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

By

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With 3 Plates.

In the two papers[1] recently published on the molluscan remains of the Jô-Ban coal-field, I described those from the lowest beds as well as from the uppermost. What now remains are those of the beds between, which are treated in the following pages.

Unfortunately, the fossils sent me by Dr. Tokunaga as derived from these beds are not only small in number, but very imperfectly preserved, making their determination extremely difficult. Moreover, while the already known intermediate beds containing fossils are four in number—in descending order, the Misawa, the Kamenoo, the Mizunoya and the Goyasu[2]—what I have obtained are only the specimens from two of them, the *Kamenoo* and the *Mizunoya*. Besides, however, there are also fossils from beds whose exact geological position is at present unknown, but which are decidedly younger than the above and much better preserved.

1. Fossils from the Mizunoya-and Kamenoo-Beds.

The fossil-bearing rock is a shale grey to yellowish in colour and often sandy or tufaceous. The fossils are mostly flat-pressed or distorted.

The species from the *Mizunoya-Beds* which I could distinguish are the following:

1. Turritella nipponica Yok.
2. Turritella sp.
3. Tellina besshoensis Yok.
4. Tellina sp.

1) Jour. Sci. Coll., Vol. XLV, Art. 3 and Art. 5.

2) The fifth beds, the Shirasaka, which are below the Goyasu, do not contain fossils.

5. Lucina (Phacoides) borealis L.
6. Venericardia ferruginea Ad.
7. Pectunculus sp.
8. Yoldia sagittaria n. sp.
9. Nucula insignis Ad.

Leaving out 3 which are not specifically determined, there remain only 6, of which Tellina besshoensis is *Miocene* and *Pliocene*, Lucina borealis, Venericardia ferruginea and Nucula insignis are *Miocene, Pliocene,* and *recent.* Turritella nipponica is *Pliocene,* while Yoldia sagittaria is entirely new. Therefore, if we are left with these few forms to judge their age, we may say they are either *Miocene* or *Pliocene,* though a little more weight seems to fall on the latter determination. Such being the case, it may be advisable to see how things are in the beds above, the *Kamenoo.* Here the number of species is somewhat greater and consequently better fitted to determine their age. They are the following:

1. Natica sp.
2. Macoma dissimilis Mart.
3. Lucina (Phacoides) borealis L. (?)
4. Lucina (Phacoides) sp.
5. Venericardia laxata Yok.
6. Venericardia pacifera Yok. (?)
7. Venericardia ferruginea Ad.
8. Venericardia orbica n. sp.
9. Pecten tairanus n. sp.
10. Pectunculus sp.
11. Leda pennula n. sp.
12. Leda inermis n. sp.
13. Yoldia tokunagai n. sp.
14. Nucula eximia n. sp.
15. Solemya tokunagai Yok.

Out of 10 specifically well determined forms, 1 (Venericardia laxata) is *Miocene,* 1 (Venericardia ferruginea) *Miocene, Pliocene* and *recent,* 1 (Macoma dissimilis) *Pliocene* and *recent,* 1 (Solemya tokunagai) up to this time only *Pliocene,* while 6 are quite new. From this, we can not but consider the Kamenoo-Beds as *Miocene,* from which it naturally follows that the *Mizunoya-Beds* which underlie the Kamenoo must also be

Miocene.

2. Fossils from Beds whose Geological Position is Still Uncertain.

In and near the sea-side town of Minato in Hitachi and also in the regions of Shimo-Ogawa and Tateishi in Iwaki, Dr. Tokunaga found fossiliferous beds whose exact geological position he is unable to point out, that is to say, to which of the several beds, already distinguished near Yumoto they correspond. The rock is mostly sandstone, tolerably hard, dark-grey to light grey and fine-grained, though sometimes it may become coarse, breccia-like and greenish as at Hiraiso, or include pebbles and become a real conglomerate as near the Matsugane-Mine. Anyhow, petrographically, the beds show some peculiar character, foreign to the already known ones.

The fossil localities in the Minato Region are given as follows: Minato, Ushikubo, Kaimon Bridge, Isozaki and Hiraiso.[1]

In the Shimo-Ogawa Region,[2] the beds occur at Shibahara, Ochiai, Tateshitazawa and Matsugane Mine. The fossil-bearing rock of the first two places is mostly similar to that of Minato, that is to say, a hard dark-grey sandstone, though from Shibahara there are a few pieces of yellowish shale containing fossils (only two species, a Tellina and Cardium shinjiense). The rock of Tateshitazawa is a soft grey shale with only two species of fossils, Cardium shinjiense and Phacoides borealis, while that of the Matsugane Mine is a coarse conglomerate with a whitish sandy cement, on which account the fossils are very badly preserved.

In the Tateishi Region,[3] the fossil locality is only one; that is a place between the villages of Tateishi and Shiogu. The rock is a light-grey fine-grained sandstone in which rounded pebbles of tufaceous rock, are scattered.

The number of fossil species found in all these places amounts to 42, as seen in the following table:

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1) 常陸那珂郡湊、牛久保、海門橋 、磯崎、平磯。
2) 磐城石城郡下小川 、柴原、落合、立下澤、立平久保松金鑛山。
3) 同双葉郡龍田村立石、鹽具ノ間。

	Minato-Region	Tateishi-Region	Shimo-Ogawa-Region	Occurrence in Japan.
1. Ringicula sp.	+			
2. Pleurotoma sp.	+			
3. Fusus perplexus Ad.	+			Pliocene—Recent.
4. Chrysodomus despectus L.			+	Pliocene—Recent.
5. Nassa (Hima) japonica Ad	+			Pliocene—Recent.
6. Triton (Priene) oregonensis Redf.	+	+		Pliocene—Recent.
7. Cassis japonica Rve.	+			Pliocene—Recent.
8. Turritella nipponica Yok.	+		+	Pliocene.
9. Calyptraea mammilaris Brod.	+			Miocene—Recent.
10. Crepidula aculeata Gm.	+			Recent.
11. Crepidula convexa n. sp.	+			
12. Natica janthostoma Desh.		+	+	Miocene—Recent.
13. Polinices (Neverita) ampla Phil.	+			Pliocene—Recent.
14. Bembix sp.		+		
15. Fissuridea humilis n. sp.	+			
16. Chlorostoma sp.			+	
17. Helcioniscus pallidus Gld.			+	Pliocene—Recent.
18. Dentalium sp.	+			
19. Panope generosa Gld.	+	+		Pliocene—Recent.
20. Mactra sulcataria Desh.	+			Pliocene—Recent.
21. Spisula grayana Schr.	+			Pliocene—Recent.
22. Raeta elliptica Yok.	+			Pliocene (or Pleistocene).
23. Tresus sp.		+		
24. Tellina sp.			+	
25. Macoma inquinata Desh.	+			Miocene—Recent.
26. Dosinia troscheli Lke.	+	+	+	Pliocene—Recent.
27. Dosinia angulosa Phil.	+		+	Recent.
28. Venus (Mercenaria) stimpsoni Gldi.		+		Pliocene—Recent.
29 Tapes variegatus Hanl.	+			Pliocene (or Pleistocene)—Recent.
30. Cardium shinjiense Yok.	+		+	Miocene—Pliocene.
31. Diplodonta usta Gld.	+		+	Pliocene (or Pleistocene)—Recent.
32. Lucina (Phacoides) borealis L.	+	+	+	Miocene—Recent.
33. Venericardia ferruginea Ad.	+			Miocene—Recent.
34. Cardita cumingiana Dkr.	+			Pliocene (or Pleistocene)—Recent.
35. Lima goliath Sow.		+		Pliocene—Recent.
36. Pecten laetus Gld.	+			Pliocene—Recent.
37. Pecten iwakianus n. sp.		+		
38. Arca sp.	+			
39. Pectunculus vestitus Dker.	+			Miocene—Recent.
40. Parallelodon obliquatus Yok.	+			Pliocene—Recent.
41. Yoldia sagittaria Yok.		+		Miocene (Mizunoya).
42. Nucula mirabilis Ad. et Rve.			+	Pliocene - Recent.

The region which yielded the greatest number of species is Minato with 30. The Shimo-Ogawa-and Tateishi-Regions gave respectively only 12 and 11. There are no noteworthy peculiarities in these little faunas except the great frequency of *Turritella nipponica* and *Crepidula aculeata* in the Minato-Region and of *Phacoides borealis* and *Nucula mirabilis* in the Shimo-Ogawa.

The proportion of extinct forms against living is in all the three regions nearly equal, that is to say about 20%. If we try to judge the geological age of the beds in which these fossils were found from this percentage as well as from other considerations given in the last column of the above table, we can not but say that it is *Pliocene*, as the greatest weight seems to fall on that age. In fact, palaeontologically speaking, the whole fauna can hardly be distinguished from that of the Shirado-Beds which I took for *Upper Pliocene*. Nevertheless, there is one reason which forces me to assume that the beds in question, in spite of their belonging to the same age, are lower in position than the Shirado. And that reason rests on a careful observation of Dr. Tokunaga in the Minato-Region. Here the beds are said to be markedly inclined, while the layers above which he takes for the Shirado are nearly horizontal, thus showing a distinct line of unconformability between the two.

From this it may perhaps be questioned if these inclined beds of Minato are not the equivalent of the Misawa of the Yumoto-Region which conformably overlie the Kamenoo, but unconformably underlie the Shirado. To this question it is at present not possible to answer, as the fossil content of the Misawa is still quite unknown, although petrographically there is a difference. Anyhow, when we consider the great resemblance of the Minato fossils to those of the Shirado and their little relation to those of the Kamenoo, it is highly probable that they belong to a horizon, if not quite the same, still very close to the Shirado-Beds, which in the neighbourhood of Yumoto did not come to deposition.

It is to be mentioned here that at present it is still not quite certain whether the Shimo-Ogawa-and Tateishi-beds are strictly contemporaneous with those of Minato, though petrographically viewed, they presumably are.

Description of the Species.

1. Fossils from the Mizunoya-and Kamenoo-Beds.

1. Turritella nipponica, Yokoyama

Turritella nipponica. Yokoyama, Foss. Miura Penin., p. 71, pl. IV, figs. 16—19. Moll. Rem. Uppermost Part Jô-Ban Coal-field, p. 13, pl. II, fig. 8.

A few examples.

Fossil occurrence.—*Mizunoya-Beds :* Fujiwara.[1] Shirado-Beds. Lower Musashino.

2. Turritella sp.

Pl. I. Fig 1.

Casts of a large form whose spiral ridges are quite variable in number and size. Some have five subequal ridges, while others have the lower two very broad and transversely striated, while upper ones are comparatively very small. All the specimens are in fragments, so that it is impossible to make out their exact characters. There is a doubt, however whether they do not belong to an abnormally large form of the preceding species.

Fossil occurrence.—*Mizunoya-Beds :* Nagako in Kubota-mura.[2]

3. Natica sp.

A very poorly preserved specimen. The species is not determinable.

Fossil occurrence.—*Kamenoo-Beds :* Fukuda,[3] Sekimoto.

4. Macoma dissimilis, Martens (?)

Pl. I, Fig. 19.

A few casts closely resembling in form to the above named species already found in the Shirado-beds (Yokoyama, Moll. Rem. Uppermost Part Jô-Ban Coalf., p. 20, pl. v. fig. 9).

Fossil occurrence.—*Kamenoo-Beds :* Yunami[4]; between Yunami and Onsenba. Shirado-Beds. Musashinos.

5. Tellina besshoensis, Yokoyama.

Tellina besshoensis. Yokoyama, Moll. Rem Lowest Part Jô-Ban Coalfield, p. 14, pl. II, figs. 1—5. Moll. Rem. Uppermost Part, p. 19.

Several undoubted specimens.

Fossil occurence.—*Mizunoya-Beds :* Fujiwara; Yuzen,[5] Yunami. *Asagai-Beds.* Shirado-Beds.

6. Tellina sp.

An indeterminable form.

Fossil occurrence.—*Mizunoya-Beds :* east of Tebaizaka in Yumoto.[6]

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1) 磐城石城郡磐崎村藤原（大日本炭礦會社事務所下）　2) 同郡窪田村長子
3) 常陸多賀郡關本村福田　4) 常陸多賀郡關本村湯網　5) 同湯善
6) 湯本手這坂ノ東

7. Lucina (Phacoides) borealis, Linné.

Pl. I. Fig. 2 (?)

Lucina borealis. Yokoyama, Foss. Miura Penin., p. 133, pl. X, fig. 7. Moll. Rem. Uppermost Part Jô-Ban Coalfield, p. 24, pl. V, figs. 5—8.

A right valve from the Mizunoya-Beds tolerably large and measuring 50 millim, in length and 49 millim. in height belongs undoubtedly to this species. There are also specimens from the Kamenoo-Beds like the one here figured which, though imperfect, seem to belong to the same species.

Fossil occurrence.—*Mizunoya-Beds :* Fujiwara. *Kamenoo-Beds* doubtful specimens), Fukuda and Yunami.

Living.—Central Japan.

8. Lucina (Phacoides) sp.

Pl. I. Figs. 3, 4, 5, 18.

There are several flatly pressed impressions of a *Lucina* which are apparently different from the preceding species in being generally longer and more markedly subtruncate behind. The sculpture is similar, showing distant, raised, concentric lamellae with fine concentric lines between. The proportion of length to height is variable, but the shell is invariably longer than high. Whether these specimens belong to a distinct species, or are only the deformations of the preceding, I am now not in a position to decide.

Fossil occurrence.—*Kamenoo-Beds :* Ebata (Yamada)[1]; Ishibatake (Nishiki)[2]; Ishimoriyama[3]; Tabasaka (Yumoto)[4]; Tsuchibashi (Kadono)[5]; Miyanosaku (Shimoyata near Yumoto)[6]; Ōdate, Taira.[7]

9. Venericardia laxata, Yokoyama.

Pl. I. Figs. 11, 12 (?)

Venericardia laxata. Yokoyama, Moll. Rem. Lowest Part Jô-Ban Coal-Field, p. 19, pl. III, figs. 16–18.

A rather small, more or less transversely roundly elliptical shell with flat radiating ribs which number a little over twenty is, I believe, the same species as that described from the Asagai-beds, though somewhat shorter in form.

Fossil occurrence.—*Kamenoo-Beds :* Shimo-Yunagaya (Yumoto).[8] Doubtful specimens are found at Ebata (Yamada), Tanamisaku (Shimo-Funao),[9] and Hirakata coast.[10]

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1) 磐城石城郡山田村江畑 2) 同錦村石畑 3) 石森山一名磐城富士（平町ノ北、平窪村）
4) 田場坂 5) 上遠野土橋 6) 下矢田宮ノ作 7) 平町大館 8) 湯本下湯長谷
9) 下船尾蛇井作 （磐崎村） 10) 平潟海岸

10. **Venericardia pacifera,** Yokoyama (?)

Pl. I. Fig. 13.

A young individual with about fifteen ribs, distant and flat, seems to belong to the above-named species (Moll. Rem. Lowest Part., p. 18, pl. IV, figs. 1, 2.)

Fossil occurrence.—*Kamenoo-Beds:* Daikatsu Bore-hole at Yokonesawa (Uchigō).[1]

Venericardia ferruginea, Adams.

Pl. I. Figs. 6, 7.

Venericardia ferruginea. Yokoyama, Moll. Rem. Upper most Part, p. 24, pl. V, fig. 4.
Venericardia sp. Yokoyama, Moll. Rem. Lowest Part, p. 19, pl. III, figs. 8, 9.

Poorly preserved specimens.

Fossil occurrence.—*Mizunoya-Beds:* Fujiwara. *Kamenoo-Beds:* Tsuchibashi (Kadono).[2] Shirado-Beds. Musashino Formation.

Living.—Northern Japan.

12. **Venericardia orbica,** n. sp.

Pl. I. Fig. 10.

An ill-preserved specimen which, however, is characteristic enough to be created into a new species.

Shell nearly circular, almost as high as long, ornamented with nearly thirty flattish radiating ribs separated by interspaces of nearly equal breadth. Growth-lines distinct, fine, numerous and crossing the ribs. Length 34 millim. Height 32 millim. The thickness is not measurable, as the only specimen we possess is flatly pressed on the stone.

This shell has a striking resemblance in form to *Venericardia imbricata* Lam. of the Paris Basin as reproduced in Zittel's Text-book of Paleontology. p. 475 (fig. 764).

Fossil occurrence.—*Kamenoo-Beds:* Ishibatake (Nishiki-mura).

13. **Pecten tairanus,** n. sp.

Pl. I. Figs. 8, 9.

A small, neat, flat shell circuler in outline, slightly longer than high. The surface is smooth, only coarse concentric corrugations being present. The ears of the left valve, though somewhat unequal in shape, are triangular, while the anterior one of the right valve is long and narrow with a few coarse radiating ribs and a deep byssal notch below. The left valve

1) 内郷村横根澤大勝試錐孔 2) 上遠野土橋 3) 平町久保町

(fig. 8) which is nearly perfect is 13 millim. long and 11 millim. high.

Fossil occurrence.—*Kamenoo-Beds :* Kubo-Street in the town of Taira.

14. **Pectunculus** sp.

Pl. I. Fig. 17.

Imperfect specimens, much like those of *Pectunculus vestitus* Dkr. (Yokoyama, Upper Musashino, pl. XVI, figs. 1, 2).

Fossil occurrence.—*Mizunoya-Beds :* East of Tebaizaka, Yumoto. *Kamenoo-Beds :* Miyanosaku, Shimoyata.

15. **Leda pennula**, n. sp.

Pl. II. Figs. 7, 8, 9.

Shell small, thin, compressed, transversely elongated, very inequilateral, rounded in front, longly rostrate, narrowed, and mostly truncate behind. The length is about double the height. Postero-dorsal border nearly straight, inclining to concave ; ventral almost straight in the posterior half. Area narrow, distinct. Surface with prominent concentric lirae, suddenly turned upward at the areal border with a broad angle and continuing into the area. A few examples, one of which measures 19 millim. long and 9 millim. high.

This species looks like *Leda ramsayi* Sm. (Foss. Miura Penin., p. 176, pl. XIX, fig. 3), but the shell is longer.

Fossil occurrence.—*Kamenoo—Beds.* Daikatsu bore-hole, Yokonesawa ; Yotsusawa (near Nakoso Station), Kubota[1] ; Takinosaku (Kami-Arakawa, Iino-mura).[2] A doubtful specimen occurs also at Saku (Iino).[3]

16. **Leda inermis**, n. sp.

Pl. II. Figs. 1—6.

Shell comparatively large, thin, flatly convex, transversely oblong, with the length usually a little over one and a half times the height ; inequilateral with anterior side somewhat shorter than posterior ; rounded in front, rounded or subtruncate behind, broadly arched at ventre ; antero- and postero-dorsal borders arched, the former more sharply than the latter. Surface smooth. Teeth about 20 on the posterior side, about half as many on the anterior.

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1) 窪田四澤 (石城郡) 2) 飯野村上荒川瀧ノ作 3) 飯野村作

The largest specimen measures a little over 40 millim. in length. The thickness of the shell can not be well measured as it is more or less flattened by pressure, but it seems to be about one-sixth the length. Rather frequent.

Fossil occurrence.—*Kamenoo-Beds:* Tamatsuyu (Izumi)[1]; Hirakata coast; Inouye (Uyeda)[2]; Osaku near Nakoso Railway Station[3]; between Yunami and Onsenba.

17. **Yoldia sagittaria,** n. sp.

Pl. II. Figs. 10, 11.

Shell thin, strongly compressed, lanceolate, more than twice as long as high, subequilateral, anteriorly rounded, posteriorly narrowed, rostrate and pointed (?) Surface with distant concentric impressed lines. Teeth about 25 on the anterior side, a little less on the posterior. Rare.

Two specimens. The one measures 22 millim. high and 45 (?) millim. long. The other is 27 millim. high and more then 50 millim. long.

Fossil occurrence.—*Mizunoya-Beds:* Between Kosai and Aburahira (Sekimoto)[4]; Nagako, Kubota.

18. **Yoldia tokunagai,** n. sp.

Pl. II. Figs 12—18.

Shell medium-sized, thin, compressed, transversely suboblong, nearly twice as long as high, inequilateral with the anterior side almost double the length of the posterior, rounded in front, subrostrate and rounded behind; antero-dorsal border nearly straight, postero-dorsal slightly excavated, ventral broadly arched and obliquely ascending behind. Surface with fine divaricating lines. Anterior teeth a little over 20 in number, posterior a little less and coarser.

This species is somewhat like *Yoldia laudabilis* Yok. (Moll. Rem. Lowest Part., p. 22. pl. IV. figs. 11, 12) of the Asagai-Beds in outline, though the surface-sculpture is quite different.

Fossil occurrence.—*Kamenoo-Beds:* Ishimoriyama; Kami-Kabeya[5]; Saku; Takinosaku; Miyanosaku; Honya (Izumi)[6]; Shimoyunagaya (Yumoto); between Yunami and Onsenba. A doubtful specimen occurs also at Yotsusawa, Kubota.

19. **Nucula insignis,** Adams.

Nucula insignis. Yokoyama, Moll. Rem. Lowest Part Jô-Ban Coal-Field, p. 21. Moll. Rem. Uppermost Part, p. 30.

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1) 泉村玉露（石城郡） 2) 植田井上 3) 大作
4) 關本村小才油平ノ間（多賀郡） 5) 上神谷（神谷村） 6) 泉村本谷

An imperfect specimen.

Fossil occurrence.—*Mizunoya-Beds :* Yuzen, Yunami[1]; Asagai-Beds. Shirado-Beds. Musashinos.

Living.—Northern Japan.

20. **Nucula eximia,** n. sp.

Pl. I. Figs. 14, 15, 16.

Shell rather large, trigonal, somewhat longer than high, a little inequilateral, anterior side longer than posterior, rounded at both ends, although sharply in front and quite broadly behind ; antero-dorsal border nearly straight, sloping, postero-dorsal but slightly arched and also descending. Surface with neat divaricating riblets. The proportion of length to height is 10 to about 8,2. The largest example measures some 40 millim. in height.

This species is quite characteristic by its large size, trigonal shape and divaricating sculpture.

Mostly found as casts and flatly pressed, so that it is not possible to know the thickness.

Fossil occurrence.—*Kamenoo-Beds :* Hayashizaku (Iino) ; Takinosaku (Iino) ; Saku (Iino) ; Kamenoo-sawa (Mizunoya) ; north of Sekiba (hill-top).

21. **Solemya tokunagai,** Yokoyama.

Pl. I. Figs. 20, 21.

Solemya tokunagai. Yokoyama, Moll. Rem. Upperm. Part, p. 31, pl. VI, figs. 1—3.

Imperfect specimens. Yet they are easily recognized by the peculiar processes of the periostracum.

Fossil occurrence.—*Kamenoo-Beds :* west of Fukuda. Shirado-Beds.

II. Fossils from Uncertain Beds.

1. **Ringicula** sp.

A few ill-preserved specimens resembling *Ringicula musashinoensis* Yok. (Foss. Miura Penin., p. 30, pl. I., figs. 3, 8), but somewhat more slender.

Fossil occurrence.—*Minato Region :* Ushikubo.

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1) 湯網湯善

2. **Pleurotoma** sp.

Two mutilated specimens, fusiform in shape and having three spiral ridges on the whorls except the last which has eight.

Fossil occurrence.—*Minato Region :* Ushikubo.

3. **Fusus perplexus**, A. Adams.

Fusus perplexus. Yokoyama, Foss. Miura Penin., p. 50, pl. II, fig. 17. Foss. Up. Musash., p. 51.

A fragmentary example.

Fossil occurrence.—*Minato Region :* Ushikubo. Musashinos.

Living.—Northern, Central and Western Japan.

4. **Chrysodomus despectus**, (Linné).

Neptunea despecta. Harmer, Plioc. Moll. Brit. Brit., part I, p. 160.

Chrysodomms phoeniceus. Yokoyama, Foss. Miura Penin., p. 50, pl. II, figs, 8—10, Moll. Rem. Lowest Part Jô-Ban Coalf., p. 9. Moll. Rem. Upperm Part, p. 10, pl, I, fig. 1.

The shell which I used to call *Chrysodomus phoeniceus* Dall is, as I am now convinced, identical with *Neptunea despecta* L. of Harmer. This author distinguishes some ten varieties out of this variable species, but I must confess that it is not always possible to determine to which variety or varieties our fossil specimens belong, especially when their preservation is not perfect. Nevertheless, I may say that those from the Musashino of Koshiba (figs. 8-10, pl. II, Foss. Miura Penin.) agree with such varieties as *carinata, antiquata* and *intersculpta* of Harmer. A specimen figured in plate I of my "Molluscan Remains from the Uppermost Part of the Jô-Ban Coal-field" seems to resemble var. *intersculpta* most.

Fossil occurrence.—*Shimo-Ogawa Region :* Matsugane Mine. Shirado-Beds. Lower Musashino.

Living.—Circumpolar seas. Northern down to Western Japan.

5. **Nassa (Hima) japonica**, A. Adams.

Nassa (Hima) japonica. Yokoyama. Foss, Miura Penin., p, 56, pl. II, fig. 5, Foss. Up. Musash., p. 58.

Several specimens, though imperfect.

Fossil occurrence.—*Minato Region :* Ushikubo. Musashinos.

Living.—Central and Western Japan.

6. **Triton (Priene) oregonensis**, Redfield.

Triton (Priene) oregonensis. Yokoyama. Foss. Miura Penin., p. 64, pl. III, figs. 19, 20. Foss. Up. Musasah., p. 68. Moll. Rem. Up. Part Jô-Ban Coalf., p. 11.

Some fragments.

Fossil occurrence.—*Minato Region*: Isozaki. *Tateishi-Region*: Between Tateishi and Shiogu. Shirado-Beds. Musashinos.

Living.—Northern Japan, Alaska, Oregon, etc.

7. **Cassis japonica,** Reeve.

Cassis japonica. Yokoyama, Moll. Rem. Upperm. Part Jô-Ban Coalf., p. 11, pl. I, fig. 5.

A cast.

Fossil occurrence.—*Minato Region*: Hiraiso. Shirado-Beds.

Living.—Central and Western Japan.

8. **Turritella nipponica,** Yokoyama.

Pl. III. Figs. 4, 5.

Turritella nipponica. Yokoyama. Foss. Miura Penin., p. 71, pl. IV, Figs. 16—19. Moll. Rem. Upperm. Part., p. 13, pl. II, fig. 8.

Specimens are quite frequent and found in almost all the fossil localities.

When I first described this species from the Musashino Formation, the specimens obtained were rather young ones which normally had four spiral ridges, though abnormaly five or even six. In the specimens which I now possess, there are many young as well as fully grown ones in which latter especially an interstial ridge appears between the main ones. These interstials often grow in size so as to make the whorls appear several ridged. In such cases, interstial striae may again appear, so that the number of ridges which are of various sizes becomes many, and especially on the body-whorl.

Fossil occurrence—*Minato Region*: Ushikubo, Minato, Kaimon Bridge and Isozaki. *Shimo-Ogawa Region*: Shibahara, Yachishita, Ochiai. Shirado-Beds. Lower Musashino.

9. **Calyptraea mammilaris,** (Broderip).

Calyptraea mammilaris. Yokoyama, Moll. Rem. Lowest Part., p. 11, pl. I, fig. 17. Moll. Rem. Uppermost Part, p. 13.

Rather frequent.

Fossil occurrence.—*Minato Region*: Ushikubo and Hiraiso. Asagai-Beds. Shirado-Beds.

10. **Crepidula aculeata,** (Gmelin).

Pl. III, Figs, 8, 9.

Crepidula aculeata. Pilsbry, Catalogue Marine Mollusks Japan, p. 70. Tryon, Man. Conch., VIII, pl. 39, figs. 61—65. Iwakawa, Cat. Jap. Moll. Tokyo Imp. Museum, p. 49.

Numerous examples from Hiraiso. All are more or less decorticated. Now and then, there are specimens with traces of radiating ribs which are occassonally divaricating, a character also sometimes seen in the living ones. The sculpture according to the figures of Tryon seems to be very variable.

Fossil occurrence.—*Minato Region :* Hiraiso and Ushikubo.

Living.—Central, Western and Southern Japan. Australia, India, West coast of America, Florida, etc.

11. **Crepidula convexa,** n. sp.

Pl. III. Fig. 3.

A single specimen which, though to a greater part deprived of its shell, is characteristic enough to be described as a new species.

It is oval in outline and high-convex, the length being 30 millim., the breadth 18 millim. and the height 14 millim. The apex is small, prominent, narrowed and recurved. The surface, so far as can be judged from a little of the shell remaining, seems to have been smooth, being only corrugated by rude lines of growth.

The general form of this shell strongly reminds of *Crepidula ungana.* Dall (Geol. and Palaeont., Harriman Alaska Expedition, p. 119, pl. x, figs. 8, 9) from the Miocene of Alaska which has the apical part more inflated.

Fossil occurrence.—*Minato Region :* Ushikubo.

12. **Natica janthostoma.** Deshayes.

Natica janthostoma, Yokoyama, Moll. Rem. Lowest Part., p. 12, pl. I, fig. 20. Moll. Rem. Upperm. Part, p. 13.

Fossil occurrence.—*Shimo-Ogawa Region :* Shibahara and Ochiai. (frequent). *Tateishi-Region :* Between Tateishi and Shiogu. Asagai-Beds. Shirado-Beds. Lower and Upper Musashino.

Living.—Northern and Central Japan. Kamchatka.

13. **Polinices (Neverita) ampla,** (Philippi).

Polinices ampla. Yokoyama, Foss. Miura Penin., p. 78, pl. V, figs. 5, 6. Foss. Up. Musash., p. 84. Moll. Rem. Upperm. Part, p. 14.

Rare.

Fossil occurrence.—*Minato Region :* Ushikubo. and Kaimon Bridge. Shirado-Beds. Lower and Upper Musashino. Pliocene of Kii and Totomi.

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

14. **Bembix** sp.

A fragment of the body-whorl, much decorticated and looking like that of *Bembix crumpii* Pils. (Yokoyama, Foss. Miura Penin., pl. v. figs. 27, 28.) living in Japan and also fossil in the Musashino Formation.

Fossil occurrence.—*Tateishi Region :* Between Tateishi and Shiogu.

15. **Fissuridea humilis**, n. sp.

Pl. III. Fig. 7.

Shell rather thin, oblong in outline, low-conical ; the apex in front of the middle ; anterior slope almost straight, shorter than the slightly arched posterior one which has a blunt edge in the middle. The sculpture consists of numerous, subequal, straight, radiating riblets occasionally with a finer interstitial between ; the interspaces are finely latticed by growth-lines.

A single example not quite perfect, about 22 millim. long, 13 millim. broad and 5 millim. high. The shape of the apical fissure can not be well made out, as it is somewhat broken.

This shell has a close resemblance to *Fissuridea patagonica* Orb. (Tryon, Man. Conch., XII, pl. 61, figs. 21—23). now living in Patagonia. It is, however, distinguished by its shape being not narrowed in front and lower.

Fossil occurrence.—*Minato-Reyion :* Hiraiso

16. **Chlorostoma** sp.

Several casts which seem to belong to *Chlorostoma argyrostoma* Gm. (Lischke, Jap. Meeresconch., I, p. 96, pl. VII, figs. 3—5) living in our seas.

Fossil occurrence.—*Shimo-Ogawa Region :* Matsugane Mine.

17. **Helcioniscus pallidus**, (Gould).

Helcioniscus pallidus. Yokoyama, Foss. Miura Penin., p. 101, pl. VI, figs. 16, 17. Moll. Rem. Upperm. Part, p. 15, pl. I, fig. 4.

A few small examples.

Fossil occurrence.—*Shimo-Ogawa Reyion :* Matsugane Mine. Shirado-Beds. Musashinos.

Living.—Northern and Central Japan.

18. **Dentalium** sp.

A fragment which looks like *Dentalium octogonum* Lam. (Yokoyama,

Foss. Miura Penin., p. 103, pl. VI, figs. 22—24), but having more ribs (more than 10).

Fossil occurrence.—*Minato Region :* Ushikubo.

19. **Panope generosa,** Gould.

Panope generosa. Yokoyama, Foss. Up., Musash., p. 121, pl. V, figs. 14, 15. Foss. Moll. Neog. Izumo, p. 4. Tert. Moll. Dainichi, p. 14. Moll. Rem. Upperm. Part, p. 16, pl. VI, fig. 6

Rather rare and mostly in fragments.

Fossil occurrence.—*Minato Region :* Ushikubo. *Tateishi Region :* Between Tateishi and Shiogu. Pliocene of Izumo and Dainichi. Shirado-Beds. Upper Musashino.

Living.—Northern Japan. West coast of America.

20. **Mactra sulcataria,** Deshayes.

Mactra sulcataria. Yokoyama, Foss. Up. Musashino, p. 126, pl. VII, fig. 6. Moll. Rem. Upperm. Part, p. 17.

Several examples.

Fossil occurrence.—*Minato Region :* Isozaki. Shirado-Beds. Upper Musashino.

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

21. **Spisula grayana,** (Schrenck).

Spisula grayana. Yokoyama, Moll. Rem. Upperm Part, p. 17, pl. II, fig. 11.

Several large specimens.

Fossil occurrence.—*Minato Region :* Isozaki. Shirado-Beds. Upper Musashino.

Living.—Northern Japan. Behring Sea.

22. **Raeta elliptica,** Yokoyama.

Raeta elliptica. Yokoyama, Foss. Up. Musashino, p. 131, pl. VIII, fig. 7.

A single small valve.

Fossil occurrence.—*Minato-Region :* Near Kaimon Bridge. Upper Musashino.

23. **Tresus** sp.

A cast looking like *Tresus nuttali* Conr. (Foss. Up. Musash., p. 133, pl. VIII, fig. 8) fossil as well as living in Japan.

Fossil occurrence.—*Tateishi Region :* Between Tateishi and Shiogu.

24. Tellina sp,

A cast transversely elongated and looking like *Tellina alternata* Say *var. chibana* Yok. (Moll. Rem. Lowest Part, pl. II, fig. 20), though not well determinable. The rock in which it is contained is a shale.

Fossil occurrence.—*Shimo-Ogawa Region:* Shibahara.

25. Macoma inquinata, (Deshayes).

Macoma inquinata. Yokoyama, Moll. Rem. Lowest Part, p. 13. Foss. Miura Penin., p. 117, pl. VIII, figs. 1, 2.

A single valve.

Fossil occurrence.—*Minato Region:* Ushikubo. Iwaki-Beds. Pliocene of Kii. Lower and Upper Musashino.

Living—Northern, Central and Western Japan. Sea of Okhotsk. West coast of North America.

26. Dosinia troscheli, Lischke.

Dosinia troscheli. Yokoyama, Foss. Miura Penin., p. 119, pl. VIII, figs. 5, 6. Moll. Rem. Upperm. Part, p. 20.

Rather rare.

Fossil occurrence.—*Minato-Region:* Isozaki. *Shimo-Ogawa Region:* Ochiai and Shibahara. *Tateishi Region:* Between Tateishi and Shiogu. Shirado-Beds. Pliocene of Dainichi. Lower and Upper Musashino.

Living.—Central and Western Japan.

27. Dosinia angulosa, Philippi.

Pl. II. Figs. 19, 20.

Dosinia angulosa. Philippi, Catalogue, p. 126. Philippi, Abbild., II, p. 229, pl. VI, fig. 1. Iwakawa, Catal., p. 297.

Artemis penicillata. Reeve, Conch. Icon., fig. 33.

A species close to the preceding, but distinguished by its more circular, consequently higher shape. The length and height in this species are nearly equal and the angle formed by the postero-dorsal and posterior borders is not so marked as in *Dosinia troscheli.* Moreover the pallial sinus is more rounded at end and finger-like in this species. The largest example is a left valve 55 millim. in length and height. Not rare in the Minato Region.

Fossil occurrence.—*Minato-Region:* Isozaki, Ushikubo and Hiraiso. *Shimo-Ogawa Region:* Shibahara.

Living.—Western Japan. Philippines and further south.

28. Venus (Mercenaria) stimpsoni, Gould.

Venus (Mercenaria) stimpsoni. Yokoyama, Foss. Up. Musash., p. 148, pl. XI, figs. 11, 12. Moll. Rem. Upperm. Part, p. 21.

Several large specimens, though all are casts.

Fossil occurrence.—*Tateishi Region:* Between Tateishi and Shiogu. *Shimo-Ogawa Region:* Matsugane Mine. Shirado-Beds. Pliocene of Izumo. Upper Musashino.

Living.—Northern and Western Japan.

29. Tapes variegatus, Hanley.

Pl. III. Fig. 13.

Tapes variegatus. Yokoyama, Foss. Miura Penin., p. IX, figs. 4, 5. Foss. Up. Musash., p. 153.

Several specimens, one of which is 40 millim. high. The sculpture is somewhat different from that of the living ones by having the impressed radiating lines at more regular intervals and running more or less straight (not so wavy as in the latter).

Fossil occurrence.—*Minato Region:* Ushikubo, Kaimon Bridge, and Isozaki.

Living.—Central and Western Japan. Philippines.

30. Cardium shinjiense, Yokoyama.

Pl. III, Figs. 10, 11.

Cardium shinjiense. Yokoyama, Molluscan Rem. Lowest. Part, p. 16, pl. III, figs. 13—15. Moll. Rem. Up. Part, p. 23.

A few examples.

Fossil occurrence.—*Minato Region:* Ushikubo, Isozaki. *Shimo-Ogawa Region:* Ochiai (Shibahara), Shibahara (in a fine yellowish tufaceous shale) and Tateshita-zawa (in a soft grey sandy shale). Iwaki- and Asagai-Beds. Shirado-Beds. Pliocene of Izumo.

31. Diplodonta usta, Gould.

Diplodonta usta. Yokoyama, Foss. Up. Musash., p. 159 pl, XIII, fig. 3. Foss. Miura Penin., p. 130, pl. IX, figs. 14—16.

Rare.

Fossil occurrence.—*Shimo-Ogawa Region:* Ochiai (Shibahara). *Minato Region:* Kaimon Bridge, Minato. Musashinos.

Living.—Northern and Central Japan.

32. Lucina (Phacoides) borealis, Linné.

Pl. III. Figs. 1,2.

Lucina (Phacoides) borealis. Yokoyama, Moll. Rem. Upperm. Part, p. 24, pl. V. figs. 5—8.

Quite common at Shimo-Ogawa, though mostly in small forms.

Fossil occurrence.—*Shimo-Ogawa Region:* Shibahara, Ochiai, Tateshita-zawa (shale) and Tanishita. *Minato Region:* Kaimon Bridge, Minato. *Tateishi Region:* Between Tateishi and Shiogu. Shirado-Beds. Musashinos. Pliocene of Kii. Miocene, Pliocene and Pleistocene of Europe.

Living.—Central Japan. Atlantic.

33. **Venericardia ferruginea**, (A. Adams).

Venericardia ferruginea. Yokoyama, Moll. Rem. Upperm. Part, p. 24, pl. V, fig. 4.
Venericardia sp. Yokoyama, Moll. Rem. Lowest Part, p. 19, pl. III, figs. 8, 9.

Rare.

Fossil occurrence.—*Minato Region:* Ushikubo. Iwaki-Beds. Shirado-Beds. Musashinos.

Living.—Northern Japan.

34. **Cardita cumingiana**, Dunker.

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

A strongly worn specimen.

Fossil occurrence.—*Minato-Region:* Hiraiso. Musashino.

Living.—Central and Western Japan.

35. **Lima goliath**, Sowerby.

Lima goliath. Yokoyama, Moll. Rem. Upperm. Part, p. 26, pl. III, figs. 1, 4.

A single valve.

Fossil occurrence.—*Tateishi Region:* Between Tateishi and Shiogu, Shirado-Beds. Lower Musashino.

Living.—Central Japan. Patagonia.

36. **Pecten laetus**, Gould.

Pecten laetus. Yokoyama, Moll. Rem. Upperm. Part, p. 26. Foss. Miura Penin., p. 152, pl. XIV, figs. 1, 2. Foss. up. Musashi., p. 180, pl. XIV, fig. 20.

Only two isolated valves.

Fossil occurrence.—*Minato Region:* Hiraiso. Shirado-Beds. Musashinos. Pleistocene of Awa.

Living.—Northern, Central and Western Japan.

37. **Pecten iwakianus**, Yokoyama.

Pl. III. Fig. 13.

A fragment of a large valve which, however, shows such a peculiar sculpture as not to be confounded with any hitherto described.

The shell is nearly 80 millim. long, strongly compressed and furnished with more than twenty elevated, rounded, radiating ribs, narrower than the valleys in each of which there is a fine riblet. The ribs as well as the riblets are closely scaled.

The species comes closest to *Pecten crassicostatus* Sow. (Yokoyama, Foss. Miura Penin., pl. XII, fig. 7) living and fossil in Japan. This latter, however, has the ribs broader than the valleys and more coarsely and distantly scaled.

Fossil occurrence.—*Tateishi Region :* Between Tateishi and Shiogu.

38. **Arca** sp.

A young form looking like that of *Arca subcrenata* Lke. (Yokoyama, Foss. Up. Musash., p. 187, pl. PV, fig. 12).

Fossil occurrence.—*Minato Region :* Ushikubo.

39. **Pectunculus vestitus,** Dunker.

Pectunculus vestitus. Yokoyama, Foss. Miura Penin., p. 167, pl. XVIII, figs. 10, 11. Foss. Up. Musash., p. 189, pl. XVI, figs. 1—3. Moll. Rem. Lowest Part, p. 21. Moll. Rem. Upperm. Part, p. 29.

Several large specimens.

Fossil occurrence.—*Minato-Region :* Ushikubo and Hiraiso. Iwaki-Beds. Shirado-Beds. Musashinos.

Living.—Central Japan.

40. **Parallelodon obliquatus,** Yokoyama.

Parallelodon obliquatus. Yokoyama, Foss. Miura Penin., p. 167, pl. XVII, figs. 10, 11. Moll. Rem. Lowest Part, p. 21. Moll. Rem. Upperm Part, p. 29.

Several small examples.

Fossil occurrence.—*Minato Region :* Hiraiso. Shirado-Beds. Musashinos. Pleistocene of Awa.

Living.—Northern and Central Japan.

41. **Yoldia sagittaria,** Yokoyama.

A single ill-preserved valve of the species described before (p. 10).

Fossil occurrence.—*Tateishi Region :* Between Tateishi and Shiogu. Mizunoya—Beds.

42. **Nucula mirabilis**, Adams et Reeve.

Pl. III. Fig. 6.

Nucula mirabilis. Yokoyama, Foss. Miura Penin., p. 180, pl. XIX, fig. 9. Moll. Rem. Upperm. Part, p. 30.

Quite frequent, some attaining a comparatively large size (over 30 millim. in length).

Fossil occurrence.—*Shimo-Ogawa Region:* Ochiai (Shibahara). Shirado-Beds. Musashino. Pliocene of Izumo.

Correction.

While this paper was under press, Dr. Tokunaga, after a more thorough examination, found the Tateishi layers as an equivalent of the Shirado-Beds in horizon, just as their fossils show.

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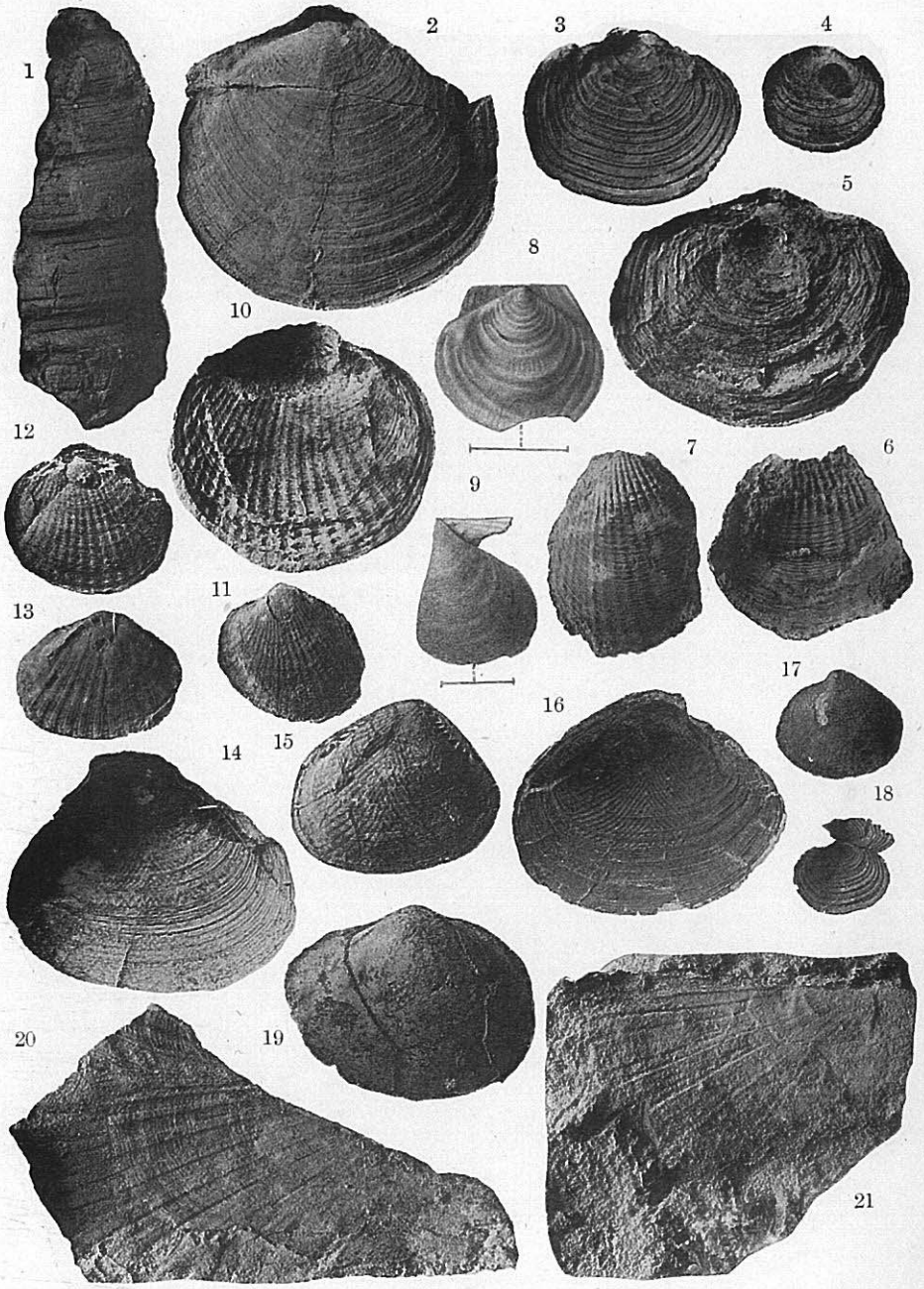

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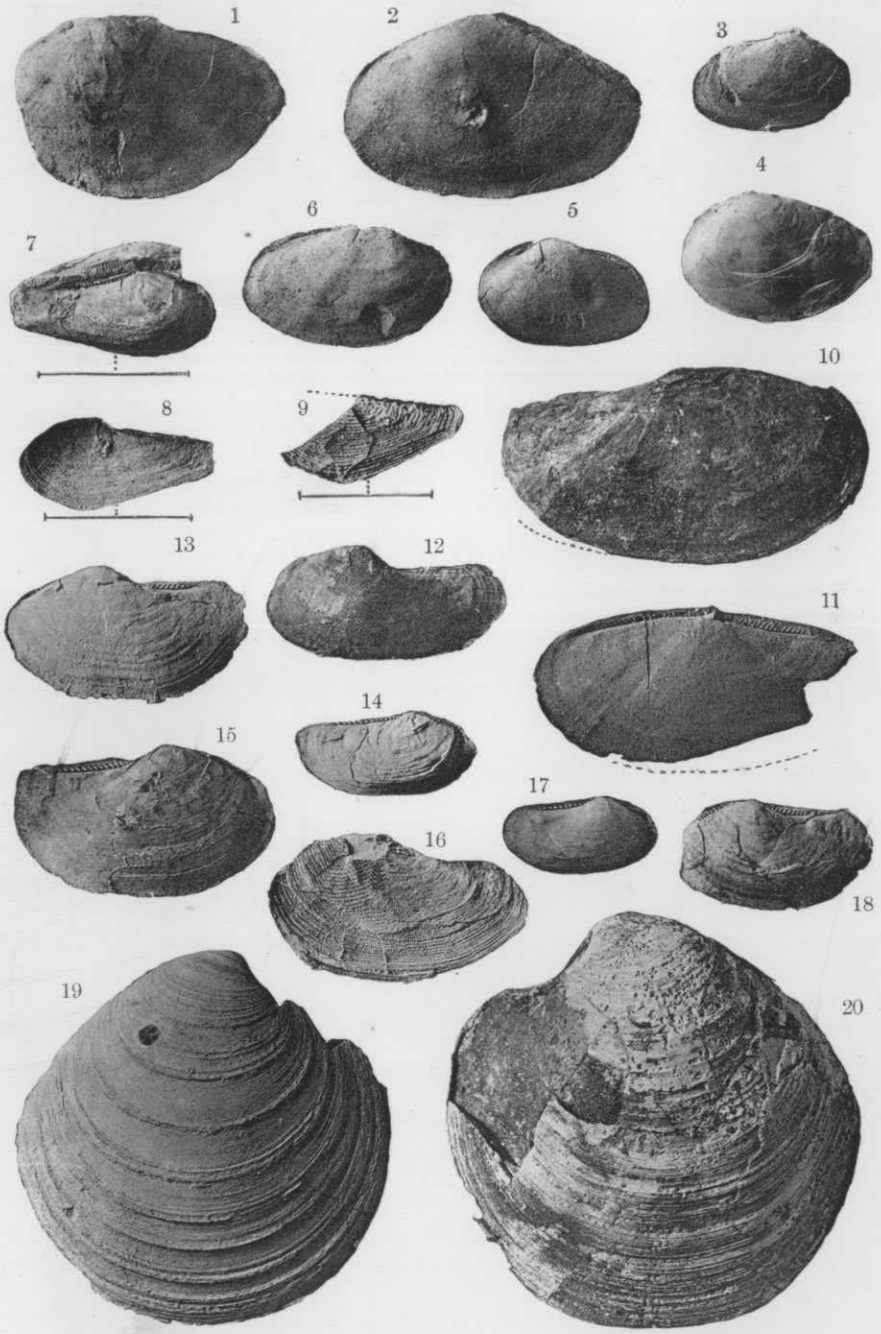

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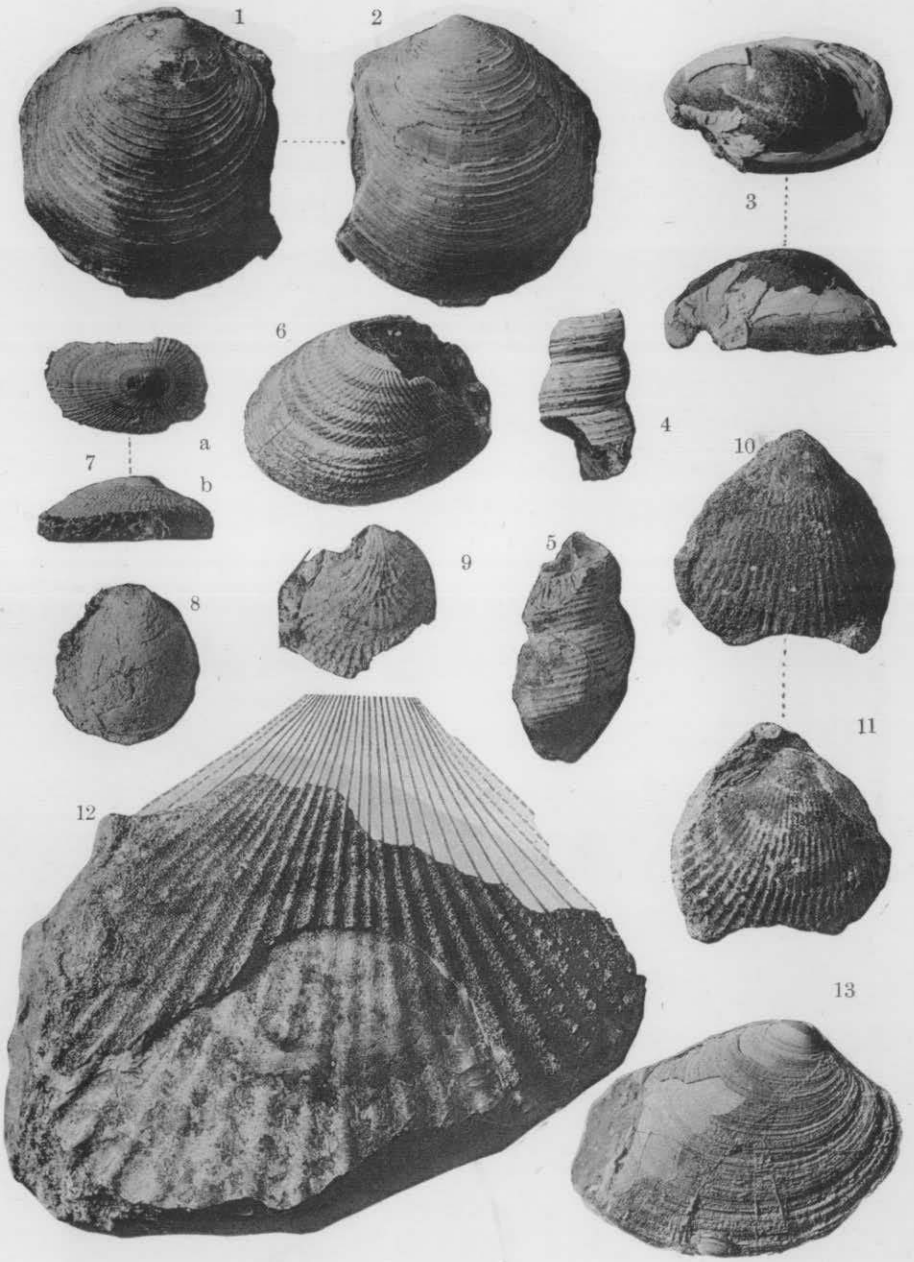

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