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ON SOME FOSSIL CETACEANS OF JAPAN

BY

HIKOSHICHIRO MATSUMOTO

With 3 Plates and 5 Text-Figures

INTRODUCTION

Cetacean remains are by no means rare in the Japanese Neogene, though they have not yet been studied, owing to the lack of good specimens. The writer here submits a report on some scanty material of the fossil Cetaceans of Japan, as an aid to future studies.

The specimens of the giant Physeterid and the Eurhinodelphinid described in the present report were presented to our Institute by Mr. N. Sakai, of Fukuoka Town, Ninohe District, Province of Mutsu, and by Mr. B. Funazaki, of Akadani-mura, Kita-Kambara District, Province of Echigo, respectively, while those of the orc and the Balanopterid were submitted for study to the writer by Professor Yokoyama, of the Imperial University of Tōkyō, and by Mr. H. Takeuchi, of Hirosaki City, Province of Mutsu, respectively. To all these gentlemen, the writer's thanks are due. The paratype of the orc was examined by the writer in the Imperial Museum of Ueno under the permission of its authorities. The type-specimens of the pygmy Physeterid were collected by Mr. K. Koizumi, a graduate of our institute, at present, of the Hirosaki High School.

As a result of the present study, it has clearly been proved that two forms of these five, viz., the Eurhinodelphid and the Balanopterid, having been derived from either Helvetian or Tortonian, are almost or exactly congeneric with certain forms, which occur abundantly in the Belgian Pontian or Pontian-Pliocene, one, viz., the giant Physeterid, also of Helvetian, appears to be closely allied with a certain form of the Californian Helvetian; while two, viz., the pygmy Physeterid and the orc, having been derived from Calabrian or near, belong to living genera, which have hitherto been unknown either before Pleistocene or in a fossil state. It may not be very improbable that several Cetaceans have had their original homes of evolution in the Pacific Ocean, though it may, of course, be premature to enter into a discussion of such a great problem with such fragmentary material as that of the present report.

Family Physeteridae

Ontocetus oxymycterius Kellog (?)

Pl. VIII (I), Figs. 1-4


Specimen: fragmentary tooth, which is probably a lower one of left side.

Locality: Yuda, Ninohe District, Province of Mutsu.

Horizon: a bed of tufaceous sandstone of the Yuda Formation.
Unfortunately, the specimen is fragmentary and badly preserved. The height of the fragment is about 112 mm.; the original height of the tooth may probably have been more than twice the height of the fragment. The greatest fore-and-aft and side-to-side diameters of the specimen as preserved are 54 mm. and 61 mm., respectively; those of the tooth might be more than these measurements, if it were complete. Both the tip and the alveolar part of the root are broken away. It is, therefore, not certain, within the limits of the present specimen, whether the tip had an enamel cap or not; judging, however, from the abrupt concavity of the inner side at the part very close to the apical broken end of the specimen, it might possibly have had one. At the centre of the alveolar broken surface, there is present a very minute pore, about 0.5 mm. in diameter, which is evidently the remnant of the pulp cavity; no doubt, the pulp cavity is extremely reduced in the form represented by the present specimen. Worn surfaces are marked on a certain side of the specimen; it is judged from this wearing, as well as the general shape of the specimen, that it might be a lower tooth and, hence, of the left side; certainly, the form represented by the present specimen might have had very stout teeth on both the upper and lower jaws. The tooth tapers rather rapidly toward the tip, so that the part represented in the present specimen is subconical as a whole, and is curved, so that its outer anterior side is convex and its inner posterior side concave. It consists of a heavy coat of cement and a cylindrical core of dentine. In a cross section, the outlines of both the tooth as a whole and the core of dentine are oval, though not so markedly as in the living Physeter. The layer of cement is very thick in a certain part, appearing to have been some 20 mm. thick on the inner side of the stoutest part of the tooth if it be completely preserved; it becomes uniformly thinner toward the tip. The core of dentine measures 29 mm. and 25 mm. in its maximal and minimal diameters, respectively, on the alveolar broken surface of the specimen. The original surface of cement is markedly grooved vertically and faintly striated horizontally, while that of the dentine, exposed by the breaking away of the layer of cement, is markedly striated horizontally and faintly grooved vertically.

The specimen is very strongly fossilized, and is blackish to grayish brown in colour.

It is almost impossible to determine definitely the generic and specific reference of such a fragmentary tooth as the present specimen. In its size and in the great thickness of the layer of cement, the present tooth approaches one of those of *Oncodon oxymycterus* Kellogg of the Californian Helvetian. As stated below, the present specimen appears to be referred also to Helvetian. There may be certain possibilities, that it is conspecific with the Californian form.

Age: The Yuda Formation yields, besides others, two noteworthy fossils, *Vicaryia* and *Desmostylus*, and corresponds to the lower one of the two *Desmostylus* horizons in this field. It appears to represent probably the upper part of the older Miocene. The writer is inclined to look upon it as to be referred to Helvetian, or to Helvetian-Tortonian if younger at all.

*Kogia priscia*, sp. nov.

Pl. VIII (1), Figs. 5-7; Text-Figs. 1, 2

Type-specimens: six fragments of teeth, probably of right ramus of mandible.

Locality: Mito City, Province of Hitachi.

Horizon: soft clayish tuff developed in the environs of the city.

The teeth are cylindro-conical, slender and very high; some of them are considerably, and the others very slightly, curved. The total height is estimated to be some 50 mm. or near that in the smallest tooth at hand, and some 90 mm. or more in the largest. The maximal fore-and-aft and
On Some Fossil Cetaceans of Japan

Fig. 1. *Cetodon australis* (Ord.): left lower molar, viewed from posterior and slightly enlarged, natural size.
side-to-side diameters measure 6.5 mm. and 7.5 mm., respectively, in the smallest tooth, and 10 mm. and 10.5 mm., respectively, in the largest. The crown is slenderly conical and very acute, coated with enamel; the proximal border of the enamelled part, i.e., of the crown proper, is very oblique, instead of being nearly horizontal, so that, for instance, the vertical distance between the highest and lowest points of the said border measures 6 mm. in the smallest tooth and 14 mm. in the largest; the surface of enamel is very smooth. The height of the crown, measured from its lowest point above, is about 14 mm. in the smallest tooth, while it is estimated to be about 25 mm. or near that in the largest. The fore-and-aft and side-to-side diameters at the lowest point of the crown measure 5.5 mm. and 6 mm., respectively, in the smallest tooth, and about 7.5 mm., each, in the largest. The root is cylindrical and very high, covered over by a layer of cement, which becomes thinner both above and below. The thickness of this layer at the greater middle part of the root measures about 0.5 mm. in the smallest tooth and about 1 mm. in the largest. The pulp cavity is confined only to the distal part of the root, the greater upper part of the same and above it being entirely solid; the aperture of the cavity is fairly large. The surface of the layer of cement is faintly, irregularly grooved and striated vertically, while that of the core of dentine, exposed by the breaking away of the layer of cement, is grooved vertically and very markedly striated horizontally.

These teeth are very peculiar in their shape and structure in general, save that they closely resemble those of living *Kogiopsis*, to which genus the writer has come to refer the present species. The smallest tooth at hand might probably be a very anterior or very posterior one, while the largest, which is the least curved at hand, might probably be one belonging to the anterior middle part of the tooth row. The other teeth, which have not been properly described above, are next to the largest one in size and are considerably curved; they might probably be moderately anterior or posterior ones.

![Fig. 2. *Kogiopsis* grisea](image)

Reconstruction of type-teeth, right lower ones; viewed from behind; natural size.

The present specimens are more or less well fossilized and are very slightly sticky to the tongue; they are nearly similar to the type-specimen of *Emmetopias watasei* described in another report of the writer’s, as well as that of *Pseudorica yokoyamai* in the present report, in the degree of fossilization. They are yellowish to septic brown in colour.
The teeth, which represent the present species, differ from those of the living representative of the present genus in the larger dimensions in general and in the presence of the rather distinct layer of cement. The present species would appear to stand between the smaller forms of the Miocene Physeterids and the living representative of the present genus, though it is, doubtless, much closer to the latter.

Age: The present genus has as yet been unknown in a fossil state, on the one hand, while the stratigraphical correlation of the clayish tuff of the environs of Mito with some other better known horizons is yet to be made in future, on the other. Judging simply from the degree of fossilization, the present fossil may probably be referred to Calabrian, or to Cromerian if younger at all.

Family Eurhinodelphinidae

Eurhinodelphis pacificus, sp. nov.

Pl. IX (11), Figs. 1-4; Text-Fig. 3

Type-specimen: fragment of rostrum and mandible in situ, both bearing numerous teeth.

Locality: Ōkōdōzu, Santō District, Province of Echigo.

Horizon: a sandstone bed of the Shiiya Formation — alternation formation of Middle Miocene of the Echigo Oil-Field.

The fragment measures as follows (in mm.):

<table>
<thead>
<tr>
<th>Description</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length as preserved</td>
<td>400</td>
</tr>
<tr>
<td>Width of snout at posterior part of the fragment</td>
<td>80</td>
</tr>
<tr>
<td>Ditto at about middle part of the fragment</td>
<td>70</td>
</tr>
<tr>
<td>United width of premaxillae at the anterior ends of maxillae</td>
<td>25</td>
</tr>
<tr>
<td>Ditto at posterior part of the fragment</td>
<td>38</td>
</tr>
<tr>
<td>Height of snout at posterior part of the fragment</td>
<td>55</td>
</tr>
<tr>
<td>Width of symphysial region at symphysial angle</td>
<td>62</td>
</tr>
<tr>
<td>Width of mandibular ramus at the part 180 mm. behind symphysial angle</td>
<td>20</td>
</tr>
<tr>
<td>Distance between two mandibular rami at the same</td>
<td>30</td>
</tr>
<tr>
<td>Height of symphysial region at symphysial angle</td>
<td>50</td>
</tr>
<tr>
<td>Height of mandibular ramus at the part 180 mm. behind symphysial angle</td>
<td>55</td>
</tr>
</tbody>
</table>

The snout is slightly bent upward, as a whole, so that its upper side is concave and its palatal side convex in lateral view. The maxillae do not reach so far anteriorly as the premaxillae, and as also the mandible, do; their anterior ends lying about 50 mm. anterior to the symphysial angle: a characteristic of the present genus. As a representative of the present genus, they are comparatively wide and stout. In a frontal section, they are subtriangular and wider than high; those of both sides do not join each other on the palatal surface, being separated by a narrow longitudinal groove. The premaxillae are very long and narrow; the left one is slightly overlapped by the right along the median line. As observed in a frontal section, they are thicker below — outwards, and thinner above — mesially; their common outline in the same section forms nearly a semicircle. They appear to be free of teeth, as a characteristic of the present genus. Their common width is less than their height in the greater posterior part, but just the reverse in the anterior part free from the maxillae. A pair of distinct grooves are present along the premaxillo-maxillary sutures. Continuations of the same grooves run forward on both sides of the premaxillae in their anterior part free from maxillae. The vomer observed in a frontal section appears to be single-pieded, instead of being doubled.
Fig. 3. *Eurhinodelphys pacifica*

Frontal sections of type-specimen — snout and mandibular rami at their certain middle part (right figure) and symphysial region of mandible at its certain posterior part (left figure); natural size.

The mandibular rami are much flattened interio-externally and are rather high. Two anterior mental foramina are present on the outer side of each ramus posterior to the symphysial angle, and each of them is continuous anteriorly with a distinct groove, which is some 70–80 mm. long. Laying aside these grooves, the longitudinal groove in general on the outer side of each ramus is not very well marked, while that on the inner side is very distinct. The two rami are set close to each other, the symphysial angle being very acute. They are wider above than below, as can be observed in a frontal section. The symphysial region is slightly wider than high; the upper side of its outline in a frontal section forms a rounded embayment, corresponding to the symphysial groove, and the lateral to lower sides as a whole of the same form just a half of an oval figure.

The teeth appear to be confined to the maxilla and mandible. They are very numerous, their frequency in a length of 100 mm. being 11 to 13. They are single-rooted; their crown is slenderly conical, curved and very acute; their cross section is oval, the side-to-side diameter being greater than the fore-and-aft. They are entirely free of accessory tubercles and basal cingula, and are neither contracted nor especially expanded at the base of the crown, being uniformly tapered toward the tip from a certain part of the root. They appear not to wear down, keeping their acute tips, perhaps, almost throughout life. The surface of enamel is very smooth. Toward the anterior end of the present specimen as preserved, the tooth rows of both sides of the mandible become less distant from each other, and the successive lower teeth become more closely set. Within the limit of the most anterior two or three lower teeth of either side as preserved, the teeth become stouter very rapidly forward, so that, for instance, the most anterior right one, being the stoutest in the present specimen, measures 12 mm. and 15 mm. in the fore-and-aft and side-to-side diameters of its root, respectively. It appears probable that the anterior part of the symphysial region might have borne a number of especially stout teeth, of which the two rows of both sides are closely set to each other. Many of these dental characteristics, except the especially stout anterior symphysial teeth, appear to
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correspond well to those of the present genus in contrast to the Acrodelphinidae. The more anterior upper teeth in general measure some 10 mm. and 3.5-4 mm., the more posterior upper ones 12-13 mm. and 4-4.5 mm. and the lower ones, except a few most anterior ones mentioned above, 8-9 mm. and 3-3.5 mm., respectively, in the height and the fore-and-aft basal diameter of the crown.

The specimen is strongly fossilized and is sepic brown in colour.

The present species appears to be rather closely allied with *Eurhinodelphis* (described as *Priscodelphinus*) *prodatus* (DU BUS), though it is peculiar in the thinning-out and overlapping mesially of the premaxillary as observed in a frontal section and in the increasing in size anteriorly of the anterior symphysis teeth. Possibly, the present species may represent a form more primitive than the known European ones of the present genus. According to ABEL, the present genus hitherto known is confined to both sides of the North Atlantic in its distribution. The occurrence of the present species in Japan is somewhat interesting in that connection.

**Age:** The present genus is one of those which flourished in younger Miocene—especially in Pontian. The present fossil might indicate, therefore, either a horizon belonging to younger Miocene or one which is more or less older. The Shiuya Formation, i.e., the alternation formation of middle Miocene of the Echigo Oil-Field, lies between the deposits of the principal transgression of older Miocene and those of the same of younger. In certain other fields, the mid-Miocene break is located in such a position. It would appear probable that the alternation formation of this kind, as well as the mid-Miocene break, is referred chiefly to Tortonian, though its lower limit may well belong to Helvetic. Thus, the evolutionary stage shown in the present fossil and the Stratigraphical position of the bed yielding the same appear to answer well to each other.

**Family Delphinidae**

**Pseudorca yokoyamai,** sp. nov.

Pl. VIII (1), Figs. 8–11; Text-Figs. 4, 5

Type-specimens: two isolated teeth, probably representing the last and penultimate ones of either left maxilla or right mandibular ramus. Paratype: Imperial Museum of Ueno, No. 2216; fragment of right ramus of mandible, bearing seven teeth, four of which are incompletely preserved, in situ.

Locality of the type: Hommoku, Yokohama. That of the paratype: Ichinosawa, Sekinoyatsu, Seki-mura, Kimitu District, Province of Kazusa.

Horizon of the type: probably one and the same formation as that of the paratype, though its locality lies on the opposite side of the Gulf of Tōkyō. That of the paratype: lower part of the Sanuki Formation, or *Eusephalus protomamontens* zone, of the Narita Series.

The type-specimens measure as follows (in mm.):

<table>
<thead>
<tr>
<th></th>
<th>PENULTIMATE TOOTH</th>
<th>LAST TOOTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total height</td>
<td>47±a</td>
<td>50</td>
</tr>
<tr>
<td>Height of crown</td>
<td>10±a</td>
<td>16</td>
</tr>
</tbody>
</table>


Hikoshichirô Matsumoto

Height of root: 38
Fore-and-aft diameter of crown at base: —
Side-to-side diameter of the same: 13
Fore-and-aft diameter of root: 17
Side-to-side diameter of the same: 18

The teeth are recurved as a whole. The crown is conical and acutely pointed. The surface of enamel is very smooth. The root is subcylindrical, as a characteristic of the present genus in contrast to Oreia; its alveolar part is especially stout; either the anterior inner or posterior inner side of the root is flattened or very slightly hollowed, but not so markedly as in Oreia. A very thin, practically negligible layer of cement is present, covering the root. The pulp cavity is very small.

The teeth are rather strongly fossilized, being not at all sticky to the tongue. The enamel is blue, tending to be amber-coloured toward the tip of the crown and grayish brown toward the base of the same, while the root is dirty-brown.

Fig. 4. *Pseudencia yokoyamai*
Reconstruction of type-teeth, penultimate (l) and last ones of either right maxilla or left mandibular ramus; natural size.

The paratype represents the part from the posterior end of symphysis to a certain extent behind the last tooth. This part bears seven teeth. Three or four more teeth might have been present before them if the symphysial region were not broken away. The measurements of this specimen are given as follows (in mm.):

- Height of ramus between the first and second teeth as represented in this specimen: 61.5
- Ditto between the third and fourth teeth: 61.5
- Ditto just behind the last tooth: 67
- Width of ramus at between the first and second teeth: 46
- Ditto between the third and fourth teeth: 47
- Ditto the last tooth: 48
- Ditto at 40 mm. behind the last tooth: 32
- Fore-and-aft diameter of crown at base of the first tooth: 15
- Ditto of the second: 14
- Ditto of the third: 15
- Ditto of the fourth: 14
- Fore-and-aft diameter of root at alveolar margin of the first tooth: 18
- Ditto of the second: 18.5
- Ditto of the third: 18
- Ditto of the fourth: 17
- Ditto of the fifth: 19
- Ditto of the sixth: 15
Ditto of the last ........................................ 14.5
Diastema between the first and second teeth ............ 8
Ditto between the second and third .................... 9
Ditto between the third and fourth ................... 9
Ditto between the fourth and fifth ................... 9
Ditto between the fifth and sixth .................... 5
Ditto between the sixth and last ..................... 13
Length of the series of these seven teeth ............. 177

Though closely allied with the living representative of the present genus, the present species appears to differ from it in the presence of seven teeth, instead of six, on the part of the ramus posterior to the posterior end of the symphysis and in the smaller dimension of the teeth in general. Both the mandibular ramus and teeth of the present species are distinctly stouter than those of the living species of Globicephalus. Thus, the present species appears to stand between the living representatives of the present and the last-mentioned genera, so far as the parts represented in the specimens described here are concerned. It may not be very improbable, that either or both the living representatives of these two genera have descended from such a form as is represented by the present species.

Age: In the writer's opinion, the Euclephas protomammontensis zone is to be referred to Calabrian, younger Pliocene.

Family Balanopteridae

Idiocetus tsugarensis, sp. nov.

Pl. X (III), Figs. 1-3

Type-specimen: fragment of skull, representing parts of parietals, frontals, nasals, maxillae and premaxillae in the limit of its upper side.

Locality: said to have been derived from the Akaishi Valley, Naka-Tsugaru District, Province of Mutsu.

Horizon: probably, one of the nodule ("pseudoconglomerate") beds of the Black Shale of older Miocene, as far as its said locality is correct at all.

The specimen measures as follows (in mm.):

Length, as preserved .................................. 302
Width, as preserved .................................. 200
Height, as preserved ................................ 140
Length of inter-frontal suture ..................... 35±
Length of inter-nasal suture ....................... 120±
United width of nasals at their anterior ends ........ 50
Distance between the two maxillo-premaxillary sutures at their posterior ends 52
Ditto at the anterior ends of nasals ................ 80

The skull is keeled along the inter-parietal suture, so as to be widely angular above in a frontal section across the same suture. The parietals overlap the frontals at the fronto-parietal sutures, which are very strongly zigzagged. The parts of the frontals along the inter-frontal suture are not keeled but flattened. The frontals are also deeply overlapped by the maxillae at the fronto-maxillary sutures, which are also very strongly zigzagged. A small supra-orbital foramen is present on each
maxilla at about a frontal level just behind the anterior ends of the nasals and some 25 mm. outside the maxillo-premaxillary suture. Both the nasals and premaxillæ are very narrow. All the features in the limit represented in the present specimen answer well exactly to those of the present genus.

The specimen is very strongly fossilized and is light brown in general colour, variegated at places with darker shades. The matrix appears to have been a nodule, looking quite similar to those which are very common in the marine Miocene shales of Japan.

The present species stands between *Idiocetus* (or *Mesocetus?*) *laxatus*¹ and *I. longifrons*² of the Belgian Black Crag and Diestian, respectively, in the limit of the shape of nasals and premaxillæ, though it is more closely allied with the latter than with the former.

**Age:** All the hitherto known species of the present genus are referred to Pontian or Pliocene. Recollecting here, however, the Palæontological evidence that the Balaenopteridae are of ancient origin, occurring for the first time in uppermost Oligocene and having descended directly from the Archæoceti, it cannot be safely said that the present genus is confined to these limited younger ages. One thing which appears probable is that the present fossil might indicate either a horizon belonging to younger Miocene or Pliocene, or one which is more or less older. The Black Shale, as well as the underlying Meta-Shale if present, of the Japanese Miocene of the oil-field type in general, appears to correspond to the deposits of the period of the principal transgression of older Miocene. In certain other fields, the deposits of such a period, as well as the overlying alternation formation if present yield either or both the very characteristic fossils, *Vicarca* and *Desmostylus*, the former of which makes the Japanese horizons comparable with the Indian and Malaysian, and the latter with the North American. It would appear probable, that the said period of the principal transgression might correspond chiefly to Helvetian, while that of the overlying alternation formation or the mid-Miocene break in another case, chiefly to Tortonian. At any rate, the present species might be the oldest representative of the present genus ever known.

² *Ibid.*, pp. 73–76, Pia. LXIV–LXIX.
Fig. 1. *Ontocetus oxymycterus* Kellogg (?); left lower tooth from Yuda; posterior view; nat. size.

Fig. 2. Ditto; ditto; posterior inner view; nat. size.

Fig. 3. Ditto; ditto; anterior view; nat. size.

Fig. 4. Ditto; ditto; lower broken end; nat. size.

Figs. 5-7. *Kogia prissa*, n. sp.; type teeth, lower ones probably of left side; posterior view; nat. size.

Fig. 8. *Pseudorca yokoyamai*, n. sp.; one of the type-teeth; outer view; nat. size.

Fig. 9. Ditto; ditto; either anterior or posterior view; nat. size.

Fig. 10. Ditto; the other of the type-teeth; outer view; nat. size.

Fig. 11. Ditto; ditto; either anterior or posterior view; nat. size.
PLATE IX (II)

Fig. 1. *Eurinodelphis pacificus*, n. sp.; fragment of snout and mandible *in situ*, type-specimen; left side view; \( \times \frac{1}{4} \).

Fig. 2. Ditto; ditto; right side view; \( \times \frac{1}{4} \).

Fig. 3. Ditto; ditto; upper view; \( \times \frac{1}{4} \).

Fig. 4. Ditto; ditto; lower view; \( \times \frac{1}{4} \).
PLATE X (III)

Fig. 1. *Idiocetus tsugarensis*, n. sp.; fragment of skull, type-specimen; upper view;  $\times \frac{1}{4}$.

Fig. 2. Ditto; ditto; right side view;  $\times \frac{1}{4}$.

Fig. 3. Ditto; ditto; lower view;  $\times \frac{1}{4}$. 