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On the Fossil Teeth of *Stegolophodon pseudolatidens* (YABE) from the Miocene Bed of the Abukuma mountains

By

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Abstract

Stegolophodon has a pecular position in the taxonomy as well as in the phylogeny of order Proboscidea. In this article, some fossil teeth of *Stegolophodon pseudolatidens* (YABE) hitherto considered to be the earliest form of *Stegolophodon* were examined. The materials, DP$\underline{4}$ and M$\underline{1}$, were obtained from the upper part of the Asakawa Formation (lower Middle Miocene) at Kitashioko, Omiya-machi, Naka-gun, Ibaraki Prefecture, North-east Japan. The DP$\underline{4}$ is first known in this species. Compared with other specimens of *Stegolophodon* (*pseudolatidens, tsudai* and *shinshuensis*), the ridge formula for the species is proposed as follows:

$$\mathrm{DP4}\,\frac{\frac{1}{2}-3-\frac{1}{4}}{},\quad \mathrm{M1}\,\frac{\frac{1}{4}-4-\frac{1}{2}}{\frac{1}{4}-4-\frac{1}{2}},\quad \mathrm{M2}\,\frac{\frac{1}{2}-4-\frac{1}{2}}{\frac{1}{2}-4-\frac{1}{2}},\quad \mathrm{M3}\,\frac{\frac{1}{4}-5}{\frac{1}{2}-5}$$

Paleohistology of the teeth was also carried out, and some characteristics were clarified. The enamel area is generally composed of prisms with cross section of keyhole shape. No typical ginkgo-leaf shaped cross section is observed. It may represent a basic pattern of the enamel structure of *Stegolophodon*.

Introduction

In 1958, M. OMORI described the occurrences of the mammalian fossils from the Miocene deposits in the Abukuma mountains, North-east Japan (OMORI, 1958). He mentioned as follows: "Mammalian fossils are rare, but the occurrence of *Dicroceras tokunagai* MATSUMOTO was reported by Tokio SHIKAMA and the writer (1952) from the Kita-shioko Formation of the Kamiogawa District, Ibaraki Prefecture. It is to be mentioned, that although waiting for description, the writer has obtained the molar teeth of an elephant closely resembling *Eostegodon pseudolatidens* YABE" (p. 59). Later, the authors have an opportunity to observe those materials of "*Eostegodon*", but the generic name *Eostegodon* in the quotation above is now thought to be invalid and *Stegolophodon* is currently used.

According to OMORI, the present materials were found at Kitashioko, Omiya-machi, Naka-gun, Ibaraki Prefecture, by Yoko KANEKO, a schoolgirl of the Shioda

Middle School in January of 1956. A teacher of that school, Mr. Hiroshi YANAGIBASHI offered them for the study to Dr. OMORI. By the courtesy of Dr. OMORI, those materials were sent to Paleontological Institute of Kyoto University. The materials were so fragmental and ill-preserved that it was necessary to make much time to prepare them for the precise study. Fortunately, after careful preperation, those materials were reconstructed nearly to the original shape, and so the authors could give some paleontological works for those teeth.

The authors are grateful to Prof. M. OMORI, Dean of the Faculty of General Education, Azabu University, who gave them an opportunity to study. Late Prof. K. HATAI and other staffs of Institute of Geology and Palaeontology of Tohoku University kindly gave them facility to study the holotype and other specimens of *Stegolophodon*. Prof. S. FUJII of Toyama University offered some plastocopies of molars of *Stegolophodon* which he treated. Dr. KOZAWA of Nihon University gave advices for the histological study. The authors express their gratitudes to all of them. This study was supported in part by Grant-in-Aid for Scientific Research of Ministry of Education, Science and Culture.

Geological setting

The present materials were recovered from mudstone at Kitashioko, Omiyamachi, Naka-gun, Ibaraki Prefecture, where the Miocene Asakawa Formation is distributed. The Formation extends its distribution to north-east and north in belt, and it reaches to Kamiogawa where once a ramus of fossil deer *Dicrocerus tokunagai* was found (SHIKAMA and OMORI, 1952). The deer fossil was yielded from conglomeratic sandstone of the lower part of the Asakawa Formation.

For the area around mammalian fossil localities the junior author made geological survey more than ten years ago, and then he divided the Miocene deposits in the area into five stratigraphical units as follows; (1) Nantaisan Agglomerates Formation, (2) Takikawa Formation, (3) Asakawa Formation, (4) Osawaguchi Tuff Formation and (5) Kanazawa Formation, in descending order (KAMIYA, 1969). From litho- and biostratigraphy, he concluded that those sediments indicate principally vertical facies change from freshwater to marine through brackkish water environment.

The Asakawa Formation has eventually rather complicated facies changes and is controlled horizontally and vertically by the sediments of sandstone, conglomeratic sandstone, mud and sand alternation and tuffs. The mammalian fossils like as deer and elephant have been considered to be recovered in the lower part of this formation, and it is known that the present materials were taken with fossil gastropod *Vicarya in situ*. From the upper part of the Asakawa Formation and the overlying Takikura Formation many molluscan fossils including *Vicarya* were sampled. Faunal contents of those molluscan assemblages suggest a close ralation to the Middle Miocene Kadonosawa fauna, which is the representative of Middle Miocene assemblage of North-east Japan.

Especially, it should be noted that *Dicrocerus tokunagai* was also reported from the Shirado Formation of Joban coal field which is distributed adjacent to the present area (TOKUNAGA, 1927). The Shirado Formation is also characterized by the presence of *Vicarya* fauna.

In addition, formaminifers, *Miogypsina kotoi* and *Operculina complanata* which are considered to be the association of Middle Miocene were obtained from muddy facies of the Nantaisan Agglomerates Formation which occupies the upper-most part of the Miocene in this area (OMORI, 1958). This fact may help to confirm Middle Miocene age of the Asakawa Formation.

On the other hand, abundant fossil plants and drifted woods were known from the underlying Kanazawa Formation and the middle part of the Asakawa Formation. The occurrence of *Liquidambar formosana, Metasequoia glyptostroides, Ulmus appendiculata, U. longifolia, Alangium, Cinnamomum, Cornus, Cyclobaranopsis, Parotia?, Populus, Pterocarya, Smilax, Wistaria* suggest warm-temperate and subtropical climate. Besides, those floral assemlage indicate that they are a typical flora correlative with the Lower Miocene Daijima flora of North-east Japan.

From those faunal and floral evidences it is possible to say that the mammalian horizon of the Asakawa Formation discussed here may belong to the Nishikurosawa stage of the Japanese Neogene standard section. It means that the geological age of the horizon is assignable to early Middle Miocene in the Japanese Islands (IKEBE *et al.*, 1977).

Systematic Description

Order PROBOSCIDEA ILLIGER 1811

Family MASTODONTIDAE GIRARD 1852

Genus STEGOLOPHODON SCHLESINGER 1917

Stegolophodon pseudolatidens (YABE), 1950

1926 *Prostegodon latidens* (CLIFT); MATSUMOTO: *Sci. Rep. Tohoku Imp. Univ., 2nd ser.* (*Geol.*), vol. 10, no. 1, Pl. 5, figs. 1–3.

1942 *Stegplophodon latidens* (CLIFT); OSBORN, Proboscidea, vol. 2, p. 846, fig. 721.

1950 *Eostegodon pseudolatidens* YABE; *Proc. Japan Acad.*, vol. 26, no. 9, pp. 61–65, text-figs. 1–5.

1961 *Stegolophodon pseudolatidens* (YABE); TAKAI and FUJII: *Prof. Jiro Makiyama*

Memorial Volume, pp. 225–228, Pl. 1.

1964 *Stegolophodon pseudolatidens* (YABE); FUJII and MINABE: *Toyamaken Chigaku Kenkyu-Ronshu* (in Japanese with English abstract), no. 4, pp. 98–101, Pl. 1.

Holotype: Upper right third molar (IGPS Reg. No. 7861) and lower left third molar (IGPS Reg. No. 72696) of the same individual from Shiogama near Sendai, Miyagi Prefecture, Japan (in Institute of Geology and Palaeontology of Tohoku University, Sendai).

Specimens described: Upper left third premolar (specimen A) and upper left first molar (specimen B) kept in Department of Geology and Mineralogy, Faculty of Science, Kyoto University, Kyoto, Japan.

Locality: Kitashioko, Omiya-machi, Naka-gun, Ibaraki Prefecture, North-east Japan.

Horizon: Lower part of the Asakawa Formation; lower Middle Miocene.

Description: The materials dealt with here are two isolated teeth somewhat broken. They are assumed to be upper left third premolar, l DP$\underline{4}$ (specimen A) and upper left first molar, l M$\underline{1}$ (specimen B) respectively.

The holotype specimens which were recovered from the Miocene Tiganoura Formation of Shiogama, Miyagi Prefecture are composed of two last molars rM$\underline{3}$ and lM$\overline{3}$. Among them, the specimen of M$\underline{3}$ was first described and figured by MATSUMOTO (1926) as rDP$\underline{4}$ or M$\underline{1}$ of "*Prostegodon*" (=*Stegolophodon*) *latidens*, but later, OSBORN (1942) revised it as rM$\underline{3}$. Whilst, the latter, specimen of lM$\overline{3}$, which was fortunately procured by the Institute of Geology and Palaeontology of Tohoku University fifteen years after the description of the former molar was yielded from the same locality. YABE (1950) reffered it to rM$\overline{3}$, and he considered it to belong to one and the same skull to which the former molar belong. On the same time, basing on those specimens, he proposed new genus and species *Eostegodon pseudolatidens*, and he designate the rigde formula of the last molar of the species as $\frac{1/4\text{–}4\text{–}1/2\,(\text{or } 1/4\text{–}5)}{1/2\text{–}5}$. Certainly, the Japanese specimens are distinguishable in having smaller size, less number of ridges and more number of conelets of each ridge, to compare with other species of *Stegolophodon* like as *cautleyi*, *latidens* and so on, of South-east Asia and India. Moreover, the Japanese species was considered to be the oldest among other species of *Stegolophodon*. Therefore, it seems reasonable to exclude the Japanese species, *pseudolatidens* from genus *Stegolophodon* in which Mio-Pliocene species are included, but diagnostic character of genus *Eostegodon* is considered to be not yet sufficient to deliver this new genus from the genus *Stegolophodon* established formerly. Consequently, *psudolatidens* is regarded in the present paper to belong to the animal under the genus *Stegolophodon*.

YABE (1950) described also another specimen from the Miocene Kanayama Bed of Hunaoka-machi, Miyagi Prefecture (Hunaoka specimen). This specimen is consisted of upper jaw bone with rM$\underline{2}$, rM$\underline{3}$, lM$\underline{2}$ and lM$\underline{3}$ *in situ*, and lower jaw bone with rM$\bar{1}$, rM$\bar{2}$, rM$\bar{3}$, lM$\bar{2}$ and lM$\bar{2}$ *in situ*. By carefull observation on this specimen, the authors have awared that the holotype specimen of lower molar was erroneously identified in tooth position; that is not right side molars but left side molars.

To compare both specimens of the present A and B with the holotype specimens, the former two are clearly distinguished by far smaller size than the latters, though the morphological characters are common in all. In connection with this, the specimen B seems to be comparable in size and form with rM$\bar{1}$ of the Hunaoka specimen, though the specimen B belongs to the upper jaw tooth. Apart from this, other two specimens of *Stegolophodon pseudolatidens* were reported from Miocene deposits of Toyama Prefecture; one was from Harinoki mine, Yashiro colliery, Himi City (Himi specimen) (TAKAI and FUJII, 1961) and another was from a river bed of Tochizu River, Tochizu, Tatayama-machi, Nakaniikawa-gun (Tochizu specimen) (FUJII and MINABE, 1964). The former was referred to rM$\underline{1}$, while the latter to rM$\bar{3}$. In this situation the authors could compare the present specimen B with the Himi specimen, rM$\underline{1}$, and found to be identical. Besides them, rM$\underline{1}$ of *Stegolophodon tsudai* was also known from the upper part of the Kurosedani Formation of the Miocene Yatsuo Group at Kasuga, Ogano-machi, Kaminiikawa-gun, Toyama Prefecture (Kasuga specimen) (SHIKAMA and KIRII, 1956). It seems that the form and size of this specimen are as same as those of the specimen B.

The specimen A is much smaller than the specimen B, but it may be sure that both teeth belong to one and the same tooth row of one individual. Although the trace of wearing can be seen distinctly on the occulsal surface of the former, the latter presents rather complete unerupted molar form. Then, the specimen A is probably referable to the decidious teeth series, and is identified as dP$\underline{4}$.

The specimen A is represented by a detached crown, but some portions, mesial side of the first ridge, one fourth of mesiobuccal side of the first and second ridges, one fifth of lingual side of the third ridge and coronal half of distobuccal side of the fourth ridge, have been lost by damage. In occulusal view, it reveals quadrate form with four ridges being parallel. The ridges are straight and regularly stand side by side, but the first and second ridges are closely packed each other, and the third and fourth ridges are slightly convex to mesial. In the most distal portions the presence of an accessory ridge is assumed from the contour of the crown. In this consequence, the ridge formula is designated as 1/2–3–3–1/4.

In lateral view, all ridges are erected vertically with typical narrow V-shaped valleys between ridges, but incline slightly to mesial. The enamel is well developed and very thick, and reveals lustrous light yellow on the surface but white fine fibrous structure in fractured surface. The enamel is as thick as 4–5 mm. Light brown to brown dentine is exposed on worn surfaces and crown base, but secondary dentine does not fully fill the pulp cavity. So far, the root of tooth is only scaresly seen in the base of crown. The cementum is quite absent.

The median fissure runs in fore- and-aft direction through the first, second and third ridges, but it is not so clear in the fourth ridge. Therefore, each ridge from the first to third, is divided into two portions; narrow buccal one and broad lingual one. Further, each portion is consisted of two cusps, and then, each ridge has four cusps in total, except for the fourth ridge. Apical portions of lingual cusp of ridge seem to be splitted into two tubercles. The number of cusps in the fourth ridge is unknown, but remainning lingual half has two larger tubercles and three smaller accessory tubercles.

The basal cingulum is not developed. The basal part of the enamel surface is rather rugose.

Measurement:

Total length of crown ....60.4 mm +

Maximum breadth of crown ....46.0 mm (third ridge)

Maximum height of crown ....24.1 mm (lingual side of fourth ridge)

22.9 mm (buccal side of third ridge)

Specimen B; This specimen belongs to l/l/M1 which has been unworn and not yet erupted. Four ridges form regular rows, and an accessory ridge is preserved at distal side of the tooth. Due to damage, mesial (or mesioligual) and distoligual portions of the crown are lost. As a whole, it reveals dark brown in color. The ridge formula is designated as +-4- 1/4.

The ridges of the first, second and third stand vertically, but the apical portion of the first and second ridges tends to bend mesially, while that of the third has a tendency to bend distally. The fourth ridge incline markedly to distal, and the mesial facet of this ridge is so exposed as to develop wide slope. In front of the most lingual cusp of the fourth ridge, an accessory cusp appears rather faintly. The valley between the ridges forms V-shape, except one between the third and fourth ridges. Each ridge is composed basically of four cusps, but those cusps are further divided apically into number of tubercles. The number of tubercles is usually six to seven in one ridge. The tubercles are arranged regularly in one line, and the straight ridges formed in this way run paralell side by side on occulusal surface.

The median fissure is distinctly observed and clear in the first, second and third ridges, but it is obscure in the fourth ridge. By means of this median fissure, each ridge is divided into two parts buccal and lingual, and it is general that the buccal part is narrower than the lingual part. Basal cingulum is weakly developed on the lingual side of crown. The most distal accessory ridge is composed of many tubercles and is independant as a half ridge, but it looks like a part of talon which is modified. The enamel is thick (about 5 mm.), and it reveals fibrous structure on fractured furfaces. The dentine fills only the apical portion of the pulp cavity of each ridge, and is deposited on inner basal surface of valley. Therefore, most of inner side of the crown is remained in vacant situation. The cement of yellow color is sporadically developed in the bottom of valley.

Measurements:

Total length of crown .... 88.6 mm +
Maximum breadth of crown ....56.9 mm (second ridge)
Maximum height of crown ....32.0 mm (lingual side of third ridge)
33.8 mm (buccal side of second ridge)

Remarks: The specimen A is a small teeth which is slightly worn. Taken the wearing condition of the succeeding tooth M$\underline{1}$ of specimen B into consideration, the specimen may belong to DP$\underline{4}$. Because the specimen A is slightly worn, and the succeeding specimen B is unworn and not erupted tooth. It is natural that the wearing process of the first molar is usually followed by that of the last deciduous tooth. However, any deciduous teeth of *Stegolophodon latidens* have never been described hitherto. Then, with the present specimen the counterparts in other species of *Stegolophodon* should be compared here.

OSBORN (1942, p. 842) made designation of the ridge formula for DP$\underline{4}$ of *Stegolophodon cautleyi* as 1/2–3–1/2. On the other hand, that of the present is 1/2–3–1/4. FALCONER and CAUTLEY (1846) presented the illustrations of three deciduous teeth of "*Mastodon*" (=*Stegolophodon*) *latidens* in their classical atlas of "Fauna Antiqua Sivalensis" (Pl. 31, Figs. 1–3). Among them, the specimen of Fig. 3 (the specimen kept in British Museum Natural History) may be excluded from deciduous teeth sereis by morphological character, but those of Figs. 1 and 2 (the specimens kept in British Museum Natural History) may belong to the deciduous teeth, probably DP$\underline{4}$, without doubt. Based on those teeth, the ridge formula for DP$\underline{4}$ of *Stegolophodon latidens* is designated as 1/2–3–1/4. Nevertheless, to compare them morphologically they are distinguishable from the present specimen in having large size, more curved shape of the ridges and less number of tubercles on each ridge.

Comparison of measurement is shown below:

	Stegolophodon latidens			*Stegolophodon pseudolatidens*
	1 (fig. 1),	2 (fig. 2),	3 (fig. 3),	specimen A
Length of crown in mm.	67.5	92.5	95.0	60.4+
Breadth of crown in mm.	60	65.0	65.0	46.0
Number of tubercle on one ridge	4	3–5		4–6

Specimen B reffered to rM$\underline{1}$ is closely resemble in size and form to the Himi specimen which is considered to be rM$\underline{1}$ (FUJII and MINABE, 1964). The ridge formula of the former is also coincidental with that of the latter, that is 1/2–4–1/2. In the Funaoka specimen, the tooth of rM$\overline{1}$ is present (YABE, 1950), but due to its ill preservation, the morphology and measurement for that specimen is hardly to be known. The Kasuga specimen of *Stegolophodon tsudai* is represented by rM$\underline{1}$ (SHIKAMA and KIRII, 1956), and has the same ridge formula to that of *pseudolatidens*. But the specimen is distinguishable from *pseudolatidens* in the presence of accessory cusp (conulet) between the first and second ridges and by somewhat thick enamel.

The ridge formula of M$\underline{1}$ is common in several species of *Stegolophodon,* like as *cautleyi, cautleyi progressus, latidens, tsudai* and *pseudolatidens*. But among them, M$\underline{1}$ of *pseudolatidens* has a characteristic features which is distinct from others. It may be important specific characters that the straight ridges stand regularly side by side in paralell and have numerous tubercles on the apical portion of the ridge. The size of tooth crown is slightly larger to compare with other species. Comparison of measurements is given below:

	Stegolophodon tsudai (Kasuga specimen)	*Stegolophodon pseudolatidens* (Himi specimen)	*Stegolophodon pseudolatidens* (specimen B)
Length of crown in mm.	79.0	88.4	88.6+
Breadth of crown in mm.	46.7	55.0	56.9
Height of crown in mm.	20.2+	29.0	33.8
Number of cusps		4–5	5

Paleohistology

With respect to the pattern of enamel organization of living and fossil Proboscidea the results from observations by light microscopy and electron microscopy have been discussed. But some controversies relating with form of enamel prism have thrown on those results (IJIRI and KAWAI, 1948; SHOBUSAWA, 1952; KAIBARA, 1968; KOZAWA, 1974, 1976, 1977a, 1977b, 1978; BOYDE, 1965, 1967, 1971; TAKUMA *et al.*, 1980). For *Stegolophodon,* KOZAWA (1977b) made an observation on molar teeth by scanning electron microscopy, and he reported that the pattern of enamel prism of this genus is similar to that of *Mastodon* and different from *Elephas*. KOZAWA's specimens were obtained from the materials of *Stegolophodon shinshuensis* from the Pliocene Shigarami Formation of Nagano Prefecture which is geologically younger than the present specimens (FOSSIL ELEPHANT RESEARCH GROUP, 1979). In this paper, therefore, the observation was given to examine whether intra-specific variations are detectable or not in the enamel structure.

For the purpose of examining structural characteristics of the enamel of the present specimen, light microscopy and scanning electron microscopy (SEM) have been used. The materials were taken from mesiolingual portion of the first ridge of specimen A and the buccal side of the fourth ridge of specimen B. For light microscopy, ground section being cut longitudinally and transversely were prepared. Specimens for SEM were prepared either by fracturing in longitudinal, transverse or oblique-transverse directions, or by polishing and etching facets in the enamel. All the specimens were embeded in plastic (epoxy resine) to facilitate handling. After grinding to the chosen level and orientation, the facets were polished dry. They were then etched for times of from tens of seconds (most commonly 30 seconds) with 0.5% HCl. After etching, each specimen was washed in distilled water, and rinsed and air-dried. A thin film of gold was coated by vacum evaporation on the etched facets for SEM. Electron microscope (T–20 type, JEOL, Tokyo) was operated at 20 kV accelerating voltage.

Light microscopy: In sections the thickness of enamel appeares to be ranged from 3 to 4 mm., but sometimes it attains to 5 mm. As the preservation of specimens are rather ill, sufficient informations from the enamel area were hardly to be caught from light microscopic observations. Nevertheless, twisting arrangement of bundles of enamel prism which were crossed with growth lines (RETZIUS's lines) were clearly identified. It was characteristic that those lines which are very narrow width were closely set side by side (Pl. 2, Figs. 1, 2).

In horizontal sections being cut nearly parallel to the occulusal surface, the growth lines were distributed throughout whole area of the enamel. Further, there were some variations in the feature of the growth lines; narrow ones and wide ones, or, transparent ones and dark ones. In the arrangement of transverse enamel prism, the keyhole shape pattern was regularly alternated each other. The lines of dentinoenamel junction was rather smooth and simple, without any infolding or complicated structure.

Scanning electron microscopy: By the SEM preparations of the enamel area on the etched facets, three different zones (surface, intermediate and deep) could be observed on the basis of shapes and atitudes of enamel prisms. It is very important to treat them zone by zone, otherwise the interpretation of prism shape will give rise confusion (BOYDE and JONES, 1971).

The deep zone which was 15–20 μm in thickness was characterized by the presence of prismless enamel. In this zone crystal aggregates of needle shape were arranged, and they showed the direction of growth which was vertical to detinoenamel junction.

The intermediate zone was dominated by enamel prisms which were characteristic in having keyhole shape transverse section. The arrangement of this pattern was regularly alternated (Pl. 2, Fig. 3). There were observed two types of keyhole shape: one is a shape with semicircular head, and another is laterally depressed elongate shape. In the arrangement of prisms of the latter type, sometimes ginkgo-leaf shape transverse sections were found (Pl. 2, Fig. 4). Size of the former was usually 5–6 μm in width and 6–7 μm in length (in this case, the length means the distance from head to tail of keyhole shape section, and width is the distance measured perpendicular to the length mentioned above), while those of the latter were ca. 7 μm and 5.5–6.5 μm respectively.

The surface zone was disturbed by ill-preservation in observation. Hence, the shape of enamel prism was not clearly defined. In addition, coagulated needle-like crystall aggregates were developed inside the prism, and they usually obliterated the boundary feature of each prism.

Apart from this, ill-preservation of specimens used to prevent to define the shape and boundary of the enamel prism commonly in those three zones (Pl. 2, Fig. 5).

In the dentine area, the remaining dentinal tubules were clearly observed. The outer diameter of those tubules ranges 1–1.5 μm, and the inner tubules were vacantly hold escaping from any fillings. Sometimes some fibrous images were observed, which may suggest to be preserved portions of the dentinal fiber (Pl. 2, Fig. 6). Indeed it is true, but the preservation of the dentine area was rather in bad condition as a whole.

Summarized the results of observations mentioned above, it is possible to say that the paleohistology of teeth of *Stegolophodon pseudolatidens* is characterized by the presence of the enamel area which is generally composed of the enamel prisms with keyhole shape transverse section. This conclusion may accord with the observation of the teeth of *Stegolophodon shinshuensis* (KOZAWA, 1977b). But different from the latter, the former has no typical ginkgo-leaf shape pattern in the enamel area. Nevertheless, it should be added that in the former some ginkgo-leaf-like shape pattern appeared partly in the enamel area.

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Explanation of Plates

Plate 1

Fig. 1. *Stegolophodon pseudolatidens* (YABE)
1DP4 a; lingual view, b; occulusal view, c; buccal view.

Fig. 2. *Stegolophodon pseudolatidens* (YABE)
1M1 a; lingual view, b; occulusal view, c; buccal view.

Scale shows 20 mm of length.

Plate 2

Light microscopy and electron microscopy of teeth of *Stegolophodon pseudolatidens* (YABE)

Fig. 1. The longitudinal section of the enamel and the dentine. E; enamel, D; dentine. Optical microscopic (OM) image. Parallel nicol.

Fig. 2. The same section. The growth lines are clearly observed. OM image. Crossed nicol.

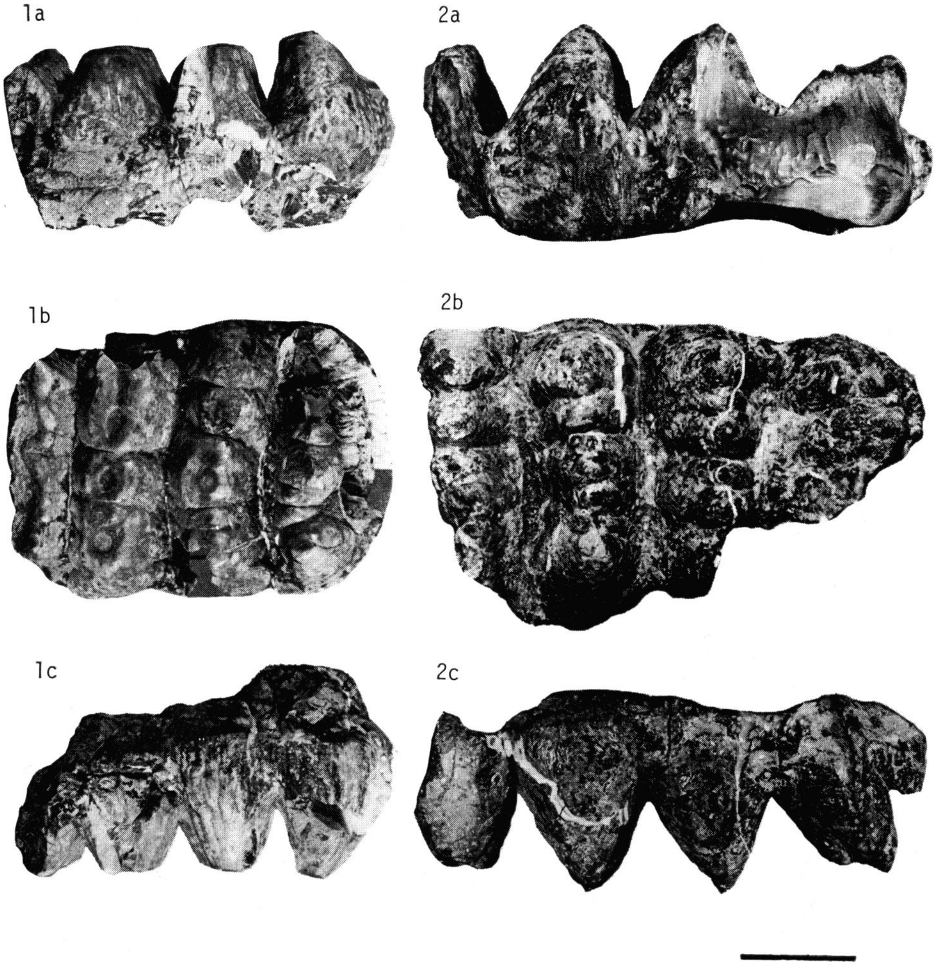
Fig. 3. The keyhole shaped transverse section of the enamel prisms observed in the intermediate layer of the enamel. The needle like crystallites arrange in parallel. Horizontal section. SEM image.

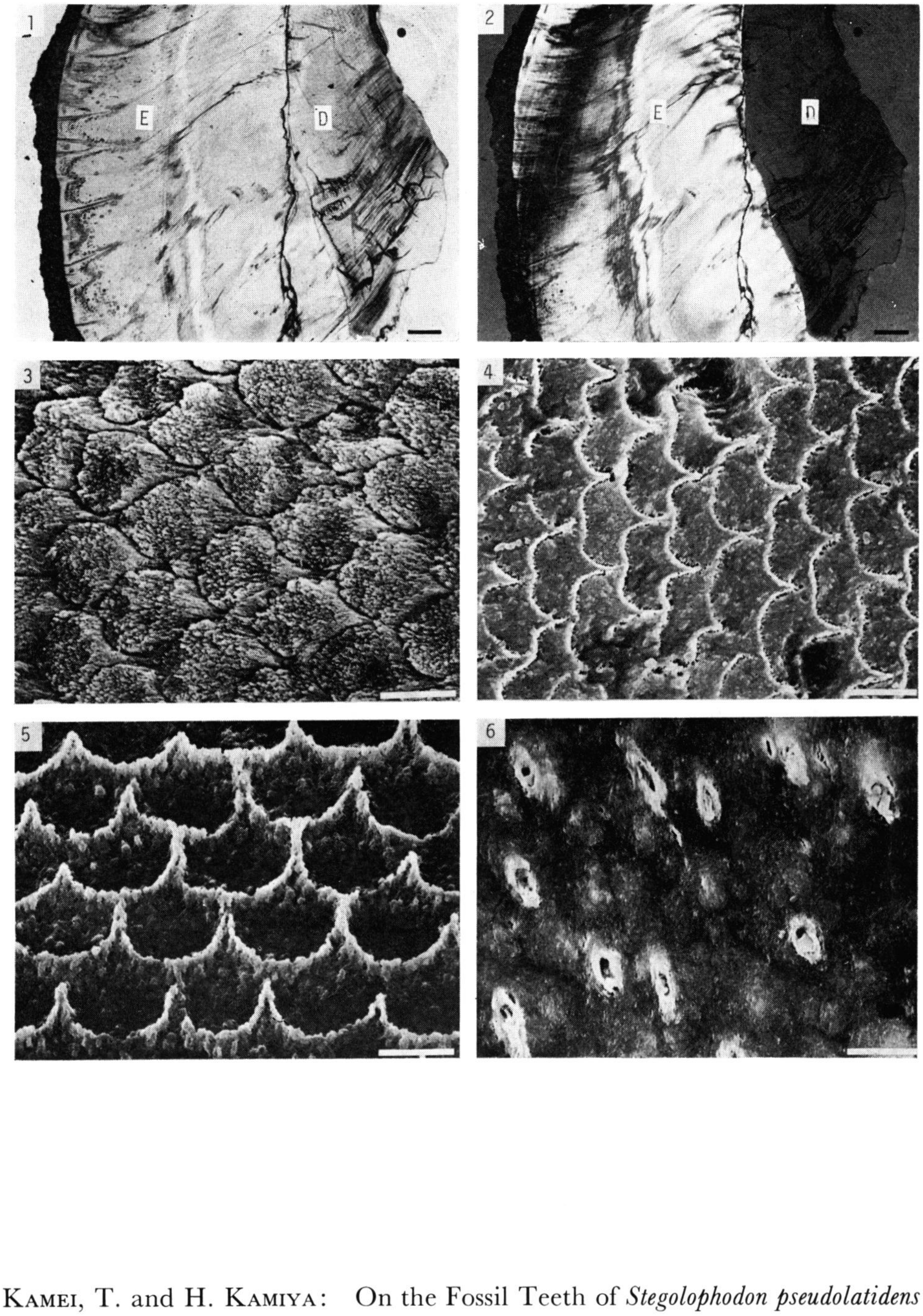
Fig. 4. The transverse section resembling the ginkgo-leaf type in the intermediate layer. Horizontal section. SEM image.

Fig. 5. The keyhole shaped transverse section of the enamel prism in the intermediate layer which is not well preserved. The arrangement of the crystallites is not so clear. Horizontal section. SEM image.

Fig. 6. The dentinal tubucles in the dentine. The dentinal fiber is partially remained. Horizontal section. SEM image.

Scale shows 5 micron meters except figs. 1 and 2 (0.5 millimeters).


1a
2a
1b
2b
1c
2c



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