

Cretaceous Trigonidae from Amakusa Islands,
Prov. Higo, Kyûshû, Japan.

By

S. Yehara, *Rigakushi*.

With 4 Plates.

With the synclinal relation, the Cretaceous formation of Amakusa Islands which is overlaid by the coal bearing series (Palaeocene) and underlaid by Palaeozoic, exposes along the both sides of the Islands (the east coast of Kamishima and the west coast of Shimoshima). It consists of *Trigonia*-Sandstone overlaid by the *Ammonite*-bearing shale. From the latter Prof. Yabe described some Senonian fossils¹⁾ (*Inoceramus Schmidtii* Mich. var., *Gaudryceras tenuiliratum* Yabe, *Pachydiscus* cf. *Haradai* Jimbo and *Peroniceras Amakusense* Yabe) identical with those found in the Hokkaido, comparing the above-stated shale to the *Pachydiscus* bed of the Hokkaido.

Trigonia-Sandstone of Amakusa exposed at Goshono-ura-shima, Shishijima and Ôemura occupies the lowermost horizon of the Cretaceous of the Islands and consists of the sandstone which intercalates schalstein, shale and conglomerate. The *Trigonidae* more richly found than other Lamellibranchs and Gastropods in the sandstone are closely related with those of the Hokkaido, Sakhalin, Queen Charlotte Is. (Queen Charlotte series), Vancouver Is. (Nanaimo series), Oregon and California (Chico series), and are divided into 4 groups and 8 species. They are:

1) H. Yabe: Zur Stratigraphie u. Pal. d. Oberen Kreide v. Hokkaido u. Sakhalin. Zeitschr. d. Deutsch. Geol. Gesellsch., Bd.61, 1909, Heft.4.

Scabrae group

T. dilapsa sp. nov.*T. Ogawai* sp. nov.*T. Hokkaidoana* Yeh.*T. Sakakurai* sp. nov.*T. Yokoyamai* var.

Pennatae subgroup

T. subovalis Jimbo.

Glabrae group

T. Kikuchiana Yok.

Scaphoidea group

T. Japonica sp. nov.

Among the *Trigonia*-Sandstones hitherto known in Japan, the one of Amakusa is considered to be closely connected faunistically and stratigraphically with that of the Hokkaido and Sakhalin.

Description of the species.

Scabrae group.

Trigonia dilapsa sp. nov.

PL. IV. Fig. 1, 1a, 2; PL. V. Fig. a.

Dimensions :

Height 37,0 mm

Length 41,0 mm

Breadth 14,0 mm

Shell subtrigonal, anteally truncated, posteally contracted and cuneate; ventral margin strongly rounded; anterior side convex with its border very long ascending nearly vertically to the beak and at the same time describing a gentle curve; posterior extremity quite narrow, rounded or subtruncated; dorsal margin straight, horizontal and sharply carinate.

Escutcheon occupying the whole upper surface, concave, anteally wide and posteally narrow, and crossed by about 12 smooth costellae which extend from the inner border obliquely backward to the superior border and are closer together near the umbones though posteriorly they become gradually distant and finally disappear. These costellae are distinct, somewhat raised on the surface at the inner border, but becoming obsolete on approaching the superior. Area excavated, anteally narrow, posteally broad, smooth except the umbonal portion which is crossed by a series of transverse costellae extending backward and linking those of the escutcheon with the costae on the pallial surface of the valve.

Pallial surface of the valve provided with numerous, smooth costae all of which originate at the border of the area; these costae are shed-roof-shaped, with the anterior side steep and the posterior gently sloping; 5 costae nearest to the umbones arranged concentrically or in oblique curves, and disappearing near the anterior border; the succeeding 5 enlarging or becoming inflated in their middle portion and passing obliquely forward either to the anterior border or to the lower; the other 2 or 3 occupying the flattened posterior portion of the valve, straight, directed obliquely backward.

This species is closely related to *T. longiloba* Jimbo¹⁾ found in the *Trigonia*-Sandstone of the Hokkaido, but it is distinguished from the latter by the sculpture on the escutcheon and the thicker costae all of which originate at the marginal carina. This species is also allied to *T. brevicula*²⁾ Yeh. from the *Trigonia*-Sandstone of the Hokkaido, from which it is distinguished by the sculpture on the escutcheon and area and smooth costae.

1) S. Yehara: The Cretaceous *Trigoniae* from Miyako and Hokkaido. Sc. Rep. Tohoku Imp. Univ. Sendai, Japan, II. Ser. (Geology), Vol. II, No.2, 1915. Pl. I, Fig 9; Pl. II. Fig. 10a, b, 11, 12.

2) *ibid*: Op. cit. Pl. II, Fig. 18, 19.

Locality :—Gosho-no-ura-shima, an island of Amakusa, Prov. Higo;
 Ōemura, the west coast of Shimoshima
 of Amakusa, Prov. Higo.

Trigonia Ogawai sp. nov.

PL. IV. Fig. 3—5.

Dimensions :—

Height	20,0 mm
Length	24,0 mm
Breadth	5,6 mm

Shell like *T. dilapsa* Yeh.; escutcheon occupying almost the whole of the upper surface, concave, anteally broad and posteally narrow and crossed by about 15 smooth costellae, which extend from the inner border obliquely backward to the superior. Area excavated, smooth except the umbonal portion which is ornamented with a series of transverse costellae extending backward and linking those of the escutcheon with the costae found on the pallial surface of the valve.

Pallial portion of the valve occupied by 15 tuberculated costae of which the 7 nearest to the umbones are oblique; the next 5 on the most inflated portion of the valve make a gentle flexure and swell a little in their middle portion while the remaining 3 on the posterior depressed portion are straight and oblique.

In the external form the species resembles *T. dilapsa* Yeh. and *T. brevicula* Yeh., but it is easily distinguished from the former by the different sculpture of the escutcheon and the tuberculated costae and from the latter by the backward course of the costellae of the escutcheon.

Locality :—Gosho-no-ura-shima, an island of Amakusa, Prov. Higo.

Trigonia Hokkaidoana Yeh.

PL. VII. Fig. 3-5.

1915. *Trigonia Hokkaidoana* Yeh. : Cretaceous Trigoniae from Miyako and Hokkaido. Sc. Rep. Tohoku Imp. Univ. Sendai, Japan, II. Ser. (Geology). Vol. II., No. 2, p. 30, Pl. I, Fig. 1-8.
1921. *Trigonia* cf. *Hokkaidoana* Yeh. : On a collection of the Cretaceous Fauna from Russian Sakhalin. Records of the Geol. Committee of the Russian Far East. No. 12, p. 5, Pl. I, Fig. 2.

Dimensions :—

Height	25,0 mm
Length	42,0 mm?
Breadth	15,0 mm

The specimen from Amakusa obtained by the writer is rather in a bad state of preservation so that the whole characters are not clearly discernible.

Shell inflated in front, produced, attenuated behind; umbones elevated. Pallial surface of the valve ornamented with many tuberculated costae; 5 or more costae on the most inflated portion of the valve make a gentle flexure and swell a little in their middle portion, while the remaining costae on the posterior depressed portion are straight and obliquely set.

As the writer has already mentioned in his paper called "Cretaceous Trigoniae from Miyako and Hokkaido", the specimens found in the Hokkaido as well as in Miyako are both variable, the former in the breadth of the escutcheon and the latter in that of the area. Moreover, the anterior border of the valve in the Miyako specimens is longer than in those of the Hokkaido, and the crenulation of the ribs of the former are more distinct than those of the latter.

As to the specimens of Amakusa, they are more related to

those of the Hokkaido than to those of Miyako.

T. Evansana Meek¹⁾ and *T. Evansana* var. *Oregana* Packard²⁾ found in the Chico group are closely related to the present species and the distinction of the North American species from that of Amakusa is the variability of the width of the escutcheon in the latter.

Locality:—Gosho-no-ura-shima, an island of Amakusa, Prov. Higo.

***Trigonia Sakakurai* sp. nov.**

PL. IV. Fig. 6.

Dimensions:—

Height	63,0 mm
Length	79,0 mm ?
Breadth	14,0 mm ?

This peculiarly shaped and uniquely ornamented species is unfortunately badly preserved.

Shell large, tumid; the pallial portion of the valve ornamented with 10 or more oblique, nearly straight costae which are broad, heavy, rounded ridges apparently showing no tendency to become tubercular. The 4 or more posterior costae on the depressed portion of the valve are less conspicuous; they are short, narrow, close and oblique.

The species is closely related to *T. Columbiana* Packard³⁾ from the Haida formation of the Queen Charlotte Series, but it is distinguished by having wider intercostal spaces and costae not so thick.

Locality:—Gosho-no-ura-shima, an island of Amakusa, Prov. Higo.

-
- 1) E. L. Packard: The Trigoniae from the Pacific Coast of North America: 1921. Univ. Oregon Publ. Vol. I, No 9, PL. 9, Fig. 5,6.
 - 2) *ibid*: Op. cit. Pl. 9, Fig. 7.
 - 3) *ibid*: Op. cit Pl. 11, Fig. 1,3.

Trigonia Yokoyamai var.

PL. VI. Fig. 8.

1915. *Trigonia Yokoyamai* Yeh.:—Cretaceous Trigoniae from Miyako and Hokkaido, Sc. Rep. Tohoku Imp. Univ. Sendai, Japan. II. Ser. (Geology). Vol. II., No. 2, p. 41, Pl. II, Fig. 15, 16a, b, 17.

Dimensions:—

Height 37,0 mm

Length 53,0 mm

Breadth 11,0 mm

Shell arcuate, subtrigonal, inflated in front and attenuated behind; umbones elevated, anteromesial; anterior side of the valve convex, wide, its border arcuately curved with the lower border which is oblique posteally; siphonal border obliquely truncated.

Area excavated, wider posteally, with a distinct median groove. Lines of growth seen at the siphonal border.

Pallial surface of the valve provided with numerous smooth costae all of which, with the exception of a few posterior ones, originate at the marginal carina; the costae shed-roof-shaped, with the anterior side steep and the posterior gently sloping; 6 of the costae on the most inflated portion of the valve enlarge or become inflated in their middle portion and pass obliquely forwards either to the anterior border or to the lower; the 4 remaining ones occupying the flattened posterior portion of the valve originate not at the marginal border but a little below it, and are short, narrow, close and oblique.

The species is closely related to *T. Yokoyamai* Yeh.¹⁾ of the Cretaceous of Miyako, but it is distinguished by the thicker costae, the wider intercostal spaces and the angulated marginal carian.

1) S. Yehara: op. cit. p. 41, Pl. II, Fig. 15, 16a, b, 17.

Locality :— Goshō-no-ura-shima, an island of Amakusa, Prov. Higo.

Pennatae subgroup.

***Trigonia subovalis* Jimbo.**

PL. VI. Fig. 1-5.

1894. *Trigonia subovalis* Jimbo: Beiträge zur Kenntniss der Fauna der Kreideformation von Hokkaido. Pal. Abh., Bd. VI. (Neue Folge Bd. II) Heft. 3, S. 42, Taf. VIII (XXIV), Fig. 5, 5a.
1915. *Trigonia* cfr. *subovalis* Jimbo: Cretaceous Trigoniae from Miyako and Hokkaido. Sc. Rep. Tohoku Imp. Univ. Sendai, Japan. II. Ser. (Geology). Vol. II. No. 2, p. 42, Pl. I, Fig. 14-17.
1921. *Trigonia* cfr. *sublacvis* (Jimbo) Yehara: On a collection of the Cretaceous fauna from Russian Sakhalin. Records of the Geol. Comm. of the Russian Far East. No. 12, Pl. I, Fig. 2.

Dimensions :—

Height	13,5 mm
Length	30,0 mm
Breadth	4,0 mm

This species shows a wider distribution than the preceding ones; it has been first described by Prof. Jimbo from the Cretaceous of the Hokkaido, then by the writer from the same Cretaceous and afterward by Mr. Hayasaka from the Cretaceous of Russian Sakhalin. The writer discovered the species also in Amakusa from the *Trigonia*-Sandstone and the *Ammcnite*-bearing shale.

As the writer has mentioned in another paper, the species contains two forms; the one which is larger in size and thick-shelled and

the other which is smaller in size and thin. However, they are identical in all other essential characters. The same is the case with the Amakusa specimens which resemble in all their essential characters to the species of the Hokkaido; but the vertical and horizontal costae are somewhat more numerous. The oblique costellae found on the escutcheon are well preserved on some young specimens.

This species is closely allied to *T. Newcombei* Packard¹⁾ of the Haida formation of the Queen Charlotte-series from which, however, it differs by a greater number of vertical costae. *T. Maudensis* Whiteaves²⁾ from the same formation is distinguished by the differently sculptured escutcheon.

Locality:—Gosho-no-ura-shima, an island of Amakusa, Prov. Higo;
 Ōdo and Wadanohana, east coast of Shimoshima. Amakusa Is. Prov. Higo.

Glabrae group

Trigonia Kikuchiana Yokoyama

PL. VII. Fig. 1,2.

1891. *Trigonia Kikuchiana* Yok.: On some Cretaceous fossils from Shikoku. Journ. Coll. Sc. Tokyo. Vol. IV, Pt. II. p. 363, Pl. XL. Fig. 4, 5a,b,6.
1915. *Trigonia Kikuchiana* Yok.: Cretaceous Trigoniae from Miyako and Hokkaido. Sc. Rep. Tohoku Imp. Univ. Sendai, Japan. II. Ser. (Geology). Vol. II, No. 2, p. 44, Pl. II, Fig. 1-3, 4a, b, 5a, b, 6-9.

Dimensions:—

Height	47,0 mm
Length	46,0 mm
Breadth	11,0 mm

1) E. L. Packard: Op. cit. Pl. 9, Fig. 4; Pl. 10, Fig. 2,4,6; Pl. 11, Fig. 2.

2) ibid: Op. cit. Pl. 9, Fig. 2.

The species was described by Prof. Yokoyama from the Cretaceous of Shikoku and afterward by the writer from Miyako. It is found also in Amakusa.

The well preserved specimens of Amakusa resemble those of Miyako; the outline is ovately quadrate with the postero-dorsal margin oblique. The area is wide; the umbones are incurved, with 2 or 3 sulci. Pallial portion smooth with two or more concentric line of growth.

Some specimens obtained from the Cretaceous of the Katsuragawa basin, Prov. Awa show three or more strong sulci on the apex of the valve.

Locality:—Gosho-no-ura-shima, an island of Amakusa, Prov. Higo.

Scaphoidea group

Trigonia Japonica sp. nov.

PL. VI. Fig. 6, 7.

Dimensions:—

Height	75,0 mm?
Length	77,0 mm
Breadth	16,0 mm

There is a species with a peculiar shape and ornamentation. It occurs at two places Amakusa and Sanuki.

The pallial surface of the valve is provided with numerous cord-like costae which originate at the marginal border with the exception of some posterior ones; two or more costae of the umbonal portion are concentric, but the remaining ones occupy a greater portion of the valve are curved.

The tubercles on the costae in the middle portion of the valve are irregular and thick.

Area smooth, bifurcated; a row of tubercles is on the median groove at the umbonal portion.

Locality: — Ōemura, the west coast of Shimoshima in Amakusa, Prov, Higo; Kitadani Prov. Sanuki.

Explanation of Plate IV.

(All figures in Nat. size)

- Fig. 1, 1a. *Trigonia dilapsa* sp. nov. *Trigonia*-Sandstone of Goshonoura-shima, Amakusa Is.; external mould of an adult specimen.
- Fig. 2. *Trigonia dilapsa* sp. nov. *Trigonia*-Sandstone of Goshonoura-shima, Amakusa Is.; external mould showing the costellae of the escutcheon and area.
- Fig. 3-5. *Trigonia Ogawai* sp. nov. *Trigonia*-Sandstone of Goshonoura-shima, Amakusa Is.; external moulds.
- Fig. 6. *Trigonia Sakakurai* sp. nov. *Trigonia*-Sandstone of Goshonoura-shima, Amakusa Is.; external mould of an adult specimen whose umbonal and postal portion are not preserved.

Explanation of Plate V.

(All figures in Nat. size)

- Fig. a. *Trigonia dilapsa* sp. nov. and Fig. b. *Trigonia Ogawai* sp. nov. *Trigonia*-Sandstone of Goshonoura-shima, Amakusa Is.; external mould.

Explanation of Plate VI.

(All figures in Nat. size)

- Fig. 1, 2. *Trigonia subovalis* Jimbo. *Ammonite*-bearing shale, Wadanohana of Kamishima, Amakusa Is.; adult specimens.
- Fig. 3-5. *Trigonia subovalis* Jimbo. *Ammonite*-bearing shale, Wadanohana of Kamishima, Amakusa Is.; showing costellae on the escutcheon of young examples.
- Fig. 6. *Trigonia Japonica* sp. nov. Izumi-Sandstone, Kitadani,

- Prov. Sanuki ; external mould of an adult specimen whose umbonal portion is not preserved.
- Fig. 7. *Trigonia Japonica* sp. nov. *Trigonia*-Sandstone of Ōemura of Shimoshima, Amakusa Is. ; external mould of an adult specimen whose posterior portion is not preserved.
- Fig. 8. *Trigonia Yokoyamai* var. *Trigonia*-Sandstone of Goshono-ura-shima, Amakusa Is. ; external mould of an adult specimen.

Explanation of Plate VII.

(All figures in Nat. size)

- Fig. 1. *Trigonia kikuchiana* Yok. *Trigonia*-Sandstone of Goshono-ura-shima, Amakusa Is. ; external mould
- Fig. 2. *Trigonia kikuchiana* Yok. *Trigonia*-Sandstone of Goshono-ura-shima, Amakusa Is. ; external mould of a pressed specimen.
- Fig. 3. *Trigonia Hokkaidoana* Yeh. *Trigonia*-Sandstone of Goshono-ura-shima, Amakusa Is. ; external mould of an adult specimen whose posteal portion is not preserved.
- Fig. 4, 5. *Trigonia Hokkaidoana* Yeh. *Trigonia*-Sandstone of Goshono-ura-shima, Amakusa Is. ; external moulds of two specimens which show a portion of the shell.