# Mammalian Fossil Fauna : a most modern tool for dating the Pleistocene deposits

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Archaeologists, as far as I understand, study man, his cultures and the tools which he prepared in various environments he lived during the prehistoric times. Within the span of this time he invented numerous techniques in the preparation of tools which matched properly with the environments. Thus for thorough understanding of the background for invention of various techniques, close study of the environment is a must, and for this the biota (fauna and flora), climate, soil/rock and morphology of the region are investigated comprehensively as the environment is the sum total of the effects of these forces among themselves. It has also to be investigated whether the numerous techniques evolved gradually in different parts of the world or they developed simultaneously in the same region or in far off areas; and for solving this the palaeontological and radiometric methods are very helpful. Thus, the field of archaeology appears wide enough to be studied by a group of scholars specialised in different branches mentioned above. The aim of the present paper is to throw light on how the knowledge of the mammalian palaeontology helps to determine the geological age of the Pleistocene deposits where tools may also occur at their factory sites or after being transported from there.

## HISTORICAL RUSUME

Leaving aside all that has been done on the Pleistocene, it will be appropriate to start from the work of De Terra and Paterson who tried to give a comprehensive account of India during the Pleistocene period by the study of glaciation, terrace formations, fluvo-lacustrine deposits, fauna, including early man, and the tools he used.[1] According to these authors the beginning of the Pleistocene period which is synchronous with the commencement of the first glaciation, is recognised in India at the base of the Tatrot beds, and other Indian Pleistocene deposits have been correlated after accepting it. This view is still held by many Indian archaeologists and palaeobotanists. But mammalian palaeontologists revised this view in the 18th International Geological Congress held in the Great Britain,[2] and agreed that Blancan

(USA), Villafranchian (Europe), Pinjaurs (India), and Djetis beds (Java) marked the beginning of the Pleistocene equivalently. Later, by a detailed study of the fauna and the lithology of the Upper Siwaliks, east of Chandigarh, it has been recognised that the Lower Boulder Conglomerate is equivalent to Gunz[3] and other Indian Pleistocene deposits have been correlated on this basis. Recently a new correlation chart of the Indian Pleistocene deposits has been given.[4] (Fig. 1)

## METHODS OF CORRELATION AND AGE DETERMINATION

The degree of fossilisation was sometimes considered as a valid criterion for distinguishing the old from the young age bed. But it has now been widely recognised that the fossils collected from the younger sandstone beds were more fossilised than those from the older clay beds. Even the degree of fossilisation in sandstone beds of the same age from different localities is not the same if the conditions for fossilisation at two places differ.

It has also been observed that with the passage of time flourine and nitrates, etc., gradually accumulate in the fossils. Thus it was presumed that the high percentage of these in the fossils collected from a bed would be older than the bed or beds whose fossils show low percentage of these. Later experience proved that the high or low percentage of these items does not indicate the geological age of the bed. On the contrary, it presents the high or low percentage of these items in the beds where the fossils come from.

Similar heavy mineral suits were used for correlating the beds. But it was discovered after considerable work that similar heavy mineral suits might be of different ages, whereas dissimilar heavy mineral suits might be of the same geological age. Thus, similar heavy mineral suits indicates similar source rocks rather than similar geological age.

Human artefacts have sometimes been used for determining the geological ages of the beds where they have been collected from. But it has been realised that they are not always *in situ* and mostly have come to rest there by way of transported material from factory sites.

K/Ar and $C^{14}$ methods are very useful to find out the exact age of the rocks, directly and indirectly despite some discrepancies. But $C^{14}$ method is not applicable for the rocks older than 60,000 years, and K/Ar method is unreliable for the rocks younger than 1,50,000 years[5], whereas the period from 1,50,000 to 60,000 years is very crucial for prehistorians. Under these circumstances only fossils can be helpful for

correlation of the rocks and other geological formations of this period.

PALAEONTOLOGICAL METHOD

The purpose of the palaeontological studies is to date the rocks in which the fossils are found, and consequently to correlate the rocks occuring far apart from one another. Invertebrate fossils are used for correlating the Palaeozoic formations, when evolution and dispersal of these animals were rapid, and vertebrate fossils were inadequently known. Mainly reptilian fossils are relied upon for the correlation of the Mesozoic formations, and invertebrate fossils serve as supplements. Tertiary and Quaternary formations are correlated mainly on the mammalian fossils, when their evolution and migration were very fast, whereas those of invertebrate (except for micro-fossil) and reptilian were almost constant.

Despite the fact that during the 19th century vertebrate fossils were the only reliable source to date the Mesozoic, Tertiary and Quarternary formations, geologists rarely used them for correlation, and mostly depended upon the invertebrate fossils. This was only because of the rarity of the vertebrate fossils. Besides, their detailed morphological study demanded more time which geologists of that period could not afford. Naturally, the study of the vertebrate fossils was taken up by zoologists who did not care for the localities and horizons which yielded the fossils. Ultimately, vertebrate fossils became show-pieces of museums practically without any correlative use. During the period, the knowledge of the vertebrate palaeontology was developing and refining; geologists, finding the invertebrate fossils inadequate, resorted to other methods for correlations mentioned above. But as has already been said, invertebrate and reptilian fossils are not useful for correlative purpose of the Pleistocene period. Palaeobotany of this period was also not much developed and refined for the determination of the age, except for ecological interpretation. Thus, in this connection, only mammalian fossils can be safely used since nearly all large forms of the Pleistocene period are thoroughly studied with respect to their temporal and spatial distribution.

A brief summary of how it has been achieved is given below with reference to Indian works only to maintain brevity.

In the first half of the nineteenth century vertebrate fossils were collected in India with great enthusiasm and their brief descriptions mostly appeared in the journals of the Asiatic Society of Bengal, but specific localities were not mentioned, and passing reference to the geological age was made. The last phase of this type of work is that of Falconer.[4] Lydekker[7] took up detailed description of the specimens

## Fig. 1. SUMMARY OF CHRONOLOGICAL PLEISTOCENE EVENTS IN INDIA

| AGE | DE TERRA & PATERSON (1939) | | SANKALIA (1962) | |
|---|---|---|---|---|
| | JAMMU & PUNJAB | CENTRAL INDIA | CENTRAL INDIA | |
| Holocene | T 5 | T 5 = Cotton Soil | Dry, New alluvium chalcolithic<br>Dry, silt (upper clay) Microlith & survival of Middle Palaeolithic tool type | |
| IV glaciation | T 4, loam silt and gravel. Reddish loam | T 4 = Pink clay (upper silt) | Wet, gravel (Upper gravel)<br>Middle Palaeolithic or late soan and rolled Lower Palaeolithic Abbevillio-Acheulian | Late Pleistocene |
| III inter-glacial stage | T 3, Degradation (Soan industry) | T 3 = sand (upper gravel) | Dry, silt (lower clay), developed Lower Palaeolithic. Fresh Acheulian Hand axes and Flakes | Middle Pleistocene |
| II glaciation | T 2, Potwar loessic silt, ± 350 ft. (Soan industry) | T 2 = Pink clay (lower silt) | Wet, gravel (lower gravel) Lower Palaeolithic Abbevillio-Acheulian | |
| II inter-glacial stage | T 1, Upper Terrace gravel (Chello-Acheulian and Early Soan Cultures) | T 1 = Conglomerate and sand (lower gravel) | Dry..... | |
| II glaciation | Erosion, tilting, Boulder Conglomerate zone ± 2000 ft. Boulder gravel in fan formation (oldest Flake industry) | | | |
| I inter-glacial stage | Pinjore zone ± 2500 ft. Pink silt and sand, Early Pleistocene fauna of Upper Siwaliks | | | Early Pleistocene |
| I glaciation | Tatrot zone, conglomerate and sand, Upper Siwalik fauna | | Wet, Primary laterite | |
| Early Pleistocene | | | | |
| Upper Pliocene | | | | |

| SAHNI & KHAN (1964) | | KHAN (1968) | |
|---|---|---|---|
| PUNJAB (Simla Hills) | NARMADA VALLEY | PUNJA (Simla Hills) | NARMADA VALLEY |
| T 5 | ? Break | T 5 | Black Cotton Soil |
| T 4 | Upper silt | T 4 | Narmada Channel = Hiatus |
| T 3 | Upper gravel | T 3 | upper silt<br>upper gravel<br>lower silt<br>lower gravel<br>(Lower & Middle Stone Age tools) |
| T 2 | lower silt | T 2 | lower gravel ? |
| T 1 | lower gravel | T 1 | ? |
| Upper Boulder Conglomerate | | Upper Boulder Conglomerate | ? |
| Break | | Hiatus ? | |
| Lower Boulder Conglomerate | | Lower Boulder Conglomerate | |
| Pinjaur | | Pinjaur | |
| Tatrot | | Tatrot | |

briefly described by earlier workers. He paid special attention to mentioning the localities but was not very careful about horizons. Pilgirm[8] was very particular of the horizons which yielded fossils. For this purpose he himself made fresh collections from the Potwar region and rejected all earlier collections which, in his opinion, were admixture of various horizons.[9] Thus, he. for the first time, established well founded correlation of the Siwaliks based on assemblage of fauna. Matthew[10] challenged the correlation put forwarded by Pilgrim, and emphasised that appearance of new species is a better criterion for correlation than that based on the assemblage of fauna, which indicates more of ecological environments rather geological age of the beds. Pilgrim modified his previous view to a great extent.[11]

Recently, the Upper Siwaliks around Chandigarh has been thoroughly investigated,[12] and for the first time a definite line of demarcation has been drawn between the Tatrots (Upper Pliocene) and Pinjaurs (Lower Pleistocene) on the basis of the appearance of new species. Very recently the author[13] visited the Narmada alluvial deposit, and also checked the fossils collected earlier from there. He has come to the conclusion that the age of the deposit ranged between 1,20,000 to 60,000 years, and the implements are unreliable to determine the geological age of the deposit since they are not at the factory sites but have been transported there from such sites. *In his opinion the Early Man reached Central India during the third glacial age.*[14]

The above conclusion has been drawn on the basis of mammalian fossils whose knowledge has been refined to such an extent that K/Ar data are checked with the age of the beds determined through mammalian fossils[15]

To elaborate the above point further it is better to explain it by the examples of some fauna fossils.

*Stegodon* :—The earliest species (*S. clifti*) of this genus is known from the Dhok Pathan stage (Middle Pliocene). This species is replaced by another advanced species (*S. insignis-ganesa*) during the upper Pliocene (Tatrots) and a further advanced species (*S. pinjorensis*) becomes common during the lower Pleistocene (Pinjaurs). Naturally, a more advanced species is expected from the Narmada alluvial deposit. But the species of *Stegodon* common in the Narmada fossil collection is recognised as *S. insignis-ganesa* whereas this is highly misleading. This is so only because the Narmada fossil collections have not been revised by any competent palaeontologist, and the result is that the mistake made in the early days has been repeated. It has been the practice during early days that new species were established on isolated teeth, whereas it has been proved beyond doubt that the characters of the skull should be

taken on the whole, and no over-emphasis be laid on the characters of the isolated teeth, which are subjected to variation depending upon the age, sex and individual variations.[16]. Clearly, till complete skull of *Stegodon* is unearthed from the Narmada alluvial deposit the fossils should not be identified beyond generic stage. Recently, it has been claimed that *Stegodon* did not exist during the period the Narmada alluvial deposit was laid down[17] but a molar of the genus has been collected by the same author from there (Geology Museum, Panjab University). Moreover, most of the photographs of the fossils have not been properly arranged by Khatri to show the characteristic features of the species or even of the genus.[18] I am of the opinion that we in India urgently need publications with detailed and correct study and more photographs than hitherto available.

*Hypselephas hysudricus*.—The earliest fossil of this species is known from the Pinjaurs (Lr. Pleistocene), and it seems that this genus originated from *Archidiskodon planifrons* which itself orginated during the lower part of the Upper Pliocene. A variant of *Elephas namadicus* has similar teeth characters as those of *H. hysudricus*, and the finds of isolated teeth compelled the earlier workers to recognise them as those of *H. hysudricus*. This mistake has been repeated since those days, and recently even the skull of *E. namadicus* has been incorrectly identified as *E. indicus*.[19] The author studied almost all the material in the British Museum, Museum of the Geological Survey of India, Geology Museum of Panjab University, and came to the conclusion that the teeth recognised as those of *H. hysudricus* actually belong to *E. namadicus*, after taking into account the morphological characters of the skulls on the whole to which teeth of such characters are attached, and the distribution of *H. hysudricus* and *E. namadicus* in space and time.

*Bovidae*.—The sub-family of Bovidae can be identified with some degree of certainty, even on the basis of isolated teeth. But it is nearly impossible to distinguish the genera of the same sub-family on the basis of such teeth. Till complete skulls are found, species of the same genus cannot be separated but it has been the general practice that all the specimens of bovids, found in the entire Narmada alluvial deposit are recognised as *Bos namadicus*, and even in a recent work[20] this has been followed. Thus it seems that the same species (*Bos namadicus*) persisted from the Middle to Upper Pleistocene without any specific change, whereas this, in general, is against the observations made world over about the mammalian fossil fauna of the Pleistocene period.[21] Unless all the specimens of *B. namadicus* in British Museum, Museum of Geological Survey of India and Geology Museum of Punjab University are restudied thoroughly, definite identification of incomplete skulls cannot be made.

The claim of Khatri[22] that the remains of *Bison* are found in the Narmada beds, is

FIG. 2. **SPECIES AND THEIR GEOLOGICAL RANGES**

| Species | Upper pliocene | Pleistocene | | | |
|---|---|---|---|---|---|
| | Tatrot | Pinjaur | 1st to 3rd glacial | 3rd Inter-glacial | 4th glacial |
| PRIMATES.— | | | | | |
| *Papio sub-himalayanus* | | | | | |
| *Presbytis sivalensis* | | | ? | | |
| *Presbytis entellus* | | | | | |
| CARNIVORA.— | | | | | |
| *Mellivora sivalensis* | | | | | |
| *Ursus namadicus* | | | | | |
| *Crocuta sivalensis* | | | | | |
| *Hyaena crocuta* | | | | | |
| PROBOSCIDEA.— | | | | | |
| *Stegodon insignis-ganesa* | | | | | |
| *Stegodon pinjorensis* | | | | | |
| *Stegodon (? namadicus)* | | | | | |
| *Mammuthus (Archidiskodon) planifrons* | | | | | |
| *Elephas (Hypselephas) hysudricus* | | | | | |
| *Elephas (Platelephas) platycephalus* | | | | | |
| *Elephas namadicus* | | | | | |
| RHINOCEROTIDAE.— | | | | | |
| *Rhinoceros sivalensis* | | | | | |
| *Rhinoceros karnuliensis* | | | | | |
| *Punjabitherium platyrhinum* | | | | | |
| *Rhinoceros deccanensis* | | | | | |
| EQIDAE.— | | | | | |
| *Equus sivalensis* | | | | | |
| *Equus namadicus* | | | | | |
| *Equus asinus* | | | | | |

| Species | Upper Pliocene | Pleistocene | | | |
|---|---|---|---|---|---|
| | Tatrot | Pinjaur | 1st to 3rd glacial | 3rd inter-glacial | 4th glacial |
| HIPPOPOTAMIDAE.— | | | | | |
| *Hexaprotodon sivalensis* | — | — | | | |
| *Hexaprotodon palaeindicus* | | | | — | |
| SUIDAE.— | | | | | |
| *Sus hysudricus* | — | — | | | |
| *Sus ( ? namadicus)* | | | | — | |
| CAMELIDAE — | | | | | |
| *Camelus sivalensis* | — | — | | | |
| GIRAFIDAE.— | | | | | |
| *Sivatherium giganteum* | | — | | | |
| BOVIDAE.— | | | | | |
| *Sivacobus palaeindicus* | | — | | | |
| *Hemibos triquetricornis* | | — | | | |
| *Hemibos acuticornis* | | — | | | |
| *Leptobos falconeri* | | — | | | |
| *Pre-bison debmi* | — | — | | | |
| *Bison sivalensis* | | — | | | |
| *Bos namadicus* | | | | — | — |
| *Bubalus platyceros* | | — | | | |
| *Bubalus palaeindicus* | | | | — | — |

baseless because it is based upon not only incorrect identification of the fossils but also author's inadequate knowledge of the distributton of *Bison* in space and time.

Now it should be clear that wrong identification of the specimen is wholly responsible for misleading determination of the geological ages of the deposits, whereas the correct identification gives extremely precise results.

GEOLOGICAL RANGE OF IMPORTANT INDIAN PLEISTOCENE MAMMALIAN FAUNA

It would be appropriate to mention here that the Siwalik Hills and Narmada Valley are famous for the mammalian remains of the Pleistocene period. Till very recently it was the general view that the remains of the mammalian fauna are found in India from the Lower to the Upper Pleistocene without any faunal break—the mammalian fauna of the Lower Pleistocene in the Siwaliks and those of the Middle and Upper in the Narmada alluvial deposits. But the author is of the view[23] that almost all the mammalian remains unearthed from the Narmada alluvial deposits are of the last interglacial age. *Thus, on the one hand, the mammalian fauna existing in India during the time from the first to third glaciation is unknown so far, and on the other hand, the fauna of the last glacial age is scantily recognised.* Till this knowledge is complete, actual geological ranges of the known Pleistocene mammalian fauna of India cannot be definitely found out. However, taking into account the origin, migration, evolution, distribution and geological ranges of the various mammalian fauna of the world, the geological ranges of the Indian Pleistocene mammalian fauna can be inferred with greater degree of precision by the experienced palaeontologists. For general guidance geological ranges of the various Indian mammalian fauna of the Pleistocene period is given below. (Fig. 2)

## NOTES

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