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Fossil Mollusca from the Oil-Fields of Akita

By

Matajiro YOKOYAMA, *Rigakuhakushi*

With 2 Plates

The fossil Mollusca treated in the following pages are those collected partly by Mr. Murayama and partly by Mr. Chitani, both geologists of the Imperial Geological Survey, in the oil-bearing strata of the province of Ugo, generally known under the name of Akita Oil-Fields, Akita being the name of the prefecture in which the whole province lies.

Messrs. Murayama and Chitani classify the strata composing the oil-fields in descending order as follows:

BEDS A. Sandstone yielding fossil shells at Anden,[1] Tominaga[2] and Nakaseki.[3]

BEDS B. Sandy Shale containing shells at Mangwanji,[4] Kurosawa[5] and Samukawa.[6]

BEDS C. Grey Shale or Alternations of Sandstone and Shale. Some shells at Nunomata.[7]

BEDS D. Black Shale with fish-remains in Echigo, a province south of Ugo.

BEDS E. Siliceous Shale with some fish remains at Tsubakigawa.[8]

BEDS F. Greenish Tuffite, coarse-grained, more or less breccia- or conglomerate-like. Shell remains at Kinonezaka.[9]

1. Beds A or Sandstone

The fossils of this highest zone are quite numerous. The principal locality is Anden, the other two having yielded only a few. The names of all the species are given in the following table:

1) 南秋田郡五里合村安田(男鹿半島)　2) 同郡脇本村富永(男鹿半島)
3) 同郡太平村中關稻荷　4) 由利郡小友村萬願寺　5) 南秋田郡太平村黑澤
6) 河邊郡下北手村寒川　7) 仙北郡大澤鄉村布又　8) 河邊郡川添村椿川
9) 仙北郡外小友村谷地木ノ根坂

	Anden	Tominaga	Nakaseki	Geological Occurrence
I. Gastropoda				
1. Volvula angustata (A. Ad.)	+			Upper Musashino, Recent
2. Cylichna musashiensis Tok.	+			Lower and Upper Musashino, Recent
3. Cylichna andenica Yok. n. sp.	+			
4. Ringicula musashinoensis Yok.	+			L. a. U. Musashino, Recent
5. Terebra lischkeana Dkr.	+			L. Musashino, Recent
6. Mangilia deshayesii Dkr.	+			L. a. U. Musashino, Recent
7. Genotia pseudopannus Yok.	+			U. Musashino
8. Olivella fortunei (A. Ad.)	+			Pliocene, U. Musashino, Recent
9. Voluta megaspira Sow.	+			Miocene ? Pliocene, Musashinos, Recent
10. Fusus coreanicus Sm.	+			U. Musashino, Recent
11. Siphonalia cassideaeformis (Rve.)	+			Pliocene, U. Musashino, Recent
12. Siphonalia stearnsii Pils.	+			L. Musashino, Recent
13. Buccinum leucostoma Lke.			+	Miocene, Pliocene, U. Musashino, Recent
14. Volutharpa perryi (Jay.)	+			L. a. U. Musashino, Recent
15. Columbella burchardi Dkr.	+			L. a. U. Musashino, Recent
16. Thylacodes medusae Pils.	+			L. a. U. Musashino, Recent
17. Turritella kiiensis Yok.	+			Pliocene.
18. Crepidula grandis Mid.	+			U. Musashino, Recent
19. Natica janthostoma Cesh.	+			Miocene, Pliocene, Musashinos, Recent
20. Polinices ampla Phil.	+			Pliocene, Musashinos, Recent
21. Turbonilla chitaniana Yok. n. sp.	+			
22. Leptothyra purpurescens (Dkr.)	+			U. Musashino, Recent
23. Gibbula inornata Yok. n. sp.	+			
24. Puncturella nobilis (A. Ad.)	+			U. Musashino, Recent
25. Emarginula vadososinuata Yok.	+			Pliocene, U. Musashino
26. Acmaea schrencki Lke.	+			U. Musashino, Recent
27. Helcioniscus pallidus (Gld.)	+			Pliocene, Musashino, Recent
II. Scaphopoda				
28. Siphonodentalium ozawai Yok.	+			U. Musashino, Recent
III. Lamellibranchiata				
29. Corbula venusta Gld.	+			Pliocene, Musashinos, Recent
30. Mactra dunkeri Yok.	+			U. Musashino, Recent
31. Spisula grayana Sehr.	+			Miocene, Pliocene, U. Musashino, Recent
32. Solen krusensternii Schr.	+			Pliocene, U. Musashino, Recent
33. Psammobia kazusensis Yok.	+			U. Musashino
34. Siliqua pulchella (Dkr.)	+			U. Musashino, Recent
35. Tellina miyatensis Yok.	+			U. Musashino

	Anden	Tominaga	Nakaseki	Geological Occurrence
36. Tellina alternata Say var. chibana Yok.	+			Miocene, U. Musashino
37. Macoma nipponica (Tok.)	+			U. Musashino, Recent
38. Macoma inquinata (Desh.)	+			Miocene, Pliocene, Musashinos Recent
39. Macoma secta (Cour.)	+			U. Musashino, Recent
40. Gastrana yantaiensis (Cr. et Deb.)	+			Recent
41. Dosinia troscheli Lke.	+			Pliocene, Musashinos, Recent
42. Meretrix (Callista) chinensis (Chem.)	+			Miocene, Pliocene, Musashinos, Recent
43. Venus (Mercenaria) stimpsoni (Gld.)	+			Pliocene, U. Musashino, Recent
44. Saxidomus purpuratus Sow.	+			Pliocene, U. Musashino, Recent
45. Cardium californiense Desh.	+			Pliocene, Musashinos, Recent
46. Thyasira rotundata Yok. n. sp.	+			Recent
47. Kellia laperousii Desh.	+			Recent
48. Diplodonta usta Gld.		+	+	Pliocene, Musashinos, Recent
49. Diplodonta gouldi Yok.	+			U. Musashino, Recent
50. Lucina (Phacoides) borealis (L.)	+			Miocene, Pliocene, Musashinos, Recent
51. Astarte hakodatensis Yok.	+	+		U. Musashino, Recent
52. Astarte sulcata Dac.	+			English Crag, U. Musashino, Recent
53. Venericardia cipangoana Yok.	+			Pliocene, Musashinos, Recent
54. Venericardia ferruginea (Ad.)	+			Miocene, Pliocene, Musashinos, Recent
55. Crassatella oblongata Yok.	+			L. a. U. Musashino
56. Clavagella japonica Yok. n. sp.	+			
57. Pandora pulchella Yok. n. sp.	+			
58. Myodora fluctuosa Gld.	+			U. Musashino, Recent
59. Anomia lischkei D. et F.	+			L. a. U. Musashino, Recent
60. Pecten laetus Gld.	+			Pliocene, Musashinos, Recent
61. Pecten yessoensis Jay.	+	+	+	Pliocene, Musashinos, Recent
62. Pecten swiftii Bern.	+			Pliocene, Musashinos, Recent
63. Ostrea gigas Thunb.	+			Pliocene, Musashinos, Recent
64. Arca inflata Rve.	+			Pliocene, Musashinos, Recent
65. Arca kobeltiana Pils.	+			L. a. U. Musashino, Recent
66. Arca decussata Sow.	+			L. Musashino, Recent
67. Pectunculus yessoensis Sow.	+	+		Pliocene, Musashinos, Recent
68. Pectunculus pilsbryi Yok.	+			U. Musashino, Recent
69. Limopsis crenata A. Ad.	+			Pliocene, Musashinos, Recent
70. Nucula insignis A. Ad.	+			Miocene, Pliocene, Musashinos, Recent
IV. Brachiopoda				
71. Hemithyris psittacea Chem. var. woodwardi Ad.	+			Pliocene, U. Musashino, Recent

The seventy-one species enumerated above may be divided into the following three groups :

1. Species hitherto found fossil as well as living 56
2. „ „ „ only fossil 12
3. „ „ „ „ living 3

Of the fifty-six species hitherto found fossil as well as living, nine go up to the *Miocene*, twenty-one to the *Pliocene* older than the *Lower Musashino* (Upper Pliocene), eleven to the *Lower Musashino*, and fifteen to the *Upper Musashino :* Of the twelve species hitherto found only fossil, one occurs between *Miocene* and *Upper Musashino*, one in the *Pliocene* older than *Lower Musashino*, one between *Pliocene* and *Upper Musashino*, one in the *Lower* as well as in the *Upper Musashino*, three only in the *Upper Musashino*, and five are *new*.

From this we see that the species which have actually been found in the *Upper Musashino* and which we can confidentially expect to find in the same, because they occur in the older formation as well as in the recent seas, are the most numerous that is to say, sixty-two ; while those of the *Lower Musashino* are forty-four, and of the *Pliocene* older than the *Lower Musashino* only thirty-two. Consequently we may safely conclude that the shells of the highest beds belong to the *Upper Musashino*. This is further borne out by the low percentage of extinct forms, which amount to only about 17% of the whole, a percentage similar to that of the shells of Atsumi (16%) in Mikawa.

2. Beds B or Sandy Shale

The species of fossils found at Mangwanji, Kurosawa and Samukawa amount to twenty-eight and one variety, as given in the following table :

Gastropoda	Mangwanji	Kurosawa	Samukawa	Geological Occurrence
1. Drillia contraria Yok. n. sp.	+			
2. Genotia ogurana Yok.	+			Upper Musashino
3. Cancellaria murayamai Yok. n. sp.	+			
4. Turriella saishuensis Yok.	+			Pliocene, U. Musashino
5. Natica janthostoma Desh.	+			Miocene, Pliocene, Musashino, Recent
6. Polinices pallidus Gld.	+			Low. a. Up. Musashino, Recent
7. Umbonium suchiense Yok.	+			Pliocene

II. Lamellibranchiata	Mangwanji	Kurosawa	Samukawa	Geological Occurrence
8. Spisula grayana Schr.	+			Miocene, Pliocene, U. Musashino, Recent
9. Venus (Mercenaria) stimpsoni Gld.	+			Pliocene, U. Musashino, Recent
10. Cardium muticum Rve.		+		Pliocene, Musashinos, Recent
11. Cardium nuttalii Conr.		+	+	Miocene, Pliocene, U. Musashino, Recent
12. Thyasira bisecta (Conr.)		+		Miocene, Pliocene, U. Musashino, Recent
13. Thyasira bisecta var. nipponica Yabé.		+		Miocene, Pliocene, U. Musashino
14. Diplodonta usta Gld.		+		Pliocene, Musashinos, Recent
15. Astarte borealis L.	+	+		English Crag, U. Musashino, Recent
16. Astarte sulcata Dac.		+		English Crag, U. Musashino, Recent
17. Venericardia ferruginea A. Ad.	+			Miocene, Pliocene, Musashinos, Recent
18. Pecten yessoensis Jay.		+		Pliocene, Musashinos, Recent
19. Pecten heteroglyptus Yok.		+		U. Musashino
20. Pecten murayamai Yok. n. sp.		+		
21. Pecten kurosawensis Yok. n. sp.		+		
22. Pecten akitanus Yok. n. sp.		+		
23. Arca inflata Rve.	+			Pliocene, Musashinos, Recent
24. Pectunculus yessoensis Sow.	+	+		Pliocene, Musashinos, Recent
25. Pectunculus vestitus Dkr.	+			Miocene, Pliocene, Musashinos, Recent
26. Parallelodon obliquatus Yok.	+			Pliocene, Musashinos, Recent
27. Limopsis tokaiensis Yok.	+	+		Lower Musashino
28. Limopsis woodwardi A. Ad.		+		U. Musashino, Recent
29. Nucula cobboldiae Sow.		+		Pliocene

Of these twenty-nine forms, those which are found only as fossils are twelve, while the remaining seventeen are fossil as well as recent. Of the former, those which occur in the *Pliocene* (inclusive of Lower Musashino) are five with an equal number of new ones. Of the latter, six go up to the *Miocene*, ten to the *Pliocene* (inclusive of the Lower Musashino) and one to the *Upper Musashino*.

From these facts, it is very probable that we have here to deal with a fauna which is *Pliocene* in age. And from the position of the beds immediately below those which are to be ascribed to the Upper Musashino, as well as from the occurrence of *Limopsis tokaiensis* which has never been found until now outside of the Lower Musashino or of a formation corresponding to it in its geological horizon, we can conclude that the Beds B are *Upper Pliocene* or *Lower Musashino*.

3. Beds C. Grey Shale or Alternations of Sandstone and Shale

The species which are found in these beds, and at a single locality of Nunomata, are only six in number. They are :

1. Buccinum leucostoma Lke.
2. Priene oregonensis (Redf.)
3. Panope generosa (Gld.)
4. Cardium nuttalii Conr.
5. Thyasira bisecta (Conr.), var. nipponica Yabé et Nom.
6. Lucina (Phacoides) borealis (L.)

These six species are all found recent as well as fossil. *Buccinum leucostoma*, *Cardium nuttallii*, *Thyasira bisecta var. nipponica* and *Lucina borealis* have already been found in the *Miocene* as well as in the *Pliocene*, while *Priene oregonensis* and *Panope generosa* have not until now been known to occur in layers older than *Pliocene*. It is most likely that the Beds C belong to the *middle part* of the *Pliocene*, approximately corresponding in horizon to the *Satsuka* Beds of Tôtômi.

4. Beds D and E

These beds not yet yielding Molluscan fossils are still uncertain in age.

5. Beds F or Greenish Tuffite

The fossils occurring in these beds at Kinonezaka are also few. Those that I have been able to distinguish are the following eleven, several of which are specifically undeterminable on account of their bad preservation :

1. Natica sp.
2. Calyptraea sp.
3. Dentalium sp.
4. Cardium muticum Rve.
5. Cardium nuttalii Conr.
6. Venericardia ferruginea (Ad.)
7. Lima sp.
8. Pecten murayamai Yok.
9. Pecten akitanus Yok.
10. Ostrea gravitesta Yok. n. sp.
11. Arca sp.

Of the six specifically determined species, *Cardium nuttalii* and *Venericardia ferruginea* range between *Miocene* and *Recent*, *Cardium muticum* between *Pliocene* and *Recent*, *Pecten murayamai* and *Pecten akitanus* are found in the Beds B above mentioned, while *Ostrea gravitesta* is new. From these few forms, it is difficult to determine the age of the beds in which they were found. But as *Ostrea gravitesta* is a form hitherto never found in the *Pliocene* or still younger layers, the Beds F may possibly be *Miocene* in age.

Description of New or Rare Species

1. **Cylichna andenica,** nov. spec.

Pl. XLIV. Fig. 1.

Shell small, subcylindrical, somewhat tapering behind, slightly contracted in the middle, rounded both in front and behind. Spire concealed. Surface smooth, save for lines of growth. Aperture as long as the height of the shell, narrowed behind, considerably dilated in front, the dilatation commencing at about the middle part of the aperture. Columella-fold absent.

Two examples. The larger measures 3.7 millim. in height and 2 millim. in diameter.

Fossil occurrence.—Beds A : Anden.

2. **Pleurotoma contraria,** nov. spec.

Pl. XLIV. Fig. 2a, 2b.

Shell medium-sized, sinistrally wound, fusiform. Whorls about ten, somewhat convex, smooth. Body-whorl about as high as spire, with rounded periphery and rather rapidly narrowed base which ends in a long canal. Aperture broad-fusiform. Outer lip thin, with the sinus somewhat distant from the suture, broadly v-shaped and blunt at bottom.

Two specimens. The one lacks the apex, and the other the canal. The former measures 10 millim. in diameter. The height, if perfect, would be about 28 millim.

"A Pleurotoma sinistrally wound" mentioned in my note "On Some Pliocene Shells from Kaga and Noto" (Jour. Geol. Soc. Tokyo, Vol. XXXIII, No. 391, April 20, 1926) belongs to the same species as this.

Fossil occurrence.—Beds B : Mangwanji. Lower Musashino of Kaga.

3. **Cancellaria murayamai**, nov. spec.

Pl. XLIV. Fig. 3.

Shell small, ovato-fusiform. Whorls five, of which the first is nuclear, smooth and rounded; postnuclear whorls angulate in the middle, with the surface above the angle flat and steeply sloping, below, flat and vertical. Longitudinally plicate and spirally costellate. Plicae fourteen on the penultimate whorl and about fifteen on the ultimate, rather weak, unequal and indistinct on the last part of the latter, separated by interspaces which are usually broader. Spiral costellae two, one on the angle and one between the angle and the lower suture; on the body-whorl, however, there are three, the lowest being just at the place corresponding in position to that of the lower suture of the upper whorls. Base abruptly narrowed, with about eight spiral costellae gradually diminishing in size as they go downward. Aperture fusiform. Canal very short. Lip-folds hardly developed.

This species is closely akin to *Cancellaria lischkei* Yok. of Sado (Fossil Shells from Sado, p. 264, pl. XXXII, figs. 16, 17), but in the latter, the spiral costellae are one less in number and the whorls more convex. But it is not impossible that the present species is only a variety.

A single specimen. Height 5.7 millim. Diameter 2.7 millim.

Fossil occurrence.—Beds B: Mangwanji.

4. **Turritella saishuensis**, Yokoyama

Pl. XLIV. Figs. 4, 5.

Turritella saishuensis, Yokoyama, Some Foss. Shells Saishu, p. 3, pl. I, fig. 2. Tert. Moll. Shinano, p. 6. Tert. Moll. Shiobara, p. 131.

Many specimens, with whorls ornamented with three strong flat-topped spiral ridges.

Fossil occurrence.—Beds B: Mangwanji. Upper Musashino of Saishu. Pliocenes of Shinano and Shiobara.

5. **Turbonilla (Mormula) chitaniana**, nov. spec.

Pl. XLIV. Fig. 7.

Shell high-turrete. Whorls about thirteen, the first two to four nuclear, smooth and strongly convex, the succeeding only slightly convex, longitudinally plicate and spirally ornamented with about ten incised

lines which in general are subequally distributed, though somewhat closer near the upper suture. Plicae about eighteen on the penultimate whorl, rather weak, often unequal, indistinct near the lower suture as well as on the last part of the body-whorl where they are difficult to count. Base abruptly narrowed, convex, with several incised spiral lines which make the interspaces appear like flat cords. Aperture elliptical. Height 18 millim. Diameter 4.2 millim. There is a great variation in these dimensions.

Numerous specimens.

Fossil occurrence.—Beds A : Anden.

6. **Gibbula inornata,** nov. spec.

Pl. XLIV. Figs. 6, 10.

Shell small, high-turbinate. Whorls about five, somewhat convex, perfectly smooth. Periphery angulate. Base convex. Aperture oval. A long chink is present outside of the inner lip.

Two examples. The smaller is perfect, measuring 6.5 millim. in height and 4.5 millim. in diameter.

Fossil occurrence.—Beds A : Anden.

7. **Gastrana yantaiensis,** (Crosse et Debeaux)

Pl. XLIV. Fig. 14.

Gastrana yantaiensis. Pilsbry, Catal. Mar. Moll. Japan, p. 124.

Tellina yantaiensis. Reeve, Conch. Icon., Tellina, pl. L., fig. 295. Syst. Conch. Cab., p. 278, pl. 52, figs 8-10.

Fragilia yantaiensis. Crosse et Debeaux, Jour. de Conch., 1863, p. 78, pl. 9. fig. 2.

Fossil occurrence.—Beds A : Anden.

A single right valve, a little broken in the anterior portion.

The shell is large, very thick, markedly trigonal, the length being only a little greater than the height. Compared with Reeve's figure, it is somewhat longer, although shorter than the figures given in the "Systematisches Conchylien Cabinet." The height measures 58 millim.

Fossil occurrence.—Beds A : Anden.

Living.—Japan (according to Dunker). China.

8. Kellia laperousii, DESHAYES

Pl. XLIV. Fig. 8.

Kellia leperousii. Fischer, Manuel de Conchyliologie, pl. XIX, fig. 11.
Chironia laperousii. Chenu, Man. de Conch., p. 126. Fig. 601.

A single right valve, elliptical in form, somewhat inequilateral and convex. Height 4.3 millim. Length 5.5 millim. Depth 1.6 millim.

Fossil occurrence.—Beds A : Anden.

Living.—Gulf of California.

9. Thyasira rotundata, nov. spec.

Pl. XLIV. Figs. 9, 13.

Shell small, of moderate thickness, convex, orbicular, anterior border making a rounded angle with excavated antero-dorsal. Surface smooth, showing no posterior flexure. Beaks small, bluntly pointed. Lunula short-lanceolate, excavated, valley-shaped, laterally bounded by sharp edges. A tooth-like process is found in both valves. Muscular impressions elongated.

Two valves, right and left. The right valve measures 4 millim. in length and height, and 1 millim. in depth, while the left measures 4.9 millim. in height and length, and 1.5 millim. in depth.

A living form which Messrs. Yabé and Nomura (Notes on the Recent and Tertiary Species of Thyasira from Japan, p. 12, pl. I, fig. 4) took for my *Thyasira trigonata* (Foss. Up. Musash., pl. XXIII, fig. 4) is, I believe, identical with the present species. *Thyasira trigonata* is, as the name implies, markedly triangular, while the form taken for such by the above authors is roundly quadrate, an outline which presents but little difference from that of the present species.

Fossil occurrence.—Beds A : Anden.

Living.—Northern Japan (Yabé and Nomura).

10. Clavagella japonica, nov. spec.

Pl. XLIV. Figs. 11, 12.

Two fragmentary tubes, one of which is 10 millim. long and the other 7 millim. long, both measuring about 4 millim. in diameter. Both have four frills, the last three being closer to one another than they are to the first one. The surface is transversely corrugated.

Fossil occurrence.—Beds A : Anden.

11. **Pandora pulchella,** nov. spec.

Pl. XLV. Fig. 4.

Two right valves, the smaller of which is not quite perfect.

Shell rather thin, but firm, quite flat, subsemilunar, very inequilateral, rounded in front, attenuated and also rounded behind, the posterior border meeting with the excavated postero-dorsal nearly at a right angle. Surface concentrically corrugated, crossed by divergent impressed lines which are rather distant from one another, slightly sinuous, some reaching the ventral border, some vanishing before attaining it. Posterior area linear, flat, laterally bounded by a sharp edge making a right angle with the general surface. Inner surface nacreous. Cardinal border provided with the diverging ridges, the anterior of which is much thicker than the posterior. Adductor impressions distinct, anterior roundly quadrate, posterior short-elliptical, with a small oblong accessory impression below it. The perfect valve measures 38 millim. in length and 24.5 millim. in height.

Fossil occurrence.—Beds A : Anden.

12. **Pecten murayamai,** nov. spec.

Pl. XLIV. Figs. 18, 19, 20.

Shell thick, compressed, orbicular, slightly higher than long. Right valve with nine, strong, broad, rounded, rigid, radiating ribs separated by intervals of about equal breadth. Ears somewhat unequal; anterior ear smaller, triangular in outline with anterior border somewhat receding below, provided with a few radiating riblets; byssal notch hardly developed; posterior ear also triangular, with posterior border somewhat convex, oblique, with upper end more anterior in position, radiately ribbed like the anterior. Left valve of the same convexity as the right, radiately ribbed; ribs nine, roof-shaped, with ridges sharp; ears triangular, subequal.

Several specimens. One of the perfect right valves is 55 millim. high, 54 millim. long, and 7.5 millim. deep; while one of the perfect left is 22 millim. high, 21.5 millim. long and 3 millim. deep. The largest right valve, which is partly broken, is 86 millim. high.

Fossil occurrence.—Beds B : Kurosawa. Beds F : Kinonezaka.

13. **Pecten kurosawensis,** nov. spec.

Pl. XLV. Fig. 3.

Three right valves.

Shell rather small, orbicular, of moderate thickness, compressed, radiately ribbed. Ribs twenty-seven to thirty-two, straight, rigid, with interspaces varying in breadth, sometimes equal, sometimes narrower, sometimes broader. One of the specimens is covered with a fine mesh-like structure. Ears unequal, with a few radiating riblets. Byssal notch shallow, rounded.

One of the examples measures 35.5 millim. in height, 37 millim. in length and 5 millim. in depth; while another measures 30.5 millim. in height, 30 millim. in length and 4.3 millim in depth.

This species has a close resemblance to *Pecten yessoensis* Jay, but has the ribs smaller and more numerous.

Fossil occurrence.—Beds B : Kurosawa.

14. **Pecten akitanus,** nov. spec.

Pl. XLIV. Figs. 15, 16, 17.

Shell small, rather thick, compressed, orbicular, somewhat higher than long, radiately ribbed.

Right valve : Ribs about twenty-five in number, flattened, usually broader than interstices, often split into two by a median groove ; ears unequal, with radiating riblets, anterior longer and larger than posterior, byssal notch triangular. Left valve : Of about the same convexity as the right valve, ribs also about twenty-five, but with an intercalary in every interspace, occasionally splitting into two like those of the right valve ; ears unequal, with posterior larger, radiately ribbed. Frequent.

One of the right valves is 10 millim. high, 9.3 millim. long and 2.2 millim. deep ; while one of the left is 16.2 millim. high, 14.7 millim. long and 3.3 millim. deep.

Fossil occurrence.—Beds B : Kurosawa. Beds F : Kinonezaka.

15. **Ostrea gravitesta,** nov. spec.

Pl. XLV. Figs. 1, 2.

Three left or convex valves.

The shell is very large, uncommonly thick, elongate or ovate.

Surface concentrically rudely corrugated with faint longitudinal plications. Beak pointed, with a long, triangular ligamental groove below it.

The largest example has an elongated shape, 240 millim. in height, 140 millim. in length and 90 millim. in depth. Of this 90 millim., 50 millim. belong to the thickness of the shell. The next largest is ovate in shape, and is 160 millim. high, 130 millim. long and 75 millim. deep, and of this 75 millim., 45 millim. is taken by the thickness of the shell.

In general, this shell resembles in shape *Ostrea gigas* Thunb., so frequent in our Tertiary and Quaternary layers. But the thickness of the shell far exceeds that of the latter.

Fossil occurrence.—Beds F : Kinonezaka.

Plate XLIV

Fig. 1. Cylichna andenica, n. sp. Beds A : Anden. P. 383

Fig. 2a, 2b. Pleurotoma contraria Yok. Beds B: Mangwanji. P. 383

Fig. 3. Cancellaria murayamai n. sp. Beds B: Mangwanji. P. 384

Figs. 4, 5. Turritella saishuensis Yok. Beds B: Mangwanji. P. 384

Figs. 6, 10. Gibbula inornata n. sp. Beds A: Anden. P. 385

Fig. 7. Turbonilla (Mormula) chitaniana n. sp. Beds A: Anden. P. 384

Fig. 8. Kellia laperousii Desh. Beds A: Anden. P. 386

Fig. 9. 13. Thyasira rotundata n. sp. 9. Right valve 13. Left valve. Beds: Anden. P. 386

Figs. 11, 12. Clavagella japonica n. sp. Beds A: Anden. P. 386

Fig. 14. Gastrana yantaiensis Cr. et Deb. Right valve. Beds A: Anden. P. 385

Figs. 15, 16, 17. Pecten akitanus n. sp. 15, 17. Left valves. 16. Right valve. Beds B: Kurosawa. P. 388

Figs. 18, 19, 20. Pecten murayamai n. sp. 18, 20. Right valves. 19. Left valve. Beds B. P. 387

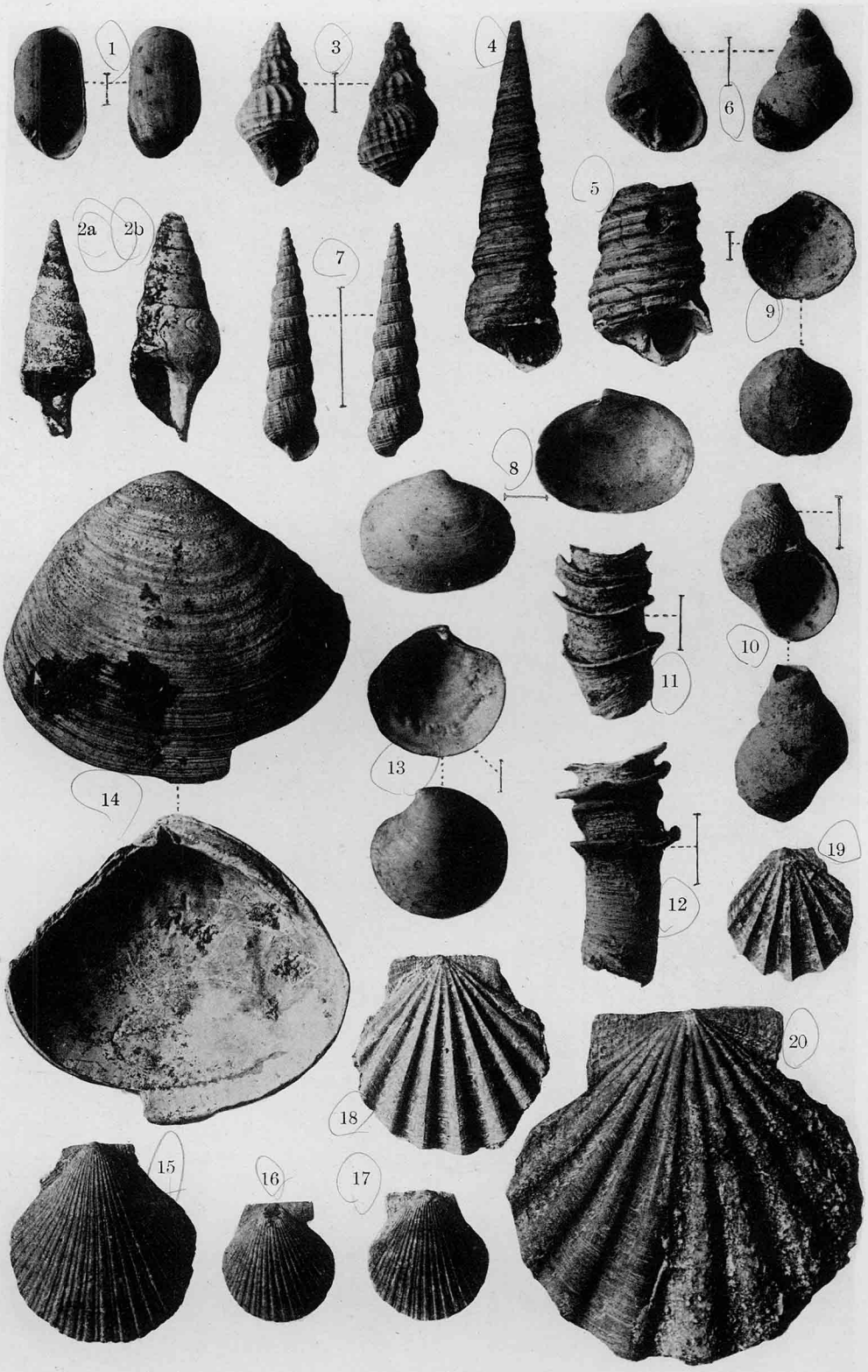

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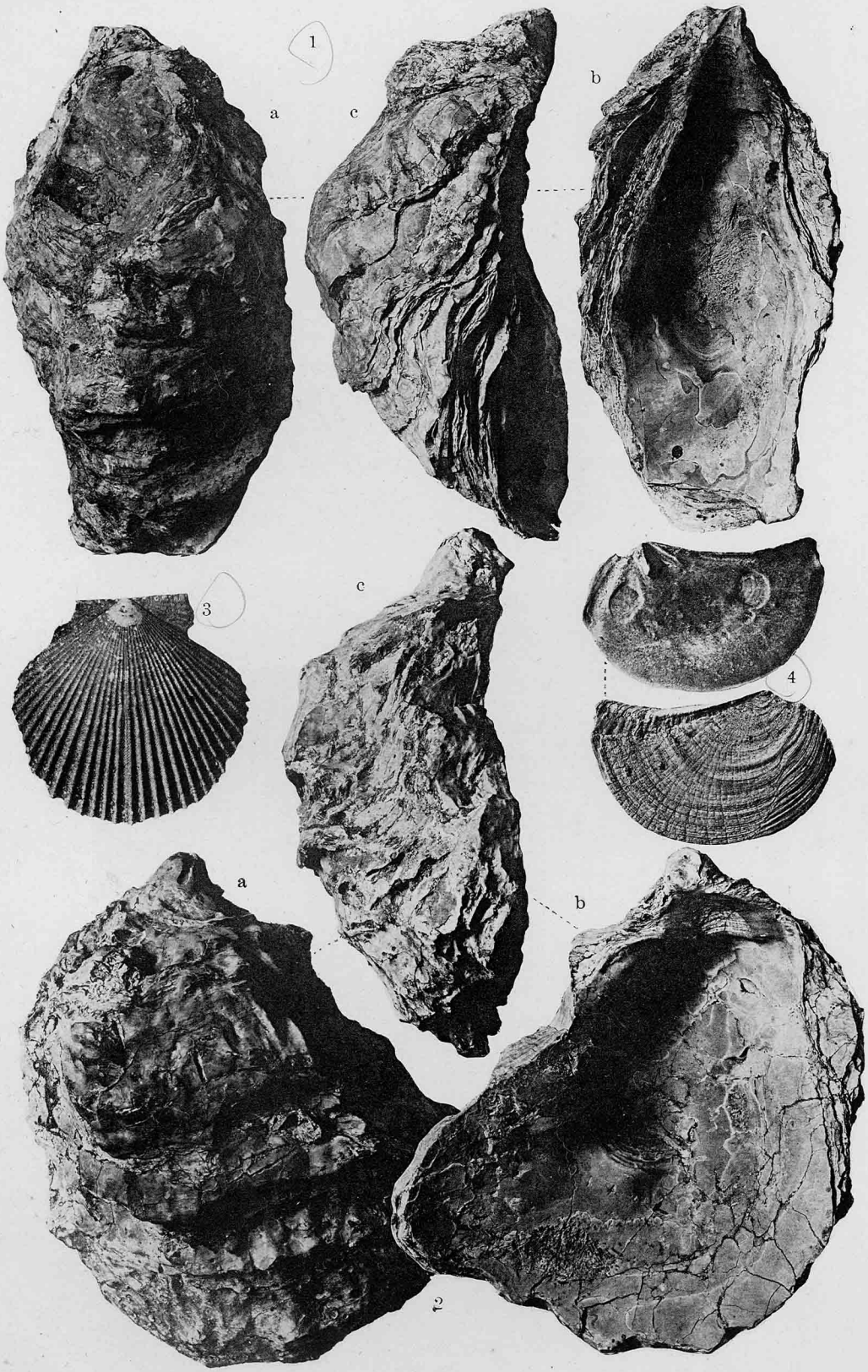
Plate XLV

Figs. 1. 2. Ostrea gravitesta n. sp. ⅓ nat. size. Left or convex valves.
1. Elongated form. 2. Ovate form. a. Outer view. b. Inner view.
c. Lateral view, showing depth. Beds F{ Kinonezaka. P. 388

Fig. 3. Pecten kurosawensis n. sp. Right valve. Beds B{ Kurosawa. P. 388

Fig. 4. Pandora pulchella n. sp. Right valve. Beds A: Anden P. 387



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