

MAMMALIAN FAUNAS AND CORRELATION OF TERTIARY AND EARLY PLEISTOCENE OF SOUTH CHINA*

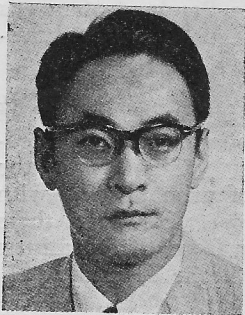
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ABSTRACT.—All the fossil localities of Tertiary and Early Pleistocene mammals so far known in South China are summarized. The characters of mammalian faunas and their comparison with their correlative ones in North China and in Southeastern Asia are briefly discussed. Preliminary remarks are made on some undescribed materials from the latest Eocene of Tientung, Kwangsi, of the *Dryopithecus* fauna of Kaiyuan, Yunnan and some others. Problems regarding the age of the recently discovered Hisatsaohwan fauna and *Gigantopithecus* are also discussed.

I. INTRODUCTION

THE occurrence of mammalian fossils in southern China was known as far back as Sir Richard Owen's time (1870). But with



the exception of a few miscellaneous teeth of dubious provenance recorded by E. Koken (1887) and Max Schlosser (1903) nearly all the fossil mammals known from South China before 1932 belong to the same wide distributed Middle Pleistocene *Stegodon-Ailuropoda* fauna (Sino-Malayan fauna of Von Koenigswald) of southeastern Asia, a situation contrasting strikingly with the richness and variety of materials found in other parts of Asia, particularly North China and India.

A few fragmentary mammalian teeth and bones found in the "Pliocene" Tsaichiachung beds of Chuching, Yuannan, as described by C. C. Young in 1932 are the first definite record of Tertiary mammals in South China though the geologic age of the fossil bearing marls is now known to be Oligocene instead of Pliocene (*vide infra*).

Nearly at the same time and in the subsequent years a number of localities with Tertiary or Early Pleistocene mammalian fossils were discovered and the fossils were

described by Granger (1932), Teilhard de Chardin and Young (1936), Young (1938, 1939, 1943, 1944), Bien (1939), Colbert (1940) and Mi (1943). Still recent discoveries were reported by Hooijer and Colbert (1951), Young (1955), and Chow and Hu (1956).

Early information has been partially summarized by Young and Bien (1932) and Colbert (1940).

The present paper is intended to give a summary review on this subject. The writer has incorporated in it some observations based on the unpublished materials at his disposal and personal opinions regarding some of the existing problems.

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II. EARLY TERTIARY MAMMALIAN FAUNAS

1. MIDDLE EOCENE *Propaleotherium* BEDS OF HENGYANG, HUNAN

In 1939 Young and Bien reported the occurrence of a fossil mammal in the "Red Beds" of Hengyang Basin, Hunan, the age of which had been a subject of much controversy among geologists. The fossil was

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preliminarily determined as *?Adapidium* sp., a problematic primate originally known from the Upper Eocene of Yuanchu in Southern Shansi. The specimen was later restudied by Young (1944) and proved to be a new species of palaeohippid perrisodactyle of the genus *Propaleotherium* to which the name *P. hengyangensis* Young was given. The age of the red beds was thus taken as Middle Eocene, being a correlative of the Lutetian Kuanchuang beds of Shantung, North China.

The single specimen of *Propaleotherium hengyangensis*, therefore, represents the oldest fossil mammal known in South China.

2. THE LATE EOCENE MAMMALIAN FAUNA OF LUNAN, YUNNAN

The red beds of Lunan Basin in Yunnan were formerly regarded as of Triassic age. In 1939 Young and Bien reported the occurrence of some Eocene mammalian fossils collected by them in 1937 and 1939. Additional discoveries have lately been made by geologists working in that district. Although the fossils collected therefrom are mostly very fragmentary, the following forms are present in the fauna.

- Creodont* indet.
- Amynodon* sp. (A. cf. *mongoliensis* Osborn)
- Cænolophus* sp. nov.
- Cænolophus* cf. *minimus* Matthew and Granger
- Deperetella* sp.
- Helelatidae* indet.
- cf. *Metatelmatherium* sp.
- Anthracotherium* sp.

3. THE LATEST EOCENE FAUNA OF TIEN TUNG, KWANGSI

One of the most interesting discoveries of Tertiary mammals made in China in recent years is the Eocene mammalian fossils found in Tientung and Tienyang district in eastern Kwangsi. The fossils are found in the conglomeratic sandy beds of Tientung series and are mostly fragmentary. The mammalian fauna consists of the following forms.

- Creodont* indet.
- Metatelmatherium* cf. *browni* Colbert
- Deperetella* sp.
- Paramynodon* cf. *birmanicus* (Pilgrim and Cotter)
- Anthracothema rubrica* (Pilgrim and Cotter)
- Anthracokeryx birmanicus* (Pilgrim and Cotter)
- Anthracokeryx* cf. *moritus* (Pilgrim)
- Tragulid indet.

It can be noted from the above list that practically all the recognizable species in the Tientung fauna are identical or closely comparable to those characteristic of the Pondaung fauna of Burma. The Pondaung sandstone of Central and Northern Burma is the best known Eocene mammal bearing beds in southeastern Asia. The fauna had been authoritatively investigated by Pilgrim and Cotter and more recently by Colbert (1943). The age of the Pondaung fauna is regarded as latest Eocene by the above-mentioned authors.

The Tientung fauna is similar to that of Pondaung in the abundance of anthracotheriid remains and differs from the latter in the absence of primates but with the presence of carnivore. However, these differences arise chiefly from the scantiness of materials, especially from Tientung.

According to the study of Colbert (1938) the Pondaung fauna is approximately equivalent to the Shara Murun fauna of Inner Mongolia. In this case it is difficult to explain the differences between the mammalian fauna of Pondaung and Tientung and that of Lunan which contains a mammalian assemblage that is quite similar to the distant Shara Murun fauna but differs decidedly from the geographically much closer Tientung fauna.

Before more and better materials are accessible the possible explanations seem to be that, on the one hand, the age of Tientung or Pondaung fauna is younger than that of Lunan which can be more closely correlated with the Shara Murun fauna, and that, on the other, probably the Pondaung and Tientung beds are deltaic deposits while the Lunan beds are typically basin deposits.

4. EUDINOCERAS BED OF YANGCHI, HUPEH

In 1939 Teilhard de Chardin and Young described a crushed skull of *Eudinoceras* cf. *knobolochiensis* Osborn from the Eocene Tunghu lacustrine beds of Yangchi, Hupeh. The genus *Eudinoceras*, originally recorded from the Upper Eocene Irдин Manha formation of Inner Mongolia is perhaps the most widely distributed Eocene mammals of China. The locality at Yangchi marks the southernmost limit of its distribution. The relationship between the mammal bearing horizon of the Tunghu series and the other late Eocene localities in Kwangsi and Yuannan is unknown, but it seems older than the latter according to the established faunal sequence in Mongolian region.

5. EOCENE LOCALITY AT SINYU, KIANGSI

Some time ago some teeth fragments of an *Eudinoceras*-like amblypod together with shell fragments of a large *Amyda* and *Anosteira* were collected from Sinyu, Kiangsi province. This represents the first record of the presence of possible Eocene vertebrates in that province.

6. EARLY OLIGOCENE MAMMALIAN HORIZON OF CHUCHING, YUANNAN

In his report on some fossil mammals from the Cenozoic of Yunnan, Young (1932) described a fragment of lower molar tooth from the Tsaichiachung beds of Chuching in eastern Yunnan. The specimen was identified as *Merycopotamus* sp. and the age of the tooth bearing beds as Early Pliocene. Later in the review of Tertiary mammalian horizons of South China Young and Bien (1939) after examining some additional fossils collected by the latter author in 1937 from the Tsaichiachung marly beds reached the conclusion that "it is probably correct to regard the Tsaichiachung beds of Chuching as lower Oligocene in age and comparable to the Ardyn Obo formation of Mongolia". The correlation was based on the finding of some fragmentary teeth of *Cadurcodon* cf. *ardynense* Osborn in the fossiliferous marly beds. The present writer has re-examined the original tooth fragment described by Young as *Merycopotamus* sp. and found it to be very close to the Oligocene genus *Bothriodon* the age of which is in accord with that of *Cadurcodon*.

LATER TERTIARY MAMMALIAN FAUNAS

1. LATE MIOCENE ANCHITHERIUM BEDS OF FANHEUSHAN, NANKING

Fossil mammals of Miocene age have been unknown in South China before. Last year a lower jaw of *Anchitherium aurelianensis* (Chow and Hu, 1956) and some fragmentary teeth of small traguloid remnants were discovered from the Tonghsuankwan beds at Fanshan near Nanking. As *Anchitherium aurelianensis* is characteristic of the late Miocene of Europe and Tung Gur formation of North China, the fossiliferous beds at Fanshan represent the first and so far the only Miocene mammalian horizon known in Southern China.

2. EARLY PLIOCENE *Dryopithecus* FAUNA OF KAIYUAN, YUNNAN

The occurrence of Late Miocene or Pliocene mammals in Kaiyuan, Yunnan, was first reported by Young and Bien in 1939 when some teeth of *Chleuastocheerus* cf. *stehlini* Pearson were identified from the lignite beds at Hsiaolungtan in that region. In the recent years the present writer has gathered a number of mammalian fossils collected by geologists working there. At least the following mammalian forms can be recognized in the collection.

Dryopithecus kaiyuanensis Woo

Tetralophodon sp.

Serridentinus cf. *chinjiensis* Osborn

Rhynchotherium sp.

Suidae indet.

Of these fossils *Dryopithecus* has been described by J. K. Woo (1957) as a new species named *D. kaiyuanensis* which is very close to the Indian species *D. punjabicus* Pilgrim from the Chinji and Nagri zones of Siwaliks. Among the proboscideans *Serridentinus* cf. *chinjiensis* Osborn is almost indistinguishable from the type specimen of the Siwaliks. The teeth reported by Young and Bien may also be related to one of the many fossil suids found in the Siwaliks instead of that of *Chleuastocheerus* which is more typical of Pontian of North China.

The more significant feature of the mammalian fauna of Kaiyuan is its affinity with the Siwaliks. This is natural in view of their geographic contiguity but seems to have been overlooked by previous authors

(Young and Bien, 1939). The Kaiyuan fauna which without much doubt may compare with or even belong to the same fauna of the Chinji or Nagri zone of Siwaliks is apparently different from the *Hipparion* fauna of North China of which the plain and steppe type mammals are dominant. On the other side meanwhile in the south, forest type mammals predominate.

The differentiation of mammalian fauna into southern and northern ones in China seems to have begun before the close of Eocene; it only became more pronounced from Pontian onwards in connection with the uplifting of the principal Cenozoic mountain ranges and topographic and climatic changes coupled with it which came to be effective barriers for freer faunal intermigration. But even then and afterwards, migration between the South and the North though somewhat more limited, still did exist by way of thoroughfare along the southern and eastern coastal regions. For instance, in the Middle Pleistocene *Sinanthropus* fauna of Choukoutien the Peking Man itself is a Southern element present in northern fauna.

3. CAVE AND FISSURE DEPOSITS OF SZECHUAN AND FUKIEN WITH MASTODONT REMAINS

While studying some new fossils from Wanhsien, Szechuan, Young (1939) described a milk molar of *Mastodon* sp. brought to him by some natives and presumed that some fissure deposits older than that of the classical Middle Pleistocene Yenchingkuo localities might be in existence in the region. In a recent note Hooijer and Colbert (1951) describe a molar tooth of *Synconolophus* sp. in the Chicago Museum of Natural History which is supposed to come from the same general region, and the age of which is taken by the authors as late Miocene or Pliocene.

The writer has in his possession a last molar tooth of *Trilophodon* from Wushan, a neighbouring district of Wanhsien, and a molar fragment from the cave deposits of Fukien related evidently to the same mastodont genus *Synconolophus*. From all these data it seems clearer than ever that there exists in the caves and fissures of South China a Late Miocene or Early Pliocene mammalian fauna with distinct Siwalik affinity. It may

probably belong to the same *Dryopithecus* fauna as that of Yunnan,

EARLY PLEISTOCENE OR LATE PLIOCENE FAUNAS

1. GIGANTOPITHECUS FAUNA OF KWANGSI

The latest discovery of the three teeth and two fairly complete lower jaws from the cave deposits of Tahsin and Liuchen districts by Pei has solved at least partially the long suspended problems on the provenance and age of *Gigantopithecus*. The newly discovered material has been preliminarily reported by Pei and Woo (1956) and Pei (1957). The remains of *Gigantopithecus* from both Tahsin and Liuchen are reported to have been found in association with fossils of *Stegodon-Ailuropoda* fauna of Middle Pleistocene age. The fauna of Liuchen apart from *Gigantopithecus* consists of *Sus* sp., Cervids (two species), *Tapirus* sp., *Stegodon* sp., *Rhinoceros* sp. and *Mastodon* sp.

With all these new facts coming into light the long debated problem of *Gigantopithecus* instead of being clarified seems to be only getting more complicated. It appears to the writer that *Gigantopithecus* is probably not a component element of *Stegodon-Ailuropoda* fauna as it is generally thought to be. Rather it belongs to a distinct fauna to which the name "*Gigantopithecus* fauna" may be applied, and the age is in all probability older than that of *Stegodon-Ailuropoda* fauna, namely, Early Pleistocene (Villafranchian) or even earlier. The reasons are briefly as follows:

In the first place, the age of nearly all the mammalian genera found in association with *Gigantopithecus* as listed by Pei (1957) can be anywhere from Latest Middle Pliocene to Middle Pleistocene. The invariable smallness in size of the teeth of tapirs and deer and the presence of the tooth of *Mastodon* sp. is noteworthy. On the other hand, the mammalian fossils of *Stegodon-Ailuropoda* fauna have been intensively and extensively investigated for many years. To date more than twenty localities with abundant remains typical of the fauna have been recorded and a number of them have been more or less systematically excavated. But no trace of either

Gigantopithecus or "Mastodon" has been encountered. And all the known examples of the latter are of unknown sources, and are now considered to be definitely from the older deposits. (*vide supra*)

Stratigraphically the deposits which yield the remains of *Gigantopithecus* both at Tahsin and Liuchen are found in the caves at a height of more than ninety meters above the local ground level; while the caves with fossils of *Stegodon-Ailuropoda* fauna are generally found but a few meters above the local ground level (Teilhard de Chardin *et al.*, 1935). Furthermore, the cave deposits with fossils of *Gigantopithecus* are hard reddish travertine beds instead of the yellowish silty or clayey sediments as is generally the case with *Stegodon-Ailuropoda* fauna.

All this alludes to the fact that *Gigantopithecus* belongs to a fauna distinct from the *Stegodon-Ailuropoda* fauna and is older than the latter in age, that is Early Pleistocene or Latest Pliocene.

2. THE HSIACHAOHWAN FAUNA OF KIANGSU

Another interesting and important recent discovery in connection with the study of fossil mammals of China is Pleistocene mammal found at Hsiachaohwan in northern Kiangsu (formerly Anhwei). The stratigraphy of the locality was reported by Young and Chow (1955). The mammalian fossils have partly been described by Young (1955) and the study of the remaining collection is being carried out by the writer.

The age of the fauna is taken as Middle Pleistocene in view of the presence of a new species of giant beaver (*Trogontherium sinensis* Young) related to *T. cuvieri* which has also been recorded in *Sinanthropus* fauna at locality 1 of Choukoutien to which the Hsiachaohwan fauna was compared. According to the preliminary determination of the writer the mammalian fauna consists of:

- Trogontherium sinensis* Young
- Cervidae indet.
- Rhinoceros* sp.
- Stegolophodon* sp.
- Archidiskodon* sp.

As can be noted from the above list, the Hsiachaohwan fauna is above all significant, because it shows a mixture of northern and southern elements. This can be reasonably

expected when its geographical position is taken into consideration.

The presence of *Stegolophodon* and *Archidiskodon* which are characteristic of the Early Pleistocene of southeastern Asia indicates that the age of the Hsiachaohwan beds is older than that of *Sinanthropus* locality at Choukoutien as previously thought. It is more probably a correlative of the Nihowan North China and Upper Irrawaddies of Burma in Southern Asia.

3. EARLY PLEISTOCENE DEPOSITS WITH *Equus*, *Archidiskodon*, etc.

The *Equus* Beds of Yuanmo Basin ("Ma Kai") is the first known locality in South China with a definitive early Pleistocene (Villafranchian) mammalian fauna. The mammal bearing beds of Yuanmo was first explored by Granger in 1926 and was later revisited by Bien (1939). The fossils collected by Granger were studied by Colbert (1940) who lists the fauna containing *Stegodon* sp., *Rhinoceros* sp., *Equus yunnanensis* Colbert, *Sus* sp., *Cervus* sp., *Bos* (*Bibos*) (?) sp. and chelonian. The tilted silty beds containing the fossils are correlative in age with the Upper Irrawaddy beds of Burma and the Nihowan lacustrine deposits of North China.

Other mammalian localities in South China comparable with Yuanmo are: the tin bearing gravels of Papu and Hohsien in Kwangsi with *Stegodon preorientalis* Young (Young, 1938, Young and Mi, 1941), of Kochiu in Yunnan with *Equus*, and of Chungshan in Kwangsi with *Archidiskodon* cf. *planifrons* (Mi, 1943).

SUMMARY

It is evident from the preceding accounts that some important progress has been made in the recent years in the study of Tertiary and Early Pleistocene mammals of South China. The materials summarized in Table I and the fossil localities sketched in the accompanying map (fig. 1) may represent the present status of our knowledge on this subject. In comparison with the data outlined by Young and Bien in 1939 the following points may be given as supplements.

1. Tertiary mammalian horizons which are formerly unknown: Middle Eocene with *Propaleotherium*, Uppermost Eocene with Pondaung fauna, Upper Miocene with *Anchitherium*.

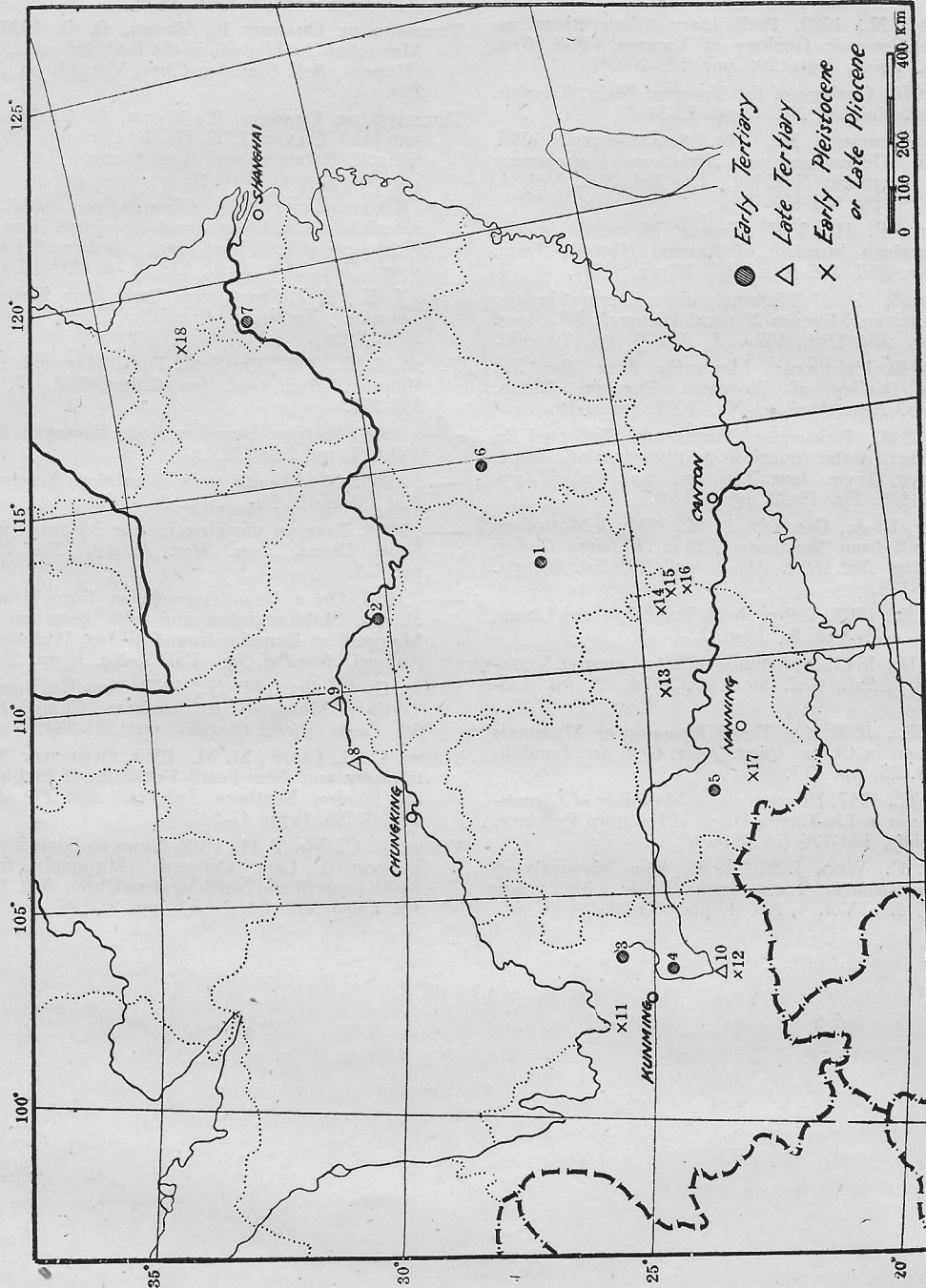
2. New localities in the provinces where Tertiary or early Pleistocene mammals were formerly unknown: Eocene fauna of Kwangsi and Kiangsi Miocene and early Pleistocene of Kiangsu, Pliocene of Fukien, etc.
3. Faunas formerly thought to be more directly related with those of North China but now showing definite southern affinities: *Dryopithecus* and *Equus* beds of Yunnan.
4. Faunas the geologic age of which are doubtful: *Gigantopithecus* fauna of Kwangsi, Hsiachaohwan fauna of Kiangsu. They are of early Pleistocene age rather than Middle Pleistocene.

POSTSCRIPT

Since the manuscript of this paper was finished in 1957, a series of new discoveries have been made. The more important ones are: the discovery of the primitive entelodont *Eoentelodon yunnanense* from the Upper Eocene of Lunan, Yunnan; the occurrence of an early Oligocene mammalian horizon with *Baluchitherium* (a more primitive small form) and *Brachyodus*; and the discovery of the fossil remains of Indian elephant in the Pleistocene cave of the Yangtze Gorge District. Besides, the opinion expressed in this article that *Gigantopithecus* fauna is most probably of early Pleistocene age becomes clearer in the light of the new materials discovered since then.

Geologic Age	Mammalian Fauna of Horizon	Correlatives
Early Pleistocene	<i>Stegodon - Equus</i> beds (Yuanmo and Kuchiu in Yunnan; Papa, Hohsien Chungshan in Kwangsi). Hsiachaohwan fauna with <i>Trogotherrium</i> , <i>Stegolophodon</i> , etc. (Kiangsu)	Nihowan (N. China) Upper Irrawaddies (Upper Burma)
Early Pleistocene (or Latest Pliocene)	<i>Gigantopithecus</i> fauna (Kwangsi)	?
Early Pliocene	<i>Dryopithecus</i> fauna (Yunnan); Cave and fissure deposits with <i>Trilophodon</i> , <i>Synconolophus</i> (Szechuan and Fukien)	Chinji zone of Siwaliks (India), <i>Hipparion</i> red clays (North China)
Late Miocene	<i>Anchitherium</i> Bed (Kiangsu)	Tung Gur (Inner Mongolia)
Early Oligocene	Tsaichiachung Marls with <i>Cadurcodon</i> , <i>Botheriodon</i> , etc. (Yunnan)	Ardyn Obo (Inner Mongolia)
Late Eocene	Tientung Sandstone with Pondaung fauna (Kwangsi); Lunan beds with <i>Caenolophus</i> , <i>Amynodon</i> , etc. (Yunnan) <i>Eudinoceras</i> Beds (Hupeh); Eocene mammalian locality (Kwangsi)	Pondaung Sandstone (Burma) Shara Murun (Inner Mongolia) Irdian Manha (Inner Mongolia)
Middle Eocene	<i>Propaleotherium</i> beds (Hunan)	Kuanchuan series (N. China)

Sketch map showing geographical distribution of fossil localities mentioned in the text.



TEXT FIG. 1

- Explanation : 1, Hengyang; 2, Yangchi; 3, Chuching; 4, Lunan; 5, Tientung; 6, Sinyu; 7, Nanking
 8, Wansien; 9, Wushan; 10, Kaiyuan; 11, Yuanmo (Ma | Kai); 12, Kachiu
 13, Luichen; 14, Chungshan; 15, Hohsien; 16, Papu; 17, Tahsin; 18, Hsiachaohwan.

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