913  
*Trilophodon macrognathus*, Pilgrim, 1913  
*Rhynchotherium chinjiensis*, Osborn, 1929  
*Anancus properimensis*, Osborn, 1935  
*Synconolophus tychodus*, Osborn, 1929  
*Serridentinus browni*, Osborn, 1926  
*Serridentinus metachinjiensis*, Osborn, 1929  
*Serridentinus chinjiensis*, Osborn, 1929  
*Serridentinus prochinjiensis*, Osborn, 1929  
*Serridentinus hasnotensis*, Osborn, 1929  
*Stegolophodon cautleyi progressus*, Osborn, 1929  
*Stegolophodon nathotensis*, Osborn, 1929  
*Tetracygodon progressus*, Osborn, 1929
7. **Dhok Pathan/Potwar/ Hasnot, Pakistan**  
*Trilophodon pandionis*, Falconer, 1857  
*Trilophodon hasnotensis*, Osborn, 1935  
*Tetralophodon falconeri*, Lydekker, 1877  
*Tetralophodon punjabiensis*, Lydekker, 1886  
*Synconolaphus dhokpathanensis*, Osborn, 1929  
*Synconolaphus prapathensis*, Osborn, 1929  
*Synconolaphus corrugatus*, Pilgrim, 1913  
*Synconolaphus hasnoti*, Pilgrim, 1913  
*Stegodon cliftii*, Falconer, 1857
8. **Gaj Beds/ Bugti Hills, Pakistan**  
*Deinotherium indicum* var. *gajense*, Pilgrim, 1912  
*Trilophodon pandionis*, Falconer, 1857  
*Trilophodon cooperi*, Osborn, 1932  
*Trilophodon angustidens* var. *palaeoindicus*, Lydekker, 1884
9. **Gaj, Sindh, Pakistan**  
*Deinotherium indicum* var. *gajense*, Pilgrim, 1912  
*Trilophodon pandionis*, Falconer, 1857
10. **Godavari valley, Andhra Pradesh**  
*Stegodon insignis-ganesa* Falconer & Cautley, 1845
11. **Haridwar, Uttranchal**  
*Pentalophodon sivalensis* Cautley, 1836
12. **Hoshangabad/Narmada, Madhya Pradesh**  
*Paleoloxodon namadicus*, Falconer & Cautley, 1846  
*Stegodon insignis-ganesa*, Falconer & Cautley, 1845  
*Stegodon namadicus*, Biswas & Dassarma, 1981
13. **Kachhach, Gujrat**  
*Moeritherium* spp., Andrews, 1901?
14. **Kachhach, Gujrat**  
*Deinotherium angustidens*, Koch, 1845  
*Deinotherium pentapotamiae*, Falconer et Lydekker, 1876
15. **Kamalia stage, Pakistan**  
*Trilophodon pandionis*, Falconer, 1857  
*Trilophodon angustidens* var. *palaeoindicus*, Lydekker, 1884
16. **Kanpur Dehat/ Kalpi Uttar Pradesh**  
*Hypselephas hysudricus*, Falconer & Cautley, 1845, 1846  
*Stegodon cliftii*, Falconer & Cautley, 1847
17. **Kangra, Himachal Pradesh**  
*Stegodon bombifrons*, Falconer & Cautley, 1847
18. **Kangra foothills/ Bandel village**  
*Deinotherium indicum*, Falconer, 1845  
*Stegodon bombifrons*, Falconer & Cautley, 1847
19. **Karewa, Kashmir**  
*Paleoloxodon priscus* var. *bosei*, Chakravarti, 1935
20. **Kumarghat, N. Tripura**  
*Trilophodon pandionis*, Falconer, 1857
21. **Naraingarh Ambala, Punjab**  
*Stegodon khet-puralensis*, Nanda, 1980  
*Stegodon katiliensis*, Nanda, 1980 .
22. **Narsinghpur, Madhya Pradesh**  
*Stegodon namadicus*, Falconer & Cautley, 1846
23. **Perim Island, Gujrat**  
*Deinotherium indicum*, Falconer, 1845  
*Deinotherium pentapotamiae*, Falconer et Lydekker, 1876  
*Trilophodon pandionis*, Falconer, 1857  
*Anancus perimensis*, Falconer and Cautley, 1847  
*Stegolophodon cautleyi*, Lydekker, 1880
24. **Pinjor stage, Kalka, Himachal Pradesh & Punjab**  
*Archidiskodon planifrons*, Falconer & Cautley, 1845  
*Platelephas platycephalus*, Osborn, 1929  
*Hypselephas hysudricus*, Falconer & Cautley, 1845, 1846  
*Stegodon insignis-ganesa*, Falconer & Cautley 1845  
*Stegodon pinjorensis*, Osborn, 1929  
*Stegolophodon stegodontoides*, Pilgrim, 1913
25. **Poonch, Jammu & Kashmir/ Tatrot stage**  
*Pentalophodon falconeri*, Osborn, 1935
26. **Salt Range/Attock/Kuldhana Formation, Pakistan**  
*Anthracobune pinfoldi*, Pilgrim, 1940  
*Anthracobune daviesi*, Pilgrim, 1940  
*Lamminthania wardii*, Pilgrim, 1940  
*Deinotherium sindiense*, Lydekker, 1880  
*Deinotherium pentapotamiae*, Falconer et Lydekker, 1876  
*Deinotherium orlovii*, Sahnii, 1957  
*Trilophodon angustedens* var. *palaeoindicus*, Lydekker, 1884
27. **Saketi, Himachal Pradesh**  
*Stegodon insignis-ganesa*, Falconer & Cautley, 1845
28. **Son valley, Uttar Pradesh**  
*Stegodon insignis-ganesa*, Falconer & Cautley, 1845
29. **Subathu Formation, Kalakot, Shimla hills/ Siswan, Jammu & Kashmir**  
*Anthracobune aijiensis*, Kumar, 1991  
*Pilgrimella pilgrimi*, Dehro + Oettingen-Speilberg, 1958  
*Ishatherium subathuensis*, Sahnii & Kumar, 1980  
*Platelephas platycephalus*, Osborn, 1929  
*Hypselephas hysudricus*, Falconer & Cautley, 1845, 1846
30. **Tatrot stage, Jammu**  
*Pilgrimella pilgrimi*, Debro + Oettingen-Speilberg, 1958  
*Pentalophodon falconeri*, Osborn, 1935  
*Paleoloxodon priscus* var. *bosei*, Chakravart, 1935  
*Stegodon insignis-ganesa*, Falconer et Lydekker, 1845  
*Stegolophodon nathotensis*, Osborn, 1929
31. **Una, Himachal Pradesh**  
*Hypselephas hysudricus*, Falconer & Cautley, 1845, 1846  
*Stegodon insignis-ganesa*, Falconer & Cautley, 1845
32. **Varanasi, Uttar Pradesh**  
*Stegodon insignis-ganesa*, Falconer & Cautley, 1845
33. **Yenangyang, Mynmaar (Burma)**  
*Stegodon cliftii*, Falconer & Cautley, 1847  
*Stegolophodon latidens*, Clift, 1828

of arrangement of cones and conelets forming the enamel crests, the trend of the crests running straight across the crown or in an oblique direction, or in a curve; the height of the crests, the nature of valleys, open or obstructed by accessory canals, the relation of such conules with the main cones or conelets; the part played by cement when present, etc., are the characters intimately connected with the mode of consumption of food, the movement of the lower jaw, the nature of food and hence also with the habitat of the individual species which ultimately determines its position within this order.

### CLASSIFICATION AND NOMENCLATURE

For the sake of simplicity and continuity, the nomenclature of different species and genera and their allotment to various subfamilies and families, as given in this paper, broadly follows that given by Osborn (1935, 1942) and the latest classification of the four recognized suborders within this Order is based on Carroll (1988), even though several important changes have quite often been made from time to time by other authorities as well, following further studies and individual interpretations. Synonymy thus poses considerable problems, as various authors at different times have assigned different names to the same or similar paleontological finds with the result that very often new species have been created on even minor considerations and the prevalent names have been discarded. Some confusion is thus bound to result from such an approach although there is no remedy. This fact is of prime importance while making a critical analysis of such a review.

Following Carroll (1988), the members of this Order, as discovered from the Indian subcontinent may be considered to belong to four suborders, eight families, and twenty genera covering over fifty species discussed below. These follow the lists given by Osborn (1921, 1936, 1942), Colbert (1935), Madden (1983), etc. though it is quite possible that certain names might have been added, deleted, subdivided or even radically altered by other authors following fresh discoveries on the consideration of other facts brought to light subsequently.

Line drawings of a few of these forms are shown in fig. 2.

### TUSKS

Of special interest are the rare discoveries of well formed and record size tusks of these elephantoid forms. In this paper, some of their details will follow along with their dimensions, compared with the record size tusks of the two extant species viz. *Elephas maximus* Linn., 1758 (the Indian Elephant) and *Loxodonta africana* Blumenbach, 1797 (the African Elephant).

### Fossilised forms from the Indian subcontinent

The following four suborders have been recognized.

#### *Suborder - Moeritherioidea Osborn, 1921:*

This suborder contains two families Anthracobuniidae and Moeritheriidae and is believed to have been the earliest in the line of evolution of this Order (Carroll, 1988).

The anthracobunids are believed to have evolved towards the end of early Eocene, about fifty million years ago. On the basis of the topping of their molars by four massive and rounded cusps in the form of two transverse ridges, some authorities have assigned these to this Order, but the presence of large canines and a different dental formula is considered by others to be against such an assumption. Four genera from this family have been reported from the Indian subcontinent, along with the geologic ranges to which these belong.

Anthracobuniidae (middle to upper Eocene)

#### *Genus Anthracobune*

1. *A. pinfoldi* Pilgrim, 1940
2. *A. daviesi* Pilgrim, 1940

Both these species have been reported from West Punjab in Pakistan

3. *A. aijeensis* Kumar, 1991

Reported from the Subathu Formation, Kalakot, Jammu and Kashmir : middle Eocene.

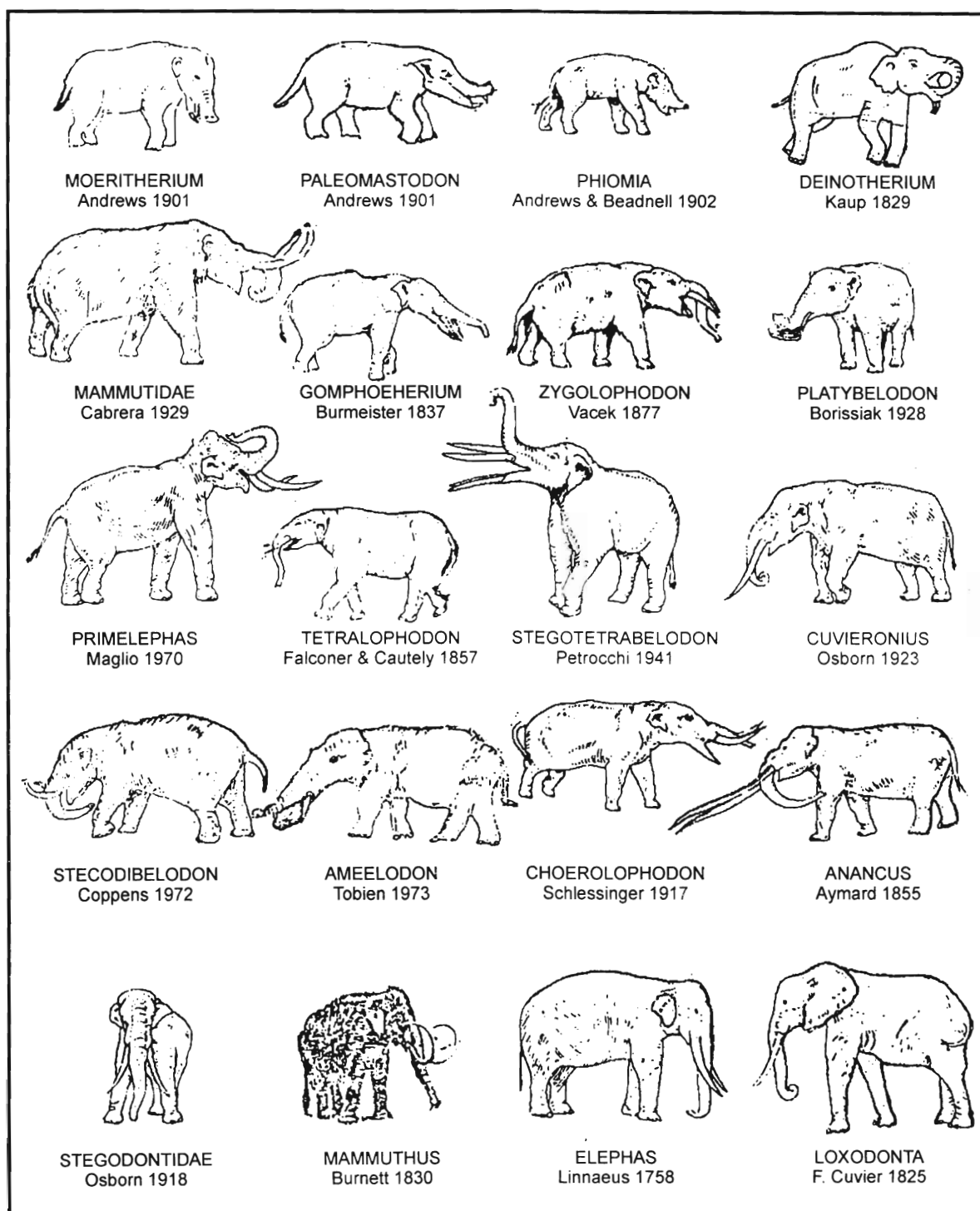


Fig. 2. Pictorial reconstruction of some important proboscidean genera from the Indian subcontinent (Not to scale).

*Genus Pilgrimella* Dehm &

Oettingen-Speilberg, 1958

*P. pilgrimi* Dehm & Oettingen-Speilberg, 1958

Reported from Jammu & Kashmir and also from Pakistan.

*Genus Lammindhanja* Gingerich, 1977*L. wardii* (Pilgrim, 1940) Gingerich, 1977

Reported from the Kuldhana Formation, Pakistan.

*Genus Ishatherium* Sahni & Kumar, 1980*I. subathuensis* Sahni and Kumar, 1980

Reported from the Subathu Formation (lower Eocene) Simla hills, India. West (1983) has recently transferred this genus to Moeritheriidae (1983)

**Moeritheriidae** Andrews, 1906 (late Eocene : 37- 33 m.y. B.P.)

The earliest members of this family were first discovered by Andrews in 1874 and their fossil remains were found in the marine sediments of the ancient and now extinct Lake Moeris along the swampy depressions of Qasr el Sagha Formation of Late Eocene, about 40 m.y. B.P. or so. This was about 100 Kms. to the south of the present day Cairo in Egypt. Some more discoveries of the members of this family were also made from the Djebel el Qatrani Formation of Egypt, Gao (Mali), Kaolack (Senegal) and Dor el Talha, Libya. Similar discoveries from the middle Eocene Harudi Formation of western Kachchh (Bajpai, Srivastava and Jolly, 1989) and from Jammu & Kashmir, India have also been reported, but their allotment to this family is under dispute.

Perhaps semi-aquatic creatures resembling the present-day tapirs, these had a restricted habitat among swamps. With an estimated shoulder height of nearly one meter, their skull was only about 40-45 cms. long. These had a longish body supported by short and thin legs. Beginnings of proboscoid evolution are clear from large and receding nasal openings, formation of air sacs or diploe in the back of the skull, emergence of tusks in the second incisors in both the upper and lower jaws, tuberculate or bunodont molars,

and the presence of a total of 36 teeth, with the dental formula as 3.1. 3.3/2.0.3.3. By late Eocene, these had become extinct. Till the discovery of the Algerian species mentioned in the preceding paragraph, members of this family were considered to be the earliest progenitors of this Order. So far, only one genus, *Moeritherium* Andrews, 1901, containing one species has been assigned to this family from India (West, 1983). However, Coppens *et al.* (1978) considers this to be a Mastodon, *Trilophodon pandionis* Osborn 1906.

*Suborder - Deinotheriidea* Osborn, 1921 (lower Miocene to middle Pleistocene): This was discovered for the first time in the form of a skull from the Miocene beds of Hesse-Darmstadt near Eppelsheim, Germany by Kaup, 1829), who described the same and assigned it an independent status as a distinct proboscoid species. There were similar finds from parts of Europe, France, Rumania and Hungary. Kaup (1832) also described a similar form.

Evolving sometime in the lower Miocene (Aquitanian) over 20.00 m.y. B.P. and becoming extinct sometime by the middle Pleistocene, about 0.50 m.y. B.P., these were considered to be fluvatile or river bank proboscideans by Osborn. These differed from the Moeritheres in the absence of upper incisors and the downturned of lower incisors that curved in. Apart from this singular difference, these were quite akin to other proboscideans in skull form, limb structure and perhaps also a long trunk. A more primitive species, their upper and lower molars were simple and bilophodont (having two parallel ridges on top of the crown). The shape of their lower tusks has given rise to the speculation that these were perhaps partly amphibious and survived on the vegetation of the swamps digging with their upturned tusks. Their upper molars resembled those of a tapir and not of any other proboscidean. Lydekker (1877, 1878, 1880) considered these to be a generalized form connecting the Ungulata to Sirenia and Proboscidea.

Comprising only one family Deinotheriidae with two genera *Deinotherium* and *Prodeinotherium*, their fossil remains were discovered from Europe, South Asia, including the Indian subcontinent and

Africa. The early Miocene forms evolved in Europe, the middle and upper Miocene forms appeared in India, the Oligocene forms in Rumania, Hungary and France, and the Pleistocene forms appeared in Africa. Starting from 1911 onwards, remains were uncovered from East Africa, Egypt and the Olduvai Gorge, Kenya. The earliest deinotheres were reported for the first time in India from the Perim Islands in the Gulf of Cambay (Khambaat), Gujarat Koch, 1845. This was followed by other discoveries from Salt Ranges of Attock, Pakistan; Kachchh in Gujarat, Himachal Pradesh; Poonch in Kashmir, as also in the Gaj beds and Chinji deposits of the Lower Siwaliks of Pakistan. Palaeontologists have divided the Indian finds into two groups depending upon the bulge or the lack of it in the jaws of either side behind the third molar, appearance or absence of cingulum or a girdle-like structure on the outer surface of tooth, and the development or otherwise of the talon ridge. In all, the following species have been reported from the Indian subcontinent.

1. *D. sindiense* Lydekker, 1880

Salt Range (Attock, Pakistan) (mid Miocene)

2. *D. indicum* Falconer, 1845

Perim Island, Gulf of Cambay (Khambaat), Gujarat; Middle Siwalik beds near Bandel Village, Kangra foothills, Himachal Pradesh; and Basal Conglomerates of Middle Siwaliks (Sahni and Gupta, 1982; Sahni and Mishra, 1975).

3. *D. pentapotamiae* Falconer and Lydekker, 1876

Indus Valley, (Attock, Pakistan, upper Miocene)  
Kachchh, Gujarat (upper Miocene).

Perim Island, Gulf of Cambay, Gujarat (upper Pliocene).

4. *D. angustidens* Koch, 1845

Cambay, Gujarat (middle Pliocene).

5. *D. indicum* var. *gajense* Pilgrim, 1912

Gaj deposits of the Bugti beds on the Bugti hills, Pakistan (lower Miocene).

6. *D. orlovii* Sahni, 1957

About 1.0. km. east of Malal, Attock District, West Pakistan. (Kamalia Stage of Lower Siwaliks).

Some of the later authors are of the view that whereas *D. sindiense*, and *D. angustidens* are merely different forms of *D. indicum*, *D. pentapotamiae* is just another form of *D. indicum* var. *gajense*.

**Suborder - Euelephantoidea** Osborn, 1918: In the context of the Indian subcontinent, three families, viz. Trilophodontidae (Gomphotheriidae), Serridentidae and Elephantidae together constitute this order.

Of these, Trilophodontidae has been further subdivided into four subfamilies, viz. Longirostrinae, Tetralophodontinae, Rhynchostrinae and Brevirostrinae. Among these, the first three are represented by one genus each, i.e. *Trilophodon*, *Tetralophodon*, and *Rhynchotherium*, whereas, the last is represented by as many as three genera, viz. *Anancus*, *Pentalophodon* and *Synconolophus*. Serridentidae, the second family, has only one genus *Serridentinus*, and Elephantidae, the third family is represented by as many as three subfamilies Mammontinae, Loxodontinae and Elephantinae. All of these are described below in brief.

**Family Gomphotheriidae** Hay, 1922

The basic feature of Gomphotheriidae is the occurrence of central conules in between the valleys of pretrite (unworn) molars, which after the same get worn out, present the shape of a trefoil over the crown. Though absent in the primitive members of this family, these occur attached to the external cones of the superior molars and the internal cones of the inferior molars, forming outer and inner trefoils in the case of the more advanced members. Quite often the molars retain or progressively develop single, double or even quadruple trefoils in the valleys. These are thus the true bunomastodonts ( Gr. Bunos= a rounded hill; mastos : a nipple; odontos = a tooth) as opposed to the mastodonts which do not have these central conules within the valleys. Their crowns however, remain persistently brachyodont ( Gr. : brachy = short crowned ) in the case of the

Longirostrinae. But the size of the crowns progressively increases till these become hypsodont (Gr. hypsos = height) in the case of the Brevirostrinae. Length, size and shape of the jaws separate the four subfamilies, the time frame of which varies from lower Eocene, nearly 25.00 m.y. B.P. to 20.00 m.y. B.P., right up to the present.

**Subfamily Longirostrinae** Osborn, 1918

These are also known as the beak-jawed mastodonts (Latin: Rostrum = a beak)

In the case of this subfamily, the lower jaws were excessively long and have long and narrow teeth. Other important features are the existence of both the upper as also the lower tusks even though only the upper tusks were surrounded by enamel bands. The lower incisive tusks existed in all the males and probably in the females as well, These were rounded, oval or compressed laterally. The intermediate molars were trilophodont (Gr. : lophos, = a crest or ridge) or had three ridges, or were tetrabunodont i.e. having four bunos on each ridge, Single trefoils arose in the middle of the valleys of both superior as also the inferior molars but these got progressively doubled with more advanced species. Two grinders were in use at the same time in their middle age.

Only one genus with six species has been reported from the Indian Subcontinent.

**Genus Gomphotherium** Burmeister, 1837 syn. Trilophodon, Falconer, 1846

1. *T. cooperi* Osborn, 1932

Reported from the Bugti beds of the Upper Nari horizon in the Bugti hills of Baluchistan, in Pakistan. Miocene.

2. *T. pandionis* Falconer, 1857

Reported from the Kamalial Stage of the Bugti hills; Dhok Pathan of Potwar and lower Manchhar Stage of Larkana, Sind, Pakistan; Bokabil Formation of the Surma Group near Kumarghat, N.Tripura (36); and the Perim Island, Cambay, middle Miocene to upper Miocene.

3. *T. angustidens* var *palaoeindicus* Lydekker. 1884

Reported from the Bugti hills, Baluchistan, Salt range, Punjab (Pakistan); Simla hills; Bakralla Ridge; Attock and Rawalpindi; Kamalial stage near Kamalial, Pakistan; Lower Manchhar stage, middle Miocene.

4. *T. chinjiensis* Pilgrim, 1913

Reported from west of Chinji Bungalow, Lower Chinji. Pakistan, Mio-Pliocene.

5. *T. hasnotensis* Osborn, 1935

Reported from north-west of Hasnot village, West Pakistan; 300 metres below the Bhandar bone bed, lower middle siwaliks, Dhok Pathan. (middle Pliocene).

6. *T. macrognathus* Pilgrim. 1913

Found in the Upper Chinji horizon near Chinji, Pakistan, middle Pliocene.

**Subfamily Tetralophodontinae** van der Maarel, 1932

The members of this subfamily had jaws that were not very long (medi longirostral). The intermediate molars were tetralophodont and had beginnings of double trefoils. With age, only third molars were in use. The central cones might or might not have been present, and the height of the crowns varied from brachyodont to sub-hypsodont in the various species. Whereas the Trilophodonts appeared to have been present between lower Miocene to middle Pliocene, the Tetralophodonts first appeared in lower Pliocene and continued till the middle Pliocene. Only one genus and two species have been reported from the Indian Subcontinent as under.

**Genus Tetralophodon** Falconer, 1847

1. *T. falconeri* Lydekker, 1877

Reported from the Dhok Pathan stage, Potwar plateau, West Punjab; and Manchhar beds at the base of the Siwaliks (middle Pliocene).

2. *T. punjabiensis* Lydekker, 1886

Reported from the Dhok Pathan stage of the Siwaliks, Pakistan. (Middle Pliocene).

**Subfamily Rhynchrostrinae** Osborn, 1918

'Rhyncho' means a snout or beak and the members of this subfamily had prominently snout shaped jaws, or beaked jaws. The lower jaws were of medium length with 'the symphysical portion strongly down curved. Both superior as also inferior tusks were persistently functional, laterally compressed, bent downwards and outwards, each with broad external enamel band. The lower tusks were slightly upturned, The molars were brachyodont. The central conule may or may not have been present in the different species. There was only a single trefoil and the molar enamel was thick. Only one species has been reported from the Indian Subcontinent.

**Genus *Rhynchotherium*** Falconer. 1856

1. *R. chinjiensis* Osborn, 1929

Discovered from near the Chinji Bungalow, almost 200 metres above the lower Siwaliks. (Mio-Pliocene).

**Subfamily Brevirostrinae** Osborn, 1918

The principal features of this subfamily are the very short jaws and skulls, and the reduction of the molars to one each in both the upper and the lower jaws, like the present day elephants. The alternation of the main internal and external cones that were placed diagonally instead of transversally to the long axis of the crown, and the in-folding of the enamel borders on the molar ridges gave these a pig like character. The molars also progressively changed from brachyodont to sub-hypsodont. Three genera, viz. *Anancus*, *Pentalophodon* and *Synconolophus* are the representatives from the Indian subcontinent.

*Anancus* had straight and very long tusks. The intermediate molars had four ridge crests and crowns varied from brachyodont to sub-hypsodont. Central conules were present but there were no trefoils. There were single external median conules in inferior molars and external median conules in superior molars as in Trilophodonts.

*Pentalophodon* did not have incisive tusks and its intermediate molars (third, fourth and fifth) had

five lophs (ridges). The molars were subhypsodont, the cones were elevated and alternating, the crowns were also subhypsodont, and there were trefoils.

In the case of *Synconolophus*, there were long, massive and upturned tusks. The intermediate molars had three and a half ridges or lophs. The molar crowns were brachyodont and the cement was strongly developed. The details of the various species are as under.

**Genus *Anancus*** Aynard, 18551. *A. perimensis* Falconer & Cautley, 1847

Discovered from the Perim Islands in the Gulf of Khambhat, Gujrat from the Dhok Pathan stage of middle Pliocene.

2. *A. properimensis* Osborn, 1935

Reported from the Chinji Bungalow, Lower Chinji Stage, about 250 meters above the base of the Lower Siwaliks and about 15 kms. To the west of the Chinji Bungalow, Punjab, Pakistan. (Mio- Pliocene).

**Genus *Pentalophodon*** Falconer, 18571. *P. sivalensis* Cautley, 1836

Reported from between the Ganga and Yamuna basins, probably near about the present day Siwaliks along Saharanpur, U.P. (now Hardwar) (Upper Siwaliks, (upper Pliocene).

2. *P. falconeri* Osborn, 1935

Discovered from the Tatrot stage (Upper Siwaliks, (upper Pliocene).

**Genus *Synconolophus*** Osborn, 19291. *S. ptychodus* Osborn, 1929

Uncovered from the Chinji stage near the Chinji Bungalow, Pakistan, nearly 250 meters above the base of the Lower Siwaliks (Mio-Pliocene).

2. *S. dhokpathanensis* Osborn, 1929

Discovered about 200 meters below the Dhok Pathan Bungalow..Middle Pliocene

3. *S. propathenensis* Osborn, 1929

Reported from the Dhok Pathan stage about 200

meters below the top of the Middle Siwaliks. (middle Pliocene).

4. *S. corrugatus* Pilgrim, 1913

Reported from the Hasnot Village, Punjab (Pakistan), Dhokpathan stage. (middle Pliocene).

5. *S. hasnoti* Pilgrim, 1913

Discovered from near Bhimbar, north –west of Jammu, Dhok Pathan stage. (middle Pliocene).

Chakravarti, (1965) is of the opinion that *Anancus perimensis*, *Synconolophus hasnoti* and *Pentalophodon sivalensis* should be considered to belong to the genus *Anancus* only.

**Family Serridentidae** Osborn, 1921

This is a very large and highly diversified family consisting of seven genera with over forty species. The basic features of this family are the absence of central conules within the valleys of the molars that are so prominent amongst Trilophodonts. Instead, these are replaced by crests along the sides of the superior internal cones and on the inferior external cones. These crests sub-divide into 2-6 smaller conelets that give the molars a serrated appearance. All these seven genera have one common character in having the serrated crests arising out from the ectoconelets in the lower molars and also from the ectoconelets in the upper molars. The ridge crests are however blunt in the specimens from the Indian subcontinent.

The jaws are of medium size or medilongirostral, and both males and females had tusks. The superior, or the upper tusks were downcurved and outcurved, were laterally compressed and had broad enamel bands around these in all the seven genera, but the lower or inferior tusks were horizontally oval, or broadly flattened and were less elongated, not touching the ground. The difference in shape of the lower tusks is of taxonomic importance and is useful in differentiating the various genera. This appears to be an example of local adaptive radiation. The crowns vary from brachyodont to hypsodont and two grinders are usually present at the same time in adult specimens. Their size is generally shorter.

Only one genus *Serridentinus* of this family is known from our subcontinent, and a total of five species of this genus have been reported. The details are as under.

**Genus Serridentinus** Osborn, 1923

1. *S. browni* Osborn, 1926

Lower Chinji (Lower siwaliks) near Chinji Bungalow, Pakistan (Mio- Pliocene).

2. *S. metachinjiensis* Osborn. 1929

as above

3. *S. chinjiensis* Osborn, 1929

as above

4. *S. prochinjiensis* Osborn, 1929

as above

5. *S. hasnotensis* Osborn, 1929

Lower Chinji zone near Hasnot, Pakistan (middle Pliocene).

**Family Elephantidae** Gray, 1821

Lydekker has defined Elephantidae as a group of Proboscidea whose members had never more than three molars in use simultaneously in every quarter of the two jaws, i.e. there were never more than twelve molars in all in the whole mouth at any given time. Also, the number of ridges in the second true molar were either equal to or more than the number on the preceding molar, though there might have been a few exceptions to this rule occasionally.

In the living or extant species of elephants there are, in all, a total of 24 grinders, but these do not occur simultaneously. Instead, the six molars on each quarter of the jaws get developed in horizontally successive manner, one at a time, and the molar following the same gets increasingly complex. After getting worn out, each anterior molar drops down and is succeeded by a growing posterior molar till there is only the last of these six molars in the old age of the animals. After these too drop out, the animals die out in nature due to lack of food intake. The third, fourth and the fifth molars are also known as Intermediate molars.

Barring a few exceptions, most of the extinct members of this family have similar characteristics, but in a few cases, the first three molars, that are known as ante-penultimate, penultimate and milk molars, get replaced by vertically growing premolars as in the case of human beings. In such cases, these premolars are followed by first, second and third true molars.

The evolution of this family is traceable to the Mio-Pliocene, about ten million years B.P. by middle Pleistocene, its members had radiated and established themselves over practically the entire world with the exception of Australia and Antarctica.

There are fundamental differences in the dental anatomy of the different genera and species belonging to this family. The molars vary from sub-hypsodont to hypsodont and are constructed in the shape of a series of numerous transversally oriented parallel plates or lamellae whose numbers vary from seven to thirty. In each molar, the lamellae are jointed by cement. Each one of these lamella consists of a shell of enamel filled with dentine. As these get worn out, their crowns look like a series of parallel line of dentine alternating with cementum. There are no trefoil patterns. The enamel shell is moderate to thin and folded in all except the earliest forms. Premolars are present only in the earlier members and these too disappear in more advanced genera.

Another special feature is that the size and the hypsodonty of the successive molars show a significant increase over that of the preceding molar.

There are no lower tusks and the jaw symphysis becomes short in the early evolutionary stages. The cranium is however much higher and also shorter, bearing huge curved upper incisors or tusks. There is consequently a radical change in the masticatory function of this family.

The family has been subdivided into three sub-families, viz. Mammontinae, Loxodontinae and Elephantinae. The first of these is represented by three genera, namely *Archidiskodon*, or the southern mammoth; *Parelephas*, or the north temperate mammoth; and *Mammonteus*, or the true northern

mammoth, the well known woolly mammoths whose entire bodies were discovered from the frozen Siberian tundras barely a century back in fairly good condition. The second subfamily is also represented by three genera viz. *Loxodonta* which includes the present day African elephants; *Paleoloxodon*, discovered from India, the Mediterranean Island, Japan, and Indonesia; and the *Hesperoloxodon* discovered from Europe. The third subfamily Elephantinae which includes the present-day elephants of India, is also represented by three genera, namely *Elephas*, *Hypselephas* and *Platelephas*. This phylogenetic classification is primarily based on the evolutionary characteristics of the cranium and jaws harmonizing with the molars, specially the third superior and inferior molars. In other words, differences in the structure of cranium, molars and tusks determine the identity of the various genera. The details are given below.

#### *Subfamily Mammontinae* Osborn, 1921

A gradual abbreviation of the fore- and aft facio-cranial, and an increase in the vertical heights of the cranium and the jaws, vertical lowering of the molar crowns, and the occipitofrontal apex differentiate the three genera enumerated above. The molars vary from a primitive sub-hypsodont stage in the *Archidiskodon* to a very high or hyper-hypsodont stage in *Mammonteus*.

So far, only one genus *Archidiskodon* has been reported from the Indo-Pak Siwaliks, and here too, only one species has been discovered from out of a total of nearly twenty two species described by Osborn.

*Genus Archidiskodon* Pohlig, 1855,  
1888

This is one of earliest members of this sub-family and had appeared along with others in Pliocene. Their molars had few ridges. or ridge plates not exceeding 15 lamellae. The crowns were broad, short and had thick enamel. There was cement in between the enameled ridge plates that formed the lamellae.

*A. planifrons* Falconer and Cautley, 1845

Syn. *Elephas planifrons* Falc. And Caut., 1845

This species from the upper Pliocene of India is geologically the earliest member of this family. It was discovered from the Pinjor horizon of the Upper Siwaliks, near Kalka, Charnian, Siswan, Chandigarh and Mirzapur (Punjab).

**Subfamily Loxodontinae** Osborn, 1918

The three genera enumerated in this subfamily, have a more or less common character of having a relatively primitive cranium, that is flat, short and rather high, having widely divergent tusks embedded in a broad base in the posterior part of the upper jaw. The molars are moderately hypsodont, varying from narrow to broad shape. In the case of *Loxodonta*, which appears to be the most primitive amongst these, the molars are lozenge shaped (Gr.: *loxos* = curved) and appear suitable for browsing, and crushing. Besides, these have also a more primitive ridge formula. Apart from *Elephas* this is the only extant species occurring in Africa.

**Genus Paleoloxodon** Matsumoto, 1924

Considered by some authorities to have evolved in South Africa, it diversified into nearly 30 species, as per Osborn's classification, from a very wide geographic range right from S. Africa to Tanzania, N. Africa, Algeria, Malta, Cyprus, Crete, Italy, India, Indonesia and Japan.

While similar to *Loxodonta* in having a low occiput (back of head), and wide bones before the maxilla (jaw bone), these differ from the former in having compressed ridge plates, and in not having *Loxodont sinus* (Gr.: *loxos* = oblique; *sinus* = cavities). The ears had larger ear flaps as compared to those of the Asian elephants. Their skull is relatively broader and flattened.

Whereas previously only one species *P. namadicus* was believed to have been discovered from the Narmada valley area, Chakravarti, D.K. considered yet another species *P. priscus* var *bosei* to have been discovered from the Jammu Siwaliks. These are discussed below.

*P. namadicus* Falconer and Cautley. 1846

Falconer named it *P. namadicus* after the

Narmada river, the Namadus of Ptolemy. where it was first discovered in the alluvial deposits of Narmada valley near Dongaria, Hoshangabad, Madhya Pradesh. (Pilgrim, 1905). Tripathi and Basu (1982) also discovered a fossilized upper jaw containing both the last molars of a proboscidean from the middle Pleistocene deposits along the right bank of the Narmada river near this very place in 1971 together with three Acheulian hand axes, all lying in a gravelly matrix. They had provisionally identified these as belonging to *Elephas namadicus* Falc. & Caut. Further deposits from the Tundiari nala Allahabad (Verma, 1996), the Ganga bridge site at Bhagalpur (Verma, 1996), the late Quaternary deposits of Bankura, Burdwan and Purulia, West Bengal (Dassarma *et al.*, 1982) and the Son valley in U.P. (Dassarma and Biswas, 1977), have also been reported from upper Pliocene to upper Pleistocene.

*P. priscus* var *bosei* Chakravarti, 1935. This species was discovered from the Jammu Siwaliks and also from the Karewas of Kashmir (Osborne, 1921, 1936, 1942) upper Pleistocene.

**Subfamily Elephantinae** Osborn, 1910

Included amongst the three genera comprising this subfamily, the most progressive and recent, *Elephas maximus* is the only extant or living member found in southeast Asia even today in sizeable numbers. The other two had become extinct quite sometime back even though their fossilized forms have been discovered from this subcontinent.

The specific characters of this subfamily which often overlap in the three genera enumerated above, include a short cranium varying from a flattened head to a gradually tapering shape; a gradual shortening of jaws, smaller tusk cavities; upper tusks upturned, outturned and finally inturned; smaller in size compared to *Loxodonta*; the molars become progressively hypsodont, the ridge plates more numerous with the succeeding genus; and finally the inferior ridge plates exceeding the superior ridge plates in number as opposed to Mammontinae.

Details of the two extinct genera are as under.

**Genus Platelaphas** Osborn, 1936

The main features of this genus are a relatively flattened and long skull, elongated pre-maxillaries in front of molars, elevated orbits, directly transverse

and limited number of ridge plates usually upto 15-16.

Only one species has been described

*P. platycephalus* Osborn, 1929-21

First discovered from the bed of Amilee Creek near Siswan, Simla hills from a horizon having a time frame varying from upper Pliocene to lower Pleistocene nearly 1.5 m.y. B.P. or so, this species appears to belong to an earlier stage in the evolution of Elephantidae. Its head is flattened like a plate and is elongated with a characteristic lowering of the front occipital profile. The cranium is also much longer and narrower as compared to its width. No tusks are known.

*Genus Hypselephas* Osborn, 1936

Assigned to the lower Pleistocene their crania are elevated, the condyles are raised above the molars, the back of the head is also raised with frontal crests and the compressed pre-maxillaries are deeply concave. The tusks are more straight, the orbits are depressed and convexo-concave ridge plates numbering up to 18 on low molar crowns are in evidence.

*H. hysudricus* Falconer & Cautley, 1845, 1846

Syn. *Elephas hysudricus* Falc. & Caut.

Reported to be abundant in the lower Pleistocene. Its fossilized forms have been uncovered from the following places:

- a. Originally discovered from near Siswan (Simla), Chandigarh, Charnian and Kalka (Barnum Brown's collection of 1922), it appears to have been distributed rather profusely around these areas, as several finds have been recorded from this strata. These were perhaps deposited there by erosion from the Boulder Conglomerates.
- b. Pinjor stages of the Siwaliks from the east of Jhelum.
- c. Pachkauri, about 20 kms. From Kora-Jahanabad on the road to Kanpur (now in Kanpur Dehat). (37)

- d. Ganga bridge at Allahabad. (Verma, 1996)
- e. Belan –Soti confluence, south of Meja, Allahabad, (Verma, 1996)
- f. Bhagalpur, at the site of the Ganga bridge in Bihar (Verma *et al.*, 1996)
- g. Una District of Himachal Pradesh –Lower Pleistocene (Verma and Vashisht, 1998)

Originally known as *E. hysudricus*, the following are some other details about this species.

The widely separated thin lamellae are enclosed in thin coatings of cement. The third upper milk molars have 6-7 ridge, whereas the lower corresponding milk molars have 7-9 ridges. The number of ridges in true molars are more than seven. The intermediate molars may be hepta or even octolophodonts. The last true molars may have as many as 17-18 lamellae. However, these are much less than those in *Elephas*. Plates of enamel are lower, but are narrow and vertical. The intervening spaces between the various lophs or ridges, known as valleys are generally wider than these plates. The worn crown surfaces are thick and flat.

The tusks are oval in shape, narrow and convex. The short symphysis has a very small and narrow spout.

*Suborder-Mammutoidea* Cabrera, 1929: This suborder consists of two families : Stegodontidae and Mammutidae.

*Family Stegodontidae* Osborn, 1918

Primarily an Asiatic group of mammutid origin, this family is believed to have evolved sometime by the middle Miocene (Langhian age), nearly 15.00 m.y. B.P. back and became extinct by the late Pleistocene, about 30-40,000 years ago. Stegodonts appear to be transitional between true mastodonts on the one hand, and true elephants on the other. The true mastodonts had a small number of cusps over the crown of their molars (Gr: mastos = breasts) that were nipple shaped, and the molars of true elephants had lophs, or parallel plate like structures joined by cement. However the stegodonts (Gr: stegein = to cover) had the cusps over the crown of their molars covered by thick layers of enamel, thereby giving a roof like character over



Fig. 3. Part of *Stegodon* tusks from the village Ghansi, Hoshangabad, M.P. (*in situ*).

these cusps that were fairly numerous.

The summits of these ridges were subdivided into five or six rounded prominences. There were also layers of cement over the enamel in an unworn tooth, but there was not much accumulation of the same in the intermediate valleys. This is in contrast

with the case of true elephants where there is plenty of cement in the valleys.

Other characters are low crowned teeth, as opposed to bunodont or high crowned teeth in the true elephants, apically converging sides lacking intra-valley columns, and short jaws lacking incisors. The

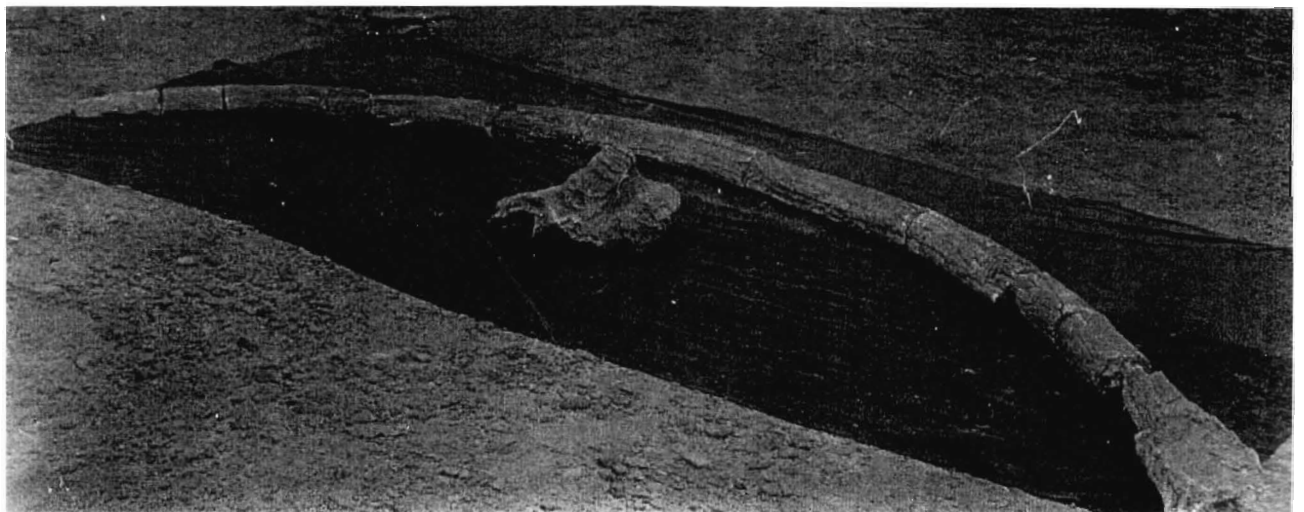


Fig. 4. Fossil tusk and upper jaw of *Stegodon* sp. kept at the district museum, Hoshangabad, M.P.

skull is short and broad. Lydekker (1877, 1878, 1880) had defined these as 'elephants' whose intermediate molars do not generally have more than eight low ridges, and in which the cement does not form a continuous surface with the ridges in the germ molars.

Fossil finds from southeast Asia indicate that this was perhaps their original home where subsequently only two species, appear to have evolved and expanded. One was *Stegodon trigoncocephalus* that invaded Java in Indonesia in the Pliocene. The other is *S. kaiensis* that had appeared in East Africa in certain formations of Uganda in the Pleistocene.

Two genera, viz. *Stegodon* and *Stegolophodon* have been reported from the Indian subcontinent. Their details are given below.

*Genus Stegodon* Falconer, 1857

A total of seven species have been discovered from the Indian subcontinent.

1. *S. cliftii* Falconer & Cautley ), 1846

Syn. *S. elephantoides* Clift, 1828

These were discovered from the Dhok Pathan and Tatrot stages of the middle and upper Siwaliks, corresponding to Middle and Upper Pliocene in West Pakistan, as also from the left bank of the Irrawady river near Yenangyang in Mynmaar (Burma). Very recently (1997), one molar was also discovered from the bed of the Yamuna river at Kalpi along the Lucknow -Jhansi road in U.P. (Singh, pers. comm..)

2. *S. bombifrons* Falconer & Cautley), 1846.

Discovered from the Dhok Pathan and Tatrot stages, corresponding to the middle and upper Pliocene in the Siwaliks of the Kangra district, Punjab.

3. *S. insignis-ganesa* Falc. & Caut, 1846.

Though often considered as two separate species, most of the authorities believe *S. insignis* and *S. ganesa* to be the female and male forms respectively of the same species. Discovered from the Pinjor stage of the Upper Siwaliks, corresponding to lower Pleistocene from Hasnot, Pakistan; Jammu (Tatrot); old alluvial deposits of Ganga, Yamuna, Narmada, Godavari and Krishna rivers (Verma, 1996); and Verma, Mishra, Mishra and Kumar, 1998

the Pleistocene alluvial deposits of Nevasa (Ahmednagar, Maharashtra, Tripathi, 1962), the Ganga bridge site at Bhagalpur (upper Pliocene); Naini, Yamuna Railway bridge, Allahabad; the older alluvium of Prahaladpur, Varanasi U.P.; and the Saketi Formation in the Siwaliks of Himachal Pradesh., several record size tusks of this species have also been discovered from some of these sites.

It would be interesting to note that the Indian Postal department had issued a special stamp featuring this species to commemorate the centenary of the Geological Survey of India in 1951.

4. *S. pinjorensis* Osborn, 1929

These were discovered from the Pinjor horizon of the Upper Siwaliks corresponding to Lower Pleistocene from Siswan, Chandigarh, India.

5. *S. namadicus* Biswas and Dassarma, 1981 (5)

Discovered from near Dhansighat (Hoshangabad) and Devekachar of the Narsinghpur district of Madhya Pradesh, and later from near the Narmada river from the villare Ghansi, Hoshangabad in 1991, this has been assigned to the Middle Unit of the Narmada valley Quaternary alluvial deposits (upper Pleistocene). These show a slight morphological variation from *S. ganesa*.

6. *S. khet puralensis* Nanda, 1980.

Discovered from the Tatrot formation, 1.00km. N.N.W. of Khet purali in the Naraingarh tehsil of the Ambala district of Punjab, this species shows some variation in its morphology. These belong to the Upper Siwaliks.

7. *S. katiliensis* Nanda, 1980.

This has been discovered from near Ambala, Punjab, and has been assigned to the Upper Siwalik beds (lower to upper Villafranchian). The molars of this species are comparatively massive with thicker enamel as compared to other species found in the Siwaliks.

Nanda (1976) is reported to have discovered two more species of this genus but the details are lacking.

**Genus *Stegolophodon*** Schlesinger, 1917

Five species have been so far discovered from the Indian subcontinent as below.

1. *S. stegodontoides* Pilgrim, 1913

Discovered from Lehri, Punjab (India) from the Pinjor horizon of the Upper Siwaliks.

2. *S. cautleyi* Lydekker, 1880

These were discovered from the Perim Islands in the Gulf of Khambaat, Gujrat, and have been assigned to middle Pliocene.

3. *S. cautleyi* var *progressus* Osborn, 1929

These were discovered from the Chinji bungalow area, Chinji, Pakistan about 700 metres above the base of Lower Siwaliks and have been assigned to Mio-Pliocene.

4. *S. latidens* Clift, 1828

Discovered from near Yenanyaung, Irrawady river, Mynmaar (Burma), these have been assigned to the Irrawady soils corresponding to lower Pliocene.

5. *S. nathotensis* Osborn, 1929

These have been uncovered from the lower Chinji zone at Nathot, Pakistan from the lower Siwaliks, and also from the Tatrot zone. It appears to have spanned a period of nearly 14 million years right from the lower Miocene, about 15 m.y. B.P. up to Pleistocene about one million years B.P. Later, these spread from India to Africa and Europe.

**Family *Mammutidae*** Hay, 1922

Fossil of only one species *Tetrazygodon* spp. Osborn, 1929 has been described from a place east of the Chinji bungalow, Potwar plateau, Pakistan by Tobien (1978). This was from the Lower Chinji horizon about 700 metres above the base of the Lower Siwaliks, and has been assigned to middle Miocene / Mio-Pliocene.

## FOSSIL PROBOSCID TUSKS FROM INDIA

Although findings of fossil tusks from this country have been extremely rare, and those of complete tusks even rarer, the details of a few important finds are given below for the sake of interest and records.

Though very many pieces of tusks have been recorded from almost all the fossiliferous strata of the country, separate records for these are not readily available.

Among the earliest references made by Lydekker (1880), there is a mention of a specimen of a mandibular symphysis obtained by one Mr. Theobald from Punjab. This was reported to have a pair of large and compressed, oval shaped (in section), tusks that were considerably arched, and were composed solely of ivory without any enamel band. Their transverse diameter was 5.00 cms. (2''), and the vertical diameter was 8.00 cms. (3'').1) but neither the species, nor their length have been given. Lydekker considered these to belong to *Gomphotherium (Trilophodon) pandionis*.

The other reference is to a *Stegodon ganesa* tusk discovered by Col. Baker, which at its base had a vertical diameter of almost 15.00 cms. (10''). It appears to have been a fairly big tusk, but again the details have unfortunately not been recorded.

Lydekker has also reported about a piece of a left side tusk of *S. ganesa* kept at the Indian Museum at Calcutta that belonged to some place known as Biltari in the Nerbudda. It consisted of a good portion of its middle part and was laterally compressed with its extreme end curving upwards and inwards. Its dimensions were as under.

1. Length of fragment along concave upper border : 200.66 cms. (6'7'')
2. Length of chord of arc : 185.42 cms. (6'1'')
3. Vertical diameter near thicker side..21.60 cms. (8'').5)
4. Transverse diameter near thicker side : 18.54 cms. (7'').3)
5. Vertical diameter near thinner end : 17.02 cms. (6'').7)
6. Transverse diameter near thinner end : 12.00 cms. (4'').7)

Its base was found missing.

Another specimen, identified by Falconer as belonging to *Elephas namadicus* Falc. & Caut and later renamed as *Paleoploxodon namadicus* Falc. & Caut., 1846, has been reported by Lydekker who considered it to belong to *Stegodon ganesa* Falc. &

Caut., 1845. Its transverse diameter was 36.56 cms. (14"4.). The length of this piece has, however, not been recorded.

One tusk of *Paleoloxodon namadicus* Falc. & Caut., 1846 in length was discovered by Wadia, D.N. from Murlipur, Allahabad. It had a broad end diameter of 20.00 cms. And the narrow end diameter of 19.00 cms. This has been assigned to Middle Pleistocene.

A left upper incisor of *Stegodon ganesa* Falc. & Caut., 1845 was discovered from the Village Jagati nine kms. due north of Jammu City, which is a magnificent specimen of a complete tusk (Wadia, 1925). It was found in the lower part of the Upper Siwaliks (Tatrot stage), along with its cranium, two huge molars, and a broken part of the second tusk that was about 35 cms. in length. The dimensions of this tusk are as under.

1. Length of the tusk along its concave border...322. 58 cms. (10'7")
2. Length of the chord of its arc.... 312. 58 cms.. (10'3")
3. Vertical diameter near thicker end.. 21. 08 cms (8".3)
4. Transverse diameter near thicker end ...16.26 cms. (6".4)
5. Vertical diameter at the tip : 8.13 cms. (3".2)
6. Transverse diameter at the tip ... 2.29 cms. (0".9)

At its thicker end, this tusk was unsheathed in a thick bony covering, though else where, it was cut up by a number of transverse cracks. At the moment, it is reported to be housed in the Jammu University.

It will be interesting to know that in 1984, Shri S.S. Gupta, a Geologist of the G.S.I. Jammu Circle, discovered yet another pair of *Stegodon ganesa* tusks along with cranium from almost the same locality in the upper part of the Labli member (= Tatrot) of Uttarveni Formation of the Siwaliks, 2.00 kms. North of Nagrota (Jagati area) and 10 kms. north of Jammu City. The right tusk measured a record 350.00 cms. (11'5") along its outer curve (concave side). It had a maximum diameter of 15.00 cms. The left tusk measured 170.00 cms. (5'5".5). Though supposed to be housed in the museum of the G.S.I at Jammu, bearing a registration number Y/121, it is reported to have been kept there in a very indifferent manner

and may even have been partly destroyed by now. This tusk might have been almost two million years old (Ann., 1985), Its species has, however, not been recorded.

Biswas and Dassarma (1979) reported the finding of three skulls, molars and tusks of a new species *Stegodon namadicus* (Biswas and Dassarma, 1981) from Dhansighat of the Hoshangabad district of Madhya Pradesh, and from the Devakachhar area of Narsinghpur district of the same State. These had been assigned to the middle unit of the Narmada Valley Quaternary alluvial deposits. belonging to upper Pleistocene. Two fragmentary tusks (Sp. no.G.S.I. 19635) were found detached from the skull. The length of one tusk was only 39.00 cms. Its cross section was approximately circular in the proximal end and slightly elliptical towards the distal end. The maximum diameter near proximal end was 8.5 cms.

Lamba (1993) discovered a pair of record size fossilized tusks and the upper jaw of a *Stegodon* (*namadicus* !) from the banks of the Narmada river in Village Ghansi of the Hoshangabad district of Madhya Pradesh. According to the measurements carried out by Prasad, an eminent expert on the environs of the Narmada valley systems (pers. Comm.), the first tusk was in seven pieces, and the second in four.

Their dimensions, as measured by him, are given below:-

A. First tusk.

Piece no	Length in cms.	Girth in cms.
1.	73.00	65.00
2.	44.00	46.00
3.	55.00	45.00
4.	61.00	46.00
5.	43.00	40.00
6.	20.00	34.00
7.	27.00	31.00
Total		323.00 (10'7")

Proper measurements of the second tusk could not be made as all the pieces were badly damaged and partly broken (Figs. 3, 4).

These finds have been assigned to middle Pleistocene and are believed to be nearly 0.05 million years old. For the present, these have been housed in the district museum at Hoshangabad, M.P., though

their upkeep leaves much to be desired. Figs. 3 and 4 show these tusks, one *in situ* and the other on the table in the museum.

Singh I.B. and his three associates, Smt. Shikha Sharma, Sri Maneesh Sharma and Sri Pradip Srivastava in (1997) uncovered first a massive proboscidean shoulder blade, about 1.0 meters in width followed by an all time world record size tusk from south-west Asia, hardly 20.25 meters away, along the right bank of the Yamuna river below the road bridge connecting Kanpur to Kalpi, just before the Kalpi town in the Jalaun district of U.P. It was about 15 meters below the road level and only 2-3 meters above the water level of the river.

Provisionally considered to belong to some species of *Stegodon*, its length is 353.87 cms. (11'7") and it has a maximum girth of 54.00 cms. (21".2). At the moment, it is housed in the Geology department of the Lucknow University and, though in ten pieces, is in an excellent shape. According to the dating tests, its age has been computed to be 28,530+1090 years (Singh, Pers. Comm.).

### OTHER WORLD RECORDS OF PROBOSCIDEAN TUSKS FOR EXTINCT SPECIES

This information is given for the sake of general interest and is primarily based on the Guinness Book of World Records.

The world record for all time is held by a single fossilized tusk of a woolly mammoth (*Mammuthus primigenius* Burnett, 1830, Syn. *Mammontus primigenius* Blumenbach, 1799, 1803) said to be preserved in the Fränkisches museum at Brno, Czechoslovakia, now the Czech Republic. It measures a whopping 5.02 meters (16'5".5) along its outer curve.

In August 1933, a single tusk of an Imperial mammoth (*Mammuthus imperator*) measuring at least 4.87 meters (16') without its extreme end (that was missing) was recorded from Post, Texas, U.S.A. It was presented to the American Museum of Natural History, New York City, U.S.A. where it might be lying at present.

The tusks of a straight tusked Proboscidean, *Paleoloxodon antiquus* Osborn, 1931 which lived in North Germany, about 0.3 million years ago are said to be the longest with an average length of 5.0 meters (16'5"), but there are no specific records.

The heaviest recorded pair of fossil tusks belong to a 4.06 meter (13' 4") tall Colombian mammoth (*Mammuthus columbi*) discovered from Campbell, Nebraska, USA in 1915. These are at present housed at the State Museum, Lincoln, Nebraska, USA. The combined weight of this pair is 226 Kgms. (498 lbs.) and these are 4.21 meters (13'9") and 4.14 meters (13'7") long respectively.

### WORLD RECORDS OF TUSK FOR LIVING (EXTANT) SPECIES

The longest recorded tusks belong to an African elephant, *Loxodonta africana oxyotis* Matschie, 1903. The right one is 349.25 cms. (11.5".5) along its outer curve and its circumference at the thickest place is 47.00 cms. (18.5).. The left tusk is 335.27 cms. (11' 0") long and its girth at the thickest place is also 47.00 cms. (18".5). These are reported to have been collected from the present day Zambia, later owned by King Menelek of Abyssinia, now Ethiopia, who presented these to some European political officer. Eventually, these were offered for sale in London, were purchased by Rowland Ward, and finally presented to the New York Zoological Society by one Mr. Charles Barney. At the moment, these have been kept by the Society at the National Collection of Heads and Horns at Bronx Park, New York, U.S.A.

A single tusk reported to be over 350.52 cms. (11'6") long has also been mentioned, but its details are not available

The heaviest pair of tusks of the African elephant weighed 209.54 Kgms. (461 lbs.). Believed to originate from the Kilimanjaro region of Africa, these were purchased in Zanzibar, now Zambia, in 1900 and exhibited for some time by Tiffany & Co. of New York. The length of the large tusk was 307.34 cms. (10'1") along the outer curve, and its girth at the hollow end was 60.33 cms. (23".75). One of these

tusks is reported to be in the British Museum and its weight is 102.73 Kgms. (226 lbs.)

According to the Journal of Bombay Natural History Society, as quoted by Burke in his Indian Field Shikar Book, Sixth edition Pp. 46, the longest pair of tusks of an Indian elephant, *Elephas maximus* Linn., 1758 were measured as under according to the owner's measurements.

Tusk No.	Length	Max. girth
1.	3.0 m. (9' 10".5)	39.37 cms.
2.	2.9 m. (9' 6")	39.12 cms.

These were kept at the Royal Siamese Museum, Bangkok, Thailand.

The longest tusks belonging to the Asiatic elephant, *Elephas maximus* Linn., 1758 were recorded from the terai forests of Uttar Pradesh, India. These are at present in the personal collection of H.M. the Queen of England. Their dimensions are given below.

Tusk No.	Length	Max. girth
1.	266.70 cms. (8' 9")	55.50 cms. (21" 9")
2.	260.35 cms. (8' 6".5)	55.88 cms. (22" 0")

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