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Tertiary Mollusca from Shinano and Echigo

By

Matajirō YOKOYAMA, *Rigakuhakushi*

With 7 Plates

In 1894, Professor N. Yamasaki made a fairly large collection of well preserved fossils in the Tertiary Formation surrounding the volcano of Myōkō in Northern Shinano, while engaged in the investigation of that volcano by order of the Earthquake Investigating Committee. These fossils¹⁾, together with those brought back by Mr. R. Kodaira in 1920 from some of the places where Professor Yamasaki had already collected, form the subject of the present paper.

The places where the fossils were found are the following five, viz: Shigarami,²⁾ Sakae,³⁾ Togakushi,⁴⁾ Semmi⁵⁾ and Gōzu,⁶⁾ of which the first four are in the province of Shinano, while the last is in that of Echigo. In Sakae, however, the fossils seem not to be restricted to any single locality, as we find in the labels attached to them such names as Ikari,⁷⁾ Nakajo⁸⁾ and Hitaka⁹⁾ which are "Ōaza" or subdivisions of the village of Sakae. But as there are also fossils without denomination of such subdivisions, I have deemed it advisable for the present to treat them all under the name of Sakae fossils, inasmuch as they seem to present no great differences in their geological horizons.

The number of fossil species found in the above five places amount in all to 58. But when we take each place separately, 42 were found in Shigarami, 24 in Sakae, 9 in Togakushi, 7 in Gōzu and 3 in Semmi, as shown in the following table:

1) The enumeration of these fossils, though not accurately determined, is given by Professor Yamasaki in his "Report on the Volcano of Myōkō" (No. 8 of the Reports of the Earthquake Investigating Committee, 1895, published in Japanese).

2) 上水内郡榑. 3) 同榮. 4) 岡戸隠. 5) 北安曇郡美麻村千見. 6) 中頸城郡郷津.
7) 五十里. 8) 中條. 9) 日高.

	Shigami.	Sakae.	Togakushi.	Semmi.	Gôzu.	Geological Occurrence.
1. <i>Chrysodomus despectus</i> L.	+	+				Pliocene-Recent.
2. <i>Buccinum leucostoma</i> Lke.		+				Miocene-Recent.
3. <i>Trophon solitarius</i> Yok.	+					
4. <i>Priene oregonensis</i> Redf.		+			+	Pliocene-Recent.
5. <i>Vermetus shinanoensis</i> Yok.	+					
6. <i>Turritella saishuensis</i> Yok.	+	+			+	Upper Musashino.
7. <i>Crepidula navia</i> Yok.	+					
8. <i>Natica janthostoma</i> Desh.	+	+			+	Miocene-Recent.
9. <i>Polinices</i> (Neverita) <i>ampla</i> Phil.	+	+			+	Pliocene-Recent.
10. <i>Sigaretus festivus</i> Yok.	+					
11. <i>Leptothyra sakaensis</i> Yok.		+				
12. <i>Haliotis gigantea</i> Chem. var. <i>kamtschatkana</i> Jon.	+					Recent.
13. <i>Emarginula vadoso-sinuata</i> Yok.	+					Upper Musashino.
14. <i>Acmaea schrencki</i> Lke.	+					Recent.
15. <i>Helcioniscus pallidus</i> Gld.	+	+				Pliocene-Recent.
16. <i>Dentalium weinkauffii</i> Dkr.	+					Pliocene-Recent.
17. <i>Panope generosa</i> Gld.	+	+	+			Miocene-Recent.
18. <i>Corbula venusta</i> Gld.	+					Pliocene-Recent.
19. <i>Mya arenaria</i> L. var. <i>japonica</i> Jay.		+				Miocene-Recent.
20. <i>Mactra sulcataria</i> Desh.		+				Pliocene-Recent.
21. <i>Mactra semmiana</i> Yok.				+		
22. <i>Spisula grayana</i> Schr.		+				Miocene-Recent.
23. <i>Tresus nuttali</i> Cour.	+					Up. Musashino-Recent.
24. <i>Solen grandis</i> Dkr.	+					Pliocene-Recent.
25. <i>Solen krusensternii</i> Schr.	+	+				Up. Musashino-Recent.
26. <i>Psammobia commoda</i> Yok.			+			
27. <i>Tellina sejugata</i> Yok.		+				Miocene.
28. <i>Dosinia angulosa</i> Phil.	+					Pliocene-Recent.
29. <i>Venus</i> (<i>Mercenaria</i>) <i>stimpsoni</i> Gld.	+		+			Pliocene-Recent.

225663
225692

	Shigarami.	Sakae.	Togakushi.	Semmi.	Gōza.	Geological Occurrence.
30. <i>Saxidomus purpuratus</i> Sow.	+	+				Pliocene-Recent.
31. <i>Cardium shinjiense</i> Yok.	+					Miocene-Pliocene.
32. <i>Cardium angustum</i> Yok.	+		+			
33. <i>Papyridea</i> (<i>Fulvia</i>) <i>nipponica</i> Yok.	+			+		Miocene.
34. <i>Thyasira bisecta</i> Contr.						Miocene-Recent.
35. <i>Diplodonta usta</i> Gld.			+			Pliocene-Recent.
36. <i>Lucina</i> (<i>Phacoides</i>) <i>borealis</i> L.	+	+	+			Miocene-Recent.
37. <i>Coralliophaga coralliophaga</i> Chem.		+				Up. Musashino-Recent.
38. <i>Thracia pubescens</i> Pult.	+					Pliocene-Recent.
39. <i>Mytilus grayanus</i> Dkr.		+				Pliocene-Recent.
40. <i>Modiola modiolus</i> L.	+	+				Miocene-Recent.
41. <i>Anomia lischkei</i> Dautz. & Fisch.	+					Pliocene-Recent.
42. <i>Anomia densicostulata</i> Yok.	+					
43. <i>Placunanomia ingens</i> Yok.	+					
44. <i>Pecten laetus</i> Gld.	+					Pliocene-Recent.
45. <i>Pecten yessoensis</i> Jay.		+				Pliocene-Recent.
46. <i>Pecten yamasakii</i> Yok.	+		+			
47. <i>Pecten tryblum</i> Yok.	+	+				
48. <i>Pecten insolitus</i> Yok.	+					
49. <i>Pecten turpiculus</i> Yok.	+					
50. <i>Ostrea gigas</i> Thunb.		+				Pliocene-Recent.
51. <i>Arca amicula</i> Yok.	+	+	+	+	+	
52. <i>Cucullaea longissima</i> Yok.	+					
53. <i>Pectunculus yessoensis</i> Low.	+	+			+	Pliocene-Recent.
54. <i>Pectunculus yamasakii</i> Yok.	+				+	
55. <i>Pectunculus minochiensis</i> Yok.			+			
56. <i>Terebratella excelsa</i> Yok.	+					Upper Musashino.
57. <i>Terebratalia gouldii</i> Dall.	+					Pliocene-Recent.
58. <i>Hemithyris psittacea</i> Chem. var. <i>woodwardi</i> Ad.	+					Recent.

Of the 42 species found in Shigarami, 19 are, so far as our present knowledge goes, not known in a living state, while the remaining 23 are recent. Among the former, there are 5 which have already been described from the Tertiary formation of other parts of Japan, namely, 1 from the Miocene, 1 from the Miocene and Pliocene, and 3 from the Upper Musashino (Uppermost Pliocene or Lower Pleistocene). Among the latter, there are 3 which have hitherto been only recent. Of the remaining 20, 4 go up to the Miocene, 14 to the Pliocene and 2 to the Upper Musashino.

From these considerations, the layers containing the above fossils are to be ascribed to the *Pliocene*, and very probably to its *lower part*.

As to the Sakae fossils,¹⁾ if we take all the minor localities as belonging approximately to the same age, the number of extinct forms is comparatively small; for, out of the 24 species yielded by all the localities only 5 are extinct, the remaining 19 being living. Of the former 1 is Miocene, 1 Upper Musashino, and 3 hitherto undescribed. Of the latter, 7 go up to the Miocene, 10 to the Pliocene, and 2 to the Upper Musashino. With Shigarami, 13, or 54 %, are common. Therefore in spite of the small percentage of the extinct forms against the living, the fauna is to be taken as belonging approximately to the same age as that of Shigarami, that is to say, *Lower Pliocene*.

Of the 9 species found in Togakushi, 5 are extinct and 4 living, and 6 occur in common with Shigarami and 3 with Sakae. Therefore they are also to be taken as *Lower Pliocene*. And so are also the 7 species of Gōzu, which consist of 3 extinct and 4 living, and are all found either in Shigarami or Sakae.

As to the 3 species found in Semmi, of which 2 are extinct and 1 Miocene to recent, I can only say that they are probably of the same age as those of the other localities.

It is a noteworthy fact that we find in the faunas above alluded to several northern forms, that is to say, forms which at present live more to the north of the fossil localities. Such are *Chrysodomus despectus*, *Priene oregonensis*, *Panope generosa*, *Spisula grayana*, *Solen krusensternii*, *Pecten yessoensis* and *Pectunculus yessoensis*. I have already pointed out in my previous papers that these northern forms also occur in our Upper Pliocene. From this it seems to be most probable that this intermingling of northern forms is a character common to the faunas of the whole Pliocene, Lower as well as Upper.

1) A. Kryštofovich mentions two fossil plants from this place. They are *Fagus japonica* Max. and *Zelkova keaki* Sieb., both still living in Japan (Jour. Geol. Soc. Tokyo. Vol. 28, p. 272, 1920).

Description of the Species.

1. *Chrysodomus despectus*, (LINNÉ).CM 22543 -1-3
CM 22544

Pl. I. Fig. 3.

Neptunea despecta. Harmer, Plioc. Moll. Grt. Brit., part I, p. 160. Yokoyama, Moll. Rem. Middle Part Jō-Ban Coalfield, p. 12.

Chrysodomus phoeniceus. Yokoyama, Foss. Miura Penin., p. 50, pl. II, figs. 8-10. Moll. Rem. Lowest Part Jō-Ban Coalfield, p. 9. Moll. Rem. Uppermost Part, p. 10, pl. I, fig. 1.

That the shell which I had called *Chrysodomus phoeniceus* in my papers previously published is identical with *Neptunea despecta* L. of Harmer, I have already pointed out in my work on the "Molluscan Remains from the Middle Part of the Jō-Ban Coal-field" p. 12. Harmer distinguishes some ten varieties of this variable species, but I must confess that it is not always possible to determine to which of these 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, Fossils from Miura Peninsula) correspond to 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 Jō-Ban Coal-Field" seems to resemble var. *intersculpta* most. The fossils from Shigarami and Sakae belong apparently to one or more of the above three varieties.

Fossil occurrence.—Shigarami and Sakae (Hitaka). Miocene and Pliocene of the Jō-Ban Region. Lower Musashino. Pliocene and Pleistocene of Europe.

Living.—Northern Japan. Japan Sea. Okhotsk and Bering Seas. Circumpolar Seas. Northern Atlantic.

2. *Buccinum leucostoma*, LISCHKE.CM 22545-6
(S) CM 22546

Pl. II. Fig. 6.

Buccinum leucostoma. Yokoyama, Foss. Upper Musash., p. 55, pl. II, fig. 11. Moll. Rem. Uppermost Part, p. 9.

Several large examples, though mostly lacking the shell.

Fossil occurrence.—Sakae (Hitaka). Miocene and Pliocene of the Jō-Ban Region. Upper Musashino.

Living.—Central Japan.

CM22547 - 1

CM22548 - 2

3. *Trophon solitarius*, N. SP.

Pl. I. Figs. 1, 2.

Shell small, short-fusiform, with spire shorter than body-whorl. Whorls five, shouldered, step-like with the surface above the shoulder concave, below vertical; longitudinally ribbed; ribs about seventeen on body-whorl, high, rounded, separated by nearly equal interspaces, somewhat flexuous, more or less swelling at the shoulder, but very thin above. Body-whorl more or less convex on the lateral side, suddenly contracted at base. Aperture ovate. Canal short. Height 13 millim. Diameter 8 millim. Height of body-whorl about 9 millim. Only two examples, more or less imperfect.

Fossil occurrence.—Shigarami.

CM22549

(R) CM22550

4. *Priene oregonensis*, (REDFIELD).

Priene oregonensis. Yokoyama, Foss. Miura Penin., p. 64, pl. III, figs. 10, 12. Foss. Up. Musash., p. 68. Moll. Rem. Upper. Part, p. 11.

Three examples from each locality.

Fossil occurrence.—Sakae and Gōzu. Pliocene of Hitachi. Musashinos.

Living.—Northern Japan. Alaska to Oregon.

CM22551 - 10

CM22552

5. *Vermetus shinanoensis*, N. SP.

Pl. I. Fig. 10.

Shell large, at first spiral, then more or less protracted and only slightly spiral, circular in section. Surface covered with subequal spiral cords separated by equal or wider interspaces and crossed by rude lines of growth making the cords often granular. Diameter of tube about 14 millim.

Present in fragments, but differing from our *Thylacodes medusae* Pils. to which they present a great resemblance in sculpture, having no intermediate thread as in the latter.

Fossil occurrence.—Shigarami.

CM22553

CM22554

CM22555

6. *Turritella saishuensis*, YOKOYAMA.

Turritella saishuensis. Yokoyama, Some Fossil Shells from Saishu, p. 3, pl. I. fig. 2.

This species is characterized by three prominent spiral ridges with a weak one close to the lower suture.

A few specimens from each locality.

Fossil occurrence.—Shigarami, Sakae and Gōzu. Musashino of Saishu (Quelpart).

(2) CM 22556-1-4
CM 22557-1-5

7. *Crepidula navia*, N. SP.

Pl. I. Figs. 4, 5.

Shell rather thin, convex, oval in outline, rapidly growing. Apex small, pointed, curved sidewise. Surface with distant radiating riblets (preserved only on one side of the shell). Length 28 millim. Breadth 22 millim. Thickness 9 millim.

Only two specimens, one of which is a young individual with the apex a little straighter.

This species has some resemblance to *Crepidula aculeata* Gm. (Moll. Rem. from Middle Part, Jō-Ban Coal-Field, pl. III, fig. 8, 9), though the radiating sculpture is much finer.

Fossil occurrence.—Shigarami

CM 22558.
CM 22559
CM 22560

8. *Natica janthostoma*, DESHAYES.

Natica janthostoma. Yokoyama, Foss. Miura Penin., p. 77, pl. V, figs. 3, 4. Foss. Up. Musash., p. 33. Foss. Moll. Izumo, p. 4. Tert. Moll. Dainichi, p. 12. Tert. Foss. Kii, p. 53. Moll. Rem. Lowest Part Jō-Ban Coal., p. 12, pl. I, fig. 20. Moll. Rem. Upper. Part, p. 13. Moll. Rem. Middle Part, p. 14.

This shell, so common in the Tertiary formation of the various parts of Japan, is also represented by many examples.

Fossil occurrence.—Shigarami, Sakae (Hitaka) and Gōzu. Miocene and Pliocene in several parts of Japan.

Living.—Northern and Central Japan. Kamchatka.

CM 22561
CM 22562
CM 22563

9. *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. 58. Moll. Rem. Upper. Part Jō-Ban Coal., p. 14. Moll. Rem. Middle Part, p. 14.

This is also a frequent shell in the Tertiaries of Japan. Many examples from Gōzu.

Fossil occurrence.—Shigarami, Sakae and Gōzu. Pliocene.

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

CM 22564-6

10. *Sigaretus festivus*, N. SP.

Pl. I. Fig. 6.

Shell ovate, obliquely conoidal; spire short but prominent; whorls about five, quickly growing separated by deep sutures. Surface with fine, close, spiral, impressed lines making the interspaces appear like spiral threads. Growth-lines distinct. Height about 30 millim. Longer diameter 31 millim. Shorter diameter 25 millim.

A single specimen, tolerably well-preserved, though the surface is much worn.

This species is much like *Sigaretus neritoideus* L. (Tryon's Manual of Conchology, p. 55, pl. 22, figs. 33, 38-40) which Tryon unites with *Sigaretus insculptus* Ad. et Rve, *S. latifasciatus* Ad. et Rve, *S. javanicus* Gray, etc. of the Eastern Seas. But it is decidedly distinguished by its higher spire.

Fossil occurrence.—Shigarami.

CM 22565-8

11. *Leptothyra sakaensis* N. SP.

Pl. I. Fig. 8.

Shell small thick, turbinate. Whorls about five, quickly growing, angulate in the middle, the surface above obliquely sloping, below nearly vertical and spirally corded. Cords three except on the body-whorl which shows four, the lowest forming the angulate periphery. Base suddenly contracted, with several small cords (mostly worn off in our specimen). Aperture entire, circular. Outer lip rather thick. Height 13.4 millim. Diameter 11.3 millim.

The only specimen we have is much weather-worn. It resembles very much a form which I described from the Lower Musashino (Foss. Miura Penin., p. 86, pl. V, fig. 15) under the name of *Leptothyra paucipartita*, Dall, although it is higher. Dall's species, as figured in Tryon's Manual of Conchology pl. 63, fig. 27, is decidedly lower than the present one.

Fossil occurrence.—Sakae.

CM 22566-11

CM 22567-12

CM 22568

12. *Haliotis gigantea*, Chemnitz, var. *kamtschatkana*, JONAS.

Pl. I. Figs. 11, 12.

Haliotis gigantea var. *kamtschatkana*. Iwakawa, Cat. Jap. Moll. Nat. Hist. Dep., Tokyo Imp. Mus., p. 12. Tryon, Man. Conch., XII, p. 85, pl. 9, fig. 47.

This oval depressed shell with spiral cords and strong radial undulations is represented by several specimens, though not well-preserved.

Fossil occurrence.—Shigarami.

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

CM 22569

13. *Emarginula vadoso-sinuata*, YOKOYAMA.

Emarginula vadoso-sinuata. Yokoyama, Foss. Up. Musashino, p. 117, pl. VI, fig. 5.

A single specimen. The riblets on the posterior side are more regular in arrangement than in the Musashino fossil, that is to say, the strongest riblets are very distinct and the interspaces are regularly filled with three smaller riblets, of which the middle one is somewhat larger than the other two.

Fossil occurrence.—Shigarami. Upper Musashino.

14. *Acmaea schrencki*, LISCHKE.

CM 22570
2-5, 1

Pl. II. Figs. 5, 5a.

Acmaea schrencki. Lischke, Jap. Meeresconch., I, p. 107, pl. 8, figs. 1-4.

Acmaea concinna. Lischke, Jap. Meeresconch. II, p. 98 pl. 6, fig. 16.

A single, half-decorticated example.

Fossil occurrence.—Shigarami.

Living.—Northern, Central and Western Japan.

15. *Helcioniscus pallidus*, (GOULD).

CM 22571
CM 22572

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

Foss. Up. Musash., p. 117. Moll. Rem. Upper. Part Jō-Ban Coalf., p. 15, pl. I, fig. 4.
Moll. Rem. Middle Part, p. 15.

Three examples, tolerably large.

Fossil occurrence.—Shigarami and Sakae (Nakajo). Pliocene of the Jō-Ban Region. Musashinos.

Living.—Northern and Central Japan.

CM 22573

16. *Dentalium weinkauffii* DUNKER.

Dentalium weinkauffii. Yokoyama, Foss. Miura Penin., p. 102, pl. VI, figs. 19-21.

Foss. Up. Musash., p. 118, pl. VI, fig. 6. Moll. Rem. Upper. Part, p. 16.

Only some fragments.

Fossil occurrence.—Shigarami. Pliocene of the Jō-Ban Region. Musashinos.

Living.—Central Japan.

CM 22574
CM 22575
CM 22576
CM 22577

17. *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. Up. Part, p. 16, pl. VI, fig. 6. Moll. Rem. Middle Part, p. 16.

Fossil occurrence.—Shigarami (frequent), Sakae (Nakajo) and Togakushi. Pliocene of Izumo, Dainichi and the Jō-Ban Region. Upper Musashino. Miocene, Pliocene and Pleistocene of California.

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

CM 22578

18. *Corbula venusta*, GOULD.

Corbula venusta. Yokoyama, Foss. Miura Penin., p. 107, pl. VII, figs. 4-6. Foss. Up. Musash., p. 122.

A single right valve.

Fossil occurrence.—Shigarami. Musashinos.

Living.—Northern Japan.

(P) CM 22579-33
CM 22580

19. *Mya arenaria*, Linné, var. *Japonica*, JAY.

Pl. III. Fig. 3.

Mya arenaria L. var. *japonica*. Yokoyama, Moll. Rem. Uppermost Part Jō-Ban Coal., p. 16, pl. VI, fig. 4.

Frequent.

Fossil occurrence.—Sakae (Hitaka). Miocene and Pliocene of the Jō-Ban Region.

Living.—Northern, Central and Western Japan.

CM 22581

20. *Macra sulcataria*, DESHAYES.

Macra sulcataria. Yokoyama, Foss. Up. Musash., p. 126, pl. VII, fig. 6. Moll. Rem. Uppermost Part Jō-Ban Coal., p. 17.

A single right valve.

Fossil occurrence.—Sakae (Hitaka). Upper Musashino. Pliocene of the Jō-Ban Region.

Living.—Northern, Central and Western Japan.

21. *Mactra semmiana*, N. SP.

CM 22582-5

Pl. IV. Fig. 5.

A single specimen with both valves, but half decorticated. It is moderately large, rather thin, convex, trigonal, inequilateral, the posterior side almost double the anterior, rounded in front, bluntly pointed behind and broadly arched at ventre. The surface is smooth. The beak is small, pointed and curved in. Length 70 millim. Height 60 millim. Thickness about 32 millim.

In shape this shell comes close to the preceding as well as to *Mactra spectabilis* Lke. (Yokoyama, Moll. Rem. Upper. Part, p. 17, pl. I, figs. 7, 8). However, it is distinguished from the former by its more inequilateral, and from the latter by its higher, form.

Fossil occurrence.—Semmi, Mima.

CM 22583 43

22. *Spisula grayana*, SCHRENCK.

Pl. IV. Fig. 3.

Spisula grayana. Yokoyama, Foss. Up. Musash., p. 130, pl. VIII, figs. 1, 2. Moll. Rem. Upper. Part, p. 17, pl. II, fig. 11. Moll. Rem. Middle part, p. 16.

A beautiful example nearly 100 millim. long.

Fossil occurrence.—Sakae. Pliocene and Miocene of the Jō-Ban Region. Upper Musashino.

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

CM 22584

23. *Tresus nuttali*, (CONRAD).

Tresus nuttali. Yokoyama, Foss. Up. Musash., p. 133, pl. VIII, fig. 8.

A single, but tolerably well-preserved specimen.

Fossil occurrence.—Shigarami. Upper Musashino.

Living.—Northern, Central and Western Japan. Alaska down to San Diego on the American side.

CM 22585

24. *Solen grandis*, DUNKER.

Solen grandis. Yokoyama, Foss. Up. Musash., p. 134, pl. IX, fig. 1. Moll. Rem. Upper. Part, p. 18.

Several fragments.

Fossil occurrence.—Shigarami. Pliocene of the Jō-Ban Region. Upper Musashino.

Living.—Western Japan. Philippines.

CM 22586¹²
CM 22587

M. Yokoyama

25. *Solen krusensternii*, SCHRENCK.

Solen krusensternii. Yokoyama, Foss. Up. Musash., p. 134, pl. IX, fig. 5.

Also in fragments.

Fossil occurrence.—Shigarami and Sakae (Hitaka). Upper Musashino.

Living.—Northern Japan.

CM 22588-92

26. *Psammobia commoda*, N. SP.

Pl. III. Fig. 2.

Shell large, rather thin, compressed, transversely elliptical, the length being a little over one and a half times the height, inequilateral, anterior side a little shorter than posterior, rounded in front, obliquely subtruncate behind; ventral border broadly arched and forming a rounded angle with posterior; antero-dorsal somewhat arched; postero-dorsal straight, forming an obtuse angle with posterior. Surface with a flat edge running from beak to postero-ventral corner and rude concentric lines of growth. Beaks small, touching. Length 105 millim. Height 60 millim. Thickness 27 millim.

This species is like *Psammobia maxima* Rve. (Conch. Icon., pl. I, fig. 4, *Psammobia*) from Panama, which is, however, more inequilateral, posteriorly broader, and more markedly truncate.

A single specimen with both valves, though somewhat broken.

Fossil occurrence.—Togakushi.

CM 22589

27. *Tellina sejugata*, YOKOYAMA.

Tellina sejugata. Yokoyama, Moll. Rem. Lowest Part Jō-Ban Coalf., p. 14, pl. II, figs. 9-11.

A right valve rather imperfectly preserved, 39 millim. long, and 26 millim. high.

Fossil occurrence.—Sakae (Hitaka). Miocene of the Jō-Ban Region.

CM 22590

CM 22591

28. *Dosinia angulosa*, PHILIPPI.

Dosinia angulosa. Yokoyama, Moll. Rem. Mid. Part Jō-Ban Coalf., p. 17, pl. II, fig. 19, 20.

Several specimens.

Fossil occurrence.—Shigarami. Sakae (?) Pliocene of the Jō-Ban Region.

Living.—Western Japan. Philippines and further south.

29. *Venus (Mercenaria) stimpsoni*, GOULD.

13
(2) CM 22592
CM 22593

Venus (Mercenaria) stimpsoni. Yokoyama, Moll. Rem. Upper. Part, p. 21. Moll. Rem. Mid. Part, p. 18.

Two young individuals.

Fossil occurrence.—Shigarami and Togakushi. Pliocene of Izumo and the Jō-Ban Region. Upper Musashino.

Living.—Northern, Central and Western Japan.

CM 22594
CM 22595
CM 22596
CM 22597

30. *Saxidomus purpuratus*, SOWERBY.

Saxidomus purpuratus. Yokoyama, Foss. Miura Penin., p. 127, pl. IX, fig. 8. Foss. Up. Musash., p. 153, pl. XII, fig. 9.

Quite common.

Fossil occurrence.—Shigarami and Sakae (Nakajō, Ohata and a place not particularly indicated). Musashino.

Living.—Northern to Southern Japan. Sitka. California. Chile. Indian Ocean.

~~(2)~~ CM 22598

31. *Cardium shinjiense*, YOKOYAMA.

Cardium shinjiense. Yokoyama, Foss. Moll. Neog. Izumo, p. 7, pl. II, fig. 6. Moll. Rem. Lowest Part, p. 16, pl. III, figs. 13-15. Moll. Rem. Upper. Part, p. 23. Moll. Rem. Mid. Part, p.

A few ill-preserved specimens.

Fossil occurrence.—Shigarami. Pliocene of Izumo. Miocene and Pliocene of the Jō-Ban Region.

~~(2)~~ CM 22599-42
(2) CM 22600

32. *Cardium angustum* N. SP.

Pl. IV. Fig. 2.

Shell moderate in size, thin, strongly convex, longitudinally oval, almost one and a half times higher than long, subequilateral. Surface with more than thirty radiating ribs generally somewhat broader than interspaces, becoming very faint near the anterior as well as the posterior end of the shell. Beak prominent, inflated, incurved, and pointed. Length 43 millim. Height 30 millim. Depth about 13 millim.

A right and a left valve, but quite peculiar in shape, of which the former is larger, but more imperfect.

Fossil occurrence.—Shigarami and Togakushi.

CM 22601

33. *Papyridea (Fulvia) nipponica*, YOKOYAMA.

Papyridea (Fulvia) nipponica. Yokoyama, Moll. Rem. Lowest Part, p. 17, pl. III, figs. 3, 4.

A single specimen not quite perfect. It shows the ribs of the posterior portion somewhat more distant from each other which may possibly be an abnormality.

Fossil occurrence.—Shigarami. Miocene of the Jō-Ban Region.

CM 22602

34. *Thyasira bisecta*, (CONRAD).

Thyasira bisecta. Yokoyama, Moll. Rem. Lowest Part, p. 18, pl. III, fig. 2. Moll. Rem. Upper. Part, p. 24, pl. VI, fig. 5.

A tolerably large specimen lacking the greater part of its shell.

Fossil occurrence.—Semmi. Miocene and Pliocene of the Jō-Ban Region. Miocene and Pliocene of the west coast of North America.

Living.—Alaska. Puget Sound.

CM 22603

35. *Diplodonta usta*, GOULD.

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

Two badly preserved examples.

Fossil occurrence.—Togakushi. Musashinos.

Living.—Northern and Central Japan.

CM 22604

CM 22605

CM 22606

36. *Lucina (Phacoides) borealis*, LINNÉ.

Lucina (Phacoides) borealis. Yokoyama, Moll. Rem. Upper. Part Jō-Ban Coal., p. 24, pl. V, figs. 5-8. Moll Rem. Middle Part, p. 7.

Not rare.

Fossil occurrence.—Shigarami, Sakae, and Togakushi. Miocene and Pliocene of the Jō-Ban Region. Pliocene of Kii. Miocene, Pliocene and Pleistocene of Europe.

Living.—Central Japan. Atlantic.

CM 22607

37. *Coralliophaga coralliophaga*, (CHEMNITZ).

Coralliophaga coralliophaga. Yokoyama, Foss. Up. Musash., p. 166, pl. XIV, fig. 5. Moll. Coral-Bed Awa, p. 51, pl. III, fig. 9.

Small, but thick-shelled. Common.

Fossil occurrence.—Sakae. Upper Musashino. Pleistocene of Awa.

Living.—Central and Western Japan. South Sea. West Indies.
Red Sea.

38. *Thracia pubescens*, PULTENEY.

Pl. III. Fig. 4.

Thracia pubescens. Yokoyama, Foss. Shells Saishu, p. 6, pl. I, figs. 1. Moll. Rem. Upper. Part, p. 25, pl. I, fig. 11.

A large specimen, though imperfect.

Fossil occurrence.—Shigarami. Pliocene of the Jō-Ban Region.
Musashino of Saishu. English Crag.

Living.—Atlantic.

CM 22608 +4

39. *Mytilus grayanus*, DUNKER.

Pl. II. Fig. 1.

Mytilus grayanus. Yokoyama, Moll. Rem. Upper. Part, p. 25, pl. II, fig. 10.

Two large left valves, one of which is more flattened than the other due to pressure. Height nearly 130 millim. in the larger one.

Fossil occurrence.—Sakae (Ikari and Nakajo). Pliocene of the Jō-Ban Region.

Living.—Northern Japan. Philippines. Tasmania.

CM 22609-21
CM 22610
CM 22611

40. *Modiola modiolus*, LINNÉ.

Pl. II. Fig. 2.

Modiola modiolus. Yokoyama, Foss. Miura Penin., p. 145, pl. XI, fig. 21. Foss. Up. Musash., p. 175. Foss. Moll. Neog. Izumo, p. 7. Moll. Rem. Lowest, Part, p. 20, pl. IV, figs. 7, 8.

Large specimens are common.

Fossil occurrence.—Shigarami and Sakae. Miocene and Pliocene of the Jō-Ban Region. Pliocene of Izumo. Musashinos. Pliocene of Europe.

Living.—Northern, Central and Western Japan. North Pacific.
North Atlantic.

CM 22612-22
CM 22613
CM 22614

41. *Anomia lischkei*, DAUTZENBERG ET FISCHER.

Anomia lischkei. Makiyama, Plioc. Moll. Maiko, p. 22, Iwakawa, Cat. Jap. Moll. Imp. Mus. Tokyo, p. 238.

Anomia nipponensis. Yokoyama, Foss. Miura Penin., p. 147, pl. XI, figs. 18, 19. Foss. Up. Musash., p. 176.

CM 22615

Quite numerous.

Fossil occurrence.—Shigarami. Pliocene of Maiko (Makiyama).
Musashinos.

Living.—Northern, Central and Western Japan.

CM 22616-2-3

42. *Anomia densicostulata*, N. SP.

Pl. II. Fig. 3.

Shell rather large, thin, compressed, transversely oval, rounded in front, subrostrate and bluntly pointed behind; surface covered with close undulating unequal radiating riblets, which may here and there swell or contract, so that they look very irregular. Growth lines coarse, often interrupting the riblets. Right valve almost flat, left somewhat convex.

A single example with both valves preserved, though the flat one is much worn on surface. Length 60 millim. Height 49 millim. Thickness 15 millim.

Fossil occurrence.—Shigarami.

CM 22617-4-1

43. *Placunanomia ingens*, N. SP.

Pl. IV. Fig. 1.

Only a lower or right valve.

The shell is comparatively very large, thick, circular in outline and almost flat. The surface shows toward the ventral margin radiating undulations, though worn smooth in other parts. Perforation roughly oval, narrower above. The pearly layer covering the inner side is still well preserved. Diameter 85 millim.

Fossil occurrence.—Shigarami.

~~CM~~ 22618

44. *Pecten laetus*, GOULD.

Pecten laetus. Yokoyama, Foss. Miura Penin., p. 152, pl. XIV, figs. 1, 2. Foss. Up. Musash., p. 180, pl. XIV, fig. 20. Moll. Rem. Upper. Part, p. 26. Moll. Rem. Mid. Part, p. 19.

Several young examples.

Fossil occurrence.—Shigarami. Pliocene of the Jō-Ban Region and Saishu. Musashinos. Pleistocene of Awa.

Living.—Northern, Central and Western Japan.

45. *Pecten yessoensis*, JAY.

Pl. IV. Fig. 4.

Pecten yessoensis. Yokoyama, Foss. Miura Penin., p. 159, pl. XIII, figs. 14, 15. Moll. Rem. Upper. Part, p. 27.

A very large right valve more than 140 millim. in height, and a few young ones.

Fossil occurrence.—Sakae (Ikari). Lower Musashino. Pliocene of the Jō-Ban Region.

Living.—Northern Japan. Sea of Okhotsk.

46. *Pecten yamasakii*, n. sp.

Pl. V. Figs. 1, 2, 4, 5.

Shell medium-sized, rather thin, compressed, orbicular, height equal or slightly greater than length, inequivalve, right valve slightly more convex than left, radiately ribbed; ribs twenty or a little over, which in the right valve are broad, flat and more or less elevated, broader than interspaces and usually equally or unequally tripartite towards the ventral margin, though they may be bipartite in front and behind, while in the left valve they are much narrower than interspaces, elevated though rounded and usually with a single interstitial riblet, though in rarer cases there may be two or more, especially in grown specimens and towards the lateral margins. Ears radiately costellate, equal in the left valve, unequal in the right in which the anterior one is larger and has a shallow byssal notch below. If we take the height equal to 10, the depth of the right valve is not quite 2.

Very common. The largest example we possess is over 90 millim. in height.

Fossil occurrence.—Shigarami and Togakushi. There is an ill-preserved specimen from Sakae looking like this species.

47. *Pecten tryblium* n. sp.

Pl. VI. Figs. 1, 2. Pl. VII. Figs. 1, 5.

Shell somewhat larger than the preceding, rather thin, compressed, a little longer than high, inequivalve, radiately ribbed, ribs a little over twenty in number. Right valve flatly convex with ribs, broad, elevated, broader than intervals, usually with a longitudinal groove in the lower two-thirds of the shell dividing them into equal or unequal parts, though

CM 22619-44
X CM 22620

CM 22621-54
R CM 22622-52
R CM 22623-4
R CM 22624-5
CM 22625
CM 22626 R
CM 22627 R

CM 22628-6-1
CM 22629-62
CM 22630-7-1
CM 22631-7-5
CM 22632

CM 22633 (R)

occasionally it is either absent or so well developed and deep as to divide the ribs into two, save near beak; intervals smooth. Left valve almost flat with ribs narrow, ridge-like with intervals broader in which an intercalary riblet may sometimes be present; in one specimen a fine reticulate structure covers the surface. Ears equal in the left valve, unequal in the right in which the anterior is marked by a shallow notch below; radiately costellate, though sometimes quite indistinct. Length taken as 10, height 8.7-8.8, while depth is in the right valve 1.5, in the left not quite 1.

The largest example is 155 millim. long.

This species is closely related to *Pecten healeyi* Arnold (Tert. a. Quatern. Pectens of California, p. 103, pl. XXXVI, fig. 1, 1a, pl. XXXVII, figs. 1, 1a, 2) in which the shell is higher and all the ribs are bipartite. Moreover the appearance of an intercalary rib in the left valve is regular, and the hinge-line comparatively shorter.

Several specimens.

Fossil occurrence.—Shigarami and Sakae.

② CM 22634 4-3

48. *Pecten insolitus* N. SP.

Pl. V. Fig. 3.

Only a right valve present. It is small, thick, compressed, orbicular, radiately ribbed. Ribs about twenty, subequal, broad and squarish, inequidistant, the interspace usually narrower and provided with a riblet which fills its greater part and is proportional to the width of the interspace. If main ribs are close together, there is no intercalary riblet. Ears unequal, anterior triangular, radiately ribbed and with the byssal notch hardly developed. Posterior ear broken. Length 29.5 millim. Height 28.5 millim. Depth 5 millim.

Fossil occurrence.—Shigarami.

② CM 22635 - 4

49. *Pecten turpiculus* N. SP.

Pl. II. Fig. 4.

A single valve present has ears broken, so that it is not possible to say whether it is a right or a left. However, its sculpture is quite peculiar, coinciding with none hitherto described.

Shell rather small, thick, strongly convex, as high as long, radiately ribbed. Ribs about ten in number, usually split into two, rarely into three; interspaces between the ribs about equal in breadth to the latter,

filled with two or three riblets equal to, or somewhat smaller than, the divisions of the main ribs. Three concentric constrictions are present, one near the beak, one near the ventral margin, and one between. Convexity of the shell is strongest in the middle part, while above the umbonal constriction and below the ventral, it is much less convex. Possibly this character may be due to a deformation. Length and height 43 millim. Depth 13 millim.

Fossil occurrence.—Shigarami.

CM 22636

50. *Ostrea gigas*, THUNBERG.

Ostrea gigas. Yokoyama, Foss. Miura Penin., p. 162. pl. XV, figs. 1, 2. Foss. Up. Musash., p. 184. Moll. Coral Bed Awa, p. 57. Moll. Rem. Upper. Part, p. 28.

A few large narrow elongated forms.

Fossil occurrence.—Sakae (Hitaka). Pliocene of the Jō-Ban Region. Musashinos. Pleistocene of Awa.

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

51. *Arca amacula*, N. SP.

Pl. VII. Figs. 2, 3, 4.

Shell medium-sized, thick, obliquely subquadrate, longer than high, very inequilateral, convex, rounded in front, obliquely truncate behind, broadly arched at ventre and without making any angle at antero-ventral as well as at postero-ventral corner, Surface radiately ribbed; ribs about thirty, squarish, usually somewhat broader than intervals, almost invariably split into two parts by a median longitudinal groove, each part often made again bipartite by a smaller groove. Growth-lines fine, regular, a little elevated and crossing the ribs as well as their valleys often giving them a latticed appearance. Postero-dorsal edge obtuse. Beaks small, rather approaching each other. Area narrow. Hinge-line about $\frac{1}{3}$ — $\frac{2}{3}$ the shell-length. Inner margin of shell crenate. Proportion of length and height is about 10 to 7.4 with depth about 2.4. The largest example is over 80 millim. in length, though it is usually about 50 millim. Very common.

This species seems to be related to *Arca fennemai* Martin (Foss. v. Java, p. 371, pl. I, II, fig. 96) from the Miocene of Java in the formation of the ribs and in the presence of concentric elevated striae, though the ribs are more numerous and the area wider in the latter.

Fossil occurrence.—Sakae, Shigarami, Togakushi, Semmi and Gōzu.

CM 22637-72
CM 22638-73
CM 22639-74
CM 22640

CM 22641
CM 22642
CM 22643
CM 22644

(R) CM 22645-31

52. *Cucullaea longissima*, N. SP.

Pl. III. Fig. 1.

We possess a single internal cast of a large shell which is so peculiar in shape that I can not leave it without a name.

It is *Arca*-like in outline, convex, about 115 millim. long, 55 millim. high, and 35 millim. thick, very inequilateral, posterior side being about 1.8 times as long as anterior. Beaks approaching. Mantle-line and muscular impressions distinct. Below the posterior muscular impression there is one of an elevated buttress which shows that this shell is a *Cucullaea* and not an *Arca*. The shell seems to have been thick.

A fuller description will be given hereafter on the discovery of a better preserved specimen.

Fossil occurrence.—Shigarami.

CM 22646
~~CM 22647~~
~~CM 22648~~

53. *Pectunculus yessoensis*, SOWERBY.

~~Pl. IV. Fig. 4~~

Pectunculus yessoensis. Yokoyama, Foss. Miura Penin., p. 168, pl. XVIII, figs. 1, 2. Foss. Up. Musash., p. 189, XVI, figs. 6, 7.

Several young individuals and a few ill-preserved adult ones.

Fossil occurrence.—Shigarami, Sakae (Hitaka), Gōzu. Musashinos. Living.—Northern Japan.

CM 22649 46
 CM 22650
 CM 22651

54. *Pectunculus yamasakii* N. SP.

Pl. V. Fig. 6.

Shell rather small, thick, strongly compressed, orbicular, somewhat longer than high, nearly equilateral, dorsal margins sloping with passages into lateral margins rounded, though a little more sharply behind than in front. Surface with numerous straight impressed radiating lines which at several places appear punctured, especially near the crossing points of growth-lines. Beaks small, touching. Area with a few striations as usual. Length taken as 10, height 8 to 8.5, thickness 3.1 to 3.3. Generally younger individuals are more convex. The largest example we possess is an imperfect one, broken at one end and 34 millim. in height, from which its length must have been over 40 millim.

This species, though resembling the preceding one and also

Pectunculus vestitus Dkr. living in our seas and also often fossil in the Pliocene strata, is readily recognized by its compressed form.

Fossil occurrence.—Shigarami (rather frequent), and Gōzu.

55. *Pectunculus minochiensis*, N. SP.

CM 22652 2/

Pl. II. Fig. 7.

Shell rather large, thick, compressed, nearly orbicular, slightly oblique, almost equilateral, as high as long. Surface with many impressed radiating lines, the interspaces of which are again ornamented with two or three finer impressed longitudinal lines, so that the entire surface appears densely and finely striated. Beaks small, pointed, touching. Inner margin crenated.

This species resembles the preceding in its strongly compressed shell, but is much higher and orbicular.

A single specimen 60 millim. in length and height, and 25 millim. in thickness. The area is not exposed to view, but seems to have been very narrow.

Fossil occurrence.—Togakushi.

CB 22653-1-9

56. *Terebratella excelsa*, YOKOYAMA.

Pl. I. Fig. 9.

Terebratella excelsa. Yokoyama, Foss. Shells Saishu, p. 8, pl. I, figs. 3, 4.

A single poorly preserved specimen.

Fossil occurrence.—Shigarami. Upper Musashino of Saishu.

CB 22654

57. *Terebratalia gouldii*, (DALL).

Terebratalia gouldii. Hayasaka, Some Tert. Brach. Japan, p. 12, pl. II, fig. 5.

Dr. Hayasaka described this species from Sabusawa, Rikuzen, found in a bed supposed to be Pliocene. But I found it also in the Brachio-poda-bed of Miyata in Hitachi, where well-preserved specimens are frequent. Those of Shinano are not good, though not rare.

Fossil occurrence.—Shigarami. Upper Pliocene of the Jō-Ban Region.

Living.—Northern and Central Japan.

CM 22655 58. *Hemithyris psittacea*, (Chemnitz), var. *woodwardi*, A. ADAMS.

Pl. I. Fig. 7.

Rhynchonella psittacea. Davidson, Recent Brachiopoda, p. 168, pl. XXIV, figs. 12, 13.

A small example triangular in shape with the beak pointed and the surface smooth is unmistakably a form described by Davidson under the above name. It is 10.5 millim. long, 11 millim. high, and 4.7 millim. thick, and seems to have been a little flattened by pressure, so that the ventral view of the suture is more straight. The delthyrium embraced by two elongated deltidial plates is well preserved.

Fossil occurrence.—Shigarami.

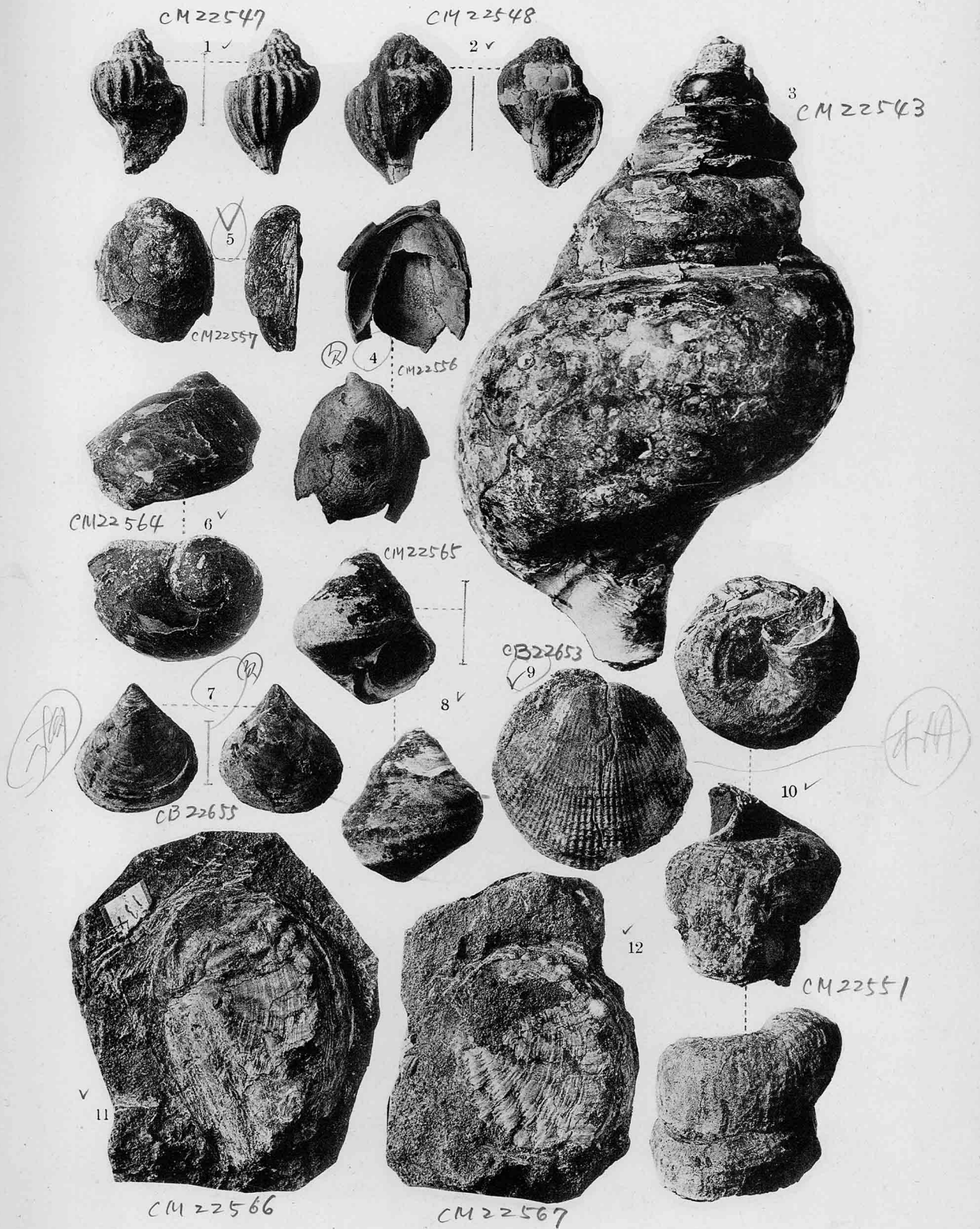
Living.—Northern and Western Japan.

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Plate I.

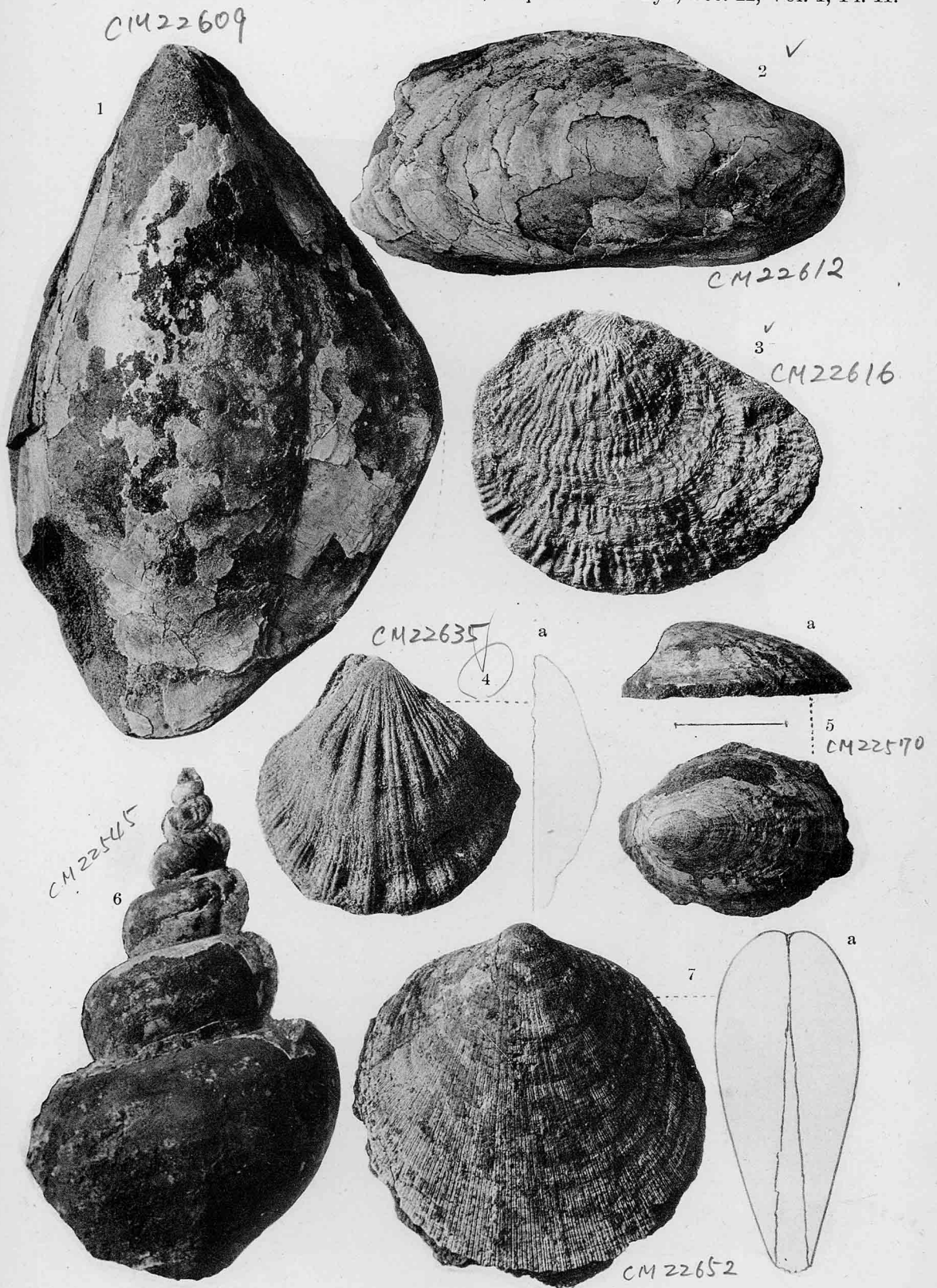
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M. YOKOYAMA: Tertiary Mollusca from Shinano and Echigo.

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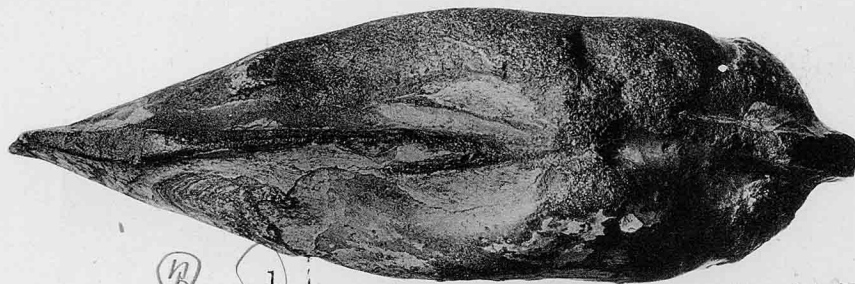
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M. YOKOYAMA: Tertiary Mollusca from Shinano and Echigo.

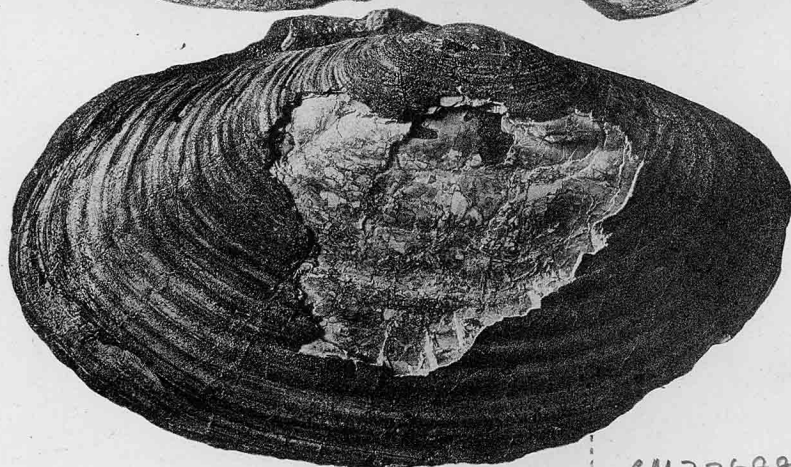
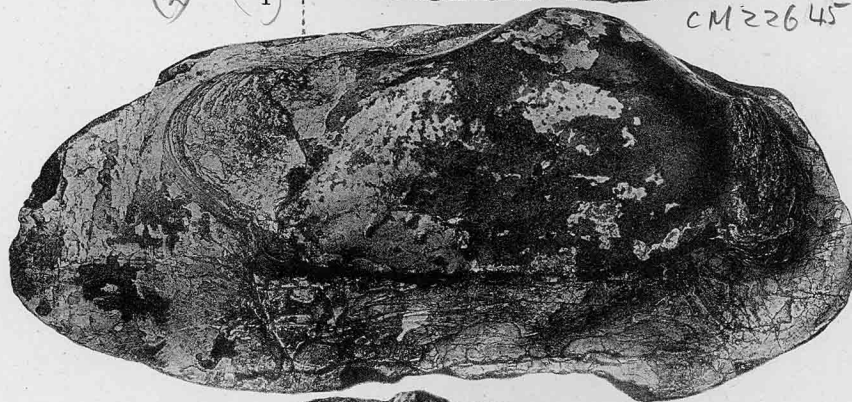
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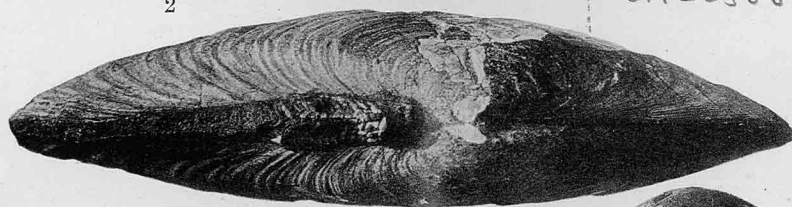


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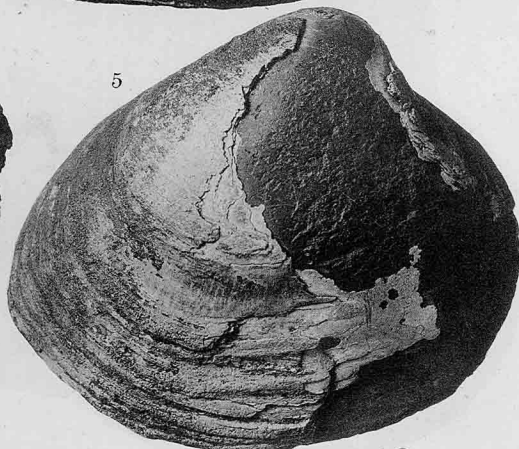
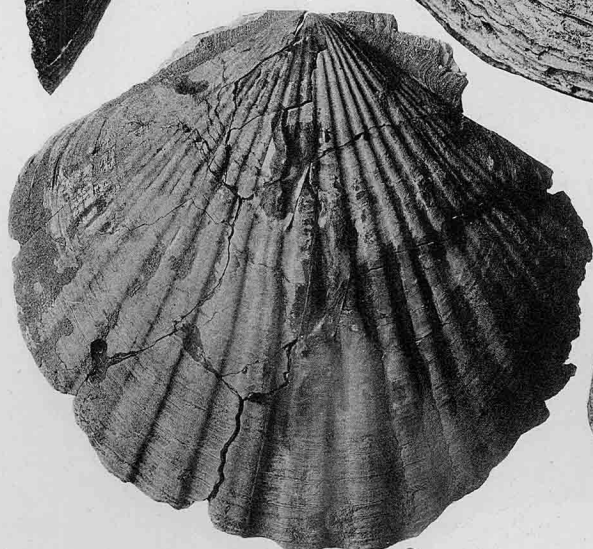
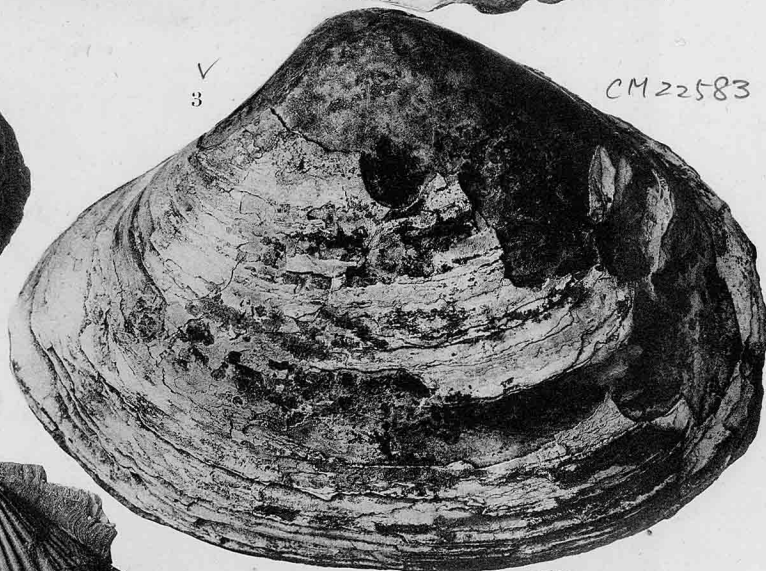
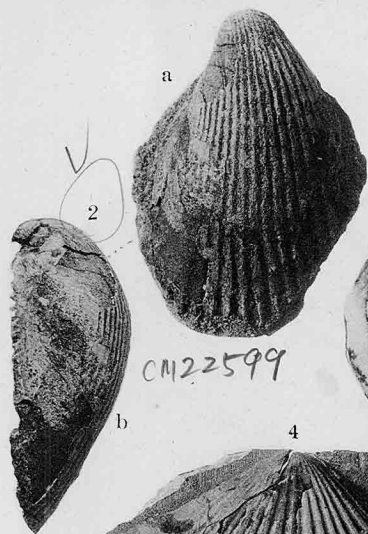
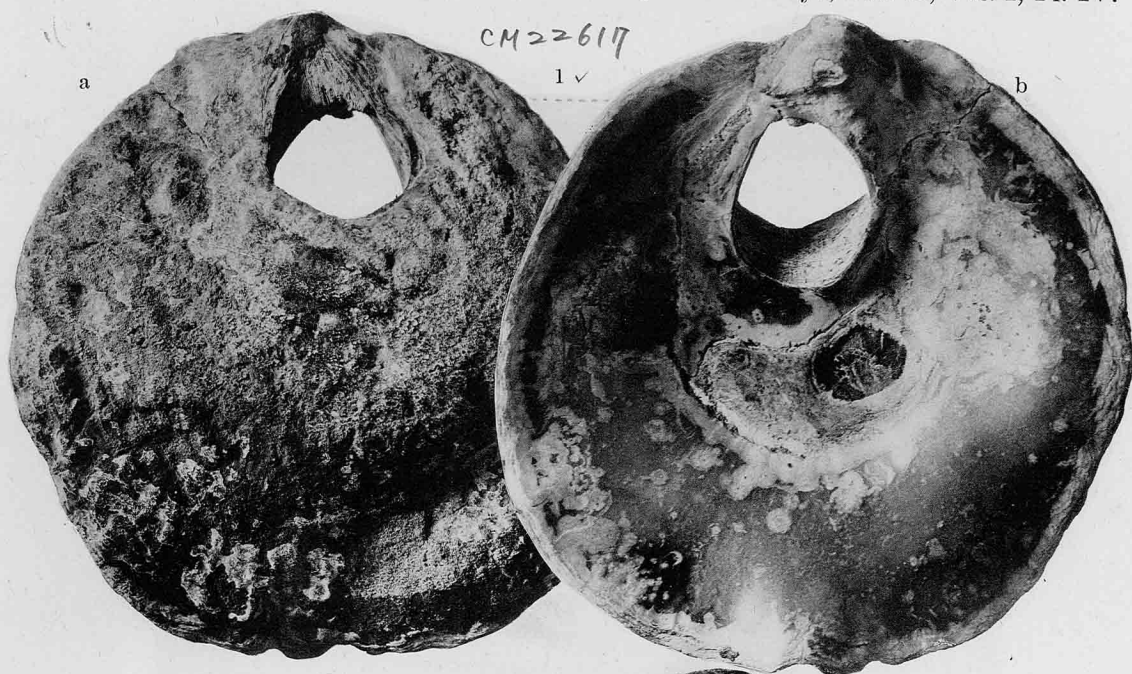
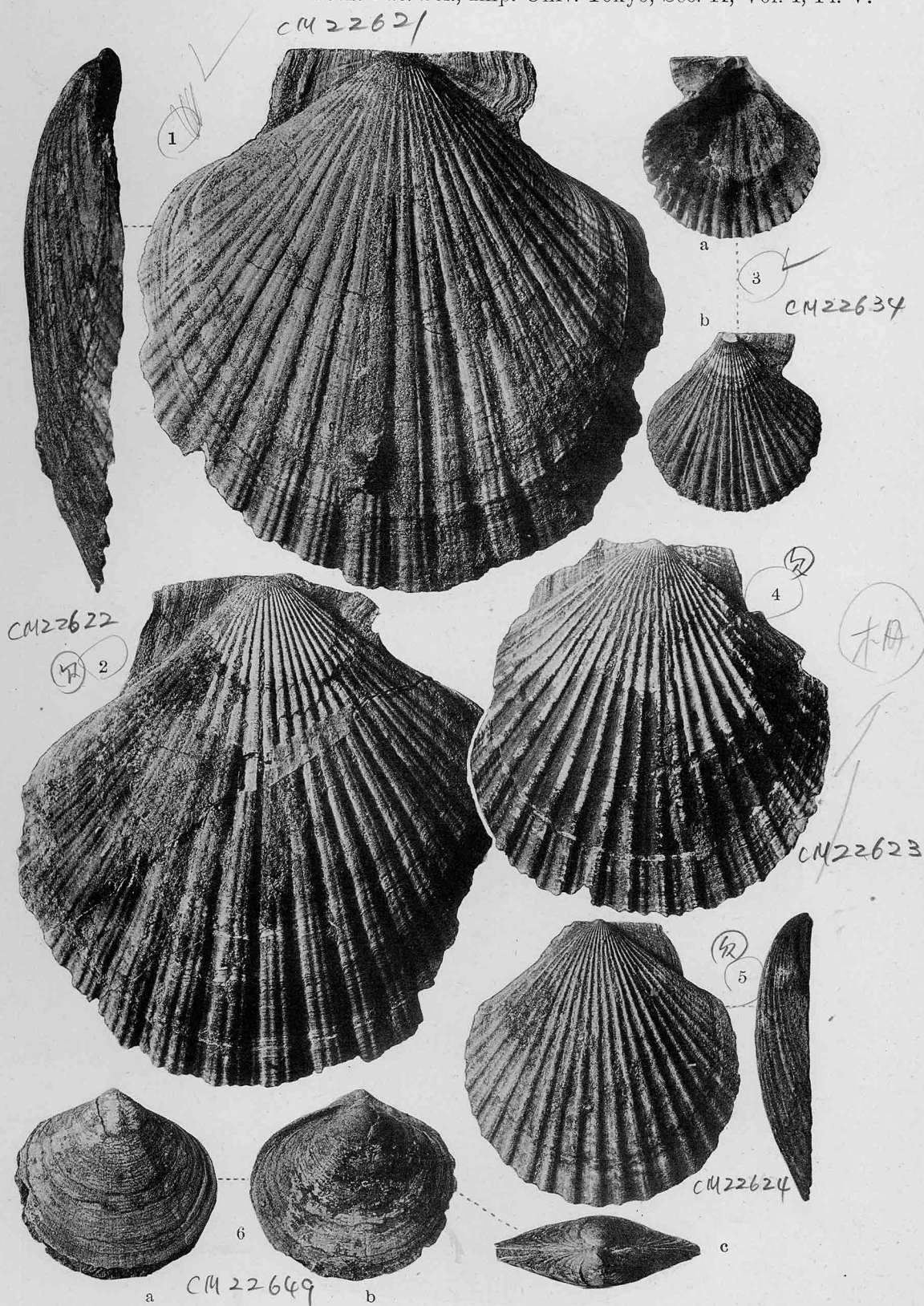


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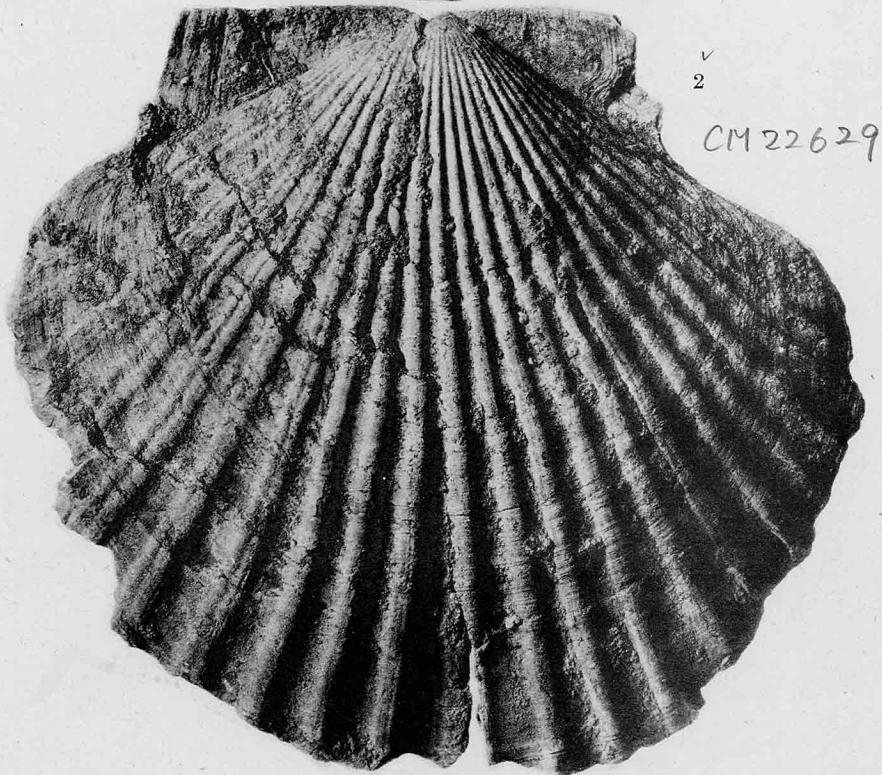
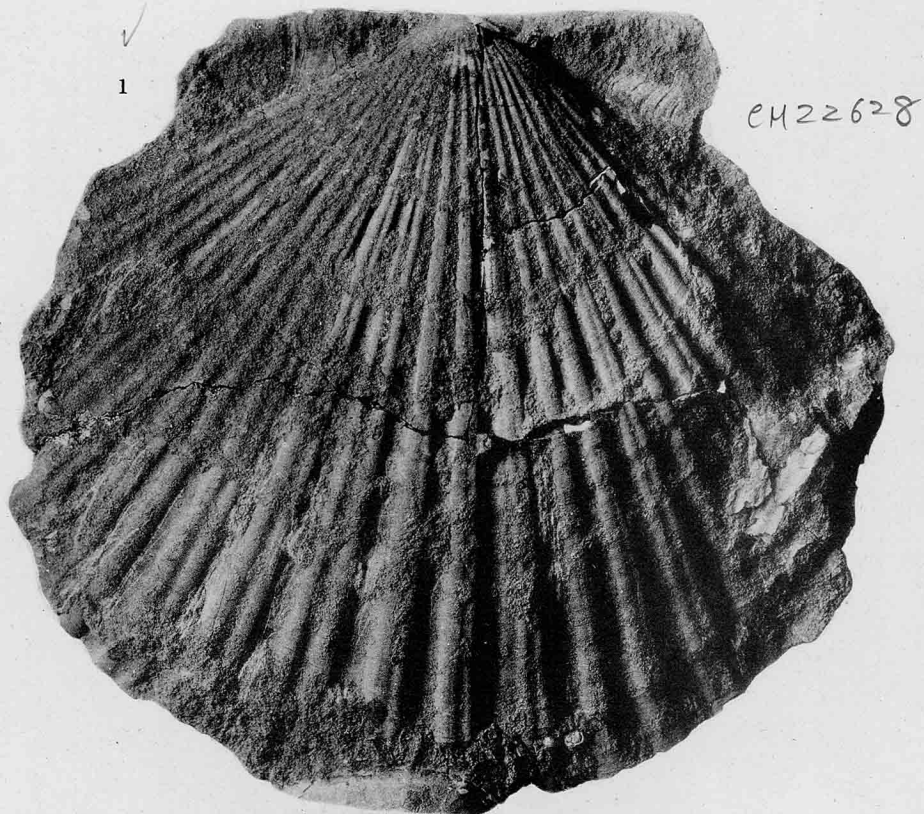
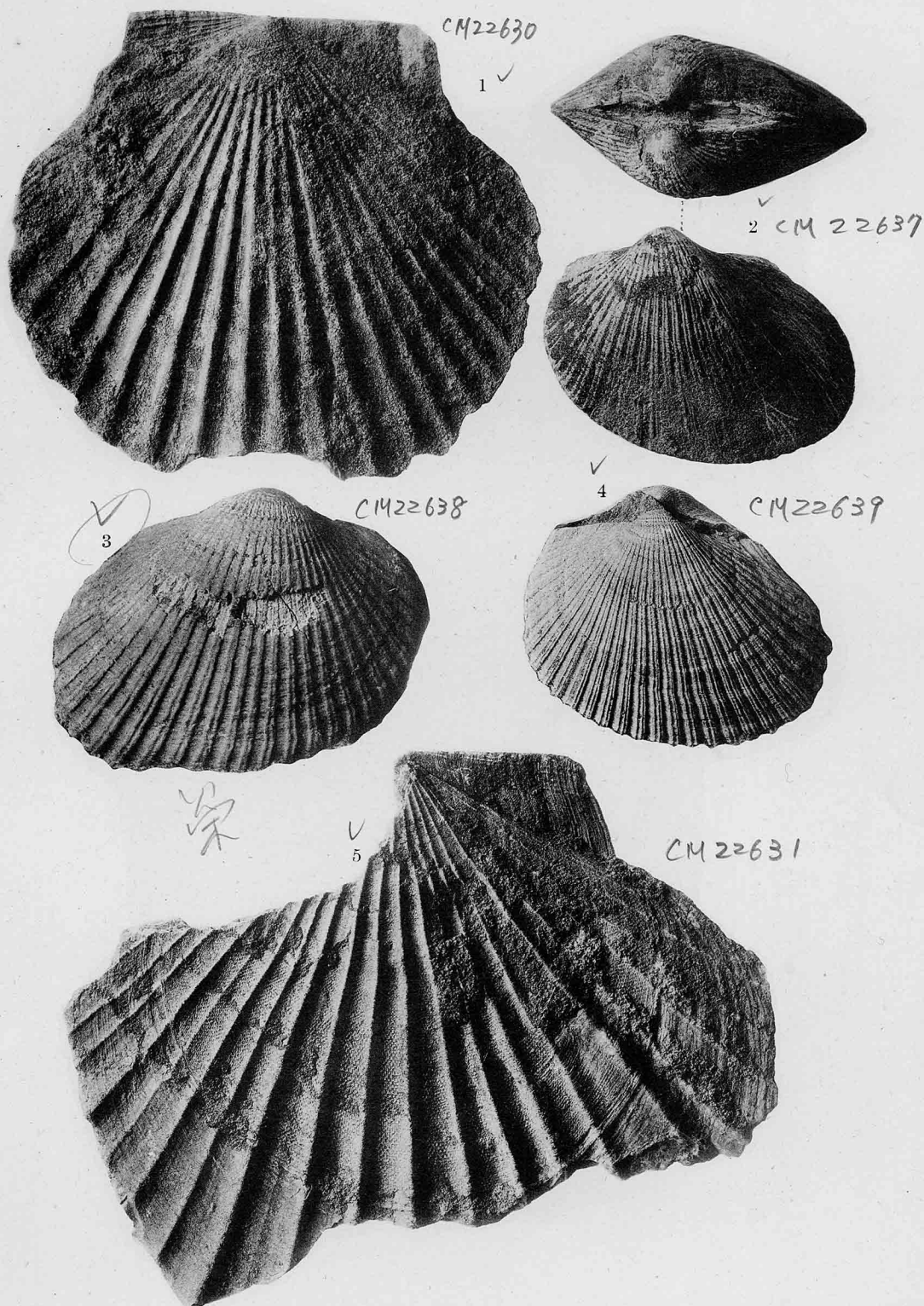


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