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ON SOME CRETACEOUS FOSSILS FROM
THE ISLANDS OF AMAKUSA,
KYÛSHÛ, JAPAN

By

Takumi NAGAO

With 3 Plates.

The Islands of Amakusa include two larger islands, Amakusa-Kami-shima and Amakusa-Shimo-shima, and numerous adjacent islets scattered in the Yatsushiro-nada in Kyûshû. These islands, due to the geological and palaeontological investigations undertaken by various Japanese geologists⁽¹⁾, are now known to be composed mainly of Cretaceous and Palaeogene deposits.

- (1) D. YAMASHITA: "Explanatory Text to the Geological Map Kumamoto Sheet in 1: 200,000," 1895. S. KANAHARA: "Explanatory Text to the Geological Map Hitoyoshi Sheet in 1: 200,000," 1907. S. KANAHARA: "Report on the Geology of the Coal-field of Amakusa-Shimo-shima," 1904. M. KUHARA: "Geology of Amakusa," 1910 (manuscript). T. KAWAI: "Geology of Amakusa," 1911 (manuscript). M. YOKOYAMA: "Some Tertiary Fossils from the Miike Coal-field." Jour. Coll. Sci., Imp. Univ. Tôkyô, Vol. XXXVII, 1911. S. YEHARA: "The Izumi-Sandstone of Kyûshû." Jour. Geol. Soc., Tôkyô, Vol. XXVIII, 1921. S. YEHARA: "Cretaceous Formation of the Amakusa Island." Ibid., Vol. XXIX, 1922. T. NAGAO: "Geology of the Islands of Amakusa." Ibid., Vol. XXIX, 1922. T. NAGAO: "Nummulite-bearing Beds in the Amakusa Islands." Ibid., Vol. XXX, 1923. T. NAGAO: "On the Boundary between Mesozoic and Old-Tertiary Formations in Kyûshû." Ibid., Vol. XXXI, 1924. H. YABE: "Zur Stratigraphie und Palaeontologie der oberen Kreide von Hokkaidô und Sachalin." Z. d. deutsch. geol. Gesell., Vol. LXI, 1909. H. YABE: "Note on Three Upper Cretaceous Ammonites from Japan, outside of Hokkaidô." Jour. Geol. Soc., Tôkyô, Vol. VIII, Vol. IX, 1901-1902. H. YABE and S. HANZAWA: "Nummulitic Rocks of the Islands of Amakusa (Kyûshû, Japan)." Sci. Rep., Tôhoku Imp. Univ., Ser. II, Vol. VII, 1925. S. YEHARA: "Cretaceous Trigoninae from the Amakusa Islands, Prov. Higo." Jour. Geol. Soc., Tôkyô, Vol. XXX, 1923. S. YEHARA: "Cretaceous Trigonina from South-Western Japan." Jap. Jour. Geol. & Geogr., Vol. II, 1923. T. NAGAO: "Stratigraphical Boundary between the Cretaceous and Tertiary Strata of Kyûshû, Japan." Jap. Jour. Geol. & Geogr., Vol. IV, 1925. T. NAGAO: "Stratigraphy of the Palaeogene Formations of Kyûshû, Pt. I. The Amakusa Coalfield." Jour. Geogr., Vol. XXXVIII, 1926. T. NAGAO: "Palaeogene Coal-bearing Formations of the Island of Kyûshû." Sci. Rep. Tôhoku Imp. Univ., Ser. II, Vol. XI, 1927. T. NAGAO: "Palaeogene Fossils of the Island of Kyûshû, Japan. Pt. I." Ibid., Vol. IX, 1928. T. NAGAO: "A Summary of the Palaeogene Stratigraphy of Kyûshû, Japan, with some Accounts on the Fossiliferous Zones." Ibid., Vol. XII, 1928.

The Cretaceous deposits are divided by me into the following two groups⁽²⁾ (Pl. I.).

- I. The Goshonoura Group.
- II. The Himenoura Group.
 - a. The Lower Division.
 - b. The Middle Division.
 - c. The Upper Division⁽³⁾.

These complexes are sometimes very fossiliferous, *Trigonia* being the most common in the Goshonoura and ammonites and *Inoceramus* dominant in the Himenoura.

The Cretaceous fossils previously reported from the Islands of Amakusa are enumerated below :

- I. H. YABE: "Zur Stratigraphie und Palaeontologie der oberen Kreide von Hokkaidô und Sachalin." Zeitschr. d. deutsch. geol. Gesell., Vol. LXI, p, 402, 1909.

The Himenoura Group.

Inoceramus schmidtii MICHAEL

Pachydiscus cfr. *haradai* JIMBO

Gaudryceras tenuiliratum YABE

- II. H. YABE: "Note on Three Upper Cretaceous Ammonites from Japan, outside of Hokkaidô," Jour. Geol. Soc., Tôkyô, Vol. VIII, 1901, p. 1; IX, 1902, p. 1.

The Himenoura Group.

Peroniceras amaxense YABE

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- (2) T. NAGAO: "Stratigraphical Boundary between the Cretaceous and Tertiary Strata of Kyûshû, Japan." Jap. Jour. Geol. & Geogr., Vol. IV, 1925, p. 55.
 - (3) Dr. YEHARA divided the Cretaceous of this area as follows:—

- A. The *Trigonia* Sandstone Beds
 - (a) The *Trigonia longiloba* zone
 - (b) The *Pectunculus* zone
- B. The Ammonite Beds
 - (a) The *Peroniceras amaxense* zone
 - (b) The *Pachydiscus* zone
 - (c) The *Inoceramus* zone

The *Trigonia longiloba* zone of YEHARA is almost identical with the Goshonoura Group, while his *Pectunculus* zone and the Ammonite Beds correspond to the Himenoura.

- III. S. YEHARA: "Cretaceous Trigonidae from the Amakusa Islands, Prov. Higo, Kyûshû, Japan." Ibid., Vol. XXX, p. 1, 1923.

The Goshonoura Group.

Trigonia dilapsa YEHARA

T. ogawai YEHARA

T. hokkaidoana YEHARA

T. sakakurai YEHARA

T. yokoyamai YEHARA var. (= *T. sakakurai* YEHARA var. in the next article)

T. subovalis JIMBO (= *T. subovalis* var. *minor* YABE and NAGAO)

T. kikuchiana YEHARA

The Himenoura Group.

T. japonica YEHARA

- IV. S. YEHARA: "Cretaceous Trigonidae from South-western Japan." Jap. Jour. Geol. and Geogr., Vol. II, p. 59, 1923.

Most of the species described in this article are the same as the preceding, but *T. yokoyamai* YEHARA var. is called *T. sakakurai* YEHARA var. Moreover, *T. pocilliformis* YOK. is added; this form is treated in the present paper under the name *T. pustulosa* NAGAO nov. nom.

- V. S. YEHARA: "On the Izumi-Sandstone Group in the Ônogawa-Basin (Prov. Bungo) and the Same Group in Uwajima (Prov. Iyo)." Ibid., Vol. III, p. 27, 1924.

The Goshonoura Group.

Callista cfr. *plana* SOW. (probably identical with *Callista pseudoplana* YABE and NAGAO var. *alta* YABE and NAGAO)

- VI. H. YABE and S. SHIMIZU: "A New Species of *Nautilus*, *N. (Cymatoceras) pseudo-atlas* YABE and SHIMIZU, from the Upper Cretaceous of Amakusa." Ibid., Vol. III, p. 41, 1924.

The Himenoura Group.

Nautilus (Cymatoceras) pseudo-atlas YABE and SHIMIZU

- VII. H. YABE and S. SHIMIZU: "Japanese Cretaceous Ammonites belonging to Prionotropidae, I." Sci. Rep. Tôhoku Imp. Univ., Ser. II, Vol. VII, No. 4, p. 125, 1925.

The Himenoura Group.

Mortoniceras fukazawai YABE and SHIMIZU

The following table shows the names of the fossils to be described in this article.

I. The Himenoura Group.

Glycimeris amakusensis nov.

Nucula formosa nov.

Lucina cfr. *occidentalis* (MORTON)

L. sp.

Trigonia subovalis JIMBO var. *minor* YABE and NAGAO

II. The Goshonoura Group.

Glycimeris amakusensis var. *solidus* nov.

Veniella japonica nov.

Trigonia pustulosa nov. nom.

T. subovalis JIMBO var. *minor* YABE and NAGAO

Cerithium pyramidaeforme nov.

Nerinaea sp.

Glauconia (?) sp.

All these specimens belong to the Institute of Geology and Palaeontology, Tôhoku Imperial University, Sendai.

Stratigraphical Notes.

The Cretaceous formations of the Islands of Amakusa are unconformably underlaid by gneissose rocks and crystalline schists and unconformably overlain by the Palaeogene Miroku Group and the equivalent Fukami Sandstone. The Cretaceous rocks attain a few

thousand feet in thickness and are divided into the following two groups :—

- I. The Goshonoura Group.
- II. The Himenoura Group.

I. THE GOSHONOURA GROUP

On Goshonoura-jima, an islet south of Amakusa-Kami-shima, the Goshonoura Group is developed. This complex is composed mainly of dark gray, fine-grained sandstone having, in addition to a thin coal-seam of no practical importance, some layers of gray sandy shale in the lower part, and medium-grained sandstone in the upper. Moreover, it is worthy of note that some thin layers of variegated shale are intercalated in the lowest part visible on this island. This group forms a syncline of NNE-SSW trend, which, on the north-western coast, is separated by a fault or faults from the very steeply inclined and much disturbed younger Himenoura Group. Abundant fossils are found on this island, *Trigonia* and *Cerithium* being common. The following species were described by Dr. S. Yehara :

Trigonia subovalis JIMBO

T. pocilliformis YOK.

T. ogawai YEHARA

T. hokkaidoana YEHARA

T. dilapsa YEHARA

T. sakakurai YEHARA

T. kikuchiana YOK.

Callista cfr. *plana* SOW.

Of these, his *T. subovalis* JIMBO is *T. subovalis* var. *minor* YABE and NAGAO, and *Callista* cfr. *plana* Sow. may be identical with *C. pseudoplana* YABE and NAGAO, while his *T. pocilliformis* YOK. from this island is now regarded to be distinct from the type form from Shikoku and called *T. pustulosa* nov. in the present paper.

The species collected by me on this island are

Trigonia ogawai YEHARA

T. dilapsa YEHARA

T. pustulosa NAGAO nov. nom.

Glycimeris amakusensis nov., var. *solidus* NAGAO nov.

Ostrea sp.

Veniella japonica NAGAO nov.

Crassatellites sp.

Cerithium pyramidaeforme NAGAO nov.

besides a fragment of an indeterminable Ammonite.

The Goshonoura Group is also well developed on Shishi-jima, south of Goshonoura-jima, in a syncline. It contains

Trigonia pustulosa NAGAO nov. nom.

T. ogawai YEHARA

Nerinea sp.

Cerithium pyramidaeforme NAGAO nov.

This group is now thought not to be represented on either Amakusa-Kami-shima or Amakusa-Shimo-shima, though it was once thought to be.

II. THE HIMENOURA GROUP

The Himenoura Group, which has long been known as the fossiliferous Cretaceous in Kyûshû, is well developed on the eastern coast of Amakusa-Kami-shima, Amakusa-Shimo-shima, Maki-shima, and in the Uto peninsula, yielding numerous fossils in many localities.

This complex comprises three divisions.

a. The Lower Division.

On Hino-shima and Kuku-shima, the two small islets close to the eastern coast of Amakusa-Kami-shima, white or gray sandstone, with

subordinate conglomerate and dark coloured shale, rests directly upon the so-called "Gneiss Series" and dips westward. This complex is the lower division of the Himenoura Group and yields *Glycimeris* sp. and numerous fragments of *Inoceramus* sp., probably identical with *I. amakusensis* NAGAO⁽⁴⁾ or *I. cfr. regularis* D'ORB. The same complex, with its lithological nature identical with that of Hinoshima, is exposed at Kôjiro, Himedo-mura, on the eastern coast of Amakusa-Kami-shima, where it also unconformably covers "the Gneiss Series," representing the lowest part of the Himenoura Group which is well developed around Himenoura, Himedo-mura.

Furthermore, at a sea-cliff about 1 km. east of Higashiura, Ôdo-mura, on the southern coast of Amakusa-Kami-shima, there are exposed a basal conglomerate and conglomeratic sandstone followed by a sandstone. The conglomerate is composed of numerous large pebbles, derived from the underlying gneissose granite. It contains *Glycimeris* sp. and other indeterminable fossils. This complex is overlaid by the green sandstone of the Middle Division exposed at the sandstone quarry of Ôdo-mura, to be described later.

On the western coast of Amakusa-Shimo-shima are exposed dark gray and greenish sandstones alternating with layers of dark-coloured shale at Ôe, Ôe-mura, being here underlaid by the crystalline schists of the Sambagawa System. These sandstones were once thought by Mr. Yehara and also by the present writer to be the Goshonoura Group. But it is better to regard them as representing the Lower and Middle Divisions of the Himenoura.

Thus, on Amakusa-Kami-shima as well as on Amakusa-Shimo-shima, there is not developed the Goshonoura Group, the younger Himenoura always unconformably overlying "the Gneiss Series" or the Sambagawa System. One must go southward from Amakusa-Kami-shima to find the Himenoura Group exposed in juxtaposition with the Goshonoura.

(4) T. NAGAO: "Cretaceous *Inoceramus* of Japan," (manuscript), 1929.

On Maki-shima, west of Goshonoura-jima, a conglomeratic sandstone containing *Glycimeris* sp. dips northwestward and gradually passes into the overlying Middle Division with its characteristic fossils. The base of this conglomeratic sandstone, which represents the Lower Division of the Goshonoura, is not observable here and accordingly its stratigraphical relation to the Goshonoura Group of Goshonoura-jima is not certainly determined, for the latter is separated from the former by an area of the much disturbed Middle or Upper Division of the Himenoura which is faulted on both sides.

b. The Middle Division.

The Middle Division, the main part of the Himenoura Group, consists of dark-coloured shale with intercalating layers of grayish or greenish sandstone. On Hino-shima, the Lower Division is followed by a complex composed of gray shale and greenish sandstone in alternation, which yields

Glycimeris sp.

Inoceramus amakusensis NAGAO nov.

Hamites sp.

This is the Middle Division of the Himenoura Group.

At Wadanohana, just opposite the preceding locality, is exposed a dark coloured shale with thin layers of sandstone and conglomeratic sandstone, containing the following species:

Inoceramus schmidtii MICHAEL

Glycimeris amakusensis NAGAO nov.

Trigonia subovalis JIMBO var. *minor* YABE and NAGAO

Polyptychoceras cfr. *haradanum* (YOK.)

Parapachydiscus cfr. *haradai* (JIMBO)

Gaudryceras tenuiliratum YABE

Farther west, at the sandstone quarry, about 1 km. east of Higashiura, Ôdo-mura, are found⁽⁵⁾

Arca? sp.

Inoceramus amakusensis NAGAO nov.

Glycimeris sp.

Trigonia subovalis JIMBO var. *minor* YABE and NAGAO

Hamites sp.

Mortoniceras fukazawai YABE and SHIMIZU

Puzosia sp.,

in a green sandstone and overlying dark-coloured shale. Specimens of *Inoceramus amakusensis* NAGAO are found at Higashiura, Ôdo-mura, on a rock-platform of a shale in the upper part of this division.

From a grayish green sandstone and shale, which follow the Lower Division at the northern end of Mayushima, west of Goshonoura-jima, were obtained⁽⁶⁾

Glycimeris sp.

Inoceramus sp. aff. *I. amakusensis* NAGAO

Hamites sp.

Mortoniceras fukazawai YABE and SHIMIZU.

On the western coast of Goshonoura-jima and the northern coast of Shishi-jima, are found in the thin-bedded dark-coloured shale

Inoceramus sp.

Inoceramus schmidtii MICHAEL

Gaudryceras tenuiliratum YABE.

Another fossil locality of this division is Himenoura, Himedo-mura, on the eastern coast of Amakusa-Kami-shima, where Kojima, a small islet off Himenoura is composed of thin-bedded shale, containing

(5) Mr. S. YEHARA reported an occurrence of *Peroniceras amaxense* YABE from this locality. Cfr. YEHARA: "Cretaceous Formation of the Amakusa Islands." Op. cit., p. 143.

(6) Mr. YEHARA reported from this locality *Peroniceras amaxense* YABE. Cfr. YEHARA, S.: "Cretaceous Formation of the Amakusa Islands." Op. cit., p. 142.



Nucula formosa NAGAO nov.

Polyptychoceras cfr. *haradanum* (YOK.)

Parapachydiscus haradai (JIMBO)

Gaudryceras tenuiliratum YABE.

The last mentioned species is the most common here. It has also been discovered at Biwanokubi in Himenoura. Moreover,

Inoceramus schmidtii MICHAEL

I. sp. aff. *I. amakusensis* NAGAO

Nautilus (*Cymatoceras*) *pseudo-atlas* YABE and SHIMIZU

were obtained from shale layers forming the rock-platform north of Himenoura. This shale occupies a horizon probably a little higher than that of Kojima.

On the western coast of Amakusa-Shimo-shima, a complex of gray and greenish sandstone and dark coloured shale is exposed at Ôe, Ôemura, as cited before. Its lower part, resting directly upon the Sambagawa System, is regarded as the Lower Division of the Himenoura Group, but its main part may represent the Middle Division. Here were collected

Inoceramus sp. (belonging to the group of *I.* cfr. *regularis*)

Glycimeris sp. cfr. *G. amakusensis* NAGAO

Trigonia subovalis JIMBO var. *minor* YABE and NAGAO,

and from its upper part occupying the western slope of the mountain between Ôe and Sakitsu was obtained

Inoceramus schmidtii MICHAEL.

Moreover, Mr. YEHARA⁽⁷⁾ described *Trigonia japonica* YEHARA from Ôe. This species is also reported by him from the basal part of the Izumi Sandstone of Shikoku.

(7) S. YEHARA: "Cretaceous Trigoniae from Amakusa Islands, Prov. Higo, Kyûshû, Japan," p. 10, Pl. VI, figs. 6, 7. S. YEHARA: "Cretaceous Trigoniae from South-western Japan." Op. cit., p. 83, Pl. XII, figs. 3-4.

On the eastern coast of Amakusa-Shimo-shima, at Fukami and Shimohira, there is exposed a complex of dark-coloured shale with intercalated layers of sandstone. From this, the author got

Inoceramus sp., (belonging to the group of *I. cfr. regularis* D'ORB.)

Glycimeris sp. cfr. *G. amakusensis* NAGAO.

Trigonia subovalis JIMBO var. *minor* YABE and NAGAO.

The stratigraphical position of this shale-complex is not easily determinable, but most probably it belongs to the Middle Division of the Himenoura.

Apart from the Amakusa Islands,

Hamites sp.

Mortoniceras fukazawai YABE and SHIMIZU

were found at Ôda and Shinyashiki, Ôda-mura in the Uto peninsula. This fossiliferous bed is composed of thin-bedded shale intercalated with several layers of sandstone and conglomerate and overlain by the Palæocene Akasaki Beds. It is regarded as the Middle Division of the Himenoura Group, though that this complex may be the Upper Division, next to be described, is not deniable.

c. The Upper Division.

This Division, passing gradually into the preceding, is excellently exposed along the sea-cliff of Ôdo-mura between Higashiura and Akasaki near Ikenoura. It is mainly composed of thin-bedded shale with subordinate sandstone. It is well developed also on Maki-shima, west of Goshonoura-jima, with the same lithologic nature.

The Upper Division is, in general, very poor in fossil content, only one fossiliferous layer being found in the two localities, above cited, at its uppermost part, that is a point 20 to 40 feet below the base of the overlying Akasaki Beds. Of the fossils derived from this division,

Lucina cfr. *occidentalis* (MORTON)

Lucina sp.

came from the former locality, and a large specimen of

Parapachydiscus haradi (JIMBO)

was obtained from the latter.

It is clearly concluded that the Himenoura Group, in its greater part, is Lower Senonian in age as indicated by the evidence of the cephalopods and *Inoceramus*. Prof. H. YABE first reported the following species from the Cretaceous deposits of Amakusa-Kami-shima :

Inoceramus schmidtii MICHAEL⁽⁸⁾

Parapachydiscus haradai (JIMBO)

Gaudryceras tenuiliratum YABE

Peroniceras amaxense YABE,⁽⁹⁾

and eminently regarded the complex, from which this fauna was derived, as being Lower Senonian and equivalent to the well known Upper Ammonites Beds of Hokkaidô; the first three fossils above enumerated are found in Hokkaidô. These species, except *Peroniceras amaxense*, are rather common in the Himenoura Group as described before. This last mentioned species is not in the present author's collection from Amakusa, but it is very probable that its original locality may be either Wadanohana or Higashiura on Amakusa-Kami-shima, where the Middle Division of the Himenoura is well developed. Moreover, *Mortoniceras fukazawai* YABE and SHIMIZU points the Lower Senonian age of the Himenoura.

Besides the fossils above cited, there are *Nucula formosa* NAGAO nov., *Trigonia japonica* YEHARA and *Lucina* cfr. *occidentalis* (MORTON); the first of these is found also from the Upper Ammonites Beds of South Saghalin; the second is closely akin to the American Lower

(8) H. YABE: "Zur Stratigraphie und Palaeontologie der oberen Kreide von Hokkaido und Sachalin." Z. d. deutsch. geol. Gesell., Vol. LXI, 1909, p. 402.

(9) H. YABE: "Notes on Three Upper Cretaceous Ammonites from Japan, outside of Hokkaido." Jour. Geol. Soc. Tôkyô, Vol. VIII, 1901; IX, 1902.

Senonian species; and the third is reported from the basal part of the Izumi Sandstone of Sanuki (Lower Senonian).

The geological age of the Goshonoura Group is not determinable with much certainty. It is very rich in *Trigonia* and accordingly regarded by Mr. YEHARA⁽¹⁰⁾ as contemporaneous with the *Trigonia* Sandstone (Cenomanian) of Hokkaidô. Of the species of *Trigonia*, *T. subovalis* var. *minor* YABE and NAGAO ranges from the *Trigonia* Sandstone to the Hakobuchi Sandstone (Senonian) but is not yet known from the older Monobegawa Series of Japan, while *T. kikuchiana* YOK. is confined to the Monobegawa. As to *T. hokkaidoana*, this form was common in the *Trigonia* Sandstone of Hokkaidô as well as the Monobegawa Series of Miyako district in the Kitakami Mountainland, Honshû. None of the other species points to the precise geological age of the complex.

The stratigraphical relation between the Goshonoura Group and the Himenoura is not determined, these two formations being always separated by faults. It is worthy of note, however, that the latter rests directly upon "the Gneiss Series" or the Sambagawa System on Amakusa-Kami-shima and Amakusa-Shimo-shima, where the Goshonoura is not developed at all. This leads us to suppose an unconformable relation of these two Cretaceous formations. It must be added that the lower part of the Goshonoura Group is intercalated with several layers of variegated shale, as is the case in the lower part of the Lower Cretaceous deposits developed in Mifune district, province of Higo and the Onogawa district, province of Bungo, both in Kyûshû. Moreover, there are two species from the Goshonoura, worthy of mention; *Nerinaea* sp. seems to belong to the group of *N. etalloni* PICT. and CAMP. from the Valanginian and *N. aptiensis* PICT. and CAMP. from the Aptian, of Europe, and *Glaucania* (?) sp. is allied to the specimens of this genus, which are very common in the Ryôseki Series (Wealden) of Japan.

(10) S. YEHARA: "Cretaceous Formation of the Amakusa Islands." Jour. Geol. Soc., Tôkyô, Vol. XXIX, 1922.

Taken as a whole, the Goshonoura Group may be older than the *Trigonia* Sandstone of Hokkaidô, being supposed to be Lower Cretaceous in age.

Description of Species

LAMELLIBRANCHIATA

Nucula, LAM.

Nucula formosa nov. sp.

Pl. II, Fig. 2.

Shell rather small, obliquely elongate-ovate, slightly convex; very inequilateral, anterior side being about twice the posterior and narrowly rounded along the margin; antero-dorsal margin long and slightly arcuate, the postero-dorsal one nearly straight, making an obtuse angle with the antero-dorsal margin; ventral margin broadly arched; postero-ventral end subpointed. Umbo relatively low, incurved, opisthogyrous and presumably approximate; lunule very narrow and bordered by a sharp ridge; escutcheon unknown; area depressed, margined by a rounded ridge and divided into two parts, the lower part being concave, the upper one convex and pouching along the postero-dorsal margin of the shell. Surface ornamented with numerous, crowded and distinct concentric ribs and much narrower grooves in alternation; there is also a narrow and fairly depressed zone running from the umbo to the anterior end. Inner margin probably smooth. Test thin.

Dimensions:	Height	Length	Thickness of one valve
	11 mm.	14 mm.	3 mm.

Two specimens were examined, the larger one being the holotype. The present species is similar in many points to *N. ishidoensis* YABE and NAGAO⁽¹¹⁾ from the Neocomian Ishidô Group of the Kwantô Mountain-

(11) H. YABE, T. NAGAO, and S. SHIMIZU: "Cretaceous Mollusca from the Sanchû Graben in the Kwantô Mountainland, Japan." Sci. Rep. Tôhoku Imp. Univ., Ser. II, Vol. IX, No. 2, 1926, p. 41, pl. XIII, figs. 46-47.

land, Honshû, but it has a less convex shell, with a thinner test and a larger angle between the dorsal margins. Our form is, moreover, allied to *N. solitaria* GABB from the Chico Group of California⁽¹²⁾ and the Upper Cretaceous of the Queen Charlotte Islands and *N. taubica* STOL.⁽¹³⁾ from the Ariyalur Group of S. India, but it is longer than these two foreign ones. It is also distinguished from the North American species in having a thinner shell with a less prominent umbo.

Locality: Himenoura Group; Himenoura, Himedo-mura, Amakusa-Kami-shima. There are here two specimens, specifically identical with this species, from the Upper Ammonite Beds of Saghalin, the locality being Oku-Kawakami along the Suzuyagawa, South Saghalin.

Glycimeris, DA COSTA

Glycimeris amakusensis nov. sp.

Pl. II, Figs. 4-7.

Shell small, nearly equilateral, suborbicular, slightly longer than high, and moderately convex; antero-dorsal part somewhat produced and the postero-dorsal obliquely subtruncated; posterior margin broadly rounded, passing gradually into the arcuate ventral. Umbo small, incurved and nearly central. Hinge line fairly long, moderately curved and provided with about 9 anterior teeth and about 10 posterior; area presumably very short and narrow. Surface with numerous, flat radial ribs, separated by very narrow grooves; concentric lines of growth crowded, somewhat wavy on the radial ribs and strengthened into growth ridges at intervals; inner margin crenulated. Test rather thin.

(12) W. M. GABB: Paleontology of California, Vol. II, p. 197; J. F. WHITEAVES: "On the Fossils of the Coal-Bearing Deposits of the Queen Charlotte Islands." Mesozoic Fossils, Vol. I, p. 232, pl. XXXI, figs. 3a, 3b.

(13) F. STOLICZKA: "Cretaceous Fauna of Southern India," Vol. III, Pelecypoda. Palaeont. India, Vol. VI, p. 328, pl. XVII, figs. 14, 16.

Dimensions:	Height	Length	Thickness of one valve
	20 mm.	22 mm.	7 mm.
	18 mm.	20 mm.	(?)

Several specimens were obtained.

The present species is distinguishable from *G. hokkaidoensis* (YABE and NAGAO)⁽¹⁴⁾ from the *Trigonia* Sandstone (Cenomanian) of Hokkaidô in having a longer and less inflated shell with a thinner test and more numerous, smooth radial ribs. It is more closely allied to *G. subimbri-cata* (M. & H.)⁽¹⁵⁾ from the Fox Hills Group of N. America, but the former has a less prominent umbo and more numerous radial ribs. Of the Cretaceous fossils from S. India, *G. subplanata* (STOL.)⁽¹⁶⁾ from the Ariyalur Group has some resemblance to ours, but the Japanese form is covered by broader radial ribs.

Locality: Himenoura Group; Wadanohana, Takado-mura, Amakusa-Kami-shima.

Glycimeris amakusensis var. *solida* nov. var.

Pl. III, Figs. 13, 13a, 14.

Shell orbicular, subequilateral, very convex; umbo small, prominent and incurved; area very short and small, with a few inverted V-shaped ligamental grooves. Hinge line moderately long and evenly curved. Surface ornamented with numerous, flat, fine radial ribs, separated by linear grooves; inner margin crenulated. Test thick.

Dimensions:	Height	Length	Thickness of one valve
	30 mm.	29 mm. (?)	11 mm.

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- (14) H. YABE and T. NAGAO: "Cretaceous Fossils from Hokkaidô: Annelida, Gastropoda and Lamellibranchiata." Sci. Rep. Tôhoku Imp. Univ. Sendai, Ser. II, Vol. IX, No. 3, p. 82, pl. XVII, figs. 22, 22a, 22b.
- (15) F. B. MEEK: "A Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country." U. S. Geol. Surv. Territ., Vol. IX, p. 95, pl. XXVIII, figs. 14, 14a-14d.
- (16) F. STOLICZKA: Op. cit., p. 347, pl. XVII, figs. 28-30; pl. XLIX, fig. 10.

The author has a few specimens belonging to *Glycimeris* from the Goshonoura Group exposed on Goshonoura-jima, which are closely allied to the preceding species and it is not impossible that these two forms may be identical. The present one, however, seems to have a more convex shell with thicker test, hence the author is inclined to regard it as a variety of the type species.

Locality: Goshonoura Group; Goshonoura-jima, Province of Higo.

Trigonia BRUG.

Trigonia pustulosa nov. nom.

Pl. III, Figs. 9-12.

1923. *Trigonia pocilliformis* (pars.) YEHARA: "Cretaceus Trigoniae from South-western Japan." Jap. Jour. Geol. & Geogr.,

Vol. III, p. 71, pl. X, figs. 1, 1a, 2, 3.

Shell crescentic, inflated anteriorly, elongate and attenuate posteriorly; anterior margin rounded, passing gradually into the ventral which is slightly arched and ascends posteriorly; postero-dorsal margin broadly convex; umbo prominent, strongly incurved and approximate. Pallial portion of the shell ornamented with numerous costae (about 20 in number in a specimen 25 mm. long) which are narrow, sharp, elevated and finely crenulated, very divergent near the antero-ventral margin; anterior 5 or 6 costae, concentric and not reaching the anterior margin; next about 10, divergent and somewhat flexuous; remaining costae, nearly straight and oblique to the outer margin of the area; interspaces between the costae, concave and about three times as broad as the costae. Area narrow, beginning near the umbo as a narrow ridge and rather rapidly widening toward the end; for the greater part of its length bifurcated by a shallow mesial groove and ornamented with fine pustules and transverse plications; pustules arranged in two sets of rows which cross each other and give to rise a reticulate appear-

ance; plications more or less elevated. Escutchen broad, excavated, rising at the inner margin and provided with numerous costellae; costellae transverse or anteriorly oblique, narrow, and finely crenulated.

The present form was first reported by Dr. S. YEHARA from Goshonoura-jima, Amakusa, and included by him in *T. pocilliformis* YOK.⁽¹⁷⁾ It is really allied to *T. pocilliformis* but differs in its costae being more numerous, narrower and more finely crenulated. Moreover, the area is provided with fine pustules. Our form is closely similar to *T. hokkaidoana* YEHARA⁽¹⁸⁾ on the other hand, but it is distinguishable from the latter by its more finely crenulated costae and its pustulated area. As stated by Mr. YEHARA, *T. pocilliformis* is very variable in many features but the present author is inclined to distinguish the specimens from Goshonoura-jima as a species distinct from this well known form.

Locality: Goshonoura Group; Goshonoura-jima, Amakusa-gun, Province of Higo; Shishi-jima, Nagashima-mura, Province of Satsuma.

Trigonia subovalis JIMBO var. *minor* YABE and NAGAO

1915. *Trigonia* cfr. *subovalis* YEHARA: "The Cretaceous Trigoniae from Hokkaidô and Miyako." Sci. Rep. Tôhoku Imp. Univ., Ser. II, Vol. II, p. 42, pl. I, figs. 14-17.
1921. *Trigonia* cfr. *subovalis* HAYASAKA: "On a Collection of the Cretaceous Fauna from Russian Sakhalin." Publ. Geol. Comm. Russian Far East, No. 12, p. 4, pl. I, fig. 2.
1923. *Trigonia* cfr. *subovalis* YEHARA: "Cretaceous Trigoniae from Amakusa Islands, Prov. Higo, Kyûshû, Japan." Jour. Geol. Soc., Tôkyô, Vol. XXX, p. 8, pl. VI, figs. 1-5.

(17) M. YOKOYAMA: "On Some Cretaceous Fossils from Shikoku." Jour. Coll. Sci., Tôkyô, Vol. IV, p. 361, pl. XL, figs. 1a, 2, 3.

(18) S. YEHARA: "The Cretaceous Trigoniae from Miyako and Hokkaidô." Sci. Rep. Tôhoku Imp. Univ., Ser. II, Vol. II, p. 39, pl. I, figs. 1-8.

1923. *Trigonia* cfr. *subovalis* YEHARA: "Cretaceous Trigoniae from South-western Japan." Jap. Jour. Geol. & Geogr., Vol. II, p. 78, pl. XI, figs. 4-8.
1923. *Trigonia* cfr. *subovalis* TOKUNAGA: "Again on the Cretaceous Formation in the Futaba District, Iwaki." Jour. Geol. Soc., Tôkyô, Vol. XXX, p. 259.
1924. *Trigonia subovalis* JIMBO var. *minor* YABE and NAGAO: "New or Little Known Cretaceous Fossils from North Saghalin." Sci. Rep. Tôhoku Imp. Univ., Ser. II, Vol. VII, p. 116.

This form was long thought to be identical with *T. subovalis* which was first described by the late Prof. K. JIMBO from the *Trigonia* Sandstone (Cenomanian) of Hokkaidô. These two are really found in association at the gorge of the Ikushumbets near the Ikushumbets coal mines. Prof. H. YABE and the present author, however, separated them and called the smaller one var. *minor*. This variety has a wide geological range from the Cenomanian to the Senonian in Hokkaidô, and also in Amakusa it is found in the Himenoura Group (Senonian) of several localities except Goshonoura-jima on which Mr. YEHARA reported an occurrence of this var. *minor* in the older Goshonoura Group.

Localities: Goshonoura Group; Goshonoura-jima (according to Yehara). Himenoura Group; Fukami-mura and Ôe, Ôe-mura, both on Amakusa-Shimo-shima; Wadanohana, Takado-mura, and Higashiura, Ôdo-mura, both on Amakusa-Kamishima.

Lucina, BURG.

Lucina cfr. *occidentalis* (MORTON)

Pl. II, Fig. 8.

Compare:

1876. *Lucina occidentalis* MEEK: "A Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country." U. S. Geol. Surv. Territ., Vol. IX, p. 143, pl. XCII, figs. 4, 4a-d.

Shell slightly convex, subequilateral; transversely elongate-ovate, rounded anteriorly and obliquely subtruncated posteriorly; ventral margin semiovate in outline; antero-dorsal margin slightly concave in front of the umbo, the postero-dorsal nearly straight, sloping downward more steeply than the antero-dorsal. Umbo depressed, small, pointed and almost central, with a posterior umbonal fold running from it to the postero-ventral end; lunule small, lanceolate and shallow. Surface ornamented with distinct concentric lamellae and finer interstitial striae.

Dimensions :	Height	Length
	26 mm.	36 mm.

The author has two specimens of *Lucina* which, though imperfect, seem to be closely allied to *L. occidentalis* (MORTON) from the Pierre and Fox Hills Groups of N. America.

Locality: Himenoura Group; Akasaki, Ôdo-mura, Amakusa-Kami-shima.

Lucina sp. indet.

Pl. II, Fig. 10.

Compare :

1890. *Lucina* cfr. *fallax* YOKOYAMA: "Versteinerungen aus der japanischen Kreide." Palaeontogr., Vol. XXXVI, p. 176, pl. XVIII, figs. 9a, 9b.

Another imperfect specimen of *Lucina* was found at Akase in association with the preceding form. The shell is small (about 17 mm. long and 15 mm. high), nearly orbicular, being slightly longer than high and almost equilateral with a very small subcentral umbo; anterior and ventral margins nearly rounded. The surface of the shell is covered by numerous concentric lamellae and finer interstitial striae. The lunule is very small.

This form, though very poorly preserved, is apparently allied to, and possibly identical with, the specimens described by Prof. YOKOYAMA

under the name *L. cfr. fallax* Forbes,⁽¹⁹⁾ from the Upper Amonites Beds of Hokkaidô.

Locality: Himenoura Group; Akase, Ôdo-mura, Amakusa-Kamishima.

Veniella, STOL.

Veniella (?) *japonica* nov. sp.

Pl. II, Figs. 1, 3, 3a, 3b.

Shell trapezoid or ovate in outline, very convex near the umbo and flattened toward the ventral margin; inequilateral, rounded anteriorly and almost vertically truncated posteriorly; antero-dorsal margin concave beneath the umbo, the postero-dorsal nearly straight, and the ventral weakly arcuate, forming a nearly right angle with straight posterior margin. Umbones prominent, strongly incurved and moderately prosogyrous, contact, with a distinct carina extending from the umbo to the postero-ventral end. Lunule broad and deeply excavated; escutcheon narrow, occupying about one half of the postero-dorsal margin. Dorso-posterior area behind the umbonal carina almost perpendicular to the flank, with a broad and shallow depression running from the umbo to the posterior margin and separated by a distinct narrow groove from the carina. Surface ornamented all over with crowded, numerous concentric lines. Test thick. Hinge unknown.

Dimensions:	Height	Length	Thickness
	ca. 65 mm.	ca. 73 mm.	ca. 45 mm.

At first sight the present specimens remind one some species of *Roudaireia*, for instance, *R. drui* MUN.-CHALM.⁽²⁰⁾ from the Upper

(19) For *Lucina fallax* FORBES see F. STOLICZKA: Op. cit., p. 256, pl. XIII, figs. 13, 15-17; pl. XIV, figs. 3-5, 7-8.

(20) A. QUASS: "Beitrag zur Kenntnis der Fauna der oberen Kreidebildungen in der libyschen Wüste." Palaeontogr., XXX-2, p. 221, pl. XXIV, figs. 20-22. G. DI STEPHANO: "Osservazioni sul cretaceo e sul l'Eocene del Deserto Arabico di el-Sibaiya nella valle del Nilo." Boll. d. R. Comitato Geologico d'Italia, Ser. V, Vol. XLVII, p. 13, pl. III, figs. 3, 4.

Cretaceous of Arabia and N. Africa and especially *R. forbesiana* Stol.⁽²¹⁾ from the Trichinopoly Group of India and the Senonian of Madagascar. But reference of our species to *Roudaireia* seems to be incorrect, for it has a more rounded umbonal carina and, though the surface is more or less eroded, it lacks prominent concentric ridges, a very characteristic feature of *Roudaireia*.

Our species is allied to *Veniella mortoni* MEEK and HAYDEN⁽²²⁾ from the Fort Benton Group of N. America, from which it differs in having a higher shell with a more rounded anterior margin and a more prominent umbo. There are also two American species akin to ours, *V. conradi* MORTON⁽²³⁾ from the Senonian and *V. trigona* (GABB)⁽²⁴⁾ from the Turonian and Senonian, these two forms being regarded as synonymous by J. A. GARDNER. These American species, however, are provided with two or more elevated concentric lamellose ribs and seem to lack a longitudinal depression on the postero-dorsal area behind the umbonal carina.

Furthermore, the Japanese species is somewhat similar to "*Cyprina*" *securiformis* SHARPE⁽²⁵⁾ from the Aptian of Portugal, but the latter is distinguishable from the former by its triangular and less convex shell with a narrower lunule. Moreover, the escutcheon is divided into two halves by a longitudinal ridge in the Japanese species.

Locality: Goshonoura Group; Goshonoura-jima, Province of Higo.

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- (21) F. STOLICZKA: "Cretaceous Fauna of Southern India." Op. cit., p. 197, pl. IX, figs. 2-8. J. COTTREUA: "Fossiles Cretacés de la Cote Orientale." Ann. de Paléont., 1912, p. 48, pl. VI, figs. 2, 3.
- (22) F. B. MEEK: "A Reprint of the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country." U. S. Geol. Surv., Territ., Vol. IX, p. 154, pl. IV, figs. 3a-b.
- (23) R. P. WHITFIELD: "Branchiopoda and Lamellibranchiata of the Raritan Clays and Greensand of New Jersey." U. S. Geol. Surv. Mon., Vol. IX, p. 44; p. 147, pl. XIX, figs. 4-10. S. WELLER: "A Report of the Cretaceous Palaeontology of New Jersey." Geol. Surv. N. Jersey, Palaeontology, Vol. IV, p. 534, pl. LVIII, figs. 18, 19.
- (24) R. P. WHITFIELD: Op. cit., p. 149, pl. XIX, figs. 11-14. S. WELLER: Op. cit., p. 537, pl. LIX, figs. 1-3. J. A. GARDNER: Maryland Geological Survey, Upper Cretaceous, p. 643, pl. XXXVIII, figs. 2-7.
- (25) SHARPE: Quart. Jour. Geol. Soc., Vol. VI, p. 182, pl. 22, figs. 1-3.

Cerithium BRUG.*Cerithium pyramidaforme* nov. sp.

Pl. III, Figs. 4-8, 15

Shell solid, large, turreted and composed of numerous whorls (more than 15 in number in a specimen about 60 mm. high); suture deep and grooved; spire very high, the upper whorls being very narrow but the lower ones rather rapidly increasing their diameter. Each of the spire-whorls low and broad, very bluntly shouldered a little below the upper suture, the surface sloped outward above, and nearly vertical below the shoulder. Body whorl somewhat inflated, short, slightly concave at the middle of the side; base convex; aperture partly broken, narrow, elongate and probably pointed posteriorly; anterior canal imperfectly preserved, presumably very short, narrow and oblique. Surface smooth except for fine lines of growth which run very obliquely forward from the suture.

Dimensions:	Height	Width
	130 mm. ?	50 mm.
	60 mm. ?	23 mm.

Several specimens were collected, all of which are more or less imperfect, lacking the upper and lower extremities. Sometimes very abundant on the western coast of Goshonoura-jima. *

Locality: Goshonoura Group: Goshonoura-jima, Province of Higo.

Nerinaea, DEFR.*(Nerinaea, s. s.)**Nerinaea* sp. indet.

Pl. III, Figs. 1-3

Shell rather large, turreted with high spire; apical angle about 15 degrees or less. Whorls numerous (more than 30? in number), broad

and prominently concave, very slowly increasing in width and height; cross section of a whorl rectangular and provided with three spiral folds inside; of the folds, that on the external wall narrow, most elevated and situated a little below the midheight of the wall; that on the posterior wall (parietal fold) near its inner corner narrowest and least elevated; that on the columella broadest and moderately high. Aperture unknown; columella apparently solid and short; test thin. Surface smooth.

All the specimens are very imperfect but their general features are more or less preserved so as to enable one to compare them with some allied species. They belong to a species which is somewhat similar to *N. etalloni* PICT. and CAMP.⁽²⁶⁾ from the Valanginian of Switzerland and *N. aptiensis* PICT. and CAMP.⁽²⁷⁾ from the Aptian of the same country. It is distinguished, however, from these European forms by its more prominent spiral fold on the external wall. Very recently, E. BAUMBERGER reported⁽²⁸⁾ and figured some specimens of *Nerinaea* from the Neocomian of Sumatra, which he regarded as belonging to the group of *N. etalloni* from Switzerland. These Sumatran specimens differ from ours in having a more prominent spiral parietal fold.

Locality: Goshonoura Group; Western coast of Shishi-jima, Province of Satsuma.

Glauconia, GIEB.

Glauconia (?) sp. indet.

Pl. II, Fig. 9.

Here is a turreted shell with a relatively large apical angle (30 degrees). It is composed of numerous flat whorls, each of which is

(26) F. J. PICTET and G. CAMPICHE: "Description des Fossiles du Terrain Cretacé des Environs de Sainte-Croix." Mater. Pal. Suiss, Ser. III, p. 232 pl. LXVI, figs. 5-7.

(27) F. J. PICTET and G. CAMPICHE: Ibid., p. 244, pl. LXIX, figs. 3.

(28) E. BAUMBERGER: "Die Kreidefossilien von Dusun Pobungo Batu Kapur-Menkadai und Sungai Pobungo." Beitr. z. Geol. u. Palaeont. v. Sumatra, No. 6, p. 258, text-figs. 5-9.

provided with a prominent spiral keel near the indistinct lower suture. The surface is otherwise smooth. The body whorl is not preserved in the present specimen, hence its generic position is very doubtful. There are, however, some resemblances to the specimens of *Glauconia* from the Lower Cretaceous of various localities in Japan, such as those from Ôno-gun, Province of Bungo, Bômeki, Province of Shinano, and Massaki, Province of Rikuzen.

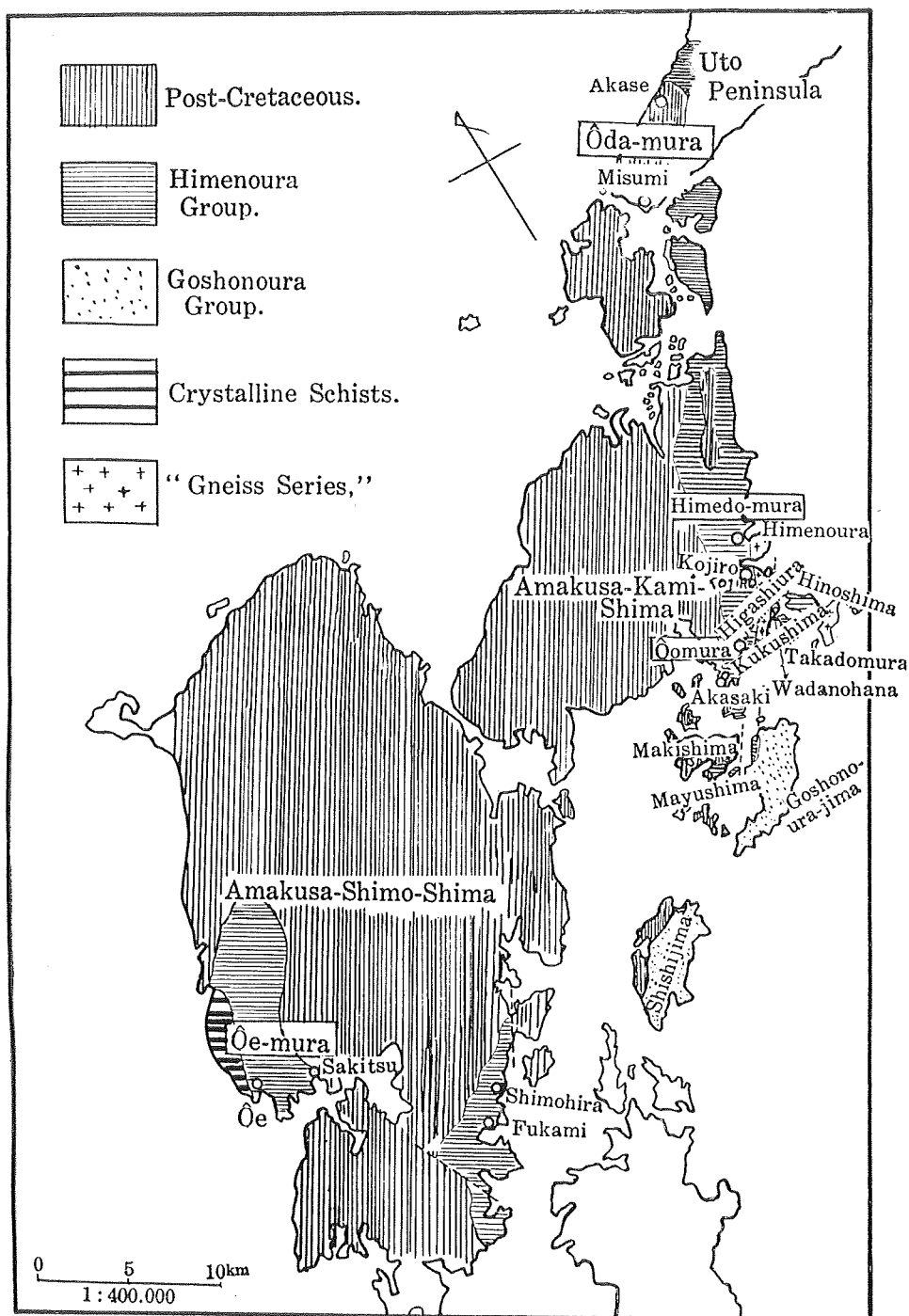
Locality: Goshonoura Group: Goshonoura-jima, Province of Higo.

In conclusion, I wish to express my cordial thanks to Prof. H. Yabe of the Institute of Geology and Palaeontology, Tôhoku Imperial University, for his kind advice on various points.

Plate I

PLATE I.

Geological Map of the Islands of Amakusa, showing the Distribution of the Cretaceous Deposits. Scale 1 ; 400,000.



(Toriki del.)

T. Nagao: Cretaceous Fossils from Amakusa.

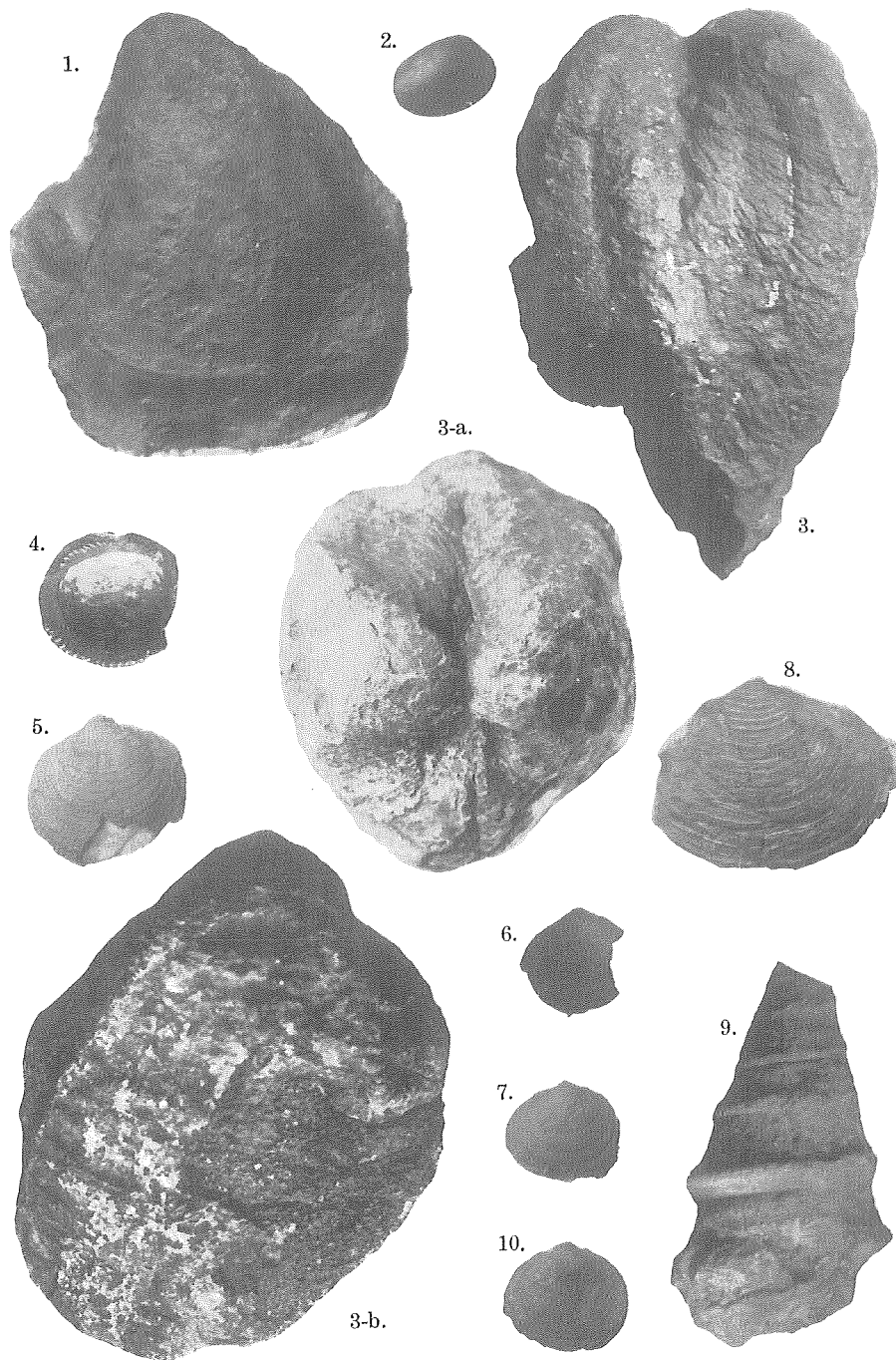


Plate II

PLATE II.

The figures are of natural size.

- Figs. 1, 3, 3a, 3b. *Veniella japonica* NAGAO. Goshonoura-jima ; the Goshonoura Group.
- Fig. 2. *Nucula formosa* NAGAO. Kojima, Himenoura, Himedo-mura, Amakusa-Kami-shima ; the Himenoura Group.
- Figs. 4-7. *Glycimeris amakusensis* NAGAO. Wadanohana, Takado-mura, Amakusa-Kami-shima ; the Himenoura Group.
- Fig. 8. *Lucina* cfr. *occidentalis* (MORTON). Akasaki, Ôdo-mura, Amakusa-Kami-shima ; the Himenoura Group.
- Fig. 9. *Glauconia* (?) sp. Goshonoura-jima ; the Goshonoura Group.
- Fig. 10. *Lucina* sp. Akase, Ôdo-mura, Amakusa-Kami-shima.



(Ebina photo.)

T. Nagao : Cretaceous Fossils from Amakusa.

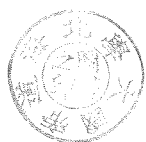


Plate III

PLATE III.

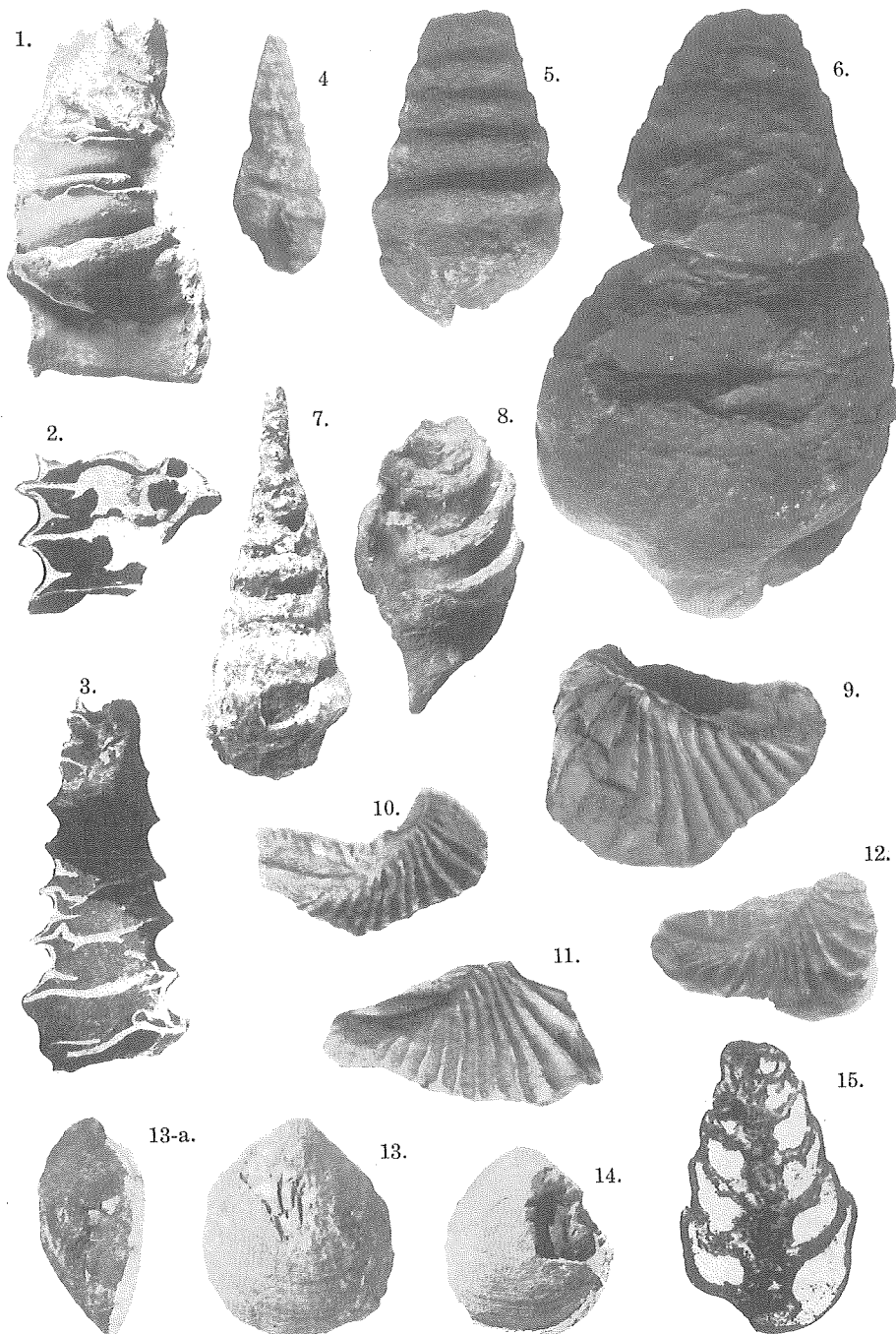
The figures are of natural size.

Figs. 1-3. *Nerinaea* sp. Shishi-jima ; the Goshonoura Group.

Figs. 4-8, 15. *Cerithium pyramidaeforme* NAGAO. Goshonoura-jima ;
Goshonoura Group.

Figs. 9-12. *Trigonia pustulosa* NAGAO. Goshonoura-jima ; the Goshonoura Group.

Figs. 13, 13a, 14. *Glycimeris amakusensis* NAGAO var. *solida* NAGAO.
Goshonoura-jima ; the Goshonoura Group.



(Ebina photo.)

T. Nagao : Cretaceous Fossils from Amakusa.

