Crassatellites and Venericardia from the Miyazaki Group : Palaeontological Study of the Miyazaki Group-IV

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Crassatellites and *Venericardia* from the Miyazaki Group (Palaeontological Study of the Miyazaki Group-IV)*

By

Tsugio SHUTO

Introduction

Crassatellites KRÜGER 1823 and *Venericardia* LAMARCK 1801 are very important as the index fossils of the successive ages throughout the Caenozoic Era and a number of authors have reported and discussed these genera. In our country, as well, several species belonging to these genera have been known to be stratigraphically significant.

Lately I have examined a good many specimens of *Crassatellites* and *Venericardia* collected from the Mio-Pliocene Miyazaki group. The main purpose of this paper is the systematic descriptions of them as a part of a series entitled "Palaeontological Study of the Miyazaki Group". However, a review of the generic and subgeneric nomenclature is necessary for comparing definitely the forms from the Miyazaki group with those of other regions. It is furthermore desirable to trace the evolutional history of the genera. For this account the paper contains a brief discussion of the taxonomy and phylogeny of the genera.

I devote my hearty thanks to Professor Tatsuro MATSUMOTO of the Kyushu University for his valuable criticism on the present subject and reading of the typescript. I am also indebted to Mr. Katura OYAMA of the Geological Survey of Japan for his helpful advice and reading through the descriptive part of the typescript. Thanks are also due to Professor Jiro MAKIYAMA of the Kyoto University for giving me access to necessary books and specimens of that University. This work has been partly financed by a grant from the Science Research Fund of the Ministry of Education.

Systematic Descriptions

Family Crassatellidae DALL

Genus *Crassatellites* KRÜGER 1823

[Type species: *Crassatellites sinuatus* KRÜGER (by monotypy)]

There was a excessive confusion in the nomenclature of this genus. Some authors adopted *Crassatella* LAMARCK 1799 and others *Crassatellites* KRÜGER 1823. It is admitted now by almost all workers that the confusion was due to LAMARCK's

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misidentification at the time of the original designation and to the inconsistency in the subsequent usage, He figured and designated "*Mactra cygnea* CHEMNITZ", which belongs actually to the Mactridae, as the type of the genus, whereas his citation of the deep lunule and escutcheon and the ligamental cavity above the teeth indicates that he actually described a crassatellid. Under *Crassatella* of the practically same diagnosis as above LAMARCK (1801) figured *C. gibba* (with a concise description) and *C. sulcata* (a nomen nudum). In 1807 he gave to the same specimen as the original one of *C. gibba* another name *C. tumida* and added a notation that the genus had been founded on it. Thus confusion was caused from the beginning by LAMARCK's inconsistency.

The confusion continued as is shown by the following designations of the type species by different authors.

Venus ponderosa GMELIN by SCHMIDT 1818
Crassatella kingicola LAMARCK by CHILDREN 1822
Crassatella tumida LAMARCK by ANTON 1839
Venus ponderosa GMELIN by GRAY 1847
Crassatella gibba LAMARCK by WOODWARD 1851
Crassatella gibba LAMARCK by MEEK 1876
Crassatella ponderosa (GMELIN) by STEWART 1930

Among these specific names, *Venus ponderosa*, *Crassatella ponderosa*, *C. gibba* and *C. tumida* have been thought to be synonymous with *C. plumbea* LAMARCK by several authors.

KRÜGER's *Crassatellites* was established in 1823 on the basis of *Crassatellites sinuatus* KRÜGER from the Eocene of Paris Basin with the description of the species "Mit sehr dicken Schalen, tiefen Muskeleindrücken und einzelnen Querreifen, welche auf der Oberfläche mit dem untern Rande der Schalen gleichlaufen. Häufig bei Grignon." *Crassatellites* is available for the generic name because of its clear definition. For instance WOODRING (1925, pp. 93-94) used the name after giving the particular definition to it. Although some workers, especially of french school seem to retain *Crassatella*, it is the practical and the easiest solution of the problem to adopt *Crassatellites*, as COX (1930, p. 210) pointed out and GARDNER (1943, p. 61) has followed him.

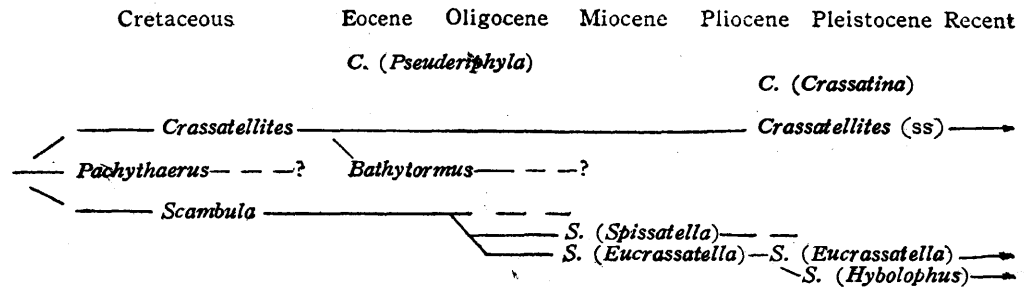
Since the establishment of genus *Crassatellites* several subgenera have been proposed within the genus. Among them *Crassatellites* KRÜGER (s. s.), *Crassatina* KOBELT 1881, *Eucrassatella* IREDALE 1924, *Spissatella* FINLAY 1926 and *Scambula* CONRAD 1869 should be brought into consideration in connection with the crassatellids from the Miyazaki group. The criteria to distinguish them are mainly in the shape, the disposition of the hinge teeth and the crenation of the inner ventral margin of the valve. STEWART, FINLAY and MARWICK hold that the ventral crenation is the most important character to separate the subgroups (subgenera or sections) of the genus. I am agreeable with them, although the biological meaning of the crenation may not be perfectly clear. Actually the great majority of the European species of the genus are ventrally crenate, while almost all the species from the southern hemisphere have the smooth margin. The crassatellids

from the interjacent regions, such as Far East, Central America and Gulf province, contain both ventrally crenate and smooth forms. This fact suggests there is a marked phylogenetic difference of remote origin between the crenate and smooth groups. However the two characters do not seem to be perfectly separated. For instance, DALL (1903, p. 1467) pointed out that *Scambula* was usually smooth at the inner margin of the valve but was rarely crenate, and COSSMANN (1905, p. 139) has noted that in *Pseuderiphyla*, a "section" of *Crassatina*, the smooth margin was not a constant feature.

Distinction between *Crassatellites* and *Crassatina*, the ventrally crenate subgenera, is clear. The former has the heavy, rather larger and subquadrate to subtrigonal shell with the anterior and the posterior lateral teeth. The latter has the oval and fairly small shell with a small lateral tooth just behind the resilium.

Difference among the ventrally smooth three subgenera lies in the disposition of the hinge. From the descriptions of the type species of the subgenera it is evident that *Eucrassatella* has two cardinals but *Spissatella* and *Scambula* have one. However, as is clearly illustrated in the original figures, the cardinal of the latter two subgenera is bifid and has a shorter posterior arm and can be regarded as the fused two teeth. Therefore the above difference is by no means great, but rather gradational. Among the species of subgenus *Crassatellites* there is apparent difference in the shape of the shell and in the disposition of the hinge. As to the shape one group is characterized by the extended and wing-like posterior part (group of *Crassatellites sinuatus* KRÜGER="*Crassatella gibbosula* LAMARCK") and the other has the attenuate "*Crassatellites* like" posterior part (group of *Crassatellites compressus* (LAMARCK)). In addition the resilium pit of the former group is wide and its anterior and the posterior cardinals are fused into a triangular solid tooth. While the resilium pit of the latter is narrow and the cardinals are composed of the two fused thin teeth, a cuneate anterior tooth and a very tiny posterior branch. Whole species of the subgenus *Crassatellites* from the Miyazaki group belong to the latter group. The descriptions and the illustrations by many authors inform, however, the existence of various intermediate forms, for instance, the species provided with the shell of the former group and the hinge of the latter group and so on. Therefore subdivision of the subgenus *Crassatellites* is not desirable in the present state of our knowledge.

Concluding the foregoing remarks, I offer a revised scheme of classification with the tentative phylogenetic lines as below. (1) The ventrally crenate and smooth groups are separated as distinct genera. (2) Among the hitherto proposed names *Crassatellites* should be adopted for the ventrally crenate genus and *Scambula* for the smooth one by precedence. (3) I retain *Crassatina* as a subgenus of *Crassatellites* and *Spissatella* and *Eucrassatella* as subgenera of *Scambula*.



Subgenus *Crassatellites* KRÜGER 1823

Crassatellites (*Crassatellites*) *tenuiliratus* n. sp.

Material.—Holotype, reg. no. GK-L 4261; paratypes, GK-L 4265, 4277 and 4278.

Diagnosis.—Shell medium in size and ovato-trigonal. Umbo rather prominent, pointed and slightly incurved. Antero- and postero-dorsal margins straight, forming an angle of 92 to 120 degrees. Anterior margin narrowly rounded; posterior end flattened and truncated. A distinct ridge extends from the umbo to the postero-ventral corner. Ventral margin broadly rounded at the anterior half and almost straight at the posterior half. Lunule sunk and lanceolate; escutcheon long and narrow. External surface ornamented with the fine and regular concentric lirae; lirae numerous, continuous and almost equally spaced throughout the entire surface of the valve except for the ventral part, where they become close set and rather irregular. Hinge plate strong; ligament and resilium internal; resilifer deep, vertically elongated and lunular below beak; three cardinal teeth in the right valve, of which the anterior one, high, strong and slightly oblique; the middle fused with the anterior one, small and oblique along the anterior edge of the lower half of the resilifer; the posterior rudimantal, narrow, oblique and effaced by the resilium. In the left valve two subequal radiating cardinals are separated by a deep and wide socket; the posterior one forming a ridge along the anterior edge of the resilifer. Right valve bears a rather distinct cardinal and a short anterior lateral tooth and an obscure posterior one. Left valve provided with a long and distinct posterior lateral and an obscure anterior one. Adductor muscle impressions deep with a slight rim; the posterior scar larger than the anterior one. Pallial line simple. Inner margin finely crenate.

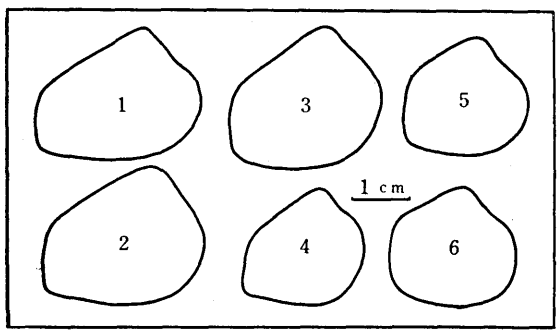


Fig. 1. Variation of the outline of the shells in *Crassatellites* (*Crassatellites*) *tenuiliratus* n. sp. 1 and 6 are the end forms and 2-5 the intermediate ones.

Remarks.—The range in the shape of this species is rather wide, and two popula-

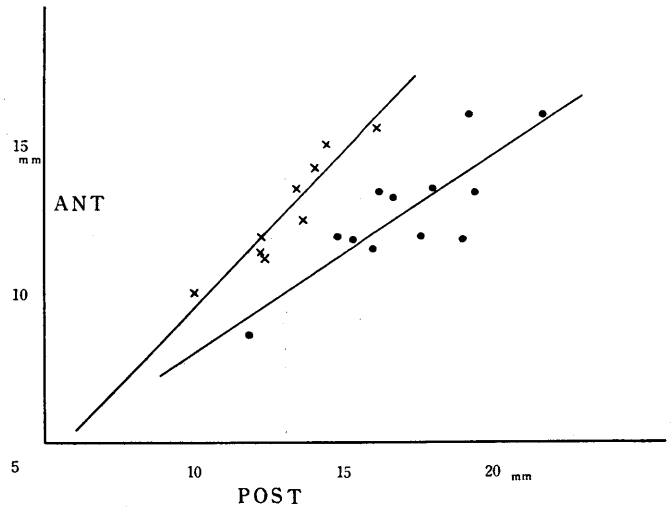


Fig. 2. Diagram of the length of the antero-dorsal margin plotted against that of the postero-dorsal margin of *Crassatellites* (*Crassatellites*) ***tenuiliratus*** n. sp.

• *C.* (*C.*) ***tenuiliratus tenuiliratus*** n. subsp.

× *C.* (*C.*) ***tenuiliratus triangularis*** n. subsp.

Regression coefficients calculated by the least square method are

$y=-0.727+1.030x$ in ***triangularis*** and

$y=1.418+0.661x$ in ***tenuiliratus.***

tions are readily distinguished if we examine the ratio between the antero-dorsal length and the postero-dorsal one (table 1 and text-figs. 1 and 2). The morphological differences between the populations are so small that they can be regarded as intraspecific distinction. I propose to call the one population with the longer form and less distinct ventral crenation *Crassatellites* (*C.*) *tenuiliratus tenuiliratus* and the other with the shorter form and clearer ventral crenation *C.* (*C.*) *tenuiliratus triangularis.*

Crassatellites (*Crassatellites*) *tenuiliratus tenuiliratus* n. subsp.

Pl. 22, figs. 6, 7, 8 and 12

Material.—Holotype, GK-L 4261; paratypes, GK-L 4265, 4277 and 4278.

Measurements.—Shown in table 1.

Diagnosis.—Shell laterally elongate, ovato-trigonal and very inequilateral. Umbo situated at about the anterior third of the shell-length. Antero-dorsal margin three-fourths as shorter as the postero-dorsal margin; both margins form an angle of 93 to 115 degrees. Posterior end rostrated, attenuated and truncated. Ventral crenation very fine or occasionally very weak.

Comparison.—The present new species belongs to the group of *Crassatellites compressus* (Lam.) having the typical cardinals and valves as above noted.

Japanese recent species, *Crassatellites nanus* (Ad. et Rve.) (Adams and Reeve, 1850, pp. 81-82) is an ally to the present subspecies, but the former has much

Table 1. Measurements of the selected specimens of *Crassatellites* (*Crassatellites*) *tenuiliratus* n. sp.

Reg. No. GK-L	Locality MI-	Length (mm)	Height (mm)	Depth (mm)	H/L (%)	D/L (%)	Umbonal Angle (degrees)	P/A (%)	Remarks
4261*	157	26.3	23.8	6.2	90.5	23.6	93	1.20	left valve
4262*	157	26.7	21.9	7.0	81.8	26.3	98	1.45	right valve
4263*	157	25.8	19.3	6.8	74.9	26.3	112	1.48	right valve
4264*	770	22.6	22.3	5.5	98.6	24.3	93	1.26	right valve
4265*	770	25.0	23.6	6.3	94.4	25.2	95	1.33	right valve
4266*	770	17.8	14.0	4.3	78.5	24.7	121	1.37	right valve
4268*	157	23.0	18.5	5.5	80.4	23.4	102	1.39	left valve
4270*	770	19.7	19.3	5.6	98.0	28.4	93	1.24	left valve
4277*	770	24.9	20.4	6.8	82.2	27.3	98	1.60	left valve
4278*	173	28.6	24.3	6.7	84.7	23.4	93	1.36	right valve
4281*	770	25.7	19.7	5.7	76.5	22.2	115	1.21	right valve
4269**	157	21.0	20.5	5.2	97.5	24.7	96	0.98	right valve
4271**	157	23.4	21.1	5.8	90.4	24.8	101	1.04	left valve
4272**	157	18.0	15.7	4.2	87.4	23.3	111	1.00	right valve
4273**	770	21.1	19.4	6.1	91.8	28.9	102	0.99	left valve
4274**	770	21.9	21.8	5.6	99.5	26.5	99	1.08	left valve
4275**	157	22.0	21.1	6.2	96.0	28.2	92	0.96	right valve
4280**	770	21.6	18.5	5.2	85.6	24.1	99	1.07	right valve

* *C.* (*C.*) *tenuiliratus tenuiliratus* n. subsp.
** *C.* (*C.*) *tenuiliratus triangularis* n. subsp.
In the nineth column P and A indicate the length of the anterior and the posterior side respectively.

more produced ventral margin than the latter and the sculpture of *nanus* consists of coarse ribs in the young and becomes irregular threads in the adult stage.

Crassatellites radiatus (Sow.) from the pliocene beds of Boemiajoe, Java (OOSTINGH, 1935, pp. 165–167, text-fig. 20) also resembles the present subspecies, but the former has the produced and regularly curved ventral margin and has much stronger and less numerous concentric lirae than the latter. Therefor it is more closely allied to *Crassatellites nanus* than to the present new subspecies.

Scambula (*Spissatella*) *obesa* (A. AD.) reported from the Awamoan of New Zealand (SUTER, 1914, pp. 48–49, pl. viii, f. 4) resembles the present subspecies, especially when the weakly crenate specimens are brought into comparison. In dentition, the shell-form and in the sculpture, the two show a remarkable similarity. However I am inclined to refer the present species to *Crassatellites* (s. s.), since it does show ventral crenation. Analogous to *C. tenuiliratus tenuiliratus, C. nanus* is another example; about one-eighth of its unworn specimens before me scarcely show the ventral crenation. Whether the feature is rudimentary or otherwise is not clear. It may be significant that there is and was the apparently intermediate form between the ventrally crenate and smooth forms in the interjacent area between the main habitats of the latter two forms.

Horizon.—The middle part of the Tano member (transitional horizon between the

Middle and the Upper Miocene).

Localities.—Akatani 1[1] (MI-157) and 2[2] (MI-770) and Kusumi[3] (MI-173), Takaoka machi, Higashi-Morogata gun, Miyazaki Prefecture.

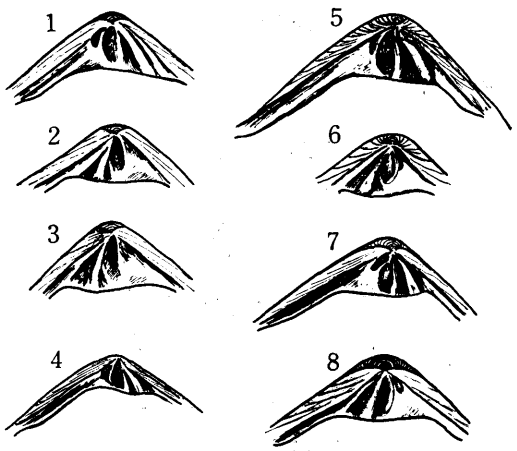


Fig. 3. Hinge plates of the species of the subgenus ***Crassatellites*** from the Miyazaki group and the Shimajiri group.
1-2, *C.* (*C.*) ***tenuiliratus tenuiliratus*** n. sp. and subsp. 1, left valve; 2, right valve.
3, *C.* (*C.*) ***tenuiliratus triangularis*** n. subsp., right valve.
4, *C.* (*C.*) ***nanus*** (A. Ad. et Rve.), left valve, from Shimajiri group.
5-6, *C.* (*C.*) ***tsumaensis*** n. sp. 5, left valve; 6, right valve.
7-8, *C.* (*C.*) ***takanabensis*** n. sp. 7, left valve; 8, right valve.

Crassatellites (*Crassatellites*) *tenuiliratus triangularis* n. subsp.

Pl. 22, figs. 9, 10 and 11

Material.—Holotype, GK-L 4269; paratypes, GK-L 4275 and 4704.

Measurements.—Shown in table 1.

Diagnosis.—Shell rounded trigonal, rather solid and nearly equilateral. Umbo somewhat prominent, and situated at about the middle of the shell-length. Antero- and postero-dorsal margins almost straight and nearly equal in length. Umbonal angle ranges from 92 to 110 degrees. Anterior margin narrowly rounded; posterior one flattened and truncated. Ventral margin broadly arcuated. Ventral crenation fine but distinct.

Comparison.—The present subspecies essentially resembles the preceding one except for the roundly trigonal outline and clearer ventral crenation. However, the frequency diagram of the form characters of the composite sample shows the bimodal distribution. That is to say, two populations are distinguishable in the sample. Furthermore it may be naturally considered that they were reproductively isolated to some extent. The reason is as follows. They are found at the same

1) 宮崎県東諸県郡高岡町　赤谷 1
2) 宮崎県東諸県郡高岡町　赤谷 2
3) 宮崎県東諸県郡高岡町　楠見

localities and even in the same blocks, which are characterized by the autochthonous faunal assemblages. This means two populations dwelt together in the same niche. Consequently they must have been capable of interbreezing freely, if they were not reproductively isolated. And any bi-modal diagram should not be resulted from the frequency analysis of the form characters.

Horizon.—The middle part of the Tano member (transition of the Middle and the Upper Miocene).

Localities.—Akatani 1[1] (MI-157) and 2[2] (MI-770), Takaoka machi, Higashi-Morogata gun, Miyazaki Prefecture.

Crassatellites (*Crassatellites*) *tsumaensis* n. sp.

Pl. 22, figs. 3a, b and 4

Material.—Holotype, GK-L 4481; paratype, GK-L 4705 and a few imperfect specimens.

Measurements.—Length, 28.5 mm; height, 22.9 mm; maximum diameter from the umbo to the ventral margin, 25.8 mm; depth, 7.4 mm; length of the antero-dorsal margin, 16.7 mm; length of the postero-dorsal margin, 20.6 mm; umbonal angle, 100 degrees; H/L, 80.4%; D/L, 26% in the holotype.

Diagnosis.—Shell medium in size, ovato-trigonal, rather solid and inequilateral. Umbo prosogyral, small, pointed and slightly incurved. Antero-dorsal margin straignt and four-fifths as shorter as the postero-dorsal margin; postero-dorsal margin straight, forming the umbonal angle of 100 degrees with the antero-dorsal margin. Anterior margin narrowly rounded; posterior margin rostrated, attenuated and truncated; a strong ridge extends from the umbo to the postero-ventral corner; the other distinct ridge discernible from the beak to the posterior end. Area between the two ridges slightly concave. Ventral margin broadly and regularly rounded anteriorly and almost straight or slightly concave posteriorly. Lunule sunk and lanceolate; escutcheon long and narrow. External surface ornamented with the concentric sculpture, which is coarse, distinct and regular ribs in the young stage and fine and rather irregular threads in the adolescent and the adult stages. Hinge plate strong and triangular; resilifer deep, elongated and lunular below the umbo, separated from the ligamental pit by a slight rim. Two cardinal teeth in the left valve, of which the anterior tooth high, strong and oblique and tapers upward; the posterior distinct and vertical; cardinals of the right valve consist of three teeth, of which the anterior and the middle ones fused and diverging at an acute angle; the posterior one reduced to a ridge along the lower edge of the resilifer. The left valve has a long posterior lateral and a less distinct anterior one. Adductor muscle impressions deep, of which the anterior one pear-shaped and the posterior one ovate; both impressions equal in size. Pedal scar small but deep and situated just behind the anterior adductor scar. Inner margin finely crenate.

1) 宮崎県東諸県郡高岡町 赤谷 1
2) 宮崎県東諸県郡高岡町 赤谷 2

Comparison.—The present new species belongs to the group of *Crassatellites compressus* (LAM.) and is closely allied to *C.* (*C.*) *tenuiliratus tenuiliratus* n. subsp. These two species are characterized by the straight ventral margin, but the shell of the present species has two ridges on the posterior part, the clear ventral crenation and surface sculpture which consists of the concentric ribs instead of the lirae of *tenuiliratus* in the young and irregular threads in the adolescent and the adult stages.

C. nanus (AD. et RVE.), a Japanese living species, is also an ally, but its shell has more rounded antero-dorsal margin, much more produced ventral margin and only one ridge on the posterior part. Furthermore its hinge plate is less prominent and the crenation at the interior margin is finer than the present new species, and the irregular threads on the outer surface appear only in the adult or gerontic stage in *nanus*.

Horizon.—The lower part of the Tsuma member (the lower Upper Miocene).

Locality.—Yamaji[1] (MI-5061), Mino mura, Koyu gun, Miyazaki Prefecture.

Crassatellites (*Crassatellites*) *takanabensis* n. sp.

Pl. 22, figs. 1a, b and 2

Material.—Holotype, GK-L 4697; paratypes, GK-L 4698, 4699 and 4701.

Measurements.

Specimen Reg. No.	Length (mm)	Height (mm)	Depth (mm)	Umbonal Angle (degrees)	Valve	Remarks
GK-L 4697	21.9	18.4	6.2	100	left	mature
GK-L 4698	23.2	19.7	6.1	106	left	mature
GK-L 4699	21.2	18.2	5.5	106	left	immature
GK-L 4700	18.8	16.8	5.0	97	right	immature
GL-L 4701	14.0	12.4	3.8	100	left	immature

Diagnosis.—Shell moderately small, rather solid, subtrigonal, inequilateral and inequivalve; right valve slightly deeper than the left one. Umbo prosogyral, high and incurved. Antero-dorsal margin slightly excavated and shorter than the almost straight postero-dorsal margin. Anterior margin rounded and continuous to the broadly curved ventral margin; posterior margin truncated. A feeble ridge extends from the umbo to the postero-ventral corner. Area distinct, depressed and bounded by the sharp ridges; escutcheon of the right valve wider than that of the left valve. Hinge plate heavy and trigonal; the distinct anterior and the small lamellar middle tooth are fused and diverge at an acute angle and the posterior one absent in the right valve; in the left valve there are two distinct cardinal teeth tapering upward and separated by a deep socket; a long posterior lateral tooth and a less distinct anterior one are discernible. Surface sculpture is crowded concentric riblets in the umbonal region, becoming coarser as the shell grows and finally is irregular rugae in the ventral region of the full grown shell. The ribs are twice in number on the postero-dorsal area behind the posterior ridge except for the umbonal region by the intercalation of an additional rib in

1) 宮崎県児湯郡三納村山路

every interstice. Adductor scars depressed; the anterior and the posterior one subequal. Pedal scar deep and slightly apart from the anterior adductor scar. Pallial line simple. Inner margin of the valve finely crenate.

Comparison.—The present species is characterized by its small ovato-trigonal shell. Its dentition is of *C. compressus* type; the resilium is very narrow and the ligamental pit is sub-parallel to the postero-dorsal margin. In this respect this species is allied to *Crassatellites belhulus* (AD.) from the south east Asiatic seas (MARTINI-CHEMNITZ, 1886, S. 35, T. 9, F. 6), but the former is smaller and higher than the latter. Moreover the crenation of the inner ventral margin is very faint in *C. belhulus*.

Crassatellites suyamensis OINOMIKADO from the Middle Miocene bed of Takasaki, Kwanto region of Japan (OINOMIKADO, 1938, p. 674, pl. 20, f. 9 and 10) resembles the present species. They might have direct phylogenetic relation, but the exact comparison cannot be done without examing the dentition of the former. The observable difference between the two species is as follows; the former has somewhat convex postero-dorsal margin and its sculpture is obsolete on the postero-dorsal border. In the latter species the ribs are twice closer on the posterior part behind the ridge than on the main part.

Scambula (*Spissatella*) *luteophila* MARWICK from the Miocene beds of New Zealand (MARWICK, 1931, p. 67, pl. v, f. 73) resembles the present species in general feature except for the ventral crenation, but the resemblance is perhaps superficial.

Horizon.—The Takanabe member (the Lower Pliocene).

Locality.—Kizukume[1] (MI-5739), Tonda mura, Koyu gun, Miyazaki Prefecture.

Subgenus Crassatina KOBELT 1881

[Type species: *Crassatella triquetra* "SOWERBY" REEVE, (original designation)]

Crassatellites (*Crassatina*) aff. *oblongatus uchidanus* (YOKOYAMA)

Pl. 22, fig. 5.

1926 ***Crassatella uchidana*** YOKOYAMA; Jour. Fac. Sci. Imp. Univ. Tokyo, ser. II, vol. 1, p. 356, pl. 39, fig. 6.

1927 ***Crassatellites oblongatus uchidanus***, MAKIYAMA; Mem. Coll. Sci. Kyoto Imp. Univ. ser. B, vol. 3, no. 1, art. I, p. 39.

Material.—GK-L 4665 and 4706 and a few imperfect specimens.

Measurements.—

Specimen Reg. No.	Length (mm)	Height (mm)	Depth (mm)	H/L %	D/L %	Umbonal Angle (degrees)	Remarks
GK-L 4665	10.2	8.2	3.0	80	30	119	left valve
GK-L 4706	16.5	13.3	4.5	80.6	28	114	left valve

Remarks.—The specimens from the Miyazaki group are similar, in many respects, to the holotype and the topotypes of the subspecies from the Tenno sand of the Kakegawa group in Shizuoka Prefecture, but slightly differ from them in having more rounded postero-ventral margin which continues the posterior and the ven-

1) 宮崎県児湯郡富田村鬼付女

tral margins without any angulation. The available material is not sufficient enough to decide whether the difference is a mere variation or has subspecific significance. Since the occurrence of the subspecies in the Miyazaki group is stratigraphically somewhat older than that in the type locality, the former may be ancestral to the latter.

Horizon.—Lower part of the Tsuma member (the lower Upper Miocene).

Locality.—Yamaji[1] (MI-5060), Mino mura, Koyu gun, Miyazaki Prefecture.

Genus *Scambula* Conrad 1869

[Type species: *Scambula perplana* Conrad (original designation)]

Subgenus *Eucrassatella* Iredale 1924

[Type species: *Crassatella kingicola* Lamarck (original designation)]

Scambula (*Eucrassatella*) sp. indet.

text-fig. 4

Material—GK-L 4663. A single imperfect specimen. Left valve.

Measurements.—Length, 36 mm; height, 26 mm; umbonal angle, 120 degrees; umbonal angle of the inner mould, 138 degrees.

Description.—The shell is moderate in size with the very solid test which is more than 2.5 mm thick. In the left valve the strong hinge plate has two distinct cardinal teeth, deep resilifer and the weak posterior lateral tooth. Oblique anterior and almost vertical posterior cardinals taper upward and converge. Adductor muscle scars are deep and bounded by the low ridges. The elongated posterior scar is larger than the circular anterior one. The surface ornamentation is visible only at a small part near the antero-ventral margin, where the sculpture consists of the distinct and rather irregular concentric riblets. The ventral margin is smooth. Judging from the position of the posterior scar, the attenuated posterior part is possibly extended laterally.

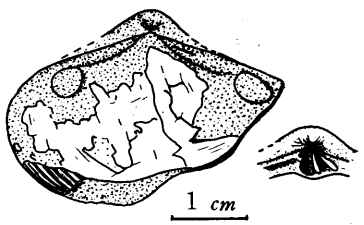


Fig. 4. *Scambula* (*Eucrassatella*) sp. GK-L 4663, left valve; loc. Yamaji, Mino mura, Koyu gun, Miyazaki Prefecture.

Remarks.—The present form certainly belongs to *Eucrassatella*, but further identification is impossible because of the imperfect preservation and paucity of the specimen. The dentition, especially the position of the lateral teeth, and the rostrated posterior part may suggest the relation to the typical *Eucrassatella*.

Locality.—Yamaji[2] (MI-5070), Mino, mura, Koyu gun, Miyazaki Prefecture.

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2) 宮崎県児湯郡三納村山路

Family Carditidae GILL

Genus *Venericardia* LAMARCK 1801

[Type species: *Venericardia imbricata* LAMARCK=*Venus imbricata* GMELIN (subsequent designation by SCHMIDT 1818)]

Venericardia panda (YOKOYAMA) was compared by the original author with *V. jouanneti* BASTEROT, which is the type species of subgenus *Megacardita* SACCO 1899, and recently HATAI and NISIYAMA refered *panda* to *Megacardita* (HATAI and NISIYAMA, 1952, p. 152). *V. ferruginosa* was once identified to *Cardites* LINK 1807 by NIINO (NIINO, 1936, p. 248) and recently HABE, (HABE, 1951, p. 108, f. 216 and 217) and UOZUMI (UOZUMI, 1953, p. 3, pl. 21, f. 165) refered it to *Megacardita*. *V. granulicostata* NOMURA was also included in *Cardites* by OTUKA (OTUKA, 1937, p. 129, f. 41). In these circumstances the discrimination of these subgenera is necessary before entering into the specific description.

Subgenus *Megacardita* was established on the basis of *Venericardia jouanneti* BASTEROT from the Miocene of Italy and fossil species belonging to it occur in the Miocene formations of Mediterranean, Indo-Pacific and Gulf regions and recent species of it concentrate in the Indo-Pacific region.

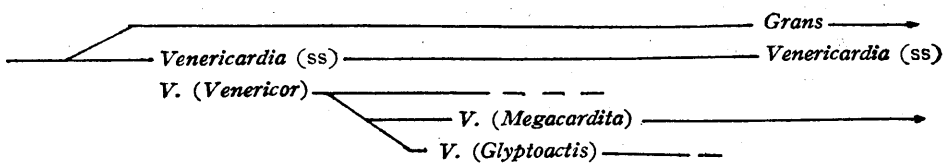
The related genera and subgenera we find in literature are *Venericardia* (s. s.), *Venericor* STEWART 1930, *Glyptoactis* STEWART 1930, *Cardites* LINK 1807 and *Grans* MEGERLE 1811. Among these genera and subgenera *Grans* so clearly differs from others in having the well developed lateral teeth that I agree with many authors to recognize it as a distinct genus. All other forms are considered to be subgenera of the genus *Venericardia* and the distinction among them is based mainly on the shell-form, hinge-character and the surface sculpture.

The subgenera *Venericardia* and *Venericor*, type species of which occurred in the Eocene beds of Paris basin, are characterized by the shell slightly wider than high and by three cardinals on the right valve. *Megacardita* and *Glyptoactis*, type species of which came from the Miocene beds of Italy and Florida respectively, have the laterally elongate shell of moderate size, and their surface sculpture consists of the granulated or subgranulated radial ribs, which are intermediate between the serrated ribs of *Venericardia* and almost flat ones of *Venericor*. It must be kept in mind that early ribs of both *Venericardia* and *Venericor* are sharply crested and crenate similarly in spite of the divergence in the adult stage. The main difference between *Megacardita* and *Glyptoactis* is found in the hinge teeth. The right posterior cardinal of the latter is slightly slenderer than that of the former and the anterior cardinal of the former is obsolete and pustular. *Glyptoactis* has a shorter shell and more granular ribs than *Megacardita*. Though the difference in shell-form and ribbing is very slight, it can be regarded as one of the subgeneric distinctions.

"*Cardita* BRUGUIÈRE 1792" (type species *Cardita sulcata* BRUGUIÈRE=*Chama antiquata* LINNÉ designated by CHILDREN 1822) is synonymous with *Cardites* LINK 1807 (type species *Chama antiquata* LINNÉ by original designation). This is included in genus *Venericardia*. *Cardites*, say, is an intermediate representative between

Venericardia (s.s.) and *Megacardita*. Namely *Cardites* has the valves similar to those of *Venericardia*, but its dentition, a more important character than the shell-form, resembles that of *Megacardita*. Hence *Cardites* is perhaps more related to *Megacardita* than to *Venericardia*. However on the basis of the morphology besides the dentition *Venericardia granulicostata* NOMURA and *V. ferruginosa* (AD. et RVE.) are considered to belong not to *Cardites* but to *Megacardita*.

Considering the character of the adult shell, the ontogeny and the stratigraphic occurrence, the following lines of descent may be tentatively drawn:



Subgenus *Megacardita* SACCO 1899

[Type species: *Venericardia jouanneti* BASTEROT (original designation)]

Venericardia (*Megacardita*) *panda* (YOKOYAMA)

Pl. 22, fig. 14

1926 ***Cardita panda*** YOKOYAMA; Jour. Fac. Sci. Imp. Univ. Tokyo, sec. II, vol. I, pt. 9, pp. 355–356, pl. 39, figs. 1 and 2.

1926 ***Venericardia panda***, MAKIYAMA; Mem. Coll. Sci. Kyoto Imp. Univ., ser. B, vol. 3, art. 1, pp. 40–41, pl. 2, figs. 15 and 16.

1928 ***Cardita panda***, YOKOYAMA; Jour. Fac. Sci. Imp. Univ. Tokyo, sec. II, vol. I, pt. 7, p. 334.

1930 ***Venericardia panda***, OTUKA; Geograph. Rev. Japan, vol. 6, no. 7, pp. 507 and 509.

1952 ***Venericardia panda***, SHUTO; Rep. Fac. Sci., Kyushu Univ., Geol. vol. 4, no. 1, p. 24, table 2.

In addition to the above list this species was cited without illustration as *Cardita panda* or *Venericardia panda* in the following papers, but I have had no opportunity to scrutinize the referd specimens themselves.

YOKOYAMA; 1929, Imp. Geol. Surv. Japan, Rep. 104, p. 11. OTUKA; 1931, Jour. Geol. Soc. Tokyo, vol. 38, no. 451, p. 178. OTUKA; 1933, Bull. Earthq. Res. Inst., vol. 11, pt. 3, p. 548. OTUKA; 1934, Jour. Geol. Soc. Tokyo, vol. 41, no. 492, p. 568. NOMURA; 1937. Japan. Jour. Geol. Geogr., vol. 14, no. 3-4, p. 71. OTUKA; Jour. Fac. Sci. Imp. Univ. Tokyo, ser. II, vol. 5, pt. 1 and 2, p. 11.

Material and Measurements.—Shown in table 2.

Remarks.—For the comparison of the holotype with the specimens from the Miyazaki group the original description of *V.* (*M.*) *panda* given by Prof. YOKOYAMA (1926) is quoted:

> "Shell moderate in size, very thick, convex, obliquely ovato-trigonal, very inequilateral, rounded in front, somewhat obliquely truncate behind, broadly arched at ventre, with postero-ventral corner obtusely subangulate. Surface radiately ribbed; ribs coarse, about fifteen in number, broad, flat-topped with interspaces somewhat narrow, usually more or less coarsely imbricate in the anterior and posterior portions of the shell, especially towards its ventral border. Beaks pointed, incurved. Inner border coarsely

crenate. Length, height, and depth of the valves are in the ratio of 10, 8 and 3.6 on an average."

The topotypes preserved in Kyushu University and Kyoto University are quite identical to the original description of YOKOYAMA. Though the specimens from the Miyazaci group are also similar to the illustrated holotype, the ratio between the shell-height and the length and that between the depth of the valve and the length are somewhat smaller than those presented by YOKOYAMA. However on examining the topotypes, I have found no significant difference between the specimens of the two areas. Therefore they are specifically identical. A remark is given below (in page 84-85) on some characters and ontogenetic features of this species in comparison with others.

Horizon.—The Takanabe member (the Lower Pliocene).

Locality.—Tôriyama[1] (MI-5595), Kawaminami mura, Koyu gun, Miyazaki Prefecture.

Table 2. Measurements of the selected specimens of *Venericardia* (*Megacardita*) *panda* group.

Reg. No. GK-L	Locality MI-	Length (mm)	Height (mm)	Depth (mm)	H/L (%)	D/L (%)	Umbonal Angle (degrees)	Number of the Ribs	Remarks
4357	5595	48.4	38.3	16.0	79.1	33.0	100	16	right valve, conjoined
4359	5595	50.4	39.9	16.5	79.1	33.7	99	15	left valve, conjoined
4360	5595	56.9	43.0	19.2	75.6	33.7	102	16	right valve
4361	5595	52.6	40.4	16.2	76.8	31.7	104	16	left valve, conjoinld
4491	5595	36.0	28.0	12.4	77.7	34.4	97	16	left valve
4492	5595	37.0	28.4	12.3	77.1	33.2		15	right valve
4658*	4717	43.0	33.1	16.2	76.7	37.6	110	17	right valve
4660*	4717	34.5	26.1	11.2	78.5	32.5	117	16	left valve, conjoined
4482**	5061	31.7	25.3	10.5	79.8	33.1	107	19	left valve

* *Venericardia* (*Megacardita*) *oyamai* n. sp.

** *V.* (*M.*) *megacostata* n. sp. The other specimens are *V.* (*M.*) *panda* (YOKOYAMA).

Venericardia (*Megacardita*) *oyamai* n. sp.

Pl. 22, figs. 15 and 16

Material.—Holotype, GK-L 4658; paratypes, GK-L 4659 and 4660. The illustrated specimens originally showed their complete outline but their valves were unfortunately partly broken before taking photograph.

Measurements.—Shown in table 2.

Diagnosis.—Shell moderate in size, ovato-rhomboidal, very solid, inflated and inequilateral. Beak elevated, prosogyral and incurved; situated at about one fourth of the shell-length from the anterior end. Antero-dorsal margin concave and shorter than the gently curved postero-dorsal margin. Anterior end narrowly rounded and smoothly continuous to the broadly rounded ventral margin. Posterior end obtusely subtruncated. Lunule small but well defined and bounded by

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a deep groove. Surface ornamented with 16–17 prominent radial ribs, which are separated by the deep and narrower interstices, rounded on top in the early growth stage, flat in the late stage and nearly smooth except for the moderately crenate anterior ones. Inner margin coarsely crenate. Ligament deeply inset, marginal and mounted on the heavy nymph. Hinge plate wide, trigonal and heavy with two strong cardinal teeth. Trigonal small anterior tooth and cuneate, heavy and oblique posterior one in the right valve. In the left valve anterior tooth trigonal and larger than that of the right valve; posterior one elongate and lamellar just below the nymph.

Comparison.—The specimens before me apparently indicate its nearest relation to *Venericardia* (*Megacardita*) *panda* (Yokoyama). However the valve of *V.* (*M.*) *panda* attains larger size and has lower and slightly less numerous ribs and larger umbonal angle than *V. oyamai*. Furthermore the nymph of the former is produced and spatulate.

It is also obviously related to *V.* (*M.*) *megacostata* n. sp., but the latter is smaller and has larger umbonal angle and more numerous ribs, which are more quadrate in cross section than the former.

Horizon.—The Tonogôri member (the Uppermost Miocene).

Locality.—Tonogôri[1] (MI-4717), Tonogôri mura, Koyu gun, Miyazaki Prefecture.

Venericardia (*Megacardita*) *megacostata* n. sp.

Pl. 22, figs. 19a, b and c

Material.—Holotype, GK-L 4482; paratype, GK-L 4661. Other specimens are fragmentary.

Measurements.—Shown in table 2.

Diagnosis.—Shell medium in size, attaining about 30 mm in length, solid, ovate and inequilateral. Beak obtuse and very prosogyral; situated at about one-fifth of the shell-length from the anterior end. Antero-dorsal margin short with concave part just below the umbo; postero-dorsal margin slightly convex and much longer than the antero-dorsal margin. Anterior margin narrowly rounded and smoothly continuous to the ventral margin. Posterior margin obliquely subtruncated and joined with the dorsal and the ventral margin with the angulations; ventral margin produced and broadly and regularly rounded. Lunule exceedingly small but distinct and deep. Surface ornamented with about 18 prominent radial ribs, which are nearly as wide as the interstices, almost quadrate in sectional view and heavily crenulated except for the posterior ones. Inner margin of the shell is crenate in correspondence with the ribs. Ligament opisthodetic, deeply inset and mounted on the heavy nymph. Hinge plate heavy, wide and trigonal with two cardinal teeth. In the left valve the anterior tooth short, trigonal, heavy and separated from the antero-dorsal margin, and the posterior one lamellar, laterally elongate, as long as the length of the nymph and subparallel to the postero-dorsal edge. In the right valve small anterior tooth entirely fused with the antero-dorsal edge

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and the posterior one heavy, cuneate, oblique and tapers upward. Anterior and posterior muscle impressions equal in size, distinctly impressed and ovate. Pedal scar small and shallow at the anterior end of the hinge plate. Pallial line entire.

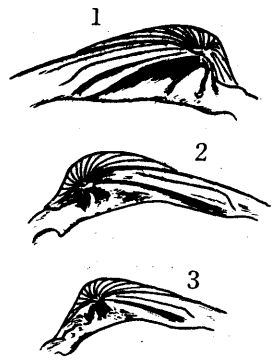


Fig. 5. Hinge plates of the species of ***Venericardia*** (***Megacardita***) ***panda*** group from the Miyazaki group. 1, *V.* (*M.*) ***megacostata*** n. sp. left valve; 2, *V.* (*M.*) ***panda*** (YOKOYAMA) right valve; 3, *V.* (*M.*) ***oyamai*** n. sp. right valve.

Comparison.—The ribs of *Megacardita* are in general sharply crested in the young stage, increase in the width more rapidly than in their height and become broader than the interstices. The present new species, however, is characterized by the relatively narrow and high ribs even in the adult stage. The fact suggests that it may be a primitive form of *Megacardita*.

Venericardia (*Megacardita*) *panda* (YOKOYAMA) is a close ally to this species, but the former attains larger size and has less numerous ribs, which are lower, broader and rounded in sectional view and more smooth on the top than the latter.

V. (*M.*) *oyamai* n. sp. also attains larger size and has less numerous, lower and more smooth ribs than the present species.

V. (*M.*) *lamarckiana* (CLESSIN) from the Indonesian sea (MARTINI-CHEMNITZ, 1886, S. 20, T. 6, F. 1 and 2) is fairly similar to the present species in the character of the ribs but the former has somewhat higher shell, more rounded postero-dorsal margin and slightly narrower ribs than the latter. In these respects *V. lamarckiana* may be regarded as a straight descendant of the present new species. However further evidence is necessary to confirm this idea.

V. (*M.*) *ovalis* (REEVE) from the Philippines (REEVE, 1843, pl. vi, sp. 28) may have some relation to the new species, but the former has more rounded and somewhat broader ribs than the latter. In the character of the ribs it seems to have relation with *V.* (*M.*) *panda* (YOKOYAMA).

Horizon.—The Tano and the Kawabaru members (the lower Upper Miocene).

Localities.—Yamaji[1] (MI-5061), Mino mura, Koyu gun; Yusunoki Hashi[2] (MI-1021), Mukasa mura, Higashi-Morogata gun, Miyazaki Prefecture.

Relation among Venericardia (*Megacardita*) *panda* (YOKOYAMA), *V.* (*M.*) *oyamai n. sp. and V.* (*M.*) *megacostata n. sp.*—From the morphological resemblance a question may naturally arise whether there is any phylogenetic relation among them or not. To answer the question I have scrutinized not only their morphology but also the ontogeny as well as the stratigraphical occurrence.

In the Miyazaki group *V.* (*M.*) *panda, oyamai* and *megacostata* occur in the strata of Early Pliocene, Mio-Pliocene and Late Miocene respectively. The main

1) 宮崎県児湯郡三納村山路
2) 宮崎県東諸県郡穆佐村柞木橋

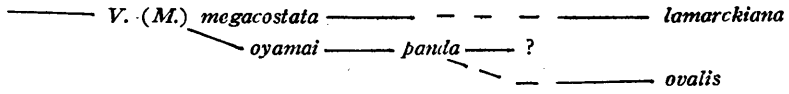
difference among them lies in the size of the shell, the umbonal angle, the disposition of the cardinals and the number and the characters of the ribs (table 3). The three species show a serial change of these characters, as is clearly understood from the preceding descriptions. From both the stratigraphic and morphological facts I am inclined to consider that this serial change is evolutional.

Table 3. Comparison of the species of *Venericardia* (*Megacardita*) *panda* group from the Miyazaki group.

	panda	*oyamai*	*megacostata*
Stratigraphic Horizon	Early Pliocene (Hlb)	Late Miocene (Late G)	early Late Miocene (Early G)
Length of the Mature Shell (mm)	50-55	40	32
Height/Length (%)	75-79	75-79	78-80
Depth/Length (%)	32-34	32.5-37.5	30-33
Number of the Ribs	15	16	18
Umbonal Angle (degrees)	96-104	110-117	107-115
Form of the Ribs at the Ventral Margin	Low and Rounded	← Intermediate →	Quadrate

It is, furthermore, interesting to compare the ontogenetic development of the ribs among these species. As illustrated in the text-figure 6 the ribs of *V.* (*M.*) *oyamai* in the gerontic stage are similar to those in the adolescent-mature stage of *V.* (*M.*) *panda*, and the adolescent rib-character of the former species appears in the nepionic stage of the latter. In other words, the body is enlarged and sexual maturity is retarded in *V.* (*M.*) *panda* (epistasy of EIMER 1890 and prolongation of other authors).

The ribs of *oyamai* and *megacostata* develop almost equally untill the early adolescent stage. In the later stages of development, however, the interstices broaden more rapidly than the ribs in *megacostata*, and in *oyamai* the ribs broaden more rapidly than the interstices as the shell grows. That is to say the two deviate to different trends of development at the early adolescent stage. Thus I tentatively conclude the following phylogenetic lines. Of course further evidences are needed to confirm the idea.



In the phylogenetic line from *megacostata* to *panda* the evolutional change in the morphological characters are enlargement of the shell, magnification of the nymph, decrease of the umbonal angle and the number of the ribs, broadening of the ribs in proportion to the interstices and reduction of the elevation, angulation and crenation of the ribs.

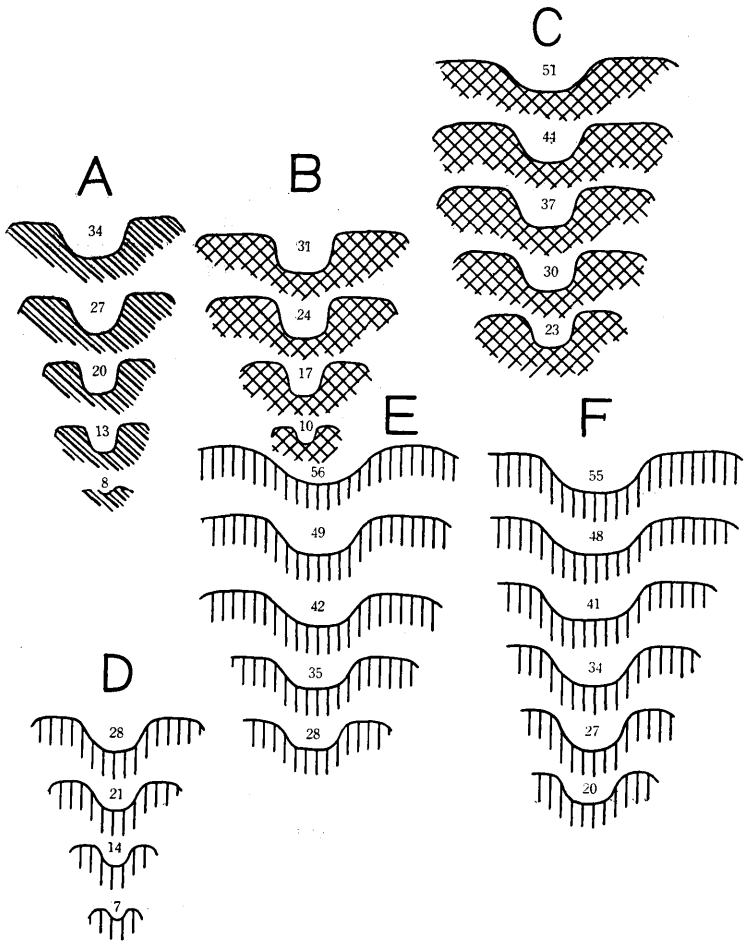


Fig. 6. Ontogenetic change in the form of the ribs of *Venericardia* (*Megacardita*) *panda* group diagrammatically illustrated in cross-section. A, *V.* (*M.*) *megacostata* n. sp., B-C, *V.* (*M.*) *oyamai* n. sp., D-F, *V.* (*M.*) *panda* (YOKOYAMA).

The mumbers indicate the distance in mm. from the umbo. The hatched parts represent the shell substance.

Venericardia (*Megacardita*) *ferruginosa* (ADAMS et REEVE)

Pl. 22, fig. 13 and text-fiig. 7

1850 ***Cardita ferruginosa*** A. ADAMS et REEVE; The Zoology of the Voyage of H. M. S. Samarang, p. 76, pl. 21. fig. 29.

1951 ***Venericardia* (*Megacardita*) *ferruginosa***, HABE; Genera of Japanese Shells, no. 2, p. 108, text-fig. 216 and 217.

1953 ***Venericardia* (*Megacardita*) *ferruginosa***, UOZUMI; 新生代の研究 (Shin Seï Dai no Kenkyu) no. 17, p. 3, pl. 21, figs. 165 and 165a.

Material.—The present species is commonly found on the sandy bottom of the mesoneritic and subneritic fascia of Pacific Ocean around Japan excluding the northern area and has been reported by a number of authors. I have examined the valves of the living species in comparison with the fossil material. Several specimens from the Miyazaki group are referable to the present species.

1 *cm*

Fig. 7. *Venericardia* (*Megacardita*) *ferruginosa* (AD. et RVE.), GK-L 4707, right valve; loc. Iwawaki, Tonda mura, Koyu gun, Miyazaki Pref.

Measurements.—

Specimen Reg. No.	Length (mm)	Height (mm)	Depth (mm)	Number of the Ribs	Locality	Remarks
GK-L 4503	12.0	9.8	4.0	12	Takeuchi	left valve
GK-L 4662	28.4	21.2	7.5	13	Maruno	inner mould
GK-L 4707	17.5	14.5	5.4	13	Iwawaki	right valve

Remarks.—The specimens from Takeuchi (GK-L 4503 and other fragmental unregistered specimens) are probably immature, since they have the sharply crested and high ribs. The specimen GK-L 4707 is quite identical with the living species.
Horizon.—The Tano and Takanabe members (the lower Upper Miocene and Lower Pliocene respectively).
Localities.—Maruno[1] (MI-3644) and Takeuchi[2] (MI-X 2), Miyazaki City and Iwawaki[3] (MI-5674), Tonda mura, Koyu gun, Miyazaki Prefecture.

Venericardia (*Megacardita*) *granulicostata* (NOMURA)

Pl. 22, figs. 17 and 18

1928, ***Venericardia cipangoana*** YOKOYAMA; Imp. Geol. Sur. Japan, Rep, no. 101, p. 86-87, pl. 9, figs. 3-5.
1953, ***Venericardia granulicostata*** NOMURA; Sci. Rep. Tohoku Imp. Univ., ser. 2 (Geol.), vol. 16, pp. 70-72, pl. 2, figs. 7a, b, c and d.
1937, ***Venericaria*** (***Cardites***) ***granulicostata***, OTUKA; The Venus, Malacol. Soc. Japan, vol. 7, no. 3, p. 129, text-fig. 41.
1952, ***Venericardia granulicostata***, SHUTO; Rep. Fac. Sci. Kyushu Univ., vol. 4, no. 1, p. 24, table 2.

The present species was originally described on the basis of the specimens from the Byoritsu formation (Pliocene) of Formosa. It occurs commonly in the same formation as reported by OTUKA, TAN and other authors. It was cited in many papers other than the above noted ones, but I omit them in this list because I have not examined the material. The species has been known nowhere besides Formosa.

This is very variable in the outline of the shell as has already been pointed out by the original author, but in other important characters including the hinge

1) 宮崎県宮崎市丸野
2) 宮崎県宮崎市竹内
3) 宮崎県児湯郡富田村岩脇

and the ribs it is rather invariable.

Horizon.—The Takanabe member (Lower Pliocene).

Locality.—Tôriyama[1] (MI-5595), Kawaminami mura, Koyu gun, Miyazaki Prefecture.

Works Cited

CHAVAN, Thoiry A. (communicated by Julia GARDNER) (1952) Nomenclatural Notes on Carditids and Lucinids. *Jour. Washington Acad. Sci. Vol.* 42, *No.* 4, pp. 116-122.

COSSMANN, Maurice (1905) Mollusques Éocéniques de la Loire-Inférieure. *Tom.* 3, Deuxième *Fascicule*, pp. 135-189, pls. 9-19.

COX, R. L. (1930) The Fossil Fauna of the Samana Range and Some Neighbouring Areas. *Mem. Geol. Surv. India* (*Palaeontologica Indica*), *New Ser. Vol.* 15, pp. 129-222, pl. 17-22.

DESHAYES, G. P. (1824) Déscription des Coquilles Fossiles des Anvirons de Paris. *Tom.* 1, pp. 1-392.

——— (1837) ibid. Atlas, pls. 1-101.

FINLAY, H. J. and MARWICK, J. (1937) The Wangaloan and Associated Molluscan Fauna of Kaitangata-Creen Island Subdivision. *New Zealand Geol. Surv. Branch Palaeontological Bull., No.* 15, pp. 1-140, pls. 1-17.

GARDNER, Julia (1926) The Molluscan Fauna of the Alum Bluff Group of Florida, Part II, Astartacea, Carditacea, Chamacea. *U. S. Geol. Surv. Prof. Pap.* 142-B, pp. 81-95, pls. 16-17.

——— (1939) The *Venericardia planicosta* Group in the Gulf Province. ibid. 189-F, pp. 143-196, pls. 33-46.

——— (1943) Mollusca from the Miocene and Lower Pliocene of Virginia and North Carolina, Part 1, Pelecypoda. ibid. 199-A. pp. 1-144, pls. 1-23.

KRÜGER, J. F. (1823) Geschichte der Urwelt, Bd. 2 (inaccesible here, but cited from GARDNER 1943, p. 61).

MARWICK, J. (1931) The Tertiary Mollusca of the Gisborne District. *New Zealand Geol. Surv. Branch Palaeontological Bull. No.* 13, pp. 1-177, pls. 1-18.

MAKIYAMA, Jiro (1927) Molluscan Fauna of the Lower Part of the Kakegawa Series in the Province of Totomi, Japan. *Mem. Coll. Sci. Kyoto Imp. Univ. Ser.* **B**, *Vol.* 1, *Art.* 1, pp. 1-147, pls. 1-6.

MARTINI-CHEMNITZ (1886) Systematisches Conchylien Cabinet, Neuherausgegeben und Vervollständigt. *Bd.* 10, *Abt.* la, *Crassatella.*

——— (1886) ibid. *Bd.* 10, *Abt.* la, Carditacea.

NONURA, Sitihei (1933) Catalogue of the Tertiary and Quartery Mollusca from the Island of Taiwan (Formosa) in the Institute of Geology and Palaeontology, Tohoku Imperial University, Sendai, Japan. *Sci. Rep. Tohoku Imp. Univ.*, 2nd *Ser.* (*Geol*), *Vol.* 16, pp. 1-106, pls. 1-4.

——— (1937) The Molluscan Fauna from the Pliocene of Tosa. *Japan. Jour. Geol. Geogr. Vol.* 14, *Nos.* 3-4, pp, 67-90, pl. 6.

——— and ZIMBO, Noboru (1935) Molluscan Fossils from the Simaziri Beds of Okinawa-Zima, Ryukyu Islands. *Sci. Rep. Tohoku Imp. Univ.* 2nd *Ser. Vol.* 18, pp. 226-266, pl. 11.

COSTINGH, C. H. (1935) Die Mollusken des Pliozäns von Boemiajoe (Java). *WetenschapeliJhe Medeedlingen No.* 26, pp. 1-256.

OTUKA, Yanosuke (1930) 宮崎県高鍋町附近の地質学的問題. Some Geological Problems at the Takanabe District, Miyazaki Prefecture (in Japanese). *Geogr. Rev. Vol.* 6, *No.* 7, pp. 496-522.

——— (1937) Mollusks from South Formosa (3). *The Venus, Mal. Soc. Japan, Vol.* 7, *No.* 3, pp. 128-143.

REEVE, L. A. (1843) Conchologia Iconica. *Vol.* 1, *Cardita* pls. 1-9, spp. 1-50.

1) 宮崎県児湯郡川南村通山

SUTER, Henry (1914) Revision of the Tertiary Mollusca of New Zealand. ***New Zealand Geol. Surv. Branch Palaeontological Bull. No.*** 2, pp. 1-64, pls. 1-17.

SHUTO, Tsugio (1952) 宮崎層群の地史学的研究. Stratigraphic Study of the Miyazaki Group (in Japanese). ***Rep. Fac. Sci. Kyushu Univ. Geol. Vol.*** 4, ***No*** 1, pp. 1-40.

STEWART, R. B. (1930) GABB's California Cretaceous and Tertiary Type Lamellibranchia. ***Acad. Nat. Sci. Philad. Special Publ. No.*** 3, pp. 1-309, pls. 1-17.

TAKI, Isao and OYAMA, Katura (1954) M. YOKOYAMA's "The Pliocene and Later Faunas from the Kwanto Region in Japan". ***Palaeontol. Soc. Japan Special Pap. No.*** 2, pp. 1-68, pls. 1-49.

THIELE, Johanes (1935) Handbuch der Systematischen Weichtierkunde. ***Bd.*** 2, pp. 779-1154.

UOZUMI, Satoru (1953) 北海道産 ***Venericardia*** 属について. On the Fossil ***Venericardia*** from Hokkaido (in Japanese). ***Shinsei-Dai no Kenkyū, No.*** 17, pp. 1-5, pl. 21, figs. 162-173.

Van der VLERK, I. M. (1931) Caenozoic Amphineura, Gastropoda, Lamellibranchiata, Scaphopoda. ***Leidische Geol. Medeedlingen, No.*** 5, pp. 206-296.

WOODRING, Wendell P. (1925) Miocene Mollusks from Bowden, Jamaica. Pelecypods and Scaphopods. Contributions to the Geology and Palaeontology of the West Indies. ***Carnegie Institution of Washington Publ. No.*** 366, pp. 1-222, pls. 1-28.

YOKOYAMA, Matajiro (1926) Tertiary Mollusca from Southern Totomi. ***Jour. Fac. Sci. Imp. Univ. Tokyo, Sec.*** **II**, ***Vol.*** 1, ***Pt.*** 9, pp. 377-389, pls. 44-45.

——— (1928) Shells from Hyuga. ibid. ***Sec.*** **II**, ***Vol,*** 1, ***Pt.*** 9, pp. 313-364, pls. 38-41.

——— (1928) Mollusca from the Oil-Field of the Island of Taiwan. ***Imp. Geol. Surv. Japan, Rep. No.*** 101, pp. 1-112, pls. 1-18.

——— (1929) Pliocene Shells from Tonohama, Tosa. ibid. ***No.*** 104 pp. 9-17, pls. 7-8.

T. SHUTO

Crassatellites and *Venericardia* from the Miyazaki Group
(Palaeontological Study of the Miyazaki Group—IV)

Plate

Explanation of the Plate 22

Crassatellites (***Crassatellites***) ***tenuiliratus tenuiliratus*** n. sp. and subsp.....p. 73

Fig. 6 (×1), holotype, left valve, GK-L 4261, loc. Kano, Takaoka machi, Higashi-Morogata gun, Miyazaki Prefecture.

Fig. 7 (×1), paratype, right valve, GK-L 4265, loc. Akatani, Takaoka machi.

Fig. 8 (×1), paratype, right valve, GK-L 4278, loc. Kusumi, Takaoka machi.

Fig. 12 (×1), paratype, left valve, GK-L 4277, loc. Akatani, Takaoka machi.

Crassatellites (***Crassatellites***) ***tenuiliratus triangularis*** n. subsp.....p. 75

Fig. 9 (×1), holotype, right valve, GK-L 4269, loc. Kano, Takaoka machi, Higashi-Morogata gun, Miyazaki Prefecture.

Fig. 10 (×1), paratype, right valve, GK-L 4275, loc. same as the preceding one.

Fig. 11 (×1), paratype, right valve, GK-L 4704, loc. Akatani, Takaoka machi.

Crassatellites (***Crassatellites***) ***tusmaensis*** n. sp.....p. 76

Fig. 3a (×1,5), holotype, external view of the left valve, GK-L 4481, loc. Yamaji, Mino mura, Koyu gun, Miyazaki Prefecture.

Fig. 3b (×1), internal view of the same specimen.

Fig. 4 (×1), paratype, right valve, GK-L 4705, loc. same as above.

Crassatellies (***Crassatellites***) ***takanabensis*** n. sp. .....p. 77

Fig. 1a (×1.5), holotype, external view of the left valve, GK-L 4697, loc. Kizukume, Tonda mura, Koyu gun, Miyazaki Prefecture.

Fig. 1b (×1,5), internal view of the same specimen.

Fig. 2 (×1.5), paratype, left valve, GK-L 4698, loc. same as the preceding one.

Crassatellites (***Crassatina***) aff. ***oblongatus uchidanus*** (YOKOYAMA) .....p. 78

Fig. 5 (×1), left valve, GK-L 4665, loc. Yamaji, Mino mura, Koyu gun, Miyazaki Prefecture.

Venericardia (***Megacardita***) ***panda*** (YOKOYAMA).....p. 81

Fig. 14 (×1), right valve, GK-L 4360, loc. Tôriyama, Kawaminami mura, Koyu gun, Miyazaki Prefecture.

Venericardia (***Megacardita***) ***oyamai*** n. sp.....p. 82

Fig. 15 (×1), holotype, right valve, GK-L 4658, loc. Tonogôri, Tonogôri mura, Koyo gun, Miyazaki Prefecture.

Fig. 16 (×1), paratype, left valve, GK-L 4660, immature, loc. same as above.

Venericardia (***Megacardita***) ***megacostata*** n, sp.....p. 83

Fig. 19a (×1.5), holotype, external view of the left valve, GK-L 4482, loc. Yamaji, Mino mura, Koyu gun, Miyazaki Prefecture.

Fig. 19b (×1.5), internal view of the same specimen.

Fig. 19c (×1), top view of the same specimen.

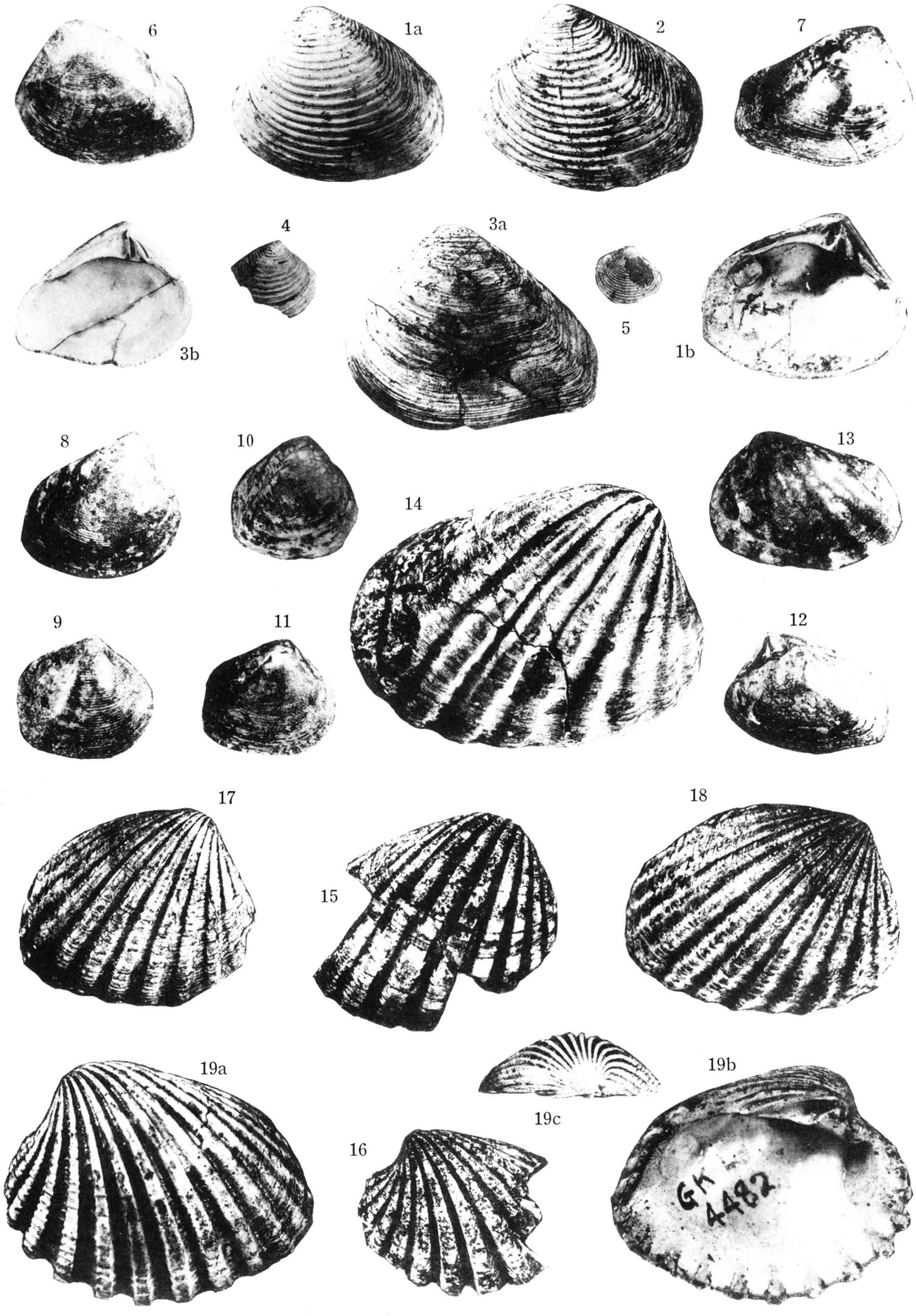
Venericardia (***Megacardita***) ***ferruginosa*** (AD. et RVE.).....p. 86

Fig. 13 (×1), inner mould, GK-L 4503, loc. Maruno, Kibana, Miyazaki City.

Venericardia (***Megacardita***) ***granulicostata*** (NOMURA) .....p. 87

Fig. 17 (×1.5), right valve, GK-L 4489, loc. Tôriyama, Kawaminami mura, Koyu gun, Miyazaki Prefecture.

Fig. 18 (×1.5), right valve. GK-L 4483, loc. same as the preceding one.



T. Shuto: *Crassatellites* and *Venericardia*