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A Study on the Pelecypod-Fauna of the Upper Triassic Nabae Group in the Northern Part of Kyoto Prefecture, Japan

Part 3. Halobiids and others

By

Keiji NAKAZAWA

Geological and Mineralogical Institute, University of Kyoto

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Abstract

This article is treated with the species of *Halobia*, *Oxytoma*, "*Ostrea*", *Plicatula*, *Pinna*, *Neoschizodus*, *Minetrigonia*, *Palaeoneilo*, *Nuculana*, *Parallelodon*, *Palaeopharus*, and *Cardinia*. Among them, *Plicatula*, "*Ostrea*", *Pinna* and *Nuculana* are the genera which have not yet been described from the Triassic formations in Japan.

Description of species

Family Halobiidae

Genus *Halobia* BRONN, 1830

Halobia kawadai YEHARA, 1927

Pl. XIII, Fig. 1

1927. *Halobia kawadai*, YEHARA, p 31, pl. 3, figs. 5, 6.
1943. *Halobia kawadai*, KOBAYASHI and AOTI, p. 245, pl. 24, figs. 1-3, 4(?); ?, pl. 25, figs. 8, 9.
1954. *Halobia kawadai*, ICHIKAWA, p. 54, pl. 1, fig. 3.

Many of the specimens belonging to *Halobia* are identified to *H. kawadai* YEHARA, the most common species of the genus in Japan. All of them are fairly deformed by secondary crustal movement, but they agree well with the specimens from the Sakawa basin and the Sakuradani and Kito areas in Shikoku, in the position of the umbo, the concentric wrinkles, and the radial sculptures. Some observations on the ear and the radial ornaments are added here. Anterior ear is divided into the convex lower half, "*Byssuswulst*", and the narrow flat upper half, the latter of which is rarely differentiated to "*Flachteil*" and "*Randleiste*". Wide flat-topped primary ribs on the antero-median part make their appearence near the umbo, attaining 7 or so in number, and become finer to

riblets towards the both sides. The wider ribs are sometimes bi- or rarely trifurcated towards the ventral margin, and somewhat variable in strength. The finer ribs on the anterior part vary from 7 to 12 in number, and posterior ones from 10 to 15. Generally there is a smooth area below the posterior hinge margin, but sometimes weakly and finely striated on the periphery.

Remark : — The specimens described as *H. kawadai* by KOBAYASHI and AOTI from the Asa area (1943, p. 25, pl. 26, figs. 8. 9) are doubtful in identification, because they are very small, less than 7 mm in height and can hardly be distinguished from the jevenile of *H. aotii* KOBAYASHI and ICHIKAWA (1949, p. 185 ; *H. multistriata* KOBAYASHI and AOTI, 1943, p. 250, pl. 24, figs. 12, 13, pl. 25, figs. 10–14) associated with them. *H. aotii* resembles closely *H. kawadai* in ornamentaion in young stage, when the main ribs are not yet divided by furrows.

Occurrence :— Common, lower part of N_3 formation, Nabae (Loc. nos. N. 205, 208) ; rare, ? middle part of N_3 formation at Kichisaka (Loc. no. N. 113). (Reg. nos. JM. 10212–228, ? 10231–232)

Halobia cf. **kawadai** YEHARA

Pl. XIII, Fig. 2

There are several specimens which remind one of *H. moluccana* WANNER, 1907 or *H. talauana* WANNER, 1907 in the postero-ventrally expanded outline. But their ornaments are more similar to the preceeding species. The similarity in outline may be superficial caused by secondary deformation.

Occurrence :— Lower part of N_3 formation, Nabae (Loc. no. N. 208). (Reg. nos. JM. 10219–220)

Halobia obsoleta KOBAYASHI and AOTI, 1943

Pl. XIII, Fig. 3

1943. *Halobia obsoleta*, KOBAYASHI and AOTI, p. 249, pl. 24, figs. 8–11.

There are two incomplete right valves and a few fragmental ones which can be referred to *H. obsoleta*. They agree very well with the type specimens from the Sakawa basin in the outline of the shell, the obscure sculpture and the distinct, fairly large anterior ear. But the radial sculptures are more obscure, and the concentric wrinkles are almost absent, which are observable in the type specimens on the umbonal half of the shell.

Observations and Remarks :— Radial sculptures are limited on the mesial part of the shell, and are wider, somewhat differentiated and nearly straight on its anterior half, while the posterior ribs become finer and gently arcuate with the convex side towards the rear side. At a disfance about 9 mm from the beak, the ribs bend sharply foward with "*Knickungzone*", then are suddenly weakened and hardly seen, continuing their direction towards the outer margin. In the

type specimens from Shikoku, the outer part is bounded from the ribbed inner or umbonal part by a concentric folding, and is quite smooth.

In the topotype specimen (JM. 10256) which has been donated to this institute through the courtesy of Prof. T. KOBAYASHI, University of Tokyo, as well as the specimen kept in that university from Tokombo in the Sakawa basin (MM. 52/1), there can be seen sharp bending of the ribs near the smooth outer zone, and this bending zone may be regarded as "*Knickungzone*". In this point this species is more intimate to the group of *H. rugosa* and its allies than to the group of *H. charlyana*.

Occurrence:— Very rare, middle and upper part of N_3 formation, Nabae (Loc. nos. N. 207, 216). (Reg. no. JM. 10221)

Halobia new species, indet.

Pl. XIII, Figs. 4, 5, 6 b, c.

Four left valves are in hand. Though all of them are incomplete and a little deformed secondarily, specific characters can be offered.

Description:— Shell of large size in adult one, perhaps nearly equilateral, longer than high, semicircular in outline with relatively short hinge-line; umbo a little anterior to the middle of the shell length at least in young stages, and protruded above hinge-margin. Anterior ear defined from the body by a shallow furrow, and divided into two parts, the dorsal half narrower and nearly flat, the ventral half broader and slightly convex, provided with a few obscure sinuated growth wrinkles on it. Main body divisible into two parts like preceeding species, i. e. the ornamented umbonal part and the nearly smooth outer. Surface of the umbonal part covered with weak concentric wrinkles and fine, close-set, simple, nearly straight radial ribs, which are slightly broader on the mesial part and sometimes bifurcated there; on the rear part they becoming finer, concave to the anterior, and almost invisible near the posterior hinge-margin. At a distance of 15–17 mm from the beak, the ribs bend forward forming "*Knickungzone*", beyond which on the flatter outer part, they become abruptly obscure, sometimes nearly smooth.

Observation and Comparison:— In one specimen (Pl. XIII, Fig. 4), several radial ribs on the anterior side of the umbonal half are minutely waved; intercostal furrows of the outer half are nearly as wide as the ribs, and are undulated and very weakly striated. In another specimen (Pl. XIII, Fig. 5), the outer part is almost lacking in sculpture, and nearly smooth. The most conspicuous character of the species is a marked contrast in ornamentation between the outer and the inner or umbonal part of the shell. In this point, this is closely related to *Halobia obsoleta*, but differs in the stronger radial ribs and more symmetrical outline. It is much similar to some specimens of *H. cordillerana* SMITH (1927,

p. 114, pl. 99, fig. 3) and *H. comata* BITTNER (KRUMBECK, 1924, p. 308, pl. 191, fig. 18), but generally distinguished in the more conspicuous contrast in ornamentation and in the more straight ribs. There is an incomplete left valve collected by the writer from the upper Triassic Nakatsuka formation (HASE, 1950) in Tsubuta, Yamaguchi Prefecture. The specimen is associated with *H. aotii* KOBAYASHI and ICHIKAWA and much similar to this species. It differs only in the broader outline. It is not clear whether the specimen maintains the original shape or not, but it is most intimate to this species if not conspecific. As the specimens under consideration are all incomplete, a proposal of a new specific name is refrained from.

Occurrence :— Common, middle part of N_3 formation, Nabae (Loc. no. N. 207). (Reg. nos. JM. 10222 a, b, c, 10223)

Halobia sp. α

Pl. XIII, Figs. 6d, 7

Single incomplete left valve is at hand, which is slightly depressed secondarily dorso-ventrally.

Description :— Judging from the concentric wrinkles developed on the umbonal region, shell roundly ovate in outline, nearly equilateral with subcentral umbo. Hinge-area partly preserved in the outer mould, very narrow and striated by 2 or 3 weak furrows parallel to the hinge-margin; anterior ear well preserved, clearly defined from the rest of the shell and divided into two parts, of which the ventral half is a little convex and sculptured by sinuated growth wrinkles showing a byssal sinus, and the dorsal half slightly convex near the umbo, but flat or even concave near the frontal extremity and sculptured by very fine growth-lines. Surface covered with 5 wide, flat-topped radial ribs divided by 4 or 5 furrows on the antero-mesial part, and with 5 narrower, bifurcated ribs on the postero-mesial part, which become to finer, denser, numerous riblets posteriorly. These radials suddenly changing into very weak ribs bending forward at a height of about 12 mm from the beak and making a nearly smooth outer zone. In the general outline and marked contrast in ribbing, this is most related to the preceeding species, but differs in the more differentiated radial ribs somewhat resembling those of *H. aotii*.

Occurrence :— Middle part of N_3 bed, Nabae (Loc. no. N. 207). (Reg. no. JM. 10222 d, d')

Halobia cf. **aotii** KOBAYASHI and ICHIKAWA, 1949

Pl. XIII, Fig. 11

cf. 1943. *Halobia multistriata* KOBAYASHI and AOTI, p. 250, pl. 24, figs. 12,13; pl. 25, figs. 10-14. (not *H. kwaluana* var. *multistriata* VOLZ, 1899, p. 34, pl. 1, fig. 11)

1949. *Halobia aotii* KOBAYASHI and ICHIKAWA, p. 185

There is an incomplete, deformed left valve which has multistriated main radial ribs like those of *H. austriaca* or *H. aotii*. Accurate shape of the shell unknown, umbo situated rather anteriorly at about anterior one-third of the shell-length and a little salient above hinge-margin. Anterior ear distinctly seperated from the body by a furrow, and divided into two parts. Concentric wrinkles limited to the umbonal half of the shell, amounting 8 in number. Surface ornamented by radial ribs, of which three on the middle part of the shell flat-topped and very wide, sculptured with 7–11 fine furrows, about 7 ribs on its front narrow and simple, 5 on the posterior side generally bifurcated, becoming finer and denser posteriorly into numerous riblets. The specimen cannot be comparable with *H. austriaca* MOJSISOVICS in the asymmetrical outline. It also differs from the typical specimens of *H. aotii* in the broader and less number of main ribs on the mesial part of the shell. But judging from the many specimens of *H. aotii* collected by the writer from Tsubuta, Yamaguchi Prefecture, the ornaments are fairly variable and one of them (JM. 10238) has much resemblance to this specimen.

Occurrence:— Very rare, N_3 formation (exact horizon unknown), Kichisaka (Loc. no. N. 113). (Reg. no. JM. 10233)

Halobia cf. **austriaca** MOJSISOVICS, 1874

Pl. XIII, Fig. 9

cf. 1874. *Halobia austriaca* MOJSISOVICS, p. 26, pl. 4, figs. 1-3, pl. 5, fig. 14.
1906. *Halobia austriaca*, RENZ, p. 34.
1912. *Halobia austriaca*, KITTL, p. 101, pl. 6, figs. 11-14.
1924. *Halobia austriaca*, KRUMBECK, p. 146. pl. 187, figs. 12-23.
1924. *Halobie* cf. *austriaca* KRUMBECK, p. 146, pl. 187, fig. 25.
1924. *Halobia austriaca* var.? KRUMBECK, p. 145, pl. 187, fig. 24.
1927. *Halobia austrica*, SMITH, p, 113, pl. 99, figs. 12,? 10, 11.
1954. *Halodia* aff. *austriaca*, ICHIKAWA, p. 187, pl. 17, fig. 15.

One incomplete right valve and a few fragmental specimens are at hand. A figured specimen is elongated antero-posteriorly by deformation and devoid of postero-ventral part. Shell nearly equilateral with subcentral umbo judging from the strong concentric sculptures. Anterior ear sharply defined from the disk by a furrow and divided into two parts, of which the ventral half is nearly smooth, while the dorsal half provided with concentric wrinkles. Concentric sculptures of the disk almost limited on the umbonal half of the shell, counting 13 in number and becoming denser to the beak. Radial ribs slightly arcuate with the concave side forward, and broader on the antero-median part, where they are initiated near the umbo and inserted with 3–6 weak furrows, of which the median furrow is more or less stronger and, sometimes, begins near the beak.

Ribs on the anterior side becoming narrower anteriorly, provided with 2–4 furrows near the mesial ribs, and bifurcated near the anterior ear. Those of posterior side unknown. This species resembles very much *Halobia austriaca*, but the radials seem somewhat denser than usual.

Occurrence:— Very rare, lower part of N_3 formation, Nabae (Loc. no. N. 208). (Reg. no. JM. 10230)

Halobia sp. β

Pl. XIII, Figs. 10, 12, 13

Shell relatively large, roundly ovate, very inequilateral, perhaps a little expanded postero-ventrally, longer than high, maximum height situated posteriorly; umbo lying at about two-fifths or one-third of the length from the frontal extremity and slightly salient above the straight hinge-margin, anterior ear distinctly defined from the body by a weak furrow, and divided by an obscure ridge radiating from the umbo. Surface ornamented with numerous, fine, nearly straight radial ribs, of which the anterior ones are relatively wider. They are generally bifurcated weakly, and changing to narrower riblets somewhat irregular in strength. These radials suddenly bend forward at about 14 mm distant from the umbo on the postero-ventral direction, then minutely undulated except on the posterior part. This species belongs to the group of *Halobia rugosa*, and resembles especially *H. superba* MOJS. (1874, p. 30, pl. 4, figs. 9, 10; KITTL, 1912, p. 151, pl. 7, figs. 17, 18; SMITH, 1927, p. 118, pl. 93, figs. 1–5; pl. 94, fig. 7; pl. 97, figs. 1–3 and others'). It is more closely related to *H.* n. sp. indet, and quite resemble in the umbonal half, but differs in the more distinctly ribbed outer part and, more inequilateral outline.

Occurrence:— Rare, lower part of N_3 formation, Nabae (Loc. no. N. 208). (Reg. nos. JM. 10224–225, 10228).

Halobia sp. γ

Pl. XIII, Fig. 8

Two internal moulds of left valves are at hand, both of which are compressed obliquely. Shell small, larger one of them 12 mm high and equally long, but considered to be longer than high orginally, subcircular in outline, and nearly equilateral; umbo subcentral and slightly protruded above the relatively short hinge-line. Anterior ear slightly convex, neither sharply defined nor divided. Surface ornamented with coarse but weak, flat-topped radial ribs, about 10 in number, not reaching to the umbo except the mesial 3 or 4; postero-dorsal part smooth. Main ribs sometimes bifurcated, rarely trifurcated, and at about 6 mm from the beak bending strongly forward where they are striated by about 3 feeble furrows.

Concentric wrinkles weak, limited on the umbonal half. This species resembles closely *H. maximiliani* KITTL (1912, p. 53, pl. 7, fig. 19), but differs in the smaller size and more symmetric outline.

Occurrence :— Rare, lower part of N_3 formation, Kichisaka (Loc. no. N. 114). (Reg. nos JM. 10227–8).

? Family Pteriidae

Genus *Oxytoma* MEEK, 1864

Oxytoma new species ? indet.

Pl. XIII, Figs. 14–19

Description :— Shell of medium size, quite inequivalve, inequilateral, perhaps obliquely ovate in outline, expanded postero-ventrally. Left valve, considered to be larger than the right, moderately inflated, most convex at about one-third of the hight below the umbo; umbo lying at one-third or two-sevenths of the hinge-length from the front, a little projected over the straight hinge-margin, and slightly prosogyrous. Anterior ear small, depressed, nearly rectangled triangular in shape, not sharply defined from the disk, but on the surface of the internal mould a distinct excavation is recognizable there; posterior wing large, obtusely ? triangular with almost straight posterior margin, but in younger stages sinuated below hinge-margin (Pl. XIII, Fig. 19). Surface of the shell sculptured by radial ribs of first to fourth order, primary ones prominent but narrow, counting 6–8 in number, usually alternated with the secondaries and a little projected beyond the periphery, interspaces somewhat broader on the anterior side, the secondaries setting off near the umbo, relatively weak and sometimes hardly distinguished from the ribs of the lower orders, riblets of third and fourth orders nearly equal in strength, attaining 5 to 10 in number between higher orders on the periphery. Anterior ear sculptured by 5–8 riblets with intercalating striae; posterior wing ornamented with closely set riblets and alternating striae which grow stronger and nearly equal as the riblets at the margin. Growth-lines can hardly be seen except near the periphery. Right valve slightly convex, flattened towards the margin; surface covered with dense, fine radial striae of uniform strength. Byssal ear small, subquadrate in outline, and deeply sinuated below.

Observations and comparison :— One of the internal moulds of the right valves (Pl. XIII, Fig. 16) preserves a part of pallial line, which lies at about three-fourths of the height from the hinge-line on the mesial portion. This species has a close resemblance to *O. zitteli* (TELLER) (in MOJSISOVICS, 1886, p. 127, pl. 19, figs. 10a–b; KOBAYASHI and ICHIKAWA, 1950, p. 220, pl. 2, figs. 3–6) in ornamentation, but differs in the weaker secondary ribs, straight posterior margin and, perhaps, more oblique outline.

This is supposed to be a new species, but the new name is left in future,

until satisfactory materials will be obtained.

Occurrence:— Very rare, N_2 formation, Kongoin (Loc. no. N. 202) and Miuchi (N. 401); common, N_3 formation, Nabae (N. 211, 213, 215, 216, 216') and Nishimitsumatsu (N. 201). (Reg. nos. JM. 10257–265, 266?)

Oxytoma? sp.

Pl. XIII, Fig. 20

External mould of a left valve small, strongly compressed laterally, provided with 8 strong radial ribs on the disk; their interspaces wide, slightly concave and smooth. Anterior ear small, depressed, ornamented with 3 riblets; posterior ear large, subtrigonal in shape, apparently smooth. General outline and strong ribbing suggest that the species belongs to *Oxytoma*, but somewhat doubtful, because the interspaces seem to be smooth, unusually in *Oxytoma*. This species is similar to "*Oxytoma*" *dieneri* KOBAYASHI and ICHIKAWA (1950, p. 226, pl. 2, fig. 9), but too poor in preservation for comparison.

Occurrence:— N_3 formation ?, east of Kichisaka pass (Loc. no. N. 124). (Reg. no. JM. 10268)

Family Ostreidae

Genus *Ostrea* LINNÉ, 1785

"Ostrea" sp.

Pl. XIII, Fig. 21, Pl. XIV, Figs. 1, 2.

Description:— Shell of medium size, very inequivalve, inequilateral; the left valve considerably convex, the right one slightly convex in younger stages, but nearly flat or even slightly concave later; general outline obliquely ovate somewhat produced postero-ventrally, anterior and ventral margins broadly rounded, posterior margin provided with a shallow postero-dorsal sinus. Ligament-area relatively long and rather narrow with a shallow subtriangular central pit. Inflated left valve depressed distinctly at the posterior umbonal region where it may be attached to other substances. Adductor muscle-scar shallow, situated near the postero-dorsal concavity. Surface covered with fine, close-set growth-lines not developing to distinct lamellae, and provided with several weak concentric folds, radial plications almost absent, but in the left valve, at about 25 to 30 mm distance from the umbo, near the ventral margin, 2 or 5 weak plications appearing; right valve perhaps absent in radial sculptures. Crenulation on the both sides of the hinge-area not developed. Shell-thickness relatively thin.

Observations and Remarks:— Most of the left valves are less than 50 mm in height, lacking in strong radial plications, and may be placed in *Liostrea*

DOUVILLÉ (1904, p. 273; COX, 1952, p. 68). But there is a large specimen (Pl. XIII, Fig 2) provided with rather strong, somewhat irregular plications near the outer margin which are not seen in the genus. In this point, the species is related to those of *Lopha*, BOLTEN, 1798. As the Triassic ostreids are in need of detailed observations and discussions, the species is placed here in *Ostrea* s. l. for the time being. This species resembles a little "*Ostrea*" *fimbriata* MOOR (1861, p. 501, pl. 16, fig. 2) from Raetic beds of England in marginal plication, but differs in the outline of the shell.

Occurrence:— Common, middle part of N_2 formation, Kongoin (Loc. nos. N. 102, 103); rare, lower part of N_3 formation, Terada (N. 304), Shinmichi (N. 405), Miuchi (N. 414), Kichisaka (N. 121, ? N. 112, N. 120) and Monobe (N. 601). (Reg. nos. JM. 10066c, 10242–245, 10254–255).

Family Plicatulidae

Genus *Plicatula* LAMARCK, 1801

Plicatula hekiensis NAKAZAWA, new species

Pl. XIV, Figs. 3–7ab

Description:— Shell inequivalve, nearly equilateral, somewhat variable in shape from subcircular to ovate with narrower umbonal region. Left valve moderately or a little inflated, right valve flatter. Hinge of *Plicatula* type consisting of two teeth and two sockets divergent from the apex in each valve, inserting a strong resilifer pit between them; ligament-area very small. Surface of the shell covered with close-set concentric lamellae and numerous projections arranged on each lamella; radial sculpture lacking at all. Concentric lamellae becoming stronger and coaser towards the periphery; projections on them scaly in younger stages, and growing into short, semi-tubiform spines later. These sculptures obsolete near the umbo. Posterior adductor scar large, distinct, situated on the postero-dorsal side, anterior one degenerated, pallial line distinct and entire.

Remarks:— Majority of the specimens are left valves, only two are right, both of which are internal moulds. External sculptures above described, therefore, are of left valves. This species is characteristic in ornamentation. It consists of the concentric lamellae and projections instead of radial ornaments which are commonly developed in *Plicatula*. *Plicatula difficilis* HEALEY (1908, p. 44, pl. 8, fig. 3a, b) from the Napeng beds of Burma resembles this species in the subcircular outline and concentrically arranged spines, but differs in the coarser ornaments and tubular spines.

Occurrence:— Common, upper part of lower beds of Heki formation, Heki (Loc. nos. N. 701, 702); rare, lower part of N_3 formation, Monobe (N. 601) and ? middle part of the same formation, Nabae (N. 211). (Reg. nos. JM. 10246–252)

Family Pinnidae

Genus *Pinna* LINNÉ, 1758

Pinna sp. cf. **Pinna** aff. **lima** BÖHM, REED, 1927

Pl. XIV, Figs. 8–10

cf. 1927. *Pinna* aff. *lima*, REED, p. 242, pl. 19, fig. 8

Description :— Shell large, rounded fan-shape, moderately convex at the middle, but flattened at the rear side, posterior opening considered to be very narrow, hinge-line long and straight. Ventral margin slightly convex dorsally, continuing to the broadly rounded postero-ventral margin; posterior margin slightly curved, intersecting at nearly right angle with the hinge-margin. Median ridge bluntly angular at the anterior part, but growing obscure twoards the posterior. Surface ornamented with regular concentric folds, which are stronger on the ventral side; radial sculptures absent.

Observations and *comparison* :— The largest specimen (Pl. XIV, Fig. 8) which is considered to be slightly crushed, attains more than 16 cm in length and has an spical angle of 50° or so, another specimen (Pl. XIV, Fig. 10) is strongly flattened and elongated antero-posteriorly, and has an apical angle of 30°. This species has much resemblance to *Pinna* aff. *lima* BÖHM reported by Reed from the upper Triassic? formation from Yun-nan, in the general outline and sculptures. Besides an inaccurate apical angle of the species, there is only a small difference between the slightly arcuate ventral margin of the former and the straight one of the latter.

Occurrence :— Very rare, middle part of N_2 formation, Kongoin (Loc. no. N. 102); rare, lower part of N_3 formation, Kichisaka (N. 126), Miuchi (N. 412), and upper part of lower beds of Heki formation (N. 701, 704). (Reg. nos. JM. 10039c, 10269–273)

Family Myophoriidae

Genus *Neoschizodus* GIEBEL, 1856

Neoschizodus semicostatus NAKAZAWA, new species

Pl. XV, Figs. 1–5

Description :— Shell small in size, equivalve, inequilateral, roundly subtrigonal in outline, longer than high, and fairly convex; umbo slender but prominent, somewhat prosogyrous, rather strongly incurved, lying a little forward from the middle of the shell. Posterior area defined from the flank by a distinct marginal carina, and usually divided by a weak median furrow which grows obsolete towards the margin; escutcheon bordered by a distinct external carina from the area. Dentition of *Myophoria* type bearing no crenulation, left valve

provided with three cardinal teeth, the anterior one oblique and prolonged-trigonal, the middle one strong, isoscelese-trigonal, and the posterior one slender, nearly parallel to the shell-margin; right valve with two cardinals, anterior one strong and trigonal, posterior one long and slender. Posterior side of anterior muscle-scar bordered by a myophorous buttress, posterior one not impressed; pallial line visible only near the anterior scar. Surface of the body ornamented with fine, regular, concentric striae developed on the anterior half only, posterior half of the flank and umbonal portion as well as the posterior area almost smooth.

Remarks:— Though the concentric sculptures on the anterior side are fine and weak, they are referred as costae better than growth-lines, because they are uniform in strength nearly equal as their interspaces and regularly disposed. This species is clearly distinguished from any other species of *Neoschizodus* by the characteristic ornamentation just mentioned.

Occurrence:— Common, N_4 formation, Nishimitsumatsu (Loc. no. N. 222). (Reg. nos. JM. 10289–295)

Family Trigoniidae

Genus *Minetrigonia* KOBAYASHI and KATAYAMA, 1938

Minetrigonia hegiensis (SAEKI), 1925

Pl. XV, Figs. 6–10

1925. *Trigonia hegiensis* SAEKI, p. 35, pl. 12, figs. 1–3.
〃 *Trigonia yeharai* SAEKI, p. 36, pl. 12, figs. 4–5.
1952a. *Minetrigonia hegiensis*, KOBAYASHI & ICHIKAWA, p. 72, pl. 3, figs. 4–11.

The genus and species were fully discussed by KOBAYASHI and ICHIKAWA (KOB. & ICH., 1952a, p. 69; ICHIKAWA, 1954b, p. 63). Some observations are here noted. KOBAYASHI and KATAYAMA (1938) concluded correctly that "*Trigonia*" *hegiensis* and "*T.*" *yeharai* are no more than a single species which was erroneously seperated by a difference of shape caused by secondary deformation. This conclusion is surely confirmed by several specimens contained in one and the same slab (Pl. XV, Fig. 6). Concentric costae are usually counted 25–30 in number, even 40 in the large specimen which attains 30 mm in height. Radial ribs vary between 5 and 18 in number (see table), and stronger and complete ones of them are 4–7 and almost limited on the posterior half. But some specimens (Pl. XV, Fig. 7) are ribbed on the most part of the body and resemble more closely *M. katayamai* KOBAYASHI & ICHIKAWA (KOBAYASHI & KATAYAMA, 1938, p. 188, text-figs. 1–2; ICHIKAWA, 1954b, p. 63, pl. 4, figs. 9, 10a, b) than usual.

Number of ribs	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	mean. 9
Number of specimen	0	1	5	11	8	8	5	2	5	1	1	1	1	0	1	Total. 50

The rearmost radial rib which forms a marginal carina, is usually bifurcated and rarely trifurcated. Ligament is opisthodetic and the posterior external ligament-area is rarely observable. It is as long as about two-fifths of the dorsal margin of the escutcheon, and is deeply excavated (Pl. XV, Fig. 9).

Occurrence:— Abundant, N_2 formation through Maizuru district, Hirubatake (Loc. no. N. 134), Kongoin (N. 102, 103), Sugitani (N. 503); rare, lowest part of N_3 formation, Monobe (N. 603); common, upper part of lower beds of Heki formation (N. 701, 2, 4, 5); rare, uppermost part of N_1 formation (N. 220). (Reg. nos. JM. 10066b, 10296–304)

Family Ctenodontidae

Genus *Palaeoneilo* HALL, 1869

Palaeoneilo sp.

Pl. XV, Figs. 11–13

There are several specimens which may belong to the same sepcies. All of them are severely crushed, and show marked differences in outline each other. So it is difficult to reconstruct the actual shape. One of them (Pl. XV, Fig. 11) which suffers from relatively weak dorso-ventral depression, showing a transversely elongate suboval outline, and moderately inflated. Umbo lying between the anterior one-third and two-fifths of the length, and distinctly prosogyrous. Shell bearing neither radial sinus, nor umbonal ridge; surface nearly smooth except very fine growth-lines. Hinge consisting of two rows of taxodont denticles, which meet below the umbo in an obtuse angle; posterior denticles more than 30 in number, decreasing in size towards the umbo, drawn up in a slightly arcuate line, anterior ones distinctly stronger than the posterior, arranged in a somewhat concave line. Posterior adductor-scar lying near the end of the posterior teeth, very weak, anterior scar and pallial line invisible.

Though the strict comparison is almost impossible, the species is considered to resemble *Palaeoneilo subtinella* KRUMBECK (1924, p. 230, pl. 197, figs. 1, 2, 4) and *P. iwaiensis* ICHIKAWA (1954c, p. 45, pl. 1, figs. 8; 1954b, p. 131, pl. 17, figs. 1–3), but differs from the former in the smaller size and more minute denticles, and from the latter in the higher outline and more numerous denticles.

Occurrence:— Rare, N_3 formation, Nabae (Loc. nos. N. 205?, 208–6, 213 and 216), and Kichisaka (N. 112), (Reg. nos. JM. 10281–286, 10287?)

Family Nuculanidae

Genus *Nuculana* LINK, 1807

Subgenus *Dacryomya* AGASSIZ, 1840

Nuculana (Dacryomya) sp.

Pl. XV, Figs. 14–16

Description:— Shell small, inequilateral, elongate transversally, subtrigonal

in outline, and tapering posteriorly. Ventral margin broadly rounded, in some specimens obtusely truncated at the posterior end, postero-dorsal margin slightly concave. Umbo opisthogyrous, and considered to lie at about one-third or two-fifths of the length from the front. Area long, narrow, excavated and bordered on the flank by a sharply rounded, concave umbonal carina. Surface covered with distinct, uniform, closely and regulary set concentric costae, which become slightly wavy near the umbonal carina, posterior area nearly smooth. Hinge consisting of two rows of denticles which are interrupted by an internal chondrosphore below the umbo; the dinticles counted 9–10 in number in the straight anterior row which becomes convex below the umbo, and 10 or more in the slightly concave anterior one. In the largest specimen of 12 mm in height the anterior teeth reaching 17 in number. Anterior adductor scar barely visible just below the frontal end of the hinge; pallial line and posterior scar unrecognizable in the specimens at hand.

Remarks and Comparison:— There are three internal and five external moulds, all of which are remarkably crushed like others. One of the external moulds (Pl. XV, Fig. 15) shows an anteriorly protruded outline with a subcentral umbo, but this may be caused by secondary deformation. The internal moulds are obscurely truncated at the postero-ventral extremity, but the externals are not. This species has a close resemblance to "*Palaeoneilo*" *fujinohira* ICHIKAWA (1954b, p. 141, pl. 1, figs. 5a, b, 6, 7) in outline and sculptures, and seems to differ only in the unrecognizable pallial line and posterior scar which are clearly seen in the latter species. As the hinge of *P. fujinohira* is entirely inobservable, it cannot be decided whether this species should be placed in *Palaeoneilo* or *Nuculana*. So the identification between the two species is left in future. Aside from *fujinohira*, the species may be much allied to "*Leda*" *semicrenata* Trechmann (1917, p. 191, pl. 21, fig. 20) from the upper Trias of New Zealand, but distinguished in the more anteriorly located umbo and more regularly disposed costae.

Occurrence:— Rare, N_3 formation, Nabae (Loc. nos. N. 205, 208, 212, 215–2), Kichisaka (N. 132), and Terada? (N. 304). (Reg. nos. JM. 10274–79? 10280–81).

Family Parallelodontidae

Genus *Parallelodon* MEEK and WORTHEN, 1886

Parallelodon monobensis NAKAZAWA, new species

Pl. XV, Figs. 17a, b, Pl. XVI, Figs. 1–3a, b

1939. *Macrodon* sp. aff. *M. Buchii* BÖHM, KATAYAMA, p. 132. (listed)

Description:— Shell medium in size, elongate, trapezoidal, fairly inflated, equivalve, highly inequilateral; anterior margin well rounded, ventral margin nearly straight, subparallel to the hinge-margin except a distinct ventral sinus lying at a little anterior from the middle, and intersecting with the posterior margin

forming a rounded acute angle, posterior carina obtusely rounded, delimiting a little concave posterior area. Umbo broadly rounded, prominent, placed at the anterior one-fourth or more of the length; ligament-area narrow, long, provided with several deep, chevron-shaped ligament-grooves; hinge consisting of 2, relatively short, horizontal anterior teeth, 2–3, long posterior ones subparallel to the hinge-margin, and numerous, vertical detincles between them. Surface ornamented with numerous, fine, regularly spaced, sometimes bifurcated radial riblets and irregularly spaced growth-lamellae which become closer near the outer margin. Adductor scars and a pallial line not preserved.

Observations and remarks:— All the materials are fairly crushed. The holotype specimen is elongated and flattened, so the species is actually higher than it. The denticles under the umbo are very weak and often not preserved partially or entirely. They have a tendency to incline postero-ventrally just before the posterior series of teeth and antero-ventrally immediately behind the anterior series, and so they are arranged, in some degree, radially from the umbo, but not continuous to the both series. In the normal species of *Parallelodon* including the genotype *P. rugosum* (BUCKMANN), the denticles change the inclination anteriorly, continuously from perpendicular to parallel to the hinge-margin. Accordingly relatively long, linear anterior teeth discontinuous with the following denticles like this species suggest a new subgenus.

The muscle-scars which are not preserved in the present specimens, however, are observable in those of the upper Triassic Hirabara formation in Yamaguchi Prefecture. They are situated just below the both sides of the hinge-margin respectively, and are linked by a simple pallial line.

Comparison:— This species resembles *P. imbricarius* (BITTNER) (1895, p. 120, p. 15, figs. 8–12) from the Alps in the general ornamentation, but differs in the finer radials, especially on the posterior area, and in the ventral margin subparallel to the hinge-line, while the latter species increases its height towards the posterior end. This is also related to *P. buchii* (BÖHM) (1903, p. 39, pl. 4, figs. 11, 14) from the Bear Island, but distinguished by the more conspicuous ventral sinus and more anteriorly located umbo.

Occurrence:— Common, lower part of N_3 formation, Monobe (Loc. no. N. 601); rare, upper part of lower beds of Heki formation (N. 701). (Reg. nos. JM. 10310–313)

? Family Pleurophoridae

Genus *Palaeopharus* KITTL, 1907, emend. KOBAYASHI and ICHIKAWA, 1951

Pl. XVI, Figs. 4–6, 8

Palaeopharus maizurensis KOBAYASHI and ICHIKAWA, 1951

1951. *Palaeopharus maizurensis* KOBAYASHI and ICHIKAWA, p. 19, pl. 1, figs. 1-6.

1952a. *Palaeopharus maizurensis* KOBAYASHI and ICHIKAWA, p. 79, pl. 3, figs. 1-3.

This is the most common species through the Maizuru district, and a large number of materials are before hand. Detailed descriptions of the genus and the species are referred to those by KOBAYASHI and ICHIKAWA (1951). Some additional observations are stated below. Sculpture of the umbonal region which was not ascertained at the time of the description is well preserved in several specimens. It consists of 3–4 concentric costae quite similar to that of *Pal. anderssoni* (BÖHM) (1903, p. 45, pl. 4. fig. 4) as shown in Pl. XVI, fig. 4a. In the holotype specimen it seems to have a broad, crenulated pseudocardinal tooth in front of the cardinal in the right valve, and two pseudocardinals on both sides of a large pseudocardinal socket in the left, as described by KOBAYASHI and ICHIKAWA. But many specimens in hand show a codsiderable variation in pseudocardinals. In some cases the pseudocardinal "tooth" of the right valve is depressed just like a socket, but usually has a tendency to be differentiated to a depressed posterior half and an inflated anterior one, and occasionally projected as a ridge at the anterior margin (Pl. XVI, Figs. 4–6, 8a). Usually no groove can be seen between the cardinal and pseudocardinal, though observable in the holotype. The latter case may be an exceptional one. On the other hand the triangular anterior groove is well developed in all specimens. The pseudocardinals of the left is also variable. It is puzzling whether this cardinal is regarded as a tooth or a socket or a combination of the both. It may be more suitable to be called a crenulated pseudocardinal area. Above this area, anterior to the beak, there can be seen a narrow, transversally striated, variously developed ligament-area besides a long posterior parivicular one. So the ligament is amphidetic. The lower one of two posterior lateral teeth of the right valve is regarded as a marginal thickening of the lateral groove. Pallial line is indiscernible, but is most probably entire like that of the intimate species, *Pal. paucicostatus* n. sp. described below.

Occurrence :— Common, N_2 formation, Nabae (Loc. no. N. 226), Kongoin (N. 102, 103), Uene (N. 302, 303), Miuchi (N. 401), Sugitani (N. 803) and Ōmachi (N. 504); Common, N_3 formation, Nabae (N. 215–1), Kichisaka (N. 114, 124, 126), Arakura (N. 152), Shinmichi (N. 405–7), Miuchi (N.414) and Monobe (N. 601, 602); common, lower beds of Heki formation, Heki (N. 701, 704, 706). (Reg. nos. JM. 10288-299)

Palaeopharus maizurensis KOB. and ICH. new subspecies?

Pl. XVI, Figs. 7a, b, c

A very elongate right valve is at hand, which attains 5.7 in the ratio of length and height. Though the specimen is elongated secondarily, the proportion is too large to be resulted from the deformation only, as the other elongated ones are not over 5 in the ratio. Moreover the radial sculpture on the umbonal ridge and near the dorsal margin is also distinct where it is more or less obscured

by strong growth-lines in *maizurensis*. The concentric sculpture of the umbonal region is also observable (Pl. XVI, Fig. 10b). This species may be separated as an elongate subspecies of *maizurensis*.

Occurrence :— N_2 formation, Kongoin (N. 102). (Reg. no. JM. 10300).

Palaeopharus paucicostatus NAKAZAWA, new species

Pl. XVI, Figs. 11a, b

This species is founded on a well preserved pair of valves. It agrees well with *Pal. maizurensis* in the general outline as well as the hinge-character, but is readily distinguished by undeveloped radial ribs, which are limited on near the umbonal ridge only, initiated apart from the umbo and are extinguished at about a half length of the posterior dorsal margin from the umbo. Those of another right valve referrable to this species (JM. 10302) are a little stronger and attain to almost postero-ventral extremity. The cardinal tooth and socket of both valves are ill-preserved, and seem to be less developed than *maizurensis*. The crenulated pseudocardinal area is well preserved, and differentiated to a large subtrigonal pseudocardinal tooth and a narrow, deep anterior furrow in front of it in the left valve, and a corresponding socket and a tooth in the right. These pseudocardinals are reverse in arrangement in comparison with those of the holotype of *maizurensis*, but the difference is not regarded as conspicuous, because the pseudocardinals of the latter species are variable as already stated. Weak entire pallial line is present.

Occurrence :— A pair of valves from lower part of N_3 formation, Shinmichi (N. 405) and a right valve from Kichisaka (N. 114) and Monobe (N. 601). (Reg. nos. JM. 10301, 2).

Family Cardiniidae

Genus *Cardinia* AGASSIZ, 1838

Cardinia triadica KOBAYASHI and ICHIKAWA, 1952

Pl. XVI, Fig. 9

1952a. *Cardinia triadica* KOBAYASHI and ICHIKAWA, p. 62, pl. 1, figs. 1-5.

This species is commonly found not only at Heki (Loc. nos. N. 701, 704, 705) but also at Kongoin (N_2 formation, N. 102, 103), Shinmichi (N_3 formation, N. 406, 407), Sugitani (N_2 formation, N. 503) and Monobe (N_3 formation, N. 601, 602). (Reg. nos. JM. 10303-307)

Cardinia cf. **misawensis** KOBAYASHI and ICHIKAWA, 1952

Pl. XVI, Fig 10

cf. 1952b. *Cardinia misawensis*, KOBAYASHI and ICHIKAWA, p. 265 pl. 10, figs. 7-8.
1954b. *Cardinia misawensis*, ICHIKAWA, p. 58, Pl. 4, figs. 7, 12-14.

A pair of valves and a right valve from the N_2 formation of Kongoin (Loc. no. N. 102) are conferrable to *C. misawensis* in the outline and the position of the umbo. But other associated fossils are all remarkably deformed, so the writer hesitates to indentify decidedly. (Reg. nos. JM. 10308, 9).

Acknowledgement

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Plate XIII

Explanation of Plate XIII

Halobia kawadai YEHARA .....P. 243

Fig. 1. Internal mould of a bivalved specimen (Reg. no. JM. 10212) ×1., Loc. Nabae (N. 208).

Halobia cf. *kawadai* YEHARA.....P. 244

Fig. 2. External mould of a left valve and internal mould of a part of a right valve (Reg. no. JM. 10220) ×1, Loc. ditto.

Halobia obsoleta KOBAYASHI and AOTI .....P. 244

Fig. 3. Clay cast of the external mould of a right valve (Reg. no. JM. 10221) ×1, Loc. Nabae (N. 207)

Halobia new species, indet. ..... P. 245

Fig. 4. Clay cast of the external mould of a left valve (Reg. no. JM. 10222a) ×1. Loc. ditto.

Fig. 5. Internal mould of a right valve (Reg. no. JM. 10223) ×1. Loc. ditto.

Figs. 6 b, c. Internal moulds of two right valves (Reg. no. JM. 10222 b, c) ×1. Loc. ditto.

Halobia sp. *α*.....P. 246

Fig. 6 d. Internal mould of a right valve (Reg. no. JM. 10222d') ×1. Loc. ditto.

Fig. 7. Clay cast of the external mould of the same specimen (Reg. no. JM. 10222d) ×1.

Halobia sp. *γ* ..... P. 248

Fig. 8. Internal mould of a left valve (Reg. no. JM. 10227) ×2, Loc. Kichisaka (N. 114).

Halobia cf. *austriaca* MOJSISOVICS .....P. 247

Fig. 9. Internal mould of a right valve (Reg. no. JM. 10230) ×1. Loc. Nabae (N. 208).

Halobia sp. *β* ..... P. 248

Fig. 10. Internal mould of a left valve (Reg, no. JM. 10224) ×1, Loc. ditto.

Fig, 12. Gypsum cast of the external mould of a left valve (Reg. do. JM. 10228) ×1, Loc. ditto.

Fig. 13. External mould of a right valve (Reg. No. JM. 10225) ×2, Loc. ditto, showing a bending of radial ribs.

Halobia cf. *aotii* KOBAYASHI and ICHIKAWA ..... P. 246

Fig. 11. External mould of a right valve (Reg. no. JM. 10233) ×1, Loc. Kichisaka (N. 113).

Oxytoma new species ? indet. .....P. 249

Fig. 14. Internal mould of a left valve (Reg. no. JM. 10257) ×1, Loc. Nishimitsumatsu (N. 201).

Fig. 15. Gypsum cast of the external mould of a left valve (Reg. no. JM. 10258) ×1, Loc. ditto.

Fig. 16. Internal mould of a right valve (Reg. no. JM. 10265) ×1, Loc. Nabae (N. 215), showing a pallial line.

Fig. 17. Gypsum cast of the external mould of a right valve (Reg. no. JM. 10262a) ×1. Loc. Nishimitsumatsu (N. 201), showing radial ornaments.

Fig. 18. Gypsum cast of the external mould of a left valve (Reg. no. JM. 10259) ×1, Loc. ditto, showing radial ornaments.

Fig. 19. Clay cast of the external mould of a left valve (Reg. no. JM. 10262b) ×1, Loc ditto, showing a sinuation of a posterior wing in young stage.

Oxytoma ? sp. .....P. 250

Fig. 20. Gypsum cast of the external mould of a left valve (Reg. no. JM. 10268) ×1, Loc. east of Kichisaka pass (N. 124).

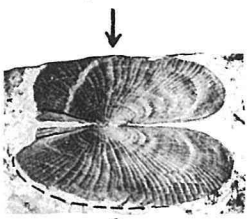
"*Ostrea*" sp.....P. 250

Fig. 21. Internal mould of a right valve (Reg. no. JM. 10242) ×1.5, Loc. Kongoin (N. 102).

(Erratum : for '×2' in the plate read '×1.5.')

Notes on Pl. XIII-XVI: Arrows indicate apparrent directions of depression or compression by secondary deformation.

All specimens here illustrated are kept in the Geological and Mineralogical Institute of University of Kyoto.



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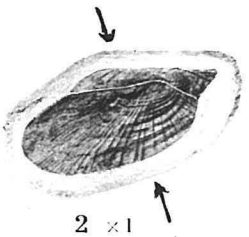

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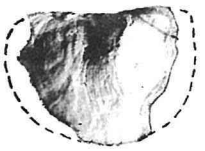

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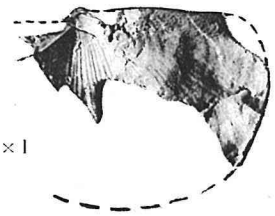

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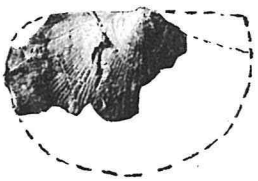

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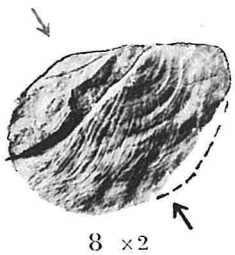
7 ×1



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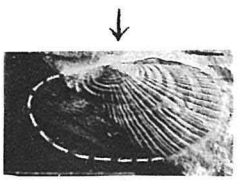
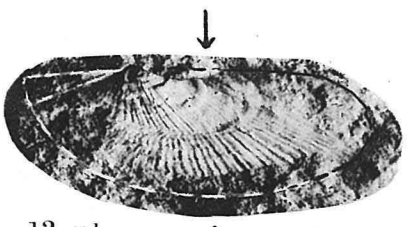


9 ×1

10 ×1

11 ×1



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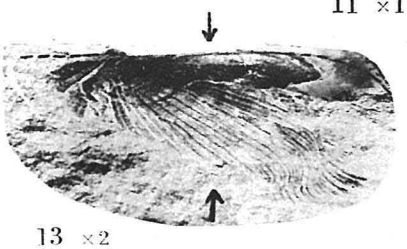

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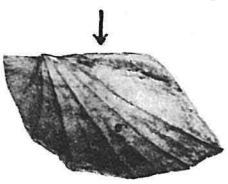

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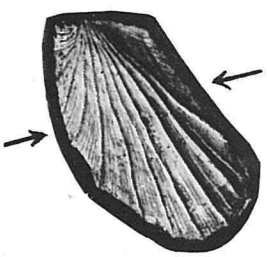

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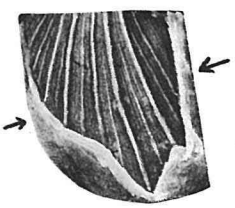
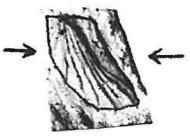
17 ×1

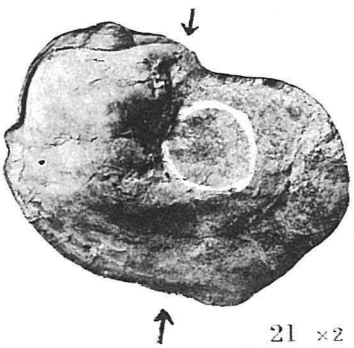


18 ×1

19 ×1



20 ×1



21 ×2

Plate XIV

Explanation of Plate XIV

"*Ostrea*" sp. ..... P. 250

Fig. 1. Gypsum cast of the internal mould of a right valve (Reg. no. JM. 10243) ×1. Loc. Kongoin (N. 102)

Fig. 2. Cypsum cast of the external mould of a left valve (Reg. no. JM. 10245) ×1, reconstructed from the internal mould. Loc. ditto, showing marginal plications.

Plicatula hekiensis NAKAZAWA, new species ..... P. 251

Fig. 3. Gypsum cast of the external mould of a left valve; paratype (Reg. no. JM. 10250a) ×1, Loc. Monobe (N. 601).

Fig. 4. Gypsum cast of the internal mould of a right valve; paratype (Reg. No. JM. 10250b) ×1, Loc. ditto.

Fig. 5. Internal mould of a left valve; holotype (Reg. no. JM. 10246a) ×2, Loc. Heki (N. 701).

Fig. 6. Internal mould of a left valve; paratype (Reg. no. JM. 10247) ×2, Loc. ditto.

Fig. 7a. Clay cast of the external mould of a left valve; paratype (Reg. no. JM. 10248) ×2, Loc. ditto.

Fig. 7b. A part of the external mould of the same specimen, ×3, showing semi-tubiform spines.

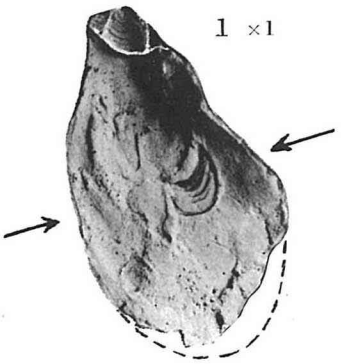
Pinna sp. cf. *Pinna* aff. *lima* BÖHM, Reed. ..... P. 252

Fig. 8. External mould of a right valve (Reg. no. JM. 10272) ×½, Loc. Heki (N. 704).

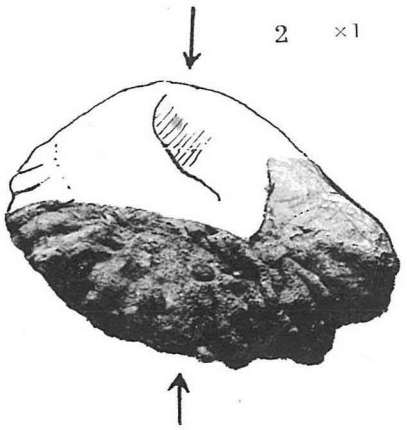
Fig. 9. Sketch of the interior of the umbonal part retouched from the internal mould of a left? valve (Reg. no. JM. 10306) ×1, Loc. ditto.

Fig. 10. External cast of a left valve (Reg. No. JM. 10269) ×1, Loc. Miuchi (N. 412).

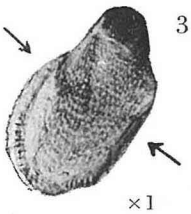
Notes: Same in the Plate XIII.



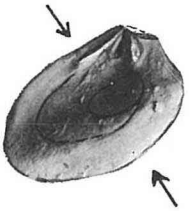
1 ×1



2 ×1

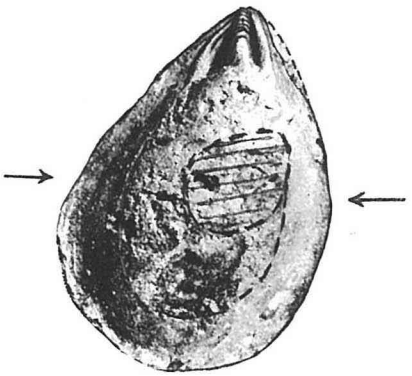


3 ×1

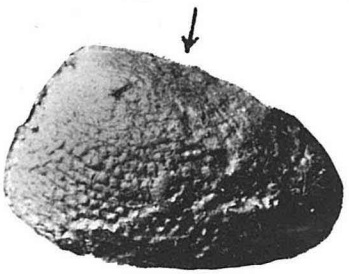


4 ×1

5 ×2

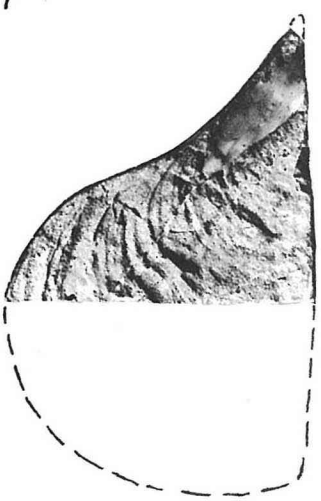


6 ×2

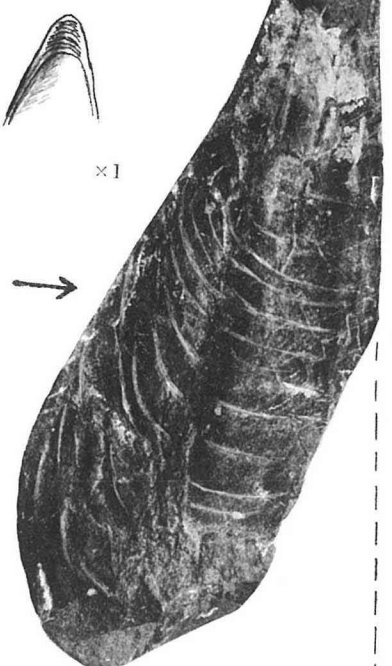


7a ×2

7b ×3



8 ×½



9 ×1

10 ×1

Plate XV

Explanation of Plate XV

Neoschizodus semicostatus NAKAZAWA, new species .....P. 252

Fig. 1. Clay cast of the external mould of a left valve; holotype (Reg. no. JM. 10289) ×2, Loc. Nishimitsumatsu (N. 222).

Fig. 2. Internal mould of a right valve; paratype (Reg. no. JM. 10291a) ×2, Loc. ditto.

Fig. 3. Clay cast of the external mould of a right valve; paratype (Reg. no. JM. 10291b) ×2, Loc. ditto.

Fig. 4. Dorsal view of the internal mould of a right valve; paratype (Reg. no. JM. 10292) ×2, Loc. ditto.

Fig. 5. Dorsal view of the internal mould of a left valve; paratype (Reg. no. JM. 10290) ×2, Loc. ditto., umbonal part being removed to show a hinge.

Minetrigonia hegiensis (SAEKI).....P. 253

Fig. 6. External moulds of several individuals (Reg. no. JM. 10302) ×1, Loc. Kongoin (N. 103), showing a marked deformation, a: "*Trigonia*" *hegiensis* type, b, c: "*T.*" *yeharai* type.

Fig. 7. Gypsum cast of a right valve (Reg. no. JM. 10299) ×1, Kongoin (N. 102), showing radial ribs developed on the nearly whole surface of the flank.

Fig. 8. Gypsum cast of a left valve retaining a nearly actual shape (Reg. no. JM. 10296a) ×1, Loc. Heki (N. 704).

Fig. 9. Clay cast of the external mould of a left valve (Reg. no. JM. 10296b) ×1, Loc. ditto, showing a posterior area and a external ligament-area (l).

Fig. 10. Clay cast of the internal mould of the same specimen. ×1.

Palaeoneilo sp. ..... P. 254

Fig. 11. Internal mould of a right valve (Reg. no. JM. 10286) ×2, Loc. Kichisaka (N. 112)

Fig. 12. Internal mould of a right valve (Reg. no. JM. 10281) ×2, Loc. Nabae (N. 209), umbonal part being removed.

Fig. 13. Internal mould of a right valve (Reg. no. JM. 10283) ×2, Loc. Nabae (N. 208).

Nuculana (*Dacryomya*) sp. .....P. 254

Fig. 14. Upper-dorsal view of the internal mould of a left valve (Reg. no. JM. 10275) ×2, Loc. Nabae (N. 215-2), showing a hinge, umbonal part being removed.

Fig. 15. Clay cast of the external mould of a left alve (Reg. no. JM. 10277) ×2, Loc. Nabae (N. 208).

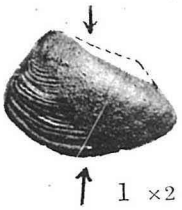
Fig. 16. Clay cast of the external mould of a left valve (Reg. no. JM. 10279) ×2, Loc. Kichisaka (N. 132).

Parallelodon monobensis NAKAZAWA, new species ..... P. 257

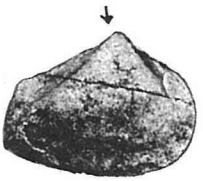
Fig. 17a. Internal mould of a left valve; holotype (JM. 10310) ×2, Loc. Monobe (N. 601).

Fig. 17b. Gypsum cast of the external mould of the same specimen, ×1.

Notes: Same in the Plate XIII.



1 ×2

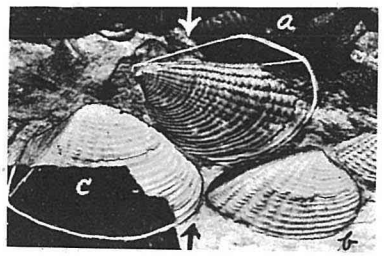


2 ×2

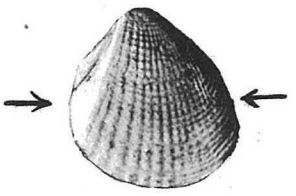
3 ×2

4 ×2

5 ×2

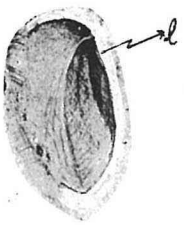


6 ×1



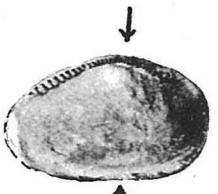
7 ×1

8 ×1

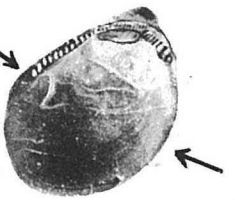


9 ×1

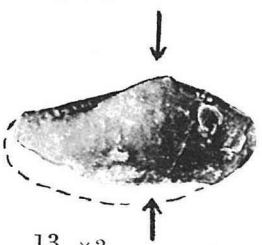
10 ×1



11 ×2



12 ×2

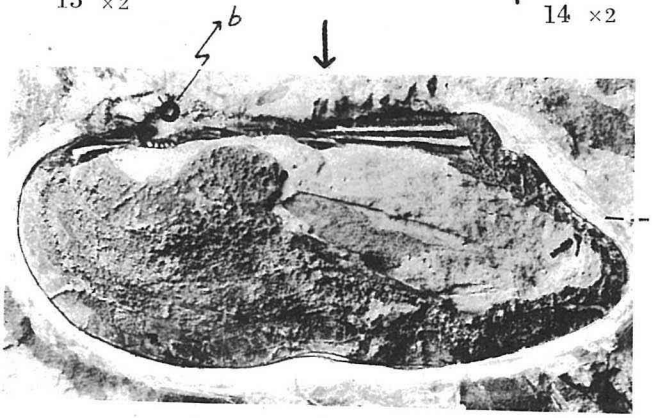


13 ×2

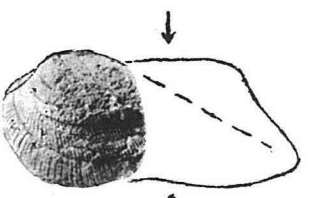
14 ×2

15 ×2

16 ×2



17a ×2



17b ×1

Plate XVI

Explanation of Plate XVI

Parallelodon monobensis NAKAZAWA, new species ..... P. 255

Fig. 1 Internal mould of the hinge-area of a right valve; paratype (Reg. no. JM. 10313) ×1.5, Loc. Heki (N. 701),

Fig. 2. Schematic figure of the hinge-area.

Fig. 3. Internal mould of a right valve (Reg. no. JM. 10311) ×1.5, Loc. Monobe (N. 601). The specimen is partially seperated to show a hinge-area.

Palaeopharus maizurensis KOBAYASHI and ICHIKAWA ..... P. 256

Fig. 4a. Gypsum cast of the external mould of a right valve (Reg. no. JM. 10292) ×1, Loc. Shinmichi (N. 404), showing umbonal sculptures.

Fig. 4b. Clay cast of the internal mould of the same specimen, ×1.

Figs. 5,6. Clay casts of the internal moulds of right valves. 6: (Reg. no. JM. 10270b), Miuchi (N. 414). 7: (Reg. no. JM. 10294), Loc. ditto.

Figs. 8a, b. Schematic illustrations of hinge-area. lp: posterior ligament-area, la: anterior ligament-area, cs: cardinal socket, ct: cardinal tooth, ps: crenulated pseudocardinal area, as: anterior pseudocardinal socket, at: anterior pseudocardinal tooth, ad: anterior adductor-scar, pd: pedal retractor-scar.

Palaeopharus maizurensis KOB. & ICH. new subspecies?.....P. 257

Fig. 7a. Internal mould of a right valve (Reg. no. JM. 10300) ×1. Loc. Kongoin (N. 102).

Fig. 7b. Gypsum cast of the external mould of the same specimen, ×2.

Fig. 7c. Clay cast of the internal mould of the same specimen, ×1, showing a hinge.

Palaeopharus paucicostatus NAKAZAWA, new species ..... P. 258

Fig. 11a. Gypsum cast of the internal mould of bivalved specimen; holotype (Reg. no. JM. 10301) ×1, Loc. Shinmichi (N. 405).

Fig. 11b. Gypsum cast of the external mould of the same, ×1.

Cardinia triadica KOBAYASHI and ICHIKAWA.....P. 258

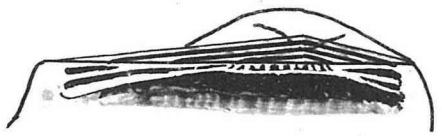
Fig. 9. Clay cast of the external mould of a right valve (Reg. no. JM. 10304) ×1, Loc. Kongoin (N. 102).

Cardinia cf. *misawensis* KOBAYASHI and ICHIKAWA.....P. 259

Fig. 10. Internal mould of a right valve (Reg. no. JM. 10308) ×2, Loc. ditto.

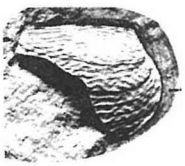
Notes: Same in the Plate XIII.

1 ×1.5



2

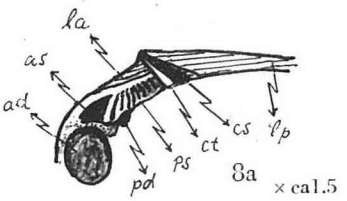
3 ×1.5



4a ×1

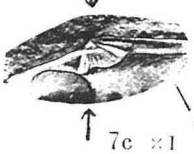
4b ×1

5 ×1



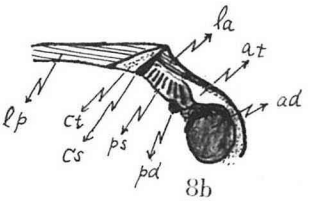
8a ×ca1.5

6 ×1

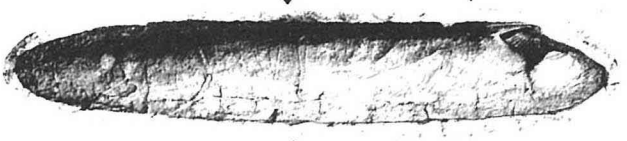


7c ×1

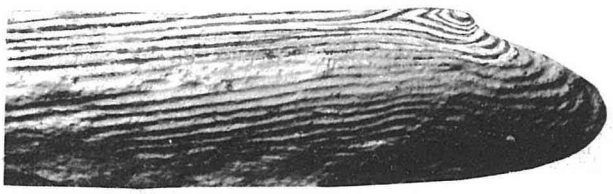
9 ×1



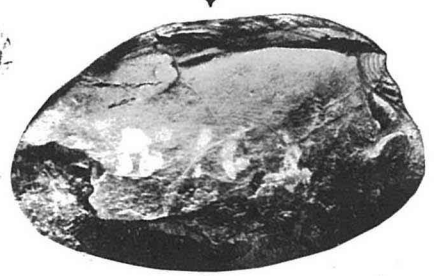
8b



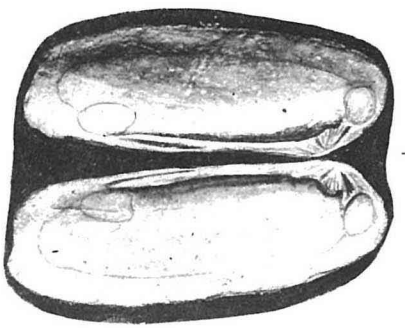
7a ×1



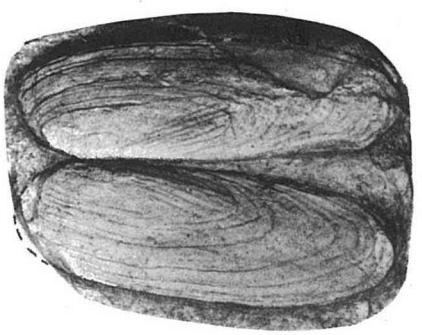
7b ×2



10 ×2



11a ×1



11b ×1