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NEW RECORDS OF MAMMALS FROM THE MIDDLE PLEISTOCENE OF SANGIRAN, CENTRAL JAVA

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Collections of fossil vertebrate remains from the Sangiran area in Java have recently been presented to the Rijksmuseum van Natuurlijke Historie by Mr. H. R. van Heekeren and by Mr. J. H. Houbolt. They form a most welcome addition to the Museum collection of fossil vertebrates made by Eugène Dubois in Java in the 1890's; Sangiran is a site known to but not collected at by Dubois. We are grateful to Messrs. Van Heekeren and Houbolt for their generous gift to the Museum; the more important specimens in the Sangiran collection will be the subject of the present note.

The Sangiran dome (for the geology of the area see Van Es, 1931: 55-68, and Von Koenigswald, 1940: 26-39), situated approximately 12 km north of Solo (Soerakarta) between the Kali Brangkal and the Kali Tjemoro in Central Java, has been extensively collected at by Dr. G. H. R. von Koenigswald during the 1930's. The cranial and mandibular remains of hominids retrieved from this site between 1936 and 1941 by that indefatigable collector rank among the most important fossil hominid specimens ever found in Asia. In the course of his investigations in Java Von Koenigswald established a succession of faunas two of which, the Djetis and the Trinil fauna, are of special interest here as both do occur at Sangiran. The former has been assigned a Lower Pleistocene age, the latter a Middle Pleistocene age by Von Koenigswald; it is even possible that the Sangiran succession extends downward to include an earlier fauna, the Kali Glagah (originally placed in the Upper Pliocene by Von Koenigswald), as a molar fragment of the mastodont described by Van der Maarel (1932) as *Tetralophodon bumiajuensis* has been recovered, too (Von Koenigswald, 1940: 30). This mastodont, considered characteristic of the

Kali Glagah fauna, and of that fauna only, unfortunately had not been found in situ but is a washed-out specimen as are most of the Sangiran fossils including the hominids (Von Koenigswald, 1940: 38).

In the Sangiran collection now available there is no mastodont, but there is a new species of *Lepus,* and there are a number of specimens that add to our knowledge of several faunal elements thus far little known, or that fill in gaps in dental series already described before. Therefore, it would seem worth while to devote a note to the Sangiran specimens of Messrs. Van Heekeren and Houbolt. Whether they are derived from the black clays of the Poetjangan (Djetis) Beds or from the Kaboeh sands and conglomerates (Trinil Beds) is not known, with the sole exception of one specimen in the Van Heekeren collection that comes from the Trinil Beds at Sangiran. However, the present consensus of palaeontological opinion is that the Djetis Beds, although underlying the Trinil Beds and therefore geologically older, nevertheless on account of their faunal content belong to the same Middle Pleistocene *Stegodon-Ailuropoda* complex as do the Trinil Beds. The analysis of the fauna of the Djetis layers has shown that its maximal age is early Middle Pleistocene, post-Villafranchian (Hooijer, 1962; Kahlke, 1962; Kurtén, 1962; Kurth, 1962).

In his contribution to the same Festschrift Von Koenigswald (1962) prefers to voice his old view. Not relying on faunal evidence, as alone we should, he now offers some Potassium-Argon dates. One is from a basalt at the Moeria volcano in northern Central Java, in a complex that also contains tuffs with Trinil fauna, and the other is from a number of tektites found in the south-east Asian-Australian area (not in Java). Tektites, however, had been noticed in the upper layers at Sangiran that are poor in fossils but allegedly of Trinil age. The assumption is that the Australasian tektites are contemporaneous, and hence would offer a means of dating the Trinil Beds with *Pithecanthropus* (and *"Meganthropus"*). Averaging the results, Von Koenigswald arrives at an age of 610,000 years (the dates actually determined range from about 510,000 to 690,000 years). The Trinil Beds are placed at the bottom of the Middle Pleistocene, and figured as equivalent to early Günz through late Mindel. The implication, then, is that the Djetis Beds are Villafranchian, i.e., Early Pleistocene. The weaknesses in this line of thought are, first of all, the foregoing of the all-important principle in mammalian palaeontology and correlation that the fauna is the criterion, not celestial bodies of spurious origin and out of context, and a geological dating technique of great potential accuracy that has not yet outgrown its teething troubles. The method should be applied to primary matrix of the fossils to be dated (see below, p. 82).

Then, the far-fetched procedure of relating the Java sequence to that of Alpine glacials, about which enough has been said in the 1962 papers cited above. The Villafranchian has not been reliably K/A dated yet, but interpretation of available data suggests a time-range between 1.8 and 1.0 million years ago, long before the onset of the Günz glaciation.

As more material is becoming available for study from the type localities of the Djetis and the Trinil fauna (Djetis, near Modjokerto, East Java, and Trinil on the Kali Solo west of Ngawi, Central Java) the similarity between the two faunas becomes increasingly clear, although the Djetis fauna has a lower percentage of living forms than the Trinil. The hominid „*Meganthropus*", which is the australopithecine *Paranthropus* (Robinson, 1953, 1955), regarded by Von Koenigswald as confined to the Djetis Beds, also occurs in the Kaboeh Beds as the 1952 mandible shows (Robinson, 1962: 127), and hence forms part of both faunas, as does *Pithecanthropus*. In most cases there is even specific identity between the mammals, and often the Djetis form is characterized by its larger size, suggestive of a subspecific difference from the Trinil form only. In general, however, incompleteness of the palaeontological material prevents such fine distinctions between two or more samples from being made, and our subspecies usually parade in the guise of species or even distinct genera. There is no need here to go into this problem, so admirably dealt with by Simpson (1943); I only wish to record one recent example, viz., that of the Djetis antelope named "*Antilope modjokertensis*" by Von Koenigswald (1934: 192). Based on teeth that are slightly larger than those of *Duboisia santeng* (Dubois) from Trinil, and without any horn cores available, the Djetis antelope (known from Djetis as well as from Sangiran) could serve as a distinctive element to the Djetis fauna until it was found that *Duboisia* horn cores do occur in true Djetis Beds, and that the range in size of the *Duboisia* teeth from the Trinil Beds proper includes the Djetis sample (Hooijer, 1958: 8-18). We might now denominate the Djetis antelope *Duboisia santenq modjokertensis* (Von Koenigswald), and the Trinil antelope *Duboisia santeng santeng* (Dubois), the former being of larger average size than the latter; at any rate I have lumped "*Antilope modjokertensis*" with *Duboisia santeng* as there is nothing for it but to consider them conspecific.

Order Primates Linnaeus

CERCOPITHECIDAE Gray

Macaca fascicularis (Raffles) subsp.

Arboreal monkeys are not very abundant as fossils, but macaques at least are better represented than are the leaf-monkeys. Only one tooth of a macaque was present in the Selenka Expedition collection made at Trinil (Stremme, 1911).

Two isolated teeth in the Houbolt collection from Sangiran represent M^2 sin. and M^3 dext. The M^2 is much worn down, and the full length cannot be given; its width is 8.5 mm, just within the recent range (7.0-8.6 mm for ♂♂: Hooijer, 1962a: 53). In a palate in the Dubois collection from Bangle M^2 is even 9.4 mm wide. The M^3 is unworn with the base of the crown incomplete. It is at least 7.7 mm wide, within the range of its recent homologues (6.5-8.5 mm: Hooijer, 1962a). An M^3 dext. from Trinil (Coll. Dub. no. 3792) is likewise unworn and closely agrees in crown structure, the four cusps being only slightly more closely set; this is a tooth that measures 6.7 mm in width only.

The present specimens are undoubtedly conspecific with the living Java macaque, *Macaca fascicularis mordax* Thomas & Wroughton; the only difference between the Pleistocene material thus far recorded from Java and the recent specimens is one of size, the fossil macaque averaging somewhat larger than the living.

Order Lagomorpha Brandt

LEPORIDAE Gray

Lepus lapis n. sp.

Diagnosis: Teeth larger than in either *Lepus nigricollis* F. Cuvier of Java or *Nesolagus netscheri* (Schlegel) of Sumatra, differing from the former in P_3 having a more marked postero-internal angle, and from the latter in P_3 having an anterior median groove.

Holotype: The P_3 sin. described and figured in the present paper.

Paratype: The I^1 dext. of the present paper.

Locality: Sangiran, ca. 12 km N. of Soerakarta, Central Java.

Age: Middle Pleistocene.

In the Houbolt collection there are two teeth of a large hare. This is an extremely rare element to the Pleistocene fauna of Java; there is no material of *Lepus* in the Dubois collection, and Von Koenigswald (1940: 56, pl. 3 fig. 7) mentions only incisors from Sangiran equalling those of *Lepus nigricollis* F. Cuvier of Java, as well as the presence of an undescribed larger leporid with premolars more complicated in structure.

The upper incisor is preserved for a length of 8 mm including the worn edge; it has a longitudinal groove on its anterior face placed at one-third of the width from the median angle. It is 4.2 mm wide and 2.8 mm thick labiolingually. The P_3 (fig. 1), 14 mm high as preserved, has a sharp median groove in the narrow anterior portion. On the external surface, behind a shallow anterior fold, there is a very narrow and long posterior fold, extending almost entirely across the tooth. The posterior enamel wall of this fold is finely crenulated. On the internal surface there is an anterior fold, extending half way across the crown. The postero-internal angle of the crown is well-marked.

I have compared the present fossil specimens with their homologues in the two surviving hares of the Malay Archipelago, and found that they agree with *Lepus nigricollis* F. Cuvier except in size (table 1) and the more marked postero-internal angle to the crown of P_3 in the fossil. This slight development of the postero-internal angle is characteristic of most of the *Lepus* specimens of P_3 I have seen. On the other hand, in *Nesolagus netscheri* (Schlegel) of Sumatra (table 1) the P_3 does have a well-marked postero-internal crown angle, as in the fossil, but the recent specimens lack the characteristic anterior median fold of the *Lepus* pattern, and in addition are smaller and relatively shorter anteroposteriorly.

Fig. 1. *Lepus lapis* nov. spec., occlusal pattern of P_3, × 5.
W. C. G. Gertenaar del.

TABLE 1

Measurements of I^1 and of P_3 in *Lepus* and *Nesolagus* (mm)

	Lepus lapis	*Lepus nigricollis*, Leiden Museum, cat. ost.							
		a	b	c	d	e	f	g	h
I^1, width	4.2	2.3	2.5	—	3.4	2.8	2.7	2.8	2.7
P_3, length	5.0	3.4	3.6	3.8	—	4.1	3.9	4.2	3.8
width	4.3	2.6	3.0	3.5	—	3.3	3.1	3.4	3.0

	Nesolagus netscheri, Leiden Museum, reg. nos.						
	680	1013A	1013B	1013C	5522	12433	12434
I^1, width	3.2	3.1	3.0	2.8	2.7	2.6	3.2
P_3, length	3.0	3.1	3.2	2.8	3.0	2.9	3.1
width	3.1	2.9	2.9	2.6	2.7	2.7	2.9

Fortunately, the P_3 plays an important rôle in the classification of the Leporidae (Dice, 1929; Kormos, 1934; Schreuder, 1936; Bohlin, 1942; Hibbard, 1963), and it is perfectly clear that, although in size *Lepus lapis* exceeds the living Eurasiatic forms, the structure of P_3 is that of a *Lepus*.

The Middle Pleistocene *Lepus wongi* Young of Choukoutien (see Teilhard de Chardin & Pei, 1941) does exceed the living northern Chinese *Lepus europaeus tolai* Pallas, and even *Lepus oiostolus* Hodgson in size, and approaches that of the fossil Java species. In the more rounded postero-internal angle of the crown the recent as well as the fossil species appear to differ from *Lepus lapis*, but there is some amount of variation in this, too; and in some *Lepus* specimens, most clearly so in *L. timidus* L., Leiden Museum, cat. ost. b, I find good agreement with the Sangiran P_3 in the marked development of that angle.

The material available at this moment does not allow of deciding to which of the living forms of *Lepus* the fossil Sangiran form is most closely allied. The occurrence in Java, beyond the actual range of *Lepus* (*L. nigricollis* has long been believed to be but a human introduction from India or Ceylon, and is confined to the western part of the island anyway), and in a Middle Pleistocene deposit, would seem to entitle it to distinct subspecific rank at least. For convenience, the Sangiran form is here described as a distinct species; it may be lowered to subspecific status if and when its relationships to the living or fossil *Lepus* species have been worked out on the basis of more dental and cranial material.

Order Carnivora Bowdich

HYAENIDAE Gray

Hyaena brevirostris bathygnatha Dubois

An entire P_3 dext. and the anterior portion of an M_1 dext. belong to the species *Hyaena brevirostris* Aymard, originally described from the Pleistocene of Java as *Hyaena bathygnatha* Dubois (1908: 1265). Kurtén (1956: 39) has placed the Java form in *H. brevirostris*, and comparison of the Sangiran teeth in the Houbolt collection with those in the Dubois collection (described by Brongersma, 1937) does not reveal any significant structural differences.

The P_3 from Sangiran is 23.2 mm long and 16.1 mm wide, intermediate between two specimens from Kebon Doeren (Brongersma, 1937: 188). The M_1, 15.5 mm wide, is 1.0 mm wider than one from Kebon Doeren (Brongersma, 1937: pl. 13 fig. 15) of which, likewise, the anterior portion only is preserved.

The present hyena, which according to Von Koenigswald (1940: 56) would be confined to the Djetis Beds, is the only well-founded form of its kind known from Java; a smaller species, poorly represented and occurring in the Djetis, too, has been mentioned but not described by Von Koenigswald (1940:

58). It would be of great interest to see if this is perhaps a *Crocuta,* which appears to have ousted *Hyaena brevirostris* throughout its range in Eurasia and Africa sometime in the late Cromerian (Kurtén, 1957: 224), later corrected to Elster (= Mindel) II (Kurtén, 1959: 174).

FELIDAE Gray

Felis tigris groeneveldtii Dubois

Three teeth, P_3, P_4, and M_1, all from the left side and with the roots broken off, evidently belong together and to the tiger; they have been collected at Sangiran by Mr. J. H. Houbolt. All are within the limits of size found for fossil Java tigers (table 2, after Hooijer, 1947). In the recent subspecies of the island, *Felis tigris sondaicus* Temminck, the teeth do not attain the maxima found in the Pleistocene *Felis tigris groeneveldtii* Dubois (1907: 454). The synonymy of this Middle Pleistocene form of tiger in Java is rather involved, but has been fully worked out by Brongersma (1935: 47, 48).

TABLE 2

Measurements of teeth of *Felis tigris* L. (mm)

		Java	
	Sangiran	fossil	recent
P3, length	16.2	15-19	13.5-16.3
width	8.0	7.3-10	7.0- 8.0
P4, length	23.4	22.0-28.5	19.7-22.9
width	12.1	10.8-14	10.0-10.5
M1, length	25.4	23.8-30	22.1-25.3
width	14.1	12.1-16	11.8-13.0

Felis pardus L. subsp.

A left P_3-M_1 in situ in a mandibular fragment found at Sangiran by Mr. J. H. Houbolt represent a large panther. Measurements (table 3) show

TABLE 3

Measurements of teeth of *Felis pardus* L. (mm)

	Sangiran	Recent, Java
P3, length	13.4	9.6-12.8
width	7.4	5.1- 6.3
P4, length	18.6	14.3-18.3
width	10.0	7.2- 9.0
M1, length	21.8	14.6-18.5
width	10.4	6.9- 8.3

that the fossil specimen has teeth larger than those in the recent subspecies of Java, *Felis pardus melas* Cuvier; the ranges in length and width are those obtained from a series of fourteen skulls in the Leiden Museum, in part recorded by Brongersma (1935: 74).

It seems obvious that the Pleistocene panther of Java is not subspecifically the same as that now living on the island; it is larger. This also applies to the metapodials and a humerus found fossil in Java (Hooijer, 1947: 11 footnote 1). A fossil mandible from Sangiran II (Trinil fauna) recorded by Von Koenigswald (1934: 193, pl. 4 fig. 2) appears to be even larger than the specimen now at my disposition: it has a length P_3-M_1 of 56 mm whereas in our specimen this length is 51.5 mm (37.5-47 mm in the recent). However, in the fossil jaw recorded above P_4 and M_1 overlap to a slight extent, the premolar extending backward buccally beyond the anterior end of the carnassial, as it does in recent jaws as well. In the jaw figured by Von Koenigswald there is a small diastema between these teeth, which accounts for the greater overall length of the teeth. *Felis* cf. *pardus* of the Middle Pleistocene of China (Choukoutien, loc. 1: Pei, 1934: 137) has teeth of greater dimensions, and rather large teeth are also known from the Middle Pleistocene of Europe (Hooijer, 1961: 31 [1])).

At any given time since the emergence of the species *Felis pardus* in Eurasia and Africa in the early Middle Pleistocene (Cromerian) there must have been geographic subspeciation throughout its range, and micro-evolutionary advance in situ, as well as migrations back and forth probably. Every local population of which we have a sample is somewhat different from every other, and many subspecific names could be bestowed on them. No previous name is available for the Pleistocene Java panther; perhaps it is best to leave it unnamed until a better sample has been made available.

Order Proboscidea Illiger

ELEPHANTIDAE Gray

Stegodon trigonocephalus Martin subsp.

This is the most common species of stegodont of Java; it is smaller than the continental *Stegodon insignis* (Falconer & Cautley) which is nearly related to it, and which occurs in the Early as well as in the Middle Pleistocene of India. Molars indistinguishable from either one of these species (the skulls are distinguishable) have turned up in the Middle Pleistocene of the Near East (Israel: Hooijer, 1960; Syria: Hooijer, 1962b), indicating

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1) I may correct here a misprint in that paper: the figures 15.4 (length) and 8.0 (width) in table 11, columns under P^3 (Ksâr'Akil 11.50, F5), belong under P_3 instead.

the very wide range this stegodont once occupied in Asia. Of course we do not know, and never will, whether the fossil "species" of *Stegodon* were noninterbreeding entities. If this neozoological criterion could be established we would not need morphological criteria (cf. Mayr, 1955). The Near Eastern form of *Stegodon* I have named *Stegodon mediterraneus* as this seemed to me to be the most gainful and convenient procedure; it may eventually turn out to be but a terminal population in the range of the southeastern Asiatic species the earliest available valid name of which is *Stegodon insignis* (cf. Hooijer, 1955: 13).

The dentition of the Java stegodont is well known except for a tiny tooth, the anterior upper milk molar DM^2. This very small affair is present in the Houbolt collection from Sangiran; it is from the right side and unworn (pl. 1 fig. 3). The tooth measures 18 mm anteroposteriorly and consists of three ridges and a small talon. The anterior ridge, 13 mm high and wide, is mastodontid in build, with two cones the external of which is the larger. The second ridge carries six conelets and is 16 mm wide at base by a height of 11 mm only. The third ridge (which may also be considered a large talon) is highest internally: 9 mm. The two unworn DM^2 of *Stegodon trigonocephalus* thus far described (Janensch & Dietrich, 1916: pl. 3; Hooijer, 1955: 20, pl. 3 fig. 5) have more bud-like crowns with the ridges less clearly marked off; they agree, however, closely in dimensions (length 16-18 mm; width 15-16 mm). In *Stegodon insignis* DM^2 is 15 mm long and 21 mm wide (Sahni & Khan, 1961: 260); in *Stegodon orientalis* Owen from the Middle Pleistocene of Yenchingkou, Szechwan, China, seven specimens of DM^2 average 23 mm in length and 22 mm in width (Hooijer, 1955: 21).

Stegodon hypsilophus Hooijer

This is a pygmy species of *Stegodon* in the Pleistocene of Java, smaller and more hypsodont (and thereby more progressive) than *Stegodon trigonocephalus*. The few finds thus far known (Hooijer, 1954; 1955: 86-89) are, or may be, from the Djetis Beds.

A specimen collected at Sangiran by Mr. Houbolt is an entire DM_4 dext., an element not before recorded in this species (pl. 1 fig. 1-2). It has eight ridges; the fourth from the front is damaged on the crown surface and lingually. Only the hindmost two ridges are unworn, and present seven conelets in the usual *Stegodon* fashion. There is a trace of a median cleft in the foremost ridge; such a cleft, quite common in the anterior ridges of *Stegodon* molars and reminiscent of bunomastodont ancestry, was not found in the type pair of M^3 of *Stegodon hypsilophus* but it is possible that this ancestral character shows up in the milk molars only. The Sangiran specimen, very gradually widening from front to back as these milk molars do, has the same ridge formula as its homologue in *Stegodon trigonocephalus* but is smaller and more hypsodont, the specific character (table 4).

TABLE 4

Measurements of DM_4 of *Stegodon* (mm)

	S. trigonocephalus	*S. hypsilophus*
Length	109-122	90
Width	46-53	39
Height	26	26
Height-width index	55	67
Laminar frequency	7½-8½	9⅔

The milk molar of *Stegodon hypsilophus* has a good chunk of volcanic matrix still attached to it. A sample was forwarded to Dr. G. H. Curtis of Berkeley in the hope that it would be possible to obtain a radiometric date for it. Dr. Curtis kindly wrote to me (letter dated November 26, 1962) that the matrix is contaminated with extraneous material and unsuitable for dating. However, he adds that "it is possible that a pure tuff might occur there somewhere. Unfortunately, the tuffaceous material is cemented with a great quantity of calcium carbonate which makes working with such a sample very difficult". So, pending the discovery at Sangiran of a K-bearing matrix of primary origin (direct ashfall) enveloping a specimen, or refinement of the method, the radiometric (rather than absolute, vide Holmes, 1962) age of the Sangiran fossils remains unknown.

Elephas hysudrindicus Dubois

The species of *Elephas* occurring in the Middle Pleistocene of Java is apparently not directly ancestral to the living Asiatic elephant; its skull characters militate against such a conception (Hooijer, 1955: 114). The molars of the Pleistocene of Java, however, can hardly be distinguished from those of *Elephas maximus* L. or from those of *Palaeoloxodon namadicus* (Falconer & Cautley), the Middle Pleistocene elephant of southern and eastern continental Asia (including Borneo). In the Houbolt collection made at Sangiran there is a complete DM^3 sin. (pl. 1 fig. 4) that adds to our knowledge of the present species as no specimen of the upper third milk molar has before been made known. It is an eight-plated specimen, with five plates worn, exhibiting the usual enamel wrinkles, the apices of the remaining plates being covered by cement. The greatest width is at the sixth plate from the front.

TABLE 5

Measurements of DM³ of *Elephas* (mm)

	E. hysudrindicus	*E. maximus,* cat.ost. m	Leiden Museum cat.ost. c
Length	57	56	57
Width	32	32	32
Height	43	44	42
Laminar frequency	14	14	14

Table 5 shows that the fossil DM³ agrees in size with that in the living Asiatic elephant; cat. ost. m is from Sumatra (*Elephas maximus sumatranus* Temminck), cat. ost. c is simply labelled "Asia". The two recent specimens used for comparison have eight plates, too, as already follows from their laminar frequencies, and are absolutely indistinguishable from the fossil.

In the present case, although we cannot by any means tell the fossil tooth apart from the recent morphologically, it is unjustifiable to name it *Elephas maximus* because we know that the skull of *E. hysudrindicus* is utterly different from that of the modern Asiatic elephant. The concavity of the frontal region, the large nasal opening, the low position of the orbit, and the huge premaxillaries (Hooijer, 1955: 111-113) make the skull of *E. hysudrindicus* very similar to that of the Pleistocene African *Elephas recki* Dietrich as described and figured by Arambourg (1947: 254-255, pl. 2 fig. 2, pl. 3 fig. 1; cf. Hooijer, 1955: pl. 14 figs. 1-2). This species occurs in the Middle Pleistocene of East Africa and in the upper Villafranchian of North Africa. As noted at the time by Arambourg (1947: 268) the skull is of the type of the Early Pleistocene Indian *Elephas hysudricus* Falconer & Cautley as well as of the Early and Middle Pleistocene European *Archidiskodon meridionalis* (Nesti), but smaller in dimensions than these. So is the skull of *Elephas hysudrindicus* Dubois. The cranial measurements are very nearly the same; the resemblance of the African fossil *Elephas* skull to that of the Pleistocene of Java is very striking indeed. Is this fortuitous?

The suggestion has been made (Arambourg, 1952: 417; Cooke, 1961: 57) that the Pleistocene elephants of Africa have evolved within the continent itself, parallel but not linked to the evolution of the Eurasiatic elephants. This parallelism, then, certainly finds an amazing expression in such products as the skulls of *Elephas hysudrindicus* and of *Elephas recki.*

Order Perissodactyla Owen

CHALICOTHERIIDAE Gill

Nestoritherium cf. **sivalense** (Falconer & Cautley)

A fragment of an upper molar, left side, comprises the isolated conical protocone and most of the metaloph with a portion of the metacone and the entire hypocone (pl. 1 fig. 5-6). The margins of the crown are incomplete, but there can be no doubt that this is a chalicothere tooth. The anteroposterior diameter of the crown, on the lingual side, across protocone and hypocone, is approximately 25 mm; the external length, across the (missing) ectoloph, may have been about 30 mm.

The lengths of M^{1-3} in *Nestoritherium sivalense* (Falconer & Cautley) from the Upper Siwaliks are 28, 35, and 33 mm, respectively (Falconer, 1868, **1**: 194). In *Nestoritherium sinense* (Owen, 1870) from the Middle Pleistocene *Stegodon-Ailuropoda* fauna of southern China the length of M^3 is not less than 39 mm (vide Lydekker, 1886: 165); this is a larger species. A left M^3 from the Djetis Beds of Java, christened *Nestoritherium javanensis* by Von Koenigswald (1940: 61, pl. 2 fig. 13), is 33 mm long and 37.5 mm wide; the M^3 of *N. sivalense* is 38 mm wide (Falconer, 1868). Hence, there is no difference in size at all to account for a specific distinction of the Java form of *Nestoritherium* from that of the Siwaliks.

Von Koenigswald (1940), who erroneously gives both the length and the width of the M^3 of *N. sivalense* as 37.5 mm, finds that the Java fossil M^3 differs in being shorter and less narrowed behind. As the measurements and figures show, neither one of these supposedly differential characters are valid; the posterior width is nine-tenth the anterior width both in the Siwalik and in the Java M^3. Although the Java *Nestoritherium* may well turn out to be at least subspecifically distinct from the Siwalik form, this remains to be proven.

The serial position of the incomplete upper molar from Sangiran is of course uncertain, and it may be identified as *Nestoritherium* cf. *sivalense* (Falconer & Cautley). Its poor state notwithstanding, the specimen is an important addition to our Museum collections from the Java Pleistocene, in which *Nestoritherium* was thus far unrepresented.

RHINOCEROTIDAE Owen

Rhinoceros sondaicus sivasondaicus Dubois

A portion of a left mandibular ramus with M_2 (broken) and M_3 does belong to the species of rhinoceros today still extant on Java. The specimen was found at Sangiran by Mr. H. R. van Heekeren. Although the upper molars (and premolars) of rhinoceroses are the ones on which most work has been done, and the study of the lowers has been more or less neglected, the lower M do yield characters to distinguish *Rhinoceros sondaicus* from the other species of rhinoceros occurring in the Pleistocene of Java, viz., *Rhinoceros unicornis* L. Both of these have originally been described by Dubois (1908: 1258, 1259) as distinct species, *R. sivasondaicus,* and *R. kendengindicus,* respectively. The former differs from *R. sondaicus* living today in the proportions of its limb segments (Hooijer, 1946a); the latter differs from the living Indian rhinoceros in its teeth being somewhat less hypsodont, the upper premolars being more molariform, and the upper molars being relatively narrower behind (Hooijer, 1946: 85). Because of this combination of primitive and progressive characters the Java form of *R. unicornis* evidently represents a collateral development of the Indian form and may be regarded as a distinct subspecies (Hooijer, 1947: 13).

In the lower jaw found by Mr. Van Heekeren the postero-internal column of M_3 (entoconid) fortunately is not yet touched by wear; its height is 27 mm. In this respect the fossil Sangiran specimen agrees with *R. sondaicus* (height of entoconid of M_3 25-29 mm), and differs from *R. unicornis,* in which the M_3 is 35-37 mm high at the entoconid (Hooijer, 1946: 100).

Order Artiodactyla Owen

HIPPOPOTAMIDAE Gray

Hippopotamus sivalensis soloensis Hooijer

A good portion of the palate with P^4-M^3 sin. found in situ in the Kaboeh Beds at Sangiran by Mr. H. R. van Heekeren is the most complete specimen in the collection, and the only one on which we have stratigraphic control. The first molar is well worn down, but the second and third molars display the so-called *palaeindicus* pattern with the posterior lobe of the paracone (antero-external cusp) extending buccally beyond the anterior lobe of the metacone (postero-external cusp). This pattern is typical of the advanced race of *Hippopotamus sivalensis* Falconer & Cautley named *soloensis* by Hooijer (1950: 75, 37), and which occurs in the Middle and Upper Pleistocene of Java. There are no characters by which the Sangiran specimen can be distinguished from the series of skulls in the Dubois collection originating from Trinil and from Tinggang (Solo Valley), and in size the molars very nearly conform to the type and referred material of this subspecies (table 6).

TABLE 6

Measurements of upper teeth of *Hippopotamus sivalensis soloensis*

	Sangiran	Hooijer, 1950, table II
M^2, length	—	43-ca. 50
width	37	38-42
M^3, length	43	41-48
width	38	38-40

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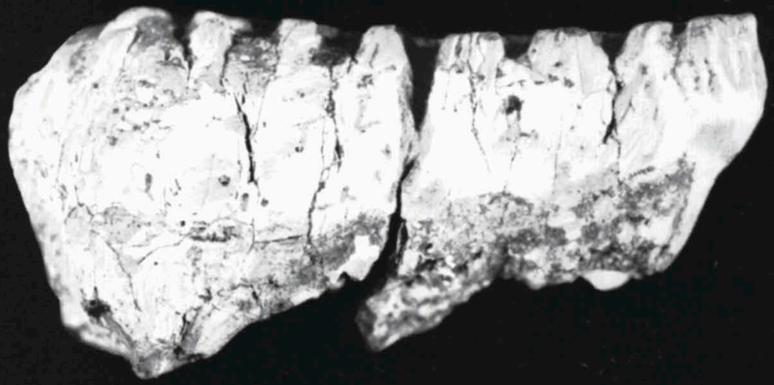

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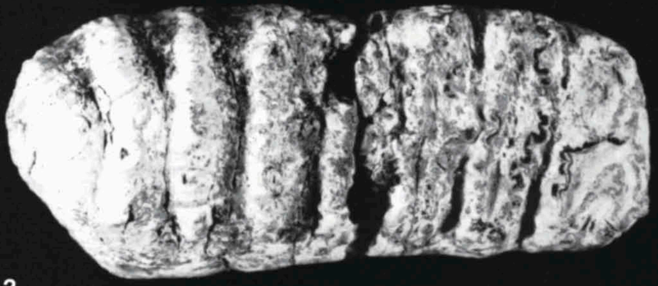

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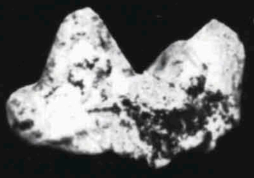

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Fig. 1-2, *Stegodon hypsilophus* Hooijer, DM4 dext.; fig. 1, buccal view, × 1.1; fig. 2, crown view, × 1.

Fig. 3, *Stegodon trigonocephalus* Martin, DM^2 dext., crown view, × 1.5.

Fig. 4, *Elephas hysudrindicus* Dubois, DM^3 sin., buccal view, × 1.

Fig. 5-6, *Nestoritherium* cf. *sivalense* (Falconer & Cautley), right upper molar; fig. 5, lingual view, × 1.3; fig. 6, crown view, × 1.3.

All specimens from the Middle Pleistocene of Sangiran, Java, collected by Mr. J. H. Houbolt.