The Cretaceous Trigoniae from Miyako and Hokkaido.

BY

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With 2 Plates.

INTRODUCTION.

In 1891, Prof. M. YOKOYAMA described in his paper,[1] "On some Cretaceous Fossils from Shikoku," three new species of *Trigonia*, *T. pocilliformis*, *T. Kikuchiana* and *T. rotundata*, from the *Trigonia* sandstone of Shikoku, which he considered as of the Gault-Cenomanian age and hence contemporaneous with the Cretaceous rocks of the Hokkaido. The latter also contain *Trigonia*, and two new species, *T. longiloba* and *T. subovalis*, together with numerous other fossils, were described subsequently by Prof. K. JIMBO in his "Beiträge zur Kenntniss der Kreideformation von Hokkaido"[2] 1894. Of all known Cretaceous rocks of Japan, those of the Hokkaido being most fossiliferous and most fully studied, the division[3] there recognized by Prof. H. YABE may be taken as the standard of reference for all other Japanese Cretaceous rocks and hence also of the *Trigonia*-bearing ones. This is, according to YABE, as follows, counting from below upwards:

1. The Lower Ammonite beds with *Orbitolina* limestone.
2. The *Trigonia* sandstone.
   a. Lower *Acanthoceras* zone or *T. longiloba* zone.
   b. *Thetis* zone.
   c. *Pectunculus* zone.
3. The upper Ammonite beds.
   a. Upper *Acanthoceras* zone.
   b. *Scaphites* beds.
   c. *Pachydiscus* beds.

Of the later discoveries of the Cretaceous *Trigonia* in Japan, that in the Miyako District in the Prov. Rikuchu only deserves special mention, for, as already briefly noted by YABE and the present writer in another paper,[4] there are many places where various species, of which some are new, are found in great profusion and at the same time in excellent preservation, more excellent than have ever been seen in the case of the *Trigonia* sandstone of the other districts in Japan.

Soon after the first specimens of *Trigonia* were collected at Hideshima in the Miyako District by Mr. S. YAEGASHI 1899, YABE gave in a short note[5] a brief account of the distribution of *Trigonia* in Japan, with

1) M. YOKOYAMA: On some Cretaceous Fossils from Shikoku. Journ. Coll. Sci. Tokyo. Vol. IV. Pt. II. 1891.
2) K. JIMBO: Beiträge zur Kenntnis der Fauna der Kreideformation von Hokkaido. Palaeontologische Abhandlungen Bd. VI. (Neue Folge, Bd. II) Heft. 3. 1894.
3) H. YABE: Cretaceous Cephalopoda from the Hokkaido. Journ. Coll. Sci. Tokyo. Vol. XVIII, Art. 2. 1903.
4) H. YABE and S. YEHARA: The Cretaceous Deposits of Miyako. Sci. Reports, Sendai. Vol. I. No. 2. 1913.
5) H. YABE: The Cretaceous Trigoniae of Japan (Japanese). Journal Geol. Soc. Tokyo. Vol. VIII. P. 545, 1901.

special reference to those from Miyako; in this note, he already expressed the specific distinction existing between the *Trigonia* from Hideshima belonging to the Scabrae group and *T. pocilliformis*, YOK., the former much approaching to an undescribed form from Hokkaido in his possession. In his subsequent visit[1] to Hideshima, in 1902, he found there not only this new form, which he then brought for comparison with *T. crenulata* LAM., but also *T. Kikuchiana* in its association.

Specimens of *Trigonia* from the Miyako District, having been collected by the present writer with special attention during 1910–1912, gradually accumlated sufficiently so as to allow him to make detailed comparison of them with those found in Hokkaido, Shikoku and Honshu; this work which the present writer began to undertake in the Geol. Inst. Imp. Univ. Tokio under Prof. KOTO and Prof. YOKOYAMA, has been subsequently continued in the Geol. Inst. Imp. Univ. Sandai under Prof. YABE. In publishing this account in the present form, the writer wishes to take occasion to express his sincere thanks to all of them for their valuable suggestions and constant encouragement. To Prof. YABE, the writer is further greatly indebted not only for his kind help on the preparation of this paper and for the labourious undertaking of proof reading, but also for his liberality in having made accessible to the writer the original specimens of *Trigonia* from Hokkaido; this material was, indeed, already worked out by Prof. YABE himself, and the present writer is priviledged by his kind generosity to describe them together with those from Miyako.

Distribution of Trigonia in the Cretaceous of Japan with some reference to foreign localities.

Some detailed stratigraphical accounts of the Cretaceous rocks developed in the Miyako District have been already given by YABE and the present writer in a paper entitled "The Cretaceous Deposits of Miyako"; it is therefore of no use to recapitulate the details again in this place. But for the sake of the convenience of the reader, the order of the succession of rocks there recognized is given in the following table, with special reference to the distribution of the species of *Trigonia* found in them.

Succession of the Cretaceous Rocks in ascending order. \ Species of *Trigonia* found	*T. Hokkaidoana.*	*T. Yokoyamai.*	*T. Datemasamunei.*	*T. Kotai.*	*T. Kikuchiana.*
I. Raga conglomerate	—	—	—	—	—
II. Moshi sandstone	×	×	—	×	×
III. Tanohata sandy shale	×	×	—	—	—
IV. Hiraiga sanstone	×	×	—	—	—
V. *Orbitolina* sandstone	×	—	×	—	—
IV. Akito sandstone	×	—	—	—	—
VII. Hideshima sandstone and shale	—	—	—	—	×

1) H. YABE and F. OTSUKI: Brief Note on the Geology of the Environs of Miyako (Japanese). Journal Geol. Soc. Tokyo. Vol. IX. p. 278, 1902.

Of these forms, *T. Kikuchiana* belongs to the Glabrae group, while all the others belong to the Scabrae. As first pointed out by YABE, the great geological importance is the association of *T. Kikuchiana* and *T. Hokkaidoana* in the Miyako District, the former of these two being hitherto known only from *Trigonia* sandstone, widely distributed in Honshu (Ohinata and Todai, Prov. Shinano; Yuasa, Prov. Kii); and Shikoku (always in association with *T. pocilliformis*), and the latter in the *Trigonia* sandstone of Hokkaido (together with *T. longiloba* JIMBO). In Hokkaido there are, beside these two, three other species, *T. brevicula*, *T. subovalis* and *T.* aff. *Tryoniana*. Of these, *T. longiloba*, *T. brevicula* and *T. Hokkaidoana* belong to Scabrae; *T. subovalis* to the Pennatae subgroup and *T.* cfr. *Tryoniana* to the Quadratae, the last species being the single representative of the group Quadratae in Japan. Regarding to the vertical distribution of these forms, YABE found *T. brevicula* only in the *Thetis* zone and *T. Hokkaidoana*, *T. longiloba*, *T. subovalis* in the *T. longiloba* zone, while the exact position of *T.* aff. *Tryoniana* is still unknown though no doubt derived from the *Trigonia* sandstone group.

Trigonia sandstone of Honshu and Shikoku is characterized by containing *T. pocilliformis* and *T. Kikuchiana* (*T. rotundata* being considered identical with *T. Kikuchiana*). This sandstone is, thus, rather monotonous palaeontologically as well as lithologically, in spite of its very wide geographical distribution. So far as is known to the writer at present, the sandstone is developed in Hokkaido (along the Ikushumbets and Ponhorokabets, Prov. Ishikari), Honshu (Awaji; Yuasa, Prov. Kii; Todai, Prov. Shinano; Sanchu, Prov. Kozuke and Prov. Shinano; Choshi, Prov. Shimosa; Oshima and Massakimura Prov. Rikuzen; Miyako, Prov. Rikuchu), Shikoku (Katsuragawa, Prov. Awa; Sakawa, Monobegawa and Ryoseki, Prov. Tosa) and Kiushu (Sakasegawa in Shimoshima, Amakusa Is.; Kawaguchi, Prov. Higo). Thus all the localities of the Cretaceous *Trigonia* and the distribution of various species in them, may be summed up as is shown on the following table.

Species of *Trigonia* / Localities		*T. pocilliformis.*	*T. longiloba.*	*T. subovalis.*	*T. Hokkaidoana.*	*T. Datemasamunei*	*T. Yokoyamai.*	*T. Kotoi.*	*T. brevicula.*	*T.* cfr. *Tryoniana.*	*T. Kikuchiana* (+ *rotundata*)
Kiushu	Sakasegawa in Shimoshima, Amakusa Is....	?	—	—	—	—	—	—	—	—	—
	Kawaguchi, Prov. Higo	?	—	—	—	—	—	—	—	—	—
Shikoku	Katsuragawa, Prov. Awa	×	—	—	—	—	—	—	—	—	×
	Sakawa, Prov. Tosa	×	—	—	—	—	—	—	—	—	×
	Monobegawa, Prov. Tosa	×	—	—	—	—	—	—	—	—	—
	Ryoseki, Prov. Tosa	×	—	—	—	—	—	—	—	—	×
Honshu	Awaji Is.	×	—	—	—	—	—	—	—	—	—
	Yuasa, Prov. Kii	×	—	—	—	—	—	—	—	—	×
	Todai, Prov. Shinano	×	—	—	—	—	—	—	—	—	×
	Sanchu, Prov. Kozuke, and Prov. Shinano.	×	—	—	—	—	—	—	—	—	×
	Choshi, Prov. Shimosa	?	—	—	?	—	—	—	—	—	—
	Oshima & Massakimura, Prov. Rikuzen ...	×	—	—	—	—	—	—	—	—	—
	Miyako, Prov. Rikuchu	—	—	—	×	×	×	×	—	—	×
Hokkaido	Ikushumbets, Prov. Ishikari	—	×	×	×	—	—	—	×	×	—
	Ponhorokabets, Prov. Ishikari	—	—	×	×	—	—	—	—	×	—

Almost all of these species of *Trigonia* have their near allies in the other Cretaceous deposits of the circum-Indopacific regions; for instance, *T. crenulata* var. *Peruana* PAULCKE (Lower Turonian) from Peru is allied to *T. Datemasamunei*; *T. subcrenulata* D'ORB. (Aptien) from Columbia and *T. Emoryi* CONR. (Vraconian and lower Cenomanian) from Mexico to *T. Hokkaidoana*; *T. Tryoniana* GABB. (Cenomanian) from the Nanaimo Cretaceous of the Vancouver Island to *T.* cfr. *Tryoniana*; and *T. Maudensis* WHITEAVES from "c" horizont of the Cretaceous of the Queen Charlotte Islands to *T. subovalis*. Further, even some of the forms found in the Cretaceous of the Atlantic side of America and Europe show remarkable resemblance to the Japanese species, thus, *T. eufalensis* GABB. (Danien) from New Jersey, U.S.A. is allied to *T. Yokoyamai* and *T. crenulata* LAM. (Turonian) from Loire, France, to *T. Hokkaidoana*.

DESCRIPTION OF SPECIES.

Scabrae Group.

Trigonia Datemasamunei sp. nov.

Pl. II (2), Fig. 13, 14.

Dimensions :—

Height = 4.7 cm.

Length = 6,8 cm.

Breadth = 1,8 cm.

Shell sublunate, moderately inflated anteally; produced, slightly attenuated and depressed posteally; umbones large, anteromesial, not prominent, incurved and slightly recurved; the anterior side rather narrow but produced vertically, with its border very broadly rounded; the lower border straight, arcuately curved with anterior border and obliquely ascending to the siphonal border; superior border slightly concave, forming an obtuse angle with the rounded siphonal border; ligamental aperture somewhat wide.

Escutcheon, occupying almost half of the upper surface of the valve, depressed, concave, wider anteally but narrower posteally; traversed by indistinctly crenulated constellae, about 15 in number, extending from the inner border obliquely upwards to the superior border; they come closer together near the umbones, but distant posteally. Area raised, excavated, narrower anteally but wider posteally, bipartite by the mesial furrow; roughly plicated, except the umbonal portion with costellae which connect those on the escutcheon and the costae on the pallial surface of the valve.

Pallial surface of the valve with numerous crenulated costae, all of which originate at the marginal border and pass forwards and downwards; costae forming an ridge with a steep anteal and gentle posteal slope. 7 costae nearest to the apex arranged concentric or curved obliquely; the succeeding 11 passing obliquely forwards either to the anterior or lower border, attenuating or enlarging gradually downwards; posteal 8, occupying the flattened or depressed portion of the valve, set oblique, enlarging towards the lower border. Crenulations of all the costae indistinct and developed only on their enlarged portion.

The narrow interstitial spaces between the shed-roof-like costae, with indistinct crenulation are characteristic of the species and renders its distinction from *T. Hokkaidoana* very easy.

T. crenulata var. *Peruana* PAULCKE[1] from the Middle Cretaceous of Peru is closely related to this species but the former is distinguished from the latter by having numerous and more distinct crenulations on the costae as well as costellae, the wider and more finely plicated area, and the wider escutcheon.

Locality :— Raga II., Miyako District.

Horizon :— *Orbitolina* sandstone.

1) W. PAULCKE: Ueber die Kreideformation in Südamerika und ihre Beziehungen zu anderen Gebieten. I. Theil. —Neues Jahrbuch für Min. Geol. u. Pal. B.B. XVII, 1903, S. 272, Taf. XV. Fig. 9, 9a, b.

Trigonia Hokkaidoana sp. nov.

Pl. I (1), Fig. 1-8.

Dimensions :—

Height = 4,0 cm.

Length = 5,6 cm.

Breadth = 1,5 cm.

Shell subcrescentic, inflated anteally, produced and slightly attenuated posteally; umbones anteromesial, elevated, attenuated incurved and slightly recurved; anterior side narrow and produced vertically, its border rounded and arcuately curved with the lower border, which is nearly straight posteally; superior border lengthened, concave, forming an obtuse angle with the siphonal border.

Escutcheon occupying more than one half of the upper surface, concave, traversed transversely by more than 19 serrated costellae; costellae arranged colsely near the umbones but distant posteally, slightly curved, with the convex surface towards the posterior side. Area narrow and raised, bifurcate by the mesial furrow, with a few, small transverse costellae on its umbonal portion and small transverse plications on the rest.

Pallial surface of the shell provided with numerous costae, originating at the border of the area as narrow, acute, erect, crenulated ridges and diverging forwards and downwards; interspaces plane, considerably wider on the anterior surface of the shell than on the posterior portion; 8 costae nearest to the apex are arranged concentric or curved obliquely; the next 9 crossing the pallial surface of the shell obliquely forwards to either the anterior or lower border, swell at their middle portion, and become attenuated near the border, and all of them show well developed crenulations, appearing as a row of obtuse nodes; the remaining 10 costae on the posteal portion of the valve, are oblique and straight.

This is only one form common to the Cretaceous of Miyako (Fig. 1–3, 8) and Hokkaido (Fig. 4–7); remarkable, however, is the great variability of escutcheon in width in the specimens from Hokkaido and of area in those from Miyako.

T. pocilliformis YOK., which is the most common form in the Cretaceous of Shikoku, is easily distinguished from the present form by its having the anterior border of the valve much shortened in vertical direction and by having less numerous costae.

T. crenulata LAM.[1] from the Turonian of Loire in France and *T. Emoryi* CONR.[2] from the Lower Cenomanian of Cerro de Muleros, Mexico, are also allied to this species but the first of the former is distinguished from this species by having the shell anteroposteally shorter, intercostal spaces narrower and the siphonal border considerably wider, and the second of the former by having the costellae on the whole surface of its area.

T. crenulata var. *Peruana* PAULCKE from the Lower Turonian of Peru is a form, most closely allied to the present species but is characterized by its finer crenulation of costae, wider area and escutcheon.

Localities :— Hideshima, Moshi, Koikorobe, Haipe, Hiraiga I & II, Raga II, Miyako District; Ikushumbets and Ponhorokabets, Prov. Ishikari, Hokkaido.

Horizon :— From *Plagioptychus* zone to Akito sandstone (Miyako); *T. longiloba* zone (Hokkaido).

1) D'ORBIGNY: Paléontologie Française. Lamellibranches. Text & Atlas.

2) E. BÖSE: Fauna cretácea de la Encantada, placer de Guadalupe, Estado de chihuahua.—Boletin del Instituto Geológico de México. Número 25, 1910. P. 121, pl. XXIV, fiig. 1–5; pl. XXV, fig. 1, 3, 5; pl. XXVI, fig. 1.

Trigonia Kotoi sp. nov.

Pl. I (1), Fig. 10 a, b, c.

Dimensions :—

Height = 5,0 cm.

Length = 5,8 cm.

Breadth = 2,5 cm.

The only specimen obtained from the *Plagioptychus* zone in the Moshi sandstone of Hiraiga I, Miyako District, is unfortunately not well preserved, its anterior side being much squeezed and the lower border broken away.

Superior border lengthened, concave, forming an obtuse angle with the siphonal border.

Escutcheon, occupying almost the whole of the upper surface, concave, raised along the superior border, wider anteally but narrower posteally; oblong in outline when the valves are closed; traversed by 16 thick costellae, extending from the inner border obliquely upwards to the superior border; they are arranged closer together near the umbones but more distant posteally. Area narrow, its umbonal portion reduced to a mere ridge; surface smooth, and bifurcate by a mesial furrow on its posterior portion.

Pallial portion of the valve with numerous very thick costae, all of which except a few posterior ones, originate at the marginal border of the valve; the 3 or more costae nearest to the apex are concentric or curved obliquely, they merge on the shell-surface before reaching the anterior border; the next 7 pass obliquely forward either to the anterior or lower border becoming there much attenuated or enlarged; these 7 ribs are very coarsely crenulated, giving rise to thick tubercular nodes; the other 4 or more, occupying posteal portion of the valve originate not on the marginal border but little below of it.

This species is allied to *T. pocilliformis*, but is distinguished from it by having slightly narrower intercostal spaces and very coarsely tuberculated ribs.

Locality :— Hiraiga I., Miyako District.

Horizon :— *Plagioptychus* zone.

Trigonia longiloba JIMBO.

Pl. I (1), Fig. 9; Pl. II (2), Fig. 10 a, b, 11, 12.

1894. *Trigonia longiloba* JIMBO : Beiträge zur Kenntnis der Kreideformation von Hokkaido. Pal. Abh. Bd. VI. (Neue Folge Bd. II) Heft. 3. s. 42, Taf. VIII (XXIV), Fig. 2–4.

Dimensions :—

Height = 2,3 cm.

Length = 3,5 cm.

Breadth = 0,9 cm.

The type specimens of this species, on which JIMBO's description is based, are in a rather bad state of preservation; hence the following supplemental note is made on better ones in YABE's collection.

Shell like *T. Yokoyamai*; escutcheon relatively short, moderately attenuated posteally, concave, remarkably raised towards the superior border and traversed by many costellae, extending from the inner border obliquely backward to the superior border. Area wide showing a faint trace of mesial furrow; smooth, except the umbonal portion of the area which has costellae originating at the marginal border, and diverging backward; the costellae are distinct near the umbones, but become gradually shorter and fainter with increased distance, and finally disappear.

Pallial surface of the valve occupied by 12 or more smooth costae, of which 3 near the umbones, are oblique; the next 6, on the most inflated portion of the valve, make a gentle flexure and swell a little at their middle portion and the remaining 3 on the posterior depressed portion are straight and set oblique.

In the external form, as well as in the ornamentation of the shell, this species resembles *T. Yokoyamai* and *T. brevicula*, but is easily distinguished from the latter two, first by the different sculpture of the area near the umbones and of the escutcheon, and second by less numerous costae.

Locality :— The first gorge of the Ikushumbets above the Ikushumbets coal mines, Hokkaido.

Horizon :— *T. longiloba* zone.

Trigonia Yokoyamai sp. nov.

Pl. II (2), Fig. 15, 16a, b, 17.

Dimensions :—

Height = 2,8 cm.

Length = 4,2 cm.

Breadth = 1,1 cm.

Shell ovately trigonal; remarkably inflated anteally, produced and attenuated posteally, umbones not elevated, anteromesial, incurved and slightly recurved; anterior side of the shell convex, wide, its border arcuately curved with the lower border, which is excavated posteally; superior border lengthened, straight and oblique, its extremity forming an obtuse angle with the siphonal border which is more or less V-shaped.

Escutcheon occupying more than one half of the upper surface of the valve, concave, wider anteally and narrower posteally, and traversed by smooth costellae, about 13 in number, which extend from the inner border obliquely upwards to the superior border, and are arranged closer together near the umbones but gradually distant posteally. Area excavated, slightly elevated; narrow anteally but wider posteally, bifurcated by a distinct median groove; plain, except the umbonal portion which is, on a certain specimen, apparently traversed by a series of transverse costellae, linking those on the escutcheon and the costae on the pallial surface of the valve.

Pallial surface of the valve provided with numerous plain costae, all of which, with the exception of a few posterior ones, originate at the border of the area; the costae shed-roof shaped, with the anterior side steep and the posterior sloping gently; 6 costae nearest to the umbones, arranged concentric or in oblique curves, disappear near the anterior border; the succeeding 7 enlarge or become inflated at their middle portion and pass obliquely forwards either to the anterior or to the lower border; the others 4, occupying the flattened posterior portion of the valve, originate not at the marginal border but a little below it; they are short, narrow, arranged close and nearly vertical.

This species appears to be closely related to *T. eufalensis* GABB.[1] in the Riplayan fauna of the New Jersey Cretaceous of the U.S.A. But the latter is distinguished from the former by having the costellae on the area making an acute angle, facing the umbones, with costae, and by having the costae on the anterior surface of the valve more curved.

Localities :— Hiraiga I, Taro, and Moshi, Miyako District.

Horizons :— *Tylostoma* zone (Hiraiga I), Moshi sandstone (Taro), *Trigonia Kikuchiana* zone (Moshi).

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1) STUART WELLER: A Report of the Cretaceous Palāontology of New Jersey, based upon the stratigraphic studies of George N. Knapp. Geological Survey of New Jersey. 1907.

Trigonia brevicula sp. nov.

Pl. II (2), Fig. 18, 19.

Dimensions :—

Height = 2,2 cm.

Length = 2,8 cm.

Breadth = 0,9 cm.

This species is represented by many specimens collected by YABE in the *Thetis* aff. *affinis* zone of the *Trigonia* sandstone of Hokkaido, one in outer cast and the other provided partly test; the best specimens of the latter are figured on plate II.

Shell ovately trigonal, inflated anteally, produced attenuated and depressed posteally; umbones small, not elevated, anteromesial, incurved and slightly recurved; anterior side very convex, with its border rounded and arcuately curved with the lower border; superior border slightly concave.

Escutcheon, occupying almost half of the upper surface depressed, wider anteally but narrower posteally, traversed by the costellae, which originate at the inner border and extend upwards to the superior border. They are usually obsolete, but sometimes distinct, little raised on the surface and sometimes quite disappearing. Area very narrow near the umbones and showing a trace of costellae, which are often hardly visible; its posterior portion smooth, only with line of growth and a median groove.

Pallial surface of the valve has numerous slightly crenulated costae, all of which, except a few posterior ones, originate at the marginal border; costae forming an obtuse ridge with a steep anteal and gentle posteal slope; more than 8 anterior costae, on inflated portion of the valve, enlarge at their middle portion and pass obliquely forwards to the anterior and lower border; the remaining 3 or more costae, occupying the flattened posterior portion of the valve, originate not at the marginal border but a little below it, and are short, narrow and closely arranged.

This species much resembles *T. Yokoyamai* and *T. longiloba*, though easily distinguishable by its slightly crenulated costae and the remarkably concave, plain or obsoletely costellated escutcheon.

Locality :— Along the Ikushumbets, some 3 km. above the Ikushumbets coal mines, Hokkaido.

Horizon :— *Thetis* aff. *affinis* zone.

(Pennatae subgroup).

Trigonia cfr. subovalis JIMBO.

Pl. I (1), Fig. 14–17.

1894. *Trigonia subovalis* JIMBO: Beiträge zur Kenntnis der Fauna der Kreideformation von Hokkaido. Pal. Abh. Bd. VI. (Neue Folge Bd. II) Heft. 3. s. 42, Taf. VIII (XXIV), Fig. 5, 5 a.

Dimensions :—

Height = 1,9 cm.

Length = 2,9 cm.

Breadth = 0,6 cm.

Trigonia subovalis is a species founded by JIMBO on two figured specimens from the *Trigonia* sandstone of Hokkaido. They are 3,6 cm. long, rather convex and provided with relatively thick test.

On the contrary, the specimens now being described are considerably smaller in size and moderately convex; they are all in the cast, but the sculpture of the shell surface is distinctly marked on them, indicating that they were provided with a relatively thin test. Notwithstanding these differences, they much resemble the original specimens of the species in all other essential characteristics.

Shell ovately trigonal, much produced posteally, moderately convex; umbones anteromesial, rather prominent; superior border straight, the anterior short, convex and the lower rounded.

Escutcheon broad, depressed, with about 18 oblique and gently curved costellae. Area narrow, appearing as a narrow keel near the umbones, becoming gradually broader posteally, smooth except the lines of growth and without longitudinal furrow.

Pallial portion of the shell with vertical and horizontal costae; the vertical costae occupying an area near the umbones and the posteroior angle (a little more than $\frac{2}{3}$ of the whole surface) and the horizontal ones the remaining part near the lower anterior margin. Vertical costae broad and flat, intercalated with narrow interspaces, about 9 posterior ones of them extending from the marginal to the lower border, while the anterior 4 are interrupted by the narrow horizontal costae, which are about 18 in number. Lines of growth distinct near the lower margin.

Trigonia maudensis WHITEAVES[1] from "c" horizont of the Cretaceous of Maud Is. in the Queen Charlotte Is. is a species very closely allied to the present form, but is distinguished from the latter in having the costellae on the escutcheon, arranged just in reverse.

Localities :— The lower course of the Ponhorokabets, near the Yubari coal mines, and the first gorge along the Ikushumbets above the Ikushumbets coal mines, Hokkaido.

Horizon :— *T. longiloba* zone.

Quadratae Group.

Trigonia cfr. Tryoniana GABB.

Pl. I(1), Fig, 11–13.

Dimensions :—

Height = 5,5 cm.

Length = 7,7 cm.

Breadth = 2,0 cm.

Three specimens of the Quadratae are now believed by the present writer to belong to one and the same species, though there are among them some slight differences regarding the surface sculpture; all of them are in the state of stone nucleus, although apparently owing to the thinness of the test, the costae, costellae and tubercles are moderately well, if not quite distinctly, impressed on them. Fig. 11 represents one of the specimens which is compressed and elongated subtrapeziform with small, anterior subterminal, not much elevated umbones.

Escutcheon imperfectly preserved on the specimen. Area extraordinally broad and flattened posteally, with a rounded siphonal border, strongly attenuated toward the umbones; longitudinally divided by a feeble furrow into two asymmetrical, narrow inner and broader outer fields. The large, rounded posterior muscular impression is marked distinctly on the middle of the area.

On the pallial surface of the shell, there are 5 distinct and 2 obsolete costae, provided with a few relatively big tubercles, and running obliquely from the marginal border downwards and forwards, the 2 or 3 posterior ones being less curved than the others.

Another specimen, Fig. 13, smaller than the former shows the smooth area better preserved near the umbones. The third one, Fig. 12, differs from the others, by having that part of the area near the umbones relatively narrower; this specimen further shows the surface of the escutcheon provided with diverging costellae. Taking these three specimens altogether as belonging to one and the same species,

1) J. F. WHITEAVES: Mesozoic fossils: Vol. I Part. III. On the fossils of the Coal-bearing Deposits of the Queen Charlotte Islands collected by Dr. G. M. DAWSON in 1878. P. 230 Pl. XXXI. Fig. 2. Geol. and Natural History Survey of Canada. 1884.

it is at least certain that the species much resembles *T. Tryoniana* GABB.[1] from Div. A of the Nanaimo Cretaceous, Vancouver Is., though the costellae of the former species on the area near the umbones are not visible, probably owing to bad preservation; otherwise there is no essential difference recognisable between the forms from Hakkaido and Vancouver Is.; neverthless the present writer thinks it better for a while not to identify the form from Hokkaido with *T. Tryoniana*, but to treat it as *T.* cfr. *Tryoniana*.

Localities :— The lower course of the Ponhorokabets, near the Yubari coal mines, and the first gorge along the Ikushumbets above the Ikushumbets coal mines, Hokkaido.

Horizon :— *Trigonia* sandstone.

Glabrae Group.

Trigonia Kikuchiana YOKOYAMA.

Pl. II (2), Fig. 1–3, 4 a, b, 5 a, b, 6-9.

1891. *Trigonia Kikuchiana* YOKOYAMA: On some Cretaceous fossils from Shikoku. Journ. Coll. Sci. Tokyo, Vol. IV. Pt. II. P. 363, Pl. XL. Fig. 4, 5 a, b, 6.

„ *Trigonia rotundata* YOKOYAMA (non ROMANOVSKY). l.c. P. 365., Pl. XL. Fig. 7, 8a, b, 9.

Dimensions :—

	(1)	(2)	(3)
Height	=7,9 cm,	3,8 cm,	2,8 cm.
Length	=8,4 cm,	4,2 cm,	3,15 cm.
Breadth	=1,0 cm,	0,9 cm,	0,9 cm.

Trigonia belonging to the Glabrae group is very abundant in the Moshi and the Hiraiga sandstone of the Miyako District; although very variable in form, all specimens are believed to belong to one species, *T. Kikuchiana* YOK.

In the paper cited YOKOYAMA distinguished two species of Glabrae from Shikoku, *T. Kikuchiana* and *T. rotundata*, the former being trigonal, and the latter rounded in outline.

In the rich materials of *Trigonia* from Miyako District, the present writer was able to find not only those forms quite identical to those typical *T. Kikuchiana* and *T. rotundata* as described by YOKOYAMA but also those connecting them in all gradations. For example, Fig. 1 and 9 show two typical specimens, one almost indistinguishable from the type specimens of *T. Kikuchiana* and the other from *T. rotundata*, while Fig. 2–4, 6 and 7 represent the forms apparently intermediate between them in outline and in the convexity of shell.

Indeed, the variation seems to go far beyond the limit indicated by *T. Kikuchiana* and *T. rotundata*; thus Fig. 5 a, b show an individium more inflated along the median line of shell than in *T. Kikuchiana*. Further the shallow depression marking the boundary of area and escutcheon and the hinge undergo also a not little variation; the former, which is more or less well marked on some specimens, is almost obsolete in the others, while the latter, especially regarding to the trigonal tooth of the left valve, is developed exceedingly stout in some specimens.

Localities :— Hideshima, Moshi, Hiraiga I, Miyako District.

Horizon :— *T. Kikuchiana* zone (Hideshima and Moshi),
Plagioptychus zone (Hiraiga 1).

1) J. F. WHITEAVES: Mesozoic fossils. Vol. I. Part. II. On the fossils of the Cretaceous Rocks of Vancouver and Adjacent Is. in the Strait of Georgia. P. 161, Pl. XVIII, Fig. 7. Geol. Survey of Canada. 1879.

Explanation of Plate I.

(All Figures in Nat. Size)

Figs. 1, 2. *Trigonia Hokkaidoana* YEHARA. *Cucullaea* zone, Hiraiga I, Miyako District; adult specimen.

Fig. 3. ,, ,, ,, Hiraiga sandstone, Haipe, Miyako District; showing the hinge line.

Figs. 4, 5, 6. ,, ,, ,, *Trigonia longiloba* zone, Ponhorokabets and Ikushumbets, Hokkaido; Internal Mould.

Fig. 7. ,, ,, ,, The same zone, Ponhorokabets, Hokkaido; external mould.

Fig. 8. ,, ,, ,, *Cucullaea* zone, Hiraiga I, Miyako District; a young example.

Fig. 9. *Trigonia longiloba* JIMBO. *Trigonia longiloba* zone, Ikushumbets, Hokkaido; external mould of a young specimen having well preserved costellae on the umbonal portion of area.

Figs. 10 a, b, c. *Trigonia Kotoi* YEHARA. *Plagioptychus* zone, Hiraiga I, Miyako District; adult specimen.

Figs. 11, 12, 13. *Trigonia* cfr. *Tryoniana* GABB. *Trigonia* sandstone, Ponhorokabets and Ikushumbets, Hokkaido; internal mould with surface ornaments.

Figs. 14, 15. *Trigonia* cfr. *subovalis* JIMBO. *Trigonia longiloba* zone, the same localities; internal mould.

Figs. 16, 17. ,, ,, ,, ,, The same zone and the same localities; External mould.

del. Yebina and Ishizaki.

Explanation of Plate II.

(All Figures in Nat. Size)

Fig. 1. *Trigonia Kikuchiana* YOKOYAMA. *Trigonia Kikuchiana* zone, Hideshima, Miyako District; normal form.

Fig. 2. ,, ,, ,, The same zone and the same locality; a varietal form.

Figs. 3, 7. ,, ,, ,, *Plagioptychus* zone, Hiraiga I, Miyako District; varietal forms.

Figs. 4 a, b. ,, ,, ,, The same, Haipe, Miyako District; a varietal form.

Figs. 5 a, b, 6. ,, ,, ,, *Trigona kikuchiana* zone, Moshi, Miyako District; varietal forms.

Fig. 8. ,, ,, ,, *Plagioptychus* zone, Haipe, Miyako District; a varietal form exhibiting the hinge.

Fig. 9. ,, ,, ,, *Trigonia Kikuchiana* zone, Moshi, Miyako District; a form closely allied to *T. rotundata* YOKOYAMA.

Figs. 10 a, b. *Trigonia longiloba* JIMBO. *Trigonia longiloba* zone, near the Ikushumbets coal mines, Hokkaido; internal mould.

Fig. 11. ,, ,, ,, The same zone and the same locality; external mould, having the diverging costellae on the umbonal portion of the area.

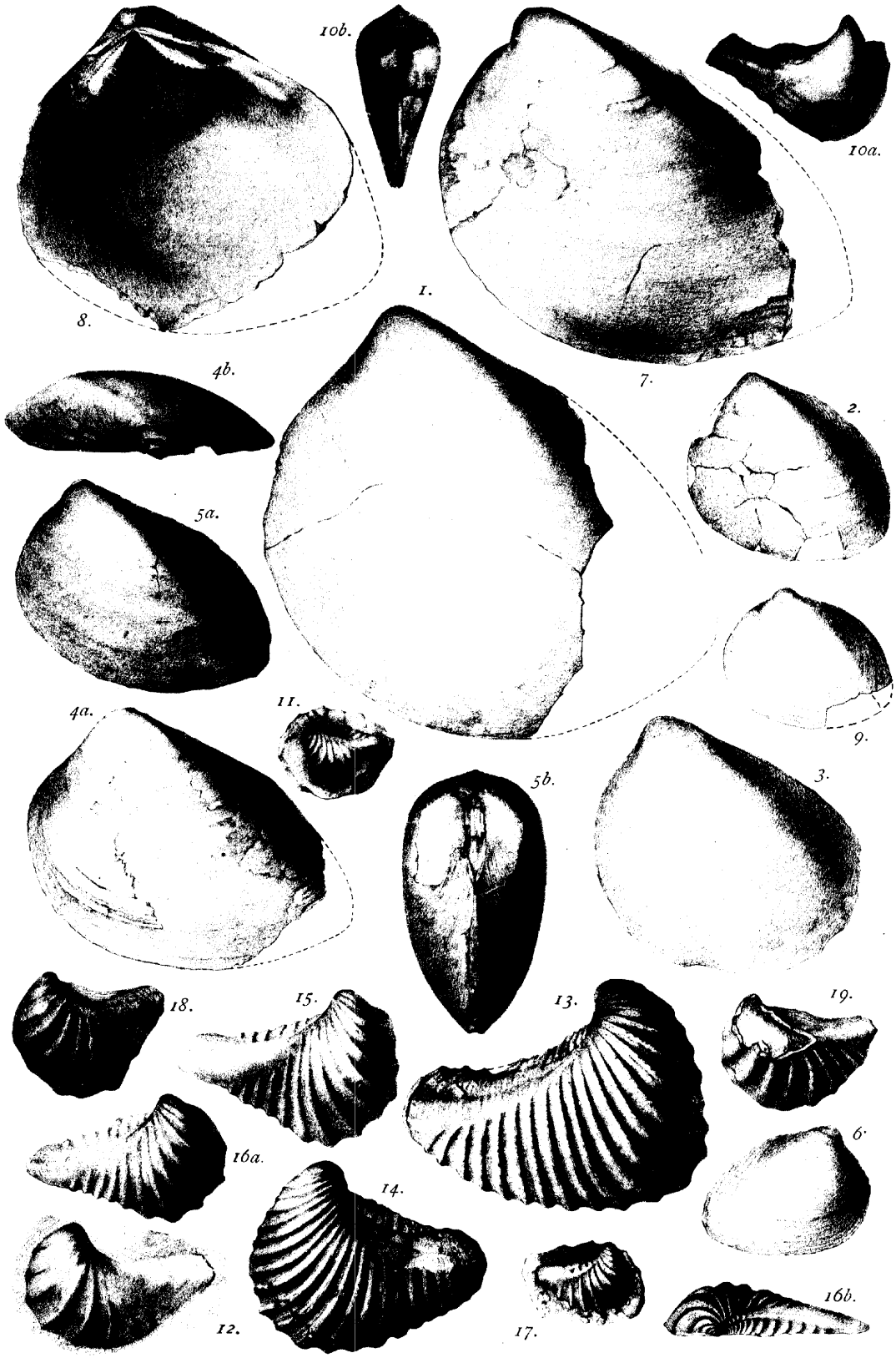
Fig. 12. ,, ,, ,, The same zone and the same locality; external mould.

Figs. 13, 14. *Trigonia Datemasamunei* YEHARA. *Orbitolina* sandstone, Raga II, Miyako District; adult specimens.

Figs. 15, 16 a, b. *Trigonia Yokoyamai* YEHARA. *Tylostoma* zone, Hiraiga I, Miyako District; adult specimens.

Fig. 17. ,, ,, ,, *Cucullaea* zone, Hiraiga I, Miyako District; a young example.

Figs. 18, 19. *Trigonia brevicula* YEHARA. *Thetis* aff. *affinis* zone, along the Ikushumbets, Prov. Ishikari, Hokkaido; adult specimen. The transverse costellae on the escutcheon scarcely visible on the figure are more pronounced on the actual specimen.



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