

Some Tertiary Fossils from the Miike Coal-field.

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With 3 plates.

The fossils which form the subject of the present paper are those obtained between 1897 and 1904, during the sinking of a shaft at a place called Manda in the Miike Coal-field. The shaft was sunk to the depth of 884 feet below the surface of the ground where there is a coal-seam about eight feet thick which is now being extensively worked. The fossils are contained in a dark greyish green sandstone which is fine to medium-grained and quite hard. They belong mostly to different horizons ranging from 240 to 842 feet in depth, only a few having been found in the same piece of stone. They are tolerably numerous; but owing to their bad state of preservation, those which I was able to determine with any degree of accuracy consist of two species of plants, a Crinoid, a Brachiopod, eight species of Mollusca, two crabs and a tooth of a shark. They are the following:—

1. *Cycas Fujiiana* n. sp.
2. *Cedroxylon* sp.

3. *Pentacrinus ariakensis* n. sp.
4. *Terebratula miikensis* n. sp.
5. *Perna Nishiyamai* n. sp.
6. *Pholodomya margaritacea* (Sow.)
7. *Crassatella fusca* n. sp.
8. *Venericardia nipponica* n. sp.
9. *Cardita mandaica* n. sp.
10. *Venus Mitsuiana* n. sp.
11. *Fusus* sp.
12. *Aturia ziczac* (Sow.)
13. *Homolopsis japonicus* n. sp.
14. *Xanthilites pentagonalis* n. sp.
15. *Lamna cf cuspidata* Ag.

These fifteen fossils arranged according to their depths or horizons are as follows:—

- | | |
|-----------|----------------------------------|
| 240 feet | <i>Terebratula miikensis.</i> |
| 277 „ | <i>Venus Mitsuiana.</i> |
| 280 „ | <i>Venericardia nipponica.</i> |
| 300 „ | „ |
| 358 „ | „ |
| „ | <i>Crassatella fusca.</i> |
| 384 „ | „ |
| (?) 393 „ | <i>Lamna cf cuspidata.</i> |
| 400 „ | <i>Cardita mandaica.</i> |
| 401 „ | <i>Pholadomya margaritacea.</i> |
| 403 „ | <i>Pentacrinus ariakensis.</i> |
| 405 „ | <i>Venericardia nipponica.</i> |
| „ | <i>Cardita mandaica.</i> |
| „ | <i>Fusus</i> sp. |
| 484 „ | <i>Xanthilites pentagonalis.</i> |

- 489 „ *Homolopsis japonicus*.
- 538 „ *Cycas Fujiiana*.
- 608 „ *Cardita mandaica*.
- 610 „ *Cedroxylon* sp.
- 613 „ *Aturia ziczac*.
- 625 „ *Perna Nishiyamai*.
- 650 „ *Crassatella fusca*.
- 842 „ *Venericardia nipponica*.

As seen from above, *Venericardia nipponica* occurs in several horizons from 280 to 842 feet. *Cardita mandaica* occurs at 400 feet, 405 feet and 608 feet, and at 405, together with *Venericardia nipponica*. *Crassatella fusca* is known from two horizons, at 358 and 650 feet in the first of which it is found together with *Venericardia nipponica*. All the others were obtained from different horizons.

Respecting the geological age of the formation, it is very difficult to speak with exactness. But that it belongs to the *Palæogene* or anterior half of the *Tertiary* is beyond all doubt. *Venericardia nipponica*, which ranges from nearly the top of the formation down to its bottom, is a near relation of *V. pectuncularis* Lam. of the French *Palæocene*. *Pholadomya margaritacea* and *Aturia ziczac* are *Palæocene* to *Miocene*, in the Occident; while *Lamna cuspidata* is hitherto known to occur only in the *Oligocene*. It is therefore highly probable that we have here a rock-complex which corresponds to the *Palæocene* and *Eocene* of Europe.

The same formation seems to be developed in at least two places on the island of Amakusa, namely, at Hangôchi and Sakasegawa. From the former we possess *Crassatella fusca* and a new species of *Lima* as described in the appendix; from the

latter there is a specimen of *Pholadomya margaritacea*. Whether another one of the same *Pholadomya* really comes from Kawachidani, Echigo, is a question; for it is doubtful whether the label now attached to it really belongs to it or not.

Recently a splendid specimen of *Aturia ziczac* was secured by one of the geologists of the Imperial Geological Survey from the coal-field of Takashima near Nagasaki, showing that the coal-bearing series of that place is also probably *Palæogene*.

DESCRIPTION OF THE SPECIES.

PLANTÆ.

1. *Cycas Fujiiana* n. sp.

Pl. I. Fig. 7.

A fragment of a Cycadeous leaf showing a marked resemblance to *Cycas revoluta* L. now living in Japan and China.

The segments are long, linear, parallel-sided, single-veined, straight or slightly bent outward, directed somewhat forward, distant and attached to the rachis with the whole base apparently without any expansion or contraction; the length may have been more than 10 centim., as there are some measuring 8–9 centim. without the apical portion; the breadth is 3–4.5 millim; the distance between the two segments at their base is about 3 millim. on an average. The rachis is comparatively slender, measuring only 2–3 millim. and is furnished with longitudinal striations on the surface.

The distinction between the present species and the living

Japanese form lies in the segments being not so markedly narrowed as in the latter. It resembles also *Cycas Steenstrupi* Heer (Flora der Ataneschichten, p. 40, pl. v. Flora Foss. Arct., vol. VI) from the Upper Cretaceous of Greenland which, however, has the segments shorter, closer together and dilated at base.

The specimen was found at the depth of 538 feet below the surface of the ground.

The species was named in honour of Prof. Fujii who was kind enough to undertake the examination of the following wood.

2. *Cedroxylon* sp.

A fossil wood, not well preserved, was found, at a depth of 610 feet. The specimen was recognized by Prof. Fujii of the Botanical Institute as *Cedroxylon* with some resemblance to *Araucarioxylon*. A description will be published by him in a separate paper.

ANIMALIA.

CRINOIDEA.

1. *Pentacrinus ariakensis* n. sp.

Pl. I. Fig. 6.

Three fragments of Crinoid columns which are pentangular, in outline with a very shallow groove between the edges. The articular surface is probably sculptured, but owing to the unfavourable state of preservation no trace of it remains. In a column about 7 millim. in diameter, the joints seem to be about

1.5 millim. in length. Our specimens are not unlike *P. oakeshottianus* Forbes (Echinoderms of the London Clay, Palæont. Soc., 1852, p. 35, Woodcut) from the English Eocene, though they are somewhat less sharply pentangular.

The depth at which the specimens were obtained was 403 feet.

BRACHIOPODA.

2. *Terebratula miikensis* n. sp.

Pl. III. Figs. 6a, 6b.

We possess only a single ventral valve firmly attached to a rock. It is moderately large, ovate, longer than wide, with the widest part anterior to the middle of the shell. It is provided with a broad shallow longitudinal median depression most distinct in its anterior half. The lateral as well as the frontal sutures run almost straight. The beak is moderately produced and incurved, truncated by a comparatively small foramen margined anteriorly by small deltidial plates. The surface is smooth, traversed by lines of growth which are rather coarse in the anterior part of the shell. The length measures 35 millim., the breadth 24 millim., and the thickness about 20 millim.

This species seems to bear a close resemblance to one figured by Davidson in his paper on the "Tertiary Brachiopoda of Belgium" (Geol. Mag., 1874) without a specific name, (pl. VIII, fig. 9) said to have been found in the Landénien of that country, which corresponds to the lowest portion of the London Basin.

The specimen was obtained at a depth of 240 feet.

3. *Perna Nishiyamai* n. sp.

Pl. I. Figs. 1a, 1b.

Shell moderately large, flattened, irregularly oval, longer than wide. Hinge-line straight, making an obtuse angle with the anterior as well as with the posterior margin; anterior margin somewhat concave, provided with a deep elongated byssal notch; lower margin almost semi-circular; posterior margin broadly rounded. Surface smooth with more or less distinct lines of growth.

The single specimen that we possess is 72 millim. high, 63 millim. broad and 20 millim. thick.

The depth at which the shell was found was 625 feet.

4. *Pholadomya margaritacea* (Sow.).

Pl. I. Fig. 4.

Pholadomya margaritacea Moesch. Monographie der Pholadomyen, p. 119, pl. XXXVII, figs. 6, 8, pl. XXXIX, figs. 1-6.

Pholadomya Konineki Nyst. Descrip. Coq. Foss. et Polyp. Terr. Tert. Belgique, p. 50, pl. I, figs 9. Deshayes. Descrip. Anim. sans Vert., vol. I, p. 278, pl. IX, figs. 11-14.

Cardita margaritacea Sowerby. Mineral Conchology, vol. III, p. 175, pl. 297, figs. 1-3.

There is a greatly deformed specimen of *Pholadomya* from Miike which on careful examination appears to belong to the same species as that of Sakasegawa in Amakusa (figs. 3a, 3b, pl. I) and Kawachidani in Echigo (fig. 2a, 2b, pl. I). Now on comparing these specimens with the *Pholadomyas* hitherto found in Europe, their sphenoid shape, prominent beak, and abruptly ending nearly perpendicular anterior side seem to show

that we are dealing here with the well-known *Pholadomya margaritacea* reaching from the lowest Palæogene up to the Miocene. The Sakasegawa specimen belongs to forms with coarser ribs, while that from Kawachidami to those with finer ones.

The depth at which the Miike specimen was found was 401 feet.

4. *Crassatella fusca* n. sp.

Pl. II. Figs. 1-3, 5, 6.

Shell moderately thick, ovately trigonal, somewhat inflated, very inequilateral, posteriorly attenuated; posterior border less sharply rounded than anterior; ventral border broadly rounded. Surface smooth with prominent lines of growth. Beaks bluntly pointed and touching. Lunula ovate, sharply bounded, twice as long as broad. Anterior tooth larger than posterior.

The specimen represented in fig. 1a has its dorso-posterior portion flattened by pressure, so that a rounded edge seems to run from the beak to the posterior ventral margin. It is dark-coloured on the surface, as if it had been covered with an epidermis of the same colour.

In outline this species resembles *Crassatella plumbea* (Chem.) of the Paris Basin (Deshayes, Descr. Coq. Foss., vol. I, p. 33, pl. III, figs. 10, 11) but has a much thinner shell.

Found at depths of 358 ft., 384 ft. and 650 ft.

6. *Venericardia nipponica* n. sp.

Pl. III. Figs. 5a, 5b.

There are several specimens of this very characteristic shell which, however, are more or less badly preserved.

The shell is oval, oblique, strongly inequilateral, thick, flatly convex, with about 23 strong, flattened, broad, rugose ribs which are separated by furrows much narrower than the ribs themselves. The hinge in none of the specimens is exposed to view, but the general characters of the shell-surface leaves no doubt of its being a *Venericardia* resembling in its compressed shape *V. pectuncularis* Lam, (Anim. sans Vert., vol. v, p. 610 no. 2 and Deshayes, Coq. Foss. Envir. Paris, p. 150. pl. XXIV, fig. 1, 2) and in its oblique oval outline *V. multicosata* Lam. (Desh. Coq. Foss. Env. Paris, p. 151, pl. XXVI, fig. 1, 2), both from the Paris Basin and occurring in the "Sables de Bracheux" which is now considered by many geologists to be Middle Palæocene.

Our specimens were obtained at depths of 280 ft., 300 ft., 358 ft., 405 ft., and 842 ft.

7. *Cardita mandaica* n. sp.

Pl. II. Figs. 8-11.

The shell is transverse, elongate, oblong or subquadrate, very inequilateral and inflated. The surface is ornamented with about 20 radiating, flattened, somewhat rugose ribs separated by intervals narrower than the ribs themselves. The beaks are prominent and incurved.

A small specimen with both valves complete (fig. 9ab) measures 15 millim. in length, 13 millim. in height and 11 millim. in thickness. The right valve represented in fig. 10 is about 27 millim. in length and 25 millim. in height.

This species bears a marked resemblance to *Cardita obovata*

Edw. (Eocene Mollusca, Bivalves, p. 148, pl. XXII, fig. 13) from the London Basin, in which, however, the ribs number about 30.

Found at depths of 405 ft. and 609 ft.

8. *Venus Mitsuiana* n. sp.

Pl. I. Figs. 5a, 5b.

The shell is small, convex, subtrigonal, very inequilateral with the anterior side only about one-third as long as the posterior. The anterior border of the shell is sloping and nearly straight, making a rounded angle with the broadly arcuate ventral border; the postero-ventral corner is rounded and less sharp than the antero-ventral. The surface is smooth, furnished only with lines of growth. The beaks are small and touch. Length 18 millim.; height 13 millim.; thickness 8 millim.

There is only a single specimen of this species the shell of which seems to have been rather thin.

As it is impossible to expose the hinge, the generic determination must be taken as provisorial.

Taken from a depth of 277 feet.

9. *Fusus* sp.

Pl. II. Fig. 7.

A medium-sized form having a long canal with the spire broken off. The body whorl shows two sharp spiral ridges one corresponding in position to its shoulder-part and the other separating the lateral surface from the lower. The interspace

between the ridges is concave, while the surface above the upper one gently ascends to the suture. The whole surface seems to have been ornamented with fine spiral lines.

Found at a depth of 405 feet.

10. *Aturia ziczac* (Sow.).

Pl. III. Figs. 1ab, 8ab.

Aturia zic-zac Edwards. A Monograph of the Eocene Mollusca, part I, Cephalopoda, p. 53, pl. IX, figs. 1a—b.

Nautilus zic-zac Deshayes. Descr. Coq. Foss. Env. Paris, vol. II, p. 765, pl. 100, figs. 2, 3. Sowerby. Mineral Conchology, vol. I, p. 9, pl. I, fig. 3.

Edwards in his Eocene Mollusca, “describes this species as follows :”—

Shell ventricose, smooth; umbilicus closed; septa concave; lateral lobes narrow, pointed; dorsal lobes much curved; siphuncle large, continuous, trumpet-shaped.

There are two specimens belonging to this characteristic species of the older Tertiary. The one is a fragment of a large whorl; the other, though smaller, is more complete and measures some 63 millim. in diameter, while its thickness is about 20 millim. in its thickest part, so that the specimens belong to the so-called compressed variety of Edwards. The narrow pointed lateral lobes are clearly seen in both specimens, as they are not furnished with shells.

The species is found in Europe in the Eocene and Miocene formations, and in Egypt in the Kurkur Series which is assigned to the Palæocene.

The depth at which the Miike shells were found was 613 feet.

CRUSTACEA.**11. *Homolopsis japonicus* n. sp.**

Pl. III. Fig. 4.

A single specimen of carapace without appendages.

Carapace ovately pentagonal, longer than wide, with the front pointed. Branchial regions distinct, extending to a little more than half the length of the carapace, approximately triangular in shape with metabranchial lobes separated from epibranchial and mesobranchial ones by a deep furrow. They do not meet in the median line of the shell at the posterior border, but are separated from each other by a broadly triangular field which is to be taken for the metacardiac lobe. Mesobranchial and epibranchial lobes both separated from each other and from the other portions by a more or less distinct furrow. Epicardiac region elevated, shield-like in shape, with a tubercular eminence on each side, so that the portion between these eminences looks like a depression. Metagastric lobes distinct each with a tubercle and extending obliquely forward and laterally. Mesogastric lobe also distinct, broadly rhombic in outline and furnished with a single large tubercle in the middle and a long narrow median process reaching nearly to the front margin of the shell. Hepatic as well as epigastric lobes each marked by a tubercle. Protogastric and urogastric lobes not well developed.

The frontal margin of the carapace is not well preserved, but seems to end in two short spines. The postero-lateral corners are also not perfect, so that it is not possible to tell

whether they are pointed or not. The carapace is somewhat tumid and its whole surface is covered with irregular granules.

Length 18 millim.; breadth 14 millim., at the broadest part which is a little anterior to the hinder border.

Of this genus, there are only two species described viz., *Homolopsis Edwardsii* Bell of the English Gault, and *H. Richardsoni* Woodward (Some Podophthalmatous Crustacea from the Cretaceous of Vancouver and Queen Charlotte Islands, Q. J. G. S., May, 1896, vol. 52, p. 224, fig. 3) from the Cretaceous of British Columbia. The Japanese species shows a decided resemblance to the latter.

Found at depth of 489 feet.

12. *Xanthilites pentagonalis* n. sp.

Pl. III. Fig. 3.

This species also is represented by a single carapace without appendages and may be characterized as follows:—

Carapace roundly pentagonal, somewhat broader than high, and uniformly flatly convex; breadth 28 millim., height 24 millim.; regions mostly distinct and apparently smooth though very small granules are discernible with a lens; frontal margin straight and furnished with a slight notch in the middle; epigastric lobes marked by a moderately large tubercle scarcely distinct from the protogastric which are large and separated by the long narrow pointed process of the mesogastric; the latter, is pentagonal in shape and is divided from the metogastric by a shallow arched groove. Urogastric lobe indistinct; cardiac region pentagonal with a broad, shallow, median depression;

hepatic region with a rounded elevation; the hepatico-branchial as well as the hepatico-gastric furrows broad and shallow; epibranchial lobes hardly divided from the mesobranchial, while both are distinctly separated from the elevated metabranchial lobes as well as from the gastric region by a shallow groove; the posterior border of the carapace, is broken, but may have been more or less straight; orbits moderate in size, and shown by shallow arched notches with elevated borders.

Of the genus *Xanthilites* the only species described is *X. Bowerbankii* Bell (Monograph of the Fossil Malacostracous Crustacea of Great Britain, part I, p. 17, pl. II, fig. 2) from the Eocene of the Isle of Sheppey, which Bell recognized as most closely allied to the species of *Xantho* now living in Japan. The difference between the Japanese fossil and all the living species of *Xantho* as well as from the English form consists in the much broader posterior border.

The specimen was found at a depth of 484 feet.

PISCES.

13. *Lamna* cf. *cuspidata* Ag.

Pl. III. Fig. 7.

We designate under the above name a subulate tooth with the root broken off, about 22 millim. long and 4 millim. broad. It is slightly recurved, flatly inflated, smooth and with sharp edges, and furnished with a slightly acute denticle on each side. The fossil is firmly attached to the stone, but judging from its general appearance, it comes nearest to the *Lamna*

cuspidata of Agassiz (Recherches sur les Poissons Fossiles, III, p. 290, pl. 37a, figs. 45-50) so widely distributed in the Oligocene of Central Europe.

Our specimen is somewhat more subulate than most of the forms figured by Agassiz, resembling in this respect *L. elegans* of the same author, which however seems to be a little smaller in size.

Found at a depth of 393 feet (?).

APPENDIX.

FOSSILS FROM HANGŌCHI, AMAKUSA.

1. *Crassatella fusca* Yok.

Pl. II. Fig. 4.

There are several casts of a bivalve which on a closer examination proved to be those of *Crassatella fusca* described from Miike in the preceding pages.

It seems to be very frequent at Hangōchi.

2. *Lima amaxensis* n. sp.

Pl. III. Fig. 2.

There is a single specimen of the right valve firmly attached to the stone. It is ovately oblong, somewhat inequilateral, oblique, compressed and thin. The surface is ornamented with about fifty simple, straight, narrow, equal, radiating ribs separated by intervals nearly as wide as the ribs themselves. The ears are broken.

Height 55 millim.; breadth 50 millim.

In the general outline of shell and number of radiating ribs, the Japanese form resembles *L. pretiosa* Desh. (Descr. des Anim. sans Vert., II, p. 64, pl. 78, figs. 16–19) from the Calcaire Grossier Inférieure of the Paris Basin, but it is much larger and more oblique.

3. *Venericardia nipponica* Yok.

Several impressions of this characteristic shell were found in a piece of sandstone containing remains of *Crassatella fusca* above mentioned.



Plate I.

- Fig. 1. *Perna Nishiyamai* n. sp. Miike. a. Side-view. b. Front-view.
Fig. 2 ab. *Pholadomya margaritacea* (Sow.). Kawachidani.
Fig. 3 ab. Do. Sakasegawa.
Fig. 4. Do. A deformed specimen. Miike.
Fig. 5. *Venus Mitsuiana* n. sp. Miike.
Fig. 6. *Pentacrinus ariakensis* n. sp.
Fig. 7. *Cycas Fujiiana* n. sp.

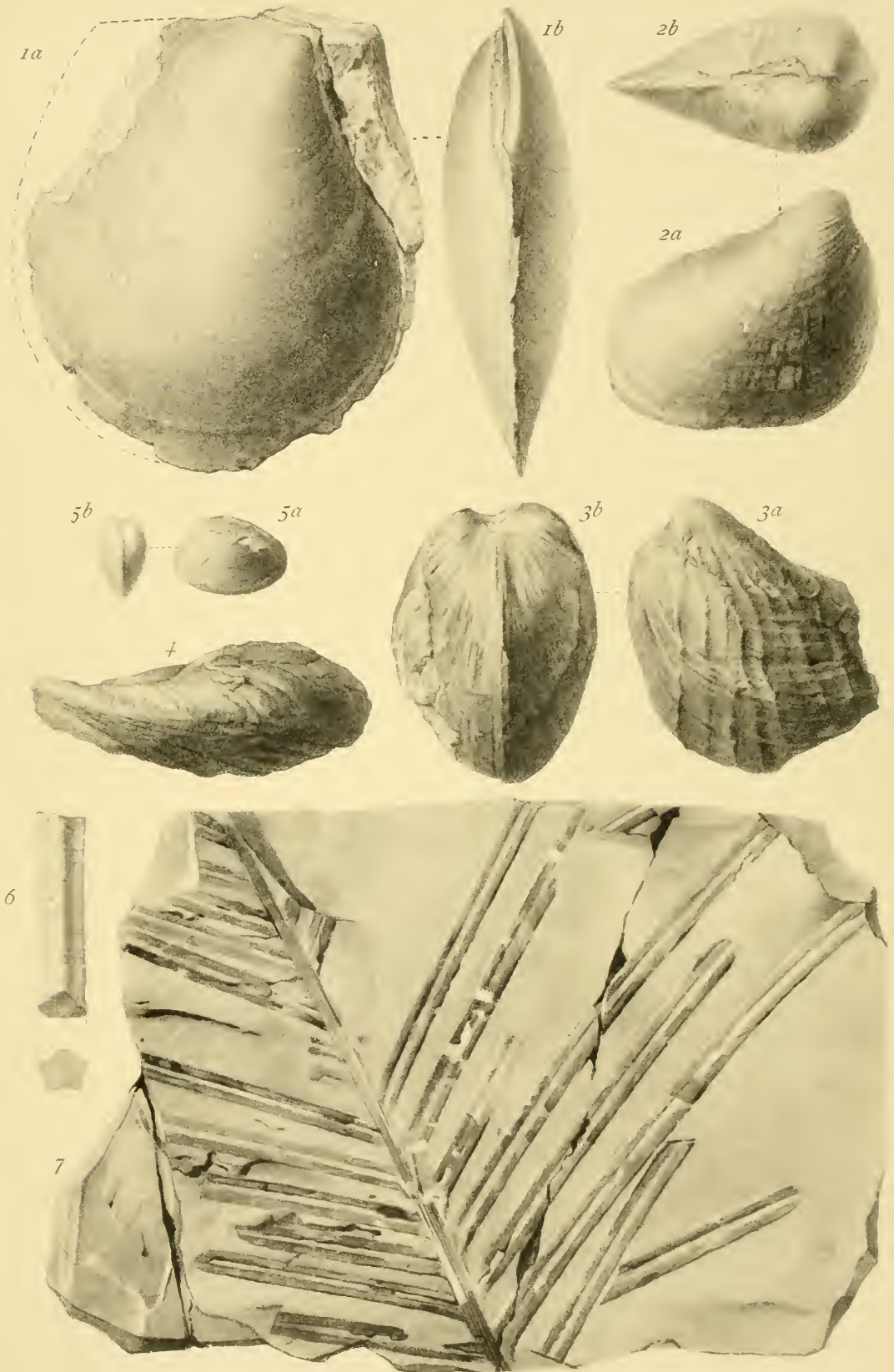


Plate II.

- Fig. 1 ab. *Crassatella fusca* n. sp. A specimen showing a rounded edge running from the beak to the postero-ventral angle owing to a pressure on the other parts of the shell. Miike.
- Fig. 2 a. Do. Right valve showing two divergent teeth. 2 b. The same showing the lunula. Miike.
- Fig. 3 ab. Do. A normal form. Miike.
- Fig. 4. Do. Inner cast. Hangōchi.
- Fig. 5. Do. Left valve showing the hinge and the inner surface. Miike.
- Fig. 6 ab. Do. A somewhat worn specimen. Miike.
- Fig. 7. *Fusus* sp. Miike.
- Fig. 8-11. *Cardita mandaica* n. sp. Miike.

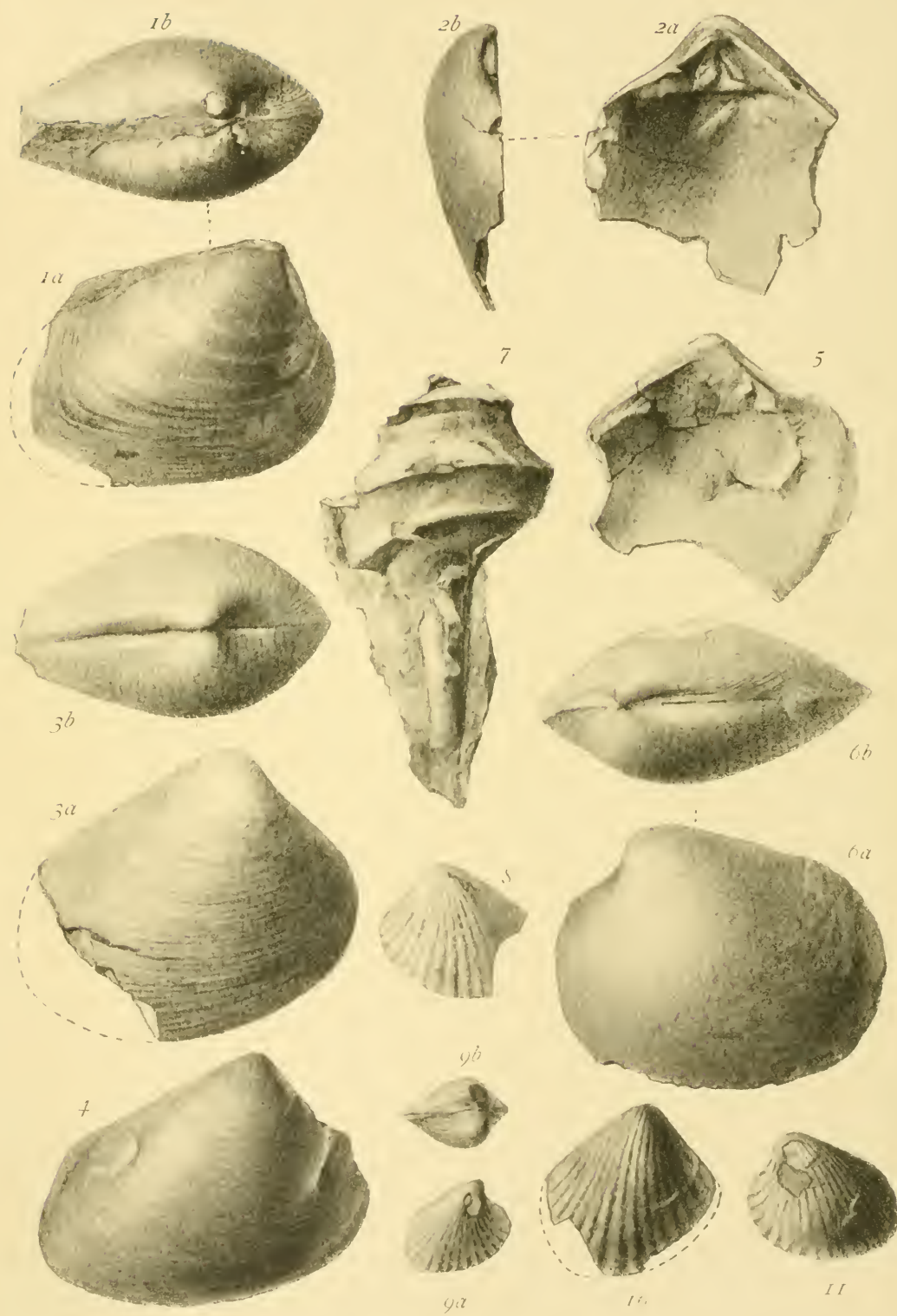


Plate III.

- Fig. 1. *Aturia ziczac* (Sow.). Miike.
a. Side-view. b. Front-view.
- Fig. 2. *Lima amaxensis* n. sp. Hangōchi.
- Fig. 3. *Xanthilites pentagonalis*. n. sp. $\frac{1.5}{1}$. Miike.
- Fig. 4. *Homolopsis japonicus* n. sp. $\frac{2}{1}$. Miike.
- Fig. 5. *Venericardia nipponica* n. sp. Miike.
a. Side-view of left valve. b. The same seen from above.
- Fig. 6. *Terebratula miikensis* n. sp. Miike.
a. Ventral valve. b. Lateral view of the same.
- Fig. 7. *Lamna* cfr. *cuspidata* Ag. Miike.
- Fig. 8. *Aturia ziczac* (Sow.). Miike.
a. Fragment of a whorl. b. The same seen from behind.

