

Mollusca from the Coral-Bed of Awa.

By

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With 5 Plates.

General Remarks.

Long since, long before modern science began to be cultivated in Japan, large masses of coral were known to occur in Awa, a province situated at the entrance of Tokyo Bay, which brought to Tokyo were cut and carved into the form of miniature mountains, the so-called *bonsai* which some people value, just as they do the well-known dwarf-trees. The place where these corals occurred was said to be not a sea-shore, but cultivated fields lying more or less inland. This naturally attracted my attention already more than forty years ago, when I was still a student in what is now the university of Tokyo. However, it was not until some twenty years afterwards that I had an opportunity to visit the locality. It was near Numa¹⁾, a village close to the town of Tateyama, and in one of the many valleys cutting into the hills made up of the Lower Musashino Formation. The distance from the sea was about one kilometre, and the height above it from ten to fifteen metres. Here, in a valley-bottom levelled and terraced into paddy fields, I found small heaps of coral fragments scattered about at several places, evidently put aside in ploughing as a nuisance. Since it was not possible in such fields to detect the true nature of the bed in which the corals had been entombed, I searched in a petty side-valley never touched by the plough for an exposure,

1) This is the correct form of the name, though in a previous paper of mine I wrote it *Noma* just as the people of the place pronounced it. *Numa* means *swamp* and may possibly point to the former nature of the land.

where I was fortunate enough to find a pit dug in the ground in which a sand-layer was seen containing not only corals but many molluscous shells. These shells presented a very young appearance, most of them having retained their original colour-markings, though in a more or less faded condition. As to their species, I noticed several which are not met with in Central Japan and which on a later examination proved to be tropical forms. And this was what was to be expected, because the corals accompanying them were true reef-building ones now only inhabiting warmer seas. But how such remains happened to be found there far from their recent habitat and in a deposit comparatively very young seemed to me at that time rather puzzling.

Since then I have been engaged for many years in the study of the Musashino fossils. And when this study had advanced enough to show me that there are several boreal forms among them, the warmer nature of the coral-bed appeared to me so much more striking. The result was my little article entitled "Climatic Changes in Japan since the Pliocene Epoch."¹⁾ As to the Musashino fossils, after much delay due to several unforeseen difficulties, they have at last appeared in two separate treatises, the one²⁾ in 1920 and the other³⁾ in 1922. And now I am glad to be able to present to the public this last of my papers already promised in one of my previous writings, i. e., a treatise on the Mollusca of the coral-bed.⁴⁾

The collection of these fossils was at first exclusively made at Numa by myself and by my lamented pupil Mr. Gordon Yamakawa. However, quite recently, a new though smaller collection has been made by Mr. Jungo Ishizaki⁵⁾ at Koyatsu⁶⁾, a place some three kilometres south of Numa, where the shells are

1) Jour. Coll. Sci., Imp. Univ. Tokyo, 1911, Vol. XXXII, Art. 5.

2) Fossils from the Miura Peninsula and Its Immediate North. The same journal, Vol. XXXIX, Art. 6.

3) Fossils from the Upper Musashino of Kazusa and Shimosa. Ibid., Vol. XLIV, Art. 1.

4) The corals require a separate treatment. Several of them do not seem to coincide exactly with those now found in Southern Japan.

5) An artist, assistant in our Geological Institute, who rendered me great service by drawing the figures of all the small-sized shells not only from Awa, but also from the Musashino Formation, with such skill and accuracy as almost to be unequalled by any one in Japan at the present moment. I therefore take this opportunity of expressing to him my heartiest thanks.

6) Generally written *Kō* (香), but called by the people of the place *Kōya-su* which may be interpreted as meaning *Kō-valley* (香谷).

scattered also over the cultivated fields occupying a valley-bottom at about an equal height to those of Numa, but somewhat nearer to the sea.

The total number of the species described is 124 as shown in the following table :

| | Koyatsu | Numa | Musashino Formation | Living. |
|--|---------|------|------------------------|---|
| <i>I. Gastropoda</i> | | | | |
| <i>Family Tornatinidae.</i> | | | | |
| 1. Retusa lineolata Yok. | | + | | |
| <i>Family Pleurotomidae.</i> | | | | |
| 2. Clathurella centrosa Pils. | | + | | Southern Japan. |
| <i>Family Buccinidae.</i> | | | | |
| 3. Euthria ferrea Rve. | | + | | Central, Western, Southern Japan. |
| 4. Eburna japonica Rve. | | + | + | North., Centr., West., South., Japan. |
| <i>Family Nassidae.</i> | | | | |
| 5. Nassa (Niotha) livescens Phil. | + | + | + | Centr., a. West. Japan. Indian Ocean. |
| <i>Family Columbelloididae.</i> | | | | |
| 6. Columbella (Atilia) masakadoi Yok. | | + | + | Central Japan. |
| 7. Columbella (Mitrella) dunkeri Try. | | + | + | Northern, Central and Western Japan. |
| 8. Columbella (Anachis) awana Yok. | | + | | |
| 9. Engina acuminata Rve. | | + | | Western Japan. |
| <i>Family Muricidae.</i> | | | | |
| 10. Ocinebra contracta Rve. | + | + | | North., West. Japan. Philippines. Fijis. |
| 11. Purpura (Thalassa) bitubercularis Lam. | + | + | | Indian Ocean, Singapore. |
| 12. Purpura (Cuma) rugosa Born. | | + | | Indian Ocean, Singapore, Java. |
| <i>Family Coralliophilidae.</i> | | | | |
| 13. Leptoconchus rostratus Ad. | | + | | Central Japan. |
| <i>Family Tritonidae.</i> | | | | |
| 14. Triton (Simpulum) costatus Born. | | + | | Centr., West. Japan. South Sea, Indian Ocean. |
| 15. Triton (Epidromus) obscurus Rve. | | + | | South. Japan. South Sea. Indian Ocean. |
| <i>Family Cypraeidae.</i> | | | | |
| 16. Cypraea carneola L. | | + | | West.-South. Japan. Philippines, South Sea. |
| 17. Cypraea candida Pease. | + | + | | Central Pacific. |
| <i>Family Cerithiidae.</i> | | | | |
| 18. Cerithium kobelti Dkr. | + | + | + | Central and Western Japan. |
| 19. Cerithium kochi Phil. | + | | + | Central and Western Japan. |
| 20. Bittium acutangulum Yok. | | + | | |

| | Koyatsu | Numa | Musashino Formation | Living. |
|--|---------|------|------------------------|--|
| 21. <i>Bittium perpusillum</i> Try. | | + | + | Western and Southern Japan. |
| 22. <i>Bittium numamuranum</i> Yok. | + | + | | |
| 23. <i>Potamides</i> (<i>Batillaria</i>) <i>zonalis</i> Brug. | + | | | North.-Western Japan. Hongkong. Australia. |
| 24. <i>Potamides</i> (<i>Batillaria</i>) <i>multiformis</i> Lke. | + | | + | Northern, Central and Western Japan. |
| <i>Family Cerithiopsidae.</i> | | | | |
| 25. <i>Cerithiopsis hilaris</i> Yok. | | + | | |
| 26. <i>Cerithiopsis pulviformis</i> Yok. | | + | | |
| 27. <i>Cerithiopsis satomii</i> Yok. | + | + | | |
| <i>Family Triforidae.</i> | | | | |
| 28. <i>Triforis otsuensis</i> Yok. | | + | + | Central Japan. |
| 29. <i>Triforis exilis</i> Dkr. | | + | | Western Japan. |
| <i>Family Vermetidae.</i> | | | | |
| 30. <i>Thylacodes medusae</i> Pils. | + | + | + | Central and Southern Japan. |
| 31. <i>Thylacodes nodosorugosus</i> Lke. | | + | | Central and Southern Japan. |
| 32. <i>Spiroglyphus tricarinatus</i> Yok. | | + | | |
| 33. <i>Vermetus reticulatus</i> Yok. | + | + | | |
| 34. <i>Vermetus annulatus</i> Yok. | | + | | |
| <i>Family Litiopidae.</i> | | | | |
| 35. <i>Litiopa</i> (<i>Diala</i>) <i>semistriata</i> Phil. | | + | | Western Japan. Corea, Hongkong, Bombay. |
| <i>Family Rissoidae.</i> | | | | |
| 36. <i>Rissoa</i> (<i>Alvania</i>) <i>concinna</i> Ad. | | + | | Western Japan. |
| 37. <i>Rissoina submerculialis</i> Yok. | + | + | + | Central Japan. |
| 38. <i>Rissoina</i> (<i>Phosinella</i>) <i>cancellata</i> Phil. | | + | | Japan. West Indies. |
| 39. <i>Fenella pupoides</i> Ad. | | + | | Central and Western Japan. |
| 40. <i>Fenella yamakawai</i> Yok. | | + | | |
| 41. <i>Fenella shinonis</i> Yok. | | + | | |
| 42. <i>Fenella orientalis</i> Yok. | | + | + | Central Japan. |
| 43. <i>Fenella kenonis</i> Yok. | | + | | |
| <i>Family Capnidae.</i> | | | | |
| 44. <i>Crepidula aculeata</i> Gm. | + | + | | Centr., West., South. Japan. Mauritius. |
| <i>Family Eulimidae.</i> | | | | |
| 45. <i>Eulima</i> (<i>Leiostraca</i>) <i>hojoensis</i> Yok. | | + | | |
| 46. <i>Odostomia</i> (<i>Miralda</i>) <i>gemma</i> Ad. | | + | | Southern Japan. |
| 47. <i>Odostomia</i> (<i>Egilina</i>) <i>marielloides</i> Yok. | | + | + | |
| 48. <i>Turbonilla humilis</i> Yok. | | + | | |
| <i>Family Neritidae.</i> | | | | |
| 49. <i>Nerita albicilla</i> L. | + | | | Central, West., South. Japan. Polynesia. |
| <i>Family Turbinidae.</i> | | | | |
| 50. <i>Turbo</i> (<i>Batillus</i>) <i>cornutus</i> Gm. | | + | | North., Centr., South. Japan. China. |

| | Koyatsu | Niima | Musashino Formation | Living. |
|---|---------|-------|------------------------|--|
| 51. Turbo (Marmorostoma) granulatus Gm. | + | + | + | Central a. Southern Japan. Indian Ocean. |
| 52. Astralium (Cyclocantha) haematragus Mke. | + | | | Central and Western Japan. China. |
| 53. Leptothyra pilula Dkr. <i>Family Trochidae.</i> | | + | | Western Japan. |
| 54. Trochus (Clanculus) atropurpureus Gm. | | + | | South Sea (Fijis, N. Guinea). |
| 55. Trochus (Clanculus) gordonis Yok. | | + | | |
| 56. Monodonta labio L. | + | | | North.-South. Japan. Moluccas. Senegal. |
| 57. Chlorostoma quantoanum Yok. | + | | + | |
| 58. Cantharidus japonicus Ad. | + | | + | Central and Western Japan. |
| 59. Umbonium costatum Val. <i>Family Stomatellidae.</i> | + | | + | Northern, Central, Western Japan. |
| 60. Stomatella lyrata Pils. <i>Family Scissurellidae.</i> | | + | + | Northern, Central, Southern Japan. |
| 61. Scissurella turbinata Ad. <i>Family Fissurellidae.</i> | | + | | Western Japan. |
| 62. Fissurella rupeellii Sow. | + | + | | Red Sea, Mauritius. |
| 63. Submarginula cratitoides Yok. | | + | | |
| <i>II. Scaphopoda.</i> | | | | |
| <i>Family Dentaliidae.</i> | | | | |
| 64. Dentalium octogonum Lam. | | + | + | Northern—Southern Japan. Ceylon. |
| <i>III. Lamellibranchiata.</i> | | | | |
| <i>Family Pholadidae.</i> | | | | |
| 65. Pholas cupula Yok. | | + | | |
| 66. Pholas subconstricta Yok. | | + | | |
| 67. Jouannetia cumingii Sow. | | + | | Western Japan. Philippines. |
| 68. Jouannetia yabei Yok. <i>Family Corbulidae.</i> | | + | | Central Japan. |
| 69. Basterotia gouldii Ad. <i>Family Semeleidae.</i> | | + | | Western Japan. |
| 70. Semele aspasia Ang. <i>Family Tellinidae.</i> | | + | | Tropical Seas. |
| 71. Tellina iridella Mart. | | + | | Central and Western Japan. |
| 72. Tellina radiato-lineata Yok. | | + | | |
| 73. Macoma inquinata Desh. <i>Family Petricolidae.</i> | + | + | + | North.—West. Japan. Lower California. |
| 74. Petricola awana Yok. <i>Family Veneridae.</i> | | + | | |
| 75. Meretrix tigrina Lam. | + | + | | Western Japan (Osumi). Moluccas. |

| | Koyatsu | Numa | Musashino Formation | Living. |
|--|---------|------|------------------------|--|
| 76. Meretrix (Callista) limatula Sow. | | + | | Central Japan. Moluccas. |
| 77. Venus jedoensis Lke. | | + | | Northern, Central and Western Japan. |
| 78. Venus toreuma Gld. | | + | | Central and Western Japan. Philip- pines. N. Australia. |
| 79. Venerupis irus L. | + | + | | North.—West. Japan. Mediterranean. |
| 80. Venerupis insignis Desh. | | + | + | North. and Centr. Japan. N. Zealand. |
| 81. Tapes philippinarum Ad. | | + | + | North.—West. Japan. Philippines. Ind. Ocean. |
| 82. Saxidomus purpuratus Sow. | | + | + | North.—South. Japan. California. Indian Ocean. |
| <i>Family Galeommidae.</i> | | | | |
| 83. Scintilla solidula. Desh. | | + | ? | Tropical Seas. |
| 84. Scintilla nipponica Yok. | | + | | |
| 85. Scintilla trigonalis Yok. | | + | | |
| 86. Galeomma adamsi Yok. | | + | | |
| <i>Family Leptonidae.</i> | | | | |
| 87. Lepton puncticulatum Yok. | | + | | |
| <i>Family Diplodontidae.</i> | | | | |
| 88. Diplodonta semiaspera Phil. | | + | + | Centr., West. Japan. W. Indies. Patago- nia. |
| 89. Diplodonta japonica Pils. | + | + | + | Central Japan. |
| <i>Family Lucinidae.</i> | | | | |
| 90. Lucina contraria Dkr. | + | + | + | Central Japan. |
| 91. Lucina pisidium Dkr. | | + | + | North., Centr., West. Japan. New South Wales. |
| 92. Codakia bella Conr. var. delicatula Pils. | + | + | | Southern Japan (Ryukyu). |
| <i>Family Chamidae.</i> | | | | |
| 93. Chama semipurpurata Lke. | + | + | + | Central, Western and Southern Japan. |
| 94. Chama retroversa Lke. | | + | | Central and Western Japan. |
| <i>Family Carditidae.</i> | | | | |
| 95. Cardita crassicosta Lam. | + | + | | Philippines. Australia. |
| <i>Family Pleurophoridae.</i> | | | | |
| 96. Coralliophaga coralliophaga Chem. | | + | + | Central and Western Japan. South Sea. |
| <i>Family Mytilidae.</i> | | | | |
| 97. Mytilus hirsutus Lam. | + | + | + | Central and Western Japan. China. Sea |
| 98. Mytilus curvatus Dkr. | | + | | Centr. a. West. Japan. Philippines. |
| 99. Modiola barbata L. | | + | + | N.-S. Japan. Mediterranean. (Fossil [in Crag]). |
| 100. Lithophaga nasuta Phil. | | + | | C., W., S. Japan. Philippines. |
| 101. Modiolaria semigranata Rve. | | + | | Central Japan. |
| <i>Family Limidae.</i> | | | | |
| 102. Lima dunkeri Sm. | | + | | Central and Western Japan. |
| 103. Lima lima L. | + | + | | Central-Southern Japan, Mediterranean. (Mioc. a. Plioc. of Europe). |

| | Koyatsu | Numa | Musashino Formation | Living. |
|---------------------------------------|---------|------|------------------------|--|
| <i>Family Spondylidae.</i> | | | | |
| 104. Spondylus cruentus Lke. | + | + | + | Central and Western Japan. |
| 105. Plicatula irregularis Dkr. | + | + | | Central and Western Japan. |
| <i>Family Pectinidae.</i> | | | | |
| 106. Pecten irregularis Sow. | + | + | + | Central and Western Japan. E. Indies. |
| 107. Pecten spectabilis Rve. | | | + | Western Japan. |
| 108. Pecten plicata L. | | | + | Western Japan. China Sea. Ceylon. |
| 109. Pecten laetus Gld. | + | + | + | Northern, Central, Western Japan. |
| 110. Pecten quadriliratus Lke. | + | | | Western Japan. |
| <i>Family Ostreidae.</i> | | | | |
| 111. Ostrea gigas Thunb. | | | + | North.-West. Japan. Shantung. |
| 112. Ostrea cucullata Born. | | | + | North.-West Japan. Bay of Bengal. |
| 113. Ostrea crenulifera Rve. | + | | + | Red Sea. |
| <i>Family Pernaidae.</i> | | | | |
| 114. Perna marsupium Lam. | | | + | Philippines. |
| <i>Family Arcidae.</i> | | | | |
| 115. Arca kobeltiana Pils. | + | | + | Northern and Central Japan. |
| 116. Arca (Barbatia) decussata Sow. | | | + | C., W., S. Japan. Philippines. Indian O. |
| 117. Arca (Barbatia) stearnsii Pils. | + | | + | Central and Western Japan. |
| 118. Arca (Barbatia) symmetrica Rve. | | | + | Central and Western Japan. Philip- pines. Indian O. |
| 119. Arca (Barbatia) tenebrica Rve. | | | + | West. a. South. Japan. Philippines. |
| 120. Arca (Barbatia) domingensis Lam. | + | | + | W. Japan. Polynesia. Indian O. W. Indies. |
| 121. Arca (Barbatia) fusca Brug. | + | | + | South Tosa (W. Japan). Philippines. Red. Sea. |
| 122. Arca kraussi Phil. | | | + | Central and Western Japan. Natal. |
| <i>Family Parallelodontidae.</i> | | | | |
| 123. Parallelodon obliquatus. Yok. | | | + | Northern and Central Japan. |
| <i>Family Limopsisidae.</i> | | | | |
| 124. Limopsis woodwardi Ad. | + | | + | Central Japan. |

Out of 124 species above numerated, 28 or about 23%, so far as our present knowledge goes; are not known to be living. The remaining 96 or about 77%, when grouped according to their habitats, are as follows:

(1) Species now living only near the fossil localities (Central Japan) or in about the same latitudes (Western Japan)¹⁾ 31.

1) Just as in my previous works on the Musashino fossils, Japan has been divided into the following four parts: (2) Northern Japan (north of the 38th parallel, north latitude). (2) Central Japan (south of the same parallel and east of 136° east longitude). (3) Western Japan (west of the same longitude, including Chugoku, Shikoku, and Kyushu). (4) Southern Japan (South of Kyushu such as the Ryukyus, the Bonins and Formosa).

| | |
|--|------|
| Percentage of the whole fauna | 32.3 |
| (2) Species now living in Central or Western Japan as well as north of it (Northern Japan) | 9. |
| Percentage of the whole fauna | 9.3 |
| (3) Species now living in Central or Western Japan as well as south of it (Southern Japan or further south)... .. | 26. |
| Percentage of the whole fauna | 27. |
| (4) Species now living in the whole of Japan (Northern-Southern) ... | 13. |
| Percentage of the whole fauna | 13.5 |
| (5) Species now living exclusively in Southern Japan or further south. | 17. |
| Percentage of the whole fauna | 17.9 |

From the above, it will be clearly seen that the fauna presents a decidedly more southern aspect than that now inhabiting the seas around Awa (Central Japan), for in addition to the latter which, indeed, forms the great majority (28%), there are also forms which are now living in more southern seas only and which amount to 17 constituting about 18% of the whole. And we have also to note that even among the Central Japanese forms, when we compare these which live south (group 3) with those which at the same time live north (group 2), the former are nearly three times as numerous.

What I call the exclusively more southern (tropical) forms are the following:

1. *Clathurella centrosa* Pilsbry.
2. *Purpura bitubercularis* Lamarck.
3. *Purpura rugosa* Born.
4. *Triton obscurus* Reeve.
5. *Cypraea carneola* Linné.¹⁾
6. *Cypraea candida* Pease.
7. *Odostomia gemma* A. Adams.
8. *Trochus atropurpureus* Gmelin.
9. *Fissuridea rueppellii* Sowerby.
10. *Semele aspasia* Angas.
11. *Meretrix trigrina* Lamarck.¹⁾

1) *Cypraea carneola* and *Meretrix trigrina* come up to the southern extremities of Kyushu and Shikoku where also some tropical trees like *Levistonis chinensis* Br. and *Ficus wightiana* Wall are found, the climate being semi-tropical.

12. *Scintilla solidula* Deshayes.
13. *Codakia bella* Conrad var. *delicatula* Pilsbry.
14. *Cardita crassicosta* Lamarck.
15. *Ostrea crenulifera* Reeve.
16. *Perna marsupium* Lamarck.
17. *Arca fusca* Bruguière.

This shows to a certainty that during the deposition of the bed in question the seas¹⁾ around the fossil localities were much warmer than now, just as the occurrence of reef-corals whose northern limit at present is the southern end of Kyushu (about 31° N. L.) points to the same conclusion. Such being the case, it is quite natural that the Awa-Mollusca do not show much relation with those of the underlying Musashino, the number of the species common to both being only about 31%. Hereupon we are naturally led to ask what is the geological age of the Awa-bed.

As already mentioned, the fauna contains 28 species or about 23% of those which are not yet known as living. Now, if these are really all extinct, the bed can not be younger than *Pliocene*. But as I have already said in the case of the Musashino fossils, so in this case also there is a great possibility of these apparently non-living forms being reduced in number by future discoveries. How far this reduction will go, it is of course not possible to say. However, even when it goes so far as to leave only a few species as extinct, it would not be advisable to take the bed for younger than *Pleistocene*, especially when we consider the decidedly warm-water character of the entire fauna, since the succeeding *Holocene* or *Alluvial* is generally accepted as representing a time in which organisms as well as climate had become essentially not different from the present.

Geologically viewed, we arrive also at about the same conclusion. The bed is certainly older than the *Alluvial formation* covering the coastal plain between the hills and the sea, because it is much higher in level. Compared with the so-called *Pleistocene* loam which overlies the Upper Musashino, although found only more to the north, there is evidence of our bed being younger. That is, when the Musashino is cut in by valleys, the loam above it, if there is any, is as a

1) The seas near Awa are comparatively cold in winter, the temperature sometimes going down to about 10°C.

matter of course also cut in, both exposing their cut flanks at the valley-sides, whereas the coral-bed is found only in the valley-bottom as its filling, thus showing that its formation is of a later date.

From these considerations I deem the age of the coral-bed of Awa as the *Youngest Pleistocene*. Very probably, the study of the shell-layers of the neighbourhood (Kachiyama, Daito, Mobarra, etc.), with their contents approximating more to the present maritime fauna of Central Japan, will throw more light on this subject.

In this connection, I may mention some beds outside of Japan considered as *Postglacial* in age in which indication of a rise of temperature above the present have been recognized, though not in a degree so marked as in Awa. Such are the Talbot Formation of Maryland and Virginia, the *Purpura*-bed of Iceland, some plant-beds of Sweden, etc. Whether our Coral-bed is quite contemporaneous with these or not, further studies alone can tell.

Description of the Species.

Gastropoda.

Family Tornatinidæ.

1. *Retusa lineolata*, YOKOYAMA.

Pl. I., Fig. 6.

Shell small, thin, cylindrical, slightly depressed in the middle; spire sunken, though not very deep; body-whorl occupying the whole length of the shell and ornamented with numerous fine impressed spiral lines which are more or less unequal and not quite at equal distances; incremental lines coarse and distinct; aperture as long as shell, narrow and linear above, expanded and ovate below, with the inner margin raised and looking like a fold; base rounded.

A single specimen, 1.5 millim. in height and 0.7 millim. in diameter.

This species is closely related to *Retusa minima* Yamakawa (Descript. Foss. Opisthobr. Diluv. Dep. Japan, Jour. Geol. Soc. Tokyo, vol. XVIII, no. 212, p. 47, pl. XI, figs. 21²-24) from the Lower as well as from the Upper Musashino. But it is distinguished by a somewhat more slender shape and the presence of distinct spiral lines.

Fossil Occurrence.—Numa.

Family Pleurotomidæ.

2. *Clathurella centrosa*, PILSBRY.

Pl. V., Fig. 15.

Clathurella centrosa. Pilsbry, New Jap. Mar. Moll., Gastr., p. 12, pl. I, fig. 6.

A single specimen whose apex is broken off.

The shell is small, fusiform and solid with the spire a little shorter(?) than the body-whorl. The whorls are convex and longitudinally as well as spirally sculptured. The longitudinal sculpture consists of ribs, eleven or twelve on the last whorl, straight, rounded and narrower than the interspaces. The spiral sculpture consists of cords which are rather thin, much narrower than the interspaces, somewhat

lamellar and elevated, numbering four on the penultimate and six or seven on the ultimate whorl. The base just below the lowest cord of the last whorl shows a space without any spiral cord and with longitudinal ribs only, followed by six oblique beaded cords which rapidly diminish in size downward, so that the last two are very small and short. The aperture is rather elongated, with the outer lip varicose without by the presence of a longitudinal rib at that place and dentate within, the teeth corresponding in number and size to the spiral cords without. Inner lip provided with a thin callus. Canal distinct, but short. Height about 6.7 millim.(?) Diameter 2.1 millim.

Fossil occurrence.—Numa.

Living.—Southern Japan (Ogasawara-jima or Bonins).

Family **Buccinidæ.**

3. *Euthria ferrea*, (REEVE).

Pl. V., Fig. 17.

Euthria ferrea. Pilsbry, Cat. Mar. Moll. Jap., p. 33.

Euthria viridula. Dunker, Moll. Jap., 3, pl. I, Fig. 16. Index. Moll. Mar. Jap., p. 19, pl. III, figs. 5-S. Lischke, Jap., Meeresconch., I, p. 39, pl. V, figs. 5, 6.

Buccinum ferreum. Reeve, Conch. Icon., Buccinum, pl. XIII, Fig. 102.

Merely a fragment belonging to the lower portion of the body-whorl. But on comparing it with the living specimens of *Euthria ferrea*, there is not the least doubt of its belonging to the same species. The basal part of the body-whorl is spirally grooved, and the interior of the outer lip is transversely striated. The aperture is narrowly ovate.

Tryon considers this species as identical with *Euthria plumbea* Phil. (Man. Conch., III, p. 150) which lives in Chile and Patagonia.

Fossil occurrence.—Numa.

Living.—Central, Western and Southern Japan.

4. *Eburna japonica*, REEVE.

Eburna japonica. Reeve, Conch. Icon., Eburna sp. 9. Dunker, Moll. Jap., p. 8. Ind. Moll. p. 34. Brauns, Geol. Env. Tokyo., p. 64. Tokunaga, Foss. Env. Tokyo, p. 9. Yokoyama, Foss. Up. Musash. Kaz. Shim., p. 57, pl. II, fig. 20.

A single fragment.

Fossil occurrence.—Numa. Upper Musashino of Musashi and Shimosa.

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

Family **Nassidæ**.

5. *Nassa (Niotha) livescens*, (PHILIPPI).

Nassa (Niotha) livescens. Pilsbry, Catal., p. 35. Lischke, Jap. Meeresconch., II, p. 52, pl. IV, figs. 1–3. Yokoyama, Foss. Miura Penin., p. 58, pl. III, fig. 18.

Six examples. Numa, Kōyatsu.

Fossil occurrence.—Lower Musashino of Miyata, Yokosuka and Naganuma.

Living.—Central and Western Japan. Indian Ocean.

Family **Columbellidæ**.

6. *Columbella (Atilia) masakadoi*, YOKOYAMA.

Columbella (Atilia) masakadoi. Yokoyama, Foss. Up. Musas. Kaz. Shim., p. 62, pl. II, fig. 23.

A single example.

Fossil occurrence.—Numa. Upper Musashino of Kazusa and Shimosa.

Living.—Central Japan.

7. *Columbella (Mitrella) dunkeri*, (TRYON).

Columbella (Mitrella) dunkeri. Tryon, Man. Conch., V, p. 129, pl. 49, fig. 15. Yokoyama, Foss. Miura Penin., p. 59, pl. III, fig. 15. Foss. Up. Musash., p. 62, pl. II, fig. 26.

Amycla varians. Dunker, Malak. Bl., 1860, p. 231. Moll. Jap., p. 6, pl. I, fig. 17. Ind. Moll., p. 55. Smith, Proc. Zool. Soc. Lond., 1979, p. 210, pl. XX, fig. 44.

Several examples.

Fossil occurrence.—Numa. Lower Musashino of Miyata and Yokosuka. Upper Musashino of Kazusa and Shimosa.

Living.—Northern, Central, and Western Japan.

8. *Columbella (Anachis) awana*, YOKOYAMA.

Pl. I., Fig. 1.

Shell very small, short-fusiform. Whorls about six, the first three smooth and rounded, the succeeding flattish and longitudinally plicate; plicae about sixteen on the body-whorl, strong, rounded, straight, somewhat oblique, with the

lower end more anterior than the upper, and the interspaces narrower. A subsutural cord is present on each whorl, which makes the sutures very distinct and the whorls somewhat step-like. Periphery rounded. Base rather abruptly narrowed and covered with longitudinal plicae which disappear at the caudal end where there are six oblique grooves. Canal short.

Only a single specimen which is slightly broken at the canal-end. Height 2.6 millim. Diameter 1.3 millim.

Fossil occurrence.—Numa.

9. *Engina acuminata*, (REEVE).

Pl. I., Fig. 3.

Engina acuminata. Pilsbry, Catal., p. 40. Dunker, Ind. Moll., p. 56.

Ricinula acuminata. Reeve, Conch. Icon., *Ricinula*, p. 52.

A single specimen lacking the apex.

The shell is tolerably solid, fusiform in outline, with the body-whorl nearly equal to, if not longer than, the spire. The whorls are angulate near the middle with the surface above obliquely sloping, and below almost vertical and somewhat convex in the middle portion. The sculpture consists of longitudinal ribs as well as of spiral cords and striae. The ribs are strong, straight, and rounded with narrower interspaces. The spiral cords are four in number on the penultimate whorl and about ten on the ultimate. Of the four cords of the penultimate whorl, one is subsutural, one suprasutural, one at the angle and one between the angle and the lower suture. The first two are weaker than the last two, especially the suprasutural one which is indistinct on the upper whorls. Between the cords there are several fine, unequal, spiral striae. The points of intersection of the ribs and cords are more or less nodose. Aperture obovate. Canal short, slightly bent. Outer as well as inner lip with coarse transverse teeth or corrugations. The diameter is 6.1 millim. The height, if the shell is perfect, would be about 15 millim.

Tryon in his Manual of Conchology (vol. V, p. 193) unites this species with *Engina contracta* (Reeve) of Panama and West Columbia.

Fossil occurrence.—Numa.

Living.—Western Japan.

Family **Muricidæ**.10. *Ocinebra contracta*, (REEVE).

Pl. I., Fig. 2.

Ocinebra contracta. Pilsbry, Catal., q. 42.*Murex (Ocinebra) contractus*. Tryon, Man. Conch., II, p. 131, pl. 38, figs. 471-474.*Pollia contracta*. Lischke, Jap. Meeresconch., II, p. 50, Dunker Ind. Moll., p. 18.*Buccinum contractum*. Reeve, Conch. Icon., Buccinum, sp. 53, pl. 8, fig. 53.

Many specimens.

The shell is solid, ovately fusiform, with the body-whorl longer than the spire. The whorls number eight or nine, and are angulate in the middle, with the surface above the angle sloping and below vertical. The sculpture consists of longitudinal plicae and spiral threads. The plicae are seven or eight, broad and flatly rounded, separated by the intervals of a somewhat less breadth. The threads are coarser below the angle than above it, and furnished with fine scales. Aperture obovate. Canal short, bent back. Inner lip smooth. Outer lip varicose without by the presence of the last longitudinal fold at that place, and with a few transverse teeth within.

Fossil occurrence.—Numa and Kōyatsu.

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

11. *Purpura (Thalessa) bitubercularis*, LAMARCK.

Pl. I., Fig. 4.

Purpura bitubercularis. Lamarck, Anim. sans Vert., X, p. 64. Küster in Syst. Conch. Cab. Mart. Chem., III, pt. I, p. 188, pl. XXXIa, figs. 3-3. Reeve, Conch. Icon., Purpura, sp. 37, pl. 8, fig. 37.

Three examples with a solid oval shell carrying two spiral rows of spiny tubercles on each whorl except the last on which there are five rows, the lowest of which is more like a ridge than a row of tubercles. These can surely be identified with the above named species of Lamarck which, according to Tryon, is identical with *P. hippocastaneum* Lam. of the tropical seas.

Fossil occurrence.—Numa, Kōyatsu.

Living.—Indian Ocean, Singapore.

12. *Purpura (Cuma) rugosa*, (BORN).

Pl. I., Fig. 10.

Purpura rugosa. Deshayes, in Lamarck's Anim. s. Vert., 2d Ed. X, p. 111, no. 78. Küster, in Syst. Conch. Cab. Mart. Chemn., III, pt. 1, p. 145, pl. 24 a, fig. 5. Tryon, Man. Conch., II, p. 201, pl. 63, figs. 328, 329, 334.

Purpura sacellum. Reeve, Conch. Icon., Purpura, no. 58, pl. XI, fig. 58.

Murex rugosus. Born, Mus. p. 305, pl. 11, fig. 6, 7.

A single specimen, with the apex and the outer lip broken.

The shell is biconical with whorls angulate below the middle, the surface above the angle being somewhat inclined and below vertical. The sculpture consists of longitudinal plicæ and spiral threads or striae. The plicæ number about eight on the body-whorl, are broad, flatly rounded or roof-like, and provided on the angle with an acute spine which is a folded lamina open in front. On the body-whorl, there are two more rows of spines below that of the angle. The spiral threads are subequal, or alternately large and small, and scaly, and cover the entire surface of the shell. Inner lip smooth.

Fossil occurrence.—Numa.

Living.—Indian Ocean. Java, Singapore.

Family **Coralliophilidæ**.13. *Leptoconchus rostratus*, A. ADAMS.

Pl. I., Fig. 5.

Leptoconchus rostratus. A. Adams, Ann. Mag. Nat. Hist., 1864, p. 210. Dunker, Ind. Moll., p. 45, pl. VI, figs. 20, 21. Pilsbry, Catalogue, p. 46.

Magilus rostratus. Tryon, Man. Conch., II, p. 216.

A single worn specimen lacking the acute rostrum of the mouth. Yet the body-whorl shows some traces of spiral striae crossed by undulating lines of growth which are in the form of fine lamellæ.

Tryon is of opinion that this species is identical with *Magilus antiquus* Lam. of the western portion of the Indian Ocean (Red Sea, Bourbon, etc).

Fossil occurrence.—Numa.

Living.—Central Japan.

Family Tritonidæ.

14. *Triton (Simpulum) costatus*, (BORN).

Pl. I. Fig. 16.

Triton costatus. Watson, Challenger Gastropoda, p. 390.*Tritonium costatum*. Pilsbry, Catal., p. 46.*Triton olearium*. Lischke, Jap. Meeresconch., I, p. 48.*Murex costatus*. Born, Mus. Caes., p. 297, (non Gmelin).*Murex olearium*. Linné, Syst. Nat., Ed. 12, p. 1217, (non Ed. 10).*Murex parthenopus*. v. Salis, Reise, P. 370, pl. VII, fig. 1.

This characteristic and well-nigh cosmopolitan species is represented by an adult as well as by a young specimen.

Fossil occurrence.—Numa.

Living.—Central and Western Japan. South Sea. Indian Ocean. Mediterranean Sea. East and West Atlantic.

15. *Triton (Epidromus) obscurus*, REEVE.

Pl. I. Fig. 9.

Triton obscurus. Reeve, Conch. Icon., Triton, spec. 63, pl. 16, fig. 63. Küster in Syst. Conch. Cab. Mart. Chemn., III, pt. 2, p. 212, pl. 60, figs. 1, 2. Tryon, Man. Conch., III, p. 26, pl. 14, figs. 127, 128, pl. 18, fig. 157..

Triton comptus. A. Adams, Proc. Zool. Soc. Lond., 1854, p. 312.

A fusiform shell with about ten moderately rounded whorls whose surface is quite covered with longitudinal as well as with spiral threads. The intersection-points of these two kinds of threads are more or less tubercular. Besides, there are also large varices, usually one on each whorl, the last of which is situated close to the outer lip, though its margin is thin and sharp. The inner lip is covered with a glaze which elevates below into a lamina directed sidewise.

Four examples, all lacking the apex. The largest measures 15.5 millim. in diameter. The height, if the shell is perfect, would be a little over 45 millim.

Fossil occurrence.—Numa.

Living.—Southern Japan (Yaeyama Islands). China (according to A. Adams), South Sea, West Indies, Cape Verde Islands, Indian Ocean.

Family *Cypraeidae*.16. *Cypraea carneola*, LINNÉ.

Pl. I. Fig. 11.

Cypraea carneola. Linné, Syst. Nat., Ed. 12, p. 1194. Sowerby, Thes. Conch., IV, p. 12, pl. III, figs. 11-13, pl. XXX, figs. 322. Tryon, Man. Conch., VII, p. 166, pl. III, figs. 26-30. Pilsbry, Catal., p. 172.

Two examples, the larger of which measures 75 millim. in height and 47 millim. in diameter. The shell is characterized by its ovate, swollen form, and the long narrow aperture is lined on both sides with many transverse teeth. The smaller specimen has on the back four broad transverse colour-bands preserved.

This is also a decidedly tropical form, coming up to Japan Proper only to its southernmost ends, as stated below.

Fossil occurrence.—Numa.

Living.—Western Japan (Satsuma and Tosa), and Southern Japan (Ryukyus). Philippines, Moluccas, Society Islands, Red Sea, Reunion, etc.

17. *Cypraea candida*, PEASE.

Pl. II. Fig. 1.

Cypraea candida. Pease, Descr. New Gen. a. Spec. Mar. Moll. Centr. Pacific, Proc. Zool. Soc. Lond., 1865, p. 515.

Cypraea clandestina. Linné, var. *candida*. Tryon, Man. Conch., VII, p. 187, pl. 16, figs. 39, 40.

This is a small-shelled *Cypraea* which is perfectly white when fresh. In shape it is much like the preceding species, though a little more tapering at the anterior end. Pease says that there are very fine longitudinal striations. These probably refer to the lines of growth which are more or less distinct on our fossil.

Three specimens, one of which is nearly 20 millim. in height and 12 millim. in diameter.

Fossil occurrence.—Numa, Kōyatsu.

Living.—Central Pacific (according to Pease).

Family **Cerithiidae.**18. *Cerithium kobelti*, DUNKER.

Cerithium kobelti. Dunker, Ind. Moll., p. 106, pl. IV, figs. 8, 9. Pilsbry, Catal., p. 56. Yokoyama, Foss. Miura Penin., p. 66, pl. IV, fig. 10.

Several fine examples.

Fossil occurrence.—Numa, Koyatsu. Lower Musashino of Yokosuka.

Living.—Central and Western Japan.

19. *Cerithium (Clava) kochi*. PHILIPPI.

Cerithium (Clava) kochi. Yokoyama, Foss. Up. Musash. Kazusa a. Shimosa, p. 71, pl. III, fig. 13.

A single example.

Fossil occurrence.—Koyatsu. Upper Musashino of Shimosa and Musashi.

Living.—Central and Western Japan. East Coast of Africa.

20. *Bittium acutangulum*, YOKOYAMA.

Pl. I. Fig. 7.

Shell small, thin, ovately conic. Whorls about ten with a prominent corded angle a little above the sutures, the surface above the angle being moderately inclined and flat or slightly concave, below receding and markedly concave. The sculpture consists of longitudinal ribs and spiral striae. Ribs nine on the penultimate and ten on the last whorl, obtuse, distant, with interspaces flat and at least as broad as the ribs themselves, except the last on the body-whorl which is somewhat narrower than the others. Striae somewhat distant, with a finer interstitial one between. Body-whorl abruptly narrowed at base, and furnished with two strong spiral cords, one close to the periphery and one midway between the upper cord and the caudal end of the shell; spaces not occupied by cords finely spirally striated, the striae being usually equal in size, with a finer interstitial between. Aperture irregularly quadrangular, with posterior angle right-angled. Outer lip thin, more or less angulate where the cords end. Inner lip with a reflexed peristome. Canal very short, comparatively broad and nearly straight.

A single specimen which is 9 millim. in height and 4.4 millim. in diameter.

Dunker's *Bittium scalatum* (Index Moll., p. 108) seems to resemble the

present species, though apparently more slender. It is to be regretted that he does not give any figure.

Fossil occurrence.—Numa.

21. *Bittium perpusillum*, TRYON.

Bittium perpusillum. Yokoyama, Foss. Miura Penin., p. 67, pl. IV, fig. 13. Tryon, Man. Conch., IX, p. 154, pl. 30, fig. 17.

Bittium pusillum. Dunker, Moll. Jap., p. 11, pl. II, fig. 6.

Two examples, one of which measures 5.5 millim. in height and 1.6 millim. in diameter.

Fossil occurrence.—Numa. Lower Musashino of Yokosuka.

Living.—Western and Southern Japan.

22. *Bittium numamuranum*, YOKOYAMA.

Pl. I. Fig. 13.

Shell small, narrow, conical. Whorls about eleven, the first three smooth and rounded, the remaining nearly flat, separated by deep sutures, longitudinally plicate and spirally corded. Plicæ obtuse, rounded, with somewhat narrower interspaces, about twenty-one on the penultimate whorl, obsolete or nearly so on the last half of the body-whorl. The body-whorl has usually two varices on it, one near its beginning and the other at some distance from its end. Spiral cords three, flat, occasionally splitting into two equal or unequal parts by a fine groove running parallel to their sides. The crossing points of plicæ and cords are tubercular. Periphery rounded. Base quickly narrowing downward and furnished with about five smooth spiral threads, with an interstitial thread now and then between. Aperture ovate, with inner lip reflexed and outer lip sharp. Posterior canal distinct, short and broad, anterior also short, bent sidewise. Numerous specimens, the largest being 6 millim. in height and 2.5 millim. in diameter.

Fossil occurrence.—Numa and Koyatsu.

23. *Potamides (Batillaria) zonalis*, BRUGUIÈRE.

Pl. V. Fig. 18.

Potamides (Batillaria) zonalis. Yokoyama, Foss. Up. Musash., p. 72.

A single small specimen.

Fossil occurrence.—Koyatsu. Upper Musashino of Shimosa and Musashi.

Living.—Northern, Central and Western Japan. Hongkong. Australia.

24. *Potamides (Batillaria) multiformis*, LISCHKE:

Potamides (Batillaria) multiformis. Yokoyama. Foss. Miura Penin., p. 69, pl. IV, fig. 9. Foss. Up. Musash., p. 72.

A single example.

Fossil occurrence.—Koyatsu. Lower Musashino of Yokosuka. Upper Musashino of Shimosa and Kazusa.

Living.—Northern, Central and Western Japan.

Family **Cerithiopsidae**.

25. *Cerithiopsis hilaris*, YOKOYAMA.

Pl. I. Fig. 8.

Shell small, ovately conic. Whorls about ten, the first three smooth and rounded, the succeeding flat, separated by deep sutures, longitudinally plicate and spirally corded. Longitudinal plicae nineteen on the body-whorl, obtuse, wider than intervals. Spiral cords three, flat, somewhat wider than intervals, often splitting into two equal or unequal parts by a groove running parallel to the sides. Intersection-points of plicae and cords tubercular. Periphery rounded. Base suddenly narrowed below, with about eight smooth spiral threads of which the two uppermost are larger than the others. Aperture ovate, slightly channelled in front. Height 5 millim. Diameter 2.2 millim.

This species is frequent and in many respects like the preceding, but it is shorter and more decidedly conic, and entirely devoid of varices.

Fossil occurrence.—Numa.

26. *Cerithiopsis pulviformis*, YOKOYAMA.

Pl. I. Fig. 15.

Shell very small, subcylindrical, pupaeform, attenuated towards apex. Nuclear whorls about five, smooth, rounded, growing very slowly in size; post-nuclear whorls about six, nearly flat, longitudinally costulate and spirally cordep.

Longitudinal costulae straight, obtuse; somewhat wider than intervals, about twenty-two on the body-whorl, becoming smaller and finally obsolete in its last part. Spiral cords two on upper whorls, nearly equal; three on the penultimate and ultimate whorl, the middle one in the former being very small, and the uppermost in the latter being somewhat larger than the other two. Points of intersection of costulae and cords tubercular. Periphery angulate, the angle being formed by a crenulate cord. Base abruptly narrowed, with a smooth spiral cord close to the caudal end. Aperture short, ovate. Canal short, strongly bent sidewise.

A single specimen, 2.5 millim. in height, and 0.7 millim. in diameter.

This shell is like *Cerithiopsis pulvis* Issel (Tryon, Man. Conch., IX, p. 172, pl. 36, fig. 48) from Suez which, however, has three spiral cords also on the upper whorls.

Fossil occurrence.—Numa.

27. *Cerithiopsis satomii*, YOKOYAMA.

Pl. I. Fig. 23.

Shell small, turrete. Whorls about twelve, the first three nuclear, smooth and rounded, the following almost flat, separated by deep sutures, longitudinally costellate and spirally corded. Costellæ about twenty-two on the body-whorl, obtuse, broader than interspaces, the second and the eleventh being somewhat varicose. Cords four, of about the same size as costellæ and crossing them, the intersection-points being tubercular. Periphery rounded. Base abruptly narrowed, furnished with three smooth spiral cords as well as with one or two caudal plications. Aperture roundly rhombic. Canal short but distinct, strongly bent sidewise. Height 5.6 millim. Diameter 15. millim. Rare.

This species is somewhat like *Cerithiopsis hilaris* above described in sculpture, though higher and with longitudinal costellæ more in number.

Fossil occurrence.—Numa and Kōyatsu.

Family **Triforidae**.

28. *Triforis otsuensis*, YOKOYAMA.

Triforis otsuensis. Yokoyama, Foss. Miura Penin., p. 69, pl. IV, fig. 11. Foss. Up. Musashi. Kazusa, Shimōsa. p.

Two examples.

Fossil occurrence.—Numa. Lower Musashino of Yokosuka. Upper Musashino of Kazusa.

Living.—Central Japan.

29. *Triforis exilis*, DUNKER.

Pl. V. Fig. 14.

Triforis exilis. Dunker, Moll. Jap., p. 10, pl. II, fig. 9.

There are two specimens in both of which the apex is lacking. The preserved whorls number ten of which the first two are embryonal, smooth and rounded. The remaining whorls are almost flat, with longitudinal ribs and spiral cords. The ribs number about twenty-three on the body-whorl, while the cords are only three. The intersection-points of ribs and cords are tubercular. Periphery formed by a crenate spiral cord and subangulate. Base quite abruptly narrowed with a single, smooth, tolerably strong, spiral cord. Aperture squarely rhombic, with the posterior end of the outer lip notched. Canal short, bent. Height 4.5 millim. Diameter 1.5 millim.

Fossil occurrence.—Numa.

Living.—Western Japan.

Family **Vermetidae**.

30. *Thylacodes medusae*, PILSBRY.

Thylacodes medusa. Pilsbry, Catal., p. 59, pl. IV, V. Yokoyama, Foss. Miura Penin., p. 71, pl. IV, fig. 7. Foss. Up. Musash., p. 75.

Several fine specimens.

Fossil occurrence.—Numa, Kōyatsu. Lower Musashino of Miyata and Yokosuka. Upper Musashino of Shimosa.

Living.—Central and Southern Japan.

31. *Thylacodes nodoso-rugosus*, (LISCHKE).

Thylacodes nodosorugosus. Pilsbry, Catal., p. 59.

Vermetus nodosorugosus. Lischke, Jap. Meeresconch., I, p. 84, pl. V, figs. 1-4.

A young specimen, very small in size, irregularly coiled, prone and flattened below, with the apertural portion erect. The tubular shell is round in section, with an indistinct carina in the middle of the back. Very characteristic are the transverse wrinkles which are sometimes elevated and sublamellar. The aperture is only 1 millim. in diameter.

Fossil occurrence.—Numa.

Living.—Central and Southern Japan.

32. *Spiroglyphus tricarinatus*, YOKOYAMA.

Pl. I. Fig. 14.

Shell very small, planorboid, attached and flat below, longitudinally tricarinate on the free portion, with the middle carina nearly in its middle and the two others at some distance from the middle one, the surface beyond falling nearly vertical. Besides these carinae, the whole surface of the shell shows a fine reticulate sculpture. Aperture round. The diameter of the shell is 2 millim., while that of the aperture is 0.7 millim. Two specimens.

Fossil occurrence.—Numa.

33. *Vermetus reticulatus*, YOKOYAMA.

Pl. I. Figs. 17, 18, 19.

Shell rather small, consisting of irregularly and flatly coiled tubular whorls of a roundish section, usually without any longitudinal dorsal ridges on the younger portions, though there may be several of them (four or five) on the older, transversely coarsely corrugated, the corrugations, if not too much worn, being covered with elevated threads which form nets of various sizes and of irregular polygonal shape.

This species is somewhat like *Vermetus tokyoensis* Pilsbry (Catal., p. 61, pl. I, figs. 9-11), but larger (the diameter of the whorl at aperture being 4.7 millim., while in *V. tokyoensis* it is only 1.5 millim.) and covered with nets on the surface. Specimens are not rare.

Fossil occurrence.—Numa and Koyatsu.

34. *Vermetus annulatus*, YOKOYAMA.

Pl. II. Fig. 2.

Shell very small, irregularly coiled and creeping, attached with the last part, erect. The free surface is ornamented with close, more or less elevated cross-ridges or rings which are usually bent forward in the middle portion. Now and then, there is an intermediate ridge which is present only on the exterior half of the surface.

Fossil occurrence.—Numa.

Family **Litiopidae.**35. *Litiopa (Diala) semistriata*, PHILIPPI.

Pl. I. Fig. 20.

Litiopa (Diala) semistriata. Tryon, Man. Conch., IX, p. 282, pl. 53, fig. 81.*Diala varia.* A. Adams, Ann. Mag. Nat. Hist., 1861, p. 243.

Shell small, high-conic. Whorls about nine, flattish to flatly convex, smooth except near the lower suture where there are a few fine spiral grooves which may be sometimes quite obsolete. Periphery subangulate. Base convex, with several spiral furrows. Aperture ovate, pointed behind. Outer lip thin, subangulate in the middle, though the angulation is sometimes indistinct. Height 4.4 millim. Diameter 1.8 millim.

Specimens are quite common, often with the original ornamentation of a brownish colour preserved, consisting of forked streaks directed downward.

Fossil occurrence.—Numa.

Living.—Western Japan. Corea and Shantung. Hongkong, Bombay, Red Sea.

Family **Rissoidae.**36. *Rissoa (Alvania) concinna*, (A. ADAMS).

Pl. V. Fig. 11.

Alvania concinna. A. Adams, New Moll. fr. China a. Jap., Ann. Mag. Nat. Hist., 1861, VIII, p. 138.

Shell small, ovately conic. Whorls about seven, convex, the first three nuclear and smooth, the remaining longitudinally costulate and spirally striate.

Longitudinal costulae eighteen on the penultimate whorl, becoming obsolete toward the last part of the body-whorl, slightly oblique and sinuous, getting weaker toward the lower suture and sometimes vanishing before reaching it. Spiral striae many, closer above and wider below, inconspicuous on costulae. Periphery rounded. Base convex, with close spiral striae only. Aperture broadly ovate, with peristome continuous, angulate behind. Outer lip subvaricose without, smooth within, the anterior margin being somewhat reflexed outward.

A single specimen, measuring 3.3 millim. in height and 1.3 millim. in diameter.

Although Adams' description is very concise, I believe, this is the shell which he meant by the above name. It is a pity that he did not give its figure.

Fossil occurrence.—Numa.

Living.—Western Japan (Tsushima at 26 fathoms).

37. *Rissoina submerculialis*, YOKOYAMA.

Rissoina submerculialis. Yokoyama, Foss. Miura Penin., p. 73, pl. IV, fig. 15.

Several specimens, the largest being nearly 5 millim. high.

Fossil occurrence.—Numa and Kōyatsu. Lower Musashino of Yokosuka.

Living.—Central Japan.

38. *Rissoina (Phosinella) cancellata*, PHILIPPI.

Pl. V. Fig. 10.

Rissoina cancellata. Philippi, Zeitschr. Malak., 1847, p. 127. Dunker, Index Moll., p. 127, Tryon, Man. Conch., IX, p. 381, pl. 57, figs. 82-84.

The shell is small and pupoid. The whorls are flatly convex and longitudinally as well as spirally costellated. Longitudinal costellae twenty-two on the penultimate whorl and twenty-four on the ultimate, thin, straight, slightly oblique. Spiral costellae of about the same size as the longitudinal ones, six on the penultimate whorl and seven on the ultimate. Base with a broad, shallow, spiral sulcus crossing the longitudinal costellae, below which there are three spiral costellae. Aperture semilunar, with corners rounded and inner or straight side somewhat concave in the middle. Outer lip as well as anterior portion of peristome thick, with a strong varix outside of the former.

A specimen with the broken apex, and two fragments. The former has six whorls preserved, and, if perfect, would be about 5.5 millim. high. The diameter is 1.9 millim.

The fossil specimen looks most like the so-called *var. pulchra* of C. B. Adams (figs. 82 and 83 of Tryon's Manual) from the West Indies, with this difference that the number of longitudinal costellæ in the former is a little more (sixteen or eighteen in the latter). This may possibly be due to our specimen being somewhat larger, but if it should prove to be a different variety, I would call it *var. awana*.

Fossil occurrence.—Numa.

Living.—Japan (according to Dunker). West Indies.

39. *Fenella pupoides*, A. ADAMS.

Pl. V. Fig. 9.

Fenella pupoides. A. Adams, Jour. de Conchyl., XVI, p. 47, pl. IV, fig. 5. Tryon, Man. Conch., p. 394, pl. 60, fig. 76.

The shell is small, subcylindrical, and pupoid, about nine whorls which are usually convex, though indistinctly subangulate on the upper ones. The sculpture consists of spiral striae which are close, subequal, and seven or eight on the penultimate whorl. Incremental lines very coarse on the upper half of the whorls and looking almost like longitudinal sculptures. Aperture oval. Height 4 millim. Diameter 1.2 millim.

Three specimens, all showing the whorls more convex than the figures given by Tryon.

This species is closely related to *Fenella virgata* Phil. (Tryon's Manual, IX, p. 394, pl. 60, fig. 79) from the Red Sea, so that Tryon is inclined to consider it as a variety of the latter.

Fossil occurrence.—Numa.

Living.—Central and Western Japan.

40. *Fenella yamakawai*, YOKOYAMA.

Pl. I. Fig. 24.

Shell small, ovately conic. Whorls about seven and a half, the first two and a half embryonal and smooth, the remaining indistinctly subangulate in the upper part, strongly convex in the lower. Sculpture: Longitudinal striae fine, some-

what unequal, either close and equidistant, or inequidistant, more than thirty on the body-whorl, getting weaker and closer toward its end; spiral striae of about equal size as longitudinal ones, close and about eight in number on the penultimate whorl. Periphery rounded. Base convex, with several close, spiral striae. Aperture oval, with sharper end above. Outer lip thin, apparently without varix. Height 1.2 millim. Diameter 1 millim. Four examples.

The sculpture is like that of the foregoing species, but the shell is shorter.

Fossil occurrence.—Numa.

41. *Fenella shinonis*, YOKOYAMA.

Pl. I. Fig. 25.

Shell small, high-conic. Whorls about nine, the first two smooth and rounded, the succeeding subangulate near the middle, with the surface above the angle sloping and below vertical. If the angulation is indistinct, as is sometimes the case, the whorl appears strongly convex, such a character being often seen on the body-whorl. The surface-sculpture consists of longitudinal and spiral costellae. The longitudinal costellae are about sixteen on the penultimate as well as on the ultimate whorl, straight, obtuse, with interspaces of about equal breadth; on the body-whorl, there is often a strong varix near its outer end beyond which the costellae may get feebler and closer, in which case their number exceeds sixteen. The spiral costellae five, the upper two weaker and situated on the sloping shelf. Points of intersection of both kinds of costellae tubercular. Periphery rounded. Base convex, with three or four smooth spiral cords. Aperture ovate, with the anterior end somewhat produced and looking like an indication of a channel. Outer lip thin. Height 3.6 millim. Diameter 1.4 millim. Rather frequent.

Fossil occurrence.—Numa.

42. *Fenella orientalis*, YOKOYAMA.

Pl. I. Fig. 26.

Fenella orientalis. Yokoyama, Foss. Miura Penin., p. 74, pl. IV, fig. 12.

A single example lacking the apex, but somewhat larger than those of the Lower Musashino. Height about 5 millim. Diameter 1.3 millim.

Fossil occurrence.—Lower Musashino of Yokosuka.

Fossil occurrence.—Numa.

Living.—Central Japan.

43. *Fenella kenonis*, YOKOYAMA.

Pl. I. Fig. 27.

Shell small, turrete, somewhat pupoid. Whorls about nine, convex, longitudinally and spirally ribbed. Longitudinal ribs about fourteen on the penultimate, and more on the last whorl on account of their getting weaker and closer toward the extreme end, obtuse, narrower than, or equal to, intercostal spaces. Several varices on the body-whorl. Spiral ribs five, thinner than longitudinal ones, with the upper two smaller than the rest. Crossing points of both kinds of ribs more or less tubercular. Periphery rounded. Base convex, with several spiral ribs. Aperture ovate. Outer lip thin, not varicose without. Height 3.6 millim. Diameter 1.1 millim. Several examples.

This species is somewhat like *Fenella shinonis* above described, but higher and pupoid, with the body-whorl comparatively longer. Besides, there are more varices.

Fossil occurrence.—Numa.

Family Capulidae.

44. *Crepidula aculeata*, (GMELIN).

Pl. I. Fig. 12 ab.

Crepidula aculeata. Dunker, Ind. Moll., p. 124. Lischke, Jap. Meeresconch., II, p. 76. Reeve, Conch. Icon., XI, pl. IV, fig. 22, V, fig. 27. Carpenter, Moll. N. W. America, Brit. Assoc. Rep., 1856, p. 323, 1863, p. 622, no. 200.

Patella aculeata. Gmelin, Syst. Nat., p. 363, no. 6.

This well-nigh cosmopolitan shell characterized by its flatly convex form and up to about ten spiral ribs carrying little spines on their back is represented by several worn specimens.

Fossil occurrence.—Numa and Kōyatsu.

Living.—Central, Western, and Southern Japan. Both coasts of North and South America, Australia, Mauritius, etc.

Family Eulimidae.

45. *Eulima (Leiostraca) hojoensis*, YOKOYAMA.

Pl. I. Fig. 21.

Shell small, subulate, with apex blunt. Whorls about eight, flat, smooth,

shining. Body-whorl somewhat longer than spire. Sutures indistinct. Aperture pear-shaped, pointed behind, truncate in front. Inner lip slightly concave.

A single specimen whose height is 2.3 millim. and diameter 0.5 millim.

This species resembles *Eulina acanthylis* and *E. acerrima* of Watson (Challenger Gastropoda, p. 512, pl. XXXV, fig. 8. p. 513, pl. XXXV, fig. 1), from both of which the Japanese fossil differs by the longer body-whorl.

Fossil occurrence.—Numa.

46. *Odostomia (Miralda) gemma*, (A. ADAMS).

Pl. V. Fig. 16.

Odostomia (Miralda) gemma. Dall and Bartsch. Notes on Jap., Indopac., a. Amer. Pyramidellidæ, Proc. U. S. Nat. Mus., vol. XXX, p. 356, pl. XXII, fig. 1.

Chrysalida gemma. A. Adams, Ann. Mag., 1861, VIII, 1862, p. 302.

Odontosmia gemma. Pilsbry, Cotal., p. 86.

Two specimens, one of which is comparatively shorter than the other. The latter measures 2.5 millim. in length and 1 millim. in diameter.

The shell is recognized by three strong spiral keels, the two upper ones of which are crossed by longitudinal ribs, with crossing points tubercular. A full description is found in the work of Dall and Bartsch above quoted.

Fossil occurrence.—Numa.

Living.—Southern Japan (Bonins).

47. *Odostomia (Egilina) marielloides*, YOKOYAMA.

Odostomia (Egilina) marielloides. Yokoyama, Foss. Up. Musash. Kazusa a. Shimosa, p. 100, pl. IV, fig. 34.

A single young specimen only 1.4 millim. in height and 0.7 millim. in diameter.

Fossil occurrence.—Numa. Upper Musashino of Shimosa.

48. *Turbonilla humilis*, YOKOYAMA.

Pl. II. Fig. 3.

Shell small, shortly turriculate, slightly pupoid. Nuclear whorls helicoid, standing on edge at the summit, and partly immersed in the first post-nuclear whorl. Post-nuclear whorls seven, flatly convex, indistinctly shouldered at

summit, so that sutures become very distinct, longitudinally costellated. Costellæ twenty three on the body-whorl, a little oblique and sinuous, rounded, broader than interspaces, ending on the body-whorl at the rounded periphery. Base convex, smooth. Aperture rhomboidal. Inner lip bent in the middle.

A single example, 1.9 millim. in height and 0.5 millim. in diameter.

Fossil occurrence.—Numa.

Family Neritidae.

49. *Nerita albicilla*, LINNÉ.

Pl. II. Fig. 6.

Nerita albicilla. Linné, Syst. Nat., Ed. 10, p. 778. Martens in Mart. Chem. Syst. Conch. Cab., Nerita u. Neritopsis, p. 25, pl. 8, figs. 1, 2. Lischke, Jap. Meeresconch., I, p. 85, II, p. 81, III, p. 60. Sowerby, Thes. Conch, v, p. 112, pl. 464, figs. 26—28. Pilsbry, Catal., p. 87. Iwakawa, Cat. Jap. Moll., p. 25.

A much worn specimen. The shell is thick and solid, transversely oval-elliptical with broad, unequal, close, spiral ribs. The spire is quite flat. Outer lip thick, toothed within. Columella margin also finely toothed, with columella-surface granulated.

Fossil occurrence.—Kōyatsu.

Living.—Central, Western and Southern Japan. Indian Ocean. Polynesia.

Family Turbinidae.

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

Pl. I. Fig.

Turbo cornutus. Gmelin, Syst. Nat., Ed. 13, p. 3593. Reeve, Conch. Icon., Turbo, pl. II, fig. 2. Lischke, Jap. Meeresconch., I, p. 87, II, p. 81. Schrenck, Moll. Amurl. u. d. nordjap. Meeres, p. 362. Dunker, Ind. Moll., p. 127. Tryon, Man. Conch., X, p. 216, pl. 43, figs. 50, 52. Pilsbry, Catal., p. 88.

A single young example of about 23 millim. in height without the spines of the adult.

Fossil occurrence.—Numa.

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

51. *Turbo (Marmorostoma) granulatus*, GMELIN.

Turbo (Marmorostoma) granulatus. Pilsbry, Catal., p. 80. Yokoyama, Foss. Up. Musash., p. 107, pl. V, fig. 10.

Turbo granulatus. Gmelin, Syst. Nat., Ed. 13, p. 3601. Lischke, Jap. Meeresconch., I, p. 87. Tokunaga, Foss. Env. Tokyo, p. 28, pl. I, fig. 59.

Three very good specimens and several opercula.

Fossil occurrence.—Numa and Koyatsu. Upper Musashiuo of Shimosa.

Living.—Central, Western and Southern Japan. China. Indian Ocean.

52. *Astralium (Cyclocantha) haematragus*, (MENKE),

Pl. II. Fig. 7.

Astralium (Cyclocantha) haematragus. Pilsbry, Catal., p. 89. Iwakawa, Cat. Jap. Moll., p. 34. Tryon, Man. Conch., V, p. 236, pl. 54, figs. 57, 58.

Calcar haematragus. Dunker, Ind. Moll., p. 129.

Trochus haematragus: Menke, Catal. Coll. Malsb. Pymonti 1329, p. 18. Dunker, Moll. Jap., p. 20.

Trochus columellaris. Philippi in Mart. Chemn. Syst. Conch. Cab., Bd. II, p. 123, pl. 21, fig. 5.

A single specimen, but well preserved. It is distinguished by flat whorls with many oblique ribs whose lower end is produced into a spine. The base is flat with concentric squamose liræ.

Fossil occurrence.—Kōyatsu.

Living.—Central and Western Japan. China.

53. *Leptothyra pilula*, (DUNKER).

Pl. V. Fig. 20.

Leptothyra pilula. Pilsbry, Cat., p. 90. Tryon, Man. Conch., X, p. 258, pl. 58, fig. 59.

Liotia pilula Dunker, Moll. Jap., p. 19, pl. II, fig. 7. Ind. Moll., p. 131.

Cynisca japonica. A. Adams, Ann. Mag., VIII, 1861, p. 244.

The shell is solid, globose-conic, umbilicate, with spire low-conical. The whorls number four and are angulate, with the surface above the angle flat and only little sloping, and below somewhat convex. The flat upper surface is ornamented with spiral cords, three upon the penultimate and four upon the ultimate whorl, one or two upper ones being cut into transversely elongated beads. The angle itself is formed by a strong cord, there being also a prominent one in

the middle of the surface below it. On the body-whorl, the surface below the angle is furnished with two strong cords and a few unequal spiral striae between. Periphery angulate and corded. Base somewhat convex with many (eleven in our specimen) spiral threads. Umbilicus small, with margin coarsely crenate. Aperture circular, with peristome thick. A single example whose height is 4.2 millim. and diameter 5.9 millim.

The brown radiating maculations found on a fresh shell are still distinctly preserved.

The fossil specimen looks much like the figure given by Tryon, that of Dunker showing the shell as if it were quite smooth.

Fossil occurrence.—Numa.

Living.—Western Japan.

Family Trochidae.

54. *Trochus (Clanculus) atropurpureus*, (GOULD).

Pl. II. Fig. 5.

Trochus (Clanculus) atropurpureus. Tryon, Man. Conch., XI, p. 77, pl. 15, figs. 50, 51, pl. 11, figs. 28-32, pl. 13, figs. 86, 57.

Trochus (Monodonta) atropurpureus. Gould, Proc. Bost. Soc. Nat. Hist., III, p. 107. U. S. Expl. Exped. Shells, p. 189, pl. 13, fig. 224.

Trochus samoensis. Hombrom et Jacquinot, Voy. au Pole Sud, Zool., V, p. 58, pl. XIV, figs. 21-25.

Characterized by its coloration which consists of dark purplish or ferruginous brown, with apex carmine. This coloration is also distinctly preserved on our specimens which are three in number. The shape of the shell is a depressed cone, with the umbilicus open, deep and bordered by a marginal rib bearing strong teeth. The whorls are covered with granose spiral lirae.

The largest of the specimens measures 9.3 millim in height and 12 millim. in diameter.

Fossil occurrence.—Numa.

Living.—South Sea (Fijis, Solomons, New Guinea, etc.).

55. *Trochus (Clanculus) gordonis*, YOKOYAMA.

Pl. II. Fig. 4.

Shell small, rather solid, flatly conical, with base somewhat convex. Whorls

flat, five in number, separated by subchannelled sutures, spirally granose-lirate; liræ four, distant, alternately large and small, the uppermost being the smaller one. Just at the lower suture, there is also a fine smooth spiral stria. Spaces between the granose liræ of the body-whorl provided with an interstitial spiral thread. Incremental lines very distinct, appearing on the upper whorls like a longitudinal sculpture. Periphery angulate, formed by a smooth cord. Base with many smooth subequal spiral threads almost as large as the granose liræ of the whorls. Umbilicus closed, but with a small shallow hole. Aperture quadrate, with lips thin. Outer lip sulcate and nacreous within.

The original colouration of the shell is more or less distinctly preserved. It seems to have been a light red or pink, with dark purplish dots on some of the granules.

A single example measuring 7.4 millim. in height and 7.2 millim. in diameter.

Fossil occurrence.—Numa.

56. *Monodonta labio*, (LINNÉ).

Pl. II. Fig. 8.

Monodonta labio. Pilsbry, Catal., p. 93. Iwakawa, Cat. Jap. Moll., p. 20. Tryon, Man. Conch., XI, p. 86, pl. 19, figs. 95, 96. Lischke, Jap. Meeresconch., I, p. 95. Dunker, Moll. Jap., p. 28. Ind. Moll., p. 139. Philippi in Mart. Chemn. Syst. Conch. Cab., II, p. 166, pl. 27, fig. 1.

Trochus labio. Linné, Syst. Nat., Ed. 10, No. 516.

This is a thick-shelled, ovate-conical, imperforate species with granular or wrinkled spiral cords. The aperture is oval, higher than broad. Outer lip sharp at margin and with several transverse ridges within. The columella ends below with a tooth which is often bifid.

A few examples.

Fossil occurrence.—Koyatsu.

Living.—Northern, Central, Western and Southern Japan. China. Moluccas. Senegal.

57. *Chlorostoma quantoanum*, YOKOYAMA.

Chlorostoma quantoanum. Yokoyama, Foss. Miura Penin., p. 88, pl. V, fig. 24.

A single, but a splendid specimen.

Fossil occurrence.—Koyatsu. Lower Musashino of Yokosuka.

58. *Cantharidus japonicus*, (A. ADAMS).

Cantharidus japonicus. Yokoyama, Foss. Miura Penin., p. 89, pl. V, fig. 26.

One bad specimen.

Fossil occurrence.—Kōyatsu. Lower Musashino of Miyata and Yokosuka.

Living.—Central and Western Japan.

59. *Umbonium costatum*, (VALENCIENNES).

Umbonium costatum. Yokoyama, Foss. Miura Penin., p. 95, pl. VI, fig. 6. Foss. Up. Musashino, p. 114.

A small but well-preserved specimen.

Fossil occurrence.—Koyatsu. Lower Musashino of Nagayama. Upper Musashino of Kazusa and Shimosa.

Living.—Northern, Central and Western Japan.

Family, **Stomatellidae**.

60. *Stomatella lyrata*, PILSBRY.

Stomatella lyrata. Yokoyama, Foss. Up. Musashino, p. 115, pl. VI, fig. 2.

This is a depressed-globose shell with several unequal spiral liræ on the surface, the interspaces of which are closely latticed by oblique striae.

Several specimens, the largest of which measures 10 millim. in height and 14 millim. in diameter.

Fossil occurrence.—Numa.

Living.—Northern, Central and Western Japan.

Family. **Scissurellidæ**.

61. *Scissurella turbinata*, (A. ADAMS).

Pl. V., Fig. 21.

Anatomus turbinatus. A. Adams, Ann. Mag. Nat. Hist., X, 1862, p. 347.

Shell small, thin, turbinata, with spire only little elevated. Whorls about three and a half, carinate in the middle, the surface above the carina being nearly

flat, horizontal, ornamented with fine, distant, curved, elevated, longitudinal striae, and below, nearly vertical, somewhat convex, with the same kind of sculpture as on the upper shelf, while on the body-whorl there are, besides, two elevated spiral striae, making the surface finely latticed. The carina above mentioned is always made up of two elevated parallel lamellae. Periphery rounded, its boundary with the base being indistinct, if the second spiral stria is not taken for it. Base convex, with several, distant, spiral striae smaller than those found on the lateral side of the body-whorl. Incremental lines distinct, but not elevated. Umbilicus small, deep. Aperture ovate, with the posterior corner pointed. Height 1.2 millim. Diameter. 1.7 millim. Only two specimens.

Adams' description of the above species is very concise and is not accompanied by any figure. But, I believe, it is the same species as our fossil.

Fossil occurrence.—Numa.

Living.—Western Japan.

Family Fissurellidæ.

62. *Fissuridea rueppellii*, (SOWERBY).

Pl. II., Fig. 9.

Fissurella rueppellii. Sowerby, Proc. Zool. Soc. Lond., 1834, p. 128. Thes. Conch., III, p. 107, pl. 240, figs. 107, 108.

Glyphis rueppellii. Pilsbry in Tryon's Man. Conch., XII, p. 217, pl. 39, figs. 82–85.

Fissurella elevata. Philippi, Abbild., II, p. 67. pl. 2, fig. 4.

The elliptical shell, the strongly elevated and anteriorly curved apex, the closely latticed sculpture, and the squarish oblong hole are some of the characteristics of this species. Height 10 millim. Longer diameter 20 millim. Shorter diameter 12 millim.

The specimens are quite frequent.

Fossil occurrence.—Numa, Koyatsu.

Living.—Red Sea, Mauritius, Cape of Good Hope, etc.

63. *Submarginula cratitoides*, YOKOYAMA.

Pl. II., Fig. 10.

Shell small, solid, elevated, oblong, radiately ribbed; ribs a little more than twenty in number, rounded, generally alternately large and small, latticed by

distant concentric riblets. Apex somewhat posterior, directed backward. Slit shallow, situated either at the end of a rib, or close to it.

Two examples. One measures 3.6 millim. in height, 7.1 millim. in length and 4.6 millim. in breadth, while the other measures 2.9 millim. in height, 6.3 millim. in length and 4.1 millim. in breadth. The larger specimen is much worn.

This shell is not unlike *Submarginula cratitia* A. Adams (Proc. Zool. Soc., 1851, p. 92, no. 19. Tryon's Manual, XII, p. 282, pl. 29, figs. 21, 22) in sculpture. But it is more quadrate and the apex more posterior. Sowerby's *Emarginula longissa* (Thes. Conch., II, pl. 246, fig. 60) is also like our fossil, though the slit is not so deep.

Fossil occurrence.—Numa.

Class Scaphopoda.

Family Dentaliidae.

64. *Dentalium octogonum*, LAMARCK.

Dentalium octogonum. Lamarck, Anim. s. Vert., V, p. 344. Brauns, Geol. Env. Tokio, p. 95. Tokunaga, Foss. Env. Tokyo, p. 33, pl. II, fig. 15. Yokoyama, Foss. Miura Penin., p. 103, pl. VI, figs. 22–24. Foss. Up. Musashino, p. 118.

Two fragments.

Fossil occurrence.—Numa. Lower Musashino of Miyata, Yokosuka and Naganuma. Upper Musashino of Musashi, Kazusa and Shimosa.

Living.—Northern, Central and Southern Japan. China, Australia, Ceylon.

Class Lamellibranchiata.

Family Pholadidae.

65. *Pholas cupula*, YOKOYAMA.

Pl. II., Fig. 15.

Shell small, thin, more or less globose, differently sculptured in front and behind, the boundary between being somewhat flattened and marked by a strong, rounded, somewhat flexuous, umbono-ventral rib within. Anterior half with ventral margin ascending and indented in the middle, and dorsal margin curved

back, ornamented with close, elevated, wavy, concentric striae, the waves making longitudinal rows and looking like radiating striae. Posterior half somewhat longer and flatter than anterior, and concentrically, rather rudely corrugated.

A single left valve, 4.7 millim. in height. 4.5 millim. in length and 2.2 millim. in depth.

This shell looks somewhat like *Pholas terecinaeformis* Sowerby. (Thes. Conch., II, p. 490, pl. 108, figs. 97, 98) from the West Indies which, however, possesses an umbono-ventral groove not present in our fossil.

Fossil occurrence.—Numa.

66. *Pholas subconstricta*, YOKOYAMA.

Pl. II., Fig. 13.

Shell transversely elongated, divided into two nearly equal parts by an oblique umbono-ventral groove. Anterior half convex, concentrically striated and radiately ribbed, obtusely pointed at end; concentric striae elevated, lamelliform, made undulating by radiating ribs which are flatly rounded and generally very close; lower margin also wavy, and upper margin reflexed. Posterior half semi-oblong, rounded at end, concentrically roughly striated. Accessory valves not preserved.

The shell is much like *Zirphaea constricta* Sowerby (Thes. Conch., III, p. 489, pl. 104, fig. 27) living in the Sunda Straits. But the fossil shows its anterior half much less convex, so that the whole shell is less ventricose.

A right and a left valve. The former is 25 millim. long, 13 millim. high and 6.8 millim. deep, while the latter is comparatively larger, being 22 millim. in length, 9 millim. in height and 4 millim. in depth.

Fossil occurrence.—Numa.

67. *Jouannetia cumingii*, (SOWERBY).

Pl. II., Fig. 14.

Jouannetia cumingii. Dunker, Index Moll., p. 170.

Triumphalia cumingii. Sowerby, Proc. Zool. Soc. Lond., 1849, p. 161, pl. 5, fig. 3. Thesaur. Conchyl., II, p. 502, pl. 106, figs. 56, 57.

The shell is globular, with valves unequal. The surface is divided into two unequal parts by an umbono-ventral furrow. The anterior part is much longer

than the posterior, finely concentrically striated, with radiating riblets toward the anterior end. The posterior part is very short, with elevated concentric striae. The right valve is provided with a triangular, rather tongue-like, posterior extension. Tolerably frequent.

Fossil occurrence.—Numa.

Living.—Western Japan. Philippines.

68. *Jouannetia yabei*, YOKOYAMA.

Pl. II., Fig. 11.

Shell thin, transversely elongated, divided into two nearly equal parts by a somewhat oblique umbono-ventral groove. Anterior half triangular, with ventral margin a little longer than a reflexed dorsal, bluntly pointed at end, concentrically lamellate and radiately costellate. Costellæ more than ten in number, absent on the posterior slope down to the groove, and crossing the concentric lamellæ which, thereby, elevate themselves into little scale-like processes. Posterior half also subtriangular, with end rounded and ventral margin somewhat shorter than dorsal, furnished with distant, slightly elevated, concentric striae as well as with fine, distant, radiating lines, the intersection-points being more or less spiny. Between the concentric striae, there is usually a fine interstitial one.

A fragment of a right valve which, if perfect, would be about 8 millim. long. The height is 4 millim.

Fossil occurrence.—Numa.

Living.—Central Japan.

Family **Corbulidæ**.

69. *Basterotia gouldii*, (A. ADAMS)

Pl. III., Fig. 2, 3.

Basterotia gouldii. Pilsbry, Catal., p. 118.

Euchavis gouldii. A. Adams, Ann. Mag. Nat. Hist., 1864, p. 309, 1865, p. 366.

The shell is ovate-triangular in outline, swollen, with beaks strongly curved forward. The anterior part of the surface has granules which, in our specimens, are not quite distinct, owing to their water-worn state. The dentition

consists of a long tooth in the right valve, and two teeth in the left, the anterior of which is longer and also stronger.

The shell-outline shows some variation, some specimens being higher than others.

Three right and three left valves. The largest is a left valve measuring 11.6 millim. in length, 8.3 millim. in height and 3.9 millim. in depth. The largest right valve measures 11.1 millim. in length, 8.4 millim. in height and 3 millim. in depth.

Fossil occurrence.—Numa.

Living.—Western Japan.

Family *Semelidæ*.

70. *Semele aspasia*, ANGAS.

Pl. II. Fig. 17.

Semele aspasia. Angas, Proc. Zool. Soc. Lond., 1878, p. 860, pl. 54, fig. 3.

The shell is ovately orbicular in outline, flatly convex and nearly equilateral. The surface-sculpture consists of erect, frilled, concentric lamellæ with interstices radiately striated. Of the two main teeth of the left valve, the anterior is thick and the posterior thin. The pallial sinus is large, finger-like and obliquely ascending.

A right and a left valve, besides a fragment of a left valve. The right valve measures 28 millim. in length, 25 millim. in height and 6.4 millim. in depth, while the left measures 31.4 millim. in length, 29.7 millim. in height and 7 millim. in depth.

Angas in his "Description of Six Species of Marine Bivalve Shells in the Collection of Mr. Sylvanus Hanley and of a Helix from the Solomon Islands" published in the above quoted proceedings does not give the habitat of *Semele aspasia*. However, it is very probable that it is tropical.

Fossil occurrence.—Numa.

Living.—South Sea (?)

Family **Tellinidae**.71. *Tellina iridella*, MARTENS.

Pl. V. Fig. 23.

Tellina iridella. Martens, Ann. Mag. Nat. Hist., 1865, p. 431. Lischke, Jap. Meeresconch., II, p. 114, pl. X, figs. 8, 9. Dunker, Ind. Moll., p. 191. Pilsbry, Cat., p. 124.

A few examples.

This is a small, thin and compressed shell, rounded in front, and narrowed and bluntly pointed behind. A right valve which is the largest we possess is 9.7 millim. long, 5.5 millim. high and 1.5 millim. deep.

Fossil occurrence.—Numa.

Living.—Central and Western Japan.

72. *Tellina radiato-lineata*, YOKOYAMA.

Pl. II. Fig. 18, 19.

Shell small, thin, compressed, transversely round-rhomboidal, subequilateral, with anterior side slightly longer than posterior, somewhat inequivalve with a distinct posterior flexure. Anterior margin sharply rounded, posterior indistinctly truncate, antero-dorsal nearly straight, postero-dorsal slightly arched, ventral broadly rounded. Surface-sculpture consisting of regular, distant, more or less elevated, concentric striae with fine, rather irregular, impressed radiating lines between, which near the beaks are more or less indistinct (defaced?). Cardinal teeth two in each valve, the anterior in the left and the posterior in the right being stronger. Lateral teeth large and distinct. Pallial sinus very large, reaching beyond the median line of the shell. The original colour of the surface seems to have been reddish, as such a tint is preserved on some specimens. Rather rare.

The largest right valve measures 7.5 millim. in length, 6 millim. in height, and 1.7 millim. in depth, while the largest left measures 7 millim. in length, 6 millim. in height and 1.8 millim. in depth.

Fossil occurrence.—Numa.

73. *Macoma inquinata*, (DESHAYES).

Macoma inquinata. Pilsbry, Cat., p. 124. Arnold, Pal. a. Strat. Mar. Plioc. a. Pleistoc. San Pedro, p. 162, pl. XVII, fig. 4. Yokoyama, Foss. Miura Penin., p. 117. pl. VIII, figs. 1, 2. Foss. Up. Musash., p. 142.

Tellina inquinata. Deshayes, Proc. Zool. Soc. Lond., 1854, p. 357.

A few specimens.

Fossil occurrence.—Numa, Koyatsu. Lower Musashino of Miyata and Yokosuka. Upper Musashino of Shimosa. Pliocene and Pleistocene of California.

Living.—Okhotsk Sea down to Western Japan. Alaska to Lower California.

Family **Petricolidæ**.74. *Petricola awana*, YOKOYAMA.

Pl. II. Fig. 12. Pl. III. Fig. 1.

Shell thick, moderately, inflated, quadrate in outline, longer than high, strongly inequilateral and somewhat inequivalve. Antero-dorsal margin only little convex, steeply sloping, meeting in a rounded angle with broadly arcuate ventral margin. Postero-dorsal margin nearly straight and gently sloping, posterior obliquely subtruncate, making a blunt angle with ventral. Surface uneven, concentrically rudely striated. A blunt edge runs from the small beak to the postero-ventral corner. Teeth two, diverging. Pallial line indistinct.

A single example with both valves perfect. Height 13.7 millim. Length 19.5 millim. Thickness 9.5 millim.

Fossil occurrence.—Numa.

Family **Veneridæ**.75. *Meretrix tigrina*, (LAMARCK)

Pl. II. Fig. 16.

Cytherea tigrina. Lamarck, Anim. s. Vert., V. p. 569, no. 34. Sowerby, Thesaur. Conchyl., II, p. 135, figs. 155–157. Iwakawa, Hand-list of Jap. Bivalves, p. 81.

Circe tigrina. Deshayes, Conch. Brit. Mus., I, p. 94, no. 32.

Circe inflexa. H. and A. Adams, Gen. Rec. Moll., p. 429.

Lioconcha tigrina. Roemer in Malak. Blätter, 1861, p. 145, no. 14.

The shell is rather small, triangular in shape, and swollen. The surface is concentrically, though shallowly, furrowed. Pallial sinus very shallow, almost obsolete. Lunula heart-shaped, bounded by a fine line either elevated or impressed.

The colour-ornamentation is still well preserved in our fossil. It consists of many small and large triangular or inverted v-shaped figures.

Specimens frequent. The largest obtained is a right valve, 28 millim. long, 23.5 millim. high and 9.5 millim. deep.

Fossil occurrence.—Numa, Kōyatsu.

Living.—Western Japan (the southernmost part, i.d., Ōsumi in Kyushu). Philippines, Moluccas, Indian Ocean.

76. *Meretrix (Callista) limatula*, (SOWERBY).

Pl. II. Fig. 21.

Meretrix (Callista) limatula. Pilsbry, Cat., p. 127.

Callista limatula. Dunker, Ind. Moll., p. 200, H. and A. Adam, Gen. Rec. Moll., II, p. 426.

Cytherea limatula. Sowerby, Thes. Conch., II, p. 640, pl. 136, figs. 200, 201. Pfeiffer in Syst. Conch. Cab., XI, part 1, p. 58, pl. 22, fig. 5.

This shell resembling the preceding in shape and convexity is readily distinguished from it by a moderately deep, triangular, pallial sinus, a distinct furrow bounding the lunula, and the presence of an indistinct area. The colour-markings of the surface are also not unlike those of *Meretrix tigrina*, though they consist more of transverse zigzags. On comparing with the living specimens, the fossil is more markedly truncate behind.

A few examples. The largest is a left valve, 20 millim. long, 17 millim. high and 7 millim. deep.

Fossil occurrence.—Numa.

Living.—Central Japan. Moluccas.

77. *Venus jedoensis*, LISCHKE.

Pl. II. Fig. 20.

Venus jedoensis Lischke, Jap. Meeresconch., III, p. 84, pl. VII, figs. 1–9. Pilsbry, Catal., p. 127.

This is a shell frequently met with living in Central Japan. It is thick, inequilateral, oval to roundly squarish, longer than high, convex, with anterior margin rounded and posterior subtruncate. The surface is radiately ribbed; the ribs are many, more or less unequal, and are separated by interstices narrower than the ribs themselves. Crossing the ribs there are concentric striæ which are more or less elevated and at unequal distances. Ventral margin crenulate within. Lunula distinct, heart-shaped and radiately ribbed. Pallial sinus triangular, rather deep. Frequent.

Fossil occurrence.—Numa.

Living.—Northern, Central and Western Japan.

78. *Venus toreuma*, GOULD.

Pl. II. Fig. 22.

Venus toreuma. Gould, Proc. Bost. Soc. Nat. Hist, III, p. 277. Otia Conch., p. 84. Lischke, Jap. Meeresconch., I, p. 121. Pilsbry, Catal., p. 127.

Venus crebrisulca. Sowerby, Thes. Conch., II, p. 728, pl. 161, figs. 187–189.

Venus jukesi. Deshayes, Conch. Brit. Mus., I, p. 103, no. 3. Pfeiffer in Syst. Conch. Cab. Mart. Chem., XI, pt. 1, p. 217, pl. 35, figs. 7–9.

A single right valve of a young individual, 13 millim. long and 11.7 millim. high. The depth is only 4 millim., and therefore somewhat flatter than in adult specimens. The outline is suborbicular, with the surface concentrically ridged. The ridges are distant, tubercular in the hinder portion and separated by the concave interstices which are finely concentrically striated. The lunula is deeply impressed, broadly cordate. Pallial sinus triangular and shallow.

Fossil occurrence.—Numa.

Living.—Central and Western Japan. Philippines. Port Essington in North Australia.

79. *Venerupis irus*, (LINNÉ).

Pl. II. Fig. 23.

Venerupis irus. Yokoyama, Foss. Miura Penin., p. 124, pl. IX, fig. 1. Sowerby, Thes., Conch., II, p. 763, pl. 164, fig. 1. Pfeiffer in Syst. Conch. Cab. Mart. Chem. XI, pt. 1, p. 245, pl. 31, figs. 17–19.

Donaax irus. Linné, Sys. Nat., Ed. X, p. 683, Ed. XII, p. 1128, no. 111.

The shell which I call by the above name is transversely elongated, subquadrate and not very convex. The anterior margin is generally straight and sloping, meeting with the ventral at an angle less than a right angle and with the end usually bluntly pointed. The posterior margin is truncate and nearly at right angles with the ventral, though the corner is rounded. The pallial sinus is triangular and moderately deep, the upper border being nearly horizontal, and the lower obliquely descending. The surface-sculpture consists of distant concentric lamellæ, the interstices of which are radiately striated.

The specimens which are not at all rare agree quite well with the figures given by Pfeiffer in the "Systematischen Conchylien-Cabinet" above quoted, if they are young ones; but the adult are more like the figures given in the Thesaurus, the shell being more rounded at corners and also furnished with a slight median depression.

Fossil occurrence.—Numa and Koyatsu. Lower Musashino of Yokosuka. Pliocene of Europe.

Living.—Northern, Central and Western Japan. Atlantic Ocean from Britain to the Canaries, and also in the Mediterranean Sea.

80. *Venerupis insignis*, (DESHAYES).

Pl. III. Fig. 4.

Venerupis insignis. Yokoyama, Foss. Miura Penin., p. 124, pl. IX, figs. 2,3.

Rupellaria insignis. Dunker, Ind. Moll., p. 209. Deshayes, Proc. Zoll. Soc. Lond., 1853, p. 6, pl. 18. fig. 4.

A single left valve. It is tolerably thick and transversely oblong, with the anterior end bluntly pointed and the surface ornamented with concentric ridges which are partly lamellar. The pallial sinus is somewhat ascending and obtusely pointed. Length 26.7 millim. Height 19.3 millim. Depth 6.5 millim.

Fossil occurrence.—Numa. Lower Musashino of Yokosuka.

Living.—Northern and Central Japan. New Zealand.

81. *Tapes philippinarum*, (A. ADAMS et REEVE).

Tapes philippinarum. Yokoyama, Foss. Miura Penin., p. 125, pl. IX, fig. 6. Foss. Up. Musashino, p. 152. Lischke, Jap. Meeresconch., I, p. 115, II, p. 108, III, p. 78.

Venus philippinarum. Adams and Reeve, Voyage Samarang, Moll., p. 79, pl. XXII, fig. 10.

Venus decussatus, var. *philippinarum*. Tokunaga, Foss. Env. Tokyo, p. 49, pl. III, fig. 7.

A single right valve.

Fossil occurrence.—Numa. Lower Musashino of Yokosuka. Upper Musashino of Musashi, Shimosa and Kazusa.

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

82. *Saxidomus purpuratus*, (SOWERBY).

Saxidomus purpuratus. Yokoyama, Foss. Miura Penin., p. 127, pl. IX, figs. 8, 9. Foss. Up. Musashino, p. 153. Brauns, Geol. Env. Tokyo, p. 40, pl. V. fig. 8.

Saxidomus nuttali. Conrad, Jour. Acad. Sci. Phil., 1887, VII, p. 249, pl. XX, fig. 12. Tokunaga, Foss. Env. Tokyo, p. 45.

A single left valve, 83 millim. long and 60 millim. high.

Fossil occurrence.—Numa. Lower Musashino of Yokosuka. Upper Musashino of Musashi, Kazusa, and Shimosa.

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

Family Galeommidae.

83. *Scintilla solidula*, DESHAYES.

Pl. V. Fig. 22.

Scintilla solidula. Deshayes in Sowerby's Thes. Conch., III, p. 178, pl. 235, figs. 48, 49.

A small transversely oval shell, inflated, comparatively solid, and with the anterior side only a little shorter than the posterior. The anterior as well as the posterior margin is rounded, the latter a little more sharply than the former. The dorsal margin is slightly arched, while the ventral is almost straight. The outer surface is perfectly smooth, but the inner, when examined with a strong magnifier, shows extremely fine radiating lines. The teeth are two, divergent, with the anterior thick and bifid, and with a deep notch between, while the posterior is thin. Also a tooth-like transverse projection is present somewhat behind the beak, which may be looked upon as a posterior lateral.

Several examples. The largest is a left valve, measuring 8.5 millim. in length, 6.3 millim. in height and 2.3 millim. in depth.

Deshayes in describing this species did not give its habitat, but as the genus *Scintilla* has hitherto been reported only from Southern Japan and tropical regions, it is almost certain that the species is from a warmer sea.

Fossil occurrence.—Numa, Koyatsu.

Living.—South Sea.

84. *Scintilla nipponica*, YOKOYAMA.

Pl. IV. Fig. 1.

A single left valve, 7 millim. long, 5.3 millim. high and 1.5 millim. deep.

The shell is ovate-triangular, and rounded at both ends, the posterior more sharply than the anterior. The ventral margin is as a whole nearly straight, though somewhat excavated in the middle. The main teeth are two, the anterior thick and bifid, and the posterior thin and long. The surface is smooth.

This shell is flatter and more triangular than the preceding. Moreover, the anterior side is slightly longer than the posterior.

Fossil occurrence.—Numa.

85. *Scintilla trigonalis*, YOKOYAMA.

Pl. IV. Fig. 2.

A single left valve with the postero-dorsal margin slightly arched and sloping, and meeting with the broadly arched ventral at a rounded angle. The front margin is well rounded. The surface and the teeth are like the preceding species, though the shell is decidedly more triangular in shape. Length 7.7 millim. Height 5.6 millim. Depth 1.5 millim.

Fossil occurrence.—Numa.

86. *Galeomma adamsi*, YOKOYAMA.

Pl. IV. Figs. 3, 4.

Shell small, rather thin, transversely ovate, compressed, nearly equilateral, the anterior side being only little shorter than the posterior. Anterior and

posterior margins rounded, the latter a little more broadly than the former. Antero- and postero-dorsal margins only slightly arched, sloping, ventral straight or somewhat excavated in the middle. Surface flattened or depressed in the median line, ornamented with very fine radiating lines which often repeatedly dichotomize or unite. Growth-lines irregular. Beaks very small, pointed. Teeth two in each valve, diverging in the left valve and with the anterior more prominent; the posterior in the right valve is indistinct.

Two right valves and one left. The larger of the right valves measures 15 millim. in length, 11 millim. in height and 2.4 millim. in depth. The left valve is 10 millim. long, 8.3 millim. high and 1.6 millim. deep.

A. Adams describes a species of *Galeomma* from Minoshima, Tsushima Strait, under the name of *G. japonica* without figure (Ann. Mag. 1862, p. 228). It seems to be closely akin to our fossil. But he says that the ventral margin is arcuate, which is not the case in ours.

Fossil occurrence.—Numa.

Family Leptonidae.

87. *Lepton puncticulatum*, YOKOYAMA.

Pl. IV. Figs. 8, 9.

A single example, but with both valves perfect.

Shell small, rather thin, moderately convex, trigonal, slightly inequilateral, rounded at both ends, the anterior a little more broadly than the posterior. Antero- and postero-dorsal margins only little arched, sloping, ventral straight in the middle and arched toward both ends. Surface finely punctulate, the punctures being so arranged as to form two oblique rows which cross each other. Main teeth two in each valve, in the left valve just below the beak, diverging and with the anterior longer than the posterior, in the right valve, the anterior very small and grain-like, while the posterior is conspicuous, oblique, and somewhat curved with the concave side directed towards the front. Lateral teeth single, only the posterior being present, which in the right valve is double and lamellar, with the lower lamella larger. Length 8.3 millim. Height 5.3 millim. Thickness 3.6 millim.

This species is easily recognized by its puncticulate shell.

Fossil occurrence.—Numa.

Family **Diplodontidae.**

88. *Diplodonta semiaspera*, PHILIPPI.

Diplodonta semiaspera. Philippi, Arch. f. Naturgesch., I, 1836, p. 225, pl. VII, fig. 2. Dunker, Index, p. 218. Yokoyama, Foss. Miura Penin., p. 131, pl. X, figs. 2, 3. Foss. Up. Musash., p. 160.

A single valve of a young individual.

Fossil occurrence.—Lower Musashino of Miyata and Koshiha. Upper Musashino of Musashi, Kazusa and Shimosa.

Fossil occurrence.—Numa.

Living.—Central and Western Japan. West Indies. Mazatlan, Patagonia.

89. *Diplodonta japonica*, PILSBRY.

Diplodonta japonica. Pilsbry, Catal., p. 132, pl. III, figs. 6, 7. Yokoyama, Foss. Miura Penin., p. 131, pl. X, fig. 4. Foss. Upper Musash., p. 159.

Several specimens.

Fossil occurrence.—Numa, Koyatsu. Lower Musashino of Naganuma. Upper Musashino of Shimosa.

Living.—Central and Western Japan.

Family **Lucinidae.**

90. *Lucina contraria*, DUNKER.

Lucina contraria. Yokoyama, Foss. Miura Penin., p. 134, pl. X, fig. 8. Foss. Up. Musash., p. 161.

A single left valve.

Fossil occurrence.—Kōyatsu. Lower Musashino of Miyata. Upper Musashino of Musashi and Shimosa.

Living.—Central Japan.

91. *Lucina pisidium*, DUNKER.

Lucina pisidium. Dunker, Moll. Jap., p. 28, pl. III, fig. 9. Yokoyama, Foss. Miura Penin., p. 132, pl. X, fig. 6. Foss. Up. Musash., p. 160.

Not rare.

Fossil occurrence.—Numa. Lower Musashino of Miyata, Yokosuka and Naganuma. Upper Musashino of Shimosa.

Living.—Northern, Central, and Western Japan. New South Wales.

92. *Codakia bella*, Conrad var. *delicatula*, PILSBRY.

Pl. III. Fig. 8.

Codakia bella, delicatula. Pilsbry, New Jap. Mar. Moll., Pelec., Proc. Acad. Nat. Sci. Phil., 1904, July, p. 555.

The typical examples of this species have been described by Dunker as *Lucina fibula* Ad. et Reeve (Mollusca Japonica, p. 28) and *L. divergens* Phil. (Index Molluscorum, p. 217) from Nagasaki (Western Japan) which are identical with *Lucina ramulosa* Gould.

The variety *delicatula* is according to Pilsbry smaller, more inflated (the thickness exceeding half the length), with finer, more delicate sculpture.

Our examples which are quite frequent agree quite well with Pilsbry's form. The largest measures 1.9 millim. in height and length, and 11 millim. in thickness.

Fossil occurrence.—Numa, Kōyatsu.

Living.—Southern Japan (Ryukyū).

Family **Chamidae.**

93. *Chama semipurpurata*, LISCHKE.

Chama semipurpurata. Lischke, Jap. Meeresconch., II, p. 130, pl. VIII, fig. 1. Yokoyama, Foss. Miura Penin., p. 136, pl. X, figs. 13, 14. Foss. Up. Musash., p. 161.

In many specimens.

Fossil occurrence.—Numa and Kōyatsu. Lower Musashino of Miyata. Upper Musashino of Shimosa and Kazusa.

Living.—Central, Western and Southern Japan.

94. *Chama retroversa*, LISCHKE.

Pl. III. Fig. 7.

Chama retroversa. Lischke, Jap. Meeresconch., II, p. 128, pl. IX, figs. 1-3.

Two lower valves of young individuals, readily known by the beak turned to left. The free part is high and elevated, with the outline oval and the depth great. The surface is covered with irregular concentric lamellæ.

Living.—Central and Western Japan.

Fossil occurrence.—Numa.

Family **Carditidae.**

95. *Cardita crassicosta*, LAMARCK.

Pl. III. Fig. 12.

Cardita crassicosta. Lamarck, Anim. s. Vert., VI, p. 430. Reeve, Conch. Icon. Cardita, fig. 7. Clessin in Syst. Conch. Cab. Mart. Chem., X, pt. 1, p. 41, pl. IX, figs. 5, 6.

A transversely elongated, more or less quadrilateral shell, with beaks almost terminal. In shape and convexity, however, it is very variable. Some specimens are rather flattish, while the others are moderately convex. The excavation in the anterior part of the ventral margin may be very great and deeply angulate in some, while it is shallow and rounded in the others. The radiating ribs which number fourteen or fifteen are in the anterior part simply scaly, while in the posterior they are furnished with irregular lamellar elongations. In several examples, the original colour is faintly preserved as a light reddish tint.

Very frequent. The largest attains the height of 34 millim.

Fossil occurrence.—Numa, Koyatsu.

Living.—Philippines. Australia.

Family **Pleurophcridae.**

96. *Coralliophaga coralliophaga*, (CHEMNITZ).

Pl. III. Fig. 9.

Coralliophaga coralliophaga. Yokoyama, Foss. Up. Musashino, p. 166, pl. XIV, fig. 5. Pilsbry, Catal., p. 136.

Chama coralliophaga. Chemnitz, Conch. Cab., X, p. 356, pl. 172, figs. 1673, 1674.

In many specimens. There is much variation in the outline of the shell. The younger ones are usually shorter than the adult, though occasionally they are quite as long. The ventral margin which is usually straight may be more or less

arched. These must be admitted as simple variations, as a shell like this species which lives in the burrows of others must adapt itself more or less to their form.

The pallial sinus is generally pointed, though sometimes it is not at all distinct.

Fossil occurrence.—Numa. Upper Musashino of Kazusa.

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

Family Mytilidae.

97. *Mytilus hirsutus*, LAMARCK.

Mytilus hirsutus. Lamarck, Anim. s. Vert., VII, p. 38. Reeve, Conch. Icon., Mytilus, spec. 8. Yokoyama, Foss. Miura Penin., p. 144, pl. XI, fig. 16.

A few isolated valves.

The left valve is elongated, tumid, with margins almost parallel. It is the so-called narrower form. Length 27 millim. Height 12.5 millim. Depth 7.4 millim. The right valve belongs to a young individual. It is triangular, flattened behind and provided with coarse radiating riblets.

Fossil occurrence.—Numa, Kōyatsu. Lower Musashino of Miyata and Yokosuka.

Living.—Central and Western Japan. China Sea.

98. *Mytilus curvatus*, DUNKER.

Pl. III. Fig. 10.

Mytilus curvatus. Dunker, Proc. Zool. Soc. Lond., 1856, p. 361. Ind. Moll., p. 222. Reeve, Conch. Icon., Mytilus sp. 53. Clessin in Syst. Conch. Cab. Mart. Chem., VIII, p. 34, pl. XI, figs. 7, 8.

A single right valve which is thick, ovately triangular, and only moderately convex. The dorsal margin is arched, the posterior rounded, and the ventral slightly concave. The surface is ornamented with fine, dense, divaricating riblets which increase in number toward the margin by interpolation of new riblets. Incremental lines distant, making the riblets more or less crenate or subgranular. Inner surface pearly, crenulate at margin except near the byssal notch. The specimen is larger than any hitherto figured of this species.

Fossil occurrence.—Numa.

Living.—Central and Western Japan. Philippines.

99. *Modiola barbata*, (LINNÉ).

Modiola barbata. Yokoyama, Foss. Up. Musash., p. 74, pl. XIV, fig. 19. Wood, Crag Moll., Biv., p. 58, pl. VIII, fig. 2.

Mytilus barbatus. Linné, Syst. Nat., Ed. 12, p. 1956.

A single left valve, 18 millim. long, 34 millim. high and 8 millim. deep. On its back it has the original reddish colour still distinctly preserved.

Fossil occurrence.—Numa. Upper Musashino of Kazusa and Shimosa, English Crag.

Living.—Northern, Central, Western and Southern Japan. British seas to Mediterranean.

100. *Lithophaga nasuta*, (PHILIPPI).

Pl. III. Fig. 11.

Lithophaga nasuta. Dunker, Ind. Moll., p. 226.

Lithophagus nasutus. Lischke, Jap. Meeresconch., II, p. 152.

Modiola nasuta. Philippi, Abbild., II, p. 149, Modiola, pl. I, fig. 2.

A full grown specimen with both valves perfect, and several young ones, the former measuring 70 millim. in length, 22.5 millim. in height and 20 millim. in thickness.

The shell is readily recognized by its thin, cylindrical and inequilateral form, without any ornamentation on the surface. A trace of original colour is sometimes preserved near the beak as a faint purplish tint.

Fossil occurrence.—Numa.

Living.—Central, Western, and Southern Japan. Philippines, North Australia.

101. *Modiolaria semigranata*, REEVE.

Pl. III. Fig. 14.

Modiolaria semigranata. Pilsbry, Catalogue, p. 141. Lischke, Jap. Meeresconch., III, p. 110, pl. IX, figs. 18, 19.

Lithodomus semigranatus. Reeve, Conch. Icon., Lithodomus, pl. V. fig. 28 ab.

A single left valve, 3.3 millim. long, 1.8 millim. high, and 1.2 millim. deep. It is thin, transversely elongated, rather four-sided, very inequilateral, with a rounded edge running from the beak to the postero-ventral corner. The sculpture consists of fine radiating striæ which are present only on the posterior portion and the extreme anterior end of the shell. The lines of growth make these striæ more or less granular.

Fossil occurrence.—Numa.

Living.—Central Japan.

Family Limidae.

102. *Lima dunkeri*, SMITH.

Pl. V. Fig. 19.

Lima dunkeri. Pilsbry, Catal., p. 142.

Lima japonica. Dunker, Ind. Moll., p. 245, pl. XI, figs. 8, 9 (non japonica Ad.).

This species is characterized by its unusually equilateral form. The sculpture consists of fine radiating striæ.

Only two broken valves.

Fossil occurrence.—Numa.

Living.—Central and Western Japan.

103. *Lima lima*, (LINNÉ).

Pl. III. Fig. 13.

Lima lima. Pilsbry, Catal., p. 143.

Lima squamosa. Lamarck, Anim. s. Vert., VII, p. 115. Lischke, Jap. Meeresconch., I, p. 162. Dunker, Ind. Moll., p. 244. Hörnes, Foss. Moll. Tert. Beck. Wien, pp. 383, 384.

Radula lima. Sacco, Moll. Terz. Piemonte e. d. Liguria, part XXIII, Pelec., Fam. Radulidae, pp. 13, 14, pl. IV, figs. 28-31.

Ostrea lima. Linné, Syst. Nat. Ed. 10, p. 699, Ed. 12, p. 1147.

Numerous examples. The number of radiating ribs is from twenty to twenty-three, so that in this respect our fossil corresponds to the variety *dispar* (Micht.) of Sacco distinguished among the forms found in the Italian Pliocene.

Fossil occurrence.—Numa, Kōyatsu. Miocene of Vienna. Pliocene of Italy.

Living.—Central, Western, and Southern Japan. Red Sea. Mediterranean Sea.

Family **Spondylidae**.104. *Spondylus cruentus*, LISCHKE.

Pl. V. Fig. 12.

Spondylus cruentus. Lischke, Jap. Meeresconch., I, p. 172, pl. XII, figs. 1-5. Dunker, Ind. Moll., p. 246. Pilsbry, Cat., p. 143. Yokoyama, Foss. Up. Musashino, p. 179.

This well known crimson-coloured *Spondylus* very common along the coast of Central and Western Japan is represented by several specimens still retaining a part of the original colour.

Fossil occurrence.—Numa, Kōyatsu. Upper Musashino of Shimosa.

Living.—Central and Western Japan.

105. *Plicatula irregularis*, DUNKER.

Pl. IV. Fig. 5, 6.

Plicatula irregularis. Pilsbry, Cat., p. 143.

Plicatula rugosa. Dunker, Ind. Moll., p. 247, pl. XI, fig. 5 (non *P. rugosa* Lam.).

The shell is oblong-ovate in general, though often variable in shape. The lower valve is somewhat convex and the upper flat. The surface has usually irregular radiating folds. The largest specimen is about 43 millim. high and 34 millim long.

Several examples.

Fossil occurrence.—Numa, Kōyatsu.

Living.—Central and Western Japan.

Family **Pectinidae**.106. *Pecten irregularis*, SOWERBY.

Pecten irregularis. Sowerby, Thes. Conch., I, p. 69, pl. 13, figs. 51, 52. Reeve, Conch. Icon., Pecten, pl. IV, fig. 19 ab. Yokoyama, Foss. Miura Penin., p. 153, pl. XIII, figs. 1 3.

Several specimens, some of which show the remains of original red colour.

Fossil occurrence.—Numa, Kōyatsu. Lower Musashino of Miyata, Yokosuka and Koshiha.

Living.—Central and Western Japan. East Indies.

107. *Pecten spectabilis*, REEVE.

Pl. IV. Fig. 7.

Pecten spectabilis. Reeve, Conch. Icon., Pecten, pl. 29. fig. 28. Dunker, Ind. Moll., p. 241. pl. XI, figs. 12, 13. Lischke, Jap. Meeresconch., II, p. 159. Küster, in Syst. Conch. Cab. Mart. Chem., VII, pt. 2, p. 64, pl. XVI, fig. 3.

A right valve, about 34 millim. both in length and height. It is rather flattened, with about thirteen scaly radiating ribs which become bifid by a shallow groove toward the ventral margin of the shell.

Fossil occurrence.—Numa.

Living.—Western Japan.

108. *Pecten plica*, (LINNÉ).

Pl. IV. Fig. 11.

Pecten plica. Pilsbry, Catal., p. 144. Reeve, Conch. Icon., Pecten, sp. 16. Lischke, Jap. Meeresconch., II, p. 160. Dunker, Ind. Moll., p. 242. Küster in Syst. Conch. Cab. Mart. Chem., VII, Spondylus and Pecten, p. 53, pl. XIV, figs. 3, 4.

Ostrea plica. Linné, Syst. Nat., Ed. 12, p. 1145.

A single right valve, 38 millim. long and 41.5 millim. high. It is rather flattish, with four broad radiating folds, besides a small one at each end of the shell. The folds as well as these valleys are finely radiately striated. The inner surface is furnished near the ventral margin with ridge-like radiating ribs, whose position corresponds to the outer side of each fold without. Ears unequal, the anterior longer and with a byssal notch below.

Fossil occurrence.—Numa.

Living.—Western Japan. China Sea. Ceylon.

109. *Pecten latus*, GOULD.

Pecten latus. Gould, Otia Conch., p. 177. Yokoyama, Foss. Miura Penin., p. 152. pl. XIV, figs. 1, 2. Foss. Up. Musashino, p. 180, pl. XIV, fig. 26. Tokunaga, Foss. Env. Tokyo, p. 65, pl. V, fig. 2. Pilsbry, Cat., p. 144. Lischke, Jap. Meeres conch., p. 169, pl. XII, figs. 6, 7, II, p. 157.

A few young specimens.

Fossil occurrence.—Numa, Kōyatsu. Lower Musashino of Miyata, Yokosuka, and Naganuma. Upper Musashino of Musashi, Kazusa and Shimosa.

Living.—Northern, Central, and Western Japan.

110. *Pecten quadriliratus*, LISCHKE.

Pl. IV. Fig. 10.

Pecten quadriliratus. Lischke, Jap. Meeresconch., II, p. 158, pl. IX, figs. 5, 6. Pilsbry, Cat., p. 144.

A left valve 25 millim. high, 21.5 millim. broad and 5 millim. deep. The surface shows twelve folds separated by deep interspaces of about an equal breadth. The folds are usually made up of four ribs, whose intervals are much narrower. The interspaces between the folds have mostly three fine ridges which may be nearly equal or unequal in which latter case the middle one is the strongest. The spaces between these ridges as well as between the ribs of the folds are crossed by fine concentric lines or scales. The ears are very unequal.

Fossil occurrence.—Kōyatsu.

Living.—Western Japan.

Family **Ostreidae**.111. *Ostrea gigas*, THUNBERG.

Ostrea gigas. Yokoyama, Foss. Miura Penin., p. 162, pl. XV, figs. 1, 2. Foss. Up. Musash., p. 184.

Two large upper valves.

Fossil occurrence.—Numa. Lower Musashino of Yokosuka and Koshiha. Upper Musashino of Musashi, Kazusa and Shimosa.

Living.—Northern, Central and Western Japan. Shantung, Manchuria.

112. *Ostrea cucullata*, (BORN).

Pl. IV. Figs. 12, 13.

Ostrea cucullata. Born, Test. Mus. Caes. Vind., p. 114, pl. VI, figs. 11, 12. Lischke, Jap. Meeresconch., II, p. 161. Dunker, Ind. Moll., p. 252. Pilsbry, Cat., p. 146. Reeve, Conch. Icon., *Ostrea*, pl. XVI, figs. 34.

This species has a roundish, ovate, or subtrigonal shell with several angular radiating folds on the surface which make the margins coarsely dentate. The purplish hue of the fresh shell is also preserved on some of the fossil specimens.

Rather frequent, though none of a very large size. The largest is a lower valve, obliquely ovate in form, and about 80 millim. both in length and height.

Fossil occurrence.—Numa.

Living.—Northern, Central and Western Japan. Nicobar Islands. Natal in South Africa.

113. *Ostrea crenulifera*, REEVE.

Pl. V. Figs. 1—4.

Ostrea crenulifera. Reeve, Conch. Icon., Ostrea, VIII, pl. XXVIII, fig. 67ab.

Reeves describes this species as follows :

“Shell multiform, small, subcompressed, generally oblong, narrow towards the apex, with plicated margins; whitish without, greenish within; hinge small, trigonal, that of the lower valve acuminately produced; muscular impressions large.

Although the above description is very concise, several of the fossil specimens agree almost exactly with Reeve's figure. The lower valve is convex and usually elongated, with many, rather angular plications. The upper valve is commonly flattish, with plications distinct in most cases only near the margins. The beaks are acute and pointed in most specimens. The largest fossil measures 47 millim. in height. Frequent.

Fossil occurrence.—Numa, Kōyatsu.

Living.—Red Sea.

Family **Pernidae**.

114. *Perna marsupium*, LAMARCK.

Pl. V. Fig. 8.

Perna marsupium. Lamarck, Anim. s. Vert., VII, p. 77. Reeve, Conch. Icon., Perna, sp. 5. Clessin, in Syst. Conch. Cab. Mart. Chem., VIII, Malleacea, p. 32, pl. X, fig. 4.

A more or less orbicular shell which is thick, and the three left valves obtained are somewhat convex, with five or six ligamental grooves on a long and broad hinge-plate. The surface is much worn by friction, but there are remains of rude and distant concentric lamellæ. The best preserved specimen measures about 28 millim. both in length and height, and 6 millim. in depth.

Fossil occurrence.—Numa.

Living.—Philippines.

Family Arcidae.

115. *Arca kobeltiana*, PILSBRY.

Arca kobeltiana. Yokoyama, Foss. Miura Penin., p. 168, pl. XVII, fig. 4. Foss. Up. Musashi., p. 185.

Two isolated valves.

Fossil occurrence.—Kōyatsu. Lower Musashino of Koshiha, Kanazawa, etc. Upper Musashino of Kazusa and Shimosa.

Living.—Northern and Central Japan.

116. *Arca (Barbatia) decussata*, SOWERBY.

Arca decussata. Sowerby, Proc. Zool. Soc. Lond., 1833, p. 22. Reeve, Conch. Icon., Arca, spec. 81. Yokoyama, Foss. Miura Penin., p. 165, pl. XVII, fig. 5.

This shell so rare in the Musashino Formatoin is quite frequent in Awa. The largest specimen is a left valve, 55 millim. long, 33 millim. high and 14 millim. deep.

Fossil occurrence.—Numa. Lower Musashino of Koshiha.

Living.—Central, Western, and Southern Japan. Philippines. Indian Ocean.

117. *Arca (Barbatia) stearnsii*, PILSBRY.

Pl. III. Fig. 5, 6.

Arca (Barbatia) stearnsii. Pilsbry, Catal., p. 148, pl. III, figs. 8—10.

Arca stearnsii. Yokoyama, Foss. Miura Penin., p. 166, pl. XVI, fig. 9.

This species is subject to a great variation in shape. Some of the specimens show the postero-ventral corner much more angular than in Pilsbry's figure. The inner surface of the shell has radiating lines.

Frequent.

Fossil occurrence.—Numa, Koyatsu. Lower Musashino of Koshiha.

Living.—Central and Western Japan.

118. *Arca (Barbatia) symmetrica*, REEVE.

Arca symmetrica. Reeve, Conch. Icon., Arca, pl. XVII, fig. 117. Yokoyama, Foss. Miura Penin., p. 166, pl. XVII, figs. 7, 8. Foss. Up. Musash., p. 186.

This small *Arca*, thick, squarish, gibbous, with finely granular, radiating riblets, is represented by many examples. The largest is a right valve, 12 millim. in length, 9 millim. in height and 4 millim. in depth.

Fossil occurrence.—Numa. Lower Musashino of Yokosuka and Naganuma.
Upper Musashino of Shimosa.

Living.—Central and Western Japan. Philippines. Indian Ocean.

119. *Arca (Barbatia) tenebrica*, REEVE.

Pl. V. Fig. 7.

Arca tenebrica. Reeve, Conch. Icon., Arca, pl. XVI, fig. 105. Mart. Chem. Syst. Conch. Cab., VIII, Arca p. 156, pl. XXXIX, figs. 7, 8. Pilsbry, Cat. p. 148.

A shell with both valves perfect and a small left valve.

Shell small, thick, inflated, inequilateral, rounded in front, obliquely subtruncate behind; postero-ventral corner sharply rounded, posterior dorsal keel blunt. The sculpture consists of small radiating riblets which are commonly alternately large and small, and accompanied by an interstitial stria between. The form of the riblets is more or less roof-like and the interspaces are transversely finely striated, the striæ appearing also on the flanks of the riblets. Beaks small, but prominent and curved, with the back flattened or even shallowly depressed. Area long and lanceolate.

The perfect specimen measures 19,4 millim. in length, 14,2 millim. in height and 12,5 millim. in thickness.

The detailed description of the radiating riblets is not found in the works above cited. The figure of Reeve represents the shell more swollen than that given in the Conchylien-Cabinet, to the latter of which our fossil is more alike, though more uniformly swollen.

Fossil occurrence.—Numa.

Living —Western and Southern Japan. Philippines.

120. *Arca (Barbatia) domingensis*, LAMARCK.

Pl. V. Fig. 6.

Arca domingensis. Lamarck, Hist. Nat., Ed. II, Vol. VI. p. 467. Lischke, Jap. Meeresconch., II, p. 142.

Arca divaricata. Reeve, Conch. Icon., Arca, pl. 16, fig. 108, 112. Syst. Conch. Cab. Mart. Chem., VIII, Arca, p. 111, pl. 29, figs 6-9.

Arca squamosa. Lamarck, Hist. Nat., ed. II, Vol. VI, p. 474.

Arca gradata. Broderip and Sowerby, Zool. Jour., Vol. IV, 1829, p. 365. Zool. Capt. Beechey's Voyage, p. 152, pl. 43, fig. 1.

This is a small *Arca* with a sharp dorsal keel. In spite of a great variation in shape, the species is readily recognized by its divaricating ribs behind the keel.

Very frequent. The largest example is 24 millim. long, 15 millim. high and 12 millim. thick.

Fossil occurrence.—Numa, Koyatsu.

Living.—Western Japan. Polynesia. Indian Ocean. West Indies.

121. *Arca (Barbatia) fusca*, BRUGUIÈRE.

Pl. V. Fig. 13.

Arca (Barbatia) fusca. Clessin in Syst. Conch. Cab. Mart. Chem., VIII., Arca. p. 18, pl. IV, fig. 2, pl. VI. figs. 5, 6. Iwakawa, Hand-list Jap. Biv., p. 64.

Arca fusca. Bruguière, Dict. No. 10, Encycl. pl. 308, figs. Reeve, Conch., Icon., Arca, pl. XII, fig. 82.

Shell transversely oval to oblong or rarely subquadrate, convex, inequilateral, anterior side generally less than one-half of posterior. Surface without any marked keel, ornamented with numerous radiating riblets, often unequal and also often with an interstitial stria. These riblets are cut by fine concentric impressed lines into small tubercles or cubes. Beaks small, the back being medially shallowly depressed. Area long and narrow.

This is a comparatively large *Arca* very variable in outline. The largest specimen attains the length of 70 millim. with the height of 38 millim. and the depth of about 16 millim. A faint brownish to purplish tint remains on many specimens.

Fossil occurrence.—Numa, Kōyatsu.

Living.—Kashiwajima in Tosa (Western Japan). Philippines. Red Sea.

122. *Arca kraussi*, PHILIPPI.

Pl. V. Fig. 5.

Arca kraussi. Philippi, Abbild., III, p. 88, pl. V, figs. 8-10. Südafrikan. Moll., p. 14, pl. I, fig. 13. Lischke, Jap. Meeresconch., II, p. 141, III, 107. Dunker, Ind. Moll., p. 233. Pilsbry, Cat., p. 148.

Shell small, quadrate, swollen, carinate, ornamented with fine radiating striae or costellæ which are crossed by rude lines of growth, thereby becoming more or less granular. Hinge only a little shorter than shell-length. Area broad, triangular. Beaks prominent, tumid, incurved.

There is a great variation in height as well as in length. One right valve is 26.5 millim. long, and 14.5 millim high, while another is 27 millim. long and 18.5 millim. high. Many specimens.

Fossil occurrence.—Numa.

Living.—Central and Western Japan. Natal (South Africa).

Family **Paralleodontidae.**

123. *Parallelodon obliquatus*, YOKOYAMA.

Parallelodon obliquatus. Yokoyama, Foss. Miura Penin., p. 170, pl. XVII, fig. 6, pl. XVIII, figs. 9-11. Foss. Up. Musash., p. 191.

A single but perfect specimen, 24 millim. in length, 13 millim. in height, and 10 millim. in thickness.

Fossil occurrence.—Numa. Lower Musashino of Miyata, Yokosuka, and Koshiba. Upper Musashino of Kazusa.

Living.—Northern and Central Japan.

Family **Limopsidae.**

124. *Limopsis woodwardi*, A. ADAMS.

Limopsis woodwardi. Yokoyama, Foss. Up. Musashino, p. 193, pl. XVII, fig. 5.

A single worn valve.

Fossil occurrence.—Kōyatsu. Upper Musashino of Musashi and Shimosa.

Living.—Central Japan.

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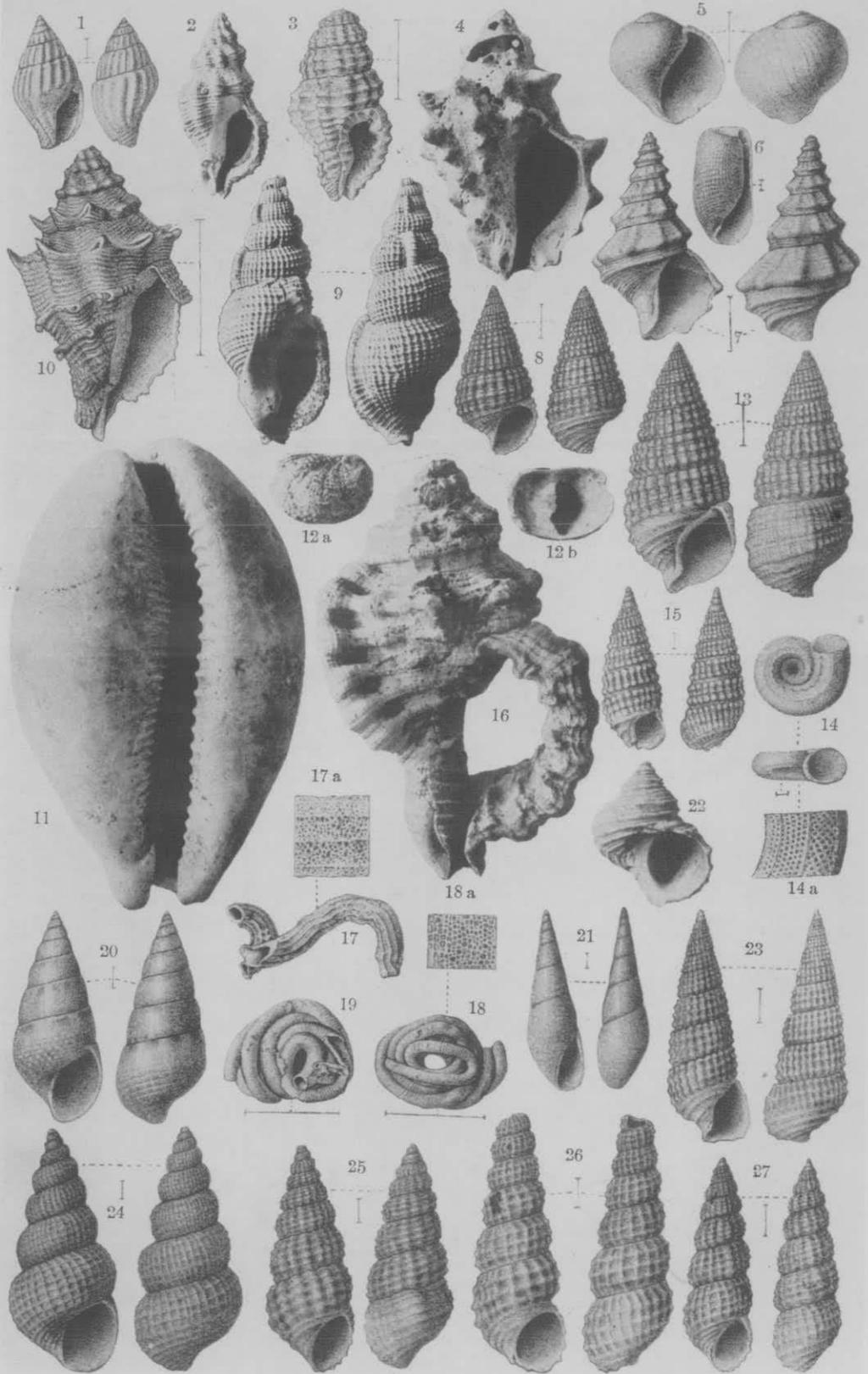
M. Yokoyama :
Mollusca from the Coral-Bed of Awa.

PLATE I.

Plate I.

(From Numa).

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Fig. 21. *Eulima (Liostraca) hojoensis* Yok. Enlarged. P. 29.
Fig. 22. *Turbo (Batillus) cornutus* Gm. P. 33.
Fig. 23. *Cerithiopsis satomii* Yok. Enlarged. P. 22.
Fig. 24. *Fenella yamakawai* Yok. Enlarged. P. 27.
Fig. 25. *Fenella shinonis* Yok. Enlarged. P. 28.
Fig. 26. *Fenella orientalis* Yok. Enlarged. P. 28.
Fig. 27. *Fenella kenonis* Yok. Enlarged. P. 29.



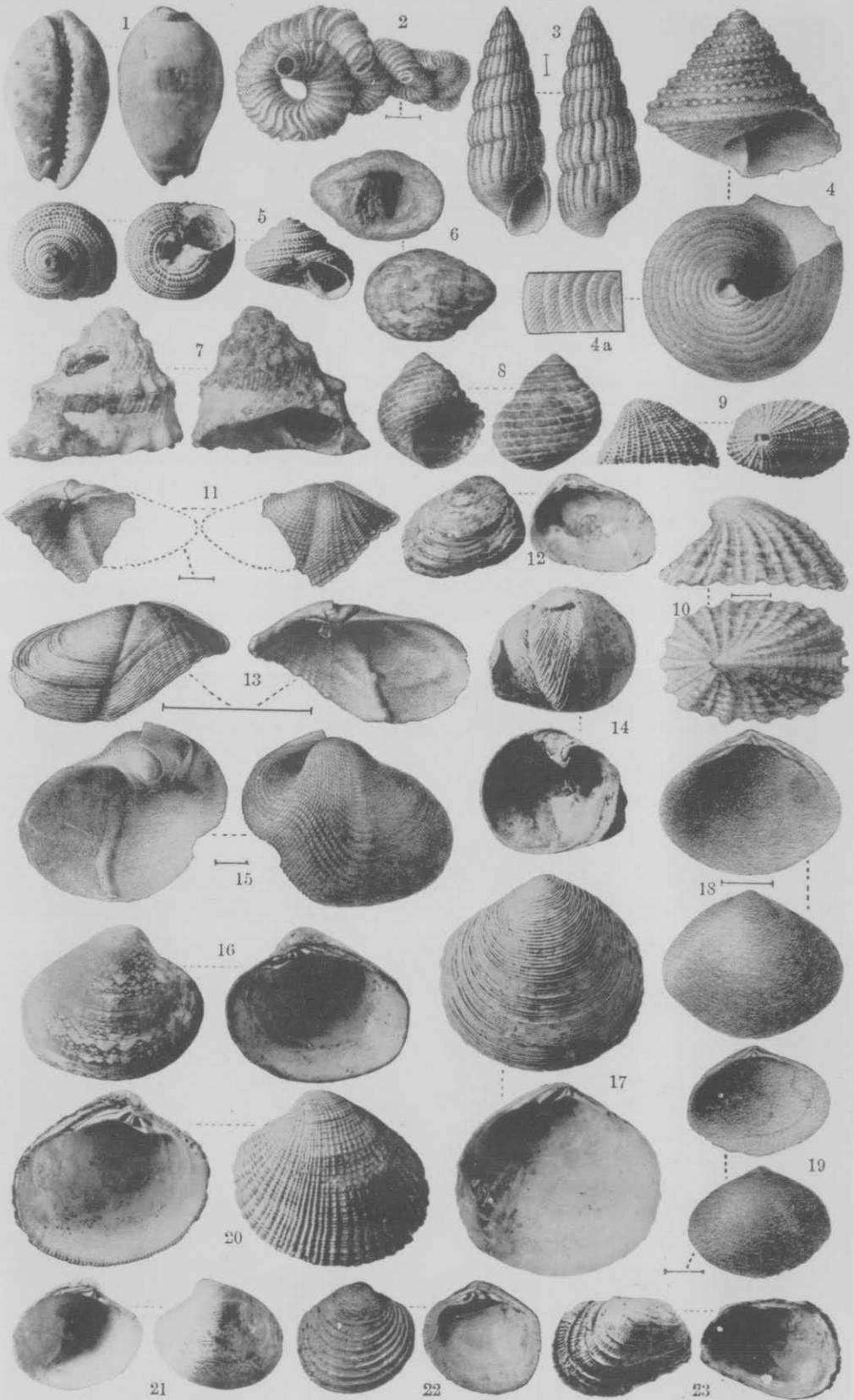
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PLATE II.

Plate II.

- Fig. 1. *Cypraea candida* Pease. Kōyatsu. P. 18.
Fig. 2. *Vermetus annulatus* Yok. Numa. P. 25.
Fig. 3. *Turbonilla humilis* Yok. Numa. P. 30.
Fig. 4. *Trochus (Clanculus) gordonis* Yok. 4 a. A part of the base enlarged. Numa P. 33.
Fig. 5. *Trochus (Clanculus) atropurpureus* Gld. Numa. P. 33.
Fig. 6. *Nerita albicilla* L. Kōyatsu. P. 31.
Fig. 7. *Astralium (Cyclocantha) haematragus* Mke. Kōyatsu P. 32.
Fig. 8. *Monodonta labio* L, Kōyatsu. P. 34.
Fig. 9. *Fissuridea rueppellii* Sow. Numa. P. 36.
Fig. 10. *Submarginula cratitoides* Yok. Numa. P. 36.
Fig. 11. *Jouannetia yabei* Yok. Numa. P. 39.
Fig. 12. *Petricola awana* Yok. Numa. P. 42.
Fig. 13. *Pholas subconstricta* Numa. P. 38.
Fig. 14. *Jouannetia cumingii* Sow. Numa. P. 38.
Fig. 15. *Pholas cupula* Yok. Numa. P. 37.
Fig. 16. *Meretrix tigrina* Lam. Numa. P. 42.
Fig. 17. *Semele aspasia* Angas. Numa. P. 40.
Figs. 18, 19. *Tellina radiato-lineata* Yok. 18. Right valve. 19. Left valve. Numa. P. 41.
Fig. 20. *Venus jodoensis* Lke. Numa. P. 43.
Fig. 21. *Meretrix (Callista) limatula* Sow. Numa. P. 43.
Fig. 22. *Venus torcuma* Gld. Numa. P. 44.
Fig. 23. *Venerupis irus* L. Numa. P. 44.



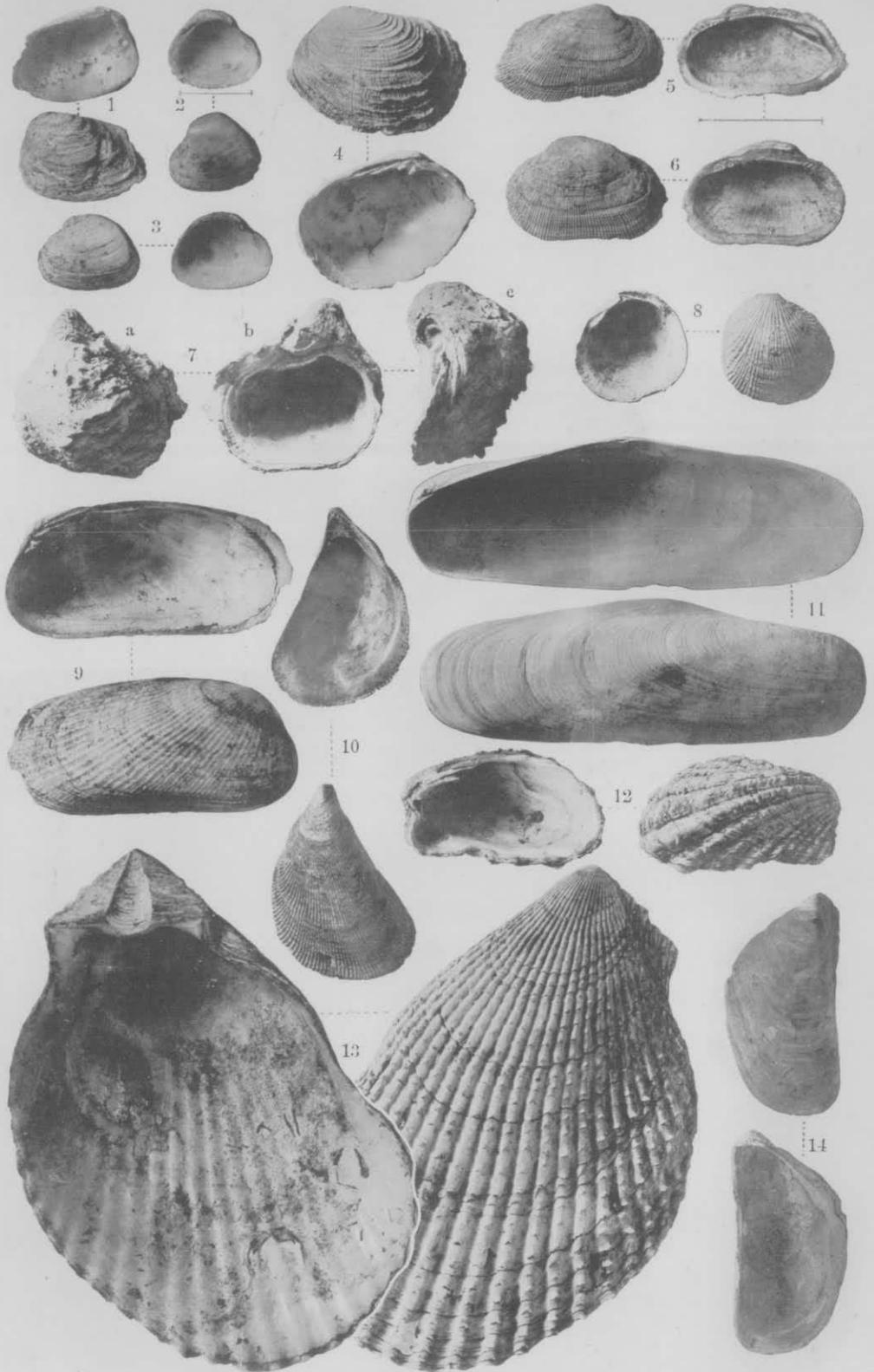
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PLATE III.

Plate III.

- Fig. 1. *Petricola awana* Yok. Numa. P. 42.
Figs. 2, 3. *Basterotia gouldi* Adams. Numa. P. 39.
Fig. 4. *Venerupis insignis*. Desh. Numa. P. 45.
Figs. 5, 6. *Arca stearnsii* Pils. Numa. P. 59.
Fig. 7. *Chama retroversa* Lke. Left valve. a. Back-view.
b. Front-view. c. Side-view. Numa. P. 50.
Fig. 8. *Codakia bella* Conr. var. *delicatula* Pils. Numa. P. 50.
Fig. 9. *Coralliophaga coralliophaga* Chem. Numa. P. 51.
Fig. 10. *Mytilus curvatus* Dkr. Numa. P. 52.
Fig. 11. *Lithophaga nasuta* Phib. Numa. P. 53.
Fig. 12. *Cardita crassicosta* Lam. Numa. P. 51.
Fig. 13. *Lima lima* Linné. Numa. P. 54.
Fig. 14. *Modiolaria semigranata* Rve. Numa. P. 53.



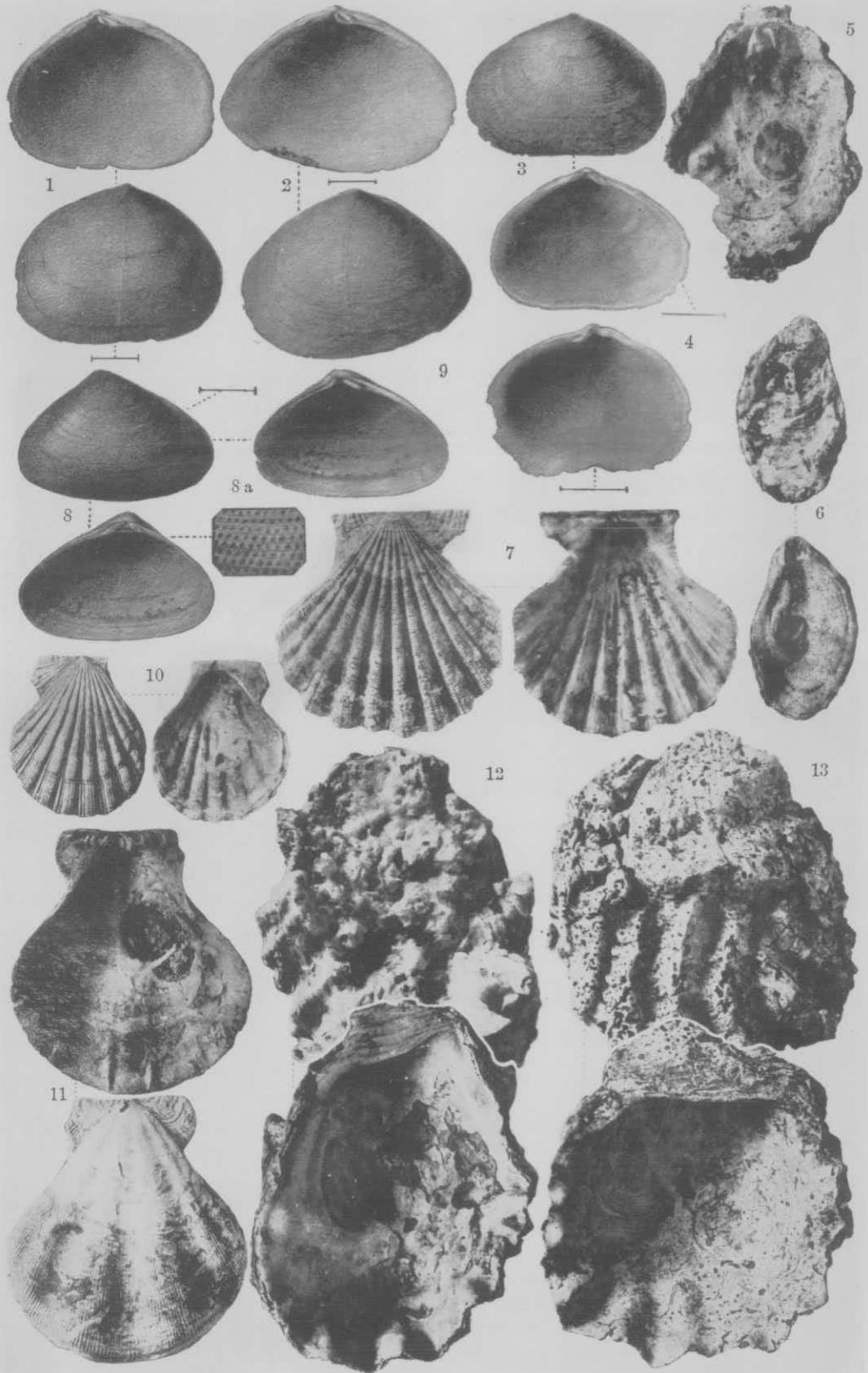
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PLATE IV.

Plate IV.

- Fig. 1. *Seintilla nipponica* Yok. Numa. P. 47.
Fig. 2. *Seintilla trigonalis* Yok. Numa. P. 47.
Figs. 3, 4. *Galeomma adamsi* Yok. 3. Right valve. 4. Left valve. Numa. P. 47.
Figs. 5, 6. *Plicatula irregularis* Dkr. 5. Right valve. 6. Left valve. Numa. P. 55.
Fig. 7. *Pecten spectabilis* Rvc. Numa. P. 56.
Figs. 8, 9. *Lepton puncticulata* Yok. 8. Left valve. 8 a. A part enlarged to show the puncticulate character. 9. Right valve. Numa. P. 48.
Fig. 10. *Pecten quadriliratus* Lke. Kōyatsu. P. 57.
Fig. 11. *Pecten plica* L. Numa. P. 56.
Figs. 12, 13. *Ostrea cucullata* Born. Left valves. Numa. P. 57.



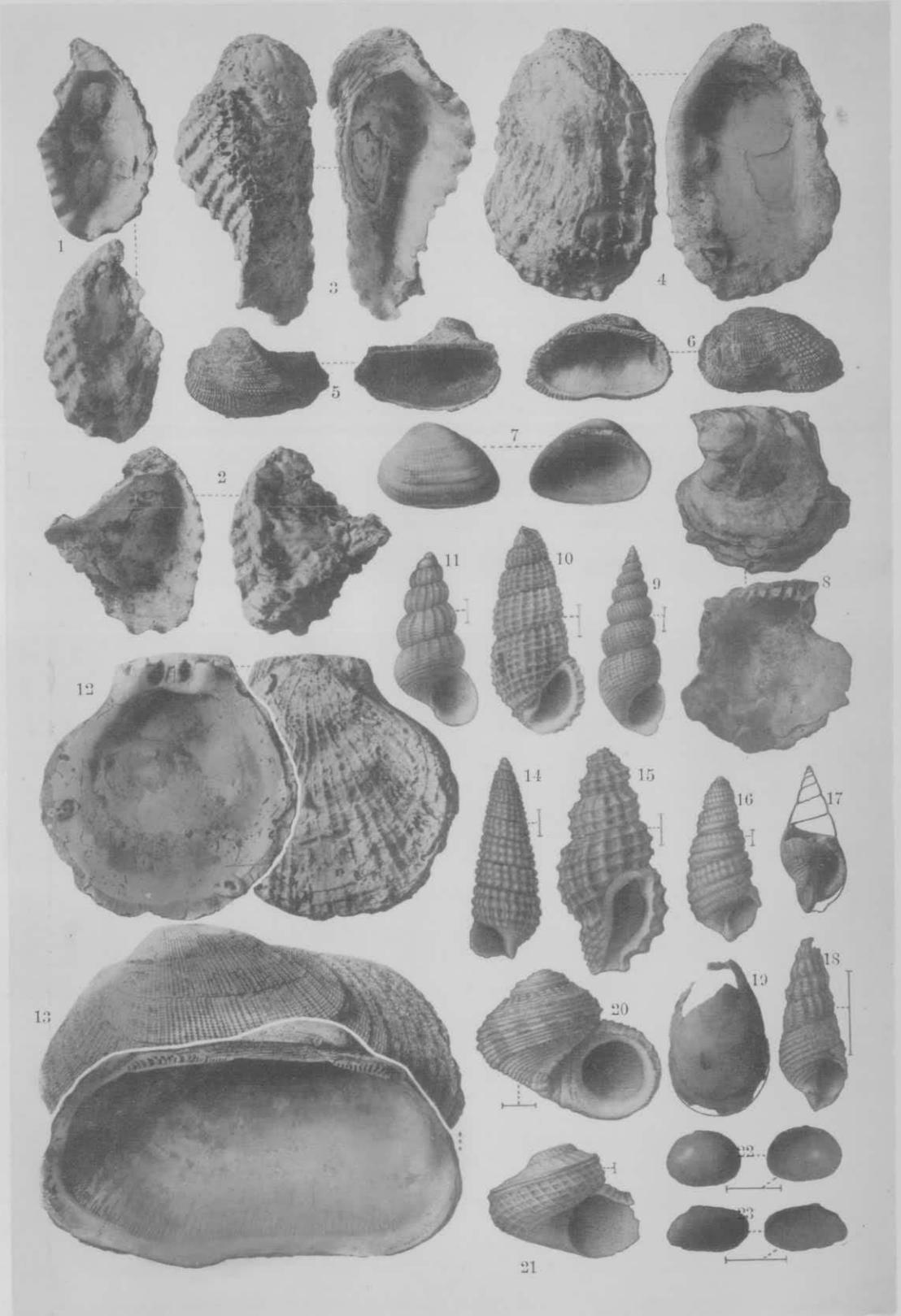
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PLATE V.

Plate V.

- Figs. 1-3. *Ostrea crenulifera* Rve. 1-3. Lower valves. 4. Upper valve. Numa. P. 58.
- Fig. 5. *Arca kraussi* Phil. Left valve. Numa. P. 61.
- Fig. 6. *Arca* (*Barbatia*) *domingensis* Lam. Left valve. Numa. P. 60.
- Fig. 7. *Arca* (*Barbatia*) *tenebrica* Rve. Left valve. Numa. P. 60.
- Fig. 8. *Perna marsupium* Lam. Left valve. Numa. P. 58.
- Fig. 9. *Fenella pupoides* Ad. Numa. P. 27,
- Fig. 10. *Rissoina* (*Phosinella*) *cancellata* Phil. Numa. P. 26.
- Fig. 11. *Rissoa* (*Alvania*) *concinna* Ad. Numa. P. 25.
- Fig. 12. *Spondylus cruentus* Lke. Free valve. Koyatsu. P. 55.
- Fig. 13. *Arca* (*Barbatia*) *fusca* Brug. Left valve. Numa. P. 61.
- Fig. 14. *Triforis exilis* Dkr. Numa. P. 23.
- Fig. 15. *Clathurella centrosa* Pils. Numa. P. 11.
- Fig. 16. *Odostomia* (*Miralda*) *gemma* Ad. Numa. P. 30.
- Fig. 17. *Euthria ferrea* Rve. Numa. P. 12.
- Fig. 18. *Potamides* (*Batillaria*) *zonalis* Brug. Koyatsu. P. 20.
- Fig. 19. *Lima dunkeri* Sm. Left valve. Numa. P. 54.
- Fig. 20. *Leptothyra pilula* Dkr. Numa. P. 32.
- Fig. 21. *Scissurella turbinata* Ad. Numa. P. 35.
- Fig. 22. *Scintilla solidula* Desh. Left valve. Numa. P. 46.
- Fig. 23. *Tellina iridella* Mart. Right valve. Numa. P. 41.



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