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Norian Pelecypod-fossils from Jito, Okayama Prefecture, West Japan

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Abstract

The Norian pelecypod-fossils from Jito are described in addition to the formerly reported cephalopod-fossils. Besides the dominant group of *Monotis*, *Tosapecten* cf. *suzukii nabaensis*, *Oxytoma* cf. *subzitteli*, *Limatula*? sp. and *Palaeoneilo*? sp. are contained. Special attention was given to the ligamental characters of *Monotis*, which suggest the origin from the alivincular ligament. A new subspecies *Monotis ochotica jitoensis* is described, and a new subspecific name *Tosapecten suzukii tokuyamae* is proposed for *T. suzukii okadai* by TOKUYAMA from Yamaguchi Prefecture.

Several years ago the writer described two cephaloped species from the Norian *Monotis* bed at Kojintawa in Jito, Okayama Prefecture, West Japan (NAKAZAWA, 1959). This is an additional paper treating with pelecypod fossils. Among these, *Monotis* (*Entomonotis*) *ochotica* and its allies are extremely dominant, while the other forms are very scarce as in the other *Monotis* beds in Japan. At Kojintawa sandy shales are fossiliferous throughout the 35 m in thickness above the coal bearing beds consisting of sandstones and shales. There is no essential faunal change throughout the fossil bed as shown in the annexed table. Neither *Monotis ochotica densistriata* nor the group of *Monotis typica* could be found, and this fossil zone is correlated with S_5 to S_6 faunizones of ICHIKAWA (1954) or C_3 zone of ONUKI and BANDO (1958) at the type locality of the Saragian (≒ Norian) stage in the southern Kitakami Massif, Northeast Japan, and is considered to be late Saragian in age. But at the other localities of Kojintawa (loc. S-10, 11) separated from above-mentioned fossil bed by fault, the writer obtained slabs of sandstone and shale containing *M. ochotica densistriata* (Pl. 1, Fig. 6), *M. yakutica* and *M.* cf. *kuikahatensis*. This faunule suggests a lower horizon S_4 by ICHIKAWA, C_2 by ONUKI and BANDO than the former fossil horizon.

The fossil occurrences are tadulated below. Among the species of *Monotis*, *yakutica*, *sublaevis* and *ochotica sparsicostata* are the first occurrence in Japan. It is noteworthy that other pelecypod fossils, though very rare, such

Table of fossil-occurrences at Kojintawa

species \ horizon in ascending order	S_{10}	S_1	S_2	S_{3-5}	S_6	S_{7-8}
* *Monotis* (*Entomonotis*) *ochotca* s.s.		○	○	◎	◎	◎
* *M.* (*E.*) *ochotica pachypleura*		○	○	×		×
* *M.* (*E.*) *ochotica sparsicostata*		×		×	×	○
* *M.* (*E.*) *ochotica eurhachis*				×		×
* *M.* (*E.*) *ochotica ambigua*				×		
* *M.* (*E.*) *ochotica jitoensis* n. subsp.				×		×
M. (*E.*) *ochotica densistriata*	○					
* *M.* (*E.*) *sublaevis*				×		○
* *M.* (*E.*) aff. *sublaevis* sp. A				×		×
* *M.* (*E.*) aff. *sublaevis* sp. B						×
* *M.* (*E.*) *yakutica*	×			○	×	×
* *M.* (*E.*) aff. *tenuicostata mabara*				×		×
M. (*E.*) cf. *muikahatensis*	×					
* *Tosapecten* cf. *suzukii nabaensis*				×		
* *Oxytoma* cf. *subzitteli*				×		
* *Limatula*? sp. indet.				×		
* *Palaoneilo*? sp. indet.						×
Arcestes (*Stenarcestes*) sp.						×
Germanonautilus kyotanii						×
Naticopsis (s.l.) sp.				○		
Rhynchonellid				×		×
stems of *Isocrinus*				○	×	○

Species with asterix are described or illustrated in this paper.
◎ Abundant, ○ Common, × rare or very rare

as *Tosapecten* cf. *szukuii nabaensis* and *Oxytoma* cf. *subzitteli*, are the members that flourished in the late Sakawan (=late Carnian) in Japan.

Description of Species

Family Monotidae FISCHER, emend. ICHIKAWA, 1958

Genus *Monotis* BRONN, 1850

Subgenus *Entomonotis* MARWICK, 1935

The genus *Monotis* was discussed in detail by ICHIKAWA (1958) together with other genera of the Triassic "Pteriidae". He noticed the absence of the ligament pit in the "opisthodetic" ligament area of *Monotis*, and adopted the name Family Monotidae. From the ligament characters and shell

structure he thought that Monotidae had a closer affinity with Posidoniidae and Halboiidae than with Pteriidae which has a typical alivincular ligament. Examining many specimens of *Monotis richmondiana*, the type species of *Entomonotis* from New Zealand, MARWICK (1935, p. 298) mentioned "Ligament set in a much extended, scarcely excavated triangular area which bears about 4 (3 to 6) paralell longitudinal grooves." Judging from his illustrations, it is not clear whether the excavated triangular area corresponds to the ligament pit of Pteriidae, although he included the genus in that family. Generally it is very difficult to observe the ligamental characters in the case of *Monotis*, because the shell wall is very thin and the ligament area is very narrow. The specimens contained in the calcareous nodule from Kojintawa are fairly good in preservation, and several specimens exhibit well the ligament area impressed in the moulds, which have been obtained by resolving the shell matter by hydrochloric acid. It is clearly shown that the posterior ligament area of the left valve is excavated by a distinct, extended, triangular pit (Pl. 1, Figs. 1, 2). The pit is grooved by several transverse striae somewhat irregular in strength, and the rest of the area is also regularly striated but fewer in number. The posterior margin of the pit is well defined, and the anterior margin demarcated by the projection of the area like MARWICK's illustrations (ibid., pl. 35, figs. 14–17); anterior to this projection the area is tapering forward and the surface is somewhat wavy suggesting a concordance with the inward projection of the right byssal ear. Nevertheless, whether this anterior part should be referred to as ligament area is questionable, because it is narrow, wavy and nearly smooth or striation is usually very weak. But in rare cases the anterior area is as wide as the posterior ligament area and distinctly grooved (Pl. 1, Fig. 2). The ligament area of the right is narrower; ligament pit is shallower, and a detailed observation is usually more difficult than the left. Some have apparently no ligament pit, but some exhibit weak but distinct ligament pit on the ligament area (Pl. 1, Figs. 3–5).

From these examples mentioned above, the ligament of *Monotis* is considered to be derived from the alivincular ligament by reduction or/and by modification of the anterior part of the ligament area. They offer an important datum for discussing the phylogeny of Monotidae, although the conclusion will be attained after the examination of the other characters as well.

Monotis (Entomonotis) sublaevis (TELLER)

Plate 1, Figures 7, 8

1886. *Pseudomonotis sublaevis* TELLER. p. 125, pl. 19, figs. 2a, b.
cf. 1932. *Pseudomonotis* aff. *sublaevis*, KIPARISOVA. p. 20, pl. 1, figs. 5, 6.
1938. *Pseudomonotis sublaevis*, KIPARISOVA. p. 20, pl. 4, fig. 8.

The species is characterized by smooth, convex, umbonal region separated from flat or even concave, ribbed, outer portion, and like *yakutica* characterized by relatively rounded outline except for straight hinge margin and obscure posterior ear. The smooth umbonal portion is measurable from 14 mm to 20 mm in height. Posterior ear is not so sharply defined from the disc as *ochotica*, but in the later growth-stage distinguished by the sinuation at the posterodorsal corner of the flank. Radial costae consist of twenty and several primaries, intervening secondaries in the medial part of the shell; the secondaries soon grow as strong as the primaries.

This species coincides very well with the type species from Werchojansk in the specific characters.

Monotis (*Entomonotis*) aff. *sublaevis* sp. A

Plate 1, Figure 9

There are two right valves, which are similar to the preceding species in the smooth, convex, umbonal portion, and the ribbed, concave, outer part. Compared with the preceding species, the umbonal portion is very small (8 mm in height); secondary costae are weak, originating at later growth stage than in *laevis*, and the posterior ear is clearly distinguished from the disc.

Monotis (*Entomonotis*) aff. *sublaevis* sp. B

Plate 1, Figure 10

In general outline and the presence of smooth umbonal portion, the specimen is similar to *sublaevis*. But there is no change in convexity between the inner and the outher portions. Furthermore, fifteen primary, radial costae regularly alternate with secondaries, and tertiary riblets are inserted at some places.

Monotis (*Entomonotis*) aff. *tenuicostata mabara* KOBAYASHI and ICHIKAWA

Plate 1, Figures 11-14

? 1936. *Pseudomonotis* sp. aff. *ochotica*, KIPARISOVA. p. 90, pl. 2, figs. 3-5.
1955. *Entomonotis tenuicostata* var. *mabara*, FUJIMOTO and YABE, p. 33, text-figs. 6-9.

Five incomplete left and one right valves have been collected. The right valve is small, as high as wide, fairly convex, and sculptured with more than 20 primary costae, which are uniform and roof-shaped in cross section. Weak secondary striae are rarely inserted in the middle or posterior part of the shell. The right valve, which is considered to belong to the same species, is flat, equilateral in outline, and the surface is covered by

close-set, radial costae, 23 in number (Pl. 1, Fig. 13). The radials have roof-shaped cross-section in the middle and anterior parts, but rounded in the posterior.

The species is similar to *Monotis tenuicostata* described by KOBAYASHI and ICHIKAWA (1949, p. 299, pl. 9, figs. 6, 7) from Shikoku, in the uniform, roof-shaped costae and in the small shell, but differs in the more equilateral outline and the smaller number of costae. It is more intimate to *tenuicostata mabara* in the outline of the shell and the number of primary costae, but the latter species is provided with secondary striae alternating with the primaries. *Entomonotis tenuicostata* var. *mabara* reported by FUJIMOTO and YABE (1955) from the upstream of the River Toné in Kwanto Province is different from *mabara* in the lack of secondary riblets, and probably identical with this species, although the radials are a little more numerous. *Pseudomonotis* sp. aff. *ochotica* from the Kolyma-Indigirka Land (KIPARISOVA, 1936) is another comparable species in costation and in the equilateral outline, and may be referrable to this species. But judging from her description the Siberian species seems to be a little wider in shape and less convex.

Measurements

Reg. no.	Height	Width
JM 10992	18	ca. 21
JM 10993	15	14.5
JM 11017b	12	11

Monotis (*Entomonotis*) *yakutica* (TELLER)

Plate 1, Figures 15–17

1886. *Pseudomonotis yakutica* TELLER. p. 124, pl. 17, figs. 16–18.
1932. *Pseudomonotis yakutica*, KIPARISOVA. p. 18, pl. 1, figs. 7–13.
1938. *Pseudomonotis yakutica*, KIPARISOVA. p. 18, pl. 3, figs. 11–14.
1954. *Pseudomonotis* (*Entomonotis*) *yakutica*, KIPARISOVA. p. 46, pl. 35, fig. 6.

Several right valves in hand are distinguished from *ochotica* in the small size, subequilateral outline, ill-defined posterior ear provided with radial ornaments, and in the more numerous and sharper primary costae (about 20 in number). Secondary riblets are weak and variable in number ranging from 5 to 15. In some cases the secondaries grow as strong as the primaries in the full grown stage. From these characters the species coincides well with *yakutica* from Werchojansk and Siberia. The Japanese species differs from the latter in the less developed radial striae on the posterior ear, but it is not a specific distinction. The right valve of *yakutica* resembles very much that of *tenuicostata*, but the radials are not roof-shaped, but rounded in cross section and the interstices are wider than those of *tenuicostata*.

Measurements

Reg. no.	Height	Width	Number or costae on the disc		
			primary	secondary	total
JM 10961b	20	28	19	15	34
JM 10968	26	35	23	15	38
JM 11014a	18	22	21	11	32
JM 11014b	15	22	20	5	25
	16	20	16	6	24

Monotis (*Entomonotis*) *ochotica* (KEYSERLING)

This well known species is highly variable in shape as well as in costation. There have been described many varieties and subspecies from numerous localities. They usually occur in association with each other, and, at least, some of them may represent merely individual variations. In fact there are many intermediate forms in the collection from Jito. But the writer will treat them tentatively as subspecific, because the solution of this problem requires critical examination on plentiful samples from many localities and different horizons.

Monotis (*Entomonotis*) *ochotica sparsicostata* (TELLER)

Plate 2, Figures 1–4

1886. *Pseudomonotis ochotica* var. *sparsicostata*, TELLER. p. 110, pl. 17, fig. 11.
1938. *Pseudomonotis ochotica* var. *sparsicostata*, KIPARISOVA. p. 17, pl. 3, fig. 3.
non 1908. *Pseudomonotis ochotica* var. *sparsicostata*, FRECH. pl. 48, figs. 3a, b, c.

This species is characterized by the small number of strong radial costae (6 to 10, generally 7 to 8), the broad, flat interstices, and weak secondary riblets. The described form agrees very well with the type from Werchojansk.

Monotis (*Entomonotis*) *ochotica jitoensis*, new subspecies

Plate 2, Figures 5–7

Materials: Two right valves and one left valve. Holotype (right valve JM 10984) has been procured from a slab of sandy shale, the exact horizon of which is unknown. The other two (JM 10985, 6) have been collected from the horizon S_3 at Kojintawa in association with *M. ochotica* and others.

Description: The outline of the shell is similar to *ochotica* s.s., but the anterior half is more expanded and the maximum height lies directly under

the beak; posterior half is rather rapidly tapering backward. Posterior extremity is located at a high position from the ventral margin, and the angle between the posterior hinge margin and the posterodorsal margin of the flank is very acute. The most characteristic feature of this subspecies is obscure costation near the periphery. In the right valve the radial costae consist of 17 to 18 primaries and alternating secondaries, all of which become obsolete towards the margin, especially in the posterior portion. In the left valve the secondary costae start from near the umbo and soon grow as strong as the primaries, both of which together attain 19 in number. They are considered to correspond to the primaries of the right valve. In addition, weak tertiary riblets are intercalated in the anterior half, but obsolete in the posterior.

Comparison: This species is allied to some varietal form of *ochotica* s.s. which has weakened radials towards the periphery (Pl. 2, Fig. 8), but differs from the latter in the outline and the more numerous and more obscure radial costae in the posterior and anterodorsal portions. *Monotis zabaicalica semiradiata* ICHIKAWA (var. *intermedia* KOBAYASHI and ICHIKAWA, 1949, p. 258, pl. 10, figs. 19, 20; ICHIKAWA, 1958, p. 139, footnote) very much resembles this form in outline as well as in obscure costation near the margin, but differs in the smaller number of radials and the absence of the secondaries. KOBAYASHI and ICHIKAWA (ibid., p. 258) considered *semiradiata* as an intermediate form between *zabaicalica* and *pachypleura*, and referred it as the subspecies of *zabaicalica*. In fact some of *pachypleura* have a tendency to weaken the radials towards the shell margin (Pl. 2, Fig. 9). On the other hand *jitoensis* is considered to represent another offshoot of *ochotica* or *eurhachys*.

Monotis muikahatensis HASÉ (1961, p. 83, pl. 12, figs. 12–17) from Yamaguchi, which is also provided with obscure radial ribs, has no direct relation with *zabaicalica* or *semiradiata*. The former species is characterized by a smooth umbonal part and ribbed peripheral one on the contrary to the case of *semiradiata*, and is more related to *Pseudomonotis* sp. nov. indet. KIPARISOVA (1936, p. 81, pl. 1, figs. 1–3; 1938, p. 20, pl. 4, figs. 12–14) from the Kolyma Basin in Siberia. These two species occur in association with the group of *M. typica*, the ancestral form of *ochotica*, and may be earlier in age than *zabaicalica* and *semiradiata*.

Measurements

Reg. no.	Height	width	Number of primary costae
JM 10984	47	65	18
JM 10985	50	72	17
JM 10986	48	52	19 (includ. 1st and 2nd)

Family Aviculopectinidae ETHERIDGE, emend. NEWELL, 1937

Subfamily Oxytominae ICHIKAWA

Genus *Oxytoma* MEEK, 1864

Oxytoma cf. *subzitteli* KOBAYASHI and ICHIKAWA

Plate 2, Figures 10-12

1950. *Oxytoma zitteli*, KOBAYASHI and ICHIKAWA. p. 220, pl. 2, figs. 3-6.
1959. *Oxytoma zitteli*, TOKUYAMA. p. 7, pl. 2, figs. 19a-c.
cf. *Oxytoma subzitteli*, KOBAYASHI and ICHIKAWA. p. 221, pl. 2, figs. 7, 8.
cf. *Oxytoma subzitteli*, TOKUYAMA. p. 8, pl. 1, figs. 23, 24.
non *Pseudomonotis zitteli*, YEHARA, 1927; KIPARISOVA, 1937 and 1938; *Oxytoma zitteli*, KIPARISOVA, 1954.

Shell is small to moderate in size; height presumably nearly equal to the width. Umbo is situated at one fifth of the length from the anterior end of the hinge margin, and is slightly prosogyrous. Posterior wing is large, projecting posterodorsally. Anterior ear is small, depressed, not sharply defined from the main body, and there is no sinuation at the anterodorsal corner of the flank; anterodorsal corner of the ear is rectangular or obtuse.

Surface is ornamented with 7-9 primary costae alternating with the secondaries somewhat irregular in strength, and 1-3 interstitial striae. Both ears are covered by fine, close-set radial striae.

Comparison: This species is quite similar to *Oxytoma zitteli* described by KOBAYSHI and ICHIKAWA (1950) from Shikoku and by TOKUYAMA (1959) from Yamaguchi in general specific characters, and is referable with that species, although the specimens at hand are compressed secondarily by later forces, and seem to the writer higher than "*zitteli*" in those regions. The present species differs slightly from "*zitteli*" in Shikoku in the left anterior ear defined from the rest of the shell less sharply, and in its obtuse-angled triangular outline. Siberian *Oxytoma zitteli* by KIPARISOVA (*Pseudomonotis zitteli*, 1937, p. 195, pl. 6, figs. 1-3; 1938, p. 21, pl. 4, figs. 17-21; *Oxytoma zitteli*, 1954, p. 39, pl. 31, figs. 1-4) and Canadian *Oxytoma kiparisovae* TOZER which is referred to be identical with the former by TOZER (1961, p. 100, pl. 29, figs. 10-13) are considered to be specifically distinct from the Japanese "*zitteli*" by KOBAYASHI and ICHIKAWA in the more numerous radial costae of the left valve. The Japanese "*zitteli*" is closely allied to *subzitteli* KOBAYASHI and ICHIKAWA from Shikoku and Yamaguchi and may be conspecific with the latter. The specific distinction of the latter two species, even if possible, requires further investigation on more numerous samples from the type locality, and the writer dares not give a new specific name for "*zitteli*" by KOBAYASHI and ICHIKAWA.

Family Pectinidae Lamark

Genus *Tosapecten* KOBAYASHI and ICHIKAWA, 1949

Tosapecten cf. *suzukii nabaensis* NAKAZAWA

Plate 2, Figures 15, 16

cf. 1952. *Tosapecten nabaensis* NAKAZAWA. p. 98, pl. 8, figs. 1, 2, 5.
cf. 1952. *Tosapecten okadai* NAKAZAWA. p. 100, pl. 8, figs. 3, 4.
non 1960. *Tosapecten suzukii okadai*, TOKUYAMA.

Two left valves collected from Kojintawa and from another locality near Jito are in hand. Shell is moderate in zize, and slightly convex, provided with inflated, lateral marginal areas. Except for the marginal areas, the disc is sculptured by six primary radial costae, and weak, alternating secondaries inserted in the broad, flat interstices. The lateral marginal areas are ornamented by several radial striae. This species belongs undoubtedly to the group of *Tosapecten suzukii*, which is one of the representative members of the late Sawawan (≒ late Carnian) in Japan. *Tosapecten suzukii* is a highly variable species and contains many varieties and subspecies such as *hirogariformis*, *inflatus*, *paucicostatus*, *regularis* and *fujimotoi* (KOBAYSHI and ICHIKAWA, 1949). *Tosapecten nabaensis* described by the writer (1952) from the Maizuru zone was distinguished from *suzukii* in the less numerous and more irregularly disposed radial costae. But the materials obtained after that time show a considerable variability of this species in the number of costae (8 to 13) in primary costae, and other features, and the species is now considered not as a distinct species from *suzukii*. Yet, it is distinguished subspecifically in other characters. The primary costae on the left are usually narrower and the interspaces are flat and broader in *nabaensis* than in *suzukii*; the secondaries are not so regularly inserted as in *suzukii* and somewhat irregular in strength. On the other hand the right valve of *nabaensis* can hardly be distinguished from *suzukii*. From the variability of *nabaensis*, *Tosapecten okadai* which occurred in the same bed of *nabaensis* is now considered to be conspecific with *nabaensis*. On the other hand *Tosapecten suzukii okadai* described by TOKUYAMA (1960, p. 29, pl. 4, figs. 15–17, textfigs. 2–7) from the Aso formation in Yamaguchi Prefecture is not *okadai*, because the right valve of the latter has no prolongation of both ears above the hinge margin, and the radial costae are broader than those of "*okadai*" by TOKUYAMA.

The left valve of TOKUYAMA's *okadai* is more similar to that of *nabaensis* than that of *suzukii* s.s. in the costation mentioned above, but the radials are generally more numerous than *nabaensis*. Furthermore postero- and anterodorsal margins of the right valve are more arcuated than in *suzukii* and *nabaensis*. Based on these differences, "*okadai*" by TOKUYAMA is referred as a new subspecies of *suzukii*, and is here named *tokuyamae* (lectotype: fig. 15 in pl. 4, TOKUYAMA, 1960, here designated). *Tosapecten suzukii tokuyamae*

resembles very much *Tosapecten subhiemalis* (KIPARISOVA) (aff. *hiemalis* 1936, p. 103, pl. 5, figs. 1, 2?, 3; 1938, p. 20, pl. 6, figs. 17?, 21, 22; *subhiemalis* 1954, p. 41, pl. 32, figs. 1-4; TUCHKOV, 1956, p. 194, pl. 6, figs. 1, 2) from Siberia in the general outline and narrow radial costae of the right valve, but differs in the dorsal auricular extention and larger convexity of the right and in the stronger secondary costae in the left. *T. suzukii* and *nabaensis* appeared already in the early Carnian, while *tokuyamae* in the late Carnian. It is noticeable that the costation of the left valve of *nabaensis* and *tokuyamae* is more similar to the Siberian *suzukii* reported by KIPARISOVA (aff. *suzukii* 1938, p. 30, pl. 7, fig. 2; var. *fujimotoi* 1954, pl. 33, figs. 2a, b) and *subhiemalis*, than to *suzukii* s.s..

The specimens from Jito are more similar to *nabaensis* and *tokuyamae* than to *suzukii* s.s., and is compared to *nabaensis* rather than to *tokuyamae* in the small number of costae.

Family Limidae d'ORBIGNY

Genus *Limatula* WOOD, 1839

Limatula? sp. indet.

Plate 2, Figure 13

Only one incomplete, left? valve has been found in association with *Monotis ochotica* and its allies. Shell is small and inflated. The exact outline cannot be estimated because the material is fragmental and no growth line is observed on the shell surface.

The surface is covered with roof-shaped radial costae more than 20 in number, which are gradually weakened towards the both lateral sides. This species is easily distinguished from *Pseudolimea naumanni* (KOBAYASHI and ICHIKAWA) (1949, p. 177, pl. 6, figs. 13-15; NAKAZAWA, 1952, p. 102, pl. 9, figs. 7, 8, pl. 10, fig. 3) from the Carnian in Shikoku and Maizuru in lacking the interstitial riblets. *Limatula asoensis* TOKUYAMA (1960, p. 33, pl. 4, figs. 4, 5) from the Aso formation is more similar in ornament, but much larger in size. Further comparison is impossible because of the poor material.

Family Ctenodontidae

Genus *Palaeoneilo* HALL, 1870

Palaeoneilo? sp. indet.

Plate 2, Figure 14

A single, fragmental, external mould is in hand, of which the anterior half is not preserved. Shell is small and fairly inflated. Surface is covered

by numerous, fine concentric striae, which are wavy and somewhat irregularly disposed near the posterior margin. Although the specimen is incomplete and no hinge character is observed, the concentric ornament suggest the species to belong to some genus of Ctenodonta such as *Nuculana*, *Palaeoneilo* or *Nucula*. It may not be *Nucula* because of the transversally elongate shape, and may be referred to *Palaeoneilo* in the absence of the marginal carina extending from the umbo to the posteroventral extremity which is usually developed in *Nuculana*.

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Explanation of Plate 1

Figs. 1–5. Ligament area of *Monotis.*

1a. Left internal mould of *Monotis ochotica pachypleura,* Reg. no. JM 10997, ×3.

1b. Sketch from the same specimen, ×3.

2. Sketch of rubber-compound cast from left external mould of ligament area of *Monotis ochotica pachypleura.* The area is slightly dislocated at the medial position ($a-a'$). Reg. no JM 1106, ×4. B : position of the beak.

3. Right external mould of *Monotis ochotica pachypleura,* Reg. no. JM 10999, ×3.

4. Right external mould of *Monotis ochotica,* Reg. no. JM 11036, ×3.

5. Sketch of ligament area of right external mould of *Monotis ochotica,* Reg. no. JM 11036b, ×3.3.

Fig. 6. *Monotis (Entomonotis) ochotica densistriata* (TELLER).
Right internal mould, Reg. no. JM 11008, ×1.

Figs. 7, 8. *Monotis (Entomonotis) sublaevis* (TELLER).

7. Right internal mould, Reg. no. JM 10980, ×1.

8. Gypsum cast from right external mould, Reg. no. JM 10979, ×1.

Fig. 9. *Monotis (Entomonotis)* aff. *sublaevis* sp. A.
Gypsum cast from right external mould, Reg. no. JM 10983, ×1.

Fig. 10. *Monotis (Entomonotis)* aff. *sublaevis* sp. B.
Right internal mould, Reg. no. JM 11004, ×1.

Figs. 11–14. *Monotis (Entomonotis)* aff. *tenuicostata mabara* KOBAYASHI and ICHIKAWA.

11. Modelling cast from left external mould, Reg. no. JM 11017, ×1.

12, 14. Left internal moulds, Reg. no. JM 10992, 3, ×1.

13. Rubber-compound cast from right external mould, Reg. no. JM 11048, ×1.5.

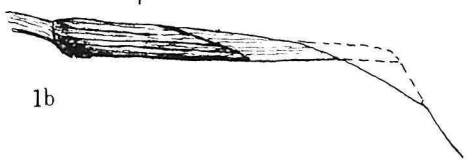
Figs. 15–17. *Monotis (Entomonotis) yakutica* (TELLER).

15. Right external mould, Reg. no. JM 10968, ×1.

16. Right external mould, Reg. no. JM 11014b, ×1.

17. Right internal mould, Reg. no. JM 11014a, ×1.

1a ×3



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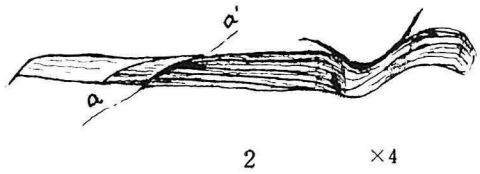
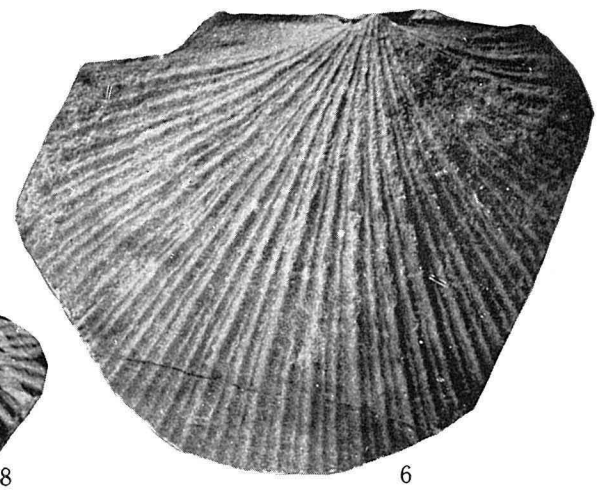


2 ×4

3 ×3

4 ×3

5 ×ca 3.3



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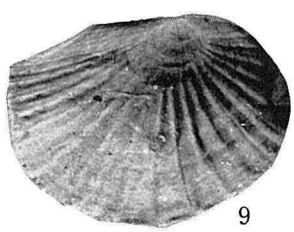

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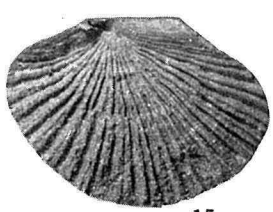

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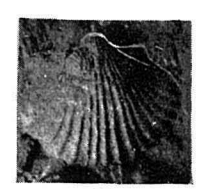

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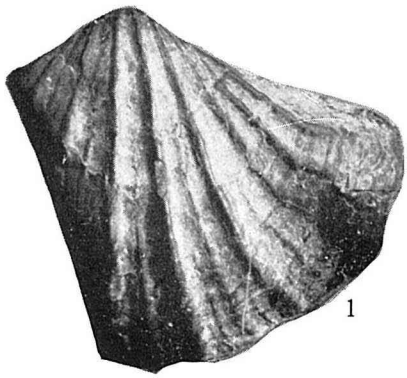
Explanation of Plate 2

Figs. 1–5. *Monotis* (*Entomonotis*) *ochotica sparsicostata* (TELLER).
1, 2. External casts of left valve, Reg. no. JM 10971 and 10981, ×1.
3. External cast of right valve, Reg. no. JM 10972, ×1.
4. Internal mould of left valve, Reg. no. JM 10974, ×1.
Figs. 5–7. *Monotis* (*Entomonotis*) *ochotica jitoensis*, new subsp.
5. Gypsum-cast from external mould of right valve, Reg. no. JM 10984, holotype, ×1.
6. External cast of left valve, depressed secondarily, Reg. no. JM 10986, ×1.
7. External mould of right valve, Reg. no. JM 10985, ×1.
Fig. 8. *Monotis* (*Entomonotis*) *ochotica* (*Keyserling*) showing obsolete costation near the margin, Reg. no. JM 10988, ×1.
Fig. 9. *Monotis* (*Entomonotis*) *ochotica pachypleura* (TELLER) showing obsolete costation near the margin, Reg. no. JM 10987, ×1.
Figs. 10–12. *Oxytoma* aff. *subzitteli* KOBAYASHI and ICHIKAWA.
10. Gypsum cast from left external mould, compressed secondarily, JM 11016, ×1.
11. Rubber compound cast from left external mould, compressed secondarily, Reg. no. JM 10976, ×1.
12. Rubber compound cast from left external mould, Reg. no. JM 11015, ×1.
Fig. 13. *Limatula*? sp. indet.
Gypsum cast from left? external mould, Reg. no. JM 11035, ×1.5.
Fig. 14. *Palaeoneilo*? sp. indet.
Rubber compound cast from left external mould, Reg. no. JM 11046, ×1.5.
Figs. 15, 16. *Tosapecten* cf. *suzukii nabaensis* NAKAZAWA.
15. Gypsum cast from left external mould, depressed secondarily, Reg. no. JM 11013, ×1.
16. Clay cast from left external mould, Reg. no. JM 11012, ×1.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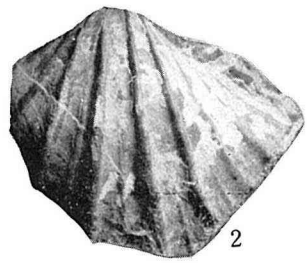
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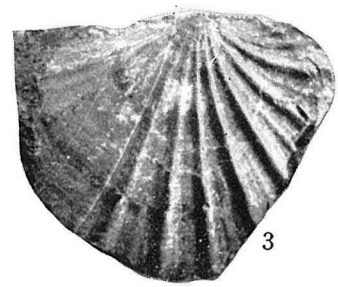
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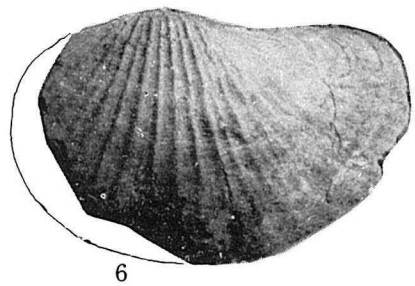
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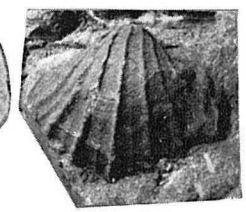
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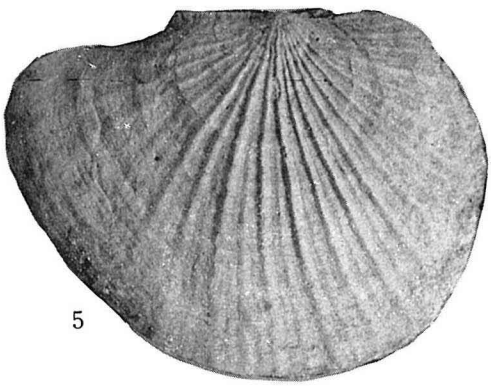
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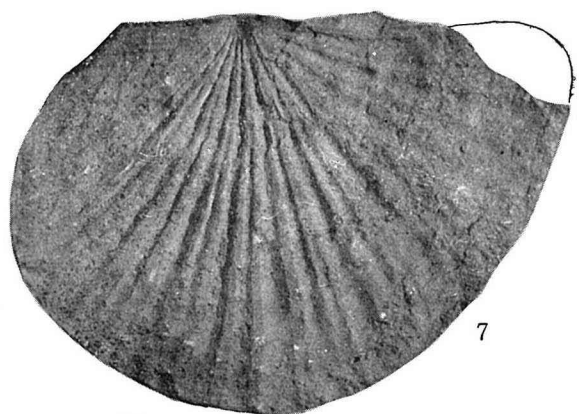
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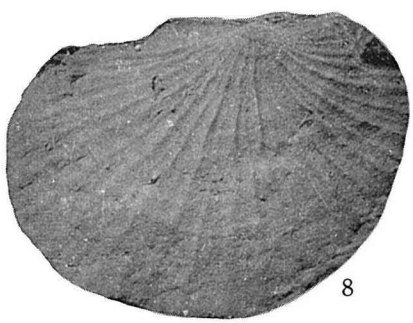
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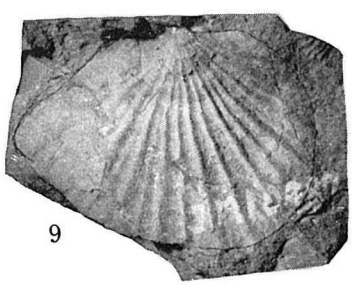
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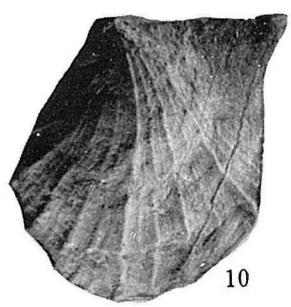
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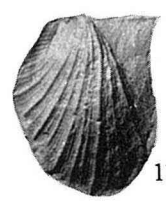
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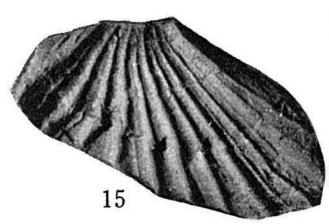
14 ×1.5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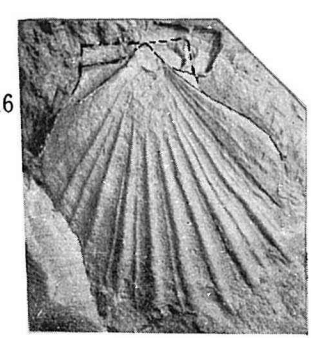
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