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Japonic Proboscidea

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With 31 Text-figures

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First Words

This is not a monograph of the Japonic Proboscidea, but my first account on the fossil materials kept in this school of geology (Geological Institute, Kyōto Imperial University). I am in debt of a number of persons for their kind helps to get the specimens together, so it is right for me to give an account in answering questions.

To my knowledge, there has not been made discovery of even a bit of Moeritheridae and Dinotheridae in this country. Our materials are made of mastodons and elephants which are put into the one and same family Elephantidae. OSBORN has given higher positions to these three divisions which are again parted into a number of families and subfamilies. In this connection, the present work may be seemed to be against the forward change by some persons, but the reason why I am not in agreement with the latest opinions will be given later. Not only a less complex ordering and a smaller number of group names are more helping for workers who are not expert of palaeontology, but the fossil elephants were not well separated in natural relation though they were very changing animals.

It is regretted that a part of the materials came from uncertain places in Japan. Some were got from the base of Inland Sea off Syōdosima by fisher-men. These fossils were not in one bed which is stretching under the sea, but they are mixed materials from different beds between the Upper Pliocene and the Middle Pleistocene. This and other Inland Sea materials are little use in geology, but some of the same sorts have recently been got from certain beds on land about the sea. With these materials we are able to have better knowledges respecting the stratigraphy and, to my belief, it is clear that no more than one species within a species group which is made up of forms in the nearest relation was in existence at the same time in the same place.

As has been given statement, this record would not be a complete last account of the Japonic elephants, but I have a thought that views based upon errors have to be put right in this chance. Still I am looking forward to more discoveries in future. The work was supported kindly by a number of persons in this country. The names are: Dr. T. OGAWA, Prof. S. NAKAMURA, Mr. I. YOKOTI, Mr. H. TANAKA, Prof. T. MATSUMOTO, Dr. T. KOBAYASHI, Dr. S. EHARA, Dr. T. UEJI, Mr. I. KURAHASI, Mr. Tom. KOBAYASI, Mr. K. HIRAI, and Mr. H. KATŌ.

Morphology of Teeth

Different names have been given to parts of the molar teeth by different writers. The names given to those of other mammals basing upon the tritubercular theory are hardly put in for the teeth of Elephantidae. The latest use by HOPWOOD (1935) will be taken up, because his system is simple and completely free from theory. In the bunodont teeth of *Bunolophodon*, every transverse ridge or colliculus of the crown is made of two pointed forms or cones separated by a middle division-line or fissure. The stronger inner cones of the upper teeth are the pretrite cones, whereas the feeble outer ones are the post-trite cones. Of the lower teeth, the pretrite cones (or conids) are forming the outer series. The pretrite cones, not only made stronger, but have conules formed on the front and back sides near the middle division-line. If a number of small conules are put in a series on the two sides of a pretrite cone, they make a structure named serridentine angle. More common is an example that a conule on every one side of a cone. When such a conule is in feeble development, it seems to be only a small expansion of the side wall giving a look of trefoil outline on the rubbed top; but, on the other hand, when a conule is in full development, it frequently takes up the base of valley between the colliculi and the median fissure. Such a strong structure does not take place on the post-trite series, but a sloping spur like the serridentine angle is made in "*Trilophodon subtapiroidea*", and for this reason, the structure will be noted as subtapiroid angle. Such angles of pretrite and post-trite cones are specially in well development of bunolophodont type of teeth. Those seen in the so-named "*Mastodon tapiroidea*" pictured by SCHLESINGER are more sharply marked than in *T. subtapiroidea*, but as the first species does not have existence any more viewing from I. R. Z. N., the second is here taken as the representative.

In teeth of polylophodont *Stegodon* and hyperlophodont *Elephas*, we do not see any different look between the pretrite and post-trite series, because cones of every colliculus are united to a very high transverse lamella which may be noted as chirolite (or cheirolite in full). Top of a chirolite before in use are made of a number of mammillae which are grouped in three parts by two deep division-lines or lateral fissures. These fissures may be equal to the top clefts of the cones in the mastodon teeth. We see another less deep division-line at the middle which is probably in agreement with the median fissure. The loxodont plica, at all times, is in the pretrite side of the median fissure and very near to it. In this way, a loxodont plica may be said to be a representative of a pretrite half and to be an united side conule.

On a rubbed crushing face of an elephant tooth, we see some three-parted enamel outlines of the back chirolites and farther back there are the four-parted tops of chirolites. On a side face of chirolite, there is a well marked loxodont plica at the middle, starting from the base running up to different heights in different forms. It is in a specially strong development in *Elephas africanus* making a typical loxodont expansion giving a diamond outline of enamel on the crushing face. Loxodont plicae take places as well in all sorts. Even hyperlophodont *Elephas mammonteus* has the plicae. The loxodont expansion is not like the small plica by a look; so it has been taken as a clear mark of the different genetic line. In my opinion, as it is in the same bioseries as the pretrite conule and serridentine angle of mastodons, loxodont structure is a common mark of elephant teeth, though it is changing in form and size. It may not be very clear in some phenotype examples. It was in well development when it was needed for stronger structure by some forms. There may have been different lines of evolution on different lands and equally there may have been exchanges of characters by interbreedings. Separate conditions in the senses of geography and geology had the most effects on making up of new sorts.

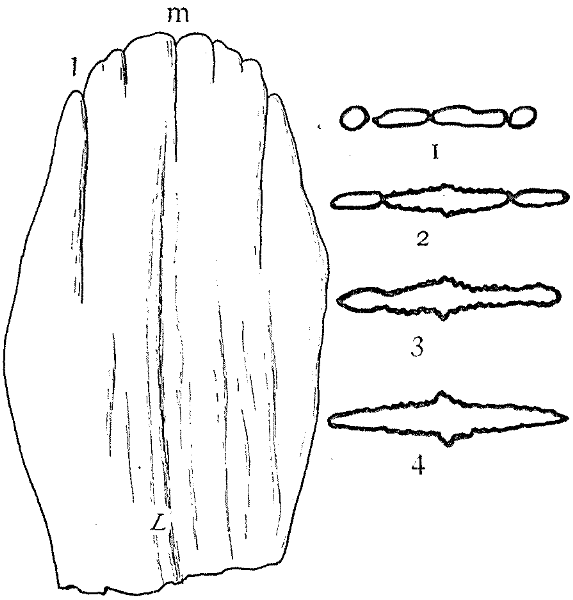

Fig. 1. Side view of an elephant chirolite (*E. namadicus naumanni*) and enamel outlines across different levels. m, median fissure; l, lateral fissure; *L*, loxodont plica.

A structure on the back end of a crown of a tooth is a talon, which is so made as a small chirolite when it is in better development; at the last step of development it becomes the true back-most chirolite with a new small talon on its backside wall. This process was done again and again while evolution went forward in almost all lines of elephants which are marked by the polylophodont and hyperlophodont tendencies. By this reason, back end forms of crowns are frequently very unfixed in one species.

We see a good talon by the last lower molar of *Bunolophodon yokotii*, while, on the other side, we do not see how the last two smaller cones in the type of *B. sendaicus* is the talon as MATSUMOTO named them so or they are truly the 5th colliculus.

Hyperlophodont degree may be noted by chirolite formula. For example, it has been used to give a sign such as $_{\times}16_{\times}$, in which $\times$ is a talon. Talons of hypsodont elephant teeth are not like a talon of mastodon which is a table-like place with small cones or tubercles. In place of talon, a new word hemichirolite will be used hereafter for smaller chirolites which are normally two in number, one at the front and the other at the back ends of a hypsodont hyperlophodont tooth. Hemichirolite and talon may be signed well by fractional expressions in the formula in place of $\times$, if the sign of the same form has not been used for broken parts of chirolites very frequently.

Hyperlophodont degree has been given into idea by laminar frequency in 10 cm. and length-lamellae quotient. These measures, however, have little value as finger-points of forms, for there is clearly no correlation between number of chirolites and length of a tooth. A very small tooth naturally has a higher laminar frequency than the normal type. Sometimes number of chirolites in 10 cm. has been taken to be a good separating measure of species by some workers in error.

Roots of the teeth are not all the same. Generally there is a small group of roots more or less normal to the base of crown in front which are joined together, while other roots are united to make a group sloping to back. The two groups will be noted simply as front root and back root. The very short roots of elephant teeth are not very regularly grouped together.

General Account

We are in debt of OSBORN who was one of the most respected palaeontologists for more detailed knowledges of the Proboscidea. His system of ordering was what he said "phylogenetic classification"; and he made an attempt to give special name in science form of every little branch. The idea of polyphylogeny is possible to be supported by the full knowledges and experiences of this great man, but at the same time, we are not able to make a protest against a statement that mixtures of bloods would have taken places at a great number of chances. Not only the palaeontologists of the past, SCHLESINGER and other later workers seem to have an opinion that range of variation of a species is very wide. In fact we see the view is true at least with the living examples.

OSBORN's system is hardly be free from theory. He made good orders of morphogeny series, but these different lines of characters are not necessarily noting families, genera or species. The phylogeny tree of the Proboscidea might be more simple, though, in detail, every branch is made of very complex net-work. Comparison between the characters of the three well put up forms—mammoth, Indian and African elephants—do not make to put them in different genera, but for that the very strongly loxodont and less hyperlophodont teeth of the African elephant make a suggestion about the subgenus *Loxodonta*. What is different between the crania of OSBORN's *Parelephas* and *Mammonteus* is less important than they being like. A number of genera lately offered such as *Parelephas*, *Mammonteus* and *Palaeoloxodon* seem to me to be no more than species group under the old genus *Elephas* which is covering the subgenera *Loxodonta* and *Archidiskodon* in addition. Uniting in this way the overvalued groups to a less number of genera and families, we have a much simpler system which is not very different from that of given by the early workers.

The same way as OSBORN has been general in this country after MATSUMOTO. Number of Japonic species was quickly increasing while in the latest years; very small marks of teeth, which seem to be within limits of variation, being taken to be separating qualities; and this error was made by myself. My new system is nothing but natural ordering.

As in the example of *Stegodon insignis* and *S. ganesa* or in another example of *S. ariwana* and *S. trigonocephalus*, teeth of different forms frequently put out in view little different outlines, structures and details, while they are widely changing. The crania in addition are not the best marks of species, for the post-embryonic development of diploë may be more or less effected by different special ways of living within a limited species.

Details of the Japonic genera and species, which come to decisions or still in doubts will be given in the lines coming after. But I have nothing to say about the *Stegolophodon latidens* given the account by MATSUMOTO from Hanareyama in Ibaraki-ken and Siogama near Sendai.

Family **Elephantidae**

Subfamily **Bunolophodontinae**

Genus **Bunolophodon** VACEK, 1877

Type: *Mastodon angustidens* Cuvier, 1817 (by SCHLESINGER, 1921).

Trilophodon FALCONER & CAUTLEY, 1846 is a synonym of *Mastodon* OKEN, 1816 (from mastodonte of CUVIER, 1806), because the second was made a division into two groups *Trilophodon* and *Tetralophodon*, of which the first is covering the type of *Mastodon*. The type of *Mastodon* was fixed to *M. giganteum* CUVIER, 1817 by FALCONER, 1868 which is said to be equal to *Mammut ohioticum* BLUMENBACH, 1797. The name *Gomphotherium* BURMEISTER, 1837 being without species seems to have no value in science as has been given the statement by HOPWOOD, 1935, though HAY, 1923 has used the name *M. angustidens* as the type.

The oldest name after the two *Bunolophodon* takes the place with its clearly offered type species. The genus *Mastodon* in narrow sense would be a synonym of *Mammut* BLUMENBACH, 1797 and may be well separated from *Bunolophodon*. *Serridentinus* OSBORN, 1923, though no type was fixed, is the group of America and not very different from *Tetrabelodon* COPE, 1884, in which the present group of Eurasia was frequently taken by error.

Bunolophodon annectens (MATSUMOTO, 1925)

Figures 2, 3 & 4.

Material: An adult lower jaw with $_3M_3$, $_2M_2$ and $_2I$ (Kyōto Univ.), from the mammiferous sandstone of Hiramaki beds (Miocene) in Mino, at Banzyō-bora in Kamino-gō near Mitake, Toki-Gōri, Gihu-ken. (Figs. 2, 3, 4)

I have made reference to *Trilophodon angustidens palaeindicus* LYDEKKER, 1884 with this material, for the dimensions and structures of teeth in the two forms seemed to be not very different. There is no record on the mandible of the Indian sort, to which the present material at hand is hardly been united, while we have another named species *Hemimastodon annectens* MATSUMOTO, 1925 in the same level at the same place.

Before going on with the discussion, I have to give details of the material. It is a lower jaw broken in part, but with the molars in their places and a left tusk. It comes short of the back ends of the two rami, the two condyloidal processes having been broken. There is no special mark different from the normal form of the mandible of the genus, but it is much smaller and has a shorter rostrum in relation than in *B. angustidens*. The front edge of the ascending ramus is sloping forward, being not normal to the horizontal ramus. The bone is made very wide with the last molar, forming a wide outer slope. There is a contraction of rami from side at the start of the rostrum, making Y-form top view to give such a comparison with the V-form outline of *B. angustidens* pictured by SCHLESINGER. We see nothing special about the symphysial canal; it is somewhat narrowed back and opened in front to make a spoon-like place. The diastema which is the edge of the canal is very little sloping, while the base of the ramus is straight without a curve or angle. In this way the mandible is not bent down viewing by a side. A mental foramen is seen at the middle on every side of the produced part; and another smaller one is near the top edge and a little back of the first.

Dimensions:

Length of mandible in all	730 mm.
Length of symphysis	230
Height of ramus at front end of $_3M$	116
Greatest height of left ramus	132
Width of left ramus at position of greatest height	61
Greatest width of left ramus	105
Distance between outer faces of broken coronoidal processes	400
Distance between inside faces of rami at front ends of $_3M_3$	80
Least width of symphysial canal	32
Width of spoon-like part of canal	80

The right third molar is measuring 127 mm. long and 59 mm. wide, while that of the left side is a little smaller being 125 mm. by 58 mm. They are rounded squares to top view, a little narrowed near the round back ends,

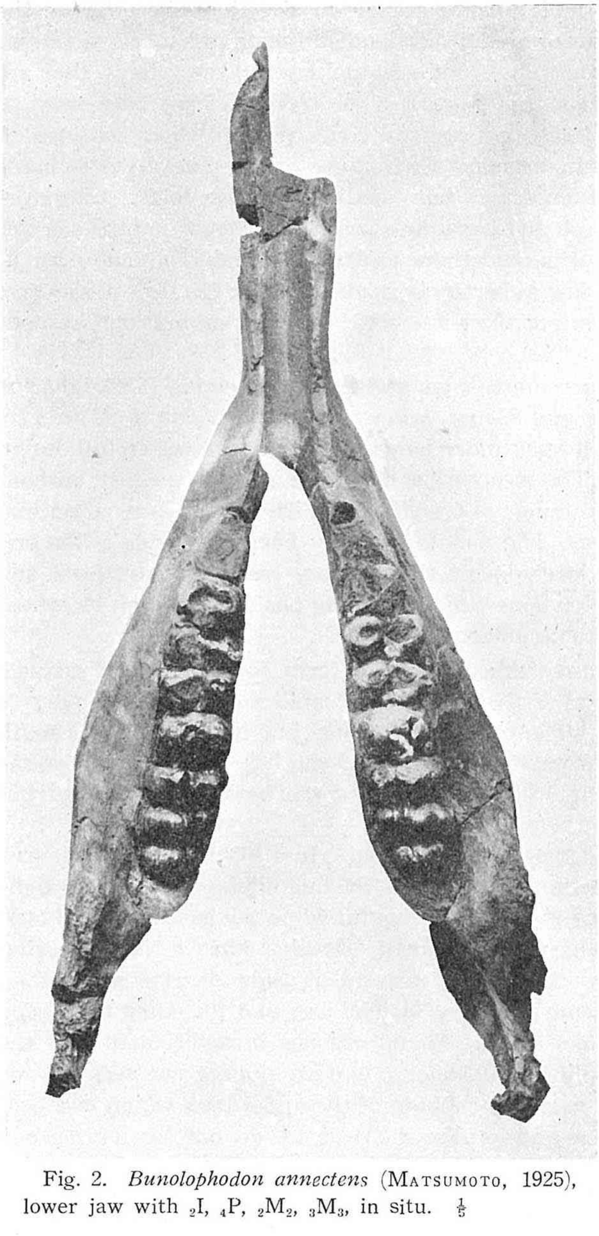

Fig. 2. *Bunolophodon annectens* (MATSUMOTO, 1925), lower jaw with $_2$I, $_4$P, $_2M_2$, $_3M_3$, in situ. $\frac{1}{5}$

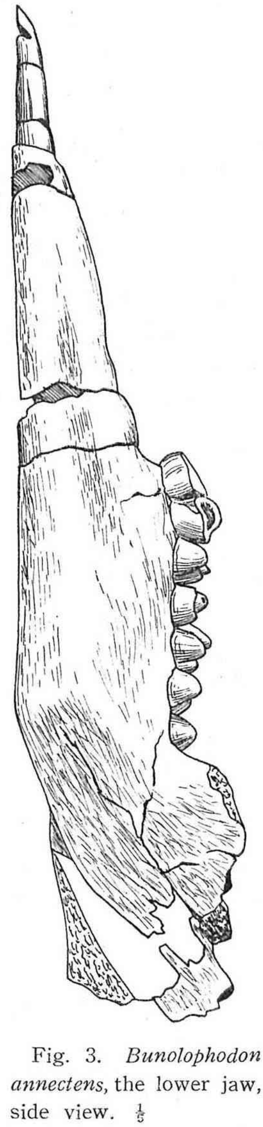

Fig. 3. *Bunolophodon annectens*, the lower jaw, side view. $\frac{1}{5}$

which are pointing they are the last molars. This molar has 4 colliculi and a talon cone joined to the back side of the last colliculus. The pretrite cones are a little wider than the others and sloping. Every top of all cones has a small fissure. In addition to serridentine angles which are in very feeble development on the front three pretrite cones, there are two true conules, one in the first valley being greater in size than the other in the second valley. The conules are in development upon the back slopes of the two front pretrite cones, but, not only making full the valleys, they are put over the middle division-line in part. The teeth had not been used so much as that only the front two pretrite cones put out their dentines on the rubbed tops. There is seen no sign of use on the back two colliculi. The lower side of the enamel face has small transverse folds. Cingulum is well marked all through the base, but for the two ends and the sides of cones. The valleys are wide and there is a shallow inlet of cingulum at every end, on which a low tubercle is made. The tubercles of the first valley are somewhat stronger than the rest. No sign or mark of cement is seen.

The second molars are more square with straight ends. The right one is measuring 94 mm. long and 56 mm. wide; and the left one is 92 mm. by 55 mm. These were used very much and put out in view the trefoil design of the pretrite enamels. The structure is much the same as the last, without taking into account the number of colliculi which is three as a normal example of *Bunolophodon*. The conule in every back inner side of the pretrite cones are in strong development, the first one being the strongest and the last one being the talon cone which is taking position upon an increased back edge of a narrow talon table.

The pretrite cones are rubbed away to form round rings of enamel. In front of the left second molar, there is a small tooth, greater part of which is in loss by use. The enamel has gone, but it was clearly a tooth with two ridges judging from the structure of the base. This tooth seems to be the fourth premolar. That of the right was broken, but for its front and back roots.

Only the left tusk is kept in the material. It is 103 mm. long measured from the pointed end to the front end of the mandible with the straight inner edge. The top face is flatly curving-in, while the base is curved out; the inner and outside edges are rounded. At the start it is measuring 36 mm. wide and 24 mm. thick. Its material is tight dentine without an enamel covering. It became short by violent use, and its outer front side was rubbed away to make a slope facing outside, in addition to that the end is pointed and sharply edged inside. A deep sloping cut seen on the front slope seems to be made by rubbing of the upper tusk which was bent down. Respecting the size and form of the tusk, we do not see any special mark different from that of the type species.

Range of different sizes in *B. angustidens* has been given in a graph by H. KLÄHN (1931). In comparison with the facts before us, the lower teeth at hand are by no reason outside the limit of variation of *B. annectens* which type material is an upper jaw with teeth. The upper last molars of the type are wider but shorter, the right one measuring 116 mm. by 68 mm., than the lower last molars of the present material. The sizes of the upper and lower molars are not like and they seem to be at the farthest points within the range of a species. By this reason in addition to the other qualities that the type is three-ridged on the last molar and that it has only feeble conules in the valleys, I did not give the same name to the present material at first. Moreover, in dimension and structure, it is like *B. palaeindicus*, though the Indian form is later in evolution having the

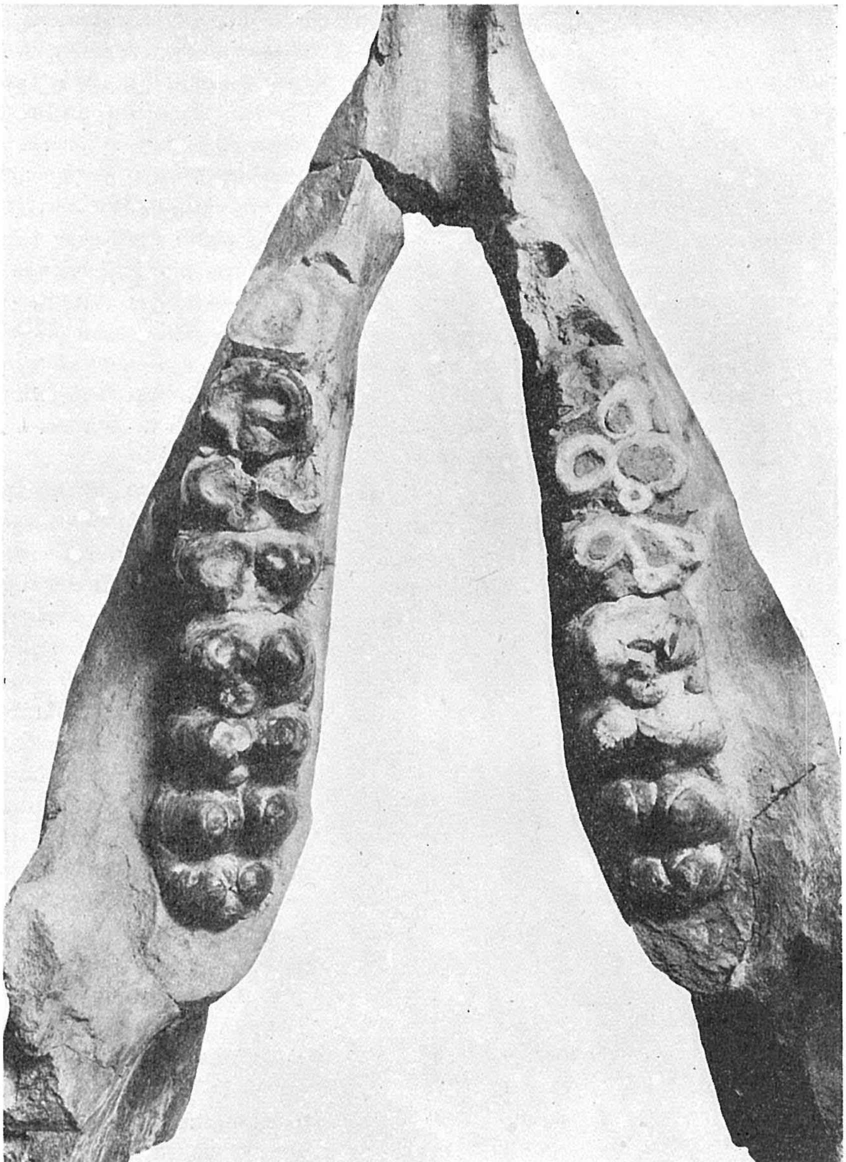

Fig. 4. *Bunolophodon annectens*, top view of teeth. ½

third conule. We have no knowledge of connection between the Indian and Japonic forms while the Miocene. Under such condition at present, I have to give support to MATSUMOTO's species which was made discovery in the same bed at the same place.

Qualities of OSBORN's *Serridentinus* and *Trilophodon* lines take places in the same but one line as has been given statement by HOPWOOD in agreement with the opinion of MATTHEW (1924). With the COOPER's material which he named *B. angustidens* (=*B. cooperi*), the upper teeth are like *Serridentinus*, while the lower teeth are quite like *Trilophodon* in having conules put in the valleys. The same is the example of *Trilophodon connexus* HOPWOOD, 1935, which seems to be in relation with *B. annectens.*

Fig. 5 a. *Bunolophodon yokotii* n. sp., holotype, M_3 M_2 in situ. $\frac{1}{2}$

MATSUMOTO put his species in the genus *Hemimastodon* PILGRIM, 1912, because the last molar is three-ridged unlike the normal *Trilophodon.* The first step of polylophodont tendency was started in the last molars of *Bunolophodon,* and under this condition, grouping based upon number of colliculi is not natural, whereas the other qualities in addition are not very different. The genus *Hemimastodon* itself is now in doubt by SCHLESINGER, COOPER and OSBORN. TOKUNAGA gave a name *Serridentinus annectens* (MATSUMOTO) in his list of Japonic fossil mammals in agreement with OSBORN. *Serridentinus* will be limited to a narrower group round the type which

Fig. 5 b. *Bunolophodon yokotii* n. sp., holotype. M_3 M_2 in situ. $\frac{1}{2}$

has not been fixed by OSBORN though he gave a number of the genotypic species.

B. annectens is in relation with *B. cooperi* (OSBORN, 1932) and *B. inopinatus* (BORISSIAK & BELIAEVA, 1928). The three forms would be grouped together, but we have very little materials to make the idea certain. The conical elements (OSBORN, 1936) of the last lower molars in these species are equally 19.

I have given details of geology of the place where this fossil was made discovery in the language of Japan. Here at Banzyōbora Common, the tuff sandstone the lowest layer of the Hiramaki beds takes fossil mammals such as:

Anchitherium hypohippoides MATSUMOTO
Palaeotapirus yagii MATSUMOTO
Teleoceras pugnator MATSUMOTO
Amphitragulus minoensis MATSUMOTO
Bunolophodon annectens (MATSUMOTO)

MATSUMOTO gave an opinion the Hiramaki be the Burdigalian in age and equal to the Gaj of India. In fact *B. annectens* is a near relation with *B. cooperi*, but it is not a form so early in evolution as to be one going first. It is highly probable as has been said before that this mastodon may be older than *B. palaeindicus*. *Anchitherium hyppohippoides* is in later development than the *Anchitherium* of Lower Miocene and has something like *Hypohippus* of the younger levels. *Palaeotapirus yagii* and *Amphitragulus minoensis* seem to be forms coming between the Lower and Middle Miocene. *Teleoceras pugnator* is clearly later than *T. fatehjaugensis* of the Gaj level. The Banzyōbora sandstone may be a little younger than Burdigalian.

To my opinion, the thick pyroclastic beds of Hiramaki being deposits by river on land are equal in time to the pyroclastic Togari beds which were made under a sea in a basin separated from the Hiramaki basin by small mountains of granite. Under the Togari, there is strata of the Lower Miocene with *Miogypsina* and corals.

Bunolophodon yokotii n. sp.
Figure 5.

Type: M_3 and M_2 with a broken part of mandible (Fig. 5).

Locality: In the Upper Banko Sandstone of the Meisen series, at Senkaibō in the Meisen district, North Kankyō-dō, see this Memoirs, vol. XI, No. 4, 1936.

I give the name as a species to the poor material for the time being. It might be a variety or a race of *B. angustidens*, but distribution of that species in China was not made clear so far. By this reason, it will be separated till the connection with other forms come to our knowledge.

The right last molar is of a great size being 177 mm. long and 74 mm. wide equal to the greatest example of *B. angustidens* in a rough measure. There are four colliculi and a talon. The median fissure takes a little inside position of the true middle line, so that the pretrite cones are much wider than the other series. All the cones are sloping back, specially those of the pretrite series, only the front side being normal to the base. Very feeble rounded subtapiroid angles are seen with the inner sides of the front three post-trite cones. Serridentine angle is not seen, while conules in front and back of every pretrite cone though small are in well development. The line of conules is roughly on the middle line of the tooth. The last pretrite cone has no conule, but a small expansion in front. The first pretrite cone has two small serridentine expansions and a back conule which is the greatest of all. The conules of the second pretrite cone are small, while the front conule of the third one is second in size. All the cones, but for the last post-trite one, were rubbed down, the first one putting out the dentine hollow. There are about three faces of rubbing which are clearly seen on the front three post-trite and the third pretrite cones, one sloping forward, one on the top and the other sloping back. The front edge of the tooth has a group of six mammillae joined to the front side of the first colliculus forming a chirolite-like ridge. In the middle of this ridge, there is a greater mammilla which is united with the front conule of the first pretrite cone. The back talon is made of about eight mammillae of which one in the middle is made much higher and greater with a round top than the rest. The ridge of talon is curved on the round back end of the crown and is well separated from the last colliculus. The cingulum is making a narrow terrace round the outer edge of the base. Only a low tubercle is seen on the cingulum at the outer end of the first valley. A small amount of cement is present in the valleys. Lower parts of the all cones are marked by horizontal parallel lines and very small folds. The front root is in the same direction as the axis of the first post-trite cone, but the back root is more sloping.

The dimensions of M_3 are:

Length	177 mm.
Width at 1st colliculus	74
„ 2nd „	74
„ 3rd „	73
„ 4th „	70
Height at 1st colliculus	162
Height of crown at 1st colliculus	49
„ „ 2nd „	61

The enamel is thick measuring 7 to 9 mm., made of two layers, a hard tight dark covering and a white rough lining inside.

The right second molar is an used and broken example. It is a trilophodont tooth with a low small talon. Complete enamel outline on the rubbed used face is put out in view by the last colliculus only. This tooth is measuring 95 mm. long, 66 mm. wide at the third colliculus and 70 mm. wide at the second colliculus. This size is greater than the second molar of *B. angustidens* in comparison with the last molar of the given size, that is to say, it is outside the range of *B. angustidens*.

Specific characters: A form of a great size, geographically separated from *B. angustidens*. M_3: subhypsodont bunodont, with four colliculi, post-trite cones with feeble subtapiroid angle; pretrite cones without serridentine angle, but with two small conules, smaller than that of *B. angustidens;* talon well separated, making a curved ridge. M_2: greater in size as to be a second molar of *B. angustidens,* trilophodont.

The third molar of this form is different from that of *B. sendaicus*

(MATSUMOTO, 1924) in having the more square outline and bunodont cones, while that species of the Upper Miocene of Japan has stronger subtapiroid angles; the tops of its cones are forming transverse colliculi as in *B. subtapiroides* and there are five lines of cones that is a condition a step forward in evolution.

B. yokotii seems to be very much like *B. wimani* (HOPWOOD, 1935) of China, but the last lower molar of the second is said to have no front pretrite conule and is marked by a special accessory structure of the posttrite series.

The geological age of the Upper Banko sandstone which is the last deposits in the cycle of the Meisen series, to my opinion, is the top of the Middle Miocene. This decision is in agreement with that *B. yokotii* is a form between *B. annectens* and *B. sendaicus* in evolution, without respecting the three forms are in one genetic line or not.

Bunolophodon sendaicus (MATSUMOTO, 1924)

MATSUMOTO gave no holotype, but he said three separate teeth probably of one and same individual are the types. No new discovery of this form outside the Sendai district has been made ever from that time. The last molars are of a form between the trilophodont and tetralophodont conditions, as it is like the special form $B.\frac{angustidens}{longirostre}$ of SCHLESINGER, 1921. In an opinion, the three cones on the back end may not be a talon, but the fifth colliculus and a talon cone. Such a form between two steps will not be very strange on a line of evolution, and a natural hybrid would be taken as probable, though we have no way to give a science test in palaeontology. From the point of view, the present species seems to have some relation with *Tetralophodon*.

Subfamily **Elephantinae**

Genus **Stegodon** FALCONER & CAUTLEY, 1847

Type: *Elephas insignis* FALCONER & CAUTLEY, 1847 (offered herewith).

The name *Mastodon elephantoides* CLIFT, 1828 the said type of *Stegodon* is not seen in Fauna Antiqua Sivalensis, though this name of species may takes the place of *S. cliftii* FALCONER & CAUTLEY, 1847 in agreement with the rule. In his later writings FALCONER says "The three species last described along with *E. insignis* constitute a peculiar section of *Elephas*" (Pal. Mem., vol. 1, p. 82) pointing clearly what he has in mind to take the representative of his new section *Stegodon*. This species is in the middle of the genus while *S. elephantoides* is in a position nearer to *Stegolophodon* or *Prostegodon* a group more early in development.

The teeth of *Stegodon* are not very good and safe to be dependent on in taxonomy, because these are in homoeomorphy or phenotype of different genetic lines. Take a molar of *S. insignis* and make it comparison with that of a Japonic form named *Parastegodon sugiyamai*; one might see some different marks of the two, the second being smaller, more hypsodont and more polylophodont than the first. Their crania, however, are little different marked by a specially flat head with a sharp angle in front. On the other hand, there is a group of teeth very little different from *P. akashiensis* as they may be looked upon in the limit of the one species, while its cranium is quite different from the first, being somewhat like that of *Elephas planifrons*. Other example in the same relation have been given in general account.

Characters of the crania, however, have not to be overvalued, because the greater sizes and forms are chiefly dependent on later development of diploë after birth, getting effects from outside as well as inside. I have a view that the flat and angled cranium of *S. insignis* is not a representative of special marks of a genus, but rightly that of a species, or a species group.

Stegodon with its narrowly limited distribution has been seemed to be a simple genus even by who is a maker of group names. *Parastegodon* MATSUMOTO, 1924, *Elephas aurorae* MATSUMOTO, 1915 as the type, is based upon an upper molar tooth which is said to be a form between that of *Stegodon* and *Elephas*. This name has been used by some palaeontologists of this country in a wider sense covering the Javan forms *S. ariwana* as well. I have no thought of separating the group. *Parastegodon* will be put on one side keeping in memory till a future need.

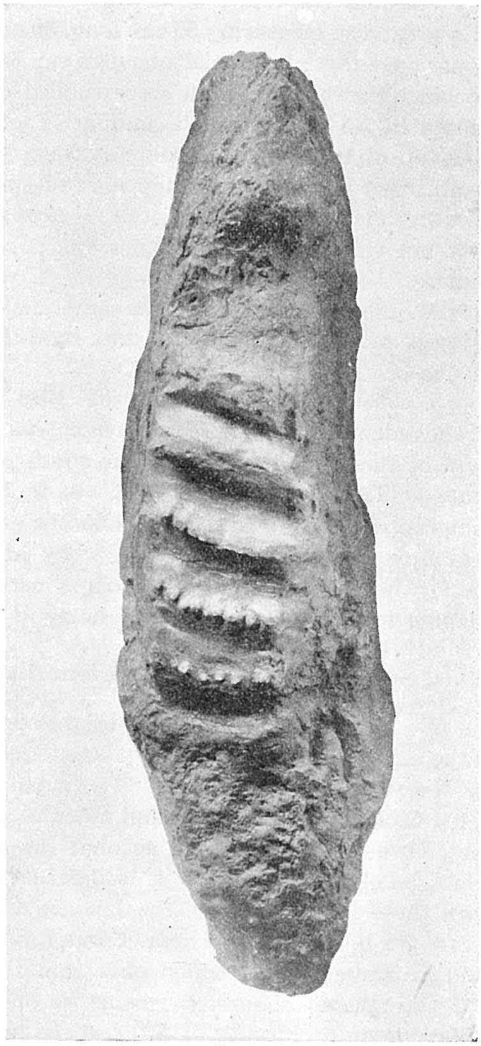

Fig. 6. *Stegodon* cf. *elephantoides*. ½

Stegodon cf. **elephantoides** (CLIFT, 1828)

Figure 6.

=*S. clifti* of MATSUMOTO, 1924 (Jour. Geol. Soc. Tokyo, **31,** 327)

Material: a broken part of mandible with two molars, from Agira in Ise (Mie-ken), Lower Pleistocene ?

The material under observation is a cast copy of a part of a ramus of a great size measuring 55 cm. long, 30 cm. high and 15 cm. wide. On the upper edge there is a molar about 25 cm. long and 11 cm. wide; six chirolites of which the three in front were rubbed down by use, are low and widely separated on top; a small amount of cement is present in every valley. The top of the fourth chirolite is made of nine mammillae. Under this tooth, deep in the bone, a top part of something like another tooth is seen. The tooth is in agreement that of *S. elephantoides* in some measure, though it is not clear which side of jaw the part be. It seems to be a second true molar.

Another example from the same place kept in the Science Museum is a lower molar measuring 290 mm. by 104 mm. with $_{\times}7_{\times}$. This size is that of the last molar.

S. cliftii FALCONER & CAUTLEY, 1846 was a name offered to a division of the older species *Mastodon elephantoides* CLIFT and it is a complete synonym of the second for which the tooth pictured by CLIFT in Fig. 6 of the plate 39 (Trans. Geol. Soc., ser. 2, vol. 2) is taken as the type. NAUMANN's material of *S. clifti* is smaller than the examples given here, and was made reference to *S. sinensis* OWEN, 1870 by MATSUMOTO. *S. sinensis*, however, having not come to our knowledges very clearly, is hardly taken for the Japonic form which is not like the type in detail.

Stegodon orientalis OWEN, 1870

We do not have enough material to do with. The best Japonic example is the mandible from Ikadati in Oomi (Siga-ken), reference to which made by NAUMANN was *S. insignis*. The type material of China is not complete, being broken bits of molars, and no more addition in detail have been made after OWEN, without taking account the note given lately by HOPWOOD, in which he gives reasons how it is different from *S. insignis*. In comparison with these type examples, the Japonic examples in that present of MATSUMOTO are better in finer details, but for the two upper jaws of Ube Coalfield in Yamaguti-ken which have some higher characters.

The species characters are as go on: The front and back sides of a colliculus or a chirolite of *S. orientalis* are straight slopes; the inner and outer ends are so made as to put out low triangle facets in view; the tops before use are forming straight edge; the cement in the valleys is poor; the back talon is made of a very low colliculus or cingulum, but not of hemichirolite; the teeth in all are almost equal in dimension to *S. insignis*. The cranium is probably like that of *S. bombifrons*, if *S. orientalis grangeri* OSBORN, 1929, of which a short statement on cranium was given, is a true subspecies of this species.

I have seen an upper true molar with 9 colliculi and a back talon measuring 226 mm. by 88 mm. A cast copy of this material, which is said to have been got from the sea base near Syōdo-sima, is kept and is one of new additions to *S. orientalis* examples. Broken bits of molar teeth from the Pleistocene in Taiwan are at hand of Prof. HAYASAKA and recorded by him as *S. orientalis.*

Place names where *S. orientalis* were made discovery are:
(1) Nansyō, Ikadati-mura, Siga-ken; (2) Inland Sea base off Syōdo-sima, Kagawa-ken; (3) Nagahama gravel hole, Minato-mati, Tiba-ken (not seen); (4) Kuzuu limestone hollow, Totigi-ken?

In the first place at a short distance from Ryūge the said place name of the NAUMANN's example by error, a thick bed of clay which seemingly had the *Stegodon* in is seen. In respect of time in geology of this clay which was made under a fresh-water basin, it does not come to decision, though to the best belief in general it is of the Lower Pleistocene. IKEBE (1933) gives an account on the stratigraphy in connection with other Pleistocene deposits.

S. orientalis was a form low in development, came straightly from the old *S. bombifrons* or its nearest relation *S. zdanskyi* HOPWOOD, 1935 and made its wide distribution in later times than *S. insignis* and other forms which were at a step forward in an earlier time. Up and down changes of the sea level from the later Pliocene till the end of the Pleistocene made a number of chances for the land animals to come into Japan and then they were locked in the islands while the times coming after. They were living under separate conditions. By this reason, we have different sorts of elephants in alternation, some like *S. orientalis* got straightly into this country and the others made special development on the islands. *S. orientalis,* in this way, seems to be a very sharp time recorder at least in this country, though the material at present is so poor that I am unable to say something more about its time in geology.

Stegodon shodoensis MATSUMOTO, 1924

Figures 7, 8 & 9.

=*S. orientalis shodöensis* MATSUMOTO, 1924 (Jour. Geol. Soc. Tokyo, **31**, 333) Material: (1) Cast copy of a palate part with ${}^{3}M^{3}$, one of the cotypes, made from the specimen kept in the Meizi Technical College (Fig. 7), got from the clay at the base of the Pleistocene, Ube Coal-field (at Onda Coal-mine). (2) Copy of ${}^{3}M$, one of the cotypes, got from the sea base off Syōdo-sima. (3) Copy of a broken mandible with ${}_{3}M$, got from the sea base off Syōdo-sima (Fig. 8). (4) A right ramus wlth M_2, property of Mr. T. MURAI, got from the sea base near Gunke in Awazi island (Fig. 9).

With the material at hand, we see different marks of this species from *S. orientalis* under which it was grouped by MATSUMOTO. First of all, it has the teeth in higher development, while it is much smaller in size. The molars are more hypsodont, and all the chirolites are fixed tightly in the mass of cement. The front and back sides of a chirolite being parallel to every another (certainly not parallel in the limited sense) are normal to the

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b

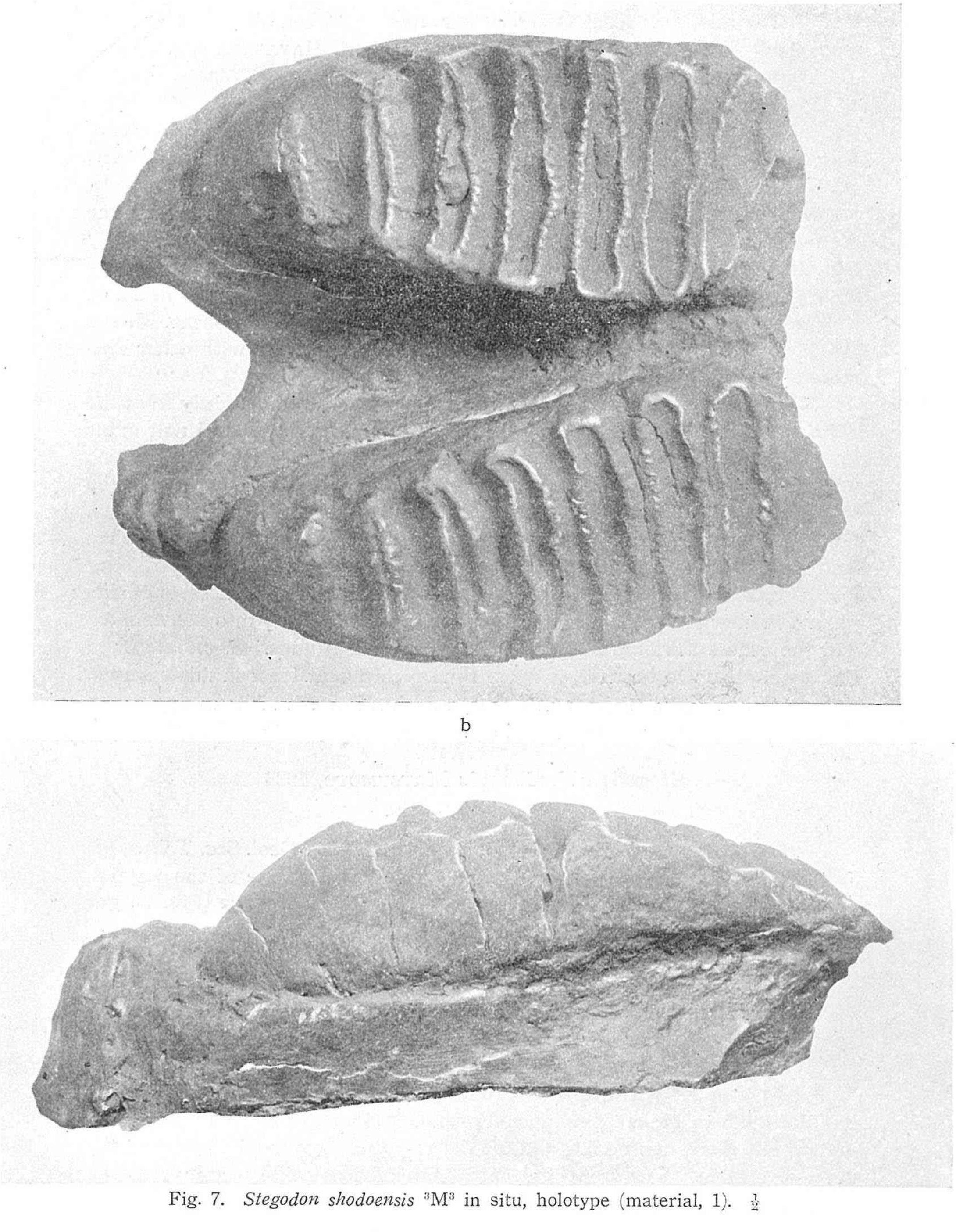


Fig. 7. *Stegodon shodoensis* $^{3}M^{3}$ in situ, holotype (material, 1). $\frac{1}{2}$

base, but for the lower part near the base, where the chirolite is made thicker, so that the valleys are U-form making such a comparison with the V-form ones of *S. orientalis*.

The material of MATSUMOTO was not enough to give full details of the species, but it was named before *Parastegodon akashiensis* TAKAI, 1936, which seems to me to be in the nearest relation, as it may have a new name form *S. shodoensis akashiensis*. More comparison with the second will be made in later pages.

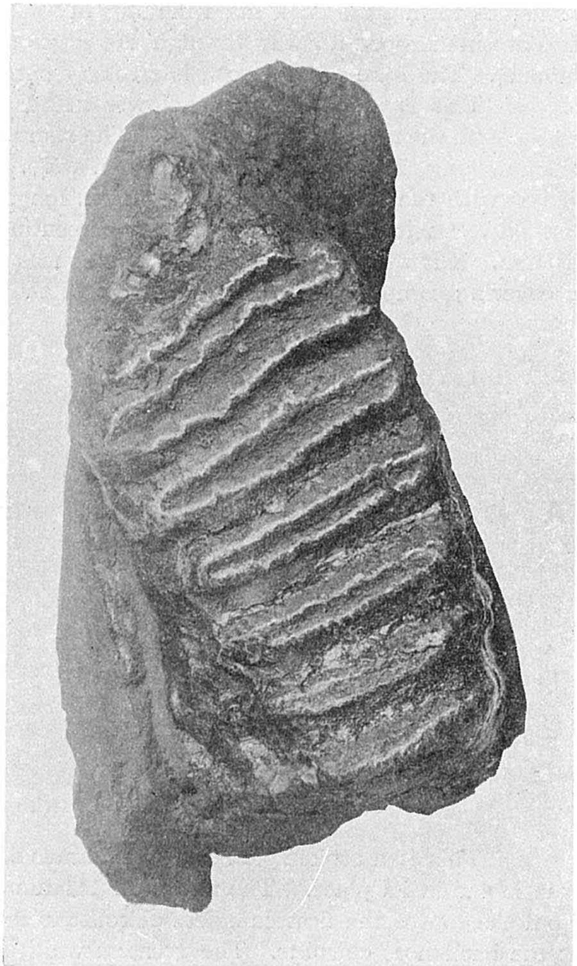


Fig. 8. *Stegodon shodoensis*, $_{3}$M, material 3. $\frac{1}{2}$

(1) This palate was pictured by TOKUNAGA and IIZUKA in the Memoirs of Waseda University (Geological Studies on the Ube Coal-Field, pl. 6, 1930) with a short note how it took place. Nothing in detail about the bone comes to light, but that the teeth are in their places as they were. There is loss of some chirolites in front, so that the number of chirolites and the true lengths of the teeth are not made clear. The left one is 208 mm. and the right one is 202 mm. long, every one keeping 9 chirolites. They are about equally wide, the widest part measuring 85 mm. at the third chirolite in front. The crowns are 45 mm. and 50 mm. high at the back ends of the left and right rubbed faces. The narrowest distance between the two insides is 20 mm. measured at the right third chirolites, while the distance between the two back ends of the crowns is 135 mm. These two teeth would be the last true molars, judging from the narrowed back ends. If they were complete, they would have been much longer than the measures. The first

chirolite in keeping seems to be the second or third ones, as there are hollows of bone in receipts of the front roots in front of the broken ends of the crowns. All the chirolites are deep in cement mass, which is covering the sides, so that enamel ends of chirolites are not able to be seen from a side view.

(2) This tooth has eleven chirolites and one hemichirolite at every one end; it is measuring 260 mm. long, 94 mm. wide (widest, at the sixth chirolite) and 55 mm. high (highest crown height, at the seventh chirolite). The cement is forming a thick mass making full of the valleys, but the chirolites are made open all way through the edges by weathering and natural rubbing. The base of the tooth is strongly curving.

(3) This is an example of a lower mandible, being a part of a left ramus with the last tooth in its place. The ramus part is measuring about 250 mm. long, 145 mm. high and 125 mm. wide. The sloping diastema together with the symphysis is about 11 cm. long. The tooth would be the last one, but its back part is broken presenting only seven chirolites in 150 mm. It is widest at the fourth chirolite measuring 89 mm. The cement is covering completely all the outer ends of the chirolites.

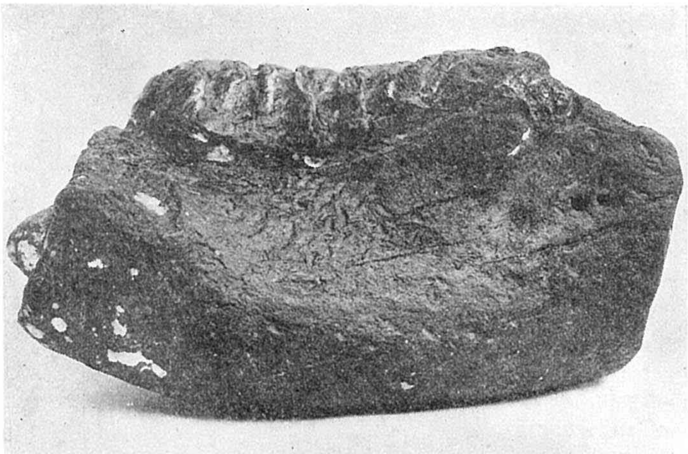


Fig. 9. *Stegodon shodoensis*. lower jaw with M_2, material 4. $\frac{1}{3}$

(4) This is a broken part of a right ramus of mandible with the second true molar in its place. The ramus is 144 mm. high in front measuring from the top of the first complete chirolite to the base and is 130 mm. high at the back-most chirolite. The greatest width is 104 mm. measured near the back end. The base is well rounded having no angle. The molar is 189 mm. long with 8 chirolites and a back hemichirolite which are deep in the mass of cement. The front end is not complete, but the true chirolite formula may be $_{\times}9_{\times}$. Widths of chirolites are: 79 mm. at 3rd (if $_{\times}8_{\times}$), 81 at 4th, 80 at 5th, 77 at 6th, 75 at 7th and 71 at 8th. The valleys are U-formed, and made wider to the inner post-trite side. The outer ends are

covered by thick cement. The material which was under the sea off Gunke on the west side of Awazi island was present for observation through Prof. KOMAKI of this University. This place is not very far from the very interesting sea-side place near Akasi where other forms are kept in different levels of the strata.

In addition to the (1) and (2), two other examples were the types of *S. orientalis shodoensis* of MATSUMOTO. Here the first example came from Ube is fixed to the only one holotype of the species.

The type was in the lowest part of the later deposits which are covering the Tertiary coal-measures. Geology of the Ube Coal-field was worked out in detail by TOKUNAGA and IIZUKA, and the time of the *Stegodon* bed is said to be Upper Pliocene of Lower Pleistocene. This may be true in a rough statement, though no decision in detail is able to be made at present. We have no more knowledge of the under sea geology round Syōdo-sima than that there may be deposits of different times.

One more material from Ube is a form in doubt. It is a palate with two third true molars and now kept in the school of geology at Tōkyō University. It is certainly greater in size and the chirolites are more widely separated than in the type *S. shodoensis*, but the chirolites are deep in cement unlike in *S. orientalis* to which it has been made reference. This form may not be in the limit of the Chinese species, though it is possibly a variety of *S. shodoensis*.

Stegodon shodoensis akashiensis (TAKAI, 1936)

Figures 10, 11 & 12.

=*Parastegodon akashiensis* TAKAI (Proc. Imp. Acad., **12**, 19).

This form has been given details by two university men F. TAKAI and T. SHIKAMA at the same time not dependent on every other. TAKAI takes an example of an upper molar, which is a private property of Mr. M. SAKURAI who got it in the *Stegodon* clay at Nisiyagi near Akasi, as the type, and his account on the new species is simply based upon observations with care about this example; while SHIKAMA has given a more general idea of his new species which has been made up with mixed materials.

The *Stegodon* clay at Nisiyagi is one of the most important units from the view point of Proboscidea palaeontology, because the bed keeps a great number of fossils. There are at least two different sorts which crania are kept in the Girl's Normal School of Akasi. A cranium which camera picture is given by SHIKAMA seems to be that of the present form judged by the teeth. Strange to say, it is like that of *Elephas planifrons* FALCONER & CAUTLEY, 1846, having a wide, flat and smooth front head. The other form is that of *S. insignis* FALCONER & CAUTLEY, 1846. The two forms were not living at the same; the first was in the green clay of the upper part, while the second was in the lower part made of sands. The name of species *Parastegodon akashiensis* would be given to the first. As I have given statement before, some qualities of teeth in *Stegodon* are common to two or more sorts of the same place. The teeth of *S. shodoensis akashiensis* may be seen how different from the other form of the lower level in very fine details only.

There is a thought that *S. ganesa* is the male of *S. insignis* which is male. Though this idea may be true, it has to be tested with more observations full in care.

Material: (1) Left ramus of mandible with $_3M$ (Fig. 10), from the *Stegodon* clay at Eigasima near Akasi, given by Mr. TANAKA; (2) M^3?, from the same place as the top, given by Mr. TANAKA; (3) Cranium with $^2M^2$ (Fig. 11), kept in the Akasi Girl's Normal School, copy in this university, in the *Stegodon* clay under the sea off Hayasi-zaki; (4) Copy of the holotype.

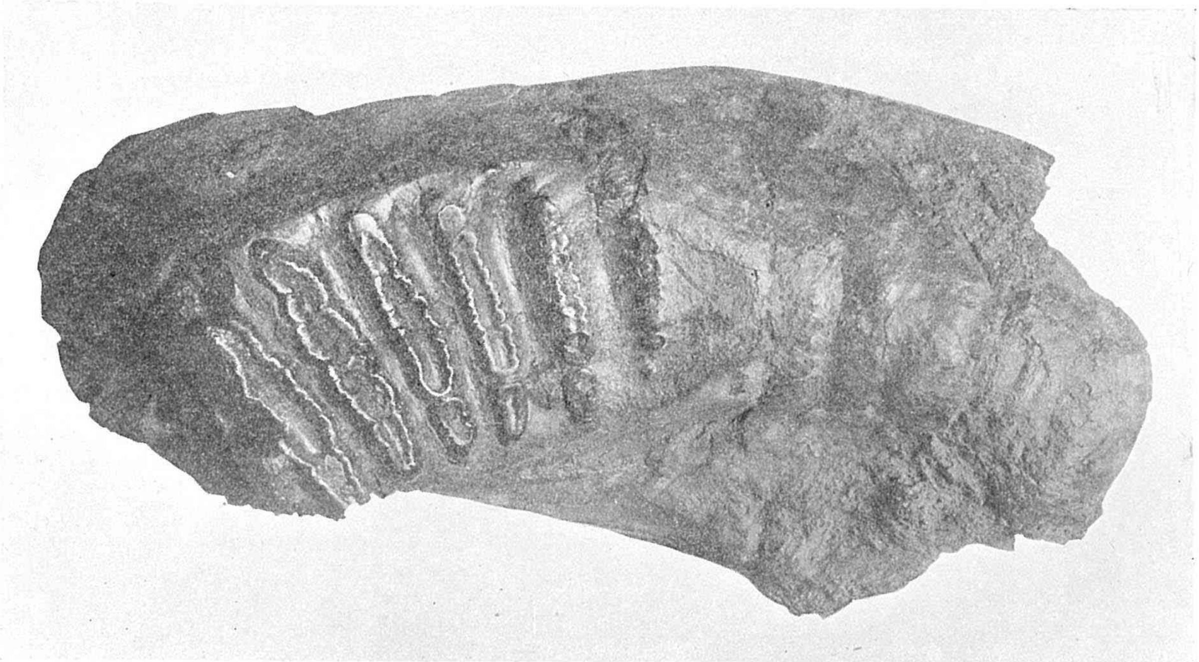
The only one example of the lower jaw (1) does not keep its front parts —diastema and symphysis. At the front end, we see the hollow in receipt of the front root of the molar. The ramus is 149 mm. high in front measuring from the base to the front end of the tooth and 114 mm. high at the middle measuring from the base to the back end of the used face of the tooth, while it is 149 mm. wide at the middle. The molar is long and strongly curved. The distance from the broken front end to the back side is 248 mm. and when complete it might be about 35 mm. longer than this measure. The present length measured on the curve is about 260 mm. There are 12 complete chirolites and a broken bit of the front-most chirolite. Hemichirolites are not kept on the two ends. The formula when complete seemed to be $_\times 13_\times$. Distances from side to side measured at different chirolites are (in mm.): 82 at 3rd, 91 at 4th, 88 at 5th, 89 at 6th, 87 at 7th, 67 at 13th. The last chirolite is 54 mm. high by 67 mm. wide and top edge is rounded. The used face is 132 mm. long with 7 chirolites and its front end is 42 mm. high from the base of the crown. The front root seems to be as long as 56 mm.

All the chirolites are deep in the cement which is covering the sides of the tooth, giving such a look as if the tooth is made of cement. The inside cement cover is less thick than the outside one. The outline of the used face is clearly marked on the cement. The enamel is thin in comparison with that of *S. shodoensis* and *S. insignis*, so that the step-forming on the used face is not well marked. It is more or less regularly folded, but without any special plica. Fissures on the chirolites are feeble not giving a strong contraction on the rubbed face, but for that made by the outer lateral fissures.

The material (2) is an uncomplete tooth made smaller by sea waves. It is in a stone full of clay substance measuring 215 by 90 mm. The tooth might be a little longer but narrower in comparison than this measure. There are $_\times 11_\times$ chirolites which are well separated from every other. The enamel is thin as in the other examples.

(3) This is the front part of a cranium; still, it is a very important material of this species, for it is enough to make comparison with other crania of *Stegodon*. The head is high, making a sharp occipital crest on the top of a very wide and flat front head. Near the crest and parallel to

a



b

Fig. 10. *Stegodon shodoensis akashiensis*, $_3$M, Material 1. $\frac{1}{2}$

Fig. 11. *Stegodon shodoensis akashiensis*, cranium, material 3.

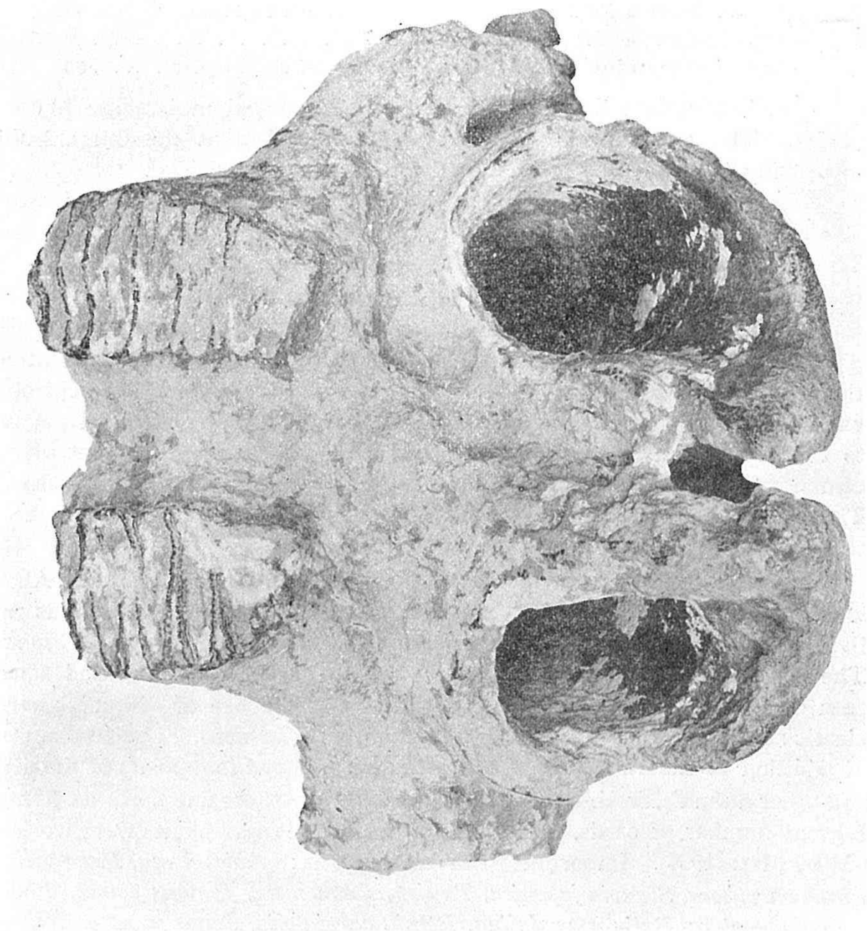


Fig. 12. *Stegodon shodoensis akashiensis*, $^{2}M^{2}$ and base of material 3. $\frac{1}{4}$

it, there is a feeble transverse ridge like that of *E. planifrons*, as the example is full in growth. The parietal contraction is stronger, while the nasal orifice is greater in relation to it than in *E. planifrons*. The back part of the cranium has been gone away from the diploë inside the front head.

The dimensions are: (in cm.)

Greatest length of cranium from shallow inlet on occipital crest to broken front ends of premaxillae	62 cm.
Distance from side to side of occipital crest	40
Parietal contraction	27
Long diameter of nasal opening	16.4
Short diameter of nasal opening	8.5
From occipital crest to upper edge of nasal opening	20

Greatest width at postorbital processes	48 cm.
From front edge of nasal opening to broken front end of left premaxilla .	35
Greatest distance from side to side of premaxillae together	30.5
Long diameter of alveolus of incisor	0.85
From right top of occipital crest to used face of right molar	53

The last molars have been broken. The second molars are in their places. The right one is 123 mm. long and widest at the 6th chirolite measuring 78 mm. The enamel is thin and regularly folded.

The holotype seems to be an upper right first true molar with a formula $_{\times}7_{\times}$ in 146 mm., and it is widest at the third chirolite measuring 71 mm. The front end has been used up with a loss of the front hemichirolite. The used face is a little curving in by the greater loss of the inner pretrite side, though the face in all is curved out as the tooth is the upper one. The post-trite lateral fissure is deeper than the others giving a marked contraction. The back hemichirolite is a small, narrow and curved back chirolite with 11 mammillae on the top, and its side ends are straight and normal to the base. The tooth has been weathered and a great amount of the cement has gone. The U-form valleys are wider to the post-trite outer inlets. The enamel has small regular folds and its rubbed top does not make a well marked step-forming.

All the examples were in the *Stegodon* clay on the sea-side near Akasi and in a higher level than that of *S. insignis.* It is certain that it was not living together with the second or other species of *Stegodon* and *Elephas.* The clay beds in all seem to be much thicker than 15 m. clay and sands seen on the sea-side. Near the top, there is a thin bed of white fine pyroclastic material which is a good key to this series of beds. The fossils are, in addition to the two sorts of *Stegodon,* a deer, some foot-prints of the deer and other animals, fresh-water molluscs which are the same sorts as living, a great number of seeds, leaves and woods. The fossil plants were worked out by MIKI (1936). Important forms are such as: *Abies firma, Picea polita, Pinus parviflora, Sequoia japonica, Thujopsis dolabrata, Juglans cinera, Pterocarya stenoptera, Salix amygdalina, Betula carpinfolia, Fagus crenata, Zelkova ungeri, Magnolia obovata, Prunus* cf. *sibirica, Rosa akashiensis, Sorbus pekinensis, Ilex cornuta, Acer nordenskiordi* and *Styrax japonicum.* MIKI has a thought that the flora was living upon a high plane some 700 m. over the sea-level at that time, because there are forms living on the mountains. His opinion about the time in geology is that it is so old as Pliocene for the flora is equal to that of Mogi and Yokohama in some measure. The view will be supported in part but not at all. The living places of the plants as they are at present may not be complete finger points to the old time when the condition was quite natural. It is not simple to make out clear how the sea-level has been changed after the Pliocene time in this place. There were at least four up and down changes of the sea-level while the Pleistocene of Japan as in the same way as in Europe, but at the same time, operations by orogenesis did more works to the strata made before the Pleistocene.

To my knowledge, the *Stegodon* clay was made under a wide stretch of water on one of the basins into which the sea water came by force while a time coming after deposited the *Elephas* beds the second group to the *Stegodon* clay. The erosion between the *Elephas* beds and the *Stegodon* clay was feeble, and the two groups of strata are nearly flat and parallel, giving no suggestion to a quick fall of the sea-level. On the other hand, there was not at all move by violent force of orogenesis. The time in geology of the *Stegodon* clay might be Pliocene in agreement with the views of MIKI and SHIKAMA. The new work by HELLMUT DE TERRA (Nature, **137,** 689, 1936) is different from G. E. PILGRIM (Am. Mus. Nov., **704,** 1934) about the times of the Cenozoic stratigraphy in India, taking the Tatrot as the lowest level of the Pleistocene. An opinion like this will be made here. I have to say the *Stegodon* clay is still in question.

S. shodoensis akashiensis is a form in relation with *E. planifrons* having the cranium of the same type. Not only this, but the teeth, in addition, are not so far from the second in development, though their looks are very different, and in having no loxodont expansion.

Stegodon insignis sugiyamai (TOKUNAGA, 1936)
Figures 13, 14, 15 & 19.

=*Parastegodon sugiyamai* TOKUNAGA (Proc. Imp. Acad., **11,** 432)

TOKUNAGA's species is based upon an upper left first or second molar came from Sikoku. This type might be a sort not in connection with *S. insignis*, but as it is less probable that such forms like in look had existences together at the same time in the same basin, I make expansion of the species. The species in wider sense is covering a form in very near relation to *S. insignis* of India with the same form of cranium. A number of the examples were made discoveries in the *Stegodon* clay at Eigasima near Akasi. Two broken crania, one palate and a number of teeth are the properties of the Akasi Girl's Normal School, got together by Mr. I. KURAHASI. We keep a mandible in full growth with two last molars which was presented by Mr. TANAKA of Eigasima (material, 1).

This form is smaller in size than *S. insignis* of India. The molars are a little more hypsodont. While the cranium is very different from that of *S. shodoensis akashiensis*, the teeth of the two sorts are very much like. It is hard to give the separating details of these teeth. Saying in general, however, those of the present form has thicker enamel, a less amount of cement and narrower V-form valleys. The two side ends of the chirolite are flat making angles with the side faces, while that of the other species under comparison are narrow and round, but for the wider lower part near the base. On the used face, the rubbed tops of the chirolites are step-forming. The step-forming that is the "Stufenbildung" of JANENSCH (1911) is a general quality common in all *Stegodon* teeth, though it is not clearly marked in some forms, for example in *S. shodoensis akashiensis*. The fissures on the chirolite heads are deeper in *S. insignis sugiyamai*, making a number of contractions of enamel layer on the used face.

Material: (1) A broken mandible with ${}_3M_3$ (Figs. 13, 14), Eigasima near Akasi; (2) Cranium with ${}^2M^2$ and ${}^3M^3$ (Figs. 15, 16), off Hayasizaki near Akasi; (3) Cranium, off Hayasizaki: (4) M^3, Huzie near Akasi. The normal school at Akasi keeps one more upper jaw, a right ramus of mandible and some uncomplete upper and lower teeth.

The mandible (1) is in two separate parts, right and left rami, which do not come to a tight touch on their front broken ends with a small loss of bone substance from the cracks, so as it is not possible to make clear the complete form of the lower jaw. The sloping rami were broken to come short of the condyles. The side view of the mandible, as in the picture, is like that of *S. insignis* and *S. ariwana*. The dimensions of the right ramus are (in mm.):

Height in front, from base to front end of molar	144 mm.
Height at the middle, from base to used face of molar at 6th chirolite	132
Same at alveolus	115
Widest diameter across back end of horizontal part	126
Distance from broken front end to back end	296

Those of the left are:

Height in front, from base to front end of molar	139 mm.
Height at the middle	122
Height at alveolus	100
Diameter	124
Distance from broken end to end	250

The mandible in comparison with that of *S. insignis insignis* is much smaller in size, but nearly equal to that of *S. shodoensis akashiensis* and *S. ariwana*. The two molars are curving and the used faces are sloping out forming a shallow concave basin, the pretrite side having been rubbed more. The right last true molar is 223 mm. long with a formula ${}_{\times}12_{\times}$. The widths of the base are (in mm.): 76 at 3rd, 78 at 4th, 80 at 5th, 81 at 6th, 78 at 7th and 62 at 12th chirolites. The used face is 128 mm. long from the front end to the back side of the 7th chirolite and 69 mm. wide at the 3rd chirolite. The front hemichirolite and the first chirolite were used up with complete losses of the enamels to make a table place of dentine. The second chirolite makes a long square cut near its base. The third chirolite puts out a feeble back loxodont plica in view. The fourth one has 4 contractions and its rubbed top is step-forming. The fifth one is cut making two round side and band-like middle enamel outlines. The feebly rubbed top of the sixth chirolite is made of 9 mammillae. The ends of the chirolites are flat, rough and with 2 to 3 longitudinal folds. The tooth is subhypsodont, the chirolites being a little higher than in *S. insignis*. It is not clear how high the crown, because the lower part of the tooth is in the bone. Distance from the back end of the base at the middle to the top of the 12th chirolite is 45 mm. The used face is 39 mm. high from the base measured on the outer end of the 6th chirolites, while it is 48 mm. high on the inner end. Roughly to say, the highest crown height is about 5 cm. The cement is in well development, covering all the chirolites not in use. The hemichirolite is very small and deep in the cement.

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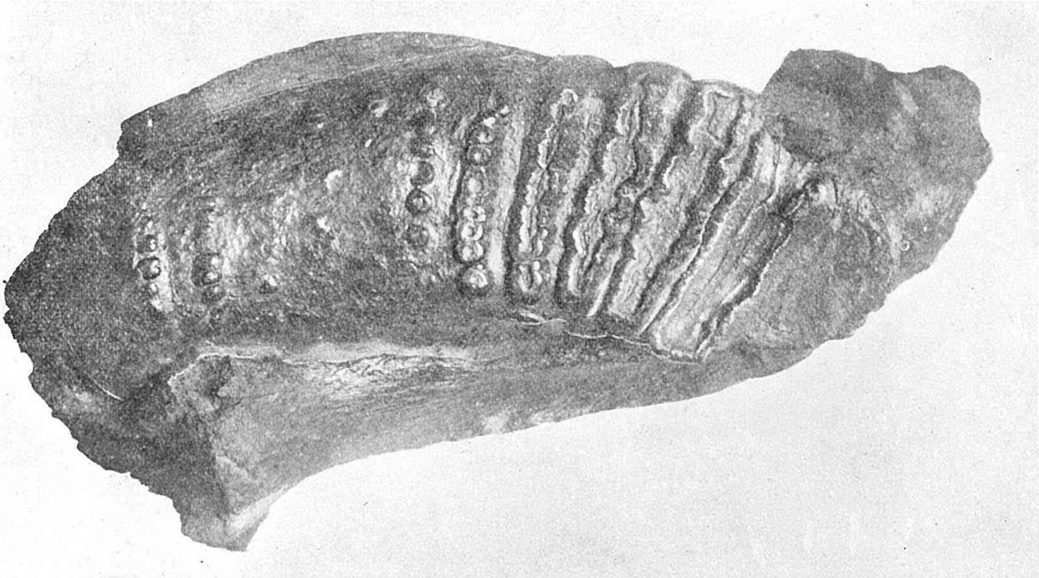

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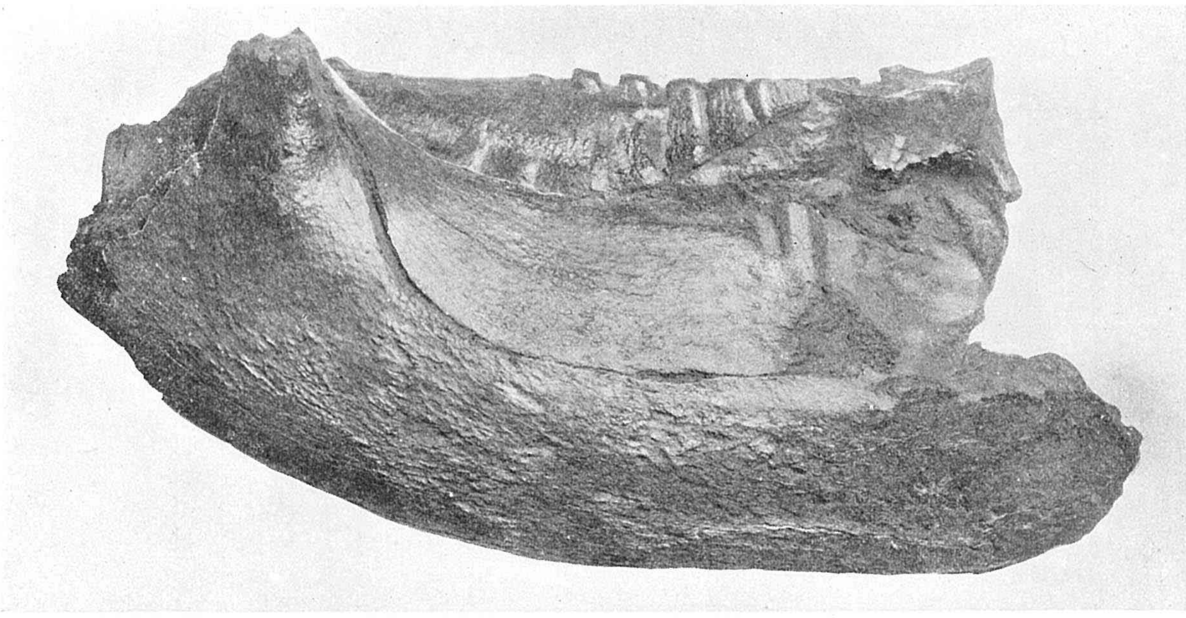

Fig. 13. *Stegodon insignis sugiyamai*, right ramus, M_3 in situ, material 1. $\frac{1}{2}$

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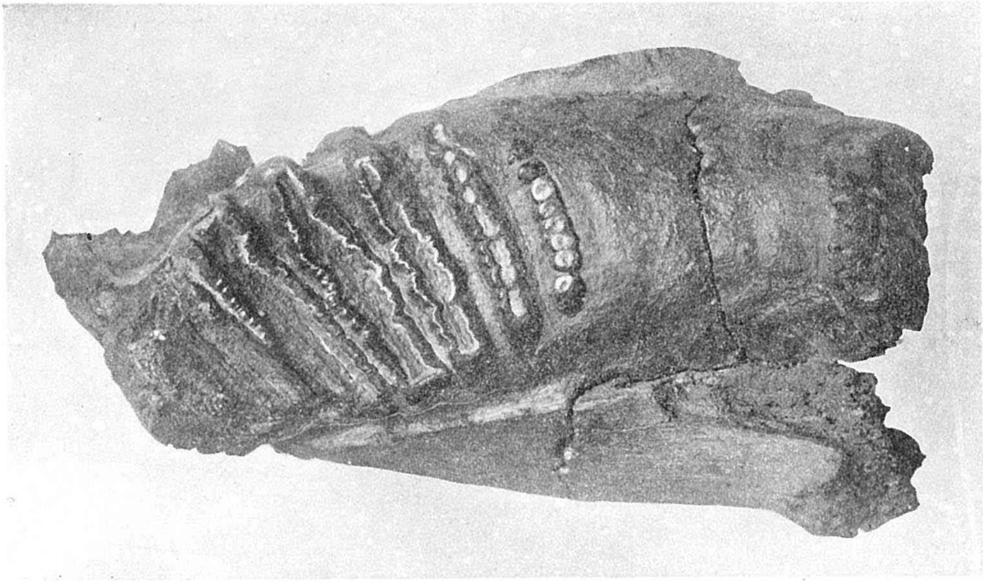

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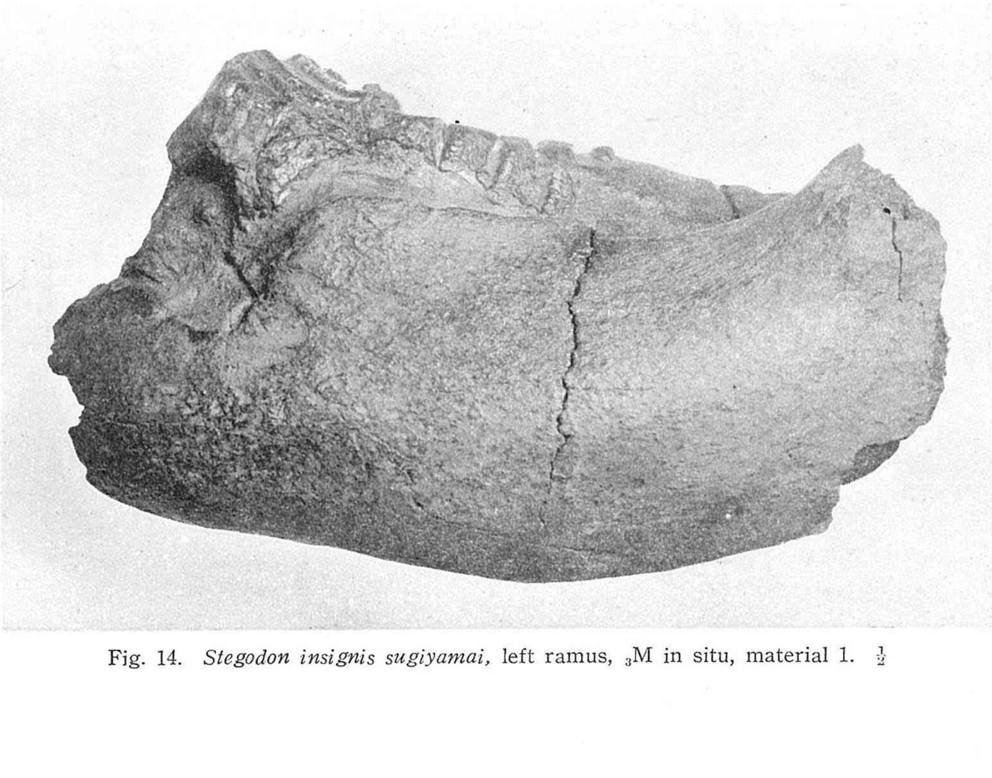

Fig. 14. *Stegodon insignis sugiyamai,* left ramus, $_3$M in situ, material 1. $\frac{1}{2}$

The left molar is 208 mm. long and 79 mm. wide with 11 complete and a broken chirolites. The hemichirolites are in loss. The widths are (in mm.): 58 at 2nd, 73 at 3rd, 76 at 4th, 77 at 5th, 79 at 6th and 7th, 77 at 8th, 70 at 10th and 11th, 63 at 12th chirolites. Height at the 12th chirolite is 47, while the highest height is about 50 mm. at the 6th. The used face is 126 mm. long with 8 chirolites and 67 mm. wide at the 4th chirolite. The front end is broken. The enamel outlines upon the rubbed tops are like those of the right tooth.

Fig. 15. *Stegodon insignis sugiyamai*, cranium (2). $\frac{1}{8}$

The cranium (2) is damaged very much at different parts, but still it keeps the special marks of the head in *S. insignis* very well. The front head is made low and has a transverse angle. On the upper edge of the nose hollow, there is again a feeble transverse angle. The form makes a marked comparison with that of *S. shodoensis akashiensis*, which is not like *S. ganesa*. As has been given a short account, *S. shodoensis akashiensis* and *S. insignis sugiyamai* do not take place in the same level of the *Stegodon* clay at Eigasima, but the second is in an older level at least at that place. The different crania are the best finger points of the two species which are hardly separated by teeth only. The example was got by a fisherman from the sea base off Hayasizaki some years before. The dimensions are (in cm.):

Distance from end to end of vertex	45 cm.
Distance from middle of vertex to broken front end of premaxillae	57
Longer diameter of nose opening (left-right)	15.5
Shorter diameter of the same (top-base)	8.3
From upper edge of nose opening to front head angle	45
Diameter of premaxillae	29

There are two groups of teeth, of which the front ones are the second true molars and the back ones are the last molars with a formula $_{\times}12_{\times}$. The right last true molar is 27 cm. long by 3 cm. wide at the fourth chirolite. The front teeth are in damage but the left one is measuring 16.2 by 7 cm. at its broken base. The enamel is so thick as in the first example and has a number of contractions and a well-marked step-forming.

The second cranium (3) is came from the same place and measuring:

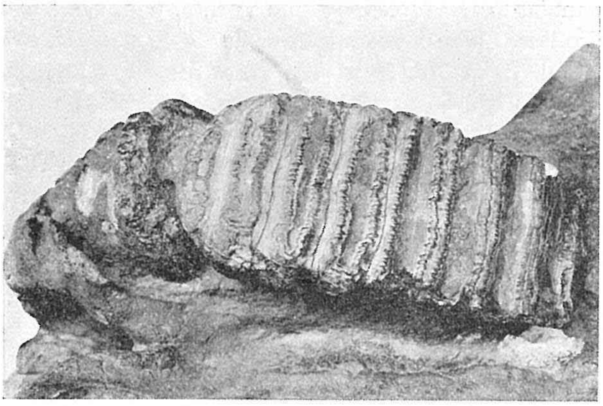

Fig. 16. *Stegodon insignis sugiyamai,* M_2, material 2. $\frac{1}{5}$

from end to end of vertex, 37.7 ; from left to right of front head, 28.2 ; from middle of vertex to broken front end of premaxillae, about 50 cm.

The material (4) is an upper right last true molar of a greater size. The front end was broken off, the rest is 199 mm. long with 12 chirolites and widest at the fourth chirolite measuring 98 mm. The formula may be $_{\times}12_{\times}$. This is the only example got in the *Stegodon* clay over the sea water.

Stegodon sp.
Figure 17.

Here is a broken part of a lower jaw with a left molar which is not complete. It was in the Upper Pliocene bed at Wakui in Yanagiwara-mura, Simo-Minoti-gōri, Nagano-ken (Sinano) and given to this school by Mr. MIMURA. The stratigraphy of this district was worked out by KIMIZUKA and he gives the accounts in a book "Geology of Simo-Minoti" got out from the education society of that district.

The bone is a middle part of ramus 11 cm. wide and 9 cm. high. The tooth is much weathered, a great amount of the cement having gone and its two ends are broken off. It is 137 mm. long at present condition with seven chirolites which are subhypsodont, and 61 mm. wide in front, 66 mm. wide at the back-most chirolite in keeping. The widest measure is 68 mm. at the second chirolite from the back end. The complete back-most chirolite is about 5 cm. high, and its top made of 7 mammillae is 39 mm. long. The used face is sloping to out, and the inner edge of the complete chirolite is shorter than the outer edge, measuring 49 and 51 mm. The valleys are narrow and V-form to the inlets, while wide and U-form to the outlets.

The general form of the chirolite is like that of *S. shodoensis akashiensis,* though it is not right to give up *S. insignis sugiyamai* for comparison. On the other hand, there are two other names to have to take into thought: *Parastegodon aurorae* MATSUMOTO, 1926 and *P. kwantoensis* TOKUNAGA, 1934 which are species of the Upper Pliocene. The first is the type of MATSUMOTO's

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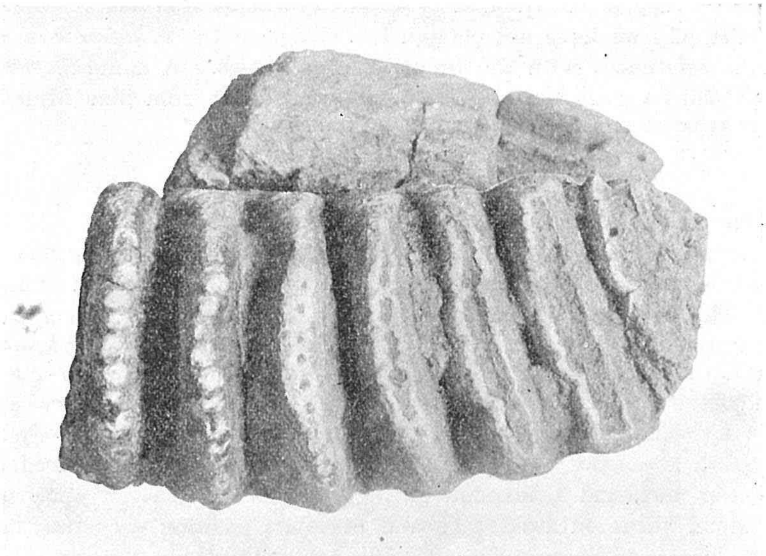

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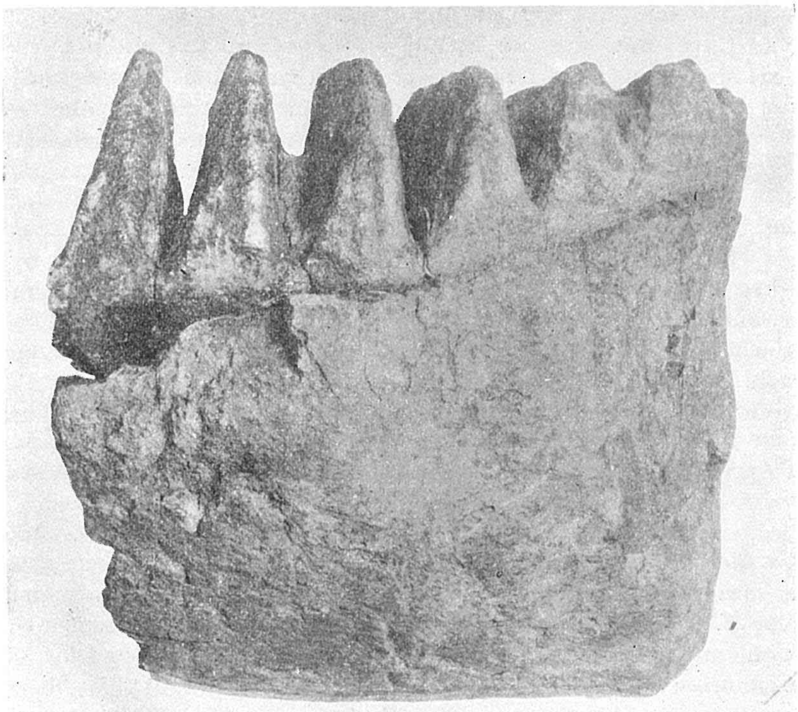

Fig. 17. *Stegodon* sp. cf. *aurorae,* a left lower true molar and the jaw. $\frac{2}{3}$

Parastegodon which is simply a more subhypsodont type of a *Stegodon* and the species may be a synonym of another form as well as the second.

Unhappily we have not enough knowledge of the *S. aurorae* in detail to make references with the Inland Sea examples. A name *Stegodon* cf. *aurorae* will be used for the present material came from Simo-Minoti and for the type of the *Parastegodon kwantoensis.*

Genus **Elephas** LINNÉ, 1758

Type: *Elephas maximus* LINNÉ, 1758 (monotype).

The type species is the Indian Elephant of Ceylon. The genus being the last representative of Proboscidea has true hyperlophodont hypsodont teeth. The chirolites became much higher than wide giving a comparison with the subhypsodont ones of *Stegodon.* All the chirolites of *Elephas* are made in the same design of structure. Units of a chirolite form are: 1) median fissure, which is a natural crack at the middle or the rest of the middle division-line of a mastodon tooth, 2) two lateral fissures, which are natural cracks deeper than the middle one, giving a look of three-forking of the top part, and 3) loxodont plica, which is the greatest plica among longitudinal plicae on a side-face and takes its position very near to the median fissure on the pretrite side; two loxodont plicae on every chirolite, one in front and the other in back. Small mammillae on the top and the plicae on the side-faces are less important.

The three units are not equally strong, being different not only in different species but in different geographical races and biotypes within a species. The plicae are strong in stenocoronine type; on the other hand, they are feeble in eurycoronine type. In stenocoronine polylophodont *E. africanus,* the chirolite is widest at the middle forming an angled expansion which is made of two loxodont plicae putting out a rhomb outline of enamel-cutting. In stenocoronine hyperlophodont *E. maximus,* the enamel is strongly folded, while the loxodont plicae are very feeble. In eurycoronine hyperlophodont *E. mammonteus,* the enamel is little folded. These three examples of the younger times are well separated being the representatives of different types, while the fossil forms in older times frequently have such types in common. There were probably a number of natural hybrids, which have the teeth of mixed qualities. The different designs of teeth in detail are of different phenotypes in a simple line with some number of genotypes.

To my view, finer division of the old genus *Elephas* is not necessary, but for *Loxodonta* CUVIER, 1827 and *Archidiskodon* POHLIG, 1888 which are grouped as subgenera under the genus being polylophodont forms. *Palaeoloxodon* MATSUMOTO, 1924 will be united to *Elephas;* this name gives a wrong idea that it is an early form on the same line as *Loxodonta,* though the type *E. namadicus naumanni* is a more hyperlophodont form. Other synonyms are *Mammuthus* BURNETT, 1830, *Dicyclotherium* GEOFFROY, 1837, *Mammontheum* BLAINVILLE, 1845, *Mammonteus* OSBORN, 1924, *Polydiskodon* POHLIG, 1888, *Sivalikia* OSBORN, 1924, *Euelephas* FALCONER, 1857, *Hesperloxodon* OSBORN, 1931 and *Parelephas* OSBORN, 1924.

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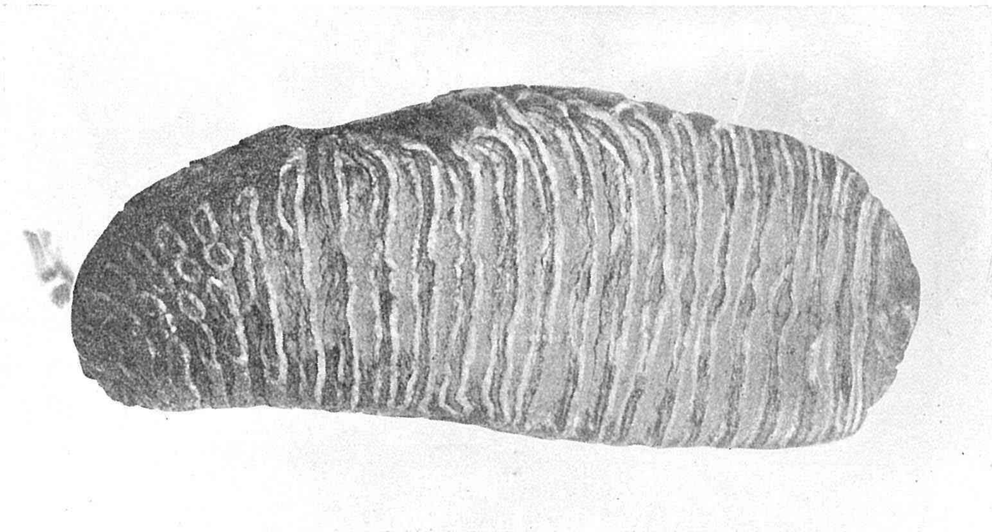

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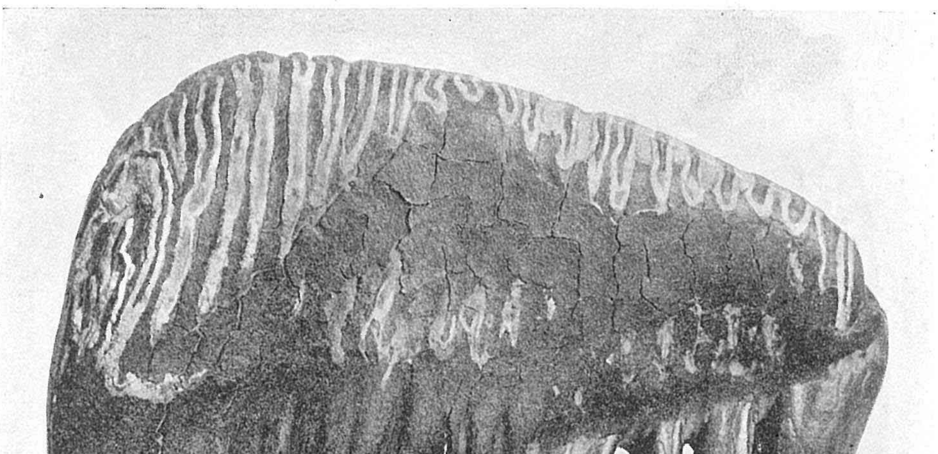

Fig. 18. *Elephas mammonteus* [*E. primigenius*], ³M, Yūbari. ½

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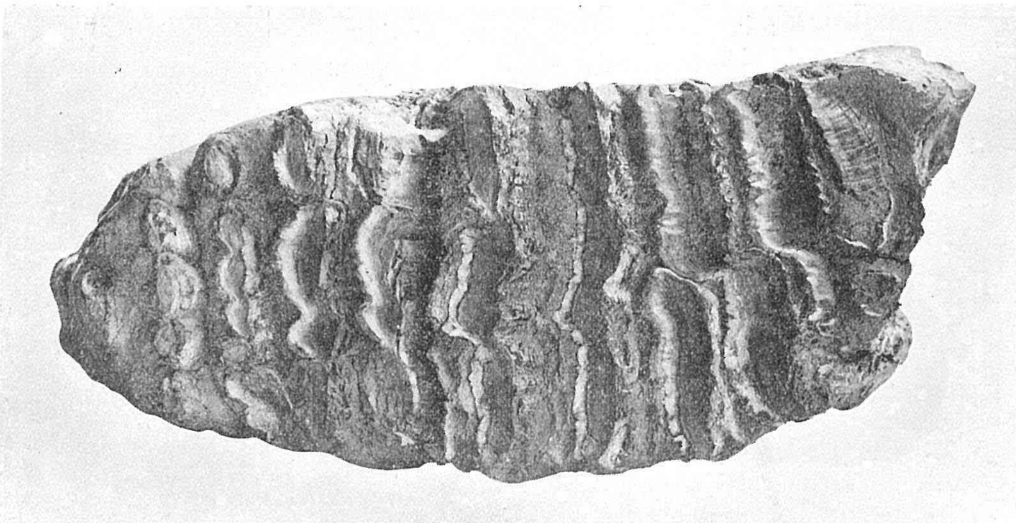


b

Fig. 19. *Elephas* cf. *trogontherioides*, ^{3}M, Nonni. $\frac{1}{2}$

Elephas mammonteus CUVIER, 1798
Figure 18.

Synonym: *Elephas primigenius* in common use, not BLUMENBACH, 1799.
Material: ^{3}M, from Yūbari, Hokkaidō.

An upper left last molar came from Yūbari seems to be only one example of *E. mammonteus* in Japan outside of Sachalin. It is brown outside, and a little weathered putting out white enamels, brown dentines and light brown cement in alternation on the top face. The dimensions are (in mm.): 142 high at back end (greatest height), 90 wide at 10th chirolite (widest), 82 at 5th, 75 at 16th, formula $_{\times}24_{\times}$, chirolite 5 to 9 thick, cement 2 to 7 thick, enamel 1 to 2 thick, dentine 2 to 6 thick.

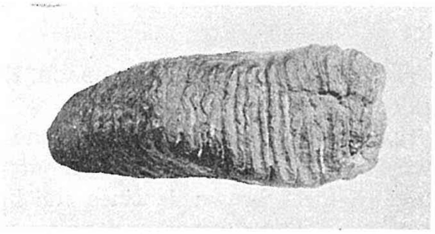
The sides are covered by the cement which is flat and smooth not making waves by the chirolites edges inside. The used face is oblong ovate in outline. The front seven chirolites were made lower to put out their loxodont expansions in view; loxodont plicae though very small are well marked. Back chirolites outside the used face were rubbed by weathering putting out their four-forked tops. The enamel is little folded, but for some longitudinal plicae on the sides; it is not so hard and tight as in other species, even a little softer than the dentine. By this reason, the used face, though made somewhat rough by three different substances, is quite smooth and flat in comparison with other common forms. Saying in the limited sense, the substance of enamel is hard, but the stratum is not tight being made of rough grains. The effect of this special quality gives a very different look of the tooth.

There is a right lower second molar of this species measuring 125 by 77 mm. with 16 chirolites and two hemichirolites at hand. The place name where this example was taken is not made clear, but probably it is not in Japan. Very lately MATSUMOTO gave an account of this species from Sachalin (Karahuto).

The Yūbari example is in the range of the Manchurian variety of *E. mammonteus* with specially eurycoronine teeth on which TOKUNAGA gives an account with a name *E. primigenius* var. The material of HOPWOOD from Mongolia in addition is in the same group and seems to be in a near relation with *Mammonteus primigenius compressus* OSBORN, 1924 which is an eurycoronine, very cyrtocephalic type with a higher chirolite formula. The present Japonic material was got in exchange for money from a trader without a note on geology in detail, but it was seemingly in the terrace deposit.

Elephas trogontherii POHLIG, 1884
Figure 20.

A small number of not complete teeth from different places in Japan were named *E. trogontherii* by error by myself, MATSUMOTO and TAKAI. I have given a short account on two molars under the same name by suggestion of MATSUMOTO, but these are now made reference to an eurycoronine



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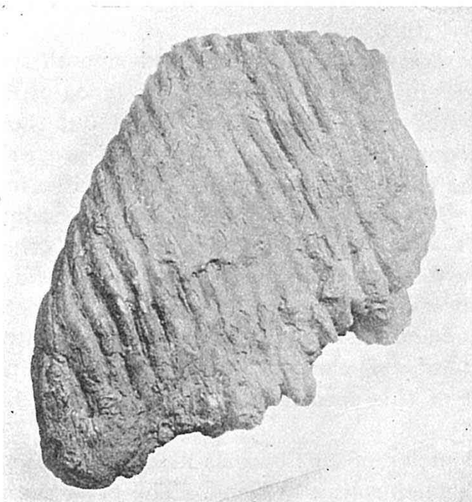

Fig. 20. *Elephas trogontherii*, M^3, Hsin-ching. $\frac{1}{5}$

race of *E. namadicus naumanni* (see the lines under this head coming after). I am not able to take away doubt about the true existence of *E. trogontherii* in this country, though it is possible supported by the fact that this specics was living on the nearest land Manchuria while the Pleistocene. I have seen a beautiful example of a right third upper true molar came from Hsin-ching.

It is a tooth of great size measuring 298 mm. long, 108 mm. wide and 242 mm. high at the 11th chirolite; it keeps 20 chirolites and a back hemichirolite. No more than two chirolites seem to be in loss at the front end. The used face is small being 138 mm. long and 92 mm. wide in front. The enamel is thicker and stronger than in *E. mammonteus* and is sent out from the used face making parallel top edges as in other elephants. The spaces full of cement between the chirolites are thin. The upper part of a chirolite is made narrower, so that the two lateral fissures have a run not parallel to the sides.

The Manchurian tooth would be made comparison with *E. trogontherii* which is limited to the sense by ZUFFARDI. I am concious of a species *E. armeniacus* FALCONER, 1857 which seems to be within the limit of *E. trogontherii* in narrow sense. Though this name is older than *E. trogontherii*, the reference is not very certain and the type is not very complete. Very lately MATSUMOTO made a reference of *E. armeniacus* from the Pleistocene of Sachalin (Karahuto).

Elephas cf. **trogontherioides** ZUFFARDI, 1913

Figures 19, 21.

Material: ^3M (Fig. 19), 3 broken bits of other molars and an incisor (Fig. 21), from the River Nonni (Nun-chiang) in the bed under the rail-way bridge, Manchuria.

This is the one more example not seen in Japan. It is like an eurycoronine form of *E. namadicus naumanni* in some measure, though very different in details. The best example is the left upper last true molar which dimensions are (in mm.): 279 long, 220 high at 10th chirolite (highest) and 100 wide at 4th chirolite (widest); 89 at 2nd, 98 at 5th, 97 at 7th; used face making an angle about 55° with chirolite sides, 217 long and 95 wide at 4th, 82 at 7th and 64 at 9th chirolites. There are 15 chirolites and a back hemichirolite; the front end was rubbed away forming a flat table made of dentine, upon which probably were the front hemichirolite and the front part of the first chirolite when complete; but if this was not so, only one more chirolite might be there. In this way the chirolite formula is $_\times15_\times$ or $_\times16_\times$. The enamel is thick, being 3 to 4 mm. measured on a chirolite in the middle; its substance is loose. The spaces between the chirolites are as wide as the chirolites or a little narrower. The loxodont plicae are very feeble; the lateral fissures are parallel to the long axis of the chirolites, but not parallel to the side edges; they are deep, getting to the level a third down of a chirolite. Dislocation with the median fissure by pressure while growth took place in the three front chirolites, in such a way as that the outer half of the first chirolite is in connection with the inner half of the second.

All the other examples are small parts of some molars of the same form. The incisor is a very small one measuring 95 cm. long on the curve of the lower side. The greatest diameter is 5 cm. at the back end. The front end is rubbed by use making a slope. Distance from end to end of the incisor is 93 cm., so as the curve is not a strong one.

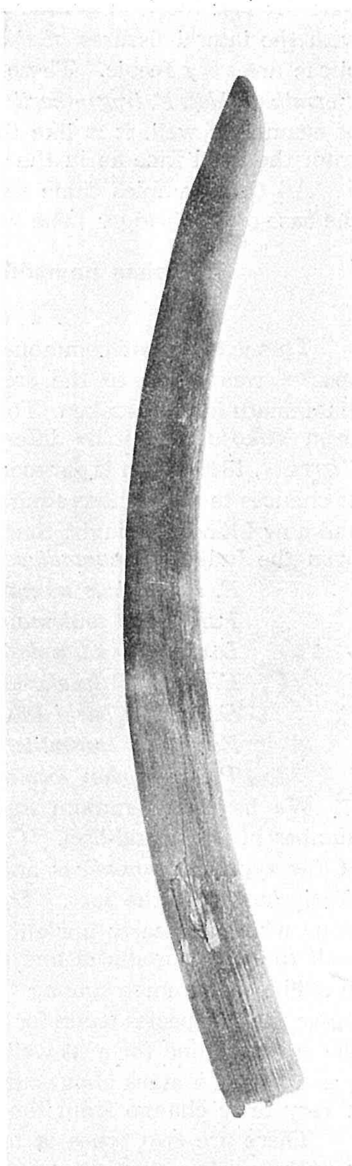

Fig. 21. *Elephas* cf. *trogontherioides*, Incisor, Nonni. $\frac{1}{7}$

These teeth seem to be that of an elephant in the nearest relation to *E. trogontheriodes*. This name was offered to a form with eurycoronine teeth in Italy as a variety of *E. antiquus*. In comparison with the eurycoronine form of *E. namadicus naumanni*, the present fossil example is different in that the last tooth is greater and wider, and the chirolites are parallel-sided with the lateral fissures of the *E. meridionalis* type and that the loxodont plicae are very feeble. These special marks are in harmony with those *E. trogontherioides*, *E. trogontherii* and *E. mammonteus*. In the loose structure of enamel as well, it is like the last species, though the enamel is put out from the used face as in the normal elephants.

All the examples came to discovery when men were working to make the base of the bridge. The river bed is made of the Pleistocene deposits.

Elephas namadicus naumanni MAKIYAMA, 1924
Figures 21—31.

This is the most common fossil elephant in Japan. The name of subspecies was given to the stenocoronine form came from Sahanma near Hamamatu in Sizuoka-ken (Tōtōmi) covering the NAUMANN's *E. namadicus* from Yokosuka as it be different from the type *E. namadicus* FALCONER & CAUTLEY, 1846 which is eurycoronine. After that time, I have had a number of chances to make interesting observation about the different forms of teeth, and now I have a thought that all the Japonic forms are equally separated from the Indian *E. namadicus*. The names listed are the synonyms:

E. namadicus namadi POHLIG, 1893 of MAKIYAMA, 1924
Parelephas protomammonteus MATSUMOTO, 1924
Loxodonta (palaeoloxodon) namadica yabei MATSUMOTO, 1929
Elephas (Palaeoloxodon) namadicus setoensis MAKIYAMA, 1929
E. indicus buski MATSUMOTO, 1929
Euelephas trogontherii of MATSUMOTO, 1924 and MAKIYAMA, 1924
Palaeoloxodon yokohamanus TOKUNAGA, 1934

We have no cranium and no complete frame work of bones, but a number of the mandibles. The lower jaw is not very different from that of the type *E. namadicus* and *E. antiquus*, but for that the front end is nearly normal to the base. The diastema and chin together make the front slope which is nearly upright to side view giving an effect in comparison with the more produced and sloping chin of *E. namadicus*. This form of mandible is common among the Japonic examples. Chiefly by this reason, I give the subspecies name for all of them in addition to the type covering the eurycoronine form as well, which was said to be *E. trogontherii* by error, because such a mark about outline, though very well noted, seems to be but a very little change from the normal type.

There are two types of molars, one stenocoronine and the other eurycoronine, as have been given the statement. The two types are frequently looking very different as if they may be separated as different subspecies. But after testing a greater number of examples, I was able to take away doubt that they are not in connection. In fact they are in connection to make up a simple species (here it is presented as a subspecies of the Indian species). Some of qualities in detail seem to be marking the special geographical races and biotypes, which are only able to see by a way of biometry with great number of examples.

In relation to the distribution of the races, Japan in the Pleistocene times was made of three chief divisions, that are the west, north and south east parts. The division lines were natural walls of high mountains and deep inlets of waters to keep back the moving herds, though sometimes ways across the walls were open for attempting animals. Of the three parts, south-east one was well separated for long years keeping a special race which is the type *E. namadicus naumanni* in narrow sense. This group have teeth of stenocoronine type with thicker enamels and greater loxodont expansions, being like *E. namadicus tokunagai* but for the increased hyperlophodont degree.

In the north and west parts, thin-enameled teeth were more general. The name *E. namadicus setoensis* was given for the eurycoronine type and that of *E. namadicus yabei* for the stenocoronine type of the thin-enameled teeth. Naturally in the first type, the chirolites have smaller loxodont expansions and little enamel folds in comparison with the second. These two forms are only different phenotypes of the same genetic line, because they are seen in the examples came from the one and same place.

In all the molars, the lateral fissures of the chirolites are near and parallel to the side edges, giving the "laterally annular, medially lamellar" design of cut on the used faces.

E. namadicus naumanni of *Sahanma.*—Material: (1) mandible with $_3M_3$ (type), (2) ^3M, (3) M^3, (4) M^2, (5) incisor.

The mandible and four teeth are kept in this school of geology given by Mr. UTIYAMA. Another example of an upper molar is the property of Mr. UTIYAMA, the land owner at Sahanma. The materials (1) to (3) and (5) were in the second cutting at Sahanma, Isami-mura near Hamamatu. WAKIMIZU got some bones from the third cutting. Details of these teeth have been given in 1924, and to my opinion, the mandible, the two upper last molars and the incisor were of one and same individual. They are one of the best examples of elephants in Japan. No more addition to the details is needed, but an account in short will be given: dimensions equal to that of *E. antiquus*, stenocoronine, the upper left last molar measuring 286 mm. long and 79 mm. wide with $_{\times}16_{\times}$ chirolites, the right one being 303 mm. by 76 mm. with $_{\times}17_{\times}$, the lower left last molar being 270 mm. by 72 mm. with $_{\times}17_{\times}$; chirolites with thick strongly folded enamel, the upper molars without loxodont expansions but made thicker to the middle, the lower molars with well marked loxodont angles and plicae; lateral fissures near and parallel to the side edges.

In comparison with these last molars, the second true molar is more eurycoronine like the wide teeth of the Inland Sea in some measure. The example (4) was in the same level at Sahanma as the others.

E. namadicus naumanni of Makinohara Pleistocene.—In the east part of Tōtōmi, Tertiary hills are covered by 20 m. to 40 m. gravel bed of the Pleistocene time making a table land. Between the gravels deposited by rivers and the sloping Tertiary beds at base, there are thick clays at some places.

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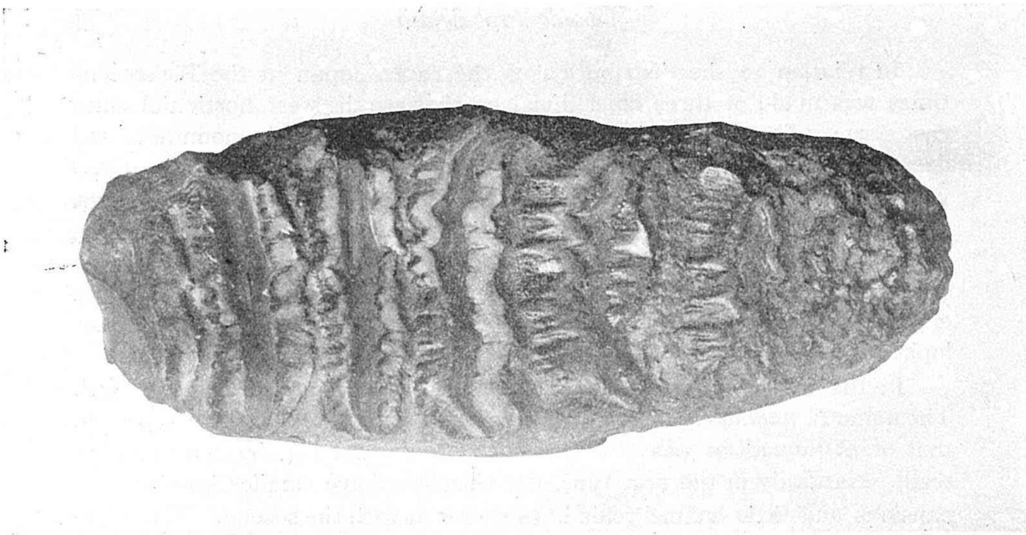


b

Fig. 22. *Elephas namadicus naumanni*, ²M, Mikuriya. ½

Mr. Tom. Kobayasi of Haibara Middle School made discovery of teeth and bones in the last year in one of the clays at Mikuriya near Kawasaki. Kobayasi made up a pelvis of *E. namadicus naumanni* (Fig. 23) from the small bits of bones. One of the teeth is a complete example of a left upper second true molar (Fig. 22). The dimensions are (in mm.): 221 long, 79 wide (widest) at 4th chirolite; chirolite formula $?\,12_{\times}$; 73 wide in front at 2nd, 72 at 6th, 57 at 11th, 210 high at 9th chirolite; used face 192 long by 79 wide at 4th, chirolite number on used face 8; angle between side of 8th chirolite and used face 50°.

The example is the greatest in size as a second molar. It is, however, very much like the Sahanma form in having thick enamel with strong folds and well-marked loxodont plicae. The third to sixth chirolites are more sloping to the used face, putting out their side faces very widely. The two ends of the wider chirolites (3rd to 4th) are bent to the back.

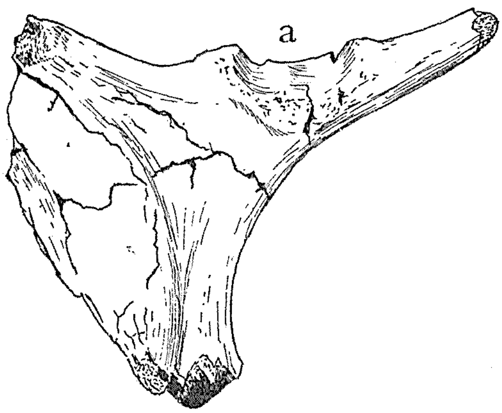
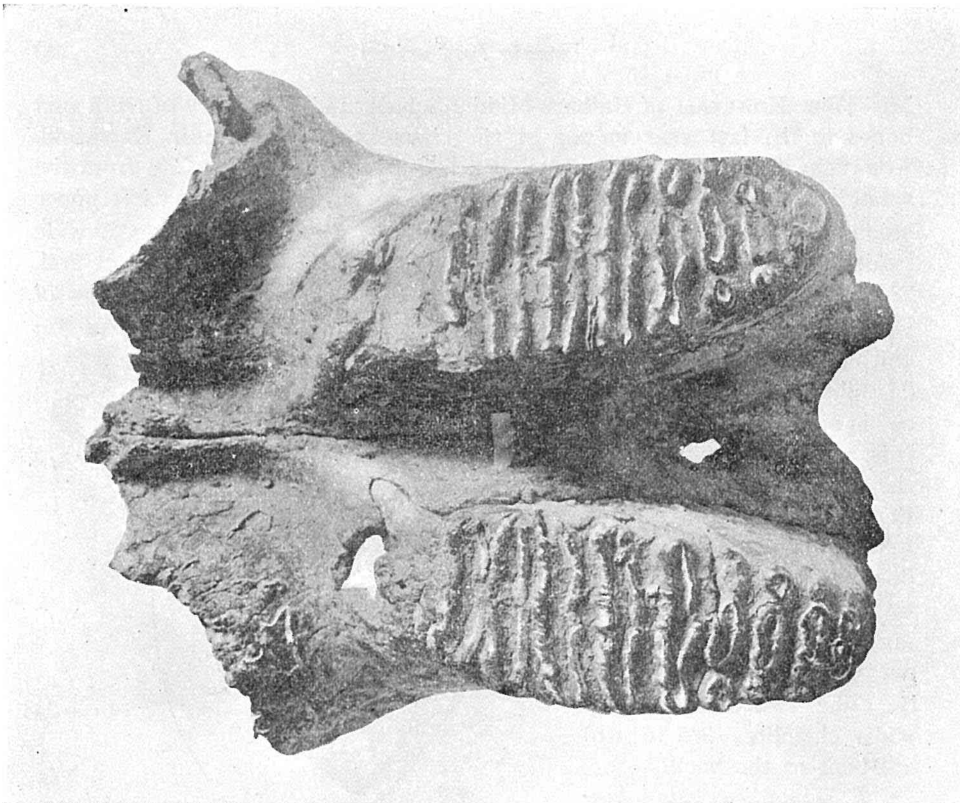


Fig. 23. *E. namadicus naumanni*, pelvic girdle, Mikuriya; a, acetabulum.

E. namadicus naumanni of the Inland Sea.—The Inland Sea or Seto-uti is covering a number of basins which were dry while the Pleistocene times forming good field full of plants where a great amount of the elephant took pleasure in living. Most probably there were stretches of waters under which sands and clays were deposited. Some land animals of which *E. namadicus naumanni* had chief power in the later times were taken to last resting-places in the deposits by their errors or by certain other reasons. Then the sea water came into the basins to make the present Inland Sea in which currents are so strong as the loose materials upon the base are quickly washed out. Bones have frequently been taken up by fisher-men from these wash-outs under the sea. There may be different deposits of different times in geology. By this reason, to our great regrets, the Inland Sea fauna as a mixed one has little use for stratigraphy.

In comparison with the type material of *E. namadicus naumanni*, the Inland Sea form is different in having widely separated chirolites with thin enamels, feeble folds and well-marked but small loxodont plicae. The molars are more eurycoronine, being wider but shorter in dimension. The chirolites are made a little wider at their middles, but not so enough as to make loxodont expansions. These different effects from the type seem to be very clear, but for some examples coming between the two forms. I have given a short account on an existence of an eurycoronine and thin-enameled second

a



b

Fig. 24. *Elephas namadicus naumanni*, palate $^3M^3$ in situ, material 1. $\frac{1}{3}$

true molar among the examples came from Sahanma. In the same way, we have more stenocoronine thick-enameled forms among the Inland Sea examples. First of all, I will give the details of the last molars.

Material: (1) $^3M^3$ on a broken part of palate, off Syakaga-hana, given by Mr. Y. KOMAI of Kōbe (Fig. 24). This is the best example I have seen. The bone is only a small part of maxillae put together with the two last molars. There are lower parts of the alveoli for incisors in front. No detail of the bone is to be given. The maxillae is 236 mm. wide measuring from outer side to side. The nearest distance between the two teeth is 55 mm. near at the front ends, while distance at the ninth chirolites is 114 mm. and that at the back ends of the used face is 175 mm. The dimensions of the right last molar are (in mm.): 276 long; chirolite formula $_\times 16_\times$; 74 wide at 3rd chirolite, 79 at 5th, 78 at 6th, 67 at 8th, 66 at 10th; 192 high at 10th; used face 196 long with 10 chirolites, 75 wide, widest at 5th chirolite. Those of the left one are: 273 long; chirolites 15 in number with a back hemichirolite at present condition, probable formula $_\times 16_\times$ when complete; 73 at 2nd (the first chirolite at present), 80 at 4th, 5th and 6th, 69 at 8th, 62 at 10th; 215 high at back end of used face; used face 150 long with 8 chirolites, 77 wide at 5th (widest).

The used face is making an angle 125° with the sloping face of the unused back part and 70° with the front side of the sixth chirolite. Of the right tooth, the front hemichirolite and the first chirolite have been rubbed away forming a small table of dentine in front, while the same part of the left one has been broken. The enamel is 3 mm. thick in general, being not thinner than that of the Sahanma examples. The back hemichirolite is made of two pipe-like structure about 9 cm. high.

Material (2): M^3, off Syōdo-sima. This uncomplete molar was pictured in the first note on the Sahanma examples (1924). The dimensions are: 211 mm. long with 14 chirolites, 77 mm. wide in front, 90 mm. wide at the middle. It is a good eurycoronine example of the species. The chirolites are not thick at the middle and the loxodont plicae are very small.

The first material is certainly the representative of MATSUMOTO's subspecies "*yabei*", and the second is equal to that said to be "*typicus*" or "*namadi*". They are, however, different in very small degree. Finer divisions are not necessary. We keep no good material of the lower last molar but for a cast copy on which an account will be given.

Material (3): M_3, joined M_2 (Fig. 25). A strange joined tooth is an interesting example of pathology. The second molar is united to the front inside of the last one. The last molar is of normal size, but more curving, the front end being moved out by a sharp bent. The outgoing part, however, is not the true front end of the last molar. There are 19 chirolites if the bent front part be taken together. The true number may be as normal being $_\times 16_\times$ or $_\times 17_\times$, of which the back hemichirolite is a pipe-like structure about 5 cm. long on the end of the pretrite series. The tooth all together is 337 mm. long, though the true last molar part seems to be less than

Fig. 25. *Elephas namadicus naumanni*, M_3+M_2, material 3. $\frac{1}{2}$

300 mm. The front inner side of the last molar is united with the back inner side of the second molar in a position as if the first is pushing the second from the back. The second molar was turned from its normal position to a direction right-angled with the axis of the last molar. The enamels of the two teeth are common on the united parts. A connection of the enamels at the middle made a strange tri-radiate star-like figure on the used face. It has to be pointed out that the join takes place at the middle of every one chirolite or on the median fissure.

The last molar is widest in front measuring 84 mm. and the highest measure of the used face is 162 mm. The chief body of the molar is not very changed from the normal eurycoronine thin-enameled type, but for the strange curve. The second molar is made very short by pressure: the eleven chirolites are forced to take places in a distance 125 mm., giving such a look as if it is a tooth of *E. mammonteus.* The used face joined with that of the last molar makes a wide concave spoon-like basin.

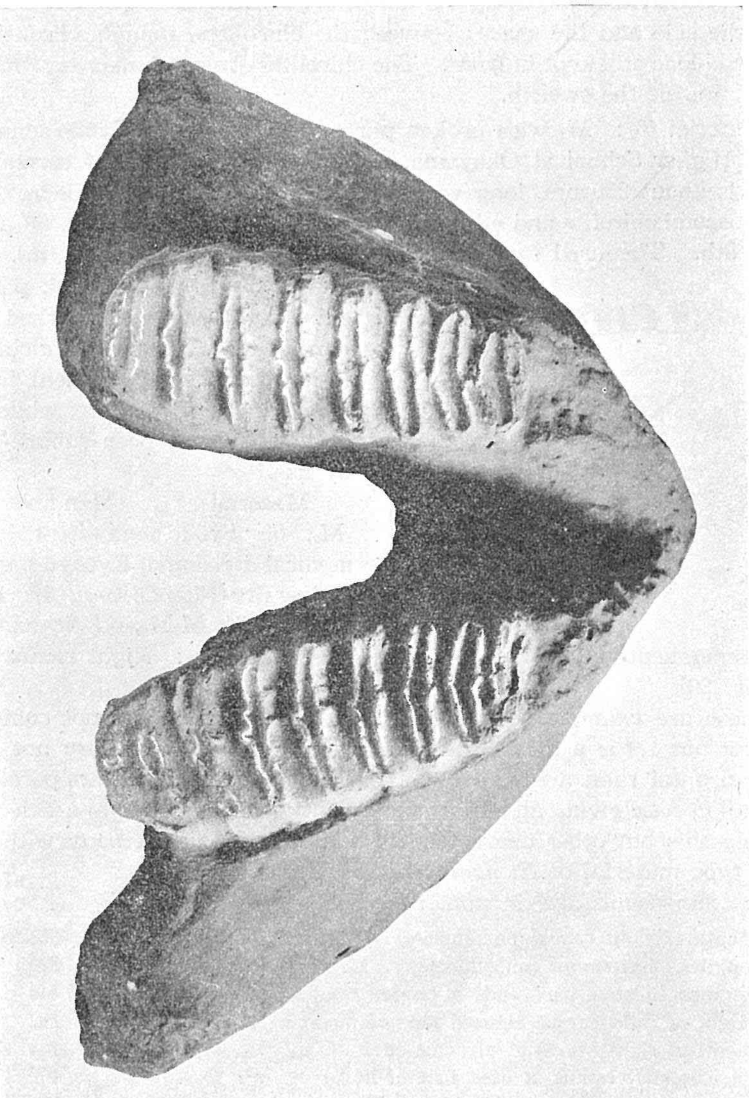


Fig. 26. *Elephas namadicus naumanni,* Lower jaw and $_2M_2$, (7). $\frac{1}{3}$

Material (4) & (5): two $_2M$, off Syōdo-sima. (4) is measuring 253 mm. by 72 mm. with a formula $_{\times}13_{\times}$. The used face is 191 mm. long and 62 mm. wide at 6th chirolite. All the chirolites are well separated from every another, the spaces being a little wider than the thickest middle parts of chirolites. The tooth is 58 mm. wide at 3rd chirolite, 69 mm. at 5th, 69 mm. at 7th and 63 mm. at 11th.

The other example (5) is a little smaller in size than the first. It is a highly weathered example, a great amount of cement having been taken away from the side and the spaces between the chirolites, though a broken part of mandible is still kept in front. The chirolites are much narrower measuring 61 mm. at the twelfth.

Material (6): M_2 with broken parts of mandible, off Syōdo-sima, kept in the Higher School at Okayama. This example of a right second true molar is about 230 mm. long with a formula $_{\times}13_{\times}$. It is as wide as 70 mm. at the second chirolite and other measures are: 71 at 4th and 5th, 69 at 6th, 62 at 8th. The used face is measuring 155 mm. by 61 mm. (4th). The chirolites are well spaced, parallel-sided and with well marked loxodont plicae. The back hemichirolite is in complete development, having good form as a chirolite, while that of in front has been rubbed away by use.

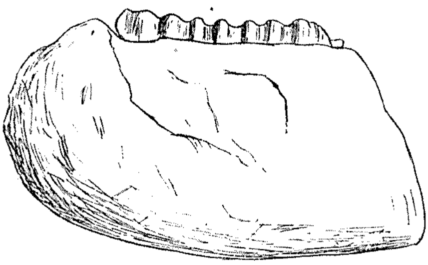


Fig. 27. The Same jaw as Fig. 26, profile. $\frac{1}{8}$

Material (7): Mandible with $_2M_2$, off Syōdo-sima, kept in the medical division of Kyūsyū Imperial University (Figs. 26, 27); (8): Right ramus with M_2M_3, off Sirahama on Syōdo-sima, kept in Third Higher School (Fig. 28); (9): Right ramus with M_2 (Fig. 29).

These are examples of the mandible, but the teeth are not complete. The first one (7) is a good example, though its back parts are not kept. The horizontal rami are very high and the edges of alveoli are parallel to the straight base giving an almost square outline of mandible to a side view. Not only this but other characters, in addition, are in harmony with that of the type material of *E. namadicus naumanni.*

The dimensions are (in mm.):

Length of right ramus (uncomplete)	355mm.
Length of left ramus (uncomplete)	320
Distance between back ends of broken rami	440
Height of right ramus at used face of molar	192
Height of right ramus at alveolus edge	164
Height of left ramus at used face of molar	197
Height of left ramus at alveolus edge	162
Diameter of right ramus	162
Diameter of left ramus	163

Distance between inner edges of last chirolites in $_2M_2$		119 mm.
Distance between $_2M_2$ at front ends		66
Width of rostrum	roughly	50-60
Length of symphysis		134
Distance from front end of alveolus to chin point		188
Height of rostrum base		116

The molars became low by a long use. Some front chirolites were gone and there are only 8 chirolites in keeping between a length of 18 cm. by the right and 17 cm. by the left. The two teeth are widest at the second chirolites from the backs measuring 78 mm. On the used face, spaces between

Fig. 28. *Elephas namadicus naumanni*, M_2 with broken parts of jaw, (8). $\frac{1}{2}$

the chirolites are a little wider than the chirolites themselves, because the face is a cut very near to the base.

In normal forms of the lower molars of *E. namadicus naumanni*, the chirolites are curved out to back, so that they are sloping back at higher parts and sloping forward at lower parts dependent on the used faces. All the chirolites come together to the top, that is to say, converging. This is one of the reasons why laminar frequency in 10 cm. is no use in work of comparison, if it is measured simply on a side or on an used face.

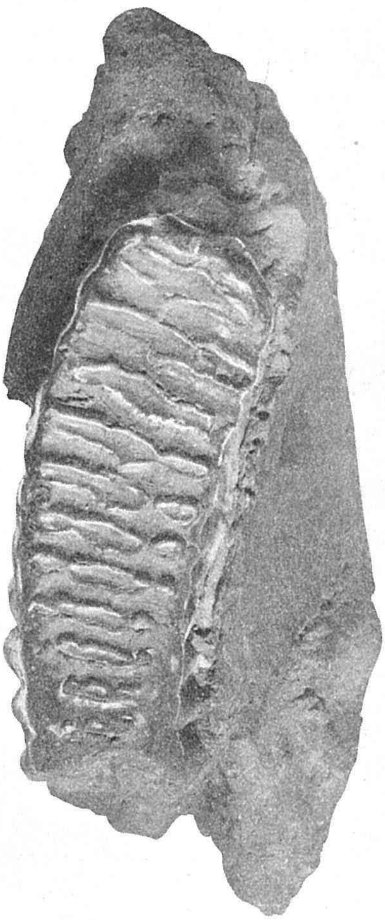


Fig. 29. *Elephas namadicus naumanni*, M_2 and the broken jaw, (9). $\frac{1}{2}$

The example (8) is a right hand side part of mandible smaller than the first, and its side view gives another look. This is an only example takes the normal form of *E. namadicus* I have seen. The horizontal ramus is long and low, made higher in front and its front edge or the diastema is sloping to make a produced chin. The dimensions are:

Length of right ramus (uncomplete)	344 mm.
Highest height in front at front end of M_2	179
Height in front at alveolus edge	140
Height at back end of horizontal ramus	137
Distance from front base of ascending ramus to broken chin	230
Diameter of ramus in front of ascending part	152

The second molar is not complete measuring 163 mm. by 64 mm. with 9 chirolites. The last true molar is deep in the bone; its front chirolites are as wide as 74 mm.

The last example (9) is a broken part of a right ramus. It seems to be smaller than (8) measuring 164 mm. high at the front end of the tooth.

The broken tooth in its place measuring 184 mm. by 62 mm. with 11 chirolites seems to be the second true molar, from which two or three back chirolites have gone. The used face is cutting the chirolites through a level not far from the first tops, giving a different look of design from the long used teeth in which the chirolites are well spaced. There are 8 chirolites in the distance 10 cm. on the used face. Height at the broken back end is 138 mm.

The second mandible (8) is a special form coming between those of *E. namadicus namadicus* and *E. namadicus naumanni*. This form is pointing the connection of the Japonic sort and the Indian species as the nearest relation. All other examples of the mandible I have seen, however, are of the form quite like that of the type Sahanma form.

Material (10): Copy of a palate part with ${}^3m^3$ and ${}^1M^1$ (Fig. 30); (11) Copy of a palate with ${}^1M^1$ (Fig, 31); Off Syōdo-sima.

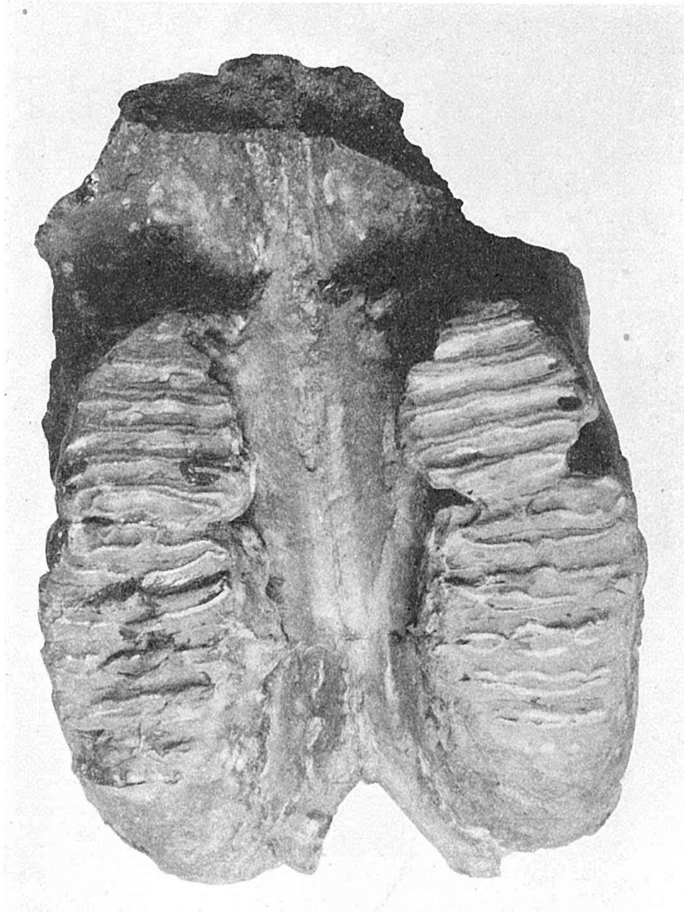


Fig. 30. *Elephas namadicus naumanni*, ${}^3m^3$, ${}^1M^1$ and palate, material 10. $\frac{1}{2}$

The first material (10) is a bit of an upper jaw with four teeth in their places. The dimensions are:

Length of maxillae at present (uncomplete)	233 mm.
Diameter of maxillae, distance from outer side to side	187
Distance between front ends of $^3m^3$	86
Nearest distance between inner sides of $^1M^1$ at front parts	53
Distance between inner edges of alveoli at back ends	73
Length of M^1	152
Chirolite formula	$\times 11 \times$
Widest width of M^1 at 3rd chirolite	71
Length of ^1M	151
Widest width of ^1M at 3rd chirolite	63

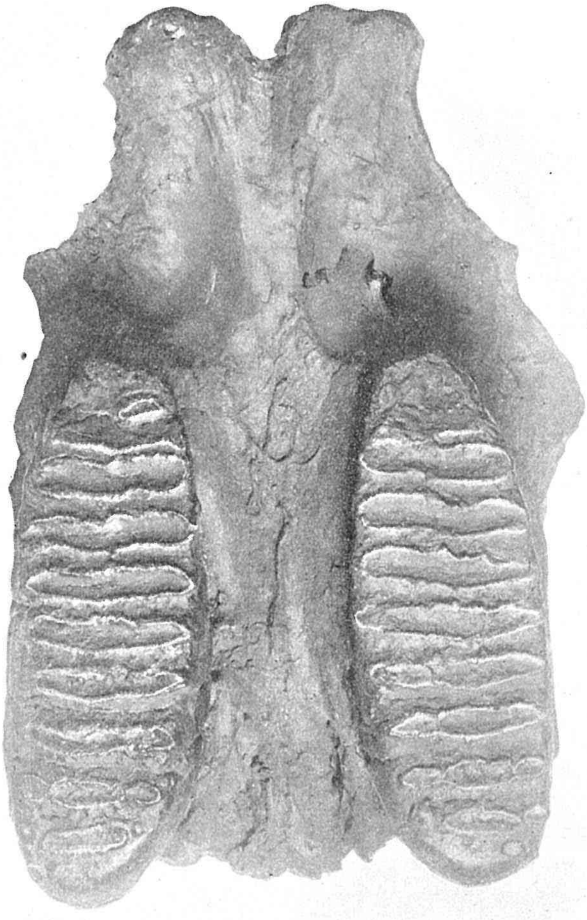


Fig. 31. *Elephas namadicus naumanni* (cf. *aomoriensis*) $^1M^1$ and palate, material 11. $\frac{1}{2}$

Length of right used face (m^3+M^1)	144 mm.
Widest width of right used face (M^1 at 2nd chirolite)	61
Length of left used face ($^3m+{}^1M$)	139
Widest width of left used face (^1M at 2nd chirolite)	58
Height of M^1 at 6th chirolite	182

The milk molars became short by long use, the right one being 59 mm. with $5_\times$ chirolites and the left one being 56 mm. with $4_\times$ chirolites. The right one is widest at the last true chirolite measuring 61 mm. while the left one is narrower measuring 59 mm. at the same position. The hemichirolites of the first true molars are very thin, and their back loxodont plicae are united with the front ones of the first chirolites as seen on the used faces. The teeth are of very eurycoronine type, being much wider than in *E. antiquus* and nearly equal to that of *E. trogontherii.*

The example (11) is a broken part of a small palate with two molars in the places. The teeth are smaller than the normal first upper true molar, but they keep $_\times 11_\times$ chirolites on every one side and not so small as to be the last milk molars. The measures are:

Distance between back ends of $^1M^1$	about 100 mm.
Nearest distance between inner sides of $^1M^1$ at 6th chirolite	37
Distance between front ends of $^1M^1$	85
Length of M^1	139
Widest width of M^1 at 7th chirolite	53
Height of M^1 at 10th chirolite	73
Length of ^1M	134
Widest width of ^1M at 8th chirolite	51
Length of right used face	127
Widest width of the same	48

This small palate seems to be that of a very small body. TOKUNAGA and TAKAI give an account on a little form from north Japan with a new species name *Palaeoloxodon aomoriensis* which tooth said to be M_1 is not far from the present teeth under observation in size. It will be seen that the line of *E. namadicus naumanni* became smaller and smaller after it got into Japan. The material (11) is a special example of an Insular Japonic form later in history.

We keep a number of other examples—broken parts of teeth and bones—came from the sea. Their details will not be needed here, but for a short note that they are within the range of variation of *E. namadicus naumanni.* Very good examples were grouped together in Waseda University and other schools and museums. They were not worked out in detail. Two small examples may be noted, for they were made discoveries in the bed on seaside at Yagi near Akasi to the west of Kōbe. They were in the so named *Elephas* bed the Pleistocene gravels upon the *Stegodon* clay.

Distribution of E. namadicus naumanni.—*E. namadicus naumanni* is made up of a number of different lines of *E. namadicus* which were mixed later to make the group separated from the chief line on the great land of Asia. Its distribution is covering all over the chief island of Japan as well as Sikoku, Kyūsyū and Hokkaidō which were in connection to make a greater island or an arm of land at certain Pleistocene times. Some broken parts of teeth came from Siga-ken (Oomi) of this sort were made reference to *E. trogontherii* by error: these are nothing but eurycoronine thin-enameled forms of *E. namadicus naumanni.*

On the side of Japan Sea, there have been made some discoveries of the stenocoronine thin-enameled form at a number of places, about which no new addition to be noted to the details given by MATSUMOTO has been made.

In the Kwantō plane, the same is not uncommon in the wide stretches of the Pleistocene deposits. Here the stenocoronine thick-enameled form is more common than the others. The Pleistocenes of Sinano (Nagano-ken) the mountain land in the middle part of Japan have the sort of the same type as that of Sahanma and Kwantō plane. Accounts on these examples with different names of genera and species were made public by different persons after the work of MATSUMOTO (1924). To my opinion, as has been given general statement, all the examples which are not *Stegodon* may be grouped under the one and same subspecies.

A suggestion will be given here, though not supported by certain test, that the separated sorts *E. protomammonteus* and *E. namadicus tokunagai* are in the same circle as *E. namadicus naumanni,* and if the first two forms are truly so old as Pliocene, the later form was started by mixed bloods of such the forms as one with hyperlophodont tendency and the other with loxodont expansions. After the bloods were mixed, the different forms would be separated, one keeping thin chirolites and the others loxodont angle in well development. But, if the two forms are not so early as Pliocene, they were living together with *E. namadicus naumanni* as its special individuals.

Elephas namadicus aomoriensis (TOKUNAGA & TAKAI, 1936)

The type material is made of an incisor, a right ramus of mandible with a molar and an ulna which were in the younger Pleistocene deposits near the town of Sitinohe in Aomori-ken. The molar was said to be the second true molar at first, but the writers changed their view when they gave the detail in English (Trans. Pal. Soc. Jap., no. 10) and it is now rightly said to be the right first true molar. The size of this molar and that of the upper molars of *E. namadicus naumanni* from the Inland Sea (material 11) are nearly in harmony.

The present form is an example of dwarfism which took place later in the line of *E. namadicus naumanni.* It is small, but keeps all the special marks of the Sahanma form in smaller scale. I am not able to come to a decision if such a little form is a good species or not. The same question is put to the example of *E. africanus pumilio.* Anyhow, this little form is a probable mutation of *E. namadicus naumanni* in later times as the observation on geology made by KANAHARA may be supported. Simply by the last reason the name "*aomoriensis*" will be used as a subspecies covering the little form of the Inland Sea as well.

Elephas namadicus tokunagai (MATSUMOTO, 1924)

=*Loxodonta* (*Palaeoloxodon*) *tokunagai* MATSUMOTO.

Material: M_2, holotype of *Palaeoloxodon tokunagai junior* MATSUMOTO, 1929 (Sci. Rep. Tohoku Univ., geol. **13**, 9-10).

This is a stenocoronine form with a low chirolite formula, M_3 being $_{\times}13_{\times}$ and M_2 being $_{\times}11_{\times}$ on the account given by MATSUMOTO. If these numbers of chirolites are true, the two teeth may be the representative of the early steps in hyperlophodont development in harmony with the view of MATSUMOTO. The dimensions and qualities in detail, however, are not outside the limit of *E. namadicus naumanni*. It is natural to give thought to that the chirolites number is fixed in one species, but in some less examples it may be smaller or greater than the normal number, smaller number being not necessarily of a lower form in evolution. The normal number is only pointing the mode of fluctuation, and its probability is the greatest, while the chances to get the other examples of less or more numbers will probably be very little. Only two examples of the said form which we have at hand are not enough to give reason for saying how they be the representatives of a separated species.

The loxodont expansion and strong folds of the enamel are dependent on narrow but long form of the tooth, though more or less stronger than in the stenocoronine form of *E. namadicus* with a higher chirolite formula. To my part, *E. tokunagai* is in doubt to be a good species, though HOPWOOD makes reference with Chinese examples. The name, however, may be used as a subspecies till a more number of examples will be tested to make decision.

Its time in geology was not made clear. The only material at present is said to be got from Syōdo-sima. The holotype was in a bed in Toyama-ken which seems to be Pleistocene. These are, however, not very certain.

Elephas protomammonteus (MATSUMOTO, 1924)

No new material is present. This species is based upon molar teeth came from the Minato district in Tiba-ken. MATSUMOTO gives accounts on two forms said to be mutations, stenocoronine and eurycoronine types of the same but one species. The teeth of stenocoronine type to which he gives a name *Parelephas protomammonteus typicus* are equal to those of *E. antiquus* in size and form, but every one has one more complete chirolite, so that 17 chirolites in M_3 and 14 in M_2; all the chirolites are thin and widely spaced, while the loxodont plicae and enamel fold are feeble quite in the same way as in an eurycoronine example of *E. namadicus naumanni*. The eurycoronine example, to which MATSUMOTO gave a name *Parelephas protomammonteus proximus*, is a wider right lower last true molar with more feeble loxodont plicae. The lateral fissures are not of the *E. meridionalis—mammonteus* type, but of *E. namadicus—antiquus*, that they are near the sides running parallel to them giving a chirolite outline made of two circles at side and one band at the middle on the face of abrasion. In the other type, the deeper fissures come almost together at lower level from two sides giving a " laterally lamellar and medially annular figures " of the chirolites.

MATSUMOTO is of opinion that this form is a representative of the first step of the genetic line of mammoth. The idea will be true at least when the parallel-sided chirolites by themselves are taken in account. I do not see any structure with the bases of teeth which is said to be cingulum in well development. It is not rightly said that the chirolites are made wider near the base in the same way as in *Stegodon*. The mandible is not of a cyrtocephalic form of the *E. trogontherii—mammonteus* group. No more discussion will be made here without a new addition to the material, but a suggestion that the form is very near to *E. namadicus* in relation. TAKAI (1936) is of opinion that it is not a possible species and he made a comparison with *E. namadicus naumanni*. Details in geology of the Minato districts are now under discussion not coming to a clear decision. SAEKI (Jap. Jour. Geol. Geogr., 8, 125-129, 1931) got a good example of the mandible with the last tooth from Misima in that district and he gave a new name *Parelephas protomammonteus matsumotoi*. It is highly probable that, without taking account the last example, other examples were in the beds younger than the Pliocene but older than the Middle Pleistocene.

Elephas maximus LINNÉ, 1758

Synonym: *Elephas indicus* CUVIER, 1798; *E. asiaticus* BLUMENBACH, 1797.

Fossil existence of *E. maximus* in Japan is doubted. NAUMANN was an opinion that the molar in the earth at Edobasi in Tōkyō and now kept in Tōkyō Imperial University is a later milk molar of *E. namadicus naumanni* in my sense. LEITH-ADAMS gave an account on a small tooth taken from a Pleistocene bed between Tōkyō and Yokohama under a name *E. indicus*. The last name has been changed to *E. namadicus* by LYDEKKER. MATSUMOTO has a view the two examples be his *E. indicus buski*, because the enamels are regularly folded. To my part, they seem to be much wider for *E. maximus*. It is not simple to make decision with such young teeth, but seemingly *E. namadicus naumanni* is the right name.

MATSUMOTO gives more examples of *E. indicus* in Japan and he says the time in geology be Post-Monastrian judging by their bright look. The geology about this form has not been made clear. It is possible to say that in fact they are not fossils, but came to this country through men from India in early days as medical material. Some were kept with care by certain old families and some others were put under the earth by events came about while the long history.

I have seen a weathered and broken right lower last true molar of *E. maximus* which were about 2 m. deep in the earth under the house of religion—Nagoya Branch of East Honganzi, and now it is a property of a school at Kuwana. A complete example of the left lower first true molar which is said to have been got on the river bed of Yasu in Siga-ken in an old day after a time of high water is at hand. I have no belief in the past existence of *E. maximus* in Japan, if it will not be judged by the eyes of geology.

Some broken bits of chirolites came from Hisi-ike and kept in Tōkyō Imperial University were said to be *E. namadicus* or *E. primigenius* by some persons. These are, however, like the example of Nagoya, part of a tooth of *E. maximus*. There are two more examples of the lower last molar at hand. Unhappily, the examples again are not noted how they took places. The chirolite formula is $_{\times}20_{\times}$; and the form is not outside the range of *E. maximus*. The look is like a fossil. Though there is no reason at present to make decision that *E. maximus* had existence in Japan, we have to take care of it at future chances of discovery.

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