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Molluscan Remains from the Uppermost Part of the Jô-Ban Coal-Field.

By

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With 6 Plates.

In my paper recently published on the fossils of the lowest part of the Jô-Ban coal-field,[1] I enumerated the several beds of which this coal-field is composed. The present paper treats of the Molluscan remains found in its uppermost beds, the so-called Shirado-Beds, which seem to be most fossiliferous, when compared with the others.

These remains are partly those collected by Dr. Tokunaga in his recent researches in the said coal-field, and partly those kept in the Museum of the Geological Institute of the Imperial University of Tokyo. Among the latter, there are many which have been collected by Dr. T. Kochibe as early as 1879, when he was studying the geology of the region corresponding to the southern part of what we now call the Jô-Ban Coal-field, and which he mentions in his "Geology of Northern Hitachi" published in 1882.[2]

The number of fossil localities amounts to more than forty, but the greater part of the fossils have been obtained at four places, viz.: Sukegawa, Tempizan, Yunami and Izura, the first having yielded 53 species, the second 23, the third 19, and the fourth 17. The remaining localities, taken all together, have given 42 species, although each one taken separately has yielded only a few, often only a single species. It is much to be regretted that where the fossils are most numerous they are mostly found as casts, thus making their determination not only difficult, but in many cases impossible.

The number of species found in all the localities taken together amounts to 96, as shown in the following table:

1) Molluscan Remains from the Lowest Part of the Jô-Ban Coal-Field. Jour. Sci. Coll., Vol. XLV, Art. 3, 1924.

2) Written in Japanese, the title in Japanese being "Jôhoku Chitsu Hen." Mem. Tokio Daigaku, No. 4.

I. Mollusca.	Sukegawa	Tempizan	Izura	Yunami	Other localities	Musashino	Living.
1. Terebra sp.					+		
2. Conus sp.					+		
3. Pleurotoma mediocarinata Yok.				+		+	
4. Pleurotoma sp.			+				
5. Drillia principalis Pils.			+			+	Northern, Central and Western Japan.
6. Bela rugulata Tros. var. schneideri Harm.					+	+	(Fossil in English Crag).
7. Olivella fortunei Ad.	?				+	+	Central Japan.
8. Voluta megaspira Sow.	+		+		+	+	North., Centr., West. Japan.
9. Chrysodomus phoeniceus Dall.	+		+	+		+	Japan? British Columbia.
10. Chrysodomus pericochlion Schr.	+						Northern Japan.
11. Buccinum leucostoma Lke.	+				+	+	Central Japan.
12. Volutharpa perryi Jay.	+					+	Northern and Central Japan.
13. Priene oregonensis Redf.	+					+	Northern Japan.
14. Galeodea (Sconsia) japonica Yok.			+	+			(Pliocene of Izumo).
15. Cassis japonica Rve.	+						Central and Western Japan.
16. Dolium luteostomum Küst.	+					+	North., Centr., West. Japan.
17. Cerithium baculum Yok.					+	+	(Pliocene of Kii).
18. Cerithium sp.					+	+	
19. Vermetus sp.	+						
20. Turritella nipponica Yok.	+		+	+	+	+	
21. Solarium sp.	+						
22. Calyptraea mammilaris Brod.		+		+	+	+	West coast of America.
23. Crepidula sp.		+					
24. Natica janthostoma Desh.	+	+	+	+		+	Northern and Central Japan.
25. Polinices (Neverita) ampla Phil.	+				?	+	North.. Centr., West. Japan.
26. Sigaretus (Eunaticina) papilla Gmel.			+			+	Central and Western Japan.
27. Turbo (Batillus) cornutus Gmel.	+						North., Centr., South. Japan.
28. Bathybembix argenteonitens Lke.	+						Central and Western Japan.
29. Stomatella japonica Ad.	+					+	Western Japan.
30. Haliotis sp.	+						

		Sukegawa	Tempizan	Izura	Yunami	Other localities	Musashino	Living.
31.	Acmaea sp.		+					
32.	Helcioniscus pallidus Gld.	+			+		+	Northern and Central Japan.
33.	Dentalium weinkauffii Dkr.	+					+	Central Japan.
34.	Dentalium complexum Dall.		+			+	+	Central Japan. Hawai.
35.	Panope generosa Gld.				+	+	+	Northern Japan. West. America.
36.	Mya arenaria L. var. japonica Jay.				+			North., Centr., West. Japan.
37.	Mactra sulcataria Desh.	+	+				+	„ „ „ „
38.	Mactra veneriformis Desh.				+		+	„ „ „ „
39.	Mactra spectabilis Lke.			+		+		Central and Western Japan.
40.	Spisula grayana Schr.	+	+			+	+	Northern Japan.
41.	Solen grandis Dkr.		+				+	Western Japan.
42.	Solen gouldii Conr.				+			Northern and Central Japan.
43.	Cultellus izumoensis Yok.					+		(Pliocene of Izumo).
44.	Siliqua pulchella Dkr.					+	+	Central and Western Japan.
45.	Soletellina violacea Lam.					+	+	North., Centr., West. Japan.
46.	Tellina besshoensis Yok.					+		(Miocene of Iwaki).
47.	Tellina optiva Yok.					+		(Pliocene of Izumo).
48.	Tellina izurensis Yok.			+				
49.	Macoma praetexta Mart.	+				+	+	Central and Western Japan.
50.	Macoma dissimilis Mart.	+	?	?		+	+	Central Japan.
51.	Dosinia troscheli Lke.	+	+			+	+	Central and Western Japan.
52.	Cyclina chinensis Chem.					+	+	North., Centr., West. Japan.
53.	Meretrix iizukai Yok.	+		+	+	+		
54.	Clementia speciosa Yok.					+		(Pliocene of Dainichi).
55.	Venus (Mercenaria) stimpsoni Gld.			+			+	North., Cent., West. Japan.
56.	Venus jedoensis Lke.	+					+	Central and Western Japan.
57.	Venus toreuma Gld.	+	+					„ „ „ „
58.	Tapes undulatus Born.	+						„ „ „ „
59.	Cardium californiense Desh.		+				+	North., Centr., West. Japan.
60.	Cardium muticum Rve.					+	+	„ „ „ „

	Sukegawa	Tempizan	Izura	Yunami	Other localities	Musashino	Living.
61. Cardium modestum Ad. et Rve.	+					+	Central Japan.
62. Cardium shinjiense Yok.	+	+		+	+		(Miocene and Pliocene).
63. Diplodonta semiaspera Phil.	+				+	+	Central and Western Japan.
64. Lucina (Phacoides) borealis L.	+		+	+	+	+	Central Japan.
65. Thyasira bisecta Conr.	+				+		Alaska. North. Pacific. Puget Sound.
66. Cardita cumingiana Dkr.	+					+	Central and Western Japan.
67. Venericardia ferruginea Ad.				+	+	+	Northern Japan.
68. Thracia pubescens Pult.					+		Atlantic. (Fossil in Saishu).
69. Mytilus grayanus Dkr.		+					North.—South. Japan.
70. Mytilus sp.		+					
71. Modiola sp.	+						
62. Lima lima L.	+						Central-Southern Japan.
73. Lima angulata Low.	+					+	North., Central Japan, Philippines.
74. Lima vulgatula Yok.	+					+	
75. Lima goliath Sm.	+	+			+	+	Central Japan. Patagonia.
76. Pecten laetus Gld.	+	+				+	Northern, Central, Western Japan.
77. Pecten vesiculosus Dkr.	+					+	Central Japan.
78. Pecten swiftii Bern.	+					+	Northern Japan. Sea of Okhotsk.
79. Pecten yessoensis Jay.		+	+		+	+	Northern Japan. Sea of Okhotsk.
80. Pecten kimurai Yok.	+		+	+	+		
81. Ostrea gigas Thunb.		+				+	North., Centr., West. Japan.
82. Pinna japonica Hanl.					+	+	Central and Western Japan.
83. Arca kobeltiana Pils.	+	+				+	Northern and Central Japan.
84. Arca subcrenata Lke.	+			+	+	+	Centr., West., South. Japan.
85. Arca setoensis Yok.				+	+	+	(Pliocene of Kii).
86. Pectunculus vestitus Dkr.		+				+	Central Japan.
87. Parallelodon obliquatus Yok.	+	+				+	Northern and Central Japan.
88. Limopsis azumana Yok.	+					+	
89. Leda confusa Hanl.			?		+	+	Central Japan. China Sea.
90. Leda sp.	+				+		

	Sukegawa	Tempizan	Izura	Yunami	Other localities	Musashino	Living.
91. Yoldia lischkei Smith.	+			+			Central Japan.
92. Nucula insignis Ad.	+					+	Northern Japan.
93. Nucula mirabilis Ad. et Rve.	+					+	Central and Western Japan.
94. Solemya tokunagai Yok.					+		
II. Brachiopoda.							
95. Terebratulina caput-serpentis L.						+	Central Japan. North. Pacific. Atlantic.
96. Pereudesia grayi Dav. var. transversa Dav.		+					Northern, Central, Western Japan. California.

Of the 96 species above enumerated, 12 are not well determined, and of the remaining 84, 17 are not yet known as living. They are the following:

1. *Pleurotoma mediocarinata Yok.*
2. *Bela rugulata Tros., var. schneideri Harm.*
3. *Galeodea (Sconsia) japonica Yok.*
4. *Cerithium baculum Yok.*
5. *Turritella nipponica Yok.*
6. *Cultellus izumoensis Yok.*
7. *Tellina besshoensis Yok.*
8. *Tellina optiva Yok.*
9. *Tellina izurensis Yok.*
10. *Meretrix iizukai Yok.*
11. *Clementia speciosa Yok.*
12. *Cardium shinjiense Yok.*
13. *Lima vulgatula Yok.*
14. *Pecten kimurai Yok.*
15. *Limopsis azumana Yok.*
16. *Arca setoensis Yok.*
17. *Solemya tokunagai Yok.*

Of these 17, which make about 20% of the whole fauna, 13 have already been found fossil in the same or other parts of Japan; namely, 5 in the Musashino Formation of the neighbourhood of Tokyo, 7 in the Pliocene of Totomi, Kii and Izumo, and 1 in the lowest part (Miocene) of the same coal-field, while 4 are entirely new forms.

Besides the above 17, there are 4 or at least 3 which are not yet known from Japanese waters. They are *Calyptraea mammilaris Brod.* of the west coast of America, *Thyasira bisecta Conr.* of the eastern half of the

Northern Pacific and *Thracia pubescens Pult.* of the Atlantic. *Chrysodomus phoeniceus Dall* which has been described from the northern part of the west coast of America may possibly be found also in the Japanese seas, as I found a specimen in our Geological Institute with no locality given, but which does not seem to be foreign.

The whole fauna, when compared with the already known ones in Japan, shows closest relationship to that of the *Musashino Formation.* Out of the 84 species which constitute it, 61 or 72.6% occur in this latter formation. Consequently, the Shirado-Beds from which these fossils have been obtained, if they are Tertiary at all, must be looked upon as *Upper Pliocene*, and not older.

Very interesting is the more northern aspect of the fossil fauna, when compared with the recent one of the neighbouring seas. The 67 living species grouped together according to their present habitat are as follows:

1. Species now living only near the fossil localities (Central Japan) or in about the same latitudes (Western Japan). ... 28
   Percentage of the whole fauna. 41.7
2. Species now living in Central or Western Japan as well as north of it. 22
   Percentage of the whole fauna. 32.8
3. Species now living in Central or Western Japan as well as south of it (Southern Japan and further south). 2
   Percentage of the whole fauna. 3.0
4. Species now living in whole Japan (Northern—Southern Japan). 3
   Percentage of the whole fauna. 4.5
5. Species now living only in Northern Japan 8
   Percentage of the whole fauna. 12.0
6. Species now living only outside of Japan. 4.0
   Percentage of the whole fauna. 6.0

As might be expected from the very young age of the fossil fauna, out of 67 living froms, 55 or 82% are those now living in Central and Western Japan, that is to say, in the seas near the fossil localities or further to the west, but in about the same latitudes. However, if we divide these 55 into four groups (no. 1–no. 4) as above done, the number of species also living in the north far exceeds those also living in the south, being more than ten times

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As in my three previous papers, Northern Japan is north of the 38th parallel, north latitude, while Central Japan is the part lying south of it and east of 138° east longitude. Western Japan is the part west of the same longitude, including, Chugoku, Shikoku and Kyushu. Southern Japan includes all the islands lying south of Kyushu.

as many. Besides, what I have to emphasize is the occurrence of 8 species which now live only in Northern Japan. They are the following:

1. *Chrysodomus pericochlion Schr.*
2. *Priene oregonensis Redf.*
3. *Panope generosa Gld.*
4. *Spisula grayana Schr.*
5. *Venericardia ferruginea Ad.*
6. *Pecten swiftii Bern.*
7. *Pecten yessoensis Lay.*
8. *Nucula insignis Ad.*

To these 4 others are to be added which have the same value as these north-Japanese forms. They are the two deep-sea ones *Lima goliath Sm.* and *Yoldia lischkei Sm.* (above included in no. 1) and two foreign ones *Chrysodomus phoeniceus Dall* and *Thyasira bisecta Conr.* These altogether make 14, which is about 20% of the living species.

From this it becomes quite evident that the fossil fauna represents one which is more northern or, as naturalists usually say, more boreal than the recent. And this is quite in accordance with the results[1] obtained by studying the Musashino fossils. Therefore, so far as the molluscan remains are concerned, it now becomes imperative to assume a more or less cooler state of the sea-water of Central Japan during the later Pliocene epoch, compared with the present.[2]

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1) Yokoyama. Fossils from the Miura Peninsula and its Immediate North, p. 24. Fossils from the Upper Musashino of Kazusa and Shimosa, p. 21.

2) Among our savants, there is one who, for several years, has been trying to negate, or at least to belittle, the conclusion at which I have arrived on the faunistic character of the Musashino fossils, by purposely studying a group of Protozoa called Foraminifera found in the same formation. Whatever may be the result which he draws from these minute creatures, the one obtained by me from the Musashino Mollusca remains unshaken.

By the way, it seems to me that this endeavor has arisen from a misunderstanding, as if I had taken the Musashino fauna for "arctic," because this savant says that the Foraminifera taken altogether are not at all "arctic." It is true that I have pointed out the intermingling of a few arctic species among the fauna, but the fauna itself I never called "arctic" on that account. I simply said that it bears a "more boreal character, when compared with the recent" ("Fossils from the Miura Peninsula, p. 22). By the term arctic," as I understand it, is meant around the "North Pole," while "boreal" means simply "northern" and no more.

Furthermore, I must say that his statement that I consider the Lower Musashino as *Lower* Pliocene is not quite correct. I said in the work above quoted, p. 21, that the fauna is to be brought somewhere near that of the Red Crag of Newbourne (Newbournian). If this Newbournian is according to his own opinion *Lower* Pliocene, I have nothing to say. But if he accepts the classification of the Crag generally adopted in Europe, he should call it *Upper* Pliocene, or at lowest *Middle* Pliocene.

I must not omit here to mention the uncommonly large growth of the two fossil species of *Lucina* (*Phacoides*) *borealis* and *Venericardia ferruginea*, in comparison to their recent representatives. The large specimens of the former, I have already noticed in studying the Musashino fossils, which I then took as belonging to a distinct species. But by examining the numerous specimens obtained in the Shirado-Beds, I became convinced that they are only more fully grown forms of one and the same species. If this has any connection with the sea-temperature, then these two species must be said to thrive best in cooler waters. Anyhow, *Venericardia ferruginea* is now found only in Northern Japan.

Description of the Species

Mollusca

1. Terebra sp.

There are several imperfect specimens of a *Terebra* strongly resembling those of *Terebra lischkeana* Dkr. (Yokoyama, Foss. Miura Penin., p. 31, pl. I, fig. 10). The ribs, however, are more prominent with the transverse impressed lines deeper, so that the former appears more or less nodose.

Fossil occurrence.—Kamanomaye (Kadōno)[1].

2. Conus sp.

A mutilated specimen looking much like *Conus sieboldi* Rve (Yokoyama, Foss. Miura Penin., p. 34, pl. I, fig. 14).

Fossil occurrence.—North of Toyoma (Toyomamura)[2].

3. Pleurotoma mediocarinata, Yokoyama.

Pleurotoma mediocarinata, Yokoyama, Foss. Miura Penin., p. 36, pl. I, fig. 18.

Rather common.

Fossil occurrince.—Kagenosaku (Yunami in Sekimoto)[3]. Lower Musashino.

4. Pleurotoma sp.

Pl. I. Fig. 9.

A specimen with only the last two whorls. It seems to be a large form of *Pleurotoma kamakurana* Pils. (Yokoyama, Foss. Miura Penin., p. 35, pl. I, fig. 17) However, the vertical folds on the body-whorl are

1) 磐城石城郡上遠野釜ノ前 2) 同郡豐間 3) 常陸多賀郡關本村湯網影ノ作

rather weak and indistinct. An accurate determination is at present not possible.

Fossil occurrence.—Izura[1].

5. **Drillia principalis,** Pilsbry.

Drillia principalis. Yokoyama, Foss. Miura Penin, p. 36, pl. I, fig. 20. Foss. Up. Musashino, p. 14, pl. I, fig. 18.

A single example of a young individual, with ribs more prominent than in the adult ones.

Fossil occurrence.—Izura. Lower and Upper Musashino.

Living.—Northern, Central and Western Japan.

6. **Bela rugulata,** Troschel, **var. schneideri,** Harmer.

Bela rugulata var. schneideri. Yokoyama, Foss. Up. Musash., p. 44, pl. I, fig. 37.

A single imperfect specimen which, however, undoubtedly belongs to the species above named.

Fossil occurrence.—Enamura Quarry[2]. Upper Musashino. English Crag.

7. **Olivella fortunei,** (A. Adams).

Olivella fortunei. Yokoyama, Foss. Up. Musash., p. 47, pl. II, fig. 3.

A single determinable specimen. Numerous casts from Sukegawa may possibly belong to the same species.

Fossil occurrence.—Futatsujima; Sukegawa[3] (Tsurushihama)? Upper Musashino.

Living.—Central Japan.

8. **Voluta megaspira,** Sowerby.

Voluta megaspira. Yokoyama, Foss. Miura Penin., p. 46, pl. II, fig. 18. Foss. Up. Musashino, p. 50.

Quite frequent. Some specimens are tolerably large.

Fossil occurrence.—North of Toyoma (Toyomamura);[4] Izura; Sukegawa (Tsurushihama and Hatsuzaki).[5] Lower and Upper Musashino.

Living.—Northern, Central and Western Japan.

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1) 五浦（常陸多賀郡） 2) 江名村（磐城石城郡） 3) 助川都留志濱（常陸多賀郡） 4) 豐間村（磐城石城郡） 5) 初荷

9. Chrysodomus phoeniceus, DALL.

Pl. I. Fig. 1.

Chrysodomus phoeniceus. Foss. Miura Penin., p. 50, pl. I, figs. 8-10.

Several specimens, some of which are quite large.

Fossil occurrence.—Izura; Yunami (Tōzenji)[1]; Sukegawa (Tsurushihama). Lower Musashino.

Living.—Japan? British Columbia.

10. Chrysodomus pericochlion, SCHRENCK.

Pl. I, Fig. 2.

Chrysodomus pericochlion. Pilsbry, Cat. Mar. Moll Japan, p. 28.

Tritonium (Buccinum) pericochlion. Schrenck, Moll. d. nordjap. Meeres. p. 433, pl. xvii, fig. 11, 12.

Several specimens, all of which, however, are in the form of casts. In comparing with *Chrysodomus schrenckı* Yok. (Foss. Miura Penin., p. 51, pl. III, fig. 1) which may possibly be only a varietal form of Schrenck's species, the whorls are flatter.

Fossil occurrence.—Sukegawa (Tsurushihama and Hatsuzaki). Lower Musashino.

Living.—Northern Japan.

11. Buccinum leucostoma, LISCHKE.

Buccinum leucostoma. Yokoyama, Foss. Up. Musashino, p. 55, pl. II, fig. 11.

Many large examples. Nearly all as casts.

Fossil occurrence.—Oyazaku[1]; Sukegawa (Tsurushihama and Hatsuzaki). Upper Musashino.

Living.—Central Japan.

12. Volutharpa perryi, (JAY).

Volutharpa perryi. Yokoyama, Foss. Miura Penin., p. 55, pl. IV, fig. 11. Foss. Up. Musashino, p. 57, pl. II, fig. 19.

This is a very variable species, the young individuals being much more slender than the adult ones which are rather globular. The fossil found in Hitachi, though quite common, belongs to the former.

Fossil occurrence.—Sukegawa (Tsurushihama and Hatsuzaki). Lower and Upper Musashino.

Living.—Northern and Central Japan.

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1) 關本村湯網東禪寺 (多賀郡) 2) 小谷作 (好間村)

13. Priene oregonensis, (Redfield).

Priene oregonensis. Yokoyama, Foss. Miura Penin., p. 64, pl. III, fig. 10, 12. Foss. Up. Musashino, p. 68.

Numerous, though mostly found as casts.

Fossil occurrence.—Sukegawa (Tsurushihama and Hatsuzaki). Lower and Upper Musashino.

Living.—Northern Japan. Alaska, Oregon.

14. Galeodea (Sconsia) japonica, Yokoyama.

Pl. I. Fig. 10.

Galeodea (Sconsia) japonica. Yokoyama, Foss. Moll. Neog. Izumo, p. 3, pl. I, fig. 4.

A few specimens not well preserved.

Fossil occurrence.—Izura; Yunami (Tōzenji). Pliocene of Izumo.

15. Cassis japonica, Reeve.

Pl. I. Fig. 5.

Cassis japonica. Reeve, Conch. Icon., Cassis, no. 23, pl. IX, fig. 23. Mart. Chemn. Syst. Conch. Cab., III, part 1, Cassis p. 24, pl. 44, fig. 5. Lischke, Jap. Meeresconch., I, p. 65. Dunker, Index Moll. Mar. Jap., p. 64.

This shell which is characterized by its swollen oval shape with a short conical spire and convex whorls ornamented with numerous spiral grooves is frequently found as casts.

Fossil occurrence.—Sukegawa (Tsurushihama).

Living.—Central and Western Japan.

16. Dolium luteostomum, Küster.

Dolium luteostomum. Yokoyama, Foss. Miura Penin., p. 66, pl. IV, fig. 2. Foss. Up. Musashino. p. 69, pl. III, fig. 10.

A small young individual.

Fossil occurrence.—Sukegawa (Tsurushihama). Lower and Upper Musashino.

Living.—Northern, Central and Western Japan. Indian Ocean.

17. Cerithium baculum, YOKOYAMA.

Pl. II. Figs. 6.

Cerithium baculum. Yokoyama, Tert. Foss. Kii, p. 52, pl. VI, fig. 12.

Some time ago, I described from Kii a species of *Cerithium* under the above name. It was founded on a single imperfect specimen. Since then better ones have been found in Iwaki. From these, in spite of their being outer impressions, by taking their casts, we can get a tolerably good idea of their external characters.

The specimen figured is a nearly perfect one, though not the largest. The shell is high-turrete, acute at apex and is composed of about seventeen whorls which are nearly flat, except the last one which is rounded towards the periphery. The ornamentation consists of a subsutural row of spine-like tubercles, some seventeen or eighteen in number on the body-whorl and several (usually six) unequal spiral cords of which the lowest or suprasutural one is the largest. Below the rounded periphery there are about ten spiral cords more or less equal in size. Some of the cords on the whorls show a granular or bead-like aspect. It is about 49 millim. in height and 15 millim. in diameter.

Fossil occurrence.—Yamoto in Kadōno[1]; boundary between Kadōno and Iwasaki[3]. Pliocene of Kii.

18. Cerithium sp.

Pl. II. Fig. 7.

Several impressions of a large *Cerithium*, much larger than the preceding, but having a smaller apical angle and fewer tubercles, thus approaching a form known as *Vicarya callosa* Jenkins from the Miocene of Java and Philippines and also reported from some parts of Japan.

Fossil occurrence.—Close to Kamanomaye[2] and Yamoto, both in Kadōno.

19. Vermetus sp.

Casts of *Vermetus* resembling *Vermetus tricarinatus* Yokoyama (Moll. Coral-Bed. Awa, p. 24, pl. I, figs. 17–19) in the mode of convolution.

Fossil occurrence.—Sukegawa (Tsurushihama).

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1) 矢本 (磐城石城郡上遠野) 2) 釜ノ前 3) 磐崎

20. **Turritella nipponica,** YOKOYAMA.

Pl. II. Fig. 8.

Turritella nipponica. Yokoyama, Foss. Miura Penin., p. 71, pl. IV, figs. 16-19.

Not rare. Of the four prominent spiral ribs found on each whorl, the three lower ones may be nearly equal in size, leaving the uppermost as the smallest.

Fossil occurrence.—Sukegawa (Tsurushihama and Hatsuzaki); Yunami (Tozenji and Kagenosaku)[1]; Izura; Enamura Quarry; Harakida[2]. Lower Musashino.

21. **Solarium** sp.

A cast which seems to be that of *Solarium perspectivum* Linné (Tryon, Man. Conch., IX, pl. II, fig. 18-21).

Fossil occurrence.—Sukegawa (Tsurushihama).

22. **Calyptraea mammilaris,** (BRODERIP).

Calyptraea mammilaris. Yokoyama, Foss. Miura Penin., p. 75, pl. IV, fig. 5. Foss. Up. Musashino, p. 82. Moll. Rem. Lowest Part Jô-Ban Coal-field, p. 11, pl. I, fig. 17.

Several large specimens, one of which is about 26 millim. in diameter and 13 millim. in height. In most cases they are deprived of their shell.

Fossil occurrence.—Yunami (Tozenji); Futatsujima[3]; Tempizan. Lower and Upper Musashino. Asagai-Beds.

Living.—West coast of America from Puget Sound down to the Strait of Magellan.

23. **Crepidula sp.**

Several casts of a large *Crepidula* up to 40 millim. in the greatest diameter. They suggest some of the grown forms of *Crepidula aculeata* (Gm.) (Tryon, Man. Conch., VIII, pl. 39, figs. 61-65) or possibly also *Crepidula grandis* Mid. (Dunker, Index Moll., pl. VI, figs. 1, 2).

Fossil occurrence.—Tempizan.

24. **Natica janthostoma,** DESHAYES.

Natica janthostoma. Yokoyama, Foss. Miura Penin., p. 77, pl. V, figs. 3, 4. Foss. Up. Musashino, p. 83. Foss. Moll. Neog. Izumo, p. 4. Tert. Moll. Dainichi, p. 12. Tert. Foss. Kii, p. 53. Moll. Remains Lowest Part Jô-Ban Coal-field, p. 12, pl. I, fig. 20.

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1) 影ノ作（湯網） 2) 原木田（磐城石城郡玉川村） 3) ニツ嶋（磯原）

Frequent.

Fossil occurrence.—Sukegawa (Tsurushihama and Hatsuzaki); Tempizan[1]; Yunami (Tozenji); Izura. Lower and Upper Musashino. Pliocene of Izumo, Dainichi and Kii. Asagai-Beds.

Living.—Northern and Central Japan. Kamchatka.

25. **Polinices (Neverita) ampla,** (PHILIPPI).

Polinices (Neverita) ampla. Yokoyama, Foss. Miura Penin., p. 78, pl. V, figs. 5, 6. Foss. Up. Musash., p. 84. Tert. Moll. Dainichi, p. 12. Tert. Foss. Kii, p. 53.

Frequent.

Fossil occurrence.—Sukegawa (Tsurushihama and Hatsuzaki). North of Toyoma? Lower and Upper Musashino. Pliocene of Kii and Dainichi.

Living.—Northern to Western Japan, Philippines, etc.

26. **Sigaretus (Eunaticina) papilla,** (GMELIN).

Sigaretus (Eunaticina) papilla. Yokoyama, Foss. Up. Musash., p. 84, pl. V, fig. 8, Tert. Moll. Dainichi, p. 12.

A single example.

Fossil occurrence.—Izura. Upper Musashino.

Living—Central and Western Japan. Philippines and Moluccas.

27. **Turbo (Batillus) cornutus,** GMELIN.

Turbo (Batillus) cornutus. Yokoyama, Moll. Coral-Bed Awa, p. 31, pl. I. fig. 22.

Several specimens, some of which are very large, but all in the form of casts.

Fossil occurrence.—Sukegawa (Tsurushihama). Pleistocene of Awa.

Living.—Northern to Southern Japan. China Sea.

28. **Bathybembix argenteo-nitens,** LISCHKE.

Pl. I. Fig. 3.

Bathybembix argenteo-nitens. Pilsbry, Catal., p. 97.

Trochus argenteo-niteno. Lischke, Jap. Meeresconch., III, p. 16, pl. IV, fig. 1.

A. beautiful shell with the whorls furnished with a single angle, except the last which shows two such angles, the lower one being formed by the periphery. Some specimens are up to 40 millim. in diameter.

Very frequent.

Fossil occurrence.—Sukegawa (Tsurushihama).

Living.—Central and Western Japan.

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1) 天妃山（常陸多賀郡磯原）

29. Stomatella japonica, A. Adams.

Pl. II. Fig. 3.

Stomatella japonica. A. Adams, Proc. Zool. Soc. London, Feb. 1850, p. 31. Pilsbry, Catal.. p. 104, Dunker Moll. Jap., p. 23. Index Moll., p. 145. Sowerby, Thes. Conch., II, p. 838, pl. 174, fig. 14.

This species is allied to *Stomatella lyrata* Pils. (Yokoyama, Foss. Up. Musashino, p. 115, pl. VI, fig. 2) from which it is distinguished by its whorls being more closely ribbed and nodulous.

A single imperfect specimen about 30 millim. in diameter.

Fossil occurrence.—Sukegawa (Tsurushihama).

Living.—Western Japan.

30. Haliotis sp.

Very frequent as casts which in all probability belong to *Haliotis diversicolor* Rve. (Pilsbry, Man. Conch., XII, pl. 104, fig. 105) living in Central and Western Japan, and also in China, Australia, etc.

Fossil occurrence.—Sukegawa (Tsurushihama and Hatsuzaki).

31. Acmaea sp.

A single mutilated cast, oval in shape 35 millim. long, 28 millim. broad and about 10 millim. high. It seems to be that of *Acmaea nigro:lineata* Rve. (Lischke, Jap. Meeres conch., vol. I, pl. VIII, figs. 5–11), living in our seas.

Fossil occurrence.—Tempizan.

32. Helcioniscus pallidus, (Gould).

Pl. I. Fig. 4.

Helcioniscus pallidus. Yokoyama, Foss. Miura Penin., p. 101, pl. VI, figs. 16, 17. Foss. Up. Musash., p. 117.

This is a very frequent shell, though mostly as casts.

Fossil occurrence.—Yunami (Tōzenji); Sukegawa (Tsurushihama and Hatsuzaki). Lower and Upper Musashino.

Living.—Northern and Central Japan.

33. **Dentalium weinkauffi,** DANKER.

Dentalium weinkauffi. Yokoyama, Foss. Miura Penin., p. 102, pl. VI, figs. 19-21. Foss. up. Musashi., p. 118, pl. VI, fig. 6.

Mostly present as casts.

Fossil occurrence.—Sukegawa (Tsurushihama). Lower and Upper Musashino.

Living.—Central Japan.

34. **Dentalium complexum,** DALL.

Pl. II. Fig. 9.

Dentalium complexum. Yokoyama, Foss. Miura Penin., p. 101, pl. VI, fig. 27. Foss. Moll. Neog. Izumo, p. 4.

Several specimens, but differing from the preceding by its more rapidly tapering shape toward the apical end.

Fossil occurrence.—Tempizan; between Niida and Shimoyamada[1]; Nonohido[2] in Kadono; Toyoma. Lower and Upper Musashino. Pliocene of Izumo.

Living.—Central Japan, Sandwich Islands.

35. **Panope generosa,** (GOULD).

Pl. VI. Fig. 6.

Panope generosa. Yokoyama, Foss. Up. Musash., p. 121. pl. V, figs. 14, 15. Foss. Moll. Neog. Izumo, p. 4. Tert. Moll. Dainichi, p. 14.

Fossil occurrence.—Yunami (Tōzenji); Harakida; between Niida and Shimoyamada; north of a triangulation-point in Shimoyamada; Iida[3], and Misawa (Kashima); Kamanomaye in Kadono; railway-cutting, Nakoso[4]. Pliocene of Izumo and Dainichi.

Living.—Northern Japan. West coast of North America.

36. **Mya arenaria Linne, var. japonica,** JAY.

Pl. VI. Fig. 4.

Mya arenaria var. japonica. Pilsbry, Catal., p. 118.

Mya arenaria. Lischke, Jap. Meeresconch., I, p. 138.

Mya japonica. Jay, Rep. Shells Jap. Explor. Exped. Perry, p. 292, pl. I, figs. 7, 10.

Two specimens somewhat imperfect. The Japanese form is generally considered as a variety of the typical one, on account of the shell being more pointed behind. Our fossil unfortunately lacks the posterior end.

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1) 仁井田・下山田間 2) 野々日堂 3) 鹿嶋村飯田・三澤 4) 勿來

Fossil occurrence.—Yunami (Tōzenji).

Living.—Northern, Central and Western Japan.

37. **Mactra sulcataria,** DESHAYES.

Mactra sulcataria. Yokoyama, Foss. Up. Musash., p. 126, pl. VII, fig. 6.

Two casts, one of which seems somewhat longer than usual.

Fossil occurrence.—Sukegawa (Tsurushihama); Tempizen. Upper Musashino.

Living.—Northern, Central and Western Japan. North China. Possiet Bay.

38. **Mactra veneriformis,** DESHAYES.

Mactra veneriformis. Yokoyama, Foss. Miura Penin., p. 109, pl. VIII, fig. 10. Foss. Up. Musash., p. 127.

A few isolated valves.

Fossil occurrence.—Yunami (Tōzenji). Lower and Upper Musashino.

Living.—Northern, Central and Western Japan.

39. **Mactra spectabilis,** LISCHKE.

Pl. I. Figs. 7, 8.

Mactra spectabilis. Lischke, Jap. Meeresconch., II, p. 120, pl. XI. figs. 1, 2. Pilsbry, Cat., p. 119.

This is a large and beautiful species which is distinguished from *Mactra sulcataria* by its more inequilateral and triangular shape as well as by its larger growth. The beaks are also more pointed and bent. Mostly present as casts.

Fossil occurrence.—Izura; Nakayama[1]; Nakanosaku[2]; Tsuchibashi in Kadōno; Aoya in Watanabe[3].

Living.—Central and Western Japan.

40. **Spisula grayana,** (SCHRENCK).

Pl. II. Fig. 11.

Spisula grayana. Yokoyama, Foss. Up. Musash., p. 130, pl. VIII, figs. 1, 2.

Several casts.

Fossil occurrence.—Sukegawa (Tsurushihama); Tempizan; Fujiwara (opposite the river).

Living.—Northern Japan. Okhotsk Sea. Bering Sea.

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1) 石城郡飯野村中山 2) 同江名村中ノ作 3) 同渡邊村青谷

41. **Solen grandis,** DUNKER.

Solen grandis. Yokoyama, Foss. Up. Musash., p. 134, pl. IX, fig. 4.

Only fragments which are, however, readily recognized by the large size of the shell.

Fossil occurrence.—Tempizan. Upper Musashino.

Living.—Western Japan. Philippines.

42. **Solen gouldii,** CONRAD.

Pl. II. Fig. 5.

Solen gouldii. Conrad, Amer. Jour. Conch., III, Appendix, p. 28. Dunker, Ind. Moll., p. 173, pl. XVI, fig. 11.

Solen gracilis. Gould (non Phil.), Proc. Bost. Soc. Nat. Hist., VIII, p. 26. Otia Conch.. p. 165. Lischke, Jap. Meeresconch., II, p. 123.

Two isolated valves. More slender than *Solen krusensterni* Schr. (Foss. Up. Musash., pl. IX, fig. 5) so frequent in the Upper Musashino in the neighbourhood of Tokyo.

Fossil occurrence.—Yunami (Tozenji).

Living.—Northern to Central Japan.

43. **Cultellus izumoensis,** YOKOYAMA.

Pl. V. Figs. 2, 3.

Cultellus izumoensis. Yokoyama, Foss. Moll. Neog. Izumo, p. 5, Pl. II, fig. 1.

When I first described this species, the only specimen at hand was broken in front. Now we have several and much larger ones which have the anterior end perfect. It is rounded as was previously presumed, but much more sharply than the posterior end.

Quite frequent.

Fossil occurrence.—North of a triangulation-point, Shimoyamada; between Niida and Shimoyamada[1]; Iida in Kashima[2]; Enamura Quarry[3]; Ushiroda in Uyeda[4]; Coast of Nakoso. Pliocene of Izumo.

44. **Siliqua pulchella,** (DUNKER).

Siliqua pulchella. Yokoyama, Foss. Up. Musashino, p. 135, pl. IX, fig. 7.

Almost always as casts.

Fossil occurrence.—North of Kamikamado and also Aoya, Watanabe; east of Kamitakaku in Iinomura[5]; near the railway station of Taira. Upper Musashino.

Living.—Central and Western Japan.

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1) 仁井田下山田間 2) 鹿嶋村飯田 3) 江名村石切場 4) 植田後田 5) 飯野村上高久

45. **Soletellina violacea,** LAMARCK.

Soletellina violacea. Yokoyama, Foss. Up. Musashino, p. 137, pl. IX, figs. 13, 14.

Rather frequent at some places.

Fossil occurrence.—Kamanomaye and Yamoto in Kadōno ; Tabe in Izumi[1] ; Kawakamimaye in Iwasaki.[2]

Living.—Northern to Western Japan. Philippines. Moluccas.

46. **Tellina besshoensis,** YOKOYAMA.

Tellina besshoensis. Yokoyama, Moll. Rem. Lowest Part. Jô-Ban Coal-Field, p. 14, pl. II, figs. 1-5.

Several specimens.

Fossil occurrence.—Kamanomaye in Kadōno. Asagai-Beds (Miocene)

47. **Tellina optiva,** YOKOYAMA.

Tellina optiva. Yokoyama, Foss. Moll. Neog. Izumo, p. 6, pl. II, figs. 3, 4.

Frequent.

Fossil occurrence.—Near Takakuraji[3] ; north of a triangulation-point, Shimoyamada ; Nakoso-coast. Ushiroda (Uyeda) ; Ōishi (Fujiwara, Yumoto.)[4] Pliocene of Izumo.

48. **Tellina izurensis,** YOKOYAMA.

Pl. II. Fig. 12.

There is only a left valve which is to a greater part deprived of its shell, but so characteristic in outline that there is none which can be confounded with it, either among the fossil or living forms hitherto found in Japan.

It is about 52 millim. long and 37 millim. high, roughly triangular in outline, compressed, almost equilateral, the posterior half being only a little longer than the anterior. The anterior border together with the antero-dorsal forms one broadly rounded arch. The posterior border is also rounded, but much more sharply, the postero-dorsal sloping down at a tolerably high angle and insensibly passing into it. The ventral border is straight except at both ends where it curves to meet the anterior and posterior borders respectively, without, however, making any sharp angle. The surface of the shell seems to have been smooth, as can be judged from a little of it still preserved.

Fossil occurrence—Izura.

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1) 石城郡泉村田部 2) 磐崎村川上前 3) 高倉寺 4) 湯本町藤原大石

49. Macoma praetexta, (Martens).

Macoma praetexta. Yokoyama, Foss. Up. Musashino, p. 142, pl. X, figs. 2, 3. Moll. Remains Lowest Part Jô-Ban Coal-Field, p. 13.

Rare.

Fossil occurrence.—Sukegawa (Tsurushihama). Kokozura near Hirakata.[1] Upper Musashino. Asagai-Beds (Miocene).

Living.—Central and Western Japan.

50. Macoma dissimilis, (Martens).

Pl. V. Fig. 9.

Macoma dissimilis. Yokoyama, Foss. Miura Penin., p. 116. pl. VII, figs. 19, 20. Foss. Up. Musash., p. 143, pl. X, fig. 4.

A few undoubted examples and several doubtful casts.

Fossil occurrence.—Nakayama; Toyoma; Futatsujima; Sukegawa (Tsurushihama); Izura? Tempizan?.

Living.—Central Japan.

51. Dosinia troscheli, Lischke.

Dosinia troscheli. Yokoyama, Foss. Miura Penin., p. 119, pl. VIII, figs. 5, 6. Foss. Up. Musashino, p. 144. Tert. Moll. Dainichi, p. 15.

Rare.

Fossil occurrence.—Futatsujima; Misawa[2]; Tempizan; Sukegawa (Hatsuzaki). Lower and Upper Musashino. Pliocene of Dainichi.

Living.—Central and Western Japan.

52. Cyclina chinensis, (Chemnitz).

Cyclina chinensis. Yokoyama, Foss. Miura Penin., p. 119, pl. XI, figs. 7, 8. Foss. Up. Musashino, p. 145.

Fossil occurrence.—Kamanomaye in Kadōno. Lower and Upper Musashino.

Living.—Northern, Central and Western Japan. China Sea. Cochin China.

53. Meretrix iizukai, Yokoyama.

Pl. III. Figs. 2, 3.

Shell moderate in size and thickness, convex, obliquely oval, very inequitateral, anterior side very short, rounded in front and behind,

1) 石城郡窪田村九面（平潟港附近） 2) 三澤

though more sharply in the former, ventral border broadly arched. Surface only with rude lines of growth. Beaks nearly touching, swollen, incurved, pointed. A cordate lunula is present usually bounded by a shallow line on both sides. Sinus shallow, triangular, usually blunt at end and somewhat directed upward. The length being taken as 10, the height is about 8 and the thickness about 6 on an average. The dentition is at present unknown. The largest example is 73 millim. long, 56 millim. high and 46 millim. thick.

The outward shape is remarkably like that of *Saxidomus purpuratus* Sow. (Yokoyama, Foss. Miura Penin., pl. IX, fig. 8. Foss. Up. Musashino, pl. XII, fig. 9) living and fossil in Japan. But by a careful comparison with the latter, it is somewhat thinner, more inequilateral, with the pallial sinus shorter and more triangular and usually with a lunula more or less bounded by shallow depressions on both sides which is not present in Saxidomus purpuratus of about equal size. But it may possibly turn out to be only a variety of the latter which, however, must remain undecided as long as the dentition is not known.

This shell is also not unlike in shape *Meretrix lamarcki* Agassiz of the Miocene of Europe (Cossman et Perot, Conch. Neog. Aquit., pl. 15, figs. 11–15. Hörnes, Foss. Moll. Wiener Becken, pl. 18, fig. 5).

The shell seems to be variable in shape, as some of the example have the beaks more swollen than in the others. Rather frequent.

Fossil occurrence.—Between Niida and Shimoyamada; Takakuraji; Harakida; Kokozura near Hirakata; Izura; Yunami (Tōzenji); Sukegawa (Tsurushihama and Hatsuzaki).

54. **Clementia speciosa**, Yokoyama.

Pl. I. Fig. 6.

Clementia speciosa. Yokoyama, Tert. Moll. Dainichi, p. 15, pl. II, figs. 14, 15.

A few young specimens.

Fossil occurrence.—Between Niida and Shimoyamada; Railway cutting, Nakoso. Pliocene of Dainichi.

55. **Venus (Mercenaria) stimpsoni**, Gould.

Venus (Mercenaria) stimpsoni. Yokoyama, Foss. Up. Musashino, p. 148, pl, XI, figs. 11, 12. Foss. Moll. Izumo, p. 6, pl. I, fig. 5.

A very young individual.

Fossil occurrence.—Izura. Upper Musashino. Pliocene of Izumo.

Living.—Northern to Western Japan.

56. Venus jedoensis, Lischke.

Venus jedoensis. Yokoyama, Foss. Miura Penin., p. 120, pl. VIII, figs. 9, 10. Foss. Up. Musash., p. 148. Moll. Coral-bed Awa, p. 43, pl. II, fig. 20.

A few casts.

Fossil occurrence.—Sukegawa (Hatsuzaki). Lower and Upper Musashino. Pleistocene of Awa.

Living.—Central and Western Japan.

57. Venus toreuma, Gould.

Venus toreuma. Yokoyama, Moll. Coral-Bed Awa, p. 44. pl. II, fig. 22.
Venus crebrisulca. Sowerby, Thes. Conch., II, p. 728, pl. 161, figs. 187-189.
Venus jukesii. Syst. Conch., Cab. Mart. Chem., Venus, p. 217, pl. 35, figs. 7-9.

This is a thick-shelled, swollen, almost globular shell with raised, lamellar, concentic ribs. Rare.

Fossil occurrence.—Tempizan; Sukegawa (Hatsuzaki). Pleistocene of Awa.

Living.—Central and Western Japan. Philippines. Australia.

58. Tapes undulatus, (Born).

Pl. V. Fig. 1.

Tapes undulatus. Dunker, Index Moll., p. 206. Pilsbry, Catal., p. 129.
Venus undulata. Born, Mus. Caes. Vind., p. 67.
Venus rimosa. Philippi, Abbild., III, pl. VII, fig. 7.

A transversely much elongated shell and rather compressed, with both ends rounded. The proportion of length to height is about 10 to 6. A few casts.

Fossil occurrence.—Sukegawa (Hatsuzaki).

Living.—Central and Western Japan.

59. Cardium californiense, Deshayes.

Cardium californiense. Yokoyama, Foss. Miura Penin., p. 127, pl. IX, fig. 10. Foss. Up. Musashino, p. 154.

A single cast.

Fossil occurrence.—Tempizan. Lower and Upper Musashino.

Living.—Northern to Western Japan. Behring Sea to California.

60. Cardium muticum, Reeve.

Cardium muticum. Yokoyama, Foss. Miura Penin., p. 128, pl. IX, fig. 11. Foss. Up. Musash., p. 155.

A large and good example.

Fossil occurrence.—Komeda in Kashima[1]. Lower and Upper Musashino.

Living.—Northern, Central and Western Japan. Philippines. East Indies.

61. Cardium modestum, Adams et Reeve.

Cardium modestum. Yokoyama, Foss. Miura Penin., p. 128, pl. IX, figs. 12, 13. Foss. Up. Musash., p. 55.

Numerous casts which somewhat look like those of the next species, but readily recognized by the impression of much finer ribs at the ventral border.

Fossil occurrence.—Sukegawa (Hatsuzaki).

Living.—Central Japan.

62. Cardium shinjiense, Yokoyama.

Cardium shinjiense. Yokoyama, Foss. Moll. Neog. Izumo, p. 7, pl. II, fig. 6. Moll. Rem. Lowest Part. Jô-Ban Coal-Field, p. 16, pl. III, figs. 13-15.

Very frequent, but mostly as casts and more or less distorted.

Fossil occurrence.—Sukegawa (Tsurushihama); Tempizan; Yunami (Tōzenji and Kagenosaku); Ushiroda, Uyeda; Kamanomaye in Kadōno; north of the triangulation-point in Shimoyamada. Pliocene of Izumo. Iwaki- and Asagai-Beds.

63. Diplodonta semiaspera, Philippi.

Diplodonta semiaspera. Yokoyama, Foss. Miura Penin., p. 160, pl. XIV, fig. 2. Foss. Up. Musash., p. 130, pl. X, figs. 2, 3.

Many casts.

Fossil occurrence.—Kamikamado in Watanabe[2]; Sukegawa (Hatsuzaki). Lower and Upper Musashino.

Living.—Central and Western Japan. West Indies.

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1) 鹿嶋村米田 2) 渡邊村上釜戸

64. Lucina (Phacoides) borealis, (Linne).

Pl. V. Figs. 5-8.

Lucina borealis. Yokoyama, Foss. Miura Penin., p. 133. pl. X, fig. 7. Foss. Up. Musashino, p. 160, Tert. Foss. Kii, p. 67, pl. VI, fig. 11.

Lucina spectabilis. Yokoyama, Foss. Miura Penin., p. 134, pl. X, figs. 10-12.

Very frequent, some being very large. *Lucina spectabilis* which I described from the Lower Musashino of Koshiba represents, as I am now convinced, only very large forms of the same species. The shell is variable in shape. The living ones are small.

Fossil occurrence.—Taira (Park); Komeda in Kashima; between Kinuya and Yakuōji[1]; Toyoma; Enamura Quarry; Iwasaki; Sukegawa (Tsurushihama and Hatsuzaki); Tempizan; Yunami (Tōzenji); Izura. Lower and Upper Musashino. Pliocene of Kii. Miocene, Pliocene and Pleistocene of Europe.

Living.—Central Japan. Atlantic and Mediterranean Sea.

65. Thyasira bisecta, (Conrad).

Pl. VI. Fig. 5.

Thyasira bisecta. Yokoyama, Moll. Rem. Lowest Part Jô-Ban Coal-Field, p. 18, pl. III, fig. 2.

Several examples better preserved than that figured in the above work.

Fossil occurrence.—Sukegawa (Tsurushihama and Hatsuzaki); Ishiwaki in Kabeya[2]; Taira (Park); Harakida; Iwasaki (Kawakamimaye). Asagai-Beds. Miocene and Pliocene of the Pacific coast of North America.

Living.—Coast of Alaska. Puget Sound.

66. Cardita cumingiana, Dunker.

Cardita cumingiana. Yokoyama, Foss. Miura Penin., p. 137, pl. X, fig. 16, pl. XI, fig. 1.

Rare.

Fossil occurrence.—Sukegawa (Tsurushihama and Hatsuzaki). Lower Musashino.

Living.—Central and Western Japan.

67. Venericardia ferruginea, (Adams).

Pl. V. Fig. 4.

Venericardia ferruginea. Yokoyama, Foss. Miura Penin., p. 139, pl. XI, fig. 3, 4. Foss. Up. Musashino, p. 162.

Venericardia sp. Yokoyama, Moll. Rem. Lowest Part Jô-Ban Coalf., p. 19, pl. III, figs. 8, 9.

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1) 草野村絹谷、大野村藥王子ノ間 2) 神谷村石脇

The specimens attain a much larger size than those hitherto found fossil or living. The length attained is 30 millim., that is to say, it is one and a half times larger.

A shell which I described from the Iwaki-Beds under the name of *Venericardia sp.* belongs, as I am now convinced, to this same species.

Fossil occurrence.—Harakida; Komeda in Kashima; Toyoma; Enamura Quarry; Kokozura near Hirakata; Tsuchibashi and Nonohido in Kadōno[1]; Yunami (Tōzenji). Lower and Upper Musashino. Iwaki-Beds.

Living.—Northern Japan.

68. **Thracia pubescens,** PULTENEY.

Pl. I. Fig. 11.

Thracia pubescens. Yokoyama, Foss. Shells Saishu, p. 6, pl. I, fig. 1.

A few, though undoubted specimens.

Fossil occurrence.—Gomasawa in Taira.[2] Upper Musashino of Saishu. Crag of England.

Living.—Atlantic.

69. **Mytilus grayanus,** DUNKER.

Pl. II. Fig. 10.

Mytilus grayanus. Dunker, Zeitsch. f. Malac., 1853, p. 84. Index Moll., p. 221. Lischke, Jap. Meeresconch., I, p. 153, pl. X, figs. 7, 8.

Mytilus dunkeri. Reeve, Conch. Icon., Mytilus, sp. 17.

Several casts of this beautiful triangular compressed shell.

Fossil occurrence.—Tempizan.

Living.—Northern Japan. Sakhalin, Philippines, Tasmania, etc.

70. **Mytilus sp.**

A single cast, smaller, more elongated and inflated, looking that of *Mytilus hirsutus* Lam. fossil and living in Japan.

Fossil occurrence.—Tempizan.

71. **Modiola sp.**

A cast very much like that of *Modiola barbata* L., fossil and living in Japan.

Fossil occurrence.—Sukegawa (Tsurushihama).

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1) 上遠野土橋及ヒ野々日堂 2) 平町ゴマ澤

72. **Lima lima**, (LINNÉ).

Lima lima. Yokoyama, Moll. Coral-Bed Awa, p. 54, pl. III, fig. 13.

A single cast.

Fossil occurrence.—Sukegawa (Tsurushihama). Pleistocene of Awa. Pliocene of Italy. Miocene of Vienna.

Living.—Central to Southern Japan. Red Sea. Mediterranean Sea.

73. **Lima angulata**, SOWERBY.

Lima angulata. Yokoyama, Foss. Miura Penin., p, 148, pl. XII, fig. 12. Foss. Up. Musash., p. 177.

Two small isolated valves.

Fossil occurrence.—Sukegawa (Tsurushihama). Lower and Upper Musashino. Neogene of New Zealand.

Living.—Northern and Central Japan. Philippines. Australia.

74. **Lima vulgatula**, YOKOYAMA.

Lima vulgatula. Yokoyama, Foss. Up. Musashino, p. 179, pl. XVII, figs. 18, 19.

A single valve, somewhat larger than those of the Upper Musashino and also with the ribs a little more numerous.

Fossil occurrence.—Sukegawa (Tsurushihama). Upper Musashino.

75. **Lima goliath**, SOWERBY.

Pl. III. figs. 1, 4.

Lima goliath. Yokoyama, Foss. Miura Penin., p. 147, pl. XVI, figs. 7, 8.

Two nearly perfect valves with several fragments, one of which is very large.

Fossil occurrence.—Kamanomaye in Kadōno; Tempizan; Sukegawa (Tsurushihama and Hatsuzaki). Lower Musashino.

Living.—Central Japan (Sagami Bay). Southeastern Japan at 750 fathoms (Challenger). Patagonia.

76. **Pecten laetus**, GOULD.

Pecten laetus. Yokoyama, Foss. Miura Penin., p. 152, pl. XIV. figs. 1, 2. Foss. Up. Musashino, p. 180, pl. XIV. fig. 20. Foss. Shells Saishu, p. 7. Moll. Coral-Bed Awa, p. 56.

Though not frequent, some specimens are very large.

Fossil occurrence.—Sukegawa (Tsurushihama and Hatsuzaki); Tempizan. Lower and Upper Musashino. Pleistocene of Awa.

Living.—Northern to Western Japan.

77. Pecten vesiculosus, DUNKER.

Pecten vesiculosus. Yokoyama, Foss. Miura Penin., p. 154, pl. XIII, figs. 11-13. Foss. Up. Musashino, p. 181.

A right valve about 40 millim. in length and height.

Fossil occurrence.—Sukegawa (Tsurushihama). Lower and Upper Musashino.

Living.—Central Japan.

78. Pecten swiftii, BERNARDI.

Pl. II. Fig. 1.

Pecten swiftii. Yokoyama, Foss. Miura Penin., p. 154, pl. XIV, fig. 11.

A large right valve.

Fossil occurrence.—Sukegawa (Tsurushihama). Lower Musashino.

Living—Northern Japan. Sea of Okhotsk. Alaska.

79. Pecten yessoensis, JAY.

Pecten yessoensis. Yokoyama, Foss. Miura Penin., p. 159, pl. XIII, figs. 14, 15.

Pretty frequent.

Fossil occurrence.—Izura; Tempizan; Isohara. Lower Musashino.

Living.—Northern Japan. Sea of Okhotsk.

80. Pecten kimurai, YOKOYAMA.

Pl. IV. Pl. II. Fig. 4.

Shell large, moderately thick, orbicular, compressed, inequivalve, nearly equilateral. Surface with radiating ribs; ribs on the right valve usually nine in number, broad, rounded, with a few longitudinal riblets or striae on the back, separated by shallow valleys of about equal breadth which are smooth at bottom and show no sharp demarcation against the ribs; ribs on the left valve also usually nine in number, roof-like, sharp with valleys equally formed, that is to say broadly V-shaped. Ears unequal, the anterior one coarsely and radiately corded, with a shallow rounded byssal notch below, while the posterior one is equally long, but usually smooth. Height slightly greater than length; thickness about one-fourth the height.

The largest specimen measures about 100 millim. in height.

This shell is much like *Pecten tokyoensis* Tok. (Yokoyama, Miura Penin., pl. XIV, fig. 7, 8), but the ribs are more prominent and elevated.

Fossil occurrence.—Izura; Yunami (Tōzenji); Sukegawa (Hatsuzaki); Kashima (Iida and Komeda); Taira (Gomasawa and also near the railway station); Toyoma; Kamitakaku in Iino; Enamura Quarry; Kusano (between Mizushina and Yamazaki)[1]; Tamaye, Kobisa.[2]

81. **Ostrea gigas,** THUNBERG.

Ostrea gigas. Yokoyama, Foss. Miura Penin., p. 162, pl. XV, figs. 1, 2. Foss. Up. Musashino, p. 184. Moll. Coral-Bed Awa, p. 57.

A single fragment of the beak-portion of a lower valve.

Fossil occurrence.—Tempizan. Lower and Upper Musashino. Pleistocene of Awa.

Living.—Northern, Central and Western Japan. China.

82. **Pinna japonica,** HANLEY.

Pl. VI. Fig. 7.

Pinna japonica. Yokoyama, Foss. Up. Musashino, p. 185, pl. XV, fig. 8.

A fragment.

Fossil occurrence.—Iida in Kashima. Upper Musashino.

Living.—Central and Western Japan.

83. **Arca kobeltiana.** PILSBRY.

Arca kobeltiana. Yokoyama, Foss. Miura Penin., p. 163, pl. XVII, fig. 4. Foss. Up. Musash., p. 185. Moll. Coral-Bed Awa, p. 59.

Quite frequent.

Fossil occurrence.—Sukegawa (Tsurushihama and Hatsuzaki). Tempizan. Lower and Upper Musashino. Pleistocene of Awa.

Living.—Northern and Central Japan.

84. **Arca (Scapharca) subcrenata,** LISCHKE.

Arca (Scapharca) subcrenata. Yokoyama, Foss. Up. Musashino, p. 187, pl. XV, fig. 12.

Several imperfect examples.

Fossil occurrence.—Yumoto (entrance of the coal-mine of Fujiwara); between Niida and Shimoyamada; Toyoma; Yunami (Tozenji); Sukegawa (Tsurushihama). Upper Musashino.

Living.—Central, Western and Southern Japan.

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1) 草野(水晶・山崎ノ間) 2) 小久町田前

85. **Arca setoensis,** YOKOYAMA.

Arca setoensis. Yokoyama, Tert. Foss. Kii, p. 58, pl. VII, fig. 13.

A few isolated valves, larger than the specimens described from Kii.

Fossil occurrence.—Yunami (Tōzenji); between Mizushima and Yamazaki in Kusano; Shimoyamada (north of a triangulation-point). Pliocene of Kii.

86. **Pectunculus vestitus,** DUNKER.

Pectunculus vestitus. Yokoyama, Foss. Miura Penin., p. 167, pl. XVII, figs. 10, 11. Foss. Up. Musashino, p. 189, pl. XVI, figs. 1-3. Foss. Shells Saishu, p. 7. Moll. Rem, Lowest Part., p. 21.

Numerous examples.

Fossil occurrence.—Tempizan. Iwaki-Beds. Musashinos.

Living.—Central Japan.

87. **Parallelodon obliquatus,** YOKOYAMA.

Parallelodon obliquatus. Yokoyama, Foss. Miura Penin., p. 170, pl. XVIII, figs. 9-11. Foss. Up. Musash., p. 191. Moll. Coral-Bed Awa, p. 62.

Not rare.

Fossil occurrence.—Sukegawa (Tsurushihama and Hatsuzaki). Tempizan. Lower and Upper Musashino. Pleistocene of Awa.

Living.—Northern and Central Japan.

88. **Limopsis azumana,** YOKOYAMA.

Limopsis azumana. Yokoyama, Foss. Miura Penin., p. 174, pl. XVIII, figs. 19-21. Foss. Up. Musashi., p. 193.

Several specimens.

Fossil occurrence.—Sukegawa (Hatsuzaki). Lower and Upper Musashino.

89. **Leda confusa,** HANLEY.

Leda confusa. Yokoyama, Foss. Up. Musash., p. 195. pl. XVII, fig. 4.

Several isolated valves.

Fossil occurrence.—Harakida; Kamitakaku in Iino; Yunami (Tōzenji); Izura? Upper Musashino.

Living.—Central Japan. China Sea.

90. Leda sp.

Casts of a more elongated form like *Leda ramsayi* Sm. and *Leda gordonis* Yok. All being broken at the posterior end, it is not possible to determine them.

Fossil occurrence.—Sukegawa (Tsurushihama and Hatsuzaki; Futatsujima.

91. Yoldia lischkei, Smith.

Pl. II. Fig. 2.

Yoldia lischkei. Smith, Challenger Lamellibranchiata, p. 242, pl. XX, fig. 4.

The shell is thin, moderately convex, transversely squarely oblong, somewhat inequilateral, anterior border rounded, posterior subtruncate. Surface smooth. A faint ridge runs from the beak to the postero-ventral corner behind which the surface is a little depressed.

Most of the specimens are found as casts.

Fossil occurrence.—Sukegawa (Tsurushihama and Hatsuzaki); Yunami (Tōzenji and Kagenosaku).

Living.—Central Japan (Sea of Sagami at the depth of 345 fathoms).

92. Nucula insignis. Gould.

Nucula insignis. Yokoyama, Foss. Miura Penin., p. 179, pl. XIX, figs. 7, 8. Foss. Up. Musashi., p. 198. Foss. Shells Saishu, p. 7. Moll. Rem. Lowest Part Jo-Ban Coal-Field, p. 21.

A few examples.

Fossil occurrence.—Sukegawa (Tsurushihama). Lower and Upper Musashino. Asagai-Beds.

Living.—Northern Japan.

93. Nucula mirabilis, Adams et Reeve.

Nucula mirabilis. Yokoyama, Foss. Miura Penin., p. 180, pl. XIX, fig. 9. Foss. Shells Neog. Izumo, p. 9.

Several examples.

Fossil occurrence.—Sukegawa (Hatsuzaki). Lower Musashino. Pliocene of Izumo.

Living.—Central and Western Japan.

94. Solemya tokunagai, YOKOYAMA.

Pl. VI. Figs. 1, 2, 3.

Several specimens of this interesting shell were collected at three places. Though more or less imperfect, they still give a fairly good idea of its general characters.

The shell is moderate in thickness, compressed, very inequilateral, transversely elongated, more or less rectangular, though broadest in front. The anterior border is truncate, the posterior sharply rounded. The dorsal and ventral borders are almost parallel, the former very slightly arched and the latter somewhat excavated. The antero-ventral corner is rounded The surface is radiately channelled, with the channels slightly curved in the anterior part, broad, shallow, equal to, or somewhat broader than interspaces, anteriorly distinct, but gradually getting shallower, narrower and indistinct posteriorly, although we can trace them even near the posterior end of the shell. In general the most distinct are the anterior six or seven. The dark periostracum of the channels are elongated into long processes.

The most perfect specimen is that given in fig. 2. It has both valves preserved, only with the postero-ventral corner broken. It is 94 millim. long and 38 millim. high. Another with the processes of the anterior part preserved (fig. 1) is broken at the posterior end. It is somewhat longer than the other, being presumably over 70 millim. long with the height only 22 millim. It may possibly belong to a different species, but the general outline being quite similar, at present I can, at the utmost, only treat it as a variety.

Solemya johnsoni Dall (Moll. and Brach. dredged in Deep Water, Proc. U.S. Nat. Museum. Vol. XVII, pl. XXV, fig. 1) and *Solemya agassizii* Dall (Moll. a. Brach., Rep. Dredg. Oper. W. Coast of America, pl. XVI, fig. 10) of the Western Pacific may be compared to the Japanese fossil, without being perfectly identical.

Fossil occurrence.—Shiogu in Tatsuta; Tsuchibashi in Kadōno; Enamura Quarry.

Brachiopoda.

95. Terebratulina caput-serpentis, (LINNÉ).

Terebratulina caput-serpentis. Yokoyama, Foss. Miura Penin., p. 182, pl. XIX, figs. 15-18. Hayasaka, Some Tert. Brach. Japan, p. 7, pl. I, figs. 9-12.

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1) 龍田村鹽具

Only as casts.

Fossil occurrence.—Sukegawa (Tsurushihama and Hatsuzaki). Lower Musashino. Miyata, near Sukegawa, but older in age (?). Pliocene and Miocene of Europe.

Living.—Central Japan. Northern Pacific. Atlantic.

96. **Pereudesia grayi, Davidson var. transversa,** Davidson.

Pereudesia grayi var. transversa. Hayasaka, Tert. Brach. Japan, p. 16, pl. II, figs. 13, 14.

Eudesia grayi. Yokoyama, Foss. Up. Musash., p. 199, pl. XVII, fig. 11, 12.

Quite frequent.

Fossil occurrence.—Tempizan. Upper Musashino. Pliocene (?) of Yanagawa-machi, Iwaki (according to Hayasaka).

Living.—Northern, Central and Western Japan. California.

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Errata.

P. 4, line 19 and P. 7, line 12. Read Lima goliath *Sow.*

M. YOKOYAMA:

Molluscan Remains from the Uppermost Part of the Jô-Ban Coal-Field.

PLATE I.

Plate I.

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Fig. 2. Chrysodomus pericochlion Schr. Cast. Tsurushihama, Sukegawa. p. 10.

Fig. 3. Bathybembix argenteo-nitens Lke. Cast. Tsurushihama, Sukegawa. p. 14.

Fig. 4. Helcioniscus pallidus Gld. A large cast from Tsurushihama, Sukegawa. p. 15.

Fig. 5. Cassis japonica Rve. Cast. Tsurushihama, Sukegawa. p. 11.

Fig. 6. Clementia speciosa Yok. Railway Cutting, Nakoso. p. 21.

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Fig. 10. Galeodia (Sconsia) japonica Yok. Tozenji, Yunami. p. 11.

Fig. 11. Thracia pubescens Pult. Gomasawa, Taira. p. 25.

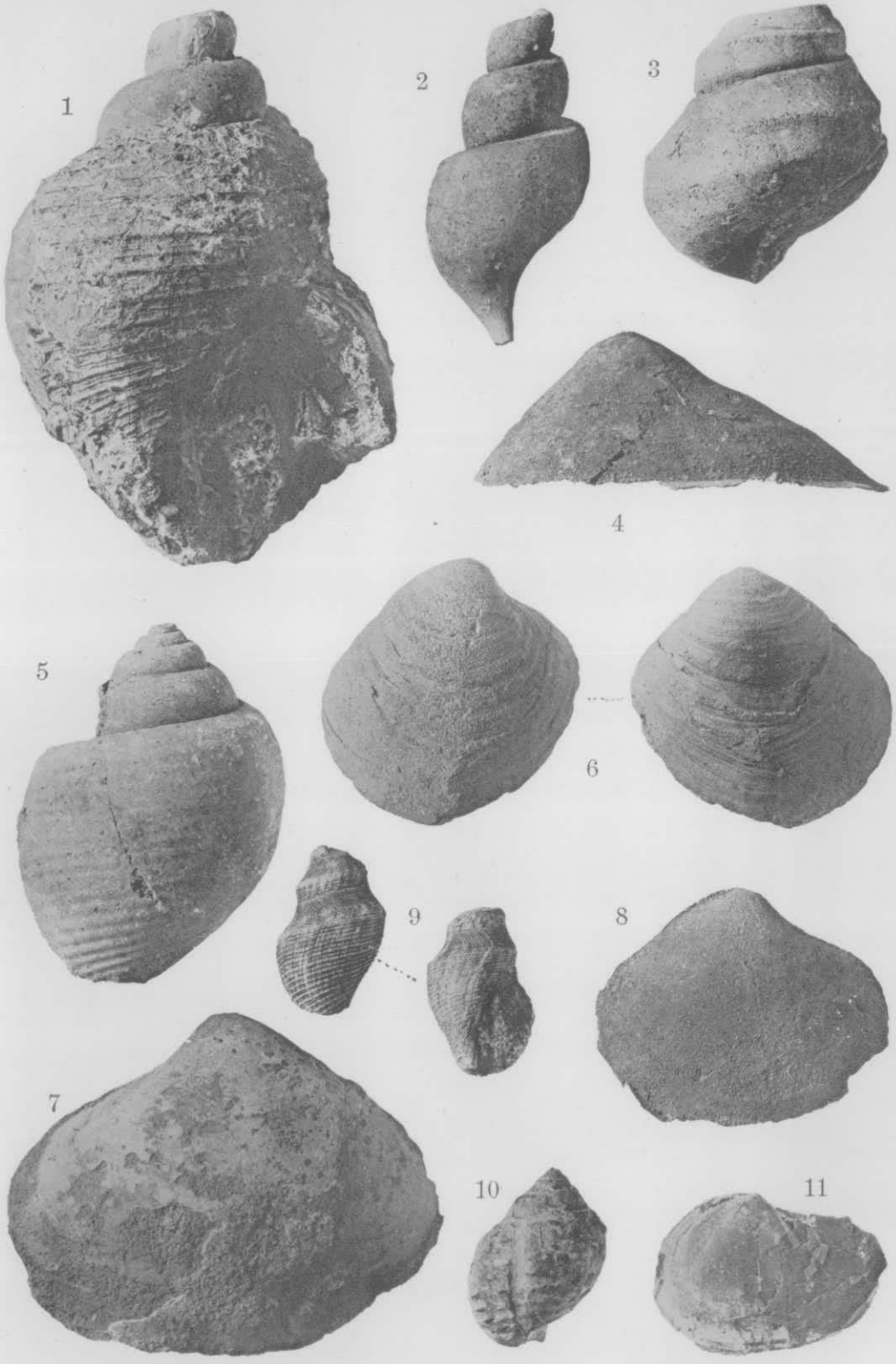

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PLATE II.

Plate II.

Fig. 1. Pecten swiftii Bern. Right valve. Tsurushihama, Sukegawa. p. 27.

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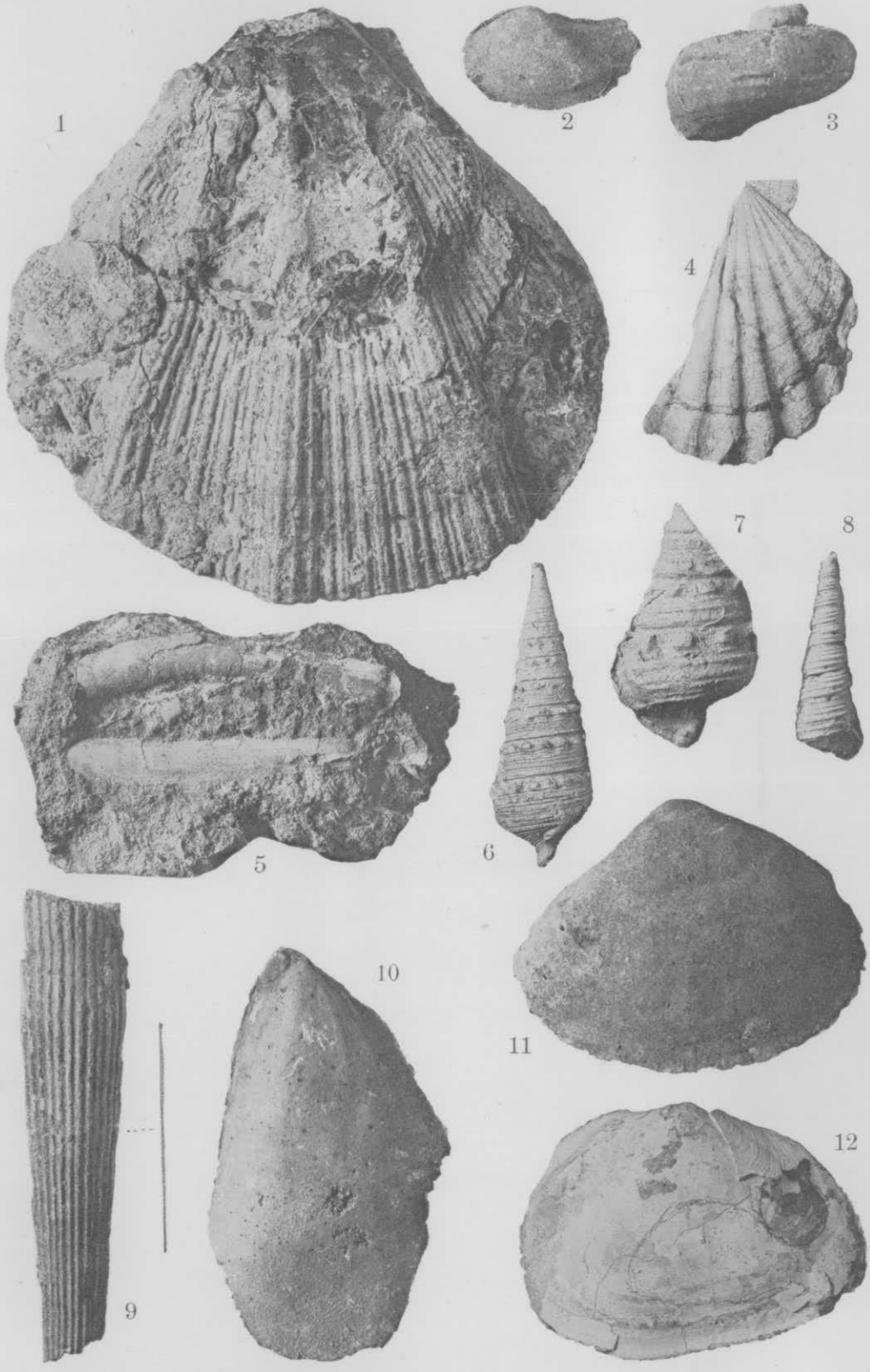

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PLATE III.

Plate III.

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PLATE IV.

Plate IV.

Pecten kimurai, Yok.

P. 27.

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Fig. 2. Left valve seen from the inner side. Izura.

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Fig. 4. Right valve (water-worn). Tamaye, Kobisa.

Fig. 5. Right valve. of the same individual as Fig. 1. Izura.

Fig. 6. Right valve. Izura.

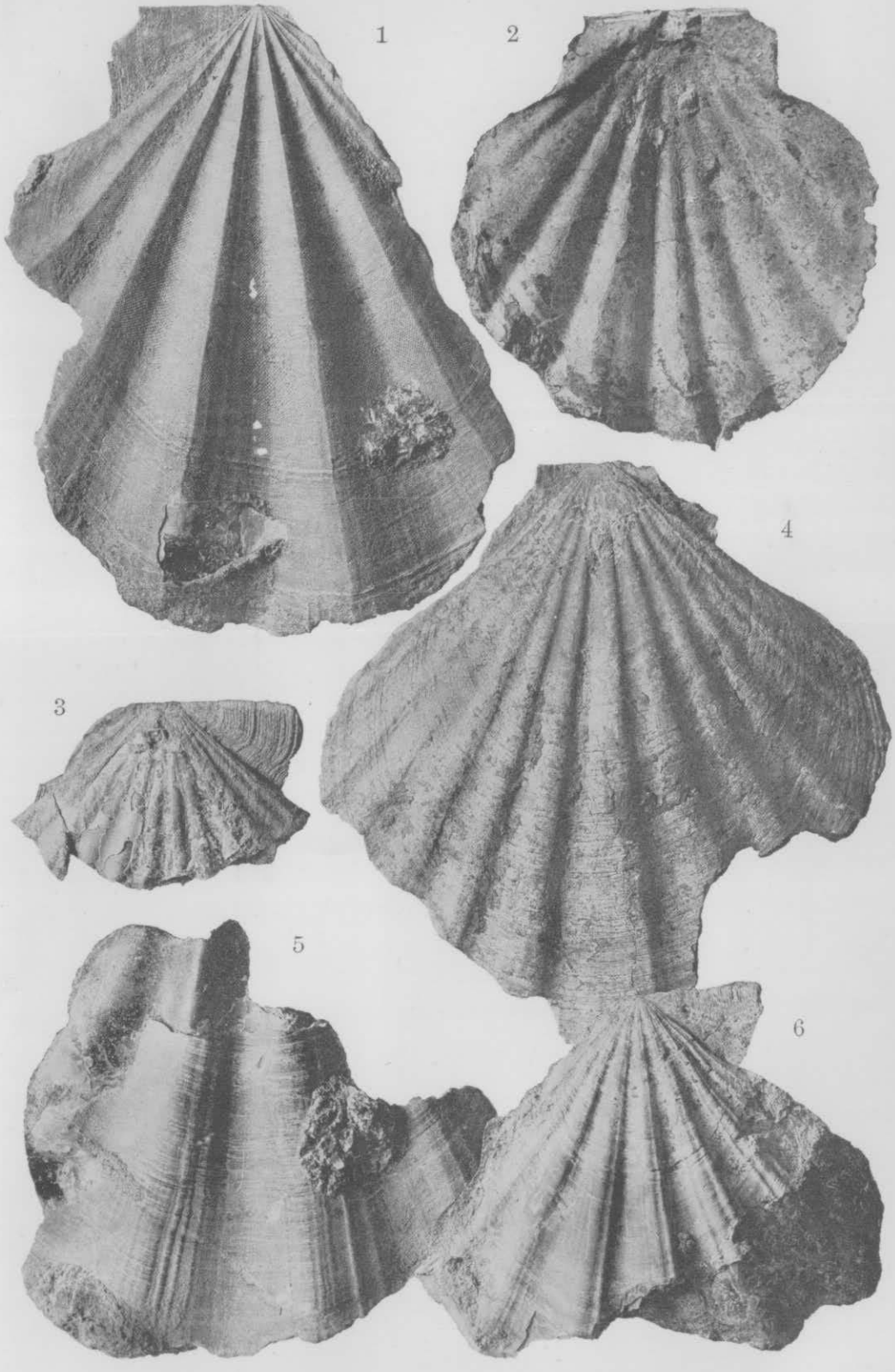

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Plate V.

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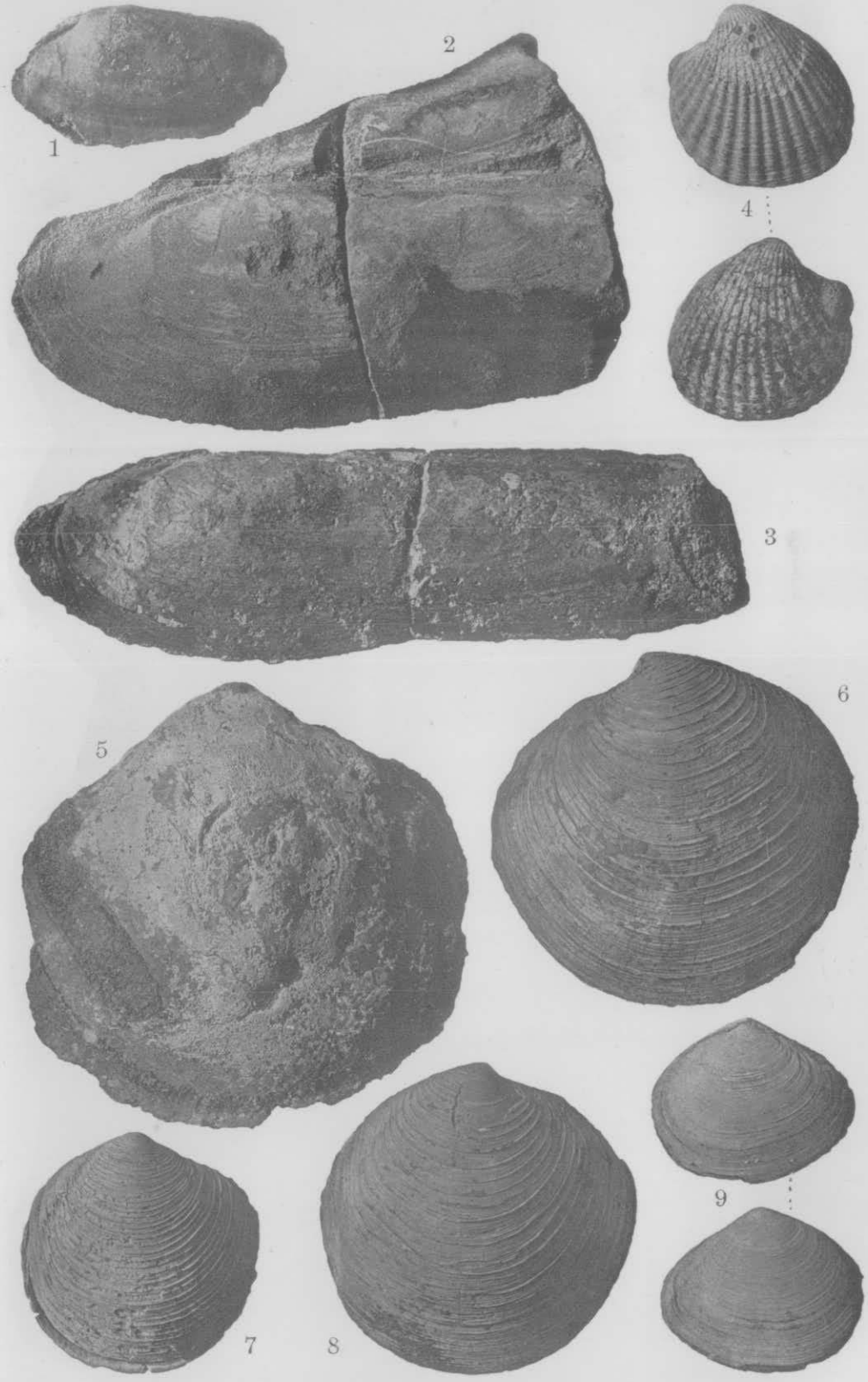

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Plate VI.

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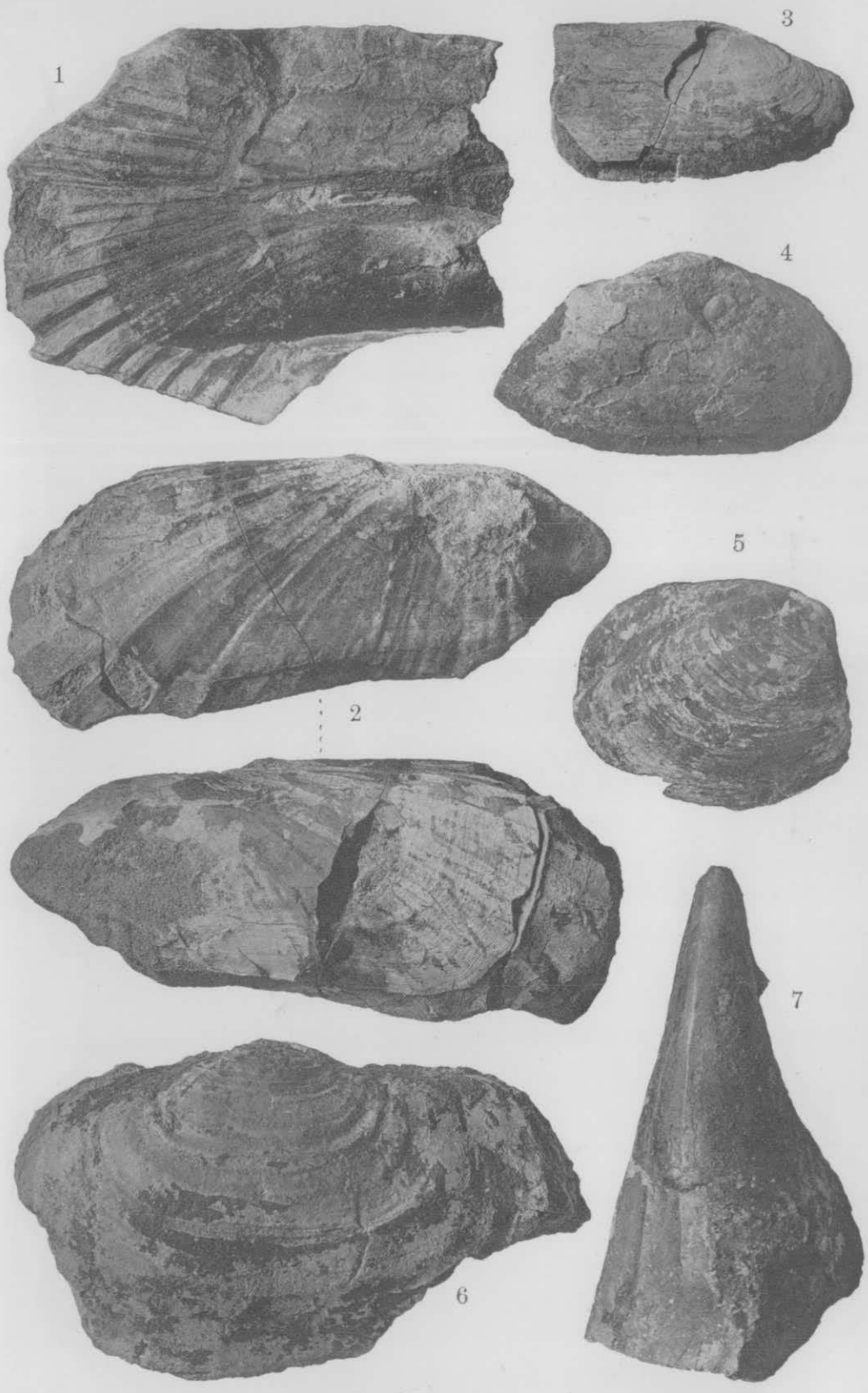

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