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Molluscan Fauna of the Lower Part of the Kakegawa Series in the Province of Tôtômi, Japan.

By

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With Plates I—VI.

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Contents.

INTRODUCTION

Since 1919 a detailed study of the stratigraphical and faunal relations of the Tertiary rocks of East Tôtômi (Sizuoka-ken) on the Tôkaidô, Japan, was undertaken at the suggestion of Prof. S. NAKAMURA. The present paper is a result of that study and is restricted to the fauna and an outline of the stratigraphy of the lowest part of the type Kakegawa series which is found between the town of Kakegawa and Mori. The occurrence of a fauna in the Dainiti sands which is the basal bed of the Kakegawa series had been first brought to the attention of Imperial Geological Survey many years ago by the late Dr. K. NAKAJIMA and the Pliocene age of it had been recognized. Recently Prof. YOKOYAMA in his paper entitled "Tertiary Mollusca from Dainichi"* described forty-two species of which ten were quite new to science, and deemed the age of the Dainiti fauna to be the Lower Pliocene.

My conclusion is that the Dainiti sands as well as the overlying Tennô sands belongs to the Lower Pliocene in age. The fauna of these beds while not a large one is evidently a typical strand-line facies, and the assemblage

* Jour. Coll. Sci. Univ. Tokyo, vol. 45, art. 2. 1923.

as a whole represents warm temperate conditions resembling the living fauna which is found in the shallow waters along the Pacific coast from Sagami Bay to the Kii Peninsula. Besides Mollusca, there were found a few species of Foraminifera, Crustacea, Madreporaria, Bryozoa and Brachiopoda. These fossils and the fauna of the Upper Kakegawa will be published in other papers. The study of the tectonic geology and the complete stratigraphy of the Tertiary deposits in this district requires much time in the future for complete study.

Particular acknowledgment is gratefully made to Prof. S. NAKAMURA of our Institute, whose valuable advice made this work possible. I also wish to acknowledge my indebtedness to Mr. T. KURODA for information concerning modern malacology and for the use of his own collection of living faunas. Mr. I. ŌMURA, Mr. Y. CHITANI and Mr. W. YAGURA likewise very kindly furnished me with valuable information. Thanks are due to Mr. N. TAKAHASI of the Institute for his assistance given in the preparation of the report.

Very recently, after I finished this description, Prof. YOKOYAMA described a hundred and twenty-two species of Mollusca in his paper entitled "Tertiary Mollusca from Southern Tôtômi"* not only including a part of the Lower Kakegawa, but also those of the underlying formations and of the Upper Kakegawa. Consequently, some of my new species are displaced by his names. As for the names of genera and species, I have attempted to follow the International Code of Zoological Nomenclature as rigidly as I could. Therefore, all pre-Linnean names have been rejected and those of BOLTEN have been availed of. Simply for this reason, I have changed many long-established names used by Prof. YOKOYAMA. It was obviously impossible to make perfect identifications with the early ambiguous descriptions and figures of species, but fortunately the whole of the foreign and a large number of Japanese shell collections made by HIRASE, now preserved in the Geological Institute of Kyôto Imperial University and Mr. KURODA's collection include many valuable specimens named by experienced malacologists of Europe and America.

* Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, pt. 9. 1926.

STRATIGRAPHIC POSITION AND GENERAL CHARACTER OF THE KAKEGAWA SERIES IN TÔTÔMI

In east Tôtômi, the Mesozoic and Cainozoic formations commencing from the bottom are Mikura (Cretaceous or Palaeogene), Ooigawa (Lower Miocene or older), Sagara (Upper Miocene), Horinouti (Transition), Kakegawa (Lower Pliocene), Soga (Upper Pliocene), Ogasa Conglomerate (Upper Pliocene), and the gravelly deposits of the Pleistocene age.

The Kakegawa formation as discussed in this paper occurs between Hutamata and Minamiyama. The type locality is the district between Mori and Kakegawa, where the formation is about 640 m. thick, the lithological characters of the strata represent a perfect cycle of sedimentation, commencing from the littoral facies of the basal part, gradually changing upwards into the thick muddy deposition of a deep sea and the again the shallow water condition following. A distinct unconformity with the underlying Ooigawa is observed in the type locality, but to the east of Kakegawa the base passes insensibly into the Horinouti formation.

There is found a marked unconformity between the top of the Kakegawa and the Soga, which is of the littoral facies and exhibits the final condition of the emergence of late Kakegawa times. The erosion had removed more materials from the top of the Kakegawa to the west of the type locality than to the east, before the Soga times.

The strata have dips of 10°—15° S on an average and a strike of about N 50° W. There are observed many small, dip and strike faults and very slight foldings. Hereafter, all local groups corresponding to the typical Kakegawa formation will be called "the Kakegawa series." The age represented by the fauna of the Lower Kakegawa series will be named "Dainitian."

LITHOLOGY

The Kakegawa series between Mori and Kakegawa is a northwest-southeast strip about 10km. in length. The unconformable relation to the underlying Ooigawa is marked by an eroded undulating rock-surface penetrated by boring shells, the basal conglomerate containing the rounded pebbles derived from the stones of the Ooigawa materials and the difference of the dips and strikes.

The Kakegawa is subdivided into three members. The sequence* of the strata along the NNE–SSW cross-section examined through Kakegawa is, in descending order, as follows:

unconformity.

D. Upper(Ketienzi Mudstone).** 8. Blue-gray muddy superfine sand, very massive. ..... 224 m.

C. Middle (Nangô Beds).***
7. Alternating sands and mud. ..... 146 m.
6. Brown medium-grained thin-bedded sand. ..... 133 m.
5. White fine tuff and tuffaceous superfine gray sandstone. (Hosoya Beds) ..... 32 m.

B. Transition (Iesiro Beds).**** 4. Alternating sands and mud. ..... 30 m.?

A. Lower (Dainiti Beds).*****
3. Blue fine-grained sand (Tennô sands)..... 40 m.
2. Brown medium-grained massive sand (Dainiti sands)... 27 m.
1. Basal conglomerate. ..... variable.

unconformity.

It is evident that the transgression of the Kakegawa sea had taken place from the west to the east, being shown in that the time-lines including the faunal zones and the pyroclastic beds overstep to the east. At 2 km. southwest of Mori, the following sequence of rocks is observed.

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* Mr. CHITANI mentions the stratigraphy of the Tertiary depositions in Southern Tôtômi. (Jour. Geogr., vol. 38, pp. 84—89. in Japanese). The following is a reformed correlation of his local subdivisions with mines:

Hizikata Beds ..... Ketienzi mudstone, (8).
Satuka Beds ..... Nangô Beds, (7–6).
Iozumi tuffite ..... Hosoya Beds, (5).
Utida Beds ..... Iesiro** Beds, (4) and Dainiti Beds, (3–1).
Hotta tuffite ..... Siraiwa tuff, (the tuff of no. 2 at 2km. southwest of Mori).

** 結縁寺泥岩　　*** 南郷層
**** 家代層　　***** 大日層

unconformity.

C. Middle.
6. Alternating sands and mud. (lithologically equal to B.)
5. Tuffaceous fine sandstone. (lithologically Tennô sands with admixture of pumiceous materials).
4. White fine tuff.

A. Lower.
3. Buff medium-grained massive sand (Dainiti sands).
2. White fine compact tuff, 0·5 m.
1. Buff medium-grained massive sand. (Dainiti sands).

In this section, the white tuff of No. 4 corresponds to that of No. 5 in the section through Kakegawa. Lithologically, the massive sand lower than this horizon is the same as the Dainiti sands in the first section. The lower pyroclastic horizon of No. 2 is of older origin than the basal bed at Dainiti. The probable same horizon reappears to the east of Kakegawa between the Kakegawa formation and the Horinouti formation. The local name of this tuff in the latter district is "Siraiwa tuff."

The rocks of the Lower Kakegawa are more sandy to the west than to the east. To the east, on the contrary, fine micaceous sands are predominant. The Dainiti sands near Kakegawa is 27 m. in thickness, but it is 45 m. at Dainiti and more to the west. The thickness of the Tennô sands is 40 m. at Kakegawa end 30 m. at Iesiro about 3 km. northwest of Kakegawa. In alternating beds, the sandy seams become thicker and thicker in approaching Mori.

FAUNA OF DAINITI

Abundant shell remains are found in the basal conglomerate and successive massive sand. The shells are generally snowy white, and shine out brilliantly against the surrounding matter; they are, however, generally not well preserved, and mostly weathered, particularly the pelecypodan shells. Hence, large and fragile bivalves were only safely obtained from hardened calcareous nodules. The fauna found in the very basal portion does not differ much from that of the following horizon.

The most characteristic forms are *Turritella perterebra* YOKOYAMA, *Suchium suchiense* YOKOYAMA, *Suchium mysticum* YOKOYAMA, *Latrunculus elatus* (YOKOYAMA), *Hinia kurodai* n. sp., *Asthenotoma yokoyamai* n. sp.,

Terebra abdita n. sp. and *Macoma totomiensis* n. sp.

Cancellaria nodulifera SOWERBY, *Ancilla albocallosa* LISCHKE and *Terebra bifrons* HINDS are the most common species which have survived to the recent. Among very common froms *Siphonalia cassidariaeformis declivis* YOKOYAMA and *Scapharca satowi castellata* YOKOYAMA are very closely related to the living species. Besides these, some forms grouped under the living species exhibit more or less certain ancestral variations.

Being an exotic fresh-water form, the occurrence of *Thiara totomiensis* n. sp. is very interesting. The number of described species is 98.

FAUNA OF HÔNOHASI*

The preservation of the fossils in the bed of medium-grained brown sand with occasional pockets of pebbles of Hônohasi of which the outcrop at the tunnel between Hônohasi and Iwasibara is the best, is better than in most localities, and their abundance in a few localities makes the collections from this place particularly valuable. Most of the fossils are in two zones, one near the base and the other in the bed approximately 10 m. above it.

The upper zone comprises *Pecten praesignis* YOKOYAMA abundantly while that species is very rare in the lower zone The most characteristic species of the basal bed are *Glycimeris totomiensis* n. sp., *Venus yokoyamai* n. sp., *Venericardia panda* (YOKOYAMA), *Siphonodentalium nipponicum* n. sp., *Suchium obsoletum* MAKIYAMA, *Bittium kurodai* n. sp. and *Terebra eoa* n. sp. *Venericardia panda* was very rare at Dainiti, but here it is found very abundantly.

The most abundant living species is *Dosinorbis bilunulata* GRAY. Species common to Dainiti and this locality are *Acila minuta* n. sp., *Scapharca satowi castellata* YOKOYAMA, *Latrunculus elatus* (YOKOYAMA), *Siphonalia cassidariaeformis declivis* YOKOYAMA, *Caesia demissa* YOKOYAMA, *Terebra bifrons ugaliensis* n. subsp., and *Clavatula patruelis dainichiensis* (YOKOYAMA). *Turritella perterebra* YOKOYAMA is not so numerous as in the first locality. Some forms subspecifically differ from the species of

* 方ノ橋

Dainiti; *Terebra asukensis* YOKOYAMA (from *T. abdita*), *Cytharella totomiensis tachymorpha* n. subsp., and *Kurtziella ugali hobasiensis* n. subsp., are the examples.

As a whole, the fauna of Hônohasi and Iwasibara seems to be a little younger than that of the Dainiti. This consideration is also shown by the eastward overlap of the Dainiti sands upon the old erosion surface.

FAUNA OF THE BASAL BED TO THE WEST OF TENNÔYAMA

The conglomerate found near the bridge of Saigô contains abundant fossil shells. Compared with the above two faunas, the preservation of this fauna is not good. Most of the materials are hardly determined. Although the distance between this locality and the Hônohasi-tunnel is only about a kilometer, the fauna is evidently younger, roughly corresponding to the *Pecten praesignis* zone at Iwasibara.

The most characteristic forms are *Glycimeris totomiensis* n. sp., *Pecten praesignis* YOKOYAMA, and *Suchium obsoletum conglomeratum* MAKIYAMA.

The latter subspecies was very rare in the Hônohasi zone, but reaches its acme in this horizon. The conglomerate is not thicker than 2 m. and the immediately following calcareous sandstone also contains casts of a similar fauna.

FAUNA OF TENNÔYAMA

Just above the buff massive Dainiti sands at Saigô there is a richly fossiliferous fine sand stratum which is the type of the Tennô sands. The shell remains are mostly of autocthonic origin and indicate somewhat deeper conditions of deposition. The fauna may be subdivided into three horizons, though they are not separated by distinct boundaries but transitional without being interrupted by a barren portion. The lowest horizon is found at the west-side of Tennôyama (in front of the Tennô-shrine) and is represented by a mutation of *Suchium suchiense* YOKOYAMA which differs somewhat from the parent form of the Dainiti zone. The middle part of the bed cropping out at the east-side of the hill contains a large number of Gastropoda. Owing to the high weathering, the fossils are very fragile and a perfect

specimen was hard to obtain except for some cemented in nodules.

The uppermost horizon is divided from the middle merely by the reason that it contains a greater number of *Pecten praesignis* YOKOYAMA and *Crassatellites oblongatus uchidanus* YOKOYAMA. Instead of *Suchium suchiense*, there are obtained many *Suchium obsoletum arenarium* MAKIYAMA and *Turricula subdeclivis* (YOKOYAMA) in these middle and upper horizons. *Scapharca satowi castellata* YOKOYAMA, *Venericardia panda* (YOKOYAMA), *Latrunculus clatus* (YOKOYAMA), *Ancilla albocallosa* (LISCHKE) are likewise very common. *Glycimeris totomiensis* n. sp. is now very rare, while *Glycimeris rotunda* (DUNKER) comes in abundance replacing the position. The new addition of *Microfusus magnificus* (LISCHKE) and *Xenophora exuta* (REEVE) is very noteworthy.

COMPLETE FAUNAL LIST

The following is a complete list of the species from the different localities : the species found are marked with ×.

Abbreviation of the local names :

大 : Dainiti, Ugari-mura, Suti-gun. (周智郡宇刈村大日)

方 : Hônohasi, Saigô-mura near Kakegawa. (西郷村方橋)

鰯 : Iwasibara and Asuka, Taruki-mura near Kakegawa. From the upper horizon of the Dainiti sands. (垂木村鰯原, 同飛鳥)

西 : Saigô-bridge to the west of Tennôyama near Kakegawa.

社 : Westside of Tennôyama, in front of the Tennô-shrine ; shortly designated as Tennô-shrine. (天王神社)

天 : Eastside of Tennôyama, shortly designated as Tennôyama. (天王山)

垂 : All localities in Kamiyasiki and Asuka, Taruki ; belonging to the Tennô sands ; shortly designated as Taruki. (垂木村上屋敷, 同飛鳥)

仁 : Including all outcrops which almost always contain fossil remains in Nitô, Kakegawa-mati. The Tennô sands. (掛川町仁藤)

U : B, C and D divisions of the Kakegawa formation in the type locality.

神 : Kakegawa series of Tosa Province. (Kônomine* Beds).

L : Living species of Central and Western Japan between the Bôsô Peninsula and Nagasaki Harbour. Those indicated by (×) are not found living in this region but in other places of the world.

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* 神ノ峯

	大	方	鰐	西	社	天	亜	仁	U	神	L
1. *Acila minuta*	×	×	...	...	...	...	...	...	...	...	...
2. *Acila mirabilis*	...	...	...	...	...	×	...	×	...	×	×
3. *Leda confusa*	×	×	...	...	×	...	...	×	...	...	×
4. *Limopsis tokaiensis*	...	...	...	...	...	×	...	...	...	...	×
5. *Barbatia (Scapharca) satowi castellata*	×	×	×	×	...	×	...	...	...	×	...
6. *Glycimeris totomiensis*	...	×	×	...	...	×	...	×	...	...	...
7. *Glycimeris nakamurai*	...	×	...	...	×	...	...	...	...	...	...
8. *Glycimeris rotunda*	...	...	...	×	×	×	...	×	...	×	×
9. *Pinna* cf. *attenuata*	...	×	...	...	...	...	...	...	...	...	×
10. *Atrina japonica*	×	×	...	...	...	...	...	...	...	...	×
11. *Ostrea musashiana*	×	×	...	...	×	...	...	...	...	...	×
12. *Ostrea* cf. *palmipes*	...	×	...	...	...	...	...	...	...	...	×
13. *Ostrea folium*	...	...	...	...	...	...	×	...	...	...	...
14. *Pecten (Amussiopecten) praesignis*	...	×	×	×	×	×	...	×	...	×	...
15. *Lima (Limatu'a) subauricu'ata*	...	×	...	...	...	...	...	...	...	...	×
16. *Anomia lischkei*	...	×	...	...	...	...	...	...	...	...	×
17. *Myodora reeveana*	...	×	...	...	...	...	...	...	...	...	×
18. *Cuspidaria* sp.	...	...	...	...	...	×	...	...	...	...	...
19. *Cuspidaria (Cardiomya) gouldiana*	×	...	...	...	...	...	...	...	...	...	×
20. *Crassatellites yagurai*	...	...	...	...	...	×	...	...	...	×	(×)
21. *Crassatellites oblongatus uchidanus*	...	...	...	...	...	×	...	×	...	...	...
22. *Venericardia panda*	×	×	×	×	...	×	...	×	...	×	...
23. *Lepton nipponicum*	×	...	...	...	...	...	...	...	...	...	...
24. *Rochefortia yokoyamai*	×	...	...	...	...	...	...	...	...	...	...
25. *Cardium (Papyridea) muticum*	...	×	...	...	×	×	...	...	...	×	×
26. *Cardium (Nemocardium) modestum*	...	...	...	...	...	×	...	×	...	...	×
27. *Dosinia troscheli*	×	×	...	×	×	...	...	...	...	...	×
28. *Dosinia biluna'ata*	...	×	...	...	...	...	...	...	...	...	×
29. *Clementia vatheleti*	×	...	...	...	×	...	...	...	...	×	×
30. *Venus yokoyamai*	...	×	...	...	...	...	...	...	...	...	...
31. *Chione isabellina*	×	×	...	...	...	...	...	...	...	×	×
32. *Macrocallista pacifica*	...	×	...	...	×	×	...	...	...	...	×
33. *Paphia euglypta*	×	...	...	...	...	...	...	...	...	...	×
34. *Paphia schnelliana*	...	×	...	×	×	×	...	...	...	×	×
35. *Tellina kurodai*	×	...	...	...	...	...	...	...	...	...	×
36. *Macoma totomiensis*	×	...	...	...	...	...	...	...	...	...	...
37. *Macoma praetexta*	×	...	...	...	×	...	...	...	...	...	×
38. *Donax kiusiuensis*	×	...	...	...	...	...	...	...	...	...	×
39. *Psammosolen divaricatus*	×	×	...	...	...	...	...	...	...	...	×

	大	方	鱗	西	社	天	乖	仁	U	神	L
40. *Solen* cf. *gordonis*	×	…	…	…	×	…	…	…	…	…	×
41. *Mactra crossei*	×	…	…	…	…	…	…	…	…	…	×
42. *Mactra sulcataria*	×	…	…	…	…	…	…	…	…	…	×
43. *Raëta pulchella*	×	…	…	…	…	…	…	…	…	…	×
44. *Lutraria maxima*	…	×	…	…	…	…	…	…	…	…	×
45. *Corbula erythrodon*	×	…	…	…	…	…	…	…	…	…	×
46. *Corbula scaphoides*	…	…	…	…	…	…	×	…	…	×	×
47. *Panope generosa*	×	…	…	…	…	…	…	…	…	…	×
48. *Dentalium (Antalis) weinkauffi*	…	…	…	…	…	×	..	…	..	…	×
49. *Dentalium (Antalis) buccinulum*	×	×	…	…	×	..	…	…	…	…	×
50. *Dentalium (Fissidentalium)* sp,	…	…	…	…	…	×	…	…	…	…	?
51. *Dentalium (Episiphon) filum*	…	…	…	…	..	×	×	…	…	…	(×)
52. *Siphonodentalium nipponicum*	…	×	…	…	…	…	…	…	…	…	…
53. *Monilea cingulata*	×	×	…	…	…	…	…	…	…	…	…
54. *Calliostoma unicum*	×	…	…	…	…	…	…	…	…	…	×
55. *Lischkeia alwinae*	…	…	…	…	…	×	…	…	…	…	×
56. *Umbonium (Suchium) suchiense*	×	…	…	…	×	…	…	…	…	…	…
57. *Umbonium (Suchium) suchiense subsuchiense*	…	…	…	…	…	×	…	…	×	…	…
58. *Umbonium (Suchium) mysticum*	×	…	…	…	…	…	…	…	…	×	…
59. *Umbonium (Suchium) obsoletum*	…	×	×	…	…	…	…	…	…	…	…
60. *Umbonium (Suchium) obsoletum conglomeratum*	…	×	…	×	…	…	…	…	…	…	…
61. *Umbonium (Suchium) obsoletum arenarium*	…	…	…	…	×	×	…	×	…	×	…
62. *Theodoxus (Clithon) retropictus*	…	…	…	…	…	×	…	…	…	…	×
63. *Acmaea pygmaea*	×	…	…	…	…	…	…	…	…	…	×
64. *Lacuna intermedia*	×	…	…	…	…	…	…	…	…	…	…
65. *Cingula (Setia) subangulata*	×	…	…	…	…	…	…	…	…	…	…
66. *Thiara totomiensis*	×	…	…	…	…	…	…	…	…	…	…
67. *Bittium kurodai*	…	×	…	…	…	…	…	…	…	…	…
68. *Bittium crosio*	×	…	…	…	…	…	…	…	…	…	×
69. *Triphora* sp.	×	…	…	…	…	…	…	…	…	…	…
70. *Turritella perterebra*	×	×	×	×	×	×	…	×	…	×	…
71. *Turritella totomiensis*	×	…	…	…	…	…	…	…	…	…	…
72. *Xenophora exuta*	…	…	…	…	…	×	…	…	…	…	×
73. *Bursa ranelloides*	…	…	…	…	…	×	…	…	…	…	×
74. *Gyrineum (Biplex) perca prisca*	…	…	…	…	…	×	…	…	…	…	×
75. *Phalium (Bezoardica) japonicum*	…	…	…	…	…	×	…	…	…	…	×
76. *Tonna luteostoma*	…	…	…	…	…	×	…	…	…	×	×

	大	方	鰯	西	社	天	垂	仁	U	神	L
77. *Tonna japonica*	×	…	…	…	…	…	…	…	…	…	…
78. *Natica janthostoma*	×	×	×	…	×	×	…	…	…	×	×
79. *Polinices sagamiensis*	×	×	×	×	×	×	…	…	…	…	×
80. *Eunaticina papilla*	×	…	…	…	…	…	…	…	…	…	×
81. *Cypraea* sp	×	…	…	…	…	…	…	…	…	…	…
82. *Erato callosa*	…	×	…	…	…	…	…	…	…	…	×
83. *Lyria mizuhonica*	…	…	…	…	…	×	…	…	…	×	×
84. *Fulgoraria (Psephaea) totomiensis*	…	…	…	…	…	×	…	…	…	…	…
85. *Uromitra nakamurai*	…	…	…	…	…	×	…	…	…	…	…
86. *Oliva mustelina*	…	…	×	…	…	…	…	…	…	…	×
87. *Olivella fulgurata*	×	…	…	…	…	…	…	…	…	…	×
88. *Olivella consobrina*	×	…	…	…	…	…	…	…	…	…	×
89. *Olivella spretoides*	×	×	…	…	…	…	…	…	…	×	…
90. *Ancilla albocallosa*	×	×	…	…	…	×	…	×	…	×	×
91. *Marginella (Cystiscus) tokaiensis*	…	…	…	…	…	×	…	…	…	…	…
92. *Cypraeolina solida*	…	×	…	…	…	…	…	…	…	…	…
93. *Cancellaria nodulifera*	×	…	…	…	…	…	…	…	…	…	×
94. *Cancellaria spengleriana*	…	×	…	…	…	×	…	…	…	…	×
95. *Cancellaria pristina*	×	×	…	…	…	×	…	…	…	×	…
96. *Trigonostoma kurodai*	×	…	…	…	…	…	…	…	…	×	…
97. *Terebra abdita*	×	…	…	…	…	…	…	…	…	…	…
98. *Terebra asukensis*	…	×	×	…	…	…	…	…	…	…	…
99. *Terebra yokoyamai*	×	…	…	…	…	…	…	…	…	…	…
100. *Terebra eoa*	…	×	…	…	…	…	…	…	…	…	…
101. *Terebra amabilis*	×	…	…	…	…	…	…	…	…	…	…
102. *Terebra straminea*	…	×	…	…	…	…	…	…	…	…	×
103. *Terebra* cf. *woodwardiana*	…	×	…	…	…	…	…	…	…	…	…
104. *Terebra bifrons*	×	…	…	…	…	…	…	…	…	…	×
105. *Terebra bifrons ugaliensis*	×	×	…	…	×	…	…	…	…	…	…
106. *Terebra (Hastula) dainichiensis*	×	…	…	…	…	…	…	…	…	…	…
107. *Terebra (Acuminia)* sp	×	…	…	…	…	…	…	…	…	…	…
108. *Conus sieboldianus*	…	…	…	…	…	…	…	×	…	…	…
109. *Conus tuberculatus*	×	…	…	…	…	…	…	…	…	…	…
110. *Turris ugaliensis*	×	…	…	…	…	…	…	…	…	…	…
111. *Turris kurodai*	…	…	…	…	…	×	…	…	…	…	…
112. *Turris (Gemmula)* cf. *granosa*	…	…	…	…	…	×	…	…	…	…	×
113. *Asthenotoma yokoyamai*	×	…	…	…	…	…	…	…	…	…	…
114. *Asthenotoma subdifficilis*	×	…	…	…	…	…	…	…	…	…	…
115 *Asthenotoma difficilis*	×	…	…	…	…	…	…	…	…	…	×

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116. *Genota lühdorfi*	...	×	...	...	...	×	...	...	...	...	×
117. *Turricula subdeclivis*	...	...	...	...	...	×	...	×	...	×	...
118. *Turricula (Surcula) sobrina*	×	...	...	...	...	...	...	...	...	×	...
119. *Clavatula kakegawensis*	...	...	...	...	...	×	...	...	...	...	...
120. *Clavatula himea*	...	×	...	...	...	...	...	...	...	...	...
121. *Clavatula patruelis dainichiensis*	×	×	...	...	...	...	...	...	...	...	...
122. *Inquisitor eoa*	...	...	...	...	...	×	...	...	...	...	...
123. *Inquisitor pseudoprincipalis*	×	×	...	...	...	...	...	...	...	...	...
124. *Inquisitor jeffreysii*	...	...	...	...	...	×	...	...	...	...	×
125. *Cymatosyrinx benten*	...	×	...	...	...	...	...	...	...	...	...
126. *Cymatosyrinx solicitata*	...	...	...	...	...	×	...	...	×	...	×
127. *Cymatosyrinx praegracilis*	...	×	...	...	...	...	...	...	...	...	...
128. *Etrema saigoensis*	...	×	...	...	...	...	...	...	...	...	...
129. *Mangilia kurodai*	×	...	...	...	...	...	...	...	...	...	...
130. *Lora crosio*	...	...	...	...	...	×	...	...	...	...	...
131. *Cytharella hiradoensis*	×	...	...	...	...	...	...	...	...	...	×
132. *Cytharella totomiensis*	×	...	...	...	...	...	...	...	...	...	...
133. *Cytharella totomiensis tachymorpha*	...	×	...	...	...	...	...	...	...	...	...
134. *Macteola (Kurtziella) ugali*	×	...	...	...	...	...	...	...	...	...	...
135. *Macteola (Kurtziella) ugali hobasiensis*	...	×	...	...	...	...	...	...	...	...	...
136. *Strigatella dainitiensis*	×	...	...	...	...	...	...	...	...	...	...
137. *Cantharus totomiensis*	×	×	...	...	...	...	...	...	...	...	...
138. *Cantharus totomiensis balani*	...	×	...	...	...	...	...	...	...	...	...
139. *Latrunculus elatus*	×	×	×	×	×	×	×	×	×	×	...
140. *Siphonalia dainitiensis*	×	×	...	...	...	...	...	...	...	...	...
141. *Siphonalia cassidariaeformis declivis*	×	×	...	...	×	×	...	...	...	...	...
142. *Siphonalia mikado*	...	...	...	...	...	×	...	...	...	...	×
143. *Siphonalia stearnsii*	...	...	...	...	...	×	..	...	...	...	×
144. *Kellettia kellettii*	×	...	...	...	...	...	...	..	...	...	×
145. *Microfusus magnificus*	...	...	...	...	×	×	...	×	×	×	×
146. *Microfusus lischkei*	...	...	...	...	...	×	...	...	×	...	×
147. *Nassarius (Hinia) kurodai*	×	...	...	...	...	...	...	...	...	...	...
148. *Nassarius (Hinia) caelatus dainitiensis*	×	...	...	...	...	...	...	...	...	×	...
149. *Nassarius (Caesia) demissus*	×	×	...	...	...	...	...	...	...	...	...
150. *Nassarius* sp	×	...	...	...	...	...	...	...	...	...	...
151. *Mitrella varians*	×	×	...	...	...	×	...	...	...	...	×
152. *Zafra yokoyamai*	×	...	...	...	...	...	...	...	...	...	...
153. *Atilia* sp	×	...	...	...	...	...	...	...	...	...	...
154. *Atilia smithi*	...	×	...	...	...	...	...	...	...	...	×

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155.	*Murex (Chicoreus) totomiensis*	×	…	…	…	…	…	…	…	…	…	…
156.	*Murex (Acupurpura)* cf. *djarianensis*	…	×	…	…	…	…	…	…	…	…	…
157.	*Tritonalia dainitiensis*	×	…	…	…	…	…	…	…	…	…	…
158.	*Cyphonochilus arcuatus*	…	×	…	…	…	…	…	…	…	…	×
159.	*Thais nakamurai*	×	×	…	…	…	…	…	…	…	…	…
160.	*Rapana thomasiana*	×	…	…	…	…	×	…	…	…	…	×
161.	*Actaeopyramis eximia*	×	…	…	…	…	…	…	…	…	…	×
162.	*Turbonilla yokoyamai*	×	…	…	…	…	…	…	…	…	…	…
163.	*Turbonilla actopora*	×	…	…	…	…	…	…	…	…	…	×
164.	*Turbonilla* sp	×	…	…	…	…	…	…	…	…	…	…
165.	*Odostomia sublimpida*	×	×	…	…	…	…	…	…	…	…	…
166.	*Odostomia totomiensis*	×	…	…	…	…	…	…	…	…	…	…
167.	*Odostomia hilgendorfi*	…	×	…	…	…	…	…	…	…	…	×
168.	*Odostomia unica*	×	×	…	…	…	…	…	…	…	…	…
169.	*Odostomia perforata*	×	…	…	…	…	…	…	…	…	…	…
170.	*Odostomia desimana*	…	×	…	…	…	…	…	…	…	…	×
171.	*Odostomia* sp	×	…	…	…	…	…	…	…	…	…	…
172.	*Melanella* sp	…	×	…	…	…	…	…	…	…	…	…
173.	*Niso obtusocarinata*	…	×	…	…	…	×	…	…	…	…	…
174.	*Heliacus angularis*	…	…	…	…	…	×	…	…	…	…	…
175.	*Retusa gordoni*	…	×	…	…	…	…	…	…	…	…	…
176.	*Retusa globosa*	…	×	…	…	…	…	…	…	…	…	…
177.	*Retusa (Coleophysis) minima*	×	…	…	…	…	…	…	…	…	…	…
178.	*Volvulella acuminata tokunagai*	×	×	…	…	…	…	…	…	…	…	×
179.	*Ringicula musashinoensis*	×	…	…	…	…	…	…	…	…	…	×
180.	*Ringicula oehlertiae pacifica*	…	×	…	…	…	×	…	…	…	…	…
181.	*Cylichnella (Bullinella) totomiensis*	×	…	…	…	…	…	…	…	…	…	…

SUMMARY OF FAUNAL LIST

Pelecypoda	47.
Scaphopoda	5.
Gastropoda	129.
Total number	181.
Number of determinable species and subspecies	171.
Number of recent pelecypod forms	35.
Number of recent scaphopod forms	3.
Number of recent gastropod forms	42.

Total number of recent species and subspecies ..... 80.
Percentage of recent forms to total fauna ..... 46·8%
Percentage of extinct forms ..... 54·2%
Total number of species only .....164.
Total number of recent species..... 85.
Percentage of recent species ..... 51·8%
Number of species from Dainiti..... 98.
Number of recent species from Dainiti..... 38.
Percentage of recent species in Dainiti .....40·4%
Number of species from Hônohasi..... 72.
Number of recent species from Hônohasi..... 30.
Percentage of recent species in Hônohasi ..... 41·6%
Number of species from Tennôyama..... 56.
Number of recent species from Tennôyama..... 31.
Percentage of recent species in Tennôyama..... 53·6%
Average percentage of recent species ..... 43·8%

It is obvious from the above list that the proportion of recent Gastropoda is much lower than that of recent Pelecypoda. This difference is in harmony with the more rapid evolution of the Gastropoda as compared with the Pelecypoda.

COMPARISON WITH THE RECENT FAUNA

It is a noticeable feature that the fauna is very closely related to the living molluscan fauna of the Pacific coast between Sagami Bay and Kii. There are only two northern forms, *Panope generosa* GOULD and *Lora crosio* n. sp. But the former, living in the warmer zones of Japan, is excluded from the northern fauna and the latter has no specific relative among the typical *Lora*. The majority of the remainder is found living in Southern and Western Japan. Some of the members are widely distributed throughout the subtropical and tropical waters from the Malay Archipelago to Japan and South China. The following forms are examples: *Pinna attenuata* REEVE, *Ostrea folium* LINNÉ, *Raëla pulchella* (ADAMS & REEVE), *Corbula scaphoides* HINDS, *Eunaticina papilla* (GMELIN), *Xenophora exuta* (REEVE) and *Bursa ranelloides* (REEVE). The species

of *Turritidae* and *Terebridae* also exhibit a close relationship with the tropical fauna.

The characteristic genera of the Japanese element are *Acila, Dosinorbis, Lischkeia, Suchium, Siphonalia, Microfusus* and *Psephaea.*

The remarkable genera belonging to the element of the warm waters of the Far East are: *Heliacus, Cypraea, Bezoardica, Bursa, Biplex, Cantharus, Latrunculus, Chicoreus, Acupurpura, Cyphonochilus, Thais, Strigatella, Lyria, Oliva, Ancilla, Cancellaria, Trigonostoma, Terebra, Turris, Asthenotoma, Genota, Cytharella* and *Conus.*

The exotic forms extinct in Japan are *Amussiopecten* and *Thiara.*

We may judge of the temperature of the waters of the Kakegawa sea from the present geographical range of the recent species in its fauna. With this as a criterion, the waters of that sea were of about the same temperature as the waters of the present coast of Kii which should be classed as warm temperate. The Japanese marine Cainozoic molluscan faunas may be divided into two types, the one of the Kurosio, the warm current, and the other of the Oyasio, the cold current. The present fauna under consideration is of the typical Kurosio type.

COMPARISON WITH FOREIGN NEOGENE FAUNAS

According to Dr. NOETLING* and Prof. MARTIN,** during the Miocene period the Indian province of the ocean was already well separated from that of Europe with regard to the fossils from the Miocene of Java and Burma, it having been proved that there is no species in common with the Miocene of Europe. A similar conclusion may be arrived at in the cases of the Pliocene, Pleistocene and Holocene marine faunas. With a few exceptions such as *Limatula subauriculata* (MONTAGU) and *Episiphon filum* (SOWERBY) the Dainitian fauna little related to the European. The regional development of benthic molluscan faunas separated by land barriers and tropical or boreal waters have caused a great variation of genera and species. Therefore, the Japanese Neogene faunas

* NOETLING, Fauna of the Miocene of Burma, p. 88, 1901.

** MARTIN, Tiefbohrungen auf Java, p. 355, 1887.

are independent from those of the temperate zones of Europe and of America. But there can be found certain noteworthy relations with the neighbouring boreal and tropical faunas. As already stated, the Dainitian fauna is of the typical " Kurosio ", markedly differing from the northern fauna of Japan which comprises some elements common to the Pacific coast of North America.

On the other hand, compared with the Pliocene species of Timor, we can find obvious relations. There are a few examples in common, but their stratigraphical values are not so important, all belonging to the recent species. Many species of *Conus*, *Triton*, *Ranella*, *Cassis*, *Cypraea*, *Strombus*, *Rostellaria*, *Cerithium*, *Telescopium*, *Trochus*, *Arca*, *Circe*, *Cytherea* and *Tellina* described by Dr. TESCH * compose the majority of the assemblage and are of genuine tropical types being not found in the Japanese fauna. But some species of *Turritidae* and *Terebridae* of both fauna exhibit close affinities to each other. Below are the list of the examples and those of Timor to which they are related.

Kakegawa	Timor
Dentalium sp.	*D. junghuhni* MARTIN.
Hinia kurodai n. sp.	*Nassa canaliculata* LAMARCK.
Terebra cf. *woodwardiana* MARTIN.	*T. Woodwardiana* MARTIN.
Terebra abdita n. sp.	*T. Martini* Tesch.
Turris ugaliensis n. sp.	*Pleurotoma gendinganensis* MARTIN
Asthenotoma yokoyamai n. sp.	*Pleurotoma madinensis* MARTIN.

The relation with the Miocene fauna of Java is rather closer than with that of the Pliocene of that country as well as of Timor. Two of Prof. MARTIN's species in the above list are of the Miocene of Java. Besides these there is one species *Murex djiarianensis* MARTIN ranging from the Lower Miocene to the Upper Miocene of Java. It is very noticeable that *Venericardia panda* (YOKOYAMA) and *Turritella perterebra* YOKOYAMA, the most characteristic species of the Lower Kakegawa, are very closely affined to *Cardita decipiens* MARTIN, a Miocene and Pliocene species, and *T. terebra* LAMARCK var. a Miocene form, respectively. *Latrunculus elatus* (YOKOYAMA), the most abundant species, is not known

* TESCH, Jangtertiäre u. Quartäre Mollusken von Timor.

living in Japanese waters, but resembles *L. canaliculatus* (SCHUMACHER), a species of the Miocene, the Pliocene, and the recent of Java.

The determination of the fauna, however, soon proved that the majority of the species are not in common with those of tropical provinces. Roughly speaking, it more resembles the Upper Miocene of Java than the recent of that island, but the data are not enough for the purpose of correlation. The occurrence of some common and closely related forms shows the existence of the Kurosio which has been favourable to migrating marine animals since early Neogene times.

COMPARISON WITH THE PLIOCENE OF IZUMO

Prof. YOKOYAMA* describes twenty-two species of Mollusca from the Izumo Pliocene, out of which two belong to the Cephalopoda—*Nautilus izumoensis* YOKOYAMA and *Argonauta tokunagai* YOKOYAMA. He is inclined to regard the fauna as of the Lower Pliocene in age, being decidedly older than the Lower Musasino, south of Tôkyô. The following forms are in common with the Kakegawa: *Tonna japonica* (YOKOYAMA), *Natica janthostoma* DESHAYES, *Dentalium (Fissidentalium)* sp., *Panope generosa* GOULD, *Venus yokoyamai* n. sp., and *Acila mirabilis* ADAMS. There are found the following forms of the Japan Sea element: *Turritella* aff. *saishuensis* YOKOYAMA, *Cardium pauperculum* YOKOYAMA, *Cardium shinjiensis* YOKOYAMA and *Pecten yessoensis* JAY. These Japan Sea elements and some characteristic extinct forms such as *Cultellus izumoensis* YOKOYAMA and *Pecten kagamianus* YOKOYAMA are entirely absent from the Kakegawa fauna. The age of the deposition is probably near that of the Kakegawa, but exact correlation is impossible owing to the paucity of species.

COMPARISON WITH THE TERTIARY FOSSILS FROM KII

Prof. YOKOYAMA** distinguished thirty-two species of fossils from

* On some Fossil Mollusca from the Neogene of Izumo, Jap. Jour. Geol. Geogr., vol. 2, no. 1, 1923.

** Tertiary Fossils from Kii, Jap. Jour. Geol. Geogr., vol. 2, no. 3, 1923.

the sandstone of Tanabe, Kii (Wakayama-ken), and considered their age must be looked upon as probably Lower Pliocene and not Miocene. Many un-named species collected by HIRASE and preserved in the Institute of Kyôto Imperial University being added, the fauna becomes a tolerably rich one. The fauna show the evident effect of the warm current, having a similar assemblage of Mollusca to that found on the present Pacific coast of South-western Japan. In this connection, the Tanabe fauna and the Kakegawa fauna are in the same condition, while the majority of the species are not in common. Prof. YOKOYAMA mentions that fourteen out of the thirty-two species are extinct. But this number seems to me to be too small. Many of the extinct forms are less related to the living than those of the Kakegawa. Therefore, the age of the Tanabe sandstone must be older. Moreover, the occurrence of *Vicarya baculum* YOKOYAMA which is very closely related to *V. callosa* JENKINS, a valuable index fossil of the Miocene of the East, is very noteworthy.

COMPARISON WITH THE TOGARI FAUNA

The Togari formation in Mino (Gihu-ken) yields abundant well-preserved fossils the age of which Prof. YABE,* and Prof. H. Matsumoto** consider to be Miocene, while BRAUNS*** and Prof. YOKOYAMA**** ascribed it to a more recent date. The type locality of this formation is distant from Dainiti no more than a hundred kilometers. The fauna, however, decidedly differs from the latter. Perhaps that of Togari is the forerunner of the faunal element of Japan proper in the recent and had developed in an inland sea unaffected by ocean currents.

The occurrence of *Vicarya* and *Desmostylus* is in favour of the Miocene origin of the strata. If this formation is not a real marine facies of the Hiramaki formation which contains some land mammals akin to the foreign Lower Miocene forms, yet it does not much differ from that bed in age, judging from their stratigraphical relations.

* Correlation of Japanese Cainozoic strata, p. 6, (in Japanese), 1923.
** Sci. Rep. Tôhoku Univ., Geology, vol. 3. p. 73, 1918; Ibid. vol. 5, pp. 83—85, 1921.
*** Geology Env. Tokio, p. 69, 1881.
**** Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 216, 1926.

COMPARISON WITH THE TERTIARY MOLLUSCA FROM SINANO

The Tertiary Molluscan fauna of Sinano (Nagano-ken) is to be taken approximatly as belonging to the lower Pliocene according to Prof. YOKOYAMA.* It is obviously of the typical Oyasio type containing some North American elements and represents a striking contrast to the Dainitian fauna.

CORRELATION WITH THE KAKEGAWA SERIES OF TOSA

The marine conglomerates and sandstones, resting unconformably upon a foundation of Mesozoic rocks, occupy a few small isolated patches along the coast of Aki-gun, Tosa (Kôti-ken in Sikoku). The occurrence of some Foraminifera was noted by Prof. YABE ** and very recently Prof. YOKOYAMA *** determined some fossil shells collected by Mr T. SUZUKI of the Imperial Geological Survey. I made a rich collection of molluscan remains from various zones of these beds, and I am convinced that they are the equivalents of the Kakegawa series. The Kônomine Béds at Tônohama are especially rich in fossils. Below is a list of the characteristic species of the Kakegawa series in common, rare examples being omitted:

Acila mirabilis ADAMS & REEVE.
Scapharca satowi castelata YOKOYAMA.
Glycimeris totomiensis n. sp.
Glycimeris rotunda (DUNKER).
Pecten praesignis YOKOYAMA.
Crassatellites yagurai n. sp.
Venericardia panda (YOKOYAMA.)
Papyridea mutica REEVE.
Chione isabellina PHILIPPI.
Clementia vatheleti MABILLE.

* Jour. Fac. Sci. Univ. Tokyo, sec. 2. vol. 1. p. 4, 1925.
** Sci. Rep. Tôhoku Univ., Geology, vol. 4, p. 115, 1918.
*** Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 365, 1926.

Paphia schnelliana (DUNKER).
Corbula scaphoides HINDS.
Suchium obsoletum arenarium MAKIYAMA.
Natica janthostoma DESHAYES.
Polinices sagamiensis PILSBRY.
Xenophora exuta (REEVE).
Turritella perterebra YOKOYAMA.
Tonna luteostoma (KÜSTER).
Latrunculus elatus (YOKOYAMA).
Hinia caelata dainitiensis n. subsp.
Microfusus magnificus (LISCHKE)
Chicoreus totomiensis n. sp.
Lyria mizuhonica n. sp.
Oliva mustelina LAMARCK.
Olivella spretoides YOKOYAMA.
Ancilla albocallosa (LISCHKE).
Cancellaria pristina (YOKOYAMA).
Trigonostoma kurodai n. sp.
Turricula subdeclivis (YOKOYAMA).
Surcula sobrina (YOKOYAMA).
Cymatosyrinx solicitata (SOWERBY).

Besides the above, there are many species new to science the description of which together with detailed stratigraphy will be published at another opportunity. Judging from the assemblage, the Kônomine Beds as a whole correspond to the Tennô sands.

I discovered at Aki another horizon which seems to be somewhat older, containing *Suchium mysticum* YOKOYAMA, a characteristic form of the Dainiti horizon.

AGE

The percentage method which, at least theoretically, may be applied to the determination of the age of the Lower Kakegawa, but as to the practical application there is considerable disagreement. The proportions of living forms noticed in the Neogene faunas of Tropical Asia by Prof. MARTIN,* Dr. NOETLING** and Mr. VREDENBURG*** are generally

* Die Tertiärschichten auf Java, p. 24, 1880.
** Fauna of the Miocene Beds of Burma, p. 97, 1901.
*** Proc. Malac. Soc., vol. 10, pp. 259—261, 1912.

greater than those met with in the standard horizons of Europe. This divergence from the Lyellian standard must be much reduced in Japan, because the climatic changes caused by the variation of the ocean currents, as compared with the uneventful Neogene history of the tropical seas which must have allowed therefore a much more gradual evolution of the marine fauna, have been of considerable significance. For this reason, the percentage method may approximately be applied in Japan. As has already been noted, Prof. YOKOYAMA placed the Dainitian in the Lower Pliocene, although recently he is inclined to consider it as the Middle. Using the same method he placed the Lower Musasino at a more recent date than the Dainiti. The percentage of extinct species of the typical Lower Musasino seems to become smaller than the 40·5 % given by him. The greater half of the deposition is of a deeper water origin and in this connection, the lithological characters of that bed are related the Upper Kakegawa which is of a similar origin, although the faunistic difference between these two formations rejects their equivalency.

The occurrence of *Amussiopecten praesignis* YOKOYAMA, a species very closely allied to *A. burdigalensis* Lamarck, a species of the Langhian and Helvetian of Europe. Together with this, there are a few Miocene forms of Java. But the materials are too small to admit of any exact correlation being made.

As for the most probable conclusion concerning the age of the Dainitian fauna, I am inclined to the first opinion of Prof. YOKOYAMA. Roughly speaking, it corresponds to the Plaisancian, or if the standard of India be adopted without regarding the temperate condition of our climate, it will be taken as Pontian.

SUMMARY

1. The Kakegawa sediments overlap towards the east at least in the type locality upon the older Tertiary rocks.

The subdivisions of the lower part and their fossiliferous horizons are summarized as follows:

Dainitian.

b. Tennô sands. Zone of *Suchium obsoletum arenarium* and *Turricula subdeclivis.*

a. Dainiti sands. 3. Zone of *Suchium obsoletum conglomeratum.*

2. Zone of *Glycimeris totomiensis* and *Suchium obsoletum.*

1. Zone of *Suchium mysticum.*

2. The geological age is approximately Plaisancian.

3. The climatic condition of the sea was similar to the existing sea between Sagami and Kii. The fauna is perfectly of the Kurosio type.

4. The Tertiary rocks of Tanabe, Togari and Izumo are older than the Dainitian.

5. The typical Lower Musasino is younger than the Dainitian.

6. The Kakegawa series of Tosa comprises the two zones: The lower—*Suchium mysticum* zone and the upper—Tennô sands horizon.

7. The fauna contains 171 species of Mollusca, 46·8 % of which is exactly known as living.

8. The evolution of the Gastropoda is much more rapid than that of the Pelecypoda.

9. The Dainitian is a stratigraphic and faunal unit. It might play the rôle of standard for the future studies of the Japanese Cainozoic.

DESCRIPTION OF THE SPECIES

PELECYPODA

Nuculidae

Acila minuta n. sp. (*Plate I, figs. 8, 9.*)

Shell small, thin, oblique and very inequilateral, ovately subtriangular, convex, with divaricating sculpture. Beaks subterminal, very opisthogyrate and inturned, approximate, elevated into an acute angle. Anterior dorsal margin long, sloping, lightly convex, narrowly rounded on meeting the regularly convex ventral margin; posterior dorsal margin short, about half the length of the anterior, very rapidly descending, nearly straight, slightly convex in the middle; postero-ventral angle obtuse, roughly 105°. Lunule linear, indistinctly marked, short, scarcely extending to the middle of the dorsal slope. Escutcheon round, faintly indicated without bounding lines, smooth except for the fine incremental lines. Dorsal area oblong, bounded by obtuse ridges running from the beaks to the postero-ventral angle, shallowly grooved inside the bounding ridge, lightly pouting in the middle, sculptured by oblique bifurcating threads which do not extend in the escutcheon. Sculpture like *Acila insignis*, consisting of oblique divaricating threads; the line at which the divaricating threads cross is near the middle of the shell; the threads bifurcate near the anterior dorsal margin. Prodissoconch smooth. Interior nacreous, smooth, shining and the margins crenulated. Hinge with a narrowly triangular chondrophore directed forward; the anterior line of teeth long, started from the beak, slightly arched, increasing in height distally, about two-thirds the length of the dorsal margin, with about 18 teeth; the posterior one meeting the anterior at nearly a right angle, short and straight, with about 10 teeth; the first tooth is parallel to the lower edge of the chondrophore; there is a small triangular platform of shell substance. Length, 5.12 mm.; height, 4.49 mm.; diameter about 3.1 mm. Type: Holotype, no. 201.

Occurrence.—Dainiti (frequent). Hônohasi (not rare, type).

Acila minuta n. sp. is much akin to *A. insignis* GOULD a species living in the waters of north Japan and whose fossils are known in the Miocene and the Pliocene of this country. It differs from the latter species in that the shell is smaller, probably not attaining the size more than 10 mm. long, less inflated and not so elongate; the posterior end is not so truncated; the margin is distinctly crenulate and that there is no lamella at the posterior edge of the chondrophore. *A. insignis* has a sharp lamella at that edge, behind which there is an oblique triangular pit directed forwards. The first posterior tooth in that species makes the posterior edge of this pit which is as long as the half of the length of the chondrophore.

A. insignis GOULD is neither a synonym nor a variety of *A. mirabilis* REEVE & ADAMS, which was supposed to be a Korean form of *A. divaricata* HINDS by Dr. DALL. The difference between these species were well observed by Prof. YOKOYAMA and Prof. TOKUNAGA. Moreover, in *A. mirabilis* the pit below the chondrophore is less prominent and the line of the posterior teeth begins from the top of the pit. In this point, *A. minuta* is more closely allied to *A. mirabilis*—though it has not such a pit—than to *A. insignis*. The angle at the apex between the lines of teeth is obtuse in *A. mirabilis* and *A. insignis*. The escutcheon of *A. mirabilis* is well defined by a distinct line.

Acila mirabilis. (ADAMS et REEVE)

1866. *Nucula mirabilis*, HANLEY, in SOWERBY's Thes. Conch., vol. 3, sp. 19, f. 114.
1871. *Nucula mirabilis*, SOWERBY, in REEVE, Conch. Icon., sp. 4.
1881. *Nucula cobboldiae*, BRAUNS, Geol. Env. Tokio, p. 46.
1882. *Nucula mirabilis*, DUNKER, Index. Moll. Mar. Jap., p. 238.
1885. *Nucula (Acila) mirabilis*, SMITH, Challenger Rep., Lamellibranchiata, p. 230.
1898. *Nucula (Acila) divaricata*, DALL, Tert. Fauna Florida, p. 572.
1906. *Nucula mirabilis*, TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21. art. 2, p. 56.
1914. *Nucula mirabilis*, IWAKAWA, Hand-list Jap. Biv., p. 48.
1920. *Nucula mirabilis*, YOKOYAMA, Foss. Miura Penin. (Jour. Coll. Sci. Univ. Tokyo, vol. 39, art. 6), p. 180, pl. 19, f. 9.
1923. *Nucula mirabilis*, YOKOYAMA, Jap. Jour. Geol. vol. 2, p. 9.
1925. *Nucula mirabilis*, YOKOYAMA, Jour. Coll. Sci. Univ. Tokyo, vol. 45, art. 5, p. 30.
1925. *Nucula mirabilis*, YOKOYAMA, Ibid., art. 7, p. 21.
1925. *Nucula mirabilis*, YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, pp. 125, 137, 226.

Occurrence.—Tennôyama. Nitô.

Distribution.—Upper Musasino of Tôkyô. Naganuma Beds. Lower Musasino of Miura. Pliocene and Miocene of the Zyôban coal-fields. Miocene of Mino. Neogene of Siobara, Izumo and Titibu.

Living.—Central and western Japan. Korea.

This species is distinguished from *A. minuta* n. sp. in having the larger shell, the marked escutcheon, the long distinct lunule, the acute postero-ventral and obtuse apical angles, the prominent lamella below the chondrophore and the small triangular pit between the chondrophore and the posterior teeth. Prof. YOKOYAMA* considers that the day when *N. mirabilis* and *N. cobboldiae* will be proved to belong to the same species will probably come, and that, even if that does not, still it can not be denied that there is a close relationship between the two forms. He also says *N. insignis* may be the young of one of these species. The most important hinge character, however, has been neglected.

A. mirabilis is represented in the Tennô sand by several fragments of detached valves and by a few inner moulds.

Ledidae

Leda confusa HANLEY.

1866. *Leda confusa* HANLEY, SOWERBY's Thes. Conch., vol. 3, p. 119, f. 85.
1871. *Leda confusa*, SOWERBY, in REEVE, Conch. Icon, sp. 24.
1874. *Leda confusa*, LISCHKE, Jap. Meer. Conch., vol. 3, p. 109.
1881. *Leda confusa*, BRAUNS, Geol. Env. Tokio, p. 45.
1882. *Leda confusa*, DUNKER, Index Moll. Mar. Jap., p. 238.
1895. *Leda confusa*, PILSBRY, Cat. Mar. Moll. Jap., p. 151.
1906. *Leda confusa*, TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 56.
1922. *Leda confusa*, YOKOYAMA, Foss. Up. Musashino (Jour. Coll. Sci. Univ. Tokyo, vol. 44, art. 1.), p. 195, pl. 17, f. 4.
1923. *Leda confusa*, YOKOYAMA, Tert. Moll. Dainichi, p. 18.
1925. *Leda confusa*, YOKOYAMA, Jour. Coll. Sci. Univ. Tokyo, vol. 45, art. 5. p. 29.
1925. *Leda confusa*, YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 124.
1926. *Leda confusa*, YOKOYAMA, Ibid. p. 226.

Occurrence.—Dainiti. Hônohasi. Tennô-shrine.

* Jour. Fac. Sci. Univ. Tokyo, Sec. 2, vol. 1. p. 246.

Distribution.—Upper Musasino of Tôkyô and Tiba-ken. Neogene of Titibu and Zyôban coal-fields. Miocene of Mino.

Living.—China Sea. Central and western Japan.

This species is frequently found in the Dainiti sands. The specimens are mostly of young ones, exhibiting very variable general contours. An adult shell measures: length 16·6 mm., height 9·3 mm. and thickness of right valve 3·2 mm. It is slightly more elongate than the type figured by HANLEY, perhaps corresponding to the variety "*producta.*" Examination of many specimens shows that this variety may not be a well-established one.

Limopsidae

Limopsis tokaiensis YOKOYAMA.

1910. *Limopsis tokaiensis* YOKOYAMA, Jour. Geol. Soc. Tokyo, vol. 17, p. 1, pl. 9, f. 1, 2, 3, 5, 6, 7.

1910. *Limopsis tokaiensis* var. *elongata* YOKOYAMA, Ibid., p. 2, pl. 9, f. 4.

1920. *Limopsis tokaiensis* YOKOYAMA, Fos. Miura Penin., p. 172, pl. 18, f. 14, 15, 16.

Occurrence.—Tennôyama.

Distribution.—Lower Musasino of Miura. Nagunuma Beds. Pliocene of Kunôzan.

Living.—Off Bôsyû, rare (YOKOYAMA).

This species is very rarely found in the Tennô sands. The specimens are mostly dwarf. An example measuring hight 8·5 mm., length 8·7 mm. shows thickened margin and less number of teeth and highly developed ligamental area of the maturity, halfway interrupting the line of teeth.

This species is related to *L. marionensis* SMITH and *L. pelagica* SMITH, the differences of which were fully observed by Prof. YOKOYAMA. *L. tokaiensis* is also related with *L. tajimae* SOWERBY, a living species of the Japan Sea, from which it differs in being smaller, in having smaller number of radial lines and a shorter hinge margin with a narrower ligamental fossette and a higher area. Moreover, the nepionic shell of *L. tajimae* is less tumid and has a crenulated ventral margin like *L. crenata* A. ADAMS. The shells of those species are very variable. But, on an average, *L. tokaiensis* is more narrowly oblique with the shorter dorsal margin and is

more inflated and thicker. *L. tokaiensis* is found together with *L. tajimae* in the Lower Musasino and in the Pliocene of Kunôzan.

Arcidae

Barbatia (Scapharca)* satowi castellata (YOKOYAMA)

1923. *Arca castellata* YOKOYAMA, Tert. Moll. Dainichi, p. 17, pl. 2, f. 10—13.

1926. *Arca (Anomalocardia) infiata*, YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo. sec. 2, vol. 1, p. 350.

Occurrence.—Dainiti. Hônohasi. Tennôyama. Nitô. Iwasibara.

Distribution.—Kakegawa series of Tosa.

B. satowi is characterized by its obtuse antero-dorsal angle, its rounded anterior end and its 33 to 39 flattened ribs. *B. nipponensis* (PILSBRY) and *B. castellata*, being not differentiated from the species in character, may be considered as geological or geographical varieties of *B. satowi* DUNKER. *B. satowi castellata* is longer than the living species and has a slightly longer postero-dorsal edge.

Glycimeris totomiensis n. sp. (*Plate I, figs. 1—4.*)

Shell medium in size, thick and solid, oblique, roundly triangular, slightly inequilateral, moderately convex. Beaks a little anterior to the middle, prominent, incurved, close together. Anterior end rounded with the subtruncated and descending dorsal margin; posterior end somewhat produced, forming a rounded angle; postero-dorsal margin truncate; ventral margin regularly arcuate; an indistinct ridge descending from the beaks to the posterior angle. Surface with about 25 rather obscure radiating striae, obsolete on the posterior area circumscribed by the ridge and towards the anterior end; crossed by fine incremental lines and well-marked growth periods. Interior porcellaneous, smooth; basal margin prominently crenated; postero-dorsal margin with a very fine but well-marked ridge. Hinge-plate heavy, broad, arcuate, with 8 to 12 oblique, lamellar teeth on each side of the middle, decreasing in size medially and distally. The series of teeth

* WOODLING, W, P., Miocene Mollusks from Bowden, Jamaica, p. 41, 1925.

The subgeneric name "*Scapharca*" displaces *Anadara* which type is *Arca antiquata* LINNÉ and not *A. antiquata* POLI.

in adult shell interrupted in the middle. Adductor-scars distinct; the posterior one elevated with sharp boundary. Height, 33 mm.; length, 33·5 mm.; diameter, 23.4 mm. Type: Cotype, no. 203. (Hônohasi).

Occurrence.—Hônohasi (abundant). Saigô-bridge. Iwasibara. Tennô-yama (rare). Nitô (rare).

This species is very variable in form, some being more depressed and some others being much higher than the types. The dimensions of 7 examples from Hônohasi measured and calculated in the ratio of height to length:

	Height	Length	H : L
I.	37.7	34.7	1.09
II.	32.4	30.0	1.08
III.	33.0	32.9	1.00
IV.	32.2	33.3	0.97
V.	33.0	33.5	0.98
VI.	28.8	30.4	0.94
VII.	25.0	28.1	0.89

The blunt ridge extending from the beaks to the posterior end seems to be the constant character of the species. The ridge is but obsoletely recognized in some living allied species such as *G. yessoensis* SOWERBY and *G. vestita* DUNKER. This species is also related to *G. nipponica* YOKOYAMA which occurs in the Lower Musasino of Miura Peninsula, but it differs from that species in that it possesses a heavier and more tumid shell with a moderately heavy hinge and a well-defined posterior ridge.

Glycimeris nakamurai n. sp. (*Plate. I, figs. 5, 6.*)

Shell attaining a large size, thick and solid, suborbicular, a little longer than high, convex, nearly equilateral. Beaks large, moderately elevated, tumid, median, close together. Anterior and posterior ends subequally broadly rounded, the anterior being slightly larger, with nearly straight and rather short dorsal margins; ventral margin arcuate, passing insensibly to the regular curves of both ends. Surface with many radiating lines which become obsolete and crowded on both sides; also crossed by very fine

numerous subequal concentric striae. The upper central portion of the outer surface with many irregularly scattered fine dots. Ligamental area much depressed and narrow, about half the length of the shell, smooth. Hinge-plate heavy, broad and rather high; the upper margin horizontally straight, the lower margin arcuate; teeth 28 in the type, thick, more or less hooked, vertical in the middle, oblique towards the sides. Adductor-scars subequal, oval, raised from the surface, the compression caused by their thickening, making a fold of shell substance between the hinge-plate. Pallial line simple, well-marked. Basal margin prominently crenate. Length, 78 mm.; height, 71 mm.; thickness of right valve, 26 mm. Type: Holotype, no. 206. (Hônohasi).

Occurrence.—Hônohasi. Tennô-shrine.

In general contour, this species resembles *G. cisshuensis* MAKIYAMA, a Lower Miocene species of Korea. It differs from that species in that the shell is more equilateral, the beaks are larger and nearly contiguous, the ligamental area is narrower, and the radial rays are less in number—about 11 between the length of 3 cm. on the middle portion at the distance of 5 cm. from the beak; that of *G. cisshuensis* is about 16—and in having the peculiar fine dots.

G. nakamurai n. sp. is more closely allied to *G. albolineata* LISCHKE, a living species of Japan, but it differs from that species in being more circular in the full-grown examples, in possessing a heavy and solid shell, a higher hinge-plate and smaller number of the surface dots. The dots of *G. albolineata* are numerous and show a regular arrangement. Probably the living species had been derived from this fossil species.

Glycimeris rotunda (DUNKER). (*Plate. I, fig. 7.*)

1882. *Pectunculus rotundus* DUNKER, Index. Moll. Mar. Jap., p. 236, pl. 16, f. 9. 10.

1889. *Pectunculus rotundus*, PILSBRY, Cat. Jap. Mar. Moll., p. 150.

1922. *Pectunculus yamakawai*, YOKOYAM , Foss. Up. Musashino, p. 190, pl. 16, f. 4. 5.

Occurrence.—Tennôyama (common). Saigô-bridge. Tennô-shrine. Nitô.

Distribution.—Kakegawa-series of Tosa at Kônomine. Upper Musasino.

Living.—Between Tôkyô Bay and Tosa. Also Nagasaki.

The fossils found in the Tennô sands are hardly differentiated from the species living in the warmer waters of Japan. The full-grown specimens are not so circular as figured by DUNKER but oblique with a slightly produced posterior ventral corner. It is also characterized by fine concentric striae. The living examples are always peculiarly starred with white. Prof. YOKOYAMA assigned *P. rotundus* DUNKER found in the upper Musasino to the young of *P. vestitus* DUNKER. What he thought as *P. rotundus* is not really *P. rotundus* of DUNKER, but is the young of *P. vestitus*.

This species is more compressed and lenticular than *G. totomiensis* and lacks the posterior ridge. One of the fossil specimens measures 34 mm. in height, 36 mm. in length and 12 mm. in diameter.

Pinnidae

Pinna cf. attenuata REEVE.

1915. *Pinna attenuata* MENKE, IWAKAWA, Hand-list Jap. Biv., sp. 155.

Occurrence.—Hônohasi.

Living.—South-western Japan.

A fractured young specimen missing the apical and basal portions is at hand. The posterior side has a few obscure radial ribs and the anterior is obliquely wrinkled. Compared with the living form, it is found as identical with our "Habôki-gai" which is said to be the same as *Pinna attenuata* REEVE of the Mollucas (Conch. Icon., sp. 46.)

Atrina japonica ('HANLEY' REEVE).

1922. *Pinna japonica*, YOKOYAMA, Foss. Up. Musashino, p. 185, pl. 15, f. 8.

1923. *Pinna japonica*, YOKOYAMA, Tert. Moll. Dainichi, p. 17.

1925. *Pinna japonica*, YOKOYAMA, Jour. Coll. Sci. Univ. Tokyo, vol. 45, art. 5, p. 28, pl. 6, f. 7.

Occurrence.—Dainiti. Hônohasi.

Distribution.—Sirado Beds of Kasima. Upper Musasino of Tôkyô and Tiba-ken.

Living.—Central and western Japan.

A fragment of the apical portion of this species from the sands of Dainiti was determined by Prof. YOKOYAMA. There is also a much fractured shell assignable to this form in the sands of Hônohasi. The apical portion

of this species is entire and not fissured; therefore it belongs to the genus *Atrina*.

Ostraeidae

Ostrea musashiana YOKOYAMA.

1920. *Ostrea musashiana* YOKOYAMA, Foss. Miura Penin., p. 163, pl. 16, f. 1—5.
1922. *Ostrea musashiana* YOKOYAMA, Foss. Up. Musashino, p. 185, pl. 15, f. 5.

Occurrence.—Dainiti. Hônohasi. Tennô-shrine.

Distribution.—Upper Musasino of Yokosuka and Tiba-ken. Lower Musasino at Kosiba.

Living.—Sagami Bay.

Three specimens from Hônohasi represented under this category, consist of very convex lower valves of a small *Ostrea* possessing an elongate ovate contour with an uneven laminated surface. The shells adhere to the interior of the outer lips of dead Gastropod shells. The surface sheltered by the outer lip is smooth, and has a strong spiral keel which corresponds to the posterior angle of the aperture. The materials from the other locality are larger. One of the specimens measures 31 mm. in height and is like the type specimens of the Musasino. An oyster living in the deeper and clearer water of Sagami Bay and named *Ostrea cochlea* POLI seems to me differing little from the present species.

Ostrea cf. palmipes SOWERBY.

1871. *Ostrea palmipes* SOWERBY, Conch. Icon., sp. 56.

Occurrence.—Hônohasi.

The small lower valves adhering to a shell of *Umbonium* are probably closely related to *O. palmipes*, a living species of the Philippines and Formosa. The specimens are too young and imperfect to admit of a more precise identification. The shell is flat and subquadrate in outline. On both sides of the hinge, the inner margin is crenate. One of the specimens measures 17 mm. in height and 14 mm. in length. The living shell of the Philippines was described as possessing a distantly ribbed surface. But this character is not a constant one; many of the specimens adhering to smooth depressed bivalves exhibit no radial sculpture.

Ostrea palmipes was found in the upper Pleistocene of Kii by Prof. NAKAMURA and Mr. KURODA.

Ostrea folium LINNE.

1871. *Ostrea folium*, SOWERBY, in REEVE, Conch. Icon., sp. 40.
1882. *Ostrea folium*, DUNKER, Index. Mar. Moll. Jap., p. 249.
1909. *Ostrea (Alectryon) folium*, MARTIN, Die Fossilien von Java, p. 339, pl. 47, f. 24, 25.
1920. *Ostrea (Alectryonia) folium*, TESCH, Pal. Timor, vol. 8, p. 89, pl. 16, f. 236.
1924. *Ostrea cucullata*, YOKOYAMA, (non BORN), Jour. Coll. Sci. Univ. Tokyo, vol. 45, p. 57, pl. 4, f. 12, 13.

Occurrence.—Taruki.

Distribution.—Upper Pleistocene of Numa, Tiba-ken. Pliocene of Sonde, Java. Pliocene of Kampong Fatoekan, Timor.

Living.—Central America. East India. Southern Japan.

This determination applies to a single immature upper valve which is obliquely oval with the beak curved backward. The sides are divergently folded, but the central portion near the beak is roughly tuberculated. The tube-shaped median rib observed by SOWERBY and MARTIN is also prominently developed in some Japanese living examples. But this is not a constant character of the species. In this connection, it is doubtful whether *O. plicatula* GMELIN and *O. dubia* SOWERBY are good species or not. The inner margins on both sides of the low hinge are finely tubercled. The muscular impression is at the middle of the height and a little posterior. The specimen measures 39 mm. in height and 35 mm. in length. Compared with the recent specimens from Kii, the fossil one may safely be assigned to the same species.

Pectinidae

Pecten (Amussiopecten) praesignis YOKOYAMA.

1922. *Pecten praesignis* YOKOYAMA, Jour. Geol. Soc. Tokyo, vol. 29, no. 350, pl. 5.

Shell rather thin, orbicular, more than 10 cm. in length, slightly broader than high, compressed, inequivalve being a little more inflated than the left, nearly equilateral, with broad radial ribs. Prodissoconch small, ovately triangular, higher than long, smooth. Dorsal margins long, concave,

sloping gently toward the rounded ends, subequal, the anterior being slightly longer than the posterior. Apical angle large, a little larger than 120°. Ventral margin very long, regularly arched, nearly twice as the dorsal margins; the diagonal connecting the posterior and anterior ends crossing the height at its upper fourth. Right valve moderately inflated near the beak, flattened on the ventral area. Left valve plano-convex, less inflated than the right valve, flatly concave near the beak. Sculpture consisting of 16 to 18, subequal, broad, low and flat radial ribs, the lateral ribs often splitting into two or more obscure riblets; the interspaces on the right valve are narrower than the ribs themselves, while on the left just opposite is the case. The ribs of young shells are narrower than those of the adult. Surface also radially obscurely striated all over, Incremental lines distinct, looking like striations, somewhat lamellated on the left valve. Hinge margin straight, occupying half of the length of the shell. Ears subequal, with crowded imbricating incremental lines, obliquely truncated posteriorly; the anterior margin of the right convex, shallowly sinuated below, representing the byssal notch. The right ears higher distally than the left ones and their upper cardinal margins bent over the other ones. The lateral margins of the deep resilial pit of the left valve are sharply raised into tooth-like ridges which correspond to the lateral slope of the broad pit of the opposite valve. The margin of the lateral slope has a round tubercle which fits into the corresponding depression at the outside of the tooth-like ridge of the left valve. Hinge line with two distinct cardinal crulas which are finely vertically striated. Interior sculptured with 16 to 18 pairs of sharp ridges ending in a sharp point at a short way above the ventral margin. The space between the paired ridges corresponding to the interspace of the surface ribs, often filled with shell substance and appearing as a quadrate costa at the upper portion. Length, 123mm.; height, 110mm.; diameter, 18 mm. (Holotype in Geol. Inst. Imp. Univ. Tokyo, measured by Prof. YOKOYAMA). Length, 78 mm.; height, 71 mm.; hinge line, 36 mm.; diameter, 13 mm. (Plesiotype in Geol. Inst. Kyôto Imp. Univ., no. 51.)

Occurrence.—Tennôyama (Abundant). Nitô. Tennô-shrine. Saigô-bridge. Iwasibara. Hônohasi (rare).

Distribution.—Kakegawa series of Tosa, at Kônomine.

This species differs from *P. burdigalensis* LAMARCK, the type of *Amussiopecten* and an European Miocene species, in that the byssal notch is smaller and shallower, the incremental lines of the posterior ear are not so much curved, and the ribs are more in number. Their resemblance, however, is so striking that they may be possibly conspecific. *Amussiopecten* was proposed by SACCO as a genus, but has subsequently been united to *Flabellipecten* of the same author by Dr. DEPÉRET and ROMAN. In many respects, these forms have intermediate characters between the typical *Pecten* and *Amusium*. The latter genus has been considered since early days to be distinct from *Pecten*.

Limidae

Lima (Limatula) subauriculata (MONTAGU).

1920. *Lima subauriculata*, YOKOYAMA, Foss. Miura Penin., p. 150, pl. 12, f. 10.

1921. *Lima subauriculata*, Dall, U. S. Nat. Mus. Bull., 112, p. 20.

1922. *Lima subauriculata*, YOKOYAMA, Foss. Up. Musashino, p. 178.

Occurrence.—Hônohasi.

Distribution.—Upper Musasino of Miura and Tiba-ken. Pliocene and Miocene of Europe.

Living.—Great Britain. Scandinavia. Greenland. North America (DALL). Japan (KURODA).

This is a very widely distributed and somewhat locally variable species. The fossil form of the Upper Musasino differs little from the Japanese living form. It has more than thirty radials and a well-marked median sulcus. The fossil of Miyata has only sixteen riblets as described by Prof. YOKOYAMA. This species is represented in the Kakegawa series by a few small detached valves which bear a close resemblance to the form of Miyata in having only thirteen radials. The radials are slender but sharp and not granuled by the incremental lines.

Anomiidae

Anomia lischkei DAUTZENBERG et FISCHER.

1906. *Anomia Lischkei* DAUTZENBERG et FISHER, Jour. de Conch., vol. 54, p. 40.

1920. *Anomia nipponensis* YOKOYAMA, Foss. Miura Penin., p. 147, pl. 11, f. 18, 19.

1922. *Anomia nipponensis* YOKOYAMA, Foss. Up. Musashino, p. 176.

1923. *Anomia Lischkei*, MAKIYAMA, Jap. Jour. Geol. Geogr., vol. 2, p. 22.

1925. *Anomia lischkei*, YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 15.

Occurrence.—Hônohasi.

Distribution.—Upper Musasino of Tôkyô, Miura and Tiba-ken. Upper Pliocene of Maiko. Naganuma Beds. Pliocene of Sigarami, Nagano-ken.

Living.—Widely distributed in the Japanese waters.

Only one fractured specimen represents this species occuring in the Dainiti sands.

Myochamidae

Myodora reeveana SMITH.

1904. *Myodora reeveana*, PILSBRY, Proc. Acad. Nat. Sci. Phila., p. 558, pl. 41, f. 7—10.

1916. *Myodora reeviana*, IWAKAWA, Hand-list Jap. Biv., sp. 687.

1920. *Myodora reeviana*, YOKOYAMA, Foss. Miura Penin., p. 143, pl. 11, f. 12, 13.

1922. *Myodora reeviana*, YOKOYAMA, Foss. Up. Musashino, p. 171, pl. 14, f. 8, 11.

Occurrence.—Hônohasi.

Distribution.—Lower and Upper Musasino.

Living.—Western Japan and China.

There is no significant difference among the fossils of the Kakegawa, the fossils of the Musasino and the living form.

Cuspidariidae

Cuspidaria sp.

Occurrence.—Tennôyama.

A single imperfect specimen of closed valves measuring about 20mm. in height and 14mm. in diameter is under exmination. The dimensions indicate this as belonging to a species as large as *C. chinensis* GRAY; the shell is similarly solid. Nothing is known regarding the character of the rostrum which is in much fractured condition. The shell is rather convex with a round, low, opisthogyrate beaks. The anterior dorsal margin is slightly convex and considerably sloping, the posterior more oblique and gently concave. The anterior end is narrowly rounded. The ventral outline is regularly widely arcuate under the main portion of the shell with a small

shallow sinuation at the commencement of the rostrum. The sculpture consists of concentric lines of unequal sizes; some of them rise into laminae on the posterior part of the main portion of the shell. This form may most probably be identified with *C. chinensis* GRAY which is known also living in Japan.

Cuspidaria (Cardiomya) gouldiana (HINDS).

1843. *Neaera Gouldiana* HINDS, Proc. Zool. Soc. Lond., p. 77.
1862. *Neaera gouldiana*, CHENU, Manuel de Conch., vol. 2, p. 50, f. 208.
1895. *Cuspidaria (Cardiomya) gouldiana*, PILSBRY, Cat. Mar. Moll. Jap., p. 136.
1906. *Neaera gouldiana*, TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 37, pl. 2, f. 23.

Occurrence.—Dainiti.

Distribution.—Upper Musasino of Sinagawa.

Living.—Western Japan to Malay Archipelago.

A small left valve of this species was found in the Dainiti sands. The number of radial costae is eighteen. The type of this species has twenty radials. *C. singaporensis* HINDS is distinguished from the present species in having lateral teeth in both valves.

Crassatellitidae

Crassatellites yagurai n. sp. (*Plate II, figs. 1—4.*)

Shell ovate-trigonal, longer than high, slightly inequilateral, solid, moderately thick, convex, concentrically sculptured. Beaks elevated, approximate, inrolled, slightly prosogyrate, with a convex, smooth and pointed prodissoconch. Anterior end a little shorter, narrowly rounded, the dorsal margin descending, straight or sligthly concave; posterior end produced forming a rostrum, the dorsal margin descending and straight, about 5/4 times longer than the anterior; basal margin regularly rounded in front, but straightened in ascending to the posterior end, and slightly sinuated behind. There runs a strong carina from the beaks to the posterior end. Lunule distinct, longitudinally striated, deeply impressed in an excavate area bounded by a rounded ridge extending from the beak to the anterior end. Escutcheon narrow, lanceolate, shorter than the lunule, impressed. The

anal area outside the escutcheon and inside the posterior carina makes nearly right angle with the surface of the main part and is marked by an impressed line. Sculpture consisting of subequal concentric ribs which are lowered from the incremental lines near anterior and posterior ends, and are getting smaller and obsolete at the carina, but near the beaks they extend halfway over the anal area. Interior margin finely crenate. Hinge heavy; the third right (posterior) cardinal effaced; resilifer subvertical, deep. Adductor-scars deep, unequal, the anterior oval, vertical and smaller; the posterior roundish, somewhat longer than high. *Length*, 37 mm.; height, 27 mm.; number of ribs, 30. Type: Holotype preserved in the Maiko Conchological Cabinet, came from Kiirun, Formosa.

Occurrence.—Tennôyama.

Distribution.—Kakegawa series of Tosa, at Kônomine.

Living.—Formosa.

A few more or less fractured fossil valves representing this species are related to *C. jubar* REEVE, a living species of Australia, in their shape and coloration. But the present new species differs from that species in having distinct concentric ribs. The type is a dead shell dredged from Kiirun Harbour and retains the brown colour.

Crassatellites oblongatus uchidanus YOKOYAMA.

1926. *Crassatella uchidana* YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 356 pl. 39, f. 6.

This subspecies differs from the species (*Crassatella oblongata* YOKOYAMA), a fossil of the Musasino, in that the shell is higher and more trigonal, with more elevated beaks and more steeply sloping dorsal margins and in that the number of the concentric ribs is larger. The ribs in the largest specimen of the species are 30 in the height of 12mm., while in the subspecies are more than 45 in the height of 13 mm. The lunule is more deeply impressed and bounded by a more prominent edge in the right valve than in the left. On the contrary, the unequally divided escutcheon is less developed in the right half. The hinge is normal of the genus. The rudimentary right posterior cardinal of the young shell is absorbed in

the adult. The resilifer is large and oblique. Height, 13mm.; length, 15·6mm.; thickness of right valve, 4·5mm.

Occurrence.—Tennôyama (very frequent in the lower horizon). Nitô (abundant).

This is a very common form in the Tennô sands though the majority of the specimens are in bad preservation. There is not known such a *Crassatellites* living in the Japanese waters. The species which is very frequently found in the Lower Musasino is perhaps a descendant or a local variety of the present subspecies.

Carditidae

Venericardia panda (YOKOYAMA) (*Plate II, figs. 15, 16.*)

1926. *Cardita panda* YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 355, pl. 39, f. 1, 2.

Shell moderately large, solid, ovate-subtrigonal to subcordate, inequilateral, somewhat produced posteriorly, swollen, strongly radiately ribbed. Beaks at about the anterior third, contiguous, pointed, curved inwards. Antero-dorsal margin very short, steeply descending, excavated; anterior end rounded; ventral margin broadly arcuate, straightened posteriorly; postero-ventral corner subangulate; posterior end shortly subtruncate; postero-dorsal margin long, slowly descending, arcuate. Lunule small, cordate, concave but not deep, with imbricated incremental lines. Sculpture consisting of regular, equidistant, flat-topped, prominent radiating ribs, 13 to 14 in number, wider than their deep interspaces, smooth, but subsquamose toward the ventral margin. The three to four posterior ribs are less prominent rounded at the tops and finely imbricated by incremental lines. Hinge plate broad and solid; the right valve with three divergent strong cardinals, the median stouter, the anterior short and vertical; the left valve with a long lamellar posterior and a short anterior cardinal; lateral teeth feeble. Adductor-scars deeply impressed, subequal; pallial line distinct, entire. Length, 49 mm.; height, 40 mm.; diameter, 34·6 mm. Length, 35 mm.; height, 28 mm.; diameter, 22 mm.

Occurrence.—Hônohasi (abundant). Dainiti (rare). Suigô-bridge. Tennôyama and Nitô (common). Iwasibara (not rare).

Distribution.—Kakegawa series of Tosa.

No allied form survives in the waters of this country. This species has some relations to *Cardita decipiens* MARTIN, a fossil species of Javanese Miocene and Pliocene, but it differs from that species in that the postero-dorsal margin is not so straight but arcuate and the ribs are more rounded.

Leptonidae

Lepton nipponicum n. sp. (*Plate II, figs. 5, 6.*)

Shell small, thin and fragile, ovate, inequilateral, moderately convex, hyaline. Beaks posteriorly situated, prominent, prosogyrate, contiguous; prodissoconch 0·35 to 0·4 mm. in height, rotund, smooth and shining, slightly raised from the surface with a distinct margin. Anterior end about 3/5 of the entire length, regularly rounded, with an arcuating dorsal margin; posterior end convex, a little narrower than the anterior; posterior dorsal margin descending; ventral margin broadly rounded. Sculpture consisting of sharp unequal concentric lines, more or less lamellated, crossed by numerous microscopic bifurcating radial striae. Hinge: right valve with a pair of short lateral lamellae on each side of the wide space for the resilium, anterior one shorter but stronger; left valve anteriorly with a strong short lamella, at the proximal end which is a cardinal; posteriorly with a short obscure lamella separated from the dorsal margin by a groove parallel to it, and above this groove the margin is somewhat thickened. Anterior dorsal margin with a shallow groove in front of the lamellae. Ventral margin thin and sharp. Adductor-scars and pallial lines are indistinct. Height, 4·83 mm.; length, 6·16 mm. Another specimen measures 3·57 mm. in height 4·14 mm. in length and about 2 mm. in diameter. Type: Cotype, no. 9.

Occurrence.—Dainiti (rare).

In this species the hinge teeth are variable. For instance, the left anterior lamella may be detached or not from the cardinal; in the another valve the anterior lamella is hooked but not strong.

Lepton subrotundum DUNKER, a living shell of Japan, is a larger, subquadrate and smooth shell. Another species named *Lepton japonicum* A. ADAMS has been described but without any figure.

Rochefortia yokoyamai n. sp. (*Plate II, fig. 7.*)

Shell small, oblongly oval, moderately convex. Beaks situated at a little posterior to the middle, small, slightly produced, acute. Anterior end regularly rounded, dorsal slope regularly arcuate; posterior end narrower and shorter than the anterior, dorsal slope a trifle excavated behind the beaks, then arcuate and descending, somewhat straightened below, and making a narrow angle with the ventral margin ; ventral margin subparallel to the dorsal margins, broadly arcuating. There is a blunt ridge extending from the beaks to the posterior end. Sculpture consisting of microscopic innumerable radial lines, crossed by fine, irregularly spaced incremental lines. Left valve with two very divergent small lamellar subequal teeth, which are on the lower edge of the small inflected extentions of the dorsal margins and separated from them by a parallel shallow groove. The triangular space between the lamellae and beneath the beaks is very wide and low. Adductor-scars and pallial line obscure. Height, 1·55 mm.; length, 2·42 mm.; probable diameter, 0·9 mm.

Type : Holotype, no. 10.

Occurrence.—Dainiti.

Only the holotype which retains the left valve only, has been obtained from the Dainiti sands. But it has sufficient characters to merit the description of a new species. Formerly the genus had been known as *Montacuta* of which the first species *M. substriata* MONTAGU has some important differences of generic value from the present form. This species has a hinge similar to that of *Rochefortia australis* VÉLAIN (BERNARD, Bull. Mus. d'Hist. Nat., 1898, p. 82, f. 4.). COSSMANN'S two species of Eocene *Montacuta* described in his "Catalogue Illustrié Coquilles Fossiles de l'Eocène des Environs de Paris" were lately renamed by himself* *Rochefortia tenuissima* and *R. subquadrata*. FISCHER gave a definition** of the genus *Montacuta* upon *M. bidentata* MONTAGUE which is the type of *Tellimya* of other authors. But his *Montacuta* must be dropped into synonymy with *Rochefortia*.

* Iconographie Complète des Coquilles Fossiles de l' Eocène de Paris.

** Man. de Conch., p. 1027.

The present species differs distinctly from *R. japonica* (YOKOYAMA),* the latter being more transversely oblong.

The beaks of *R. yokoyamai*, in comparison to *R. oblongata* (YOKOYAMA), are median. *R. yokoyamai* is very closely related to *R. yamakawai* (YOKOYAMA) of the Upper Musasino. But it differs from that species in that the shell is longer in proportion to the height; the anterior end more narrowly and subangulately rounded; the triangular space for the resilium is wider; the teeth are more divergent and lamellar; and the radials are finer and more numerous.

Cardiidae

Cardium (Papyridea) muticum REEVE.

1844. *Cardium muticum* REEVE, Conch. Icon., sp. 32.
1861. *Cardium Japonicum* DUNKER, Moll. Jap., p. 28, pl. 3, f. 16.
1868. *Cardium papyraceum*, RÖMER, Syst. Conch. Cab. Mart. Chemn., vol. 10, pt. 2, p. 79.
1869. *Cardium muticum*, LISCHKE, Jap. Meer. Conch., vol. 1, p. 144.
1881. *Cardium muticum*, BRAUNS, Geol. Env. Tokio, p. 42.
1882. *Cardium muticum*, DUNKER, Index Moll. Mar. Jap., p. 211.
1895. *Cardium muticum*, PILSBRY, Cat. Mar. Moll. Jap., p. 181.
1906. *Cardium muticum*, TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 50, pl. 3, f. 10.
1920. *Cardium muticum*, YOKOYAMA, Foss. Miura Penin., p. 128, pl. 9, f. 11.
1922. *Cardium muticum*, YOKOYAMA, Foss. Up. Musashino, p. 154, pl. 12, f. 7.
1925. *Cardium muticum*, YOKOYAMA, Jour. Coll. Sci. Univ. Tokyo, vol. 45, art. 5. p. 23.
1925. *Cardium muticum*, YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 121.

Occurrence.—Hônohasi. Tennô-shrine. Tennôyama.

Distribution.—Neogene of Titibu. Musasino of Tôkyô, Tiba-ken and Miura Peninsula. Sirado Beds of Kasima.

Living.—Japan proper.

Only a fractured right valve of this species which is well known among Japanese people as "Torigai" is present in the collection. It is well characterized by its large, fragile, smooth and nearly equilateral shell. The fossil specimen of Hônohasi shows more distinct radial striae which number 36 is smaller than in the living form. A smaller oblique shell

* Foss. Up. Musashino, p. 157

living in the sea of Tosa which has been assigned to *C. papyraceum* GMELIN may easily be distinguished from the present form in that the escutcheon is shorter. *C. muticum* REEVE is slightly transversely ovate in young but becomes more or less circular in maturity. The present specimen has a height of 35 mm. and shows an outline somewhat longer than high.

Protocardia (Nemocardium) modesta (A. ADAMS et REEVE).

1920. *Cardium modestum*, YOKOYAMA, Foss. Miura Penin., p. 128, pl. 9, f. 12, 13.
1922. *Cardium modestum*, YOKOYAMA, Foss. Up. Musashino, p. 155.
1925. *Cardium modestum*, YOKOYAMA, Jour. Coll. Sci. Univ. Tokyo, vol. 45, art. 5, p. 23.

Occurrence.—Tennôyama. Nitô.

Distribution.—Sirado Beds of Sukegawa. Lower Musasino of Kosiba. Upper Musasino of Tiba-ken.

Living.—Central and Western Japan.

I can not find any difference between the fossil and living examples from Sagami Bay. There are only two specimens, one of which measures 31 mm. in height and 33 mm. in length. The surface characters were fully redescribed by Prof. YOKOYAMA.

Veneridae

Dosinia troscheli LISCHKE.

1923. *Dosinia troscheli*, YOKOYAMA, Tert. Moll. Dainichi, p. 15.

Occurrence.—Dainiti. Hônohasi. Tennô-shrine. Saigô-bridge.

Living.—Nagasaki.

Some fragments of valves reminding us of *Dosinia troscheli* are found. The figures and description given by Prof. YOKOYAMA in his "Foss. Miura Penin." are rather close to *Dosinia Japonica* REEVE.

Dosinia bilunulata (GRAY).

1850. *Artemis bilunulata*, REEVE, Conch. Icon., sp. 22.
1855. *Artemis bilunulata*, SOWERBY, Thes. Conch., vol. 2, p. 270, pl. 147, f. 66.
1874. *Dosinia bilunulata*, LISCHKE, Jap. Meer. Conch., p. 90.
1882. *Dosinia bilunulata*, DUNKER, Index Moll. Mar. Jap., p. 203.
1895. *Dosinia bilunulata*, PILSBRY, Cat. Mar. Moll. Jap., p. 126.
1922. *Dosinia bilunulata*, YOKOYAMA, Foss. Up. Musashino, p. 144, pl. 10, f. 12, 13.

Occurrence.—Hônohasi (considerably common).

Distribution.—Upper Musasino, at Ôtake.

Living.—Tôkyô Bay. Sagami Bay. Probably distributed throughout the Pacific side of Central Japan.

This species is by no means rare in the Dainiti sands of Saigô, but unfortunately all the specimens at hand are more or less fractured. It is, however, well determined by its peculiar dorsal impressed area in which the small heart-shaped lunule is set. The edge of this area as well as the long lanceolate escutcheon is bordered by a lamellated keel, while the middle of the shell is finely and regularly concentrically striated. This unique species, characterized by the so-called double lunule, is the monotype of the section "*Dosinorbis*" of Dr. DALL.

Clementia vatheleti MABILLE.

1901. *Clementia vatheleti* MABILLE, Bull. Soc. Phil. Paris (8), vol. 3, p. 57.
1913. *Clementia vatheleti*, JUKES-BROWNE, Ann. Mag. N. H. ser. 8, vol. 12, p. 61, pl. 1, f. 3, 4.
1914. *Clementia vatheleti*, JUKES-BROWNE, Ibid., vol. 13, p. 338.
1923. *Clementia speciosa* YOKOYAMA, Tert. Moll. Dainichi, p. 15, pl. 2, f. 14, 15.
1925. *Clementia speciosa* YOKOYAMA, Jour. Coll. Sci. Univ. Tokyo, vol. 45, art. 5, p. 21, pl. 1, f. 6.
1925. *Clementia speciosa* YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 19, pl. 14, f. 7.
1926. *Clementia speciosa* YOKOYAMA, Ibid., p. 222.

Occurrence.—Dainiti. Tennô-shrine.

Distribution.—Togari group (Miocene). Miocene of Titibu. Sirado Beds. Upper Musasino. The sandstone of Tanabe, Wakayama-ken. Kakegawa series of Tosa.

Living.—Central Japan (YOKOYAMA). Saseho (KURODA).

The living specimens of this large *Clementia* came from Saseho was submitted to JUKES-BROWNE by HIRASE. I have access to some other materials of the same species from the same locality in the collection of Mr. KURODA. The fossil differs little from those typical specimens. The fossils found in the older rocks are smaller in general. Without doubt *Clementia speciosa* YOKOYAMA is synonymous with *C. vatheleti* of JUKES-BROWNE.

Venus yokoyamai n. sp. (*Plate II, fig. 8.*)

1923. *Venus (Mercenaria) stimpsoni*, YOKOYAMA, Jap. Jour. Geol. Geogr., vol. 2, p. 6, pl. 1, f. 5.

Shell like *Venus stimpsoni* GOULD, solid, moderately inflated, cordately subtrigonal, inequilateral, equivalve except that the right posterior dorsal margin slightly overlapping that of the left valve. Beaks approximate, swollen and raised, incurved and turned forwards. Anterior end short, a little longer than one-fifth of the length, rounded, the dorsal margin very oblique and excavate; posterior end rounded, slightly broader than the anterior, the dorsal margin long, descending, faintly convex; basal margin regularly convex. Lunule short, broadly cordate, deep, bounded by deeply impressed line, with lamellar incremental lines. Posterior dorsal area (not escutcheon) long and lanceolate, laterally ridged, with coarse incremental lines. Surface ornamented with thin elevated concentric lamellae, the interspaces with fine striae, which are obscure on the central portion of the discs of full-grown shells. Hinge like *Venus stimpsoni* GOULD, but not so high, the anterior cardinal short, the rugose area narrow. Margin finely crenulate. The largest examples attaining nearly the same size as *V. stimpsoni* measure about 100 mm. in length. The dimensions of detached valves are given in the following remarks. Type: Cotype, no. 220.

Occurrence.—Hônohasi.

Distribution.—Neogene of Izumo.

This species is closely allied to *Venus stimpsoni* GOULD, a species found in the Japanese waters and which lived also in the Upper Pliocene and the Pleistocene of the same country. The present species differs from that species chiefly in that the shell is higher, shorter and more inflated; the beaks are larger and more raised; and in that the lunule is shorter and broader. The shell of *V. stimpsoni* is more elongate, roughly oval in outline, with a slowly sloping very long postero-dorsal margin and lenticular. Its lunule is narrower and the hinge plate is higher with long cardinals. The differences of the two species may be clearly seen in the following table showing the dimensions of the detached

valves. The unit is a millimeter.

V. yokoyamai.

Valves	Height	Length	Thickness	L : H	L : T	Loc.
closed	34	40	23	1·17	3·48	Neogene of Izumo.
right	47	56	16	1·17	3·50	Hônohasi.
left	53	63	19	1·18	3·32	Hônohasi.

V. stimpsoni

left	73	91	19	1·24	4·76	Upper Musasino.
left	72	91	21·5	1·26	4·23	Living, Aomori.
left	82	104	24	1·25	4·33	Living, Aomori.

Chione isabellina (PHILIPPI).

1869. *Venus isabellina*, PFEIFFER, Syst. Conch. Cab. Mart. Chemn., vol. 11, pt. 1, p. 194, pl. 25.

1882. *Chione isabellina*, DUNKER, Index Moll. Mar. Jap., p. 198.

1920. *Chione isabellina*, YOKOYAMA, Foss. Miura Penin., p. 121, pl. 8, f. 13.

1922. *Chione isabellina*, YOKOYAMA, Foss. Up. Musashino, p. 149.

1923. *Chione isabellina*, YOKOYAMA, Tert. Moll. Dainichi, p. 16.

Occurrence.—Dainiti. Hônohasi.

Distribution.—Musasino of Miura and Tiba-ken. Kakegawa series of Tosa.

Living.—Japan and China.

The Dainiti form agrees very well with that from the Naganuma Beds. *Venus isabellina* in REEVE's Conch. Icon. (sp. 109) is a more elongate shell and not identical with PFEIFFER's species. *Venus thiara* DILLWYN in the same monograph bears more close resemblance to the present species. According to Mr. SMITH,* REEVE's species 109 and 110 are in reality *V. foliacea* PHILIPPI.

Figs. 125 to 130 in SOWERBY's Thes. Conch. are also *V. foliacea.* RÖMER had assigned figs. 125 and 126 to be *V. tiara. V. tiara* and *V. foliacea* differ from *V. isabellina* in having the posterior lobe. *Chione tiara* of PILSBRY is probably identical with *C. isabellina* of Prof. YOKOYAMA.

* Challenger Rep., Lamellibranch., p. 122.

Macrocallista pacifica (DILLWYN).

(1817. *Venus pacifica* DILLWYN, Cat. Rec. Shells, vol. 1, p. 175.)
1855. *Cytherea Sinensis* SOWERBY, Thes. Conch., vol. 2, p. 624, pl. 131, f. 79, 80.
1864. *Dione chinensis*, REEVE, Conch. Icon., sp. 4.
1869. *Cytherea chinensis*, PFEIFFER, Syst. Conch. Cab. Mart. Chemn., vol. 11, pt. 1, p. 31, pl. 11, f. 2.
1869. *Cytherea chinensis*, LISCHKE, Jap. Meer. Conch., vol. 1, p. 122.
1882. *Callista chinensis*, DUNKER, Index Moll. Mar. Jap., p. 200.
1895. *Meretrix (Callista) chinensis*, PILSBRY, Cat. Mar. Moll. Jap., p. 127.
1920. *Meretrix (Callista) chinensis*, YOKOYAMA, Foss. Miura Penin., p. 120, pl. 8, f. 9, 10.

Occurrence.—Hônohasi. Tennô-shrine. Tennôyama.

Distribution.—Naganuma Beds.

Living.—Central and Western Japan. China Sea.

There are three partly fractured young valves which, on comparison with the recent specimens, have proved to belong to this species. Prof. YOKOYAMA'S *Callista chinensis* in his "Foss. Up. Musashino" is another species known as *Macrocallista chishimana* PILSBRY (Proc. A. N. S. Phila., 1905, p. 119.) which was proved recently to be identical with *Saxidomus brevisiphonata* CARPENTER (Proc. Zool. Soc., 1865, p. 203.) by M. TOMLIN.*

The latter species is more oval and higher, and ornamented with concentric plicate-striae all over the surface. It is also distributed in the northern cold warters of Hokkaidô.

Paphia euglypta (PHILIPPI).

1923. *Tapes euglyptus*, YOKOYAMA, Tert. Moll. Dainichi, p. 16.

Occurrence.—Dainiti.

This species is said to be very common in the Dainiti sands at the type locality. Unfortunately I have no good specimen to make a precise determination.

Paphia schnelliana (DUNKER)

1858. *Tapes schnellianus* DUNKER, Nov. Conch., p. 75, pl. 25, f. 7—9.
1869. *Tapes schnellianus*, LISCHKE, Jap. Meer. Conch., vol. 1, p. 118.

* Nautilus, vol. 37, p. 26. 1923.

1874. *Tapes schnellianus*, LISCHKE, Ibid. vol. 3, p. 80, pl. 6, f. 1—4.
1882. *Tapes schnellianus* DUNKER, Index Moll. Mar. Jap., p. 206.
1895. *Tapes schnellianus*, PILSBRY, Cat. Mar. Moll. Jap., p. 129.

Occurrence.—Hônohasi. Tennôyama. Tennô-shrine. Saigô-bridge.

Distribution.—Kakegawa series of Tosa.

Living.—Nagasaki. Tôkyô. Inland Sea. Ise. Probably throughout South-western Japan.

This species is very fragile, and most of the specimens at hand are all in broken pieces. They, however, are safely determined by their shallow concentric furrows agreeing very well with those of the perfect living specimens. The general contour is known by the mould of the shell in the fine sandstone of Tennôyama. It is not so transverse as in *P. amabilis* (PHILIPPI) and *P. euglypta* (PHILIPPI). The posterior dorsal margin figured by DUNKER is more convex than in any other specimens. This species is very rare in the Dainiti sands.

Tellinidae

Tellina kurodai n. sp. (*Plate II, figs. 10—13*).

Shell small, ovately subtrigonal, transverse, moderately convex, thin, strongly inequilateral, posterior end shorter, obtusely folded behind, very slightly bent to the right, nearly equivalve, finely concentrically sculptured. Beaks small, approximate, sharply pointed, directed slightly backwards, situated at the posterior quarter of the entire length. Anterior end rounded, dorsal slope long and straight, with a slight fold extending from the beaks to a little below the middle. Posterior end about one-third of the anterior, subtruncate, angulate below, dorsal margin sloping, concave above, convex below, passing gradually into the subtruncate posterior end. Ventral margin rounded in front, straightened in the main part, slightly ascending and running parallel to the antero-dorsal margin, ending in the posterior angle. Sculpture consisting of fine subequal concentric lines, somewhat raised on the posterior portion of the surface; they alternately stop short at the posterior fold and extend on the area behind it. Interior glossy. Hinge: right valve 2 cardinals, the posterior vertical, stout and

bifid, and 2 lamellar laterals, the anterior near the cardinal and much longer than the posterior; left valve 2 divergent cardinals, the anterior larger and bifid. Pallial line and adductor-scars are not marked. Length, 8·5 mm.; height, 5·1 mm. Type: Cotype, no. 14.

Occurrence.—Dainiti.

Living.—Nagasaki.

The living form differs from the cotypes in having a thicker shell with more regular and more distinct concentric sculptures.

This species belongs to the section *Moerella* and differs from *Tellina* (*Angulus*) *pallidula* LISCHKE, a living species of Southern Japan in its hinge. *Tellina minuta* LISCHKE is said to have no lateral.

Macoma totomiensis n. sp. (*Plate II, fig. 9.*)

Shell ovately oblong, subtrigonal, nearly equilateral, compressed, slightly inequivalve, thick, subrostrate, the posterior extremity slightly bent to the right. Beaks median, small and low. Anterior end evenly rounded, semielliptical, arcuate above and below; posterior end bluntly pointed, trigonal, arcuating dorsally. Ventral margin straightened posteriorly. On the left valve along the posterior dorsal margin is a narrow depressed area which is only separated from the main surface of the valve; on this area there is a distinct ridge extending from the beak to a little above the posterior angle. Right valve with a strongly depressed posterior area which is nearly at right angles to the main surface and separated from it by a distinct fold; on the area there is also a distinct ridge running subparallel to the edge. Hinge like that of *Macoma tokyoensis* n. n.* Pallial line not clearly observable. Length, 51·8 mm.; height, 34·3 mm. Type: Holotype, no. 15, a left valve.

Occurrence.—Dainiti (not rare).

This species resembles *M. tokyoensis*,* a recent species, but differs from that species in the following respects: it is more compressed and

* *Macoma tokyoensis* n. n. is proposed for the preoccupied name *M. dissimilis* (MARTENS) (YOKOYAMA, Foss. Miura Penin., p. 116, pl. 7, f. 19, 20.) This species is very abundant in the shell bed of Ôzi near Tôkyô (TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 45.).

not so strongly flexed to the right; the posterior end is narrower and more acutely angled; the posterior depressed area is not so wide and not so strongly grooved.

Macoma praetexta (MARTENS)

1865. *Tellina praetexta* MARTENS, Ann. Mag. Nat. Hist., vol. 16, p. 430.
1869. *Tellina praetexta*, LISCHKE, Jap. Meer. Conch., vol. 1, p. 130.
1871. *Tellina praetexta*, LISCHKE, Ibid., vol. 2, p. 113, pl. 10, f. 14.
1871. *Tellina praetexta*, RÖMER, Syst. Conch. Cab. Mart. Chemn., Tellinidae, p. 239, pl. 45, f. 8—10.
1882. *Tellina praetexta*, DUNKER, Index Moll. Mar. Jap., p. 190.
1895. *Macoma praetexta*, PILSBRY, Cat. Mar. Moll. Jap., p. 125.
1916. *Macoma praetexta*, IWAKAWA, Hand-list Jap. Biv., p. 54.
1922. *Macoma praetexta*, YOKOYAMA, Foss. Up. Musashino, p. 142, pl. 10, f. 2, 3.
1923. *Macoma praetexta*, YOKOYAMA, Tert. Moll. Dainichi, p. 15.

Occurrence.—Dainiti. Tennô-shrine.

Distribution.—Upper Musasino of Tôkyô and Tiba-ken.

Living.—Tôkyô Bay (MARTENS, LISCHKE, STEARNS). Nagasaki (DUNKER). Sikoku (HIRASE). Probably distributed all over in Central and Western Japan.

Donacidae

Donax kiusiuensis PILSBRY. (*Plate II, fig. 14.*)

1901. *Donax kiusiuensis* PILSBRY, Proc. Acad. Nat. Sci. Phila., p. 207, p. 400, pl. 20, f. 19.
1915. *Donax kiushiuensis*, IWAKAWA, Hand-list Jap. Biv., sp. 408.

Occurrence.—Dainiti (very rare).

Living.—Hirado (PILSBRY and HIRASE). Ryûkyû (Mr. KURODA). Yura, Tango.

PILSBRY describes this species as follows: "shell small, rather thin, white with one or two ill-defined ochraceous rays, or yellow with some dusky concentric streakes, the beaks brown-tipped; irregularly triangular, the length somewhat less than twice the altitude, and nearly three-times the diameter; anterior end longer, tapering, rounded; posterior end slightly convex, bluntly angular below; the beaks situated at about the posterior

two-fifths of the length. Surface glossy, sculptured with slight lines and exceedingly fine, subobsolete radial striae, angular posteriorly, the posterior area sculptured with strong, smooth radial ribs narrower than their flat intervals and terminating on the angle. Ligament very short and swollen. Interior white with brown stains near the ends; posterior lateral tooth strong, basal margin finely but distinctly crenuled. Length .9, alt. 5·5, diam. 3·3 mm. A small species belonging to the section *Chion*, chiefly distinguished by the strong sculpture of the posterior end."

There is only one right valve 8·4 mm long and 5·1 mm high in the collection.

Psammobiidae

Psammosolen divaricatus (LISCHKE).

1871. *Macha divaricata* LISCHKE, Jap. Meer. Conch., vol. 2, p. 142, pl. 10, f. 1, 2.
1882. *Macha divaricata*, DUNKER, Index Moll. Mar. Jap., p. 175, pl. 7, f. 26.
1888. *Solecurtus divaricatus*, CLESSIN, Syst. Conch. Cab. Mart. Chemn., vol. 11, pt. 3, p. 87.
1895. *Solecurtus (Macha) divaricatus*, PILSBRY, Cat. Mar. Moll. Jap., p. 121.
1906. *Macha divaricata*, TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 36, pl. 2, f. 20.
1916. *Macha (Solecurtus) divaricata*, IWAKAWA, Hand-list Jap. Biv., p. 103.
1919. *Macha divaricata*, IWAKAWA, Cat. Jap. Moll. Imp. Mus., p. 312.
1920. *Solecurtus divaricatus*, YOKOYAMA, Foss. Miura Penin., p. 112, pl. 7, f. 14.
1922. *Solecurtus divaricatus*, YOKOYAMA, Foss. Up. Musashino, p. 136.

Occurrence.—Dainiti. Hônohasi.

Distribution.—Musasino of Tôkyô, Tiba and Miura.

Living.—Enosima (STEARNS). Enoura and Tosa (IWAKAWA) Hirado (HIRASE). Nagasaki (LISCHKE). Central and Western Japan (YOKOYAMA).

This species is easily distinguished from others with its distant, impressed and clear radiating lines of the surface. It is found pretty frequently in the Musasino series, but in the Kakegawa it is rather rare. The generic name is changed by the reason that the first species of *Solecurtus* BLAINVILLE 1824 is *Solen legumen* LINNÉ, and differs very much from *Solen strigilatus*, the type of *Psammosolen* to which the present species belongs. The name *Macha* OKEN 1835 was introduced later than *Psammosolen* RISSO 1826.

Solenidae

Solen cf. **gordonis** YOKOYAMA.

Occurrence.—Dainiti. Tennô-shrine.

Solen is not rare in the Dainiti sands. But, owing to fragility of the shell, it is very hard to get a perfect specimen. The few small specimens found in hard calcareous nodules remind me of the young of *Solen gordonis* YOKOYAMA (Foss. Miura Penin., p. 111, pl. 7, f. 23.) which is living in the waters of Western Japan and has been discovered in the Miyata Beds of the Miura Peninsula.

Mactridae

Mactra crossei (DUNKER).

1882. *Trigonella crossei* DUNKER, Index Moll. Mar. Jap., p. 183, pl. 7, f. 1—4.
1923. *Mactra crossei*, YOKOYAMA, Tert. Moll. Dainichi, p. 14.

Occurrence.—Dainiti.

Living.—Tôkyô Bay.

There are several specimens of this small thin shell in the collection. They have the appearance of the immature specimens of the next species.

Mactra sulcataria DESHAYES.

1853. *Mactra sulcataria* DESHAYES, Proc. Zool. Soc., p. 15.
1854. *Mactra sulcataria*, REEVE, Conch. Icon., sp. 5.
1869. *Mactra sulcataria*, LISCHKE, Jap. Meer. Conch., vol. 1, p. 133.
1882. *Trigonella sulcataria*, DUNKER, Index Molk Mar. Jap., p. 182.
1895. *Mactra sulcataria*, PILSBRY, Cat. Mar. Moll. Jap., p. 118.
1906. *Mactra sulcataria*, TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 40, pl. 2, f. 26.
1916. *Mactra sulcataria*, IWAKAWA, Hand-list Jap. Biv., sp. 428.
1917. *Mactra sulcataria*, LAMY, Jour. de Conch., vol. 63, p. 199.
1922. *Mactra sulcataria*, YOKOYAMA, Foss. Up. Musashino, p. 126.
1925. *Mactra sulcataria*, YOKOYAMA, Jour. Coll. Sci. Univ. Tokyo, vol. 45, art. 5, p. 17.
1925. *Mactra sulcataria*, YOKOYAMA, Ibid. vol. 45, art. 7, p. 16.
1925. *Mactra sulcataria*, YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 10.

Occurrence.—Dainiti (rare).

Distribution.—Abundantly found in the Upper Musasino of Tiba-

ken ; less frequently in the same series at Tôkyô. Sirado Beds. Neogene of Titibu. Holocene of Tôkyô.

Living.—Japan proper. Also North China and Vladivostok.

A single young left valve is at hand. The adult shell is distinguished chiefly by its prominent concentric grooves, which converge neatly on each side in the areas. Young shells less than 30 mm. in height are generally smooth, The fossil specimen measures 21 mm. in length and 17 mm. in height. It differs from *M. crossei* (DUNKER) in being more equilateral.

Raëta pulchella (ADAMS et REEVE.)

1848. *Poromya pulchella* ADAMS & REEVE, Zool. Voy. Samarang, Moll., p. 83, pl. 23, f. 1.
1854. *Mactra rostralis* DESHAYES, Proc. Zool. Soc., p. 69.
1854. *Mactra rostralis*, REEVE, Conch. Icon., sp. 119.
1882. *Raëta rostralis*, DUNKER, Index Moll. Mar. Jap. pp. 185, 261.
1885. *Raeta pulchella*, SMITH, Challenger Rep. Lamellibranch., p. 56.
1895. *Raeta pulchella*, PILSBRY, Cat. Mar. Moll. Jap., p. 119.
1915. *Labiosa pulchella*, IWAKAWA, Hand-list Jap. Biv., sp. 448.
1918. *Labiosa (Raeta) pulchella*, LAMY, Jour. de Conch., vol. 63, p. 358.

Occurrence.—Dainiti.

Living.—Tôkyô Bay. Inland Sea. Hizen. Borneo.

This determination applies to many specimens found in the calcareous nodules. Probably this thin and fragile shell is not rare in the Dainiti sands. It is a little elongate, ovately subtrigonal and subequilateral shell with a broadly round anterior and a rostrated triangular posterior end. The beaks are not so posterior as in *Raëta yokohamensis* PILSBRY. The surface is sculptured by concentric undulating plicae. Prof. YOKOYAMA mentions the occurrence of a single right valve of *R. yokohamensis* in the Dainiti sands.

Lutraria maxima JONAS.

1922. *Lutraria maxima*, YOKOYAMA, Foss. Up. Musashino, p. 133, pl. 8, f. 9, 10.

Occurrence.—Hônohasi (rare).

Distribution.—Upper Musasino.

Living.—China. Central and Western Japan.

A single anterior half of a left valve represents this species.

Corbulidae

Corbula erythrodon LAMARCK.

1835. *Corbula erythrodon*, DESHAYES, Anim. s. Vert., vol. 6, p. 138.
1844. *Corbula erythrodon*, REEVE, Conch. Icon., sp. 4.
1868. *Corbula erythrodon*, A. ADAMS, Ann. Mag. Nat. Hist., p. 365.
1869. *Corbula erythrodon*, LISCHKE, Jap. Meer. Conch., vol. 1, p. 136.
1882. *Corbula erythrodon*, DUNKER, Index Moll. Mar. Jap., p. 176.
1922. *Corbula erythrodon*, YOKOYAMA, Foss. Up. Musashino, p. 122, pl. 6, f. 8, 9.

Occurrence.—Dainiti.

Distribution.—Upper Musasino.

Living.—China and Western Japan. Tôkyô Bay.

This solid and variable shell is frequently found in the sands of Dainiti. The determination applies to several small specimens which are somewhat oblong compared with the typical living form.

Corbula scaphoides HINDS.

1843. *Corbula scaphoides* HINDS, Proc. Zool. Soc., p. 56.
1844. *Corbula scaphoides*, REEVE, Conch. Icon., sp. 24.
1855. *Corbula scaphoides*, SMITH, Challenger Rep., Lamellibranch., p. 32, pl. 8, f. 3.
1887. *Corbula scaphoides*, MARTIN, Tiefbohrungen auf Java. Samm. Leiden, vol. 3, p. 196, pl. 10, f. 199.
1920. *Corbula scaphoides*, TESCH, Jungtert. u. Quart. Moll. v. Timor, Pal. Timor, vol. 8, p. 106, pl. 22, f. 281—283.

Occurrence.—Taruki.

Distribution.—Kakegawa series of Tosa at Kônomine. Pliocene and Pleistocene of Timor. Pliocene of Java.

Living.—Singapore. Philippine. Torres Strait. Hong-Kong.

A closely affined form lives in Western Japan.

There is a single fractured left valve found in the Tennô sands. Several good specimens from Tosa are in better preservation. *C. scaphoides* may easily be distinguished by its numerous superfine granular radial lines. *C. tunicata* HINDS is said to have also the minute granular radials, but may be distinguished from the present species by its much shorter and

triangular young valves. Mature valves are more triangular and strongly convex and bear certain resemblances to *C. erythrodon* LAMARCK, from which they differ in having a sharp posterior angle, more prominent concentric ridges and the above mentioned radials. There is known a much longer *Corbula* living in Kii which has been assigned to *C. sacphoides*. It is quite similar to *C. sacphoides* but has the radials almost obsolete.

The development of the shell is well observed in the Japanese fossil specimens. The young shells of about 3 mm. long and 2 mm. high are nearly smooth; the next stage about 13 mm. long and 9 mm. high are flattish, very sharply keeled posteriorly and well marked by fine radials. The mature specimens are much deeper, triangular and bear highly developed hinge teeth.

Saxicavidae

Panope generosa GOULD.

1923. *Panope generosa*, YOKOYAMA, Tert. Moll. Dainichi, p. 14.

Occurrence.—Dainiti.

Distribution.—Neogene rocks of Siobara; Sinano; Ibaraki and Izumo. Sirado Beds. Upper Musasino of Tôkyô and Tiba-ken. Miocene, Pliocene and Pleistocene of California.

Living.—West Coast of North America from Puget Sound to San Diego (DALL). Japan.

Perfect specimens attached to calcareous nodules are found in the sands of Dainiti. *Panope japonica* ADAMS (Proc. Zool. Soc., 1849, p. 170, pl. 6, f. 5.) is most probably a young shell of the present form which seems to be very variable in contour.

SCAPHOPODA

Dentaliidae

Dentalium (Antalis) weinkauffi DUNKER.

1881. *Dentalium entale*, BRAUNS, Geol. Env. Tokio, p. 35.

1882. *Dentalium Weinkauffi* DUNKER, Index Moll. Mar. Jap., p. 153, pl. 5, f. 1.

1895. *Dentalium Weinkauffi*, PILSBRY, Cat. Mar. Moll. Jap., p. 116.

1898. *Dentalium Weinkauffi*, PILSBRY & SHARP, Man. Conch., vol. 17, p. 40, pl. 2, f. 26.

1906. *Dentalium* cf. *weinkauffi*, TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21, p. 33, pl. 2, f. 1.

1920. *Dentalium weinkauffi*, YOKOYAMA, Foss. Miura Penin., p. 102, pl. 6, f. 19—21.

1922. *Dentalium weinkauffi*, YOKOYAMA, Foss. Up. Musashino, p. 118, pl. 6, f. 6.

1925. *Dentalium weinkauffi*, YOKOYAMA, Jour. Coll. Sci. Univ. Tokyo, vol. 45, art. 5, p. 16.

1925. *Dentalium weinkauffi*, YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 9.

1925. *Dentalium weinkauffi*, YOKOYAMA, Ibid. p. 118.

Occurrence.—Tennôyama.

Distribution.—Neogene of Titibu and Sinano. Sirado Beds. Lower and Upper Musasino of Miura; Tôkyô and Tiba-ken.

Living.—Central and Western Japan.

The examples from the Tennô sands differs from the living and the Upper Musasino forms in attaining a larger size and in having seven ribs in the young stage, the interspaces of which have two to four fine threads. In the Upper Musasino form the number is larger, being 9 to 12. The apical characters are the same as in the living species. The fossil variety is not known living.

Dentalium (Antalis) buccinulum GOULD.

1859. *Dentalium buccinulum* GOULD, Otia Conch., p. 119.

1872. *Dentalium buccinulum*, SOWERBY, Conch. Icon., sp. 50.

1895. *Dentalium buccinulum*, PILSBRY, Cat. Mar. Moll. Jap. p. 116.

1896. *Dentalium buccinulum*, CLESSIN, Syst. Conch. Cab. Mart. Chemn., vol. 6, pt. 14, pl. 5, p. 21, pl. 6, f. 4.

1897. *Dentalium buccinulum*, PILSBRY & SHARP, Man. Conch., vol. 17, p. 14, pl. 5, f. 74-76, pl. 6, f. 84.

Occurrence.—Dainiti. Hônohasi. Tennô-shrine.

Living.—Japan.

The shell is small, moderately regularly curved, often straightened anteriorly in mature portion, hyaline and strong and rather rapidly increasing in diameter. The primary ribs are 12 to 14, low but sharp, more prominent near the tip. A secondary rib is found in each interspace of the primary ones. It passes by degrees into the size of the primary ribs, there being thus 24 to 28 equal riblets parted by shallow intervals as wide as themselves on the surface of the shell about 2 mm. to 2·5 mm.

in diameter. The ribs vanish toward the anterior end in maturity. The apex has a very small notch on the convex side. There is a specimen the true apex of which is acicularly narrowed and pointed and has a distinct notch. One of the specimens a little fractured at the aperture measures 25·7 mm. in length (probably had been 26 mm. in the perfect state), and 3·5 mm. at the aperture, 1·4 mm. at the apex in diameters. The degree of development of the ribs is not constant; in the full-grown shell more than 30 mm. long, they are almost always obsolete and the anterior portion is polished.

Dentalium (Fissidentalium) sp.

Occurrence.—Tennôyama.

Fragments of a subrectilinear, prominently ribbed *Dentalium* are under examination. In one of them, the ribs are 25 in number near the tip. They are more closely set on the concave side. A fragment of a larger diameter has 30 equal ribs on the anterior portion which are less elevated than the apical ribs. The shell increases rapidly in diameter. This form reminds me of Prof. YOKOYAMA's *D. complexum** DALL found in the Lower Musasino and other Neogene rocks of this country, but that species is different from the species of DALL living in Hawaii. It is also allied to *D. subrectum* MARTIN, a Miocene fossil of Java, but the latter has a smaller number of more alternating ribs. The figures of *D. Junghuhni* MARTIN in his "Tiefbohrungen auf Java"** represent the same characters as the Japanese fossil, although the original figure given in his "Tertiaerschichten auf Java"*** shows a more slender shell with alternating ribs. The specimens under examination are too fragmental and small in number to give a specific name.

Dentalium (Episiphon) filum SOWERBY.

1860. *Dentalium filum* SOWERBY, Thes. Conch., vol. 3, p. 89, pl. 225, f. 45.
1860. *Dentalium fistula* SOWERBY, Ibid., p. 99, pl. 225, f. 62.
1872. *Dentalium filum* SOWERBY, Conch. Icon., sp. 32.

* Foss. Miura Penin., p. 101, pl. 6, f. 27.
** pl. 10, f. 182, 183.
*** pl. 12, f. 11.

1872. *Dentalium fistula* SOWERBY, Ibid., sp. 44.

1896. *Dentalium filum*, CLESSIN, Syst. Conch. Cab. Mart. Chemn., vol. 6, pt. 5, p. 22, pl. 4, f. 5.

1896. *Dentalium fistula*, CLESSIN, Ibid., p. 22, pl. 6, f. 10.

1897 *Dentalium (Episiphon) filum*, PILSBRY & SHARP, Man. Conch., vol. 17, p. 118, pl. 18, f. 9.

1897. *Dentalium (Episiphon) fistula*, PILSBRY & SHARP, Ibid., p. 117, pl. 18, f. 30.

Occurrence.—Tennôyama. Taruki.

Living.—Mediterranean and Atlantic; also Philippine.

The materials under examination comprise a perfect mature shell which measures 14 mm. in length and 1·5 mm. in diameter. It is very lightly curved and nearly cylindrical. The apex is truncate, tubiferous and almost as wide as the aperture. The surface is smooth except for the very fine incremental lines. There is also an apical part of a young shell which is more rapidly tapering. *D. sowerbyi* GUILDING of America differs from this form in having rings, although its Cuban form is absolutely smooth and glistening. The fossil is thick but exhibits no trace of ring. The occurrence of this species in the East has been little known.

Siphonodentaliidae

Siphonodentalium nipponicum n. sp. (*Plate II, figs. 17-19.*)

Shell small, short, thick and strong, slightly arched, moderately tapering, with a relatively large apex. Surface smooth and polished; the incremental lines indistinct. Aperture a little oblique, circular; the margin thin and fragile. Apex oblique, the convex side being higher, with 4 lobes in two pairs, one of which on the convex side is high; the other on the concave side is parted by a wide shallow sinus. Length, 6·2 mm.; diameter, 0·77 mm. Type: Holotype, no. 224.

Occurrence.—Hônohasi (frequent).

The apical character reminds us of the subgenus *Polyschides* of *Cadulus* which, however, has in general a narrowed aperture. The present species, having a cylindrical shape, is a *Siphonodentalium* without doubt. Hitherto no living form of *Siphonodentalium* has been known in Japan.

GASTROPODA

Trochidae

Monilea cingulata n. sp. (*Plate III, figs. 3, 4.*)

Shell moderate in size, turbinate-conical, widely umbilicate, strong, pretty thick, spirally sculptured. Spire conoidal, apex acute, suture canaliculate. Whorls 8, moderately convex, very slightly shouldered. Protoconch very small, smooth, of 2 whorls. Surface densely finely and elevately cingulate, the cinguli closely and finely granulated by oblique incremental striae. The next whorl to the protoconch shows three obscure riblets which are feebly developed cinguli. The fourth whorl is ornamented with three cinguli separtaed by excavated interspaces, each of which is about as wide as the cingulum. There appears a thread on later part of the interstices. In the succeeding volutions, the interstitial threads grow gradually into smaller cinguli which are situated closer to the upper cinguli. There are four pairs of these cinguli on the fifth whorl, and about 14 pairs on the body-whorl. Base convex; aperture oblique, roundly quadrate, angled above, with 9 conspicuous spiral ridges within; columella oblique, concave above, slightly reflected and produced over the spiral funicle. Umbilicus about one-third of the diameter, perspective, plicated by incremental lines, with a spiral funicle. Height, 11 mm.; diameter, 14 mm. Type: Holotype, no. 30.

Occurrence.—Dainiti.

This species may readily be distinguished from the allied species. The description was made on a single but pretty well preserved specimen faintly marked with numerous dotted drab streaks.

Calliostoma unicum (DUNKER).

1923. *Calliostoma unicum*, YOKOYAMA, Tert. Moll. Dainichi, p. 13.

Occurrence.—Dainiti (very rare).

Living.—Japan.

Lischkeia alwinae (LISCHKE).

1822. *Trochus moniliferus* LAMARCK, Anim. s. Vert., vol. 7, p. 26.
1843. *Trochus moniliferus*, DESHAYES, Ibid., 2nd edition, vol. 9, p. 146.
1871. *Trochus Alwinae* LISCHKE, Jap. Meer. Conch., vol. 2, p. 84, pl. 6, f. 17—19.
1889. *Calliostoma moniliferum*, PILSBRY, Man. Conch., vol. 11, p. 341, pl. 63, f. 15—17.
1895. *Calliostoma (Lischkeia) moniliferum*, PILSBRY, Cat. Mar. Moll. Jap., p. 99.

Occurrence.—Tennôyama.

Living.—Central and South-western Japan.

This determination applies to a single specimen of a moderate size in much fractured condition, which differs nothing from LISCHKE's *Trochus alwinae*, a species living in Japan. It measures 33mm. in diameter and is a little smaller than the figured specimen of LISCHKE. But the callus of the inner lip are developed better, covering the whole umbilicus. FISCHER'S figure in TRYON'S Manual of Conchology as well as the original figure of LISCHKE shows no such a spreading inner lip. Some of the living examples from Sagami have a similar callus. This species is not *Trochus monilifer* LAMARCK, which is a fossil of the Upper Eocene. FISCHER'S *Lischkeia* is based upon *Trochus moniliferus* LAMARCK; but these two specific names are very confusing only differing in their terminations. COSSMANN used the subgeneric name *Lischkia* of *Calliostoma* with *T. monilifer* as the type. Therefore COSSMANN'S *Lischkia* is a group quite different from FISCHER'S *Lischkeia* which is rather related to *Turcicula* and *Bathybembix* in having a nacreous shell and the similarly sculptured embryos and in general features of ornaments.

Umbonium (Suchium) suchiense YOKOYAMA.

1923. *Umbonium suchiense* YOKOYAMA, Tert. Moll. Dainichi, p. 13, pl. 2, f. 1.

Occurrence.—Dainiti. Tennô-shrine.

This species and its group are characterized by the depressed shell with many fine spiral threads. *U. suchiense* in the Tennô sands differs from the parent form in the Dainiti sands in that the spiral threads are finer with wider interspaces and are more numerous, while the basal striae are crowded around the umbilicus, so that the subperipheral zone is smooth for a certain extent. These differences are the first step of the evolutionaly changes. There is evidently a tendency for the threads and striae to become

finer and finer until at last they become almost obsolete. *U. giganteum* LESSON, the recent representative of this group, possesses neither basal striation nor surface ornamentation with the exception of a few peripheral obscure striae.

This species is the type of the subgenus *Suchium*. *Suchium* was proposed by myself with the following characters: Shell costulate, suture margined below with a band, callus pad consisting of two parts called parietal and columellar lobes divided by a deep sinus.

Umbonium (Suchium) suchiense subsuchiense MAKIYAMA.

1925. *Umbonium (Suchium) suchiense subsuchiense* MAKIYAMA, Jap. Jour. Geol. Geogr., vol. 3, p. 129, pl. 20, f. 10.

Occurrence.—Tennôyama.

Distribution.—Upper Kakegawa.

This is the intermediate form between *U. suchiense* and *U. giganteum*. There are many mutations and submutations in various horizons of the Kakegawa series, but owing to bad preservations the slight changes of their fine sculptures are hardly described exactly.

Umbonium (Suchium) mysticum YOKOYAMA.

1923. *Umbonium mysticum* YOKOYAMA, Tert. Moll. Dainichi, p. 13, pl. 2, f. 6, 7.
1925. *Umbonium (Suchium) mysticum*, MAKIYAMA, Jap. Jour. Geol. Geogr., vol. 3, pl. 20, f. 3.

Occurrence.—Dainiti.

Distribution.—Horinouti group. Kakegawa series of Tosa.

The group of *U. mysticum* is distinguished from that of *U. suchiense* by its higher shell sculptured by from four to six spiral ridges.

Key to the species and subspecies of the gens of S. mysticum.

Base with spiral grooves, surface with 4 ridges which interspases are excavate; subsutural band crenate . . . . . *mysticum.*

Base striate, surface with 4 threads, which interspaces are slightly concave; subsutural band distinctly striated . . . . . *obsoletum.*

Base smooth.

5—6 fine threads, subsutural band obscurely striate.... *conglomeratum.*

4 strong threads, subsutural band smooth or tubercled.... *arenarium.*

4—5 appressed ridges . . . . . *moniliferum.*
Shell like *moniliferum*, but has striated base and subsutural band . .
. . . . . *decoratum*

Umbonium (Suchium) obsoletum MAKIYAMA.

1925. *Umbonium (Suchium) obsoletum* MAKIYAMA, Jap. Jour. Geol. Geogr., vol. 3, p. 128, pl. 20, f. 5.

Occurrence.— Hônohasi. Iwasibara.

This is a very characteristic fossil of the upper horizon of the Dainiti sands. It differs from the preceding species in being less prominently sculptured and possessing a tubercled subsutural band.

Umbonium (Suchium) obsoletum conglomeratum MAKIYAMA.

1925. *Umbonium (Suchium) obsoletum conglomeratum* MAKIYAMA, Jap. Jour. Geol. Geogr. vol. 3, p. 129, pl. 20, f. 6.

Occurrence.—Saigô-bridge. Hônohasi (rare).

This subspecies is abundant in the uppermost horizon of the Dainiti. It must have been derived from the species.

Umbonium (Suchium) obsoletum arenarium MAKIYAMA.

1925. *Umbonium (Suchium) obsoletum arenarium* MAKIYAMA, Jap. Jour. Geol. Geogr., vol. 3, p. 129, pl. 20, f. 7.

Occurrence.—Tennô-shrine and Tennôyama. Nitô.

Distribution.—Kakegawa series of Tosa.

This is the characteristic form of the Tennô sands.

Neritidae

Theodoxus (Clithon) retropictus (MARTENS).

1879. *Neritina retropicta* MARTENS, Syst. Conch. Cab. Mart. Chemn., vol. 2, pt. 10, p. 169, pl. 17, f. 18–20.

1888. *Neritina retropicta*, TRYON, Man. Conch., vol. 10, p. 67, pl. 24, f. 40, 41.

1895. *Neritina retropicta*, PILSBRY, Cat. Mar. Moll. Jap., p. 88.

Occurrence.—Tennôyama.

Living.—Nagasaki. Hirado. Ryûkyû. Siam. Viti Islands.

The specimen has remained the only one which has come under

examination. Compared with the many examples of *C. retropicta* from Hirado, it is hardly doubtful that the fossil is identical with that species, but it may perhaps be questioned whether its coloration agrees well with that of the recent ones or not. A new species of *Clithon* which is at my hand obtained from the Naganuma Beds resembles very closely *C. retropicta* in its general shape. But in coloration, the fossil species differs from the latter in having blackish-purple zigzag lines on the whitish ground.

The distinction between *C. retropicta* and *C. sowerbyana* RECLUZ would not be difficult if a variety of the latter did not take the narrower shape similar to the former.

The specimen measures 10mm. in height and 8mm. in diameter.

Acmaeidae

Acmaea pygmaea (DUNKER.)

1861. *Patella Heroldi* DUNKER, Moll. Jap., p. 24, pl. 3, f. 13.
1861. *Patella pygmaea* DUNKER, Ibid., p. 24, pl. 3, f. 20.
1871. *Acmaea Heroldi*, LISCHKE, Jap. Meer. Conch., vol. 2, p. 96.
1882. *Tectura Heroldi* DUNKER, Index Moll. Mar. Jap., p. 154.
1891. *Acmaea Heroldi* form *pygmaea*, TRYON, Man. Conch., p. 45, pl. 9, f. 19, 20, 21.
1895. *Acmaea Heroldi*, PILSBRY, Cat. Mar. Moll. Jap., p. 110.
1920. *Acmaea heroldi*, YOKOYAMA, Foss. Miura Penin., p. 99, pl. 6, f. 12.

Occurrence.—Dainiti.

Distribution.—Upper Musasino of Yokosuka.

Living.—Western Japan, from Tôkyô Bay to Nagasaki.

An immature shell of about 4mm. long represents the species which has been known as a variety of *Acmaea heroldi* (DUNKER). But DUNKER had given the name *Patella pygmaea* to this form in 1860 (Malak. Blätt.) previous to *Patella Heroldi* which was proposed by him in 1861.

Littorinidae

Lacuna intermedia n. sp. (*Plate III, fig. 5.*)

Shell minute, transversely oval, obliquely depressed, auriform, thick, smooth, perforate. Spire very small; whorls 3, rapidly increasing, convex, the last large, inflated, rounded at periphery, dilated in front. Suture grooved.

Incremental striae form the only sculpture. Umbilicus large, open, penetrate, encircled by an acute keel, excavate on its inner surface. Aperture large, oblique, transversely ovate. Outer lip somewhat diffused, sharp, continuous to the umbilical keel. Columella suboblique, straightish, sharply margined, flattened in front, the flattened surface somewhat depressed from the peristome. Inner lip a short way hangs over the perforation. Height, 2 mm.; diameter, 2·2 mm.; oblique diagonal of the aperture, 1·8 mm. Type: Holotype, no. 42.

Occurrence.—Dainiti.

In this species the form more approaches *Stenotis laxata* A. ADAMS than *Lacuna stenotomorpha* PILSBRY (Cat. Mar moll. Jap., p. 64, pl. 8, f. 3.). It differs from *S. laxata* (Jour. de Conch., 1868, p. 54, pl. 4, f. 7.) in that the aperture is more oblique and not narrowed behind, the umbilicus is smaller and the body-whorl never solute.

L. intermedia differs from *L. stenotomorpha* in that the shell is much more transversely inflated, much more obliquely depressed, the aperture is larger and the spire is smaller.

Rissoidae

Cingula (Setia) subangulata n. sp. (*Plate III, fig. 6.*)

Shell minute, conoidal, moderately thick, smooth, rimate, Spire elevated conical, 4/3 times the height of the aperture, faintly gradate, with a blunt apex, outline slightly convex. Protoconch depressed, bluntly rounded, smooth. Whorls $4\frac{1}{2}$, flatly convex, with slight angles above and below the suture, the last large, about 2/3 of the entire height, narrowly and roundly shouldered; periphery roundly angulate; base oblique, flattish. Suture deep, channeled. Sculpture: the first whorl next to the protoconch has 5 spiral striae; the later whorls smooth except for microscopic incremental lines. Aperture suboblique, ovate-rotund, with the outer half more curved, narrowly rounded above; peristome continuous, slightly thickened inside, with a blunt edge, slightly reflected at the base. Columella vertical, straight, very slightly arcuate above. Height, 1·47 mm.; diameter, 0 92mm. Type: Holotype, no. 46.

Occurrence.—Dainiti.

Many species of the subgenus *Setia* have convex whorls and round periphery, while some others have more flattened whorls. The present species is characterized by the narrow shoulder and the roundly angled periphery that continues from the margin of the profound suture. Mr. KURODA kindly showed me some unnamed species of Japanese living *Setia* in his collection. The fossil species is related to none of these living forms.

Thiaridae

Thiara totomiensis n. sp. (*Plate III, fig. 7.*)

Shell of moderate size; ovate, slightly ventricose. Spire much eroded. Whorls few, rapidly increasing, sharply concavely shouldered at the upper part, the angles flatly tubercled by up-projecting axial folds, about 10 on the penultimate whorl. Surface sculptured by irregular incremental lines. Body-whorl very large, slightly ventricose; base ornamented with 8 to 9 indistinct spiral threads. Aperture large, suboblique, elongately ovate, sharply angled above. Outer lip thin, sharp, somewhat sinuate at the base. Columella subvertical, rather long. Height of the uneroded $3\frac{1}{2}$ whorls, 27 mm.; diameter, 16 mm. Type: Cotype, no. 49.

Occurrence.—Dainiti.

Being allied to *Melania amarula* LINNÉ, this species belongs without doubt to the genus *Melania* s. str. which, in accordance with the rule, is now called *Thiara*. This *Thiara* s. str. is quite exotic to the Japanese fauna. *T. thiarella* LAMARCK is the closest to the present new species. But in *T. totomiensis* the tuberculations are compressed, while in *T. thiarella* they are cylindrical. This fresh water form must have been mixed with the marine fauna by chance.

Cerithiidae

Bittium kurodai n. sp. (*Plate III, fig. 8.*)

Shell turreted, narrow and high with spirally prominently sculptured whorls. Spire high, about five-times the height of the aperture, outline straight. Whorls 11, slowly and regularly increasing, convex, contracting

gradually upwards into the suture, contraction shorter and more rapid towards the bottoms. Protoconch of 1½ smooth, convex whorls, a little deviated from the vertical axis. Base concave around the neck, smooth, often with a few obsolete spirals. Suture impressed, linear, margined. Sculpture consisting of narrow spiral keels, 2 on the first whorl next to the protoconch, 2 on the last; on the upper contraction there are usually 2 prominent spiral cords; there are one more marginal cord at the bottom of the whorl; the three keels are equidistant, separated by excavated interspaces narrower at first and wider at last than the keels; periphery with 2 spirals continuous with the marginal cords of the suture. Axials consisting of obscure plicated equidistant ribs. Aperture oblique, rhombic, angled above; canal very short, open and broad, appearing as an acuminated point of the aperture. Outer lip thin and sharp. Columella arcuate, below vertical, inner lip very narrow. Height, 7.6 mm.; diameter, 2 mm. Type: Holotype, no. 235.

Occurrence.—Hônohasi.

This form is quite unique in having a long turreted shell with strong spirals and without varix. It reminds us something of *Turritella*, but the axial plicae and the short canal rather represent the characters of *Bittinae*. Undoubtedly it is neither *Tachyrhynchus* nor *Aclis*.

Bittium crosio n. sp. (*Plate III, fig. 11.*)

Shell minute, narrowly conical, reticulate, lightly tubercled, thick. Spire not very high, about 2½ times the height of the aperture, pointed; outline straight but slightly angulated. Protoconch of two smooth depressed blunt subrounded whorls. Whorls 5, exclusive of those the protoconch, regularly increasing, short, flatly convex, angular, feebly contracted at the suture; the last about half the entire height, rounded at the periphery; base concave around the neck. Suture in itself unrecognisable, but distinctly canaliculate being defined by the contraction at top and bottom of each whorl. Sculpture consisting of 4 squarish spiral threads on the upper whorls, 5 on the body-whorl, the uppermost close to the suture, the lowest on the angle of the upper sutural contraction; crossed by straight equidistant axial riblets, about 21 on the body-whorl, the beads very feeble; base with a squarish

spiral thread above and a very fine thread around the neck. Aperture roundly ovate, suboblique, obtusely angled above, narrowly effuse below, but no distinct canal, with a slight notch. Outer lip thin and slightly convex. Columella subvertical. Height, 2·9 mm. diameter, 1·4 mm. Type: Holotype, no. 50.

Occurrence.—Dainiti.

Living.—Tanabe, Wakayama-ken.

The above description is partly based upon the living specimen, the colour of which is yellowish brown or chestnut brown.

Triphoridae

Triphora sp.

Shell small, elongate-conic, sinistral. Spire high; outline almost straight, Protoconch high, convex, smooth, apex broken. Whorls 5, regularly increasing, flat; base flat. Sculpture: the early whorls have two equal keels, but the later ones have a smaller keel intercalated between them; all these keels are crossed by about 18 axial riblets, the point of intersection raised into rounded gemmules. Periphery of the base acutely angled with a smooth keel, Aperture round; columella vertical, arcuate. Height about 2·25 mm.; diameter, 1·6 mm.

Occurrence.—Dainiti.

The only example of this form is unfortunately imperfect, its apex being absent while its principal characters of the base are also wanting. It resembles an immature shell of *T. otsuensis* (YOKOYAMA) in its sculpture.

Turritelidae

Turritella perterebra YOKOYAMA.

1923. *Turritella perterebra* YOKOYAMA, Tert. Moll, Dainichi, p. 11, pl. 2, f. 2–5.

Occurrence.—Dainiti. Hônohasi. Tennô-shrine. Saigô. Nitô.

Distribution.—Kakegawa series of Tosa,

This is one of the most common forms of the Lower Kakegawa series. The coarser spiral threads have been described to be six to eight, but mature whorls having a diameter more than 20 mm., have about ten of such threads. The threads and alternating finer threads are unequal in

their magnitudes. In wider interspaces of these threads on the lower surface there intervenes a finer thread of the third cycle. The shell probably attains a large height, more than 120 mm., in the adult. The aperture has a rather thick inner lip with a free margin. A fossil *Turritella* found in the Upper Miocene of Java and named *T. terebra* LAMARCK var. by Dr. K. MARTIN, is interesting as showing relationships to *T. perterebra*. This shell of MARTIN is described to have 7 sharp spiral threads which interspaces regularly have each a finer one. The spiral are somewhat stronger in it than in the Japanese shell, some individuals of which presenting a less convex shell.

The living *T. terebra* LAMARCK apparently approaches the fossil species, but is not easily mistake for them.

Turritella totomiensis n. sp. (*Plate III, fig. 9.*)

Shell turreted, narrow and high, with spiral cords. Whorls regularly and slowly increasing. The upper third of the surface of a whorl is flat and slopes steeply, with 2 fine and indistinct spiral threads; the lower two-thirds is ventricose, with 4 narrow-topped spirals, interspaces of which are much broader and concave-bottomed. Base nearly flat, spirally sculptured by many obsolete threads Surface also sculptured with fine regular incremental striae all over, a few of which exceptionally growing into strong incontinuous cords showing the early peristomes. Aperture oval, slightly angled above, oblique. Columella vertical, straight and sharp. Diameter, 9 mm. Type: Holotype, no. 48.

Occurrence.—Dainiti (very rare).

This species is based upon an unique specimen with a broken apex. The height of the shell is probably about 40 mm. with about 15 whorls. It is distinguished from all the other fossil species by its peculiar sculpture. The shell substance of this species is porcellaneous, while it is earthy in *T. perterebra*.

Xenophoridae

Xenophora exuta (REEVE).

1842. *Phorus exutus* REEVE, Proc. Zool. Soc., p. 162.

1851. *Xenophora exuta*, PHILIPPI, Syst. Conch. Cab. Mart. Chemn., vol. 2, pt. 3, p. 348, pl. 48, f. 4.
1869. *Xenophora exuta*, LISCHKE, Jap. Meer. Conch., vol. 3, p. 82.
1878. *Phorus exutus*, SOWERBY, Conch. Icon., sp. 7.
1881. *Xenophora exuta*, DUNKER, Index Moll. Mar. Jap., p. 123.
1886. *Xenophora exuta*, TRYON, Man. Conch., vol. 8, p. 161, pl. 46, f. 90, 91.
1895. *Xenophora exuta*, PILSBRY, Cat. Mar. Moll. Jap., p. 70.
1919. *Xenophora exuta*, IWAKAWA, Cat. Jap. Moll. Imp. Mus., p. 48.

Occurrence.—Tennôyama.

Distribution.—Kakegawa series of Tosa.

Living.—Pacific coast of Japan to the west of Sagami. Ogasawara Islands. Inland Sea. China.

The laminar dilation of the periphery is broken in every specimen under examination. The spire whorls are, however, quite the same as in the living *X. exuta*. They are marked with diagonal striae which obliquely across the growth-lines. The sutures are ill-defined, very superficial and unevenly undulating. The protoconch is small, conic and consists of a few convex, smooth polished whorls. The succeeding earlier whorls exhibit marks of agglutination of small foreign bodies; and this is an evidence for that those non-agglutinate species grouped under the subgenus *Tugurium*, have the ancestry with the habit of the typical *Xenophora*.

Cymatiidae

Bursa ranelloides (REEVE).

1844. *Triton ranelloides* REEVE, Proc. Zool. Soc., p. 111.
1844. *Triton ranelloides* REEVE, Conch. Icon., sp. 10.
1881. *Ranella cruentata*, TRYON, Man. Conch., vol. 3, p. 39.
1895. *Ranella ranelloides*, PILSBRY, Cat. Mar. Moll. Jap., p. 48.

Occurrence.—Tennôyama.

Living.—Island of Luzon, Philippine. Sagami Bay, Japan.

Shell of medium size, ovate, nodulous, varices discontinuous. Spire high, acutely conical, about the same height as the aperture, Protoconch smooth, conical. Whorls 8 to 9, depressed at the upper part. Sculpture consisting of a varix or two, many series of nodules and very fine reticulation

over the whole surface; varices prominent, round, rather compressed laterally; two consecutive varices making an angle about 200° at the axis of the spire. The spire whorls are encircled by a row of about 10 prominent nodules; the surface above this line is axially granulately plicated. There is a row of smaller nodules beneath the main one; the dody-whorl exhibits three rows of nodules, the interspaces of which are encircled by three or more series of small grains. Suture distinct, not deep, undulating. Base somewhat excavated below. Aperture oblique, oval with a deep canal above, produced below into a short, open, slightly recurved and truncate canal. Outer lip expanded, sharp, with a thick varix on the outside, denticulate within; columella vertical, somewhat concave, slightly bent to the left on reaching the canal; inner lip broadly extending, with a free edge, plicately denticulate all over, spreading as a thin callus far beyond the parietal wall, leaving the nodules and grains still visible, thickened above at the entrance of the posterior canal.

Gyrineum (Biplex) perca prisca n. subsp. (*Plate III, fig. 6.*)

Occurrence.—Tennôyama.

This form is evidently one of the ancestors of the species which lives in the waters of South-western Japan and the Philippines. The species has been known as *Ranella pulchra* GRAY, but this name of PERRY has the priority. The subspecies differs from the species in that the varices are not so stellately pinnate and the surface of the later whorls are not so latticed. In the adult of the species, the nodules at the crossing points of the lattice are nearly obsolete on the median portion of the whorls. In the subspecies the axial sculptures are obsolete on the last two whorls. The varices of *Gyrineum* (*Biplex*) *pamotanensis* (MARTINS)* are narrower and have round margins. Most probably this Japanese Miocene species is the forerunner of the evolutionary lineage of *Biplex perca.*** *B. perca prisca* is an intermediate mutation of the series. It has more specialised varices, they being wider and more angular than in the Javanese form. The

* Fossilien v. Java, p. 151, pl. 23, f. 352.

** *Biplex perca* PERRY, Conch. pl. 4, no. 5, 1811.

living representative has more prominent varices with stellate margins. The holotype is no. 301 and measures 59mm. in height and 34mm. in diameter.

Cassididae

Phalium (Bezoardica) japonicum (REEVE).

1848. *Cassis japonica* REEVE, Conch. Icon., sp. 23.
1857. *Cassis japonica*, KÜSTER, Syst. Conch. Cab. Mart. Chemn., vol. 3, pt. 1, p. 24, pl. 44, f. 5; p 43, pl. 42, f. 9.
1869. *Cassis japonica*, LISCHKE, Jap. Meer. Conch., vol. 1, p. 64.
1882. *Cassis japonica*, DUNKER, Index Moll. Mar. Jap., p. 64.
1885. *Cassis saburon* var. *japonica*, TRYON, Man. Conch., vol. 7, p. 275, pl. 5, f. 76, 77.
1895. *Cassis japonica*, PILSBRY, Cat. Mar. Moll. Jap., p. 48.
1925. *Cassis japonica*, YOKOYAMA, Jour. Coll. Sci. Univ. Tokyo, vol. 45, art. 5, p. 11, pl. 1, f. 5
1925. *Cassis japonica*, YOKOYAMA, Ibid., art. 7, p. 13.

Occurrence.—Tennôyama.

Distribution.—Sirado Beds.

Living.—From Bosô Peninsula to Kyûsyû, China.

This determination applies to a single fractured specimen which has the same characters as the living species. I have nothing to say more concerning this species, having only one specimen, except that the generic name must be changed to a more precies one adopted in the modern conchology.

Tonnidae

Tonna luteostoma (KÜSTER).

1857. *Dolium luteostomum* KÜSTER, Syst. Conch. Cab. Mart. Chemn., vol. 3, pt. 1, b, p. 66, pl. 58, f. 2.
1858. *Dolium japonica*, DUNKER, Nov. Conch., p. 194, pl. 35, 36.
1869. *Dolium luteostomum*, LISCHKE, Jap. Meer. Conch., vol. 1, p. 65.
1871. *Dolium luteostomum*, LISCHKE, Ibid., vol. 2, p. 57.
1881. *Dolium luteostomum*, BRAUNS, Geol. Env. Tokio p. 60.,
1882. *Dolium luteostoma*, DUNKER, Index Moll. Mar. Jap., p. 58.
1885. *Dolium luteostoma*, TRYON, Man. Conch., vol. 7, p. 261, pl. 1, f. 6, pl. 2, f. 7.
1895. *Dolium luteostoma*, PILSBRY, Cat. Mar. Moll. Jap., p. 49.

1906. *Dolium luteostomum*, TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 17, pl. 1, f. 30.

1920. *Dolium luteostomum*, YOKOYAMA, Foss. Miura Penin., p. 66, pl. 4, f. 2.

1922. *Dolium luteostomum*, YOKOYAMA, Foss. Up. Musashino, p. 69, pl. 3, f. 10.

1925. *Dolium luteostomum*, YOKOYAMA, Jour. Coll. Sci. Univ. Tokyo, vol. 45, art. 5, p. 11.

Occurrence.—Tennôyama.

Distribution.—Upper Musasino of Miura: Miyata Beds and Yokosuka Beds. Naganuma Beds. Upper Musasino of Tôkyô and Tiba-ken. Kakegawa series of Tosa.

Living.—Japan, distributed from Hakodate to Nagasaki, especially abundant in Tôkyô Bay.

The several specimens herewith determined are in much fractured condition. But, from these partial materials the characters of the fossil form have been observed fairly well. There is found little difference from the living species. The sculpture consists of flat-topped equal spiral ribs, interspaces of which are flat and as wide as themselves; the upper interstices often have a small intervening ridge. The only difference between the fossil of the Tennô sands and the living species is that the interstices of the latter are more excavated and narrower.

Tonna japonica (YOKOYAMA).

(not *Dolium japonicum* DUNKER)

1923. *Galeodea (Sconsia) japonica* YOKOYAMA, Jap. Jour. Geol. Geogr., vol. 2, p. 3, pl. 1, f. 4.

1923. *Galeodea (Sconsia) japonica* YOKOYAMA, Tert. Moll. Dainichi, p. 11.

Occurrence.—Dainiti (very rare).

Distribution.—Neogene of Izumo. Sirado Beds (YOKOYAMA). Tertiary of Nara.

An ill-preserved specimen is in the Geological Institute of Tôkyô Imperial University. After examining the topotype, Mr. KURODA has come to the conclusion that it is not a *Galeodea* but belongs to *Tonnidae*; it is differentiated, however, from *Tonna* in having peculiar tuberculated spirals. A new group-name with its detailed description will be published by Mr. KURODA in another opportunity when he gets more specimens.

Naticidae

Natica janthostoma DESHAYES.

1923. *Natica janthostoma*, YOKOYAMA, Tert. Moll. Dainichi, p. 12.

Occurrence.—Dainiti. Hônohasi. Iwasibara. Tennô-shrine. Tennôyama.

Distribution.—Widely distributed in the Tertiary rocks of Japan.

Living.—Japan proper. Hokkaidô. Kamchatka.

Besides the above reference, Prof. YOKOYAMA mentions the occurrence of this species in the following papers:

Foss. Miura Penin., p. 76, pl. 5, f. 3, 4.

Foss. Up. Musashino, p. 83.

Jap. Jour. Geol. Geogr., vol. 2, p. 4; p. 53.

Jour. Coll. Sci. Univ. Tokyo, vol. 45, art. 3, p. 12.

Ibid. art. 5, p. 13.

Ibid. art. 7, p. 14.

Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 7; p. 116; p. 278.

This species is a wellknown common form of the late Cainozoic periods of Japan. The shape of the fossils under examination agrees so well with the living *N. janthostoma* that there have apparently been little evolutionary change since the older Pliocene times. The lowest horizon from which this species is found is the Asagai sandstone of probable Oligocene origin.

Polinices sagamiensis PILSBRY. (*Plate III, figs. 1, 2.*)

1904. *Polinices sagamiensis* PILSBRY, Proc. Acad, Nat. Sci. Philadelphia, p. 23, pl. 4, f. 37, 37a.

Occurrence.—Dainiti. Hônohasi. Saigô-bridge. Tennô-shrine. Tennôyama.

Distribution.—Kakegawa series of Tosa.

Living.—Sagami. Awazi.

Perhaps this is the same form as Prof. YOKOYAMA's *P. ampla* and *P. powisianus*. Recent *P. sagamiensis* is distinguished from *P. powisiana* RECLUZ and other allied species by its large size of the umbilical lobe and by the strong cord around the umbilical crescent. But, the umbilical crescent of the fossil form is much shallower and has no cord while its flat-topped lobe of the funiculum is much more projected into the umbilicus. Therefore,

the fossil of the Kakegawa series is not exactly conspecific with *P. sagamiensis*, but must be the forerunner of the living form.

Eunaticina papilla (GMELIN).

1923. *Sigaretus (Eunaticina) papilla*, YOKOYAMA, Tert. Moll. Dainichi, p. 12.

Occurrence.—Dainiti (rare).

Distribution.—Upper Musasino.

Living,—Central and Western Japan. Philippine. Moluccas.

Cypraeidae

Cypraea sp.

Occurrence.—Dainiti.

An oblong-ovate, anteriorly attenuate shell with a narrow aperture. The general outline of this form is very common of the small species of *Cypraea* living in Japanese waters. But it can not be determined, having been broken to pieces, although it retains some characteristic features. The most important and unique character of this form is that the outer lip is faintly denticulate within. The basal part of the shell is flattened as in *Cypraea talpa* LINNÉ. The height is about 27 mm. and the diameter 16 mm.

Erato callosa A. ADAMS et REEVE.

1861. *Erato callosa*, DUNKER, Moll. Jap., p. 17.

1865. *Erato callosa*, SOWERBY, Conch. Icon., sp. 2.

1866. *Erato callosa*, SOWERBY, Thes. Conch., vol. 3, p. 82, pl. 219, f. 35–37.

1871. *Erato callosa*, LISCHKE, Jap. Meer. Conch., vol. 2, p. 68.

1879. *Erato callosa*, WEINKAUFF, Syst. Conch. Cab. Mart. Chemn., vol. 5, pt. 4, p. 146, pl. 25, f. 2, 3.

1882. *Erato callosa*, DUNKER, Index Moll. Mar. Jap., p. 56.

1883. *Erato callosa*, TRYON, Man. Conch., vol. 5, p. 9, pl. 4, f. 38, 39.

1895. *Erato callosa*, PILSBRY, Cat. Mar. Moll. Jap., p. 52.

1906. *Erato callosa*, TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 10, pl. 1, f. 12.

1910. *Erato lachryma* var. *callosa*, SMITH, Proc. Malac. Soc., vol. 9, p. 17.

1919. *Erato callosa*, IWAKAWA, Cat. Jap. Moll. Imp. Mus., p. 96.

1922. *Erato callosa*, YOKOYAMA, Foss. Up. Musashino, p. 69, pl. 3, f. 11.

Occurrence.—Hônohasi (rare).

Distribution.—Upper Musasino of Tôkyô and Tiba-ken.

Living.—Central and Western Japan. China. Philippine. Mauritius.

Only one specimen 4·5 mm. high before me can be referred to this species. The shell is swollen at the upper part forming an outline of an equilateral triangle. Mr. SMITH thinks *E. callosa* is a variety of *E. lachryma*, differing only in colour, and that misidentified *E. lachryma* of SOWERBY and REEVE led PILSBRY to quote that species as Japanese. Prof. YOKOYAMA considers the Japanese *E. lachryma* which is said to have the indistinct crenulation of the outer lip may possibly be assigned to *E. callosa*. The figures of *E. lachryma* GRAY show the shell to be inequilateral and the last whorl gently convex without being swollen at the upper part. There is such a shell referable to *E. lachryma* at hand from Awazi. Prof. TOKUNAGA's figure also shows the outline of *E. lachryma*.

Volutidae

Lyria mizuhonica n. sp. (*Plate III, figs. 12, 13.*)

Shell ovately fusiform, thick, axially plicate. Spire low, pyramidal, its height about half that of the aperture, sharp at the apex, outline straight. Protoconch small, bulbiform, consisting of $1\frac{1}{2}$ smooth volutions; the nucleus depressed. Whorls 6, much broader than high, regularly increasing, lightly convex; the last very large, about 3/4 of the entire height, inflated, slightly contracted below. Sculpture confined to axial plicate ribs, about 12 on the penultimate whorl, extending from suture to suture, subvertical, gradually fading towards the base. Aperture suboblique, elongate, narrowed and channeled above, truncate at the base. Outer lip thickened, effused, smooth, with a varix. Columella subvertical, straight, forming a slight concavity above, in joining the parietal wall, provided with about 10 or more somewhat inequidistant, unequal transverse plaits, of which the lowest but one is the strongest. Inner lip thin, spreading short way over the body-whorl, lamellate anteriorly and separated by a groove from the fasciole. Height, 31 mm.; diameter, 15 mm.; height of aperture, 23 mm. Type: Holotype, no. 302.

Occurrence.—Tennôyama.

Distribution.—Kakegawa series of Tosa at Kônomine.

The type of this species is the single specimen discovered in the Tennô sands of the type locality. It is distinguished from *L. cassidula* REEVE, a common species of the existing sea of the Japanese Empire, by its less inflated shell with the higher and more acuminated spire, and that the axials are less in number. *L. mizuhonica* is not rare in the Pliocene sandstone of Kônomine. Some of the specimens show faded spiral colour lines, 3 on a whorl.

Fulgoraria (Psephaea) totomiensis n. sp. (*Plate III, figs. 17, 18.*)

A species very closely allied to *Psephaea concinna* BRODERIP. Whorls roundly shouldered; the slope a little concave, its height about one-third of the whorl; the surface below the angle nearly vertical, very slightly contracted at the suture. Body-whorl lightly convex, very little contracted below. Sculpture consisting of 13 axial plicate costae crossed by many spiral threads; the axials forming elongate nodules on the angle of the body-whorl, diminishing towards the base; the interspaces wide and concave; the spirals like those of *P. hirasei* SOWERBY, a little more than 40 in the penultimate whorl, subequal, broader than the intervened grooves, running all over the surface of the later whorls. Aperture elongate rather narrow, slightly canaliculate at the upper angle, truncated at the base. Outer lip thickened and rounded, slightly expanded above, thinner near the base. Columella subvertical, with one oblique plait. Inner lip thin, spreading broadly over the dody-whorl, with an arched free edge. Height of the body-whorl, 40mm.; diameter, 24mm. Type; Holotype, no. 303.

Occurrence.—Tennôyama.

This species is represented by a single much broken type missing the spire. It differs from *Voluta concinna* BRODERIP, the genotype of *Psephaea* CROSSE, in that the whorls are not so distinctly angulate, the costae are not so prominently tubercled on the angle of the shoulder and the spirals are not so fine. The spirals of the latter species is much more numerous and finer.

P. totomiensis n. sp. is also closely related to *P. hirasei* SOWERBY,* a living species of Japanese water, from which it differs in having no callus on the suture, a less number of more angulate costae. The body-whorl of *P. hirasei* is more rounded and the costae are not tubercled. The fossil species is a collective type of the above two living forms and most probably extinct in the present sea.

Uromitra nakamurai n. sp. (*Plate III, fig. 10.*)

Shell small, slender, fusiform, rather thick, smooth. Spire elevated conic, acute, outline very slightly convex, about $\frac{4}{3}$ times the height of the aperture. Whorls 8, slowly increasing, flatly convex, subcylindrical; the last high, convex, with an excavate base and a longish twisted snout. Protoconch of $1\frac{1}{2}$ volutions, tilted, with a pointed nucleus. Suture deeply impressed, making the whorls look somewhat telescopic. Surface smooth except for a fine presutural lira which lies at a quarter of the height of the whorl in advance of the suture, and several faint striae, often more or less well-defined near the lira. Incremental lines hair-like, a little arcuate, concave side facing forward. Aperture narrow, elongate, angled above, produced below into a widely open rather long recurved canal, its base not truncate. Columella oblique, turned to the left below, provided with 4 oblique plaits, decreasing in size towards the base, the lowest minute; they continue as spiral ridges separated by narrow grooves upon the snout. Inner lip thin and narrow. Outer lip with blunt edge, internally with transverse plicae and dense microscopic striae. Height, 15·3 mm.; diameter, 4 mm. Type: Holotype, no, 304; paratype, no. 305.

Occurrence.—Tennôyama.

This species of *Uromitra* resembles very closely *U. plicatula* BROCCI, a Pliocene species of Italy in its general features. It is also allied to *U. ebenus* LAMARCK, an European form to which a fossil of Japanese Pliocene has been assigned by Prof. YOKOYAMA. *U. ebenus* has the similar presutural lira. The present species differs from that species in the slender shell with a longish canal, the flat surface sometimes with faint lirae and entirely

* Ann. Mag., 1912, p. 471, f. 1.

devoid of the axials even on the early whorls. This form will be a modification in temperate zones derived from certain highly ornamented tropical species.

Olividae

Oliva mustelina LAMARCK. (*Plate III, figs. 14, 15.*)

1844. *Oliva mustelina*, LAMARCK, Anim. s. Vert. (Deshayes's edition), vol. 10, p. 616.
1850. *Oliva mustelina*, REEVE, Conch. Icon., sp. 23.
1869. *Oliva mustelina*, LISCHKE, Jap. Meer. Conch., vol. 1, p. 69.
1871. *Oliva mustelina*, LISCHKE, Ibid., vol. 2, p. 61.
1878. *Oliva mustelina*, WEINKAUFF, Syst. Conch. Cab. Mart. Chemn., vol. 5, pt. 1, p. 92, pl. 24, f. 10, 11.
1882. *Oliva mustelina*, DUNKER, Index. Moll. Mar. Jap., p. 46.
1883. *Oliva mustelina*, TRYON, Man. Conch., vol. 5, p. 78, pl. 22, f. 6.
1895. *Oliva mustelina*, PILSBRY, Cat. Mar. Moll. Jap., p. 23.

Occurrence.—Iwasibara.

Living.—Nagasaki (LISCHKE). Inland Sea. Singapore. Hongkong.

This is one of the species most frequently found living in the seas of Japan. Compared with the living specimen, the fossils do not show any difference in their characters of spires and apertures; and the general contour agrees entirely with that of the species. Three specimens are gift of Mr. CHITANI.

Olivella fulgurata (ADAMS et REEVE.)

1880. *Oliva fulgurata*, MARRAT, Thes. Conch, vol. 4, sp. 193, f. 424, 425.
1883. *Olivella lepta*, TRYON, Man. Conch., vol. 5, p. 69, pl. 16, f. 11.
1895. *Olivella fulgurata*, PILSBRY, Cat. Mar. Moll. Jap., p. 23.

Occurrence.—Dainiti (not rare).

Living.—Tôkyô Bay. Kamakura. Tango.

This species living in Tôkyô Bay is distinguished from *O. fabula* MARRAT, a common species of the same bay, by that the parietal callus is not so thickened and the columella-fold is only one and the protoconch is smaller. The parietal callus of the latter species is peculiarly thickened, forming a ridge throughout the whole length. In *O. fulgurata*, the inner lip reflecting over the columella is broader and thicker and has one fold on its obliquely

truncated border; but often there are found a few very obscure traces of folds above it; in this respect, this species is more colsely allied to *O. fortunei* ADAMS. The columella of the latter species, however, has three distinct folds, the middle one is usually broad and obliquely striated. The figure given by Prof. YOKOYAMA* somewhat differs from those in Thesaurus Conchyliorum.** MARRAT's shells are slightly shouldered and flattened below, while the fossils from the Musasino are flattened above and rounded at the base. One of the good specimens of *O. fulgurata* from Dainiti measures 10mm. in height and 4mm. in diameter.

Olivella consobrina (LISCHKE.)

1871. *Oliva consobrina*, LISCHKE, Jap. Meer. Conch., vol. 2, p. 62, pl. 5, f. 10, 11.
1883. *Olivella lepta*, TRYON, Man. Conch, vol. 5, p. 69.
1895. *Olivella fulgurata*, PILSBRY, Cat. Mar. Moll. Jap., p. 23.

Occurrence.—Dainiti (rare).

Living.—North Kyûsyû.

This is not *Olivella consobrina* of Prof. TOKUNAGA***and BRAUNS which is identical with *O. fortunei* according to Prof. YOKOYAMA.**** *O. consobrina* LISCHKE is a thin and fragile shell with two columella-folds. The shell is usually slender with more acuminate spire than in *O. fulgurata*. The examples before me from the sea of Hizen conform very well with the figures given by LISCHKE. The single fossil specimen from Dainiti differs little from these living specimens, and measures 9mm. in height, 3mm. in diameter. This species may not be synonymous with *O. fulgurata* ADAMS and REEVE. *O. fabula* also is quite different in its peculiar parietal callus.

Olivella spretoides YOKOYAMA.

1922. *Olivella spretoides* YOKOYAMA, Foss. Up. Musashino, p. 47, pl. 2, f. 4.
1923. *Olivella spretoides* YOKOYAMA, Tert. Moll. Dainichi, p. 7.

Occurrence.—Dainiti. Hônohasi (frequent).

* Foss. Up. Musashino. pl. 2, f. 3.
** Pl. 350, f. 422, 423.
*** Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 29.
**** Foss. Up. Musashino, p. 47.

Distribution.—Upper Musasino of Tiba-ken, at Semata. Kakegawa series of Tosa.

This species is not rare in the Dainiti sands of Hônohasi. There are a few examples larger than the type of Prof. YOKOYAMA, one of them measures 9 mm. in height and 4 mm. in diameter. The shell is rather ovate, with five flat smooth whorls. The spire is about half the height of the aperture, conoidal, with papillate apex. The protoconch consists of two convex glossy whorls. The inner lip spreading a short way over the parietal wall as a thin glaze. The aperture is narrowed towards the base. The columella is short and oblique provided with a bifid fold.

One specimen from Hônohasi-tunnel exhibits a short spire with a concave outline. In the early stage of development, this specimen has grown regularly and takes the usual form of the species, but in the late stage, the whorls increase rapidly in breadths. This special case is not an extreme of fluctuation in the QUETELET's principle, but a kind of tachymorphy.*

Ancilla albocallosa (LISCHKE).

1861. *Ancilla (Ancillaria) rubiginosa*, DUNKER, Moll. Jap., p. 9.

1874. *Ancillaria albo-callosa* LISCHKE, Jap. Meer. Conch., vol. 3, p. 44, pl. 2, f. 24, 25.

1878. *Ancillaria albo-callosa*, WEINKAUFF, Conch. Cab. Mart. Chemn., vol. 5, pt. 1a, p. 14, pl. 5, f. 1, 2.

1882. *Ancillaria albo-callosa*, DUNKER, Index Moll. Mar. Jap., p. 47.

1923. *Ancilla okawai* YOKOYAMA, Tert. Moll. Dainichi, p. 5, pl. 1, f. 1.

Occurrence.—Dainiti (abundant). Hônohasi (rare). Tennôyama. Nitô.

Distribution.—Kakegawa series of Tosa.

Living.—Central and Western Japan.

This species living in the Japanese waters is very variable in its general contour; the hundred specimens in Mr. KURODA's collection brought from different localities show this. The shell is fusiform in the type and subfusiform inclining to cylindrical in some others. The typical form has the acute apex and long aperture occupying more than seven-tenths of the height. One of the local varieties of Kii shows a solid, subfusiform shell, with an obtuse spire and a shorter aperture. All its

* SCHMIDT, H., Paleont. Zeitsch., vol. 7, 204.

characters agree with those diagnosed in the description of *A. hunomotoensis* YOKOYAMA. Another variety which lives in Awazi has the same specific characters as *A. okawai* YOKOYAMA.

There are evidently three extreme forms representing the three independent factors, the combinations of which in different magnitudes bring about all these individual variations.

1. Fusiform, apex acute, aperture long ..... type.
2. Subfusiform, apex blunt, aperture short .....
3. Subfusiform, apex acute, aperture long ..... *okawai.*

These are united together by intermediate forms. All varieties belong to one species to which the oldest name *albocallosa* is to be adopted.

Marginellidae

Marginella (Cystiscus) tokaiensis n. sp. (*Plate IV, fig. 2.*)

Shell about 3·5mm. in height, a little oblong, moderately solid, smooth and polished. Spire one-fifth the length of the aperture, broadly conic, with a blunt apex. Protoconch broadly round, covered with enamel. Whorls 4, very low, flatly convex, the lower half covered with callus; the last very large, broadly convex at the periphery, narrowed towards the base. Suture filled with enamel, but quite distinct. Aperture oblique, high and narrow, slightly widening below, notched at the base. Outer lip thickened, straight, slightly retrocurrent towards the suture, denticulate within. Columella a little oblique, provided with 4 oblique equidistant sharp plaits, of which the foremost is the most prominent and forms the reverted edge at the base. Height, 3·54mm.; diameter, 2·21mm. Type: Holotype, no. 306.

Occurrence.—Tennôyama.

This species bears some resemblances to *M. sueziensis* ISSEL, which is a living species of the Red Sea, and Mr. BAVAY* mentions its occurrence in this count y. I had access to the specimen of his *M. sueziensis* in Mr. KURODA's collection, but it did not agree with that species of the Red Sea, having many plaits, more than four, and a less elevated spire. The

* Jour. de Conch., vol. 43, p. 108.

figure of *M. sueziensis* shows that the outer lip is not so straight but slightly constricted towards the base. *M. bulbosa* REEVE is more cylindrical, although it is closely affined to *M. tokaiensis*.

Cypraeolina solida n. sp. (*Plate IV, fig. 1.*)

Shell minute, solid, smooth, roundly ovoid, the greatest diameter being at a little above the middle, somewhat narrowed anteriorly. Spire perfectly immersed, the apex well rounded. Aperture as high as the shell, but a little shortened and narrowly rounded by the thickened callus of the outer lip both above and below, bent, narrow, very slightly expanded in front, but nearly of the same breadth throughout. Outer lip arcuate, very thick, blunt, with inconspicuous teeth inside, receding both anteriorly and posteriorly, externally broadly variced, the varix continued from the very apex to the base, thickened in the middle. Inner lip curved, particularly above, below with 4 oblique plaits, the uppermost one at a little below the middle, inconspicuous. Height, 2·15mm.; diameter, 1·69mm. Type: Holotype, no. 246.

Occurrence.—Hônohasi.

CERULLI-IRELLI'S *Cypraeolina* (1911) antedates DALL'S genus *Merovia* (1920). The present species is very closely allied to the genotype *C. clandestina*, but the shell is more gibbous at the apex and has a more prominent labral varix. The thickened outer lip of *C. solida* is very peculiar; it is unusual for the genus.

The new species is thus easily distinguished from *Marginella cotamago* YOKOYAMA, a living shell of Central Japan which had been questionably identified with *M. occulta* MONTEROSATO by Mr. BAVAY, besides, it is broader in proportion to the height and more solid in substance.

Cancellariidae

Cancellaria nodulifera SOWERBY.

1855. *Cancellaria nodulifera* SOWERBY, Thes. Conch., vol. 2, p. 440, f. 57.
1856. *Cancellaria nodulifera*, REEVE, Conch. Icon., sp. 6.
1861. *Cancellaria nodulifera*, CROSSE, Jour. de Conch., vol. 9, p. 238.
1871. *Cancellaria nodulifera*, LISCHKE, Jap. Meer. Conch., vol. 2, p. 55.

1882. *Cancellaria nodulifera*, DUNKER, Index. Moll. Mar. Jap. p. 103, pl. 6, f. 24, 25.
1887. *Cancellaria nodulifera*, LÖBBECKE, Syst. Conch. Cab. Mart. Chemn., vol. 4, pt. 4, p. 27, pl. 8, f. 1, 2.
1895. *Cancellaria nodulifera*, PILSBRY, Cat. Mar. Moll. Jap., p. 22.
1906. *Cancellaria nodulifera*, TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 12, pl. 1, f. 16.
1922. *Cancellaria nodulifera*, YOKOYAMA, Foss. Up. Musashino, p. 45, pl. 2, f. 1.

Occurrence.—Dainiti.

Living.—Central and Western Japan.

This species is not rare. An exact description is given in Conch. Cab. There is no difference between the fossil and the living species.

Cancellaria spengleriana DESHAYES.

1843. *Cancellaria spengleriana* DESHAYES, Anim. s. Vert., vol. 9, p. 415.
1855. *Cancellaria spengleriana*, SOWERBY, Thes. Conch., vol. 2, p. 439, sp. 2.
1856. *Cancellaria spengleriana*, REEVE, Conch. Icon., sp. 11.
1861. *Cancellaria spengleriana*, CROSSE, Jour. de Conch., vol. 9, p. 235.
1863. *Cancellaria spengleriana*, DEBEAUX, Jour. de Conch., vol. 11, p. 263.
1871. *Cancellaria spengleriana*, LISCHKE, Jap. Meer. Conch., vol. 2, p. 55.
1882. *Cancellaria spengleriana*, DUNKER, Index Moll. Mar. Jap., p. 103.
1885. *Cancellaria spengleriana*, TRYON, Man. Conch., vol. 7, p. 67, pl. 1, f. 2, 3.
1886. *Cancellaria spengleriana*, WATSON, Challenger Rep. Gastr., p. 273.
1887. *Cancellaria spengleriana*, LÖBBECKE, Syst. Conch. Cab. Mart. Chemn., vol. 4, pt. 4, p. 25, pl. 7, f. 1—8.
1906. *Cancellaria spengleriana*, TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 11, pl. 1, f. 15.
1920. *Cancellaria spengleriana*, YOKOYAMA, Foss. Miura Penin., p. 44, pl. 2, f. 2, 3.
1923. *Cancellaria spengleriana*, YOKOYAMA, Foss. Up. Musashino, p. 45.

Occurrence.—Hônohasi. Tennôyama.

Distribution.—Upper Musasino.

Living.—Central and Western Japan. Philippine. China.

This species is uncommon in the Dainiti sands. There are only two young specimens at hand which have a more sloping shoulder and narrower but stronger spirals than those of the fossil of the Naganuma Beds. This species is very variable. Most of the living examples are of the same race as the fossil form of Naganuma. The fossil under examination differs

from all of the living forms in having stronger spirals. But this is not an important specific or subspecific difference.

Cancellaria pristina (YOKOYAMA). (*Plate IV, fig. 3, 4.*)

1922. *Mitra pristina* YOKOYAMA, Tert. Moll. Dainichi, p. 9, pl. 1, f. 8—12.

Shell thin, medium in size, fusiform, oblong, attenuate, imperforate; spire turreted; whorls about 8 in adult, flatly convex, slightly shouldered; suture impressed; surface axially ornamented with about 14 round-topped fairly heavy distant ribs, latticed with many revolving cords, the interspaces between which are wider than themselves; in each interspaces there are one to three fine threads. Peristome oblong-ovate, about half the height of shell; outer lip thin, dentate within; inner lip incrusted; columella straight with two oblique plaits; canal short, very slightly twisted. Height, 30mm.; diameter, 13mm.; major diameter of the aperture, 17mm.

Occurrence.—Dainiti. Hônohasi. Tennôyama.

Distribution.—Kakegawa series of Tosa.

This species belongs to the section *Narona* which is distinguished from all other species of the genus by its elongate *Mitra*-like shape. *C. pristina* is quite unique in the fauna of Japan.

Trigonostoma kurodai n. sp. (*Plate IV, fig. 8.*)

1923. *Cancellaria crispata*, YOKOYAMA, Tert. Moll. Dainichi, p. 7, pl. 1, f. 3.

1926. *Cancellaria bocageana*, YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 333, pl. 38, f. 10.

Shell small, oblong-ovate, rather thick, minutely umbilicate; spire acuminately turreted; whorls moderately convex, excavately shouldered near the upper suture; number of whorls in adult 6 or 7; surface of shell sculptured with narrow strong axial ribs crossed by rather distant obsolete spiral threads. There are about 10 ribs on the body-whorl. Aperture triangularly ovate, rather narrow, as long as the spire; outer lip thickened, obscurely ridged within; columella straight, with three moderate plaits. Height, 15. 7mm.; diameter, 10mm. Type: Holotype, no. 78.

Occurrence.—Dainiti.

Distribution.—Kakegawa series of Tosa.

Trigonostoma kurodai n. sp. differs from *Trigonostoma crispatum* SOWERBY, a living species of the Philippines, in that it is a more slender shell; the ribs are not so strong and not so raised at the shoulder; the inner lip is but obscurely and shortly striated. In *T. bocageanum*, the ribs are less in number, more rounded, and not so sharp at the angle.

Terebridae

Terebra abdita n. sp. (*Plate IV, fig. 9.*)

Shell subulate, axially plicated. Spire narrowly conical, long, about three-times the height of the aperture, outline straight. Whorls 12, regularly increasing, flatly concave, high, base round, contracted around the neck. Protoconch missing. Suture deep, margined above in young types. Sculpture consisting of many weak flexuous axial plicae, less conspicuous on the later whorls; the surface of a whorl is divided in three differently sculptured spiral zones, he upper subsutural zone is about ¼ of the height of a whorl, and the lower supra-sutural zone is nearly equal to the upper one in breadth. The plicae are vertical in the subsutural zone and then down to the middle zone, they are abruptly weakened and bent backwards; in the supra-sutural zone, they are oblique and as strong as in the uppermost zone. On the later whorls, the plicae are obsolete throughout the three zones, there are developed two spiral series of grains, one at the top and the other at the base of the middle zone. There is no trace of the spiral on the interspaces of the plicae even along the series of grains. Periphery with a distinct spiral thread; base often sculptured with a few obscure spirals. Aperture subvertical, oblongly ovate; canal short but distinct, rather broad, slightly recurved. Columella vertical, narrowly drawn out to a point at the base of the canal; broadly excavate on joining a somewhat convex parietal wall. Outer lip thin and sharp. Fasciole marked by a sharp ridge. Height, 44mm.; diameter, 8·7mm. Type: Cotype, no. 80.

Occurrence.—Dainiti.

This peculiar species is frequently found in the Dainiti sands of its type locality. No similar form has hitherto been described from the Tertiary rocks of Japan.

Terebra asukensis YOKOYAMA.

1926. *Terebra asukensis* YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 327, pl. 38, f. 3.

Occurrence.—Hônohasi (very rare). Iwasibara.

Most probably this is a mutation of the preceding species. The shell is relatively broader and lower than that species. The spire has more whorls; the whorls are not so high, and more strongly constricted in the middle. The three zones of sculpture are equal in their breadths, the upper and the lower with vertical plicae and the middle being concave and smooth. The surface is also spirally striated, the striation being more obscure than incremental lines. The base is shorter and more rounded, with distinct unequally-spaced spiral threads.

Terebra yokoyamai n. sp. (*Plate IV, fig. 10.*)

Shell subulate, axially plicate. Spire slender, subcylindrical, about five-times the aperture in height. Protoconch missing. Whorls many, 14 in the height of 32mm., regularly increasing, flatly convex, slightly constricted at a posterior sulcus which is found at some distance about ¼ of a whorl from the upper suture. Suture deep, impressed, slightly undulating. Sculpture consisting of lightly curved, equidistant, roof-shaped, vertical axial riblets extending from suture to suture; they are flexuous at the periphery and becoming obsolete toward the base; the interspaces excavated; incremental lines fine and dense, conspicuous upon the interspaces. Aperture oblique, oblong-oval, with a rather narrow and short recurved canal below. Columella subvertical, stout, continued as a narrow ridge to the base of the canal, concave on joining the flat parietal wall. Inner lip thin, semicircular in front. Height, 32mm.; diameter, 5·5mm. Type: Cotype, no. 81.

Occurrence.—Dainiti.

This species may easily be, and has been, mistaken for *T. lischkeana* DUNKER, a species living in Western Japan and which had lived in the seas of the Musasino age. However, it differs from the latter species in

the following respects : the shell is more slender, as the whorls are increasing regularly, the outline of the spire is straight, the sutural band is narrower and there is no trace of intercostal spirals.

Terebra eoa n. sp. (*Plate IV, fig. 13.*)

Shell small, conically subulate, with granular whorls. Spire high, narrowly conical, acuminate, much higher than the aperture. Whorls 15, rather regularly increasing, somewhat concave. Protoconch of 3 to 4 convex smooth whorls, elongately conical, with deeply impressed suture. Base concave, oblique. Periphery with a shallow groove, Sculpture of the young whorls consisting of two rows of grains, one around the upper part and the other the lower part ; the upper series grows gradually into the subsutural band of the later whorls ; the grains are axially elongated upon the band. There appears a subordinate granular row in the middle of the 11th whorl. In this way the last whorl has three rows of different magnitudes ; the uppermost one is the largest consisting of axially elongated grains ; the middle one separated from the upper by a narrower space is the smallest ; the lower grains are round. Suture impressed. Aperture oblique, narrowly oval, with a rather narrow recurved canal below. Height, 11·8mm. ; diameter, 3·1mm. Type : Holotype, no. 251.

Occurrence.—Hônohasi.

This species is quite unique in its sculpture. It is related to MARTIN's *T. samarangana* (Tiefbohrung auf Java, P. 75), a species found in the Upper Miocene and Pliocene rocks of Java. The latter species is distinctly axially plicated, the plicae connecting all of the grains in three series.

Terebra amabilis n. sp. (*Plate IV, figs. 11, 12.*)

Shell rather small, subulate, spirally striated. Whorls probably 9, regularly increasing, nearly flat ; suture impressed. Sculpture consisting of 5 fine impressed spiral grooves of which the uppermost one is found at a distance from the upper suture about a quarter of a whorl, the second is nearly at the middle of a whorl ; the three remaining grooves are on the lower half of the whorl and have nearly equal interspaces. The distance between the lowermost groove and the suture is about twice as

broad as the interspaces. Surface marked with fine flexuous growth-lines. Suture impressed. Periphery of the body-whorl roundly subangulate. Base abruptly contracted, obscurely spirally striated. Aperture suboblique, subrhombic, with a short, rather narrow, oblique and recurved canal. Inner lip narrow, thin, distinctly bounded. The few apical whorls and the outer lip are broken off. Height, 15mm. or more; diameter, 3·8mm. Type: Holotype, no. 82.

Occurrence.—Dainiti (rare).

This species is closely related to *T. quadriarata* YOKOYAMA (Foss. Up. Musashino, p. 32, pl. 1, f. 22.) from which, however, it may easily be distinguished by its peculiar ornament. In *T. quadriarata*, the uppermost one of the four impressed spiral lines is found at some distance about one-third of a whorl from the suture.

Terebra straminea GRAY.

1834. *Terebra straminea*, GRAY, Proc. Zool. Soc., p. 62.
1847. *Terebra straminea*, HINDS, Thes. Conch., vol. 1, p. 169, pl. 42, f. 22, 23.
1860. *Terebra straminea*, REEVE, Conch. Icon., sp. 47.
1885. *Terebra straminea*, TRYON, Man. Conch., vol. 7, p. 28, pl. 8, f. 42, 43.
1917. *Terebra straminea*, HIRASE, Terebridae of Japanese Empire, p. 13, pl. 6, f. 91—94.
1919. *Terebra straminea*, IWAKAWA, Cat. Jap. Moll. Imp. Mus., p. 151.

Occurrence.—Hônohasi.

Living.—China (DESHAYES). Philippine (REEVE). Fiji (WATSON). Northeast Australia (BRAZIER). Tranquebar (SCROETER). Kagosima and Kii (HIRASE). Suruga (IWAKAWA).

A single fractured specimen consisting of the early whorls appears to be difficult to separate it from the recent species. The spire is slightly bent near the top. The whorls are numerous, low and broad, with straight and vertical surfaces. The subsutural band is about half the height of a whorl and is divided by a sulcus into two parts, the upper part being broader and more convex than the lower. The surface below the band is slightly concave and with two spiral grooves. The axials are developed only upon the subsutural band. The last whorls with the aperture are missing in the specimen.

Terebra cf. woodwardiana MARTIN.

1887. *Terebra Woodwardiana* MARTIN, Tiefbohrungen auf Java*, p. 73, pl. 5, f. 76.
1915. *Terebra Woodwardiana*, TESCH, Pal. Timor, vol. 5, p. 38, pl. 7, f. 79.

Occurrence.—Hônohasi.

The specimen herewith determined is in a much fractured condition and the characters of the aperture are not known. It is obviously related to K. MARTIN'S *T. Woodwardiana*, a Miocene species of Java and Timor. The shell is shorter and broader than *T. yokoyamai* and is sculptured with more prominent axial plicae and more well-defined intercostal spiral threads than *T. lischkeana* DUNKER. But I can not find any difference from *T. woodwardiana* which was precisely described by Dr. K. MARTIN and was excellently figured by Dr. TESCH.

There are several more specimens of immature shells at hand. They are small, less than 10mm., and sculptured by axial plicate riblets. Their protoconchs are of three volutions, convex and smooth. The posterior sulcus is well-defined. These small shells may be the young of the present species or partly of *T. yokoyamai*. The early whorls of the latter species only differs from those of *T.* cf. *woodwardiana* in being narrower and constituting a more slender spire with an acuter apex.

Terebra bifrons HINDS.

1843. *Terebra bifrons* HINDS, Proc. Zool. Soc., p. 155.
1847. *Terebra bifrons*, SOWERBY, Thes. Conch., vol. 1, p. 174, pl. 43, f. 57.
1860. *Terebra bifrons*, REEVE, Conch. Icon., sp. 62.
1882. *Terebra bifrons*, DUNKER, Index Moll. Mar. Jap., p. 72.
1885. *Terebra bifrons*, TRYON, Man. Conch., vol. 7, p. 19, pl. 4, f. 71.
1917. *Terebra bifrons*, HIRASE, Terebridae of the Japanese Empire, p. 18, pl. 4, f. 45, 46.
1922. *Terebra smithi* YOKOYAMA, Fossil. Up. Musashino, p. 33, pl. 1, f. 21.
1922. *Terebra tsuboiana* YOKOYAMA, Ibid., p. 35, pl. 13, f. 12, 13.
1923. *Terebra tsuboiana* YOKOYAMA, Tert. Moll. Dainichi, p. 4.

Occurrence.—Dainiti.

Distribution.—Upper Musasino.

Living.—Pacific side of Western Japan.

* Samm. Geol. Mus. Leiden, ser. 1, vol. 3.

The apex is smooth for about one volution; the next two or three whorls are ornamented with straight axial costae and very fine spiral threads in the following two whorls, the costae are slightly curved, then a spiral groove running a little above the middle of the whorl makes its appearance. The axial sculpture found on the sixth whorl is continued unchange to the eleventh or twelfth whorl. The spiral threads persist throughout: on the later whorls they grow into coarser ones making the costae tubercular in crossing them. The growth of the spirals is much accelerated on the succeeding whorls. In the early stages the axials are much stronger than the spirals, but later become less markedly so, and in full-grown whorls, the sculpture consists of granular spiral ribs only.

Terebra bifrons ugaliensis n. subsp. (*Plate IV, figs. 6, 7.*)

Occurrence.—Hônohasi (frequent). Dainiti (rare). Tennô-shrine.

This is a fossil variety discovered with the species, from which it differs in the following respects: the radial ribs are numerous; the whorls are deeply spirally grooved at the middle; and the base is cancellate. In the early stage of development, the subspecies is like the species in all its characters. The cotypes are from Hônohasi. (no. 254)

Terebra (Hastula) dainichiana YOKOYAMA.

1926. *Terebra dainichiana* YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 328, pl. 38, f. 4, 5.

Shell small, acicularly subulate, axially plicate. Spire high, pointed, outline slightly convex. Whorls about 9, first rapidly then more slowly increasing in breadth, flat; periphery round, base somewhat contracted. Protoconch unknown. Surface sculptured with 24 equal continuous axial plicae. Suture deeply impressed, not undulated. Aperture subvertical, narrow, with a short broad canal below; columella rather short, but a little twisted. Height, 13·4mm.; diameter, 3·3mm.; height of the aperture, about 4mm. Type: Topotype, no. 85.

Occurrence.—Dainiti.

This small species is distinguished from *T. strigillata* LINNE, the type

of the subgenus, by the following respects : the adult shell is much smaller ; the axial plicae are not so flat and stout ; the whorls are less in number and the suture is not undulating.

Terebra (Acuminia) sp.

Occurrence.—Dainiti.

A species of *Acuminia* is represented by a single small shell with a largely fractured aperture. It has a height of about 8mm. in seven whorls, and its last whorl has a diameter of over 2mm. in perfect condition. It resembles in some respects a new species of *Acuminia* from Amami-Ôsima, but it is more slender and smaller. The surface exhibits very obscure axials.

Conidae

Conus sieboldianus n. sp. (*Plate IV, figs. 16, 17.*)

Shell rather small, straight, elongate-biconic, very broadly and angularly shouldered, not very thick. Spire conoidal, scalar, about one-third the height of the aperture, outline straight. Whorls about 8, regularly increasing, concave ; the angle of the shoulder close to the lower suture forming a supra-sutural ridge ; the surface below the angle vertical, less than a sixth of the height of a whorl ; the last large, attenuated below. Suture impressed, irregularly undulating, slightly appressed. Sculpture : the angle granulate on the early 3 post-embryonal whorls ; the concave slope of the shoulder with numerous hair-like curved radial threads, nothing but enforced incremental lines, crossed by very obscure unequal spiral lines ; the body-whorl with about 4 shallow grooves around the periphery just below the angle, and many spiral grooves on the anterior portion, increasing the widths anteriorly ; curve of incremental lines concave above the angle and slightly arched forward below. Aperture straight and narrow, with parallel lips. Height, 28mm. ; diameter, 14mm. Type : Cotype, no 401.

Occurrence.—Nitô.

This species is very closely allied to *C. sieboldii* REEVE (Conch. Icon., sp. 269.), a species living in the temperate waters of Japan, from which

it differs in that the shell is much smaller, the spire is straight and not so sharply acuminate, the supra-sutural ridges is not so elevated, the suture is appressed, and that there is shallow but distinct peripheral grooves on the body-whorl. Some of *C. sieboldii* are less elongate and approach the present species. But the spire of the living species is always acuminate and its outline is markedly concave. I have not examined the specimens of *C. rarimaculatus* SOWERBY, a living species of the China Sea, which is said to be the young of *C. sieboldii*. Judging from the figure (Proc. Zool. Soc., 1870, pl. 22, f. 4.), that species has no peripheral grooves of *C. sieboldianus*.

Conus tuberculatus YOKOYAMA.

1920. *Conus tuberculatus* YOKOYAMA, Foss. Miura Penin., p. 34, pl. 1, f. 15, 16.

Occurrence.—Dainiti.

Distribution.—Lower Musasino of Miura.

A small specimen with a height of 8mm. of this pretty species has come under examination. It has a mammillar protoconch consisting of two convex smooth volutions. The post-embryonal whorls are four; their angles are tuberculated; the slope of the shoulder is somewhat concave and has a few fine spiral lirae. The shape, the ornamentation and all the other characters show that the specimen is unquestionably identical with Prof. YOKOYAMA's species, although it is somewhat smaller than the type.

Turritidae

Turris ugaliensis n. sp. (*Plate IV, fig. 18.*)

Occurrence.—Dainiti (very rare).

This is an extinct form which partakes of the characters of *T. unedo* VALENCIENNES, *T. leucotropis* ADAMS & REEVE and *T. gendinganensis* MARTIN.* There is only a fractured body-whorl with a diameter of 19mm. In sculpture, it approaches closely *T. unedo*, which, however, differs in having a double rib on the angle and more prominent threads generally.

* K. MARTIN, Fossilien von Java, p. 32.

T. leucotropis possesses more regular spiral threads, and the interstitial striae of them are finer. It differs from *T. gendinganensis*, a Pliocene species of Java and Timor, in that the spirals are not so strong and the shoulder is not so high. Unfortunately the specimen is too much fractured to admit of any valuable description being made. It is apparently a new species and probably an extinct ancestry of *T. unedo*.

Turris kurodai n. sp. (*Plate IV, figs. 19, 20.*)

Shell rather small, rather thick, fusiform, narrow and strongly carinate, with a longish canal. Spire acute and slender, scalar, angularly turriculate, much higher than the aperture with the canal (about 4/3 times). Whorls 9, with a large raised keel at the middle, the surface above and below the keel concave; periphery of the body-whorl convex, with 3 keels which are less conspicuous than the median one; base feebly contracted and drawn out into a longish narrow cone. Suture indistinct, margined below with a keel; the uppermost of the peripheral keels first appears on the penultimate whorl close to the suture. Whole surface also ornamented with very fine numerous unequal irregularly spaced spiral threads, which appear as striation to the un-aided eye. Protoconch of 3 whorls, nucleus depressed, tilted; the second smooth, globular; the third smooth, roundly angulate at the middle; the angle developes into the median keel of the post-embryonal whorls. Aperture suboblique, narrow, almost club-shaped, being oval above with an angle, and produced below into a straight, subvertical canal, which is not long for the genus, Columella subvertical, straight, drawn out into a fine point on the left margin of the canal; inner lip spread as a narrow callus on the columella and the slightly excavate parietal wall. Height, 14·5 mm.; diameter, 4·8 mm. Type: Cotype, no. 807.

Occurrence.—Tennôyama.

The shell herewith described consists of only three specimens, which unfortunately are more or less fractured. It differs from *T. leucotropis* ADAMS, the best known living species of Japan, in its stronger carina in the middle of the whorls and in its shorter canal. *T. indica* BOLTEN also has a longer canal. The shell is much narrower than these living species.

Turris (Gemmula) cf. **granosa** (HELBLING).

1779. *Murex (Fusus) granosus* HELBLING, Abhandl. Priv. Böhm. Math., vol. 4, p. 116, pl. 2, f. 16.

1843. *Pleurotoma carinata*, REEVE, Conch. Icon. sp. 56.

1884. *Pleurotoma (Gemmula) carinata*, TRYON, Man. Conch., vol. 6, p. 173, pl. 4, f. 49.

1887. *Pleurotoma carinata*, WEINKAUFF, Syst. Conch. Cab. Mart. Chemn., vol. 4, pt. 3, p. 15, pl. 3, f. 1.

1895. *Pleurotoma* (s. s.) *carinata*, GRAY; var. *woodwardi* MARTIN, Fossilien von Java, p. 37, pl. 6, f. 91–96.

1915. *Pleurotoma* (s. s.) *carinata*, TESCH, Pal. Timor, vol. 5, p. 25, pl. 4, f. 39–45, pl. 5, f. 46, 47.

1916. *Turris (Gemmula) granosa*, MELVILL, Proc. Malac. Soc., vol. 12, p. 145.

Occurrence.—Tennôyama.

This determination applies to a single specimen in much fractured condition, which is obviously related to GRAY'S *Turris carinata*, a species distributed in the existing seas from Southern Japan to the Persian Gulf, and ascribed to HELBLING'S *Fusus granosus*. The fossil form in the Neogene rocks of Timor is said to be very variable in sculpture and in outline according to Dr. TESCH. The Japanese living examples from Kii are, however, relatively constant in characters. The fossil form of the Kakegawa series is somewhat narrower, more strongly keeled, and less conspicuously threaded than the living form of Japan.

Asthenotoma yokoyamai n. sp. (*Plate IV, figs. 21, 22.*)

Shell rather small, turriculate; spire moderately high; whorls about 8, regularly increasing, surface nearly flat, spirally sculptured. Sculpture consisting of two carinae, one at the lower quarter and the other, which is less prominent, at the upper quarter; the space between the carinae slightly excavate, with two thread-like spiral lirae. Suture bimarginate with indistinct sutural threads. Surface crossed by fine incremental striae, flexured a little above the lower carina exhibiting the anal fasciole. Protoconch of 3 volutions, conoid, a little convex, smooth. Body-whorl slightly convex, and then contracted below, sculptured by about 10 spiral cords. Aperture pyriform, occupying 3/7 the entire height, acutely angled

above, ending in a short open and very slightly recurved oblique canal; outer lip thin and sharp, broadly convex below; sinus moderately deep. Columella subvertical, folded, oblique below, ending in a sharp point; inner lip thin, spreading over the nearly straight parietal wall. Height, 13·5 mm.; diameter, 4·6 mm. Height, 9·5 mm.; diameter, 3.4 mm. Type: Cotype, no. 88.

Occurrence.—Dainiti (very common).

This species apparently resembles *Drillia quantoana* YOKOYAMA, a fossil species of the Naganuma Beds. It differs from the latter in the following respects: the shell is smaller; the whorls are nearly flat and keeled at a little above the suture and the aperture is longer. The whorls of the latter form are angulated subcentrally, and ornamented with five to six spiral threads. The species of Prof. YOKOYAMA belongs evidently to *Asthenotoma* but not to *Drillia*.

Asthenotoma subdifficilis n. sp. (*Plate IV, figs. 23, 24.*)

Shell small, turriculate; spire moderately high, spirally sculptured. Whorls 8 to 10, regularly increasing, slightly angled a little below the middle, nearly flat above, concave below. Sculpture consisting of a strong spiral keel on the submedian angle, 2 to 3 spiral unequal lirae above, and one or two threads below, the angle; incremental striae moderately distinct, equally raised, flexuous, suboblique. Protoconch bulbose, with about two smooth whorls. The keel and the subsutural thread start from the third whorl. Suture indistinct. Base contracted, encircled by about 9 fine lirae of an equal size. Aperture elongate, somewhat club-shaped, occupying a third of the entire height; outer lip concave above; canal rather short, narrowed, slightly recurved. Columella straight, pointed, turned to the left below. Height, 12 mm.; diameter, 5·4 mm. Type: Cotype, consisting of three specimens, no. 89.

Occurrence.—Dainiti.

This species is very closely related to *A. difficilis* SMITH, a species living in Kii and Kyûsyû, from which, however, it differs in the shorter aperture and in the absence of the subsutural keel. From *A. nivea*

makemonos JOUSSEAUME and *A. yokoyamai* n. sp., it is distinguished by the difference in the details of the sculpture.

Asthenotoma difficilis (SMITH).

1879. *Pleurotoma difficilis* SMITH, Proc. Zool. Soc., p. 187, pl. 19, f. 8.
1884. *Pleurotoma difficilis*, TRYON, Man. Conch., vol. 6, p. 173, pl. 32, f. 16.
1887. *Pleurotoma difficilis*, WEINKAUFF, Syst. Conch. Cab. Mart. Chemn., vol. 4, pt. 3, p. 189, pl. 37, f. 5.

Occurrence.—Dainiti.

Living.—Kii. Sikoku. Kyûsyû.

The shell is rather fusiform having an aperture about three-sevenths the height. The whorls are dwarfishly cylindrical and encircled by two threads below the submedian carinate angle. There is one more keel just below the suture. SMITH describes that the space between the two keels has two thread-like lirae. The unique fossil specimen from Dainiti shows no such spirals, but has raised flexuous regular growth-lines.

Genota lühdorfi (LISCHKE).

1874. *Pleurotoma Lühdorfi* LISCHKE, Jap. Meer. Conch., vol. 3, p. 23, pl. 1, f. 2, 3, 4. (The first description in Mal. Blatt., 1872.)
1887. *Pleurotoma (Genota) Lühdorffi*, WEINKAUFF, Syst. Conch. Cab. Mart. Chemn., vol. 4, pt. 3, p. 32, pl. 6, f. 8.
1884. *Genotia Luhdorfi*, TRYON, Man. Conch., vol. 6, p. 175, pl. 7, f. 100.
1895. *Genotia Lühdorfi*, PILSBRY, Cat. Mar. Moll. Jap., p. 16.
1926. *Genotia luedorfi*, YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 330.

Shell ovately fusiform, with nodulous keeled whorls. Spire high, conical, a little lower than the height of the aperture. Protoconch consisting of 2 volutions, nucleus rounded, smooth. Whorls 8, broad, short, regularly increasing with an expressed, rounded and beaded keel at the middle, concave above and nearly vertical below the keel; he top of each whorl is slightly appressed below the suture; the last large, long, somewhat tumid, contracted towards the base, prolonged into a twisted beak. Sculpture: the concave surface above the keel is encircled by more than 5 spiral catagenetic lirae which are almost obsolete on the last whorl; the appressed zone at the top of the whorl often makes a granulated collar; below the

keel there are three flattened costae of an equal strength separated by narrower grooves; the nodulous band on the keel is twice as broad as the costae below it, and has a spiral line at its lower portion; the base is obscurely costate; the costae are more crowded in front around the beak; the wider interspaces are occupied by a few indistinct riblets. The axials are represented by foldings parallel to the incremental lines; they are somewhat marked in crossing the collar, the carinal band and the costae; the incremental lines are fine and dense, retrocurved on the shoulder, oblique and flexuous further down. Suture deep, margined below. Aperture large, oblong, angled above, with a very short broad open truncated canal, the lower part of which has a slight turn to the right; outer lip sharp, strongly angled and with a profound sinus at the keel, then regularly forming a convex expansion below; columella straight with an oblique thickening, pointed below, slightly concave on meeting the parietal wall; inner lip thin, a little extending over the columella with a regularly curved edge.

Occurrence.—Tennôyama. Hônohasi.

Living.—Tôkyô Bay. Nagasaki.

The fossil of this species in the Kakegawa is somewhat different from the living forms. The latter has a higher spire with an excavated shoulder. The apical angle of the fossil specimen is about 40°, while that of the living from Nagasaki is a little smaller than 35°. The surface above the keel is slightly concave in the fossil.

This species has been considered as belonging to the genus *Genota* (=*Genotia* of authors, but originally *Genota*) by LISCHKE, WEINKAUFF, TRYON and PILSBRY. WEINKAUFF compared it with *Pleurotoma mitraeformis* WOOD and *P. cataphracta* BROCCHI and mentioned their close alliance. However, the former species is the type of *Genota* and the latter is the type of *Bathytoma*. At present, there can not be found any reason to put it in the group of *Bathytoma*.

There is a variety of this species to which the fossil form of Hônohasi-tunnel and some of the living examples from Nagasaki belong. It is characterized by the gemmuled spirals, the striated keel and the well-defined

spiral threads on the concave surface of the shoulder. But it is linked to the typical species with intermediate forms.

Genota junghuhni (TESCH) is much like the present form, but that species has more prominent gemmules.

Turricula subdeclivis (YOKOYAMA.)

1926. *Pleurotoma subdeclivis* YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 329, pl. 38, f. 8; p. 367, pl. 42, f. 4.

Shell subfusiform, turreted, carinate, smooth. Spire elevated, a little higher than aperture, narrowly conical. Apex globular, very small. Whorls about 10, angular, regularly increasing, concave above, slightly contracted below the carina, the carina placed nearest the lower suture on the young whorls and then rises to about the lower fifth of the whorl. Surface obscurely spirally striated; incremental lines fine, marked better than the spirals, deeply sinuated at the middle of the concave shoulder. Periphery sharply angulated by the carina, below which the last whorl is slightly swollen; base rapidly contracted, drawn out into a rather long canal. Suture impressed, linear. Aperture oval, angled above, with an elongate, slightly recurved canal. Outer lip fractured in all specimens at hand. Inner lip normal, shortly spreading over the parietal wall, with regularly rounded edge. Columella straight, narrow, slightly twisted below and ending in a point. Height, 39 mm.; diameter, 14·5 mm. Type: Cotypes, no. 308.

Occurrence.—Tennôyama. Nitô.

Distribution.—Kakegawa series of Tosa, at Kônomine.

In the general shape this shell is very much like *Turris leucotropis* ADAMS & REEVE, but the deeply incised notch is distinctly far above the carina and nearly at the middle of the concave surface. It differs from *Turricula tornata* DILLWYN, the type species of the genus, in that the whorls are more sharply carinated and the carina is placed anteriorly close to the lower suture. The species most closely related is *Turricula brugnonei* (SEGUENZA), an Italian Pliocene form, which has a narrower shell with a round keel and a longer canal. Some specimens of *T. subdeclivis* have

a more rounded periphery and might be considered as conspecific with the Italian form, if they were not so apart geographically. The genus *Turricula* herewith used is not that of KLEIN but of SCHUMACHER 1817 (*T. flammea* SCHUMACHER = *Murex tornatus* DILLWYN).

Turricula (Surcula) sobrina (YOKOYAMA).

1923. *Drillia sobrina* YOKOYAMA, Tert. Moll. Dainichi, p. 5, pl. 1, f. 1.

Occurrence.—Dainiti.

Distribution.—Kakegawa series of Tosa, at Kônomine.

This species is characterized by its peculiar sculpture closely resembling that of *Searlesia coreanica* (SMITH). I think the shell is related to some Tertiary species of Java and Timor. Unfortunately the materials are too meagre to admit of any comparison being made. It is not much different from *Pleurotoma kamakurana* PILSBRY which belongs to the subgenus *Surcula*.

Clavatula kakegawensis n. sp. (*Plate IV, fig. 5.*)

Shell fusiform, like *C. patruelis* (SMITH), but smaller, with fine cancellate sculpture. Spire turriculate, high and acute, the height being about $1\frac{1}{2}$ times that of aperture. Protoconch depressed, smooth, of two whorls; the succeeding two young whorls convex, with many fine axial threads extending from suture to suture. Whorls 9 including those in the protoconch; mature 5 angled at the middle, with a sloping concave shoulder, below vertical, slightly concave. Suture distinct, but not deep, linear, appressed. Base contracted at a little way below the round periphery, acutely conical below, ending in a sharp point. Sculpture of the same pattern as in *C. patruelis* (SMITH), but finer; axial plicae numerous, obscure, raised to a quadrate nodules on the spiral band of the angle, below which they are again obscure, appearing as a periodical strengthening of the incremental lines, but reënforced into a bead in crossing the spiral, and often bifurcate on the lower surface; the number of the nodules about 26 on the penultimate whorl. Spiral sculpture: the shoulder with many fine spiral threads of unequal strengths and their subequal interspaces much wider than themselves; a few threads on the angle of the shoulder are raised composing the

band of nodules, the breadths of which are about a fifth the height of a whorl; there is a much stronger beaded cord at a short way above the suture; the space between the nodulous band and the beaded cord has one or two threads; the base is cancellate with more than 16 spiral threads and the axial plicae are continued from the spire, both of which are more distinct than on the spire. Aperture pyriform, oblique, angled above, with a short recurved wide truncate canal below. Outer lip thin, fractured; anal sinus not well known. Columella straight, subvertical, ending in a sharp point. Inner lip narrow. Height, 8·6 mm.; diameter, 4 mm. Type: Holotype, no. 309.

Occurrence.—Tennôyama.

This species is closely allied to *C. patruelis dainichiensis* (YOKOYAMA), especially in its general outline and in its sculpture, but it is easily distinguished from that species by the finer sculpture. In the sculpture this species somewhat resembles *Pleurotoma sangiranensis* MARTIN,* a fossil species of Java, but it differs from the latter in that the shell is broader and the whorls are more angled and sculptured with beaded spirals on the lower surface.

Clavatula himea n. sp. (*Plate V, fig. 3.*)

Shell small, thick, ovate, fusiform, with a nodulous sculpture and the suture strongly marginate. Spire acute, conical, a little higher than the aperture. Whorls 8, regularly increasing, much broader than high, a little concave at the narrow shoulder, convex below it; body-whorl flatly rounded at the periphery and below it, but faintly contracted at the base. Development: the nucleus small and depressed, half immersed in the apex of the smooth globular second embryonal whorl; the third embryonal whorl, keeled at the lower third, but not axially sculptured; the fourth nepionic, sculptured with many flexuous axial plicae, extending from suture to suture, facing their concave side forward; the succeeding whorls mature. Sculpture: a strong spiral cord slightly beneath the suture; spiral band on the angle about a quarter of the height of the whorl in breadth; between the cord and band, a fine thread appears on the penultimate whorl; the suture

* Fossilien von Java, p. 295, pl. 43, f. 706.

marginate above by a nodulous thread; axial plicae are obsolete on the anal fasciole and on approaching the sutures, but strong on the angle; they are oblique, of equal sizes and equally spaced, 18 on the last whorl. The nodules of the supra-sutural spiral thread are made in crossing the plicae. Base with 12 equal spiral threads, below somewhat spaced wider, 4 of those on the neck less conspicuous. Incremental lines indistinct upon the band. Suture more or less appressed, indistinct, but well-defined by the margination. Aperture oblique, pyriform, angled above, with strongly concave inner lip, not much contracted below but gradually produced below into a short, broad and recurved canal, slightly emarginate at the base. Outer lip regularly arcuate, margin broken in the specimens at hand. Columella vertical, turned to the left below. Inner lip smooth, narrow and thin, hollowed on the columella. Height, 6·13 mm.; diameter, 2·41 mm. Type: Holotype, no. 257.

Occurrence.—Hônohasi (rare).

This strikingly ornamented small shell which is represented by the holotype only seems to be immature. It is distinguished from *C. consimilis* (SMITH), a small living relative, by its smaller, broader and less acute shell with a less granulate sculpture and by the absence of the fine spiral threads.

Clavatula patruelis dainichiensis (YOKOYAMA). (*Plate IV, figs. 14, 15.*)

1923. *Drillia dainichiensis* YOKOYAMA, Tert. Moll. Dainichi, p. 6, pl. 1, f. 2.

Occurrence.—Dainiti. Hônohasi.

This form has been precisely described excepting the apex and the base. The protoconch consists of two smooth and convex volutions and axially plicated one. The nucleus is slightly tilted and depressed. The aperture is about one-third of the entire height of the shell. The base is contracted and produced into a sharply pointed snout which is slightly turned to the left. The canal is short but wide, recurved and truncate at the base. An example of Dainiti measures 6·1 mm. in diameter and 16·5 mm. in height. The specimens of Hônohasi are smaller, one example which retains 9 whorls measures 9·6 mm. in height and 3·5 mm. in

diameter.

This form may hardly be differentiated from the species of SMITH* which has more spiral threads on the shoulder of the last whorl.

Inquisitor ? eoa n. sp. (*Plate V, figs. 1, 2.*)

Shell small, narrow, turriculate, axially costate and spirally lirate. Spire slender, acuminate, about 1½ times the aperture. Whorls 8, regularly increasing, convex, with narrow slightly concave shoulder, body-whorl flatly rounded below the angle and narrowed to a sharp point of snout, but faintly contracted at the base. Protoconch globose, of 3 smooth whorls, nucleus depressed, oblique. Suture deep, with a very slightly swollen margin below. Sculpture consisting of about 8 broadly convex nodulous subvertical axial ribs on a whorl, not extending over the depression of the shoulder, and dying out on the base, parted by rounded furrows somewhat wider than themselves, and crossed by fine numerous spiral lirae which are obscure on the shoulder. Aperture narrow, subvertical, club-shaped, produced below into a short wide canal, slightly turned to the left and backwards, lightly channeled above. Outer lip thin and sharp, broken off. The sinus is situated at the shoulder, round and moderately deep, judging from the incremental lines. Below the angle, the outer lip is lightly curved and slightly contracted anteriorly. Columella subvertical, slightly twisted to the left, ending below in a fine point. Inner lip narrow, smooth, thin but distinctly bounded on the outer margin; parietal wall lightly concave. Height, 11·3 mm.; diameter, 3·7 mm. Type: Holotype, no. 310.

Occurrence.—Tennôyama.

This small species is well distinguished by its small size, very slender spire, raised nodulous ribs and obscure spirals. The last rib of the type specimen is somewhat more swollen than the others, indicating that the shell is full-grown. *Inquisitor longispira* (SMITH), a living species of this country, has less axials and a shorter aperture.

* *Pleurotoma patruelis*, in Ann. Mag., 1875, p. 419 and in Proc. Zool. Soc., 1879, p. 188, pl. 19, f. 10.

Inquisitor pseudoprincipalis (YOKOYAMA).

1920. *Pleurotoma (Drillia) pseudoprincipalis* YOKOYAMA, Foss. Miura Penin., p. 37, pl. 1, f. 21.

1923. *Drillia pseudoprincipalis* YOKOYAMA, Tert. Moll. Dainichi, p. 5.

Occurrence.—Dainiti. Hônohasi.

Distribution.—Naganuma Beds. Upper Musasino of Yokosuka.

This species occurs very frequently in the Dainiti sands. One perfect adult specimen resembles very much those of the Naganuma Beds in dimensions with a height of 32 mm. and a diameter of 9 mm.

This species is not known living in the present seas, but a variety of this species from Kii is found in the collection of Mr. KURODA. It is a white, solid shell with 16 whorls. In general appearance and in the pattern of the sculpture, the living form closely approaches the fossil. The base, however, is not so narrowed and pointed as in the typical species, but has a strong fasciole and an opened umbilicus. Its dimensions are 48 mm by 14 mm.

Inquisitor pseudoprincipalis is closely affined to *I. bataviniana* (MARTIN) and *I. suturalis* (GRAY) both found in the Neogene rocks of Java and Timor. It differs from MARTIN'S species in the canal being shorter, and from GRAY'S species in that the suture is more appressed and has coarse spirals on the concave shoulder.

Inquisitor jeffreysii (SMITH).

1875. *Drillia jeffreysii* SMITH, Ann. Mag., p. 417.

1884. *Drillia jeffreysii*, TRYON, Man. Conch., vol. 6, p. 177.

1895. *Drillia jeffreysii*, PILSBRY, Cat. Mar. Moll. Jap., p. 18.

1895. *Drillia principalis* PILSBRY, Ibid., p. 17, pl. 2, f. 17.

1906. *Pleurotoma (Drillia) principalis*, TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 14, pl. 1, f. 2, 3.

1920. *Pleurotoma (Drillia) principalis*, YOKOYAMA, Foss. Miura Penin., p. 36, pl. 1, f. 20.

1922. *Drillia principalis*, YOKOYAMA, Foss. Up. Musashino, p. 39.

1925. *Drillia principalis*, YOKOYAMA, Jour. Coll. Sci. Univ. Tokyo, vol. 45, art. 5, p. 9.

Occurrence.—Tennôyama.

Distribution.—Sirado Beds. Naganuma Beds. Upper Musasino of Tôkyô and Tiba-ken.

Living.—Tôkyô Bay. Sagami Bay. Kii. Inland Sea.

Several examples of this species under examination are unfortunately imperfect. According to Mr. KURODA no difference can be found between SMITH'S and PILSBRY'S species. A specimen from Kii in HIRASE'S collection and named *D. jeffreysii* by Dr. PILSBRY is slightly broader than the topotype of *D. principalis*, but they are linked with all gradations of intermediate forms. *Inquisitor* HEDLEY, 1918 (type: *Pleurotoma sterrha* WATSON).

Cymatosyrinx benten (YOKOYAMA).

1920. *Pleurotoma (Drillia) benten* YOKOYAMA, Foss. Miura Penin., p. 40, pl. 1, f. 2, 3.

Shell small, polished, fusiform, rather solid. Spire acutely conical, the height about 1½ times that of aperture. Protoconch globular, of 2 convex whorls, smooth and glossy, nucleus obliquely tilted. Whorls 7 in 8 mm.; regularly increasing, anal fasciole flattened, about one-third of the height of the whorl, the lower surface lightly convex, plicated. Sculpture consisting of low, strong, rounded, oblique axial plicae, equal to their interspaces in width, 9 on the penultimate, obsolete on the anal fasciole and on the body-whorl, nearly continuous up the spire; spiral none; incremental lines indistinct. Suture deeply impressed. Body-whorl flatly rounded below the round periphery, but faintly contracted. Aperture narrow, somewhat widened and angled above, with a short open recurved constricted and truncate canal. Outer lip sharp, lower margin produced, with a blunt varicosity behind; anal sinus conspicuous. Columella subvertical; inner lip narrow, with a thin callus whose edge distinct on the outer side, narrowed and drawn out to a fine point towards the left margin of the canal. Height, 7·96 mm.; diameter, 2·05 mm.

Occurrence.—Hônohasi (rare).

Distribution.—Naganuma Beds.

The shell under examination differs little from the type of Prof. YOKOYAMA whose dimensions are somewhat larger. But it is evidently an adult specimen having a hump-like varix in some distance behind the outer lip. *C. parciplicata* (SOWERBY)* a species living in Nagasaki harbour,

* *Drillia parciplicata* SOWERBY, Ann. Mag., 1915, p. 164, pl. 10, f. 1.

is most closely related to the present species. But that species differs from the present one in that the shell is larger, the spire is more elevated and turriculate, the whorls are more convex anteriorly, the anal fasciole is more constricted, the suture is less conspicuous, being strongly appressed, the axials are narrower and larger in number and the base has spiral grooves. *Cymatosyrinx* DALL, 1889, (type : *Pleurotoma lunata* LEA).

Cymatosyrinx solicitata (SOWERBY).

1913. *Drillia solicitata* SOWERBY, Ann. Mag. p. 234, pl. 3, f. 2.

Occurrence.—Tennôyama.

Distribution.—Upper Kakegawa (abundant).

Living.—Japan (Miyagi-ken and Nagasaki-ken).

The shells of the Kakegawa series are of large sizes, compared with such rather small forms of this species as living in the sea of Northern Japan. The large specimen with perfect terminations and possessing nine whorls measures 15·4 mm in height and 5·5 mm. in diameter. Those of the living form of Northern Japan have uniform dimensions, the largest example measuring 12 mm. by 4 mm. The type of the species is rather close to the fossils in its dimensions as given by G. B. SOWERBY 14 mm. by 5·5 mm.

The spire is high, acute and turriculate. The protoconch is composed of two smooth elevated globular and tilted volutions with a depressed nucleus. The succeeding whorls are slightly convex, with concave shoulder, furnished with oblique raised subcontinuous ten axial plicae which begin on an obtuse angulation beneath the anal fasciole and extend to the suture, but not to the base, where they die out more gradually than they arose; they are parted by round hollows, which are of equal width to them. The incremental lines are oblique to the left below the angle and run over the plicae. The suture is appressed, distinct and linear. The canal of the fossil is relatively long compared with the livings. The outer lip is fractured in all specimens at hand, but judging from the incremental lines, it must has been quite the same as the typical species and has a deep anal sinus which is rather narrow at the entrance and then roundly

expanded. Sometimes this narrowing at the entrance is aided by the thickening of the inner lip upon the parietal wall. Apparently this form differs from others of the genus in being slender and in having the contracted base with the longish canal.

Cymatosyrinx praegracilis n. sp. (*Plate V, fig. 5.*)

Shell slender with very high spire, thick. Spire narrow, acute, twice as high as the aperture. Protoconch bulbiform, of 2 volutions smooth and glossy, the nucleus slightly oblique. The subsequent whorls 6, regularly slowly increasing, a little convex; anal fasciole immediately in front of the suture, slightly constricted, nearly a quarter of the height of the whorl; base abruptly contracted, produced into a short acutely conical snout. Suture appressed, distinct. Sculpture of 10 oblique round strong axial ribs, a little narrower than the concave interspaces, continuous from whorl to whorl but not extending in the anal fasciole and vanishing towards the base. Aperture narrow, oblique, narrowed anteriorly and passing into a short, broad and slightly twisted canal. Outer lip slightly thickened, contracted towards the base, with a shallow rounded anal sinus above. Columella oblique, straight, lightly excavated on meeting the short parietal wall. Inner lip narrow, smooth, very thin. Height, 9·8 mm.; diameter, 3 mm.; height of the spire, 6·5 mm. Type: Holotype, no. 264.

Occurrence.—Hônohasi (very rare).

This species is easily distinguished from the preceding two species by its slender shell and the prominent axials.

Etrema saigoensis n. sp. (*Plate V, fig. 4.*)

Shell small, elongate, turreted, comparatively thick, bicarinate, with axial ribs. Spire elevated, narrow and acuminate, about twice the height of the aperture. Protoconch of three smooth volutions, with a globular and obliquely tilted nucleus, the later half of the whorls sharply carinate at the lower surface. Whorls 8 including the protoconch, angled, constricted at the suture, regularly increasing; the last round, contracted at the base. Sculpture consisting of 2 spiral threads, each of which lies upon the two carinae, one at the middle and the other below that. The

upper carina makes a sloping shoulder, and ascends somewhat from the middle on the later whorls. There are an inconspicuous intermediate thread between the two others on the last two whorls. The surface between the two carinae is vertical and slightly excavate. The axial ribs 10 to 14 on the last whorl, vertical, round, not extending to the suture, overridden by the spirals. Base with about 9 inconspicuous spiral threads. Incremental lines indistinct. Suture impressed. Aperture pyriform, angled above, narrowed below into a short, wide canal. Outer lip thickened with a varix, obscurely denticulate within; sinus with a pair of tubercles at the entrance, round, effuse. Columella vertical, turned to the left below, ending in a point. Inner lip not thick, spreading narrowly over the concave parietal wall; its margin free. Canal short, widened at the base. Height, 6·84 mm.; diameter, 2·53 mm. Type: Cotype, no. 261.

Occurrence.—Hônohasi.

This unique species found in the temperate fauna is not so solid as the tropical species of the same genus.

Mangilia kurodai n. sp. (*Plate V, fig. 13.*)

Shell small, elongate, turreted, thin, with spiral cords. Spire elevated, narrow acute, about 1½ times the height of the aperture. Protoconch tilted, of 2½ smooth convex whorls with deep suture. Whorls 6, slightly convex, regularly increasing, contracted at base; periphery round. Sculpture consisting of prominent spiral cords, 2 on the first whorl next to the protoconch, the upper one lying at the middle and stronger than the other, making an obtuse angle. On the fourth whorl, there appears an intermediate cord; all three cords are in equal strength on the penultimate whorl; body-whorl has a strong peripheral cord, a faint thread at the middle of the supra-sutural interspace, and 7 or more, less prominent basal spirals which are vanished below around the short snout. The axials are nearly obsolete, they are represented by very low foldings with subequal periodicity on the later whorls. Sinus area remaining smooth except for the incremental lines. Incremental lines hair-like, oblique and straight on the lower half of the whorls. Suture inconspicuous, linear,

margined above with a fine thread which is continued to the peripheral cord of the body-whorl. Aperture pear-shaped, oblique, broadly angled above, produced below into a short oblique canal, its base slightly notched. Outer lip thin and sharp, with a shallow sinus near the suture, smooth inside. Columella somewhat arcuate, turned to the left below. Inner lip thin and narrow, simple. Height, 5·26 mm.; diameter, 1·62 mm. Type: Holotype, no. 94.

Occurrence.—Dainiti.

This determination applies to a single specimen of which no allied form can be found among the described living species. The general feature reminds us of the genus *Mangilia* defined by Dr. DALL.

Lora crosio n. sp. (*Plate V, fig. 7.*)

Shell ovately fusiform, angulated, rather thick, cancellated. Spire scalar, conoidal, somewhat higher than the aperture. Protoconch of 2 smooth whorls, eroded. Whorls 6 including the nucleus, with a sloping shoulder and a sharp carinated angle, vertical below the angle, the height of the shoulder about one-third that of the whorl; anal fasciole extending from the suture to the angle; base convexely contracted to a short snout. Suture deep. Sculpture: anal fasciole spirally striate, a fine thread in the upper portion, crossed by antecurrent, hair-like, closely-set, incremental lines; axial sculpture consisting of 13 plicate riblets, obscure on the shoulder, tuberculate at the angle, vanished at the snout of the body-whorl; spirals in front of the angle consisting of unequal cords, 6 on the penultimate whorl, that in the middle of the whorl is the strongest, the anterior two being the next in magnitude, running over the axials, nodulous at the intersections; base with many somewhat alternating cords. Aperture simple. Canal very short, twisted, defining a distinct fasciole. Columella oblique, arched. Height, 8·2 mm.; diameter, 3·8 mm.; height of the aperture, 4 mm. Type: Holotype, no. 311.

Occurrence.—Tennôyama.

A single specimen is under examination. This species of the boreal genus is of a rare occurrence in the fauna of the temperate water. It is

distinguished from the other species described from Japan by its rough unequal sculpture resembling that of *Mangilia*.

Cytharella hiradoensis n. sp. (*Plate V, fig. 12.*)

Shell small, ovately fusiform, thick, white, turricurate, distinctly axially costate. Spire conic, scalar, of the same height of the aperture. Protoconch of 3 whorls, smooth and convex, the nucleus flattened. Whorls 6, low and broad, regularly increasing, distinctly shouldered, the shoulder sloping, convex, meeting a flatly round and somewhat contracted lower surface in an oblique but distinct angle, which lies at about one-third down the whorl; the last slightly convex, attenuate but scarecely constricted below at the base. Suture deep, impressed, more or less undulated. Sculpture consisting of straight, narrowly round-topped, discontinuous prominent axial costae, 9 to 10 on the last whorl, evanescent at the snout, diminishing in a backward curve to the suture, interspaces broadly concave; spiral none, but about 6 lirae on the snout of the base. Color white, with 2 orange-brown intercostal bands, one being subsutural and the other on the surface below the angle, the base with a narrower band. Aperture oblique, very narrow, rounded above, slightly narrowed and drawn out to a short canal below, its base truncated. Outer lip thickened by the last rib, inflexed, with a deep round sinus below the suture. Columella straight, oblique, slightly arcuate on meeting the short parietal wall. Inner lip narrow, smooth, its free margin somewhat thickened. Height, 5·9 mm.; diameter, 2·2 mm. Type; Holotype, in Mr. KURODA's collection, living at Hirado.

Occurrence.—Dainiti.

Living.—Hirado.

The fossil example is an immature shell 4·6 mm. high. This species somewhat resembles *Pleurotoma (Drillia) tabatensis* TOKUNAGA,* a fossil from the Pleistocene estuary clay of Tabata near Tôkyô. It differs, however, from that species in the shell being larger, and the costae being more elevated and more in number. *C. hiradoensis* resembles *Mangilia*

* Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 15.

flavescens ANGAS,* an Australian species of the genus *Guraleus*,** but has no spirals. Some Philippine species hitherto known as *Mangilia* or *Cithara* are related to this Japanese species.

Cytharella totomiensis n. sp. (*Plate V, fig. 6.*)

Shell small, elongate-fusiform, turriculate, with prominent axial ribs. Spire elevated, conic, gradate, about 1½ times the height of the aperture. Protoconch of 4 convex volutions, conical, symmetrical, apex round, first two volutions smooth, the succeedings sculptured by numerous, equally spaced, curved, fine, oblique cords, facing their concave sides forward. The adult whorls 4, regularly and more slowly increasing than the embryonics, convex, constricted at the suture. Sculpture: axial ribs suboblique, distant, round, low, not extending to the sutures, swelling in the middle, discontinuous from suture to suture, degenerate on the later whorls and vanishing to the base, 8 on the penultimate; spirals consisting of prominent threads, running over the ribs and projecting at the intersections, 2 on the spire-whorls, the upper lying beneath the anal fasciole about one-third down the whorl, there are one or two less-prominent threads on the fasciole; the whole surface are covered by numerous very fine, spiral lirae which are punctated in crossing the close, microscopic, incremental lines. Body-whorl gently convex, somewhat contracted at the base; the base sculptured by about 11 spiral equal cords similar to those on the spire-whorls; the anterior 5 on the produced snout are close together. Suture well marked, but lightly appressed. Aperture subvertical, about 3/7 the entire height, narrow, angled above, produced below into a short, deep, straight canal. Outer lip fractured. Columella vertical, slightly turned to the left in front and ending in a sharp point. Height, 7·45 mm.; diameter, 2·3 mm. Type: Holotype, no. 95.

Occurrence.—Dainiti.

Cytharella totomiensis tachymorpha n. subsp. (*Plate V, fig. 10.*)

Type: Cotype, no. 262.

* Proc. Zool. Soc., 1877, p. 37.

** HEDLEY, A Review of the Australian Turridae, Rec. Aust. Mus., vol. 13, p. 315.

Occurrence.—Hônohasi (rare).

It is not known whether this subspecies is a local variety or a mutation. It is distinguished from the species by the small shell with rapidly increasing whorls. The protoconch comprises three and half volutions of which the last is sculptured by the oblique threads. The adult shell retains three and half subsequent whorls. The entire height of the shell is 5·43 mm. and the diameter is 2·2 mm. in the type. The type specimen of the species is much higher but is still immature not having a variced lip which is well marked in the specimens of the subspecies. The aperture is higher than in the species. The varix is larger than the ribs and its labial margin extends a thin broad expanse. The anal sinus is a deep, round, subsutural excavation where the outer lip is effuse and slightly reflected over the varix. The inner lip is thickened and continued above with the outer lip of the sinus. A broad, short, recurved canal is present. The fasciole is not differentiated. The interior surface is marked with microscopic, transverse striae all over. Although the aperture is not plicated, this species may be referred to HEDLEY'S genus *Etrema*. HEDLEY has pointed out that his "*Guraleus* is perhaps a development in temperate seas of a tropical citharoid stock in which less favourable growth conditions have effected structural economies, by reduction of the varix, the teeth within the aperture, and the granular microscopic sculpture and by a looser winding of the whorls." Similar reduction may takes place in the North Pacific region. *Cytharella hiradoensis* n. sp. seems to me to be not much different from *Guraleus* which is, however, restricted to the southern hemisphere. *Cytharella totomiensis* n. sp. in comparison with the latter species is a less reduced subtropical shell having the large varix and frosted appearance of the microscopic sculpture. The high spire, the contracted base produced below into a narrow snout, the sculpture, the sinus, and the lips strongly remind us the close relation to *Etrema*, some species of which live in Southern Japan. I think that the presence of the plicae within the aperture has been overvalued in classification.

Etremella may be distinguished as a new section of *Cytharella*,

with *Cytharella totomiensis* as the type.

Macteola (Kurtziella) ugali n. sp. (*Plate V, fig. 9.*)

Shell small, thin, fusiform, axially costate and spirally lirate. Spire conical, scalar, slightly higher than the aperture. Protoconch conic, of 3 convex volutions, the apical 1½ smooth, the succeedings with many oblique, regularly spaced, fine axials which gradually merge into those of the adult type. Whorls 7½, the upper ones convex, the lower ones obscurely angled with a narrow sloping shoulder, convex below it, base contracted. Suture deeply impressed, not appressed, undulating, margined below with a thread. Sculpture consisting of axial equidistant straight suboblique round riblets, 10 on the last whorl, broader than elevation, extending from suture to suture, but not continuous over the whorls, persisting faintly down to the base, constricted in front of the suture, over-ridden by spirals, interstices of about the same width as, or slightly narrower than, the riblets; spirals consisting of 4 subequal threads of which the second from the top is the most prominent, the crossing points produced into small beads; the rest of the surface covered by smaller uniform threads with about equal interspaces, and given a frosty appearanc by fine sharp close-set incremental lines. Aperture oblong, angled above, narrowed below and ending in a short oblique rather wide canal, truncated at its base; outer lip thin, anal fasciole feebly indicated; columella vertical, slightly turned to the left and pointed below; inner lip narrow and thin. Height, 6·56 mm.; diameter, 2·9 mm. Type: Holotype, no. 96.

Occurrence.—Dainiti (rare).

This species appears at first sight to be *Lora* (=*Bela*), but the small mucronate apex, the development of the sculpture and the frosty surface have not been observed in that genus. These peculiarities rather remind us of *Kurtziella* DALL* which is close to *Macteola* HEDLEY.

Macteola (Kurtziella) ugali hobasiensis n. subsp. (*Plate V, fig. 8.*)

Type: Holotype, no. 263.

* Proc. U. S. Nat. Mus., vol. 56, p. 64, 1910.

Occurrence.—Hônohasi.

This is a variety of the preceding species found in the upper horizon. It differs from the species in that the shell is smaller, the spirals are finer and faint, being hardly observable without an aid of the microscope, and the axials are also somewhat less prominent than in the species, and vanish at the base. The suture is slightly appressed but not margined. Height, 4·61 mm.; diameter, 2·04 mm.

Mitridae

Strigatella dainitiensis n. sp. (*Plate V, figs. 15, 16.*)

Shell fusiform, rather solid, smooth. Spire elevated, acutely conic, a little higher than the aperture. Protoconch unknown. Whorls about 7, smooth, flattish; suture superficial, uneven; base slightly contracted. Aperture subvertical, high and narrow, angular above, truncated at the base; outer lip vertical, almost parallel with columella, rounded below, with a smooth thickened edge; columella subvertical, with 4 oblique plaits decreasing in size and space from above; inner lip narrow, sharply defined, spreading over the slightly concave parietal wall. Height, 24 mm.; diameter, 9·7 mm. Type: Holotype, no. 72.

Occurrence.—Dainiti.

This species is based upon a single badly preserved specimen, but it is easily distinguished from the living species of the genus in having the flattish whorls parted by very superficial sutures. It is distinguished from *S. scutulata* (GMELIN) which is known living in South-western Japan by that the shell is narrower with a less acuminate spire and the base has no spiral groove.

Buccinidae

Cantharus totomiensis n. sp. (*Plate V, figs. 21, 22.*)

Shell ovately fusiform, moderately thick, spirally threaded and axially broadly costate. Spire conical, turreted, gradate, a little lower than the aperture with canal. Whorls 6 to 7, first regularly slowly, then rather rapidly, increasing, sharply angled at the middle, with a concave sloping shoulder, lightly convex below it; base weakly contracted. Sculpture:

the axial costae of the early 3 whorls next to the protoconch 8 to 9 in number, broadly rounded, elevated, discontinuous; further down they are almost obsolete, but produced into prominent conical tubercles upon the angle; number of the tubercles on the last two whorls are 6 to 7; spirals on the shoulder regularly alternating, crossing over the axials, about 7 pairs of strong and weak threads on the penultimate whorl; spirals on the vertical surface below the angle very unequal and irregularly forming fascicules separated by grooves. Suture impressed, undulating. Aperture suboblique, oblongly ovate, with an oblique, widely open, slightly recurved canal below. Outer lip thick, arcuate, denticulate within. Columella vertical, concave, spirally ridged below at the left margin of the canal. Inner lip narrow, spreading over the concave parietal wall, partly filling the depression of the fasciole. Height, 39 mm.; diameter, 22 mm.; height of the aperture with canal, 24 mm.

Type: Holotype, no. 236, Hônohasi.

Occurrence.—Dainiti. Hônohasi.

This peculiar species characterized by its sharply angled shoulder with strong tubercles, is easily distinguished from all the living forms in Japan. In the early developmental stage it appears to be allied to *C. cecillei* PHILIPPI, but the last whorl of the latter is roundly convex, and has no tubercled costae. In *C. totomiensis*, the base is a little contracted and the canal is shorter, open and nearly straight.

Cantharus totomiensis balani n. subsp. (*Plate V, figs. 19, 20.*)

Type: Holotype, no. 243.

Occurrence.—Hônohasi.

Only one specimen of this subspecies has so far been found. Further collections might decide whether it should remain as a subspecies or be elevated to the rank of the species. It differs from the species in the following respects: the whorls are not sharply angled but roundly shouldered; the last two whorls are not tuberculate but axially roundly costate; the costae extend from suture to suture and down to the base; and the spirals are stronger.

The spire-whorls are ornamented with seven regular spiral cords of

unequal strengths, the fifth and the sixth counted from the top, being stronger than the others. The interspaces are usually occupied by a fine thread. The spirals of the base are irregularly fasciculed, each fascicule having one major median and several smaller riblets; the interspaces are unequal, narrow and deep. The type specimen has nine such fascicules.

This form resembles somewhat *C. cecillei* in general contour and in sculpture, but it differs from the latter in that the suture is not so deep; the spirals are stronger but less elevated and the outer lip is broadly arcuate, being neither straightened nor recurved below. The height is 38 mm. and the diameter is 21 mm.

Latrunculus elatus (YOKOYAMA).

1923. *Eburna elata* YOKOYAMA, Tert. Moll. Dainichi p. 9, pl. 1, f. 16, 17.

Occurrence.—Dainiti (abundant). Hônohasi (abundant). Iwasibara. Saigô-bridge. Tennô-shrine. Tennôyama. Taruki. Nitô.

Distribution.—Kakegawa series of Tosa. Upper Kakegawa. Sandstone of Tanabe.

The whorls are tabulate beneath the suture. The table is less prominent, flat and sloping in early stages of development, and then it becomes more sharply defined and shallowly channeled. *L. japonicus* has many points of close resemblance to the present species, from which, however, it is distinguished by its rounded indistinct shoulder. Apparently *L. elatus* resembles *L. canaliculatus* (SCHUMACHER) and *L. lutosus* (LAMARCK), which live in the tropical regions of the Pacific, in their general contours and in their conspicuous tabulated shoulders. The latter two forms, however, differ in their large umbilicus with strongly plicated and flexured broad fascioles which are defined by a projecting spiral rib running in a shallow channel. The umbilical part of *L. japonicus* is much smaller than those of the preceding two species and has a smooth fasciole and a less prominent spiral bounding rib. In this respect, *L. elatus* stands between those two species and the Japanese species, somewhat nearer to the latter. The umbilicus is not always perforate but often covered with an expanded callus.

Siphonalia dainitiensis n. sp. (*Plate V, fig. 11.*)

Shell not large, obesely fusiform, roundly shouldered, rather solid. Spire acutely conical, a little lower than the height of the aperture including canal, outline lightly convex. Protoconch unknown. Whorls 6, excepting the protoconch, sculptured with 12 to 13 subvertical axial round ribs, separated by excavate broader interspaces and crossed by unequal equidistant spiral cords, strong ones alternating with much narrower and lower lirae. The surface of shoulder whose angle lies at a little above the middle is slightly excavate. Base rapidly contracted, obscurely plicate, plicae growing into the prominent ribs on the shoulder of the body-whorl. Suture impressed, undulating. Aperture oblique, large, pyriform, angled above, produced below into a short canal. Height, 27 mm.; diameter, 14 mm.; height of the aperture, 16 mm. Type: Holotype, no. 61, Dainiti.

Occurrence.—Dainiti. Hônohasi.

This species resembles somewhat *S. vanattai* PILSBRY in the general contour; but it differs from the latter in that the spire is higher; the shoulder is not so angular on the last two whorls; the ribs are more prominent; the spiral cords are narrower; and that the canal is not so strongly recurved. The general feature of *S. dainitiensis* reminds us of the early whorls of *S. vanattai*, *S. cassidariaeformis* (REEVE), *S. spadicea* REEVE and some other Japanese species. In *S. vanattai* the early two to three whorls next to the protoconch have the round angle and widely spaced spiral cords and increase slowly in width. These characters, appearing in the young shells, must have been ancestral ones. The same characters are retained in the adult of *S. dainitiensis*.

Siphonalia cassidariaeformis declivis (YOKOYAMA).

1923. *Siphonalia cassidariaeformis*, YOKOYAMA, Tert. Moll. Dainichi, p. 9, pl. 1, f. 13—15.
1926. *Siphonalia declivis* YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 337, pl. 38, f. 19—21.

Occurrence.—Dainiti (abundant). Hônohasi (abundant).
Tennô-shrine. Tennôyama.

Siphonalia cassidariaeformis (REEVE) is a very variable species. According to LISCHKE *S. ornata* (A. ADAMS) is synonymous with this species, although DUNKER thought it to be a different species having colour lines similar to those in *S. signum* (REEVE). Typical *S. cassidariaeformis* which lives in the water of North Kyûsyû is a large shell ornamented with rather prominent spiral cords. Dimensions of six examples are as follows :

Height.	46	53	51	45	53	47 mm.
Diameter.	30	30	32·5	28	31·5	28 mm.

The fossils of this form were discovered in the Kimizu Beds by Mr. UEZI together with a smaller form which is assigned to var. *ornata*.

The latter form is much more variable in contour and in coloration. The following ten are the typical examples of this variety living in Kii :

Height.	32·3	30·4	33·9	29·6	35·5	31·9	34·7	30	33·2	46 mm.
Diameter.	18 8	28	19·3	19·5	20·3	17·5	18·4	17·5	18·5	22 mm.

The sculpture, however, is constant consisting invariably of many irregular spiral grooves. Some larger individuals are hardly be differentiated from the typical species.

The present subspecies differs from the species chiefly in that the spiral sculpture consists of finer threads with wide interspaces. The threads are more closely set upon the surface above the periphery than on the base. The interspaces are spirally striated in most of the specimens.

There are two races, one of Hônohasi and the other of Dainiti. The Hônohasi race differs from the species in that the spire is not so scalar but conical with a long, flattish, sloping shoulder, and that the angle lies lower, close to the suture.

The Dainiti race differs little in shape from the above, but has a slightly excavate shoulder which is rather rarely met with in the species. A specimen of the Hônohasi race measures 37 mm. by 23 mm. and the Dainiti 33 mm. by 21 mm.

Siphonalia mikado MELVILL. (*Plate VI, fig. 1, 2.*)

1888. *Siphonalia mikado* MELVILL, Jour. Conch., vol. 5, p. 348.

1895. *Siphonalia hyperodon* PILSBRY, Cat. Mar. Moll. Jap., p. 30, pl. 2, f. 6.

1905. *Siphonalia mikado*, PILSBRY, Proc. Acad. Nat. Sci. Phila., p. 103.

Occurrence.—Tennôyama.

Living.—Kii and Sagami

This determination applies to a well preserved example of this species measuring 44 mm. by 28 mm. although its apical regions are imperfect.

This species is easily distinguished from other forms by the unique character observed by Dr. PILSBRY that the strong nodule within the inner lip near the posterior angle defines a channel there. It is also peculiar to have a siphonal fasciole marked above with a free laminar edge. The fossil example differs from the species in that the shell is wider and lower; the dimensions given by Dr. PILSBRY are 51 mm. by 26 mm. and 43 mm. by 21 mm. Mr. KURODA has kindly shown me a small intermediate form measuring 32 mm. by 18 mm. Naturally, the broad fossil form has more angular whorls with a nearly horizontal shoulder. The spiral cords are strong in the most of the living examples, but those of the fossil are very inconspicuous.

Siphonalia stearnsii PILSBRY.

1895. *Siphonalia Stearnsii* PILSBRY, Cat. Mar. Moll. Jap., p 29.
1908. *Siphonalia mikado* var., HIRASE, Conch. Mag., vol. 2, no. 2, p. 4, pl. 23, f. 6.

Occurrence.—Tennôyama.

Living.—Sagami to Sikoku.

A specimen under examination agrees very well with the topotype of PILSBRY'S species in Mr. KURODA'S collection. *Siphonalia mikado* var. of HIRASE is a local variety of this species living in Tosa.

Kellettia kellettii (FORBES).

1850. *Fusus kellettii* FORBES, Proc. Zool. Soc., p. 274, pl. 9, f. 10.
1869. *Siphonalia kellettii*, LISCHKE, Jap. Meer. Conch., vol. 1, p. 38, pl. 3, f. 3, 4.
1871. *Siphonalia Kellettii*, LISCHKE, Ibid., vol. 2, p. 28.
1881. *Siphonalia Kellettii*, TRYON, Man. Conch. vol. 3, p. 134, pl. 54, f. 352.
1895. *Siphonalia (Kellettia) kelleti*, PILSBRY, Cat. Mar. Moll. Jap., p. 30.
1901. *Kelletia kelleti*, COSSMANN, Paleoconch. Comp., vol. 4, p. 109, pl. 7, f. 14, 15.
1921. *Kellettia kellettii*, DALL, Mar. Moll. N. W. America, U. S. Nat. Mus. Bull. 112, p. 89.
1922. *Siphonalia kellettii*, YOKOYAMA, Foss. Up. Musashino, p. 56, pl. 5, f. 1.

Occurrence.—Dainiti,

Distribution.—Upper Musasino at Sitô.

Living.—Tôkyô Bay to Nagasaki. California and Lower California.

This unique species has been well figured and described by LISCHKE and COSSMANN, and no doubt can exist with regard to the identity of the specimen from Dainiti, which consists of only the spire missing the last whorl, with those described from the existing seas of Japan.

Microfusus magnificus (LISCHKE).

1871. *Nassaria magnifica* LISCHKE, Jap. Meer. Conch., vol. 2, p. 38.
1881. *Nassaria magnifica*, TRYON, Man. Conch., vol. 3, p. 222, pl. 84, f. 551.
1882. *Nassaria magnifica*, DUNKER, Index Moll. Mar. Jap., p. 38.
1893. *Nassaria magnifica*, PILSBRY, Cat. Mar. Moll. Jap., p. 34.

Occurrence.—Tennôyama. Tennô-shrine. Nitô.

Distribution.—Upper Kakegawa. Kakegawa series of Tosa. Musasino series of Bôsô Peninsula.

Living.—Sagami. Kii. Kyûsyû.

This species is very variable. Some fossil forms of the Kakegawa series may be mutations or geographical varieties of this species. The typical form of the species is a fine shell ornamented with about ten axial ribs with two to three series of tubercles and obscure spiral cords. But this is a catagenetic form, because the young whorls have distinct spirals. In a variety living in Kii, the spirals are stronger in adult. This latter variety is found in the Lower Musasino of Bôsô Peninsula at Sanuki and in the sands of Tennôyama accompanied with two other varieties, one sculptured with narrower but more elevated spirals and the other having the prominent tubercles which are sharply keeled at their tops by crossing cords.

The Upper Kakegawa form differs from the preceding forms being akin to *M. lischkei.* The shell is ovately fusiform, being broader and shorter in proportion as compared with the typical form. The spire is less turreted and not so scalar; the whorls are round and ornamented with regularly alternating spirals. The tubercles are less prominent than the others. It is smaller on the average, the largest specimen having a height of 31 mm. and a diameter of 15 mm.

This species differs very much from *Buccinum nivea* GMELIN the type of *Hindsia* which had been incorrectly called *Nassaria*. It is a more turreted shell with a rather long twisted canal and its inner lip is very thin and narrow with a tooth close to the posterior end. In the general feature, it is more closely allied to *Siphonalia*.

Microfusus was proposed by Dr. DALL as a subgenus of his *Plicifusus* for *Chrysodomus acutispiratus* SOWERBY. *Sipho obesiformis* YOKOYAMA in the Musasino series is nothing but a variety of the latter species having catagenetic spirals. The protoconch and the nepionic as well as a few young whorls are common to *Nassaria magnifica*, *Sipho obesiformis* and *Chrysodomus acutispiratus*. Mr. KURODA has informed me that after examining hundreds of specimens he came to the conclusion that these species belong to one and the same genus different from either *Hindsia* or *Plicifusus*.

Microfusus lischkei n. n. named by Mr. T. KURODA.

1874. *Nassaria magnifica* var. LISCHKE, Jap. Meer. Conch., vol. 3, pl. 4, f. 11, 12.
1881. *Nassaria magnifica*, TRYON, Man. Conch., vol. 3, p. 222, pl. 84, f. 552.

Occurrence.—Tennôyama.

Living.—Sagami.

A small partly broken specimen from the Tennô sands differs from the preceding species in having 16 or more nontubercled axial ribs and more rounded whorls. A more precise observation will be made on living specimens by Mr. KURODA.

Nassariidae

Nassarius (Hinia) kurodai n. sp. (*Plate VI, figs. 3, 4.*)

Shell ovate, acuminated, solid, cancellated and granulated. Spire subturreted, a little higher than the aperture, outline lightly convex. Protoconch of 4 smooth, convex whorls, turreted, slowly increasing. Whorls 5, very slightly convex, sculptured with 4½ granose spiral belts, separated by narrower sulcae, the grains oblongly rectangular, disposed in suboblique axial rows, the rows 25 in number on the penultimate whorl, their interspaces wider than themselves; the subsutural belt with a

wide excavate groove in front. Body-whorl convex, contracted below, with 10 to 11 spiral belts. Suture distinctly canaliculate. Fasciole defined with a spiral deep groove, with two or more indistinct grooves upon the surface. Aperture ovate, suboblique, slightly channeled above and with a short broad reflected and deeply notched canal below. Outer lip convex, thick, denticulate within. Columella short and concave, obliquely truncate below, with a distinct basal fold; parietal wall with a tooth above. Inner lip tubercled, thick, with free margin. Height, 18·3 mm.; diameter, 10·4 mm. Type, Holotype, no. 57.

Occurrence,—Dainiti.

In the general aspect and the sculpture this species resembles somewhat *N. ranidus* (ADAMS) a living species of Southern Japan and the Philippines. Their differences are as follows:

N. ranidus: Spiral belts 6, axials 35, grains elongately squarish, callus thin and spreading, fasciole small.

N. kurodai: Spirals 4½, axials 25, grains oblongly rectangular, callus thick and its margin free, fasciole large.

Nassarius (Hinia) caelatus dainitiensis n. subsp. (*Plate V, figs. 17, 18.*)

Occurrence.—Dainiti.

Distribution.—Kakegawa series of Tosa.

Probably this subspecies is the ancester of *Nassarius caelatus* (A. ADAMS), a living species of Southern Japan and the Philippines. It differs from the species in having distinctly canaliculate suture. *N. euglyptus* (SOWERBY) and *N. verbeeki* (MARTIN) are the allied species. The chief differences are as follows:

N. euglyptus: Spirals consisting of lirae passing over the axial ribs forming gemmules; suture not canaliculate.

N. verbeeki: Spirals consisting of obscure sulcae, punctate by the axial ribs; suture subcanaliculate.

N. caelatus: Spirals consisting of distinct sulcae running over the axial ribs; suture subcanaliculate or not canaliculate.

N. caelatus dainitiensis: Sculpture like the species; suture canali-

culate.

The dimensions of an example of the subspecies are 20·3 mm. in height and 10 mm. in diameter. The shell named *Nassa livescens* by Prof. YOKOYAMA in his Foss. Miura Penin., p. 6 seems to me to be not PHILIPPI'S species, but a variety of *N. caelatus*.

Nassarius (Caesia) demissus (YOKOYAMA).

1923. *Nassa (Hima) demissa* YOKOYAMA, Tert. Moll. Dainichi, p. 10, pl. 2, f. 8, 9.

Occurrence.—Dainiti. Hônohasi.

This species is rather frequently found in the Dainiti sands. The shell is narrow, elevated and rather thin. In the full-grown whorls, the catagenesis of the axial sculpture takes place. The convex whorls become subcylindrical at the fifth whorl. The Hônohasi form is in general smaller and its development is more accelerated than the Dainiti form. In some thin examples the spirals begin from the second whorl of the protoconch, while the axials become obscure early from the nepionic whorl. In any case, the spirals are constant. The upper two to three cords are narrower and separated by wider interspaces. As a rule the lower cords are wider than the above ones.

Nassarius sp.

Shell small, narrowly ovate, acuminate. Spire about 2½ times the height of the aperture. Protoconch unknown. The remained whorls 5, sculptured with 11 to 12 axial round ribs with wider interspaces, crossed by equally spaced, 4 spiral striae, of which the uppermost almost obsolete. Suture impressed, undulating. Body-whorl convex, contracted around the fasciole, base with 2 spiral cords in the middle. Aperture round, lightly angled above with very short reflected and deeply notched canal. Outer lip thickened with a marginal varix, with 3 teeth inside on its lower half. Inner lip rather thin, more or less free, with callosity spreading over the parietal wall and extending some distance beyond the aperture. Height, 7 4 mm.; diameter, 4·2 mm.

Occurrence.—Dainiti.

This form is apparently new to science. Unfortunately the only one

specimen at hand is largely fractured.

Pyrenidae

Mitrella varians (DUNKER).

1861. *Amycla varians* DUNKER, Moll. Jap., p. 6, pl. 1, f. 17.
1883. *Columbella (Mitrella) Dunkeri*, TRYON, Man. Conch., vol. 5, p. 129, pl. 49, f. 15.
1920. *Columbella (Mitrella) dunkeri*, YOKOYAMA, Foss. Miura Penin., p. 59, pl. 3, f. 7.
1922. *Columbella (Mitrella) dunkeri*, YOKOYAMA, Foss. Up. Musashino, p. 62, pl. 2, f. 26.
1923. *Columbella (Astyris) Dunkeri*, MAKIYAMA, Jap. Jour. Geol. Geogr., vol. 2, p. 21.

Occurrence.—Dainiti. Hônohasi. Tennôyama.

Distribution.—Upper Musasino. Pliocene of Maiko.

Living.—Japan.

This variable well-known species is not rare in the rocks of the Kakegawa, but most of the specimens are small and immature. Prof. YOKOYAMA'S two species of *Atilia*,—*A. masakadoi* and *A. praecursor* are perhaps nothing but the varieties of this species, the many living forms before me resembling these two species, may be linked with the present species. The fluctuation is extraordinarily large in this species.

This species is very close to *Mitrella scripta* (LINNE), the type of the genus. Some slender and thick individuals differ from the latter only in its colour being darker.

Zafra yokoyamai n. sp. (*Plate V, fig. 14.*)

Shell minute, rather thin, slender, ovate-fusiform, axially ribbed. Spire elevated, conical, scalar. Whorls 7, subcylindrical, flatly convex, narrowly shouldered at the top. Protoconch blunt, round, dome-shaped, polished, the tip being immersed and flattened down. Body-whorl slightly inflated; base contracted above the neck of the canal. Sculpture: first 4 whorls smooth and glossy, remainder axially ribbed, the ribs prominent, straight, as broad as their interspaces, amounting to 17 on the penultimate, at the periphery they become feeble and obsolete on the base; incremental lines extremely fine and ill-defined. Beneath the suture, along all the sculptured whorls, winds a cord less prominent than the ribs, uniting nd overriding them which rise into small beads; in the axial interspaces a

faint tendency to spiral scratches is visible. On the neck of the base are four very feeble spiral threads. Suture deeply impressed and well marked by the projection of the shoulder below it. Aperture oblique, narrow, a little shorter than the height of the spire, angulated above, obliquely prolonged below into a short open, slightly recurved canal. Outer lip fractured. Columella straight above, forming a blunt angle with the parietal wall, bent to the left below. Inner lip narrow and thin. Height, 3·09mm.; diameter, 1·32mm. Type: Holotype, no. 70.

Occurrence.—Dainiti.

The interior surface of the shell is sculptured with numerous microscopic irregular spiral striae. These striae can not be observed in the living specimens of *Zafra*.

This species resembles rather closely *Zafra pumila* (DUNKER), a recent species of this country. But *Z. yokoyamai* is not so broad and has a more strongly contracted base with a turned neck. *Z. pumila* is a more oval shell with flat, graded but not shouldered whorls. The spiral cords of the base and the axial ribs are well-marked in the latter species.

Atilia sp.

Shell elongately fusiform, whorls about 6, with round apex, flat, smooth, except the last which are more or less axially plicate. Periphery of the last-whorl rounded, contracted at the base; suture deep, margined below. Aperture narrow, acutely angled above, with a distinct open recurved canal below; columella vertical, twisted, forming an angle with the short parietal wall. Height, 4·16mm.; diameter, 1·6mm.

Occurrencce.—Dainiti.

The only example of this form is unfortunately imperfect and immature. The sculptures of the described species of the genus are catagenetic, having the axial plications visible only in early whorls, whereas, just the reverse is the case with the present indeterminable form.

Atilia smithi YOKOYAMA.

1923. *Columbella (Atilia) smithi* YOKOYAMA, Foss. Up. Musashino, p. 60, pl. 2, f. 24.

Occurrence.—Hônohasi (rare).

Distribution.—Upper Musasino.

Living.—Central Japan (YOKOYAMA).

The axial plicae are less distinct in the specimens under examination than in the typical Musasino form. The subsutural pinched line and the line upon the sharply angled periphery characterize this species. The outer lip has a varix at its upper part.

Muricidae

Murex (Chicoreus) totomiensis n. sp. (*Plate VI, figs. 20, 21.*)

Shell elongately fusiform, thick, with 3 varices. Spire high, acuminately turreted, gradate, about the same height as the aperture with canal. Protoconch unknown. Whorls 6, slowly increasing, feebly angled in the middle with a sloping shoulder. Varices thickened, rounded, more or less frondose, slightly discontinuous, rising at the angle of the shoulder into a semitubular short spine; between each two varices and at slightly lower than the level of the spines are 3 large rounded tubercles. Spiral sculpture consisting of numerous granular threads of irregular magnitudes; they are fasciculed in regular intervals; there are 8 such fascicules on the body-whorl. The intersections of the varices and the spirals rise into fronds. Aperture ovate, round above, produced below into a lightly recurved, oblique, rather short, narrowly opened canal. Inner lip fairly thick, spreading, continuous below forming the sharp left margin of the canal; outer lip rather thin, faintly denticulate within. Height, 43·5mm.; diameter, 22mm.; height of the aperture, 12·5mm.; length of the canal, 12mm. Type: Holotype, no. 64.

Occurrence.—Dainiti.

This species is closely allied to *Chicoreus penchinati* CROSSE, a living species of Southern Japan, but it differs in having a less elevated spire consisting of more angulate whorls, and the surface being finely granular all over.

Murex borni HÖRNES is very close to this species in its general aspect; probably there exist some interesting relations between these forms. But the Japanese species has the prominent spines at the angle.

Murex (Acupurpura) cf. **djarianensis** MARTIN.

1895. *Murex* (s. str.) *djarianensis* MARTIN, Fossilien von Java, p. 124, pl. 19, f. 282—284.

Occurrence.—Hônohasi.

Some much fractured and fragmental specimens bear many resemblances to MARTIN'S species in the Neogene rocks of Java. The materials are too imperfect to be identified exactly. The spire is comparatively low and nearly equal to the height of the aperture. The sculpture consists of three varices with short tubular spines and numerous spiral lirae.

Some recent species of *Acupurpura* such as *M. tenuispina* LAMARCK, *M. ternispina* LAMARCK, *M. troscheli* LISCHKE, etc., have extraordinarily elongated spines. These spines have been developed from the short spinose proccesses of the varices occurring at the points of crossing of the varices with spirals, found in the ancestral forms of the later Miocene and early Pliocene ages. Being closely allied to *M. ternispina*, *M. verbeeki* MARTIN in the Pliocene of Java and Timor, is considered by Dr. TESCH* as merely a short-spined variety of the former. It is more than a homotaxial variety, since the long-spined forms have been derived only very recently.

Tritonalia dainitiensis n. sp. (*Plate VI, figs. 7, 8.*)

Shell medium in size, fusiform, fairly heavy, axially costate, spirally finely sculptured. Spire elevated, gradate, nearly equal to the aperture in height. Protoconch unknown. Whorls slowly increasing, angulated at the middle with a slightly concave, sloping shoulder, number of whorls unknown. Axials consisting of round subequal costae, 8 on the penultimate, 9 on the body whorl, obsolete on the shoulder, more or less nodulous at the angle, separated by wide excavated interspaces; spirals consisting of numerous, closely set, unequal threads, finely imbricated in crossing the incremental lines. Suture well marked, but not deep, uneven. Base contracted toward the canal. Aperture ovate, obtusely angled above, produced below into a moderately long recurved canal. Outer lip unknown. Columella subvertical, concave. Inner lip moderately thick, extending a short dis-

* Pal. Timor, vol. 9, p. 63.

tance beyond the columella, with a well-defined margin, and having a small transverse process close to the posterior angle of the aperture. Umbilical fissure narrow, but deep. Exact height and breadth unknown, about 40mm. in height and roughly 22mm. in diameter. Type: Hololype, no. 66.

Occurrence.—Dainiti.

This species is described upon a single much fractured specimen. The generic name is uncertain, but the species has many points of resemblance to *Tritonalia poulsoni* NUTTALL, excepting its more concave columella and more distinct spirals. None of the living and fossil species of Japanese *Muricidae* is related to this form.

Cyphonochilus arcuatus (HINDS).

1866. *Typhis arcuatus*, SOWERBY, Thes. Conch., vol. 3, p. 320, pl. 284, f. 3—5.
1874. *Typhis arcuatus*, SOWERBY, Conch. Icon., sp. 10.
1880. *Typhis arcuatus*, TRYON, Man. Conch., vol. 2, p. 136, pl. 30, f. 293, 297.
1882. *Typhis arcuatus*, DUNKER, Index Moll. Mar. Jap., p. 9.
1922. *Typhis arcuatus*, YOKOYAMA, Foss. Up. Musashino, p. 76, pl. 3, f. 3.

Occurrence.—Hônohasi.

Distribution.—Upper Musasino. Naganuma Beds.

Living.—Western Japan. China. Cape of Good Hope.

The protoconch is mammillary, smooth and consisting of two lightly tilted volutions; it is larger than the protoconch figured by SOWERBY. There are five varices alternating with five tubes, each of the tubes is bent back and joined in one to the preceding varix, and looks like a varix outside. Thus there are five duplicating varices. The number of varices, however, seems to have been overestimated in classification. *Typhinae* may comprise only two genera—*Typhis* and *Cyphonochilus*.

The only example under examination measures 7·2mm. in height with six whorls including the protoconch. It agrees very well with the living form of Japan.

Thaisidae

Thais nakamurai n. sp. (*Plate VI, figs.5, 6.*)

Shell large, solid, ovate-fusiform, with a moderately elevated spire and a wide aperture. Spire conoidal, gradate, about two-thirds the height of the aperture. Protoconch unknown. Remaining whorls 5, regularly increasing, angulate at a little below the middle; the shoulder lightly concave, steeply sloping; vertical below the angulation, almost flat or very slightly concave. Suture superficial. Sculpture consisting of many fasciculed spiral lirae, 15 on the penultimate, each fascicule consisting of two to three unequal cords separated by shallow but distinct grooves, the whole crossed by crispate incremental lines; the angle of the shoulder nodulated, nodules 9 to 10, first indistinct, growing insensibly into a transverse conical round-topped protuberance on the body-whorl. Body-whorl large, slightly convex, base with 3 nodulous obscure spiral ribs; the uppermost is the strongest. Aperture large, oval, a little channeled above, with a short, lightly recurved, open canal below. Outer lip fractured in all specimens at hand. Columella vertical, slightly twisted below where it ends in a lightly arcuating ridge. Inner lip polished, spreading over the concave parietal wall as a thick callus; fasciole bounded by a strong spiral ridge and deeply detached from the inner lip. Height, 45 mm.; diameter, 31 mm. Type: Holotype, no. 67, Dainiti.

Occurrence.—Dainiti. Hônohasi.

This species differs from *Thais luteostoma* (DILLWYN), a commonest living species of Japan, in that it is much broader, the spire is not so turreted, the shoulder is lower and not so sharply nodulated. Some young shells of *Thais bronni* (DUNKER) resemble somewhat the present species, but that species is easily distinguished from the present species in having a higher spire and strong quadrate protuberances. The nodules of *Thais tumulosa* (REEVE) are round and not like those of *Thais nakamurai*.

Rapana thomasiana CROSSE.

1861. *Rapana thomasiana* CROSSE, Jour. de Conch., p. 176, p. 268, pl. 9, 10, f. 1, 2.
1861. *Rapana bezoar* var., DUNKER, Moll. Jap., p. 4.
1881. *Rapana bezoar* var. *japonica*, DUNKER, Index Moll. Mar. Jap., p. 42.
1881. *Rapana bezoar*, BRAUNS, Geol. Env. Tokio, p. 51, pl. 2, f. 2.
1895. *Rapana bezoar* var. *thomasiana*, PILSBRY, Cat. Mar. Moll. Jap., p. 44.

1906. *Rapana bezoar*, TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 5.
1922. *Rapana thomasiana*, MAKIYAMA, Jour. Geol. Soc. Tokyo, vol. 29, Jap. p. 200.
1922. *Rapana bezoar* var. *thomasiana*, YOKOYAMA, Foss. Up. Musashino, p. 66, pl. 3, f. 6.

Occurrence.—Dainiti. Tennôyama.

Distribution.—Upper Musasino.

Living.—Japan.

This species differs from *Rapana bezoar* in that the sculpture is not scaly, the aperture is reddish and the shell attains a larger size. The aperture of *R. bezoar* is white forming the contrast to the present species. *Rapana thomasiana* is widely distributed in the estuary waters of Japan.

Pyramidellidae

Actaeopyramis eximia (LISCHKE).

1874. *Monoptygma eximium* LISCHKE, Jap. Meer. Conch., vol. 3, p. 59, pl. 3, f. 4–6.
1881. *Monoptygma puncticulata*, BRAUNS, Geol. Env. Tokio, p. 31.
1895. *Pyramidella (Acteopyramis) eximia*, PILSBRY, Cat. Mar. Moll. Jap., p. 84.
1906. *Pyramidella eximia*, TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 23, pl. 1, f. 46.
1906. *Pyramidella (Actaeopyramis) eximia*, DALL & BARTSCH, Proc. U. S. Nat. Mus., vol. 30, p. 327, pl. 23, f. 1.
1922. *Pyramidella (Actaeopyramis) eximia*, YOKOYAMA, Foss. Up. Musashino, p. 94, pl. 6. f. 1.
1926. *Pyramidella (Actaeopyramis) eximia*, YOKOYAMA, Jour. Fac. Sci. Univ. Tokyo, sec. 2, vol. 1, p. 345.

Occurrence.—Dainiti.

Distribution.—Upper Musasino of Tôkyô and Tiba-ken.

Living.—Tôkyô Bay. Kamakura. Noto Peninsula. Probably throughout Central and Western Japan.

This determination applies to a single young specimen of a very small size, measuring 7·22 mm. in height and 2·78mm. in diameter. In general outline and in the details of sculpture the specimen differs little from living species. The shell is elongate-conic and polished. The protoconch is small and entirely immersed in the first whorl. The whorls are six, moderately convex, shouldered at the summit and sculptured with spiral

sulcae. The later whorls of fairly large existing specimens become more flattish and have a distinct infra-sutural zone.

Turbonilla yokoyamai n. sp. (*Plate VI, fig. 11.*)

Shell minute, slender, elongate-conic, glossy, with many ribs, a constricted suture and a small abrupt top. Protoconch small, heterostrophic, of 2 smooth, strongly convex, elevated whorls, the first somewhat extending beyond the outline of the spire. Spire very high, narrow and barely conical. Whorls excluding the protoconch 7, flatly convex, of slow and regular increase, slightly shouldered at the summit; periphery of the last whorl well rounded; base produced, well rounded, marked by feeble continuations of the axials. Axial ribs flatly rounded, vertical and straight, discontinuous, 26 on the last, 23 on the penultimate, intercostal spaces much narrower than the ribs themselves, marked by fine regularly spaced spiral striations, the striations 13 on the penultimate whorl. Suture subcanaliculate. Aperture elongately ovate, angled above, slightly effuse below. Outer lip fractured in the specimen at hand. Columella decidedly arcuate, slender, twisted, provided with a oblique fold at its insertion. Height, 3·9mm.; diameter, 1·02mm.; height of the aperture, roughly 0·8mm. Type: Holotype, no. 35.

Occurrence.—Dainiti.

This species belongs evidently to the section *Strioturbonilla*, having the close spiral striation on the spire and base. *T. pacifica* YOKOYAMA a fossil species of the Upper Musasino, differs from the present species in that the shell is narrower and that the ribs are curved, oblique and less in number.

T. sagamiana YOKOYAMA of the Upper Musasino has more flattened whorls with oblique ribs. *T. monocycla* A. ADAMS is a species rather allied to *T. sagamiana* and not like the present species.

Turbonilla actopora DALL et BARTSCH.

1906. *Turbonilla (Chemnitzia) actopora* DALL & BARTSCH, Proc. U. S. Nat. Mus., vol. 30, p. 338, pl. 20, f. 6.

Occurrence.—Dainiti (very rare).

Living.—Japan.

The specimen herewith determined is in a much fractured condition, although it retains some important characters of the type species. The protoconch is helicoid in shape comprising two smooth convex whorls and is obliquely tilted, being one-third immersed in the first of the subsequent whorls. The whorls are flattish, very narrowly shouldered at the summit. The axial ribs, according to the original description, are "rather poorly developed, low, broad, rounded, obliquely slanting axial ribs of which fourteen apear upon the second, sixteen upon the fifth and tenth whorls" and "on the penultimate these ribs are subobsolete." The fossil is a smaller specimen measuring about 6 by 1·4mm. and holds 8 whorls excepting the protoconch. *T.* (*Chemnitzia*) *teganumana* YOKOYAMA, a species of the Upper Musasino and the existing sea of Central Japan, is apparently very difficult to distinguish from the present species. The height and diameter of the type of *T. actopora* are 6·8mm. and 1·5mm. respectively, while those of *T. teganumana* are 6·5mm. and 2mm. *T. actopora* possesses a less number of axials.

Turbonilla sp.

Shell thin, elongate-conic, ribbed, with deep suture. Spire high, narrow and conical. Protoconch rather large, of 3 smooth convex sinistral whorls forming a decidedly elevated spire, the axis of which is at right angle to that of the succeeding whorls. Whorls 7, excluding the protoconch, of regular increase, flattened in the middle, rounded toward the summit and the suture. Suture very deep and impressed. Sculpture consisting of narrow strong axial ribs, the interspaces about twice as wide as the ribs, excavated, marked by microscopic, irregularly closely-spaced spiral striations; the ribs 18 in number on the penultimate. Body-whorl fractured. Height about 4 mm.; diameter about 1 mm.

Occurrence—Dainiti.

Only one imperfect specimen of this delicate shell has come under examination. Its characters are very distinctive; so that better materials

will probably warrant giving it a new specific name.

Odostomia sublimpida YOKOYAMA.

1920. *Odostomia sublimpida* YOKOYAMA, Foss. Miura Penin., p. 82, pl. 5, f. 13.
1922. *Odostomia sublimpida* YOKOYAMA, Foss. Up. Musashino, p. 95.

Shell minute, ovately conic, opaque, few-whorled. Spire conic, narrow, about 3/5 the height of shell; outline almost straight. Protoconch heterostrophic, tilted, deeply immersed in the first of the post-embryonal whorls. Whorls 5, regularly increasing, broad but not high, flatly convex, very narrowly shouldered at the summit, slightly constricted at the suture; the last longish; periphery convex; base moderately rounded, narrowly umbilicated. Sculpture none; incremental lines obscure. Suture deeply impressed. Aperture oblique, oval, posterior angle not acute, effused at the base in adult. Outer lip thin, arched. Columella strongly curved, slender, provided with a sharp deep-seated transverse fold near to its insertion; inner lip thin covering the parietal wall. Height, 2·01 mm.; diameter, 0·96 mm. Height, 3·37 mm.; diameter, 1·58 mm.

Occurrence.—Dainiti. Hônohasi.

Distribution.—Naganuma Beds. Miyata Beds (Upper Musasino). Upper Musasino of Tôkyô and Tiba-ken.

This species differs from *O. limpida* DALL and BARTSCH in the suture being deeper, and the whorls being more convex. The body-whorl of *O. limpida* is more distinctly subangulate at the periphery and is a little higher than the half of the entire height.

Odostomia totomiensis n. sp. (*Plate VI, fig. 24.*)

Shell small, ovate, almost smooth, faintly shining, opaque, perforate, subscalar, few-whorled. Spire conical, broad, nearly equal to the height of the aperture; outlines convex. Protoconch of 3 convex whorls, heterostrophic, helicoid, tilted, about one-third immersed in the first of the succeeding whorls. Whorls excluding the protoconch 4, rather rapidly increasing in breadth, well rounded, narrowly subtabulately shouldered at the summit; the last large, about 3/4 the height of the whole shell, periphery and base well rounded, narrowly and deeply umbilicate. Sculpture

consisting of an infrasutural line and vertical irregularly spaced incremental lines. Suture deep, impressed. Aperture subvertical, pyrifrom, angled above, rounded below. Outer lip somewhat thickened, slightly patulous below, straightish above. Columella oblique, arcuate, with an oblique, slight fold above, reënforced below. Inner lip but slightly expanded, forming a thin layer on the parietal wall. Height, 2·19 mm.; diameter, 1·12 mm. Type: Holotype, No. 37.

Occurrence.—Dainiti (very rare).

Odostomia hilgendorfi CLESSIN.

1900. *Odostomia hilgendorfi* CLESSIN, Syst. Conch. Cab. Mart. Chemn., vol. 1, pt. 28, p. 119, pl. 28, f. 5.

1906. *Odostomia hilgendorfi*, DALL & BARTSCH, Proc. U. S. Nat. Mus., vol. 30, p. 364, pl. 24, f. 5.

Occurrence.—Hônohasi (rare).

Living.—Hakodate (CLESSIN). Awazi (KURODA).

A specimen with five post-embryonal whorls, 3·74 mm. in height and 1·55 mm. in diameter, is before me. The shell is regularly elongate conic with a spire twice as high as the aperture. The protoconch is missing. The whorls are almost flat, abruptly constricted in front at the suture. The periphery is distinctly angled, the summit of the succeeding whorls falls a little anterior to the periphery and makes the above mentioned constricted appearance at the suture. The base is lightly convex and very narrowly umbilicate. The outer lip is thin, arched, very obscurely spirally lirate within and effuse below at the base. The columella is provided with a rather strong lamellar plait. Callus deposit upon the parietal is moderately distinct. The inner lip is free and vertical anteriorly.

This species is readily distinguished by its sharply angulate periphery.

Odostomia unica n. sp. (*Plate VI, fig. 10.*)

Shell small, elongate-conic, more or less polished, slightly scalar, imperforate. Spire conical, elevated, about twice the height of aperture. Protoconch heterostrophic, helicoid, of 2 whorls, smooth, convex, umbilicate, obliquely immersed in the first of the succeeding whorls. Whorls 5, regularly

increasing, broad but not high, tabulately shouldered at the summit, feebly constricted at the bottom, and above the constriction is faintly convex and then flat-sided. Sculpture none, but a very fine spiral line appears above and close to the suture, not continued to the periphery of the last whorl; incremental lines superfine, vertical. Body-whorl moderately convex, base rounded. Aperture oblique, oval, narrowly angulately rounded above, effuse below. Outer lip thin. Columella strong, revolute, reflected, curved, provided with a deep oblique fold at its insertion. Inner lip very thin. Height, 3·25 mm.; diameter, 1·33 mm. Type: Holotype, no. 39, Dainiti.

Occurrence.—Dainiti. Hônohasi.

This species is related to *O. shimosensis* YOKOYAMA in its general outline, but it differs from that species in that the whorls are convex and not so angulate at the periphery.

Odostomia perforata n. sp. (*Plate VI, fig. 25.*)

Shell minute, elongately oval, thin, shining, hyaline, perforate, with angled body-whorl. Spire elevated conic, about 1½ times the height of the aperture; outline almost straight. Protoconch heterostrophic, globular, of 2 smooth whorls, half immersed in the first of the succeeding whorls and having their axis at right angles to them, nucleus lateral. Whorl excluding the protoconch 4, regularly increasing, very high between the sutures, cylindrical, moderately rounded, feebly constricted at the suture, narrowly subtabulately shouldered at the summit; the last moderately inflated, marked by a low distinct cord at the periphery rendering it decidedly angulated; base moderately convex. The summit of the succeeding whorls falls a little anterior to the cord at the periphery. Suture subcanaliculate. Sculpture none, but fine subvertical and somewhat flexuous incremental lines. Aperture suboblique, ovate, acutely angled above and effused below. Outer lip sharp and thin. Columella fairly strong, subvertical, arched, with a strong transverse plait, somewhat anterior to its insertion; parietal wall covered with a callus, Umbilicus rather wide and deep, partly covered by the revolute columella. Height, 2·29 mm.; diameter, 0·99 mm. Type: Holotype, no. 38.

Occurrence.—Dainiti (rare).

This species belongs to the section *Nisostomia* of COSSMANN having a decided umbilicus. It is also related to the section *Cyclodontostomia* of SACCO in its spiral cord on the periphery.

Odostomia desimana DALL et BARTSCH.

1906. *Odostoma desimana* DALL & BARTSCH, Proc. U. S. Nat. Mus., vol. 30, p. 362, pl. 25, f. 3, pl. 26, f. 2.

Occurrence.—Hônohasi.

Living.—North Kyûsyû. Awazi.

The specimen before me measures 4·99mm. in height and 2·00mm. in diameter. It holds seven post-embryonal whorls, in the apex of which the protoconch is almost entirely immersed. The outline of the spire is somewhat convex. The last whorl is roundly angulated at the periphery. The surface is very obscurely spirally striated. The summit of the succeeding whorls falls somewhat anterior to the periphery of the preceding ones; this gives a slight constriction at the suture.

It was only after some hesitation that I identified the fossil specimen herewith described with DUNKER's *O. lactea* whose specific name had been preoccupied by two other species and was subsequently replaced with a new name *desimana* by Dr. DALL and Dr. BARTSCH, because the living example of that species from Awazi exhibits somewhat different features. The general contour, however, agrees well with that of the figures of the type specimens. The columella of the fossil is more oblique and excavate. The specimen from Awazi is more distinctly angulate at the periphery.

Odostomia sp. (*Plate VI, fig. 9.*)

Shell minute, ovately conic, thick, semi-umbilicate. Spire conical, about twice as high as the aperture. Protoconch heterostrophic, of 2 smooth convex whorls, tilted at right angles to the axis of the spire, half immersed in the first of the succeeding whorls. Post-embryonal whorls 3, flatly convex, the last angled at the periphery, regularly increasing; base slightly rounded, narrowly umbilicate. Suture deep, subcanaliculate, mar-

gined below. Sculpture none; incremental lines fine, vertical. Aperture oval, posterior angle moderately acute. Outer lip thick, fractured below in the specimen. Columella excavated, with a very distinct lamellar plait at the middle; parietal wall covered by a moderately thick callus. Height, 1·62 mm.; diameter, 0·88 mm.

Occurrence.—Dainiti.

This minute shell which is the only example in the collection is so much fractured at the aperture that its specific determination falls in doubt. Probably it is an immature shell of some larger *Odostomia*. *O. hilgendorfi* resembles the present shell in its general characters; but the protoconch is not so deeply immersed.

Strombiformidae

Melanella sp.

Occurrence.—Hônohasi.

The single specimen of a *Melanella (=Eulima)* is much fractured at the apex and the aperture. It holds seven flat whorls in the height of about 3 mm. They are very slightly constricted at the indistinct suture. The periphery is rounded and the base is convex. This very imperfect specimen shows a close relation with *Eulima (Leiostraca) sagamiana* YOKOYAMA, a fossil species of the Naganuma Beds. But exact specific determination is impossible with such an imperfect sample.

Niso obtusocarinata n. sp. (*Plate VI, fig. 13.*)

Shell small, turriculate, acuminate, smooth, solid many-whorled. Spire narrowly conical, three-times the height of the aperture, outline straight. Protoconch missing. Whorls 8, regularly increasing, broad but not high, flatly convex, slightly more rounded below, obtusely angulate at the periphery; the summit of the succeeding whorls falls very much anterior to the angulated periphery and gives to the whorls a decided constriction at the suture. Suture impressed. Sculpture none. Base well rounded. Umbilicus rather small. Outer lip of the aperture thin and sharp. Columella strongly arcuate; inner lip thick, spreading a short way upon the parietal

wall, its margin free. Height, 6·2 mm.; diameter, 2·5 mm. Type: Holotype, no. 229.

Occurrence.—Hônohasi.

In general contour and appearance this species is like *N. interruptus* SOWERBY, a species living in Central America. It is chiefly distiguished from the latter by its more or less convex and subcarinate whorls. *N. brunnea* SOWERBY which is known living in the Japanese waters, differs in having a much more convex whorl.

Architectonicidae

Heliacus angularis n. sp. (*Plate VI, figs. 22, 23.*)

Shell small, depressed, axially and spirally sculptured, thick, sharply angled at the periphery. Spire low, depressed conical, a little lower than the height of the aperture; apex obtuse; outline lightly convex. Protoconch loosely coiled, smooth, narrow, tube-like, with a sharply pointed tip, of 1¼ volutions. Whorls 4, rapidly increasing in diameter, straightish; the last has an acutely angled periphery with a strong carina upon it; base convex. Suture distinct, not much impressed. Sculpture consisting of unequal spiral threads, crossed by very fine, irregularly spaced radial grooves; the threads 9 on the penultimate; the uppermost subsutural and the widest of all, flat-topped; the lowest being supra-sutural, more elevated than the others and having a round granulate top; base with 4 threads, alternated by finer threads at its posterior half; the anterior half provided with 3 spiral fine grooves. Umbilicus margined by a stout and crenulate cord, rather narrow, about one-fifth of the diameter of the base, deep, perspective. Aperture subcircular. Diameter, 6 11 mm.; height, 3 13 mm. Type: Holotype, no. 312.

Occurrence.—Tennôyama.

This species is very rare and there is a single type specimen which, however, exhibits the unique characters. It is distinguished from *H. enoshumensis* MELVILL (=*Torinia densegranosa* PILSBRY), a living form of Western Japan, by its sharp peripheral angle. No similar species has hitherto been described as belonging to the genus *Heliacus*. Mr. KURODA

showed me another new species of the genus living in Southern Japan, having an angular periphery and an operculum. The protoconch of *Heliacus* differs from that of *Architectonica* in being narrower and loosely coiled.

Retusidae n. n.

(=Tornatinidae)

Retusa gordoni n. sp. (*Plate VI, fig. 14.*)

Shell small, ovately cylindrical; spire raised, conical, scalar, averagely one-fifth the height of the aperture. Protoconch depressed globular, tilted at an angle somewhat less than 90°, half immersed in the first post-embryonal whorl, turned inwards. Whorls 4, narrowly terraced at the top, convex below the round angle of the terrace; the last cylindrical, slightly broader below, rounded at the base. Suture deeply impressed, but not canaliculate. Aperture flexuous, upper half narrow, lower half wide, with a round and slightly effused base. Outer lip thick, arched forward and contracted in the middle, moderately retracted above. Columella vertical, straight, stout, broad and flattened, forming an obtuse angle with the convex parietal wall, without fold. Inner lip thickened and continuous with the outer lip above, narrowly spreading over the parietal wall as a distinct glaze, reflected over the columella, behind which it forms a small umbilical chink. Height, 3mm.; diameter, 1·5mm. Type: Cotype, no. 266.

Occurrence.—Hônohasi.

According to Mr. T. IREDALE,* the name *Tornatina* can not be retained as distinct from *Retusa* whose type is *Bulla obtusa* MONTAGUE. Only the species with retused tops, axial sculptures and conspicuous columella folds have been taken as the typical *Retusa* thus far.

The present species is very close to PILSBRY's *Tornatina insignis* from Hirado, but it differs from that species in being more oval, more solid and in having a straight vertical columella and an umbilical chink. *Retusa globosa* YAMAKAWA differs in that the whorls are round, the aperture is as long as the last whorl and the apex is mucronate.

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* Proc. Malac. Soc., vol. 11, 1915, p. 300.

Retusa globosa YAMAKAWA.

1911. *Retusa globosa* YAMAKAWA, Jour. Geol. Soc. Tokyo, vol. 18, p. 48, pl. 10, f. 14—16.
1922. *Retusa globosa*, YOKOYAMA, Foss. Up. Musashino, p. 25, pl. 1, f. 6.

Occurrence.—Hônohasi.

Distribution.—Upper Musasino of Tôkyô and Tiba-ken.

Many specimens obtained from Hônohasi differ little from YAMAKAWA's species. The shell is small, ovately cylindrical, thick, smooth and truncated at the top with projecting nucleus. The spire is more depressed than in the type and is almost flat, the protoconch only rising above the last whorl. The protoconch is papillary, with its axis perpedicular to that of the spire. The whorls are flatly convex, separated by a canaliculate suture. The characters of the aperture are the same as those described by YAMAKAWA. The outer lip is not so thick as in *Retusa gordoni* and neither so much arched forward nor retracted at the top. The columella is vertical, but not so broad and flattened as in *R. gordoni*. There is no umbilical chink. One of the specimens measures 2·11mm. in height and 1·23mm. in diameter. It has three whorls and is decidedly immature.

Retusa (Coleophysis) minima YAMAKAWA.

1911. *Retusa minima* YAMAKAWA, Jour. Geol. Soc. Tokyo, vol. 18, p. 47, pl. 11, f. 21—24.
1920. *Retusa minima*, YOKOYAMA, Foss. Miura Penin., p. 26, pl. 1, f. 1.
1922. *Retusa minima*, YOKOYAMA, Foss. Up. Musashino, p. 25.

Shell minute, thin and fragile, cylindrical, rimate, retuse. Spire deeply sunken, concave; protoconch immersed. Whorls 4, round; the last enveloping all the others, with a narrow round periphery, slightly constricted in the middle and broadest below the constriction, bluntly rounded at the base. Suture deep. Sculpture none, incremental lines exceedingly fine, distinct posteriorly. Aperture of the full length of the shell, linear, prominetly produced posteriorly, narrow above, dilated in front. Outer lip thin and sharp, rising straight from the crown, with an inclination towards the axis, narrowly rounded above, straight, very slightly contracted in the middle, rounded and patulous below; edge lightly curved. Columella short, oblique, straight, with a strong fold, which is invisible, being sheltered behind a

twisted columella. Umbilicus narrow, slit-like. Height, 30 mm.; diameter, 1·5 mm. (Type).

Occurrence.—Dainiti (rare).

The immature shells are more convex than the adult. The largest specimen from Dainiti 2·11 mm. high and 1·05 mm. broad, has a shell flattened in the middle. YAMAKAWA's figure of an axial section (fig. 23) shows that the adult shell with a slight median contraction has been developed evidently from a more ventricose young. The columella fold is distinctly illustrated in the same figure, although he describes it as obtuse. The very highly raised aperture is the most characteristic feature of this species.

Volvulella acuminata tokunagai n. n.

1906. *Cylichna acuta* TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 32 pl. 2, f. 13.

1911. *Volvula acuta*, YAMAKAWA, Jour. Geol. Soc. Tokyo, vol. 18, p. 49, pl. 11, f. 30—32.

1920. *Volvula acuminata*, YOKOYAMA, Foss. Miura Penin., p. 26, pl. 1, f. 2.

Shell elongate, subcylindrical, centrally highly ventricose, with a sharply pointed apex and narrowly rounded base, polished, rimate, smooth in the middle, spirally striated on the terminal portions. Whorls convolute, only the last visible, which is produced to a sharp point above. Sculpture consisting of 7 to 10 subequal, distant striae on the base and a few similar striae on the narrowed portion a little below the summit. Aperture as long as the shell, linear, very narrow above, sharply pointed at the apex, widened and rounded below. Outer lip slightly arcuate, sharp, extending above to the apex, slightly effuse at the base. Inner lip with free margin, extending over the last whorl at the summit. Columella short, oblique, provided with a feeble fold. Umbilicus narrow, slit-like.

Occurrence.—Dainiti. Hônohasi.

Distribution.—Upper Musasino of Miura and Tôkyô.

The specimens under examination have the same general characters as the typical European species except for the columella fold being not so distinctly developed. YAMAKAWA has observed the fossil of the Upper Musasino to be more oval than *V. acuminata* (BRUGIERE). Prof. YOKOYAMA

mentions in his paper that his examples of the Upper Musasino stand intermediate between the typical *V. acuminata* and its variety *brevis*, as figured by TRYON in his Manual, and that it is very doubtful whether *V. oxylata* BUSH from the coast of North America is really different from the European *V. acuminata*. According to Mr. MELVILL, *V. acuminata* lives in the Persian Gulf; he says "..... species, which I cannot separate from the British and Mediterranean *V. acuminata* BRUG., which, under various names, seems ubiquitous throughout the Northern Hemisphere, both of the Old and New World."

As has already been stated, the present fossil form does not agree perfectly with the species, so the name of Dr. TOKUNAGA may be retained as a subspecific name. But it is preoccupied by a species of the West Indies.

Ringiculidae

Ringicula musashinoensis YOKOYAMA.

1881. *Ringicula arctata*, BRAUNS, Geol. Env. Tokio, p. 30.

1906. *Ringicula arctata*, TOKUNAGA, Jour. Coll. Sci. Univ. Tokyo, vol. 21, art. 2, p. 32, pl. 2, f. 11.

1920. *Ringicula musashinoensis* YOKOYAMA, Foss. Miura Penin., p. 30, pl. 1, f. 3, 8.

1922. *Ringicula musashinoensis* YOKOYAMA, Foss. Up. Musashino, p. 30, pl. 1, f. 16, 17.

Occurrence.—Dainiti (very rare).

Distribution.—Upper Musasino.

Living.—Sagami Bay.

Only one specimen is before me.

Ringicula oehlertiae pacifica n. subsp. (*Plate VI, fig. 12.*)

Occurrence.—Hônohesi. Tennôyama.

The subspecific characters are: the shell is broader in proportion, with a less acuminate spire; the aperture is wider, with the broad posterior channel; the spiral grooves are many, counting seven or more on the penultimate whorl. In general, the peristome of the subspecies is much more thickened than that of the species.

Scaphandridae

Cylichnella (Bullinella) totomiensis n. sp. (*Plate VI, figs. 15-19*)

Shell ovate to subcylindrical, subtruncated or narrowly rounded at the top, and broadly rounded at the base, more contracted above than below, rather thick, smooth. Spire sunken, top with a narrow deep axial perforation, through which often a part of the spire-whorls can be seen, partly roofed by the inner lip. Whorls when young more oval, then becoming subcylindrical, sometimes conically ovoid in the adult, the last forming the height of the shell. Aperture as high as the shell, narrow above, widened and slightly effused below. Outer lip regularly arcuate, simple, slightly advancing in the middle, thick, rising above the top and inclined inwards. Columella subvertical, thickened, with a strong fold which often appears broad but indistinct on the visible portion. Inner lip narrow, spreading over the parietal wall as a thin glaze, thick and reflected over the columella, partly or entirely covering the narrow umbilical chink, continuous above with the outer lip and hanging over the apical perforation.

Height	Diameter
4·49 mm.	2·47 mm.
3·26	1·97
3·74	2·02

Type: Cotype, no. 269.

Occurrence.—Hônohasi.

This species is very variable. The crown may be truncated with a rising outer lip and a wider apical perforation, or it is a narrow top with a narrow perforation and a depressed top of the aperture. Often the columella is much thickened; less often it is very slender. Some individuals are distinctly rimate, while some others are decidedly imperforate. In one example, the last whorl is ovately conical, the upper surface being flattened and contracted. Immature shells are always more ovate with their maximum diameter at the middle of the whorl. In the adult, the whorls are widest near the base.

Many species of *Cylichna* living in the Japanese waters were described

by A. ADAMS without illustration. The present species differs from them in having a more ovate and smooth shell at least.

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1

2

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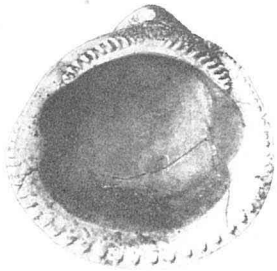

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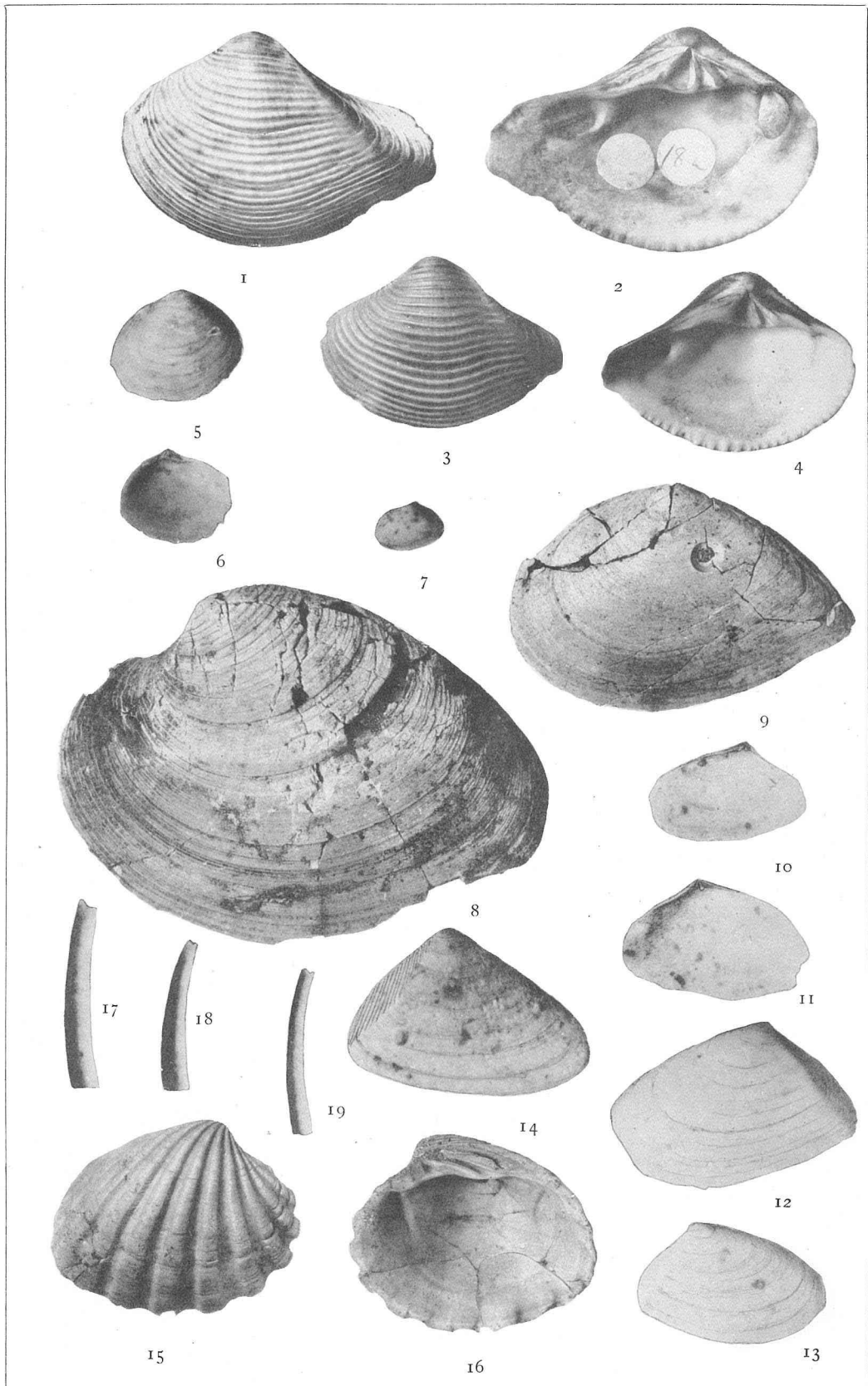
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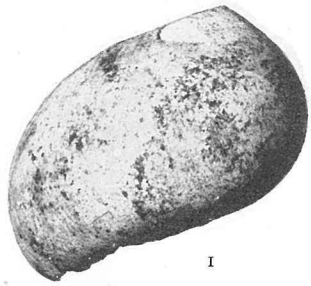
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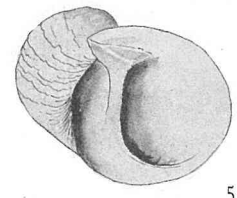
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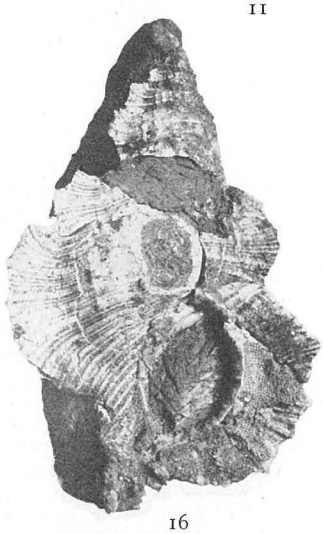
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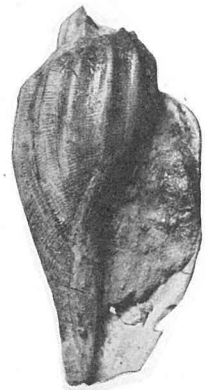
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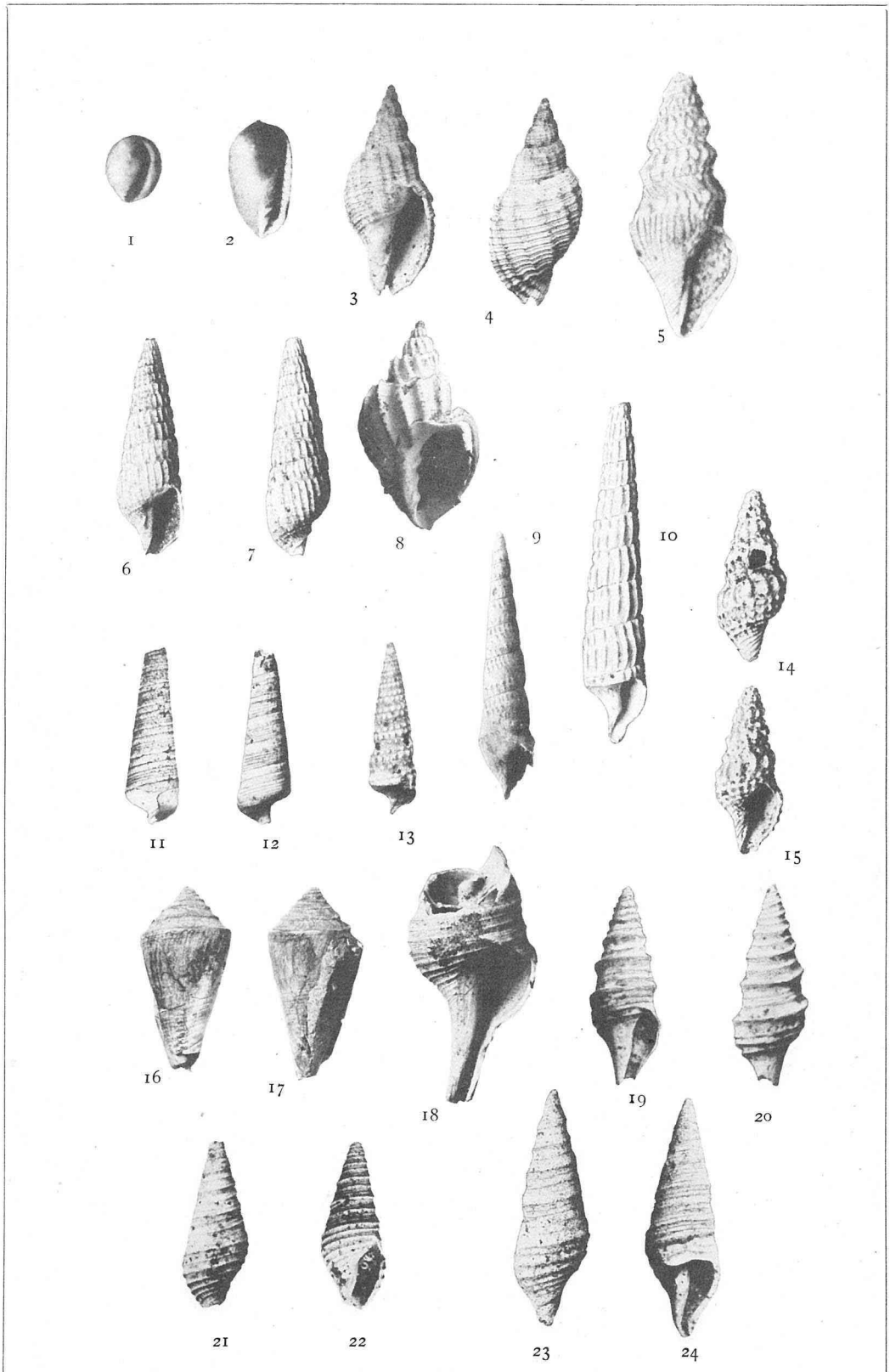
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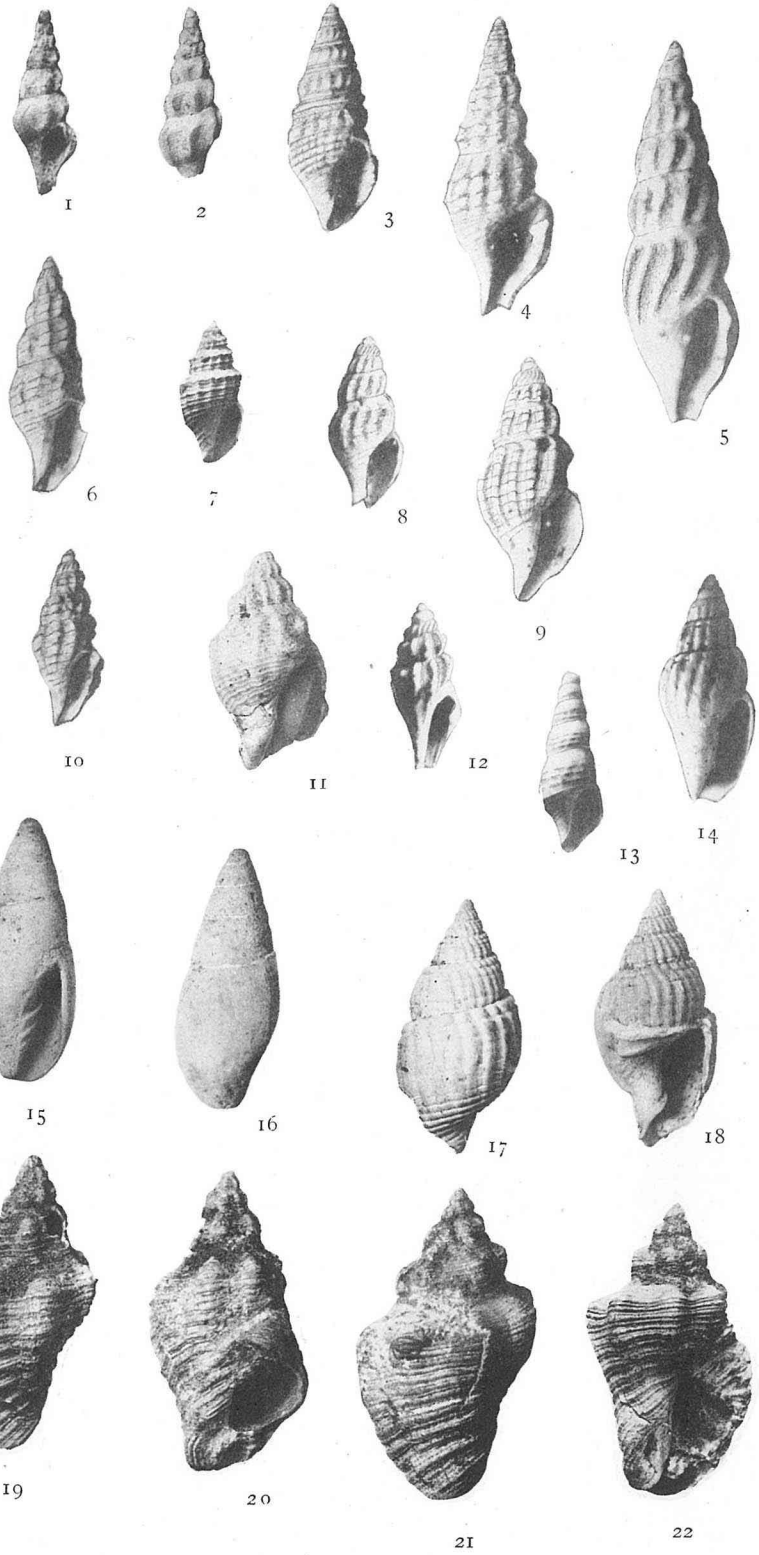
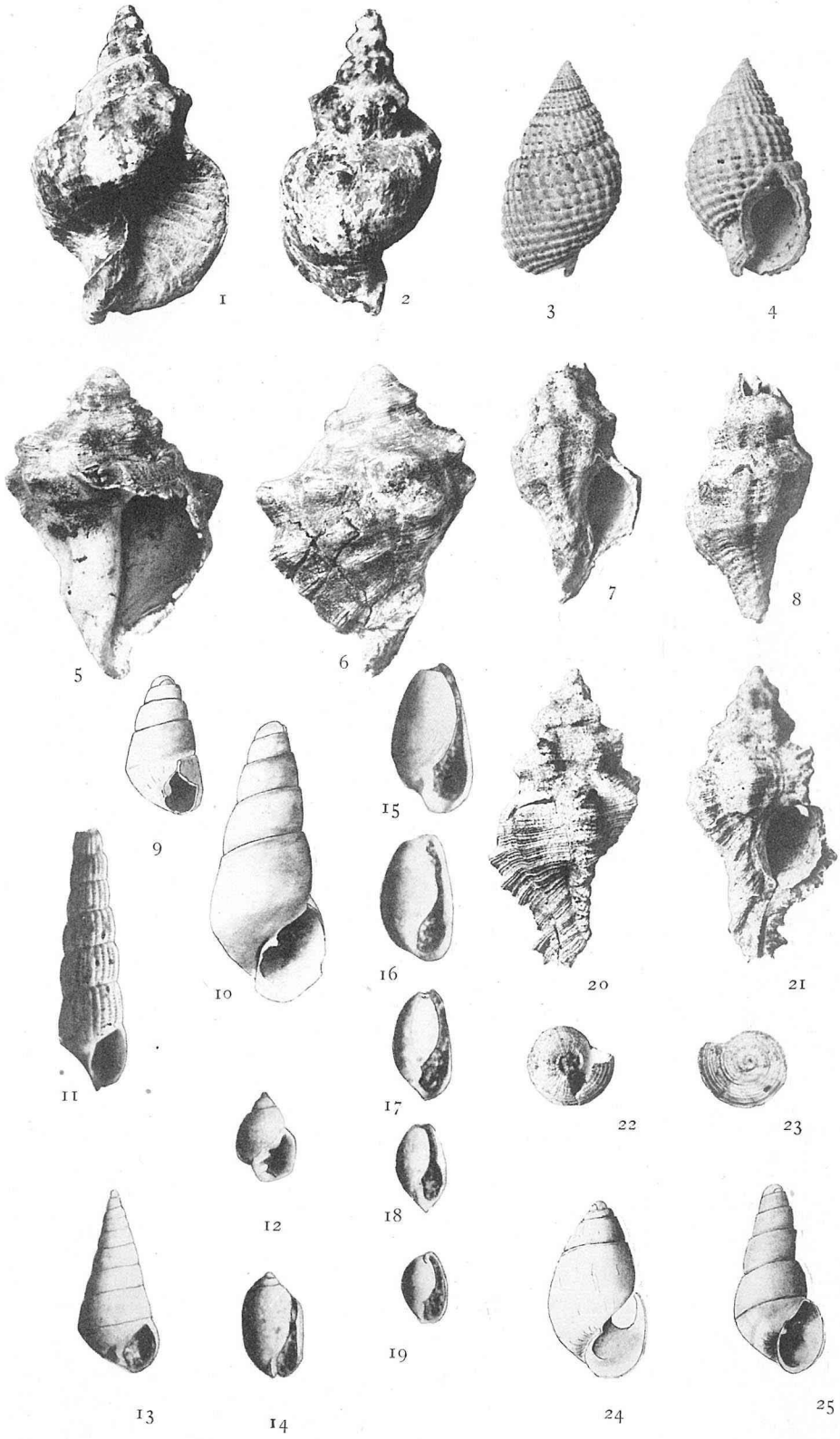


N. Takahashi Photo.

J. Makiyama—Molluscan Fauna of the Lower Part of the Kakegawa Series, etc.



N. TAKAHASHI Photo. J. MAKIYAMA—Molluscan Fauna of the Lower Part of the Kakegawa Series, etc.