

A STUDY OF THE PTEROTRIGONIAE FROM JAPAN

(I) Taxonomy

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ABSTRACT

This part (I) deals with the descriptions of the taxonomical classification of the pterotrigonian fossils from the Cretaceous of Japan. The pterotrigonians are classified into 3 subgenera, i.e., *Pterotrigonia* (s. s.), ?*Scabrotrigonia* and *Ptilotrigonia*, belonging to the genus *Pterotrigonia*. 3 subgenera and 22 species including 4 new species, i. e., *Pterotrigonia* (*Ptilotrigonia*) *amakusensis* sp. nov., *Pterotrigonia* (*Ptilotrigonia*) *miyanoharensis* sp. nov., *Pterotrigonia* (*Ptilotrigonia*) *tamurai* sp. nov. and *Pterotrigonia* (*Ptilotrigonia*) *usuiensis* sp. nov., are described under the genus *Pterotrigonia*, from the various localities of the Cretaceous in Japan.

INTRODUCTION

Since Jimbo (1894) described *Trigonia longilova* Jimbo, from the Cretaceous of Central Hokkaido, many trigonians which were referred to the members of "*Acanthotrigonia*" and "*Scabrotrigonia*" had been describe from the Aptian to Cenomanian strata of the various localities in Japan by many elder authors. The "*Acanthotrigonia*" was firstly elected for the Japanese trigonians, i. e., *Trigonia longilova* Jimbo, *Trigonia moriana* Yehara, *Trigonia ogawai* Yehara and *Trigonia pustulosa* Nagao, by Kobayashi and Nakano (1957). On the other hand "*Scabrotrigonia*" was treated by Nakano (1958) based on the several trigonians, i. e., *Scabrotrigonia imanishii* Nakano, *Scabrotrigonia obsoleta* Nakano, *Scabrotrigonia kobayashii* Nakano and *Scabrotrigonia* sp.. One of us (Tashiro) once had been debate a point of view relative to the systematic relationships between "*Acanthotrigonia*" and "*Scabrotrigonia*", together with Dr. Minoru Tamura, based on the materials from the

Mifune and Goshonoura Groups in Central Kyushu (Tamura and Tashiro, 1967).

As recently abundant specimens belonging to the "*Acanthotrigonia*", "*Scabrotrigonia*" and *Pterotrigonia* s. s., were collected from the Nagase, Kajisako, Miyanohara, Fukigoshi, Hagino, "Hagion" and Bunjo Formations in Shikoku, the Goshonoura, Mifune, Onogawa Haidateyama and Miyaji Groups or Formations in Kyushu, and Middle Yezo Group in Hokkaido, we offer revised taxonomic classification of the Japanese pterotrigonians in this part (I).

Before going into our study, we wish to express our sincer thanks to Prof. Emer. Tatsuro Matsumoto of Kyushu Univ., for his continuously encouragement. We also thank to Prof. Minoru Tamura of Kumamoto Univ., for his valuable suggestion and the supply of many trigonian specimens from the Miyanohara Formation. Thanks are due to Dr. Kenshiro Ogasawara of Tohoku Univ., who supplied us the replicas of the type specimens of the trigonians by Dr. Yehara, keeping in Tohoku

Univ. (IGPS). We thank to Dr. Yasumitsu Kanie of Yokosuka Nat. Museum, Mr. Nobuyuki Kitamura of Meisei Highschool of Tokyo, Mr. Hitoshi Tanaka of Hiroshima Univ., Mr. Tatsuya Matsumoto of Kumamoto City and Mr. Takeshi Kozai of Tosayamada Jounior School of Kochi, for their supply of the pterotrigonian specimens.

THE PTEROTRIGONIAN SPECIES IN EACH CRETACEOUS STRATUM OF JAPAN

The materials of pterotrigonian species which are treated in this study, are collected from the various strata as follows.—

Shikoku

Monobe Area

1. Monobe Formation
Pterotrigonia (*Pterotrigonia*) *pocilliformis* (Yokoyama)
2. Hibihara Formation
Pterotrigonia (*Pterotrigonia*) *pocilliformis* (Yokoyama)
3. Hagino Formation
Pterotrigonia (?*Scabrotrigonia*) *moriana* (Yehara)
4. Fukigosho Formation
Pterotrigonia (?*Scabrotrigonia*) *imanishii* (Nakano)
Pterotrigonia (?*Scabrotrigonia*) *monobeana* Tashiro et Kozai
Pterotrigonia (*Ptilotrigonia*) *mashikensis* (Tamura et Tashiro)
5. Nagase Formation
Pterotrigonia (?*Scabrotrigonia*) *pustulosa* (Nagao)
Pterotrigonia (?*Scabrotrigonia*) *monobeana* Tashiro et Kozai
Pterotrigonia (*Ptilotrigonia*) *brevicula* (Yehara)
Pterotrigonia (*Ptilotrigonia*) *higoensis* (Tamura et Tashiro)
Pterotrigonia (*Ptilotrigonia*) *mashikensis* (Tamura et Tashiro)
6. Kajisako Formation
Pterotrigonia (*Pterotrigonia*) cf. *kofujiensis* Tamura

Sakawa Area

7. Doganaro Formation
Pterotrigonia (*Pterotrigonia*) *pocilliformis* (Yokoyama)
8. Kaisekiyama Formation
Pterotrigonia (*Pterotrigonia*) *pocilliformis* (Yokoyama)
9. Kurohara Formation
Pterotrigonia (*Pterotrigonia*) *pocilliformis* (Yokoyama)
10. Bunjo Formation
Pterotrigonia (?*Scabrotrigonia*) *moriana* (Yehara)
Pterotrigonia (?*Scabrotrigonia*) sp.
11. Miyanohara Formation
Pterotrigonia (?*Scabrotrigonia*) *pustulosa* (Nagao)
Pterotrigonia (*Ptilotrigonia*) aff. *ogawai* (Yehara)
Pterotrigonia (*Ptilotrigonia*) *mifunensis* (Tamura et Tashiro)
Pterotrigonia (*Ptilotrigonia*) *miyanoharensis* Tashiro et Matsuda, sp. nov.
Pterotrigonia (*Ptilotrigonia*) *amakusensis* Tashiro et Matsuda, sp. nov.

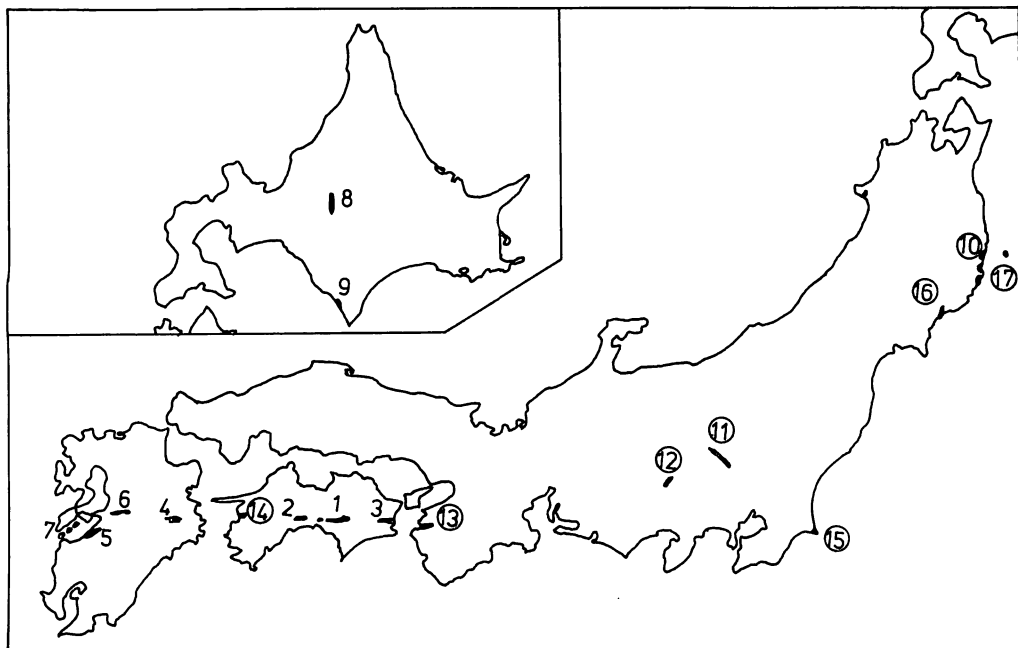
Kyushu

Yatsushiro Area

12. Yatsushiro Formation
Pterotrigonia (*Pterotrigonia*) *hokkaidoana* (Yehara)
Pterotrigonia (?*Scabrotrigonia*) sp. (by Nakano, 1958)
13. Miyaji Formation
Pterotrigonia (*Pterotrigonia*) cf. *hokkaidoana* (Yehara)
Pterotrigonia (*Pterotrigonia*) cf. *yokoyamai* (Yehara)
Pterotrigonia (*Ptilotrigonia*) *ogawai* (Yehara) (by Kobayashi and Nakano, 1958)
14. Hachiryuzan Formation
Pterotrigonia (*Pterotrigonia*) *pocilliformis* (Yokoyama)

Amakusa Area

15. Goshonoura Group (Goshonoura Island)
Pterotrigonia (*Pterotrigonia*) *sakakurai* (Yehara)
Pterotrigonia (?*Scabrotrigonia*) *pustulosa* (Nagao)
Pterotrigonia (?*Scabrotrigonia*) *obsoleta*



Text-fig. 1; Map showing the localities of the *Pterotrigonia*.

1: Monobe area, 2: Sakawa area, 3: Katsuura area, 4: Oita area, 5: Yatsushiro area, 6: Mashiki area, 7: Amakusa area, 8: Ikushunbetsu and Yubari areas, 9: Urakawa area, 10: Miyako area, 11: Sanchu area, 12: Akaishi area, 13: Yuasa area, 14: Nigyu area, 15: Choshi area, 16: Shirahama area, 17: Kuji area.

- | | |
|--|--|
| (Nakano) | Tashiro et Kozai |
| <i>Pterotrigonia</i> (? <i>Scabrotrigonia</i>) <i>yeharai</i> | <i>Pterotrigonia</i> (? <i>Scabrotrigonia</i>) aff. |
| Nakano et Numano | <i>longilova</i> (Jimbo) |
| <i>Pterotrigonia</i> (<i>Ptilotrigonia</i>) <i>ogawai</i> | <i>Pterotrigonia</i> (<i>Ptilotrigonia</i>) <i>ogawai</i> |
| (Yehara) | (Yehara) |
| <i>Pterotrigonia</i> (<i>Ptilotrigonia</i>) <i>dilapsa</i> | <i>Pterotrigonia</i> (<i>Ptilotrigonia</i>) <i>dilapsa</i> |
| (Yehara) | (Yehara) |
| <i>Pterotrigonia</i> (<i>Ptilotrigonia</i>) <i>amakusensis</i> | <i>Pterotrigonia</i> (<i>Ptilotrigonia</i>) <i>brevicula</i> |
| Tashiro et Matsuda, sp. nov. | (Yehara) |
| 16. Goshonoura Group (Shishijima, Ikarajima | <i>Pterotrigonia</i> (<i>Ptilotrigonia</i>) <i>mifunensis</i> |
| and Nagashima Islands) | (Tamura et Tashiro) |
| <i>Pterotrigonia</i> (? <i>Scabrotrigonia</i>) <i>pustulosa</i> | <i>Pterotrigonia</i> (<i>Ptilotrigonia</i>) <i>mashikensis</i> |
| (Nagao) | (Tamura et Tashiro) |
| <i>Pterotrigonia</i> (? <i>Scabrotrigonia</i>) <i>obsoleta</i> | <i>Pterotrigonia</i> (<i>Ptilotrigonia</i>) <i>higoensis</i> |
| (Nakano) | (Tamura et Tashiro) |
| <i>Pterotrigonia</i> (? <i>Scabrotrigonia</i>) <i>imanishii</i> | <i>Pterotrigonia</i> (<i>Ptilotrigonia</i>) <i>tamurai</i> |
| (Nakano) | Tashiro et Matsuda, sp. nov. |
| <i>Pterotrigonia</i> (? <i>Scabrotrigonia</i>) <i>yeharai</i> | <i>Pterotrigonia</i> (<i>Ptilotrigonia</i>) <i>usuiensis</i> |
| Nakano et Numano | Tashiro et Matsuda, sp. nov. |
| <i>Pterotrigonia</i> (? <i>Scabrotrigonia</i>) <i>monobeana</i> | |

Mashiki Area

17. Mifune Group

Pterotrigonia (?*Scabrotrigonia*) sp. aff. *P.*
(?S.) *Kobayashii* (Nakano)

Pterotrigonia (*Ptilotrigonia*) *mashikensis*
(Tamura et Tashiro)

Pterotrigonia (*Ptilotrigonia*) *higoensis*
(Tamura et Tashiro)

Pterotrigonia (*Ptilotrigonia*) *mifunensis*
(Tamura et Tashiro)

18. Mitakeyama Formation

Pterotrigonia (*Ptilotrigonia*) *mashikensis*
(Tamura et Tashiro)

Pterotrigonia (*Ptilotrigonia*) *higoensis*
(Tamura et Tashiro)

Oita Area

19. Haidateyama Formation

Pterotrigonia (*Pterotrigonia*) *pocilliformis*
(Yokoyama)

20. Sukubo Formation

Pterotrigonia (*Pterotrigonia*) *yokoyamai*
(Yehara)

Pterotrigonia (*Ptilotrigonia*) sp.

21. Tamarimizu Formation

Pterotrigonia (*Pterotrigonia*) aff.
hokkaidoana (Yehara)

22. Osaka Formation

Pterotrigonia (*Pterotrigonia*) *pocilliformis*
(Yokoyama)

23. Ryozen Formation

Pterotrigonia (*Pterotrigonia*) *kofujiensis*
Tamura

Central Japan

Akaishi Area

24. Misakubo Formation (based on Kitamura's collections)

Pterotrigonia (?*Scabrotrigonia*) *pustulosa*
(Nagao)

Pterotrigonia (?*Scabrotrigonia*) *monobeana*
Tashiro et Kozai

Pterotrigonia (*Ptilotrigonia*) *mifunensis*
(Tamura et Tashiro)

Linotrigonia sp.

N-E Japan

25. Miyako Group (based on the Tohoku Univ. collections and Matsumoto's collections in Kumamoto)

Pterotrigonia (*Pterotrigonia*) *hokkaidoana*

(Yehara)

Pterotrigonia (*Pterotrigonia*) *yokoyamai*
(Yehara)

Pterotrigonia (*Pterotrigonia*)
datemasamunei (Yehara)

26. Shirahama Group (based on the Tohoku Univ. collections)

Pterotrigonia (*Pterotrigonia*) cf. *pocilliformis*
(Yokoyama)

Hokkaido

Ikushunbetsu Area

27. Mikasa Formation

Pterotrigonia (?*Scabrotrigonia*) *pustulosa*
(Nagao)

Pterotrigonia (?*Scabrotrigonia*) *kobayashii*
(Nakano)

Pterotrigonia (*Ptilotrigonia*) *brevicula*
(Yehara)

Pterotrigonia (*Ptilotrigonia*) *mifunensis*
(Tamura et Tashiro)

(= *Trigonia longilova* Jimbo, by Yehara,
1915, 1923)

Yubari Area

28. Mikasa Formation

Pterotrigonia (?*Scabrotrigonia*) *pustulosa*
(Nagao)

Pterotrigonia (*Ptilotrigonia*) *brevicula*
(Yehara)

Pterotrigonia (*Ptilotrigonia*) *mifunensis*
(Tamura et Tashiro)

29. Lower-Yezo Group (Samani; based on the Kanie's collections)

Pterotrigonia (*Pterotrigonia*) aff.
yokoyamai (Yehara)

Some species of pterotrigonian were hitherto described or listed from many other localities which were not treated in this study. They are as follows.—

Pterotrigonia (*Pterotrigonia*) *pocilliformis* (Yokoyama): Ishido Formation of Sanchu, Kwanto Mountains, by Yabe, Nagao and Simizu (1926), and Matsukawa (1976); Todai Formation of Akaishi Area, by Maeda and Kitamura (1967), Maeda and Kawabe (1967) and Hayashi et al (1981); Arida Formation of Yuasa Area, by Matsumoto (1954, ed.); Hoji Formation of Katsuura, Shikoku, by Nakai (1968) and Nakano (1970); and Choshi Group

of Central Japan, by Hayami and Oji (1980).

Pterotrigonia (Pterotrigonia) hokkaidoana (Yehara): Ishido Formation, by Yabe, Nagao and Shimizu (1926), and Matsukawa (1976); Oshima Group of N-E Japan, by Hatai, Kotaka and Noda (1969); Gumizaki Formation of Kyushu, by Hashimoto, Hayami and Noda (1972) Hinagu Formation of Kyushu, by Matsumoto and Kanmera (1964); Nigyu Formation of Shikoku, by Nagai and Nakano (1961); Hoji Formation of Shikoku, by Nakai (1968); Arida Formation of Kishu, by Matsumoto (1954, ed.); and Misaki Formation of Misaki Area (Miocene) (reworked fossil), by Matoba (1964).

Pterotrigonia (Ptilotrigonia) brevicula (Yehara): Sandstone block of sea bottom, southern coast of Kuji Area, N-E Japan, by Hayami and Kase (1981).

Pterotrigonia (?Scabrotrigonia) longilova (Jimbo): Mikasa Formation of Ponhorokabetsu, Yubari, Hokkaido, by Jimbo (1894: original description of *T. longilova*); Sandstone block of sea bottom, southern coast of Kuji Area, by Hayami and Kase (1981).

In our opinion, almost specimens which were described or listed as *Pterotrigonia* (s. s.) *hokkaidoana* (Yehara), from Arida, Ishido, Oshima and Hoji Formations or Groups, are probably referable to *Pterotrigonia* (s. s.) *pocilliformis* (Yokoyama).

SYSTEMATIC DESCRIPTION

Class Bivalvia

Subclass Palaeoheterodonta Newell, 1965

Order Trigonioida Dall, 1889

Superfamily Trigoniacea Lamarck, 1819

Family Trigoniidae Lamarck, 1819

Subfamily Pterotrigoniinae van Hoepen, 1929

Genus *Pterotrigonia* van Hoepen, 1929

Subgenus *Pterotrigonia* van Hoepen 1929

Type species.—*Pterotrigonia cristata* van

Hoepen, 1929; Soeleland,

South Africa; Cenomanian

Diagnosis.—Shell crescent or elongated

subtrigonal or gibbous; umbo prominent, opisthogyrate, located at a point partialated to anterior; disk crescent in shape with numerous costae; the costae near the umbo concentric; next ones on the main part of the disk subdiagonal; later ones on the posterior part of the disk subradial or subvertical; area narrow with transverse costellae or smooth; escutcheon deeply depressed with transverse or subvertical costellae; posterior and marginal carinae distinct near the umbo but usually weakened or effaced on the later.

Remarks.—This subgenus is characterized by the transverse costellae on the area.

Although some species, e. g., *Pterotrigonia (Pterotrigonia) pocilliformis* (Yokoyama), *Pterotrigonia (Pterotrigonia) yokoyamai* (Yehara) and *Pterotrigonia (Pterotrigonia) sakakurai* (Yehara), are lacked the costellae on the almost part of the area. The fine several transverse costellae are observable near the umbo of the area.

List of Japanese *Pterotrigonia* s. s.

Trigonia pocilliformis Yokoyama

.....Barremian to Aptian

Trigonia hokkaidoana Yehara.....?Aptian to Albanian

Trigonia yokoyamai Yehara.....Aptian to Albanian

Trigonia datemasamunei Yehara.....Albanian

Trigonia sakakurai Yehara.....?Upper Albanian to Lower Cenomanian

Pterotrigonia kofujiensis Tamura.....Middle Turonian

Pterotrigonia (Pterotrigonia) aff. yokoyamai (Yehara).....?Albanian

Range of Japanese Pterotrigonia s. s.:—Barremian to Middle Turonian.

Pterotrigonia (Pterotrigonia) sakakurai (Yehara)

Plate 10, Figs. 1—6;

Plate 13, Fig. 9; Text-fig. 2

1923a. *Trigonia sakakurai* Yehara, *Jour. Geol. Sci. Tokyo*, vol. 30, no. 352, p. 6, pl. 4, fig. 6.

1923b. *Trigonia sakakurai* Yehara; Yehara,

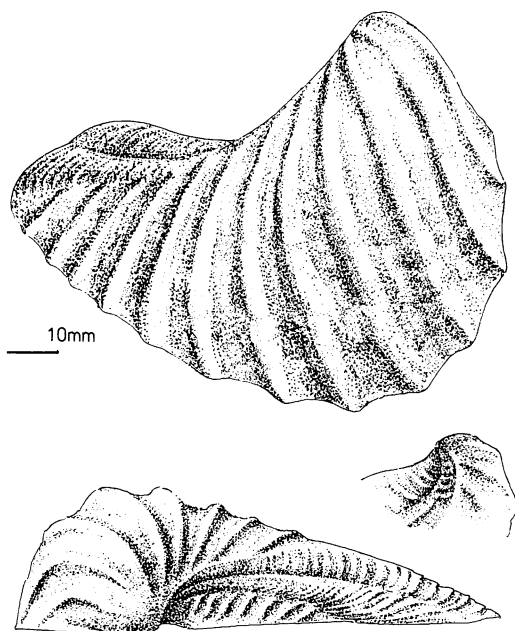
- Japan Jour. Geol. Geogr.*, vol. 2, no. 3, p. 76, pl. 11, fig. 3, pl. 13, fig. 2.
1954. *Pterotrignia sakakurai* (Yehara); Kobayashi, *Ibid.*, vol. 25, nos. 1—2, p. 77.
1961. *Pterotrignia sakakurai* (Yehara); Nakano and Numano, *Trans. Proc. Palaeont. Soc. Japan, n. s.*, no. 43, p. 93, pl. 13, figs. 9—10.
1975. *Pterotrignia sakakurai* (Yehara); Tamura, *Mem. Fac. Educ. Kumamoto Univ.*, no. 24, sec. 1, nat. sci., p. 56, pl. 2, figs. 1—7.
1975. *Pterotrignia (Pterotrignia) sakakurai* (Yehara); Hayami, *Univ. Mus., Univ. Tokyo, Bull.* 10, p. 118.

Material:—KSG 3308, KSG 3310—KSG 3311, external moulds of left valves; KSG 3309, external mould of right valve; all the specimens collected from Karakizaki, Goshonoura Island, Kyushu. KSG 3357, external mould of right valve, from east of Hegushi, Shishijima Island, Kyushu.

Remarks:—A specimen, KSG 3310, is distinctly ornamented by about 5 fine transverse costellae on the area nearest umbo. This species is similar to *Pterotrignia* (?*Scabrotrignia*) *yeharai* Nakano et Numano, from the Goshonoura Group (Nakano and Numano, 1961; Tamura, Tashiro and Motojima, 1968; Tamura, 1975), in its large valve, but differs in its transverse costellae on the area, smooth costae on the disk, and rounded outline of the valve.

Occurrence:—Sandstone of the Upper Formation of the Goshonoura Group (III Formation by Matsumoto, 1938), at the seashore of Karakizaki, Goshonoura Island, Kumamoto Prefecture; upper part of lower

Lower Cenomanian or upper Lower Cenomanian. Sandstone of the Upper part of the Goshonoura Group at about 300m east of Hegushi, Shishijima Island, Kagoshima Prefecture; Lower Cenomanian.



Text-fig. 2. *Pterotrignia (Pterotrignia) sakakurai* (Yehara).

Pterotrignia (Pterotrignia) pocilliformis (Yokoyama)

Plat 8, Figs. 18—20; Plate 12, Figs. 1—6

1891: *Trigonia pocilliformis* Yokoyama, *Jour. Coll. Sci. Imp. Univ., Tokyo*, vol. 4, no. 2,

Measurements:- (in mm.)	<i>Pterotrignia</i> (s.s.) <i>sakakurai</i> (Yehara)		
Specimen	Length	Height	Thickness
KSG 3308, l. ex. mould	83.1	59.0	25.5
KSG 3309, r. ex. mould	84.0	66.0	30.0
KSG 3310, l. ex. mould	ca 73.1	ca 70.0	ca 25.0
KSG 3311, l. ex. mould	65.3	52.5	17.3
KSG 3357, r. ex. mould	ca 93.0	ca 65.0	—

- p. 361, pl. 40, figs. 1—3.
 1923: *Trigonia pocilliformis* Yokoyama; Yehara, *Jour. Geol. Geogr.* vol. 2 no. 3, p. 71, pl. 9, figs. 8—10, pl. 10, figs. 4—6.
 1926: *Trigonia pocilliformis* Yokoyama; Yabe, Nagao and Simizu, *Sci. Rep. Tohoku Imp. Univ.*, ser. 2, vol. 9, no. 2, p. 45.
 1927: *Trigonia pocilliformis* Yokoyama; Yabe, *Ibid.*, vol. 11, no. 1, pl. 4, fig. 3.
 1954: *Pterotrigonia pocilliformis* (Yokoyama); Kobayashi, *Jour. Geol. Geogr.*, vol. 25, nos. 1—2, p. 77.
 1956: *Myophrella (Promyophorella) obsoleta* Kobayashi et Tamura; Kobayashi, *Ibid.*, vol. 27, no. 1, p. 2, pl. 1, fig. 2.
 1957: *Pterotrigonia pocilliformis* (Yokoyama); Kobayashi and Nakano, *Ibid.*, vol. 28, no. 4, p. 229, pl. 16, figs. 8—10.
 1957: *Pterotrigonia pocilliformis* var. *yamanokamiensis* Kobayashi et Nakano, *Ibid.*, vol. 28, no. 4, p. 229, pl. 16, figs. 8—10.
 1958: *Pterotrigonia pocilliformis* (Yokoyama); Kobayashi and Nakano, *Ibid.*, vol. 29, nos. 1—3, p. 147, pl. 11, fig. 12.
 1964: *Pterotrigonia pocilliformis* (Yokoyama); Matoba, *Trans. Proc. Palaeont. Soc. Japan*, n. s., no. 55, pl. 37, figs. 6, 7.
 1967: *Pterotrigonia pocilliformis* (Yokoyama); Maeda and Kawabe, *Annual Rep. Foreign Students*, *Coll. Chiba Univ.*, no 1, p. 91, pl. 1, figs. 1—3.
 1967: *Pterotrigonia (Pterotrigonia) hokkaidoana* (Yehara); Hayami and Kawasaki, *Trans. Proc. Palaeont. Soc. Japan*, n. s., no. 66, p. 79, pl. 9, figs. 6—9.
 1981: *Pterotrigonia (Pterotrigonia) pocilliformis* (Yokoyama); Hayami and Oji, *Ibid.*, no. 120, p. 431, pl. 52, fig. 7.

Material:—KSG 3336-KSG 3337, from Kasanokawa of Ryoseki Area, Shikoku; KSG 3324—KSG 3326, from Haidateyama, Ohita; KSG 3340-KSG 3341, from Osaka, Ohita; All the specimens are external moulds.

Remarks:—This species is divided into two forms as mentioned below.—

(1) Radially costated type (B Form):—The costae on the posterior half of the disk are subradiated. The valve is generally taller than that of A Form.

(2) Parallel costated type (A Form):—The costae on the posterior half of the disk are nearly parallelated and situated subvertically.

It seems that the distinction between A Form and B Form is somewhat artificial. The former (A Form) occurs generally from the Barremian in age. While the latter is confined to the Aptian.

Occurrence:—A Form.—Fine grained sandstone of the Monobe Formation at Kasanokawa and Shingai of Ryoseki Area, and Todorono-taki of Hibihara of Monobe Area; Lower Barremian: Fine grained sandstone of the lower part of the Haidateyama Group at Haidateyama and Sukubo of Ohita Prefecture; Lower Barremian: Silty sandstone of the A Member (lower) of the Doganaro Formation of the Shimantogawa Group at Kohama, Susaki City, Kochi Prefecture; Barremain: The specimens from the Ishido Formation (Matsukawa, 1976), Aridagawa Formation, Hachryuzan Formation, Shirahama Formation, Todai Formation and Katsuragawa Formation (lower), are probably referable to this A Form.

B Form:—Sandstone of the Lower Member of the Hibihara Formation at Doiban of Odochi, and Suita of Biraifu, both in Monobe

Measurements:- (in mm.)		<i>Pterotrigonia</i> (s.s.) <i>pocilliformis</i> (Yokoyama)			
Specimen		Length	Height	Thickness	Type
KSG 3324, l. ex. mould		36.3	33.5	16.8	A
KSG 3325, r. ex. mould		41.3	32.7	11.3	A
KSG 3336, r. ex. mould		38.5	20.5	11.0	A
KSG 3337, l. ex. mould		33.5	28.0	13.6	A
KSG 3340, r. ex. mould		ca 50.0	43.0	13.0	B
KSG 3341, l. ex. mould		ca 48.0	44.5	—	B

Area, Shikoku; Lower Aptian: Sandstone of the Kurohara Formation at Ochi, Sakawa Area, Kochi; Lower Aptian: Sandstone of the "Kaisekiyama" Formation at Ujidani of Kamo, Sakawa Area; Lower Aptian: Fine grained sandstone of the B Member (middle) of the Doganaro Formation of the Shimantogawa Group at the north of Aso, and Doganaro, Susaki City; Lower Aptian: Sandstone of the Osaka Formation of the Haidateyama Group at South of Osaka, Ohita Prefecture; Aptian. The specimens (KSG 3338 and KSG 3339) from the Tamarimizu Formation of the Haidateyama Group at Ochiai, are probably referable to *Pterotrigonia* (*Pterotrigonia*) *hokkaidoana* (Yehara) (See, Plate 11, figs. 6, 7). The specimen (Pl. 52, fig. 7) which was described by Hayami and Oji (1980) from the Choshi Group, is undoubtedly referable to B Form of *Pterotrigonia* (*Pterotrigonia*) *pocilliformis* (Yokoyama).

Pterotrigonia (*Pterotrigonia*) cf. *kofujiensis*
Tamura

Plate 8, Fig. 21

Compare:—

1978. *Pterotrigonia* (*Pterotrigonia*) *kofujiensis*
Tamura, *Mem. Fac. Educ. Kumamoto Univ.*, no. 27, nat. sci., p. 82, pl. 1, figs. 1—7

*Material:—*KSG 3322, external and internal moulds of a right valve, from Mizutani of Kajisako, Monobe Area, Shikoku.

*Description:—*Shell medium in size, trigonal ovate, moderately inflated, slightly longer than high; umbo opisthogyrate, sharply prominent, somewhat incave, located at a fifth

from front of the valve; apical angle about 55°; disk crescent in the shape, ornamented with about 15 or more tuberculated costae; 3 or 4 costae near the umbo subhorizontal or somewhat concentric, weakly impressed; next 7 or so costae on the main part of the disk strongly prominent but narrower than their interspaces, situated subdiagonal; 5 or less costae on the posterior part of the disk subradical, narrower than their interspaces; area very narrow, with narrow subconcentric costellae, weakly swollen; median groove deep; escutcheon strongly depressed with numerous vertical costellae; posterior and marginal carinae distinct near the umbo but weakened on the later stage; growth lines on the disk somewhat strong.

*Observation:—*This specimen, KSG 3322, 26.0mm or more long, 25.5mm high and 8.6mm thick, is an imperfect right internal and external moulds. The posterior part of area and escutcheon are indistinct because of the weathering. The ornamentation of the disk is, however, well preserved.

*Comparison:—*This specimen is closely akin to *Pterotrigonia* (*Pterotrigonia*) *kofujiensis* Tamura (1978) from the Ryozen Formation of the Onogawa Group of Kyushu, in the tall valve and strongly prominent and tuberculated costae on the disk. This specimen is probably referable to *P. (s.s.) kofujiensis*. This specimen clearly differs from *Pterotrigonia* (*Pterotrigonia*) *pocilliformis* (Yokoyama) and *Pterotrigonia* (*Pterotrigonia*) *hokkaidoana* (Yehara), from the Lower Cretaceous of Japan (Tamura, 1975, 1978), in its less numerous and subhorizontal costae near the umbo.

*Occurrence:—*Sandstone of the lower

Measurements:- (in mm.)	<i>Pterotrigonia</i> (s.s.) aff. <i>yokoyamai</i> (Yehara)		
Specimen	Length	Height	Thickness
KSG 3313, l. ex. mould	56.0	51.8	19.6
KSG 3314, l. ex. mould	ca 21.5	18.7	11.5
KSG 3345, r. in. mould	ca 35.0	35.0	—
KSG 3346, l. ex. mould	30.0	33.0	12.0
KSG 3347, l. ex. mould	25.5	23.3	12.0

member of the Kajisako Formation at Mizutani of Kajisako, Odochi., Monobe Area, Kochi Prefecture; Middle Turonian (*Inoceramus hobetsensis* Zone).

Pterotrigonia (*Pterotrigonia*) aff. *yokoyamai*
(Yehara)

Plate 10, Figs. 7 and 8;

Plate 12, Figs. 10—14

Material:—KSG 3313, external mould of left valve; KSG 3314, external mould of left valve; both from Samani, Urakawa District, Hokkaido, collected by Dr. Y. Kanie. KSG 3345—KSG 3347, external and internal moulds, from Sukubo, Ohita Prefecture, Kyushu.

Description:—Shell large to medium in size, elongately subtriangular, well inflated; umbo sharply prominent, opisthogyrous, located at about one fifth from front of the valve; apical angle about 35°; anterior margin weakly convex; ventral margin long, weakly arched on the anterior part but nearly straight or slightly sinuated on the posterior part; siphonal margin narrowly rounded; dorsal margin elongated, moderately concave; disk crescent in the shape, ornamented with strong and finely tuberculated costae; 5 or so costae near the umbo subconcentric, closely spaced, finely crenulated; next 7 or more costae roof-shaped, subdiagonal, narrower than their interspaces; 6 or more costae on the posterior part subvertical, broadly spaced; area narrow but elongated, weakly swollen, nearly smooth except for about 8 transverse costellae near the umbo; escutcheon strongly depressed, widely lanceolated with about 14 tuberculated costellae which are directed subvertical and narrower than their interspaces; posterior carina distinctly angulated near the umbo, but gradually changing into rounded ridge on the later; dorsal carina weak but observable as a boundary line between the costellate escutcheon and the smooth area; median groove distinct but shallow.

Observation:—This species is characterized by the narrow and smooth area, and rounded siphonal margin.

Comparison:—this species is closely related to *Pterotrigonia* (*Pterotrigonia*) *hokkaidoana* (Yehara) from the Lower Cretaceous Miyako Group of N-E Japan and Yatushiro Formation of Kyushu (Yehara, 1923; Tamura, 1978), in its nearly same features of the disk, escutcheon and outline of the valve. This species is, however, discriminated from *P. (P.) hokkaidoana*, in its narrow area, less numerous costae on the disk and rounded siphonal margin. Although *Pterotrigonia* (*Pterotrigonia*) *pocilliformis* (Yokoyama), from the Lower Cretaceous of Shikoku, resembles this species in the narrow area, this is distinguishable from *P. (P.) pocilliformis*, in having its tall valve and well rounded siphonal margin. *Pterotrigonia* (*Pterotrigonia*) *datemasamunei* (Yehara) from the Miyako Group (Yehara, 1923; Tamura, 1978), is also discriminated from this species in its distinct transverse costellae on the area, and numerous crenulated costae on the disk. The distinction between *Pterotrigonia* (?*Scabrotrigonia*) *kobayashii* (Nakano) from the Mikasa Formation of Hokkaido, and this species is shown by the smooth area in the latter but ornamented area with the chevron-shaped costellae in the former.

Occurrence:—Sandstone of the Lower-Yezo Group at Samani, Urakawa District, Hokkaido; ?Albian. Dark gray siltstone of the Sukubo Formation, at Sukubo, Ohita Prefecture; Upper Ablian.

Subgenus *Scabrotrigonia* Dietrich, 1933

Type species.—*Trigonia scabra* Lamarck;
Cenomanian of Europe.

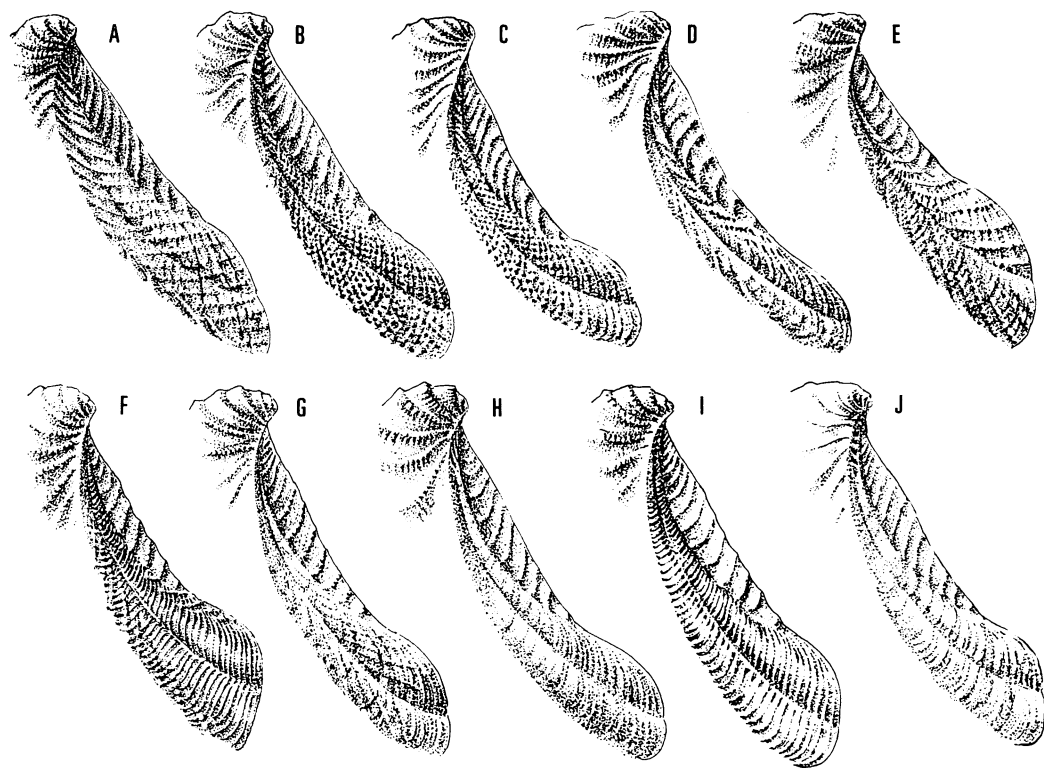
Diagnosis of Japanese ?*Scabrotrigonia*:
—Shell large to small, elongately crescent; umbo opisthogyrous, prominent sharply from the dorsal margin, located anterior; disk with numerous tuberculated costae, subconcentric near the umbo, subdiagonal on the central part of the disk and subradial or subvertical on the posterior part of the disk; area narrowly expanded to posterior with chevron-shaped or oblique costellae, or pustulated sculptures, or smooth, except for umbonal fine costellae;

escutcheon lanceolated, strongly depressed, ornamented with numerous vertical or transverse costellae; posterior carina angulated near the umbo but changing into rounded ridge on the later; marginal carina distinct near the umbo but observable as a boundary line between the depressed escutcheon and weakly inflated area; median groove shallow but distinct; apical angle small.

Remarks:—Although *Scabrotrigonia* was established as a distinct genus by Dietrich (1933), Cox (1969) ranked *Scabrotrigonia* down to a subgenus of *Pterotrigonia* van Hoepen (1929). In the typical species of this subgenus, *Trigonia scabra*. The dorsal carina is visible only as a boundary line between the depressed escutcheon and flat area. The posterior carina

not angulated and observable as a rounded ridge. Subhorizontal costellae of the escutcheon are connected with the horizontal costellae on the dorsal side of the area. The costae on the disk are also connected with the oblique costellae of the marginal side of the area on the posterior carinal ridge. The median groove is shallow but distinctly observable as a bisecting line of the chevrons which were composed of the costellae on the dorsal side of the area and the costellae on the marginal side of the area.

The Japanese species be treated as the members of the subgenus ?*Scabrotrigonia* in this paper, are characterized by the perfect or imperfect chevron shaped costellae on the area. The species are, however, distinguishable from the typical species of *Scabrotrigonia*, in their smaller apical angle, more distinct posterior



Text-fig. 3; Showing ornamentation of the area of ?*Scabrotrigonians* and *Pterotrigonians*. A: *Pterotrigonia* (?*Scabrotrigonia*) *moriana*, B: *P.* (?*S.*) *pustulosa* A Form, C: *P.* (?*S.*) *pustulosa* B Form, D: *P.* (?*S.*) *monobeana*, E: *P.* (?*S.*) *imanishii*, F: *P.* (?*S.*) *obsoleta*, G: *P.* (?*S.*) *kobayashii*, H: *P.* (?*S.*) *yeharai*, I: *P.* (s. s.) *datemasamunei*, J: *P.* (s. s.) *pocilliformis*.

carina and transverse costellae on the escutcheon. The subgeneric position of the Japanese species is uncertain. We select tentatively *Scabrotrigonia* for the Japanese species.

List of Japanese species:—

Trigonia moriana Yehara.....Lower Aptian

Trigonia pustulosa Nagao.....Uppermost

Albian to Middle Cenomanian

Trigonia longiloba Jimbo.....Middle

Cenomanian

Scabrotrigonia sp. (by Nakano,

1958).....Lower Albian

Scabrotrigonia imanishii Nakano.....Lower

Cenomanian

Scabrotrigonia obsoleta Nakano.....Uppermost

Albian to Lower Cenomanian

Scabrotrigonia kobayashii Nakano.....Upper

Cenomanian

Pterotrigonia (Rinetrigonia) yeharai Nakano et

Numano.....Lower Cenomanian

Pterotrigonia (?Scabrotrigonia) monobeana

Tashiro et Kozai.....Lower to Middle

Cenomanian

Pterotrigonia (?Scabrotrigonia) sp......Lower

Aptian.

*Distribution and age:—*Kyushu, Shikoku, Akaishi Mountains and Hokkaido; Lower Aptian to Cenomanian.

Pterotrigonia (?Scabrotrigonia) moriana

(Yehara)

Plate 6, Figs. 1—21; Text-fig. 4

1927. *Trigonia moriana* Yehara, *Japan Jour.*

Geol. Geogr., vol. 5, nos. 1—2, p. 33, pl. 3, figs. 7—8.

1954. *Pterotrigonia moriana* (Yehara);

Kobayashi, *Ibid.*, vol. 25, nos. 1—2, p. 77.

1957. *Acanthotrigonia moriana* (Yehara);

Kobayashi and Nakano, *Ibid.*, vol. 28, no. 4, p. 233, pl. 16, figs. 5—6, pl. 17, figs. 9—10.

1975. *Pterotrigonia (Acanthotrigonia) moriana*

(Yehara); Hayami, *Univ. Mus., Univ.*

Tokyo, Bull. no. 10, p. 119.

*Material:—*KSG 3221, KSG 3223—KSG 3224 and KSG 3227, external moulds of right valves; KSG 3222, KSG 3225—KSG 3226 and KSG 3228—KSG 3229, external moulds of left valves; all the specimens are collected from Hagino, Monobe Area, Shikoku.

*Description:—*Shell medium to small, crescent in outline, moderately inflated, longer than high; umbo prominent, opisthogyrus, located at about one fourth from front of the valve; apical angle about 50°; anterior margin well arched, gradually changing into broadly arched ventral margin; siphonal margin somewhat elongated, obliquely subtruncated, nearly straight or very weakly arched; dorsal margin concave, elongated; disk subtrigonal in the shape, ornamented with roof-shaped costae, each of which is narrower than the interspace; 5 or more costae near the umbo subconcentric, finely crenulated; 10 or less costae on the main part of the disk strong, subdiagonal, finely tuberculated or crenulated; later 7 or so costae

Measurements:- (in mm.)	<i>Pterotrigonia (?Scabrotrigonia) moriana</i> (Yehara)				
Specimen	Length	Height	Thickness	CB	
KSG 3221, r. ex. mould	31.1	26.7	9.2	22.0	
KSG 3222, l. ex. mould	35.9	ca 23.0	9.0	21.0	
KSG 3223, r. ex. mould	ca 27.3	24.9	6.9	19.7	
KSG 3224, r. ex. mould	33.3	ca 23.2	8.4	18.2	
KSG 3225, l. ex. mould	ca 25.5	ca 21.8	ca 7.0	16.5	
KSG 3226, l. ex. mould	21.3	16.3	7.4	—	
KSG 3227, r. ex. mould	23.8	18.7	4.7	18.3	
KSG 3228, l. ex. mould	ca 27.2	ca 20.9	—	17.6	
KSG 3229, l. ex. mould	ca 32.6	—	—	19.8	

on the posterior half of the disk short, subvertical, finely tuberculated; area broad with numerous horizontal costellae and several subradial costellae; the horizontal costellae appear nearly full surface of the area; the subradial costellae generally appear on the later stage of the growth, partially located near the posterior carina, form chevron-shaped sculptures assembling with the horizontal costellae; escutcheon very narrow, lanceolated, strongly depressed with about 20 transverse and finely tuberculated costellae; posterior carina strongly concave, angulated near the umbo but weakened on the later; dorsal carina weak but distinctly observable; median groove shallow.

Observation:—This species are very variable in the outline of the valve, but are rather constant in the number of costae and costellae on the surface. The subradial costellae are biging to appear on a point of the posterior carina apart from the umbo with about 18.5 mm in the distance (see, CB in measurements). The subhorizontal costellae on the area are dencely crowded on the anterior half of the area, but gradually weakened or changing into indistinctly tuberculations on the later stage.

Comparison:—This species resembles '*Pterotrigonia (Acanthotrigonia) moriana* (Yehara)' by Matsushima and Kitamura (1981), from the Misakubo Formation of the Akaishi Mountains, in its tuberculated costae on the disk and numerous subhorizontal costellae on the area. This species is, however, characterized

by more prominent umbo, wider interspaces of the costae on the disk, longer outline of the valve and broader area than those of '*P. (A.) moriana*'. The specimens from the Akaishi Mountaines are probably referable to the genus *Linotrigonia* van Hoepen (1929).

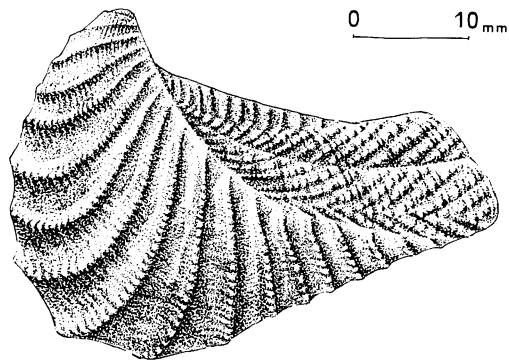
Occurrence:—Sandstone of the Hagino Formation at Hagino, Birafo-cho, Kami-gun, Kochi Prefecture. Sandstone of the Bunjo Formation at about 500m east of Bunjo, Sakawa-machi, Kochi Prefecture. Sandstone of the same formation at about 500m southwest of Yotsushiro, Sakawa-machi. Sandstone of the 'Hagino Formation' at Fukui and Mama of Kochi City. Lower Aptian.

Pterotrigonia (?*Scabrotrigonia*) sp.

Plate 7, Figs. 1—2; Text-fig. 5

Material:—KSG 3299, right valve; KSG 3300, left valve; both from Bunjo, Sakawa Area, Shikoku.

Description:—Shell medium to small, crescent or elongatedly subtrigonal in outline, moderately inflated; umbo prominent, opisthogyrous, located at about one fourth from front of the valve; apical angle about 60°; anterior margin well arched; ventral margin broadly arched but somewhat sinuated on the posterior part of the margin; siphonal margin narrowly rounded, rostrated to posterior; dorsal margin long, weakly concave; disk broad with numerous tuberculated costae; several costae near the umbo subconcentric; 6 or more costae on the main part of the disk subdiagonal; later 5 or more costae on the posterior part of the disk subvertical, widely spaced; area narrow with fine oblique costellae; the costellae generally pertialed to the part between posterior carina and median groove on the area; escutcheon strongly depressed, narrow but elongated with numerous transverse costellae; the posterior carina distinct on the anterior half of itself, but changing into rounded ridge on the later; dorsal carina observable as a angulated ridge between the costated escutcheon and the smooth area; the median groove distinct, weakly concave.



Text-fig. 4; *Pterotrigonia* (? *Scabrotrigonia*) *moriana* (Yehara).

Observation:—Two specimens are in our hand. KSG 3299 is measured for ca 38.2mm. in length, ca 27.1mm. in height and ca 12.0mm in thickness. Another specimen, KSG 3300, lacks the anterior umbonal part of the disk. Since these specimens are wrong in the preservation for the weathering, we do not establish these specimens as a distinct species.

Comparison:—This species is similar to *Pterotrigonia* (*Pterotrigonia*) *pocilliformis* (Yokoyama), from the Lower Cretaceous of southwest Japan (Tamura, 1978), in its crescentric outline, subvertical costae on the posterior part of the disk and longish area, but differs in its oblique costellae on the area. *Pterotrigonia* (?*Scabrotrigonia*) *kobayashii* (Nakano), from the Cenomanian Mikasa Formation of Hokkaido, resembles this species in the fine oblique costellae on the area. *P. (?S.) kobayashii* is, however, characterized by how far numerous costae on the disk.

Occurrence:—Sandstone of the Bunjo Formation at about 500m southwest of Yostushiro, Sakawa-machi, Kochi Prefecture. Lower Aptian.

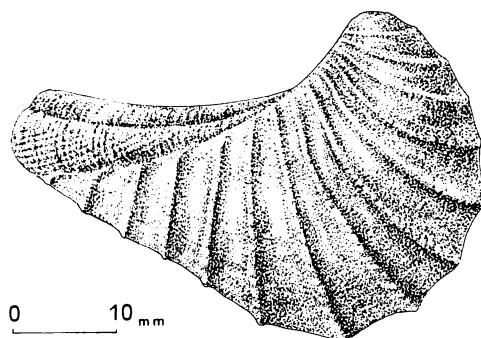
Pterotrigonia (?*Scabrotrigonia*) *pustulosa*
(Nagao)

Plate 7, Figs. 4—17; Plate 8, Figs. 1-10;

Plate 11, Figs. 9—11;

Text-figs. 6 and 7

1923. *Trigonia pocilliformis* Yokoyama; Yehara, *Japan Jour. Geol. Geogr.*, vol. 2, no. 3, p. 71, pl. 10, figs. 1—3 (non. pl. 9, figs. 8—10, pl. 10, figs. 4—6).
1930. *Trigonia pustulosa* Nagao, *Jour. Fac. Sci. Hokkaido Imp. Univ.*, ser. 4, vol. 1, no. 1, p. 17, pl. 3, figs. 9—12.
1954. *Pterotrigonia pustulosa* (Nagao); Kobayashi, *Japan Jour. Geol. Geogr.*, vol. 25, nos. 1—2, p. 77.
1957. *Acanthotrigonia pustulosa* (Nagao); Kobayashi and Nakano, *Ibid.* vol. 28, no. 4, p. 234, pl. 16, fig. 7, pl. 17, figs. 7—8.
1975. *Pterotrigonia* (*Acanthotrigonia*) *pustulosa* (Nagao); Hayami, *Univ. Mus. Univ. Tokyo, Bull.* 10, p. 120.



Text-fig. 5; *Pterotrigonia* (? *Scabrotrigonia*) sp.

1978. *Pterotrigonia* (*Acanthotrigonia*) *pustulosa* (Nagao); Tamura, *Mem. Fac. Educ. Kumamoto Univ.*, no. 27, nat. sci., p. 92, pl. 4, figs. 8—12.
1981. *Pterotrigonia* (*Acanthotrigonia*) *pustulosa* (Nagao); Matsushima and Kitamura, *Mem. Com. Educ. Shimoina*, vol. 4, p. 103.
1982. *Pterotrigonia* (*Acanthotrigonia*) *pustulosa* (Nagao); Tashiro and Kozai, *Palaeont. Soc. Japan Spec. Paps.* no. 25, p. 80, pl. 13, fig. 14.

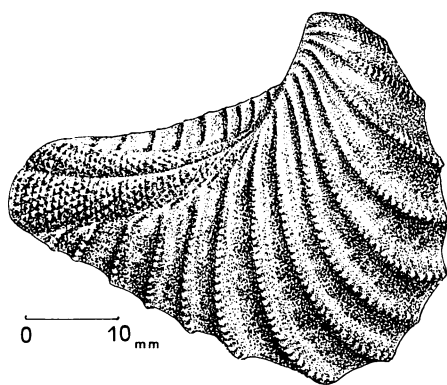
Material:—KSG 3231—KSG 3234, external moulds of right and left valves, from Enokuchi, Goshonoura Island; KSG 3235—KSG 3238, external moulds of right and left valves, from Hegushi, Shishijima Island; KSG 3242, external mould of right valve, from Kashiwaguri, Shishijima Island; KSG 3320, conjoined valves, from Kashiwaguri; KSG 3240—KSG 3241, external mould of right and left valves, from Miyano-hara, Sakawa Area, Shikoku; KSG 3239, left valve, from Miyano-hara; KSG 3342—KSG3343, external moulds, from Katsurazawa Dam-site, Mikasa City (Ikushunbetsu).

Description:—Shell medium in size, crescent or elongatedly subtrigonal in outline, longer than high, well inflated; umbo sharply prominent, located at about a fourth from front of the valve, opisthogyrate and somewhat incaved; apical angle about 40°; anterior

margin weakly convex; ventral margin nearly straight or slightly arched on the anterior half of the margin; siphonal margin obliquely subtruncated but slightly convex; dorsal margin long, moderately concave; disk ornamented with about 22 roof-shaped strong costae; 6 or more costae near the umbo crowded, finely crenulated; next 7 or so costae subdiagonal, strongly prominent, finely tuberculated, narrower than their interspaces; later 9 or more costae subradial, finely tuberculated; area narrow, ornamented with fine pustulations on the most part of it, but 10 or more concentric or oblique costellae on its umbonal part; escutcheon broad with about 20 transverse or vertical tuberculated costellae which are narrower than their interspaces; posterior carina distinctly angulated on the anterior half of it, but soon changing into narrowly rounded ridge on the later; median groove of the area shallow but distinct; dorsal carina distinct near the umbo, but recognizable as a line between the costellated escutcheon and the pustulated area.

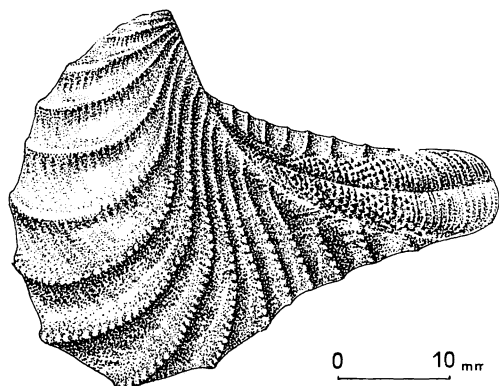
Observation:—This species is divided into two forms (A and B) in the features of the area. A Form of this species which is carried from the Uppermost Albian (Middle Formation of the Goshonoura Group in Goshonoura Island), is characterized by the distinct pustulation, numerous subtransverse costellae near the umbo, both on the area. On the other

hand in B Form of this species from the Lower Cenomanian (Miyano-hara, Misakubo and Nagase Formations and Goshonoura Group at Shishijima), the area is characterized by the indistinct pustulations in the later or mature stage and the narrower than that of A Form, the costae on the disk are some what numerous than that of A Form, and the costellae on the umbonal region of the area are oblique more than that of A Form. The distinction within the two forms are not established as the distinct species or subspecies in each other, because of the distinctions are probably artificial.



Text-fig. 6; *Pterotrigonia* (? *Scabrotrigonia*) *pustulosa* (Nagao) A Form.

Measurements:- (in mm.)	<i>Pterotrigonia</i> (? <i>Scabrotrigonia</i>) <i>pustulosa</i> (Nagao)		
Specimen	Length	Height	Thickness
KSG 3231, r. ex. mould	44.0	32.9	15.6
KSG 3232, l. ex. mould	ca 47.2	31.0	13.7
KSG 3233, r. ex. mould	34.0	28.4	9.6
KSG 3234, r. ex. mould	31.0	26.7	12.4
KSG 3235, l. ex. mould	47.2	34.2	17.7
KSG 3236, r. ex. mould	32.2	31.0	14.9
KSG 3237, l. ex. mould	ca 33.0	29.6	10.1
KSG 3238, r. ex. mould	39.2	28.0	9.5
KSG 3239, l. valve	37.9	33.4	12.5
KSG 3240, l. ex. mould	38.4	30.5	—
KSG 3241, r. ex. mould	ca 46.5	—	—
KSG 3242, r. ex. mould	27.0	24.7	9.5



Text-fig. 7; *Pterotrigonia* (? *Scabrotrigonia*) *pustulosa* (Nagao) B Form.

Comparison:—This species closely resembles *Pterotrigonia* (?*Scabrotrigonia*) *kobayashii* (Nakano), from the Mikasa Formation of Hokkaido (Nakano, 1958; Tamura, 1978), in its nearly same features of the disk, escutcheon and outline of the valve. Although this species differs from *P. (?S.) kobayashii* in its pustulated area, the specimens from the Middle Cenomanian of Hokkaido and the Shishijima Island of this species (B Form) are difficult to discriminate from *P. (?S.) kobayashii*, because of its nearly effaced pustulations on the area. This is also closely similar to *Pterotrigonia* (?*Scabrotrigonia*) *monobeana* Tashiro et Kozai (1982), from the Nagase and Fukigoshi Formations of the Monobe Area (Tashiro and Matsuda, 1982), in the pustulated area, but differs in its less protruding siphonal margin, less developed V-shaped costellae on the area and less elongated outline than those of *P. (?S.) monobeana*.

Occurrence:—A Form: Sandstone of the b member of the Middle Formation of the Goshonoura Group (IIb member by Matsumoto, 1938), at the seashore of Enokuchi, Goshonoura Island, Kumamoto Prefecture (type locality of this species); Uppermost Albian. Dark-gray siltstone of the lowest part of the Goshonoura Group of Shishijima (IIe member by Yamamoto and Hayami, 1971), at about 300m west of

Hegushi, Shishijima Island, Kagoshima Prefecture; lower Lower Cenomanian. Sandstone of the e member of the Middle Formation of the Goshonoura Group (IIe member by Matsumoto), at Karakizaki and about 200m west of Hongo, both of Goshonoura Island; lower Lower Cenomanian.

B Form: Sandstone of the Miyanohara Formation at Miyanohara, Sakawa-machi, Kochi Prefecture; upper Lower Cenomanian. Sandstone of the lower part of the Nagase Formation at Mizutani and the northern bank of Nagase Dam-site, both of Odochi (Kajisako), Monobe Area, Kochi Prefecture; upper Lower Cenomanian. Sandstone of the upper part (?) of the Goshonoura Group of Shishijima, at Hegushi (IIe member by Yamamoto and Hayami) and Kashiwaguri (IIb member by Yamamoto and Hayami), both of Shishijima Island; ? upper Lower Cenomanian. Sandstone of the Middle part of the Mikasa Formation at and near the Katsurazawa-Dam, Ikushunbetsu, Mikasa City, Hokkaido; Middle Cenomanian. This species has been reported from the sandstone of the Misakubo Formation of the Akaishi Mountains by Matsushima and Kitamura (1981); probable upper Lower Cenomanian.

Pterotrigonia (?*Scabrotrigonia*) *kobayashii*
(Nakano)

Plate 11, Figs. 1—5;

Plate 13, Fig. 8, Text-fig. 8

1958. *Scabrotrigonia kobayashii* Nakano, *Jour. Sci. Hiroshima Univ., ser. C*, vol. 2, no. 3, p. 231, pl. 29, figs. 6—7.

1975. *Pterotrigonia* (*Scabrotrigonia*) *kobayashii* (Nakano); Hayami, *Univ. Mus., Univ. Tokyo, Bull.* 10, p. 121.

1978. *Pterotrigonia* (*Scabrotrigonia*) *kobayashii* (Nakano); Tamura, *Mem. Fac. Educ. Kumamoto Univ.*, no. 27, nat. sci., p. 92, pl. 4, fig. 5.

Material:—KSG 3331 and KSG 3351 KSG 3352, external moulds, from Katsurazawa, Ikushunbetsu, Hokkaido. KSG 3328-KSG 3330, plaster casts, from the same locality.

Description:—Shell large to medium in size, crescent or elongated subquadrate, longer

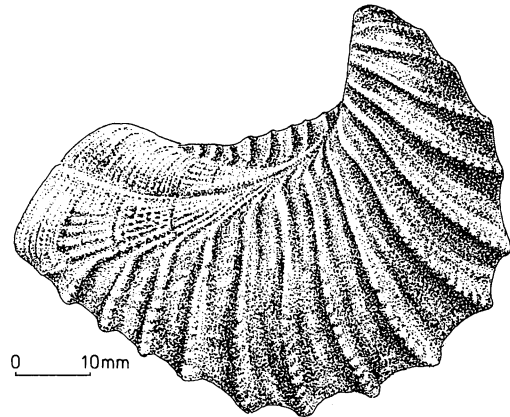
than high, moderately inflated; umbo sharply prominent, opisthogyrous, located at about one fifth from front of the valve; apical angle about 35° ; anterior margin weakly convex; ventral margin long, nearly straight or weakly arched; siphonal margin slightly rounded, rather broad for *Pterotrigonia* (s. l.); dorsal margin elongated, moderately concave; disk crescent in the shape, ornamented with about 17 tuberculated costae; 3 or so costae near the umbo weak, finely crenulated, situated subdiagonal or loosely subconcentric; next 7 or more costae strong, roof-shaped, narrower than their interspaces, situated subdiagonal on the main part of the disk; later 7 or more costae roof-shaped, broadly spaced, situated subvertical or subradial; area broad with imperfect chevron-shaped costellae; escutcheon strongly depressed, lanceolated in the shape, ornamented with about 13 vertical and tuberculated costellae; posterior carina angulated near the umbo but soon weakened and changing into roundly elevated ridge on the later; marginal carina indistinct except for the umbonal region, but visible as a boundary line between costellated escutcheon and slightly swollen area; growth lines on the area weak but distinctly observable.

Observation:—This species is characterized by the small apical angle, well prominent umbo, broad area with imperfect chevron shaped costellae, and small number of the subconcentric costae near the umbo of the disk. The chevron shaped costellae which are composed of horizontal costellae of the marginal side on the area and oblique costellae of the posterior carinal side on the area, are generally distinct like as the costellae of *Pterotrigonia* (?*Scabrotrigonia*) *imanishii* (Nakano), in the younger stage, but they are soon weakened or effaced especially on the

posterior marginal side of the area, in the mature stage. The costellae of chevrons are usually waved to fine on the later stage.

Comparison:—This species closely resembles *Pterotrigonia* (?*Scabrotrigonia*) *obsoleta* (Nakano) from the Goshonoura Group of Kyushu (Nakano, 1958; Tamura, 1978), in the large valve, imperfect chevrons of the area and finely tuberculated costae on the disk, but differs in its small apical angle, small number of umbonal costae on the disk and less developed growth lines of the area.

Pterotrigonia (?*Scabrotrigonia*) *imanishii* (Nakano) from the Horonbetsu Formation of Hokkaido (Nakano, 1958) and the Fukigoshi Formation of Shikoku (Tashiro and Matsuda, 1982), are discriminated from this species because of its small size of the valve, perfect chevrons on the area and numerous costae near umbo of the disk.



Text-fig. 8; *Pterotrigonia* (? *Scabrotrigonia*) *kobayashii* (Nakano).

Measurements:- (in mm.)		<i>Pterotrigonia</i> (? <i>Scabrotrigonia</i>) <i>kobayashii</i> (Nakano)		
Specimen	Length	Height	Thickness	
KSG 3328, r. plaster cast	64.5	49.0	ca 12.8	
KSG 3329, l. plaster cast	68.7	ca 43.0	ca 10.0	
KSG 3330, r. plaster cast	62.1	ca 40.0	—	
KSG 3331, r. ex. m.	61.3	40.5	17.0	
KSG 3351, l. ex. m.	ca 53.0	—	—	

Occurrence:—Fine grained sandstone of the Mikasa Formation at the roadside exposure about 300m west of the Katsurazawa-dam, Ikushunbetsu, Mikasa City, Hokkaido; *Inoceramus yabei* Zone: Middle Cenomanian.

Pterotrigonia (?*Scabrotrigonia*) *obsoleta*
(Nakano)

Plate 9, Figs. 1—7; Plate 11, Fig. 8; Text-fig. 9

1958. *Scabrotrigonia obsoleta* Nakano, *Jour. Sci. Hiroshima Univ.*, ser. C, vol. 2, no. 3, p. 230, pl. 29, fig. 5.

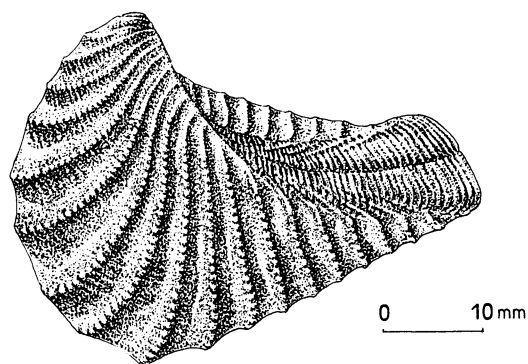
1975. *Pterotrigonia* (*Scabrotrigonia*) *obsoleta* (Nakano); Hayami, *Univ. Mus.*, Univ. Tokyo, Bull. 10, p. 120.

1978. *Pterotrigonia* (*Scabrotrigonia*) *obsoleta* (Nakano); Tamura, *Mem. Fac. Educ. Kumamoto Univ.*, no. 27, nat. sci., p. 92, pl. 4, figs. 3 and 4.

Material:—KSG 3301, external mould of right valve; KSG 3303, external mould of left valve; KSG 3302, internal mould of right valve; all the specimens collected from Hegushi, Shishijima Island, Kyushu. KSG 3344, external mould of right valve, plaster cast, from Enokuch, Goshonoura Island, Kyushu.

Description:—Shell large to medium in size, crescent or elongatedly subtrigonal in outline, well inflated; umbo sharply prominent, opisthogyrous, pointed at about one fifth from front of the valve; apical angle about 40°; anterior margin moderately convex; ventral margin weakly arched on the anterior half but nearly straight or weakly sinuate on the posterior half; siphonal margin obliquely subtruncated, somewhat protruded to posterior; dorsal margin elongated, weakly concave; disk crescentric in the shape, ornamented with about

23 tuberculated costae; 5 or more costae near the umbo crowded, subconcentric, finely crenulated; 9 or more costae on the main part of the disk roof-shaped, strongly prominent, situated subdiagonally but weakly concave, narrower than their interspaces; 9 or less costae on the posterior part of the disk short, subradiated, widely spaced; area elongated with numerous transverse costellae and imperfect chevron-shaped costellae; the chevrons composed of subhorizontal tuberculated costellae which begun to appear from the dorsal periphery of the area, and oblique tuberculated costellae which appear partially on the posterior carinal region; escutcheon strongly depressed, lanceolated with about 17 tuberculated costellae which are subvertical and narrowly spaced to their interspaces; posterior carina distinctly angulated near the umbo but recognizable as a boundary line between costated disk and costellated area; median groove of the area distinct, but shallow; dorsal carina weak but easily observable as an angulated boundary between depressed escutcheon and flated area.



Text-fig. 9; *Pterotrigonia* (? *Scabrotrigonia*) *obsoleta* (Nakano).

Measurements:- (in mm.)	<i>Pterotrigonia</i> (? <i>Scabrotrigonia</i>) <i>obsoleta</i> (Nakano)		
Specimen	Length	Height	Thickness
KSG 3301, r. ex. mould	55.6	39.4	16.5
KSG 3302, r. int. mould	45.8	40.0	—
KSG 3303, l. ex. mould	49.3	37.0	14.6
KSG 3344, r. plaster cast	ca 50.0	—	—

Observation:—Although our trigonians collection abounds with the specimens of this species, the specimens are almost consisting with the fragmental or imperfect internal and external moulds. This species is characterized by the numerous, distinct transverse costellae and the imperfect chevron-shaped costellae, both on the area. The chevron-shaped costellae number about 10 in the mature specimens, and are observable as the nearly perfect chevrons on the middle stage of the growth of the area in some specimens. The transverse costellae nearest umbo of the area, with about 8 in number, are connected with the costellae on the escutcheon at the dorsal side and with the costae on the disk at the posterior carinal side.

Comparison:—This species resembles *Pterotrigonia* (?*Scabrotrigonia*) *kobayashii* (Nakano), from the Mikasa Formation of Hokkaido (Nakano, 1958; Tamura, 1978), in its imperfect chevron-shaped costellae on the area, but differs clearly in its distinct transverse costellae on the area. The chevron-shaped costellae are strong in this species but narrow and weakly waved in *P. (?S.) kobayashii*. *Pterotrigonia* (?*Scabrotrigonia*) *monobeana* is one of resemble species to this species. *P. (?S.) monobeana* is, however, characterized by how far longer and more protruded siphonal margin than those of this species.

Occurrence:—Dark-gray siltstone of the lower part of the Goshonoura Group (IIe membr by Yamamoto and Hayami, 1971), at about 300m west of Hegushi and about 600m west of Hegushi, both of roadside exposures, Shishijima Island, Kagoshima Prefecture; lower Lower Cenomanian. Dark-gray siltstone of the same part of the Group at Katasoba, Shishijima Island. Fine grained sandstone of the IIb member (by Matsumoto, 1938) of the Goshonoura Group at Enokuchi, Goshonoura Island, Kumamoto Prefecture; Uppermost Albanian.

Pterotrigonia (?*Scabrotrigonia*) *imanishii*
(Nakano)

Plate 9, Figs. 8—11; Plate 12, Fig 15

1956. *Trigonia pocilliformis* Yokoyama; Imanishi, *Kumamoto Jour. Sci.*, ser. B, sec. 1, vol 2, no. 1, p. 53, figs. 1—3.
1958. *Scabrotrigonia imanishii* Nakano, *Jour. Sci. Hiroshima Univ.*, ser. C, vol. 2, no. 3, p. 230, pl. 29, figs. 1—4.
1975. *Pterotrigonia* (*Scabrotrigonia*) *imanishii* (Nakano); Hayami, *Univ. Mus.*, Univ. Tokyo, Bull. 10, p. 120.
1982. *Pterotrigonia* (*Scabrotrigonia*) *imanishii* (Nakano); Tashiro and Matsuda, *Trans. Proc. Palaeont. Soc. Japan*, n. s., no. 127 p. 406, pl. 64, figs. 1—8, Text-fig. 7.

Material:—KSG 3312 and KSG 3333, external moulds of left valves. from Yunokuchi, Shishijima Island, Kyushu. The other specimens from the Fukigoshi Formation of Monobe Area in Shikoku, are described in detail by Tashiro and Matsuda (1982).

Remarks:—A specimen (KSG 3333) from Kyushu, is an imperfect external mould of left valve, measured about 35.5 mm in length and about 11.5 mm in height. Although the specimens are lacking in the ventral part, characteristic features of the area are well preserved. This species is closely akin to *Pterotrigonia* (?*Scabrotrigonia*) *obsoleta* (Nakano) from the Goshonoura Group (Nakano, 1958; Tamura, 1978), in its chevron-shaped costellae and distinct transverse costellae on the area. This species is, however, characterized by more complete and numerous chevrons and weaker transverse costellae than those of *P. (?S.) obsoleta*. In addition to the distinctions, this is smaller in size and wider in the breadth of area than those of *P. (?S.) obsoleta*. In our opinion, this species is probably one of the derivatives from *Pterotrigonia* (?*Scabrotrigonia*) *obsoleta* (Nakano).

Occurrence:—Dark-gray siltstone of the ?upper part of the Goshonoura Group of Shishijima (IIa or Ib member by Yamamoto and Hayami, 1971), at about 200m southwest of Yunokuchi, Shishijima Island, Kagoshima Prefecture; Lower Cenomanian. Dark-gray siltstone of the upper member of the Fukigoshi Formation at the roadside exposure, about 30m north of Nagase Dam-site, Monobe Area, Kochi Prefecture; upper part of lower Lower

Cenomanian. The type specimens by Nakano (1958) was known from the Horonbetsu Formation of the ?Sorachi Group in Hokkaido; probable lower Lower Cenomanian.

Pterotrigonia (?*Scabrotrigonia*) *monbeana*

Tashiro et Kozai

Plate 8, Figs. 11—16

1981. *Pterotrigonia* (*Scabrotrigonia*) cf. *imanishii* (Nakano); Matsushima and Kitamura, *Mem. Com. Educ. Shimoina*, vol. 4, p. 104, pl. 2, figs. 7a and 7b.
1982. *Pterotrigonia* (?*Scabrotrigonia*) *monbeana* Tashiro et Kozai, *Palaeont. Soc. Japan, Spec. Paps.* no. 25, p. 82, pl. 13, figs. 7—13, text-fig. 1
1982. *Pterotrigonia* (?*Scabrotrigonia*) *monbeana* Tashiro et Kozai; Tashiro and Matsuda, *Trans. Proc. Palaeont. Soc. Japan, n. s.*, no. 127, p. 407, pl. 64, figs 7, 11—14, 18—21; pl. 65, figs. 18—19.

Material:—KSG 3306, external moulds of right valves, from Kashiwaguri, KSG 3321, external mould of right valve, from Yunokuchi, both in Shishijima Island, Kyushu. The other specimens from the Monobe Area are treated in Tashiro and Kozai (1982) and Tashiro and Matsuda (1982).

Remarks:—A specimen, KSG 3306, 18.5 mm in length and 7.1 mm thick, is imperfect external mould. The specimen is undoubtedly referable to *Pterotrigonia* (?*Scabrotrigonia*) *monbeana* Tashiro et Kozai (1982), from the Cenomanian of Shikoku, in its same features on the area. Another specimen, KSG 3321, is an imperfect right external mould, measured 26.0 mm in length, is collected from Yunokuchi of Shishijima Island. The specimen is also concerned with *P. (?S.) monbeana*, judging from the strongly protruded siphonal margin. A specimen which was reported by Matsushima and Kitamura (1981) as *Pterotrigonia* (*Scabrotrigonia*) cf. *imanishii* (Nakano), from the Misakubo Formation of the Akaishi Mountains, is safely identified with *P. (?S.) monbeana*, in its characteristic features of the area and elongated outline.

This species is closely akin to *Pterotrigonia* (?*Scabrotrigonia*) *pustulosa* (Nagao), in its pustulated area, and also to *Pterotrigonia* (?*Scabrotrigonia*) *obsoleta* (Nagao), in its chevron-shaped costellae on the area. This species is, however, discriminated clearly from *P. (?S.) pustulosa* and *P. (?S.) obsoleta*, in its narrow but strongly protruded siphonal margin and elongated outline.

Occurrence:—Sandstone of the upper part of the Goshonoura Group of Shishijima (IIb member by Yamamoto and Hayami, 1971), at Kashiwaguri, Shishijima Island; ?upper Lower Cenomanian. Sandstone of the same part of the Group at Yunokuchi, Shishijima Island; upper Lower Cenomanian. This species had been reported from the Middle part of the Nagase Formation (Middle Cenomanian) and Fukigoshi Formation (lower Lower Cenomanian), both in Monobe Area, Kochi Prefecture (see, Tashiro and Kozai, 1982; Tashiro and Matsuda, 1982).

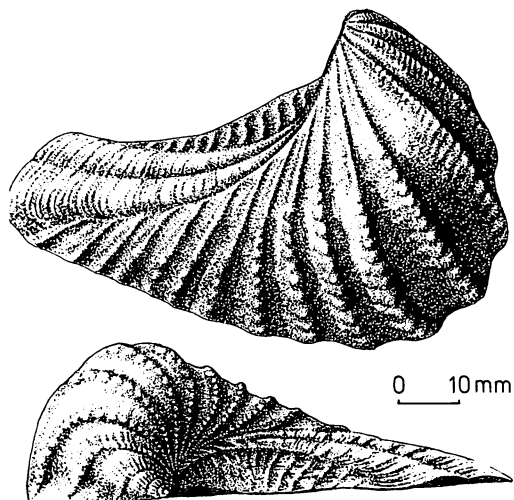
Pterotrigonia (?*Scabrotrigonia*) *yeharai*

Nakano et Numano

Plate 9, Figs. 12, 13; Text-fig. 10

1961. *Pterotrigonia* (*Rinetrigonia*) *yeharai* Nakano et Numano, *Trans. Proc. Palaeont. Soc. Japan, n. s.*, no. 43, p. 95, pl. 13, figs. 2a, b, non. fig. 1.
1968. *Acanthotrigonia yeharai* (Nakano et Numano); Tamura, Tashiro and Motojima, *Mem. Fac. Educ. Kumamoto Univ.*, no. 16, nat. sci., p. 38, pl. 1, figs. 19—23, text-fig. 2.
1975. *Pterotrigonia* (*Acanthotrigonia*) *yeharai* Nakano et Numano; Hayami, *Univ. Mus., Univ. Tokyo, Bull.* 10, p. 120.
1975. *Acanthotrigonia yeharai* (Nakano et Numano); Tamura, *Mem. Fac. Educ. Kumamoto Univ.*, no. 24, nat. sci., p. 56 (for compare), pl. 2, figs. 6—7.

Material:—KSG 3307, external mould of left valve, from Hegushi, Shishijima Island, Kyushu. KSG 3327, external and internal moulds of left valve, from Katasoba, Shishijima Island.



Text-fig. 10; *Pterotrigonia* (? *Scabrotrigonia*) *yeharai* Nakano et Numano.

Remarks:—This species is characterized by the smooth area except for several oblique costellae nearest umbo, and tuberculated stout costae on the anterior half of the disk. The apical angle of this species is about 45°. This species differs from *Pterotrigonia* (*Pterotrigonia*) *sakakurai* (Yehara) from the Goshonoura Group (Tamura, 1975), in its tuberculated costae, oblique costellae of the area near the umbo and elongated outline. This is similar to *Pterotrigonia* (?*Scabrotrigonia*) *monobeana* Tashiro et Kozai, from the Cenomanian of the Monobe Area (Tashiro and Kozai, 1982; Tashiro and Matsuda, 1982), in the finely crenulated umbonal costae on the disk and elongated outline of the valve, but differs clearly in its large valve and smooth area. *Pterotrigonia* (*Pterotrigonia*) *hokkaidoana* (Yehara) from the Miyako Group of N-E Japan (Tamura, 1975), resembles this species in its elongated outline and sharply prominent umbo.

This is, however, discriminated easily from *P.* (s.s.) *hokkaidoana*, in its less numerous and strong costae on the disk and oblique costellae nearest umbo.

Occurrence:—Sandstone of the upper part of the Goshonoura Group of Shishijima (IIe member by Yamamoto and Hayami, 1971), at about 200m north of Hegushi, Shishijima, Kagoshima Prefecture; upper Lower Cenomanian or ?Middle Cenomanian. Sandstone of the middle part of the Goshonoura Group of Shishijima (III member by Yamamoto and Hayami, 1971), at about 500m southwest of Katasoba, Shishijima Island; ?Lower Cenomanian. This species was reported from the many localities of the Upper Formation (III Formation by Matsumoto, 1938) of the Goshonoura Group in Goshonoura Island, Kyushu, by Nakano and Numano (1961), Tamura, Tashiro and Motojima (1968) and Tamura (1978).

Pterotrigonia (?*Scabrotrigonia*) *longilova*
(Jimbo)

1894. *Trigonia longilova* Jimbo, *Plaont. Abhandl., N. F.*, vol. 2, no. 3, p. 38, pl. 8, figs. 2 and 4. ?non. fig. 3
1954. *Pterotrigonia longilova* (Jimbo); Kobayashi, *Japan Jour. Geol. Geogr.*, vol. 25, nos. 1—2, p. 77.
1963. *Acanthotrigonia longilova* (Jimbo); Matsumoto, *Palaeont. Soc. Japan, 25th Anniv. vol.* 41—48, p. 45, pl. 67, figs. 2 and 4, ?non. fig. 3.
1975. *Pterotrigonia* (*Acanthotrigonia*) *longilova* (Jimbo); Hayami, *Univ. Mus., Univ. Tokyo, Bull.* 10, p. 119.
1981. *Pterotrigonia* (*Acanthotrigonia*) *longilova* (Jimbo); Hayami, in Hayami and Kase, *Trans. Proc. Palaeont. Soc. Japan, n. s.*, no. 121, p. 36, pl. 4, fig. 15.

Measurements:- (in mm.)

Pterotrigonia (?*Scabrotrigonia*) *yeharai* Nakano et Numano

Specimen	Length	Height	Thickness
KSG 3307, l. ex. mould	85.5	—	35.0
KSG 3327, l. int. mould	—	40.0	—

Remarks:—We have not obtained this species for this study. This is undoubtedly belong to the ?*Scabrotrigonia*, judging from its crescentric outline, sharply prominent umbo, roof-shaped costae on the disk, transverse costellae on the escutcheon and oblique costellae on the area near the umbo.

Distribution:—Lower Cenomanian; Mikasa Formation of Hokkaido.

Subgenus *Ptilotrigonia* van Hoepen, 1926

Type species.—*Ptilotrigonia lauta* van Hoepen, 1926; Soeleland, South Africa; Cenomanian.

Diagnosis:—Shell semicircular or roundly subtrigonal, sometimes pyriform; umbo opisthogyrous, located more anterior than mid-point of the valve length; apical angle generally large for the genus *Pterotrigonia*; disk broad, ornamented with plain or finely tuberculated costae; several costae near the umbo sub-concentric; the costae on main part of the disk subdiagonal, broadly spaced; the costae on the posterior half on the disk subradiated; area smooth except for oblique costellae near the umbo; escutcheon narrow with subhorizontal costellae, each of which usually connected with a umbonal costella of the area, or smooth; dorsal carina indistinct; posterior carina angulated near the umbo but soon changing into broadly rounded ridge on the later; median groove of the area weak, partial to dorsal side of the area; a smooth marginal sulcus extended along the boundary between the costated disk and the smooth area.

Remarks:—This subgenus is characterized by a smooth marginal sulcus extended along the boundary between the disk and the area, oblique costellae which are connected with the costellae of the escutcheon on the umbonal part of the area, and the large apical angle (see, text-fig. 2).

The Japanese species which were newly offered to the subgenus *Ptilotrigonia*, were hitherto classified into two subgenera, i. e., *Acanthotrigonia* van Hoepen, 1926, and *Pterotrigonia* s. s., van Hoepen, 1926, by many authors (Kobayashi, 1954; Kobayashi and

Nakano, 1957, 1958; Nakano and Numano, 1961; Tamura and Tashiro, 1967; Tamura, Tashiro and Motojima, 1968; Hayami, 1975; Tamura, 1975, 1977, 1978; Hayami and Kase, 1981; Matsushima and Kitamura, 1981; Tashiro and Kozai, 1982; and Tashiro and Matsuda, 1982).

The species which were classified into *Acanthotrigonia*, i. e., *Trigonia ogawai* Yehara, *Trigonia dilapsa* Yehara, *Acanthotrigonia mashikensis* Tamura et Tashiro, *Acanthotrigonia higoensis* Tamura et Tashiro, *Acanthotrigonia mifunensis* Tamura et Tashiro, are characterized by the oblique costellae on the area near the umbo. The species are, however, discriminated from *Acanthotrigonia* van Hoepen (1926), in the smooth area except for the umbonal costellae, not spinose costae on the disk, and smooth marginal sulcus.

Although *Trigonia brevicula* Yehara was treated under the *Pterotrigonia* s. s. van Hoepen (1926), by Kobayashi and Nakano (1957), and Hayami (1975, 1981 in Hayami and Kase), it undoubtedly belongs to *Ptilotrigonia* judging from its smooth area except for the umbonal oblique costellae, large apical angle, and smooth marginal sulcus.

List of Japanese *Ptilotrigonia*:—

Trigonia ogawai Yehara (1923); Upper Albian to lower Lower Cenomanian; Kyushu and Shikoku(?).

Trigonia dilapsa Yehara (1923); Uppermost Albian to Lower Cenomanian; Kyushu.

Trigonia brevicula Yehara (1915); Uppermost Albian to Lower Cenomanian; Hokkaido, N-E Japan, Kyushu, and Shikoku.

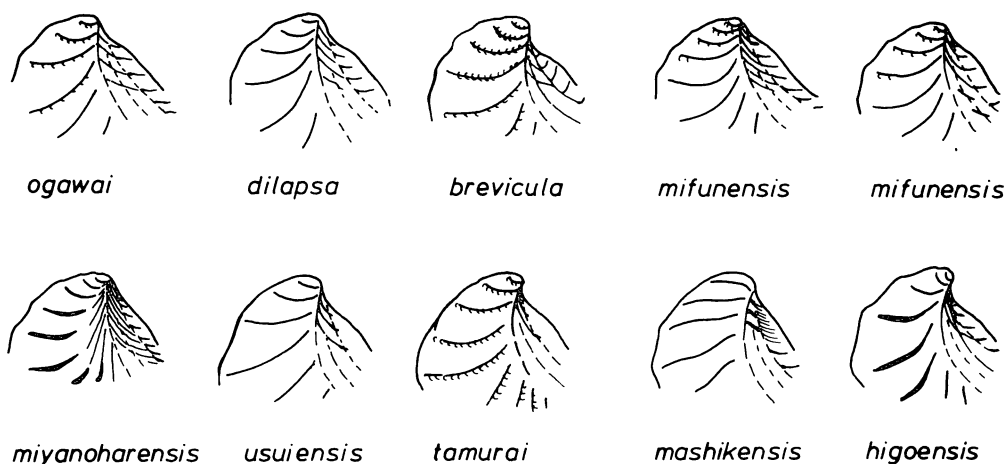
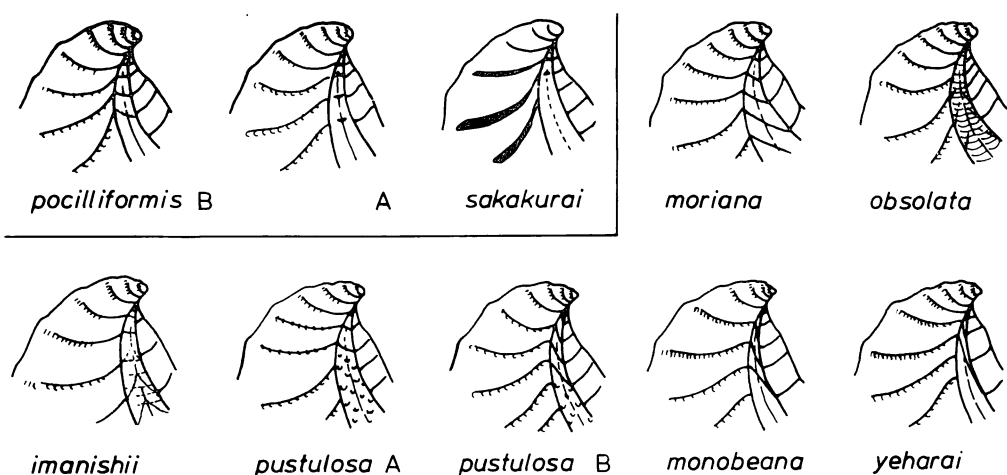
Acanthotrigonia mashikensis Tamura et Tashiro (1967); Lower Cenomanian to Middle Cenomanian; Kyushu, Shikoku.

Acanthotrigonia higoensis Tamura et Tashiro (1967); Middle Cenomanian; Kyushu, Shikoku.

Acanthotrigonia mifunensis Tamura et Tashiro (1967); upper Lower Cenomanian to Middle Cenomanian; Kyushu, Shikoku and Central Japan.

Pterotrigonia (Ptilotrigonia) miyanoharensis Tashiro et Matsuda sp. nov.; upper Lower Cenomanian; Shikoku and Central Japan (?).

Pterotrigonia (Ptilotrigonia) usuiensis Tashiro et

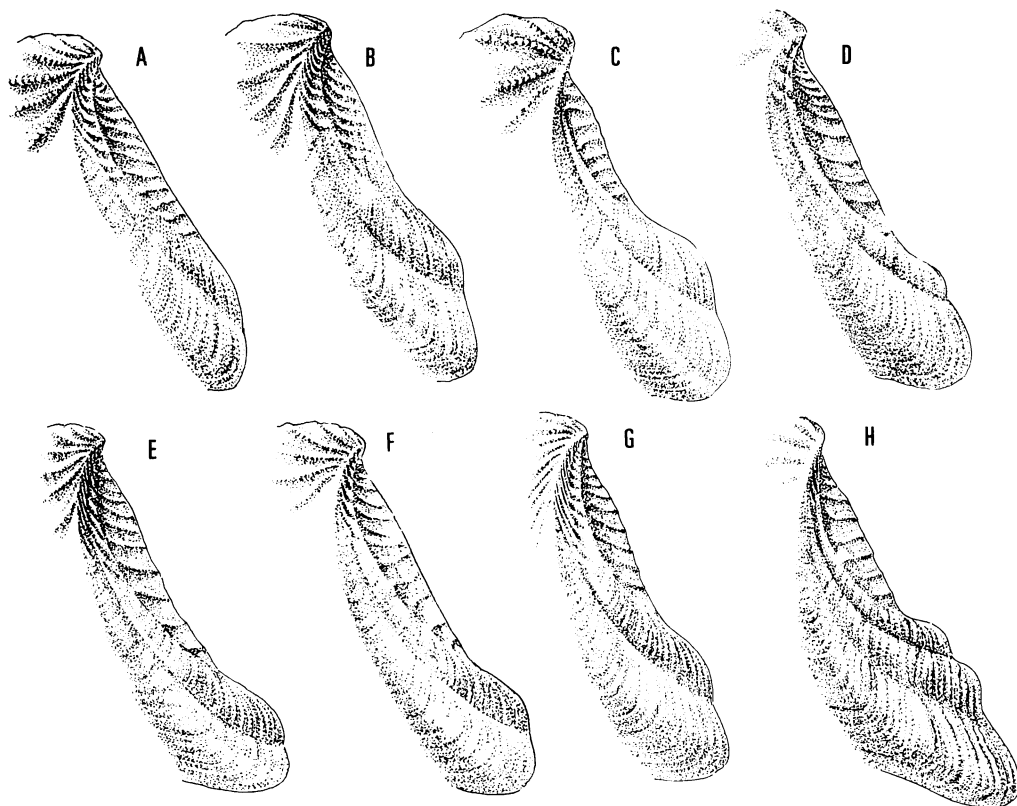
Text-fig. 11; Showing oblique castellae on the area near umbo of *Ptilotrigonians*.Text-fig. 12; Showing costellae on the area near umbo of ?*Scabrotrigonians* and *Pterotrigonians*.

Matsuda, sp. nov.; Cenomanian; Kyushu.
Pterotrigonia (Ptilotrigonia) tamurai Tashiro et
 Matsuda, sp. nov.; Cenomanian; Kyushu.
Pterotrigonia (Ptilotrigonia) amakusensis
 Tashiro et Matsuda, sp. nov.; Uppermost
 Albian to Lower Cenomanian.

Age and distribution.—Upper Albian and
 Cenomanian; South Africa, India (?) and
 Japan.

Pterotrigonia (Ptilotrigonia) ogawai (Yehara)
 Plate 1, Figs. 1—13; Text-fig. 15

- 1923a. *Trigonia ogawai* Yehara, *Jour. Geol. Sci. Tokyo*, vol. 30, no. 352, p. 4, pl. 4, figs. 3—5.
 1923b. *Trigonia ogawai* Yehara; Yehara, *Japan Jour. Geol. Geogr.*, vol. 2, no. 3, p. 75, pl. 12, figs. 6—8, pl. 13, fig. 1b.
 1954. *Pterotrigonia ogawai* (Yehara);



Text-fig. 13; Showing ornamentation of the area of *Ptilotrigonians*.

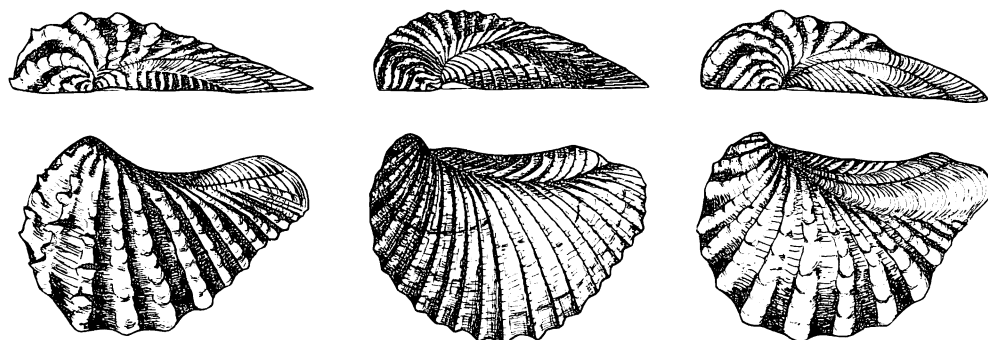
A: *Pterotrigonia* (*Ptilotrigonia*) *ogawai*, B: *P. (Ptil.) dilapsa*, C: *P. (Ptil.) amakusensis*,
D: *P. (Ptil.) mashikensis*, E: *P. (Ptil.) mifunensis*, F: *P. (Ptil.) mifunensis*, G: *P. (Ptil.)*
miyanoharensis, H: *P. (Ptil.) higoensis*.

- Kobayashi, *Ibid.*, vol. 25, nos. 1—2, p. 77.
1957. *Acanthotrigonia ogawai* (Yehara);
Kobayashi and Nakano, *Ibid.*, vol. 29, no.
4, p. 235, pl. 7, figs. 1—2.
1958. *Acanthotrigonia ogawai* (Yehara);
Kobayashi and Nakano, *Ibid.*, vol. 29, nos.
1—3, p. 150, pl. 11, fig. 4.
1975. *Pterotrigonia* (*Acanthotrigonia*) *ogawai*
(Yehara); Hayami, *Univ. Mus., Univ.*
Tokyo, Bull. 10, p. 119.

Material:—KSG 3246—KSG 3249, external
moulds of left and right valves, from Enokuchi,
Goshonoura Island; KSG 3250—KSG 3252,
external moulds of left valves, from Karakizaki,
Goshonoura Island; KSG 3253, external mould
of left valve, from Hegushi, Shishijima Island;

KSG 3244, right valve, and KSG 3245, external
mould of right valve, both from Katasoba,
Shishijima Island; KSG 3262, internal mould of
left valve, from Enokuchi.

Description:—Shell medium to small,
semicircular or roundly subtrigonal in outline, a
little longer than high, well inflated; umbo
prominent but not so large, weakly
opisthogyrous, located at about a fourth from
front of the valve; apical angle about 80°;
anterior margin well rounded, gradually
changing into well arched ventral margin;
siphonal margin obliquely truncated but not
angulated on its ventral region; dorsal margin
nearly straight or slightly concave, not
demarcated clearly from the upper region of

*Acanthotrignonia**Scabrotrignonia**Ptilotrignonia*

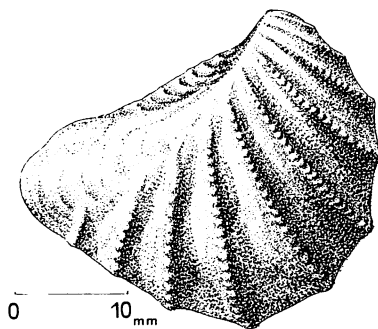
Text-fig. 14; Type species of *Acanthotrignonia*, *Scabrotrignonia* and *Ptilotrignonia*.

Acanthotrignonia shepstonei (Griesbach), (after Woods, 1908).

Scabrotrignonia scabra (Lamarck), (after, Cox, 1969).

Ptilotrignonia lauta van Hoepen, (after van Hoepen, 1929).

siphonal margin; disk semicircular with about 15 tuberculated costae which are narrower than their interspaces, strongly elevated and roof-shaped on the top; 6 or more costae on the umbonal region narrow, subconcentric; 5 or so costae on the middle part of the disk subdiagonal, elongated; 4 or more costae on the posterior part of the disk subvertical or somewhat radiated; area smooth except for umbonal costellae; the costellae oblique with about 8 in number, not tuberculated; escutcheon narrow, strongly depressed with about 15 or less tuberculated subhorizontal costellae; 8 or so costellae on the umbonal region connected with the costellae on the area; posterior carina angulated near the umbo but soon changing into a rounded and elevated ridge on the later stage; dorsal or escutcheonal carina indistinct, but observable as a line of bisecting chevrons which are composed of the costellae on the area and escutcheon; median groove of the area very weak, nearly effaced on some specimens; a smooth marginal sulcus between the costate disk and the smooth area extends narrowly from umbo to postero-ventral margin; growth lines on the surface very weak; inner surface smooth; inner ventral margin loosely crenulated.



Text-fig. 15; *Pterotrignonia* (*Ptilotrignonia*) *ogawai* (Yehara).

Remarks:—This is characterized by the finely tuberculated and sharply elevated costae on the disk for the subgenus *Ptilotrignonia*. *Pterotrignonia* (*Ptilotrignonia*) *dilapsa* (Yehara), is similar to this species in its rounded outline, but this species differs from *P. (P.) dilapsa*, in its tuberculated costae on the disk and more numerous costellae on the escutcheon.

Occurrence:—Sandstone of the IIb Member (by Matsumoto, 1938) of the Goshonoura

Group at Enokuchi, Goshonoura Island; Uppermost Albian. Sandstone of the Iie Member (by Matsumoto) of the Goshonoura Group at Karakizaki, Goshonoura Island; lower Lower Cenomanian. Sandstone of the Iie Member (by Yamamoto and Hayami, 1971) of the Goshonoura Group at about 400m west of Hegushi, Shishijima Island; lower Lower Cenomanian. Sandstone of the same member at Katasoba, Shishijima Island. This species was described from the Miyaji Formation at Nekotani of Miyaji, Yatsushiro-gun, Kumamoto Prefecture, by Kobayashi and Nakano (1958); Upper Albian. This species probably ranges from the Upper Albian to lower Lower Cenomanian.

Pterotrigonia (Ptilotrigonia) dilapsa (Yehara)

Plate 2, Figs. 1—7; Text-fig. 16

- 1923a. *Trigonia dilapsa* Yehara, *Jour. Geol. Soc. Tokyo*, vol. 30, no. 352, p. 2, pl. 4, figs. 1, 2, pl. 5, fig. a.
 1923b. *Trigonia dilapsa* Yehara; Yehara, *Japan Jour. Geol. Geogr.*, vol. 2, no. 3, p. 74, pl. 8, fig. 9, pl. 12, figs. 1—2, pl. 13, fig. 1a.
 1954. *Pterotrigonia dilapsa* (Yehara); Kobayashi, *Ibid.*, vol. 25, nos. 1—2, p. 76.
 1975. *Pterotrigonia (Acanthotrigonia) dilapsa* (Yehara); Hayami, *Univ. Mus., Univ. Tokyo, Bull.*, 10, p. 119.

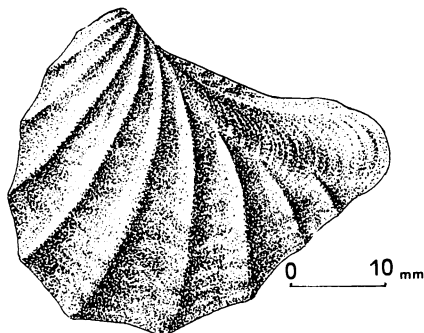
Material:—KSG 3254—KSG 3257, external

moulds of left valve, from Enokuchi, Goshonoura Island.

Description:—Shell medium in size, semicircular or roundly triangular in outline, slightly longer than high, moderately inflated; umbo opisthogyrous, prominent but small, located at about a fourth from front of the valve; apical angle about 80°; anterior margin well rounded gradually changing into broadly arched ventral margin; siphonal margin obliquely subtruncated, more or less elongated for the *Ptilotrigonia*; upper and lower sides of the siphonal margin not angulated; dorsal margin weakly concave; disk broad, semicircular in the shape, ornamented with about 13 low and smooth costae; a few costae near the umbo subconcentric; about 6 costae of the central part of the disk subdiagonal, broadly spaced, narrower than their interspaces; later 3 or 4 costae short, subradial; area broad for the genus, nearly smooth except for about 10 plain and oblique costellae near the umbo; escutcheon strongly depressed, narrowly lanceolated, ornamented with about 10 narrow, plain and horizontal costellae, each of which connected with a costella of the area; dorsal carina indistinct; posterior carina moderately concave, angulated near the umbo but soon changing into a roundly elevated ridge; median groove very weak; a smooth marginal sulcus narrowly alongs below the posterior carina.

Remarks:—This species is characterized by the smooth and broadly spaced costae on the

<i>Measurements</i> :— (in mm.)		<i>Pterotrigonia (Ptilotrigonia) ogawai</i> (Yehara)		
Specimen	Length	Height	Thickness	
KSG 3244, r. valve	28.7	22.3	9.8	
KSG 3245, r. ex. mould	30.8	22.5	9.5	
KSG 3246, l. ex. mould	32.8	24.3	8.6	
KSG 3247, r. ex. mould	28.8	22.8	7.5	
KSG 3248, l. ex. mould	25.8	19.9	6.1	
KSG 3249, r. ex. mould	24.5	17.0	6.3	
KSG 3250, l. ex. mould	21.3	13.9	7.9	
KSG 3251, l. ex. mould	24.4	19.9	9.5	
KSG 3252, l. ex. mould	31.8	23.6	9.2	
KSG 3253, l. ex. mould	26.0	20.2	8.0	



Text-fig. 16; *Pterotrigonia* (*Ptilotrigonia*) *dilapsa* (Yehara).

disk, and the escutcheonal costellae all of which are connected with the costellae of the area. This species is discriminated from *Pterotrigonia* (*Ptilotrigonia*) *mifunensis* (Tamura et Tashiro), in its less elongated outline and less numerous umbonal costae on the disk. This is also discriminated from *Pterotrigonia* (*Ptilotrigonia*) *mashikensis* (Tamura et Tashiro), in its distinct oblique costellae on the area and more sharply elevated costae on the disk.

Occurrence:—Sandstone of the IIb Member (by Matsumoto) of the Goshonoura Group at Enokuchi, Goshonoura Island; Uppermost Albian. Sandstone of the IIe Member (by Yamamoto and Hayami) of the Goshonoura Group at Katasoba, Shishijima Island; lower Lower Cenomanian.

Pterotrigonia (*Ptilotrigonia*)
mashikensis (Tamura et Tashiro)

Plate 2, Figs. 11—23; Text-fig. 17

1967. *Acanthotrigonia mashikensis* Tamura et Tashiro, *Mem. Fac. Educ. Kumamoto Univ.*, no. 15, nat. sci., p. 19, pl. 1, figs. 1—7, text-fig. 2.

1975. *Pterotrigonia* (*Acanthotrigonia*) *mashikensis* (Tamura et Tashiro); Hayami, *Univ. Mus., Univ. Tokyo, Bull.*, 10, p. 120.

1977. *Pterotrigonia* (*Acanthotrigonia*) *mashikensis* (Tamura et Tashiro); Tamura, *Mem. Fac. Educ. Kumamoto Univ.*, no. 26, nat. sci., p. 116, pl. 4, figs. 1—8.

1982. *Pterotrigonia* (*Acanthotrigonia*) *mashikensis* (Tamura et Tashiro); Tashiro and Kozai, *Palaeont. Soc. Japan, Sp. Pap.*, no. 25, p. 80, pl. 13, figs. 1—8.

1982. *Pterotrigonia* (?*Acanthotrigonia*) *mashikensis* (Tamura et Tashiro); Tashiro and Matsuda, *Trans. Proc. Palaeont. Soc. Japan, n. s.*, no. 127, p. 408, pl. 64, figs. 9, 10.

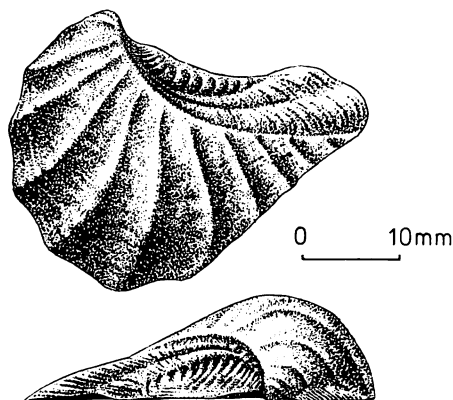
Material:—KSG 3268 and KSG 3288, external moulds of left valves, from Usui of Nagashima, Kagoshima Prefecture; KSG 3265, right valve and KSG 3266, external mould of left valve, from Magano of Matsubase, Kumamoto Prefecture; KSG 3267, internal mould of right valve, from Magano; KSG 3263 and KSG 3264, left and right valves, from Okadake of Matsubase; The other specimens are treated in Tashiro and Kozai (1982), Tashiro and Matsuda (1982), and Tamura and Tashiro (1967).

Remarks:—The specimens from Usui of Nagashima are undoubtedly conspecific with *Pterotrigonia* (*Ptilotrigonia*) *mashikensis* (Tamura et Tashiro), from the Mifune Group (Tamura and Tashiro, 1967; Tamura, 1977), in their characteristic features of the costae on the disk, well concaved posterior carina, smooth area, and semicircular outline.

Measurements:- (in mm.) *Pterotrigonia* (*Ptilotrigonia*) *dilapsa* (Yehara)

Specimen	Length	Height	Thickness
KSG 3254, l. ex. mould	46.3	30.6	11.6
KSG 3255, l. ex. mould	ca 24.1	ca 31.1	7.5
KSG 3256, l. ex. mould	34.4	26.2	9.0
KSG 3257, l. ex. mould	ca 26.8	27.0	10.0

from the Lower Cenomanian to Middle Cenomanian.



Text-fig. 17; *Pterotrigonia* (*Ptilotrigonia*) *mashikensis* (Tamura et Tashiro).

Occurrence:—Coarse grained sandstone of the “Goshonoura Group” at the southern seashore of Usui, Nagashima Island, Kagoshima Prefecture; ?Middle Cenomanian. Sandstone of the Lower Formation of the Mifune Group at Okadake and Magano (see, Tamura and Tashiro, 1967; Tamura, 1977), both in Matsubase, Shimo-mashiki-gun, Kumamoto Prefecture; Middle Cenomanian. This species was described from the lower and middle parts of the Nagase Formation and the upper member of the Fukigoshi Formation, both of Monobe Area, Shikoku (Tashiro and Kozai, 1982; Tashiro and Matsuda, 1982), Lower and Middle Cenomanian. Abundant localities of this species were treated from the Mifune Group and Mitake Formation, both in Central Kyushu, by Tamura and Tashiro (1967) and Tamura (1977). This species probably ranges

Pterotrigonia (*Ptilotrigonia*) *higoensis*

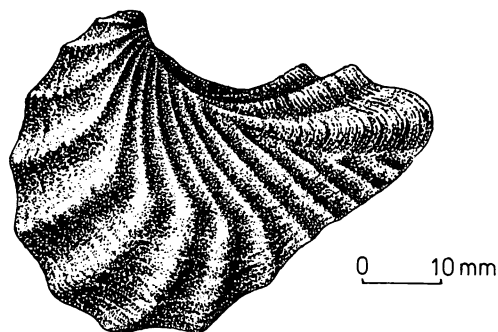
(Tamura et Tashiro)

Plate 5, Figs. 9—13; Text-fig. 18

1961. *Pterotrigonia* (*Rinetrigonia*) sp.; Nakano and Numano, *Trans. Proc. Palaeont. Soc. Japan*, n. s., no. 43, p. 96, pl. 13, fig. 3.
 1967. *Acanthotrigonia higoensis* Tamura et Tashiro, *Mem. Fac. Educ. Kumamoto Univ.*, no. 15, nat. sci., p. 17, pl. 1, figs. 1—7, text-fig. 2.
 1975. *Pterotrigonia* (*Acanthotrigonia*) *higoensis* (Tamura et Tashiro); Hayami, *Univ. Mus., Univ. Tokyo, Bull.*, 10, p. 120.
 1977. *Pterotrigonia* (*Acanthotrigonia*) *higoensis* (Tamura et Tashiro); Tamura, *Mem. Fac. Educ. Kumamoto Univ.*, no. 26, nat. sci., p. 116, pl. 4, figs. 9—12.
 1982. *Pterotrigonia* (*Acanthotrigonia*) cf. *higoensis* (Tamura et Tashiro); Tashiro and Kozai, *Palaeont. Soc. Japan, Sp. Pap.*, no. 25, p. 81, pl. 13, fig. 21.

Material:—KSG 3286 and KSG 3287, external moulds of left valves, from Usui of Nagashima, Kagoshima Prefecture. The specimens which are treated for comparison in this paper from the Nagase Formation in Monobe Area, Shikoku, and from the Mifune Group in Central Kyushu, had already been describe in detail by Tashiro and Kozai (1982), Tamura and Tashiro (1967) and Tamura (1977) (see, Plate 5, figs. 9—13)

Measurements:- (in mm.)	<i>Pterotrigonia</i> (<i>Ptilotrigonia</i>) <i>mashikensis</i> (Tamura et Tashiro)		
Specimen	Length	Height	Thickness
KSG 3263, l. valve	26.6	23.7	11.2
KSG 3264, r. valve	27.0	21.8	10.5
KSG 3265, r. valve	25.8	22.0	9.8
KSG 3266, l. ex. mould	33.0	22.8	9.0
KSG 3267, r. in. mould	32.3	19.8	—
KSG 3268, l. ex. mould	28.0	18.5	9.5
KSG 3288, l. ex. mould	ca 22.5	20.3	9.8



Text-fig. 18; *Pterotrigonia (Ptilotrigonia) higoensis* (Tamura et Tashiro)

Remarks:—Many specimens in our hand are ill preserved for weathering. Although the specimens (KSG 3286 and KSG 3287) from Usui of Nagashima, are imperfect materials, they are safely conspecific with the holotype of *Pterotrigonia (Ptilotrigonia) higoensis* (Tamura et Tashiro) from the Mifune Group of Central Kyushu (Tamura and Tashiro, 1967), because of their big costae on the anterior half of the disk, strongly waved growth line on the area, semi-circular outline of the disk and large apical angle with about 80°

Occurrence:—Coarse grained sandstone of the “Goshonoura Group” at the southern seashore of Usui, Nagashima Island, Kagoshima Prefecture; ?Middle Cenomanian. This species was reported from the middle part of the Nagase Formation of the Monobe Area, Shikoku, by Tashiro and Kozai (1982); Middle Cenomanian. The holotype of this species was described from the Lower Formation of the Mifune Group, at Magano of Matsubase, Shimo-mashiki-gun, Kumamoto Prefecture, by Tamura and Tashiro (1967); Middle Cenomanian. In so far as we knew this species is probably restricted with in the Middle Cenomanian.

Pterotrigonia (Ptilotrigonia) brevicula (Yehara)

Plate 2, Figs. 8—10; Plate 12, Figs. 7—9

1915. *Trigonia brevicula* Yehara, *Sci. Rep. Tohoku Imp. Univ.*, ser. 2, vol. 2, no. 2, p. 42, pl. 2, figs. 18, 19
1954. *Pterotrigonia brevicula* (Yehara); Kobayashi, *Japan Jour. Geol. Geogr.* vol. 25, nos. 1—2, p. 76.
1961. *Pterotrigonia brevicula* (Yehara); Nakano and Numano, *Trans. Proc. Palaeont. Soc. Japan*, n. s., no. 34, p. 91, pl. 13, figs. 4—8.
1975. *Pterotrigonia (Pterotrigonia) brevicula* (Yehara); Hayami, *Univ. Mus., Univ. Tokyo, Bull.*, 10, p. 118.
1981. *Pterotrigonia (Pterotrigonia) brevicula* (Yehara); Hayami in Hayami and Kase, *Trans. Proc. Palaeont. Soc. Japan*, n. s., no. 121, p. 34—36, pl. 4, figs. 8—14.

Material:—(MC 18—7926), external mould of left valve, from the dam site of Nagase, Kagami-machi, Monobe Area. The specimen kept in the Fossil Museum of Hirata's collections, Godaisan of Kochi City; KSG 3258, external mould of right valve, from Kashiwaguri of Shishijima Island; KSG 3334—KSG 3335, external mould of left valves, from Kushizaki of Shishijima Island; KSG 3323, external mould of left valve, from Ikarajima islet, Kagoshima.

Remarks:—This is undoubtedly referable to *Pterotrigonia (Ptilotrigonia) brevicula* (Yehara), from the Mikasa Sandstone of Hokkaido (Yehara, 1915; Nakano and Numano, 1961), judging from its low, round-topped and widely spaced costae on the disk and rounded outline of the valve. The lectotype (IGPS 4329; Yehara's specimen) of this species is smaller than this specimen from the Nagase Formation. The lectotype is probably an immature valve, as already mentioned by Nakano and Numano (1961).

<i>Measurements:</i> - (in mm.)		<i>Pterotrigonia (Ptilotrigonia) higoensis</i> (Tamura et Tashiro)		
Specimen		Length	Height	Thickness
KSG 3286, l. ex. mould		ca 28.4	ca 25.4	10.0
KSG 3287, l. ex. mould		ca 30.5	ca 26.6	—

Occurrence:—Coarse grained sandstone of the basal part of the Nagase Formation at the Northern bank of the Nagase Dam site, Nagase, Kahoku-cho, Monobe Area; Lower Cenomanian. Sandstone of the upper part of the Goshonoura Group at Kashiwaguri and Kushizaki, Shishijima Island, Kagoshima Prefecture. Coarse grained sandstone of the “Goshonoura Group” at the eastern seashore of Ikarajima islet, Kagoshima Prefecture.

Pterotrigonia (Ptilotrigonia)

amakusensis, sp. nov.

Plate 5, Figs. 4—8; Text-fig. 19

?1923. *Trigonia yokoyamai* var. Yehara; *Jour. Geol. Soc. Tokyo*, vol. 30, p. 7, pl. 6, fig. 8.

?1923. *Trigonia sakakurai* var. Yehara; *Japan Jour. Geol. Geogr.* vol. 2, no. 3, p. 77, pl. 12, fig. 9.

?1961. *Pterotrigonia (Rinetrigonia) yeharai* Nakano et Numano; *Trans. Proc. Palaeont. Soc. Japan, n. s.*, no. 43, p. 95, pl. 13, fig. 1 (non. figs. 2a and 2b).

Material:—KSG 3259 (paratype), external and internal moulds of a left valve, from Enokuchi, Goshonoura Island, Kumamoto Prefecture; KSG 3261 (holotype), external mould of right valve, from Karakizaki, Goshonoura Island; KSG 3260 (paratype), external mould of right valve, from Miyano-hara, Sakawa Area, Kochi Prefecture.

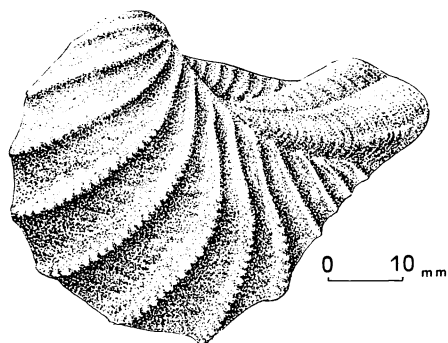
Description:—Shell large for the *Ptilotrigonia* but medium for the *Pterotrigonia* (s. l.) in size, pyriform or semicircular in outline, longer than high, well inflated; umbo large, prominent, opisthogyrate, strongly

incaved, located at about one fourth from front of the valve; anterior margin well rounded in semicircular; ventral margin long, weakly arched on anterior but moderately concaved on posterior; siphonal margin narrowly rounded, strongly expanded to posterior; dorsal margin short, moderately concave; disk broad semicircular in outline, ornamented with tuberculated costae; 4 or more costae near the umbo subconcentric; next 6 or 7 costae strong, weakly concave, subdiagonally situated, occupied on the main part of the disk; later 5 or so costae short, narrow, closely spaced but narrower than their interspaces, subradially situated; a smooth marginal band extends from the umbo to postero-ventral part of the disk; area narrow but elongated, well concave, nearly smooth except for several oblique costellae nearest umbo; median groove of the area shallow but distinct, be partial to the dorsal side; escutcheon narrow, lanceolated with several subvertical costellae; posterior carina distinct near the umbo but soon changing into rounded ridge on the later stage; dorsal carina nearly invisible except for the umbonal resion; apical angle is about 70°.

Observation:—This species is very rare in the occurrence in each locality. The costae on the disk number about 17, are roof shaped on the top. The area is nearly smooth except for very fine growth lines. The oblique costellae nearest umbo of the area are distinct but occupy about 3 mm from the umbo in the distance.

Comparison:—A specimen (JM 10163) (coll. by Yehara, 1923), is probably identical with this new species, *Pterotrigonia (Ptilotrigonia) amakusensis* Tashiro et Matsuda, in same features of costae on the disk and outline of the valve. Although Nakano and Numano (1961) had been selected the Yehara's

Measurements:- (in mm.)		<i>Pterotrigonia (Ptilotrigonia) brevicula</i> (Yehara)		
Specimen	Length	Height	Thickness	
KSG 3334, l. ex. mould	34.0	28.0	8.0	
KSG 3258, r. ex. mould	23.7	19.1	6.3	
KSG 3323, l. ex. mould	26.8	18.9	9.6	
MC 18-7926, l. ex. mould	ca 30.0	35.0	10.0	



Text-fig. 19; *Pterotrigonia* (*Ptilotrigonia*) *amakusensis* sp. nov.

specimen as a paratype of *Pterotrigonia* (*Rinetrigonia*) *yeharai* Nakano et Numano (1961), the Yehara's specimen differs from *P. (R.) yeharai* (= *Pterotrigonia* (? *Scabrotrigonia*) *yeharai* Nakano et Numano), in its larger umbo, narrower but more strongly concaved area, and less numerous costae on the disk than those of the latter.

This species resembles *Pterotrigonia* (*Ptilotrigonia*) *higoensis* (Tamura et Tashiro), from the Mifune Group in Central Kyushu (Tamura and Tashiro, 1972; Tamura, 1977), in its features of the disk and costae on the disk, but differs in its not tripartited area and somewhat weaker and roof-shaped costae. This species is akin to *Pteotrigonia* (*Ptilotrigonia*) *tamurai* Tashiro et Matsuda, sp. nov., from the Goshonoura Group of Shishijima and Usui, Kagoshima Prefecture, in the rounded outline and less numerous and tuberculated costae on the disk, but differs clearly in its costellated escutcheon. *Pterotrigonia* (*Ptilotrigonia*) *brevicula* (Yehara) from the Lower Cenomanian of Hokkaido and N-E Japan (Yehara, 1923; Nakano and Numano, 1961; Hayami and Kase,

1981), is discriminated from this species in having its round-topped costae on the disk and sharply expanded siphonal area.

Occurrence:—Sandstone of the IIb Member (by Matsumoto, 1938) of the Goshonoura Group at northern seashore of Enokuchi, Goshonoura Island, Amakusa Area, Kumamoto Prefecture; Uppermost Albian. Sandstone of the IIe Member (by Matsumoto) of the same Group at western seashore of Karakizaki, Goshonoura Island; lower Lower Cenomanian. Sandstone of the upper member of the Miyano-hara Formation at the roadside exposure of Miyano-hara, Sakawa Area, Kochi Prefecture; upper Lower Cenomanian. This species ranges probably from the Uppermost Albian to the Lower Cenomanian.

Pterotrigonia (*Ptilotrigonia*) *mifunensis*
(Tamura et Tashiro)

Plate 1, Figs. 14–26;

Plate 3, Figs. 1–27;

Text-fig. 20

1894. *Trigonia longilova* Jimbo, *Pläont. Abhandl., N.F.*, vol. 2, no. 3, p. 38, pl. 8, fig. 3 (non. figs. 2 and 4).
1915. *Trigonia longilova* Jimbo; Yehara, *Sci. Rep. Tohoku Imp. Univ., ser. 2*, vol. 2, no. 2, p. 40, pl. 2, figs. 10–12.
1923. *Trigonia longilova* Jimbo; Yehara, *Japan Jour. Geol. Geogr.*, vol. 2, no. 3, p. 73, pl. 8, figs. 5–8.
1954. *Pterotrigonia longilova* (Jimbo); Kobayashi, *Ibid.*, vol. 25, nos. 1–2, p. 77.
1957. *Pterotrigonia* (*Acanthotrigonia*) *longilova* (Jimbo); Kobayashi and Nakano, *Ibid.*, vol. 28, no. 4, p. 234, pl. 17, figs. 2–6.
1967. *Acanthotrigonia mifunensis* Tamura et Tashiro; *Mem. Fac. Educ. Kumamoto*

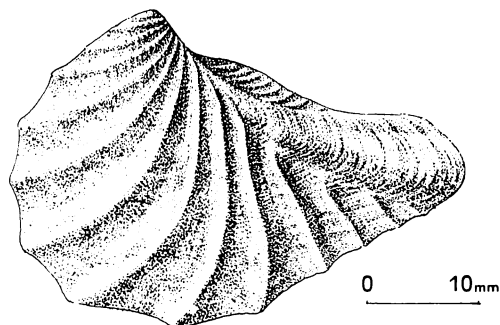
Measurements:- (in mm.)		<i>Pterotrigonia</i> (<i>Ptilotrigonia</i>) <i>amakusensis</i> sp. nov.		
Specimen		Length	Height	Thickness
KSG 3259, l. ex. mould		53.2	43.6	18.8
KSG 3260, r. ex. mould		43.0	26.5	11.6
KSG 3261, r. ex. mould		52.9	32.8	18.0

Univ., no. 15, nat. sci., p. 20, pl. 1, figs. 8—13, text-fig. 2.

1975. *Pterotrigonia (Acanthotrigonia) mifunensis* (Tamura et Tashiro); Hayami, *Univ. Mus., Univ. Tokyo, Bull.* 10, p. 120.
1977. *Pterotrigonia (Acanthotrigonia) mashikensis* (Tamura et Tashiro); Tamura, *Mem. Fac. Educ. Kumamoto Univ.*, no. 26, nat. sci., p. 116.
1981. *Pterotrigonia (Acanthotrigonia)* aff. *dilapsa* (Yehara); Matsushima and Kitamura, *Mem. Com. Educ. Shimoina, nat. sci.*, vol. 4, p. 102, pl. 1, figs. 1—14 (in Japanese).
- ?1981. *Pterotrigonia (Acanthotrigonia)* sp., Hayami in Hayami and Kase, *Trans. Proc. Palaeont. Soc. Japan, n. s.*, no. 121, p. 37, pl. 4, figs. 16a—16b.

Material:—KSG 3269—KSG 3278, external moulds of left and right valves, from Miyanohara, Sakawa Area, Shikoku. KSG 3279—KSG 3283, external moulds of left and right

valves, from Hegushi of Shishijima, Kagoshima Prefecture, Kyushu. KSG 3284—KSG 3285, external mould of left valves, from Kashiwaguri of Shishijima. KSG 3319, external mould of right valve, from Yunokuchi of Shishijima. IGPS 4143, 4352 and 4353 (stored in Tohoku Univ.), from Horonai and Ikushunbetsu, in



Text-fig. 20; *Pterotrigonia (Ptilotrigonia) mifunensis* (Tamura et Tashiro).

<i>Measurements:</i> — (in mm.)		<i>Pterotrigonia (Ptilotrigonia) mifunensis</i> (Tamura et Tashiro)		
Specimen	Length	Height	Thickness	
KSG 3269, l. ex. mould	34.8	21.5	10.5	
KSG 3270, l. ex. mould	28.2	19.8	8.0	
KSG 3271, l. ex. mould	28.3	25.4	7.8	
KSG 3272, l. ex. mould	30.9	23.1	7.2	
KSG 3273, r. ex. mould	24.8	20.2	5.4	
KSG 3274, r. ex. mould	25.6	16.8	4.8	
KSG 3275, l. ex. mould	24.3	16.4	6.8	
KSG 3276, l. ex. mould	24.8	18.4	6.0	
KSG 3279, l. ex. mould	26.7	17.3	6.9	
KSG 3280, l. ex. mould	24.8	16.5	8.0	
KSG 3278, r. ex. mould	16.0	13.5	7.8	
KSG 3277, l. ex. mould	16.0	12.9	5.0	
KSG 3281, l. ex. mould	26.0	18.3	8.5	
KSG 3282, l. ex. mould	29.8	19.0	8.5	
KSG 3283, r. ex. mould	26.5	21.0	6.0	
KSG 3284, l. ex. mould	25.8	20.3	6.5	
KSG 3285, l. ex. mould	25.0	18.5	8.5	
KSG 3319, r. ex. mould	27.4	17.1	7.2	

Hokkaido, and KE 1719—1724 (stored in Kumamoto Univ.), from Itoishi, Shimomashiki, Kumamoto, are observed for this study. Abundant specimens are internal and external moulds, from Misakubo of Akaishi Area, Central Japan, collected by Matsushima and Kitamura, are also observed.

Description:- Shell small, elongatedly sub-trigonal or pyriform, moderately inflated, longer than high; umbo small opisthogyrus, weakly prominent, located at about a fourth from front of the valve; anterior margin semi-circular in the shape; ventral margin nearly straight or weakly concave; siphonal margin narrow, well rounded, expanded to posterior; dorsal margin elongated, moderately concave, apical angle about 80°; disk crescent in the shape, ornamented with about 16 costae; 5 or more costae near the umbo subconcentric, finely tuberculated, closely spaced; next about 7 costae on the central part of the disk strong, subdiagonal, weakly concave, indistinctly tuberculated; later 5 or more costae on the posterior half of the disk subradial, nearly smooth; area smooth except for several oblique costellae near the umbo; escutcheon strongly depressed, elongately lanceolated with numerous plain subhorizontal costellae; the costellae start from the dorsal carina to dorsal margin, but generally not reach the dorsal margin; the costellae on the upper half of the escutcheon connected with the costellae of the area; dorsal carina not angulated, slightly visible as a boundary line between costellae escutcheon and smooth area; posterior carina moderately concave, angulated near the umbo but soon changing into roundly elevated ridge on the later stage; a smooth narrow marginal sulcus extends along the boundary between the costate disk and smooth area; median groove of the area distinct but very shallow, somewhat be partial to the dorsal carinal side more than posterior carinal side; growth lines on the surface generally weak.

Observation:- Abundant specimens are collected from many localities of Kyushu and Shikoku for this study. The costellae on the area are somewhat variable in number on each locality. The holotype of this species (KE 1719; Tamura and Tashiro, 1967, pl. 1, fig 8), which was originally designated by Tamura and

Tashiro (1967), has about 5 fine oblique costellae on the umbonal part of the area. The costellae are about 9 in the specimens from the Misakubo Formation of the Akaishi Area, about 7 in the specimens from the Goshonoura Group of Hegushi of Shishijima, and about 8 or more in those from the Miyanohara Formation of the Sakawa Area. The specimens (IGPS 4352—4354 and IGPS 4143) which were included in *Trigonia longilova* Jimbo by Yehara (1915), are undoubtedly conspecific with this species, judging from its same features with this species. The Yehara's specimens are characterized about 8 costellae on the umbonal area, like as the specimens from the Miyanohara Formation. This species is also variable in its outline through the growth. Generally the outline is trigonal ovate or semicircular in the younger stage. Since the siphonal margin is gradually expanded to posterior in the mature stage, the outline is changing from subtrigonal or semicircular into longish ovate or elongated pyriform. A specimen (NSM-PM 15087), which was described as *Pterotrigonia (Acanthotrigonia)* sp. by Hayami in Hayami and Kase (1981), from N-E Japan, is closely similar to the younger stage of this species. Hayami's specimen is probably identical with this species in having its nearly same feature with this younger stage.

Comparison:- Although this species was ranked beside *Pterotrigonia (Ptilotrigonia) mashikensis* (Tamura et Tashiro), as a synonym by Tamura (1977) and Hayami (1975), this species is discriminated from *P. (Ptil.) mashikensis* as a distinct species in its numerous and tuberculated costae on the disk, distinct oblique costellae on the umbonal area and elongated outline. The specimens from the Miyanohara Formation, were classified with *Trigonia longilova* Jimbo by Yehara (1915, 1923) and Kobayashi and Nakano (1957). The specimens of the Miyanohara are, however, undoubtedly conspecific with *Pterotrigonia (Ptilotrigonia) mifunensis* (Tamura et Tashiro), and are discriminated from *T. longilova* in its larger apical angle, less numerous costae on the disk and wider area than those of *T. longilova*. The specimens which were described as the member of *T. longilova* by Yehara (1915, 1923), from Hokkaido, are also conspecific with *P. (Ptil.) mifunensis*, as already mentioned. Many

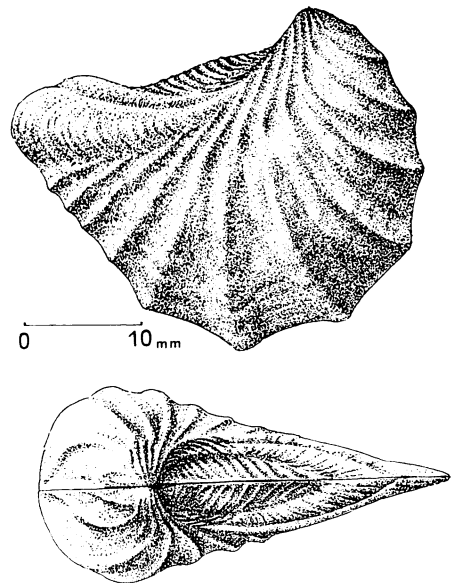
specimens which were described as *Pterotrigonia* (*Acanthotrigonia*) aff. *dilapsa* (Yehara), by Matsushima and Kitamura (1981), from the Misakubo Formation of the Akaishi Montaines, are also undoubtedly conspecific with *P. (Ptil.) mifunensis*, in their same features with *P. (Ptil.) mifunensis*. This species is discriminated from *Pterotrigonia* (*Ptilotrigonia*) *dilapsa* (Yehara), in its numerous and tuberculated costae on the disk near the umbo, numerous costellae some of which are not connected with the costellae of the area on the escutcheon, somewhat numerous costae on the posterior half of the disk, and elongated outline. The younger stage of this species is very akin to *Pterotrigonia* (*Ptilotrigonia*) *ogawai* (Yehara), in its semicircular or sub-trigonal outline, tuberculated costae on the disk, and the same features of the escutcheon and area. It seems that this species is probably one of the derivatives from *P. (Ptil.) ogawai*.

Occurrence:- Sandstone of the upper member of the Miyanohara Formation at Miyanohara, Sakawa-machi, Kochi Prefecture; Lower Cenomanian. Sandstone of the Ile (?) Member (by Yamamoto and Hayami, 1971) of the Goshonoura Group at Hegushi, Shishijima Island, Kagoshima Prefecture. Sandstone of the Iib (?) Member (by Yamamoto and Hayami) of the same group at Kashiwaguri, Shishijima. The holotype of this species was collected from the gray siltstone of the Lower Formation of the Mifune Group at Itoishi, Shimomashiki-gun, Kumamoto Prefecture; Middle Cenomanian (Tamura and Tashiro, 1967). Sandstone of the Goshonoura Group at Yunokuchi of Shishijima Island (probably Ib Member by Yamamoto and Hayami).

***Pterotrigonia* (*Ptilotrigonia*)
miyanoharensis, sp. nov.**

Plate 4, Figs. 6—13; Text-fig. 21

Material:- Holotype, KSG 3289, external mould of right valve; paratypes, KSG 3291 and KSG 3294, external moulds of left and right valves; another paratype, KSG 3290, internal and external moulds of left valve; all the specimens collected from Miyanohara, Sakawa, Shikoku.



Text-fig. 21; *Pterotrigonia* (*Ptilotrigonia*)
miyanoharensis sp. nov.

Measurements:- (in mm.)	<i>Pterotrigonia</i> (<i>Ptilotrigonia</i>) <i>miyanoharensis</i> sp. nov.		
Specimen	Length	Height	Thickness
KSG 3289, r. ex. mould	ca 25.0	22.3	8.4
KSG 3290, l. ex. mould	40.0	33.6	10.6
KSG 3291, r. ex. mould	24.3	20.2	7.5
KSG 3292, r. in. mould	29.9	18.5	8.9
KSG 3293, r. ex. mould	ca 21.4	17.4	8.4
KSG 3294, l. ex. mould	31.0	23.2	8.8

Description:- Shell medium to small, roundly subtrigonal or semicircular in outline, slightly longer than high, moderately inflated; umbo weakly opisthogyrous, slightly prominent, located at about a fourth from front of the valve; anterior margin semicircular, ventral margin short, weakly convex; siphonal margin narrow, well rounded; dorsal margin weakly concave; apical angle about 80°; disk broad, ornamented with two series of costae; the costae of the posterior series subradial, very fine, narrow, closely spaced; the costae of the anterior series subdiagonal, round-topped, low, narrower than their interspaces, broadly spaced with about 11 in number; each costa of the posterior series generally connected with one of the anterior series, and forms L-shape trend together with that of the anterior series; area smooth except for fine and numerous oblique striae or costellae near the umbo; escutcheon depressed with fine horizontal costellae, each of which connected with a costella on the area; posterior carina somewhat angulated near the umbo but soon changing into rounded ridge on the later stage; dorsal carina nearly indistinct; a smooth marginal sulcus narrowly alongs below the posterior carinal ridge; median groove on the area very shallow.

Observation:- In the several specimen, e.g., KSG 3289, the costae are more numerous in the posterior series than in the anterior ones of the disk. The costellae on the area are variable in number but nearly equal in number with the costellae on the escutcheon.

Comparison:- This species differs from the other species of *Ptilotrigonia* from Japan, in its L-trend sculptures on the disk. Although the species belonging to the Apiotrigoniinae Tashiro (1979), are characterized by the L-trend costae on the disk, the costae on the anterior series of apiotrigonians are concentric or subhorizontal. *Vaugonia* Cricmay (1932), is also characterized by the L-trend costae. The species of *Vaugonia* clearly differs from this species, in its costate and straight posterior carina.

Occurrence:- Coarse grained sandstone of the upper member of the Miyanohara Formation at Miyanohara, Sakawa-machi, Takaoka-gun, Kochi Prefecture; Lower Cenomanian.

***Pterotrigonia (Ptilotrigonia) usuiensis*, sp. nov.**

Plate 4, Figs. 1—5;

Plate 13, Figs. 4—7;

Text-fig. 22

Material:- Holotype, KSG 3295, external mould of right valve; paratypes, KSG 3296 and KSG 3297, external moulds of left valves. The specimens were collected from Usui of Nagashima, Kagoshima Prefecture. Paratypes, KSG 3355 and KSG 3356, external moulds of right and left valves, from South of Hegushi, Shishijima Island, Kagoshima Pref.

Description:- Shell medium to large, pyriform, longer than high, moderately inflated; umbo slightly opisthogyrous, weakly prominent, located at about a fourth from front of the valve; apical angle about 75°; anterior margin well rounded, semicircular in the shape; ventral margin nearly straight or slightly concave; siphonal margin narrowly rounded, expanded to posterior; dorsal margin moderately concave; disk broad with low and widely spaced costae; 3 or so costae near the umbo short, subhorizontal; about 5 costae on main part of the disk elongated, subdiagonal; later 3 or more costae on the posterior part of the disk short, narrow, subradiated; area narrow, smooth except for several oblique costellae nearest umbo; escutcheon depressed, narrowly lanceolated, nearly smooth only fine growth lines; median groove very fine; posterior carina concave, distinctly angulated near the umbo but soon changing into rounded ridge on the later stage; dorsal carina indistinct; a smooth marginal sulcus alongs below the carinal ridge, located between costate disk and smooth area.

Observation:- The costae on the disk are irregularly tuberculated and narrowly angulated on the top, and number 11 or 12 in the adult specimen. The oblique costellae on the area near the umbo number 4 in the specimen, KSG 3296, and 3 in the holotype. The dorsal area which is situated at the upper side of the median groove, is narrower than the posterior carinal area in about a half breadth. This species is characterized by the smooth escutcheon, less numerous, weak but distinct costae on the disk, and its well concaved posterior carina.

Comparison:- This species is closely similar to the specimens of *Trigonia brevicula* by Yehara (1915), in its smooth escutcheon and rounded outline of the valve, but differs in this less inflated valve. This also resembles *Pterotrigonia (Pterotrigonia) brevicula* (Yehara) by Nakano and Numano (1961: lectotype), and Hayami (1981 in Hayami and Kase), in its concaved dorsal margin, rounded outline of the valve and less numerous costae on the disk for ptilotrigonians. This species is, however, characterized by less inflated valve, smooth escutcheon and more irregularly tuberculated

and less carved costae on the disk in comparison with those of *P. (P.) brevicula*. It seems that this species is possibly conspecific or subspecific with *Trigonia brevicula* Yehara by Yehara's original specimens, but clearly differs specifically from *Pterotrigonia (Pterotrigonia) brevicula* (Yehara) by Nakano and Numano's lectotype and Hayami's syntypes.

Pterotrigonia (Ptilotrigonia) mashikensis (Tamura et Tashiro), is akin to this species in the rounded outline and number of costae on the disk, but is discriminated in its loosely spaced costellae on the area and distinct fine numerous striae on the lunular area.

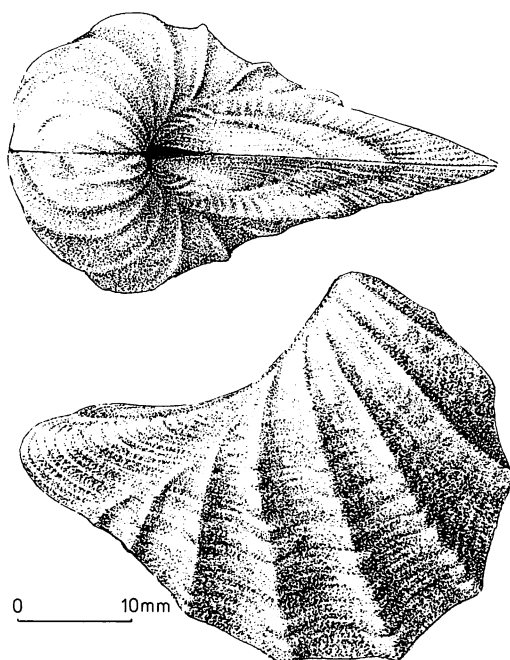
Occurrence:- Coarse grained sandstone of the "Goshonoura Group" at the southern seashore of Usui, Nagashima Island, Kagoshima Prefecture; ?Middle Cenomanian. Coarse grained sandstone of the Same Group at about 300m east of Hegushi, Shishijima Island, Kagoshima Pref.; ?Lower Cenomanian.

***Pterotrigonia (Ptilotrigonia) tamurai*, sp. nov.**

Plate 4, Figs. 14—17; Plate 5, Figs. 1—3; Plate 13, Figs. 1—3, Text-fig. 23

Material:- Holotype, KSG 3315, right external mould, from Yunokuchi of Shishijima, Kagoshima Prefecture; paratypes, KSG 3353—KSG 3354, external moulds of right valve, from east of Hegushi, Shishijima Island; Paratypes, KSG 3317, left external mould, from the same locality of the holotype; another paratype, KSG 3298, external mould of right valve, from Usui of Nagashima, Kagoshima Prefecture.

Description:- Shell large to medium, pyriform, narrowly expanded to posterior; longer than high; well inflated; umbo



Text-fig. 22; *Pterotrigonia (Ptilotrigonia) usuiensis* sp. nov.

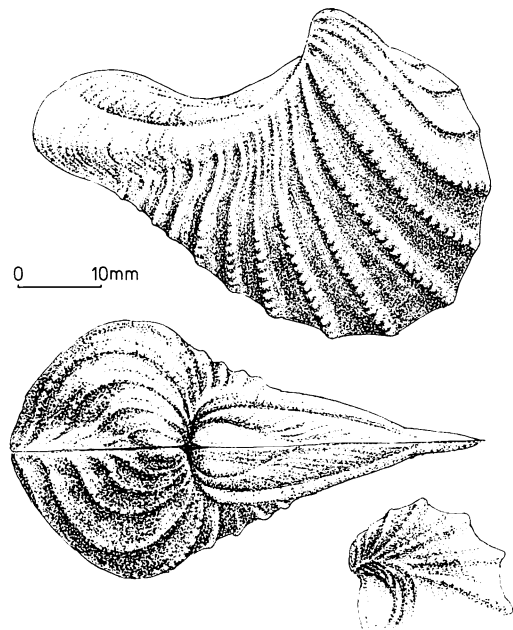
Measurements:- (in mm.)	<i>Pterotrigonia (Ptilotrigonia) usuiensis</i> sp. nov.		
Specimen	Length	Height	Thickness
KSG 3356, l. ex. mould	40.0	32.5	12.5
KSG 3295, r. ex. mould	51.0	37.2	17.0
KSG 3296, l. ex. mould	44.4	32.0	—
KSG 3297, l. ex. mould	42.2	—	11.3
KSG 3355, r. ex. mould	41.5	32.5	11.0

prominent but not so large, strongly incaved, weakly opisthogyrous, located at about a fifth from front of the valve; anterior margin well rounded; ventral margin moderately arched on the anterior half but nearly straight or slightly concave on the posterior half; siphonal margin narrowly rounded, expanded strongly to posterior; posterior margin broadly concave, as long as the ventral margin; disk broad, crescentic in the shape, ornamented with about 18 tuberculated costae; 5 or so costae near the umbo subconcentric, weak and low; next 7 or more costae strong, subdiagonal, broadly spaced, occupy the anterior half of the disk except for umbonal region; later 6 or more costae short, subradial, narrow but prominent; area very narrow but elongated, nearly smooth except for 5 or more oblique costellae nearest umbo; escutcheon strongly depressed, narrowly lanceolated, smooth except for fine growth lines; posterior carina well concave, distinctly angulated near the umbo but soon changing into rounded ridge on the later; marginal carina observable as an weak angulated ridge between the flated escutcheon and weakly inflated area; median groove very weak, partialled to marginal carinal side more than posterior carinal side; apical angle about 80° ; a smooth marginal sulcus broad, alongs under the posterior carina.

Observation:- This species is characterized by the smooth escutcheon widely spaced and finely tuberculated costae on the disk and elongately expanded siphonal margin. The lunular-like area indistinctly separated from the disk, bounded by a weak sulcus.

Comparison:- This species is nearly identified with *Pterotrigonia* (*Ptilotrigonia*) *amakusensis* Tashiro et Matsuda, except for its smooth escutcheon, indistinctly separated

lunular area and somewhat large valve. This species is probably concerned with *P. (Ptil.) amakusensis* regarding with the relationship as the same lineage. This species is similar to *Pterotrigonia* (*Ptilotrigonia*) *usuiensis* Tashiro et Matsuda, in the smooth escutcheon and elongately expanded siphonal margin, but differs in its finely tuberculated and numerous costae on the disk. Although *Pterotrigonia* (*Ptilotrigonia*) *brevicula* (Yehara) (Yehara, 1915, 1923; Nakano and Numano, 1961; Hayami and Kase, 1981), are very similar to this species in the outline and features of the costae, this species is discriminated from *P. (Ptil.) brevicula*, in its smooth and remarkable narrow area. *Pterotrigonia* (*Ptilotrigonia*) *higoensis*



Text-fig. 23: *Pterotrigonia* (*Ptilotrigonia*) *tamurai* sp. nov.

Measurements:- (in mm.)	<i>Pterotrigonia</i> (<i>Ptilotrigonia</i>) <i>tamurai</i> sp. nov.		
Specimen	Length	Height	Thickness
KSG 3353, r. ex. mould	67.5	44.5	27.0
KSG 3298, r. ex. mould	56.0	52.8	—
KSG 3315, r. ex. mould	55.0	39.5	14.8
KSG 3317, l. ex. mould	ca 40.0	ca 35.0	—
KSG 3354, r. ex. mould	62.0	44.0	27.0

(Tamura et Tashiro), is also akin to this species in its rounded outline, features of costae and large umbo, but is discriminated in its tripartited area.

Occurrence:- Coarse grained sandstone of the "Goshonoura Group" at the eastern seashore of Usui, Nagashima Island, Kagoshima Prefecture; ?Middle Cenomanian. Coarse grained sandstone of the Goshonoura Group (I Member by Amano, 1957 and Yamamoto and Hayami, 1971), at Yunokuchi, and 300m east of Hegushi, Shishijima Island, Kagoshima Prefecture; upper Lower Cenomanian. In our opinion, the I Member of the Goshonoura Group in the Shishijima Island, is probably the upper-most part of the Cretaceous System in the island, and is considerable to the upper part of the Lower Cenomanian because of the evidence through this trigonian study.

(to be continued)

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Akaishi	赤石	Kami-gun	香美郡	Odochi	大柵
Amakusa	天草	Kamo	加茂	Oita	大分
Arida	有田	Karakizaki	唐木崎	Okadake	岡岳
Birafu	美良布	Kasanokawa	笹ノ川	Onogawa	大野川
Bunjyo	文城	Kashiwaguri	柏栗	Osaka	小坂
Chinomigawa	乳呑川	Katasoba	片側	Oshima	大島
Choshi	銚子	Katsurazawa	桂沢	Ponhorokabetsu	ポンホロカベツ
Doganaro	堂ヶ奈路	Katsuuragawa	勝浦川	Ryoseki	領石
Doiban	土居番	Kishu	紀州	Ryozen	霊山
Enokuchi	江ノ口	Kochi	高知	Sakawa	佐川
Ezo	エゾ	Kohama	小浜	Samani	様似
Fukigoshi	吹越	Koshigoe	腰越	Sanchu	山中
Fukui	福井	Kuji	久慈	Shimantogawa	四万十川
Godaisan	五台山	Kumamoto	熊本	Shimomashiki-gun	下益城郡
Goshonoura	御所浦	Kurohara	黒原	Shingai	新改
Gumizaki	グミ崎	Magano	曲野	Shirahama	白浜
Hachiryuzan	八竜山	Mama	万々	Shishijima	獅子島
Hagino	萩野	Mashiki	益城	Sorachi	空知
Haidateyama	佩楯山	Matsubase	松橋	Suita	杉田
Hegushi	幣串	Mifune	御船	Sukubo	須久保
Hibiwara	日比原	Mikasa	三笠	Susaki	須崎
Hinagu	日奈久	Misaki	三崎	Takaoka-gun	高岡郡
Hoji	傍示	Misakubo	水窪	Tamarimizu	溜水
Hongo	本郷	Mitake	見獄	Todai	戸台
Horonai	幌内	Miyaji	宮地	Todoronotaki	轟ノ滝
Horonobetsu	保留運別	Miyako	宮古	Tosayamada	土佐山田
Ikarajima	伊唐島	Miyanohara	宮ノ原	Ujidani	宇治谷
Ikushunbetsu	幾春別	Mizutani	水谷	Urakawa	浦河
Ishido	石堂	Monobe	物部	Usui	薄井
Itoishi	糸石	Nagase	永瀬	Yatsushiro	八代
Kahoku-cho	香北町	Nagashima	長島	Yotsujiro	四ツ白
Kagoshima	鹿児島	Nigyū	二及	Yuasa	湯浅
Kaisekiyama	介石山	Ochi	越知	Yubari	夕張
Kajisako	楮佐古	Ochiai	落合	Yunokuchi	湯ノ口

Plates 1-13

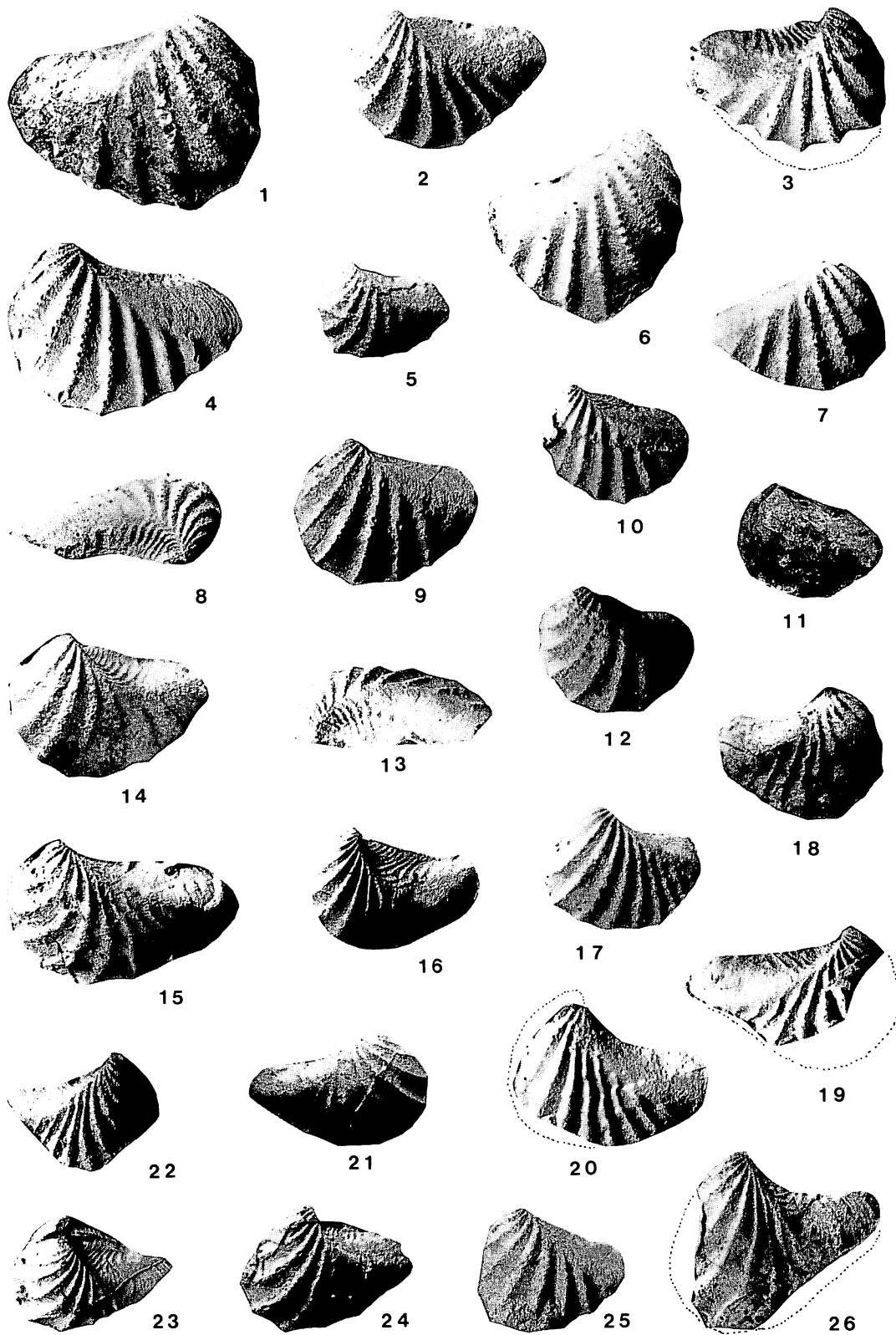
EXPLANATION OF PLATE 1

Pterotrigonia (Ptilotrigonia) ogawai (Yehara)

- Fig. 1: lateral view of right valve (KSG 3244), xl. 2, loc. Katasoba, Shishijima Island, Kagoshima Prefecture.
- Fig. 2: lateral view of left valve, gum cast of external mould (KSG 3252), xl, loc. Karakizaki, Goshonoura Island, Kumamoto Prefecture.
- Fig. 3: lateral view of right valve, gum cast of external mould (KSG 3245), xl, loc. Katasoba.
- Fig. 4: lateral view of left valve, gum cast of external mould (KSG 3246), xl, loc. Enokuchi, Goshonoura Island, Kumamoto Prefecture.
- Fig. 5: lateral view of left valve, gum cast of external mould (KSG 3250), xl, loc. Karakizaki.
- Fig. 6: lateral view of right valve, gum cast of external mould (KSG 3247), xl, loc. Enokuchi.
- Fig. 7: lateral view of right valve, gum cast of external mould (KSG 3249), xl, loc. ditto.
- Fig. 8: dorsal view of left valve, gum cast of external mould, xl, loc. ditto.
- Fig. 9: lateral view of left valve, gum cast of external mould (KSG 3248), xl, loc. ditto.
- Fig. 10: lateral view of left valve, gum cast of external mould (KSG 3253), xl, loc. Hegushi, Shishijima Island.
- Fig. 11: lateral view of left internal mould (KSG 3262), xl, loc. Enokuchi.
- Fig. 12: lateral view of left valve, gum cast of external mould (KSG 3251), xl, loc. Karakizaki.
- Fig. 13: dorsal view of right valve, gum cast of external mould (KSG 3247), xl, loc. Enokuchi.

Pterotrigonia (Ptilotrigonia) mifunensis (Tamura et Tashiro)

- Fig. 14: lateral view of left valve, gum cast of external mould (KSG 3281), xl, loc. Hegushi.
- Fig. 15: lateral view of left valve, gum cast of external mould (KSG 3282), xl, loc. ditto.
- Fig. 16: lateral view of left valve, gum cast of external mould (KSG 3280), xl, loc. ditto.
- Fig. 17: lateral view of left valve, gum cast of external mould (KSG 3285), xl, loc. Kashiwaguri, Shishijima Island.
- Fig. 18: lateral view of right valve, gum cast of external mould (KSG 3283), xl, loc. Hegushi.
- Fig. 19: lateral view of imperfect right valve, gum cast of external mould, xl, loc. ditto.
- Fig. 20: lateral view of left valve, gum cast of external mould, xl, loc. ditto.
- Fig. 21: lateral view of right valve, gum cast of external mould (KSG 3319), xl, loc. Yunokuchi, Shishijima Island.
- Fig. 22: lateral view of right valve, gum cast of external mould, xl, loc. Hegushi.
- Fig. 23: lateral view of left valve, gum cast of external mould (KSG 3279), xl, loc. ditto.
- Fig. 24: lateral view of left valve, gum cast of external mould (KSG 3284), xl, loc. Kashiwaguri.
- Fig. 25: lateral view of left valve, gum cast of external mould, xl, loc. Hegushi.
- Fig. 26: lateral view of left valve, gum cast of external mould, xl, loc. ditto.



EXPLANATION OF PLATE 2

Pterotrigonia (Ptilotrigonia) dilapsa (Yehara)

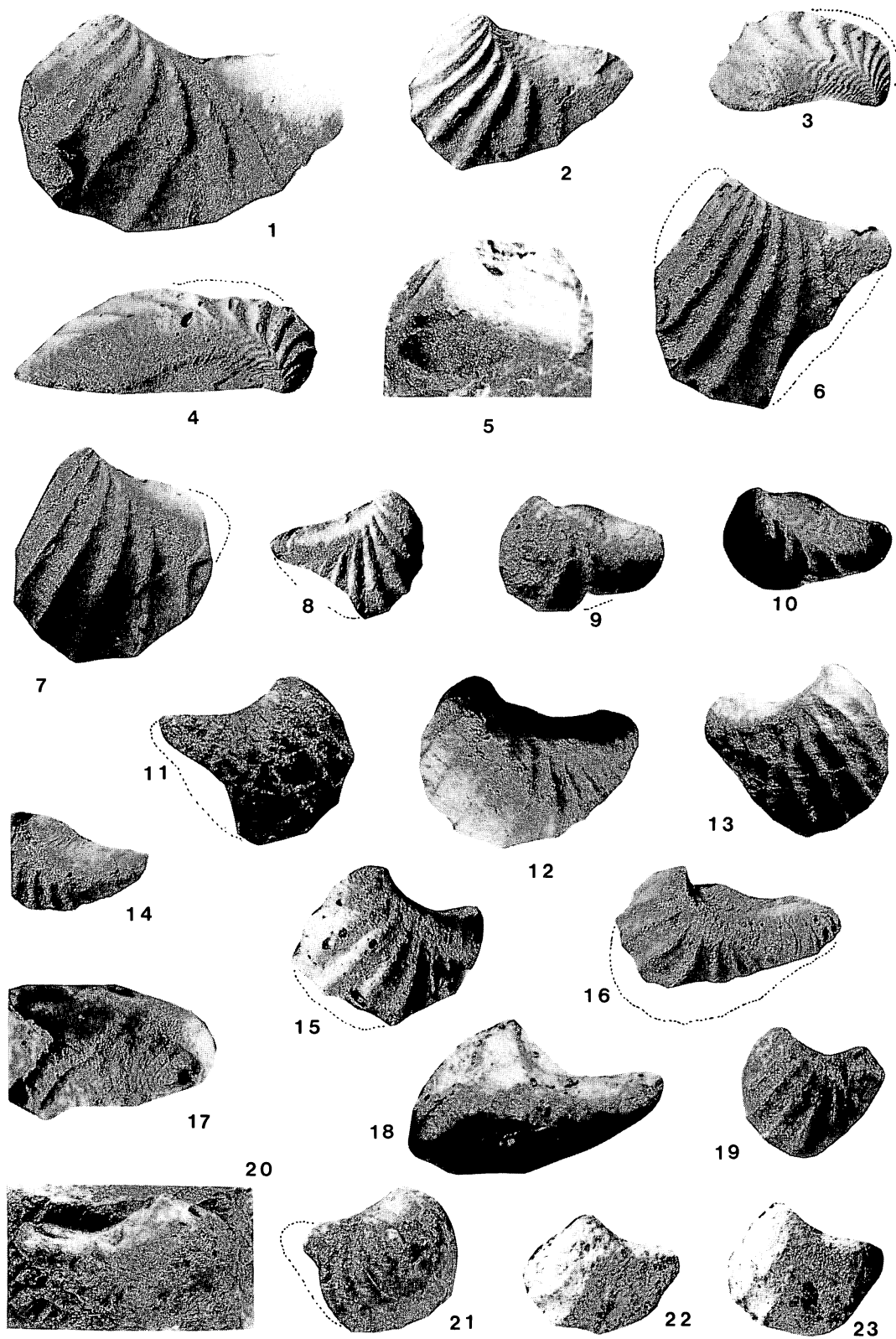
- Fig. 1: lateral view of left valve, gum cast of external mould (KSG 3254), xl, loc. Enokuchi, Goshonoura Island, Kumamoto Prefecture.
Fig. 2: lateral view of left valve, gum cast of external mould (KSG 3256), xl, loc. ditto.
Fig. 3: dorsal view of left valve, gum cast of external mould, xl, loc. ditto.
Fig. 4: dorsal view of left valve, gum cast of external mould, xl, loc. ditto.
Fig. 5: lateral view of left internal mould (KSG 3254), x0. 7, loc. ditto.
Fig. 6: lateral view of left valve, gum cast of external mould (KSG 3255), xl, loc. ditto.
Fig. 7: lateral view of left valve, gum cast of external mould (KSG 3257), xl, loc. ditto.

Pterotrigonia (Ptilotrigonia) brevicula (Yehara)

- Fig. 8: lateral view of right valve, gum cast of external mould (KSG 3258), xl, loc. Kashiwaguri, Shishijima Island, Kagoshima Prefecture.
Fig. 9: lateral view of left valve, gum cast of external mould (KSG 3323), xl, loc. western seashore of Ikarajima, Kagoshima Prefecture.
Fig. 10: dorsal view of the same specimen.

Pterotrigonia (Ptilotrigonia) mashikensis (Tamura et Tashiro)

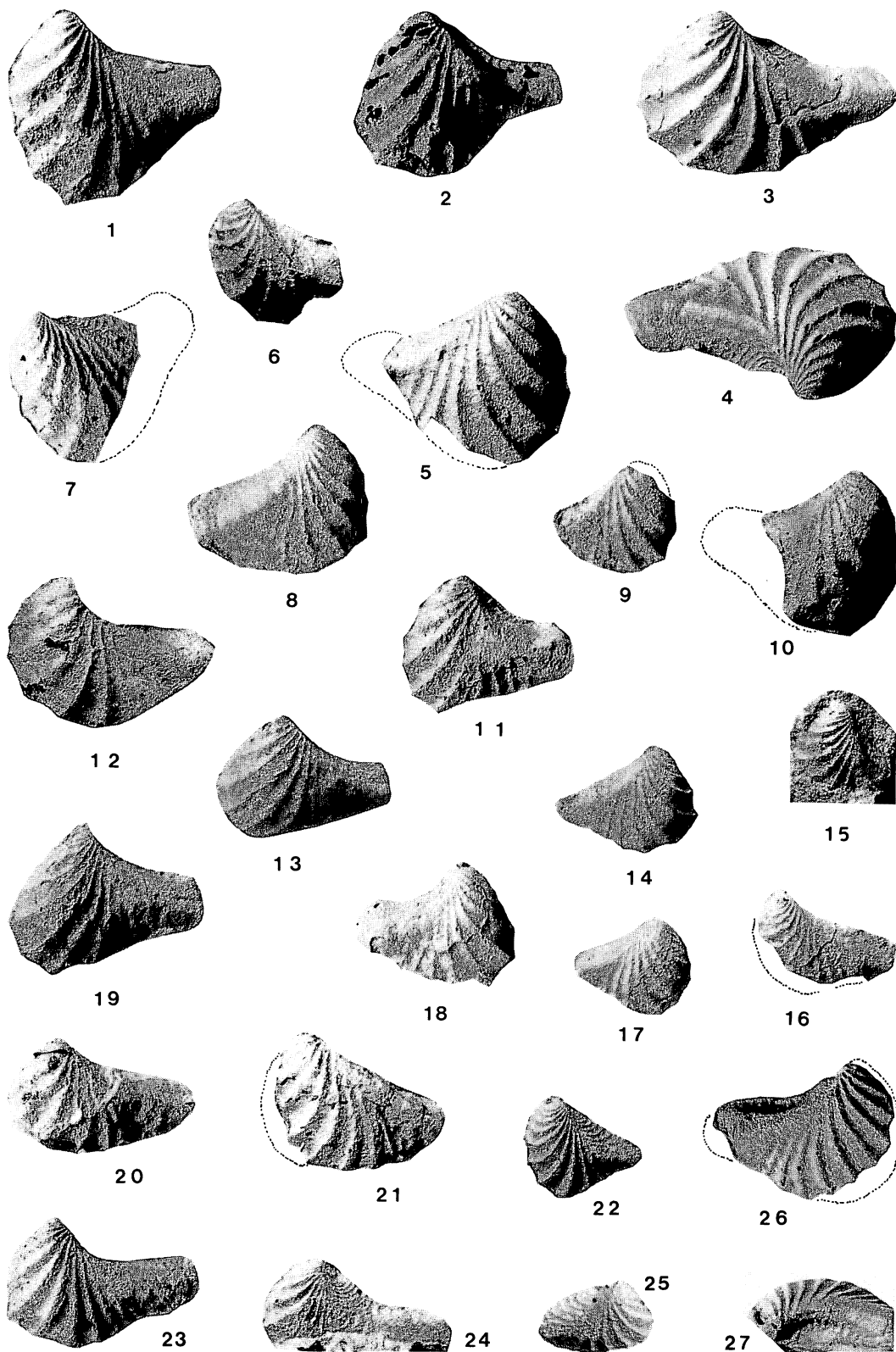
- Fig. 11: lateral view of right valve (KSG 3265), xl, loc. Magano, Shimo-mashiki-gun, Kumamoto Prefecture.
Fig. 12: lateral view of left valve, gum cast of external mould (KE 1710), xl, loc. ditto.
Fig. 13: lateral view of right valve (KE 1712), xl, loc. ditto.
Fig. 14: lateral view of left valve, gum cast of external mould, xl, loc. ditto.
Fig. 15: lateral view of left valve, gum cast of external mould (KSG 3266), xl, loc. ditto.
Fig. 16: lateral view of left valve, gum cast of external mould (KE 1711), x3, loc. ditto.
Fig. 17: dorsal view of left valve, gum cast of external mould (KE 1714), x3, loc. ditto.
Fig. 18: lateral view of left valve, gum cast of external mould (KSG 3182), xl, 5, loc. Nagase Dam-site, Kami-gun, Kochi Prefecture.
Fig. 19: lateral view of left valve (KSG 3263), xl, loc. Okadake, Shimo-mashiki-gun.
Fig. 20: lateral view of right internal mould (KSG 3267), xl, loc. Magano.
Fig. 21: lateral view of right valve (KSG 3264), xl, loc. Okadake.
Fig. 22: lateral view of left valve, gum cast of external mould (KSG 3288), xl, loc. Usui, Izumi-gun (Nagashima), Kagoshima Prefecture.
Fig. 23: lateral view of left valve, gum cast of external mould (KSG 3268), xl, loc. ditto.



EXPLANATION OF PLATE 3

Pterotrigonía (Ptilotrígónia) mifunensis (Tamura et Tashiro)

- Fig. 1: lateral view of left valve, gum cast of external mould (KSG 3271), xl.
2, loc. Miyanohara, Sakawa-machi, Kochi Prefecture.
- Fig. 2: lateral view of left valve, gum cast of external mould (KSG 3272), xl.
2, loc. ditto.
- Fig. 3: lateral view of left valve, gum cast of external mould (KSG 3269), xl.
2, loc. ditto.
- Fig. 4: dorsal view of the same specimen, xl. 2.
- Fig. 5: lateral view of right valve, gum cast of external mould (KSG 3273), xl.
2, loc. ditto.
- Fig. 6: lateral view of left valve, gum cast of external mould, xl. 2, loc. ditto.
- Fig. 7: lateral view of left valve, gum cast of external mould, xl. 2, loc. ditto.
- Fig. 8: lateral view of right valve, gum cast of external mould, xl. 2; loc. ditto.
- Fig. 9: lateral view of right valve, gum cast of external mould, xl. 2, loc. ditto.
- Fig. 10: lateral view of right valve, gum cast of external mould, xl. 2, loc. ditto.
- Fig. 11: lateral view of left valve, gum cast of external mould, xl, loc. ditto.
- Fig. 12: lateral view of left valve, gum cast of external mould (KSG 3270), xl.
2, loc. ditto.
- Fig. 13: lateral view of left valve, gum cast of external mould (KSG 3276), xl.
2, loc. ditto.
- Fig. 14: lateral view of right valve, gum cast of external mould, xl. 2, loc. ditto.
- Fig. 15: lateral view of left valve, gum cast of external mould, xl, loc. ditto.
- Fig. 16: lateral view of left valve, gum cast of external mould, xl, loc. ditto.
- Fig. 17: lateral view of right valve, gum cast of external mould (KSG 3278), xl,
loc. ditto.
- Fig. 18: lateral view of right valve, gum cast of external mould (KSG 3274), xl,
loc. ditto.
- Fig. 19: lateral view of left valve, gum cast of external mould, xl, loc. ditto.
- Fig. 20: lateral view of left valve, gum cast of external mould, xl, loc. ditto.
- Fig. 21: lateral view of left valve, gum cast of external mould, xl, loc. ditto.
- Fig. 22: lateral view of left valve, gum cast of external mould, xl. 2, loc. ditto.
- Fig. 23: lateral view of left valve, gum cast of external mould (KSG 3275), loc.
ditto.
- Fig. 24: dorsal view of left valve, gum cast of external mould, xl, loc. ditto.
- Fig. 25: lateral view of right valve, gum cast of external mould, xl. 2, loc. ditto.
- Fig. 26: lateral view of right valve, gum cast of external mould (KE 1719), xl,
loc. Itoishi, Shimo-mashiki-gun, Kumamoto Prefecture.
- Fig. 27: dorsal view of the same specimen, xl.



EXPLANATION OF PLATE 4

Pterotrigonia (Ptilotrigonia) usuiensis, sp. nov.

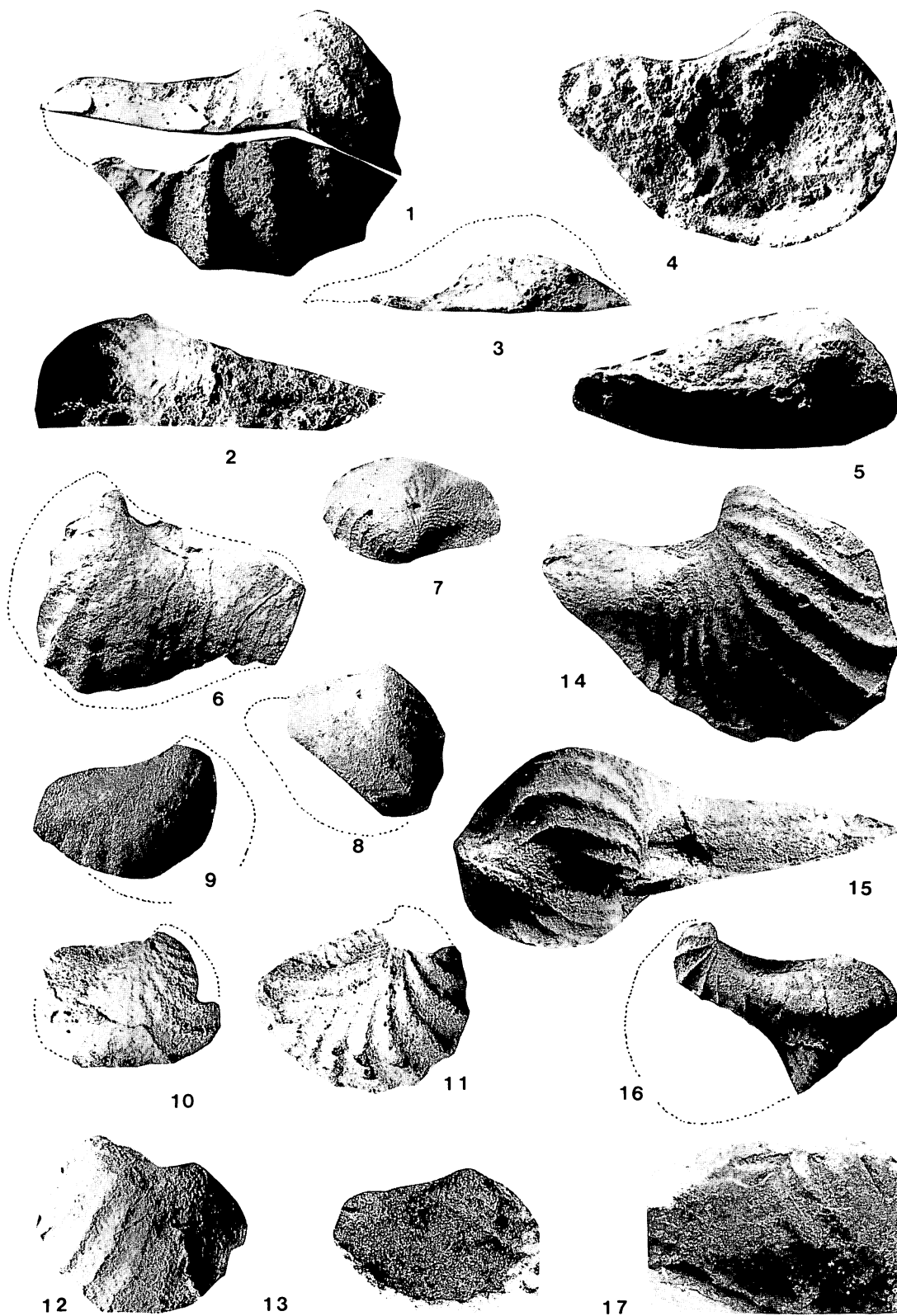
- Fig. 1: lateral view of right valve, gum cast of external mould (KSG 3295), holotype, xl, loc. Usui, Izumi-gun (Nagashima), Kagoshima Prefecture.
Fig. 2: dorsal view of the same specimen, xl.
Fig. 3: dorsal view of left valve, gum cast of external mould (KSG 3297), xl, loc. ditto.
Fig. 4: inner view of left valve, gum cast of external mould (KSG 3296), paratype, xl, loc. ditto.
Fig. 5: dorsal view of the same specimen, xl.

Pterotrigonia (Ptilotrigonia) miyanoharensis, sp. nov.

- Fig. 6: lateral view of left valve, gum cast of external mould (KSG 3290), paratype, xl, loc. Miyano-hara, Sakawa-machi Kochi Prefecture.
Fig. 7: : dorsal view of right valve, gum cast of external mould (KSG 3289), holotype, xl, loc. ditto.
Fig. 8: lateral view of the same specimen, xl.
Fig. 9: lateral view of right valve, gum cast of external mould (KSG 3292), xl, loc. ditto.
Fig. 10: lateral view of right valve, gum cast of external mould (KSG 3293), xl, loc. ditto.
Fig. 11: lateral view of right valve, gum cast of external mould (KSG 3291), xl, loc. ditto.
Fig. 12: lateral view of left valve, gum cast of external mould (KSG 3294), xl, loc. ditto.
Fig. 13: lateral view of right internal mould (KSG 3292), xl, loc. ditto.

Pterotrigonia (Ptilotrigonia) tamurai, sp. nov.

- Fig. 14: lateral view of right valve, gum cast of external mould (KSG 3315), holotype, xl, loc. Yunokuchi, Shishijima, Kagoshima Prefecture.
Fig. 15: dorsal view of the holotype, xl.
Fig. 16: lateral view of imperfect left valve, gum cast of external mould (KSG 3317), xl, loc. ditto.
Fig. 17: lateral view of right internal mould (KSG 3318), xl, loc. ditto.



EXPLANATION OF PLATE 5

Pterotrigonia (Ptilotrigonia) tamurai, sp. nov.

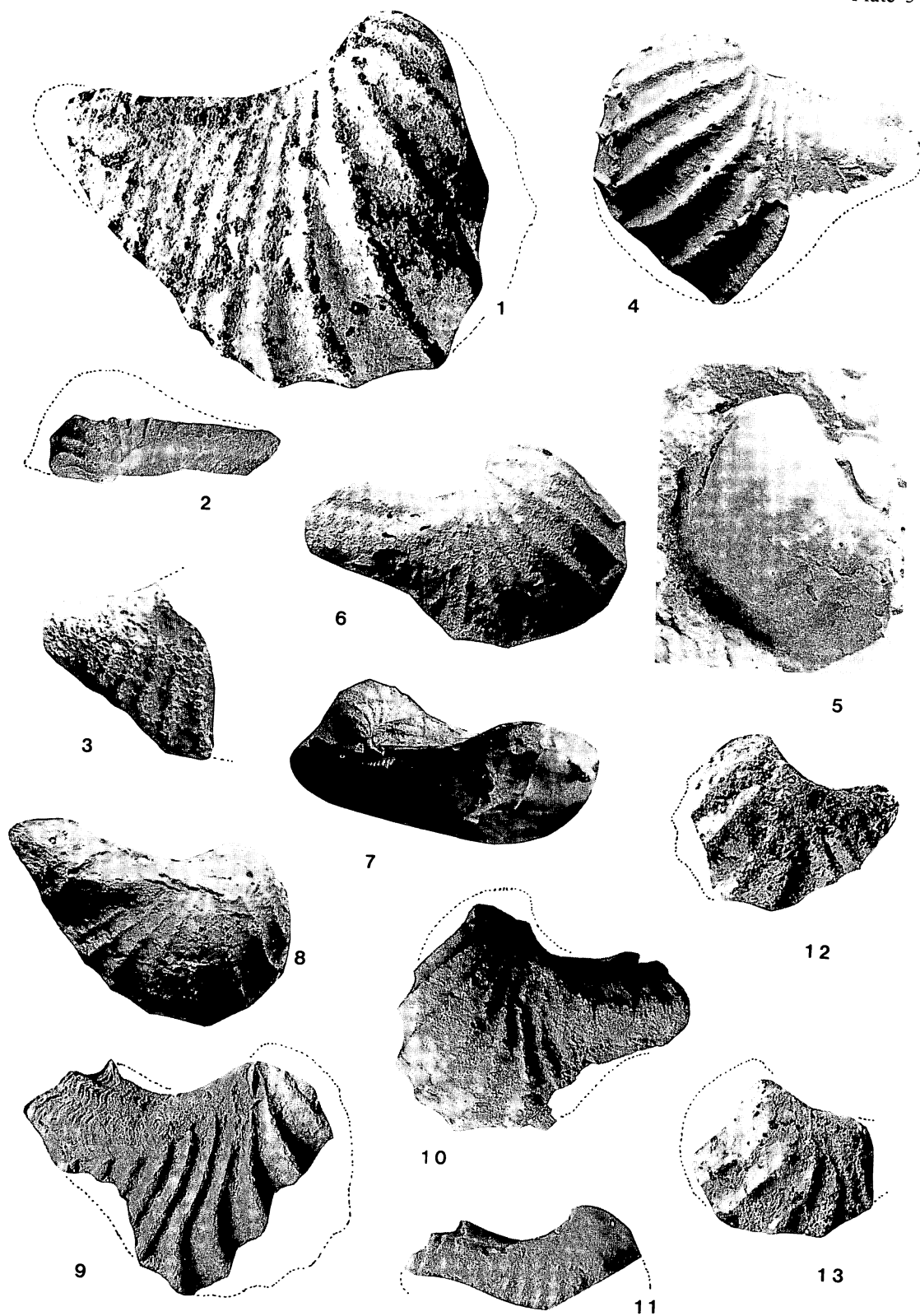
- Fig. 1: lateral view of right valve, gum cast of external mould (KSG 3298), paratype, xl, loc. Usui, Izumi-gun (Nagashima), Kagoshima Prefecture.
Fig. 2: dorsal view of imperfect right valve, gum cast of external mould (KSG 3316), xl, loc. Yunokuchi, Shishijima, Kagoshima Prefecture.
Fig. 3: lateral view of imperfect right valve, gum cast of external mould, xl, loc. Usui.

Pterotrigonia (Ptilotrigonia) amakusensis sp. nov.

- Fig. 4: lateral view of left valve, gum cast of external mould (KSG 3259), xl, loc. Enokuchi, Goshonoura Island, Kumamoto Prefecture.
Fig. 5: lateral view of left internal mould (KSG 3259), xl, loc. ditto.
Fig. 6: lateral view of right valve, gum cast of external mould (KSG 3261), xl, loc. Karakizaki, Goshonoura Island.
Fig. 7: dorsal view of the same specimen, xl.
Fig. 8: lateral view of right valve, plaster cast of external mould (KSG 3260), xl, loc. Miyanohara, Sakawa-machi, Kochi Prefecture.

Pterotrigonia (Ptilotrigonia) higoensis (Tamura et Tashiro)

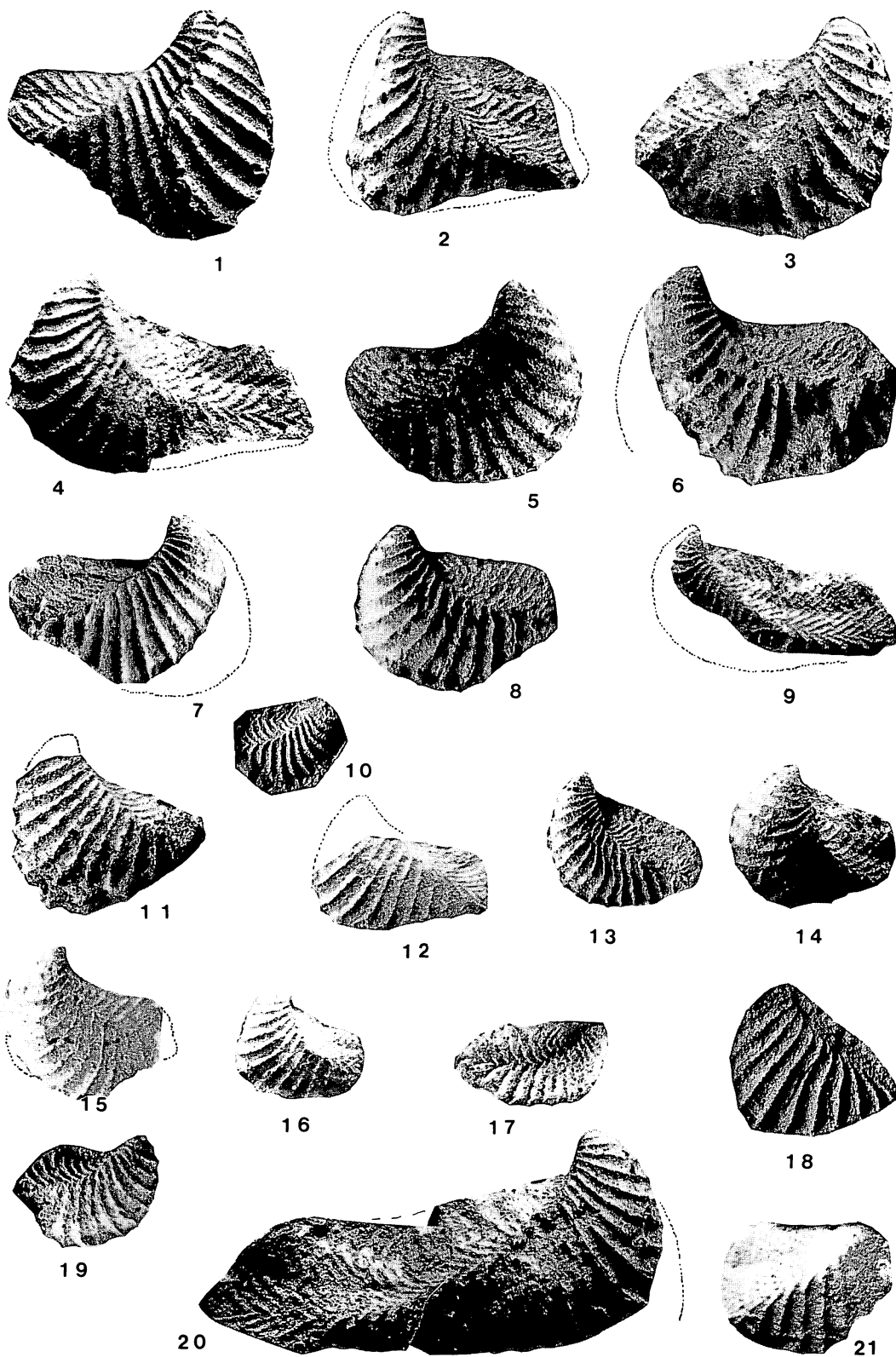
- Fig. 9: lateral view of right valve, gum cast of external mould (KE 1724), xl, loc. Magano, Shimo-mashiki-gun, Kumamoto Prefecture.
Fig. 10: lateral view of left valve, gum cast of external mould (KE 1725, holotype), xl, loc. Mitake, Kami-mashiki-gun, Kumamoto Prefecture.
Fig. 11: lateral view of imperfect right valve, gum cast of external mould, xl, loc. Magano.
Fig. 12: lateral view of left valve, gum cast of external mould (KSG 3286), xl, loc. Usui.
Fig. 13: lateral view of left valve, gum cast of external mould (KSG 3287), xl, loc. ditto.



EXPLANATION OF PLATE 6

Pterotrigonis (?*Scabrotrigonia*) *moriana* (Yehara)

- Fig. 1: lateral view of right valve, gum cast of external mould (KSG 3221), xl.
2; loc. Hagino, Kami-gun (Monobe Area), Shikoku.
- Fig. 2: lateral view of left valve, gum cast of external mould (KSG 3225) xl.
2; loc. ditto.
- Fig. 3: lateral view of right valve, gum cast of external mould (KSG 3224), xl.
2; loc. ditto.
- Fig. 4: lateral view of left valve, gum cast of external mould (KSG 3222), xl.
2; loc. ditto.
- Fig. 5: lateral view of right valve, gum cast of external mould (KSG 3227), xl.
5; loc. ditto.
- Fig. 6: lateral view of left valve, gum cast of external moulds, xl. 2; loc. ditto.
- Fig. 7: lateral view of right valve, gum cast of external mould, xl; loc. ditto.
- Fig. 8: lateral view of left valve, gum cast of external mould, xl. 5; loc. ditto.
- Fig. 9: lateral view of imperfect left valve, gum cast of external mould (KSG 3229), xl; loc. ditto.
- Fig. 10: lateral view of right valve, gum cast of external mould, xl; loc. Bunjo, Takaoka-gun (Sakawa Area), Shikoku.
- Fig. 11: lateral view of left valve, gum cast of external mould, xl. 2; loc. Hagino.
- Fig. 12: lateral view of imperfect left valve, gum cast of external mould (KSG 3228), xl; loc. ditto.
- Fig. 13: lateral view of left valve, gum cast of external mould (KSG 3226), xl; loc. ditto.
- Fig. 14: lateral view of left valve, gum cast of external mould, xl. 2; loc. ditto.
- Fig. 15: lateral view of left valve, gum cast of external mould, xl. 2; loc. ditto.
- Fig. 16: lateral view of left valve, gum cast of external mould, xl. 2; loc. ditto.
- Fig. 17: lateral view of right valve, gum cast of external mould, xl. 5; loc. ditto.
- Fig. 18: lateral view of left valve, gum cast of external mould, xl; loc. Bunjo.
- Fig. 19: lateral view of right valve, gum cast of external mould, xl. 5; loc. Hagino.
- Fig. 20: lateral view of right valve, gum cast of external mould (KSG 3230), xl. 2; loc. ditto.
- Fig. 21: lateral view of imperfect right valve, gum cast of external mould, xl. 5; loc. ditto.



EXPLANATION OF PLATE 7

Pterotrigonia (?*Scabrotrigonia*) sp.

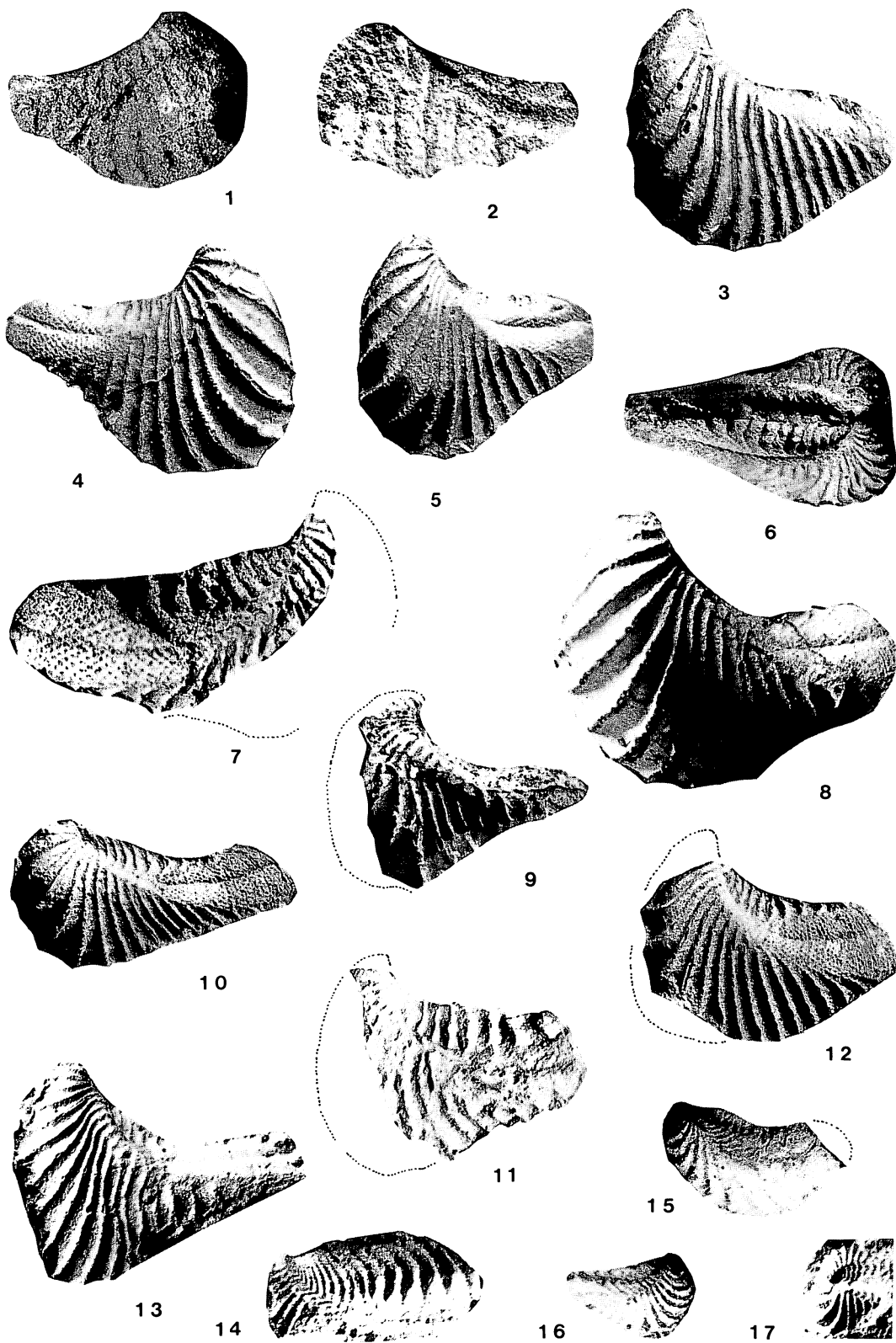
- Fig. 1: lateral view of right external mould (KSG 3299), x1; loc. Bunjo, Takaoka-gun (Sakawa Area), Shikoku.
Fig. 2: lateral view of imperfect left valve, gum cast of external mould (KSG 3300), x1. 5; loc. ditto.

Pterotrigonia (*Pterotrigonia*) *hokkaidoana* (Yehara)

- Fig. 3: lateral view of left valve, gum cast of external mould, x1; loc. Nekotani, Miyaji-machi, Yatsushiro-gun, Kumamoto Prefecture.

Pterotrigonia (?*Scabrotrigonia*) *pustulosa* (Nagao)

- Fig. 4: lateral view of right valve, gum cast of external mould (KSG 3231), x1; loc. Enokuchi, Goshonoura Island, Kumamoto Prefecture. A Form.
Fig. 5: lateral view of left valve, gum cast of external mould, x1; loc. ditto. A Form.
Fig. 6: dorsal view of conjoined valves, gum cast of external moulds, x1. 2; loc. ditto. A Form.
Fig. 7: lateral view of imperfect right valve, gum cast of external mould, x1. 5; loc. Hegushi, Shishijima Island, Kagoshima Prefecture. B Form.
Fig. 8: lateral view of left valve, gum cast of external mould (KSG 3235), x1. 2, loc. Hegushi. A Form.
Fig. 9: lateral view of left valve, gum cast of external mould, x1. 2; loc. Hegushi. B Form.
Fig. 10: lateral view of left valve, gum cast of external mould, x1. 2, loc. Enokuchi. A Form.
Fig. 11: lateral view of imperfect left valve, gum cast of external mould, x1. 5; loc. Nagase, Kami-gun (Monobe Area), Shikoku. B Form.
Fig. 12: lateral view of left valve, gum cast of external mould, x1. 2; loc. Enokuchi. A Form.
Fig. 13: lateral view of left valve, gum cast of external mould (KSG 3240), x1; loc. Miyano-hara, Takaoka-gun (Sakawa Area), Shikoku. B Form.
Fig. 14: dorsal view of left valve, gum cast of external mould, x2; loc. ditto. B Form.
Fig. 15: dorsal view of left valve, gum cast of external mould, x2; loc. ditto. B Form.
Fig. 16: lateral view of right valve, gum cast of external mould, x1. 2; loc. ditto. B Form.
Fig. 17: dorsal view of conjoined valves, gum cast of external moulds, x1. 2; loc. ditto. B Form.



EXPLANATION OF PLATE 8

Pterotrigonia (?*Scabrotrigonia*) *pustulosa* (Nagao)

- Fig. 1: lateral view of right valve, gum cast of external mould (KSG 3243), x1;
loc. Yunokuchi, Shishijima Island, Kagoshima Prefecture. B Form.
- Fig. 2: lateral view of left valve, gum cast of external mould (KSG 3239), x1;
loc. Miyanojima, Takaoka-gun (Sakawa Area), Shikoku. B Form.
- Fig. 3: lateral view of right valve, plaster cast of external mould (KSG 3241),
x1; loc. ditto. B Form.
- Fig. 4: lateral view of left valve, gum cast of external mould (KSG 3232), x1;
loc. Enokuchi, Goshonoura Island, Kumamoto Prefecture. A Form.
- Fig. 5: lateral view of right valve, gum cast of external mould (KSG 3233), x1;
loc. ditto. A Form.
- Fig. 6: dorsal view of conjoined valves, gum cast of external moulds (KSG 3234),
x1; loc. ditto. A Form.
- Fig. 7: lateral view of right valve, gum cast of external mould (KSG 3242), x1;
loc. Kashiwaguri, Shishijima Island, Kagoshima Prefecture. B Form.
- Fig. 8: lateral view of left valve, gum cast of external mould (KSG 3237), x1;
loc. Hegushi, Shishijima Island. B Form.
- Fig. 9: lateral view of right valve, gum cast of external mould (KSG 3238), x1;
loc. ditto. B Form.
- Fig. 10: lateral view of right valve, gum cast of external mould (KSG 3236), x1;
loc. ditto. B Form.

Pterotrigonia (?*Scabrotrigonia*) *monobeana* Tashiro et Kozai

- Fig. 11: lateral view of left valve, gum cast of external mould (KSG 3041), x2;
loc. Mizutani of Kajisako, Kami-gun (Monobe Area), Shikoku.
- Fig. 12: lateral view of right valve, gum cast of external mould (KSG 3306),
x1; loc. Kashiwaguri.
- Fig. 13: dorsal view of conjoined valves, gum cast of external moulds, x1; loc.
Yunokuchi.
- Fig. 14: dorsal view of right valve, gum cast of external mould (KSG 3321),
x1; loc. ditto.
- Fig. 15: dorsal view of right valve, gum cast of external mould (KSG 3185),
x2; loc. Nagase dam-site, Kami-gun (Monobe Area).
- Fig. 16: lateral view of left valve, gum cast of external mould (KSG 3180), x1.
5; loc. ditto.

Pterotrigonia (?*Scabrotrigonia*) *pustulosa* (Nakano)

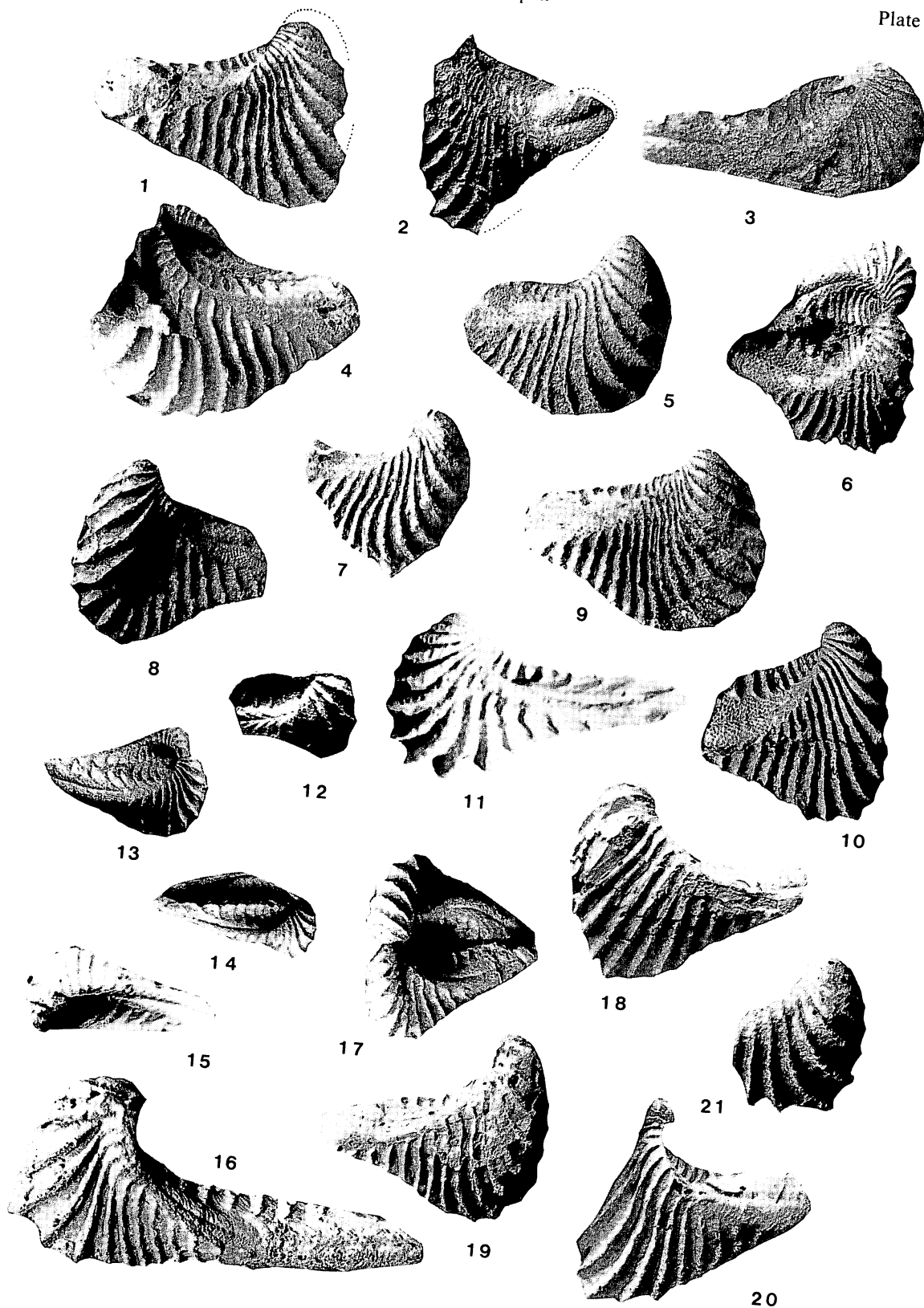
- Fig. 17: dorsal view of conjoined valves, gum cast of external moulds (KSG
3320), x1; loc. Kashiwaguri. B Form.

Pterotrigonia (*Pterotrigonia*) *pocilliformis* (Yokoyama)

- Fig. 18: lateral view of left valve, gum cast of external mould (KSG 3324), x1;
loc. Haidateyama, Minami-kaifu-gun, Oita Prefecture. A Form.
- Fig. 19: lateral view of right valve, gum cast of external mould (KSG 3325),
x1; loc. ditto. A Form.
- Fig. 20: lateral view of left valve, gum cast of external mould (KSG 3326), x1;
loc. ditto. A Form.

Pterotrigonia (*Pterotrigonia*) cf. *kofujiensis* Tamura

- Fig. 21: lateral view of right valve, gum cast of external mould (KSG 3322),
x1; loc. Mizutani of Kajisako, Kami-gun (Monobe Area), Shikoku.



EXPLANATION OF PLATE 9

Pterotrigonia (?*Scabrotrigonia*) *obsoleta* (Nakano)

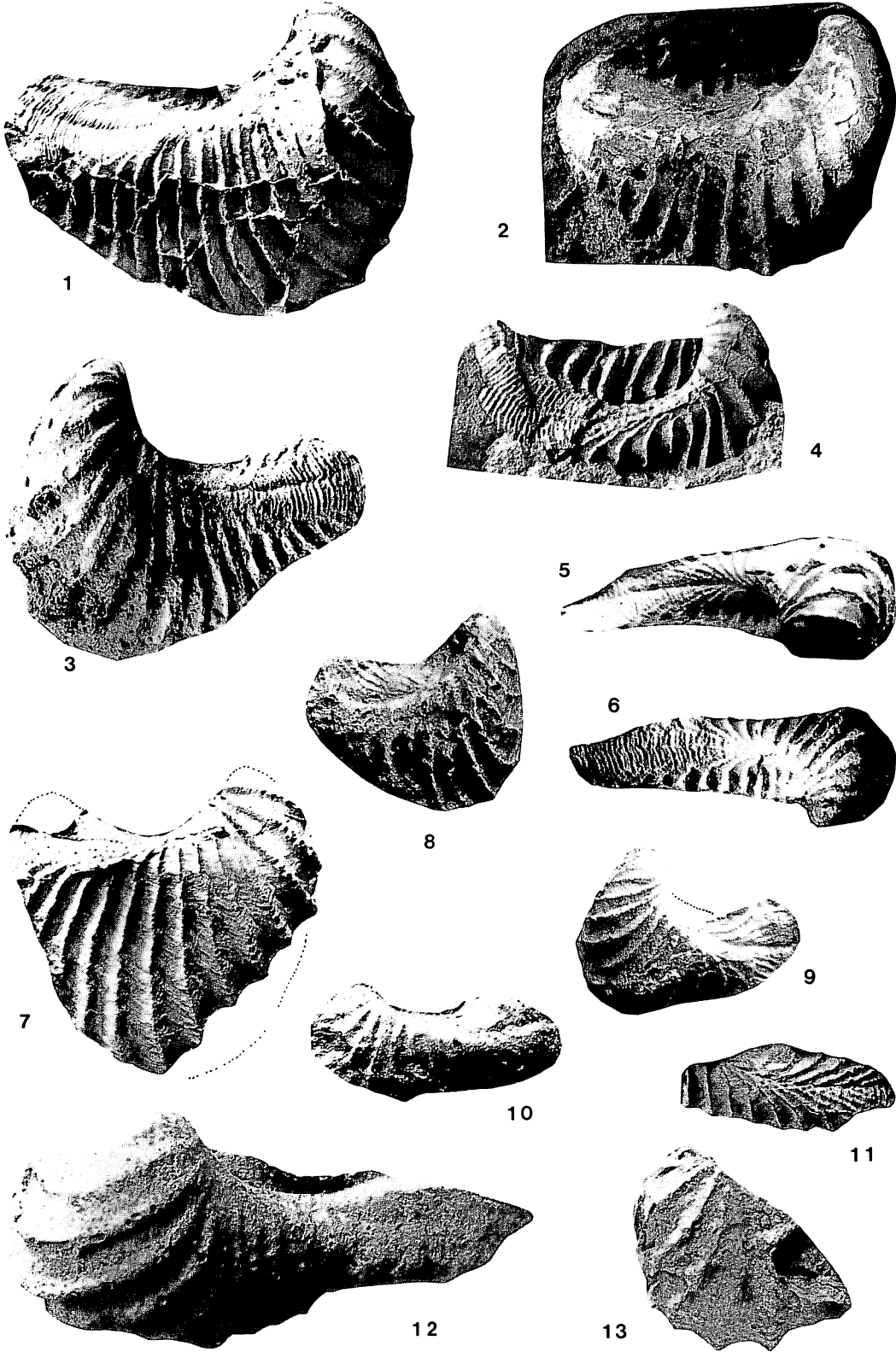
- Fig. 1: lateral view of right valve, gum cast of external mould (KSG 3301), x1; loc. Hegushi, Shishijima Island, Kagoshima Prefecture.
Fig. 2: lateral view of right internal mould (KSG 3302), x1; loc. ditto.
Fig. 3: lateral view of left valve, gum cast of external mould (KSG 3303), x1; loc. ditto.
Fig. 4: lateral view of imperfect right valve, gum cast of external mould, x1; loc. ditto.
Fig. 5: dorsal view of left valve, gum cast of external mould, x1; loc. ditto.
Fig. 6: dorsal view of the same specimen, x1.
Fig. 7: lateral view of right valve, gum cast of external mould, x1; loc. ditto.

Pterotrigonia (?*Scabrotrigonia*) *imanishii* (Nakano)

- Fig. 8: lateral view of right valve, plaster cast of external mould (KSG 3211), x1; loc. Nagase dam-site, Kami-gun, (Monobe Area), Shikoku.
Fig. 9: lateral view of left valve, gum cast of external mould (KSG 3181), x1. 2; loc. ditto.
Fig. 10: lateral view of left valve, gum cast of external mould, x1. 5; loc. ditto.
Fig. 11: lateral view of imperfect left valve, gum cast of external mould (KSG 3312), x1; loc. Yunokuchi, Shishijima Island.

Pterotrigonia (?*Scabrotrigonia*) *yeharai* Nakano et Numano

- Fig. 12: lateral view of left valve, gum cast of external mould (KSG 3307), x1, loc. Hegushi.
Fig. 13: lateral view of left internal mould (KSG 3327), x1, loc. south of Katasoba, Shishijima Island.



EXPLANATION OF PLATE 10

Pterotrigonia (Pterotrigonia) sakakurai (Yehara)

- Fig. 1: lateral view of left valve, gum cast of external mould (KSG 3310), x1,
loc. Karakizaki, Goshonoura Island, Kumamoto Prefecture.
Fig. 2: dorsal view of the same specimen, x1.
Fig. 3: lateral view of right valve, gum cast of external mould (KSG 3309), x1;
loc. ditto.
Fig. 4: lateral view of left valve, gum cast of external mould (KSG 3308), x1;
loc. ditto.
Fig. 5: lateral view of left valve, gum cast of external mould (KSG 3311), x1;
loc. ditto.
Fig. 6: dorsal view of the same specimen, KSG 3311, x1.

Pterotrigonia (Pterotrigonia) aff. yokoyamai (Yehara)

- Fig. 7: lateral view of left valve, gum cast of external mould (KSG 3313), x1;
loc. Samani, Urakawa district, Hokkaido, collected by Dr. Kanie.
Fig. 8: lateral view of left valve, gum cast of external mould (KSG 3314), x1;
loc. ditto, collected by Dr. Kanie.



EXPLANATION OF PLATE 11

Pterotrigonia (?*Scabrotrigonia*) *kobayashii* (Nakano)

- Fig. 1: lateral view of left valve, plaster cast of external mould (KSG 3329), x1, loc. Ikushunbetsu, Hokkaido.
Fig. 2: lateral view of the same specimen.
Fig. 3: lateral view of right valve, plaster cast of external mould (KSG 3328), x1, loc. ditto.
Fig. 4: lateral view of right valve, plaster cast of external mould (KSG 3330), x11, loc. ditto.
Fig. 5: lateral view of right valve, plaster cast of external mould (KSG 3331), x1, loc. ditto.

Pterotrigonia (*Pterotrigonia*) aff. *hokkaidoana* (Yehara)

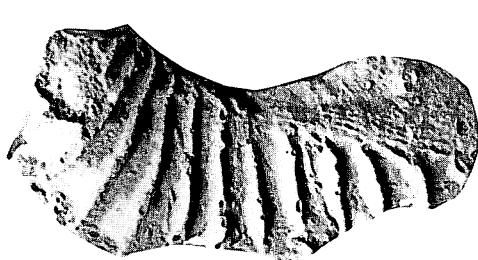
- Fig. 6: lateral view of right valve, gum cast of external mould (KSG 3338), x1, loc. Ochiai, Oita Prefecture.
Fig. 7: lateral view of left valve, gum cast of external mould (KSG 3339), x1, loc. ditto.

Pterotrigonia (?*Scabrotrigonia*) *obsoleta* (Nakano)

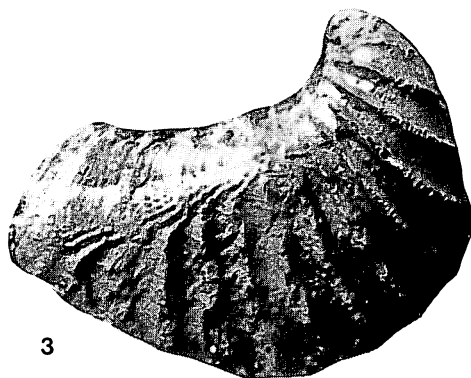
- Fig. 8: lateral view of right valve, plaster cast of external mould (KSG 3344), x1, loc. Goshonoura-jima, Kumamoto Prefecture.

Pterotrigonia (?*Scabrotrigonia*) *pustulosa* (Nagao)

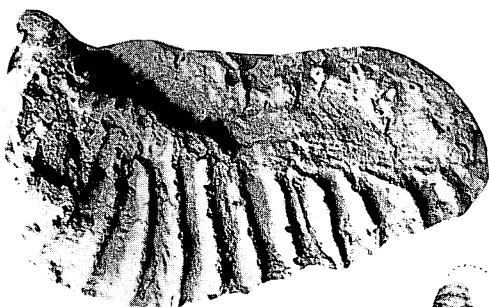
- Fig. 9: lateral view of left valve, plaster cast of external mould (KSG 3342), x1, loc. Ikushunbetsu. B Form.
Fig. 10: dorsal view of conjoined valves, plaster cast of external moulds (KSG 3343), x1, loc. ditto. B Form.
Fig. 11: dorsal view of the same specimen.



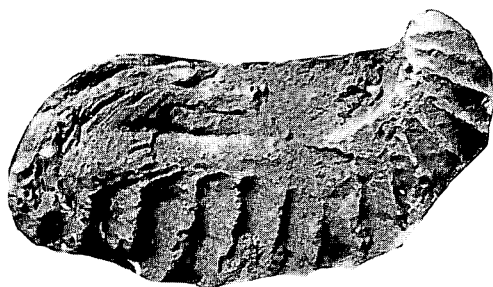
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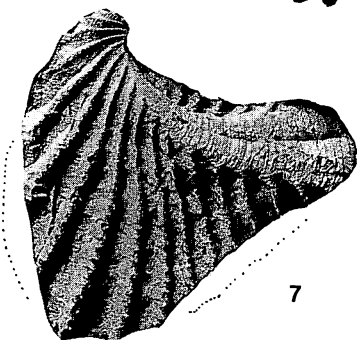
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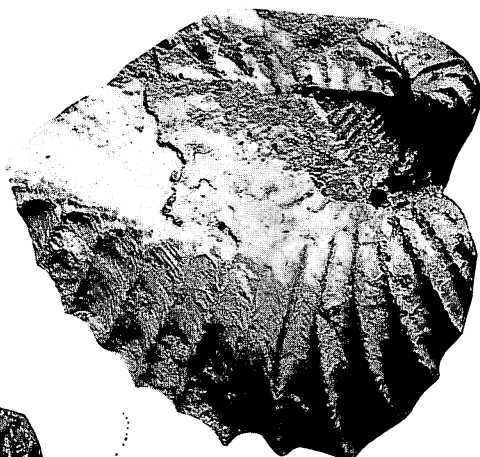
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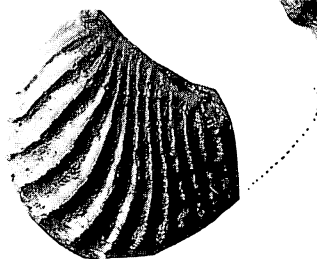
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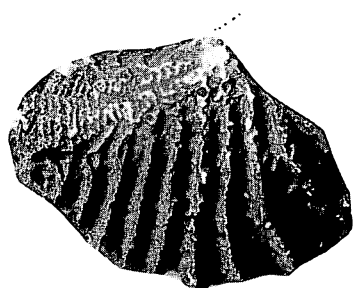
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EXPLANATION OF PLATE 12

Pterotrigonia (Pterotrigonia) pocilliformis (Yokoyama)

- Fig. 1: lateral view of left valve, plaster cast of external mould, x0. 8, loc. Singai, Kochi Prefecture. B Form.
Fig. 2: lateral view of left valve, gum cast of external mould x1, loc. Doiban, Kochi Prefecture. B Form.
Fig. 3: lateral view of right valve, gum cast of external mould, x1, loc. ditto. B Form.
Fig. 4: lateral view of left valve, gum cast of external mould x1, loc. ditto. B Form.
Fig. 5: dorsal view of conjoined valves, (KSG 3336), x1, loc. Kasanokawa, Kochi Prefecture. A Form.
Fig. 6: lateral view of left valve, gum cast of external mould, x1, loc. A Form.

Pterotrigonia (Ptilotrigonia) brevicula (Yehara)

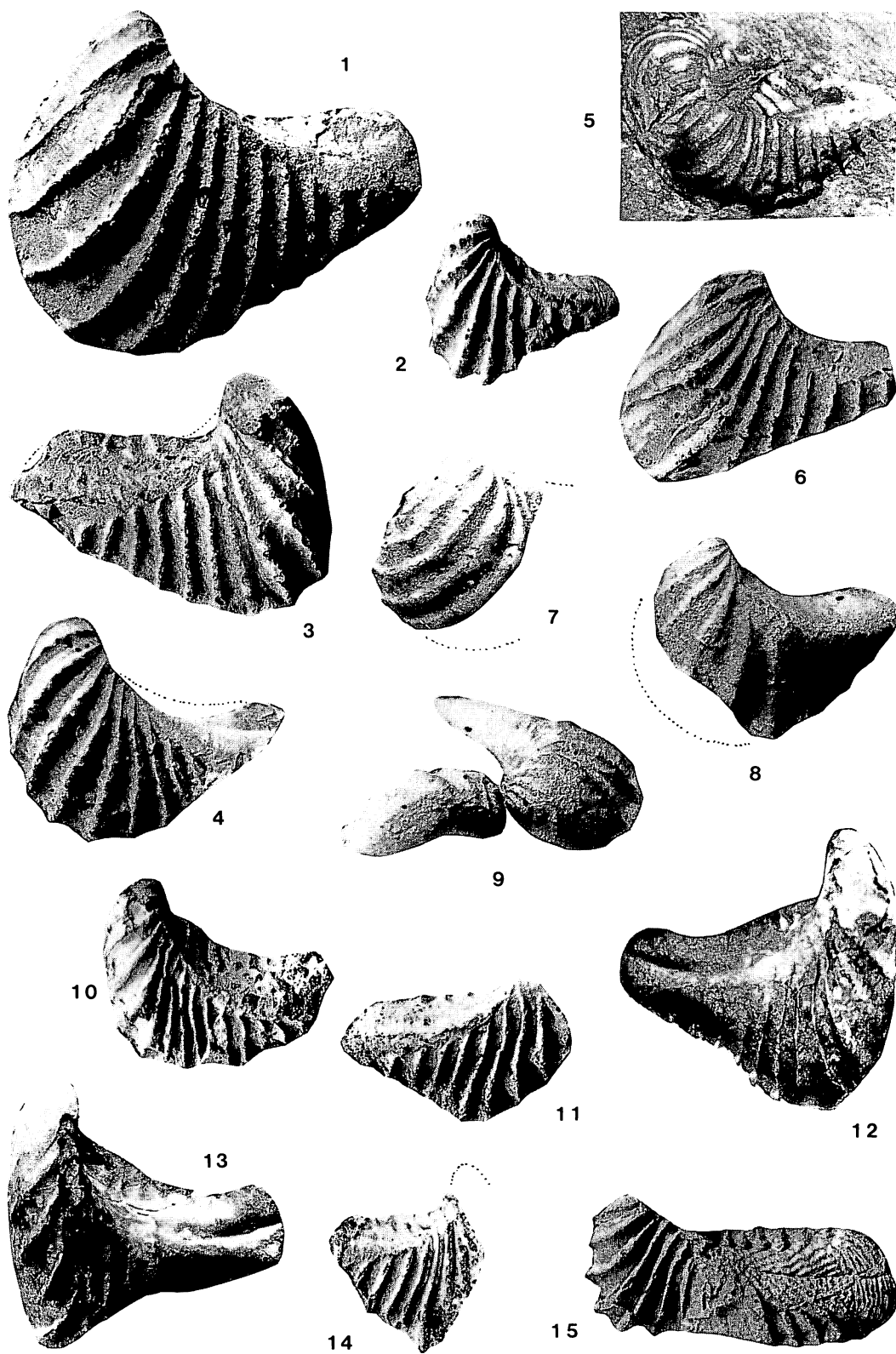
- Fig. 7: lateral view of left valve, gum cast of external mould x1, loc. Nagase, Kochi Prefecture, collected by Mr. Hirata.
Fig. 8: lateral view of left valve, gum cast of external mould (KSG 3334), x1, loc. Kushizaki, Shishijima, Kumamoto Prefecture.
Fig. 9: dorsal and ventral views of left valves, (KSG 3334, 3335), x1, loc. ditto.

Pterotrigonia (Pterotrigonia) yokoyamai (Yehara)

- Fig. 10: lateral view of left valve, gum cast of external mould (KSG 3346), x1, loc. Haidateyama, Oita Prefecture.
Fig. 11: lateral view of right valve, gum cast of external mould (KSG 3349), x1, loc. ditto.
Fig. 12: lateral view of right internal mould (KSG 3345), x1, loc. ditto.
Fig. 13: lateral view of left internal mould (KSG 3346), x1, loc. ditto.
Fig. 14: lateral view of right valve, gum cast of external mould (KSG 3348), x1, loc. ditto.

Pterotrigonia (?Scabrotrigonia) imanishii (Nakano)

- Fig. 15: lateral view of left valve, gum cast of external mould (KSG 3333), x1, loc. Shishijima.



EXPLANATION OF PLATE 13

Pterotrigonia (Ptilotrigonia) tamurai sp. nov.

- Fig. 1: lateral view of right valve, gum cast of external mould (KSG 3353), x1,
loc. Kushizaki, Shishijima, Kagoshima Prefecture.
Fig. 2: dorsal view of the same specimen.
Fig. 3: lateral view of right valve, gum cast of external mould (KSG 3354), x1,
loc. ditto.

Pterotrigonia (Ptilotrigonia) usuiensis sp. nov.

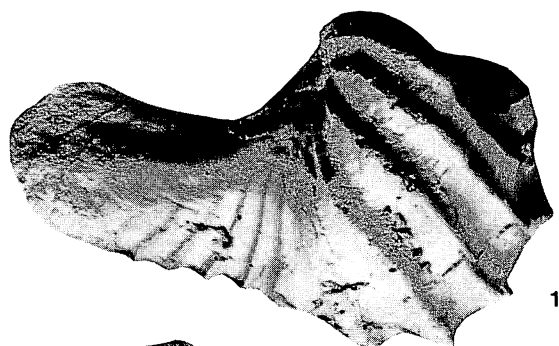
- Fig. 4: dorsal view of left valve, gum cast of external mould, x1, loc. ditto.
Fig. 5: lateral view of right valve, gum cast of external mould (KSG 3355),
x1, loc. ditto.
Fig. 6: dorsal view of left valve, gum cast of external mould, x1, loc. ditto.
Fig. 7: lateral view of left valve, gum cast of external mould (KSG 3356), x1,
loc. ditto.

Pterotrigonia (?Scabrotrigonia) kobayashii (Nakano)

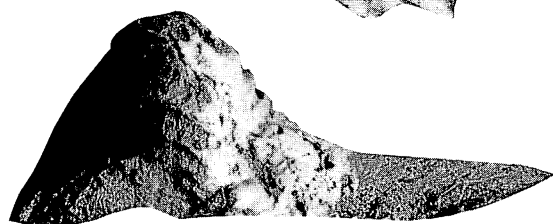
- Fig. 8: lateral view of left valve, gum cast of external mould (KSG 3352), x1,
loc. Ikushunbetsu, Hokkaido.

Pterotrigonia (Pterotrigonia) sakakurai (Yehara)

- Fig. 9: lateral view of right valve, gum cast of external mould (KSG 3357), x1,
loc. about 300m west of Hegushi, Shishijima.



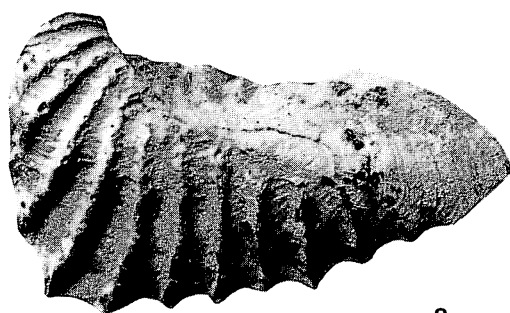
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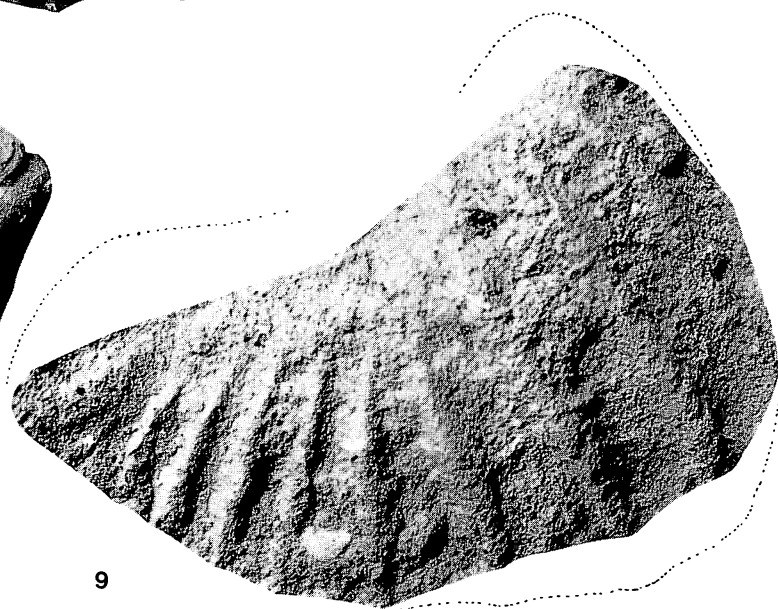
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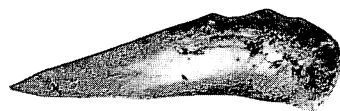
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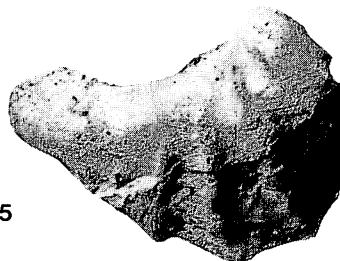
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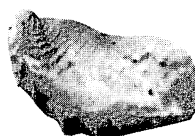
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