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## Mollusca from the Tertiary Basin of Chichibu

By

Matajiro YOKOYAMA, *Rigakuhakushi*

With 2 Plates

### General Remarks

Bounding the plain of Tokyo on the west, there is a mountain-land called Chichibu which, in greater part, is made up of older sedimentary rocks, Palaeozoic and pre-Palaeozoic, the Chichibu and Sambagawa Series of Japanese geologists.

Completely enclosed within this mountain-land, there is a Tertiary basin, usually styled the *Chichibu Basin*, through which the rapid waters of the Arakawa and its tributaries have cut gorges and channels, exposing the rock-layers most favourably for geological observation. The shape of this basin is squarish, its four sides—north, east, south and west—measuring approximately three *ri* (about 12 kilometres) each. The constituent rocks are mostly sandstones and shales, with some conglomerates. The strata are more or less inclined and covered above by younger deposits forming beautiful terraces along the river-sides.

This Basin and the surrounding mountains have been a favourite resort for students of geology in the Tokyo Imperial University since the foundation of that institution some fifty years ago. Thus in 1879, Dr. David Brauns, then professor of geology in the University, visited the place with his students and gave the result of his observations in his "Geology of the Environs of Tokio" published two years later.<sup>1)</sup>

1) Memoirs of the Science Department, Tokio Daigaku (University of Tokio), No. 4, 1881.

Between the years 1897 and 1902, Dr. S. Tokunaga<sup>1)</sup> devoted himself to making a geological survey of the Basin, tracing its boundaries and measuring the inclination of the strata wherever possible. In this way it became evident that the strata on the north and west sides as well as on the western half of the south side dip *away* from the basement rocks, while on the east side and the eastern half of the south side they dip either *parallel* with the boundary-line or *towards* it. This is undoubtedly due to the presence of faults between, of which the exact position is at present unknown, as the rock-exposures are mostly confined to the river-valleys and not found in other parts where they are concealed by terrace-deposits.

The fossils described in the following pages are those collected by Dr. Tokunaga during his said survey. Their localities<sup>2)</sup> are given as follows: (1) Kanazaki, (2) Minano, (3) Obuchi, (4) Nomaki, (5) Ota, (6) Otagawa, (7) Agumasawa, (8) Iwadonosawa, (9) Iida, (10) Hino, (11) Kami-Tano, (12) Obashira, (13) Kurodani, (14) Ogano, (15) Nagawaka, (16) Yokose, (17) Yokosegawa, and (18) Shimo-Kagemori. It is quite certain that the fossils are not restricted to any single horizon. But how many horizons there are, it is at present not possible to say. Nevertheless, if we assume that the localities closest to the basement-rocks with the strata dipping *away* from them are the *lowest*, and those showing the same position but with the strata dipping *towards* them are the *highest*, then among the above eighteen localities, the first eleven may be taken as representing approximately the horizons near the lowest, and the last three those near the highest, while the remaining four come somewhere between. This, of course, is a mere conjecture, so that much weight can not be laid on it.

The number of fossil species from the above 18 localities which I have been able to distinguish are altogether 45, as given in the following table:—

1) Tokunaga (called Yoshiwara at the time): Chichibu Bonchi no Chishitsu (Geology of the Chichibu Basin). Jour. Geol. Soc. Tokyo, vol. IX, 1902.

2) (1) 金崎. (2) 告野. (3) 大淵. (4) 野巻. (5) 太田. (6) 太田川. (7) 阿熊澤. (9) 岩巖澤. (8) 館田. (10) 日野. (11) 上田野. (12) 小柱. (13) 黒谷. (14) 小鹿野. (15) 長若. (16) 横瀬. (17) 横瀬川. (18) 下影森.

	Geological Occurrence.	Living.
1. <i>Terebra eminula</i> Yok.		
2. <i>Olivella fortunei</i> Ad.	Pliocene, Up. Musashino.	Central Japan.
3. <i>Voluta megaspira</i> Sow. var. <i>striata</i> Yok.		
4. <i>Nassa (Hima) japonica</i> , Ad.	Pliocene, Up. Mus.	Centr. a. West. Japan.
5. <i>Priene oregonensis</i> Redf.	Pliocene, Up. Mus.	Northern Japan.
6. <i>Turritella nipponica</i> Yok.	Pliocene.	
7. <i>Natica janthostoma</i> Desh.	Miocene, Pliocene, U.M.	North. a. Centr. Japan.
8. <i>Turbo (Batillus) cornutus</i> Gm.	Pliocene, Pleistocene.	North.-South. Japan.
9. <i>Leptothyra</i> sp.		
10. <i>Trochus</i> sp.		
11. <i>Fissuridea</i> sp.		
12. <i>Dentalium complexum</i> Dall.	Pliocene.	Central Japan.
13. <i>Dentalium weinkauffii</i> Dkr.	Pliocene, Up. Mus.	Central Japan.
14. <i>Panope generosa</i> Gld.	Pliocene, Up. Mus.	Northern Japan.
15. <i>Macoma praetexta</i> Mart.	Miocene, Pliocene, U.M.	Centr. a. West. Japan.
16. <i>Tellina optiva</i> Yok.	Pliocene.	
17. <i>Dosinia troscheli</i> Lke.	Pliocene, Up. Musash.	Centr. a. West. Japan.
18. <i>Dosinia angulosa</i> Phil.	Pliocene.	Western Japan.
19. <i>Meretrix (Callista) chinensis</i> Chem.	Miocene, Up. Mus.	N. C. W. Japan.
20. <i>Clementia speciosa</i> Yok.	Pliocene.	
21. <i>Venus (Mercenaria) stimpsoni</i> Gld. (?)		
22. <i>Venus</i> ? sp.		
23. <i>Tapes</i> sp.		
24. <i>Saxidomus purpuratus</i> Sow.	Pliocene, Pleistocene.	North-South. Japan.
25. <i>Cardium burchardi</i> Dkr.	Upper Musashino.	Centr. a. West. Japan.
26. <i>Cardium californiense</i> Desh.	Pliocene, Up. Mus.	North.-West. Japan.
27. <i>Cardium muticum</i> Rve.	Pliocene, Up. Mus.	North.-West. Japan.
28. <i>Cardium pauperculum</i> Yok.	Pliocene.	
29. <i>Lucina (Phacooides) borealis</i> L.	Miocene, Pliocene, U.M.	Central Japan.
30. <i>Diplodonta tokunagai</i> Yok.		
31. <i>Thyasira bisecta</i> Conr.	Miocene, Pliocene.	North Pacific.

	Geological Occurrence.	Living
32. <i>Venericardia</i> sp.		
33. <i>Venericardia ferruginea</i> Ad.	Miocene, Pliocene, U. M.	Northern Japan.
34. <i>Crassatella pauxilla</i> Yok.		
35. <i>Lima goliath</i> Sow.	Pliocene.	Central Japan.
36. <i>Lima</i> sp.		
37. <i>Pecten swiftii</i> Bern.	Pliocene.	Northern Japan.
38. <i>Pecten kimurai</i> Yok.	Pliocene.	
39. <i>Pecten</i> sp.		
40. <i>Ostrea gigas</i> Thunb.	Pliocene, Pleistocene.	North.-West. Japan.
41. <i>Area amicula</i> Yok.	Pliocene.	
42. <i>Leda confusa</i> Hanl.	Pliocene, Up. Mus.	Central Japan.
43. <i>Yoldia gratiosa</i> Yok.	Pliocene.	
44. <i>Nucula mirabilis</i> Ad. et. Rve.	Pliocene, Up. Mus.	Centr. a. West. Japan.
45. <i>Terebratulina japonica</i> Sow.	Pliocene.	Centr. a. West. Japan.

Of these 45 species,<sup>1)</sup> 9 are not well determined. Therefore if we deduct these 9, there remain 36 of which 25 are living and 11 not yet known in a living state, so that the percentage of the latter to the whole becomes about 30.

Of the 36 forms extinct and living, 32 have already been found fossil in other parts of Japan, and of these, 31 were in layers considered *Pliocene*, of which those which go up to the *Miocene* are only 6. Consequently we may safely conclude that the Chichibu Basin as a whole belongs to

1) Brauns in his "Geology of the Environs of Tokio" p. 68 mentioned 20 species as occurring in this basin. They are *Nassa livescens* Phil., *Columbella scripta* L., *Dentalium entale* L., *Panopaea generosa* Gld., *Mya arenaria* L., *Macra veneriformis* Desh., *Tapes rigidus* Gld., *Venus stimpsoni* Gld., *Dosinia exoleta* L., *Cyclina sinensis* Gm., *Cardium californiense* Desh., *Lucina borealis* L., *Leda confusa* Hanl., *Pecten laqueatus* Sow., *Pecten plica* L., *Pecten yesoensis* Jay, *Ostrea gigas* Th., *Ostrea denselamellosa* Ike., *Lima squamosa* Lam. and *Terebratulina caput-serpentis* L. Of these the following six are found in our collection: viz. *Panopaea generosa*, *Venus stimpsoni*, *Cardium californiense*, *Lucina borealis*, *Leda confusa* and *Ostrea gigas*. Of those remaining, *Dosinia exoleta* is my *Dosinia troscheli*, *Terebratulina Caput-serpentis* my *Terebratulina Japonica* and *Pecten plica* probably my *Pecten swiftii*.

I may mention here that, besides the 45 species of Mollusca above enumerated, a *Serpula*, a fragment of a round stem of a *Crinoid*, a flat *echinoid* (*Echinarachnus mirabilis*, Born?) and a tooth of an *Equus* were found in our collection.

the *Pliocene Formation*. Compared with the deposits of the same age in other parts of Japan, the Basin is decidedly older than the Lower Musashino (Upper Pliocene) south of Tokyo and the Shirado-Beds (do) of the Jō-Ban Coal-Field. But whether it is as old as the *Pliocenes* of Izumo, Kii, Shinano and Totomi which I consider *Lower Pliocene*, is at present not absolutely certain.

### Description of the Species.

#### 1. *Terebra eminula*, YOKOYAMA.

*CM22664*

Pl. XIV. Fig. 1.

A single specimen with the apical and apertural portions lacking.

The shell is moderate in size and turreted in form with the whorls apparently twelve or thirteen in number, although only eight are preserved. These whorls are quite flat, but more or less shouldered, so that the sutures are distinct. The surface is divided into two parts, upper and lower, of which the former is slightly narrower than the latter, but somewhat elevated and band-like with more than twenty longitudinally elongated tubercles separated by shallow valleys of about equal breadth. The lower part has also longitudinally elongated tubercles close together whose number is just double that of the upper. The apical angle of the shell is about 23°.

The specimen measures 15 millim. in length, but if complete it may be over 20 millim. Diameter 10 millim.

Fossil occurrence.—Obashira.

#### 2. *Olivella fortunei*, ADAMS.

*CM22665*

*Olivella fortunei*. Yokoyama, Foss. Up. Musash., p. 47, pl. II, fig. 13. Moll. Remains Upperm. Part Jō-Ban Coalf., p. 9.

A single example.

Fossil occurrence.—~~Hino~~ Shirado Beds. Upper Musashino.

Living.—Central Japan. China.

#### 3. *Voluta megaspira*, Sowerby var. *striata*, YOKOYAMA.

*CM22666-2*

Pl. XIV. Figs. 2, 3.

*CM22667-3* (4)

The shell of *Voluta megaspira* Sow. hitherto found either living or fossil (Yokoyama, Foss. Miura Penin., p. 46, pl. II, fig. 18.) is smooth,

save strong longitudinal plicae. But the examples now under consideration are spirally and closely striated, the striae going over the plicae also.

Fossil occurrence.—Obuchi and Iwadonosawa (near the temple of No. 31 Kwannon).

CM22668

#### 4. *Nassa (Hima) japonica*, ADAMS.

*Nassa (Hima) japonica*. Yokoyama, Foss. Miura Penin., p. 56, pl. III, fig. 5. Foss. Up. Musash., p. 58. Tert. Moll. Dainichi, p. 10. Moll. Rem. Mid. Part Jō-Ban Coalf. p. 12.

A few casts.

Fossil occurrence.—Obashira. Musashinos. Minato Beds. Pliocene of Dainichi.

Living.—Central and Western Japan.

CM22669  
CM22670  
CM22671

#### 5. *Priene oregonensis*, REDFIELD.

*Priene oregonensis*. Yokoyama, Foss. Miura Penin., p. 64, pl. III, figs. 10, 12. Foss. Up. Musash., p. 68. Moll. Rem. Up. Part Jō-Ban Coalf., p. 11. Moll. Rem. Mid. Part., p. 12. Tert. Moll. Shinano and Echigo, p. 6.

A few ill-preserved examples.

Fossil occurrence.—Nagawaka, Shimo-Kagemori and Agumasawa. Pliocene of Shinano. Shirado Beds. Musashinos.

Living.—Northern Japan. Alaska down to Oregon.

CM22672  
CM22673  
CM22674  
CM22675

#### 6. *Turritella nipponica*, YOKOYAMA.

*Turritella nipponica*. Yokoyama, Foss. Miura Penin., p. 71, pl. IV, figs. 16-19. Moll. Rem. Up. Part. Jō-Ban Coalf., p. 13, pl. II, fig. 8. Moll. Rem. Med. Part, p. 13, pl. III, Figs. 4, 5.

Partly in large specimens, though imperfectly preserved.

Fossil occurrence.—Obuchi, Kanazaki, Agumasawa, Ota. Lower Musashino. Shirado Beds. Minato Beds.

(2) CM22676  
CM22677

#### 7. *Natica janthostoma*, DESHAYES.

*Natica janthostoma*. Yokoyama, Tert. Moll. Shinano and Echigo, p. 7. Moll. Rem. Low. Part Jōban Coalf., p. 12, pl. I, fig. 20. Moll. Rem. Up. Part, p. 13. Moll. Rem. Mid. Part, p. 14. Tert. Foss. Kii, p. 53. Tert. Moll. Dainichi, p. 12. Foss. Moll. Izumo, p. 4. Foss. Miura Penin., p. 77, pl. v. figs. 3, 4. Foss. Up. Musash., p. 58.

A few specimens.

Fossil occurrence.—Ogano and Hipo. Pliocenes of Kii, Izumo and Tōtomi. Asagai and Shirado Beds of the Jō-Ban Coal-field. Musashinos.

Living.—Northern and Central Japan. Kamchatka.

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

*Turbo (Batillus) cornutus*. Yokoyama, Moll. Coral Bed Awa, p. 31, pl. I, fig. 22. Moll. Rem. Up. Part, p. 14.

Though frequent, all are young individuals, several of which are provided with opercula.

Fossil occurrence.—Yamada, Yokose and Kurodani. Pleistocene of Awa. Shirado Beds.

Living.—Northern to Southern Japan. China Sea.

9. *Leptothyra* sp.

Pl. XIV. Fig. 8.

Two specimens, in greater part deprived of their shell. The body-whorl shows several strong spiral rounded ridges reminding one of *Leptothyra crassilirata* Yokoyama (Foss. Up. Musashino, p. 108, pl. V, fig. 22), although twice as large.

Fossil occurrence.—Shimo-Kagemori (Takinouye).

10. *Trochus* sp.

Pl. XIV. Fig. 4.

Much worn specimens of a large *Trochus* which has its whorls slightly concave, periphery angular and base concave. The body-whorl shows five spiral rows of tubercles. Too imperfect for determination.

Fossil occurrence.—Yamada and Yokosegawa.

CM22685

11. *Fissuridea* sp.

A small specimen 7 millim. long, 4.5 millim. wide and 2 millim. high resembling *Fissuridea humilis* Yok. (Moll. Rem. Mid. Part Jō-Ban Coalif., p. 15, pl. III, fig. 7), although a strict comparison is impossible, owing to the extremely worn state of the specimen.

Fossil occurrence.—Obashira (?).

CM22686  
CM22687  
CM22688  
CM22689

12. *Dentalium complexum*, DALL.

*Dentalium complexum*. Yokoyama, Foss. Miura Penin., p. 101, pl. VI, fig. 27. Foss. Moll. Neog. Izumo, p. 4. Moll. Rem. Upper. Part Jō-Ban Coalif., p. 16, pl. II, fig. 9.

Fragments.

Fossil occurrence.—Shimo-Ogano, Minano, Omiya and Obuchi. Pliocene of Izumo. Shirado Beds. Lower Musashino.

Living.—Central Japan. Sandwich Islands.

CM22698  
CM22699  
CM22680

CM22681-4  
CM22682

CM22683-4  
CM22687

CM22685

CM22690

13. *Dentalium weinkauffii*, DUNKER.

CM22691

*Dentalium weinkauffii*. Yokoyama, Foss. Miura Penin., p. 102, pl. VI, figs. 19-21. Foss. Up. Musash., p. 118, pl. VI, fig. 6. Foss. Shells Saishu, p. 4. Moll. Rem. Up. Part Jo-Ban Coalf., p. 16. Tert. Moll. Shinano and Echigo, p. 9.

Several fragments.

Fossil occurrence.—Hino and Shimo-Kagemori. Musashinos. Shirado Beds. Pliocenes of Shinano and Izumo.

Living.—Central Japan.

CM22692

CM22693

14. *Panope generosa*, GOULD.

*Panope generosa*. Yokoyama, Foss. Up. Musash., p. 121, pl. v, fig. 14, 15. Foss. Moll. Izumo, p. 4. Tert. Moll. Dainichi, p. 14. Moll. Rem. Up. Part Jo-Ban Coalf., p. 16, pl. VI, fig. 6. Moll. Rem. Mid. Part, p. 16. Tert. Moll. Shinano and Echigo, p. 10.

A few specimens.

Fossil occurrence.—Yokose and Shimo-Kagemori. Upper Musashino. Pliocenes of Izumo, Shinano and Tōtōmi. Shirado Beds.

Living.—Northern Japan. West Coast of America.

CM22694

15. *Macoma praetexta*, (MARTENS).

*Macoma praetexta*. Yokoyama, Foss. Up. Musash., p. 142, pl. X, figs. 2, 3. Tert. Moll. Dainichi, p. 15. Moll. Rem. Lowest Part Jo-Ban Coalf., p. 13.

A small example with the posterior end a little more truncate than in the typical form.

Fossil occurrence.—Akebisawa (Yokose). Asagai Beds. Pliocene of Tōtōmi. Upper Musashino.

Living.—Central and Western Japan.

CM22695 - ♀

CM22696 - ♂

CM22697

16. *Tellina optiva*, YOKOYAMA.

Pl. XV. Figs. 4, 5.

*Tellina optiva*. Yokoyama, Foss. Moll. Neog. Izumo, p. 6, pl. II, figs. 3, 4. Moll. Rem. Up. Part Jo-Ban Coalf., p. 19.

Several specimens, though mostly deprived of their shell. The triangularly oval shell together with the more or less angular form of the pallial sinus at its uppermost corner characterizes this species.

Fossil occurrence.—Otagawa. Pliocene of Izumo. Shirado Beds.

CM 22698

CM 22699

17. *Dosinia troscheli*, LISCHKE.

*Dosinia troscheli*. Yokoyama, Foss. Miura Penin., p. 119, pl. VIII; figs. 5, 6. Foss. Up. Musash., p. 144. Tert. Moll. Dainichi, p. 15. Moll. Rem. Up. Part Jō-Ban Coalf., p. 19. Moll. Rem. Mid. Part, p. 17.

A few badly preserved examples.

Fossil occurrence.—Kami-Tano and Obashira. Musashinos. Pliocene of Tōtōmi. Shirado Beds. Minato Beds.

Living.—Central and Western Japan.

CM 22900  
CM 22707

18. *Dosinia angulosa*, PHILLIPPI.

*Dosinia angulosa*. Yokoyama, Moll. Rem. Mid. Part Jo-Ban Coalf., p. 17. pl. II, figs. 19, 20. Tert. Moll. Shinano and Echigo. p. 12.

Also a few ill-preserved specimens.

Fossil occurrence.—Kami-Tano and Hino. Pliocene of Shinano. Minato and Shirado Beds.

Living.—Western Japan. Philippines.

CM 22702

19. *Meretrix (Callista) chinensis*, (CHEMNITZ).

*Meretrix (Callista) chinensis*. Yokoyama, Foss. Miura Penin., p. 120, pl. VIII, figs. 9, 10. Foss. Up. Musashino, p. 146, pl. XI, fig. 5. Moll. Rem. Low. Part Jō-Ban Coalf., p. 14, pl. II, figs. 7, 8.

A small imperfect specimen.

Fossil occurrence.—Chichibu (exact locality ?). Musashinos. Iwaki Beds.

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

CM 22703-7  
LM 22704

20. *Clementia speciosa*, Yokoyama.

Pl. XIV. Fig. 7.

*Clementia speciosa*. Yokoyama, Tert. Moll. Dainichi, p. 15, pl. II, figs. 14, 15. Moll. Rem. Up. Part Jō-Ban Coalf., p. 21, pl. I, fig. 6.

A few young individuals.

Fossil occurrence.—Agumasawa and Obashira. Pliocene of Totomi. Shirado Beds.

CM 22705

21. *Venus (Mercenaria) stimpsoni*, GOULD (?).

An imperfect specimen, looking very much like the species above named which is quite frequent in our Pliocene layers.

Fossil occurrence.—Iida.

*CM 22706-12*

22. *Venus?* SP.

Pl. XV. Fig. 12.

An ovately triangular shell 21 millim. long and 18. millim. high. It is rather convex with coarse concentric ridges on the surface between which there are traces of fine radiating striae.

Fossil occurrence.—Agumasawa.

*CM 22707-10*

*CM 22708*

*CM 22709*

*CM 22710*

23. *Tapes* SP.

Pl. XIV. Fig. 10.

Several imperfect specimens of a shell resembling *Tapes philippinarum* Ad. et Rve. (Yokoyama, Foss. Miura Penin., pl. IX, fig. 6.) in shape, but with the radiating riblets more straight and rigid.

Fossil occurrence.—Iwadonosawa, Iida and Ogano.

*CM 22711*

24. *Saxidomus purpuratus*, SOWERBY.

*Saxidomus purpuratus*. Yokoyama, Foss. Miura Penin., p. 127, pl. IX, fig. 8. Foss. Up. Musash., p. 153, pl. XII, fig. 9. Tert. Moll. Shinano and Echigo, p. 13. Moll. Coral-Bed Awa, p. 46.

A small young specimen.

Fossil occurrence.—Shimo-Kagemori (Takinouye). Pliocene of Shinano. Musashinos. Pleistocene of Awa.

Living.—Northern, Central and Southern Japan. Indian Ocean. California. Chile. Alaska.

*CM 22712-14*

*CM 22713*

*CM 22714*

*CM 22715*

25. *Cardium burchardi*, DUNKER.

Pl. XIV. Fig. 9.

*Cardium burchardi*. Yokoyama, Foss. Up. Musashino, p. 153, pl. XII, fig. 3.

A few young individuals.

Fossil occurrence.—Obashira, Obuchi and Hipo. Upper Musashino.

Living.—Central and Western Japan.

*CM 22716*

*CM 22717*

*CM 22718*

26. *Cardium californiense*, DESHAYES.

*Cardium californiense*. Yokoyama, Foss. Miura Penin., pl. 127, pl. IX, fig. 10. Foss. Up. Musash., p. 154. Moll. Rem. Up. Part Jo-Ban Coalf., p. 22.

Not rare.

Fossil occurrence.—Shimo-Kagemori, Ume (Yokose) and Okashira(?) Musashinos. Shirado-Beds.

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

27. *Cardium muticum*, REEVE.

CM 22719

*Cardium muticum*. Yokoyama, Foss. Miura Penin., p. 128, pl. IX, fig. 11. Foss. Up. Musashino p. 155. Moll. Rem. Up. Part. Jo-Ban Coalf., p. 23.

A single specimen lacking most of its shell.

Fossil occurrence.—Komaki. Musashinos. Shirado Beds.

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

14-12

28. *Cardium pauperculum*, YOKOYAMA.CM 22720-~~14~~  
② CM 22721-~~14~~ 14-13  
CM 22722

Pl. XIV. Figs. 12, 13.

*Cardium pauperculum*. Yokoyama, Foss. Moll. Neog. Izumo, p. 6, pl. I, fig. 2.

Many specimens more or less distorted and invariably deprived of their shell. But the shape and the traces of diffuse concentric corrugations are quite like those in the fossil of Izumo.

Fossil occurrence.—Hino. Pliocene of Izumo.

CM 22723  
CM 22724  
CM 22725  
CM 22726  
CM 2272729. *Lucina (Phacoides) borealis*, LINNÉ.

*Lucina (Phacoides) borealis*. Yokoyama, Foss. Miura Penin., p. 133, pl. X, fig. 7. Foss. Up. Musash., p. 160. Tert. Foss. Kii, p. 67, pl. VI, fig. 11. Moll. Rem. Up. Part. Jo-Ban Coalf., p. 24, pl. V, figs. 5-8. Moll. Rem. Mid. Part, p. 7. pl. I, fig. 22. Tert. Moll. Shinano a. Echigo, p. 14.

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

Quite common, although mostly as casts.

Fossil occurrence.—Otagawa, Kanisawa (Kanazaki), Ota, Akebisawa (Yokose) and Komaki. Pliocene of Shinano. Shirado Beds. Mizunoya Beds. Kamenoo Beds? Musashinos.

Living.—Central Japan. Atlantic Ocean.

30. *Diplodonta tokunagai*, YOKOYAMA.CM 22728-15-15  
② CM 22729-~~15~~

Pl. XV. Figs. 15, 16.

A right and a left valve.

The shell is rather small, orbicular, convex, inequilateral and slightly longer than high. The surface is ornamented with regular, distant, raised, concentric ridges. The right valve measures about 20 millim. in length and 17 millim. in height with depth about 7 millim. The left valve is smaller being about 15 millim. long and 14 millim. high. Denticulation unknown.

The specimens are imperfect, but do not coincide with any of the *Diplodontas* hitherto described, although close to *Diplodonta semiaspera*

Phil (Yokoyama, Foss. Miura Penin., p. 131, pl. X, figs. 2, 3), from which the present species is distinguished by its raised concentric ridges.

Fossil occurrence.—Shimo-Kagemori.

CM 22730-1

CM 22731-2

CM 22732

CM 22733

CM 22734

CM 22735

### 31. *Thyasira bisecta*, (CONRAD).

Pl. XV. Figs. 1, 2.

*Thyasira bisecta*. Yokoyama, Moll. Rem. Low. Part, p. Jō-Ban Coalf., p. 18, pl. III, fig. 2. Moll. Rem. Up. Part, p. 24, pl. VI, fig. 5. Tert. Moll. Shinano a. Echigo, p. 14.

Frequent, though mostly found as casts.

Fossil occurrence.—Otagawa, Ōbuchi, Nomaki and Minano. Asagai Beds. Shirado Beds.

Living.—Coast of Alaska. Puget Sound.

(2) CM 22736-6

### 32. *Venericardia*, sp.

Pl. XIV. Fig. 6.

A right valve 22 millim. long, 17 millim. high 5,5 millim. deep and with about twenty radiating ribs seems to belong to *Venericardia laxata* which I described from the Asagai Beds (Moll. Rem. Low. Part, p. 19, pl. III, figs. 16-18) as well as from the Kamenoo Beds (Moll. Rem. Middle Part, p. 7, pl. I, figs. 11, 12?).

Fossil occurrence.—Ōbuchi.

(2) CM 22737

(2) CM 22738

### 33. *Venericardia ferruginea*, ADAMS.

*Venericardia ferruginea*. Yokoyama, Foss. Miura Penin., p. 139, pl. XI, figs. 3, 4. Foss. Up. Musash., p. 162. Moll. Rem. Low. Part. Jō-Ban Coalf., p. 19, pl. III, figs. 8, 9. Moll. Rem. Up. Part, p. 24, pl. V, fig. 4. Moll. Rem. Mid. Part, p. 19.

A few examples.

Fossil occurrence.—Otagawa and Yokose. Asagai Beds. Kamenoo Beds. Minato Beds. Shirado Beds. Musashinos.

Living.—Northern Japan.

(2) CM 22739-8

(2) CM 22740-9

(2) CM 22741-10

CM 22742-11

CM 22743

CM 22744

(2) CM 22745

(2) CM 22746

### 34. *Crassatella pauxilla*, YOKOYAMA.

Pl. XV. Figs. 8-11.

The shell is small, rather convex, subquadrate, somewhat longer than high and inequilateral. The anterior border is rounded, the posterior truncate and the ventral broadly arched. A distinct, though blunt, dorsal edge runs from the beak to the postero-ventral corner. The surface is coarsely, but regularly, concentrically furrowed. Inner margin crenulate.

The specimens are all more or less imperfect, owing to pressure or distortion. On this account the dorsal edge as well as the posterior truncation is not always distinct. The proportions of length, height and depth also vary according to the specimens. One of the right valves is 10 millim. long, 8 millim. high, and about 3.5 millim. deep, while another is 21 millim. long, 18 millim. high and about 4 millim. deep. One of the left valves is 20 millim. long, 18 millim. high and 5.5 millim. deep.

This species has some resemblance to the *Crassatella pallida* Ad. et Rve. (Voy. Samarang, p. 82, pl. XXIII, fig. 9) of China Sea.

Fossil occurrence.—Obashira (frequent), Hino, Shimo-Kagemori and Shimo-Yoshida.

(3) CM 22747-14-11

CM 22748

35. *Lima goliath*, (SOWERBY).

Pl. XIV. Fig. 11.

*Lima goliath*. Yokoyama, Moll. Rem. Up. Part Jō-Ban Coal., p. 26, pl. III, figs. 1, 4. Moll. Rem. Mid. Part, p. 19. Foss. Miura Penin., p. 147, pl. XVI, figs. 7, 8.

Frequent, but present only as casts.

Fossil occurrence.—Obashira. Shirado Beds. Lower Musashino.

Living.—Central Japan. Southeastern Japan at 750 fathoms. Patagonia.

36. *Lima* sp.

Pl. XV. Fig. 14.

CM 22749-15-14

A fragment of a *Lima* looking very much like *Lima zushiensis* Yokoyama (Foss. Miura Penin., p. 148, pl. XII, fig. 8) from the Lower Musashino.

Fossil occurrence.—Obashira.

CM 22750-15-3

(3) CM 22751

37. *Pecten swiftii*, BERNARDI.

Pl. XV. Fig. 3.

*Pecten swiftii*. Yokoyama, Foss. Miura Penin., pl. 154, Pl. XIV, fig. 11. Moll. Rem. Up. Part Jō-Ban Coal., p. 27, pl. II, fig. 7.

Two small incomplete right valves.

Fossil occurrence.—Obashira. Shirado Beds, Lower Musashino.

Living.—Northern Japan. Alaska.

CM22752

38. *Pecten kimurai*, YOKOYAMA.

*Pecten kimurai*. Yokoyama, Moll. Rem. Up. Part Jō-Ban Coalif., p. 27, pl. IV, pl. II, fig. 4.

Only in fragments.

Fossil occurrence.—Obuchi. Shirado Beds.

CM22753

(R) CM22754

39. *Pecten* sp.

Several small imperfect specimens of a radiately costulated flattish valve looking like those of *Pecten yamasakii* Yokoyama (Tert. Moll. Shinano a. Echigo, p. pl. V, figs. 1-5).

Fossil occurrence.—Obashira and Yokose.

CM22755

CM22756

CM22757

40. *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. Up. Part, p. 28. Tert. Moll. Shinano and Echigo, p. 19.

A few imperfect examples.

Fossil occurrence.—Yokose, Obashira and Obuchi. Shirado Beds. Pliocene of Shinano. Pleistocene of Awa. Musashinos.

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

CM22758-5

CM22759

41. *Arca amicula*, YOKOYAMA.

Pl. XIV. Fig. 5.

*Arca amicula*. Yokoyama, Tert. Moll. Shinano a. Echigo, p. 19, pl. VII, figs. 2-4.

A few young individuals.

Fossil occurrence.—Shimo-Kagemori and Obuchi. Pliocene of Shinano and Echigo.

(R) CM22760

CM22761

42. *Leda confusa*, HANLEY.

*Leda confusa*. Yokoyama, Foss. Up. Musashino, p. 195, pl. XVII, fig. 4. Moll. Rem. Up. Part, p. 29.

Rarely found.

Fossil occurrence.—Obashira and Agumasawa. Shirado Beds. Upper Musashino.

Living.—Central Japan. China Sea.

43. *Yoldia gratiosa*, YOKOYAMA.

(B) CM 22762-13

Pl. XV. Fig. 13.

*Yoldia gratiosa*. Yokoyama, Foss. Moll. Neog. Izumo, p. 8, pl. II, fig. 5.

A broken specimen.

Fossil occurrence.—Ota. Pliocene of Izumo.

CM 22763

CM 22764

44. *Nucula mirabilis*, ADAMS ET REEVE.

(B) CM 22765

*Nucula mirabilis*. Yokoyama, Foss. Miura Penin., p. 180, pl. XIX, fig. 9. Foss. Moll. Neog. Izumo, p. 9. Moll. Rem. Up. Part. p. 30. Moll. Rem. Mid. Part, p. 21, pl. III, fig. 6.

Not very rare.

Fossil occurrence.—Obashira, Agumasawa and Akebisawa (Yokose). Shirado Beds. Minato Beds. Pliocene of Izumo. Musashinos.

Living.—Central and Western Japan.

CB 22766-6

CB 22767-7

CB 22768

CB 22769

CB 22770

CB 22771

45. *Terebratulina japonica*, (SOWERBY).

Pl. XV. Figs 6, 7.

*Terebratulina japonica*. Davidson, Monogr. Recent Brachiopoda, p. 34, pl. III, figs. 7-11. Hayasaka, Some Tert. Brach. Japan, p. 6, pl. I, figs. 6-8.*Terebratula japonica*. Sowerby, Proc. Zool. Soc. London, 1846, p. 91.This species closely resembling *Terebratulina caput-serpentis*, yet distinct in several respects, has already been mentioned by Hayasaka as occurring in Chichibu (below the Gohei Bridge in Kunigami).

Our examples were collected at several places as given below.

Fossil occurrence.—Kanisawa, Obashira, Obuchi, Une (Yokose) and Ota. Hayasaka also mentions Ninomiya in Sagami as one of the localities which belongs to the Lower Musashino.

Living.—Central and Western Japan.

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Plate XIV.

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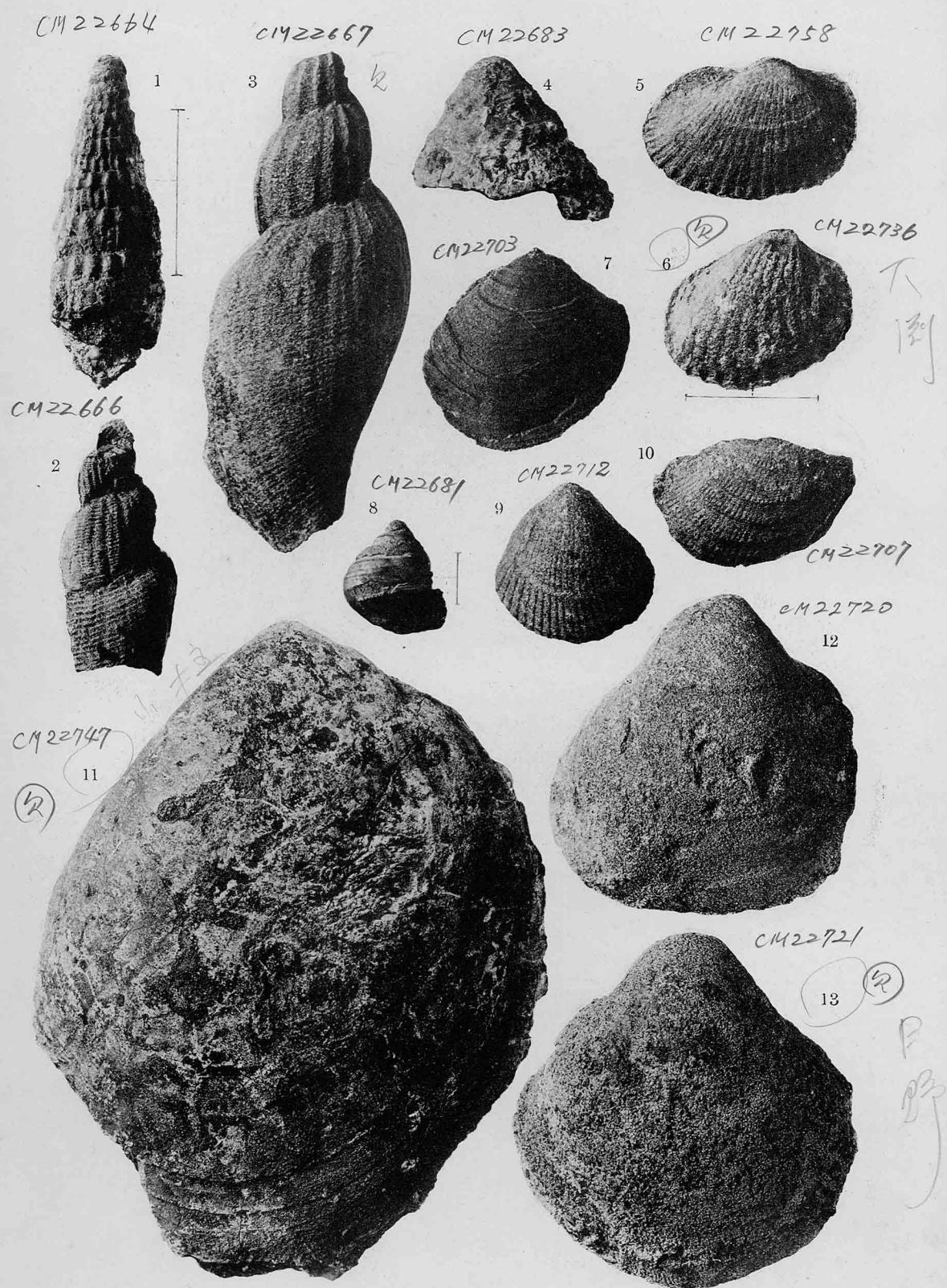
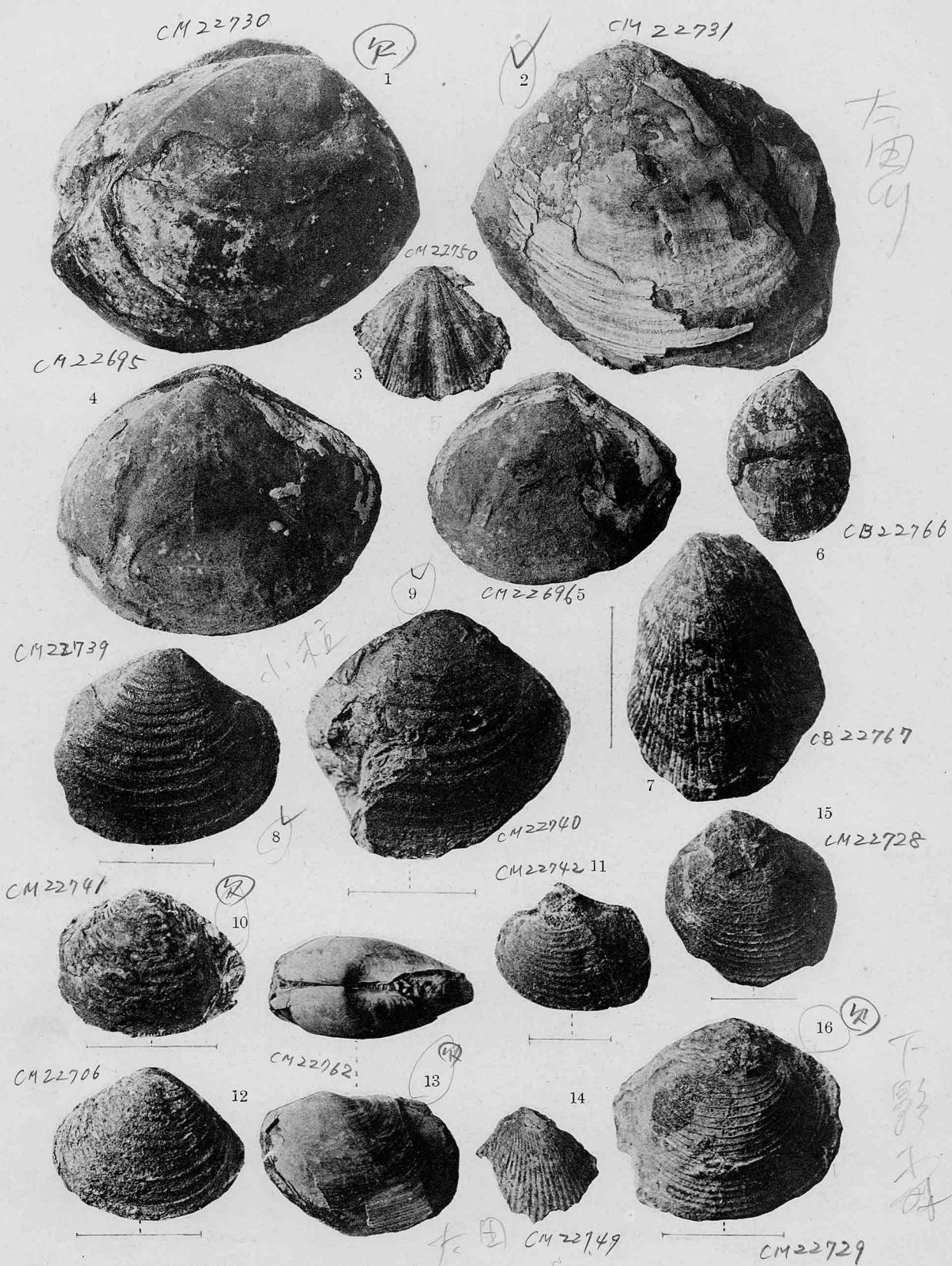


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