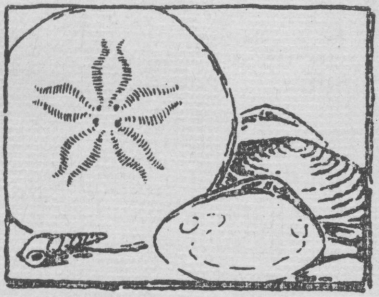
GUIDE-BOOK EXCURSION C-6

(Nov. 6th, 1926)

FOSSIL-LOCALITIES IN THE ENVIRONS OF KIOROSHI



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JAPAN

FOSSIL-LOCALITIES IN THE ENVIRONS OF KIOROSHI

GEOLOGICAL GUIDE TO THE EXCURSION TO KIOROSHI, PROVINCE OF SHIMÔSA

By Hisakatsu Yabe and Shichjhei Nomura

CONTENTS

GENERAL REMARKS

The purpose of this excursion is to study the Manzakian deposits and fauna of the Upper Musashino Formation in excellent exposures near the railway station of Kioroshi on the Narita Line[1]. The Upper Musashino Formation, which consists of almost horizontally interstratified layers of clay, sand and gravel and is overlaid by a light brown unstratified loam, forms a low but extensive uplifted platform or plateau, in spite of its rather low level; this is usually known as the "Kwantô Plain" and covers the greater part of the provinces of Musashi, Sagami, Kazusa, Hitachi and Shimôsa. The Kwantô Plain, with the city of Tôkyô in its southwestern part, is, geologically speaking, a structural basin of younger formations belonging to the Shikishima Period (the Japanese Pleistocene)[2]. It gradually ascends from the center—hardly 20 m. high—eastward to the coast of Kashima-nada, where it attains a height of more than 40 m. southeastward to

1) M. Yokoyama: Fossils from the Upper Musashino of Kazusa and Shimôsa. Jour. Coll. Sci., Tôkyô, vol. XLIV, Art. 1. 1922.

2) H. Yabé and R. Aoki: A Summary of the Stratigraphical and Palaeontological Studies of the Cainozoic of Japan, 1920—1923. Pt. II. Proc. Pan-Pacific Sci. Congr. Australia, 1923.

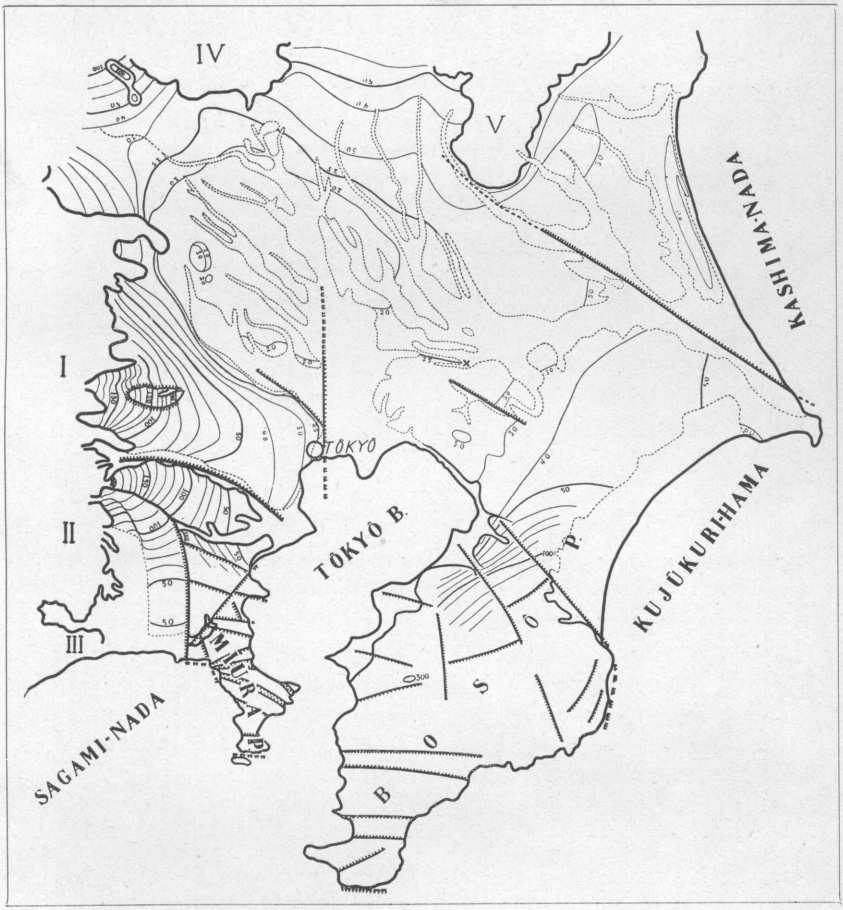
the coast of Kujûkuri-hama, where it attains a height of more than 50 m., and southward to the hilly land composed of Tertiary rocks (mostly belonging to the Younger Mizuho—the Mizuho=the Japanese Neogene) of the peninsulas of Bôsô and Miura. The southern border, which is the highest, culminates in Kanô-san at a height exceeding 300 m. The peninsulas of Bôsô and Miura were once continuous, being a horst of east-west trend, which is farther extended westward to the Ôiso Block. This horst formed the unbroken southern borderland of the Kwantô Plain before the depression of the Uraga Channel and the northern part of the Sagami-nada and the ingression of the sea. The Kwantô Plain or structural basin skirts on the north the southern foot of the Abukuma Mountainland, the Yamizo-Torinoko range, and the Shimotsuke Mountainland, and on the west the eastern foot of the Kwantô Mountainland to the southerly lying Ôiso Block. Alluvial materials derived from the mountainlands form thick fans over the surface of the basin along its northern and western borders (Plate 1).

The Kwantô Plain is now watered by many rivers, of which the more important are the Tone-gawa, Ara-kawa (Sumida-gawa), Tama-gawa and Sagami-gawa. All the river-valleys and side-valleys of tributary streams are broad and shallow, always with a relatively broad alluvial flat along the stream. The valleys are deeply buried under alluvial materials, owing to the submergence of the land as a whole, which took place prior to the last general emergence of several meters which happened in the latest geological time.

The largest of the rivers is the Tone, and to its drainage area belongs the greater part of the Kwantô Plain, except its western part. The main stream of the river traverses the Basin almost diagonally from NW to SE and runs into the open sea north of Chôshi Peninsula, which forms a salient point between the Kashima-nada coast of N-S trend and Kujûkuri-hama of NE-SW trend. There is a large distributary, the Edo-gawa, branching at 100 km. from the mouth of the main stream and flowing southward a little east of Tôkyô to Tôkyô Bay. A large canal crosses what is called the Naka-gawa, and connects the lower courses of the Edo-gawa and the Sumida-gawa, of which the latter flows through the city of Tôkyô into Tôkyô Bay. The upper course of the Sumida, called the Ara-kawa, drains the greater part of the Kwantô Mountainland proper.

Outline map of the Kwantô Plain.

Scale 1 : 1,500,000 Contour-line in meter. **Plate I**



I. Kwantô Mountainland
II. Dôshi Mountainland
} Kwantô Mountainland in broad sense.

III. Ôiso Block.

IV. Shimotsuké Mountainland.

V. The southernmost part of the Washinoko-Yamizo mountain ridge.

X. Site of Kioroshi.

The lower course of the Tone is renowned for lakes or rather swamps, mostly belonging to its own drainage system; Kasumiga-ura (177.5 sq. km.), which is the largest, has its water level about 2 m. above, and its deepest bottom 5.58 m. below, the sea-level. Kita-ura (42.2 sq. km.), Inba-numa (27.7 sq. km.) and Tega-numa (12.2 sq. km.) are three others that are well-known. The basin in all these lakes is narrow and much elongated, and in the case of Kasumiga-ura, it is forked in its upper half. The features common to these lake-basins being the elongated outline, cliffed wall on both sides, and dam of alluvial material at the lower end, the origin of the lakes is evidently ascribable to the aggradation of the river channel by the main stream of the Tone, which choked up the water of the side valleys. This process, however, would have been less effective, if it had not been accompanied by the submergence of land which certainly took place in the present region in a not very remote time subsequent to its great uplift in basin-form.

Generally speaking, we have in the Kwantô Structural Basin a very uniform plane-surface ending in more or less continuous steep bluffs along the river-valleys and sea-shores; the surface is always covered with loam and it is only along the steep slopes that the lower parts of the plateau- or basin-formations are exhibited.

The loam of the Kwantô Basin varies in thickness, being in general 3-6 m. and very uniform, contributing much to the even feature of the plateau-surface. It is a somewhat coarse sandy clay of light reddish brown colour, and usually lacks all trace of stratification, though it intercalates at places one or more pumice layers a few centimeters in thickness, or in rarer cases pebbles of older rocks in horizontal rows. It is rich in vertical clefts. In this feature, as well as in its colour and texture, it is somewhat like loess. Though the possibility of the loess-material taking a subordinate part in the constitution of our loam is by no means deniable, a considerable part of it is likely to be wind-borne volcanic materials.

Our loam is almost free from fossils: unlike loess, it is not calcareous nor does it contain any calcareous segregations. Chemical analysis of a sample shows:

1. Lighter portion of the sample after levigation, amounting to 24.4% of the whole.

2. Coarser portion of the same sample, amounting 75.52% of the whole.

	1.	2.
SiO_2	65.15%	69.885%
Al_2O_3	19.20	15.285
Fe_2O_3	7.76	8.645
CaO	1.49	1.875
MgO	0.12	trace
P_2O_5	0.20	—
Loss on ignition	6.03	—
	99.95	95.690

The coarser portion contains silicate minerals together with quartz.[1)]

According to Mr. T. Seki, the loam covering the Kwantô Basin furnishes a good example of basophilous ash-loams.

"The loam is weathered volcanic ash of olivine bearing hypersthene augite andesite with a smaller quantity of glassy particles. The parts decomposed by hot 20 per cent and cold 10 per cent hydrochloric acid solutions amount to 63 and 51 per cent of the dry materials respectively. The molecular ratios of silica and alkaline bases to alumina of those two parts are as follows:

The parts decomposed by	Molecular Ratios		
	Silica	Alumina	Alk. bases
20 per cent HCl.	1.63	1.00	0.36
10 per cent HCl.	1.36	1.00	0.17

"As the cold dilute hydrochloric acid attacks olivine and basic plagioclase, the molecular ratios of silica and alkaline bases must be less than those above given. From this fact and from its basophilous character I have assumed the main part of the argillaceous substances to be constituted of those resembling *allophane*. It was afterwards found that a small quantity of free alumina is extracted by a solution of sodium carbonate. The weak oxyphilous nature of the loam can be explained by the latter fact. The loam contains a comparatively large quantity of limonitic ferric hydrate derived mainly from magnetite which amounts to 2.3 per cent.

1) D. Brauns: Geology of the Environs of Tôkyô. Mem. Sci. Dep. Univ. Tôkyô, No. 4, 1881, p. 17.

"The strong absorptive power of the loam for ammonia and phosphoric acid can be explained by the presence of colloidal hydrates together with large quantities of allophanoidal clay. It has recently been proved that about two-thirds of the alkaline bases decomposed by 20 per cent hot hydrochloric acid are replaced by ammonia when the loam is treated with a solution of ammonium chloride. The wet loam gives a very faint acid reaction to sensible blue litmus paper. The fact that the wet loam does not give rise to remarkable plasticity can also be explained by the presence of large quantities of allophanoidal instead of kaolinitic clay."[1]

The lower alluvial field along the streams and sea-shores comprises estuarine mud and sand, deltaic deposits and overlying alluvial materials. It may be added that the division of the Plain into high and low levels is significant for agriculture, the rice-fields being in most instances confined to the lower, whilst on the higher we find barley, wheat, millet, Indian corn, many kinds of beans, the *nasu* (*Solanum melongena* L.), Satsuma *imo* (*Ipomea batatus* Poir. var. *edulis* Makino), *satoimo* (*Colocasia antiquorum* Schott) and potato, and at the same time plantations of the mulberry tree, of tea, and also many small forests. On the other hand, villages and towns with their bamboo groves and garden trees and shrubs are spread indifferently over both levels.[2]

The Basin Formation lying next beneath the loam is the Manzakian deposit, composed of sand, clay and gravel, in the lake district of the Kwantô Plain. The two formations appear at first sight to be generally conformable, with an intervening clay or cross-bedded sand layer in places. The thin light yellowish clay layer has certainly been deposited in places where there was more or less standing water, and the cross-bedded sand layer in places where there was running water. The deposition of loam, we believe, took place soon after the withdrawal of the sea-water of the Upper Musashino from the Kwantô Plain and in the initial stage of the dissection of the land surface by subaerial denudation. The stratigraphical relation between the loam and the underlying formation is believed by us to be unconformable, as in the marginal parts of the Kwantô Plain the former is superposed on various formations older than the Manzakian.

1) T. Seki: Chemical and Mineralogical Study of Japanese Volcanogenous Ash-Loams. Proc. Imp. Academy, vol. II, No. 2, 1926, pp. 64—65.

2) D. Brauns: Geology of the Environs of Tôkyô. Mem. Sci. Dep. Tôkyô, No. IV, 1881, p. 18.

The Manzakian is the name proposed by Professor Yokoyama for a fossiliferous horizon very near to the upper boundary of the Upper Musashino Formation: it is several meters thick and is separated from the overlying loam by layers of sand, gravel and clay, altogether 2-5 m. thick.[1]

While the top of the Upper Musashino is thus well defined, its base has not been fully delimited by Professor Yokoyama, who has stated in this connection only that "The upper part [i.e. the Upper Musashino Formation] is represented by the strata exposed in the plain, including the shell layers of Ôji, Tabata, Shinagawa, etc., places lying in the immediate neighbourhood of Tôkyô," that "The lower part [the Lower Musashino Formation] is typically developed in the peninsula of Miura," and that "The position of the line of demarcation between the two parts is at present uncertain, for, geologically, the whole marine series is a single complex of layers conformably superposed one upon another, and palaeontologically, the fossils found in the intermediate places have not yet been fully examined."[2]

While the Upper Musashino with 29.3% of non-living species is believed to be not younger than the Uppermost Pliocene, the Lower Musashino of Miura Peninsula is assigned by the same author to an age almost equivalent to the Newbournian of England, with species not yet known as living making 40% of the whole fauna. The Lower Musashino comprises 6 zones, the Naganuma, Koshiba, Kanazawa, Kamakura, Yokosuka and Miyata Zones, of which, however, the Naganuma, Yokosuka and Miyata zones (the latter in greater part at least) are separated by a distinct line of unconformity from the underlying part of the Lower Musashino, which includes the three other zones. Stratigraphically and palaeontologically the former three zones may safely be transferred to the Upper Musashino.

Professor Yokoyama described from the Manzakian 335 species of shells (179 species of Gastropoda, 152 of Lamellibranchiata and 4 of Brachiopoda), while Messrs. G. Yamakawa and Ishikawa had described at an earlier date 16 species of Pteropoda.[3] The total number of species thus amounts to 351, of which 103 species, 29.3% of the whole fauna, are not yet known to be living in the present

1) M. Yokoyama: Upper Musashino, p. 2.
2) M. Yokoyama: Fossils from the Miura Peninsula and its Immediate North. Jour. Coll. Sci. Tôkyô Univ., vol. XXXIX, Art. 6, 1920, pp. 3—4.
3) G. Yamakawa and Ishikawa: Some Pteropoda from the Neogene of Semata. Jour. Geol. Soc. Tôkyô, vol. XIX, 1912.

seas; but as Professor Yokoyama remarked, there is a possibility of the reduction of the above percentage by the discovery that some so-called non-living forms still survive. "How far this reduction may go, it is at present impossible to say. Admitting, however, that it might amount to one-half, which is very improbable, there would still remain about 14.6% of non-living forms, making about one-seventh of the whole fauna. When we compare this percentage with those of the Crags of England, for instance, with the 7% of the Norwich Crag and the 10% of the Red Crag which are both regarded as Pliocene, I cannot ascribe to the Manzakian an age younger than the Uppermost Pliocene."[1]

The stratigraphical division of the plateau-formation of the Kwantô Plain, now accepted by us, is given in Table I, hereto annexed. This is a scheme revised by us with the assistance of Messrs. R. Aoki and S. Shimizu from the older tables by Yabe, and Yabe and Aoki.[2]

In Chôshi Peninsula, the upper division of the Narita Series covers unconformably the Miura Series, which is in its turn underlaid unconformably by another series of rocks. The last series is very similar lithologically to that directly overlying it: it remains still unsettled whether the line of unconformity recognised between the two really marks the base of the Miura Series or lies within it.[3]

Mammalian remains, especially elephant teeth, are sometimes found in the Younger Cenozoic formations at certain places. These have been studied by Professor H. Matsumoto.[4] Molar teeth of *Parelephas protomanmonteus* Matsumoto and *Stegodon orientalis* Owen (typicus) are found in the Miura Series, those of the former species from Uehata in Akimoto-mura, Seki-mura, and Hosono, Matsuoka-mura (all in the province of Kazusa), and those of the latter from Tôgane (province of Kazusa). Molar teeth of the two species once obtained from the sand and gravel bed, belonging to the Lower Narita, exposed at Nagahama near Minato (province of Kazusa), are regarded by us as of secondary deposition, their original site being

1) M. Yokoyama: Upper Musashino, p. 18.

2) H. Yabe: Recent Stratigraphical and Palaeontological Studies of the Japanese Tertiary. Proc. I Pan-Pac. Sci. Cong., 1921, pp. 784—787. H. Yabe and R. Aoki: A Summary of Stratigraphical and Palaeontological Studies. L.c.

3) S. Yamane: Explanatory Text of the Geological Map of Japan in 1:75.000, Chôshi, 1924, p. 12.

4) H. Matsumoto: Preliminary Note on Fossil Elephants in Japan (in Japanese). Jour. Geol. Soc. Tôkyô, vol. XXXI, 1924, p. 255. Preliminary Notes on the Species of Stegodon in Japan (in Japanese). Ibid., p. 323. On Two New Mastodonts and an Archetypal Stegodon of Japan. Sci. Rep. Tôhoku Imp. Univ., (Geology), vol. X, No. 1, 1926. On the Archetypal Mammoths from the Province of Kazusa. Ibid, vol. X, No. 2, 1926.

TABLE I.

Stratigraphical Order of Succession of the Younger Cenozoic Rocks in the Kwantô Basin and in the Peninsulas of Bôsô and Miura: Scheme of 1925, revised by R. Aoki, S. Shimizu, H. Yabe and S. Nomura.

Western Part of the Kwantô Basin and Miura Peninsula	Eastern Part of the Kwantô Basin and Bôsô Peninsula
Loam	Loam
unconformity	**unconformity**
Narita Series, the upper division; or Narita Proper. Sand and gravel, with occasional intercalations of clay; almost always cross-bedded; a formation light brown in colour, as a whole. Fossils rare; a shell bed once exposed at its base at Tabata in Tôkyô.[1] 6 m. at Tabata.	Narita Series, the upper division; or Narita Proper. Sand, with occasional intercalations of gravel and clay; cross-bedding common; a formation light brown in colour, as a whole. Marine shells very common, generally water-worn; sand of shell bed containing abundant triturated shell-fragments, in addition to its mineral composition. The Manzakian shells described by Yokoyama are all derived from this division.
unconformity?	
Tôkyô Beds. Sand and clay; a formation bluish in colour as a whole, with a considerable amount of minerals derived from andesitic rocks. About 100 m. thick. The shell-beds of Ôji, Tabata and Shinagawa assigned by Yokoyama to his Manzakian, lie at or near the top, and that of Naganuma (the Naganuma Zone of the Lower Musashino of Yokoyama) at the base.	Narita Series, the lower division; or Sanuki Beds; very similar to the upper division in every feature. The shell-beds of Kanô-san, Nagahama, Ôyatsu, etc. lie at or near to its base. Total thickness of the Narita, upper and lower taken together, 150–200 m.
unconformity	**unconformity**
Miura Series.	Miura Series.
unconformity	**unconformity**
Pre-Miura (Hayama Group),[2] intruded by diorite, gabbro and serpentine.	Pre-Miura (Mineoka Group) intruded by diorite, gabbro and serpentine.

1) H. Yabe: A New Pleistocene Fauna from Tôkyô. Geol. Mag. London, N.S. Dec. V, vol. VIII, 1911, pp. 210–217.

2) K. Watanabe: Base of the Musashino Formation (in Japanese). Jour. Geogr. Tôkyô, vol. XXXVII, Nos. 439 and 440, 1925.

in the underlying Miura Series. On the other hand, *Loxodonta namadica naumanni* Makiyama is reported from Yokosuka (Miura Peninsula), Tabata in Tôkyô, Kasumiga-ura (province of Hitachi), Inba-numa (province of Shimôsa), Nakao in Kiyokawa-mura (province of Kazusa), and *Elephas trogontherii* Pohlig from Kasumiga-ura. All these occurrences belong or may belong to either the Tôkyô Beds or to the lower division of the Narita Series.

We have at present no reliable means of precisely correlating Cenozoic deposits in Japan with a definite period or series of the European and North American standards, though it is possible to do so approximately. In order to avoid this difficulty in correlation, Aoki and Yabe once tried to establish a standard division of the Cenozoic formations for Japan and proposed the following scheme:

I. Akitsu Period of Submergence—Akitsu Series,
II. Takachiho Period of Emergence—Takachiho Series,
III. Mizuho Period of Submergence—Mizuho Series,
IV. Shikishima Period of Emergence—Shikishima Series.

In a broad sense, the Akitsu, Takachiho, Mizuho and Shikishima are the Japanese Eocene, Oligocene, Neogene and Post-Tertiary respectively. In this scheme, the stratigraphical break at the top of the Miura in the Kwantô Basin was taken as the dividing line between the Mizuho and Shikishima Series.[1]

The Narita Series, as a whole, is a characteristic formation: it is, in its essential part, composed of fine- to coarse-grained quartz sand, well water-worn, with occasional mixture of gravel and intercalation of clay layers. The sand, gravel and clay are almost always light brownish in colour, and only in exceptional cases tuffaceous. In these two points, the Narita Series is in strong contrast to the Tôkyô Beds and the Miura Series, both of which are usually greenish in colour and almost always tuffaceous. Cross-bedding is universal in the sand of the Narita Series.

The Narita Series in its essential part is marine in origin, containing marine fossils in great profusion at certain places, though its uppermost part is possibly fluviatile near the borderland of the Kwantô Plain. The distribution of fossils in the sand is not uniform, but where they occur they are found in considerable numbers.

The fossils are almost exclusively confined to Mollusca and a species of Echinoderm, other fossils such as foraminifera, corals and

1) Yabe and Aoki: Correlation.

crustacea being seldom found. On the contrary, foraminifera are found abundantly in the Tôkyô Beds and the Miura Series at certain horizons. It is noteworthy that in some places, there exists a layer composed only of the tests of a sand-dollar, *Echinarachnius mirabilis* Barn., to the exclusion of all other fossils.

Shell beds are sometimes underlain by a layer of clayey rock, with numerous sand pipes in more or less vertical position, no doubt due to some burrowing organisms. While this clay layer shows no trace of agitation by violent waves, the overlying shell bed usually contains triturated shell fragments in great quantity, so that the term shell-sand often seems to be appropriate for its rock. The complete shell remains contained in the shell bed vary in state of preservation, according to their form, size and thickness, but are always more or less water-worn; further, Lamellibranchiata are seldom found with both valves intact.

The Molluscan fauna comprises forms haunting shallow seas, perhaps not deeper than 30 m.; but occasionally there are types which adhere to the rocky shore or bottom. Also estuarine types are very poorly represented in it.

More attractive is its content of many species whose present habitat is in the seas of Northern Japan or still more northern latitudes, such as

Chrysodomus arthriticus Val.
C. schrencki Yok.
Priene oregonensis Redf.
Trophon subclavatus Yok.
Puncturella nobilis Ad.
Panope generosa Gld.
Corbula venusta Gld.
C. amurensis Schrenck.
Spisula grayana Schrenck.
Spisula sachalinensis Schrenck.
Solen krusensternii Schrenck.
Tellina lutea venulosa Schrenck.
Macoma nipponica Tokunaga.
Venus stimpsoni Gld.
Diplodonta usta Gld.
Venericardia toneana Yok.
Astarte borealis Chem.

A. hakodatensis Yok.
Pectunculus yessoensis Sow.
Limopsis nipponica Yok.
Yoldia notabilis Yok.

Consequently Professor Yokoyama correctly concluded after statistical study of the subject that "The waters on the Pacific side of Central Japan during the Manzakian time were somewhat cooler than at present."[1]

As to the sea in which the Narita Series was deposited, one of us expressed in an earlier paper[2] the opinion that it was an extensive bay, some ten times as large as the present Tôkyô Bay, bordered north, west and south by land, and open to the Pacific only on the east and southeast over the present sites of Kashima-nada and Kujûkuri-hama. This Palaeo-Tôkyô Bay existed there in the early Shikishima Period, when the peninsulas of Miura and Bôsô were continuous and extended westward to the southern border of the Dôshi Mountainland and eastward far into the Pacific Ocean. It occupied a tectonic basin produced by the Post-Miura (Post-Mizuho) tectonic disturbance that took place in the Kwantô region.

ANNOTATED GUIDE

The excursion party will leave Tôkyô from the Ueno railway station. The railway runs close to the base of an escarpment of the dissected table-land or uplifted platform of Tôkyô (Takadai or Yamanote) first northeast and then northwest for 2.24 km. to Nippori, where it turns eastward. It runs for the next 15.7 km. over the broad alluvial flat along the lower courses of the Sumida-gawa and the two distributaries of the Toné-gawa, the Naka-gawa and Edo-gawa. The next station, Matsudo, lies close to the base of the escarpment of the opposite table-land, along which it runs northeast to Kita-Kogané (24.16 km. from Ueno). Then it crosses the table-land and after passing Kashiwa station (28.96), it turns east and runs through Abiko (33.44) to Kioroshi (47.23), between the northern bank of Tega-numa and the Tone-gawa. Kioroshi is a small town on the river, at its junction with a small stream which drains the Tega-numa.

Along the railway and a little east of Kioroshi station there are

1) Yokoyama: Upper Musashino, p. 21.
2) H. Yabe: Pleistocene Climate of Japan (in Japanese). Contr. Inst. Geol. and Pal. Tôhoku Imp. Univ., No. 3, 1922.

several cliffs on the edge of the table-land, which extends to the southern side of Tega-numa and the northern side of Inba-numa. Plate III, fig. 1 is a photograph of a cliff facing north and exposing the following strata:

Loam . . . . . 2 m.

Fine sand, containing small gravel, brownish in colour and cross-bedded on a small scale . . . . . 3 m.

Shell bed. Sand rendered consolidated and hard by calcareous cement, and coloured brown by ferruginous matter, more prominent on the surface of the cliff than the other beds. Numerous molluscan shells; but difficult to extract. 5 m. The lowest part, 1 m., consists entirely of tests of *Echinarachnius mirabilis* with but little parallelism to the stratification plane.

Argillaceous sand, brownish in colour and containing sand pipes . . . . . 2.5 m.

Fine greyish sand . . . . . 6 m.

In this section, the boundary between the loam and the underlying fine sand is not sharply defined but rather gradually passes from one to the other; all the other beds are also conformable.

Another cliff behind a neighbouring school-building, shows, on the other hand, that molluscan shells are included in the sand bed in irregular masses.

The shell bed is exposed more favorably for fossil-collection along the cliffs of the border of the table-land on the southern side of Tega-numa, and we have one of the best exposures of it in the village of Hossaku some 3 km. southwest of Kioroshi (Pl. III, fig. 3, and Pl. II, fig. 1). A cliff in the village shows the following order of succession of rocks:

Loam . . . . . 3 m.

Yellowish clay . . . . . 2 m.

Yellowish grey clay . . . . . 1 m.

Light yellowish grey sandy clay . . . . 1 m.

This rock is apparently "Sandy," but quickly becomes plastic when pressed between the fingers. The boundary line between this and the overlying rock is irregular, though well-marked by a ferruginous band.

Plate III

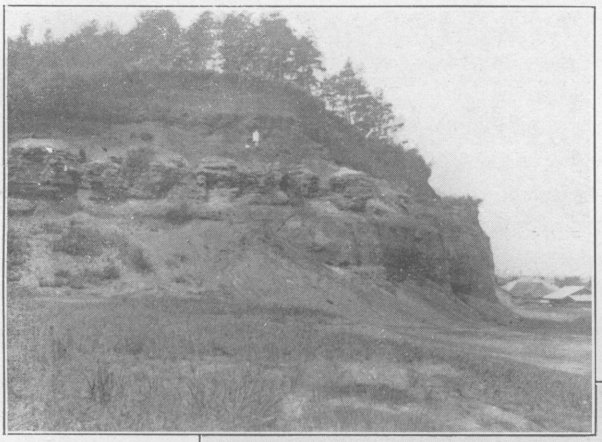


Fig. 1. A cliff near Kioroshi, along the railway and facing the Tone-gawa, 2 m. thick loam underlain by the sand and clay of the Narita Series more than 16 m. in total thickness. A shell bed, 5 m. thick rendered consolidated and hard by calcareous cement, and coloured brown by ferruginous matter, is prominent on the surface of the cliff, 3 m, below the base of loam.

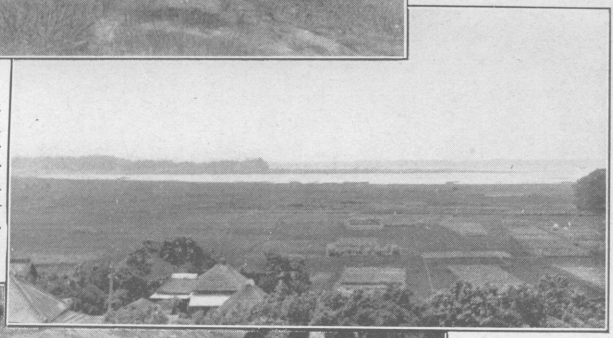


Fig. 2. View of a part of Tega-numa and the table-land surrounding it, looking northwest from a height at Kamenari near Hossaku.

Fig. 3. Manzakian shell-bed at Hossaku ; X marking the spot from which the 216 cubic feet of shell sand was excavated.

Brownish argillaceous sand . . . . . 1 m.

Shell bed. Sand with myriads of molluscan shells; the most attractive are the isolated valves of *Mactra sulcataria* Deshayes, almost always with the convex side above and arranged in regular horizontal layers . . 7 m.

Beneath the shell bed is a greyish clay bed; this is, however, not visible at the cliff, but is exposed on the roadside.

Coming back to Kioroshi, we take a train through Narita and Sakura to Chiba. The railway runs first east to Ajiki (5.4 km. from Kioroshi) and then southwest, giving views of Inba-numa on the right hand, to Narita (18.85 km.), famous for its Fudô-temple, the Shinshôji. Half way from Ajiki to Narita is the station of Manzaki with the prolific fossil locality of the Manzakian shell bed nearby. At Narita we change cars, and farther southwestward, the railway passes over the table-land of the southern side of Inba-numa and through Sakura (31.81) along the Tôkyô Bay, to Chiba (39.17), with a population of 39,000 and the government office of Chiba Prefecture.

For 16 km. northwest from Chiba, the railway runs on the table-land and along the coast of Tôkyô Bay. After passing Funabashi station (16.48 km. from Chiba), well-known for the wireless station nearby, we are again on the broad alluvial flat of the Edo-gawa, Naka-gawa and Sumida-gawa. The Edo-gawa is crossed near Ichikawa (24.32), the Naka-gawa near Kameido (33.28), and the last station, Ryôgokubashi (36.32), is situated on the left side of the Sumida-gawa, near the Ryôgoku bridge.

PARTICULAR DESCRIPTIONS

One of the writers (Nomura) procured for our laboratory[1] a mass of shell-sand, measuring 216 cubic feet and weighing 10 tons, from an excavation of a bluff at Hossaku (the spot marked with X on the accompanying photograph, Pl. III., fig. 3). One eighth part of the mass has already been thoroughly examined by him for fossil shells. The individual shells thus counted in 27 cubic feet of the sand exceed 100,000 in number. The species distinguished in the material are as follows (List I).

1) Institute of Geology and Palaeontology, Tôhoku Imp. University, Sendai.

LIST I.

Mollusca found in the Manzakian Sand of Hossaku
(Identified by Nomura)

LAMELLIBRANCHIATA

Nuculidae.

1. *Nucula* (*Acila*) *insignis* Gould.
   Otia Conch., p. 175; Yokoyama, Foss. Miura Penin., p. 179, pl. XIX, figs. 7, 8.

Ledidae.

2. *Leda confusa* Hanley.
   Thes. Conch. III, Nuculidae, p. 119, pl. CCXXVIII fig. 85; Yokoyama, Foss. Up. Musashino, p. 195, pl. XVII, fig. 4.

Limopsidae.

3. *Limopsis azumana* Yokoyama.
   Foss. Miura Penin., p. 174, pl. XVIII, figs. 19-21.
4. *Limopsis crenata* A. Adams.
   Yokoyama, Foss. Miura Penin., p. 173, pl. XVIII, figs. 17, 18.
5. *Limopsis nipponica* Yokoyama.
   Foss. Up. Musashino, p. 195, pl. XVII, figs. 16, 17.
6. *Limopsis woodwardii* A. Adams.
   Dunker, Ind. Moll., p. 237, pl. XVI, figs. 5, 6; Yokoyama, Foss. Up. Musashino, p. 192, pl. XVII, fig. 5.

Arcidae.

7. *Arca kobeltiana* Pilsbry.
   New Jap. Mar. Moll., Pelecypoda, July, 1904, p. 559, pl. XL, figs. 16-19; Yokoyama, Foss. Up. Musashino, p. 163, pl. XVII, fig. 4.
8. *Arca* (*Barbatia*) *decussata* Sowerby.
   Reeve, Conch. Icon., II, *Arca*, fig. 81.
9. *Arca* (*Barbatia*) *cf. domingensis* Lamarck.
   Compare with:—Kobelt, Conch. Cab., p. 195, pl. 47, fig. 12.
10. *Arca* (*Barbatia*) *stearnsii* Pilsbry.
    Catalogue Mar. Moll. Jap., p. 148, pl. III, figs. 8, 9, 10; Yokoyama, Foss. Miura Penin., p. 165, pl. XVI, fig. 9.
11. *Arca* (*Barbatia*) *symmetrica* Reeve.
    Conch. Icon., II, *Arca*, fig. 117; *Arca symmetrica* of Yokoyama (pars).

12. *Arca* (*Barbatia*) *tenebrica* Reeve.
Conch. Icon., II, *Arca*, fig. 105; Yokoyama, Moll. Coral-Bed, p. 60, pl. V, fig. 7.
13. **Arca* (*Barbatia?*) *sp.*
14. *Arca* (*Anadara*) *granosa* Linné.
Kobelt, Conch. Cab., VIII, p. 38, pl. III, fig. 7; Yokoyama, Foss. Up. Musashino, p. 186, pl. XV, fig. 4.
15. *Arca* (*Anadara*) *inflata* Reeve.
Conch. Icon., II, Arca, fig. 15; Yokoyama, Foss. Up. Musashino, p. 187, pl. XV, fig. 9.
16. *Arca* (*Scapharca*) *subcrenata* Lischke.
Jap. Meeresconch., I, p. 146, pl. IX, fig. 1, 2, 3; Yokoyama, Foss. Up. Musashino, p. 187, pl. XV, fig. 12.
17. *Glycymeris albolineata* Lischke.
Jap. Meeresconch., III, p. 108, pl. IX, figs. 11, 12; Yokoyama, Foss. Up. Musashino, p. 188, pl. XVII, figs. 1-3.
18. *Glycymeris rotunda* Dunker.
Ind. Moll., p. 236, pl. XVI, figs. 9, 10; Yokoyama, Foss. Miura Penin., p. 167, pl. XVII, figs. 10, 11.
19. *Glycymeris vestita* Dunker.
Ind. Moll., p. 236, pl. XVI, figs. 7, 8; Yokoyama, Foss. Up. Musashino, p. 189 (pars).
20. *Glycymeris yessoensis* Sowerby.
Yokoyama, Foss. Miura Penin., p. 168, pl. XVIII, figs. 1, 2; Up. Musashino, p. 189, pl. XVI, figs. 6, 7.

Parallerodontidae.

21. *Parallerodon obliquatus* Yokoyama.
Foss. Miura Penin., p. 170, pl. XVIII, figs. 9-11. (?pl. XVII, fig. 6).

Ostreidae.

22. *Ostrea musashiana* Yokoyama.
Foss. Miura Penin., p. 163, pl. XVI, figs. 1-5; Foss. Up. Musashino, p. 185, pl. XV, fig. 5.
23. *Ostrea gigas Thunberg.*
Tokunaga, Foss. Env. Tôkyô, p. 68, pl. IV, fig. 5; Yokoyama, Foss. Miura Penin., p. 162, pl. XV, figs. 1, 2.
24. *Ostrea denselamellosa* Lischke.
Jap. Meeresconch., I, p. 79, pls. XIII, XIV, fig. 1; Yokoyama, Foss. Miura Penin., p. 162, pl. XVI, fig. 6.

25. *Ostrea plicata* Chemnitz.
Reeve, Conch. Icon., *Ostrea*, fig. 68; Yokoyama, Foss. Miura Penin., p. 163, pl. XVII, figs. 1-3.

Pectinidae.

26. *Pecten laqueatus* Sowerby.
Thes. Conch., I, p. 46, pl. XV, fig. 101; Yokoyama, Foss. Miura Penin., p. 160, pl. XIV, figs. 9, 10.

27. *Pecten* (*Chlamys*) *laetus* Gould.
Otia Conch., p. 177; Lischke, Jap. Meeresconch., 1, p. 169, pl. XII, figs. 6, 7. Yokoyama, Foss. Up. Musashino, p. 180, pl. XIV, fig. 26.

28. *Pecten* (*Chlamys*) *subplicatus* Sowerby.
Thes. Conch., I, p. 64, pl. XLIII, fig. 37, pl. XIV, figs. 72, 73, 81; Yokoyama, Foss. Up. Musashino, p. 181, pl. XV, fig. 3.

Spondylidae.

29. *Plicatula cuneata* Dunker.
Ind. Moll., p. 246, pl. XI, fig. 3; Yokoyama, Foss. Up. Musashino, p. 180, pl. XIV, fig. 25.

30. *Plicatula muricata* A. Adams.
Dunker, Ind. Moll., p. 246, pl. XI, fig. 4.

Limidae.

31. *Lima* (*Limatula*) *subauriculata* Montagu (?)
Yokoyama, Foss. Miura Penin., p. 150, pl. XII, fig. 10.

32. *Lima* (*Mantellum*) *angulata* Sowerby.
Thes. Conch., I, p. 86, pl. XXIII, figs. 39, 40; Yokoyama, Foss. Miura Penin., p. 148, pl. XII, fig. 12.

Anomiidae.

33. *Anomia lischkei* Dautzenberg et Fischer.
Makiyama, Pliocene Moll. Maiko, p. 22; Yokoyama, Foss. Miura Penin., p. 147, pl. XI, figs. 18, 19 (*A. nipponensis*).

34. *Anomia lunula* Yokoyama.
Foss. Up. Musashino, p. 177, pl. XIV, figs. 22, 23.

35. *Pododesmus* (*Monia?*) *sematana* Yokoyama.
Foss. Up. Musashino, p. 177, pl. XIV, figs. 20, 21. (as *Anomia*).

36. *Pododesmus* (*Monia*) *sp.*

Mytilidae.

37. *Musculus cumingiana* Dunker.
Reeve, Conch. Icon., X, *Modiola*, pl. IX, fig. 63.

Thraciidae.

38. *Thracia transmontana* Yokoyama.
Foss. Up. Musashino, p. 172, pl. XIV, figs. 13, 14.

39. *Thracia? sp.*

Myochamidae.

40. *Myodora fluctuosa* Gould.
Otia Conch., p. 161; Yokoyama, Foss. Up. Musashino, p. 170, pl. XIV, figs. 6, 7.

41. *Myodora reeviana* Smith.
Pilsbry, New Jap. Mar. Moll., Pelecypoda, July 1904, p. 558, pl. XLI, figs. 7-10; Yokoyama, Foss. Miura Penin., p. 143, pl. XI, figs. 12, 13; Foss. Up. Musashino, p. 171, pl. XIV, figs. 8, 11.

Pleurophoridae.

42. *Trapezium japonicum* Pilsbry.
New Jap. Mar. Moll., 1905, p. 119, pl. V, figs. 34-36; Yokoyama, Foss. Up. Musashino, p. 166, pl. XIV, fig. 5 (*Corallio-phaga coralliophaga* of Yok. non Chemn.).

Crassatellitidae.

43. *Crassatellites heteroglyptus* Pilsbry.
Catalogue Mar. Moll. Jap., p. 135; Yokoyama, Foss. Miura Penin., p. 141, pl. XI, figs. 10, 11.

Carditidae.

44. *Venericardia cipangoana* Yokoyama.
Foss. Miura Penin., p. 137, pl. XI, fig. 2; Foss. Up. Musashino, p. 162, pl. XIII, fig. 4.

45. *Venericardia ferruginea* A. Adams.
Clessin, Syst. Conch. Cab., X, p. 17, pl. VI, fig. 11; Yokoyama, Foss. Miura Penin., p. 139, pl. XI, figs. 3, 4.

46. *Venericardia toneana* Yokoyama.
Foss. Up. Musashino, p. 163, pl. XIII, figs. 6, 7.

Chamidae.

47. *Chama semipurpurata* Lischke.
Jap. Meeresconch., II, p. 130, pl. VIII, fig. 1; Yokoyama, Foss. Up. Musashino, p. 161, pl. XIII, fig. 5.

Lucinidae.

48. *Phacoides* (*Parvilucina*) *contraria* Dunker.
Index Moll., p. 215, pl. XIII, figs. 12-14; Yokoyama, Foss. Up. Musashino, p. 134, pl. X, fig. 8.

49. *Phacoides* (*Parvilucina*) *pisidium* Dunker.
Moll. Jap., p. 28, pl. III, fig. 9; Yokoyama, Foss. Miura Penin., p. 137, pl. X, fig. 6.

Diplodontidae.

50. *Diplodonta usta* Gould.
Otia Conch., p. 170; Yokoyama, Foss. Miura Penin., p. 130, pl. IX, figs. 14-16. Foss. Up. Musashino, p. 159, pl. XIII, fig. 3.

51. *Diplodonta japonica* Pilsbry.
Catalogue Mar. Moll. Jap., p. 132, pl. III, figs. 6, 7; Yokoyama, Foss. Miura Penin., p. 131, pl. X, fig. 4.

Leptonidae.

52. *Montacuta japonica* Yokoyama.
Foss. Up. Musashino, p. 157, pl. IX, figs. 2, 3.

53. *Rochefordia paula* A. Adams.
Challenger Lamell., p. 203, pl. XII, fig. 1.

54. *Kellia subsinuata* Lischke.
Jap. Meeresconch., II, p. 136, pl. X, figs. 1-3.

Galeommidae.

55. *Scintilla cf. thoracica* Gould.
Compare with :—Otia Conch., p. 174.

56. **Scintilla cf. nipponica* Yokoyama.
Moll. Coral-Bed, Awa, p. 47, pl. IV, fig. 1.

Cardiidae.

57. *Cardium* (*Cerastoderma*) *californiense* Deshayes.
Dall, Northwest Coast Mar. Shell-bearing Moll., p. 39, pl. XIV, fig. 8; Yokoyama, Foss. Miura Penin., p. 127, pl. IX, fig. 10.

58. **Cardium braunsi* Tokunaga.
Foss. Env. Tokyo, p. 51, pl. III, fig. 11; Yokoyama, Foss. Miura Penin., p. 129, pl. X, fig. 1; Foss. Up. Musashino, p. 155, pl. XIII, fig. 2. (+*C. tokunagai* Yok.).

59. *Cardium* (*Trachycardium*) *burchardi* Dunker.
Ind. Moll., p. 210, pl. XVIII, figs. 4-6; Yokoyama, Foss. Up. Musashino, p. 153, pl. XII, fig. 3.

60. *Cardium* (*Fulvia*) *muticum* Reeve.
Conch. Icon., *Carnium*, fig. 32; Yokoyama, Foss. Up. Musashino., p. 154, pl. XII, fig. 7.

Veneridae.

61. *Dosinia japonica* Reeve.
Conch. Icon., *Dosinia*, fig. 17. (+*D. troscheli* Lischke).

62. *Cyclina chinensis* Chemnitz.
Concyl. Cab., XI, p. 111, pl. XI, fig. 5, pl. XXVIII, fig. 1; Yokoyama, Foss. Miura Penin., p. 119, pl. XI, figs. 7, 8.

63. *Clementia papyracea* Gray.
Sowerby, Thes. Conch., II, p. 700, pl. CLI, fig. 155.

64. *Sunetta excavata* Hanley.
Sowerby, Thes. Conch., II, p. 610, pl. CXXVI, figs. 13, 14; Yoko- yama, Foss. Up. Musashino, p. 147, pl. XI, figs. 6, 7, 8.

65. *Lioconcha sp.*

66. *Macrocallista chinensis* Chemnitz.
Pfeiffer, Syst. Conch. Cab., XI, p. 31, pl. X, fig. 2; Tokunaga, Foss. Env. Tôkyô, p. 46, pl. III, fig. 4. *M. chinensis* of Yokoyama (pars).

67. *Meretrix lusorina* Linné.
Pfeiffer, Syst. Conch. Cab., XI, p. 13, pl. I, fig. 8.

68. *Meretrix meretrix* Linné.
Pfeiffer, Syst. Conch. Cab., XI, p. 15, pl. III, figs. 4-6, 8, 9.

69. *Saxidomus purpuratus* Sowerby.
Lischke, Jap. Meeresconch., I, p. 127, pl. IX, figs. 4, 5; Yokoyama, Foss. Up. Musashino., p. 153, pl. XII, fig. 9.

70. *Gomphina neastartoides* Yokoyama.
Foss. Up. Musashino, p. 149, pl. XI, figs. 9, 10. (as *Venus*).

71. *Gomphina melanoegis* Roemer.
Novit. Conch., p. 40, pl. 12, figs. 12, 13. Lischke, Jap. Meeresconch., III, pl. VII, figs. 10, 11.

72. *Venus stimpsoni* Gould.
Otia Conch., p. 169; Yokoyama, Foss. Up. Musashino, p. 148, pl. XI, figs. 11, 12.

73. *Paphia* (*Ruditapes*) *cf. ducalis* Roemer.
Compare with:—Monogr. Molluskengattung, *Venus*, pl. XXIII, figs. 3, 3a, 3b.

74. *Paphia* (*Ruditapes*) *variegata* Hanley.
Thes. Conch., II, p. 696, pl. CLI, figs. 133-138; Yokoyama, Foss. Miura Penin., p. 125, pl. IX, figs. 4, 5.

75. *Paphia* (*Ruditapes*) *philippinarum* Adams et Reeve.
Lischke, Jap. Meeresconch., III, p. 78, pl. V, figs. 17-20; Yokoyama, Foss. Miura Penin., p. 125, pl. IX, fig. 10.

76. *Paphia greeffei* Dunker.
Index Moll., p. 207, pl. VIII, fig. 4; Yokoyama, Foss. Up. Musashino, p. 152, pl. XII, fig. 8 (*P. euglyptus* Yok. non Philippi).

77. *Paphia* (*Protothaca*) *jedoensis* Lischke.
Jap. Meeresconch., III, pl. VII, figs. 1-9; Yokoyama: Fossil Miura Penin., p. 120, pl. VIII, figs. 11, 12.

78. *Paphia* (*Protothaca*) *sp.*

79. *Venerupis insignis* Deshayes.
Sowerby, Thes. Conch., II, p. 765, pl. CLXV, fig. 22; Yokoyama, Foss. Miura Penin., p. 124, pl. IX, figs. 2, 3.

80. *Venerupis mitis* Deshayes.
Sowerby, Thes. Conch., II, p. 763, pl. CLXIV, fig. 1, pl. CLXV, figs. 31, 32; Yokoyama, Foss. Miura Penin., p. 123, pl. IX, fig. 1. (*V. irus* Yok. non Linné).

Petricolidae.

81. *Petricola aequistriata* Sowerby.
Reeve, Conch. Icon., XIX, fig. 19; Yokoyama, Foss. Up. Musashino, p. 151, pl. XII, fig. 1. (*Venerupis semipurpurea* Yok. non Dunker.)

Tellinidae.

82. *Tellina* (*Angulus*) *nitidula* Dunker.
Moll. Jap., p. 27, pl. III, fig. 14; Lischke, Jap. Meeresconch., II, p. 113, pl. X, figs. 10, 11; Yokoyama, Foss. Up. Musashino, p. 112, pl. VII, fig. 15.

83. *Tellina* (*Angulus*) *jedoensis* Lischke.
Jap. Meeresconch., III, p. 92, pl. IX, figs. 1-3; Yokoyama, Foss. Up. Musashino, p. 138, pl. IX, figs. 15, 16.

84. *Tellina* (*Peronidia*) *lutea venulosa* Schrenck.
Moll. Amurl., p. 556, pl. XX, figs. 2-5; Yokoyama, Foss. Up. Musashino, p. 139, pl. X, fig. 1 (+? *T. alternata chibana* Yok. Ibid., pl. X, figs. 5, 6.)

85. *Tellina ojiensis* Tokunaga.
Foss. Env. Tôkyô, p. 44, pl. II, fig. 34; Yokoyama, Foss. Miura Penin., p. 113, pl. VII, figs. 16, 17.

86. *Tellina delta* Yokoyama.
Foss. Up. Musashino, p. 141, pl. X, figs. 8-10.

87. **Tellina miyatensis* Yokoyama.
Foss. Miura Penin., p. 115, pl. VII, fig. 18; Foss. Up. Musashino, p. 141.

88. *Tellina sp.*

89. *Macoma dissimilis* Martens.
Lischke, Jap. Meeresconch., II, p. 115, pl. X, figs. 15-17; Yokoyama, Foss. Up. Musashino, p. 143, pl. X, fig. 4.

Semelidae.

90. *Semele sinensis* A. Adams.
Reeve, Conch. Icon., VIII, fig. 28.

Donacidae.

91. *Donax sp.*

Gariidae.

92. *Gari corrugata* Deshayes.
Reeve, Conch. Icon., X, fig. 9.

93. *Psammotaea violacea* Lamarck.
Yokoyama, Foss. Up. Musashino, p. 137, pl. IX, figs. 13, 14.

94. *Sanguinolaria olivacea* Jay.
Report on Shells Jap. Exped., 1856, p. 292, pl. I, figs. 8, 9; Lischke, Jap. Meeresconch., III, p. 98, pl. VIII, figs. 7-12; ? Yokoyama, Foss. Up. Musashino, p. 138, pl. VII, fig. 11; pl. IX, fig. 17.

Solenidae.

95. *Solecurtus divaricatus* Lischke.
Jap. Meeresconch., I, p. 142, pl. X, figs. 1, 2; Yokoyama, Foss. Miura Penin., p. 112, pl. VII, fig. 14.

96. *Siliqua pulchella* Dunker.
Index Moll., p. 174; Yokoyama, Foss. Up. Musashino, p. 135, pl. IX, fig. 7.

97. *Solen grandis* Dunker.
Novit. Conch., II, p. 71, pl. XXIV, fig. 5; Yokoyama, Foss. Up. Musashino, p. 134, pl. IX, fig. 1.

98. *Solen krusensternii* Schrenck.
Moll. Amurl., p. 595, pl. XXV, figs. 9-12; Yokoyama, Foss. Up. Musashino, p. 134, pl. IX, fig. 5.

Mactridae.

99. *Mactra dunkeri* Yokoyama.
Foss. Up. Musashino, p. 128, pl. VII, figs. 7, 8.

100. *Mactra sulcataria* Deshayes.
Reeve, Conch. Icon., *Mactra*, fig. 5; Yokoyama, Foss. Up. Musashino, p. 126, pl. VII, fig. 6.

101. *Mactra veneriformis* Deshayes.
Reeve, Conch. Icon., *Mactra*, fig. 78; Yokoyama, Foss. Miura Penin., p. 109, pl. VIII, fig. 10.

102. **Mactra sp.*

103. *Anatina* (*Raeta*) *yokohamensis* Pilsbry.
Catalogue Mar. Moll. Jap., p. 119, pl. III, figs. 4, 5; Yokoyama, Foss. Up. Musashino, p. 113, pl. VIII, figs. 5, 6.

104. *Anatina* (*Raeta*) *pulchella* Adams et Reeve.
Pilsbry, Catalogue Mar. Moll. Jap., p. 119; Reeve, Conch. Icon., VIII, *Mactra*, fig. 19 (*M. rostralis*); Yokoyama, Foss. Up. Musashino, p. 131, pl. VIII, fig. 7. (*R. elliptica*).

105. *Spisula* (*Hemimactra*) *grayana* Schrenck.
Moll. Amurl., p. 572; Yokoyama, Foss. Up. Musashino, p. 130, pl. VIII, figs. 1, 2.

106. *Spisula* (*Hemimactra*) *sachalinensis* imperialis Yokoyama.
Foss. Up. Musashino, p. 129, pl. VII, figs. 9, 10. (as *Mactra*).

107. *Spisula* (*Oxyperas*) *bernardi* Pilsbry.
New Jap. Mar. Moll., Pelecypoda, July, 1904, p. 550, pl. XXXIX, figs. 4-6; Yokoyama, Foss. Up. Musashino, p. 130, pl. VIII, figs. 3, 4.

108. *Lutraria maxima* Jonas.
Reeve, Conch. Icon., pl. III, fig. 11; Yokoyama, Foss. Up. Musashino, p. 133, pl. VIII, figs. 9, 10.

109. *Lutraria? sp.*

110. *Schizothaerus nuttallii* Conrad.
Yokoyama, Foss. Up. Musashino, p. 133, pl. VIII, fig. 8; ? Ibid., pl. VII, figs. 12, 13 (*Mactra ovalina* of Yokoyama non Lamarck).

Mesodesmatidae.

111. *Coecella chinensis* Deshayes.
Lischke, Jap. Meeresconch., I, p. 133, pl. X, figs. 5, 6; ? Yokoyama, Foss. Miura Penin., p. 109, pl. VII, figs. 21, 22. (*Ervilia otsuensis*).

Myacidae.

112. *Cryptomya busoensis* Yokoyama.
Foss. Up. Musashino, p. 126, pl. VII, figs. 1, 2.

113. *Mya sp.*
(? A young specimen of *M. arenaria japonica* Jay).

Corbulidae.

114. *Corbula amurensis* Schrenck.
Moll. Amurl., p. 584, pl. XXV, figs. 5-8; Yokoyama: Foss. Up. Musashino, p. 123, pl. VI, figs. 16, 17 (*C. frequens*), 18 (*C. pustulosa*).

115. *Corbula erythrodon* Lamarck.
Reeve, Conch. Icon., *Corbula*, pl. I, fig. 4; Yokoyama, Foss. Up. Musashino, p. 122, pl. VII, figs. 8, 9.

116. **Corbula pygmaea* Yokoyama.
Foss. Up. Musashino, p. 125, pl. VII, figs. 4, 5.

117. **Corbula sematensis* Yokoyama.
Foss. Up. Musashino, p. 124, pl. VI, figs. 19, 20.

118. *Corbula venusta* Gould.
Otia Conch., p. 164; Yokoyama, Foss. Miura Penin., p. 107, pl. VII, figs. 4-6.

Saxicavidae.

119. *Saxicava arctica* Linné.
Sowerby, Thes. Conch., *Saxicava*, pl. CCCCLXXI, fig. 1; Yokoyama, Foss. Up. Musashino, pl. VI, figs. 12, 13 (as young specimens of *T. nipponicum*?).

120. *Panope generosa* Gould.
Otia Conch., p. 165; Yokoyama, Foss. Up. Musashino, p. 121, pl. VI, figs. 14, 15.

Pholadidae.

121. *Zirphaea cf. constricta* Sowerby.
Compare with:—Thes. Conch., II, p. 489, pl. CIV, fig. 27.

122. *Barnea fragilis* Sowerby.
Thes. Conch., II, p. 488, pl. CVIII, figs. 92, 93; Yokoyama, Foss. Miura Penin., p. 104, pl. VI, fig. 26.

123. *Barnea? sp.*

SCAPHOPODA

Dentalinidae.

124. *Dentalium edoense* Tokunaga.
Foss. Env. Tôkyô, p. 37, pl. II, fig. 17; Yokoyama, Foss. Miura Penin., p. 103, pl. VI, fig. 28.

125. *Dentalium buccinulum* Gould.
Otia Conch., p. 119; Tryon: Man. Conch., XVII, pl. V, figs. 74-76, pl. VI, fig. 84.

126. *Dentalium nipponicum* Yokoyama.
Foss. Up. Musashino, p. 119, pl. VI, fig. 7 (=? *D. coruscum* Pilsbry, New Mar. Moll., 1905).

127. *Dentalium octogonum* Lamarck.
Lischke, Jap. Meeresconch., III, p. 75, pl. V, figs. 1-3; Yokoyama, Foss. Miura Penin., p. 103, pl. VI, figs. 22-24.

128. *Dentalium rhabdotum* Pilsbry.
New Mar. Moll. Japan, 1905, p. 116, pl. V, figs. 45-47.

GASTROPODA

Actionidae.

129. *Acteon tornatilis nipponensis* Yamakawa.
Foss. Opisthobr. Diluv. Japan, 1910, p. 39, pl. X, figs. 1, 2.

130. *Acteon* cf. *virgatus* Reeve.
Cfr.:—Conch. Icon., XV, pl. II, fig. 18; Tryon: Man. Conch., XV, p. 151, pl. XXA, figs. 63-64.

Tornatinidae.

131. *Tornatina exilis* Dunker.
Moll. Jap., p. 25, pl. II, fig. 14; Yokoyama, Foss. Up. Musashino, pl. I, fig. 4.

132. *Tornatina longispirata* Yamakawa.
Foss. Opisthobr. Diluv. Japan, 1910, p. 41, pl. X, figs. 8-10; pl. X, figs. 11, 13 (*T. longispirata var. ôtakensis*); Yokoyama, Foss. Up. Musashino, p. 24, pl. I, fig. 5.

133. *Retusa truncata* Yamakawa.
Foss. Opisthobr. Diluv. Japan, p. 44, pl. X, figs. 17-20; Yokoyama, Foss. Up. Musashino, p. 25, pl. I, fig. 7.

134. *Retusa globosa* Yamakawa.
Foss. Opisthobr. Diluv. Japan, p. 43, pl. X, figs. 14-16; Yokoyama, Foss. Up. Musashino, p. 25, pl. I, fig. 6.

135. *Retusa minima* Yamakawa.
Foss. Opisthobr. Diluv. Japan, p. 47, pl. XI, figs. 21-25; Yokoyama, Foss. Miura Penin., p. 26, pl. I, fig. 1.

136. *Retusa sp.*

Scaphandridae.

137. *Cylichna musashiensis* Tokunaga.
Foss. Env. Tokyo, p. 32, pl. II, fig. 12; Yokoyama, Foss. Up. Musashino, p. 27, pl. I, fig. 10.

138. *Cylichna yamakawai* Yokoyama.
Foss. Miura Penin., p. 29, pl. I, fig. 7.

139. **Cylichna sp.*

Ringiculidae.

140. *Ringicula musashinoensis* Yokoyama.
Foss. Miura Penin., p. 30, pl. I, figs. 3, 8; Foss. Up. Musashino, p. 30, pl. I, figs. 16, 17.

Terebridae.

141. **Terebra chibana* Yokoyama.
Foss. Up. Musashino, p. 32, pl. I, fig. 21.

142. *Terebra gotoensis* Smith.
Proc. Zool. Soc. London, 1879, p. 183, pl. XIX, figs. 1, 1a; Yokoyama, Foss. Up. Musashino, p. 31, pl. I, fig. 18.

143. *Terebra lischkeana* Dunker.
Index Moll., p. 71, pl. V, figs. 13-16; Yokoyama, Foss. Miura Penin., p. 31, pl. I, fig. 10.

144. *Terebra bathyraphe* Smith.
Watson, Challenger Gastrop., 1885, p. 377, pl. XIV, fig. 9; Hirase, Terebridae Jap. Empire, p. 10, pl. III, figs. 27-29.

145. *Terebra diversa* Smith.
Hirase, Terebridae Jap. Empire, p. 29, pl. V, figs. 63, 64.

146. *Parviterebra raritans* Yokoyama.
Foss. Up. Musashino, p. 36, pl. I, fig. 25.

Turritidae.

147. *Turris cf. declivis* Martens.
Compare with:—Kobelt, Syst. Conchyl. Cab., IV, p. 176, pl. XXXIV, fig. 7; Yokoyama, Foss. Up. Musashino, p. 37, pl. I, fig. 26 (*P. vertebrata* Yok. non Smith).

148. *Drillia principalis* Pilsbry.
Catalogue Mar. Moll. Jap., p. 17, pl. II, figs. 9, 10; Yokoyama, Foss. Miura Penin., p. 36, pl. I, fig. 20.

149. *Drillia glabriuscula* Yokoyama.
Foss. Up. Musashino, p. 40, pl. I, figs. 31, 32.

150. *Drillia subauriformis* Smith.
Proc. Zool. Soc. London, 1879, p. 195, pl. XIX, fig. 23; Yokoyama, Foss. Up. Musashino, p. 40, pl. I, fig. 30.

151. *Drillia fortilirata* Smith.
Proc. Zool. Soc. London, 1879, p. 194, pl. XIX, fig. 22.

152. *Clavatula patruelis* Smith.
Proc. Zool. Soc. London, 1879, p. 188, pl. XIX, figs. 10, 10a.

153. *Mangilia deshayesii* Dunker.
Moll. Japan, p. 3, pl. I, fig. 3; Yokoyama, Foss. Miura Penin., p. 41, pl. I, fig. 24.

154. *Mangilia ojiensis* Tokunaga.
Foss. Env. Tôkyô, p. 15, pl. I, fig. 28; Yokoyama, Foss. Up. Musashino, p. 41, pl. I, fig. 33.

155. *Mangilia tabatensis* Tokunaga.
Foss. Env. Tôkyô, p. 15, pl. I, fig. 27.

156. *Mangilia fukuchiana* Yokoyama.
Foss. Up. Musashino, p. 42, pl. I, fig. 34.

157. **Mangilia* (*Cythara?*) *sp.*

158. **Mangilia* (*Cythara*) *rugosolabiata* Yokoyama.
Foss. Up. Musashino, p. 42, pl. I, fig. 35.

159. **Mangilia* (*Cythara*) *cf. fairbankii* Nevill.
Compare with:—Tryon, Man. Conch., VI, p. 270, pl. XXII, fig. 48.

160. *Lienardia gainesi* Pilsbry.
Catalogue Mar. Moll. Jap., p. 20, pl. II, fig. 4.

161. *Bela rugulata schneideri* Harmer?.
Yokoyama, Foss. Up. Musashino, p. 44, pl. I, fig. 37.

Cancellaridae.

162. *Cancellaria spengleriana* Deshayes.
Sowerby, Thes. Conch., II, p. 439, pl. XCIII, fig. 29; Yokoyama, Foss. Miura Penin., p. 44, pl. II, figs. 2, 3; Foss. Up. Musashi- no, p. 46, pl. II, fig. 2. (*C. asperella reeviana* of Yokoyama non Crosse).

163. *Cancellaria nodulifera* Sowerby.
Thes. Conch., II, p. 440, pl. 94, fig. 57; Dunker, Index Moll., p. 103, pl. VI, figs. 24, 25; Yokoyama, Foss. Up. Musashino, p. 45, pl. II, fig. 1.

Olividae.

164. *Olivella fortunei* A. Adams.
Sowerby, Thes. Conch., IV, p. 36, pl. CCCL, figs. 422, 423; Pilsbry, Catalogue, p. 23, pl. II, fig. 11; Yokoyama, Foss. Up. Musashino, p. 47 (pars).

165. *Olivella spretoides* Yokoyama.
Foss. Up. Musashino, p. 47, pl. II, fig. 4. (=? juvenile state of the next species).

166. *Olivella fulgulata* Adams et Reeve.
Sowerby, Thes. Conch., IV, pl. CCCL, figs. 424, 425; Pilsbry, Catalogue, p. 23.

Fasciolariidae.

167. *Fusinus? sp.* (A single juvenile specimen).
Chrysodomidae.

168. *Chrysodomus? sp.*

Buccinidae.

169. *Siphonalia spadicea* Reeve.
Conch. Icon., *Bvccinum*, fig. 64 (*S. fusoides*); Yokoyama, Foss. Miura Penin., p. 53, pl. III, figs. 8-11.

170. *Siphonalia trochulus* Reeve.
Conch. Icon., *Buccinum*, fig. 7; Yokoyama, Foss. Up. Musashino, p. 56 (pars). pl. II, fig. 17.

171. *Siphonalia cassidariaeformis* Reeve.
Conch. Icon., *Buccinum*, fig. 11; Lischke, Jap. Meeresconch., I, p. 38, pl. IV, figs. 1-10.

172. *Siphonalia stearnsii* Pilsbry.
Catalogue, Mar. Moll, Japan, p. 29, pl. II, figs. 1, 2; Yokoyama, Foss. Up. Musashino, p. 56 (pars.) pl. II, fig. 16 (? 15, 18).

173. *Latrunculus japonicus* Reeve.
Conch. Icon., *Eburna*, fig. 3; Yokoyama, Foss. Up. Musashino, p. 57, pl. II, fig. 20.

174. *Cantharus cecillei* Philippi.
Tryon, Man. Conch., III, p. 157, pl. III, figs. 262, 263.

Nassariidae.

175. *Nassarius* (*Niotha*) *livescens* Philippi.
Lischke, Jap. Meeresconch., II, p. 52, pl. IV, figs. 1-3; Yokoyama, Foss. Miura Penin., p. 58, pl. III, fig. 18.

176. *Nassarius* (*Hima*) *festivus* Powis.
Tryon, Man. Conch., IV, p. 46, pl. XIV, figs. 239-242; Yokoyama, Foss. Miura Penin., p. 57, pl. III, fig. 6.

177. *Nassarius* (*Hima*) *japonicus* A. Adams.
Lischke, Jap. Meeresconch., III, p. 37, pl. II, figs. 20-23; Yokoyama, Foss. Miura Penin., p. 56, pl. III, fig. 5.

178. *Nassarius sp.*
(? juvenile specimen of the preceding species).

Columbellidae.

179. *Collumbella* (*Atilia*) *smithi* Yokoyama.
Foss. Up. Musashino, p. 61, pl. II, fig. 24.

180. *Collumbella* (*Atilia*) *praecursor* Yokoyama.
Foss. Up. Musashino, p. 61, pl. II, fig. 25.

181. *Collumbella* (*Astyris*) *dunkeri* Tryon.
Man. Conch., V, p. 129, pl. XLIX, fig. 15; Dunker, Moll. Jap., 6, pl. I, fig. 17. (*Amycla varians*); Yokoyama, Foss. Up. Musashino, p. 62, pl. II, fig. 26.

182. *Columbella* (*Astyris?*) *masakadoi* Yokoyama.
Foss. Up. Musashino, p. 62, pl. II, fig. 23.

183. *Zafra pumila* Dunker.
Moll. Jap., p. 6, pl. I, fig. 4; Tokunaga, Foss. Env. Tôkyô, p. 11, pl. I, figs. 1a, 1b.

184. *Zafra sp.*

Muricidae.

185. *Tritonalia falcata* Sowerby.
Thes. Conch., IV, p. 44, pl. CCCXCIV, fig. 149; Yokoyama, Foss. Up. Musashino, p. 65, pl. III, fig. 4.

186. *Trophon* (*Neptunea*) *subclavatus* Yokoyama.
Foss. Miura Penin., p. 60, pl. III, fig. 2; pl. VI, figs. 13, 14; Up. Musashino, pl. III, fig. 2.

187. *Trophon* (*Neptunea*) *sp.*

188. *Rapana bezoar thomasiana* Crosse.
Pilsbry, Catalogue, p. 44; Yokoyama, Foss. Up. Musashino, p. 66, pl. III, fig. 6.

Epitoniidae.

189. *Epitonium auritum* Sowerby.
Thes. Conch., *Scalaria*, p. 92, pl. XXXIII, fig. 62; Yokoyama, Foss. Up. Musashino, p. 85, pl. IV, fig. 13.

190. *Epitonium azumanum* Yokoyama.
Foss. Up. Musashino, p. 86, pl. IV, fig. 15.

191. *Epitonium kazusense* Yokoyama.
Foss. Up. Musashino, p. 87, pl. IV, fig. 16.

192. *Epitonium immaculatum* Sowerby.
Thes. Conch., *Scalaria*, pl. XXXIII, fig. 58; Yokoyama, Foss. Up. Musashino, p. 89, pl. IV, fig. 20 (*S. picturata*).

193. *Epitonium maculosum* Adams et Reeve.
Tryon, Man. Conch., IX, p. 59, pl. XII, fig. 86; Yokoyama, Foss. Up. Musashino, p. 86, pl. IV, fig. 14.

194. *Epitonium japonicum* Dunker.
Moll. Japan, p. 13, pl. I, fig. 13.

195. *Epitonium sp.* (a) (*Crisostrema* (*Nodiscala*) *attenuata* Peace?)

196. **Epitomium sp.* (b)

Tonnidae.

197. *Tonna luteostoma* Küster.
Syst. Conch. Cab., III, p. 66, pl. LVIII, fig. 2; Yokoyama, Foss. Up. Musashino, p. 69, pl. III, fig. 10.

Cassidae.

198. *Phalium strigatum* Gmelin.
Reeve, Conch. Icon., *Cassis*, fig. 26; Yokoyama, Foss. Up. Musashino, p. 68, pl. III, fig. 9.

199. *Phalium sp.*
A young specimen of *Phalium*?

Melanellidae.

200. *Subularia tokunagai* Yokoyama.
Foss. Up. Musashino, p. 90, pl. IV, fig. 22.

201. *Subularia glabroides* Yokoyama.
Foss. Up. Musashino, p. 90, pl. IV, fig. 23.

202. *Subularia unicinct* Yokoyama.
Foss. Up. Musashino, p. 89, pl. IV, fig. 21.

203. *Subularia yokosukensis* Yokoyama.
Foss. Miura Penin., p. 79, pl. V, fig. 7.

204. *Subularia sp.* (a)

205. **Subularia sp.* (b)

206. **Subularia? krishana* Yokoyama.
Foss. Up. Musashino, p. 91, pl. IV, fig. 24.

207. *Melanella sp.*
Pyramidellidae.

208. *Pyramidella* (*Actiopyramis*) *eximia* Lischke.
Jap. Meeresconch., III. p. 59, pl. III, figs. 4-6; Yokoyama, Foss. Up. Musashino, p. 94, pl. VI, fig. 1.

209. *Pyramidella* (*Agatha*) *virgo* A. Adams.
Dall and Bartsch, Jap. Indopac. and Amer. Pyramidellidae, p. 335, pl. XVIII, fig. 2.

210. *Pyramidella* (*Agatha*) *virgo brevis* Yokoyama.
Foss. Up. Musashino, p. 92, pl. V, fig. 3.

211. *Pyramidella* (*Syrnola*) *cinnamonea* A. Adams.
Dall and Bartsch, Pyramidellidae, p. 332, pl. XX, fig. 1; Yokoyama, Foss. Up. Musashino, p. 93, pl. V, fig. 2.

212. *Pyramidella* (*Syrnola*) *cf. brunnea* A. Adams.
Compare with:—Dall and Bartsch, Pyramidellidae, p. 332, pl. XXIV, fig. 4.

213. *Pyramidella* (*Tiberia*) *pulchella* A. Adams.
Dall and Bartsch, Pyramidellidae, p. 323, pl. XV, fig. 4; Yokoyama, Foss. Up. Musashino, p. 91, pl. V, fig. 6.

214. *Pyramidella* (*Tiberia*) *cf. pusilla* A. Adams.
Compare with:—Dall and Bartsch, Pyramidellidae, p. 324, pl. XXIV, fig. 6.

215. *Pyramidella* (*Iphiana*) *lischkei* Dall et Bartsch.
Dall and Bartsch, Pyramidellidae, p. 333, pl. XXV, fig. 1.

216. **Pyramidella* (*Iphiana*) *siva* Yokoyama.
Foss. Up. Musashino, p. 94, pl. IV, fig. 26.

217. **Pyramidella* (*Iphiana*) *sp.*

218. **Pyramidella* (*Eulimella*) *sp.*

219. *Odostomia* (*Odostomia*) *suboxia* Yokoyama.
Foss. Up. Musashino, p. 98, pl. IV, fig. 32.

220. **Odostomia* (*Odostomia*) *venusta* Yokoyama.
Foss. Up. Musashino, p. 97, pl. IV, fig. 30.

221. **Odostomia* (*Odostomia*) *toneana* Yokoyama.
Foss. Up. Musashino, p. 98, pl. IV, fig. 31.

222. *Odostomia* (*Odostomia*) *shimosensis* Yokoyama.
Foss. Up. Musashino, p. 96, pl. IV, fig. 28.

223. *Odostomia* (*Odostomia*) *deshimana* Dall et Bartsch.
Japan, Indopac. a. American, Pyramidellidae, p. 362, pl. XXV, fig. 3, pl. XXVI, fig. 2; Yokoyama, Foss. Up. Musashino, p. 96, pl. V, fig. 7.

224. *Odostomia* (*Odostomia*) *limpida* Dall and Bartsch.
Dall and Bartsch, l. c. p. 364, pl. XX, fig. 7; Yokoyama, Foss. Up. Musashino, p. 96, pl. XIV, fig. 1.

225. **Odostomia* (*Odostomia*) *kizakiensis* Yokoyama.
Foss. Up. Musashino, p. 97, pl. IV, fig. 29.

226. *Odostomia* (*Odostomia*) *gordonis* Yokoyama.
Foss. Up. Musashino, p. 95, pl. IV, fig. 27.

227. **Odostomia* (*Odostomia*) *sp.*

228. **Odostomia* (*Odostomia*) *sublimpida* Yokoyama.
Foss. Miura Penin., p. 82, pl. V, fig. 13.

229. *Odostomia* (*Miralda*) *gemma* A. Adams.
Dall and Bartsch, Pyramidellidae, p. 356, pl. XXII, fig. 1.

230. *Odostomia* (*Parthenina*) *takinogawensis* Tokunaga.
Foss. Env. Tôkyô, p. 23, pl. I, fig. 45; Yokoyama, Foss. Miura Penin., p. 82, pl. V, fig. 10.

231. *Odostomia* (*Odetta*) *neofelix* Yokoyama.
Foss. Up. Musashino, p. 99, pl. IV, fig. 33.

232. *Odostomia* (*Egilina*) *marielloides* Yokoyama.
Foss. Up. Musashino, p. 100, pl. IV, fig. 34.

233. **Odostomia* (*Chrysallida*) *sp.*

234. **Odostomia* (*Scalenostoma*) *cf. dotella* Dall et Bartsch.
Compare with:—Monogr. West Amer. Pyramidellid Moll., p. 230, pl. XXX, fig. 5.

235. *Odostomia* (*Evalea*) *culta* Dall et Bartsch.
Notes on Jap. Indopac. and Americ. Pyramidellidae, p. 361, pl. XXVI, fig. 9.

236. *Odostomia? sp.*

237. *Turbonilla* (*Cingulina*) *cingulata* Dunker.
Moll. Japan, p. 16, pl. I, fig. 10; Dall and Bartsch, Pyramidellidae, p. 344, pl. XXI, fig. 1.

238. *Turbonilla* (*Cingulina*) *triarata* Pilsbry.
New Jap. Mar. Moll., Gastropoda, 1904, p. 31, pl. V, fig. 48; Yokoyama, Foss. Up. Musashino, p. 105, pl. V, fig. 14.

239. *Turbonilla* (*Chemnitzia*) *actopora* Dall et Bartsch.
Jap. Indopac. and Amer. Pyramidellidae, p. 338, pl. XVII, fig. 3.

240. *Turbonilla* (*Chemnitzia*) *kidoensis* Yokoyama.
Foss. Up. Musashino, p. 103, pl. IV, fig. 39.

241. *Turbonilla* (*Chemnitzia*) *imbana* Yokoyama.
Foss. Up. Musashino, p. 101, pl. IV, fig. 35.

242. *Turbonilla* (*Chemnitzia*) *teganumana* Yokoyama.
Foss. Up. Musashino, p. 103 pl. IV, fig. 40.

243. *Turbonilla* (*Chemnitzia*) *dunkeri* Clessin.
Dall and Bartsch, Pyramidellidae, p. 336, pl. XX, fig. 3.

244. *Turbonilla* (*Chemnitzia*) *approximata* Dall et Bartsch.
Ibid., p. 337, pl. XX, fig. 1.

245. *Turbonilla* (*Chemnitzia*) *sematana* Yokoyama.
Foss. Up. Musashino, p. 103, pl. IV, fig. 41.

246. **Turbonilla* (*Chemnitzia*) sp.

247. *Turbonilla* (*Ptyceulimella*) *misella* Yokoyama.
Foss. Up. Musashino, p. 100, pl. IV, fig. 36.

248. *Turbonilla* (*Strioturbonilla*) *sagamiana* Yokoyama.
Foss. Up. Musashino, p. 104, pl. V, fig. 12.

249. *Turbonilla* (*Strioturbonilla*) *pacifica* Yokoyama.
Foss. Up. Musashino, p. 105, pl. V, fig. 13.

250. *Turbonilla* (*Pyrgolampros*) *planicosta* Yokoyama.
Foss. Up. Musashino, p. 104, pl. V, fig. 11.

251. *Turbonilla* (*Mormula*) *pausicostulata* Tokunaga.
Foss. Env. Tôkyô, p. 22; Yokoyama, Foss. Up. Musashino, p. 101, pl. IV, fig. 37.

252. *Turbonilla* (*Mormula*) *aulica* Dall et Bartsch.
Jap. Indopac. a. Amer. Pyramidellidae, p. 345, pl. XXII, fig. 7.

253. *Turbonilla* (*Mormula?*) *scrobiculata* Yokoyama.
Foss. Up. Musashino, p. 102, pl. IV, fig. 38.

254. **Turbonilla* (*Careliopsis*) *obscula* Yokoyama.
Foss. Up. Musashino, p. 106, pl. V, fig. 15.

Triviidae.

255. *Erato callosa* Adams et Reeve.
Sowerby, Thes. Conch., III, p. 82, pl. CCXIX, figs. 35-37; Yokoyama, Foss. Up. Musashino, p. 69, pl. III, fig. 11.

Triphoridae.

256. *Triphora otsuensis* Yokoyama.
Foss. Miura Penin., p. 69, pl. IV, fig. 11; Foss. Up. Musashino, p. 74, pl. III, fig. 16.

257. *Triphora exilis* Dunker.
Moll. Japan, p. 10, pl. II, fig. 9; Yokoyama, Moll. Coral-Bed, p. 23, pl. V, fig. 14.

258. *Triphora tricincta* Dunker.
Moll. Japan, p. 10, fig. 1; Pilsbry, Catalogue, p. 58.

Cerithiopsidae.

259. *Seila dextroversa* Adams et Reeve.
Tryon, Man. Conch., IX, p. 190, pl. XXXIX, fig. 58; ? Yokoyama, Foss. Up. Musashino, p. 73, pl. III, fig. 15 (*C. trisulcatus*).

260. *Cerithiopsis sp.* (a)

261. **Cerithiopsis sp.* (b)

Cerithiidae.

262. *Potamides* (*Batillaria*) *cumingi* Crosse.
Lischke, Jap. Meeresconch., I, p. 76, pl. VI, figs. 11-14.

263. *Potamides* (*Batillaria*) *zonalis multiformis* Lischke.
Jap. Meeresconch., I, p. 74, pl. VI, figs. 1-10; Yokoyama, Foss. Miura Penin., p. 69, pl. IV, fig. 9.

264. *Potamides* (*Batillaria*) *zonalis* Bruguiere.
Lischke, Jap. Meeresconch., I, p. 73, pl. VI, figs. 15, 16; Yokoyama, Foss. Up. Musashino, p. 72.

265. *Potamides* (*Tympanotonos*) *fluviatilis* Mostiez et Michand.
Yokoyama, Foss. Miura Penin., p. 68, pl. IV, fig. 14; Foss. Up. Musashino, p. 71.

266. *Clava kochi* Philippi.
Abbil., III, pl. I, fig. 3; Yokoyama, Foss. Up. Musashino, p. 71, pl. III, fig. 13.

267. *Cerithidea rhizoporum* A. Adams.
Tryon, Man. Conch., IX, p. 162, pl. XXXIII, figs. 62, 67.

268. *Bittium perpusillum* Tryon.
Man. Conch., IX, p. 154, pl. XXX, fig. 17; Yokoyama, Foss. Miura Penin., p. 67, pl. II, fig. 6.

269. **Bittium sp.*

Strombidae.

270. *Strombus japonicus* Reeve.
Conch. Icon., *Strombus*, fig. 42; Yokoyama, Foss. Up. Musashino, p. 70, pl. III, fig. 12.

Caecidae.

271. *Caecum vitreum* Carpenter?
Yokoyama, Foss. Up. Musashino, p. 76, pl. III, fig. 18.

Lacunidae.

272. *Lacuna stenotomorpha* Pilsbry.
Catalogue Mar. Moll. Japan, p. 64, pl. VIII, fig. 3.

Skeneidae.

273. *Skenea nipponica* Yokoyama.
Foss. Miura Penin., p. 75, pl. V, fig. 1; Foss. Up. Musashino, p. 81, pl. IV, fig. 7.

Rissoidae.

274. *Cingula* (*Onoba*) *sp.*

275. **Cingula* (*Setia*) *sp.*

276. *Scaliola sp.* (=? *S. bella* A. Ad.)

277. *Diala sp.* (=? *S. vitrea* Sow.)

278. **Rissoina* (*Morchiella*) *manzakiana* Yokoyama.
Foss. Up. Musashino, p. 79, pl. IV, fig. 4.

279. *Rissoina* (*Rissolina*) *laevicostulata* Pilsbry.
New Jap. Mar. Moll., Gastropoda, 1904, p. 27, pl. V, figs. 44, 44a.

280. **Rissoia* (*Apicularia*) *sp.*

281. *Fenella septentrionalis* Tokunaga.
Foss. Env. Tôkyô, p. 26, pl. I, fig. 55; Yokoyama, Foss. Up. Musashino, p. 80, pl. IV, figs. 5, 6.

282. *Fenella meridionalis* Tokunaga.
Foss. Env. Tôkyô, p. 27, pl. I, fig. 56.

283. *Fenella (?) sp.*

Capulidae.

284. *Capulus badius* Dunker.
Index Moll., p. 124, pl. XIII, figs. 15-17; Yokoyama, Foss. Up. Musashino, p. 82, pl. IV, fig. 9.

Naticidae.

285. *Polinices (Neverita) ampla* Philippi.
Tryon, Man. Conch., VIII, p. 32; Yokoyama, Foss. Miura Penin., p. 84, pl. V, figs. 5, 6.

286. *Polinices (Mamillaria) melanostoma* Gmelin.
Tryon, Man. Conch., p. 50; Pilsbry, Catalogue, p. 72.

287. *Polinices (Mamillaria) sagamiensis* Pilsbry.
New Jap. Mar. Moll., Gastropoda, 1904, p. 23, pl. IV, figs. 37, 37a.

288. *Natica (Cryptonatica) janthostoma* Deshayes.
Philippi, Syst. Conch. Cab., II, p. 53, pl. VIII, fig. 8; Yokoyama, Foss. Miura Penin., p. 77, pl. V, figs. 3, 4.

289. *Natica concinna* Dunker.
Moll. Japan, p. 14, pl. II, fig. 14.

290. *Sigaretus (Eunaticina) papilla* Gmelin.
Tryon, Man. Conch., VIII, p. 58, pl. XXV, figs. 78, 79, 87, 88; Yokoyama, Foss. Up. Musashino, p. 84, pl. IV, fig. 8.

Acmaeidae.

291. *Acmaea heroldi* Dunker.
Pilsbry, Catalogue, p. 111, pl. VI, figs. 13-18.

292. *Acmaea conulus* Dunker.
Dunker, Moll. Japan, p. 24, pl. III, fig. 19; Tryon, Man. Conch., XIII, p. 45, pl. IX, figs. 17, 18.

Patellidae.

293. *Helcioniscus pallidus* Gould (juvenile specimens).
Tryon, Man. Conch., XIII, p. 133, pl. LXVII, figs. 9, 10; Yokoyama, Foss. Miura Penin., p. 101, pl. VI, figs. 16, 17.

Turbinidae.

294. *Leptothyra pygmaea* Yokoyama.
Foss. Up. Musashino, p. 108, pl. V, fig. 17.

295. *Leptothyra rubra* Dunker.
Index Moll., p. 128, pl. XII, fig. 7-9.

Trochidae.

296. *Umbonium costatum* Lesson.
Tryon, Man. Conch., XI, p. 454, pl. LIX, figs. 34, 35; Yokoyama, Foss. Miura Penin., p. 95, pl. VI, fig. 6.

297. *Calliostoma unicum* Dunker (juvenile specimens).
Tryon, Man. Conch., XI, p. 341, pl. X, figs. 9, 10.

298. *Calliostoma hungerfordi* Sowerby.
Tryon, Man-Conch., XI, p. 343, pl. XXXIV, fig. 10 ? Yokoyama, Foss. Up. Musashino, p. 112, pl. V, fig. 25 (*C. unicum shinagawensis* Tok).

299. **Minolia tasmanica* Tenison et Wood?
Yokoyama, Foss. Up. Musashino, p. 109, pl. V, fig. 19.

300. *Minolia? sp.*

301. *Solariella philippensis* Watson?
Yokoyama, Foss. Up. Musashino, p. 110, pl. V, fig. 21.

302. **Margarites* (*Pupillaria*) *sp.*

Cyclostrematidae.

303. *Cyclostrema duplicata* Lischke.
Jap. Meeresconch., III, p. 61, pl. III, figs. 9, 10; Yokoyama, Foss. Miura Penin., p. 95, pl. VI, fig. 8.

Fissurellidae.

304. *Puncturella nobilis* A. Adams.
Tryon, Man. Conch., XII, p. 231, pl. LXIII, figs. 34-37; Yokoyama, Foss. Up. Musashino, p. 116, pl. VI, fig. 4.

305. *Macroschisma sinensis* A. Adams.
Pilsbry, Catalogue Mar. Moll. Jap., p. 107, pl. VI, figs. 6-8.

In the above list, the species not yet known to be living are marked with an asterisk.

We see in the above list that the number of species distinguishable in material derived from the single locality of the Manzakian or Upper Narita, at Hossaku, is 305, of which 123 species belong to the Lamellibranchiata, 5 to the Scaphopoda and 177 to the Gastropoda. Of the 305, 263 have been specifically identified, either accurately or more or less approximately, while 42 remain unnamed. The latter include mostly very small forms, either new to science in all probability (38 species belong to this category) or quite indeterminable owing to bad or fragmental preservation (9 species).

The annexed List II shows the species particularly abundant or dominant at the present locality.

LIST II.

Species represented by more than One Hundred Individuals in 27 Cubic Feet of Sand[1)]

Species	Number of right v.	Number of left v.	Number of jointed v.	Number of individuals
Gomphina neastartoides Yok.	38.002	37.938	339	38.309
Tellina delta Yok.	9.421	9.118	148	9.417
Fenella septentrionalis Tok.				9.188
Mactra sulcataria Desh.	5.573	5.770	21	5.693
Ringicula musashinoensis Yok.				4.698
Corbula pygmaea Yok.	4.208	4.625	95	4.512
Paphia variegata Hanley	4.537	4.493	16	4.458
Odostomia deshimana Dall & Bart.				4.350
Tornatina exilis Dkr.				4.345
Olivella fulgurata A. Ad.				4.090
Venericardia toneana Yok.	1.692	1.761	522	2.249
Subularia tokunagai Yok.				2.215
Leptothyra rubra Dkr.				1.489
Glycymeris vestita Dkr.	1.255	1.119	26	1.203
Nassarius japonicus A. Ad.				1.098
Sunetta excavata Hanley	805	894	3	853
Glycymeris yessoensis Sow.	878	684		781
Arca subcrenata Lke.	608	773	2	691
Donax sp.	528	528	24	552
Columbella smithi Yok.				450
Olivella spretoides Yok.				371
Potamides multiformis Lke.				364
Skenea nipponica Yok.				363
Odostomia gordonis Yok.				318
Ostrea gigas Thunbg.	286	298		292
Polinices ampla Phil.				282
Pyramidella cinnamonea A. Ad.				245
Rissoina manzakiana Yok.				215
Tellina sp.	269	159		214
Columbella dunkeri Tryon				213
Mactra dunkeri Yok.	194	221		208
Mangilia fukuchiana Yok.				183
Dentalium edcense Tok.				166
Pyramidella eximia Lke.				165
Odostomia suboxia Yok.				156
Mangilia rugosolabiata Yok.				153
Cardium braunsi Tok.	115	142		129
Phacoides contraria Dkr.	119	131		125
Corbula venusta Gld.	119	128	1	125
Columbella pumila Dkr.				113
Subularia glabroides Yok.				103

1) There are various conventions used by Nomura in counting the individuals, the details of which will be given by him in a paper entitled "Molluscan Fauna of the Manzakian Shell-Sand: a Statistical Study, the First Report."

Fossils other than Mollusca are exceedingly rare, with the one exception of *Echinarachnius mirabilis* Barn.; the sand-dollar is found at this place mostly in a fragmental and water-worn state, and the number of its individuals in the 27 cubic feet of sand is roughly estimated to be 4700.

Hossaku is no doubt one of the localities most prolific in the Manzakian or Upper Narita fossils. Professor Yokoyama described 175 species of Gastropoda, 4 of Scaphopoda, 152 of Lamellibranchiata and 4 of Brachiopoda, altogether 335 species, from the Manzakian sand of various localities in the provinces of Shimôsa and Kazusa, while we get 305 species from this single locality. Of the species of Mollusca described by him, 75 species of Gastropoda, 64 of Lamellibranchiata, 1 of Scaphopoda and 4 of Brachiopoda are not represented in our collection, while 35 of our species of Lamellibranchiata, 77 of Gastropoda and 2 of Scaphopoda are not recorded by him.

As already quoted in the first chapter, Professor Yokoyama stated that the number of species in the Manzakian fauna, not yet known to be now living amount to 103, or 29.3% of the whole fauna. Nomura, on the other hand, now recognizes only 26 of the 305 species from Hossaku as "not yet known to be living." On excluding 9 indeterminable species from the 305, the ratio of the species "not yet known to be living" to those living becomes 11.5%. This great reduction of the "not yet known to be living" forms is due simply to the circumstance that we have numerous minute forms found in the recent materials dredged up from the sea off the coast of the provinces of Rikuchû and Rikuzen for comparison.

There is, we believe, a possibility of still further reducing the above percentage by future discoveries, but how far such a reduction will go it is at present impossible to say. In this connection, it is worthy of note that the majority of the species "not yet known to be living" in the present fossil material are minute forms, especially many belonging to the Pyramidellidae. As at present our knowledge of these diminutive living Mollusca is very imperfect, it is quite obvious that the ratio of the forms "not yet known to be living" to those living will be increased in proportion as we take minute forms into account.

In the case of the Manzakian fauna of Hossaku, we have only 4 "not yet known to be living" species among those of small to moderate and large sizes. These are:

Terebra chibana Yok.
Arca (*Barbatia*) sp.
Cardium braunsi Tok.
Corbula sematensis Yok.

Further, there are three species of minute size, likewise "not yet known to be living," but found in great abundance, which are

Corbula pygmaea Yok.
Rissoina manzakiana Yok.
Mangilia rugosolabiata Yok.

The possibility of being really extinct is much greater in these seven species than in the others, and they constitute 2.33% of the whole fauna. Perhaps this is the lower limit in the reduction of the percentage to be expected.

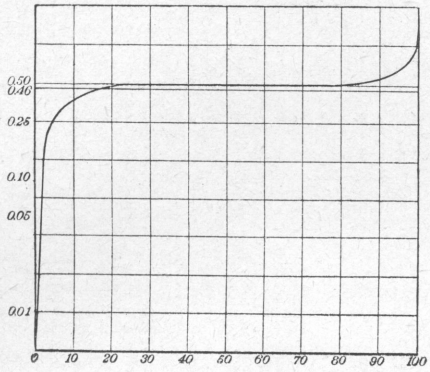
The mechanical analysis of the sand of Hossaku by Mr. Y. Tomita[1] gives the following result.

Grade	Clay	Silt		Sand			Gravel
		Fine	Coarse	Fine	Median	Coarse	
Grain size	mm. <0.01	mm. >0.01 <0.05	mm. >0.05 <0.1	mm. >0.1 <0.25	mm. >0.25 <0.5	mm. >0.5 <1.0	mm. >1.0
Average Wgt. perc.	0.7	0.7	0.5	2.4	76.3	18.8	0.6

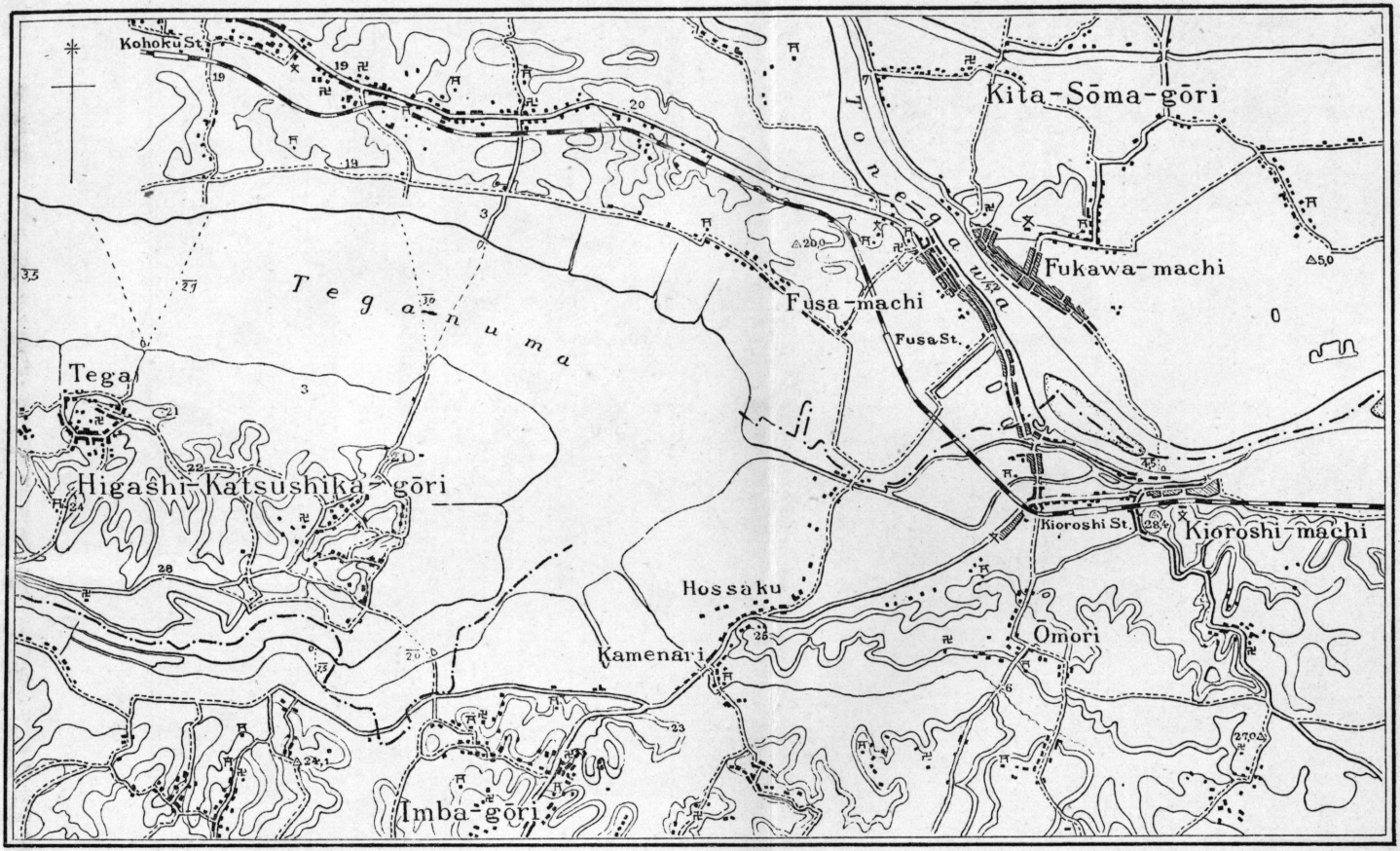
The annexed cut (Text-figure) shows the mechanical constitution curve of the sand in cumulative weight percentage: the equivalent grade of the sample, as its representative grade, is 0.460 mm., and the grading factor or homogeneity of it is 0.956. The high homogeneity of the sand indicates that it had been sufficiently sorted during its deposition, as is usually the case in the beach sand of an open seashore. Further the part of the sand of coarser grades mostly comprises moderately rounded grains of quartzite, clay-slate, quartz, orthoclase and flakes of biotite, while that of finer grades mostly consists of grains of quartz, hypersthene, magnetite, feldspars, augite, biotite and hornblende.

1) The methods of mechanical analysis applied by the author is explained in Y. Tomita: On Mechanical Analysis of Loose Sand (in Japanese). Contr. Inst. Geol and Pal. Tôhoku Imp. Univ., No. 6, 1926.

Mechanical Constitution Curve
(in cumulative weight percentage)



Map of a part of Inba-gôri and Kita-Sôma-gôri, province of Shimôsa. **Plate II**



Scale 1 : 50,000 Contour interval 10 m.

Fig. 1.

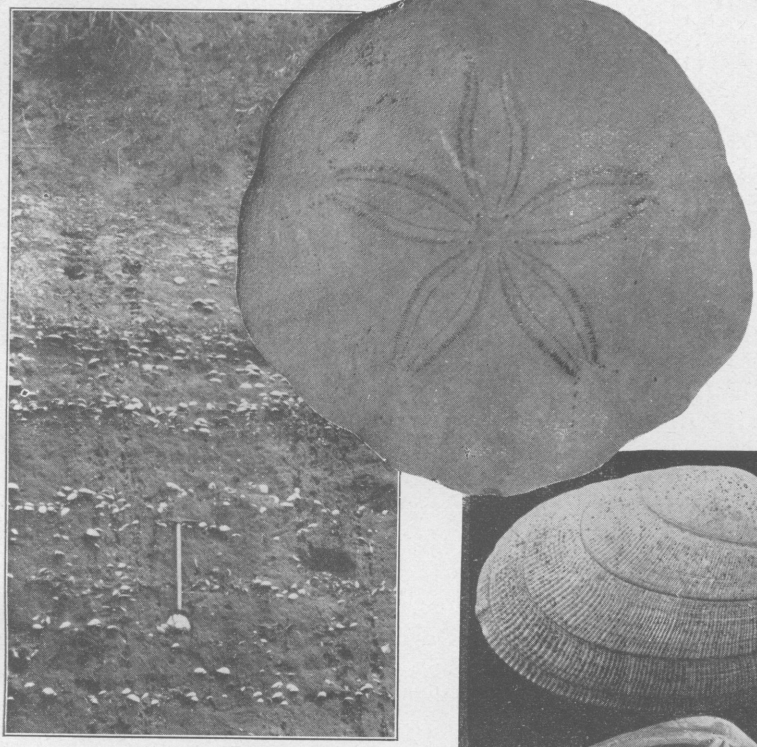


Fig. 2.

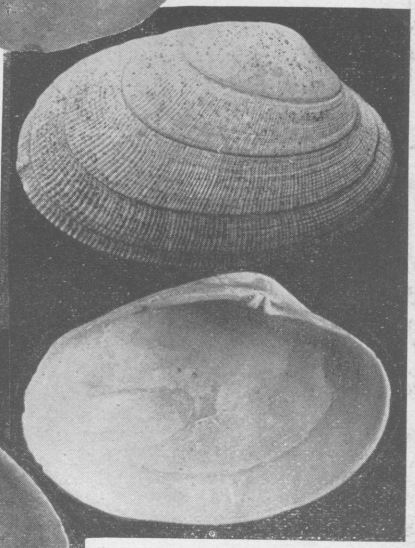


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 1. Another picture of the Manzakian shell-bed at Hossaku, showing abundant isolated valves of *Mactra sulcataria* Deshayes arranged in horizontal layers with convex surface above. **Fig. 2.** *Echinarachnius mirabilis* Barn. Nat. size. **Fig. 3.** *Paphia variegata* Hanley. Nat. size. **Fig. 4.** *Tellina delta* Yok. Nat. size. **Fig. 5.** *Mactra sulcataria* Deshayes. Nat. size.

Fig. 1.

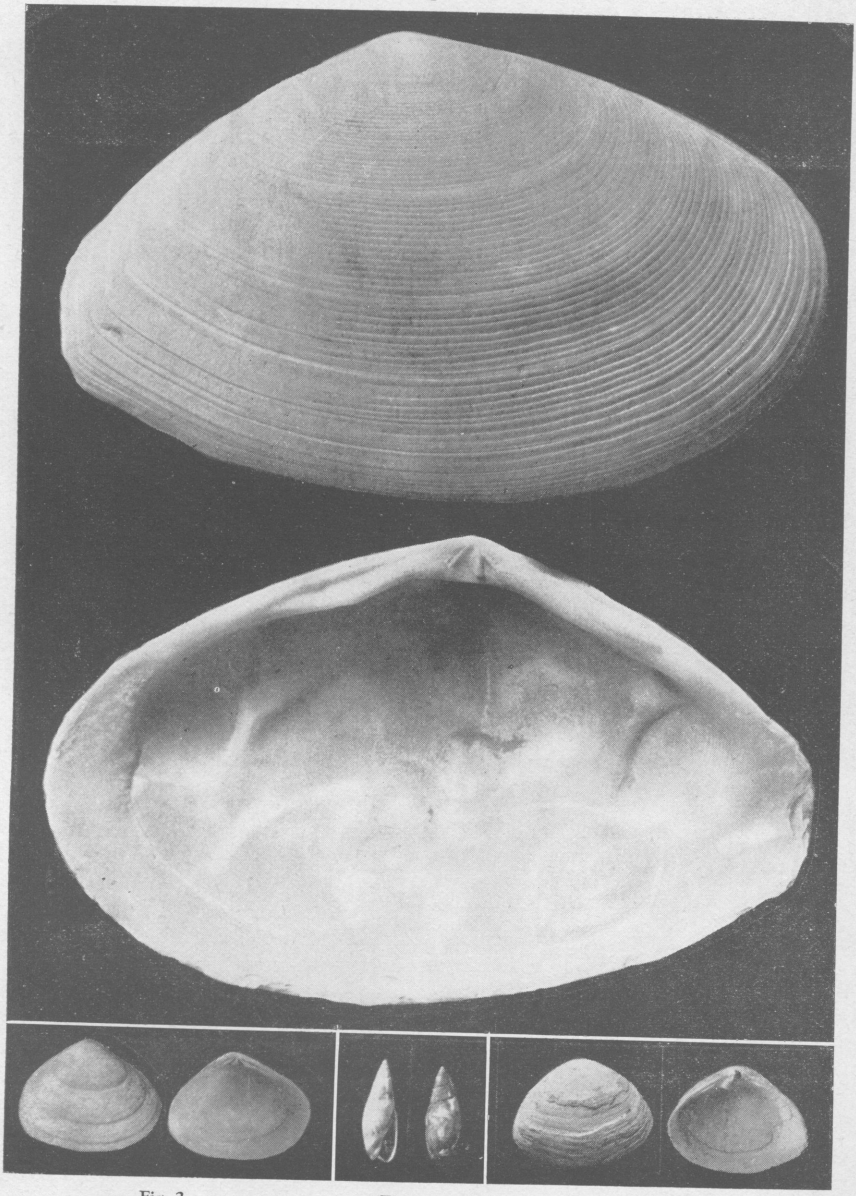


Fig. 2. Fig. 4. Fig. 3.

Fig. 1. *Tellina lutea* var. *venulosa* Schrenck. Nat. size.
Fig. 2. *Gomphina neastartoides* Yokoyama. Nat. size.
Fig. 3. *Corbula amurensis* Schrenck. Nat. size.
Fig. 4. *Olivella fulgurata* Ad. et Rve. Nat. size.

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