



TITLE:

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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 1 Pectinids and Limids

By

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With 4 plates and 3 figures

Abstract

The geology of the Maizuru district in the northern part of Kyoto Prefecture is characterized by a zonal structure consisting of the Permian and the Triassic groups and basic intrusive rocks. The Upper Triassic Nabae group contains a large number of fossils, especially, pelecypods, most of which are new species. Seven Species of Pectinidae and three species and one variety of Limidae are described below.

The geologic structure and the Triassic stratigraphy of the Maizuru district in the northern part of Kyoto Prefecture have been greatly clarified in the latest several years by T. Koga (1948), N. Kanbe (1950), K. Nakabayashi, S. Okada and the writer (1948). In this district, the Permian Maizuru group, the Middle and Lower Triassic Yakuno group, the Upper Triassic Nabae group and basic intrusive rocks form a complicated zonal structure, extending from east to west. The northern portion of the Nabae group is thrust to by the Yakuno and Maizuru groups, while the southern portion of it is intruded by the basic rocks, the entire Nabae group thus forming a narrow belt of ENE-WSW direction from Nabae (in Uchiura village, Fukui Pref.) through Matsunodera (in Maizuru city), Terada (in the same city), Oyogi (in Ayabe city), Monobe (in Monobe village) to Heki (in Nakayakuno village).

At Nabae, the type locality of the Nabae group, it is divided into four beds as follows in ascending order, (Nakazawa and Okada, 1948).

- N₁ bed Alternation of fine sandstone, sandy shale and black shale, fossils rare. Thickness 30m+
- N₂ bed Mostly white, grey, fine to medium grained, thick-bedded sandstone, often conglomeratic, intercalating fossiliferous sandy shale at the middle horizon. Thickness 100-350 m
- N₃ bed Mostly black shale and sandy shale intercalating fine sandstone and a few anthracite seams in other areas. Fossils rich, especially at the lowest and uppermost horizons. Thickness 400m-

N₄ bed Grey, fine to medium grained, bedded sandstone with black shale, fossils rare. Thickness 150m+

At Matsunodera N₂-N₄ beds, at Terada, Oyogi and Monobe N₂, N₃ beds are present. At Heki where the Nabae group is called Heki formation (T. Kobayashi, 1935), it may be divided into two beds, namely, the lower bed rich in sandstone and the upper one rich in shale.

The Nabae group is understood to have been a shallow sea or strand deposit and contains many animal fossils such as pelecypods, brachiopods, gastropods, cephalopods, crinoid, echinoid and bryozoans, and, in addition, plant fossils. These faunas are closely related to those of the lower and middle beds of the Kochigatani series in the Sakawa basin, i. e. *Oxytoma-Mytilus* bed, *Halobia-Tosapecten* bed and *Myoconcha* bed (Kobayashi and Ichikawa, 1950) and Hirabara formation of the Mine series in Yamaguchi Pref. (Katayama, 1939). The Kochigatani and Hirabara formations indicate the Sakawan age (K. Ichikawa 1950) which is nearly contemporaneous with the Carnic age of the international classification. Of fossil pelecypods, descriptions of 7 species of pectinids, 3 species and one variety of limids are given below.

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Family Pectinidae

Genus *Camptonectes* Agassiz, 1864

Camptonectes triadicus Nakazawa, n. sp.

Pl. VII Figs. 1 a, b, 2

Description:— The holotype is represented by a left valve. Shell nearly equilateral, suborbicular, moderately convex. Ornament consists of closely-set, fine, slightly punctated or reticulate, often bifurcating striae, curving upwards especially at the posterior side, and crossed by weak concentric growth wrinkles at intervals.

Anterior ear larger, obtusely triangular, with slightly convex anterior margin, covered by decussate ornament; posterior ear very small, obtusely triangular, ornamented by obliquely divergent striae from disk, without reticulate appearance. (Pl. VII, Fig 1 b) Resilifer small, triangular. (Pl. VII, Fig 2)

Height almost equal to length. Maximum thickness lying at about 15 mm below the hinge line. Apical angle large.

Dimensions of Holotype:

Height	Length	apical angle	depth
38mm	38.5mm	120°	6.5mm

Remarks and Comparison:— Although only one left valve could be obtained, judging from its orbicular outline, characteristic ornamentation, and aspect of auricles, this can be safely classified under genus *Camptonectes*. But judging from

the shapes of several specimens of *Minetrigonia hegiensis* (Saeki) in the same block, this species laterally elongated by deformation, so that the height may exceed the length and the apical angle smaller than the measurement. The upper margins of both ears do not form a straight level line, but this fact may be likewise caused by deformation.

This species resembles jurassic *C. lens* (Sow.) (Sowerby, 1818, p. 3, pl. CCV, figs. 2, 3. Arkell, 1928, pp. 94-99, Pl. VII, fig. 1, Pl. IX, figs. 4-7), the type species of the genus, but differs from the latter in its finer and denser striae, weaker and less growth-lines, the decassated ornament of the anterior ear oblique to its upper and anterior margins, and more unequal auricles. The middle portion of the disk is almost smooth as that of *C. giganteus* Arkell (1928, p. 100, Pl. VII, figs. 2, 3), but in the former the ornament is not preserved, whereas it was originally absent in the latter.

This is the first Triassic species of *Camptonectes*, so far as the writer knows.

Occurrence: Middle part of N₂ bed, Kongoin. (Loc. No. N-102) (Reg. No. JM 10001)

Genus *Velata* Quenst. 1856

Velata maizurensis Nakazawa, n. sp.

Pl. VII, Figs. 3-6.

1952 *Chlamys* sp. indet. Kobayashi and Ichikawa, p. 78, pl. 3, fig. 14.

Description:- As all specimens are considerably deformed; accurate descriptions of their outlines cannot be given.

Shell fairly large, remarkably inequivalve, inequilateral, obliquely oval, hinge-line straight, antero-dorsal margin slightly concave and longer than linear postero-dorsal; ventral margin rounded, but abruptly rising up backward, and antero-ventrally projected.

Right valve almost flat, posterior ear even and small, obtusely triangular, anterior ear larger than posterior one, sinuated deeply below as in *Chlamys*. Surface ornamented with many weak riblets, which, in paratype (Pl. VII Fig. 5), are very fine and separated by flat smooth interstices at the umbo, and some 5 mm. from the umbo, secondaries appear as strong as primaries, both increasing to more than 60 in number; in advanced growth they are gradually enlarged to the size of interspaces; on the anterior ear about 7 radial ribs and on the posterior ear 3 weak radials are present. Left valve gently convex, umbo slightly projected over hinge-margin, both ears obtusely triangular, distinctly depressed, anterior ear larger. Surface sculptured by radial ribs of three or four orders i. e. primaries, secondaries, tertiaries and quaternaries. On the umbo of another paratype only 17 primaries (Pl. VII Fig. 6) are visible, while some 6 mm below the umbo secondaries appear alternating with primaries, and approximately 10-20 mm apart from the umbo, the tertiaries are inserted; near the peripheral margin quaternary riblets appear in various places. The ribs are faint and separated by flat wide interstices till the tertiaries make their appearance, but gradually grow larger and interstices become narrower to form mere boundary sulci;

in the full grown stage tertiaries enlarge to the size of secondaries, and 3 or 4 irregularly graded riblets being visible between strong primaries on the peripheral zone.

Both valves are covered with fine crowded concentric growth-lines, which become stronger on the ears and peripheral margin and cross the radials to make reticulate or slightly knotted appearance.

Dimensions :

	Height	Length	Apical angle
Holotype (right valve)	40mm	Ca45mm	120°

Remarks and comparison :— The specimens are deformed and elongated antero-posteriorly; they are understood to differ considerably from original shapes. Perhaps the apical angle is narrower, the height being nearly equal to or greater than the length, and the anterior ear of the left valve nearly rectangled triangular. This species bears a close resemblance to those of *Chlamys* and its right valve can hardly be distinguished from that of *Chlamys mojsisovicsi* Kob. and Ichi., but judging from the remarkable unequalness of both valves — the considerable difference of their sculpture, the flatness of the right valve — and the differentiated ornamentation of the left valve, this species may be more suitably classified under *Velata*. But this species has smaller anterior ear more distinctly bordered from the disk, and straighter ribs than the typical species of *Velata*.

Chlamys sp. indet. Koš. & Ich. 1952 from Heki was described to have a well developed anterior wing of *Chlamys* type, but after careful observation of the original specimen the writer has recognized that its wing as well as its umbo are destructed and separated from the main part of the shell by secondary external forces, and in consequence the wing seems to have a deep byssal sinus. This specimen is nothing else but the right valve of *Velata maizuruensis*, as complemented by Ichikawa in their postscript. (Kobayashi and Ichikawa, 1952, p. 84)

The ornamentation of the left valve reminds one of those of Carnic *Velata veszprimiensis* (Bittner), *V. venestula* (Bittner) from Bakony (Bittner, 1901) and Jurassic *V. velata* (Goldfuss) (Goldf., 1833, p. 45, Pl. XC, fig. 2.) but the ribs are less in number than *veszprimiensis* and *velata*, and more numerous than *venestula*. The most characteristic feature is the antero-ventrally elongated ovate outline of the shell as that of *Lima*, but whether this is caused only by deformation or not is a problem yet to be solved.

Occurrence :— N_2 bed and lower part of N_4 bed and uppermost part of lower bed of Heki formation.

Kongoin (Loc. No. N-102, 103), Miuchi (N-414), Shinmichi (N-405), Sugitani (N-503), Omachi (N-504), Monobe (N-601), Heki (N-701), (Reg. No. JM 100 22-10026)

Genus *Tosapecten* Kobayashi and Ichikawa, 1949.

Tosapecten nabaensis Nakazawa, n. sp.

Pl. VIII, Figs. 1, 2, 5.

Description :— All specimens are remarkably deformed, but their general

outline or aspect closely resembles *Tosapecten suzukii* (Kobayashi) (Kobayashi, 1931. Kobayashi and Ichikawa, 1949).

Shell conspicuously inequivalve, nearly equilateral, suborbicular, postero- and anterodorsal margins slightly arcuate, ventral margin subcircular,

Right valve moderately convex; anterior ear larger and about one and a third width of posterior, convex along anterodorsal margin; byssal sinus distinct, deep, particularly in the young stage; posterior ear trigonal, a little rolled up with linear posterior margin. Surface sculptured with 13 to 15 ribs narrower than their interspaces, gradually weakened towards anterior and posterior margins; at posterior side corresponding to submargin of left valve, 2 or 3 secondary ribs are inserted, along anterior margin 1 or 2 striae are observed.

Left valve almost flat or slightly convex; anterior ear larger than posterior one, flat, trigonal with almost straight anterior margin, curving forward along disk, but not sinuous; posterior ear slightly concave, nearly right-angled triangular; submargins at both sides of disk distinct, anterior one remarkably inflated with a distinct furrow and a riblet inside, posterior one not so conspicuous but wider. Ornament consists of round-topped primary and secondary ribs, 6 to 8 secondary ribs alternating with 8 to 9 primaries; at posterior half, secondary ribs strengthened almost as strong as primaries and closely set with them; furthermore, a few tertiary striae are often observed here.

Surface covered with feeble dense growth-lines, distinct on both ears. Ligament pit triangular, small.

Dimensions:

	Length of Medial ribs	Maximum distance from medial rib to anterior margin measured parallel to hinge-line	Apical angle	
JM 10004a	81mm	40mm	125°	Right valve of Holotype (flattened and obliquely deformed)
	Height	Length	Apical angle	
JM 10007a	32mm	35mm	120°	Right valve of forma <i>distincticostatus</i> (inflated by deformation)

Comparison:— This species Shows a close affinity to *Tosapecten suzukii* (Kobayashi) from Upper Triassic formation of Sakawa in Shikoku, but differs from the latter in obscure submargin of right valve and less number of ribs of both valves, i. e., *nabaensis* possesses 8 to 9 ribs on right valve except along submargins, while 11 to 12 are present in *suzukii*. In the ornamentation of left valve the present species is similar to *T. suzukii* var. *paucicostatus* Kob. & Ichi. and *T. suzukii* var. *inflatus* Kob. & Ichi., but differs from *paucicostatus* in more numerous ribs, and from *inflatus* in less convex shell and development of secondary ribs. (Kob. & Ichi., 1949).

Occurrence:— Middle and upper part of N₃ bed, Nishimitsumatsu and Nabae. (Loc. No. N-201, 202, 207, 212 to 216. Reg. No. JM. 10004-8 except 10007)

forma *distincticostatus*

Pl. VIII, Figs. 6-8.

is represented by attached valves, i. e., strongly convex right valve and nearly flat left one, and distinguished from *nabaensis* by uniformly developed and regularly arranged radial ribs and strong secondary ribs of the left valve.

The right valve resembles closely that of *nabaensis*. The medial ridge of the right valve and both of the strongly inflated submargins of the left valve may be caused by deformation.

Occurrence: - Upper part of N_3 bed, Nishimitsumatsu. (Loc. No. N-201, Reg. No. JM 10007. a, b, c),

Tosapecten okadai Nakazawa, n. sp.

Pl. VII Figs. 3, 4.

Description: - This is represented by a convex right valve which is supposed to be longitudinally elongated by deformation. Shell subovate, equilateral, rather convex; anterior ear as wide as posterior, byssal notch shallow, but deeper in young stage; posterior ear truncated at the upper corner. Surface sculptured by seven main ribs with one faint secondary rib, submargins at both sides rather wide but ornament unknown. Trigonal resilifer is present.

Comparison: - This species closely resembles *Tosap. nabaensis*, but broader submargin, peculiar shape and subequal length of ears easily distinguish it from the latter. It is deformed by crustal movement, and its apical angle may be wider and its length larger than the present sample. Whether the truncated form of the posterior ear is caused by crushing or not, however, is doubtful.

Occurrence: - Upper part of N_3 bed, Nishimitsumatsu. (Loc. No. N-202, Reg. No. JM 10009).

Tosapecten teradensis Nakazawa, n. sp.

Pl. VII Figs. 7-9

Description: - Shell inequivalve, almost equilateral, suborbicular. Right valve moderately convex; antero- and postero-dorsal margins arcuate upward, anterodorsal margin a little longer than posterodorsal one; posterior ear rectangular trigonal, anterior ear not preserved. Surface ornamented with 10 ribs slightly narrower than interspaces; anterior and posterior submargins provided with 3 to 4 and 2 riblets respectively, which cannot be distinguished distinctly from main ribs. Left valve slightly convex, showing almost similar outline as right valve, but dorsal margin straighter; both ears subequal, triangular. Surface ornamented with 10 to 11 fine primary ribs intercalated by secondary striae; anterior submargin narrow and distinctly elevated, posterior one narrow and flat, surface of which is ornamented with several striae.

Both valves covered with distinct, close concentric growth-lines.

Dimensions:

	length	height	spical angle	
Holotype (Left valve)	21mm.	16mm.	120°	strongly deformed
Paratype (Right valve)	30mm.	33mm.	110°	slightly deformed

Comparison:— This species is smaller than *Tosapecten nabaensis* and the right valve is less convex, and ribs weaker; in the left valve ribs are slender and flat-topped, and interspaces far wider and even, which enable one to distinguish it from any other species of *Tosapecten*.

Occurrence:— Lower part of N₃ bed, Terada. (Loc. No. N-304, Reg. No. JM 10011-10013).

Tosapecten sp. cfr. *suzukii* (Kobayashi)

Pl. IX Fig. 1

1931 *Pecten* (*Velopecten*) *suzukii* Kobayashi, p. 258, pl. 25, figs. 16-18.

1949 *Tosapecten suzukii* Kobayashi and Ichikawa, pp. 167-168, pl. 5, figs. 9-12.

Though fragmentary there are a few specimens which may be identified as *Tosapecten suzukii*. One of the left valves is ornamented with radial ribs which consist of regularly alternating primaries and secondaries, respectively 11 and 9 in number, but secondary ribs are weaker than those of typical species of *suzukii*, and another incomplete right valve has more than 8 ribs and 3 riblets on the posterior submargin.

Occurrence:— Upper part of N₃ bed, Nishimitsumatsu. (Loc. No. N-201, Reg. No. JM 10002, 10003).

"*Pecten*" sp. indet.

Pl. IX, Fig. 2

Antero- and posterodorsal margins of this specimen are straight and make a slender fan-like outline. Both ears not preserved; surface sculptured with low rounded roof-like radial ribs, some of which is weaker at the middle part of disk, and inserted by two secondary ones at posterior margin. Apical angle about 80°.

Lower part of N₃ bed, Terada. (Loc. No. N-304, Reg. No. JM 10014).

Genus *Chlamys* Röding, 1798,

Chlamys mojsisovicsi Kobayashi and Ichikawa.

Pl. IX, Figs. 3-6

1949. *Chlamys mojsisovicsi*, pp. 155-166, pl. 5, figs. 1-5.

Observation:— General characters of the specimens well agree with the type species from Sakawa, though their costae, 60 or so in number, are fewer than those of the holotype, which amounts to more than 70 in number. On the left valve secondary costae are inserted between the primaries at various distances from the umbo and regularly alternate with them; on the right valve radial ribs increase in number at first by insertion of secondaries, later by insertion and bifurcation. On the byssal ear two or three radial sulci are present. The small trigonal resilifer which could not be found in Sadawa's specimen can be rarely observed (Pl. IX, Fig. 5).

Occurrence:— Middle and upper part of N₃ bed. Nabae (Loc. No. N-

211-216), Nishimitsumatsu (N-201), Hirubatake (N-131), (Reg. No. JM 10015-10020).

Family Limidae d'Orbigny

Genus *Lima* Bruguière, 1792

Lima (*Pseudolimea*?) *naumanni* Kobayashi and Ichikawa

Pl. IX, Figs. 7, 8, Pl. X, Fig. 3

1949. *Lima naumanni* Kob. and Ichi. pp. 177, 178, pl. VI, Figs. 13-15.

Subgenus *Pseudolimea* was established by Arkell in 1932 under the genus *Lima* with *Plagiostoma duplicata* Sowerby as type, and it is distinguished from the genus *Limea* Bronn (1831) by the absence of the taxodont teeth on the ventral edge of the hinge plate and more oblique outline.

This species coincides with *Pseudolimea* in sub-generic characters, i. e. roof-shaped main ribs with secondary riblets at the center of sulci and edentulous hinge plate. The outline of this species is less oblique than sub-genotype, and rather closely resembles that of *Limea*, but *var. obliqua* Kob. and Ich. (1949, p. 178, Pl. 6 Figs. 16, 17) is more like that of *Pseudolimea*. Ligament pit is slightly smaller than that of sub-genotype judging from the illustrations of Goldfuss and Quenstedt. (Goldfuss, 1834-40).

A large number of specimens show many different shapes effected by deformation and varieties such as *obliqua* etc. cannot be distinguished if present. (Pl. X, Fig 3)

Occurrence: - Abundant in the upper part of N_3 bed, rare in the lower part of N_3 and N_2 bed.

Nabae (N-205, 211-216), Nishimitsumatsu (N-201, 202), Kichisaka (N-126), Kongoin (N-102), Sugitani (N-503), Monobe (N-602), Heki (N-701). (Reg. No. JM 10028-10031)

Lima yataensis Nakazawa, n. sp.

Pl. IX, Figs. 9-10, Pl. X Figs. 1, 2, 6.

Description: - Shell fairly large, equivalve, obliquely ovate, higher than long, gently convex; anterior margin straight, antero-ventral margin broadly rounded. Hinge-margin straight, a little shorter than half the length, hinge area isosceles triangular; ligament groove almost isosceles triangular, large, and its base half as long as the hinge-line; in well preserved specimens small serration can be seen at the lower margin of the hinge area such as *Notolimea*. Both ears moderately large, nearly equal; umbones slightly salient, apical angle perhaps 80 degrees or so.



Fig. 3 The hinge of *Lima yataensis*, showing serration.

Surface ornamented with 25 to 28 rounded radial ribs which are separated by concavely rounded sulci: sulci are narrower than ribs and smooth at the umbones, but later broader than ribs and sculptured by radial weak striae; striae

can be seen distinctly through a magnifying glass, increasing their number toward the periphery where the number reaches maximum, i. e. 6 to 7 in each sulcus (Pl. X, Fig. 6); secondary riblets rarely inserted. Posterior ear, covered by gradually weakened radial ribs, 4 to 6 in number, which are separated by narrow grooves, but anterior ear is ornamented only by strong growth-lines which obscure on the disc.

Observation:— The specimens are likewise conspicuously deformed as in other specimens (Pl. X, Fig. 1). The holotype specimen is elongated antero-dorsally, and 56 mm. high, 60 mm long and has an apical angle of about 80 degrees. One of the paratype specimens (Pl. X, Fig. 1a) has an apical angle of 50 degrees and its ratio of the height by the length is nearly 2/1; on the otherhand, another specimen, which is situated at a nearly rectangular direction from the former, has an apical angle of 120 degrees, and its ratio of the height by the length is about 1/1.5 (Pl. X, Fig. 1b). Perhaps another paratype specimen retains almost original shape, the height of which being 35 mm, the length 28 mm and apical angle 85 degrees. (Reg. No. 10033)

Comparison:— Rather characteristic ornamentation of this species resembles *Lima areolaris* Bittner (Bittner, 1895, p.172, Tab. XXII, Fig. 7) and *Lima austriaca* Bittner of St. Cassian (ibid. p. 95, Tab. XXII, Fig. 18), but this species is much larger and has different shapes. This is almost similar to Lower Liassic *Lima praelonga* Martin from France (Martin, 1859. p. 89, Pl. VII, Figs. 16–18), but differs from it in the greater size of shell, and scarcity of interstitial riblets which are well developed in the latter judging from his figures.

Occurrence:— Lower part of N_3 bed. Miuchi (Loc. No. N-414), Shinmichi (N-405), Terada (N-304), Kichisaka (N-126), Heki (N-701), (Reg. No. JM 10032–10040 and 10023 except 10039).

Lima yataensis var. *kuredanienensis* Nakazawa, n. var.

Pl. X Fig. 4, 5, 7

This variety is represented by a right valve and several fragmentary specimens, and is distinguished from the preceding species in the well developed secondary ribs almost alternating with the primaries. The radial striae cannot be observed in the holotype specimen which is remarkably flattened by crustal movement, but well seen in the paratype one (Pl. X, Fig. 7). The present variety is more like to *Lima praelonga*, but more oblique than the latter.

Occurrence:— N_3 bed? and upper part of lower bed of Heki formation. Kongoin? (Loc. No. N-102), Heki (N-701b), Kuredani in Kichisaka (N-126), (Reg. No. JM 10039, 10041–10043).

Lima sp. indet.

Pl. X, Figs. 8a, b.

Description:— Shell small, inequilateral, obliquely ovate, slender, prolonged anteroventrally, height exceeding length considerably, gently convex; anterior margin long and nearly straight, posterior and ventral margins broadly rounded,

hinge-line short and straight, ears small, depressed, anterior ear larger than posterior one.

Ornament is preserved on the anterior ventral periphery, which consists of 7 radial ribs and 6 to 8 radial striae closely spaced in each broad flat interspace between ribs. On the posterior half, the internal mould, 3 obscure primary ribs can hardly be seen; closely-set growth-lines are developed on both ears and anterior periphery, and concentric plications are limited on the posterior half.

Comparison:— This species resembles *Lima arstriaca* in ornamentation, but differs from it in its more slender outline and smaller number of costae.

Occurrence:— Middle part of N_3 bed, Kichisaka (Loc. No. N-107, Rg. No. JM 10045)

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Plate VII

Camptonecles triadicus Nakazawa, n. sp. P. 96

Fig. 1a, b Gypsum cast from the external mould of the holotype, left valve (Reg. No. JM 10001a), b ($\times 3$) showing sculpture of ears. Loc. Kongoin (N-102).

Fig. 2 Internal mould of the holotype (Reg. No. JM 10001b), showing ligament

pit. ($\times 3$).

Velata maizurensis Nakazawa, n. sp. P. 97

Fig. 3, 4 Gypsum casts from the external moulds of attached valves of the holotype, Fig. 3 right valve (Reg. No. JM 10022a), Fig. 4 left valve (Reg. No. JM 10022b). Loc. Shinmichi (N-405).

Fig. 5 Gypsum cast from the external mould of the paratype, right valve (Reg. No. JM 10024), showing sculpture of umbonal portion. Loc. Heki (N-701).

Fig. 6 Gypsum cast from the external mould of the paratype, left valve (Reg. No. JM 10023a). Loc. Miuchi (N-414).

Tosapecten teradensis Nakazawa, n. sp. P. 100

Fig. 7 External mould (umbonal portion, internal mould) of the paratype, right valve (Reg. No. JM 10012a). Loc. Terada (N-304).

Fig. 8 Gypsum cast from the external mould of the holotype, left valve (Reg. No. JM 10011b). Loc. ditto.

Fig. 9 Internal mould of the holotype (Reg. No. JM 10011a).

Plate VIII

Tosapecten nabaensis Nakazawa, n. sp. P. 98

Fig. 1 Gypsum cast from the paratype, right valve (Reg. No. JM 10006a). Loc. Nabae (N-217).

Fig. 2 Gypsum cast from the external mould of the holotype, right valve (Reg. No. JM 10002a). Loc. Nabae (N-213).

Fig. 5 Gypsum cast from the external mould of the paratype, left valve (Reg. No. JM 10008). Loc. Nishimitsumatsu (N-202).

Tosapecten okabai Nakazawa, n. sp. p. 100

Fig. 3 Internal mould of the holotype, right valve (Reg. No. JM 10009a). Loc. Nishimitsumatsu (N-202).

Fig. 4 Clay cast from the external mould of the holotype (Reg. No. JM 10009b).

Tosapecten nabaensis forma *distincticostatus*. P. 99

Figs. 6, 7 Gypsum casts from the external moulds of attached valves, Fig. 6 right valve (Reg. No. JM 10007a), Fig. 7. left valve (Reg. No. JM 10007b). Loc. Nishimitsumatsu (N-201).

Fig. 8 Internal moulds of the same specimens (Reg. No. JM 10007c), upper right valve, lower left valve showing remarkable difference of convexity of both valves, illustrated from upper side of hinge-margin.

Plate IX

Tosapecten sp. cf. *suzukii* (Kobayashi) P. 101

Fig. 1 Clay cast from the external mould of a left valve (Reg. No. JM 10002). Loc. Nishimitsumatsu (N-201).

"*Pecten*" sp. indet. P. 101

Fig. 2 External cast of a right? valve (Reg. No. 10014). Loc. Terada (N-304).

Chlamys mojsisovicsi Kobayashi and Ichikawa P. 101

Fig. 3 Gypsum cast from the external mould of a right valve (Reg. No. JM 10015). Loc. Nishimitsumatsu (N-201).

Fig. 4 Gypsum cast from the external mould of a left valve (Reg. No. 10014a). Loc. ditto.

Fig. 5 Internal mould of a right valve, showing a small resilifer (Reg. No. 10017). Loc. ditto.

Lima (*Pseudolima*) *naumanni* Kobayashi and Ichikawa P. 102

Fig. 7 Internal mould of a left valve, showing a ligament pit (Reg. No. JM 10029). Loc. Nishimitsumatsu (N-201).

Eig. 8 Gypsum cast from the external mould of a left valve (Reg. No. JM 10031). Loc. ditto.

Lima yataensis Nakazawa, n. sp. p. 102

Fig. 9 Gypsum cast from the external mould of the paratype, left valve (Reg. No. JM 10023b). Loc. Miuchi (N-414).

Figs. 10. 11. . Internal mould (Fig. 10) and gypsum cast (Fig. 11) from the external mould of the holotype, left valve (Reg. No. JM 10032a, b). Loc. ditto.

Plate X

Lima yataensis Nakazawa, n. sp. P. 102

Fig. 1 Gypsum casts from the external moulds of a right valve (a) and a left valve (b), showing a remarkable deformation (Reg. No. JM 10023c). Loc. Miuchi (N-414).

Fig. 2 Gypsum cast from the external mould of a left valve (Reg. No. 10034), showing sculpture of umbonal portion and ears. Loc. Shinmichi (N-405)

Fig. 6 Gypsum cast from the external mould of a left valve (Reg. No. 10040), showing interstitial striation. Loc. ditto.

Lima (Pseudolimea?) naumanni Kob. and Ichi. P. 102

Fig. 3 External moulds of left valve (Reg. No. JM10030), showing remarkable deformation. Loc. Nishimitsumatsu (N-201).

Lima yataensis var. *kuredaniensis* Nakazawa, n. var. P. 103

Fig. 4, 5 Internal mould (Fig. 4, JM 100039a) and gypsum cast (Fig. 5) from the external mould (JM 10039b) of the holotype. Loc. Kuredani (N-126).

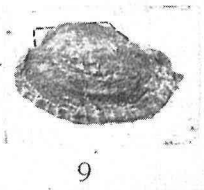
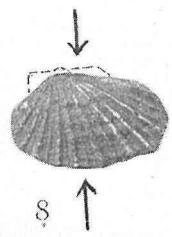
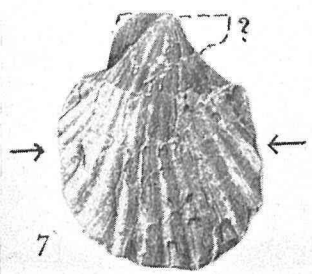
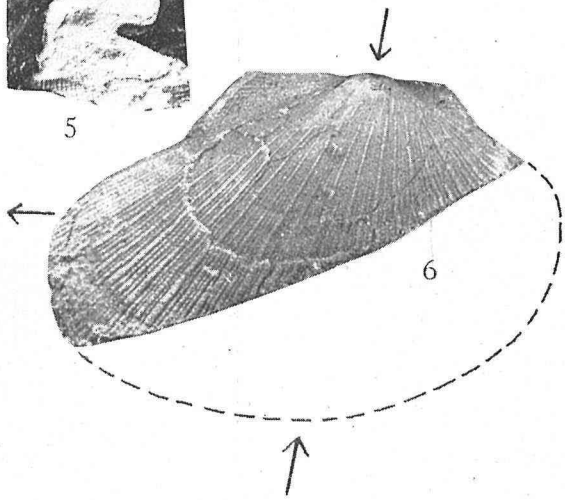
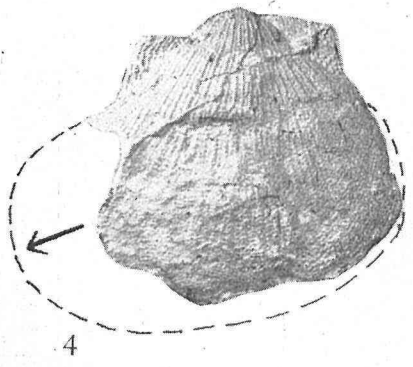
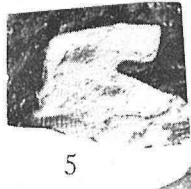
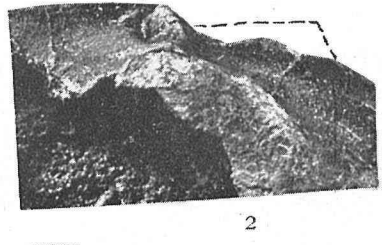
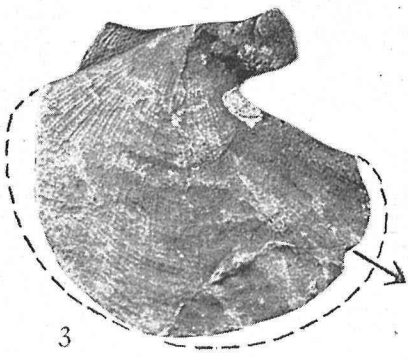
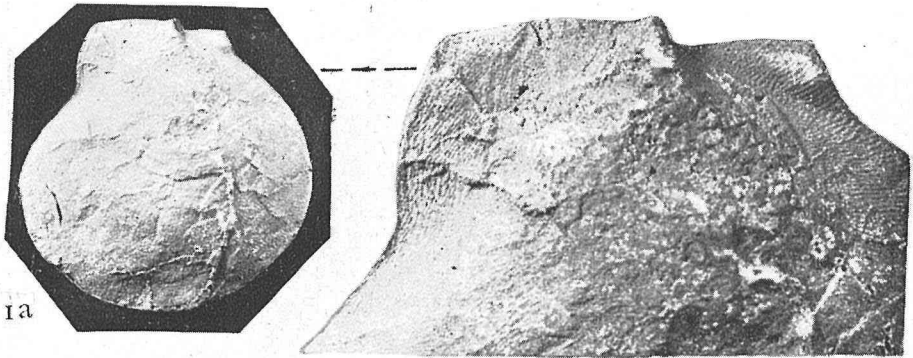
Fig. 7 Gypsum cast from the external mould of the paratype (Reg. No. JM 10042), showing sculpture. Loc. Kongion (N-102).

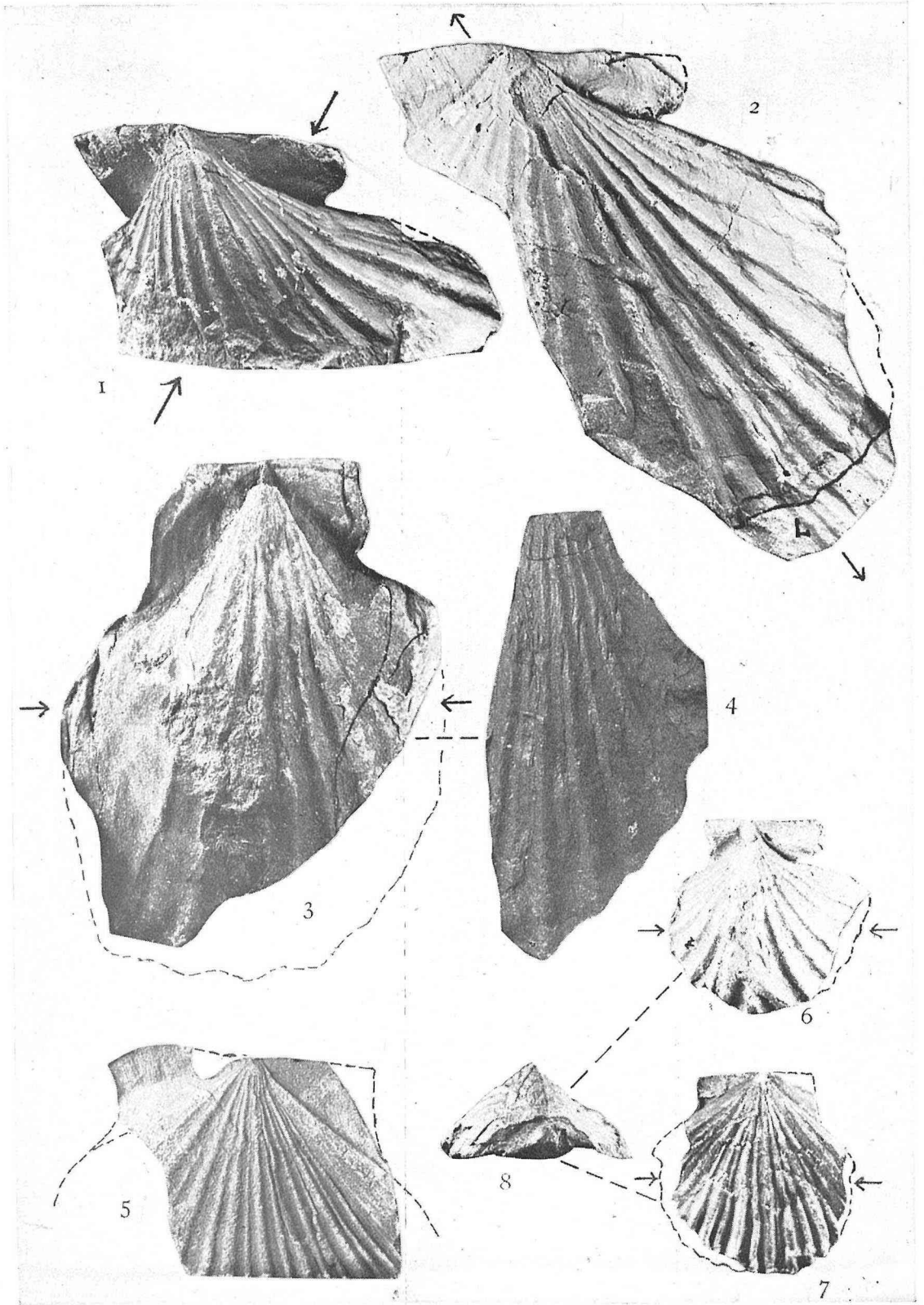
Lima sp. indet. p. 103

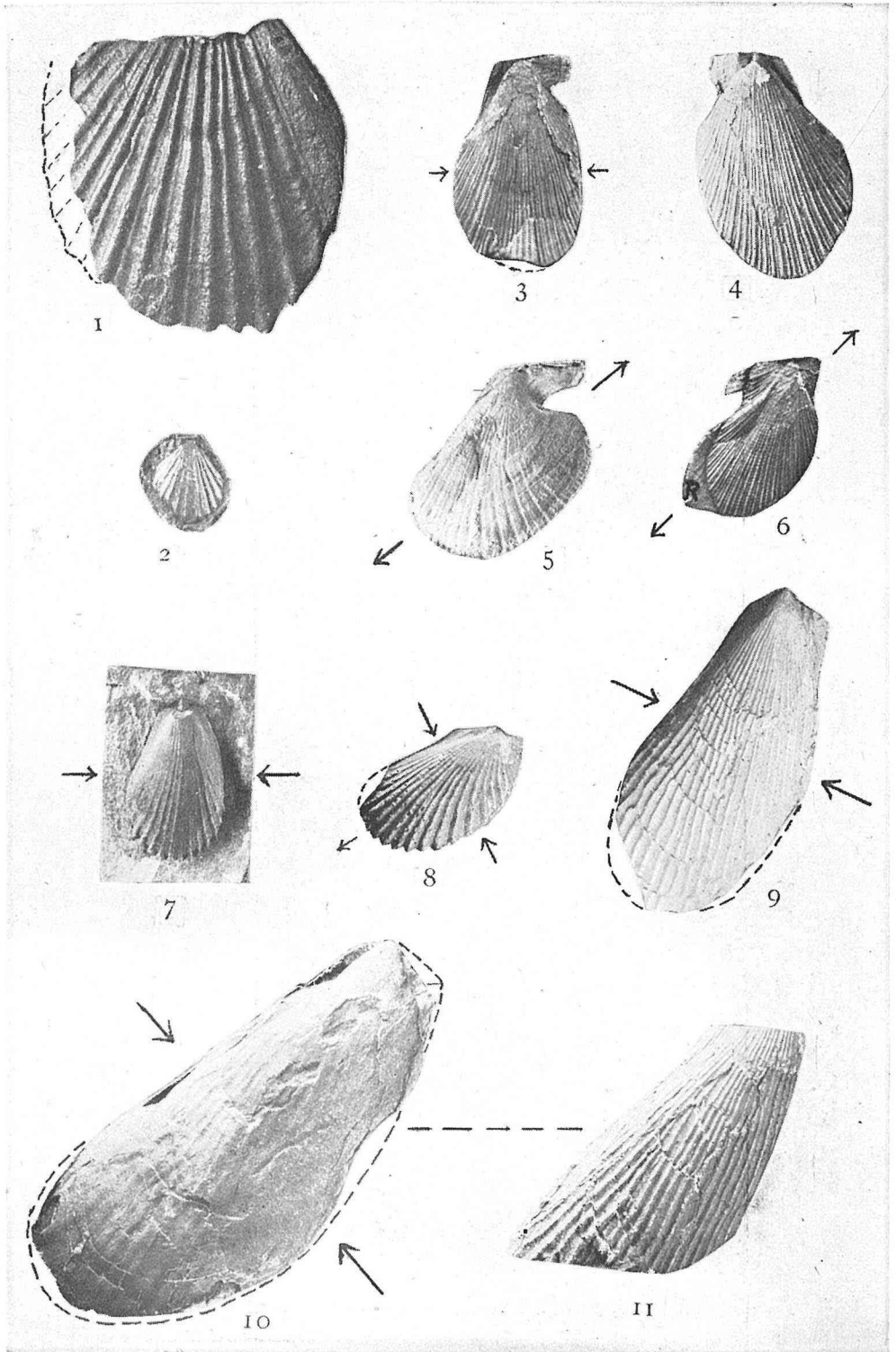
Figs. 8a, b Internal and external (antero-ventral marginal portion) moulds of a left valve (Reg. No. JM 10045) 8a, $\times 3$, 8b, $\times Ca 4.5$, showing sculpture.

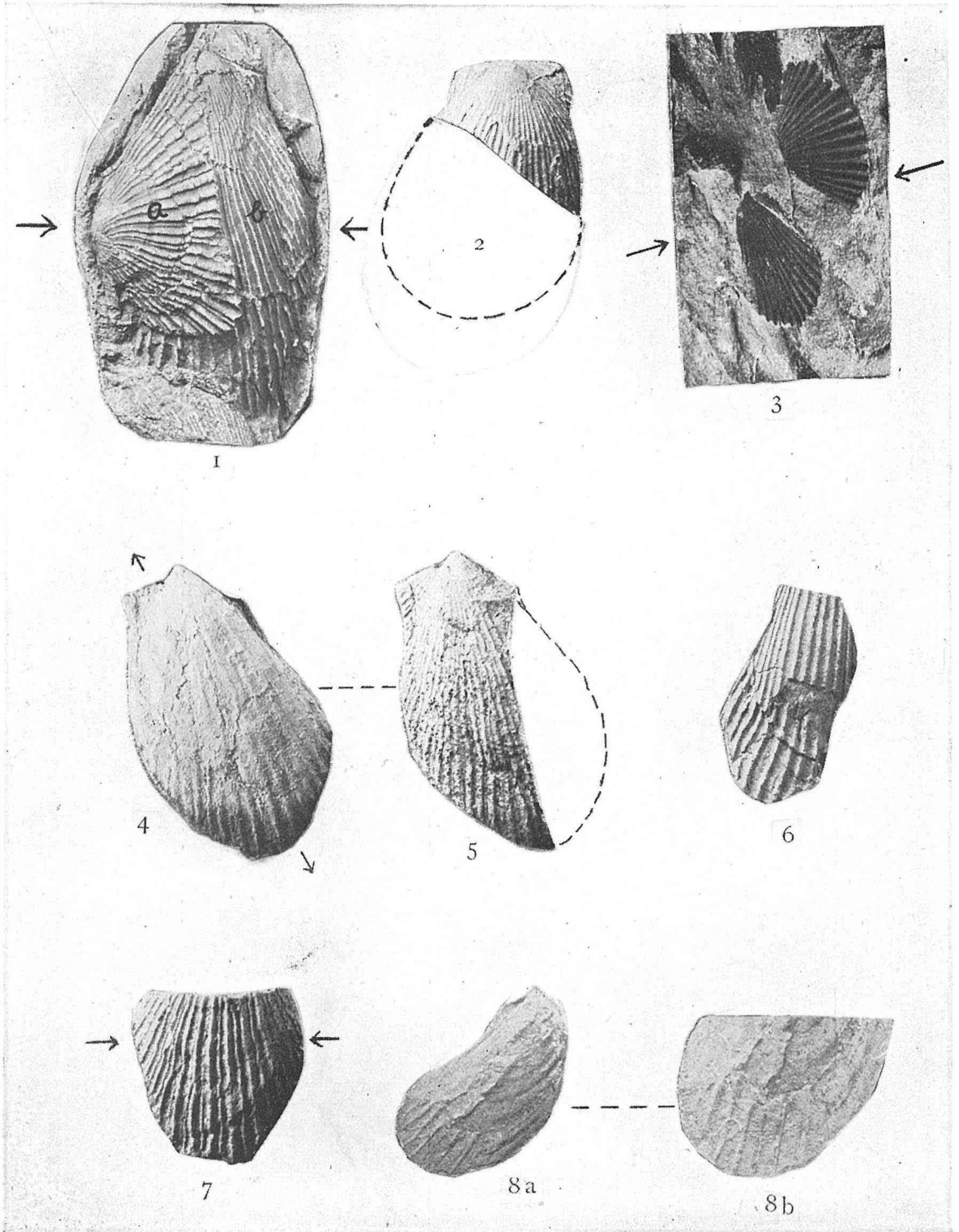
(All figures without notation of enlargement are in natural size. Arrows indicate the apparent directions of elongation or compression caused by deformation.)

(All specimens here illustrated are deposited in the Geological and Mineralogical Institute, University of Kyoto.)









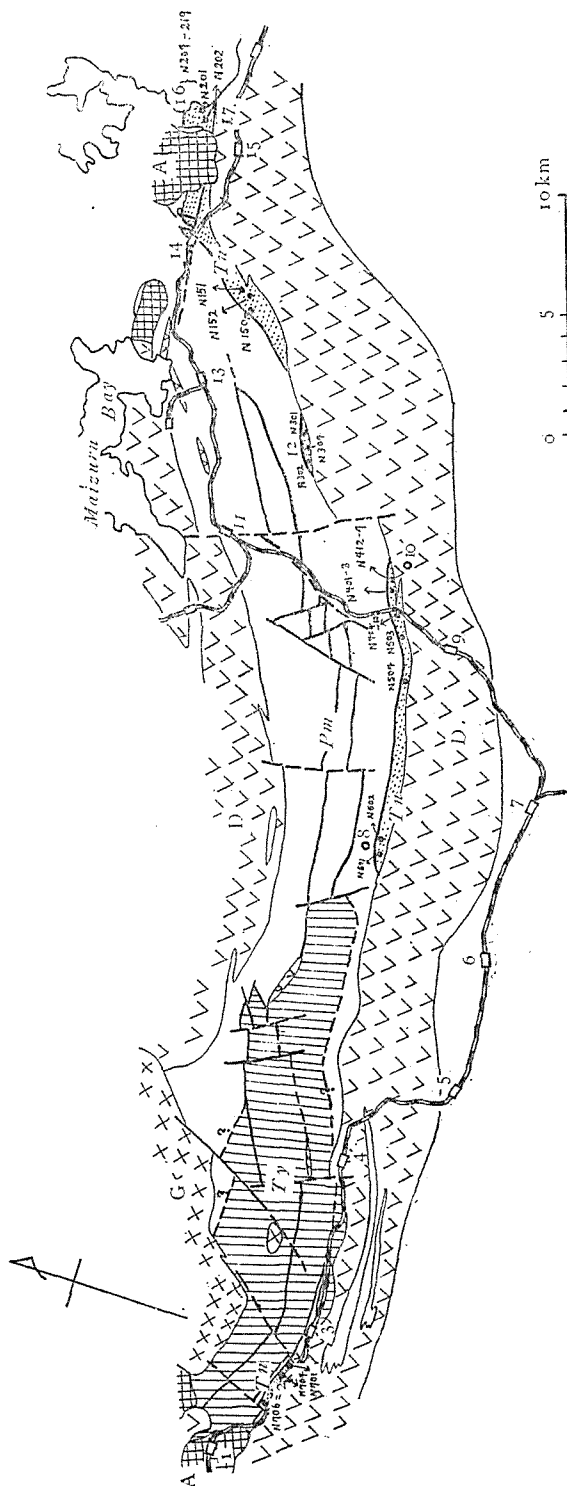


Fig. 1. Schematic Geologic Map of Maizuru District,

LEGEND

- | | | | |
|---|----------------------|----------------------|-------------------------|
| Tn : Upper Triassic (Nabae group) | 1. Kamiyakuno 上夜久野 | 7. Ayabe 綾部 | 13. Higashimaizuru 東舞鶴 |
| Ty : Middle and Lower Triassic (Yakuno group) | 2. Heke 日置 | 8. Monobe 物部 | 14. Matsunodera 松尾寺 |
| Pm : Permian (Maizuru group) | 3. Shimoyakuno 下夜久野 | 9. Umezako 梅迫 | 15. Aonogo 青郷 |
| A : Volcanic Rocks | 4. Kamikawaguchi 上川口 | 10. Oyogi 於震岐 | 16. Nabae 難波江 |
| G : Acidic Plutonic Rocks | 5. Fukuchiyama 福知山 | 11. Nishimaizuru 西舞鶴 | 17. Nishimitsumatsu 西三松 |
| D : Basic Intrusive Rocks | 6. Isa 石原 | 12. Tenada 寺田 | 18. ● Fossil Locality |

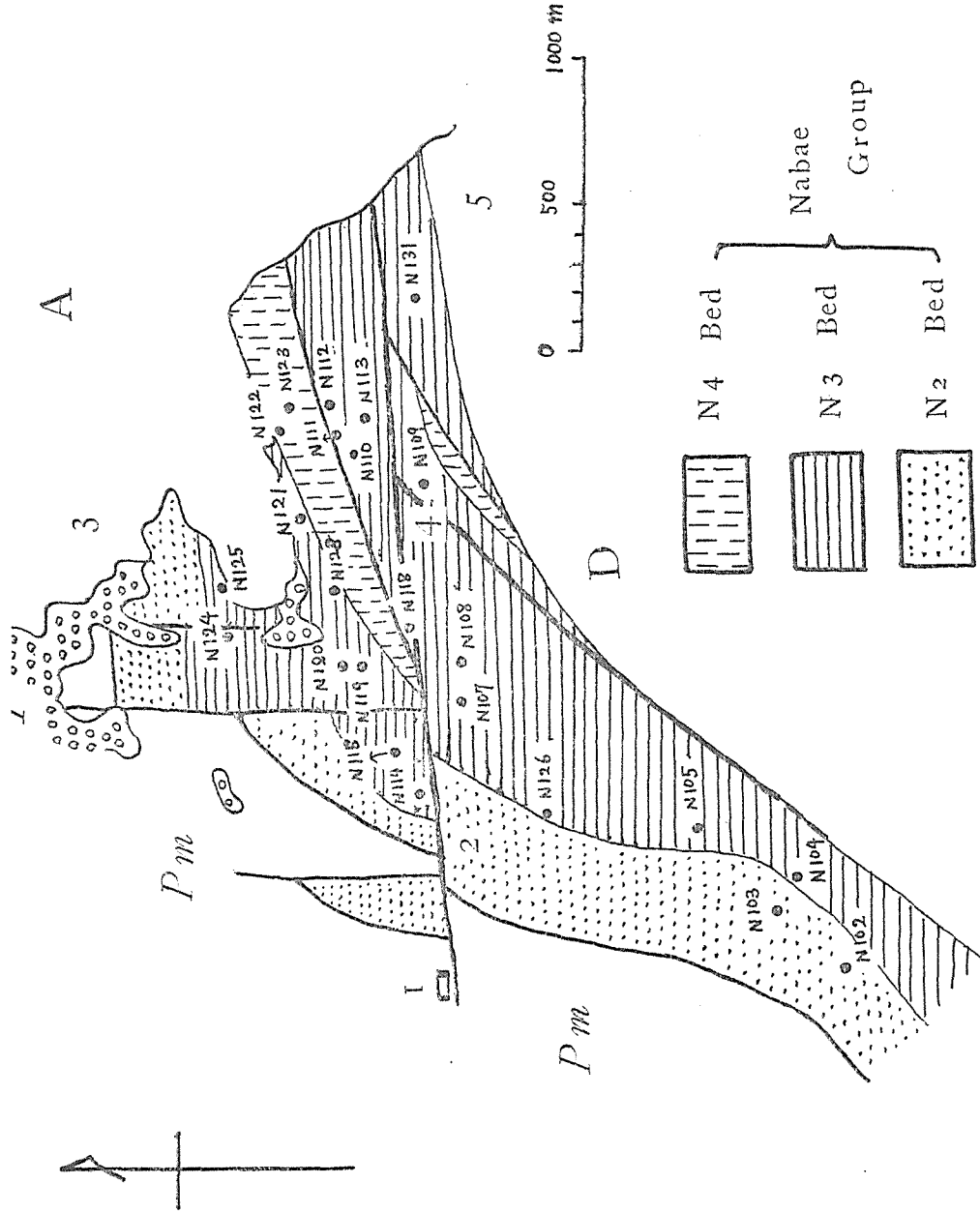


Fig. 2. Fossil Localities in Matsunodera Area.

- T. Tertiary Formations
- Pm. Maizuru Group (Pemiam)
- A. Pyroxene Andesite
- D. Basic Intrusive Rocks
- N4 Bed
- N3 Bed
- N2 Bed
- 1. Matsumodera Station 松尾寺驛
- 2. Kichisaka 吉坂
- 3. Matsuo 松尾
- 4. Kichisaka-toge 吉坂峠
- 5. Hirubatake 薪田