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Notes on a Fossil Elephant from Sahamma, Tôtômi.

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In the summer of 1921, some fossil remains of an elephant were excavated at Sahamma[1] about 12 kilometres N. E. of Hamamatsu, Tôtômi Prov., from a cutting made for reclamation of land in Lake Hamana. Informed of this discovery,[2] Prof. T. Ogawa went at once to the locality and through the courtesy of Mr. M. Uchiyama, owner of the land, Mr. T. Yamashita and other inhabitants of the village a pair of upper molar, a partly broken incisor, and a mandible together with many fragments of bones, were presented to the Geological Institute of the Kyoto Imperial University.

To our great regret, the cranium which would possibly have been found first, had been broken to pieces and buried in the reclaimed ground. Even so, however, this is one of the most important discoveries of a fossil elephant in Japan, for most probably the four molars and the incisor belong to one and the same carcase.

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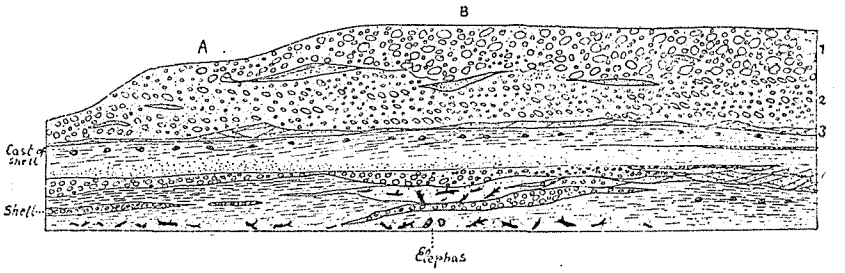
1) 遠江國敷知郡伊佐見村佐浜

2) The occurrence of fossil shells and bones of an elephant from the west or third cutting were first reported by Prof. T. Wakimizu in Journ. Geol. Soc. Tokyo, vol. 25, p. 133 (in Japanese). He supposed the probable future discovery of molar teeth of E. namadicus.

As for the nomenclature of this species, I am obliged to call it provisionally *Elephas namadicus naumanni* n. subsp. based on the reasons mentioned in the following pages.

STRATIGRAPHY

The Mikatagahara terrace is a remnant of the alluvial fan of the ancient Tenryûgawa of the Pleistocene age and dissection on its border has progressed to a mature stage of the geographic cycle. The bluff about 30 m. high at Sahamma is a part of the western border of the dissected terrace facing a tributary of the drowned valley of Lake Hamana. The lower half of the bluff consists of estuarine clay, sand and pebbles. The upper half is a thick fluvial deposit consisting of boulders, gravel, pebble and small intercalating pockets of sand or clay. The two divisions are very markedly bounded by a metre or less of cross-bedded yellowish sand.



Diagrammatic profile of the second cutting at Sahamma.

Description of section A. (At the western part of the second cutting of Sahamma)[1]

1. Coarse gravel, 10 m.
2. Medium gravel with irregular sandy lenses, 8 m.
3. Brown cross-bedded sand, thickness very variable, 3 m–0.5 m.
4. Dark blue mud, lower half sandy, cast of *Arca granosa*, 4 m.
5. Gravel, matrix greenish yellow sand, 3.5 m.
6. Bluish mud.
7. Sand and pebble with abundant estuarine molluscs, 0.3 m.

1) Behind Mr. T. Yamashita's house (山下高三郎氏)

8. Dark bluish mud, partly pass to micaceous sand with lignified drift wood.

Description of section B. (At the eastern part of the second cutting)

1. Coarse gravel and boulders, 8 m.
2. Medium gravel, 9 m.
3. Brown fine cross-bedded sand, 0.8 m.
4. Blue mud, cast of *Arca granosa*, lower half somewhat sandy, 3.5 m.
5. Bluish medium gravel, 4 m.
6. Bluish micaceous sand with drift wood, 1 m.
7. Gravel, 0.6 m.
8. Micaceous sand with drift wood and the elephant, 3 m.

Description of section C. (The first cutting about 1 km. east of the second cutting)

1. Coarse gravel, 11 m.
2. Fine gravel, lower parts sandy, 8 m.
3. Cross-bedded gravel, 5 m.
4. Bluish mud with cast of *Arca granosa*, intercalating a thin layer of blue sand, 4.8 m.
5. Brownish clay.
6. Yellow cross bedded sand, separated from 5 by a layer of gravel, total thickness of 5 and 6, 3.4 m.
7. Bluish micaceous sand.

The abundance of shells, of brackish water and lignified drift wood, as well as a nonstratified thick bed of clay with intercalating irregular lenses of coarser sediment, indicate estuarine origin of the strata lower than 4 of each sections. It is noteworthy that the elephant beds of Tabata[1] and Yokosuka contain similar estuarine molluscan fauna and drift wood. I found *Juglans Sieboldiana Hosenjiana* Kryshtohowitsch in these three localities. Forty four species of Mollusca collected by Mr. T. Ennokoshi are identified by Mr. T. Kuroda.

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1) Tokunaga, S., 'Foss. Env. Tokyo.' Journ. Coll. Sci. Tokyo, vol. xxi, art. 2. Yabe, H., 'A new Pleistocene fauna from Tokyo', Geol. Mag., 1911. p. 221.

List of Mollusca from A, 7.

Acteocina sp. indet.
Aomina Lischkei Dautzenberg et Fischer
Arca (*Anadara*) *granosa* Linné
Arca (*Scapharca*) *inflata* Reeve
Arca (*Scapharca*) *subcrenata* Lischke
Batillaria zonalis (Bruguiere)
Batillaria multiformis (Lischke)
Bullinia striata Yokoyama
Cardium Tokunagai Yokoyama
Clava kochi Philippi
Corbicula sandai (?) Reinhardt
Dentalium octangulatum Donovan
Diala varia A. Adams
Diala picta A. Adams
Dosinia (*Dosinisca*) *japonica* Reeve
Lataxiena Birileffi Lischke
Macoma inquinata Deshayes
Mangilia sp. (immature)
Meretrix meretrix Linné
Nassarius (*Hima*) *festivus* Powis
Nassarius (*Niotha*) *livescens* Philippi
Alabina reticulata A. Adams.
Alabina sp. indet.
Odostomia desimana Dall et Bartsch
Ostrea gigas Thunberg var.
Panope generosa (?) Gould
Paphia (*Ruditapes*) *textilis* Gmelin
Polinices (*Neverita*) *didyma* Bolten
Pyramidella (*Acteopyramis*) sp.
Pyramidella (*Styloptygma*) *taeniata* A. Adams
Ringicula arctata Gould
Scaliola bella A. Adams

Solen Gouldi Conrad
Soletellina chinensis Deshayes
Tellina (*Angulus*) *pallidula* Lischke
Tellina (*Angulus*) *rutila* Dunker
Thais tumulosa problematica Baker
Turbo (*Marmorostoma*) *coronatus coreensis* Reculz
Turbonilla n. sp. (No. 1.)
Turbonilla n. sp. (No. 2.)
Turbonilla n. sp. (No. 3.)
Trapezium japonicum Pilsbry

Of these, *Arca granosa*, *Macoma inquinata*, *Dosinia japonica*, *Batillaria zonalis*, *B. multiformis* and *Nassarius festivus* are the most common species. In some parts, only *Anomia Lischkei* is abundant and less often *Trapezium japonicum* occurs in colony. Though nearly all of them are still living in the Japanese waters except three new species of *Turbonilla* and a few doubtful species, the fossil fauna differs considerably from that of the recent estuarines in Tôtômi Prov. To take one example, *Meretrix meretrix* is very rare here while it is one of the most common in the Recent. This species rarely appears in the Upper Musashino series and never in the Upper Pliocene or the Lower Musashino. On the other hand, *Arca granosa* which is one of the most common species from the Upper Pliocene to the Neolithic age, is now almost obsolete in the Eastern Japanese Waters.

One may recall that the brackish forms are more persistent than the marine forms. So it may happen in many cases that the percentage of the extinct against the total number of species of the former is much smaller than that of the latter. Thus, the estuarine clays of Tabata and Surugadai in Tôkyô contain all living shells except some minute doubted forms, notwithstanding their marine equivalents at Oji and Shinagawa contain many extinct members. In still younger Manzakian, Prof. Yokoyama[1] enumerates at least 29.3 % of the whole fauna

1) Yokoyama, M., 'Foss. Up. Musashino', Journ. Coll. Sci. Tokyo, vol. xliv, art 1.

that are not exactly known living. Therefore, though the Sahamma fauna is apparently very young, I think its age is not much younger than those of the Tokyo beds, or the Lower Pleistocene.

INCISOR

The collection contains a nearly perfect permanent incisor 1.93 m long and many fragments belonging to some other ones. The curvature of the incisor is approximately equal to that of a logarithmic spiral with a constant angle between 87° and 80°. There is only a slight tendency to tortion (Pl. XII).

UPPER MOLAR

There is a pair of fair specimens of the last true molars and a right penultimate true molar.

The left upper last molar (Pl. XIV.) holds x 16 x in 286 mm. The eleven anterior ridges are invaded, showing an elongated oval grinding surface. The height of the ridges is enormous, that of the twelfth being 217 mm. The maximum breadth of the crown is 79 mm. measured on the fourth plate. The right upper last true molar (Pl. XIII.) is nearly symmetrical with the left one. There are nineteen ridges or x 17 x in 303 mm. The crown has the form of a rounded band in outline. The maximum height is 216 mm. and the breadth is 76 mm.

The invaded anterior ridges show large thick lens-shaped discs with pronounced plications. The maximum thickness of plate is 12 mm. and the average is about 10 mm.

In dimensions, this upper right last true molar is very like that of *E. antiquus* from Weimar, recorded in Mr. Soergel's table VIII,[1] No. 5. though the maximum breadth is not at the second ridge. In certain characters, the present specimens resemble very much the thick-plated variety of *E. antiquus* (C-variety of Leith Adams,[2] = *E. priscus*

1) Palaeontographica, vol. 60, 1913.
2) British Fossil Elephant, part 1, p. 31.

Falc.) from which, however, they differ in that the crown is not so quadrate; the discs are tapering on lateral ends while it is rather broadly angulate in the examples described; the enamel layer is strongly and regularly crimped and that neither special central angulations nor loopings are developed.

The exact locality of the penultimate true molar is not known. It holds x 12 x in the length of 204 mm. having a maximum breadth of 72 mm., and the outline of the crown is more oval than in the last ones. The height is 140 mm. at the posterior end. The dimensions are not like those of *E. antiquus* but nearly correspond to those of *E. meridionalis* and a little smaller than No. 12 of Mr. Soergel's table VI. The discs are feebly rhombic, and never touch each other at the central part.

MANDIBLE WITH TEETH IN SITU

This mandible with last true molars *in situ* is one of the fairest examples, though both condyloidal processes and angles are broken. It is characterized in that the outside walls of the rami are strongly convex, the diastems are nearly vertical and little divergent, the rostrum is small but distinct; and that the angle between horizontal ramus and coronoidal process is acute. Since the rather straight basal contour of the ramus appears to be parallel to the alveolar margin and the dip of the symphyse is erect, the profile view of the mandible is highly quadrate as shown in Pl. XVI. fig. 1. In many respects it resembles the mandible of *E. antiquus*.

The external mental foramina are two on the left and three on the right ramus. The larger hole is situated at about 30 mm. below the alveolus and about 70 mm. behind the margin of the diastem. The smaller one is close to the diastem and a little lower than midway. The smallest hole on the right ramus is just on the line connecting the larger ones. The mental foramina of *E. namadicus* in F. A. S. are placed higher and closer to each other. According to Leith Adams perhaps those of *E. primigenius* and *E. maximus* are closer to the free margin of the diastem than in *E. antiquus*.

The dimensions of the mandible are as follows.

Length of right ramus	405 mm.
Length of left ramus	413 mm.
Maximum thickness of left ramus	160 mm.
Height at alveolus	173 mm.
Height to broken processus coronoideus	309 mm.
Divergence of rami	413 mm.
Length of last molar (left)	270 mm.
Width of molar (left)	72 mm.

The left true molar *in situ* holds seventeen ridges in a space of 270 mm. There is a loss of ridges posteriorly in the right molar. The fourteen anterior ridges are invaded showing a lozenge-shaped complete figure of enamel with minute but well-defined central angulations in touch with each other as obtained in *E. africanus*, and regularly crimped, comparatively thick enamel layers. The crown tapers toward the heel. The sides of the ridge are not tapering, but broadly angulated. The maximum breadth of the left crown is 72 mm. at the fifth ridge, and that of the right ones is 70 mm. These dimensions are those of the last lower molars of *E. antiquus*.

NOMENCLATURE AND CONCLUSION

Leith Adams, Naumann, Weithofer, Pohlig and Lydekker remarked that *E. namadicus* is hardly distinguishable from *E. antiquus* by considering only the teeth and mandible. Further, the former species was correlated by Lydekker[1] and Mr. Pilgrim[2] to the broad-crowned or A-variety of the latter. This variety, however, is considered by Messrs. Pohlig[3] and Soergel[4] to be *E. trogontheri*, an independent species easily distinguished from *E. antiquus* by its closely crowded ridges as

1) Catalogue of the Fossil Mammalia in the British Museum, part iv, p. 167.
2) Rec. Geol. Surv. India, vol. xxxii, p. 205.
3) Abh. K. Akad. d. Wiss. II. Cl. 18, bd. I, abth. 36, s. 5, 1893.
4) *op. cit.*, p. 3.

well as many other dental characters. *E. namadicus* is not like *E. trogontheri.* Its ridges are well-spaced and its crown is comparatively less oval.

I think there are at least two varieties of the Japanese fossil elephant which have hitherto been called *E. namadicus* by many authors. The first variety is diagnosed by the broad elliptical crown and less-crowded bandy discs. The second variety, to which the elephant of Sahamma belongs, is diagnosed by its narrower bandy crown and lozenge-shaped discs.

An excellent example of the first variety is furnished by the last upper true molar dredged off the Island of Shôdo, Sanuki Prov. and is figured in Pl. XVI, fig. 2. There is a loss of several posterior ridges, leaving fourteen in a space of 211 mm. The crown is very broad being 77 mm in front, 90 mm. at the middle and 65 mm. posteriorly, measured on the second, fifth and fourteenth ridges respectively. The grinding surface displays a characteristic oval outline and well-spaced bandy discs with minute median angulations. The enamel layer is less well-crimped and thinner than that of the Sahamma form. The incomplete figure of the enamel is lat. ann. med. lam. but not so pronounced as in the second variety.

There is a fair example of the penultimate lower true molar belonging to the first variety, from Shôdo, and preserved in our Institute. The ridge formula is x 11 x in a space of 210 mm. The outline of the crown is spindle-shaped. The maximum breadth is 15 mm. at the fifth ridge. The enamel is strongly plicated. The dimensions approximately correspond to those of *E. trogontheri.*

The teeth of *E. namadicus* figured in F. A. S. seem to me to be with a few exceptions inclusive in this variety. Though the discs of the lower molars have central expansion, they never come to touch each other. The upper molars are literally broad-crowned showing an

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1) 'On some Fossil Mammals from Tsukinoki, Ugo,' Sci. Rep. Tohoku Imp. Univ., ser. ii, vol. iii, p. 40, 1915.

oval worn surface and bandy less aggregated discs. In this connection, Prof. H. Matsumoto[1] points out the difference in the last milk-molars between *E. antiquus* described by Leith Adams and *E. namadicus* from Tsukinoki in the following respects: "The milk-molars of the present specimen are distinctly shorter, wider, more oval and more convergent anteriorly; the ridges thicker and less well-spaced, and enamel layers more strongly plicated". Moreover he noticed that the figure of the enamel is only feebly lat. ann. med. lam.

The second variety is apparently referable to *E. antiquus* in many respects. Therefore, it is not unreasonable that Brauns[1] had supposed the possibility of direct migration of *E. antiquus* from Europe to Japan through Central Asia in the early Pleistocene age. He also pointed out some differences between his *E. antiquus* in Japan and the types of *E. namadicus* in India.

Craniologically, the adult *E. namadicus* is characterized by the presence of a peculiar, bold, overlapping, transverse ridge on the frontals, which, however, also exists in *E. antiquus melitensis* according to Mr. Pohlig. Further, Mr. Pilgrim,[2] after a thorough comparison of crania came to the conclusion that *E. namadicus* and *E. melitensis* are merely local varieties of *E. antiquus*. Moreover, he considered that *E. namadicus* might not be regarded phylogenetically as the direct link between *E. hysudricus* and *E. maximus*, though Mr. Soergel[3] and others supposed so by their dental appearances. It must be noted that the dental characters of the two varieties already stated are not of specific but subspecific importance.

I give here, a new subspecific name *Elephas namdicus Naumanni* to the second variety, for which type the lower teeth from Sahamma should be chosen. The first variety refered to as typical *E. namadicus*, should be called more strictly *Elephas namadicus namadi*.

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1) 'Ueber Japanische Diluviale Säugetierer', Zeitsch. Deut. Geol. Ges., 1883, pp. 35–42.
2) *op. cit.* p. 206.
3) *op. cit.* p. 96.

EXPLANATION OF FIGURE IN LATES XI--XV.

Pl. XII. The incisor ($\frac{1}{1}\frac{1}{1}$)

Pl. XIII. The right upper true molar ($\frac{3}{10}$)

Fig. 1. Profile view.

Fig. 2. Crown view.

Pl. XIV. The left upper last true molar ($\frac{3}{10}$).

Fig. 1. Profile view.

Fig. 2. Crown view.

Pl. XV The mandible ($\frac{1}{3}$).

Pl. XVI.

Fig. 1. The profile view of the mandible ($\frac{1}{3}$)

Fig. 2. Crown of a right upper last true molar dredged off the island of Shodo ($\frac{1}{2}$).

Pl. XII—Pl. XVI. Fig. 1. *Elephas namadicus Naumanni.*

Pl. XVI. Fig. 2. *Elephas namadicus namadi*

Fig. 1.

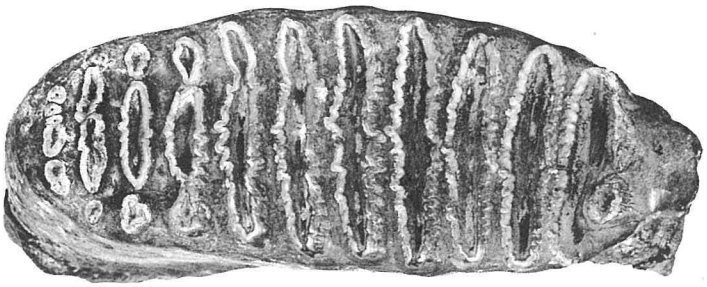

Fig. 2.

Fig. 1.

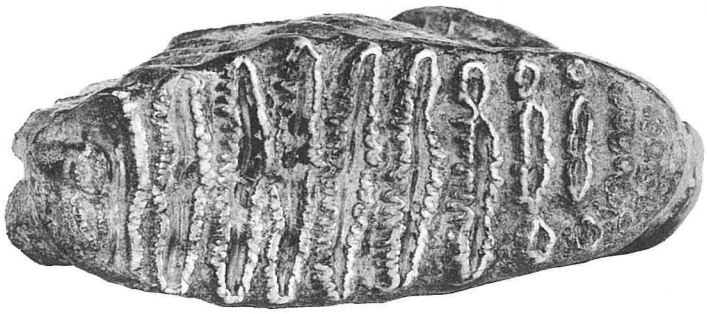

Fig. 2.

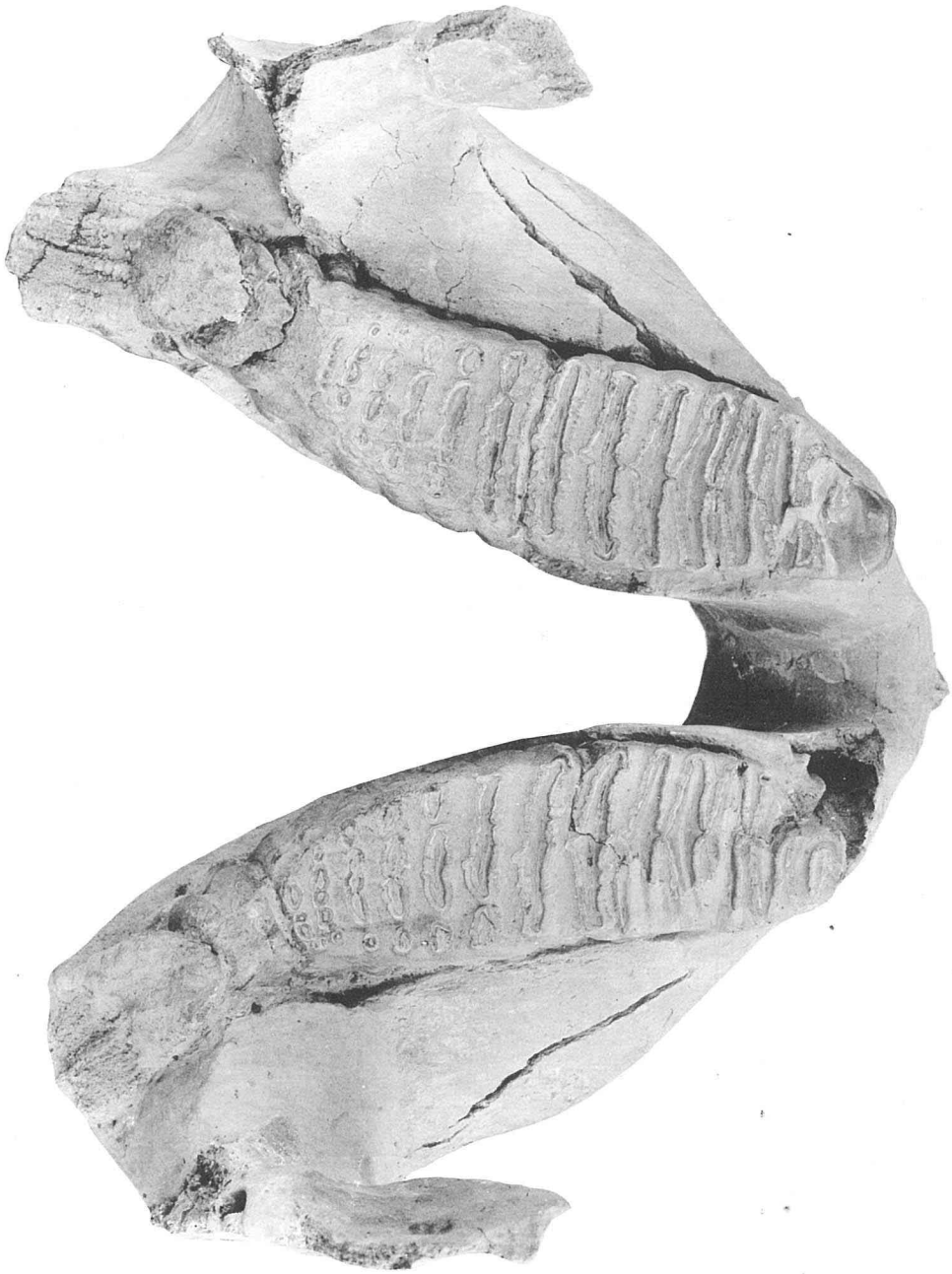

Fig. 1.

Fig. 2.