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| Title | Cretaceous Mollusca from the Miyako District, Honshu, Japan (Lamellibranchiata and Gastropoda) |
| Author(s) | Nagao, Takumi |
| Citation | Journal of the Faculty of Science, Hokkaido Imperial University. Ser. 4, Geology and mineralogy, 2(3), 177-278 |
| Issue Date | 1934-06 |
| Doc URL | http://hdl.handle.net/2115/35755 |
| Type | bulletin (article) |
| Additional Information | There are other files related to this item in HUSCAP. Check the above URL. |
| File Information | 2(3)_177-278.pdf |



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CRETACEOUS MOLLUSCA FROM THE MIYAKO
DISTRICT, HONSHU, JAPAN
(Lamellibranchiata and Gastropoda)

By

Takumi NAGAO

With 17 Plates

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I. INTRODUCTORY REMARKS

The Miyako Cretaceous deposits, as they are customarily called by Japanese geologists, are exposed at several points along the eastern border of the Kitakami Mountainland in northeastern Japan. This Mountainland consists mainly of granitic and associated igneous rocks. These ancient rocks are much folded and faulted together with the fossiliferous Triassic and Jurassic deposits and overlaid unconformably by the Lower Cretaceous strata along the Pacific coast.

The Cretaceous deposits⁽¹⁾ are found at several points, sometimes very restricted in extension and isolated from one another. These localities are broadly included in three districts (Pl. I, Fig. I), namely,

1. Ôshima, a small island in the Inlet of Ôshima, Motoyoshi-gun, province of Rikuzen⁽²⁾.
2. The Ôfunato⁽³⁾ district around the Inlet of Ôfunato lying north to Ôshima.
3. The Miyako district, Shimohei-gun, province of Rikuchû⁽⁴⁾.

It is this last district whose molluscan fossils are described in the present note, the other two being only shortly referred to in the following pages.

The Cretaceous strata of the Miyako district (Pl. I, Fig. 2) are exposed at six small and isolated areas stretching between Miyako on the south to Raga on the north at a distance of about 50 km. These localities are enumerated below from north to south :

1. Hiraiga⁽⁵⁾ including the Raga region⁽⁶⁾.
2. Omoto⁽⁷⁾.
3. Moshi⁽⁸⁾.
4. Tarô⁽⁹⁾.
5. Hideshima⁽¹⁰⁾.
6. Kuwagasaki⁽¹¹⁾ in the suburbs of Miyako.

At Omoto there are exposed terrestrial deposits containing plant remains⁽¹²⁾ which are now usually referred to the Ryôseki flora of Wealden age, while in all the other areas the Cretaceous rocks are marine in

(1) H. YABE: Cretaceous Stratigraphy of the Japanese Islands. Sci. Rep. Tôhoku Imp. Univ., ser. 2, Vol. XI, No. 1, 1927, pp. 46-52.

(2) 陸前本吉郡大島

(3) 大船渡

(4) 陸中下閉伊郡宮古

(5) 平井賀

(6) 羅賀

(7) 小本

(8) 茂師

(9) 田老

(10) 日出島

(11) 鯨ヶ崎

(12) H. YABE: Mesozoische Pflanzen von Omoto. Sci. Rep., Tôhoku Imp. Univ., ser. 2, Vol. I, 1913, pp. 57-64.

origin and sometimes highly fossiliferous. These rocks have drawn the deep attention of Japanese geologists since 1913, when Prof. H. YABE and Dr. S. YEHARA⁽¹⁾ published a very important paper on the detailed stratigraphy of these sediments describing the remarkable assemblage of marine organisms which were found in them. "Of all the Cretaceous deposits of Japan, none is more interesting than those of Miyako, they are distinguished from the other by their rich contents of well preserved fossils of great geological importance"⁽²⁾.

The material dealt with in the present paper comprises two stocks of specimens, one belonging to the Institute of Geology and Palaeontology in Sendai and the other to our Department of Geology and Mineralogy in Sapporo. The former contains mainly those specimens collected by Prof. YABE and Dr. YEHARA some twenty years ago and some others added by Dr. S. SHIMIZU in 1925. The second, constituting a part of the Collection in Sapporo, is composed mainly of those specimens obtained by Mr. S. OISHI of our Department and the present writer in 1930 and, moreover, includes some others collected by Mr. Y. SASA of our Department in the same year.

The present writer's work on the Cretaceous mollusks of Miyako was commenced in 1926, when he was in the Institute of Sendai, by the encouragement of Prof. YABE. After his absence from Japan which lasted two years—till 1930, this work has been continued in our Department in Sapporo.

During his stay in Europe, the writer had occasions to compare the Japanese specimens under consideration with the Cretaceous fossils in various collections. Some of these are stored in; the Natural History Museum, the Geological Institute of the Sorbonne and the Ecole des Mines, all in Paris; the Geological Institute of the Natural History Museum in South Kensington, London; the Geological Institute of the University in Strassburg; the Geological Institute of the University in Munich; the Natural History Museum of Vienna. The writer wishes on this occasion to express his sincere thanks to all the authorities of these institutes and museums. The writer's great indebtedness is due to Prof. YABE for his encouragement of the study of the Cretaceous fossils of Miyako and for the kind permission of the free use of the library and specimens belonging to the Institute in Sendai.

(1) H. YABE and S. YEHARA: The Cretaceous Deposits of Miyako. *Ibid.*, pp. 10-23.

(2) H. YABE and S. YEHARA: *Ibid.*, p. 9.

II. STRATIGRAPHICAL NOTE OF THE CRETACEOUS DEPOSITS OF THE MIYAKO DISTRICT

The Cretaceous deposits in the Miyako district are composed of several hundred meters of heavy bedded sandstones intercalated by layers of shale in the upper part and of conglomerate especially in the lower. Moreover, a thick basal conglomerate usually separates them from the basement complex which is represented by the Palaeozoic sedimentaries or a porphyry.

The Cretaceous sediments were divided by Prof. YABE and Dr. YEHARA in ascending order as follows :

1. The Raga Conglomerate. 80 m.
2. The Moshi Sandstone. Cross-bedded sandstone with some layers of conglomerate. The *Praeaprotina* (formerly *Plagiptychus*) zone is intercalated in its lower part and contains numerous specimens of *Praeaprotina yaegashii* (YEHARA), abundant rolled stocks of reef-building corals, a calcareous algae (*Petrophyton miyakoense* YABE) and *Orbitolina discoidea-conoidea* var. *ezoensis* YABE and HANZAWA. Besides, a number of various mollusks are met in several localities. 40 m.
3. The Tanohata Sandy Shale. Dark gray sandy shale, poor in fossil contents. 23 m.
4. The Hiraiga Sandstone. Highly fossiliferous, intercalating a number of fossil-zones, divided into three parts ; 1) the lower part with a few fossils, such as *Orbitolina japonica* var. *miyakoensis* YABE and HANZAWA, *Astarte*, *Praeaprotina*, *Limatulla* and *Trigonia*, 2) the middle, the *Tylostoma* beds, comprising the following four zones :

The Lower *Astarte* zone.

The *Cucullaea* zone.

The Upper *Astarte* zone.

The *Belemnites* zone ;

- 3) the upper containing three fossil zones, namely,

the *Ostrea* zone with numerous specimens of *Ostrea*, corals and *Petrophyton miyakoense*,

the *Nerinea* zone characterised by *Nerinea* (*N. rigida* described in this note) and containing specimens of other mollusks, besides rolled stocks of corals, and

the *Trigonia hokkaidoana* zone which is highly fossiliferous.

In the Hiraiga Sandstone are sometimes found specimens of ammonites described by Dr. SHIMIZU. Moreover, *Stenopodium chaeteti-formis* YABE and TOYAMA is known to occur. 80 m.

5. The *Orbitolina* Sandstone. Coarse grained calcareous sandstone full of the tests of *Orbitolina*, *O. planoconvexa* YABE and HANZAWA and *O. japonica* var. *miyakoensis* YABE and HANZAWA, besides *Petrophyton miyakoense*, *Nipponophycus ramosus* YABE and TOYAMA and *Lithothamnium* (?). In some of the intercalating layers of shale are found *Trigonia hokkaidoana*, *Goniomya subarchiaci* nov., *Gervillia miyakoensis* nov., and several species of echinoids. 100 m. or more.

6. The Akito Sandstone. Fossils rather rare but *Ostrea diluviana* LINN., *Praecaprotina yaegashii*, *Trigonia hokkaidoana*, *Pecten* (*P. miyakoensis* nov.), *Gervillia* (*G. miyakoensis* nov.), *Dosiniopsis* (*D. corrugata* nov.), echinoids and ammonites are found. 100 m.

7. The Hideshima Sandstone and Shale. Sandstone and shale in alternation, almost barren of fossils. 150 m.

III. SHORT PALAEOONTOLOGICAL NOTE ON THE CRETACEOUS DEPOSITS OF THE MIYAKO DISTRICT

The occurrence of the Cretaceous fossils in the Miyako district was for the first time reported by Mr. S. YAEHASHI⁽¹⁾ in 1890, who discovered *Trigonia*, *Spondylus*, and some other species from the Hideshima area. The Cretaceous deposits of Miyako are very rich in fossils which form a remarkable assemblage. We find abundant specimens of a pachyodont bivalve, numerous rolled stocks of reef-building corals belonging to several genera and fragments of calcareous algae. *Orbitolina* of three forms are met with in the rocks and myriads of their tests play an important rôle in the construction of some calcareous rocks (the *Orbitolina* Sandstone). Furthermore, there are found abundant specimens of Belemnites and crinoids, the calyces of the latter organism being frequently well preserved.

The species hitherto known from these deposits, excluding mollusks, are enumerated below.

(1) S. YAEHASHI: A Fossil Locality on the Coast of Shimohei-gun (in Japanese). Jour. Geol. Soc. Tokyo, Vol. VII, p. 187, 1900.

Four species of calcareous algae :

Petrophyton Miyakoense YABE (the Moshi Sandstone and the *Orbitolina* Sandstone)⁽¹⁾.

Nipponophychus ramosus YABE and TOYAMA⁽²⁾ (the *Orbitolina* Sandstone).

Stenopodium chaetetiiformis YABE and TOYAMA⁽³⁾ (the Hiraiga Sandstone).

Lithothamnium (?) sp.⁽⁴⁾ (the Hiraiga Sandstone and the *Orbitolina* Sandstone).

Orbitolina belonging to three forms⁽⁵⁾ :

Orbitolina planoconvexa YABE and HANZAWA (the *Orbitolina* Sandstone).

O. japonica var. *miyakoensis* YABE and HANZAWA (the *Orbitolina* Sandstone and the Hiraiga Sandstone).

O. discoidea-conoidea var. *ezoensis* YABE and HANZAWA (the Moshi Sandstone).

A species of sponge :

Eusiphonella (?) *japonica* YABE and TOYAMA⁽⁶⁾ (the Hiraiga Sandstone)⁽⁷⁾.

(1) H. YABE: Ueber einige Gesteinbildende Kalkalgen von Japan und China, Sci. Rep., Tôhoku Imp. Univ., ser. 2, Vol. I, p. 6, Pl. II, figs. 1-8; text-fig. 4. H. YABE and S. TOYAMA: On Some Rock-forming Algae from the Younger Mesozoic of Japan. Ibid., Vol. XII, 1928, p. 141.

(2) H. YABE and S. TOYAMA: Ibid., p. 150, Pl. XXII, figs. 2-4.

(3) H. YABE and S. TOYAMA: Ibid., p. 142, Pl. XVIII, figs. 1-6; Pl. XIX, figs. 1-4; Pl. XXIII, figs. 2, 3.

(4) H. YABE and S. TOYAMA: Ibid., p. 150, Pl. XIX, fig. 5.

(5) H. YABE and S. HANZAWA: Geological Age of Orbitolina-Bearing Rocks of Japan. Ibid., Vol. IX, 1926, pp. 13-20.

(6) H. YABE and S. TOYAMA: A New Calcareous Sponge from the Lower Cretaceous of Japan. Japan. Jour. Geol. and Geogr., Vol. V, 1927, p. 111.

(7) Mr. M. EGUCHI has determined the following species among the corals found in the Miyako Cretaceous:

Eugyra cotteaui DE FROMENTEL

Hydnophora cfr. *picteti* KOBAY

Thecosmilla hideshowensis EGUCHI (MS)

Pleurosmillia cfr. *renevieri* KOBAY

P. hideshowensis EGUCHI (MS)

Trocosmillia sp.

Montlivaultia (?) sp.

Thamnastraea miyakoensis EGUCHI (MS)

Astrocoenia sp.

There are before us several species of echinoids which are beyond the scope of the present note.

Among cephalopods which are rare in this district the following species were reported by Dr. SHIMIZU⁽¹⁾:

The Hiraiga Sandstone.

Cymatoceras pseudoneokomiensis SHIMIZU

Parahoplites yaegashii SHIMIZU

Acanthoplites subcornuelianum SHIMIZU

Buzosia (?) *yabei* SHIMIZU

Tornetoceras (?) aff. *intermedium* (SOW.)

Saynella matsushimaensis SHIMIZU

Salfeldiella caucasica (SAYN)

Douvilleiceras nodosocostatiforme SHIMIZU

The Akito Sandstone.

Hoplites aff. *dentata* (SOW.)

Other mollusks have not been much studied, notwithstanding their richness in genera, species and individuals in the Cretaceous rocks under consideration and their frequently remarkable good state of preservation. Among Lamellibranchiata, a species of a pachyodont bivalve, *Praeacprotina yaegashii* (YEHARA)⁽²⁾, was described from here, and five species of *Trigonia* were reported to occur by Dr. YEHARA as early as 1915⁽³⁾. They are

Trigonia hokkaidoana YEHARA

T. kikuchiana YOK.

T. yokoyamai YEHARA

T. kotoi YEHARA

T. datemasamunei YEHARA.

Besides these, *Ostrea diluviana* LINN. and *Pecten* cf. *quinquecostatus* SOW. were reported from here.

(1) S. SHIMIZU: The Marine Lower Cretaceous Deposits of Japan, with Special Reference to the Ammonites-Bearing Zones. Sci. Rep., Tôhoku Imp. Univ., ser. 2 Vol. XV, 1931, p. 1.

(2) S. YEHARA: A Pachyodont Lamellibranch from the Cretaceous Deposits of Miyako in Rikuchu. Jour. Geol. Soc. Tokyo, Vol. XXVII, pp. 39-44, Pls. XI, XII. H. YABE and T. NAGAO: *Praeacprotina*, nov. gen., from the Lower Cretaceous of Japan. Sci. Rep., Tôhoku Imp. Univ., ser. 2, Vol. IX, 1926, pp. 21-24.

(3) S. YEHARA: The Cretaceous *Trigoniae* from Miyako and Hokkaido. Ibid., Vol. II, 1915, pp. 35-44.

The present paper deals with specimens from various localities within the Miyako district.

From the Moshi Sandstone we have fossils in rather small number, though numerous specimens of *Praecaprotina yaegashii* (YEHARA), *Trigonia kikutiana* YOK., *T. hokkaidoana* YEHARA, *Astarte miyakoensis* NAGAO, *Tylostoma miyakoensis* NAGAO and *Trajanella japonica* NAGAO are found at Haibe.

The Hiraiga Sandstone is very rich in mollusks and we have numerous species from its basal part as well as from the uppermost and especially from its middle (the *Tylostoma* zone). The predominating species are as follows :

Trigonia hokkaidoana YEHARA
T. yokoyamai YEHARA
Cucullaea acuticarinata NAGAO
Astarte miyakoensis NAGAO
A. minor NAGAO
A. subomalioides NAGAO
A. semicostata NAGAO
Gervillia pseudorostrata NAGAO
Pecten (*Camptonectes*) *miyakoensis* NAGAO
Goniomya subarchiaci NAGAO
Anthonya subcanthiana NAGAO
Dosiniopsis corrugata NAGAO
Ataphrus yokoyamai NAGAO
Desmiera japonica NAGAO
Trajanella japonica NAGAO
Solarium incrassatum NAGAO
Tylostoma miyakoensis NAGAO
Natica importuna NAGAO
Avellana minima NAGAO
Cerithium (*Cimocerithium* ?) *miyakoense* NAGAO.

Besides these, *Neriner rigida* NAGAO, *Gervillia miyakoensis* NAGAO, *Exogyra yabei* NAGAO and some other species are very common in certain horizons in this complex exposed at Hiraiga. Moreover, in the Hideshima area,

Exogyra yabei NAGAO
E. subhaliotoides NAGAO
Ostrea diluviana LINN.

Chama sp.

Spondylus costatus NAGAO

and a few other forms are numerous in the lower part of the Hiraiga Sandstone (the Brachiopoda zone) and

Trigonia kikuchiana YOK.

Dosiniopsis corrugata NAGAO

Praecaprotina yaegashii (YEHARA)

Ostrea diluviana LINN.

and

Pecten (Neithea) morrisi (PICTET and RENEVIER)

are abundantly met with in the middle (the *Trigonia kikuchiana* zone), while

Trigonia yokoyamai YEHARA

Glycymeris densilineata NAGAO

Dosiniopsis corrugata NAGAO

Cardium sp.

Lima (Limatulla) ishidoensis YABE and NAGAO

are quite common in the upper (the Belemnites zone).

On the other hand, in the Moshi area

Dosiniopsis corrugata NAGAO

Astarte miyakoensis NAGAO

Trajanella japonica NAGAO

and

Praecaprotina yaegashii (YEHARA)

are rather frequent in the lower part of this Sandstone, and we find numerous specimens of the following forms in the middle and upper parts :

Ostrea diluviana LINN.

Trigonia yokoyamai YEHARA

T. hokkaidoana YEHARA

Astarte subomalioides NAGAO

Gervillia pseudorostrata NAGAO

Dosiniopsis corrugata NAGAO

Nuculana insignis NAGAO

Solarium incrassatum NAGAO

Actaeonina (Ovatateon) yeharai NAGAO

In the *Orbitolina* Sandstone at Raga and Hiraiga, overlying the Hiraiga, a number of molluscan remains are contained in the intercalating layers of shale. The common and important species are :

Trigonia yokoyamai YEHARA
Cucullaea acuticarinata NAGAO
Goniomya subarchiaci NAGAO
Pinna sp.
Gervillia forbesiana SOW.
Lucina kotoi NAGAO
Natica importuna NAGAO
Avellana minima NAGAO.

In addition to these, *Pecten (Neithea) morrisi* (PICTET and RENEVIER), *Astarte subomalioides*, *Trigonia hokkaidoana*, *Solarium incrassatum* and *Dosiniopsis corrugata* are not rare. *Trigonia datemasamunei* YEHARA is common in the upper part of this rock exposed at Raga.

The Akito Sandstone is not always rich in fossils, but is sometimes highly fossiliferous at Akito, north of Raga. In calcareous nodules we find a number of specimens of

Trigonia yokoyamai YEHARA
Dosiniopsis corrugata NAGAO
Ostrea diluviana LINN.
Goniomya subarchiaci NAGAO
Solarium incrassatum NAGAO

and echinoids. Furthermore, *Pecten miyakoensis*, *Gervillia miyakoensis*, *G. fobesiana*, *Cucullaea transversa*, and other formes are frequently contained in the sandstone exposed on the coast.

IV. LIST OF FOSSILS DESCRIBED

To be described in the present note are the following 69 species, comprising 41 species of Lamellibranchiata and 28 species of Gastropoda. Of these, 12 are identical or closely allied to some already described forms and 46 seem to be new, while the other 11 are specifically indeterminable :

Lamellibranchiata :

Nuculana insignis nov. sp.
N. sp.

- Grammatodon nipponica* nov. sp.
Cucullaea acuticarinata nov. sp.
C. transversa nov. sp.
Glycymeris densilineata nov. sp.
Pinna sp.
Gervillia forbesiana D'ORB.
G. cf. haradae (YOK.)
G. miyakoensis nov. sp.
G. pseudorostrata nov. sp.
G. sp.
Ostrea diluviana LINN.
Exogyra yabei nov. sp.
E. subhaliotoidea nov. sp.
Trigonia hokkaidoana YEHARA
T. datemasamunei YEHARA
T. yokoyamai YEHARA
T. kotoi YEHARA
T. kikuchiana YOKOYAMA
Pecten (*Neithea*) *morrisi* (PICTET et RENEVIER)
P. (N.) sp.
P. (Camptonectes) miyakoensis nov. sp.
Spondylus decoratus nov. sp.
Lima (*Ctenoides* ?) *subrapa* nov. sp.
L. (Limatula) ishidoensis YABE and NAGAO
Pholadomya subpedelnalis nov. sp.
Goniomya subarchiaci nov. sp.
Anatina (*Cercomya*) sp.
Astarte miyakoensis nov. sp.
A. subomalioides nov. sp.
A. minor nov. sp.
A. semicostata nov. sp.
Anthonya subcanthiana nov. sp.
Ptychomya densicostata nov. sp.
Praecaprotina yaegashii (YEHARA)
Lucina kotoi nov. sp.
Cardium sp.
Protocardia sp.

Dosiniopsis corrugata nov. sp.

Panope aff. *gurgitis* (BRONGN.)

Gastropoda :

Nododelphinula elengans nov. sp.

Ataphurus yokoyamai nov. sp.

A. kitakamiensis nov. sp.

Tectus crassus nov. sp.

Desmiera japonica nov. sp.

Pseudomelania elegantula nov. sp.

Trajanella japonica nov. sp.

Scala miyakoensis nov. sp.

Solarium incrassatum nov. sp.

Natica importuna nov. sp.

Tylostoma miyakoensis nov. sp.

Vanikoroa japonica nov. sp.

Turritella yaegashii nov. sp.

T. (?) sp.

Nerinea rigida nov. sp.

Nerinella sp.

Cerithium (?) sp.

C. (Circocerithium) reticulatum nov. sp.

C. (Cimocerithium ?) miyakoense nov. sp.

C. (Metacerithium) rikuchuese nov. sp.

Pyrazus scalariformis nov. sp.

Bathraspira excavata nov. sp.

Potamides ? (Exechestoma ?) sp.

Columbellina brevishphonata nov. sp.

Drepanochilus elongatodigitatus nov. sp.

Actaeonina (Ovatactaeon) yeharai nov. sp.

Actaeon (?) sp.

Avellana minima nov. sp.

The geological distribution of these fossils is tabulated on page 273.

There are several other forms not treated in this note owing to their very bad state of preservation. They belong to *Trochus*, *Turbo*, *Calliostoma*, *Turritella*, *Cerithium*, *Surcula*, *Ostrea*, *Chama*, *Plicatula*, *Pecten*, *Lima*, *Dentalium* and a few other genera.

V. DESCRIPTIONS OF SPECIES

*Lamellibranchiata**Nuculana* LINK, 1807*Nuculana insignis* nov. sp.

Pl. XXIX (VII), Figs. 10-12.

Shell small, transversely elongate-ovate or triangular in outline, moderately convex along the line between the umbo and the ventral margin, and faintly compressed posteriorly; slightly inequilateral, the anterior side being a little longer. Antero-dorsal margin faintly arcuated, sloping forward and downward rather rapidly, and the postero-dorsal faintly concave. Anterior end narrowly rounded, apparently subpointed, the posterior one pointed. Ventral margin very broadly and evenly arcuated, rather strongly ascending toward the posterior end. Umbo small, not prominent; both lunule and escutcheon narrow-lanceolate.

Surface ornamented with numerous well marked concentric ribs which disappear or become obsolete near the postero-dorsal and antero-dorsal ends; some of the ribs cut the ventral margin obliquely near its posterior end.

| | | |
|--------------|--------|---------|
| | Length | Height |
| Dimensions : | 5 mm. | 2.5 mm. |

Localities and geological horizons: The Akito Sandstone; Akito near Raga. The Hiraiga Sandstone; Moshi.

A few specimens were examined. This species is somewhat similar to *N. lineata* (Sow.)⁽¹⁾ from the Lower and Upper Greensand of England but is longer with a shorter posterior side than the latter. The anterior end is in the former slightly narrower than that of the English form.

Nuculana sp. indet.

Pl. XXIX (VII), Fig. 4.

A small specimen of *Nuculana* is before us which is smooth, most probably due to weathering, but similar in many features to the pre-

(1) H. Woods: A Monogr. Cret. Lamell. England., Vol. I, 1899, p. 7, Pl. I, figs. 28-32.

ceding form. Compared with *N. insignis*, it is slightly larger and apparently more convex with a thicker test. The anterior end seems to be more broadly rounded than in the preceding species, though the extremity is incompletely preserved in the present specimen. Under these circumstances, the present specimen is regarded, for a while, as distinct from *N. insignis*, although their being conspecific with each other is by no means excluded.

| | | |
|--------------|-----------|-----------|
| | Length | Height |
| Dimensions : | ca. 8 mm. | ca. 5 mm. |

Locality and geological horizon : The Hiraiga Sandstone ; Hiraiga.

This form is distinguished from *N. sanchuensis* YABE and NAGAO⁽¹⁾ from the Ishido Group of the Kwanto Mountainland in being much smaller, more evenly convex, and in having a narrower posterior end than the latter. It is similar in the form of the shell to *N. scapha* (D'ORB.)⁽²⁾ from the Neocomian of France and Switzerland and the Neocomian and Lower Greensand of England, but the former is apparently more convex.

Grammatodon MEEK and HAYDEN, 1860

Grammatodon nipponica sp. nov.

Pl. XXVIII (VI), Fig. 3.

Shell moderately convex transversely much elongated, the length being greater than twice the height ; considerably inequilateral ; anterior side very short, being about two-sevenths the posterior ; anterior margin short and oblique, forming an acute angle with the hinge line ; ventral margin long, slightly ascending toward the anterior and shallowly concave a little in advance of the midlength ; posterior end truncated obliquely, with the margin faintly concave above ; postero-ventral end narrowly rounded and slightly produced ; hinge line long, straight. Umbo small, not very prominent, curved inward and situated at a short distance from the anterior end. A distinct but round carina

(1) H. YABE, T. NAGANO and S. SHIMIZU : Cret. Moll. Sanchû-Graben. Sci. Rep. Tôhoku Imp. Univ., ser. 2, Vol. IX, 1926, p. 42, Pl. XIII, figs. 33-35.

(2) A. D'ORBIGNY : Pal. Franç. Terr. Crét., Vol. III, p. 167, Pl. CCCI, figs. 1-3. J. S. GARDNER : Quart. Jour., Vol. XL, 1884, p. 136, Pl. IV, figs. 13-16 (? 14) ; p. 138 (pars.) Pl. V, figs. 21, (?) 22. For the synonyms of this species see also H. WOODS : A Monograph Cret. Lamell. England, Vol. I, 1899, p. 3.

extending from the umbo to the postero-ventral end and limiting an excavated postero-dorsal area.

Surface ornamented with concentric and radial lines; concentric lines sometimes very prominent and the radial ones crowded, fine and rather obscure near the dorsal margins. Hinge area long, narrow, and ornamented with a few (3 or 4) lorenzo-shaped grooves; hinge plate markedly narrow, provided with numerous teeth divergent from a point beneath the umbo; posterior teeth two or three in number, very long, subparallel to the dorsal margin; anterior teeth numbering three, rather short, and also nearly parallel to the dorsal margin; medial teeth numerous, short, and slightly divergent upward. Test moderately thick.

| | Length | Height | Thickness of one valve |
|--------------|--------|--------|---------------------------|
| Dimensions : | 32 mm. | 14 mm. | 8 mm. |

Locality and geological horizon: The Hiraiga Sandstone; northern sea-cliff of Hiraiga.

This species is represented by a single right valve, in which the internal features except the hinge are inaccessible. Its dentition and external form are almost identical with those of *Parallelodon* MEEK and HAYDEN, regarded by H. WOODS⁽¹⁾ as a synonym of *Grammatodon* MEEK and HAYDEN.

The present species is in its external features closely akin to "*Nemodon*" *simillima* WHITEAVES⁽²⁾ from Queen Charlotte Islands (Lower Sandstone or Division E of DAWSON and Lower Shales and Sandstones or Division C). Apart from a slight difference in the hinge, this North American form is distinguishable from ours in being a little longer, more inequilateral and in having its ligamental area with more numerous grooves.

G. tociyamensis D'ORB.⁽³⁾ from the Lower Cretaceous of Columbia is another species allied to ours, but its antero-dorsal extremity is more rounded than in the latter.

(1) H. WOODS: Note on the Genus *Grammatodon*, MEEK and HAYDEN. Ann. Mag. Nat. Hist., ser. 7, Vol. III, 1899, p. 47.

(2) J. F. WHITEAVES: On the Fossils of the Coal-Bearing Deposits of the Queen Charlotte Islands, etc.. Mesozoic Fossils, Vol. I, pt. 3, 1884, pp. 234, 250 (*Nemodon Fischeri* WHITEAVES non D'ORB.); On Some additional or imperfectly understood fossils from the Cretaceous rocks of the Queen Charlotte Islands, etc.. Mesozoic Fossils, Vol. I, pt. 4, 1900, p. 293.

(3) A. D'ORBIGNY: Voyage dans l'Amérique méridionale, 1842, p. 90, Pl. XXI, figs. 1-3.

Cucullaea LAM., 1801*Cucullaea acuticarinata* nov. sp.

Pl. XXIV (II), Figs. 10-14; Pl. XXX (VIII), Fig. 5.

Shell more or less elongate, trapezoidal or sometimes subrhomboidal, slightly inequilateral, oblique, inflated along the line running from the umbo to the posterior part of the ventral margin; anterior margin forming a faintly obtuse angle with the hinge line and gradually curving toward the ventral; ventral margin slightly curved, and subparallel to the dorsal, and the posterior one nearly straight. Umbones moderate in size, prominent, incurved and separated from each other by a small space; a sharp carina running from the umbo to the postero-ventral extremity. Postero-dorsal area behind the carina almost perpendicular to the plane of the valve, flattened, more or less sharply depressed, and divided into two slightly concave and nearly equal parts by a narrow carina passing from the umbo posteriorly. Hinge-line moderate in length; area small, narrow, with several inverted V-shaped ligamental grooves.

Surface ornamented, besides concentric lines of growth, with fine radial striae all over, which are nearly obsolete on the median portion of the valve; four radial ribs occur on the antero-dorsal part of the valve and alternate with a few narrow striae. Central teeth transverse; anterior lateral teeth four in number, long and parallel to the hinge margin and the posterior lateral also numbering four, shorter than the anterior ones and subparallel to the hinge margin.

| | Length | Height | Thickness |
|-------------|----------|----------|-------------------------------|
| Dimension : | 30.0 mm. | 25.0 mm. | 12.5 mm. (a right valve) |
| | 24.5 mm. | 21.0 mm. | 16.5 mm. (both valves united) |
| | 23.0 mm. | 20.0 mm. | — |
| | 22.5 mm. | 19.5 mm. | — |

Localities and geological horizons: The Hiraiga Sandstone; Hiraiga, Haibe and Hideshima (the *Trigonia kikuchiana* zone). The Akito Sandstone; Akito.

The present species is closely allied to *C. fittoni* PICT.⁽¹⁾ and CAMP. from the Aptian of Switzerland and the Lower Greensand of England,

(1) F. J. PICTET et G. CAMPICHE: Foss. Terr. Crét. de Ste Croix. Matér. Pal. Suisse, ser. 4, pt. 3, pp. 455, 471. F. J. PICTET et E. RENEVIER: Foss. Terr. Aptien. Ibid., ser. 1, p. 105. Pl. XV, fig. 4 (*Arca Robinaldina* D'ORB.). H. WOODS: Monogr. Cret. Lamell. Englan., Vol. I, p. 52, Pl. X, figs. 4-7.

especially to those specimens which were figured by PICTET and RENEVIER from the Lower Aptian of Switzerland and referred to *Arca robinaldina* D'ORB. This last species⁽¹⁾ from France is distinguished from ours in being more elongated posteriorly and provided with a more sharply pointed postero-ventral extremity.

The new species is distinguished from *C. fittoni* in several points: in the former the posterior area is divided into two nearly equal halves which are smooth except for the concentric lines, while in the latter it is ornamented with fine radial striae and its lower area is a half the upper in breadth. The ventral margin is in the Japanese form more curved upward posteriorly than in the other.

C. cornuelina D'ORB.⁽²⁾ from the Neocomian of France and the Lower Greensand of England is also closely akin to ours but differs in being shorter and in having the carina less sharp and the anterior part of the valve smooth.

Cucullaea transversa nov. sp.

Pl. XXV (III), Figs. 1, 3-6.

Shell small, transversely elongate, subrhomboid in outline, rather thin, being moderately convex from the umbonal region to the ventral margin and attenuated towards both anterior and posterior extremities; inequilateral, the anterior side being shorter than the posterior. A rather distinct but round, broad angle extending from the umbo to the postero-ventral extremity. Postero-dorsal area behind the angle compressed and longitudinally divided into two concave subequal parts by a radial and slightly elevated median keel. Anterior margin rounded forming an obtuse angle with the hinge line and gradually passing into the almost straight ventral one which is usually subparallel to the hinge margin; posterior margin nearly straight, oblique, making an angle of about 130° with the hinge line; postero-ventral end narrowly rounded or subpointed; hinge straight, oblique to the ventral margin, and a little shorter than the total length of the valve. Umbo small, not prominent, curved inwards; ligamental area elongate, very narrow, with a few inverted V-shaped grooves.

(1) A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. III, p. 208, Pl. CCCX, figs. 11, 12.

(2) A. D'ORBIGNY: Ibid., Vol. III, p. 208, Pl. CCCXI, figs. 1-3. H. WOODS: Mon. Cret. Lamell. England. Op. cit., p. 50, Pl. VIII, figs. 11-13; Pl. X, figs. 1-3.

Hinge plate provided with numerous small teeth, gradually diverging from one point beneath the umbo; of the teeth, anterior three and posterior four or five longer than the others and distinctly oblique to the hinge line.

Surface ornamentation: The anterior slope covered by numerous very fine and crowded radial striae; the upper portion of the postero-dorsal area, when well preserved, with a few faintly visible radial striae which are equally distributed and separated from one another by broad and flat interspaces. Otherwise the surface smooth except for the dense concentric lines of growth. Test thin.

| | Length | Height | Thickness of one valve |
|-------------|--------|--------|----------------------------|
| Dimensions: | 20 mm. | 13 mm. | 5.5 mm. (an elongate form) |
| | 18 mm. | 15 mm. | 6.0 mm. (a higher form) |

Localities and geological horizons: The Hiraiga Sandstone; Hiraiga. The Akito Sandstone; Akito. The *Orbitolina* Sandstone; Hiraiga.

There are several specimens in hand which are very similar to the preceding species. The outline of the shell is somewhat variable among different individuals, being sometimes longer, with a lower umbo than in other examples. The hinge of this species is almost identical with that of *C. fittoni* PICTET and REN.⁽¹⁾ figured by WOODS from the Lower Cretaceous of England.

This form is distinguishable from *C. acuticarinata* nov. by its smaller size, thinner test, rounded umbonal angle, and less prominent and less convex umbo. The former is, moreover, generally longer and has the anterior portion of the shell smooth. It is akin in outline of the shell to the smaller specimens of *C. ezoensis* YABE and NAGAO⁽²⁾ from the *Trigonia* Sandstone of Hokkaidô (Cenomanian). It is, however, distinctly separable from the latter by its smooth flank of the shell and by its hinge which is provided with oblique anterior and posterior teeth.

The new species in question is, on the other hand, decidedly thinner than *C. fittoni* PICTET and CAMPICHE from the Lower Cretaceous of Europe.

(1) See the foot-note to the preceding species.

(2) H. YABE and T. NAGAO: Cretaceous Fossils from Hokkaidô: Annelida, Gastropoda and Lamellibranchiata. Sci. Rep. Tôhoku Imp. Univ., Vol. IX, No. 3, 1926, p. 81, Pl. XVI, figs. 1-3.

Glycymeris DA COSTA, 1778*Glycymeris densilineata* nov. sp.

Pl. XXXII (X), Figs. 8, 9

Shell small, the largest specimen not exceeding 14 mm. in length ; slightly longer than high, moderately convex especially near the umbo and faintly flattened in the postero-dorsal portion of the valve ; almost equilateral, suborbicular in outline with a well rounded anterior margin and a broadly arcuated ventral ; posterior extremity truncated by a short oblique margin which forms a distinct obtuse angle with the dorsal margin. Umbo small, prominent, much curved inward. Ligamental area narrow, slightly longer than one half of the whole length of the shell, and provided with a few inverted V-shaped grooves. Inner margin rather coarsely crenulated. Test thin.

Surface with numerous crowded, narrow radial striae separated from one another by shallow linear grooves ; each nine or eight striae forming together a rather broad, faintly elevated rib except in the anterior and postero-dorsal parts of the surface.

| | Length | Height | Thickness of one valve |
|--------------|--------|----------|---------------------------|
| Dimensions : | 14 mm. | 13.5 mm. | 5 mm. |

Localities and geological horizons : The Moshi Sandstone ; Tarô. The Hiraiga Sandstone ; Hideshima, Haibe, Moshi and Hiraiga. The Akito Sandstone ; Akito.

The present species is closely similar to *G. hokkaidoensis* (YABE and NAGAO)⁽¹⁾ from the *Trigonia* Sandstone (Cenomanian) of Hokkaido and *G. amakusensis* NAGAO⁽²⁾ from the Himenoura Group (Senonian) of Amakusa. It is distinguished from the first of the latter in being less convex, thinner-tested and from the second in having a more convex shell with a more prominent umbo. In the new species, moreover, the radial ribs are less numerous and broader and provided with more numerous striae on top than in the other two.

(1) H. YABE and T. NAGAO : Cretaceous Fossils from Hokkaidô. Op. cit., p. 82, Pl. XVII, fig. 22.

(2) T. NAGAO : On Some Cretaceous Fossils from the Islands of Amakusa, Kyushu, Japan. Jour. Fac. Sci. Hokkaido Imp. Univ., Ser. IV (Geology and Mineralogy), Vol. I, 1930, p. 15, Pl. II, figs. 4-7.

The Japanese form in question is also akin to *G. sublaevis* (Sow.)⁽¹⁾ and *G. umbonatus* (Sow.)⁽²⁾ both from the Albian of England. These English species, however, have a more convex shell with more numerous radial ribs. Moreover, *G. umbonatus* is produced in the antero-dorsal portion of the shell. On the other hand, the present species is not unlike *G. requierriani* D'ORB.⁽³⁾ from the Upper Cretaceous of France in surface sculpture but differs in having a less inflated shell with a more prominent umbo.

Pinna Linn., 1758

Pinna sp. indet.

Pl. XXVI (IV), Figs. 9-11.

A few very incomplete specimens of *Pinna* were examined.

Shell rather small, narrow, elongated, straight and compressed, with a thin lenticular cross-section; test thin. Dorsal margin straight, the ventral also straight in its greater length, but slightly convex in its posterior portion, and the posterior margin probably a little convex as suggested by the lines of growth.

Dorsal half of the valve ornamented with five or six narrow, rounded and elevated radial ribs separated by grooves which are in width nearly equal to or slightly greater than the ribs themselves; ventral half smooth except for the lines of growth. Lines of growth more distinct on the ventral half of the surface. Ribs and grooves crossed at regular intervals by numerous narrow and somewhat imbricate concentric ridges which give a granular appearance to the radial ribs.

| | |
|-------------|--------|
| | Length |
| Dimension : | 60 mm. |

Localities and geological horizons: The Hiraiga Sandstone; Hiraiga and Haipe. The *Orbitolina* Sandstone; Raga.

This species is narrower and ornamented with less numerous radial ribs than *P. sp. aff. brevis* GABB from the *Trigonia* Sandstone of Hokkaidô⁽⁴⁾.

(1) H. WOODS: Monogr. Cret. Lamell. England. Op. cit., Vol. I, 1899, p. 67, Pl. XIV, figs. 1-7.

(2) H. WOODS: Ibid., p. 69, Pl. XIV, figs. 8-12.

(3) A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. III, p. 190, Pl. CCCVII, figs. 1-6.

(4) T. NAGAO: Some Cret. Moll. Japanese Saghalin and Hokkaido. Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. IV, Vol. II, No. 1, 1932, p. 39, Pl. V, Fig. 1.

Gervillia DEFRANCE, 1820*Gervillia forbesiana* D'ORB.

Pl. XXIV (II), Fig. 8; Pl. XXV (III), Figs. 8-10.

1846. *Gervillia forbesiana* D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. III, p. 486, Pl. CCCXVI, figs. 5, 6.
1905. *Gervillia forbesiana* WOODS: A Monogr. Cretaceous Lamell. England. Palaeont. Soc., Vol. II, p. 85, Pl. XI, fig. 26; Pl. XII, figs. 1-5.
1926. *Gervillia forbesiana* YABE and NAGAO in YABE, NAGAO and SHIMIZU: Cretaceous Mollusca from the Sanchû-Graben in the Kwantô Mountainland, Japan. Sci. Rep. Tôhoku Imp. Univ., Ser. 2, Vol. IX, No. 2, p. 57, Pl. XII, figs. 36, 37; Pl. XIV, figs. 8, 9.

There are before us a few specimens of a compressed and much elongated, sabre-shaped *Gervillia*. Although all of them are more or less imperfect, the surface being sometimes eroded and the posterior extremity always broken, it is obvious that they are specifically identical with those derived from the Kawarazawa Group of the Kwantô Mountainland and referred to *G. forbesiana* D'ORB., a widely distributed Lower Cretaceous form.

Localities and geological horizons: The Akito Sandstone; Akito near Raga. The *Orbitolina* Sandstone; Raga. The Hiraiga Sandstone; Hiraiga.

Our specimens seem to be more similar to *G. forbesiana* than *G. solenoides* DEFR. from the Upper Cretaceous of Europe, India and North America. For instance, the specimens of the latter which were figured by HOLZAPFEL from Aachen are less sharply curved along the antero-ventral margin than ours.

Gervillia miyakoensis nov. sp.

Pl. XXXI (IX), Figs. 1, 2; Pl. XXXII (X), Fig. 7.

Shell (a left valve) large, inflated anteriorly and attenuated posteriorly; subquadrate, slightly oblique, nearly twice as high as long; antero-dorsal margin a little concave, and the anterior slightly convex; ventral margin rounded, abruptly ascending toward the posterior; posterior margin nearly straight, a little oblique inward and downward, faintly convex above, forming an acute angle with the short hinge line. Umbo small, incurved. A rather narrow convex portion extending from the umbo to the ventral extremity, dorsally bending

forwards; a very large compressed triangular wing-like posterior portion separated from the flank by a narrow depression. Anterior ear small.

Surface of the convex portion of the flank near the umbo provided with numerous narrow radial ribs, separated from one another by shallow interspaces; some of these ribs sometimes broader than the others and soon becoming obsolete downwards. Posterior wing-like portion with very narrow and sharp radial ribs and broad and flat interspaces in alternation. Fine concentric lines of growth more prominent in the posterior part of the valve.

Hinge plate broad, with a few large and shallow ligamental pits, besides a series of slightly oblique strong teeth. Around the byssal opening the marginal parts of the valve distinctly concave. Test thick.

Two other imperfect right valves, most probably belonging to this species, have been obtained from the Hiraiga Sandstone exposed at Hiraiga, older than the *Orbitolina* Sandstone in which the type specimens were found. Comparing them with the right valve, they are far less convex, with the convex part very indistinctly separated from the flat posterior wing-like portion and a not incurved umbo. The surface of the valve is apparently smooth.

| | Length | Height | Thickness of one valve |
|--------------|--------|---------|---------------------------|
| Dimensions : | 66 mm. | 125 mm. | ca. 30 mm. |

Localities and geological horizons: The Hiraiga Sandstone: Hiraiga. The *Orbitolina* Sandstone; Raga. The Akito Sandstone; Akito.

Two left valves were examined, one of which is nearly perfect except for the anterior ear and the postero-ventral extremity.

The present form is closely allied to *G. haradae* (YOK.)⁽¹⁾ from the Ishidô and Kawarazawa Groups of the Kwantô Mountainland. The former, however, has its shell less oblique and higher, with a shorter hinge. The posterior wing-like portion is higher and less sharply separated from the convex portion and the radial ribs on the convex portion become obsolete more rapidly than in *G. haradae*.

(1) M. YOKOYAMA: Versteinerungen aus der japanischen Kreide. Palaeontographica, Vol. XXXVI, 1890, p. 199, Pl. XXV, fig. 12. H. YABE and T. NAGAO in YABE, NAGAO and SHIMIZU: Cret. Foss. Sanchû-Graben. Op. cit., p. 59, Pl. XIV, figs. 17, 18.

G. miyakoensis is identical in form with "*Avicula*" *carteroni* D'ORB.⁽¹⁾ from the Neocomian of France but is less inflated with the radial ribs narrower. *G. alaeformis* (D'ORB.)⁽²⁾ from the Neocomian and Aptian of Europe is more oblique and more inflated than ours.

Gervillia cf. *haradae* (YOK.)

Pl. XXXI (IX), Fig. 13.

1890. *Avicula haradae* YOKOYAMA: Verstein. japan. Krede. Palaeontographica Vol. XXXVI, p. 199, Pl. XXV, fig. 12.
 1926. *Gervillia haradae* YABE and NAGAO in YABE, NAGAO and SHIMIZU: Cret. Moll. Sanchû-Graben. Sci. Rep. Tôhoku Imp. Univ., Ser. 2, Vol. IX, p. 58, Pl. XIII, figs. 1-3, 7; Pl. XIV, fig. 2.

A single small specimen of *Gervillia* has been obtained from the Hiraiga Sandstone, which is closely similar to, and most probably identical with, *G. haradae* (Yok.) from the Lower Cretaceous deposits of the Kwantô Mountainland. The shell is slightly oblique, with its anterior portion fairly convex and narrow, and its umbo acute, projecting beyond the hinge margin. The convex portion is covered with about seven or eight broad, elevated and rounded spinous radial ribs, each alternating with one or two narrower interstitial riblets. The posterior wing-like portion is distinctly separated from the convex one by a well defined groove, and ornamented with eight or nine radial ribs. The anterior ear small with radial ribs of a few number. All ribs on the surface are crossed by numerous narrow, elevated concentric striae.

Locality and geological horizon: The Hiraiga Sandstone; southern coast of Hiraiga Inlet.

Gervillia pseudorostrata nov. sp.

Pl. XXXI (IX), Figs. 6-9.

Left valve small, oblique, trapezoidal in outline; moderately

(1) A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. III, p. 472, Pl. CCCXC. F. J. PICTET et G. CAMPICHE: Foss. Terr. Crét. Ste Croix. Matér. Pal. Suisse, ser. 5, p. 86, Pl. CLVI, fig. 1.

(2) A. D'ORBIGNY: Pal. Franç., Terr. Crét. Op. cit., p. 484, Pl. CCCXCV, figs. 1-3. F. J. PICTET et E. RENEVIER: Foss. Terr. Aptien. Matér. Pal. Suisse, ser. 1, p. 127, Pl. XVIII, figs. 1, 2. F. J. PICTET et G. CAMPICHE: Op. cit., ser. 5, p. 86, Pl. CLVI, fig. 1. H. WOODS: A Monogr. Cret. Lamell. England. Op. cit., Vol. II, p. 79, Pl. XI, figs. 9-11; text-figs. 9-14.

convex along the line extending from the umbo to the postero-ventral margin; postero-ventral extremity narrowly rounded; anterior and posterior margins very broadly arcuate; hinge line relatively short, with a trace of a few pits which are horizontally elongate. Umbo inflated, prominent, moderately curved inward; the central convex part of the shell indistinctly separated from the triangular posterior part and the anterior ear; posterior triangular part compressed and oblique, while the anterior ear rather large, also triangular, slightly convex, more or less produced and pointed anteriorly.

Surface smooth except for the crowded and rude lines of growth. Test relatively thin.

| | | |
|--------------|--------|--------|
| | Height | Length |
| Dimensions : | 11 mm. | 9 mm. |

Localities and geological horizon: The Hiraiga Sandstone; Hiraiga, Haibe and Moshi.

A few left valves.

Although the present form does not show a complete hinge, it is very similar in other features to many forms of *Gervillia* to which it probably belongs. The present species is very closely akin to *G. rostrata* (SOW.)⁽¹⁾ from the Upper Greensand of England and *G. ceno-manensis* D'ORB.⁽²⁾ from the Upper Cretaceous of France; these two European forms are regarded as specifically identical to each other by H. WOODS. Our form is distinguished from these in having a much shorter hinge line, though this line is more or less variable in different individuals of the English species. The new species in question, moreover, is provided with a smaller anterior ear, a smaller posterior wing and a more inflated central portion than *G. rostrata*.

G. shinanoensis YABE and NAGAO⁽³⁾ from the Shiroi Group of the Kwanto Mountainland is somewhat similar to the present species in outline of the valve but is much larger, thick-tested and, moreover, radially ribbed.

(1) H. WOODS: Monogr. Cret. Lamell. England. Op. cit., Vol II. p. 83, Pl. XI, figs. 12-23.

(2) A. D'ORBIGNY: Pal. Fr. Terr. Crét., Vol. III, p. 476, Pl. CCCXCI, figs. 11-13.

(3) YABE, NAGAO and SHIMIZU: Cret. Moll. Kwanto Mountainland. Op. cit., p. 59, Pl. XIV, figs. 17, 18.

Gervillia (?) sp.

Pl. XXIV (II), Fig. 7.

An imperfect internal mould of an obliquely elongated shell has been obtained and very doubtfully referred to *Gervillia*. Its generic determination being correct, it is somewhat akin to *G. sublanceolata* (D'ORB.)⁽¹⁾ from the Lower Greensand of England, especially those of *G. alpina* PICTET and CAMPICHE from the Aptian and Gault of Switzerland. The latter was regarded as synonymous with *G. sublanceolata* by H. WOODS. A precise comparison of the present mould with the foreign species is impossible owing to its imperfect state of preservation.

Locality and geological horizon: The *Orbitolina* Sandstone exposed on the northern coast of Raga Inlet.

Ostrea LINN., 1758*Ostrea diluviana* LIN.

- 1852. *Ostrea carinata* RÖMER: Kreidebild. von Texas, p. 75, Pl. IX, fig. 5.
- 1871. *O. (Alectryonia) carinata* STOLICZKA: Cret. Fauna S. India. Palaeont. Indica, Vol. III, p. 468, Pl. XLVIII, fig. 5; Pl. XLIX, figs. 1, 2.
- 1871. *O. (A.) pectinata* STOLICZKA: Ibid., p. 469, Pl. XLVIII, figs. 1, 2.
- 1871. *O. (A.) diluviana* STOLICZKA: Ibid., p. 466, Pl. XLVI, figs. 1, 2; Pl. XLVII, figs. 1, 2.
- 1890. *Alectryonia* cf. *carinata* YOKOYAMA: Verstein. Jap. Kreide. Palaeontographica, Vol. XXXVI, p. 198.
- 1897. *Ostrea (Alectryonia) pectinata* NÖTLING: Upper Cret. Mari Hills. Palaeont. Indica, Ser. XVI, Vol. I, p. 38, Pl. IX, figs. 2, 3.
- 1910. *O. (A.) carinata* BÖSE: Monogr. Geol. y Paleont. del Cerro de Muleros. Bol. d. Inst. geol. d. Mexico, No. 25, p. 104, Pl. XVI, figs. 13, 14.
- 1913. *O. diluviana* WOODS: A Monogr. Cret. Lamell. England. Op. cit., Vol. II, p. 342, text-figs. 98-138.
- 1926. *O. diluviana* YABE and NAGAO: Cret. Moll. Sanchû-Graben, Kwantô Mountainland, Japan. Op. cit., p. 63, Pl. XIII, figs. 4-6.

(1) F. FORBES: Quart. Jour. Geol. Soc., Vol. I, 1845, p. 246 (*G. aviculoides*); Ibid., 1845, p. 247, Pl. III, fig. 8 (*Avicula lanceolata*). F. J. PICTET et E. RENVIER: Foss. Terr. Aptien. Matér. Terr. Crét. Suisse, ser. 1, 1858, p. 121, Pl. XVII, (*G. anceps*). F. J. PICTET et G. CAMPICHE: Foss. Terr. Crét. Ste Croix. Matér. Suisse, ser. 5, 1869, p. 83, Pl. CLV, figs. 2-4 (*G. alpina*). M. H. COQUAND: Mon. Aptien de l'Espagne, 1865, p. 145 (*G. anceps*). H. WOODS: Monogr. Cret. Lamell. England. Op. cit., Vol. II, 1905, p. 74, Pl. X, figs. 14-16.

There are in our possession a few imperfect specimens of the type of *Alectryonia carinata* LAM. and *A. rectangularis* RÖMER. These two, together with numerous allied forms found in the Lower and Upper Cretaceous rocks, have been included by H. WOODS, on a close examination of a large series of this type of *Ostrea*, in one species *O. diluviana* LIN.

Localities and geological horizons: The Hiraiga Sandstone; northern coast of Hiraiga Bay, and Hideshima. The Akito Sandstone Hiraiga and Akito. The *Orbitolina* Sandstone; Hiraiga.

This species is also reported from the Kawarazawa Group of the Kwantô Mountainland and the Lower Cretaceous of Ôshima in the province of Rikuzen.

Exogyra SAY, 1819

Exogyra yabei nov. sp.

Pl. XXV (III), Fig. 7; Pl. XXVI (IV), Fig. 1; Pl. XXVII (V), Fig. 1;
Pl. XXVIII (VI), Figs. 1, 2; Pl. XXIX (VII), Figs. 1, 14.

Shell large, thick-tested, slightly oblique; subcircular or oval in outline, more or less higher than long, with the umbo curved posteriorly in the plane of the valve.

Left or lower valve inflated, with a very large circular and concave umbonal area of attachment which involves about one half of the surface of the valve; outwardly to this area the surface is flatly convex and slopes downwards to the margins, forming an obtuse angle with the surface of attachment. Anterior margin well rounded, passing gradually into the broadly convex ventral; posterior margin rather short, distinctly excavated just behind the umbo, straight in the middle and evenly arcuated below, continuing with the postero-ventral margin.

Surface, except the postero-dorsal portion, ornamented with eleven to sixteen radial ribs which are strong, round-topped, elevated and separated from one another by concave interspaces nearly equal in width to the ribs themselves. Ribs and interspaces crossed by numerous crowded and frequently rude concentric ridges and fine lines of growth. Margins, except the postero-dorsal one, provided with strong and coarse crenulations corresponding to the ribs and interspaces of the external surface.

Right or upper valve nearly equal in form and size to the opposite valve, almost flat or slightly concave, with a narrow marginal area which is flat and slopes toward the margins. Surface with irregular concentric lines of growth. Margins strongly crenulated to conform to the left valve.

| | Height | Length |
|--------------|---------|------------------------|
| Dimensions : | 120 mm. | 100 mm. |
| | 88 mm. | 82 mm. (circular form) |
| | 95 mm. | 63 mm. (oval form) |

Localities and geological horizons : The Hiraiga Sandstone ; Haipe, Hiraiga, Moshi and Hideshima. The Moshi Sandstone ; Haipe. The *Orbitolina* Sandstone ; Raga.

Several specimens were examined. This species is somewhat akin to *E. minos* (COQ.)⁽¹⁾ from the Lower Cretaceous of Europe and South America and *E. flabellata* GOLDF.⁽²⁾ from the Cenomanian of Europe and North and South Africa. The Japanese form is decidedly more circular with its posterior margin more arcuate and its postero-ventral extremity less produced than these foreign species. Moreover, the margins of the shell are more prominently crenulated in ours.

The specific name of this form is dedicated to Prof. H. YABE of the Institute of Geology and Palaeontology, Sendai.

Exogyra subhaliotoidea nov. sp.

Pl. XXX (VIII), Figs. 1-4.

Several more or less imperfect valves of *Exogyra* are in our collection.

(1) H. COQUAND : Mon, Ostrea, Terr. Cret., 1869, p. 183, Pl. LXIV, figs. 1-3 ; Pl. LXXXIII, figs. 5-9 ; Pl. LXIV, figs. 14, 15. A. D'ORBIGNY : Pal. Franç. Terr. Crét., Vol. III, p. 702 (pars.), Pl. 468, figs. 1-3. A. D'ORBIGNY : Voyage dans l'Amérique méridionale, 1842, p. 91, Pl. XVIII, fig. 20 ; Pl. XX, figs. 8, 9 (*O. boussingaulti*). F. J. PICTET and G. CAMPICHE : Terr. Crét. Ste. Croix. Op. cit., ser. 5, 1871, p. 278, Pl. CLXXXV. C. E. WEAVER : Paleontology of the Jurassic and Cretaceous of West Central Argentina. Op. cit., 1931, p. 222, Pl. XVIII, figs. 82, 83.

(2) A. GOLDFUSS : Petref. Germaniae, Vol. II, 1837, p. 83, Pl. LXXXVII, fig. 6. GOLDFUSS : Ibid., p. 37, Pl. LXXXVII, figs. 5b-f (*E. plicata*). A. D'ORBIGNY : Pal. Franç. Terr. Crét., Vol. III, 1848, p. 717, Pl. CCCCLXXV. F. RÖMER : Die Kreidebildung von Texas, 1894, p. 69, Pl. X, fig. 1 (*E. texana*). H. COQUAND : Monogr. Ostrea, 1869, p. 126, Pl. XLIX, figs. 1-2 ; Pl. L, fig. 1 ; Pl. LII, figs. 1-6, 8, 9. L. PERVINQUIÈRE : Etudes de Paléontologie tunisienne, II. Carte géologique de la Tunisie, 1912, p. 189, Pl. XIII, figs. 6-8.

Right valve higher than long ; almost flat or slightly convex, with a broad flattened posterior part ; a distinct carina extending from the spirally curved umbo across the shell ; the surface anterior to this carina very narrow and nearly perpendicular to the posterior surface, and in some specimens broader than others ; subovate in outline, with the anterior margin well rounded and the posterior nearly straight. Surface smooth with a few low irregular ridges on the posterior slope of the valve besides numerous indistinct concentric undulations. Margins not digitate. Left valve almost like the right but usually deeper.

| | | |
|--------------|--------|--------|
| | Height | Length |
| Dimensions : | 33 mm. | 19 mm. |

Localities and geological horizons : The Hiraiga Sandstone ; Hiraiga, Hideshima and Moshi. Several fragments derived from the Akito Sandstone of Akito near Raga. The *Orbitolina* Sandstone of Raga.

As all the specimens are incomplete, it is difficult to compare the present form with other species. In various points, however, the Japanese fossil is similar to *E. conica* (Sow.)⁽¹⁾, an extensively distributed European species of the Lower and Upper Cretaceous, which is in most cases provided with a thin, flat and operculiform right valve. This valve is also shallow in ours but has usually a rounded carina. On the other hand, the left valve is very often more convex in the European form with the carina more rounded and situated more posteriorly in the former than in ours. *E. haliotoidea* (Sow.), and *E. rauliniana* (D'ORB.) with a large surface of attachment are united by H. WOODS in *E. conica*. These forms are very similar in the features of the left valve to ours.

Those specimens derived from the Utatur Group of South India and identified by F. STOLICZKA⁽²⁾ to *E. haliotoidea* (Sow.) are similar to ours in many respects, though more closely similar to the European species.

(1) A. D'ORBIGNY : Pal. Franç., Vol. III, p. 726, Pl. CCCCLXXVIII, figs. 5-8 ; Pl. CCCCLXXIX, figs. 1-3. For the synonyms of this species see H. WOODS : A Monogr. Cret. Lamell. Op. cit., Vol. II, p. 407.

(2) F. STOLICZKA : Cret. Fauna of India, Pelecypoda. Op. cit., p. 458, Pl. XXXVI, fig. 7 ; Pl. XXXVII, figs. 1-3.

Trigonia BRUG., 1789

Trigonia hokkaidoana YEHARA

1915. *Trigonia hokkaidoana* YEHARA: Cret. Trigoniae, Miyako and Hokkaidô.
Op. cit., p. 39, Pl. I, figs. 1-8.
?1916. *Trigonia hokkaidoana* (?) YABE and NAGAO: Cret. Moll. Sanchû-
Graben. Op. cit., p. 46, Pl. XIV, fig. 3.

Numerous well preserved specimens were collected from this district and figured by Dr. YEHARA.

Localities and geological horizons: The Kawarazawa Group; Kawarazawa and Ôze, province of Kôzuke (doubtful specimens). In the Miyako district it ranges from the *Plagiptychus* Zone to the Akito Sandstone; Hideshima, Moshi, Haibe, Hiraiga, and Raga. Moreover, this species occurs in the Trigonia Sandstone; Ikushumbets, Ponhorokabets, etc., Hokkaidô.

Trigonia datemasamunei YEHARA

1915. *Trigonia datemasamunei* YEHARA: The Cretaceous Trigoniae from Miyako and Hokkaido. Sci. Rep. Tôhoku Imp. Univ., Ser. 2, Vol. II, p. 38, Pl. II, figs. 13, 14.

A few specimens are in our collection. Mr. YEHARA cited a close resemblance of this species with *T. crenulata* var. *peruana* PAULCKE from the Cenomanian of Peru.

Locality and geological horizon: The *Orbitolina* Sandstone; Raga.

Trigonia yokoyamai YEHARA

1915. *Trigonia yokoyamai* YEHARA: Cret. Trigoniae f. Miyako and Hokkaidô. Op. cit., p. 41, Pl. II, figs. 15-17.

A number of specimens were collected from a few localities in the Miyako district.

This species has a long geological distribution ranging from the Moshi Sandstone to the Akito throughout all fossiliferous zones in this district.

Localities and geological horizons: The Hiraiga Sandstone; Hiraiga, Haibe, Moshi and Hideshima. The Moshi Sandstone; Moshi and Haibe, The *Orbitolina* Sandstone; Raga. The Akito Sandstone; Akito.

Trigonia kotoi YEHARA

1915. *Trigonia kotoi* YEHARA: Cret. Trigoniae from Miyako and Hokkaidô.
Op. cit., p. 40, Pl. I, fig. 10.

No specimen is in our collection.

Locality and geological horizon: The *Praecaprotina* (formerly *Plagioptychus*) Zone; Hiraiga (YEHARA).

Trigonia kikuchiana YOKOYAMA

1891. *Trigonia kikuchiana* YOKOYAMA: On some Cretaceous Fossils from Shikoku. Jour. Coll. Sci., Tokyo, Vol. IV, pt. II, p. 363, Pl. XL, figs. 4-6.
1891. *Trigonia rotundata* YOKOYAMA: Ibid., p. 365, Pl. XL, figs. 7, 8.
1915. *Trigonia kikuchiana* YEHARA: Cret. Trigoniae Miyako and Hokkaidô.
Op. cit., p. 44, Pl. II, figs. 1-9.
1923. *Trigonia kikuchiana* YEHARA: Cretaceous Trigoniae from Amakusa Islands, Prov. Higo, Kyûshû. Jour. Geol. Soc. Tokyo, Vol. XXX, p. 9, Pl. VII, figs. 1, 2.
1923. *Trigonia kikuchiana* YEHARA: Cretaceous Trigoniae from South-western Japan. Japan. Jour. Geol. and Geogr., Vol. II, p. 80, Pl. XI, figs. 1, 2.

Numerous specimens from the Miyako Cretaceous are in ours disposal.

Localities and geological horizons: Lower Cretaceous of Tosa (YOKOYAMA, YEHARA) and Awa in Shikoku (YEHARA, YABE). Goshonoura Group of Amakusa (YEHARA, NAGAO). Lower Cretaceous of Yatsushiro, Kyûshû (NAGAO). In the Miyako district, this species has been known to occur in:—

The *Trigonia kikuchiana* Zone: Hideshima, Moshi and Hiraiga.

The Moshi Sandstone (the *Praecaprotina* Zone): Hiraiga, Haibe and Moshi.

Pecten MÜLLER, 1824

(*Neithea* DROUET, 1824)

Pecten (*Neithea*) *morrisi* (PICHET and RENEVIER)

Pl. XXVI (IV), Figs. 2-6.

1858. *Jania morrisi* PICHET and RENEVIER: Foss. Terr. Aptien. Matér. Pal. Suisse, ser. 1, p. 128, Pl. XIX, fig. 2.

1865. *Jania morrisi* COQUAND: Aptien de l'Espagne. Mém. Soc. émul. Provence, p. 341.
1870. *Jania morrisi* PICTET and CAMPICHE: Foss. Terr. Crét. Ste. Croix. Ibid., ser. 5, p. 244.
- 1901-2. *Vola morrisi* CHOFFAT: Faune Crét. du Portugal, Vol. I, ser. 4, p. 147, Pl. III, figs. 5, 6.
1903. *Pecten (Neithea) morrisi* WOODS: A Monogr. Cret. Lamell. England, Vol. 1, p. 201, Pl. XXXIX, figs. 11-13.
1912. *Pecten (Neithea) morrisi* PERVINQUIÈRE: Etudes de Pal. Tunis, p. 135, Pl. IX, fig. 7.
1916. *Neithea morrisi* DOUVILLÉ: Les Terrains secondaires dans le Massif du Moghara à l'est de l'isthme de Suez. Paléontologie. Mém. l'Académie des Sciences, T. LIV, ser. 2, p. 171, Pl. XX, figs. 17, 18.

Four right and two left valves. They represent a form distinguishable from those specimens⁽¹⁾ reported from the Ishidô Group of the Kwanto Mountainland, which were referred to *P. (N.) atavus* RÖMER⁽²⁾ from the Neocomian of Europe.

Shell somewhat triangular in outline, almost equilateral, usually higher than long; very inequivalve.

Right valve moderately convex with the umbo prominent and curved inwards. Surface ornamented with strong and rounded radial ribs; six main ribs large, prominent, and sometimes roundly angulated on top, projecting at the margin of the valve. Each interspace between two main ribs moderately concave and provided with usually two somewhat unequal ribs which are much narrower and less prominent than the main ribs and separated by narrow interspaces from each other; another narrower rib always exists on either side of and close to each main rib. Two areas at both anterior and posterior extremities smooth or rarely with a few faint ribs. Ears very small and triangular in form.

Left valve flat or faintly concave, more or less ovate, slightly higher than long or sometimes a little longer. Radial ribs narrow, about sixteen in number excluding a few finer ones on the anterior and posterior areas; interspaces between the ribs broader than the

(1) H. YABE and T. NAGAO: Cretaceous Mollusca from the Sanchû Graben. Op. cit., 1926, p. 61, Pl. XIII, figs. 18, 19.

(2) A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. III, 1847, p. 627, Pl. CCCCXLII, figs. 1-3, 5. F. J. PICTET and G. CAMPICHE: Foss. Terr. Crét. Ste. Croix. Op. cit., ser. 5, 1870, p. 237, Pl. CLXXX. O. WEERTH: Die Fauna des Neocom. im Teutoburg. Walde. Palaeont. Abh., Vol. II, 1884, p. 54. J. FELIX: Verst. mexican. Jura- u. Kreide-Form. Palaeontogr., Vol. XXXVII, 1891, p. 171. H. WOODS: A Monogr. Cret. Lamell. Op. cit., Vol. II, 1903, p. 197, Pl. XXXIX, figs. 1-5.

ribs and five of them conforming to the main ribs of the right valve, broader than the others.

Both valves ornamented, moreover, with numerous fine regular concentric striae separated from one another by broad flat interspaces.

| | Length | Height |
|--------------|--------|----------------------------|
| Dimensions : | 19 mm. | ca. 21 mm. (a right valve) |
| | 18 mm. | 19 mm. (a left valve) |
| | 16 mm. | 16 mm. (a left valve) |

Localities and geological horizons: The Hiraiga Sandstone; Hiraiga, Haipe and Hideshima. The Moshi Sandstone; Hiraiga. The *Orbitolina* Sandstone; Raga. The Akito Sandstone; Akito.

From the above description, the present form does not appear to differ essentially from *P. (N.) morissi* (PICT. and RENEV.), a widely distributed Aptian species. Some specimens of this Lower Cretaceous species are very closely akin to *P. (N.) quinquecostatus* SOW⁽¹⁾, from the Gault and Upper Cretaceous of various localities. *P. morissi* is distinguished from the latter in being shorter, higher and in having stronger and more prominent main ribs, with somewhat inequal interstitial ones. Moreover, according to H. WOODS, both anterior and posterior areas are smooth in the former, while they are distinctly ribbed in the latter, though the specimens from the Utatur Group of South-east India which were included in *P. quinquecostatus* are provided with the smooth areas. Our specimens are quite identical in these points with many examples of *P. morissi*, especially those from the Lower Greensand of England and the Aptian of Portugal.

(1) G. MANTELL: Foss. S. Downs, 1822, pp. 128, 201, Pl. XXVI, figs. 14, 19, 20. A. GOLDFUSS: Petref. Germ., Vol. II, 1833, p. 55, Pl. XCIII, fig. 1. H. G. BRONN: Lethea Geogn., 1837, p. 50, Pl. XVI, fig. 2. A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. III, 1847, p. 632, Pl. CCCXLIV, figs. 1-5. F. STOLICZKA: Cret. Fauna S. India. Op. cit., 1871, p. 437, Pl. XXXI, figs. 1-6; Pl. XXXVII, figs. 4-9. H. B. GEINITZ: Das Elbthalgeb. Sachsen. Palaeontographica, Vol. XX, pt. 1, 1872, p. 201, Pl. XLV, figs. 8, 9; pt. 2, p. 36, Pl. X, figs. 17, 18. P. CHOFFAT: Faune Crét. Portugal, Vol. I, 1901-2, p. 148, Pl. III, fig. 7. H. WOODS: A Monogr. Cret. Lamell. England, Vol. I, 1903, p. 202, Pl. XXXIX, figs. 14-17; Pl. XL, figs. 1-5. H. WOODS: Ann. S. Afr. Mus., Vol. IV, 1906, p. 298, Pl. XXXV, fig. 14. J. v. L. RENNIE: New Lamell. and Gastrop. Up. Cret. Of Pondoland. Ann. S. African Mus., Vol. XXVIII, 1930, p. 179, Pl. XVIII, figs. 1-5. RENNIE: Cret. Foss. Angola. Ann. S. Afr. Mus., Vol. XXVIII, p. 17, Pl. I, fig. 13.

P. quadricostatus var. of RÖMER⁽¹⁾ from the Lower Cretaceous of Texas may be either *P. quinquecostatus*, or more probably *P. morrisi* as suggested by the great convexity of the shell, the feature of radial sculpture and the areas which are figured to be smooth.

Pecten (Neithea) sp. indet.

Pl. XXIX (VII), Fig. 8, 9.

There are two left valves of another *Neithea* which is closely similar to the preceding one but is longer and has more numerous and crowded radial ribs. The interspaces conforming with the main ribs of the opposite valve seem to be less prominent than in the latter.

Localities and geological horizons: The Hiraiga Sandstone; Haipe, Hiraiga and Hideshima. The *Orbitolina* Sandstone; Raga.

(*Camptonectes* (AG. 1864) MEEK)

Pecten (Camptonectes) miyakoensis nov. sp.

Pl. XXXI (IX), Figs. 11, 12.

Shell small, compressed, suborbicular in outline, higher than long. Right valve regularly convex with the dorsal half triangular and the ventral half semi-circular or elliptical. Antero-dorsal margin slightly concave and the postero-dorsal nearly straight; anterior and posterior margins convex. Umbo small and pointed, with the apical angle about 80°. Hinge line rather short. Ears small, inequal and distinctly separated from the valve by sulci; of them the posterior one very narrow, smaller than the anterior, with the outer angle obtuse, the anterior one broad, provided with a convex outer margin forming a right angle with the dorsal margin and distinctly notched below.

In the left valve, the anterior ear broad, with its outer margin straight, forming an acute angle with the dorsal margin; posterior ear narrow with its outer margin very obtuse.

Surface almost smooth except for fine, faintly raised concentric lamellae and very fine, almost invisible radial striae; interspaces between the striae nearly equal to or slightly broader than the striae themselves. Test very thin.

(1) F. RÖMER: Kreidebild. von Texas, 1852, p. 64, Pl. VIII, fig. 4.

| | Length | Height |
|--------------|---------|----------|
| Dimensions : | 9 mm. | 10.5 mm. |
| | 7.5 mm. | 9.5 mm. |
| | 6.5 mm. | 8.5 mm. |
| | 4.0 mm. | 5.0 mm. |

Localities and geological horizons : The Hiraiga Sandstone ; Haipe, Hiraiga and Hideshima. The Akito Sandstone ; Akito. The *Orbitolina* Sandstone ; Raga.

A number of specimens were examined. Most of the specimens are very small, but the largest example measures 20 mm. in height.

The present form is not unlike *P. (C.) placitus* WHITE⁽¹⁾ from the Upper Cretaceous of Brazil but has a slightly smaller apical angle and a narrower and higher anterior left ear than the latter. By its smaller apical angle it is also distinguished from *P. laevis* HILLS⁽²⁾ from the Cenomanian of Germany and *P. simplicius* CONRAD⁽³⁾ from the Upper Cretaceous of North America.

Spondylus LINN., 1758

Spondylus decoratus nov. sp.

Pl. XXVII (V), Figs. 2, 5-7, (?) 8.

Shell oval, slightly or fairly higher than long, a little oblique. Test thin.

Left valve regularly convex, with an evenly curved ventral margin ; umbo moderately prominent, sometimes small, with the apical angle of about 100°, or in one case slightly smaller than 90°. Both ears distinct, narrow, smooth, with an obtuse outer margin.

(1) C. A. WHITE: Contribution to the Paleontology of Brazil. Archivos do Mus. Nacional do Rio de Janeiro, Vol. VII, 1888, p. 40, Pl. IV, figs. 8, 9.

(2) H. B. GEINITZ: Das Elbth. Plaeontographica, Vol. XX, pt. 1, 1872, p. 192, Pl. 43, figs. 12, 13.

(3) R. P. WHITFIELD: U. S. Geol. Surv. Monogr., Vol. IX, 1885, p. 51, Pl. VII, figs. 11, 12. S. WELLER: A Report Cret. Paleont. New Jersey. Geol. Surv. N. J., Vol. IV, 1907, p. 480, Pl. LI, fig. 6. J. S. GARDNER: Maryland Geol. Surv., Upper Cret., p. 596, Pl. XXXIV, figs. 8, 9. L. W. STEPHENSON: The Cret. Form. North Carolina, Vol. V, pt. 1. Invert. Foss. Upper Cret. Form., 1923, p. 199, Pl. 55, figs. 6-11.

Surface covered by numerous, crowded, narrow, equal and more or less wavy radial ribs and slightly narrower shallow grooves in alternation. About seven ribs broader and more elevated than the interstitial ribs which are about six or seven in number between each two broader ones. Broader ribs distinctly and coarsely spiny.

Right valve usually flattish dorso-ventrally but evenly convex antero-posteriorly; surface of attachment sometimes large. Surface with numerous, crowded, narrow, subequal radial ribs and interstitial grooves, the latter usually almost equal in breadth to or slightly broader than the ribs themselves. Concentric lines and intermittent grooves also exist.

| | | |
|--------------|--------|----------------------------|
| | Height | Length (of the left valve) |
| Dimensions : | 37 mm. | ca. 35 mm. |

Localities and geological horizons : The Hiraiga Sandstone ; Haipe, Hiraiga, Moshi and Hideshima. The Moshi Sandstone ; Haipe. The *Orbitolina* Sandstone ; Raga.

All the specimens are more or less weathered, so that it is almost impossible to know their perfect sculpture. In one of them, the left valve is provided with seven strong radial ribs which are somewhat broader and more elevated than the interstitial ribs and ornamented with coarse prominent spines on top. In one of the other specimens, which is high, the stronger ribs are not prominent, only slightly surpassing the narrower ones in breadth.

The present species is similar in form and sculpture to *S. roemeri* DESH.⁽¹⁾ from the Neocomian of France and Germany and the Lower Greensand of England and *S. gibbosus* D'ORB.⁽²⁾ from the Gault of France and England and the Gault and Aptian of Switzerland. The Japanese form, however, has the stronger ribs broader, more distinct and more

(1) A. D'ORBIGNY : Pal. Franç. Terr. Cret., Vol., III, 1847, p. 655, Pl. CCCCLI, figs. 1-6. F. J. PICTET and G. CAMPICHE : Foss. Terr. Crét. Ste. Croix. Op. cit., ser. 5, 1870, pp. 256, 260. A. WOLLEMAN : Die Biv. u. Gastrop. d. deutsch. u. holländ. Neocom. Abhandl. d. k. preuss. geol. Landes., N. F. pt. 31, 1900, p. 20. H. WOODS : A Monogr. Cret. Lamell. England, Vol. I, 1901, p. 116, Pl. XX, figs. 4a-d.

(2) A. D'ORBIGNY : Pal. Franç. Terr. Crét. Op. cit., 1847, p. 658, Pl. CCCCLII, figs. 1-6. F. J. PICTET and W. ROUX : Moll. Foss. Grès verts de Genève, p. 514, Pl. XLVII, fig. 1 (2) (*S. brunneri*). F. J. PICTET and E. RENEVIER : Foss. Terr. Aptien. Op. cit., ser. I, 1858, p. 136 (*S. brunneri*). F. J. PICTET and G. CAMPICHE : Foss. Terr. Crét. Ste. Croix. Op. cit., ser. 5, 1870, p. 257, Pl. CLXXXII, figs. 1-4. H. WOODS : A Monogr. Cret. Lamell. England, Vol. I, p. 117, Pl. XX, figs. 5-11.

regularly disposed and the narrower ribs more crowded than in the first of these European species. It is also distinguished from the second of the latter by its less inflated left valve, with more prominent intermittent ribs. We have, moreover, another right valve (Pl. XXVII (V), Fig. 8) which is high, rather great in convexity, with a prominent umbo and covered all over by numerous concentric elevated lamellae, besides crowded narrow radial ribs. This specimen may belong to this same species in question and is similar in several points to one of the specimens of *P. gibbosus* figured by H. WOODS (Pl. XX, Fig. 7) from England.

S. dutempleanus D'ORB.⁽¹⁾ from the Upper Cretaceous of Europe is decidedly more convex and less oblique, with more crowded radial ribs than ours.

Lima BRUG., 1792

(*Ctenoides*, H. and A. ADAMS)

Lima (*Ctenoides*?) *subrapa* nov. sp.

Pl. XXX (VIII), Figs. 9, 10.

Shell rather large, moderately and evenly convex, oval in outline, much higher than long, nearly equilateral. Both anterior and posterior margins broadly convex, the ventral presumably semicircular judging from the course of the lines of growth. Umbo small, pointed, with an apical angle of about 80° ; ears relatively large, triangular, higher than long, and covered by numerous fine radial lines; anterior ear larger than the posterior, with its anterior angle slightly obtuse, the posterior ear with its outer angle very obtuse.

Surface ornamented, besides fine concentric lines and ridges, with very fine and crowded, slightly raised radial ribs which are more or less wavy and somewhat deflected on passing the growth ridges.

Localities and geological horizons: The Akito Sandstone; Akito. The Hiraiga Sandstone; Hiraiga, Haibe, Moshi, and Hideshima. The *Orbitolina* Sandstone; Hiraiga.

(1) A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. III, p. 672, Pl. CCCLX, figs. 6-11. F. J. PICTET and G. CAMPICHE: Foss. Terr. Crét. Ste. Croix. Op. cit., ser. 5, p. 262. E. HOLZAPFEL: Die Moll. d. Aachen. Kreide. Palaeontographica, Vol. XXXV, 1899, 244, Pl. XXVII, figs. 8-10. H. WOODS: A Monogr. Cret. Lamell. England, Vol. I, p. 125, Pl. XXII, figs. 11-14; Pl. XXIII, figs. 1-5.

Two specimens, in one of which the ventral half is not preserved. Though very incomplete, they represent a form closely akin to *L. (C.) rapa* D'ORB.⁽¹⁾ from the Upper Greensand and Cenomanian of England and the Cenomanian of France and Germany. The Japanese species is, however, provided with a broader anterior ear and a narrower posterior than the latter. As far as observed the radial lines on the flank of the shell seem to be finer in our.

(*Limatula* WOOD, 1839)

Lima (Limatula) ishidoensis YABE and NAGAO

Pl. XXVII (V), Figs. 9, 10.

1926. *Lima (Limatula) ishidoensis* YABE and NAGAO in YABE, NAGAO and SHIMIZU: Cretaceous Mollusca from the Sanchû Graben in the Kwan-to Mountainland, Japan. Sci. Rep., Tôhoku Imp. Univ., Ser. 2, Vol. IX, p. 60, Pl. XIV, figs. 7, 16.

A few specimens of a small *Lima (Limatula)* have been obtained. They may be specifically identical with *L. (L.) ishidoensis* YABE and NAGAO from the Ishido Group (Upper Hauterivian-Barremian) of the Sanchû Graben.

In the present specimens, the radial ribs are relatively narrower, being separated from one another by usually much broader concave interspaces than the type ones, but this feature may be attributed to a different state of preservation.

This species is easily distinguished from *L. (L.) tombeckiana* D'ORB.⁽²⁾ from the Lower Cretaceous of Europe and *L. (L.) fittoni* D'ORB.⁽³⁾ from the Upper Greensand of England by its higher shell. It is more closely similar to *L. (L.) dupiniana* D'ORB.⁽⁴⁾ from the Lower Cretaceous of Europe, though different from the latter in being slightly less equilateral and provided with a broader ribbed area. The ribs in ours, moreover, are a little broader than in *L. dupiniana*.

(1) A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. III, p. 546, Pl. CCCCXIX, figs. 1-4. H. WOODS: A Monogr. Cret. Lamell. England, Vol. II, p. 40, Pl. VI, fig. 17; Pl. VII, fig. 1; text-fig. 6. H. B. GEINITZ: Das Elbth. Sachsen. Palaeontographica, Vol. XX, pt. 1, 1872, p. 206, Pl. XLIII, fig. 4.

(2) A. D'ORBIGNY: Pal. Franç., Vol. III, p. 534, Pl. CCCCXV, figs. 13-17. H. WOODS: Cret. Lamell. England. Op. cit., Vol. II, p. 45, Pl. VII, figs. 7-9.

(3) H. WOODS: Ibid., p. 48, Pl. VII, figs. 12-15.

(4) A. D'ORBIGNY: Pal. Franç., Vol. III, p. 535, Pl. CCCCXV, figs. 18-22. H. WOODS: Cret. Lamell. England. Op. cit., Vol. II, p. 47, Pl. VII, fig. 11.

| | Height | Length |
|--------------|---------|--------|
| Dimensions : | 13 mm. | ? |
| | 10 mm. | 6 mm. |
| | 9.5 mm. | 6 mm. |

Localities and geological horizons : The Akito Sandstone ; Akito. The Hiraiga Sandstone ; Hiraiga, Haibe and Hideshima. The Moshi Sandstone ; Hiraiga. The *Orbitolina* Sandstone ; Hiraiga.

Pholadomya SOW., 1823

Pholadomya subpedelnalis nov. sp.

Pl. XXVI (IV), Fig. 8.

Shell short, subquadrate, slightly longer than high, convex, inequilateral ; anterior side very short and inflated, the posterior one somewhat produced and attenuated ; antero-dorsal margin slightly concave beneath the umbo, steeply sloping downward ; postero-dorsal margin evenly and distinctly concave behind umbo and much longer than the antero-dorsal ; anterior, ventral and posterior margins rounded. Umbones small, prominent and strongly incurved ; lunule indistinct ; escutcheon short, excavated and bounded by distinct ridges.

Surface ornamented with concentric and radial ribs ; the radial ones about nine in number, confined to the middle portion of the valve, prominent, relatively sharp, extending from the umbo to the ventral margin, and tuberculated on the intersections with the concentric ribs. The narrow area on the antero-dorsal part and the broader area on the postero-dorsal ornamented with only rude concentric ribs.

| | Length | Height |
|--------------|--------|--------|
| Dimensions : | 26 mm. | 24 mm. |

Locality and geological horizon : The Hiraiga Sandstone ; Hideshima.

The present form is characterised by its short shell, high umbo and radial ribs. The radial ribs are small in number and confined to the median portion of the valve. It is akin to *P. colombi* COQ.⁽¹⁾ from

(1) M. H. COQUAND : Monographie paléontologique de l'Etage aptien de l'Espagne, 1866, p. 96, Pl. IX, figs. 3, 4. E. v. EICHWALD : Leth. rossica, p. 765, Pl. XXVI, fig. 5. (*P. borssoekii*). C. MOESCH : Monogr. Pholadomyen, 1884, p. 113, Pl. XXXV, figs. 2, 3.

the Aptian of Spain and the Upper Cretaceous of Germany and Russia, but is distinguished from it in having a smaller umbo and in being more rounded along the anterior margin.

The new species resembles, on the other hand, *P. trigeriana* COTTEAU⁽¹⁾ from the Neocomian of Europe and especially *P. pedernalis* RÖMER⁽²⁾ from the Aptian of Europe and Texas and the Albian of Syria in the outline and ornamentation of the shell. The former seems to be distinct from these foreign forms in being shorter.

Goniomya AGASSIZ, 1841

Goniomya subarchiaci nov. sp.

Pl. XXIX (VII), Figs. 2, 3.

Shell transversely elongate-ovate, moderately convex, slightly inequilateral; anterior end rounded along the margin and the posterior subtruncated a little obliquely; antero-dorsal margin more steeply inclined downwards than the postero-dorsal which is almost straight and slightly excavated behind the umbo; ventral margin very gently arcuate, passing rather abruptly into the posterior one over a rounded postero-ventral extremity. Umbo narrow, rather prominent, curved inwards, with a faint and round angle running from it to the postero-ventral end and limiting a compressed postero-dorsal portion of the valve; both lunule and escutcheon narrow, elongate and bounded by ridges.

Surface ornamented with ribs, besides numerous rude concentric lines of growth; the ribs anterior to the umbo about 16 in number, rather sharp, oblique backwards, covering the greater part of the anterior portion of the valve; those posterior to the umbo numbering 13, also distinct, moderately oblique near the umbo and subvertical distally; dorsal half of the median portion of the valve with sharp horizontal ribs separated from one another by distinct interspaces.

| | | |
|--------------|------------|------------|
| | Length | Height |
| Dimensions : | ca. 40 mm. | ca. 24 mm. |

(1) G. COTTEAU: Moll. fossil. de l'Yonne, 1855, p. 56. F. J. PICTET: Mel. paléont., 2 Liv., 1867, p. 81, Pl. XIX, fig. 2. F. J. PICTET et G. CAMPICHE: Pal. Suisse, Sainte-Criox, Vol. I, p. 90. C. MOESCH: Monogr. de Pholadomyen, p. 89, Pl. XXXI, fig. 1; Pl. XXXIII, fig. 1.

(2) F. RÖMER: Kreidebild. Texas, 1852, p. 45, Pl. VI, fig. 4. F. J. PICTET et E. RENEVIER: Pal. Suisse, ser. 1, p. 60, Pls. VI, VII. C. MOESCH: Monogr. Pholad., p. 93, Pl. XXXII, figs. 7-9; Pl. XXXIII, fig. 2. M. BLANKENHORN: Beitr. z. Geol. Syriens. Einige Geognos.-palaeont. Monogr., 1890, p. 94, Pl. V, fig. 13.

Localities and geological horizons: The Hiraiga Sandstone; Moshi, Haïpe and Hiraiga. The *Orbitolina*; Raga and Hiraiga. The Akito Sandstone; Akito.

It is worthy of notice that a specimen almost identical with the present one has been collected from the Kawarazawa Group of the Kwanto Mountainland.

A few imperfect specimens were examined. Although all of them are in a bad state of preservation, they represent a species distinguishable from some allied forms of this genus. The Japanese species is akin to *G. archiaci* (PICTET et CAMPICHE)⁽¹⁾ from the Lower Aptian of Switzerland and the Lower Greensand of England, from which, however, it differs in having a more inequilateral shell with a narrower posterior portion. Moreover, the anterior ribbed area is broader in our species. It is more remotely similar to *G. caudata* (AG.) (*G. agassizi* D'ORB.)⁽²⁾ from the Neocomian of France and Switzerland in being more equilateral and in having a truncated posterior end and the ribs less extensively developed anteriorly as well as posteriorly.

Anatina LAM., 1809

(*Cercomya*, AGASSIZ, 1842)

Anatina (*Cercomya*) sp.

Pl. XXXII (X), Fig. 2.

A few imperfect external casts of a species of this genus have been obtained. Although they are much deformed and, moreover, without the posterior portion of the valve, they are not unlike *A. (C.) gurgitis* Pictet and Campiche⁽³⁾ from the Aptian of Switzerland and the Lower Greensand of England.

(1) F. J. PICTET et E. RENEVIER: Foss. Terr. Aptien. Matér. Pal. Suisse, ser. 1, 1855-56, p. 67, Pl. VII, fig. 5. F. J. PICTET et G. CAMPICHE: Terr. Crét. Ste. Croix. Matér. Pal. Suisse, ser. 4, 1865, p. 92. H. WOODS: A Monogr. Cret. Lamell. England. Palaeont. Soc. Publ., Vol. II, 1909, p. 254, Pl. XLII, figs. 4, 5.

(2) AGASSIZ: Etudes crit. Moll. Foss., Myes, 1842, p. 22, Pl. Ib, Figs. 1-3; Pl. I, figs. 1. A. D'ORBIGNY: Pal. Fr. Terr. Crét., Vol. III, Op. cit., p. 352, Pl. CCCLXIII, figs. 1, 2. F. J. PICTET et G. CAMPICHE: Foss. Terr. Crét. Ste. Croix. Op. cit., ser. 4, 1865, p. 84, Pl. CVI, figs. 4-6.

(3) F. J. PICTET et G. CAMPICHE: Foss. Terr. Crét. Ste. Croix. Op. cit., ser. 4, 1865, p. 105, Pl. VII, figs. 6-8. H. WOODS: Monogr. Cret. Lamell. England, Vol. II, 1909, p. 239, Pl. XXXIX, figs. 2-4.

Shell transversely elongate, very compressed; anterior margin rounded, the antero-dorsal slightly arcuate, almost horizontal, and the ventral nearly straight. Umbones not prominent, with a distinct posterior carina. A very inconspicuous groove extending from the umbo obliquely forwards.

Surface ornamentation: Besides crowded fine lines of growth, there exist, on the anterior portion in front of the groove, a number of prominent concentric ribs separated from one another by broad concave interspaces, the former becoming obsolete behind the groove. Moreover, the surface entirely covered by numerous fine radial striae, each composed of a row of small projections.

Localities and geological horizons: The *Orbitolina* Sandstone; Raga. The Hiraiga Sandstone; Haipe and Hiraiga. The Akito Sandstone; Akito.

In the presence of a more or less distinct depression between the buccal portion and the posterior, the present form resembles those specimens from the Aptian of Switzerland⁽¹⁾ and referred to *A. robinaldina* D'ORB., from the Lower Neocomian of Yonne, France. These Swiss specimens were regarded by WOODS as belonging to *A. gurgitis*. Some radial rows of pustules which are shown in the original figures of *A. gurgitis* just in front of the posterior carina, do not exist in ours, owing most probably to a bad state of preservation.

A. (C.) robinaldina D'ORB.⁽²⁾ seems to have a more arcuated antero-dorsal margin and a more distinctly sinuated ventral one than ours.

A. arcuata FORBES⁽³⁾ from the Valudayur Group of Southern India and the Upper Cretaceous of Madagascar and S. Africa is another species allied to ours, but its postero-dorsal margin is high and its concentric ribs do not become abruptly obsolete behind the radial depression.

Cercomya deserti DOUVILLÉ⁽⁴⁾ from the Aptian of Arabia is distinguished from the present form by its more elongate shell covered all over by concentric ribs.

(1) F. J. PICTET et E. RENEVIER: Foss. Terr. Aptien. Op. cit., 1855, p. 63, Pl. VII, fig. 1.

(2) A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. III, 1845, p. 374, Pl. CCCLXX, figs. 6-8.

(3) F. STOLICZKA: Cret. Pelecypoda. S. India, 1871, p. 78, Pl. III, figs. 1. M. BOULE et THEVENIN: Ann. de Paléont., Vol. I, 1906, p. 50, Pl. I, fig. 7. J. V. L. RENNIE: Ann. S. Afr. Mus., 1930, Vol. XXVIII, pt. II.

(4) H. DOUVILLÉ: Les Terrains secondaires dans le Massif du Moghara à l'est de l'Isthme de Suez. Paléontologie. Mém. l'Académie des Sciences, Pt. IV, 2^e ser., 1916, p. 174, Pl. XX, fig. 13.

Astarte SOW., 1816*Astarte miyakoensis* nov. sp.

Pl. XXX (VIII), Fig. 8; Pl. XXXII (X), Figs. 1, 3-5.

Shell ovate, nearly equal in height and length, fairly and evenly inflate; slightly or moderately inequilateral; dorsal half subtriangular, narrowing gradually to the umbo, and the ventral one evenly rounded along the margins; antero-dorsal margin broadly concave beneath the umbo, steeply sloping downwards; postero-dorsal margin long and slightly arcuate. Umbo very prominent, curved forward; lunule ovate, deeply depressed, with a sharp border; escutcheon narrow, excavated and circumscribed by a ridge. Inner margin of the valve finely crenulated. Test thick.

Surface ornamented, when well preserved, with numerous broad and flat concentric ribs and linear grooves in alternation; ribs becoming obsolete toward the ventral margin where the shell is covered by only fine concentric lines of growth and intermittent grooves.

| | Length | Height |
|--------------|----------|----------|
| Dimensions : | 30.5 mm. | 30.0 mm. |
| | 29.5 mm. | 30.5 mm. |
| | 29.0 mm. | 30.0 mm. |
| | 27.0 mm. | 26.0 mm. |
| | 16.5 mm. | 16.0 mm. |
| | 14.5 mm. | 14.2 mm. |

Localities and geological horizons: The Hiraiga Sandstone; Hiraiga, Haipe, Moshi and Hideshima. The Moshi Sandstone; Hiraiga and Haipe. The Akito Sandstone; Akito.

A number of more or less well preserved specimens.

Although in most of the specimens the surface is smooth except for numerous fine concentric lines of growth, yet in one case numerous rather broad and flat concentric ribs are observable. The present form is almost identical with *A. upwarensis* WOODS⁽¹⁾ from the Lower Greensand of England, only differing from the latter in having a slightly narrower umbo, a less convex postero-dorsal margin and a narrower escutcheon.

(1) H. WOODS: Amonogr. Cret. Lamell. England, Vol. II, p. 105, Pl. XIV, figs. 11, 12.

Astarte subomalioides nov. sp.

Pl. XXVII (V), Figs. 3, 4.

Shell small, compressed, slightly inequilateral, subquadrate, nearly equal in height and length; dorsal half of valve triangular in outline, and pointed above; antero-dorsal margin distinctly concave, and the postero-dorsal slightly arched in its upper portion and nearly straight in its lower, forming an obtuse angle with the posterior margin; anterior end roundly angulated; ventral margin convex, rather abruptly ascending toward the posterior end. Umbo small, pointed, compressed, curved forward.

Surface with prominent concentric ribs and slightly narrower concave interspaces in alternation; the concentric ribs 8 to 10 in number, broad, round on top, with a steep dorsal slope and a gentle ventral one, becoming broader and more distant from one another in passing from the umbo to the ventral margin. Inner margin of valve finely crenulated. Test rather thick.

Lunule narrow, escutcheon very slender; both lunule and escutcheon bounded by sharp ridges.

| | Length | Height | Thickness of one valve |
|-------------|---------|---------|---------------------------|
| Dimensions: | 8.0 mm. | 7.5 mm. | — |
| | 7.5 mm. | 7.0 mm. | 1.5 mm. |
| | 6.5 mm. | 5.5 mm. | — |

Localities and geological horizons: The Hiraiga Sandstone; Hiraiga, Haibe, Moshi and Hideshima. The *Orbitolina* Sandstone; Raga. The Akito Sandstone; Akito.

This species is closely similar to *A. omalioides* WOODS⁽¹⁾ from the Gault of England in the outline of the shell and the surface sculpture. The former, however, seems to have broader and more rounded concentric ribs.

"*Gouldia*" *planissima* FORBES⁽²⁾ from the Utatur Group of South India is somewhat akin to our species though the hinge is not visible in the latter. The Indian form seems to have a less convex ventral margin and a smaller concavity of the antero-dorsal margin than ours.

(1) H. WOODS: A Monogr. Cret. Lamell. England, Vol. II, p. 111, Pl. XV, figs. 5-7.

(2) F. STOLICZKA: Cret. Fauna Southern India, Pelecypoda. Palaeont. Indica, Vol. III, Nos. 1-13, 1871, p. 289, Pl. X, fig. 3.

A. subomalioides is decidedly more compressed with less numerous and broader concentric ribs than *A. subcostata* D'ORB.⁽¹⁾ from the Neocomian and Aptian of England, France and Switzerland.

Astarte minor nov. sp.

Pl. XXVIII (VI), Figs. 5-10.

Shell small, convex, oval or subquadrate in outline, nearly equal in height and length or a little longer than high, slightly or moderately inequilateral; antero-dorsal margin concave, the postero-dorsal almost straight or faintly convex; anterior and posterior margins well rounded, the ventral more broadly convex than the posterior, forming regular curves with both anterior and posterior margins; posterior end sometimes obtusely angulated. Umbones rather prominent, convex, curved conspicuously inward and slightly forward, close together. Lunule short, broadly ovate, bordered by sharp ridges; escutcheon elongate-lanceolate, smooth, also bounded by sharp margins. Inner margin of valve rather coarsely crenulated.

Surface ornamented with about 13 strong and round concentric ribs with a steep dorsal slope and a more gentle ventral one and alternated with deep concave grooves almost equal in breadth to the ribs themselves. A narrower concentric rib occurring usually on the ventral slope of each larger rib. Numerous fine radial striae running across the ribs.

Cardinal teeth strong, numbering 2 in the right valve and 1 in the left; no well developed lateral tooth.

| | Length | Height | Thickness |
|--------------|---------|---------|---------------------|
| Dimensions : | 6.5 mm. | 5.5 mm. | 3.5 mm. |
| | 5.0 mm. | 4.0 mm. | 1.8 mm. (one valve) |
| | 5.2 mm. | 5.0 mm. | 2.5 mm. (one valve) |
| | 4.5 mm. | 4.2 mm. | 2.0 mm. (one valve) |

Localities and geological horizons: The Hiraiga Sandstone; Haipe, Hiraiga, Moshi and Hideshima. The Akito Sandstone; Akito.

(1) For the synonyms of this species see H. WOODS: A Monogr. Cret. Lamell. England, Vol. II, p. 109.

This species is distinguished from the preceding one in having a more convex shell covered with narrower concentric ribs. It is similar to *A. formosa* Sow.⁽¹⁾ from the Upper Greensand of England but is usually lower and more ovate in outline. Its posterior end is more rounded, its antero-dorsal margin more distinctly excavated beneath the umbo and the concentric ribs are less numerous and slightly broader than in this English species. On the other hand, the present form is somewhat akin to *A. subcostata* D'ORB⁽²⁾ from the Neocomian of France, the Aptian of Switzerland and the Lower Greensand of England, but the latter is more distinctly pointed at the posterior end and provided with narrower, sharper and more distant concentric ribs.

"*Gouldia*" *trigonides* STOL.⁽³⁾ from the Trichinopoly Group of Southern India is externally similar to ours, though more sharply truncated posteriorly.

Astarte semicostata nov. sp.

Pl. XXV (III), Fig. 2; Pl. XXXI (IX), Figs. 3-5;

Pl. XXXII (X), Fig. 6.

Shell small, compressed, being slightly convex between the umbo and the ventral margin, moderately or very inequilateral, anterior side being longer, nearly as high as long or a little longer than high, orbicular or subrhomboid in outline. Anterior end rounded along the margin and the posterior subtruncated vertically and broadly convex along the margin; ventral margin broadly rounded forming an obtuse angle with the posterior. Antero-dorsal margin slightly concave below the umbo and inclined very steeply forward, the postero-dorsal rather short, weakly arcuated, sloping very gently downward. Umbo prosogyrous, more or less compressed and pointed, being curved a little forward, with a very indistinct angle extending from it to the postero-ventral extremity, the surface behind this angle more or less flattened.

(1) H. WOODS: Monogr. Cret. Lamell., Vol. II, p. 112, Pl. XV, figs. 8-13.

(2) A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. III, p. 64, Pl. CCLXII, figs. 7-9. F. J. PICTET and E. RENEVIER: Foss. Terr. Aptien. Op. cit., ser. 1, 1856, p. 88, Pl. X, fig. 2. E. FORBES: Quart. Jour. Geol. Soc., Vol. I, 1845, p. 241. G. COTTEAU: Moll. Foss. Yonne, 1855, p. 70. F. J. PICTET and G. CAMPICHE: Foss. Terr. Crét. Ste. Croix. Op. cit., ser. 4, 1866, p. 307. H. WOODS: A Monogr. Cret. Lamell. England, Vol. II, p. 109, Pl. XIV, figs. 29-36.

(3) F. STOLICZKA: Cret. Fauna S. India, Pelecypoda. Op. cit., p. 290, Pl. X, figs. 4-8.

Lunule lanceolate, excavated and margined by a distinct ridge; escutcheon narrow, elongated and also circumscribed by an acute margin. Inner margin finely crenulated.

Surface ornamented with numerous broad concentric ribs alternated with concave interspaces as broad as the ribs, and covered by numerous, crowded fine lines of growth. Ribs and interspaces usually confined to the upper portion of the shell, soon becoming obsolete toward the ventral margin.

| | Height | Length | Thickness |
|--------------|---------|---------|-----------|
| Dimensions : | 7.0 mm. | 7.0 mm. | 3.3 mm. |
| | 6.5 mm. | 5.0 mm. | ? |
| | 5.0 mm. | 7.0 mm. | ? |

Localities and geological horizon: The Hiraiga Sandstone; Hiraiga, Haibe and Hideshima.

This species is found in association with *A. minor* nov. from which it is distinguished by its less convex shell with the concentric ribs rather broader and confined near the umbo. It is easily distinguishable from *A. subomalioides* nov. in being more orbicular in outline and provided with more crowded concentric ribs.

The present form is somewhat similar in ornamentation to *A. subsenecta* YABE and NAGAO⁽¹⁾ from the Ishido Group of the Kwante Mountainland but differs in being much smaller, less convex and usually shorter.

A. cantabrigiensis WOODS⁽²⁾ from the Lower Greensand of England is larger and more convex than ours and its sculpture more persistent from the umbo toward the ventral margin.

Anthonya GABB, 1864

Anthonya subcantiana nov. sp.

Pl. XXV (III), Fig. 11; Pl. XXX (VIII), Figs. 6, 7.

Shell rather small, transversely much elongate; very inequilateral, with the umbo situated near the anterior end; much compressed,

(1) H. YABE, T. NAGAO and S. SHIMIZU: Cret. Moll, Sanchû Graben. Op. cit., p. 45, Pl. XIII, figs. 29, 30.

(2) H. WOODS: Cret. Lamell. England. Op. cit., Vol. II, p. 107, Pl. XIV, figs. 22-24.

faintly convex along the line from the umbo to the ventral margin; anterior side very short, with its margin moderately convex, passing gradually over the evenly rounded postero-ventral margin into the long and nearly straight ventral one; posterior margin short, straight, vertical, forming slightly obtuse angles with both ventral and postero-dorsal margins. Postero-dorsal margin nearly straight in its greater length, being provided with a faint sinuation behind the umbo and sloping very gradually towards the posterior end. Umbo acute, with a faint carina running from it to the postero-ventral end and limiting a flat or slightly concave area behind.

Surface ornamentation consisting of numerous narrow, sharp, and rather regular concentric ribs separated from one another by interstitial furrows usually greater in width than the ribs themselves.

| | | |
|--------------|--------|--------|
| | Length | Height |
| Dimensions : | 23 mm. | 13 mm. |

Localities and geological horizons : The Hiraiga Sandstone ; Hiraiga, Haipe, and Moshi. The Akito Sandstone ; Akito.

A few specimens.

The present species is identical in several points with *A. cantiana* WOODS⁽¹⁾ from the Gault of England. The latter, however, has a more elongate shell with a slightly smaller apical angle, a more concave postero-dorsal margin and a more irregularly rounded anterior end. *A. subhercynica* (MAAS)⁽²⁾ from the Gault of Germany is another closely similar species to ours, in having a long, nearly straight postero-dorsal margin, but is different from it by its larger apical angle. *A. cornueliana* (D'ORB.)⁽³⁾ from the Neocomian of France is longer, with its antero-ventral portion more produced than in ours. *A. lineata* KITCHIN⁽⁴⁾ from the Lower Cretaceous of South Africa is distinguished from the Japanese form by its shorter and more equilateral shell, while *A. cultriformia* GABB⁽⁵⁾, the genotype, from the Martinez of California is decidedly longer than the present species.

(1) H. WOODS: A Monogr. Cret. Lamell. England, Vol. II, p. 130, Pl. XIX, figs. 4, 5.

(2) G. MAAS: Die mit. Kreide des subhercynen Quadersandstein-Gebirge. Zeitschr. d. deutsch. geol. Gesell., Vol. XLVII, 1895, p. 261, Pl. V, fig. 7; text-fig. 2.

(3) A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. III, p. 74, Pl. CCLXIV, figs. 7-9.

(4) F. L. KITCHIN: The Invertebrate Fauna and Palaeontological Relations of the Uitenhage Series. Ann. S. African Mus., Vol. VII, 1908, p. 137, Pl. VII, figs. 7, 8.

(5) M. GABB: Paleontology of California, Vol. I, 1864, p. 182, Pl. XXX, figs. 236, 236a.

Ptychomya AGASSIZ, 1842*Ptychomya densicostata* nov. sp.

Pl. XXVIII (VI), Fig. 4.

Shell moderately large, transversely elliptical; moderately inflated, but with rather flattened sides; very inequilateral, the umbo being situated at a distance one quarter the length of the shell from the anterior extremity. Anterior margin well rounded, passing gradually on one side into the short, distinctly concave antero-dorsal margin and on the other into the broadly and evenly arcuate ventral; dorsal margin long, subparallel to the ventral, faintly arcuate and very gently sloping backwards. Posterior end not preserved but, as suggested by the lines of growth, truncated by a rather long posterior margin which is probably rather convex and cuts the the postero-dorsal and postero-ventral margins vertically or slightly obliquely, forming obtuse and rounded angles with both of them. Umbo low, prothogyrous, with a round, rather indistinct angle extending from it to the postero-ventral extremity and limiting the flattened area behind. Lunule narrow, elongate; escutcheon very long. Test rather thick.

Surface radially ribbed; ribs numerous, crowded, rather narrow and more or less nodose. Those ribs on the posterior part of the valve, stronger and more distant from one another than those in the anterior part. Those on the flank divergent from a nearly vertical line between the umbo and a point on the ventral margin. The ribs on the anterior part in front of this line very narrow, crowded, distinctly curved upwards; those ribs which meet at an acute angle at the above mentioned vertical line form an inverted V-shaped marking. Those on the posterior flattened area numbering 8 and originating from the umbo. Postero-dorsal margin ornamented with a series of strong nodose ribs which are curved upwards and separated from one another by convex interspaces. Internal features inaccessible.

| | Length (estimated) | Height | Thickness of one valve |
|-------------|-----------------------|--------|---------------------------|
| Dimensions: | ca. 80 mm. | 47 mm. | ca. 12 mm. |

Localities and geological horizons: The Hiraiga Sandstone exposed at the northern coast of Hiraiga Inlet. The *Orbitolina* Sandstone; Raga.

Two imperfect valves were obtained.

This species closely resembles *P. robinaldiana* (D'ORB.)⁽¹⁾ and *P. zitteli* DAMES⁽²⁾. The first of the latter, which has been reported from the Neocomian of France, the Neocomian and Aptian of Switzerland and the Lower Greensand of England, seems to be longer than ours.

The second species above referred to is described from the Turoonian of Germany and differs from ours in being also a little longer and relatively more inflated. Moreover, the ribs in the anterior part of the shell are coarser in these European forms than in the Japanese one in question.

By its much narrower and more crowded ribs on the anterior part of the shell together with several other differences in outline and sculpture, the present form is distinguished from many of the species belonging to this genus, viz., *P. stantoni* CRAGIN⁽³⁾, *P. complicata* (TATE)⁽⁴⁾, *P. neocomiensis* (DE LORIOL)⁽⁵⁾, *P. germani* PICTET and CAMPICHE⁽⁶⁾. *P. daedalea* (COQ.)⁽⁷⁾ from the Aptian of Spain is also much longer than the present species and, moreover, different in the ornamentation of the postero-dorsal area.

P. elongata ANTHULA⁽⁸⁾ from the Neocomian of Caucasia is similar to ours in its fine sculpture but is easily distinguishable from the latter in being longer, lower, and in having a probably more oblique posterior margin and a sinuous ventral. Moreover, a chevron marking is well developed in this Caucasian form.

A very extensive discussion of *P. koeneni* BEHRENDSEN and its varieties is given by WEAVER⁽⁹⁾ on a large material collected from the

(1) L. AGASSIZ: Etudes crit. Moll. Foss.; Myes, 45, p. 18, Pl. XI, figs. 3, 4. A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. III, 1844, p. 75, Pl. CCLXIV, figs. 10-13. F. J. PICTET and G. CAMPICHE: Foss. Terr. Croix. Op. cit., ser. 4, 1866, p. 352, Pl. CXXVII, figs. 2-6. F. J. PICTET and E. RENEVIER: Descript. foss. du Terr. Aptien de la Perte du Rhone et des Environs de Ste. Croix; p. 90, Pl. XI, figs. 2, 3. H. WOODS: A Monogr. Cret. Lamell. England. Op. cit., Vol. II, 1907, p. 179, Pl. XXVII, figs. 24-26.

(2) W. DAMES: Ueber Ptychomya. Zeitschr. d. deutsch. geol. Gesells., Vol. XXV, 1873, p. 380, Pl. XII, figs. 1-4.

(3) F. W. CRAGIN: Paleontology of the Malone Jurassic Formation of Texas. U. S. Geol. Surv., Bull., No. 266, 1905, p. 69, Pl. XII, figs. 4-6.

(4) R. TATE: On Some Secondary Fossils from South Africa. Quart. Jour. Geol. Soc. London, Vol. XXIII, 1867, p. 160, Pl. IX, fig. 8.

(5) P. DE LORIOL: Descr. des animaux foss. du Mont Salève, 1861, p. 71, Pl. IX, figs. 1-4. F. J. PICTET and G. CAMPICHE: Foss. Terr. Crét. Ste. Croix. Op. cit., ser. 4, 1866, p. 355, Pl. CXXVII, figs. 9-12.

(6) F. J. PICTET and G. CAMPICHE: Ibid., p. 354, Pl. CXXVII, figs. 7, 8.

(7) H. COQUAND: Monogr. pal. l'étage Aptien de l'Espagne, 1865, p. 317, Pl. XX, figs. 1, 2.

(8) D. J. ANTHULA: Ueber die Kreidefossilien des Kaukasus. Beitr. z. Palaeont. u. Geol. Österreich-Ung. u. d. Orients, Vol. XII, 1900, p. 86, Pl. IV, figs. 2a-b.

(9) C. E. WEAVER: Paleontology of the Jurassic and Cretaceous of West Central Argentina. Mem. Univ. Washington, Vol. I, 1931, pp. 338-346, Pl. XXXVII; XXXVIII, figs. 227-230.

Hauterivian and Barremian of Argentina. This species is stated to be very variable in one or more features of the shell, for instance, a sinuation in the posterior part of the ventral margin is well developed in var. *groeberi* and var. *windhauseni*. Compared with ours, most of the varieties of the South American species are longer and provided with the line from which the ribs diverge and which is situated more posteriorly, the ribs on the anterior part being less numerous and coarser. Var. *coihuicoensis* is relatively short and rounded along the posterior margin, thus approaching ours, but its sculpture is different.

Praeaprotina YABE and NAGAO, 1926

Praeaprotina yaegashii (YEHARA)

1920. *Horiopleura yaegashii* YEHARA: A Pachyodont Lamellibranch from the Cretaceous Deposits of Miyako in Rikuchû. Jour. Geol. Soc. Tokyo, Vol. XXVII, p. 39, Pls. XI, XII.
1926. *Praeaprotina yaegashii* YABE and NAGAO: *Praeaprotina*, nov. gen., from the Lower Cretaceous of Japan. Sci. Rep. Tôhoku Imp. Univ., Ser. II, p. 21, Pl. VII.

Numerous specimens of this species have been collected especially from the "Plagiptychus Zone" (the *Proeaprotina* Zone) of the Moshi Sandstone. Outside this district, it is known to occur in the contemporaneous deposits in the province of Ishikari, Hokkaidô.

Localities and geological horizons: The Moshi Sandstone; Hiraiga, Haibe, Hideshima and Moshi. The Hiraiga Sandstone: Hideshima, Moshi and Hiraiga. The *Orbitolina* Sandstone; Raga. YABE and YEHARA reported its occurrence in the Akito Sandstone of Hiraiga.

The *Orbitolina* Limestone; Shimanoshita and Pommojiri along the middle course of the Sorachi-gawa, province of Ishikari, Hokkaido.

Lucina BRUG., 1792

Lucina kotoi nov. sp.

Pl. XXIX (VII), Figs. 5, 6.

Shell small, rather compressed, being slightly convex in the umbo-nal region and attenuated both anteriorly and posteriorly; transversely ovate or subpentagonal; nearly equilateral, longer than high, the greatest length being above the mid-height. Antero-dorsal margin faintly concave in front of the umbo, the postero-dorsal nearly straight,

sloping very gently backwards and forming an obtuse angle with the nearly vertical posterior margin; anterior margin rounded, being a little produced above and passing gradually below into the evenly and broadly arcuated ventral. Umbo small, not prominent, almost central and curved forward. Lunule small, depressed and bounded by a sharp ridge; escutcheon not definitely limited. Test thin.

Surface with narrow, raised and rather irregularly spaced concentric lamellae and much broader interspaces in alternation.

| | Length | Height |
|--------------|--------|--------|
| Dimensions : | 15 mm. | 12 mm. |
| | 14 mm. | 12 mm. |
| | 11 mm. | 9 mm. |

Localities and geological horizons : The Hiraiga Sandstone; Hiraiga and Haipe. The *Orbitolina* Sandstone; Raga. The Akito Sandstone; Akito.

The present form is distinguished from *L. cf. occidentalis* (MORTON) from the Himenoura Group of Amakusa⁽¹⁾ in being much smaller, more equilateral and covered with more crowded concentric lamellae. The small *Lucina* from the Upper Ammonites Beds of Hokkaido⁽²⁾ and compared by Yokoyama with *L. fallax* FORBES of the Indian Cretaceous is more orbicular than the new species under consideration.

L. kotoi somewhat similar to *L. valdensis* PICT. and CAMP.⁽³⁾ from the Upper Aptian of Switzerland but is distinguished from it in having larger apical angle, a more produced antero-dorsal end and more crowded concentric lamellae.

The specific name is dedicated to Dr. B. KOTÔ, Emer. Professor of the Tokyo Imperial University.

Cardium LINN., 1758

Cardium sp. indet.

Pl. XXIX (VII), Figs. 7, 15.

There are a few internal moulds of a small form of *Cardium*. Shell oval, very convex, nearly equilateral or slightly inequilateral, higher than long with the anterior and ventral margins well rounded,

(1) T. NAGAO : On Some Cret. Fossils from the Islands of Amakusa. Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. IV, Vol. I, No. 1, 1930, p. 19, Pl. II, fig. 8.

(2) M. YOKOYAMA : Verstein. aus d. japan. Kreide. Palaeontographica, Vol. XXXVI, 1890, p. 176, Pl. XVIII, figs. 9, 9a.

(3) J. F. PICTET and G. CAMPICHE : Foss. Terr. Crét. Ste. Croix. Op. cit., ser. 4, p. 288, Pl. CXXII, fig. 7.

the posterior margin, being somewhat truncated vertically. Umbo prominent, curved inward and slightly forward, with an indistinct carina running from it to the postero-ventral extremity, the surface behind the carina being somewhat flattened. Internally with a narrow ridge from the umbo to the middle of the posterior margin as suggested by a shallow groove on the mould.

Ornamentation unknown, but apparently provided with numerous very fine and crowded radial ribs all over, those on the posterior surface behind the carina seemingly a little broader than the rest, judging from the impressions preserved on the specimens. Margin of the valve finely crenulated. Test apparently thin.

| | Height | Length | Thickness |
|--------------|------------|--------|-------------------------------|
| Dimensions : | ca. 22 mm. | 20 mm. | |
| | 15 mm. | 14 mm. | 7 mm. (one valve) |
| | 14 mm. | 12 mm. | 10.5 mm. (both valves united) |

Localities and geological horizon : The Hiraiga Sandstone ; Hiraiga and Hideshima (the Belemnites zone).

In its convex, subequilateral and relatively high shell with a prominent umbo, a round umbonal carina, a flattened posterior area, and a fine sculpture, the present species is not unlike *C. ibbetsoni* FORBES from the Lower Greensand of England and the Aptian of Switzerland.

Although the present specimens from Miyako do not completely show the sculpture, they seem to be similar to *C. ishidoense* YABE and NAGAO⁽²⁾ from the Ishido Group of the Kwanto Mountainland and the probability of its specific identity with the latter is by no means excluded.

Protocardia BEYRICH, 1845

Protocardia sp. indet.

Pl. XXIX (VII), Fig. 13.

Two large specimens of *Protocardia* are at our disposal ; they are, however, not specifically determinable. In one of the specimens the

(1) H. WOODS : Monogr. Cret. Lamell. Op. cit., Vol. II, p. 201, Pl. XXXII, figs. 7-10. F. J. PICTET and E. RENEVIER : Foss. Terr. Apt. Op. cit., p. 78, Pl. IX, figs. 1, 2.

(2) H. YABE, T. NAGAO and S. SHIMIZU : Cretaceous Moll. Sanchû-Graben. Op. cit., p. 48, Pl. XII, figs. 9, 16, 18.

umbonal region and postero-ventral parts are broken, while in the other the shell is very much deformed and, moreover, eroded on surface.

Shell rather large and apparently higher than long, moderately convex from the umbo to the ventral margin. Both antero- and postero-dorsal margins inaccessible, but the ventral margin broadly convex and the posterior almost straight and subvertical, probably forming a round angle with the ventral. Umbo not preserved in one specimen but is shown to be very prominent and much curved inward in the other example; a round and distinct posterior umbonal carina separating the compressed postero-dorsal area from the convex flank.

Ornamentation consisting, in the flank of the shell, of numerous regular and broad concentric ribs separated by fine grooves. In one of the specimens, the surface is covered by numerous distant, slightly raised concentric striae owing most probably to a bad state of preservation. Postero-dorsal area behind the carina ornamented with numerous narrow and crowded radial ribs.

Locality and geological horizon: The Hiraiga Sandstone exposed at Hiraiga.

Although a precise comparison with other species is precluded, the present specimens are distinguishable from *P. hillana* (Sow.)⁽¹⁾ in being higher and in having narrower radial ribs in the postero-dorsal area. They seem to approach *P. sphaeroidea* (FORBES)⁽²⁾ from the Lower Greensand of England and the Aptian of Switzerland and *P. pondicherriensis* D'ORB.⁽³⁾ from the Trichinopoly Group of S. India.

Dosiniopsis CONRAD, 1864

Dosiniopsis corrugata nov. sp.

Pl. XXIV (II), Figs. 2-6, 9.

Shell small, moderately convex, more or less inequilateral; suborbicular, nearly equal in height and length. Anterior margin evenly

(1) For the synonyms of this species see H. WOODS: A Monogr. of Cret. Lamell. England, Vol. II, 1908, p. 197.

(2) E. FORBES: Quart. Jour. Geol. Soc., Vol. I, 1845, p. 243, Pl. II, fig. 8. F. J. PICTET and W. ROUX: Moll. Foss. Grès verts de Genève, pp. 424, 425, Pl. XXX, fig. 3. F. J. PICTET and E. RENEVIER: Foss. Terr. Aptian. Op. cit., ser. 1, 1856, p. 77, Pl. IX, fig. 3. H. WOODS: A Monogr. Cret. Lamell., Vol. II, p. 195, Pl. XXXI, figs. 2, 3.

(3) F. STOLICZKA: Cret. Fauna S. India. Palaeont. Indica, Op. cit., p. 220, Pl. XII, figs. 4-7.

rounded, passing gradually into the broadly convex ventral; antero-dorsal margin concave in front of the umbo, rather steeply sloping downwards, the postero-dorsal being almost straight, high and gently inclined posteriorly; posterior margin faintly arcuate, passing rather abruptly into both postero-dorsal and ventral margins. Umbo small, more or less prominent, inflated and prothogyrous; lunule narrow-cordate, well circumscribed by an incised line, but not depressed; Postero-dorsal portion of the valve more or less flattened, with a faint depression along the margin. Inner margin of valve finely corrugated. Pallial line inconspicuous.

Surface smooth except for fine lines of growth.

Hinge: In the right valve present three nearly straight and divergent cardinal teeth; the posterior one very oblique backwards and divided by a shallow longitudinal groove; anterior and median teeth closer together, short, diverging at a smaller angle than that between the median and posterior; anterior lateral pit narrow elongate. In the left valve, the anterior cardinal teeth slightly oblique anteriorly, the median broadest of all, oblique backwards, forming a large angle with the posterior which is very oblique and slender; anterior cardinal tooth rather short.

| | Height | Length | Thickness of one valve |
|--------------|----------|----------|---------------------------|
| Dimensions : | 25 mm. | 26 mm. | 10 mm. |
| | 22.5 mm. | 24 mm. | ? |
| | 21 mm. | 22.3 mm. | 7 mm. |
| | 18 mm. | 19.5 mm. | 7 mm. |
| | 15 mm. | 16.3 mm. | 5 mm. |

Localities and geological horizons: The Hiraiga Sandstone; Haipe, Hiraiga, Moshi and Hideshima. The *Orbitolina* Sandstone; Raga. The Akito Sandstone; Akito.

This species is represented by numerous specimens. In all of them, the pallial sinus is not well observed but a trace of a broad, moderately deep triangular one is indistinctly shown on some of the internal moulds.

The present species is quite identical in dentition with "*Cytherea*" *subrotunda* Sow.⁽¹⁾ and "*Venus*" *caperata* Sow.,⁽²⁾ both from the Upper

(1) H. Woods: A Monogr. Cret Lamell. England, Vol. II, 1908, p. 181, Pl. XXVIII, figs. 1-6.

(2) H. Woods: Ibid., p. 182, Pl. XXVIII, figs. 7-10.

Greensand of England. These species are included in *Dosiniopsis* of CONRAD by H. WOODS in his "Monograph of Cretaceous Lamellibranchiata". The former of the English species is provided with a longer, more arcuate and more steeply inclined postero-dorsal margin and a less concave antero-dorsal. In the outline of the shell, our species is more closely similar to "*Venus*" *caperata*, though the latter is ornamented with broad and distinct concentric ribs. One of the most important differences of our species from CONRAD's genus seems to be the presence of the marginal corrugation, a feature well shown in some forms of *Venerinae*. The present form may not be indistinct at least subgenerically from *Dosiniopsis*.

"*Cytherea*" *turgidula* STOL.⁽¹⁾ from the Utatur Group of South India and "*C.*" *tegulensis* STOL.⁽²⁾ from the Trichinopoly and Arrialur Groups are somewhat similar to ours in some external features but less orbicular. The latter of the Indian species, moreover, seems to have a more prominent umbo.

Panope MENARD DE LA GROYE, 1807

Panope sp. aff. *P. gurgitis* (BRONGN.)

Pl. XXXI (IX), Figs. 10, 14.

Compare :

1909. *Panopea gurgitis* WOODS: A Monogr. Cret. Lamell. England. Vol. II, p. 222, Pl. XXXV, figs. 9-14; Pl. XXXVI, figs. 1-8.
 1926. *Panopea* aff. *gurgitis* YABE and NAGAO: Cret. Moll. Sanchû-Graben, Kwantô Mountainland. Op. cit., p. 55, Pl. XII, figs. 10, 15, 19, 20.

Although all of the specimens before us are very imperfect, they are very closely similar to *P. neocomiensis* LEYMERIE⁽³⁾ from the Neocomian of France. This French species is united by H. WOODS with "*Lutraria*" *gurgitis* BRONGNIART from the Aptian of Switzerland. In one of our specimens numerous crowded fine radial striae are well shown as in *P. neocomensis*⁽⁴⁾, but in other, in which the ornamentation

(1) F. STOLICZKA: Cret. Fauna, S. India, Pelecypoda. Op. cit., 1870, p. 117, Pl. VII, figs. 24-27.

(2) F. STOLICZKA: Ibid., p. 177, Pl. VII, figs. 28, 29.

(3) For the synonyms of this species see H. WOODS: A Monogr. Cret. Lamell. England, p. 222.

(4) A. LEYMERIE: Mém. Soc. Géol. Franc, ser. 2, Vol. V, 1842, p. 3, Pl. III, fig. 4. A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. III, 1845, p. 329, Pl. CCCLIII, figs. 3-8, H. WOODS: Monogr. Cret. Lamell. Op. cit., Pl. XXXV, figs. 9, 13. C. E. WEAVER: Pal. of the Jurassic and Cretaceous of West Central Argentina. Mem. Univ. Washington, Vol. I, 1931, p. 361, Pl. XLI, figs. 268-270.

is invisible, the form of the valve is quite similar to that of *P. plicata* (Sow.)⁽¹⁾ from the Lower and Upper Greensand of England.

C. E. WEAVER has recently figured the specimens of an elongate *Panope* from the Lower Neocomian of Argentina⁽²⁾ which he identified with *P. dupiniana* d'ORB⁽³⁾. This latter species from Europe is transversely very elongated, and longer than ours, with a narrow posterior extremity. The specimens from Argentina are also long but very closely akin to ours in several points, only differing from it in being narrower in the posterior end.

Localities and geological horizon : The Hiraiga Sandstone ; Haipe and Hiraiga.

Several deformed specimens from the Lower Cretaceous rocks of the Kwantô Mountainland were thought to be comparable with *P. gurgitis*.

| | | |
|--------------|------------|------------|
| | Length | Height |
| Dimensions : | ca. 80 mm. | ca. 40 mm. |

Gastropoda

Nododelphinula COSSMANN, 1915

Nododelphinula elegans nov. sp.

Pl. XXXIII (XI), Figs. 1, 2, 8.

Shell solid, large, conical in outline ; spire low and composed of a few sharply angulated whorls. Each spire-whorl separated by sub-canalculated sutures ; surface above the shoulder horizontal, broadly flattened, with a few, very fine spiral striae, while that below the angle evenly convex and decorated by three or four strong spiral ribs.

(1) F. J. PICTET et W. ROUX : Moll. Foss. Grés verts de Genève, 1852, p. 399. Pl. XXVIII, fig. 2. E. J. PICTET et E. RENEVIER : Foss. Terr. Aptien. Op. cit., 1855. p. 57, Pl. VI, figs. 4, 5. PICTET et CAMPICHE : Foss. Terr. Crét. Ste. Croix. Op. cit., 1865, p. 63. H. WOODS : Monogr. Cret. Lamell. Op. cit., Pl. XXXVI, figs. 3, 4, 6-8.

(2) C. E. WEAVER : Pal. Jour. Cret. W. C. Argentina. Op. cit., p. 362, Pl. XLI, figs. 271, 272.

(3) A. D'ORBIGNY : Pal. Franç. Terr. Crét., Vol. III, p. 328, Pl. CCCLIII, figs. 1, 2.

Besides, numerous crowded and slightly elevated transverse ribs; each transverse rib composed of several bundles of fine lines, giving a nodulous appearance to the spiral ribs on intersection. Nodules most distinct on the shoulder of the whorls.

Last whorl very large, occupying about two-thirds of the total height of the shell, flattened posteriorly, angulated at the shoulder, convex on the sides and rounded at the periphery. Base slightly convex with a large and deep umbilicus; aperture subcircular and obliquely elongated; outer lip thin and the inner one smooth, concave. Surface ornamented with spiral carinae and transverse folds. Spiral carinae narrow and few in number on the posterior surface, those on the sides numbering 5, broad, rounded and elevated, sometimes alternated with one or more fine spiral striae. Transverse folds broad, more or less irregular, alternated by narrower interspaces, and nodose on crossing the spiral carinae. Of the carinae, those situated on the shoulder and separated by the transverse folds forming a series of large and round nodules. Base covered with a few spiral ribs.

| | Height | Breadth |
|--------------|------------|---------------------------------------|
| Dimensions : | 21 mm. | 24 mm. |
| | ca. 40 mm. | ca. 55 (a somewhat deformed specimen) |

Locality and geological horizon: Hiraiga Sandstone exposed on the southern coast of Hiraiga and on the northern coast of Haipe.

Four specimens. The present species certainly belongs to the genus *Nododelphinula* of COSSMANN, as it agrees in many features with "*Turbo*" *munitus* FORBES⁽¹⁾ from the Lower Greensand of England which is included by COSSMANN in this genus. "*T.*" *munita* has been reported, moreover, from the Aptian of France, Switzerland and Tunis. This foreign species is distinguished from ours by its smaller size, broader upper surface and less numerous and more distant spiral carinae on the sides.

(1) E. FORBES: Catalogue of Lower Green Sand fossils in the Museum of the Geological Society, with notices of Species new to Britain contained in other Collections. Quart. Jour. Geol. Soc., London, Vol. I, 1845, p. 348, Pl. IV, fig. 2. A. D'ORBIGNY: Prod. II, 1850, p. 116 (*Turbo forbesiana*). J. F. PICTET and E. RENEVIER: Descr. Foss. Terr. Aptien. Op. cit., ser. I, 1850, p. 38, Pl. IV, Figs. 1, 2. L. PERVIN-QUIÈRE: Etudes Paléont. Tunis. Vol. II, 1912, p. 330.

"*Vanikoro*" *neritopsoides* BLANKENHORN⁽¹⁾ from Syria is smaller than ours and somewhat different in the sculpture. The four spiral carinae on the sides of the body whorl are equally spaced in the Syrian form, while in the present form the carinae are 5 in number, of which the two upper are least distant from each other.

Among the Cretaceous fossils reported by Stoliczka from South India, "*Delphinula*" *annularis* STOL.⁽²⁾ of the Utatur Group is allied to the form under discussion, but the nodes on the shoulder are less distinct than in the latter.

Ataphrus GABB, 1869

Ataphrus yokoyamai nov. sp.

Pl. XXXV (XIII), Figs. 2, 3.

Shell small, low-conical, nearly as high as broad, consisting of four smooth and moderately convex whorls.

Last whorl large, ventricose, higher than the spire, convex at the periphery and distinctly concave posteriorly; base slightly or sometimes moderately convex, not umbilicated. Aperture broad, obliquely elliptical with a continuous margin; outer lip simple, thickened at the posterior end and inner lip smooth; columella thickened, slightly produced and provided with a shallow longitudinal depression. Callosity unknown. Surface ornamented with fine crowded and very oblique lines of growth. Test moderately thick.

| | | |
|--------------|--------|---------|
| | Height | Breadth |
| Dimensions : | 10 mm. | 13 mm. |
| | 12 mm. | 13 mm. |
| | 8 mm. | 8 mm. |

Localities and geological horizon: The Hiraiga Sandstone; Hiraiga, Haie and Hideshima (The Brachiopoda zone).

A few specimens were examined. The present species is similar to *A. crassus* GABB⁽³⁾, the genotype, from the Martinetz Group (?) of

(1) BLANKENHORN: Op. cit., 1890, p. 102, Pl. VII, Figs. 18, 19. FRASS: Aus dem Orient, 1878, p. 323.

(2) F. STOLICZKA: Cret. Fauna S. India, Gastropoda, 1868, p. 377, Pl. XXV, Fig. 3.

(3) W. M. GABB: Paleontology of California, Vol. II, p. 171, Pl. XXVIII. R. B. STEWART: Gabb's Calif. Foss. Type Gastrop. Op. cit., p. 316, Pl. XXIV, fig. 12.

California but is higher with a distinctly concave upper portion of the last whorl. *A. compactus* (GABB)⁽¹⁾ from the Chico Group is distinguished from the Japanese form in having more convex whorls which are, moreover, covered with regular spiral ribs.

A. yokoyamai is, on the other hand, akin to *A. adriaticus* PARONA⁽²⁾ from the Cenomanian (or the Albian according to SCHUARRENBURGER) of Italy. The former, however, is lower, and at the periphery more broadly convex.

The specific name is dedicated to Prof. M. YOKOYAMA of the Tokyo Imperial University, now retired.

Ataphrus kitakamiensis nov. sp.

Pl. XXXIX (XVII), Figs. 7, 10.

We are in possession of several specimens very closely similar to the preceding form.

Shell small, low-conical, broader than high, with a short spire consisting of about four whorls. Whorls faintly convex, smooth, and separated by narrow, rather indistinct sutures. Last whorl large and ventricose, occupying more than one half of the total height of the shell, almost flattened on the sides and narrowly rounded at the periphery; base slightly convex. Aperture very obliquely elongated, otherwise apparently similar to that of the preceding form.

| | | |
|--------------|--------|---------|
| | Height | Breadth |
| Dimensions : | 10 mm. | 13 mm. |

Localities and geological horizon : The Hiraiga Sandstone; Hiraiga and Haibe.

The present species does not show its aperture perfectly, but it belongs most probably to *Ataphrus*. Some of the small specimens in hand are very similar to the young individuals of *A. yokoyamai*, but the larger ones are more regularly conical and usually broader. It is distinctly more ventricose than *A. rectus* COSSMAN⁽³⁾ from the Upper

(1) W. M. GABB : Paleont. Calif., Vol. I, p. 132, Pl. XX, fig. 89. R. B. STEWART : Op. cit., p. 316, Pl. XXIV, fig. 5.

(2) C. F. PARONA : La Fauna Coralligena del Cretaceo dei Monti d'Ocre, Nell, Abruzzo Aquilano. Mem. p. serv. Alla Descriz. della Carta geologica d'Italia, Vol. V, 1909, Pt. 1, p. 204, Pl. XXIII, figs. 30, 31.

(3) M. COSSMANN in DE BRUN, CHATELET and COSSMANN : Barrémien supér. Faciès Urgonien de Brouzet-les-Alais (Gard). II, Complément de l'étude paléont., Mollusques (Gastrop. et Pélécyp.), 1916, p. 27, Pl. II, figs. 34-38.

Barremian of France and *A. pillai* PARONA⁽¹⁾ from the Cenomanian or Albian of Italy.

Tectus MONTF., 1810

Tectus crassus nov. sp.

Pl. XXXIX (XVII), Fig. 9.

Shell thick-tested, moderately sized, conical and slightly higher than broad; spire relatively elevated with an spical angle of about 50°, consisting of about five whorls, the exact number of which is unknown, the apical portion being broken. Sutures linear and deep. Each spire-whorl rather low, prominently angulated and carinated at a little above the lower margin; upper surface almost flat, inclined outward and downward and provided with a narrow spiral depression a little anteriorly to the margin; lower surface narrow, deeply excavated.

Body whorl sharply angulated at the periphery with a nearly flat upper surface; base flatly convex, smooth except for crowded and sometimes distinct lines of growth; no umbilicus. Aperture narrow, subrhomboidal with a thin outer lip; columella strong, bearing a stout plication.

Ornamentation; Upper surface of the whorls covered by numerous (about 23 in number in the penultimate whorl), round, transversely elongated ribs alternated with convex and narrow interspaces; the infrasutural portion sometimes ornamented with numerous round tubercles. Peripheral carina of the body whorl showing a tendency to split into a spiral series of round tubercles near the aperture.

| | | |
|--------------|------------|---------|
| | Height | Breadth |
| Dimensions : | ca. 24 mm. | 21 mm. |

Locality and geological horizon: The Hiraiga Sandstone exposed at Hiraiga.

A single specimen.

The present form is somewhat similar in the sculpture to *T. tenorei* PARONA⁽²⁾ from the Cenomanian or Albian of Italy but seems to be

(1) C. F. PARONA: Fauna Coral. Cret. Monti d'Ocre. Op. cit., p. 204, Pl. XXIII, figs. 32, 33.

(2) C. F. PARONA: Ibid. Vol. V, 1909, 201, Pl. XXIII, fig. 19.

distinguished from the latter in having a larger apical angle, a more deeply excavated spire-whorl and a slightly different sculpture.

Desmiera BAYLE, 1904

Desmiera japonica nov. sp.

Pl. XXXVI (XIV), Figs. 19, (?) 20, 21-23.

Shell rather thick, neritiform in outline, transversely more or less elongate, moderately broader than high. Spire very short, scarcely elevated, consisting of a few whorls. Sutures well developed, deep and circumscribed by a rounded and inflasutural band of the whorl. Last whorl very large, globose, very convex with a round angle at the shoulder. Surface above the angle almost flat or frequently excavated, sloping but a little downwards, while that below the angle evenly convex with a broad and shallow spiral depression just anterior to the angle.

Aperture semilunar, obliquely elongated, slightly broader than high; columellar area broad, smooth and flat; outer lip convex, thin, smooth inside, the inner one straight, denticulated.

Surface ornamentation consisting of numerous transverse ribs and spiral rows of tubercles. Transverse ribs broad and prominent, originating from the suture and running a little obliquely backwards, separated from one another by convex interstitial grooves which are nearly equal in width to the ribs themselves; these ribs prominently tuberculated on the shoulder, usually splitting into two narrower ribs on the convex surface below the shoulder. Spiral rows of tubercles three in number on the flat surface above the shoulder, of which the uppermost one is situated near the margin and the middle midway between the upper suture and the shoulder, each tubercle lying on one of the transverse ribs; the lowermost row composed of the most prominent tubercles of all, situating on the shoulder itself. Besides these rows of tubercles, another row of narrower tubercles appears in the concave interspace between the middle row and the shoulder. Depressed band below the shoulder ornamented with two or three rows of smaller tubercles. Base apparently provided with fine spiral ribs.

| | Hight | Length |
|--------------|--------|--------|
| Dimensions : | 16 mm. | 23 mm. |
| | 14 mm. | 19 mm. |
| | 12 mm. | 16 mm. |

Localities and geological horizon: The Hiraiga Sandstone; Hiraiga, Haipe and Hideshima. The Akito Sandstone; Akito.

A number of specimens more or less weathered. One of the adult specimens, in which the sculpture is rather well preserved, is slightly more elongated transversely and more prominently angulated at the shoulder than the other smaller examples. Moreover, some very small individuals, included in this species, are almost smooth.

The present species is closely akin to *D. antonii* (CHOFFAT)⁽¹⁾ from the Vraconian and Cenomanian of Portugal which, judging from the description and the figures given by CHOFFAT, seems to be slightly higher than ours. The surface above the shoulder in the European species is broader and more steeply inclined than in the Japanese form under consideration. Moreover, *D. antonii* is stated to have a thin shell,

D. antonii STOL.⁽²⁾ from the Arrialur Group of South India is distinguished from the present species by its more rounded shoulder and non-tuberculated sculpture.

Pseudomelania PICTET and CAMPICHE, 1862

Pseudomelania elegantula nov. sp.

Pl. XXXVII (XV).

A number of very imperfect specimens were obtained, most of which are represented by internal moulds. Despite their unfavourable condition of preservation, the author dares to give a new name for them, because they are rather frequently met with in the Cretaceous deposits of this district and represent a form distinctly separable from some allied species of foreign countries.

Shell large, high-turreted, composed of numerous whorls. Sutures distinct and somewhat excavated. Spire whorls rather low, moderately broader than high, gradually and regularly increasing their diameter downwards, nearly flat on sides and slightly tabulated at the shoulder.

Body whorl moderately larger than the penultimate, flat-sided with a slight excavation in the middle; periphery rounded; aperture ovate, posteriorly angulated; outer lip imperfect but apparently thin, the

(1) P. CHOFFAT: Fauna crétacique du Portugal. Vol. I, Espèces nouvelles ou peu connues, ser. 4, p. 130, Pl. IV, figs. 4-10. 1901-1902.

(2) F. STOLICZKA: Op. cit., Gastropoda, p. 341, Pl. XXIII, figs. 13-14.

inner lip smooth, oblique, faintly convex above and distinctly excavated below; columella short and solid.

Surface smooth except for rather strongly sinuated fine lines of growth.

The dimensions unknown in all the specimens. One of the larger examples attains about 25 mm. in breadth and more than 90 mm. in height excluding the broken apical portion.

Localities and geological horizons; the Hiraiga Sandstone; Akito, Hiraiga, Haibe, Moshi and Hideshima. Especially abundant in the upper part of the Hiraiga Sandstone exposed at Hiraiga. The Akito Sandstone; Akito.

The present specimens represent a species closely allied to *P. dollfusi* CHOFFAT⁽¹⁾ from the Hauterivian of Portugal and distinguished from the latter by its slightly smaller body whorl and more sinuated lines of growth. *P. germani* PICTET and CAMPICHE⁽²⁾ from the Hauterivian of Switzerland seems to be another form similar to though not identical with ours, the former having a narrower aperture. L. PERVINQUIÈRE⁽³⁾ reported the occurrence of a fossil referable to this Swiss species, from the Aptian of Tunis.

P. sutherlandis (BAILY)⁽⁴⁾ from the Senonian of S. Africa and *P. reussiana* (GEIN.)⁽⁵⁾ from the Cenomanian of Germany are different from the Japanese form under consideration in having the spire whorls with a larger apical angle than in ours.

Trajanella POPOVICI-HATZEG, 1899

Trajanella japonica nov. sp.

Pl. XXXIX (XVII), Figs. 1, 2, 4, 5.

Shell elongate-conical, narrowed and pointed above, inflated and rounded below, composed of about ten whorls. Each spire whorl rather short, almost flat or very faintly convex and separated from one

(1) P. CHOFFAT: Fauna crétacique du Portugal, Vol. I, ser. 1, 1886, p. 24, Prosobranches holostomes, Pl. III, fig. 7.

(2) F. J. PICTET and G. CAMPICHE: Pal. Swiss, Ste. Croix. Op. cit., ser. 3, 1862, p. 269, Pl. LXX, figs. 6-8.

(3) L. PERVINQUIÈRE: Etudes de Paleont. Tunis. Op. cit., 1912, p. 12.

(4) H. WOODS: Cret. Fauna, Pondoland. Op. cit., 1908, p. 312, Pl. XXXVII, figs. 17, 18.

(5) H. B. GEINITZ: Elbthalgeb. Sachsen, pt. I, untere Quader. Op. cit., 1871-75, p. 241, Pl. LIII, figs. 4-6.

another by linear and indistinct sutures. Spire nearly as high as the body whorl, with an apical angle of about 30° . Surface smooth except for numerous fine and slightly wavy lines of growth.

Body whorl long, nearly equal to or a little exceeding the spire in height, subcylindrical in its greater part and slightly narrowed anteriorly; aperture rather narrow, pointed posteriorly and broadened and rounded anteriorly; outer lip thin, smooth and evenly curved; inner lip also smooth, slightly convex above, deeply concave below and thickened by a moderately developed narrow callosity; columella short and solid. Test thick.

| | Height | Breadth |
|-------------|------------|---------|
| Dimensions: | ca. 66 mm. | 23 mm. |
| | ca. 31 mm. | 13 mm. |

Localities and geological horizons: The Hiraiga Sandstone; Hiraiga, Haipe and Moshi. The Moshi Sandstone; Haipe. The Akito Sandstone; Akito.

A number of specimens belonging to *Trajanella*.

Some smaller specimens are provided with a shorter and more inflated body whorl than the type specimens. The apex is more acute but the whorls rather rapidly increase their diameter at some distance from the apex. Thus these specimens recall some form of *Oonia*, but in other features they are identical with the present species.

The genotype of *Trajanella*, *T. munieri* POPOVICI-HATZEG⁽¹⁾ from the Lower Cenomanian of Roumania, is much higher with a shorter and more triangular aperture than ours.

"*Euchrysalis*" *gigantea* STOL.⁽²⁾ from the Trichinopoly and Arrialur Groups of India, "*E.*" *stoliczkai* GEINITZ⁽³⁾ from the Cenomanian of Saxony and *Trajanella dutoiti* RENNIE⁽⁴⁾ from the Senonian of Pondoland, S. Africa, are decidedly shorter with a larger apical angle, than the present form in question.

(1) V. POPOVICI-HATZEG: Etude de la faune du crétacé sup. de Roumanie. Mém. Geol. Soc. Franc., Paleont., No. XX, 1899, p. 9, Pl. II, fig. 3.

(2) F. STOLICZKA: Cret. Fauna, S. India, Pelecypoda. Op. cit., 1868, p. 289, Pl. XXI, figs. 3-5.

(3) H. B. GEINITZ: Das Elbthalgebirge in Sachsen, Pt. I, Der untere Quader. Palaeontographica, Vol. XX, 1, 1871-1875, p. 242. Pl. LIII, figs. 2, 3.

(4) V. L. RENNIE: New Lamell. and Gastrop., Up. Cret. Pondoland. Ann. S. African Mus., Vol. XXVIII, 1930, p. 210, Pl. XXIV, figs. 16-18. H. WOODS: Cret. Foss., Pondoland. Ibid., Vol. IV, 1906, p. 313, Pl. XXXVIII, fig. 1 (*Pseudomelania* (*Oonia*) sp.).

The new species is similar in many points to *T. amphora* (D'ORB.)⁽¹⁾ from the Turonian of France and *T. brevispira* DOUVILLÉ⁽²⁾ from the Albian or Lower Vraconian of Moghara on the eastern coast of the Suez Canal, but is distinguished from the first of these foreign species in usually being shorter and in having a more conical and generally more inflated body whorl. Moreover, its aperture is anteriorly broader. From the second form it differs in its spire being higher and its body whorl slightly more inflated with sides more convex. "*Euchrysalis*" *laubeana* GEINITZ⁽³⁾ from the Cenomanian of Saxony, which may belong to this same genus, is another species akin to ours, but its spire-whorls are a little higher and its body whorl more evenly convex.

Pseudomelania paosi G. BÖHM⁽⁴⁾ from the Lower Senonian of Italy and "*Eulima*" (?) *texana* RÖMER⁽⁵⁾ from Texas which may possibly be included in this genus, are shorter than *T. japonica*.

Scala KLEIN, 1753

Scala miyakoensis nov. sp.

Pl. XXXVIII (XVI), Figs. 11, 12.

Shell small, high-turreted. Spire very high; apical angle less than 15°. Each spire-whorl slightly broader than high, a little convex and ornamented with transverse varices and numerous crowded, very fine spiral striae all over. Transverse varices about nine in number, prominent, sharply elevated, somewhat rounded on top, faintly oblique, usually continuous from the upper whorls to the lower ones, being interrupted only by the sutures. A new varix rarely appearing in some of the interspaces. Interspaces concave and broader than the ridges themselves. Last whorl very imperfect, angulated and strongly carinated at the periphery; base flattened and smooth; outer lip broken, inner lip excavated.

Dimensions: Total height unknown, the apical portion being missed. One specimen with the lower six whorls preserved attains ca. 30 mm. in height and 8 mm. in breadth.

(1) A. D'ORBIGNY: Pal. Franç., Terr. Crét., Vol. II, 1842-43, p. 66, Pl. CLVI, fig. 1.

(2) H. DOUVILLÉ: Les terr. secondaires dans le massif du Moghara. Op. cit., 1916, p. 140, Pl. XVIII, fig. 17.

(3) H. B. GEINITZ: Elbthalg. i. Sachsen, Pt. I. Op. cit., p. 242, Pl. LIII, fig. 1.

(4) G. BÖHM: Birtr. z. Kenn. d. Kreide in d. Südalpen, I. Palaeontogr., Vol. XLI, 1894-5, p. 145, Pl. XV, fig. 5.

(5) F. RÖMER: Die Kreidebild. v. Texas. Op. cit., 1852, p. 40, Pl. IV, fig. 2.

Localities and geological horizon: The Hiraiga Sandstone exposed at Hiraiga and Haipe.

Three imperfect specimens. This species is probably included into *Claviscala* DE BOURY, because it is closely allied to *S. (Claviscala) clementina* MICHELIN⁽¹⁾ from the Gault of England, France and Switzerland. The Japanese form is more slender with slightly more flattened whorls and the base of the last whorl less convex than that of the latter. The transverse varices are obsolete near the lower suture in *S. clementina* while they reach the lower margin in the new species. "*Nerinea*" *dipar* GABB⁽²⁾ from California, which is similar to *C. clementina* of Europe as stated by STEWART⁽³⁾, bears a close resemblance to our species, but is distinguished from it by the more convex whorls with an inflated lower margin. Moreover, the varices are obsolete downwards in the Californian form.

WHITEAVES⁽⁴⁾ reported the occurrence of a species of *Scala* in the Gault of Queen Charlotte Islands and first referred it to *Scalania albensis* D'ORB., later to *C. clementina*. This Canadian form differs from the Japanese one in having the varices obsolete both upwards and downwards near the sutures and the base of the last whorl moderately convex.

Solarium LAM., 1799

Solarium incrassatum nov. sp.

Pl. XXXV (XIII), Figs. 11-14.

Shell small, low, depressed conical, much broader than high, consisting of about 7 whorls; sutures distinct and channeled. Each whorl more or less tabulated near the upper margin, distinctly concave in its greater height but broadly and roundly inflated at the shoulder.

Last whorl large, with an inflated shoulder; upper surface distinctly concave and the periphery more or less sharply carinated; base

(1) S. GARDNER: Cretaceous Gastropoda. Geol. Magazine, Dec II, Vol. III, Scalaridae, 1876, p. 105, Pl. IV, figs. 1-4. J. F. PICTET and G. CAMPICHE: Pal. Suisse Ste. Croix. Op. cit., ser. 3, p. 333, Pl. LXXII, figs. 12, 13. A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. II, p. 52, Pl. CLIV, figs. 6-9.

(2) W. M. GABB: Paleont. Calif., Vol. I, p. 113, Pl. XIX, fig. 66.

(3) R. B. STEWART: Gabb's California Fossil Type Gastropoda. Proc. Acad. Philadelphia, Vol. LXXVIII, 1926, p. 322.

(4) F. J. WHITEAVES: Mesozoic Fossils, Vol. I, p. 50, Pl. IX, fig. 5.

faintly convex with a rather narrow umbilicus, the diameter of which is slightly less than that of the base and circumscribed by an abruptly convex and coarsely crenulated margin. Aperture narrowly triangular; outer lip thin and smooth; inner lip excavated below.

Surface of the upper whorls delicately cancellated by fine longitudinal and transverse striae, and granulated at their intersection. Longitudinal striae five or six in number on the penultimate whorl, narrow, subequal, regularly disposed on the concave portion and alternated with flat interspaces which are nearly equal in width to the striae themselves; transverse striae crowded, extending across the whorl obliquely backwards. Moreover, posterior portion ornamented with numerous, rather prominent, rounded and large nodules; these nodules numbering about 20 on the last whorl. Last whorl with about eight spiral striae on the sides; base with several spiral striae near the periphery alternated by broader interspaces, each interspace being provided with a narrow striae. Middle portion of the base smooth; umbilical margin covered with a few, rather crowded spiral striae, besides coarse marginal crenulations.

| | Height | Breadth |
|-------------|---------|---------|
| Dimensions: | 6 mm. | 9 mm. |
| | 5 mm. | 7.5 mm. |
| | 5 mm. | 8 mm. |
| | 4 mm. | 8 mm. |
| | 3.5 mm. | 6 mm. |
| | 4 mm. | 7 mm. |

Localities and geological horizonos: The Hiraiga Sandstone; Hiraiga, Haipe, Hideshima, and Moshi. The Moshi Sandstone; Haipe. The Akito Sandstone; Akito. The *Orbitolina* Sandstone; Raga.

A number of specimens were examined. In most cases the shell is eroded on the surface and consequently the sculpture of the base is very frequently obliterated. Moreover, the shell is more or less deformed to take a very depressed conical form with a flattened base.

By the general features of the shell with a depressed spire and an acute periphery, the present species recalls many forms of *Mummo-calcar* COSSMANN⁽¹⁾, for instances, *N. tingryanum* (PICTET and ROUX) from the Albian of Switzerland and especially *N. berthoni* (PERV.)⁽²⁾ from

(1) M. COSSMANN: Essais Paléont. comp., Vol. X, p. 138.

(2) L'PERVINQUIÈRE: Etudes Paléont. Tunis. Op. cit., p. 59, Pl. III, figs. 25-29.

the Cenomanian of Tunis. The last species is, however, generally more depressed with a broader umbilicus which is further more finely crenulated at the margin than ours. The posterior portion of the whorl is in the Japanese form ornamented with larger and less numerous nodules than in the African one. Moreover, the periphery of the last whorl is not spinous in ours.

Solarium vylapaudiensis STOL.⁽¹⁾ from the Arrialur Group of South India is similar in the outline of the shell, but the surface is smoother than the species under consideration.

Natica LAM., 1799

Natica importuna nov. sp.

Pl. XXXV (XIII), Figs. 8, 9, 15.

Shell small, globose, higher than broad, with a rather elevated spire; sutures deep and somewhat canaliculate. Whorls about six in number, moderately convex, roundly shouldered posteriorly; surface above the shoulder not flattened or excavated. Body whorl fairly larger than penultimate, relatively high, with the sides nearly vertical and evenly convex; umbilicus narrow or almost closed by a thickened umbilical rib of the columella; aperture semilunar, oblique, rounded at the anterior extremity; outer lip thin forming a regular curvature; inner lip oblique, nearly straight; columella moderately thick, excavated, its lower extremity being continuous with the anterior margin of the aperture over a rather abrupt curve; callosity more or less well developed. Test relatively thick.

Surface smooth except for sometimes distinct lines of growth.

| | Height | Breadth |
|-------------|----------|---------|
| Dimensions: | 13.5 mm. | 11 mm. |
| | 14.0 mm. | 11 mm. |
| | 9.0 mm. | 7.3 mm. |

Localities and geological horizons: The Hiraiga Sandstone; Raga, Hiraiga, Haipe and Hideshima. The Akito Sandstone; Akito. The *Orbitolina* Sandstone; Raga.

(1) F. STOLICZKA: Cret. Fauna S. India, Gastropoda. Op. cit., 257, Pl. XX, figs. 5, 6.

Several specimens.

This species seems to belong to the group of *N. lyrata* D'ORB.⁽¹⁾ from the Turonian of France, from which it is distinguished by its more rounded shoulder and more elevated spire. *N. (Lunatia) multi-striata* BAILY⁽²⁾ from the Upper Cretaceous of Pondoland, Africa, is closely similar to ours, though the posterior portion of the body whorl is stated to be flattened anteriorly to the suture.

The new species under consideration differs from *N. (Lunatia) ezoana* YABE and NAGAO⁽³⁾ from the Trigonina Sandstone (Cenomanian) of Hokkaido in having a more elevated spire and a higher, less convex body whorl. The umbilicus seems to be broader in *N. ezoana* than in the Miyako species.

Vanikoroa QUOY and GAIMARD, 1832

Vanikoroa japonica nov. sp.

Pl. XXXVIII (XVI), Figs. 3-6.

Shell globose, more or less ventricose, nearly as broad as high or a little higher than broad, with a depressed or slightly elevated spire. Whorls five or six in number, with the posterior portion anterior to the suture rather broadly flattened but not canaliculated and the shoulder somewhat rounded but distinctly defined; sides below the shoulder weakly convex and inclined steeply downward.

Body whorls much larger than the penultimate one, nearly as broad as high, with the sides evenly convex and almost vertical; umbilicus moderately large, open, circumscribed by a round smooth margin; aperture broad, oval in outline, posteriorly narrowed and anteriorly widened and rounded; outer lip broadly convex; inner lip slightly oblique, neatly straight above and excavated below; callosity not well developed. Surface ornamented with lines of growth and spiral striae; spiral striae numerous, crowded, fine, being distinct on the upper surface but becoming obsolete on the convex sides; lines of growth also fine, but very frequently distinct, very oblique backwards.

(1) A. D'ORBIGNY: Pal. franç., Vol. II, p. 161, Pl. CLXXII, fig. 5.

(2) H. WOODS: Cret. Fauna of Pondoland. Op. cit., p. 316, Pl. XXXVIII, figs. 6-8.

(3) H. YABE and T. NAGAO: Cretaceous Fossils from Hokkaido: Annelida, Gastropoda and Lamellibranchiata. Sci. Rep. Tohoku Imp. Univ., ser. 2, Vol. IX, 1928, p. 93, Pl. XVII, fig. 18.

| | Height | Breadth |
|--------------|--------|------------------------------|
| Dimensions : | 26 mm. | 22 mm. (a deformed specimen) |
| | 15 mm. | 14 mm. |

Localities and geological horizon: The Hiraiga Sandstone; Hiraiga and Haipe.

A few small specimens were obtained in association with the larger ones. One of the former (Pl. XXXVIII (XVI), Figs. 6) has a more convex shoulder and a narrower umbilicus circumscribed by a less sharp margin than the typical specimens. In most cases the shell is smooth, but in one example, the surface is spirally and finely striated and the smoothness of the other specimens is probably due to weathering.

Some larger specimens recall a form of *Gyrodes*, for instances, *G. gaultina* D'ORB.⁽¹⁾ from the Gault of Europe and Tunis, *G. excavata* (MICHELIN)⁽²⁾ from the Gault of Switzerland, those specimens derived from the Upper Cretaceous of Germany and referred by H. B. GEINITZ to *G. gentii* (SOW.)⁽³⁾, *G. pansus* STOL.⁽⁴⁾ from the Utatur of South India, *G. tenellus* STOL.⁽⁵⁾ from the Trichinopoly and Arrialur, *G. conradiana* GABB⁽⁶⁾ from the Chico of California and unnamed specimen described from the Upper Cretaceous of Pondoland, Africa, by H. WOODS⁽⁷⁾.

This resemblance is most probably be merely accidental, for the other more perfect specimens remind one of a naticoid shell rather than *Gyrodes* by their not very ventricose shell, with a moderately narrow umbilicus. The present form is in the sculpture quite identical with "*Vanikoro*" *munita* FORBES from the Utatur Group. This In-

(1) A. D'ORBIGNY: Pal. Franç., Vol. II, p. 156, Pl. CLXXIII, figs. 3, 4. F. J. PICTET and L. ROUX: Descr. Moll. foss. Gres Verts, 1847-1853, p. 184, Pl. XVIII, figs. 1a-d. L. PERVINQUIÈRE: Etudes pal. Tunis., Vol. II, 1912, p. 47.

(2) F. J. PICTET and L. ROUX: Grès verts. Op. cit., p. 186, Pl. XVIII, figs. 3a-c. L. PERVINQUIÈRE: Op. cit., p. 48 (from the Neocomian).

(3) H. B. GEINITZ: Elbthalgeb. Sachsen. Palaeontographica, Vol. XX-1, Der unfere Quader, p. 244, Pl. LIV, figs. 16; Vol. XX-2, Der mittlere und obere Quader, p. 162, Pl. XXIX, figs. 12-14.

(4) F. STOLICZKA: Gastrop. Cret. Rocks S. India. Op. cit., p. 306, Pl. XXII, figs. 9-13.

(5) F. STOLICZKA: Ibid., p. 306, Pl. XXII, fig. 14.

(6) W. M. GABB: Paleontology of California, Vol. I, p. 107, Pl. XXIX, fig. 219. STEWART: Op. cit., p. 329, Pl. XXII, fig. 2.

(7) H. WOODS: Cret. Fauna of Pondoland. Op. cit., p. 317, Pl. XXXVIII, figs. 9, 10.

dian fossil was restudied by SPENGLER⁽¹⁾ who recognized two forms, var. *non-canaliculata* from the Utatur and var. *canaliculata* from the Trichinopoly among the smaller specimens. Most specimens of the Japanese species are not canaliculated in front of the suture and thus stand near the former variety. The last one, however, has a higher shell than ours. The specimen of *V. munita* figured by F. STOLICZKA⁽²⁾ seems to have a more elevated spire than the present species from Japan. *Vanikoroa munita* is included by M. COSSMANN in *Naricopsis* CHELOT which is very different from our form.

Tylostoma SHARPE, 1849

Tylostoma miyakoensis nov. sp.

Pl. XXXIV (XII), Figs. 1-3, 6, 7; Pl. XXXIX (XVII), Fig. 3.

Shell large, moderately inflated, suboval in outline, more or less elongated, consisting of about eight whorls. Spire moderately or sometimes fairly elevated with an apical angle of about 60° in the majority of the specimens. Suture linear, not canaliculated. Each whorl slightly but evenly convex and inclined steeply downwards; upper portion convex, not much tabulated, though sometimes narrowly and horizontally flattened just anteriorly to the margin.

Body whorl large, slightly ventricose, with the evenly convex sides; aperture narrow, oblong, posteriorly narrowed and acute, anteriorly rounded; outer lip thin but sometimes thickened externally, evenly curved in its greater length; inner lip a little oblique, faintly convex above and moderately excavated below, covered with a thin collosity; columella vertical, excavated, continuing with the anterior margin of the aperture.

Surface smooth except for the lines of growth which are usually fine but distinct near the aperture.

| | Height | Breadth |
|--------------|--------|---------|
| Dimensions : | 73 mm. | 43 mm. |
| | 63 mm. | 37 mm. |
| | 63 mm. | 40 mm. |
| | 55 mm. | 34 mm. |
| | 8 mm. | 5 mm. |

(1) E. SPENGLER: Nachtr. z. oberkreidefauna Trichinopoly-Distriktes in Süd-indien. Beitr. z. Paläontologie u. Geologie Österreich-Ung. u. d. Orients, Bd. XXVI, 1913, Pl. XIV, figs. 13, 14.

(2) F. STOLICZKA: Gastropoda. Op. cit., p. 309, Pl. XXII, fig. 16.

Localities and geological horizons: The *Orbitolina* Sandstone; Hiraiga. The Hiraiga Sandstone (extremely abundant in the *Tylostoma* zone); Hiraiga, Haipe, Moshi, and Hideshima. The Moshi Sandstone; Haipe.

Numerous specimens, some of which are well preserved.

This species recalls some forms of *Ampullospira* and *Ampullina*, and some individuals in hand which have a very elevated spire closely resembles in contour of the shell *Ampullospira proelonga* (DESH.)⁽¹⁾ from the Neocomian of Europe. But in most examples, the aperture is relatively narrow, elongate, with a slightly oblique and fairly sinuous inner lip, and, hence, differ from many species of these two genera. Some specimens of *Natica* (*Amauropsis*) *sanchuensis* YABE and NAGAO⁽²⁾ from the Shiroi Group of the Kwanto Mountainland are similar to the present form but distinguished in having a more inflated body whorl which is, moreover, more convex at the shoulder and provided with a shorter and broader aperture. The Japanese species under consideration seems to stand near *Tylostoma* SHARPE⁽³⁾ in many features. All species from Portugal on which this genus was based by SHARPE were figured to have an anteriorly angulated aperture, and characterized by the presence of one or two transverse varices. The last feature is also visible in *Varicigera* (= *Varigera*) D'ORB.⁽⁴⁾ with which *Tylostoma* is considered as synonymous by COSSMANN⁽⁵⁾ in his "Essais". If SHARPE's genus is really provided with an angulated aperture, then, as cited by DOUVILLÉ⁽⁶⁾, this may be distinct from D'ORBIGNY's, but most of the species referred to *Tylostoma* have an aperture with a round anterior extremity. On the other hand, in some examples of the present species, there are observed one or more low, indistinct transverse ridges which are rather irregularly distributed and each confined to a single whorl not extending across the sutures.

A species from the Aptian of Argentina included in *Tylostoma* and named *T. jaworskii* by WEAVER⁽⁷⁾ is not stated to have varices. This

(1) A. D'ORBIGNY: Pal. franç., Vol. II, p. 152, Pl. CLXXII, fig. 1.

(2) H. YABE, T. NAGAO and S. SHIMIZU: Cret. Moll. Sanchû Graben. Op. cit., 1926, p. 64, Pl. XIII, figs. 31, 32, 48-50.

(3) D. SHARPE: On *Tylostoma*, a proposed Genus of Gastrop. Mollusks. Quart. Jour. Geol. Soc., Vol. V, 1849, pp. 376-380, Pl. IX.

(4) A. D'ORBIGNY: Prod., Vol. II, p. 103, 1850.

(5) M. COSSMANN: Essais pal. comp., Vol. XIII, 1925, p. 61.

(6) H. DOUVILLÉ: Terr. second. mass. Moghara. Op. cit., 1916, p. 144.

(7) C. E. WEAVER: Paleont. Jurassic and Cretaceous of West Central Argentina. Mem. Univ. Washington, Vol. I, 1931, p. 379, Pl. XLI, figs. 287, 288.

form is similar to ours in some features, but its body whorl is slightly longer and its aperture posteriorly broader than in ours.

Turritella LAM., 1799

Turritella yaegashii nov. sp.

Pl. XXXVI (XIV), Fig. 11.

Shell small, high-turreted; apex broken but the apical angle apparently less than 20° . Spire composed of numerous whorls separated by distinct, deeply grooved sutures. Each whorl rather low, being slightly higher than one half the breadth, slightly convex on the sides, except the lower portion which is deeply excavated.

Last whorl moderately convex at the periphery; aperture broken, presumably narrow, semilunar, judging from the lines of growth; inner lip excavated with a well developed callosity some part of which is preserved.

Ornamentation consisting of regularly granulated spiral ribs and crowded fine lines of growth; spiral ribs five in number on the upper whorls; of them the infrasutural and supra-sutural ones narrower than the other three. A finer riblet usually present between the infrasutural rib and the second and also between the latter rib and the third; moreover, other riblets appearing on even the other interspaces on the lower whorls. Of the interspaces, that below the infrasutural rib and that above the suprasutural rib narrower than the others and that below the third deeper than the next above. Base of the last whorl ornamented with a few spiral riblets.

Dimensions: Total height unknown, the both extremities being imperfect. 5 mm. in breadth.

Localities and geological horizon: The Hiraiga Sandstone; Hiraiga and Haibe.

There are before us a few imperfect specimens representing a species allied to *T. vibrayana* D'ORB.⁽¹⁾ from the Gault of France and England. The Japanese species is distinguished from the European one in having more convex and anteriorly more distinctly excavated whorls. The last whorl is more convex at the base, and the spiral ribs and riblets are less numerous in ours.

(1) A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. II, p. 37, Pl. CLI, figs. 10, 11.

Compared with the present form, *T. granulata* Sow.⁽¹⁾ from the Upper Greensand of England is less slender and has more flattened whorls with their lower portion not distinctly excavated. *T. seriati-granulata* RÖMER⁽²⁾ from Texas is also lower.

Turritella (?) sp. indet.

Pl. XXXIII (XI), Figs. 6, 7.

A few very imperfect specimens of a turreted form were obtained from the Hiraiga Sandstone, both extremities being broken and their surface more or less weathered.

Shell turreted, rather thick-tested, composed of numerous whorls separated by a distinct sutures. Apical angle unknown, but both sides of the shell diverge in an angle of about 20°. Each whorl sharply angulated and carinated at about the middle of the height, both upper and lower surfaces being moderately excavated. There occur two other spiral ribs, each along the upper and lower margin respectively, otherwise the surface is probably smooth. The carina and two ribs appear to be somewhat granulous in some specimens, but whether this is or is not merely accidental is not certain for the time being.

Locality and geological horizon : The Hiraiga Sandstone ; Hiraiga.

Nerinea DEFRANCE, 1825

(*Nerinea* s. str.)

Nerinea rigida nov. sp.

Pl. XXXVIII (XVI), Figs. 1, 2.

Numerous specimens of a *Nerinea* are met with in the Miyako Cretaceous. Although all the specimens of this form at our disposal are far from being perfect, the writer has ventured to give it a new specific name owing to its frequent occurrence in a certain horizon (the *Nerinea* zone).

(1) H. B. GEINITZ : Elbthalg. Sachsen. Pt. I, p. 239, Pl. LIV, figs. 3, 4. SOWERBY : Min. Conch., p. 565, fig. 1.

(2) F. RÖMER : Kreidebild. Texas, p. 39, Pl. IV, fig. 12.

Shell large, narrow, extremely high-turreted, very gradually tapering toward the apex; imperforate. Each whorl moderately broader than high, distinctly concave, the concavity being most exaggerated a little below the midheight. Suprasutural portion of the whorl more convex and more inflated than the infrasutural one; suture distinct. Surface apparently smooth except for crowded and pronounced lines of growth which run obliquely forward and downward. Section of the whorl higher than broad, with three simple and short plications; of the two columellar plications, the anterior one lying a little below the middle of the columella stronger than the posterior which is situated at the posterior corner of the whorl, the third situated about the middle of the external wall rather low and strong. Test moderately thick.

Locality and geological horizon; the Hiraiga Sandstone; Hiraiga.

The present species is a near relation of *N. archimedi* D'ORB.⁽¹⁾ from the Lower Aptian of France. A close comparison of these two form is precluded owing to the bad state of preservation of our material, but the Japanese species seems to have slightly broader whorls and more prominent columellar plications.

N. vogtiana DE MORTILLET⁽²⁾ from the "Urgonian" and *N. guinchensis* CHOFFAT⁽³⁾ from the Valanginian are also similar to ours but their shell increases the diameter downwards more rapidly than in the latter. Moreover, the suprasutural portion of the whorl in these European forms is ornamented with a series of round tubercles.

Nerinella SHARPE, 1849

Nerinella sp. indet.

Pl. XXXVIII (XVI), Figs. 8-10.

Fragments of a small species of *Nerinella* are sometimes found in the Miyako Cretaceous.

(1) A. D'ORBIGNY: Pal. Franç., Vol. II, p. 78, Pl. CLVIII, figs. 3, 4.

(2) F. J. PICTET and G. CAMPICHE: Description des Fossiles de Terrain Crétacé des Environs de Saite-Croix. Matér. Pal. Suisse, ser. III, p. 240, Pl. LXVIII, figs. 1, 2. M. COSSMANN in P. DE BRUN, C. CHATELET et M. COSSMANN: Le Barrémien supérieur a faciès urgorien de Brouzet-les-Alais (Gard), Pt. II, Mém. Soc. géol. France, Paléontologie, No. 51, 1916, p. 14, Pl. I, fig. 29.

(3) P. CHOFFAT: Faune crét. Portugal, Vol. I, p. 14, Prosobranches, Pl. III, figs. 15, 16.

Shell small, very slender, extremely gradual in increasing its diameter downwards from the top; sutures distinct and linear. Each whorl rather high, its height being nearly equal to or sometimes a little greater than its breadth, almost flat or slightly excavated; ornamented with four somewhat tuberculated and slightly elevated spiral ribs and another much finer one near the upper suture; of the ribs the three lower ones rather crowded.

Cross-section of the whorl apparently subquadrate with a single and moderately elevated plication at the middle of the wall and another on the columella; a third one probably present on the posterior portion of the columella.

Localities and geological horizon: The Hiraiga Sandstone; Hiraiga and Haipe.

It is remarkable that this species is closely similar to *N. algarbiensis* CHOFFAT⁽¹⁾ from the Lower Cretaceous (Aptian or Gault according to COFFAT) of Portugal. The former, however, seems to be more slender with relatively higher whorls.

Cerithium BRUG., 1789

Cerithium (?) sp. indet.

Pl. XXXIV (XII), Fig. 4.

We have an imperfect small, high-turreted and smooth specimen, with its anterior canal and outer lip broken. Being in this condition, its generic position is naturally very doubtful.

Shell small, ca. 15 mm. high and 5 mm. broad, turreted, consisting of more than seven whorls; apical angle about 25°; suture distinct and deep. Each whorl evenly convex, rather high, its height being slightly smaller than its breadth. Surface smooth except for numerous fine lines of growth.

Body whorl moderately larger than the penultimate one, convex, tapering gradually toward the anterior end; aperture partly broken but presumably narrow; inner lip excavated above, the outer one missing; columella strong, nearly vertical above.

Locality and geological horizon: The Hiraiga Sandstone exposed at Hiraiga.

(1) P. COFFAT: Faune crét. Portugal, Vol. I, ser. 4, 1901-1902, p. 121, Pl. IV.

If the present form really belongs to *Cerithium*, then it may stand near some forms of *Gymnocerithium*⁽¹⁾ of COSSMANN and it recalls a smooth *Cerithium* such as "*Cerithium*" *nostradami* Coq.⁽²⁾ from the Aptian of Spain. The latter has a much higher spire composed of more numerous whorls than ours.

(*Cirsocerithium* COSSMANN, 1906)

Cerithium (*Cirsocerithium*) *reticulatum* nov. sp.

Pl. XXXIX (XVIII), Fig. 11.

Shell small, high-conical, with a moderately elevated spire; apex unknown but the pical angle presumably about 25°; suture linear. Whorls convex, somewhat broader than high, reticulated by transverse varices and spiral ribs; transverse varices about 17 on the penultimate whorl, crowded, broad and rounded, a little recurved in the middle course; spiral ribs 4 or 5, broader than the interspaces, upper three of them roundly tuberculated on crossing the varices.

Body whorl somewhat inflated, rather larger than the penultimate one, faintly angulated at the shoulder; transverse varices prominent near the shoulder and crossed by the spiral ribs to bear two or three round tubercles; some of the interstitial grooves between the spiral ribs provided with riblets. Base of the body whorl with numerous spiral ribs, each of the latter alternating with a narrower one. Aperture broadly oval, posteriorly rounded, anteriorly somewhat narrowed, terminating in a very short and slightly twisted shallow canal; outer lip not sinuous, with a very broad and elevated external thickening which is spirally corrugated; inner lip thin, nearly straight; columella short, almost vertical, but slightly curved in its lower portion.

Dimensions: The total height unknown. One specimen about 14 mm. high, excluding the broken upper portion. 5 mm. in breadth.

Localities and geological horizon: The Hiraiga Sandstone; Haipe and Hiraiga.

A few incomplete specimens.

This species has many points in common with *C. subspinosum*

(1) M. COSSMANN: *Essais paleont. com.*, Vol. VII, 1909, p. 36.

(2) H. COQUAND: *Monogr. pal. etage Aptien*, p. 277, Pl. IV, fig. 16.

D'ORB.⁽¹⁾ from the Gault and *C. aptience* D'ORB.⁽²⁾ from the Aptian, both of France. The two latter forms are included by M. COSSMANN⁽³⁾ in his *Cirsocerithium*, the one, *C. subspinosum*, being the geno-type. *Cirsocerithium* is here regarded as a subgenus of *Cerithium*. The Japanese species in consideration seems to have more convex whorls with less numerous spiral ribs than the above two foreign ones.

(*Cimocerithium* COSSMANN, 1906)

Cerithium (*Cimocerithium*?) *miyakoense* nov. sp.

Pl. XXXVI (XIV), Figs. 1-10.

Shell of moderate size, high-conical, composed of probably more than twelve whorls separated from one another by distinct linear sutures. Spire high, its side divergent at an angle of about 25°. Each whorl rather low, nearly twice as broad as high, slightly excavated, with a weak inflation near the upper suture.

Body whorl short, being about one-fourth the total height, usually distinctly excavated at the middle, evenly rounded at the periphery and convex at the base. Aperture broken, but apparently short, subquadrate or suboblong; outer lip unknown, inner lip evenly excavated; columella strong, straight in its upper portion; anterior canal presumably short and a little twisted.

Ornamentation consisting of numerous transverse ribs and fine spiral striae, besides lines of growth; transverse ribs broad, rounded, alternated with narrower interspaces and confined to the upper portion of the whorl, becoming soon obsolete downward, but in the lower whorls reappearing in the lower portion so as to form a spiral series of round tubercles situated near the lower margin. In the upper whorls these ribs are usually more numerous and narrower than in the lower whorls, often continuous to the lower margin. Ribs in the upper portion of the whorl straight and vertical, but very frequently oblique forwards and, moreover, sometimes backwardly convex in their middle course. In some weathered specimens the ribs are sometimes sinuous, splitting into two narrower ones at a certain point in their course. Spiral striae numerous, very fine, crowded and distributed all over the

(1) A. D'ORBIGNY: Pal. Franç., Vol. II, p. 364, Pl. CCXXIX, figs. 4-6.

(2) A. D'ORBIGNY: Ibid., p. 363, Pl. CCXXIX, figs. 1-3.

(3) M. COSSMANN: Essais pal. comp., Vol. VII, p. 50.

surface. Lines of growth crowded and some times distinct, sinuous, and rather abruptly curved forward on the periphery of the body whorl, then gradually recurved on the base.

A series of distinct round tubercles usually occurs on the periphery of the body whorl.

| | Height | Breadth |
|--------------|------------|----------|
| Dimensions : | ca. 66 mm. | 19.5 mm. |
| | ca. 63 mm. | 19.0 mm. |

Localities and geological horizons : The Hiraiga Sandstone ; Hirai-ga and Haibe. The Akito Sandstone ; Akito.

A number of specimens, most of which are more or less imperfect, the two extremities being broken and the surface weathered. The sculpture is to some extent variable, especially when they are weathered.

This species probably belongs to the group of *C. belgicum* D'ARCH.⁽¹⁾ from the Cenomanian of Europe, the subgenotype of *Cimocerithium* COSSMANN⁽²⁾. It differs from the latter in having a series of tubercles usually developed along the whorl. The anterior portion of the aperture is as imperfectly known in the European form as in ours. *C. (C.) pustiferum* BALYÉ⁽³⁾ from the Upper Cretaceous of Tunis is larger and composed of broader whorls with less numerous transverse ribs than the new species under consideration. *C. hispidulum* STOL. from the Trichinopoly Group and *C. inauguratum* STOL.⁽³⁾ from the Arrialur, both of South India, and included in *Cimocerithium* by M. COSSMANN, seem to be provided with more prominent and relatively less numerous transverse ribs or infrasutural tubercles.

(1) A. D'ARCHIAC : Rapport sur les Fossiles du Tourtia. Mém. Soc. géol. France, ser. 2, Vol. II, 1847, p. 344, Pl. XXV, fig. 3. H. B. GEINITZ : Das Elbthalgeb. in Sachsen. Palaeontographica Vol. XX, 1, Der untere Quader, 1871-1875, p. 267, Pl. LIX, fig. 18. M. COSSMANN : Essais pal. comp., Vol. VII, p. 57, Pl. XIV, figs. 2 bis, 3 bis.

(2) M. COSSMANN : Essais pal. com., Vol. VII, 1906, p. 57.

(3) L. PERVINQUIÈRE : Op. cit., p. 14, Pl. I, figs. 23-25.

(4) F. STOLICZKA : Gastrop. Cret. Dep. S. India. Op. cit., p. 194, Pl. XV, figs. 16-18.

(5) F. STOLICZKA : Ibid., p. 193, Pl. XV, figs. 15, 19, 20.

(Metacerithium COSSMANN, 1906)

Cerithium (*Metacerithium*) *rikuchuense* nov. sp.

Pl. XXXV (XIII), Figs. 4-7.

Shell small, turreted, composed of more than ten whorls separated from one another by linear and distinct, not depressed, sutures. Spire high; apical angle not attainable, but the sides of the upper part of the shell cut at an angle of about 15° and the lower part at one of 28° . Each spire-whorl almost flat, extremely broad, the breadth being nearly as much as thrice the height; infrasutural portion ornamented with numerous round granules and separated by a narrow groove from the rest of the surface which is covered with numerous transverse ribs as many as the granules; each transverse rib low, rather broad, somewhat recurved, extending from the groove, above cited, obliquely forward and downward, and usually divided into two parts by a very indistinct and narrow spiral depression at about the middle of its course.

Body whorl slightly larger than the penultimate one, with a roundly angulated periphery. Base flatly convex, being provided with a broad spiral depression. Upper surface of the body whorl ornamented with transverse and oblique ribs which gradually become obsolete towards the base and reappear across the median depression to become round tubercles on the lower part of the base. Umbilicus small and open. Aperture narrow, obliquely oblong, posteriorly angulated. Outer lip thin; inner lip concave with a broken columella; anterior canal presumably very short. Test relatively thin.

| | | |
|--------------|-------------|---------|
| | Height | Breadth |
| Dimensions : | ca. 17 mm. | 6.3 mm. |
| | (estimated) | |

Localities and geological horizon : The Hiraiga Sanstone ; Hiraiga and Haipe.

Six imperfect specimens without the apex.

There appears to be no doubt about the present species belonging to *Metacerithium* COSSMANN⁽¹⁾ with *Cerithium trimonile* MICHELIN⁽²⁾ from the Gault of France and Switzerland as the genotype. The

(1) M. COSSMANN : Essais paleont. comp., Vol. VII, 1909, p. 54.

(2) M. COSSMANN : Ibid., p. 54, Pl. VI, figs. 29-31.

Japanese form under consideration is distinguished from the type by its smaller size and the absence of the suprasutural spiral band which is well developed in the European species. *M. ornatissimum* (DESH.)⁽¹⁾ from the Gault differs from ours in having a lower spire with its whorl bearing a distinct suprasutural series of granules and a rather smooth median portion.

M. fertile (STOL.)⁽²⁾ from the Utatur Group and another species⁽³⁾ from the Arrialur referred by STOLICZKA to *M. trimonile* are also distinguished from the present form by their different sculpture.

Pyræzus MONFORT, 1810

Pyræzus scalariformis nov. sp.

Pl. XXXV (XIII), Fig. 10; Pl. XXXVI (XIV), Fig. 24.

Shell moderately large, high-turreted, composed of more than ten whorls. Spire very high, occupying about two-thirds of the total height of the shell; apex not preserved but presumably with an apical angle of about 23°. Each spire-whorl relatively low, being about twice as broad as high, separated from one another by distinct sutures, and weakly convex on the sides; surface ornamentation scalariform, consisting of transverse ridges, spiral ribs and spiral striae. Transverse ribs about ten in the penultimate whorl, slightly diminishing in number towards the apex, not continuous over the sutures, usually a little shifting in position, prominent, rounded, straight and vertical, alternated with slightly broader convex interspaces. Spiral ribs five in number; the lower one usually narrower than the other, lying at the lower margin of the whorl and partly covered by the upper part of the next whorl; each rib alternated with slightly narrower stria. Ribs and striae giving a tuberculated appearance to the transverse ridges on intersection.

Body whorl ventricose, about twice as high as the penultimate one, separated from the latter by a deep suture, evenly convex and gradually narrowed below. Aperture partly broken but apparently broad and ovate, rounded posteriorly, its longer axis forming an angle

(1) A. D'ORBIGNY: Pal. Franç., Vol. II, p. 369, Pl. CCXXX, figs. 7-9. A. D'ORBIGNY: Ibid., p. 370, Pl. CCXXX, figs. 10, 11.

(2) F. STOLICZKA: Cret. Gastrop. S. India. Op. cit., p. 200, Pl. XV, figs. 11, 12; Pl. XIX, fig. 5.

(3) F. STOLICZKA: Ibid., p. 199, Pl. XV, fig. 9; Pl. XIX, figs. 2, 3.

of about 40° with that of the shell; outer lip not completely preserved, with its posterior portion much thickened, dilated and elevated as a ear-like protuberance which crosses over the surface of the suture and provided with a shallow groove; inner lip with a well developed callosity which is markedly thickened at its posterior end; columella partly broken, vertical above and probably curved below. Transverse ridges about 12 in number, a little more crowded than on the penultimate whorl, splitting into a vertical series of tubercles owing to the prominence of the spiral ribs; spiral ribs numbering seven, broad and alternated with a narrower one; base smooth except for fine crowded lines of growth, the transverse ridges being obsolete beyond the lowest rib.

| | Height | Breadth |
|--------------|-----------------------------|---------|
| Dimensions : | more than 47 mm. | 16 mm. |
| | (the apical portion broken) | |

Locality and geological horizon : The Hiraiga Sandstone exposed on the northern coast of Hiraiga.

Although the anterior extremity is not perfectly preserved in all the specimens, the present species is most probably referable to *Pyrazus*, resembling closely those specimens from the Albian of Syria and referred by H. DOUVILLÉ⁽¹⁾ to *P. valeriae* VERN. and LORIÈRE. The latter, however, is larger and provided with more numerous, narrow and homogeneous spiral ribs. In the Japanese species the transverse ribs are slightly more numerous, and, moreover, the base is smooth, while the posterior portion of the outer lip is less developed than in the Syrian form.

Bathraspira COSSMANN, 1906

Bathraspira excavata nov. sp.

Pl. XXXIV (XII), Figs. 5, 8.

Shell small, high-conical, consisting of numerous whorls. Spire rather high with an spical angle of about 40° . Each spire-whorl relatively low and broad, separated from one another by a narrow and distinct suture, and provided with a sharp ridge at the shoulder;

(1) H. DOUVILLÉ: Les Terrains secondaires dans le Massif du Moghara, etc. Op. cit., 1916, p. 136, Pl. XVIII, figs. 6-8.

surface above the shoulder nearly horizontal, deeply excavated; surface below the ridge evenly convex, inclined a little inward and downward.

Last whorl low, biangulated, the upper angle corresponding to the shoulder and the lower situated at the periphery rather indistinct, limiting the slightly convex base. Aperture narrow, ovate, with a short and slightly twisted anterior canal; outer lip smooth; inner lip excavated; columella short, nearly vertical.

Surface above the shoulder of the whorl smooth except for numerous and fine lines of growth; that below the shoulder covered with numerous narrow spiral ribs; of the ribs the three upper ones crowded and narrower than the three other ribs which are more distantly separated from one another; each interspace between the ribs bearing one to three fine striae. On the last whorl the lowermost rib situated on the lower angle. Base covered with numerous crowded fine spiral striae.

| | | |
|--------------|--------------------|----------|
| | Height (estimated) | Length |
| Dimensions : | ca. 23 mm, | 11.5 mm. |

Localities and geological horizons: The Hiraiga Sandstone; Haiepe. The *Orbitolina* Sandstone; Raga.

A few imperfect specimens were examined. That the present form belongs to *Bathraspira* COSSMANN⁽¹⁾ with *Cerithium tectum* D'ORB.⁽²⁾ from the Gault of France as its genotype seems to be beyond doubt. The Japanese species is distinguished from the genotype in having a longer columella, and smooth, narrower and more deeply excavated upper surface. It is more closely similar to *B. neocomiensis* (D'ORB.)⁽³⁾ from the Neocomian of France, Switzerland and Germany. The former, however, has its upper surface more deeply concave and its ridge sharper than in the European form.

The new species in consideration, moreover, differs from *B. cossmanni* PARONA⁽⁴⁾ from the Cenomanian (or Gault) of Italy in having a smaller apical angle and more convex spire-whorls.

(1) M. COSSMANN: Essais de Paléoconch. comparée, Vol. VII, p. 52.

(2) A. D'ORBIGNY: Op. cit., Vol. II, p. 368, Pl. CCXXX, Figs. 4-6. M. COSSMANN: Essais Pal. comp., Vol. VII, Pl. VI, figs. 25-27.

(3) A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. II, p. 360, Pl. CCXXXII, figs. 8-10. M. COSSMANN: Essais pal. comp., Vol. VII, Pl. VI, figs. 22-24.

(4) C. F. PARONA: La Fauna Coralligena del Cretaceo dei Monti d'Ocre nel Abruzzo Aquilano. Mem. per Servire Alla Desriz. della Carta Geol. d'Italia, Vol. V, 1909, p. 223, Pl. XXV, fig. 16.

Potamides BRONGN., 1810*(Exechestoma* COSSMANN, 1889)*Potamides ? (Exechestoma ?) sp. indet.*

Pl. XXXIX (XVII), Fig. 8.

A few very incomplete specimens preserving only the last whorl are at our disposal, and they recall some form of *Exechestoma* COSSMANN⁽¹⁾.

Shell solid, moderately large. Last whorl rather low, with convex sides; aperture broad, short, posteriorly somewhat narrowed and angulated, anteriorly nearly round, with a extremely short, broad and very shallow canal; outer lip evenly curved, smooth internally, thickened and spirally ribbed externally, this thickening corresponding to the varix of the upper whorl; inner lip not completely visible, but apparently convex above and excavated below. Surface ornamented with numerous strong and more or less elevated spiral ribs separated from one another by broader and flat interspaces, besides two broad and prominent transverse varices situated just opposite to each other.

Localities and geological horizon: The Hiraiga Sandstone; Hiraiga, Haipe and Hideshima.

Columbellina D'ORBIGNY, 1840*Columbellina brevisiphonata* nov. sp.

Pl. XXXIX (XVII), Fig. 6.

Shell rather small, solid, strombiform, slightly ventricose; spire short, composed probably of four or five whorls. Spire whorls separated from one another by distinct, but not canaliculated, sutures, convex and more or less tabulated with an angulated shoulder; surface above the angle flattened and rather steeply inclined outward; surface reticulated by broad transverse ridges and narrower spiral ribs; transverse ridges numerous, alternated with the interspaces narrower than the ridges themselves; spiral ribs sharp, three in number on the surface below the shoulder and one on the upper surface.

Last whorl high, occupying about two-thirds of the total height of the shell, convex on the sides and gradually tapering downwards;

(1) M. COSSMANN: *Essais pal. com.*, Vol. VII, p. 111.

aperture narrow, with a narrow, oblique and rather short posterior canal and a very short and also oblique anterior one; outer lip very thickened both externally and internally, somewhat compressed in the middle, strongly denticulated inside; inner lip concave above, provided with a well developed callosity; columella straight, verticle with several plications. Surface reticulated; spiral ribs strong, sharp, elevated and equidistant from one another: transverse ridges in the upper portion of the whorl prominent and granulated on intersection with the ribs, gradually becoming obsolete downwards.

| | Height | Breadth |
|--------------|------------|---------|
| Dimensions : | ca. 25 mm. | 14 mm. |

Localities and geological horizon: The Hiraiga Sandstone; Haipe and Hiraiga.

This species is somewhat akin to *C. ornata* (D'ORB.)⁽¹⁾ from the Cenomanian of France but has a shorter posterior canal and a more developed anterior one. Moreover, the transverse ridges are more numerous in ours than in the French species. *C. monodactylus* D'ORB.⁽²⁾ from the Neocomian of France seems to have a longer posterior canal and a smoother inner lip, besides a different surface ornamentation. The Japanese form stands more closely to *C. subarloysia* (PERON)⁽³⁾ from the Neocomian of France, but its outer lip is more distinctly compressed in the middle than in the French form.

Drepanochilus MEEK, 1864

Drepanochilus elongatodigitatus nov. sp.

Pl. XXXIII (XI), Fig. 5.

Shell small, fusiform, slightly ventricose with an apical angle of about 30°; spire high, acute, composed of about nine convex and rather high whorls. Lower whorls ornamented with transverse ribs and spiral striae, the former usually more distinct than the latter; transverse ribs numerous and crowded, narrow, oblique and more or less concave toward the aperture and alternated with concave interspaces which are slightly narrower than the ribs; spiral striae about

(1) A. D'ORBIGNY: Pal. Franç. Terr. Crét., p. 333, Pl. CCXXVI, figs. 6, 7.

(2) A. D'ORBIGNY: Ibid., p. 347, Pl. CCXXVI, figs. 2-5.

(3) See M. COSSMANN: Essais paléonch. comp., Vol. VI, 1904, p. 109, figs. 8, 9.

seven on the penultimate whorl, fine, reticulated with the transverse ribs, giving to the latter a tubercular appearance on intersection. Usually a single varix occurring in each whorl.

Last whorl rather long, occupying about one half of the total height of the shell, evenly convex on the sides and gradually narrowing downwards, biangulated, the lower angle being very indistinct; transverse ribs sinuous, becoming obsolete toward the anterior end; spiral striae more distinct than on the penultimate whorl, tuberculated; base with several fine and distant spiral striae. Aperture oblique, narrow with a moderately elongated anterior canal, the anterior portion of which is broken in the specimen; posterior end of the aperture acute with a shallow and broad groove; outer lip more or less dilated with a long, digitation which is apparently narrow, slightly inclined downward corresponding to the lower carina of the last whorl; anterior portion of the outer lip broken. The digitation provided internally with a narrow and rather indistinct longitudinal groove; its free end not preserved but, judging from the groove, presumably curving upward distally; posterior digitation almost obsolete, reducing itself to the shallow canal above described which adheres only to the penultimate whorl; columella straight, covered with a well developed callosity.

| | Height | Breadth |
|--------------|------------|---------|
| Dimensions : | ca. 20 mm. | 6 mm. |

Locality and geological horizon: The Hiraiga Sandstone; Haipe.

Three specimens were examined, of which the more complete one is figured in an accompanying plate.

This species is distinguished from most forms of *Drepanochilus* MEEK (*Dimorphosoma* GARDNER) in having a narrower and longer digitation of the outer lip, for example, *D. evansi* COSS.⁽¹⁾ from the Upper Cretaceous of Dakota, North America, the genotype of *Drepanochilus*, and *Aporrhais neglecta* TATE⁽²⁾ from the Cenomanian of England, the genotype of *Dimorphosoma*. This species is akin to some specimens of *D. calcarata* (SOW.)⁽³⁾ from the Gault of England

(1) M. COSSMANN: Pal. Comp., Vol. VI, p. 75, Pl. VI, figs. 11, 12.

(2) S. GARDNER: On the Gault Aporrhaidae. Geol. Mag., N. S., Dec. II, Vol. II, 1875, p. 398, Pl. V, figs. 8, 9, 16; Pl. XII, figs. 13-15.

(3) S. GARDNER: Ibid., pp. 128, 398. This species from the Gault of Folkestone figured by GARDNER seems to include various forms, some of which may be distinct from the type one as described by DOUVILLÉ. A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. II, p. 285, Pl. CCVII, figs. 3, 4.

and France but the European species has a longer spire and more pronounced spiral striae. *D. calcaratus* var. *ornata* DOUVILLÉ⁽¹⁾ from the Gault of Syria, in which the digitation is not preserved, is more closely allied to ours in its sculpture and form of the spire, but its shell seems to be larger, with a slightly smaller spical angle and much more numerous spiral striae than the Japanese one under consideration. In its narrow digitation, *D. elongatodigitatus* resembles *Dimorphosama toxochila* GARDNER⁽²⁾ and *D. dalatochila* GARDNER⁽³⁾, both from the Gault of England, but these English species were included in *Anchura* by COSSMANN.

Actoeonina D'ORB., 1847

(*Ovactaeonina* COSSMANN, 1895)

Actoeonina (*Ovactaeonina*) *yeharai* nov. sp.

Pl. XXXIII (XI), Fig. 3.

Shell small, ovate in outline, slightly ventricose, with a moderately elevated spire composed of about six whorls. Each spire-whorl broader than high, slightly convex, not tabulated on the shoulder, separated from one another by a distinct, not canaliculate, suture.

Last whorl large, longer than the spire, evenly and broadly convex at the shoulder, devoid of any distinct angulation. Aperture narrow, elongate-ovate, rather short, narrowed and angulated posteriorly, broadened and apparently rounded anteriorly; outer lip thin, forming a regular curve, recurved posteriorly near the suture and smooth both externally and internally; inner lip oblique, slightly convex above and excavated below; columella incomplete, but excavated, nearly vertical and smooth.

Ornamentation of the body whorl consisting of fine, more or less punctate, impressed spiral lines which are more crowded anteriorly; spiral lines on the lower portion of the body whorl and three or four on the infrasutural portion rather distinct, while those on the middle portion of the whorl obsolete. Lines of growth sometimes very prominent.

(1) H. DOUVILLÉ: Terr. Second Massif du Moghara. Op. cit., 1916, p. 134, Pl. XVIII, fig. 4.

(2) S. GARDNER: Op. cit., p. 399, Pl. V, figs. 10, 12; Pl. XII, figs. 16, 17.

(3) S. GARDNER: Ibid., p. 399, Pl. XII, figs. 18-22.

| | | |
|--------------|------------|---------|
| | Height | Breadth |
| Dimensions : | ca. 16 mm. | 7.5 mm. |

Locality and geological horizon : The Hiraiga Sandstone ; Matsushima, an islet near Moshi.

A few imperfect specimens.

From the above specific diagnosis, there is no doubt about this forms belonging to *Ovactaeonina* COSSMANN⁽¹⁾. It is similar to *A. (O.) dupiniana* D'ORB.⁽²⁾ from the Neocomian of France, though it is provided with a more globose body whorl and a less elevated spire. The new species in consideration is distinguished in the form and sculpture of the shell from *A. columnalis* STOL.⁽³⁾ from the Valudayur Group, and *A. obesa* STOL.⁽⁴⁾ from the Arrialur Group. These Indian species were placed in *Ovactaeonia* by COSSMANN. On the other hand, the Japanese form is more closely allied to *Actaeon junceus* STOL.⁽⁵⁾ from the Utatur Group. The latter, however, is stated to have a slight, twisted fold on the columella and seems to be generically distinct from ours.

Actaeon MONTF., 1810

Actaeon (?) sp. indet.

Pl. XXXIII (XI), Fig. 4.

A single, very incomplete specimen has been collected from the Hiraiga Sandstone, in which the apex of the spire and the anterior portion of the aperture are broken, so that its generic position is impossible to determine. This form is distinguishable from the preceding one in being smaller with a shorter body whorl. Moreover, the impressed spiral lines are small, less numerous, and regularly distributed all over in the former.

Locality and geological horizon : The Hiraiga Sandstone ; Hiraiga.

(1) M. COSSMANN : Essais paléococh. comp., Vol. I, 1895, p. 60.

(2) A. D'ORBIGNY : Pal. Franç. Terr. Crét., Vol. II, p. 116, Pl. CLXVII, figs. 1-3.

(3) F. STOLICZKA : The Gastropoda of the Cretaceous Rocks of Southern India. Op. cit., p. 413, Pl. XXVIII, fig. 26.

(4) F. STOLICZKA : Ibid., p. 412, Pl. XXVIII, fig. 31.

(5) F. STOLICZKA : Ibid., p. 417, Pl. XXVII, fig. 15.

Avellana D'ORB., 1842*Avellana minima* nov. sp.

Pl. XXXVI (XIV), Figs 12-18.

Shell small, semiglobose, more or less ventricose, almost as high as broad; spire very small, depressed and composed of three slightly convex whorls separated from one another by distinct, but not depressed, sutures. Last whorl very large occupying almost the total height of the shell, inflated, evenly convex, showing an obliquely ovate contour in a dorsal view.

Aperture narrow, crescent in form, posteriorly angulated, anteriorly narrowly rounded and somewhat truncated with a rather distinct notch. Outer lip evenly curved, circumscribed by a broad and prominent external thickening; inner margin provided with numerous broad, horizontally elongated crenulations; interspaces between the crenulations shallow, nearly equal in width to the ridges themselves. Inner lip evenly convex with a strong ridge near the lower extremity and another less distinct one above the former. Callosity extremely thick. Columella strong, bearing a prominent plication.

Surface of the last whorl more or less eroded, but apparently ornamented with linear spiral grooves alternated with flat and broad interspaces; spiral grooves about fifteen in number, equidistant and apparently punctated; interspaces eroded in all the specimens but probably smooth.

Localities and geological horizons: The Hiraiga Sandstone; Hiraiga, Haibe and Moshi. The *Orbitolina* Sandstone; Hiraiga.

| | Height | Breadth |
|-------------|--------|---------|
| Dimensions: | 5 mm. | 4 mm. |
| | 4 mm. | 3.5 mm. |

Numerous specimens were examined.

The present species may belong to *Eryptica* or *Avellana* judging from its short spire and much inflated body whorl. In many forms of *Eryptica*, the aperture is narrow with a rather ill developed external thickening of the outer lip, and the anterior notch indistinct. The Japanese species has a very narrow aperture due to an extremely thick callosity and its resemblance with some forms of *Eryptica*, for in-

stance, *E. perampla* WOODS⁽¹⁾ from the Upper Cretaceous of Pondoland, South Africa, is not excluded. In other points, however, it is identical with many species of *Avellana* in which it is tentatively included.

The new species seems to differ from *A. problematica* NAGAO⁽²⁾ from the Upper Ammonite Beds (Senonian) of Hokkaidô in being much smaller and provided with a narrower aperture and a more developed callosity. F. STOLICZKA⁽³⁾ described three species of *Eryptica* (= *Euptycha*) and four species of *Avellana* from the Cretaceous of South India; all these forms are easily distinguished from ours in being larger with a more elevated spire and a narrower external thickening of the outer lip.

A. minima is not unlike *A. hugardiana* D'ORB.⁽⁴⁾ from the Gault of France but is smaller, less globose and has a narrower aperture.

VI. SIGNIFICANCE OF THE CRETACEOUS FAUNA OF THE MIYAKO DISTRICT: ITS GEOLOGICAL AGE

From the above statements it is recognisable that the Cretaceous deposits of Miyako are very fossiliferous, the fossils being peculiar in their assemblage, and we find a few genera of *Gervillia*, *Astarte*, *Cucullaea*, *Trigonia*, and *Cerithium*, each represented by several species. Moreover, abundant interesting mollusks are found, for instance, a pachyodont bivalve (*Praeaprotina*), *Goniomya*, *Anthonya* and *Anatina* (*Cercomya*) among Lamellibranchiata and *Trajanella*, *Pseudomelania*, *Desmiera*, *Tylostoma*, *Nerinea*, *Nerinella*, *Bathraspira*, *Columbellina*, *Actaeonina* and *Drepanochilus* among Gastropoda. These genera are either very rarely or not represented in the Cretaceous of the other districts in Japan.

(1) H. WOODS: The Cretaceous Fauna of Pondoland. Ann. S. African Mus., Vol. IV, 1908, p. 382, Pl. XLI, fig. 2.

(2) T. NAGAO: Some Cretaceous Mollusca from Japanese Saghalin and Hokkaidô (Lamell. and Gastropoda). Jour. Fac. Sci., Hokkaidô Imp. Univ., Ser. IV (Geol. and MIN.), Vol. II, No. 1, 1932, p. 50, Pl. VII, fig. 7.

(3) F. STOLICZKA: The Gastropoda of the Cretaceous Rocks of Southern India. Op. cit., pp. 420-423, 425-427.

(4) A. D'ORBIGNY: Pal. Franç. Terr. Crét., Vol. II, p. 135, Pl. CLXVIII, figs. 17-19.

It is, furthermore, remarkable that these rocks are, as cited before, characterised by the presence, besides *Praeaprotina*, of abundant stocks of reef-building corals, thick-shelled mollusks and a few forms of *Orbitolina*. This assemblage of organisms recalls the Urgonian facies of the Tethys, though the Miyako Cretaceous deposits are mainly composed of arenaceous sediments of neritic origin. A similar fauna is found also in the *Orbitolina* Limestone⁽¹⁾ intercalated in the lower part of the Lower Ammonite Beds⁽²⁾ developed in the province of Ishikari, Hokkaido. The upper part of the Lower Ammonites Beds is certainly Gault in age, being intercalated by the *Ammonoceras ezoense* Zone with *A. ezoense* (YABE)⁽³⁾, *Infraticeras imaii* YABE and SHIMIZU⁽⁴⁾ and other ammonites, while its lower part may be referable to the Lower Aptian of Europe as indicated by the occurrence of *Toucasia carinata* (MATH.) var. *orientalis* NAGAO⁽⁵⁾, *Praeaprotina yaegashii* (YEHARA) and *Orbitolina discoidea-conoidea* var. *ezoensis*. Moreover, *Orbitolina japonica* YABE and HANZAWA, known to occur in the Moshi Sandstone in Miyako, is also found in a shale underlying the *Orbitolina* Limestone of Hokkaido. We have, thus, two complexes, nearly contemporaneous but quite different in rock-facies, the one developed in the Miyako district of Honshû and represented by an arenaceous series with some calcareous rocks (the *Orbitolina* Sandstone), the other in Hokkaido, composed of a thick complex mainly of shale and intercalated by thin layers of sandstone and limestone (the *Orbitolina* Limestone).

On the other hand, the marine Cretaceous deposits of the Miyako district are decidedly younger than the Ryôseki plant bed of Wealden age exposed at Omoto within this district, which is intruded by a porphyry. This igneous rock is, in its turn, overlaid in the other places unconformably by the marine rocks under consideration.

(1) H. YABE: Discovery of *Orbitolina* Limestone in Hokkaido (in Japanese), Jour. Geol. Soc., Tokyo, Vol. VIII, 1901, pp. 187-190. H. YABE and S. HANZAWA: Geol. Age of the *Orbitolina*-Bearing Rocks of Japan. Op. cit. T. NAGAO: *Orbitolina* Limestone of Hokkaido (in Japanese). Jour. Geol. Soc., Tokyo, Vol. XXXIX, 1932, p. 787.

(2) H. YABE: Zur Stratigraphie und Paläontologie der oberen Kreide von Hokkaido und Sachalin. Z. d. deutsch. geol. Gesell., 1909. H. YABE: Cretaceous Stratigraphy of the Japanese Islands. Op. cit., p. 38.

(3) H. YABE: Cretaceous Cephalopoda from the Hokkaido, Pt. I, 1903, p. 9, pl. I, fig. 1; Pl. V, Fig. 1.

(4) S. SHIMIZU: The Marine Lower Cretaceous Deposits of Japan, etc. Op. cit., p. 39, Pl. IV, fig. 8.

(5) T. NAGAO: Occurrence of *Toucasia* in the Lower Cretaceous of Japan. Proc. Imp. Acad., Vol. VIII, 1932, pp. 511-514.

A few lines on the Cretaceous rocks developed on Ôshima near Kesennuma and those in the Ôfunato district; the deposits of Ôshima contain marine sediments, besides plant beds with the Ryôseki or older flora. According to Prof. YABE and Dr. SHIMIZU⁽¹⁾, *Crioceras ishiwarai* YABE and SHIMIZU among the fossils points the Upper Hauterivian-Barremian age to the marine rocks of Ôshima. These deposits are intruded and contact-metamorphosed by a porphyry as in Omoto, above cited, and most probably older than the marine complex of Miyako. A similar fact is observed by Mr. K. TAN in the Ôfunato district, north of Ôshima, where the Ryôseki plant bed and the conformably overlying thick complex of sandstone and shale are metamorphosed by a porphyry. It is, moreover, noteworthy that the molluscan fauna of this Cretaceous is closely related to that of the Ôshima area and quite different from that of Miyako, as described later.

The Hiraiga Sandstone of the Mioako district is considered by Dr. SHIMIZU⁽³⁾ as ranging from Lower Aptian to Lower Albian and the Akito Sandstone, younger than the Hiraiga, is referred by the same author to Middle Albian, in both cases being based on the evidence of the contained ammonites. On the other hand, Prof. YABE and Mr. HANZAWA⁽⁴⁾ have expressed the opinion that the Hiraiga Sandstone as well as the overlying *Orbitolina* Sandstone "may perhaps range from the Upper Aptian to Gault." On a later occasion, Prof. YABE⁽⁵⁾ concluded that "although the possibility of the uppermost or the upper part of the Miyako Cretaceous being Cenomanian or Gault in age is by no means excluded, there is almost no doubt about its greater parts being older than the Gault."

(1) S. SHIMIZU: The Marine Lower Cretaceous Deposits of Japan, with Special Reference to the Ammonites-bearing Zones. Sci. Rep., Tôhoku Imp. Univ., Ser. 2, Vol. XV, 1931, p. 8. H. YABE and S. SHIMIZU: A New Cretaceous Ammonite, *Crioceras ishiwari*, from Ôshima, province of Rikuzen. Japan. Jour. Geol. and Geogr., Vol. IV, 1925, p. 85.

(2) K. TAN: On the Cretaceous Deposits of Ôfunato, Kesen-gun, Iwate Prefecture (MS.), 1928 (In Japanese).

(3) S. SHIMIZU: The Marine Lower Cretaceous Deposits of Japan, etc., Op. cit., p. 6.

(4) H. YABE and S. HANZAWA: Geological Age of *Orbitolina*-Bearing Rocks of Japan. Op. cit., p. 20.

(5) H. YABE: Geological Age of the Cretaceous Trigonina Sandstone of Japan. Proc. Imp. Acad., Vol. II, 1926, p. 21. H. YABE: Cretaceous Trigonina Sandstone of Japan. Proc. Imp. Acad., Vol. II, 1926, p. 21. H. YABE: Cretaceous Stratigraphy of the Japanese Islands. Op. cit., p. 50.

As to the molluscan fauna described in this note, there are numerous species closely similar to the Aptian forms of Europe and some others, especially those in the upper part of the Hiraiga Sandstone and the Akito Sandstone, which are related to the Gault fossils.

The following forms have their allies in the Aptian of foreign countries :

Cucullaea acuticarinata nov.
Exogyra yabei nov.
Pecten (*Neithea*) *morrissi* (PICTET and RENEVIER)
Goniomya subarchiaci nov.
Anatina sp.
Astarte miyakoensis nov.
Cardium sp.
Nerinea rigida nov.

Besides,

Gervillia cf. *haradae* (YOK.),
Spondylus decoratus nov.,
Ptichomya densicostata nov.,
Panope aff. *gurgitis* (BRONGN.),
Pseudomellania elegantula nov.,
Columbellina brevisiphonata nov.,
Actaeonina (*Ovatactaeon*) *yeharai* nov.,

and a few other species are similar to some forms of the Neocomian and Aptian of Europe.

There are, however, some others which are rather akin to some Gault species ; they are

Grammatodon nipponicus nov.,
Gervillia pseudorostrata nov.,
Lima (*Ctenoides*) *subrapa* nov.,
Astarte subomalioides nov.,
Anthonya subcantiana nov.,
Ataphrus yokoyamai nov.,

Scala miyakoensis nov.,

Nerinea sp.

Cerithium (*Metacerithium*) *rikuchuense* nov.,

Pyræus scalariformis nov.,

and

Drepanochilus elongatodigitatus nov.,

and a few other species find their allies in the Upper Cretaceous deposits of Europe, for instance, *Trajanella japonica* nov. and *Cerithium* (*Cimocerithium*) *miyakoense* nov.

On the other hand, from the accompanying table showing the geological distribution of the fossils it is easily recognisable that most of the fossils of the Hiraiga Sandstone range from its basal part to its top, and some go down into the Moshi. All species found in the Akito Sandstone, the uppermost fossiliferous rock of this area, are also met with in the *Orbitolina* Sandstone or even in the Hiraiga Sandstone. And, although the fossils before us of the Moshi and Akito are small in number and not well studied, the Cretaceous deposits of Miyako must be taken as a continuous series with one fauna and cannot be subdivided distinctly on the basis of the molluscan fauna except the ammonites. A future and more precise zonal collection of the fossils will, the writer wishes, throw light on this point.

VII. COMPARISON OF THE MOLLUSCAN FAUNA OF MIYAKO WITH THOSE OF SOME OTHER DISTRICTS IN JAPAN

Among various areas in Japan where the fossiliferous marine Lower Cretaceous deposits are known to occur, three, besides Hokkaido alluded to before, deserve note for comparison with the Miyako Cretaceous, viz.,

1. The Kwanto Mountainland⁽¹⁾,

(1) S. ÔISHI: Stratigraphy of the Mesozoic Deposits of the Sanchû-Graben (Kwanto Mountainland), 1928 (MS.). H. YABE, T. NAGAO, and S. SHIMIZU: Cretaceous Mollusca from the Sanchû-Graben in the Kwanto Mountainland, Japan. Sci. Rep., Tôhoku Imp. Univ., ser. 2, Vol. IX, 1926, pp. 33-76.

2. The Ôshima area near Kesennuma,⁽²⁾

and

3. The Ôfunato district,⁽³⁾

the last two being situated, like Miyako, on the eastern border of the Kitakami Mountainland, and the first, rich in fossils more or less studied in detail.

The Ishido Group of the Kwanto Mountainland, which is regarded to be Upper Hauterivian-Barremian on the basis of the Cephalopoda species, has only two forms identical with and two similar to those of the Miyako district. They are *Gervillia haradae* YOK., *Lima* (*Lima-tula*) *ishidoensis* YABE and NAGAO, *Panope* aff. *gurgitis* (BRONGN.), and *Cardium isidoense* YABE and NAGAO. In the Kawarazawa Group (Lower Aptian, according to Dr. SHIMIZU), younger than the Ishido, we find, in comparison with Miyako, the following two identical and two similar species :

Ostrea diluviana LINN.

Gervillia forbesiana D'ORB.

G. haradae (YOK.)

Trigonia cf. *hokkaidoana* YEHARA.

Moreover, we have two other forms closely allied or probably identical with *Goniomya subarchiaci* nov. and *Ptychomya densicostata* nov. found in the Miyako Cretaceous. There appears to be no doubt that the Miyako deposits are a little more closely related to the Kawarazawa than to the Ishido, although most of the species from Miyako are not represented in the Kawarazawa whose fauna is the continuation of that of the Ishido, and it may be safely concluded that the greater parts of the marine sediments of the Miyako district are decidedly younger than the fossiliferous parts of the Kawarazawa.

(2) T. WAKIMIZU: On the Mesozoic Deposits of Ôshima, Rikuzen (in Japanese). Jour. Geol. Soc., Tokyo, Vol. VI, 1897. S. KONDO: The Lower Cretaceous Flora of Ôshima, Rikuzen, 1922 (MS.). H. YABE: Notes on Some Mesozoic Plants from Japan, Korea and China, in the Collection of the Institute of Geology and Palaeontology. Tôhoku Imperial University. Sci. Rep., Tôhoku Imp. Univ., ser. 2, Vol. VII, 1922. H. YABE: Cretaceous Stratigraphy of the Japanese Islands. Op. cit., pp. 51, 52.

(3) H. YABE: Ibid., pp. 50-51. K. TAN: Op. cit.

The marine Cretaceous complex of Ôshima regarded by Dr. Shimizu as Upper Hauterivian or Barremian in age and the upper part of the Ôfunato Cretaceous, referred to before, must be older than that of Miyako, a fact strongly supported by evidence from the stratigraphical point of view, as stated before, and clearly indicated also by the molluscan fauna found in them. The following table shows the species found in the Miyako district and the other areas in common :

| | Ishido | Kawarazawa | Ôshima | Ôfunato | Miyako |
|-------------------------------------|--------|------------|--------|---------|--------|
| <i>Ostrea diluviana</i> | — | + | + | + | + |
| <i>Gervillia forbesiana</i> | — | + | — | — | + |
| <i>G. haradae</i> | + | + | + | + | ? |
| <i>Ptychomya densicostata</i> | — | ? | ? | — | + |
| <i>Lima (Limatulla) ishidoensis</i> | + | — | — | — | + |
| <i>Goniomya subarchiaci</i> | — | ? | ? | — | + |
| <i>Panope aff. gurgitis</i> | + | + | — | + | + |
| <i>Trigonia hokkaidoana</i> | — | ? | ? | ? | + |
| <i>Cardium ishidoense</i> | + | — | — | — | ? |

It is noteworthy that there are two species common to the Kwanto Mountainland (the Kawarazawa Group), Ôshima and Ôfunato but unknown in Miyako ; they are *Grammatodon yokoyamai* YABE and NAGAO and *Astarte subsenecta* var. *costata* YABE and NAGAO. As a whole, most of the species found in the Miyako Cretaceous are characteristic to it and the fauna under consideration is very peculiar in various respects. It is true that more species might be known in future to occur in the other areas in Japan referred to above.

| | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|---|---|---|---|---|---|---|---|---|---|---|---|--|---|---|---|--|---|---|---|---|---|---|---|--|
| <i>A. semicostata</i> | | | | X | | | | | | X | | X | | | | | X | | | | | | X | | | |
| <i>Anthonya subcanthiana</i> | | | | | | | X | | | X | | X | | | | | X | | | | | X | | X | X | |
| <i>Ptychomya densicostata</i> | | | | | | | | | | | | | | | | | X | | | | | X | | X | | |
| <i>Praecaprotina yaegashii</i> | X | X | X | | | X | X | | | X | | X | X | | X | X | | | X | X | | X | X | X | X | |
| <i>Lucina kotoi</i> | | | | | | | | | | X | | X | | | | | | | X | X | | | X | | X | |
| <i>Cardium</i> sp. | | | X | X | | | | | | | | X | | | | | | | | | | | X | | | |
| <i>Protocardia</i> sp. | | | | | | | | | | | | | | | X | | | | | | | | X | X | | |
| <i>Dosiniopsis corrugata</i> | | X | X | X | | X | X | | | X | | X | | | | X | | | X | X | | | X | | X | |
| <i>Panope</i> aff. <i>gurgitis</i> | | | | | | | | | | X | | X | | | | X | | | | | | | X | | | |
| <i>Nododelphinula elegans</i> | | | | | | | | | | X | | X | | | | | | | | | | | X | | | |
| <i>Athaphrus yokoyamai</i> | | X | | | | | | | | X | | X | | | | | | | | | | | X | | | |
| <i>A. kitakamiensis</i> | | | | | | | | | | X | | X | | | | | | | | | | | X | | | |
| <i>Tectus crassus</i> | | | | | | | | | | | | X | | | | | | | | | | | X | | | |
| <i>Desmieria japonica</i> | | X | | | | | | | | X | | X | | | | X | | | | X | | | X | | X | |
| <i>Pseudomelania elegantula</i> | | | | X | | | X | | | X | | X | | | | X | | | | | | | X | | | |
| <i>Trajanella japonica</i> | | | | | | | X | | X | X | X | X | | | | | | | X | X | | | X | | X | |
| <i>Scala miyakoensis</i> | | | | | | | | | | X | | X | | | | | | | | | | | X | | | |
| <i>Solarium incrassatum</i> | | | X | X | X | | | X | X | X | | X | | | | X | | | X | X | X | | X | X | X | |
| <i>Natica importuna</i> | | | | X | | | | | | X | | X | | | | X | | | X | X | | | X | X | X | |
| <i>Tylostoma miyakoensis</i> | | | | X | | | X | X | X | X | | X | X | | | X | | | | X | | | X | X | | |
| <i>Vanikoroa japonica</i> | | | | | | | | | | X | | X | | | X | X | | | | | | | X | | | |
| <i>Turritella yaegashii</i> | | | | | | | | | | X | | X | | | | X | | | | | | | X | | | |
| <i>T. (?)</i> sp. | | | | | | | | | | X | | X | | | | | | | | | | | X | | | |
| <i>Nerinea rigida</i> | | | | | | | | | | | | X | | | | | | | | | | | X | | | |
| <i>Nerinella</i> sp. | | | | X | | | | | | X | | X | | | | | | | | | | | X | | | |

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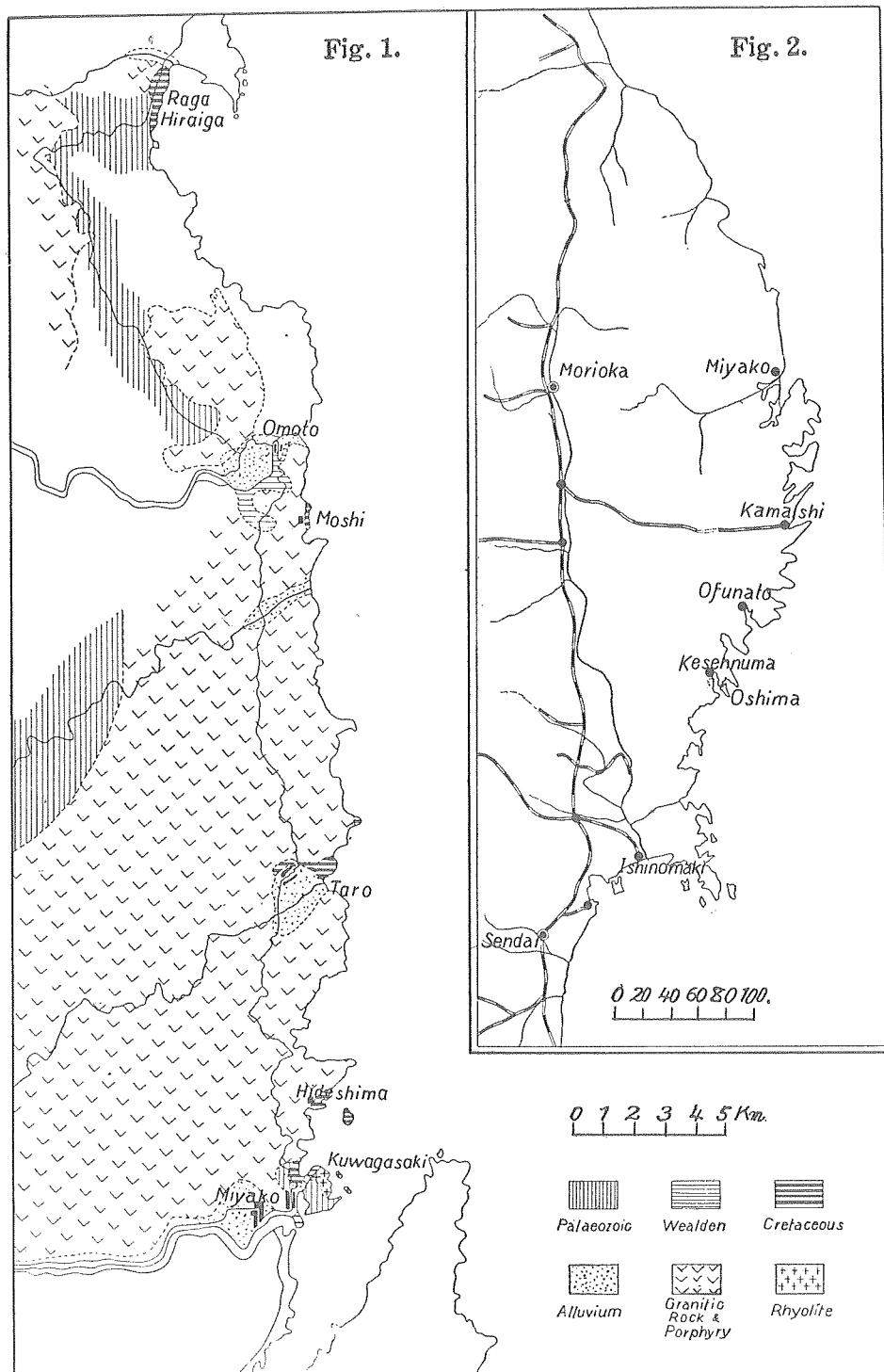
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| <i>G. sp.</i> | 201 | <i>T. yokoyamai</i> | 205 |
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| <i>Goniomya subarchiaci</i> | 215 | <i>T. yaegashii</i> | 249 |
| <i>Grammatodon nipponica</i> | 190 | <i>Tylostoma miyakoensis</i> | 247 |
| <i>Lima</i> (<i>Ctenoides</i> ?) <i>subrapa</i> | 212 | <i>Vanikoroa japonica</i> | 245 |

Plate XXIII (I)

PLATE XXIII (I)

Fig. 1. Map of the Kitakami Mountainland.

Fig. 2. Geological map of the Cretaceous district of Miyako. Reproduced from
YABE and YEHARA: The Cretaceous Deposits of Miyako, 1913.



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Plate XXIV (II)

PLATE XXIV (II)

The figures are of natural size, unless otherwise stated.

Fig. 1. A weathered surface of a block derived from the Hiraiga Sandstone; slightly reduced. a, *Cucullaea acuticarinata* NAGAO; b, *Dosiniopsis corrugata* NAGAO. Hiraiga.

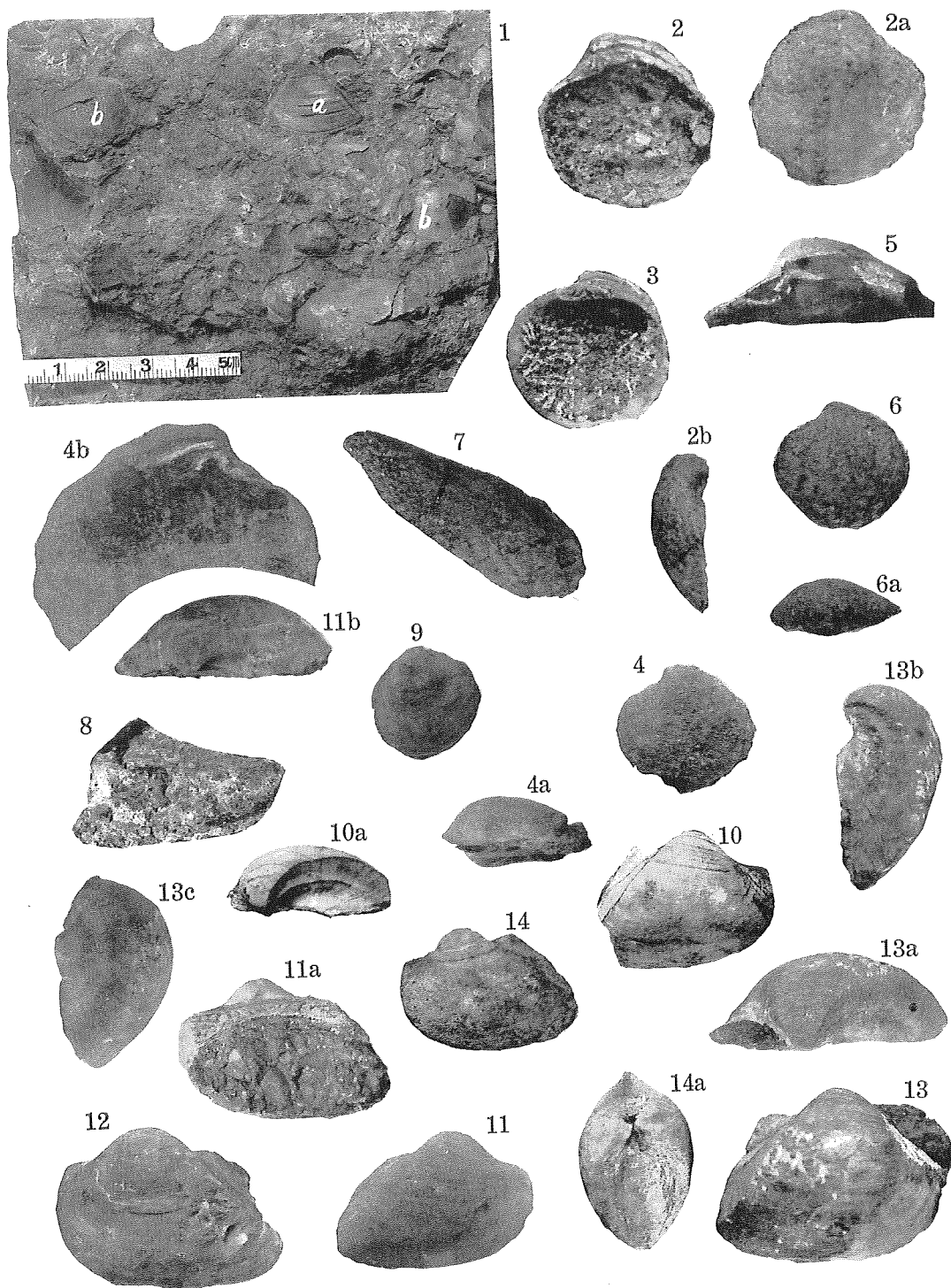
Figs. 2-6. *Dosiniopsis corrugata* NAGAO. Hiraiga Sandstone. 2 (type), Hiraiga; 3-6, Haipe. 4b, 5, $\times 2$.

Fig. 7. *Gervillia* (?) sp. Northern coast of Raga Inlet. *Orbitolina* Sandstone.

Fig. 8. *Gervillia forbesiana* D'ORB. Akito near Raga. Akito Sandstone.

Fig. 9. *Dosiniopsis corrugata* NAGAO. Hiraiga. Hiraiga Sandstone.

Figs. 10-14. *Cucullaea acuticarinata* NAGAO. Hiraiga. Hiraiga Sandstone. 11, type.



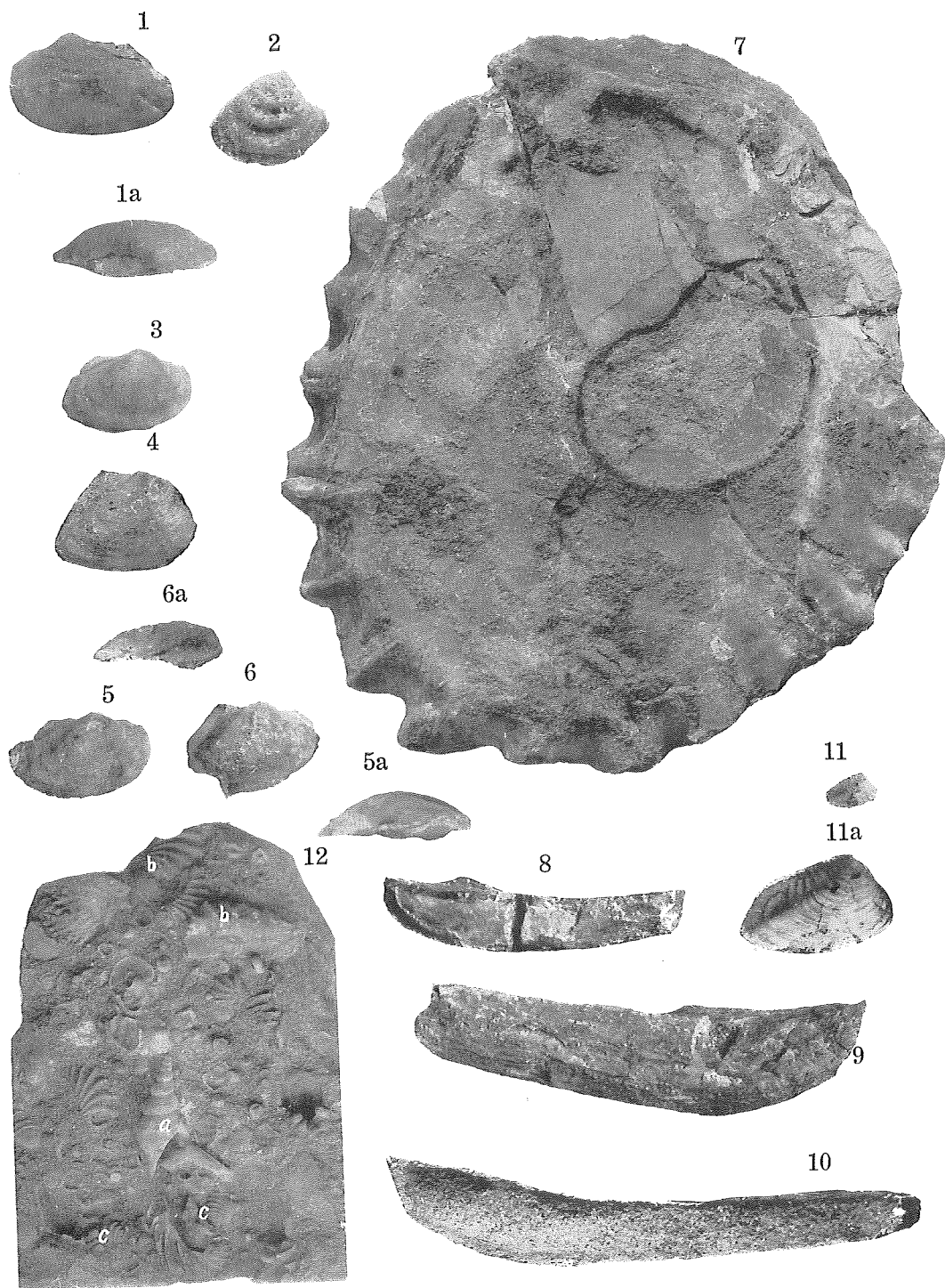
T. Nagao: Cretaceous Mollusca.

Plate XXV (III)

PLATE XXV (III)

The figures are of natural size, unless otherwise stated.

- Figs. 1, 3-6. *Cucullaea transversa* NAGAO. Hiraiga. Hiraiga Sandstone. 1, type.
- Fig. 2. *Astarte semicostata* NAGAO. Haipe. Hiraiga Sandstone. $\times 3$.
- Fig. 7. *Exogyra yabei* NAGAO. Inner view of a left valve. Northern coast of Hiraiga Inlet; Hiraiga Sandstone.
- Figs. 8-10. *Gervillia forbesiana* D'ORB. 8, Akito; Akito Sandstone. 9, Haipe near Hiraiga; Hiraiga Sandstone. 10, northern coast of Raga Inlet; *Orbitolina* Sandstone.
- Fig. 11. *Anthony subcantiana* NAGAO. Moshi. Hiraiga Sandstone. 11a, $\times 3$.
- Fig. 12. A weathered surface of a block derived from the Hiraiga Sandstone. Haipe near Hiraiga. a, *Drepanochilus elongatodigitatus* NAGAO; b, *Trigonia hokkaidoana* YEHARA; c, *Astarte minor* NAGAO.



(Mashiko and Takeda photo.)

Plate XXVI (IV)

PLATE XXVI (IV)

The figures are of natural size.

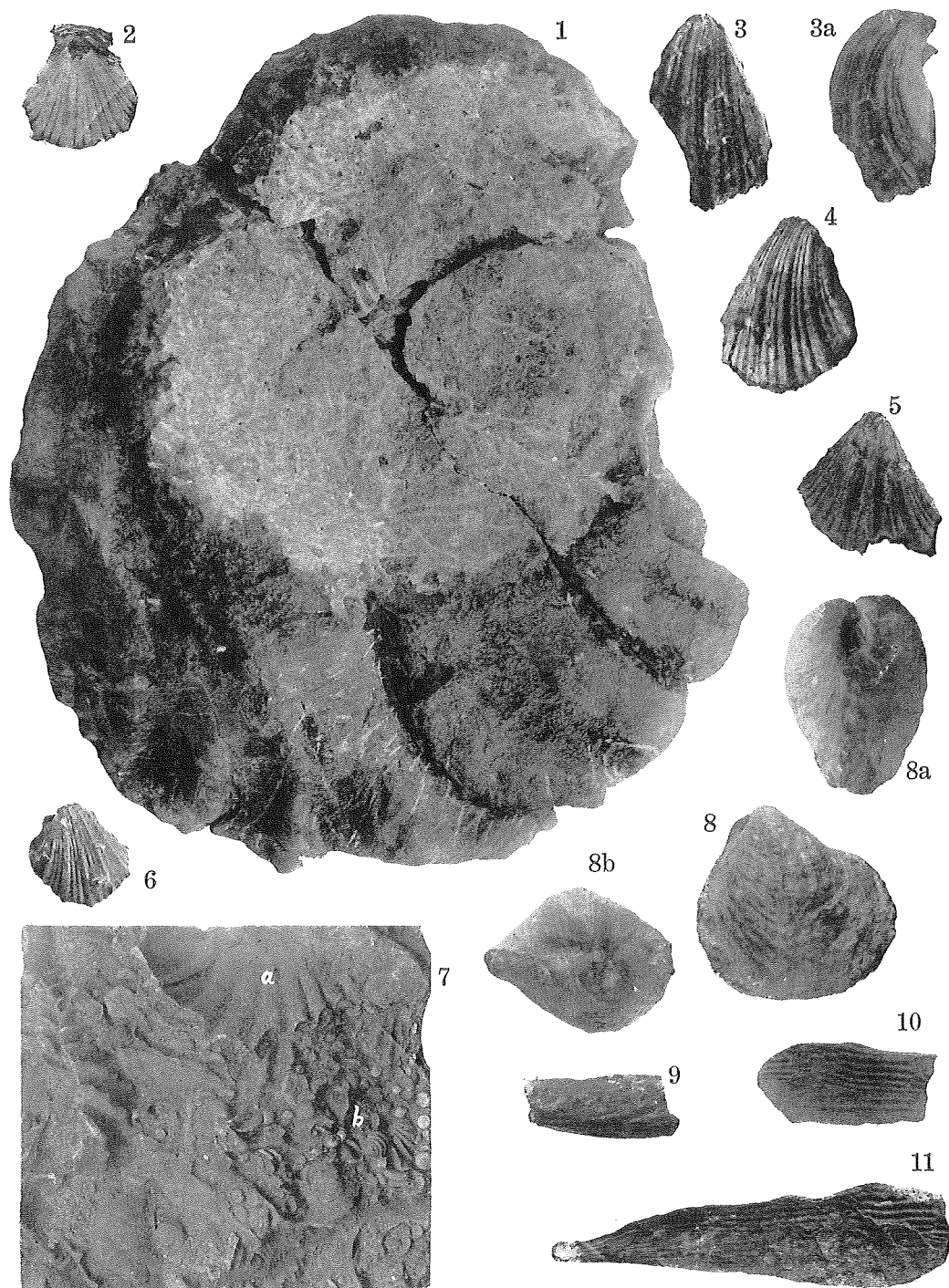
Fig. 1. *Exogyra yabei* NAGAO. Northern coast of Hiraiga Inlet. Hiraiga Sandstone.
The right valve, in outer view, of the same individual shown in Plate 111,
Fig. 7.

Figs. 2-6. *Pecten (Neithea) morrisi* (Pictet and Renevier). 2, 4, 5, northern coast
of Hiraiga Inlet; 6, Hideshima; 3, northern coast of Raga Inlet. 2-4, 6, Hira-
iga Sandstone; 3, *Orbitolina* Sandstone. 2, inner view.

Fig. 7. A weathered surface of a block derived from the Hiraiga Sandstone. Haibe
near Hiraiga. a, *Trigonia hokkaidoana* Yehara; b, *Astarte minor* NAGAO.

Fig. 8. *Pholadomya subpedelnalis* NAGAO. Hideshima. Hiraiga Sandstone.

Figs. 9-11. *Pinna* sp. Southern coast of Hiraiga. Hiraiga Sandstone.



(Mashiko and Takeda photo.)

T. Nagao : Cretaceous Mollusca.

Plate XXVII (V)

PLATE XXVII (V)

The figures are of natural size, unless otherwise stated.

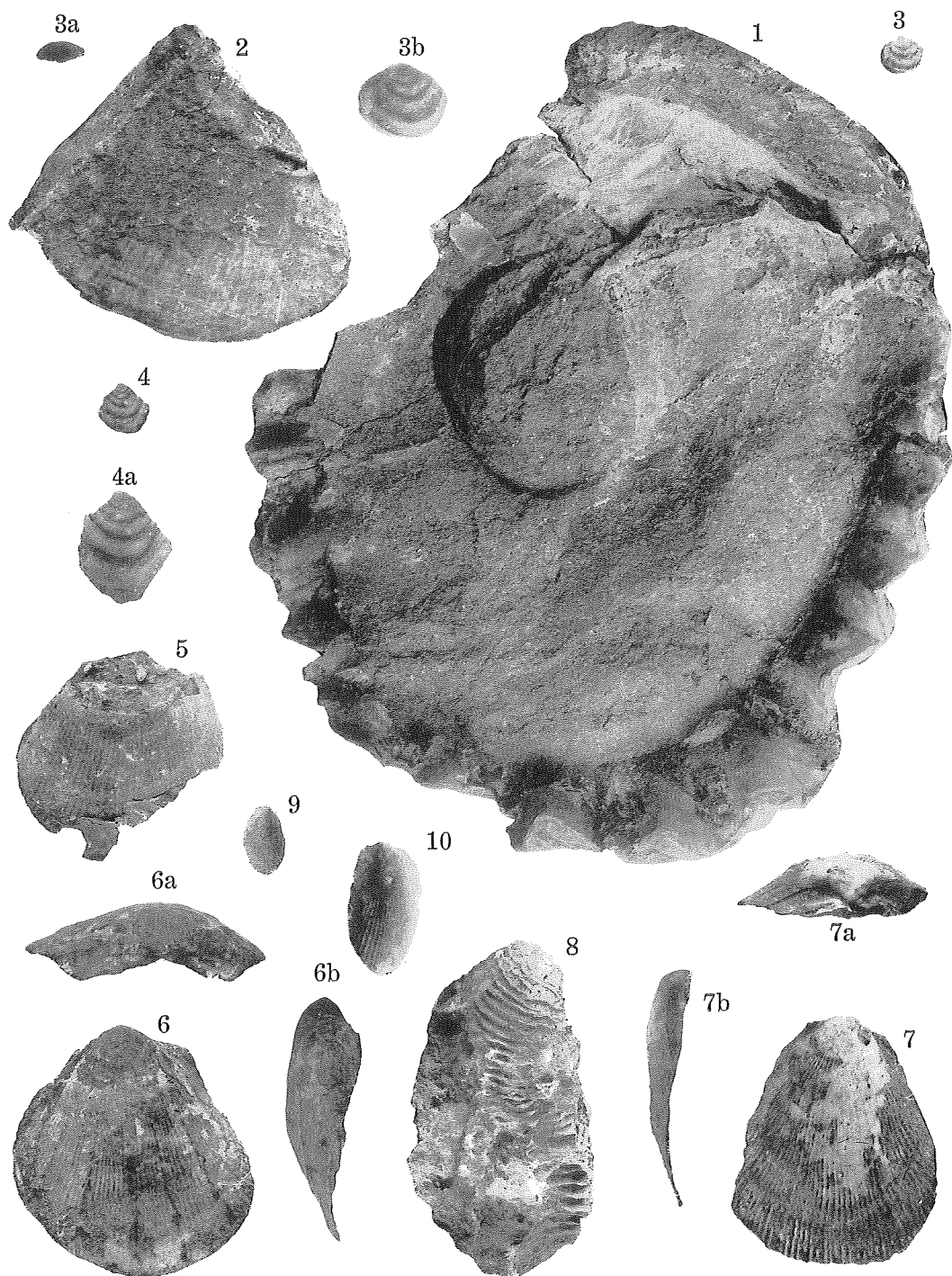
Fig. 1. *Exogyra yabei* NAGAO. Inner view of the right valve shown in Pl. IV, Fig. 1.

Figs. 2, 5-7. *Spondylus decoratus* NAGAO. 2, 7, Haipe near Hiraiga; 5, 6, Hideshima. Hiraiga Sandstone.

Figs. 3, 4. *Astarte subomaliodes* NAGAO. 3, southern coast of Hiraiga Inlet; 4, Hideshima. Hiraiga Sandstone. 3b, 4a, $\times 2$.

Fig. 8. *Spondylus* sp., aff. *S. decoratus* NAGAO. Haipe near Hiraiga. Hiraiga Sandstone.

Figs. 9, 10. *Lima (Limatula) ishidoensis* YABE and NAGAO. 9, Moshi; 10 ($\times 2$), southern coast of Hiraiga Inlet. Hiraiga Sandstone.



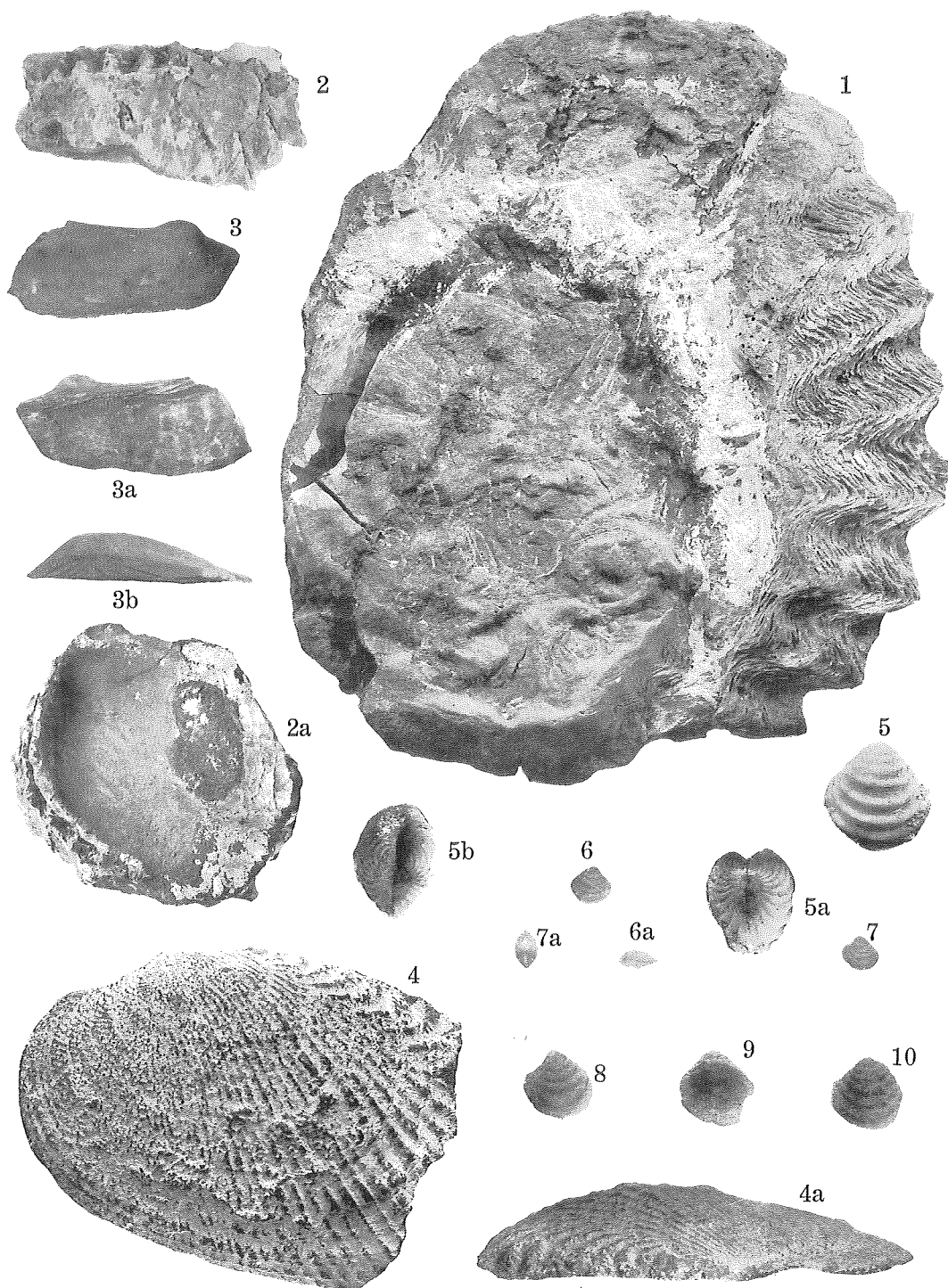
(Mashiko and Takeda photo.)

Plate XXVIII (VI)

PLATE XXVIII (VI)

The figures are of natural size, unless otherwise stated.

- Fig. 1. *Exogyra yabei* NAGAO. Outer view of the left valve shown in Pl. III, Fig. 7. a, a left valve of another individual in outer view.
- Fig. 2. *Exogyra yabei* NAGAO. Northern coast of Haibe near Hiraiga. Hiraiga Sandstone.
- Fig. 3. *Grammatodon nipponica* NAGAO. Hiraiga. Hiraiga Sandstone.
- Fig. 4. *Ptychomya densicostata* NAGAO. Northern coast of Raga. *Orbitolina* Sandstone.
- Figs. 5-10. *Astarte minor* NAGAO. Southern coast of Hiraiga Inlet. Hiraiga Sandstone. 5, 5a, 5b, $\times 3$; 8-10, $\times 2$.



(Mashiko and Takeda photo.)

Plate XXIX (VII)

PLATE XXIX (VII)

The figures are of natural size, unless otherwise stated.

Figs. 1, 14. *Exogyra yabei* NAGAO. 1, Moshi; 14, southern coast of Hiraiga. Hiraiga Sandstone.

Figs. 2, 3. *Goniomya subarchiaci* NAGAO. 2, northern coast of Raga; *Orbitolina* Sandstone. 3 (type), Akito near Raga; Akito Sandstone.

Fig. 4. *Nuculana* sp. Southern coast of Hiraiga. Hiraiga Sandstone. $\times 2$.

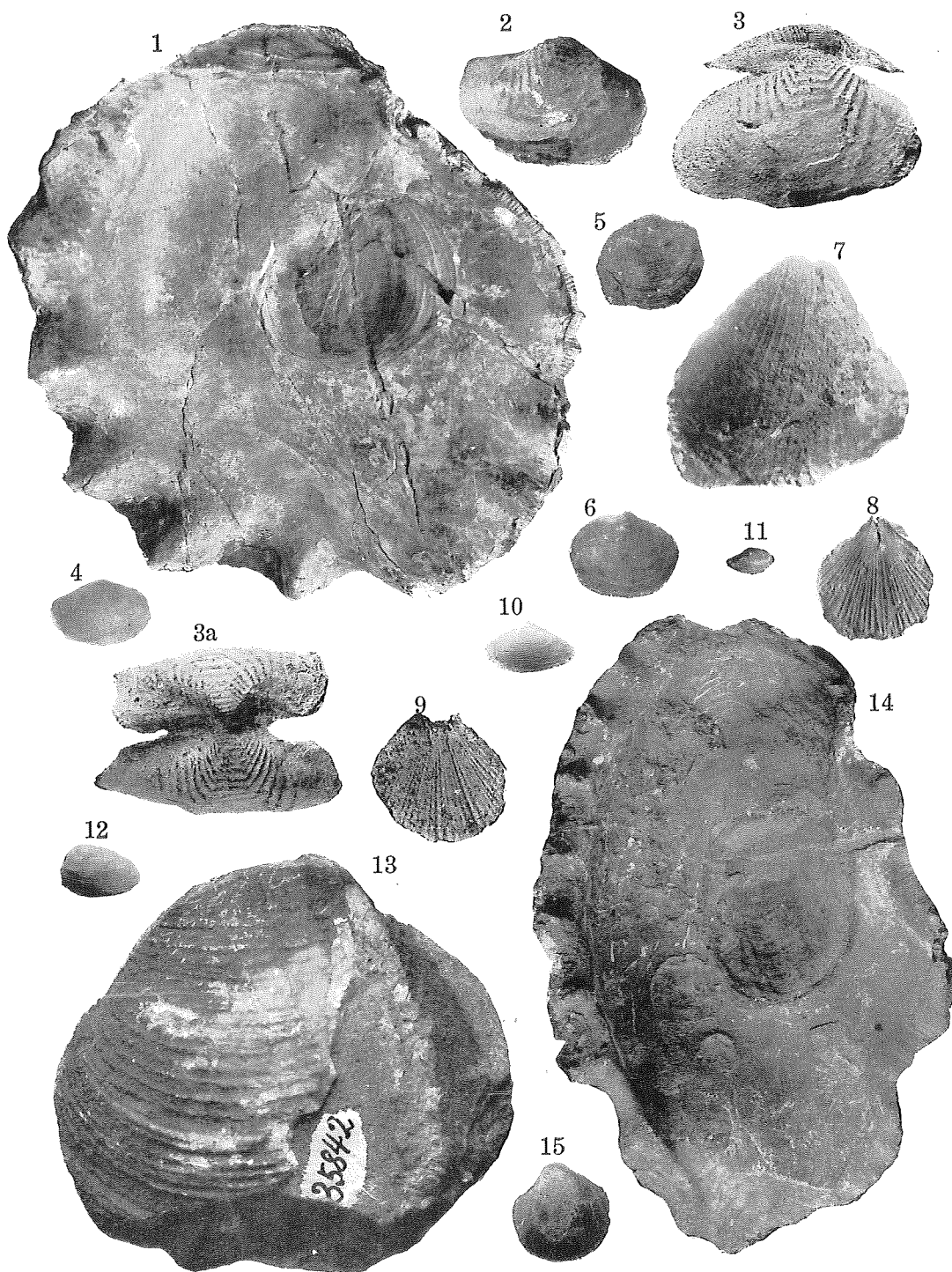
Figs. 5, 6. *Lucina kotoi* NAGAO. 5, Haipe near Hiraiga; 6 (type), Hiraiga. Hiraiga Sandstone.

Figs. 7, 15. *Cardium* sp. 7, an internal cast from Moshi ($\times 3$); 15, an internal mould from Hideshima. Hiraiga Sandstone.

Figs. 8, 9. *Pecten (Neithea)* sp. 8, northern coast of Raga; *Orbitolina* Sandstone. 9, Haipe near Hiraiga; Hiraiga Sandstone.

Figs. 10-12. *Nuculana insignis* NAGAO. 10 ($\times 3$), Akito; Akito Sandstone. 11, 12 ($\times 2$), Moshi; Hiraiga Sandstone. 10, type.

Fig. 13. *Protocardia* sp. Hiraiga. Hiraiga Sandstone.



(Mashiko and Takeda photo.)

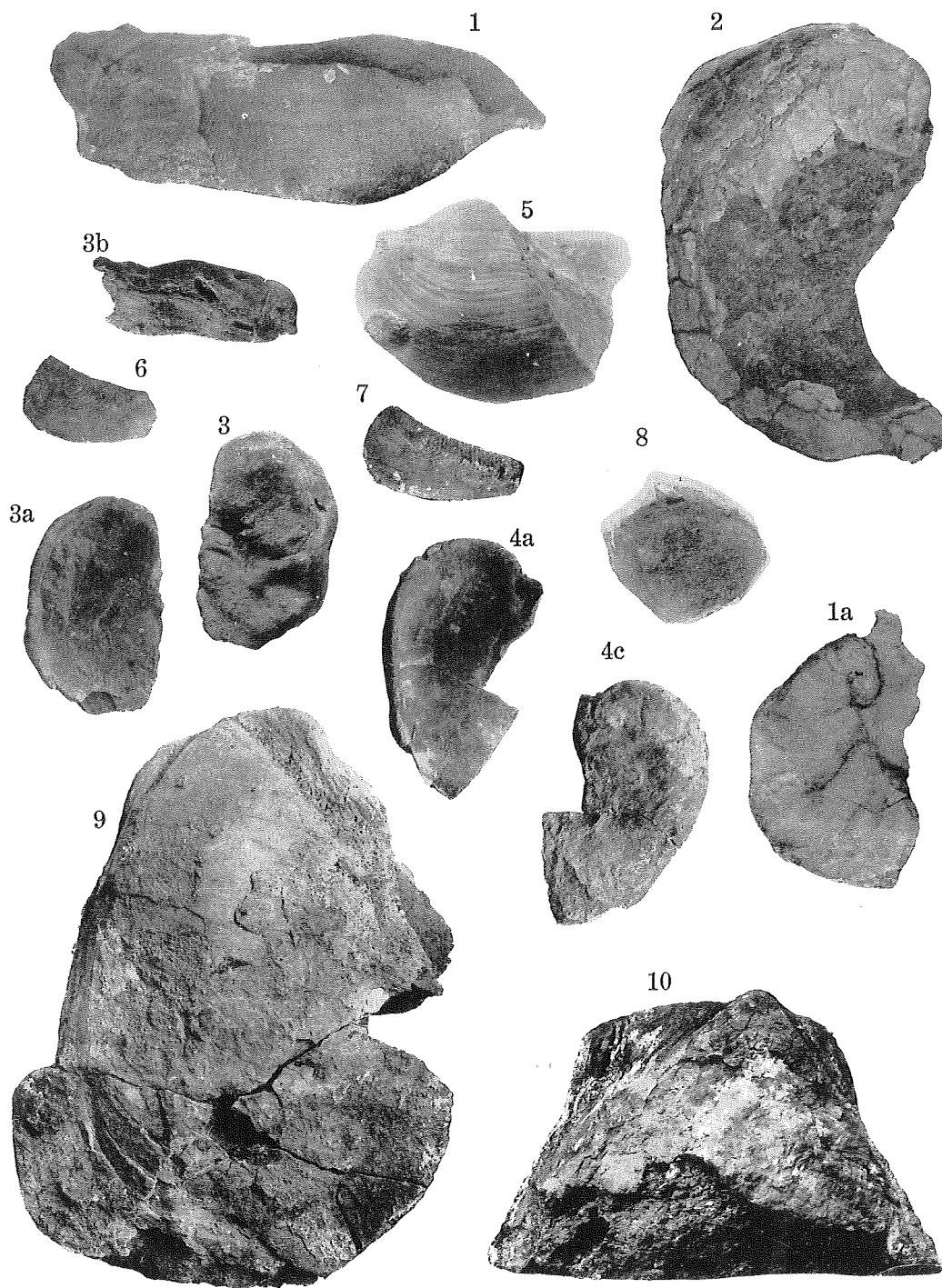
T. Nagao : Cretaceous Mollusca.

Plate XXX (VIII)

PLATE XXX (VIII)

The figures are of natural size, unless otherwise stated.

- Figs. 1-4. *Exogyra subhaliotoidea* NAGAO. 1, posterior view of a right valve; 1a, outer view of the umbonal portion. 1, 2, northern coast of Raga Inlet, 3 (type), 4, Hideshima. Hiraiga Sandstone.
- Figs. 5. *Cucullaea acuticaricarinata* NAGAO. Southern coast of Hiraiga Inlet; Hiraiga Sandstone. $\times 3$.
- Figs. 6, 7. *Anthonya subcantiana* NAGAO. 6, southern coast of Hiraiga Inlet; 7, Haipe near Hiraiga. Hiraiga Sandstone.
- Fig. 8. *Astarte miyakoensis* NAGAO. Haipe near Hiraiga; Hiraiga Sandstone.
- Figs. 9, 10. *Lima (Ctenoides ?) subrapa* NAGAO. 9, Moshi; Hiraiga Sandstone. 10, Akito near Raga; Akito Sandstone.



(Mashiko and Takeda photo.)

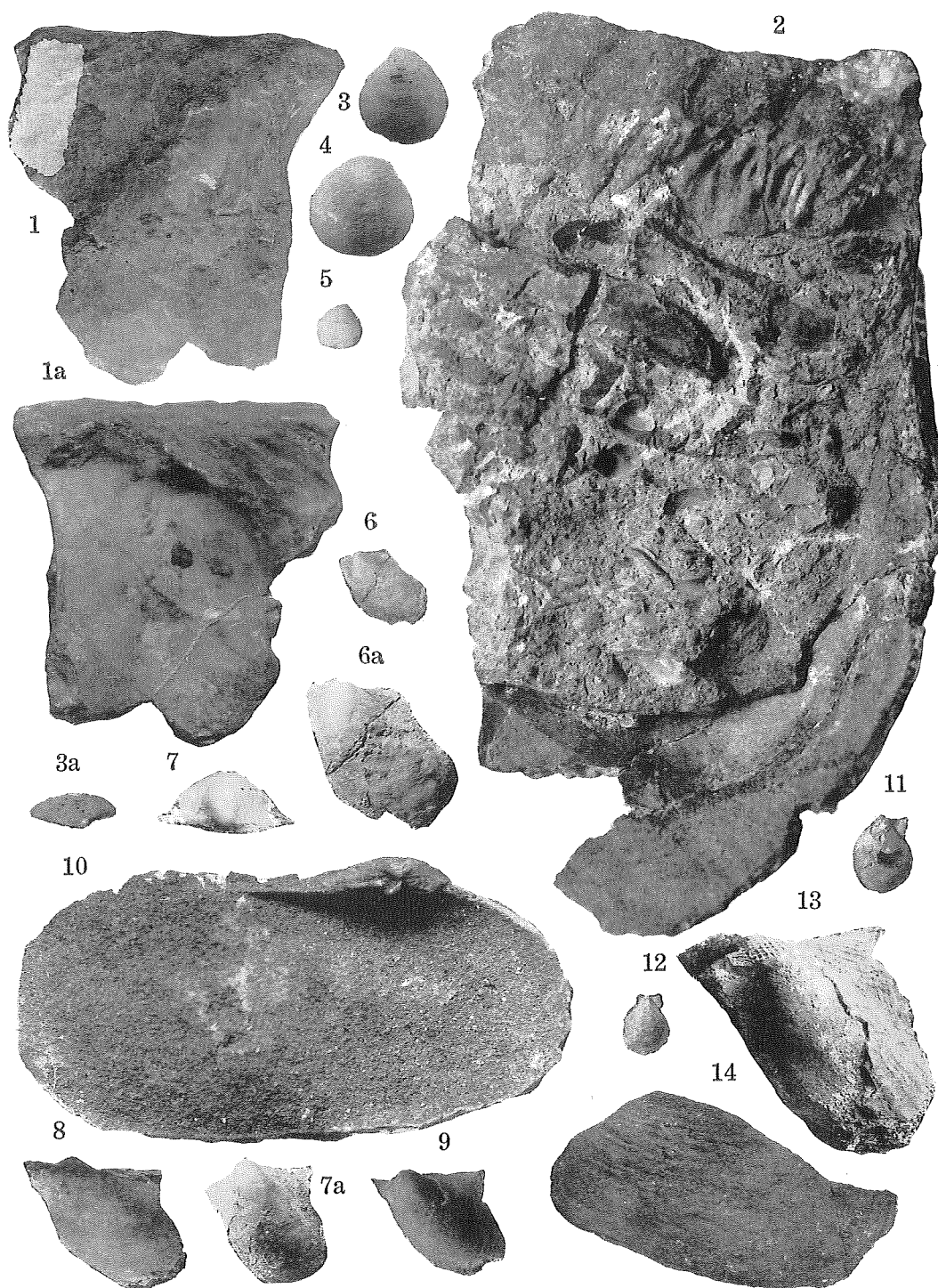
T. Nagao: Cretaceous Mollusca.

Plate XXXI (IX)

PLATE XXXI (IX)

The figures are of natural size, unless otherwise stated.

- Figs. 1, 2. *Gervillia miyakoensis* NAGAO. 1, a right valve from Hiraiga; Hiraiga Sandstone. 2, a left valve from Akito near Raga; Akito Sandstone.
- Figs. 3-5. *Astarte semicostata* NAGAO. Southern coast of Hiraiga Inlet; Hiraiga Sandstone. 3, 3a, 4, $\times 2$.
- Figs. 6-9. *Gervillia pseudorostrata* NAGAO. 6, 7, Hiraiga; 8, 9, Moshi. Hiraiga Sandstone. 6a-9, $\times 2$.
- Figs. 10, 14 (?). *Panope* sp. aff. *P. gurgitis* (BRONGN.). 10, Haibe near Hiraiga; Hiraiga Sandstone. 14, an external cast from the northern coast of Raga Inlet; *Orbitolina* Sandstone.
- Figs. 11, 12. *Pecten (Camptonectes) miyakoensis* NAGAO. 11, Akito near Raga; Akito Sandstone. 12, southern coast of Hiraiga Inlet; Hiraiga Sandstone.
- Fig. 13. *Gervillia* cf. *haradae* (YOK.) Southern coast of Hiraiga; Hiraiga Sandstone. $\times 2$.



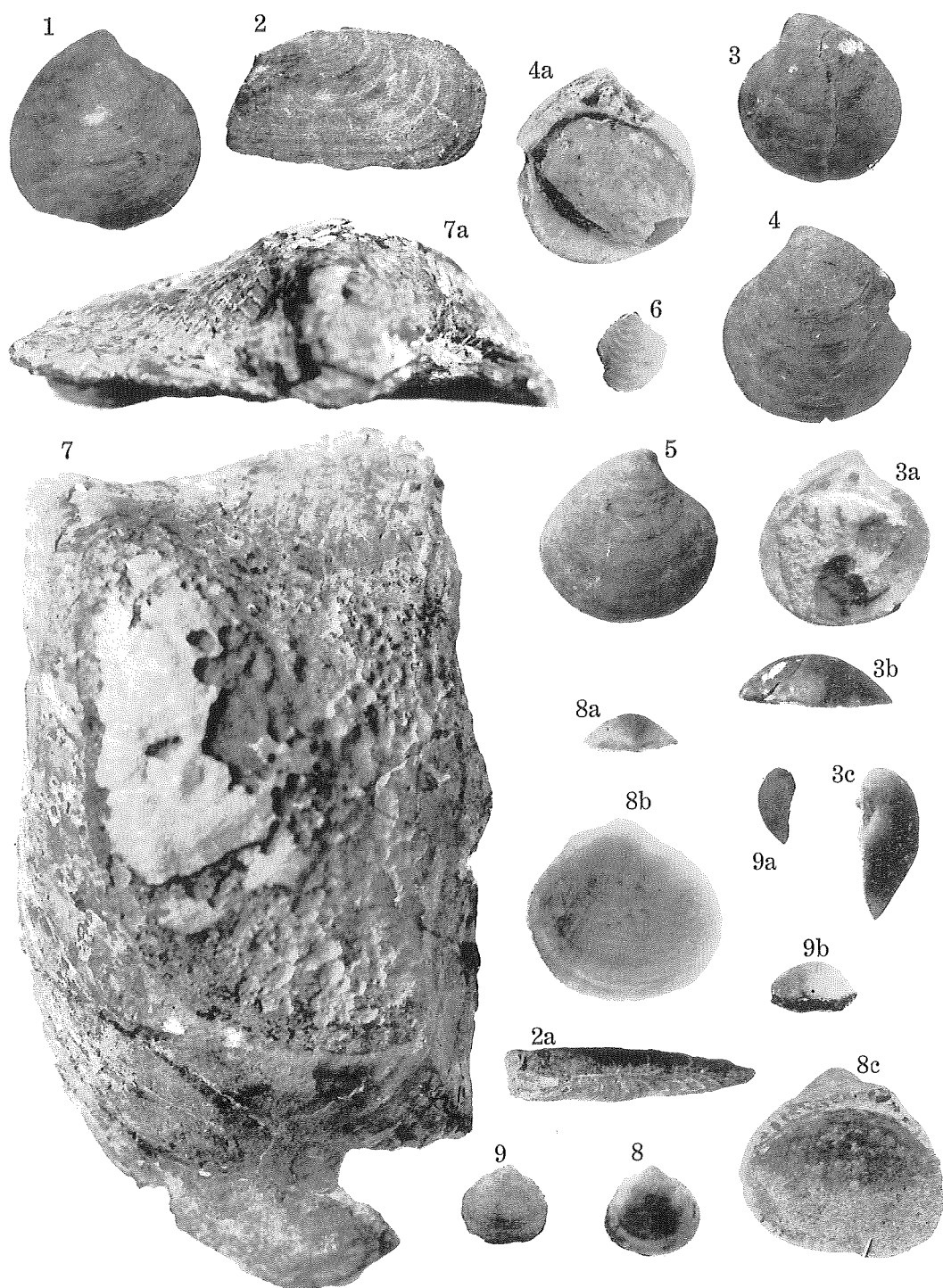
(Mashiko and Takeda photo.)

Plate XXXII (X)

PLATE XXXII (X)

The figures are of natural size, unless otherwise stated.

- Figs. 1, 3-5. *Astarte miyakoensis* NAGAO. Southern coast of Hiraiga; Hiraiga Sandstone.
- Fig. 2. *Anatina (Cercomya)* sp. An external cast from the northern coast of Raga Inlet; *Orbitolina* Sandstone.
- Fig. 6. *Astarte semicostata* NAGAO. Hiraiga; Hiraiga Sandstone. $\times 2$.
- Fig. 7. *Gervillia miyakoensis* NAGAO. The same as the left valve shown in Pl. IX, Fig. 2.
- Figs. 8, 9. *Glycymeris densilineata* NAGAO. 8 (type), Haipe; 9, southern coast of Hiraiga. Hiraiga Sandstone. 8b, 8c, $\times 2$.



(Mashiko and Takeda photo.)

Plate XXXIII (XI)

PLATE XXXIII (XI)

The figures are of natural size, unless otherwise stated.

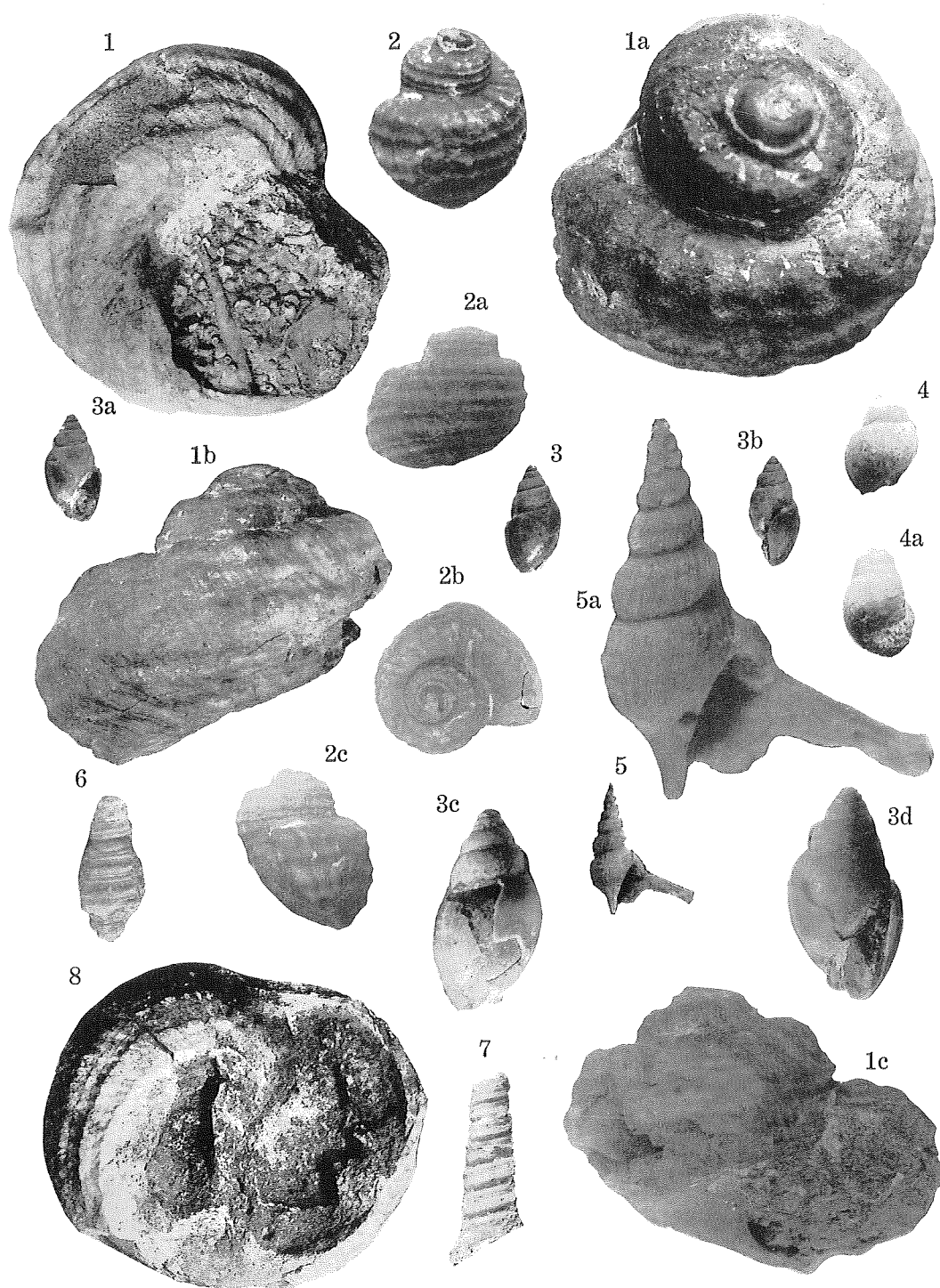
Figs. 1, 2, 8. *Nododelphinula elegans* NAGAO. Haipe near Hiraiga; Hiraiga Sandstone. 1, type.

Fig. 3. *Actaeonina (Ovatactaeon) yeharai* NAGAO. Moshi; Hiraiga Sandstone. 3c, 3d, $\times 3$.

Fig. 4. *Actaeon* (?) sp. Hiraiga; Hiraiga Sandstone. $\times 2$.

Fig. 5. *Drepanochilus elongatodigitatus* NAGAO. Haipe near Hiraiga; Hiraiga Sandstone. 5a, $\times 3$.

Figs. 6, 7. *Turritella* (?) sp. 6, Hideshima; 8, southern coast of Hiraiga Inlet, $\times 2$. Hiraiga Sandstone.



(Mashiko and Takeda photo.)

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Plate XXXIV (XII)

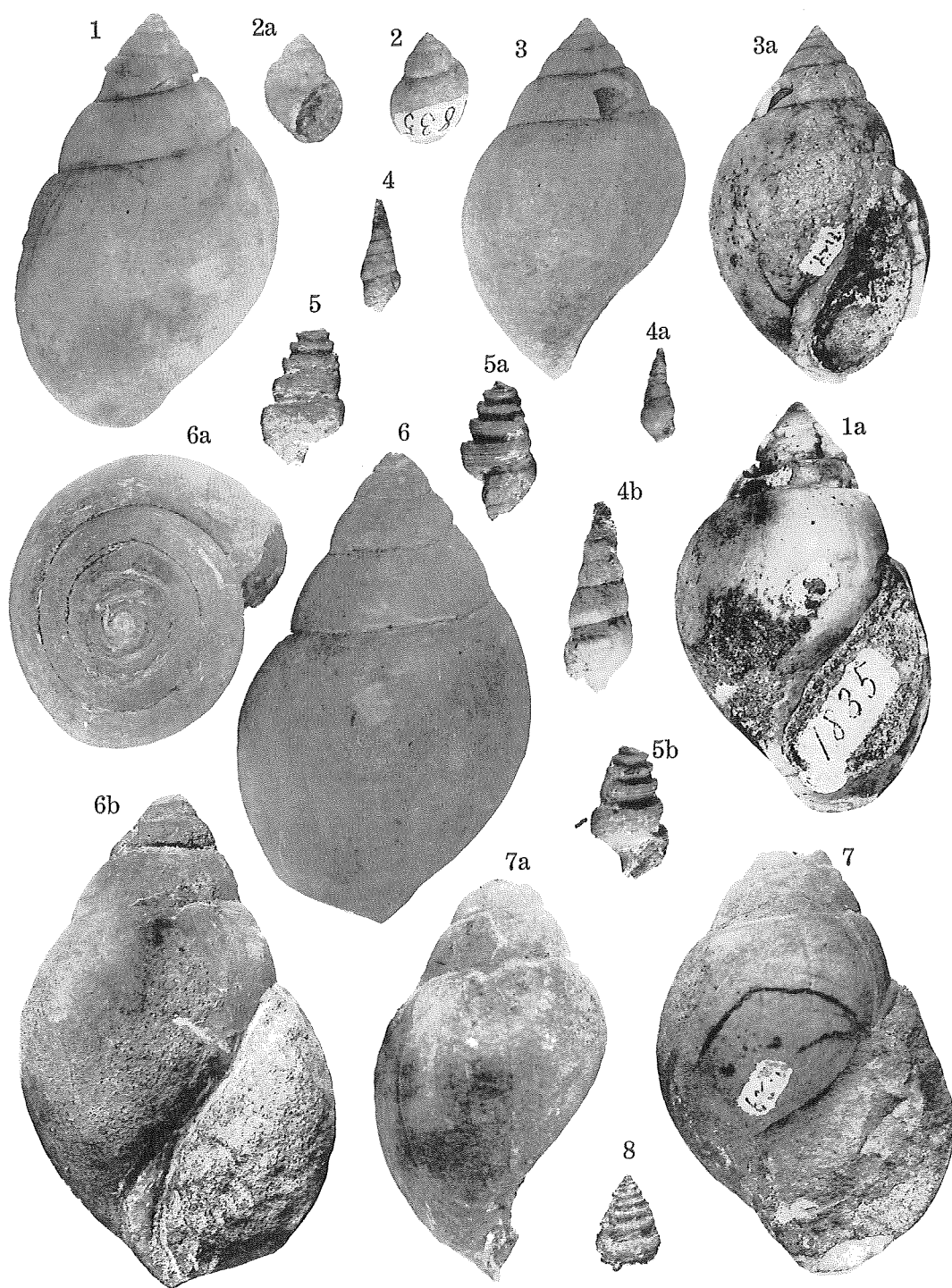
PLATE XXXIV (XII)

The figures are of natural size, unless otherwise stated.

Figs. 1-3, 6, 7. *Tylostoma miyakoensis* NAGAO. Southern coast of Hiraiga Inlet ;
Hiraiga Sandstone.

Fig. 4. *Cerithium* (?) sp. Southern coast of Hiraiga ; Hiraiga Sandstone. 4b, $\times 2$.

Figs. 5, 8. *Bathraspira excavata* NAGAO. 5 (type), northern coast of Raga Inlet ;
Orbitolina Sandstone. 8, Haipe near Hiraiga ; Hiraiga Sandstone.



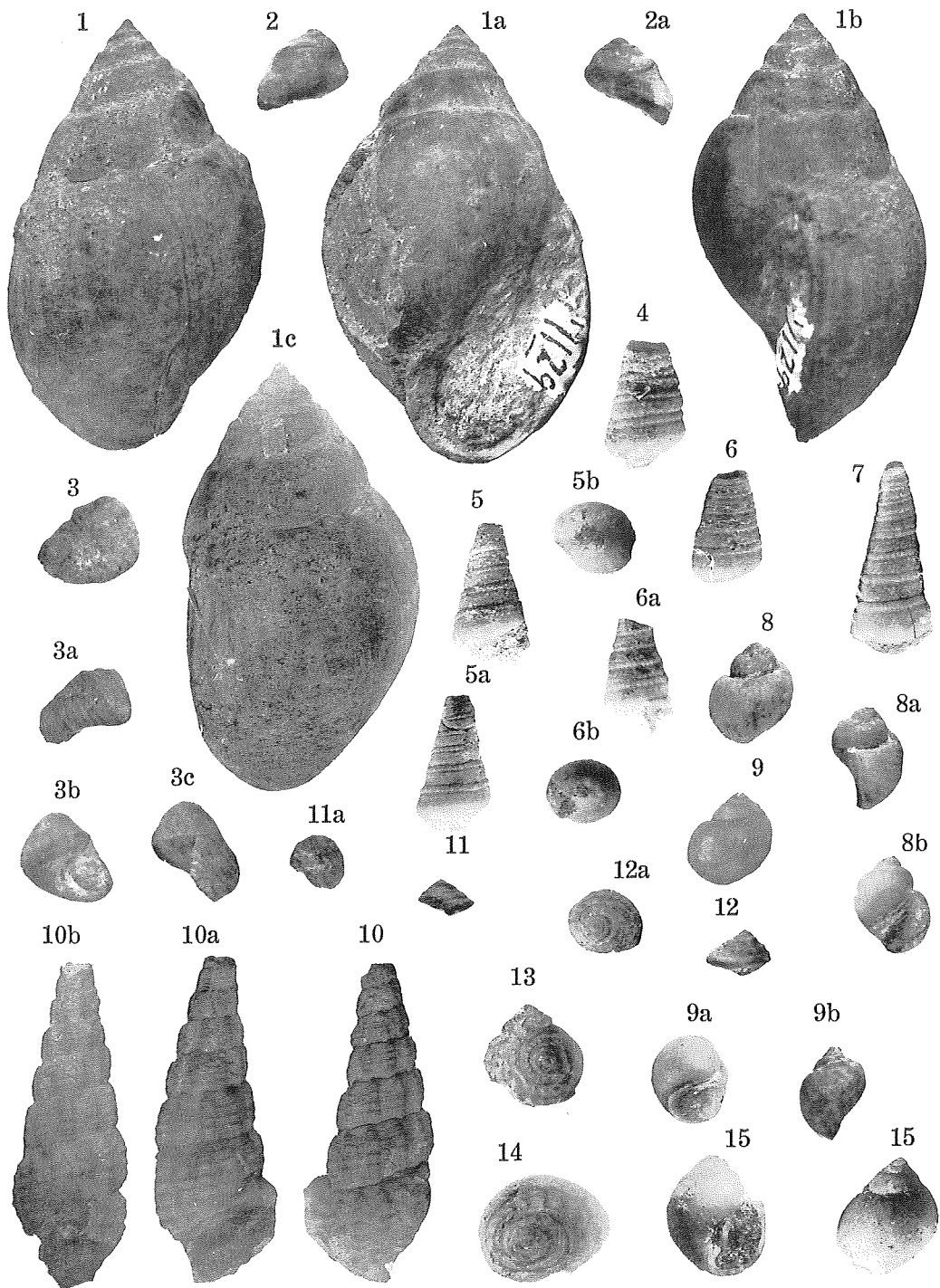
(Mashiko and Takeda photo.)

Plate XXXV (XIII)

PLATE XXXV (XIII)

The figures are of natural size, unless otherwise stated.

- Fig. 1. *Tylostoma miyakoensis* NAGAO. Sothern coast of Hiraiga Inlet; Hiraiga Sandstone. Type.
- Figs. 2, 3. *Ataphrus yokoyamai* NAGAO. Hiraiga; Hiraiga Sandstone. 3, type.
- Figs. 4-7. *Cerithium (Metacerithium) rikuchuense* NAGAO. 4, 5, 7 (type), Hiraiga; 6, Haipe. Hiraiga Sandstone.
- Figs. 8, 9, 15. *Natica importuna* NAGAO. Hiraiga; Hiraiga Sandstone. 8, type. 9, $\times 2$.
- Fig. 10. *Pyrarus scalariformis* NAGAO. Southern coast of Hiraiga Inlet; Hiraiga Sandstone.
- Figs. 11-14. *Solarium incrassatum* NAGAO. 11, 12 (type), Hiraiga; 13, 14, Hideshima. Hiraiga Sandstone. 13, 14, $\times 2$.



(Mashiko and Takeda photo.)

Plate XXXVI (XIV)

PLATE XXXVI (XIV)

The figures are of natural size, unless otherwise stated.

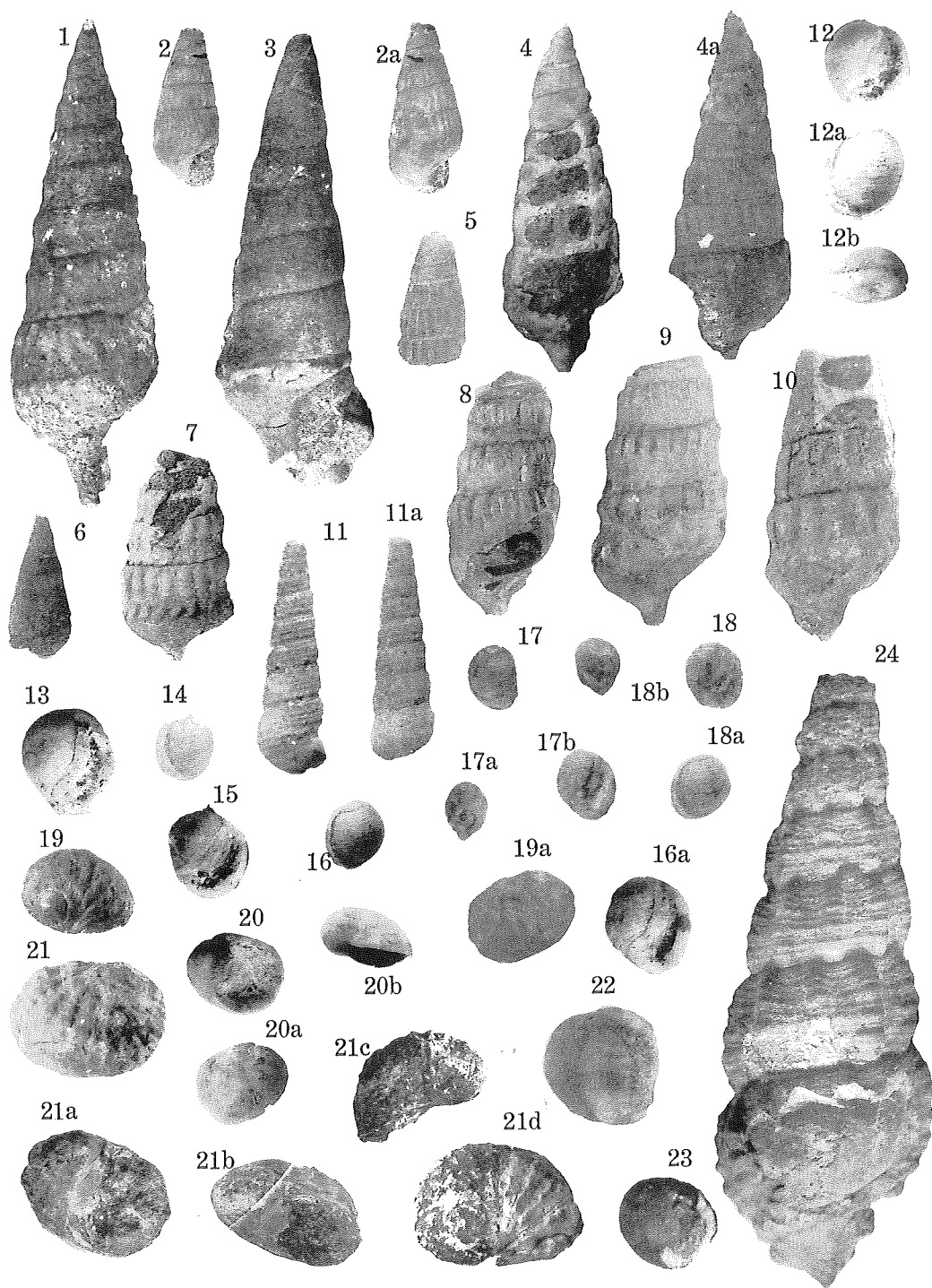
Figs. 1-10. *Cerithium (Cimocerithium) miyakoense* NAGAO. 1 (type), 4, 5, 8, 10, southern coast of Hiraiga Inlet; 2, 3, 6, Haipe near Hiraiga; Hiraiga Sandstone. 7, 9, Akito near Raga; Akito Sandstone.

Fig. 11. *Turritella yaegashii* NAGAO. Hiraiga; Hiraiga Sandstone. $\times 2$.

Figs. 12-18. *Avellana minima* NAGAO. 12 (type), 13, 15, 16, Haipe near Hiraiga; 14, 17, 18, Hiraiga. Hiraiga Sandstone. 12, 12a, 12b, 13, 15, 16a, $\times 3$; 14, 16, 17a, 17b, 18, 18a, 18b, $\times 2$.

Figs. 19-23. *Desmiera japonica* NAGAO. 19, 21 (type)-23, southern coast of Hiraiga; 20, a small smooth specimen referable to this species from Haipe near Hiraiga. Hiraiga Sandstone. 20, 20a, 20b, 22, $\times 2$.

Fig. 24. *Cerithium (Cimocerithium) miyakoense* NAGAO. The same as Pl. XIII, Fig. 10. $\times 2$.



(Mashiko and Takeda photo.)

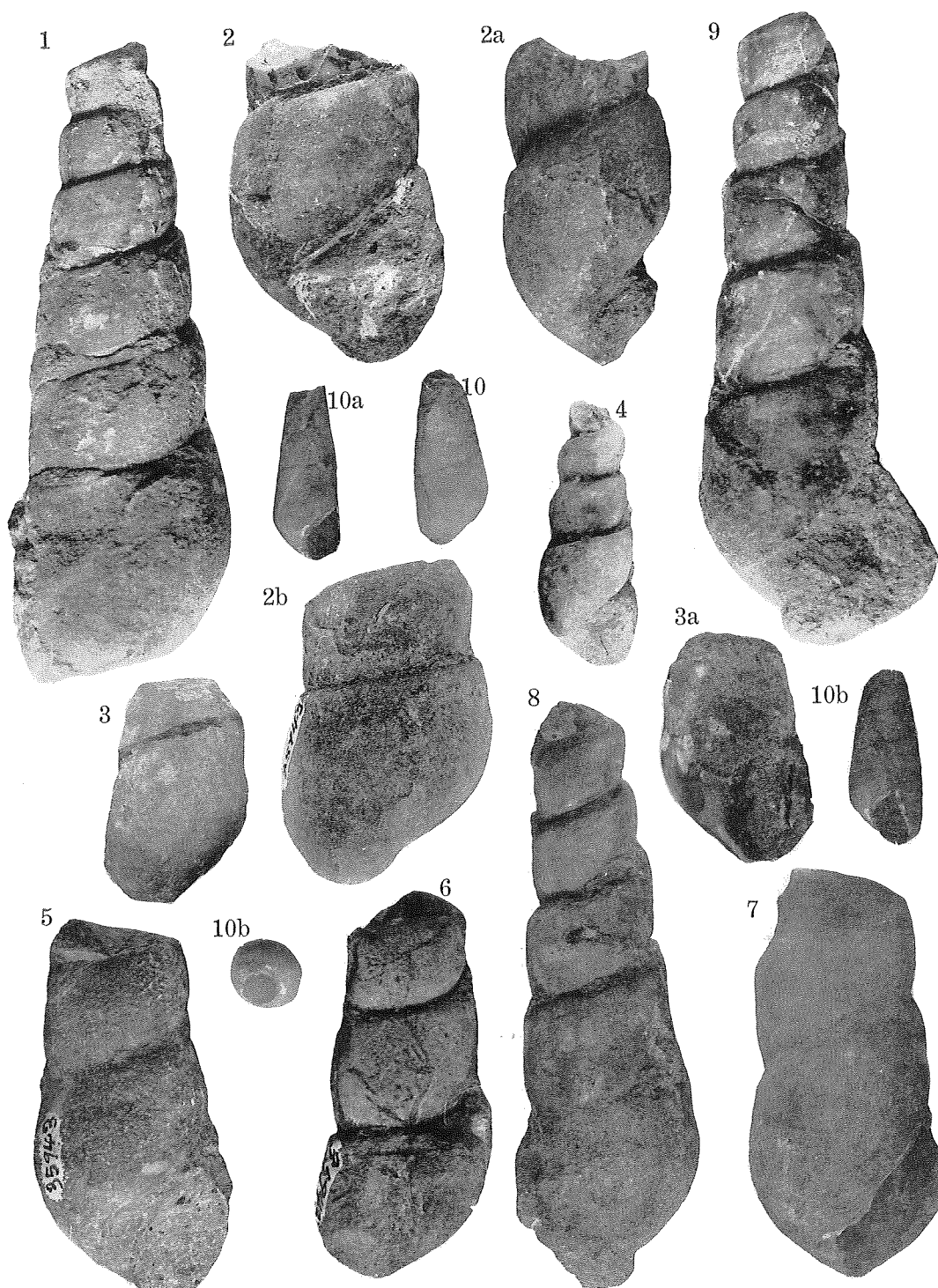
Plate XXXVII (XV)

PLATE XXXVII (XV)

The figures are of natural size.

Figs. 1-9. *Pseudomelania elegantula* NAGAO. Southern coast of Hiraiga; Hiraiga Sandstone.

Fig. 10. A small specimen referable to the same species. Haipe near Hiraiga; Hiraiga Sandstone.



(Mashiko and Takeda photo.)

Plate XXXVIII (XVI)

PLATE XXXVIII (XVI)

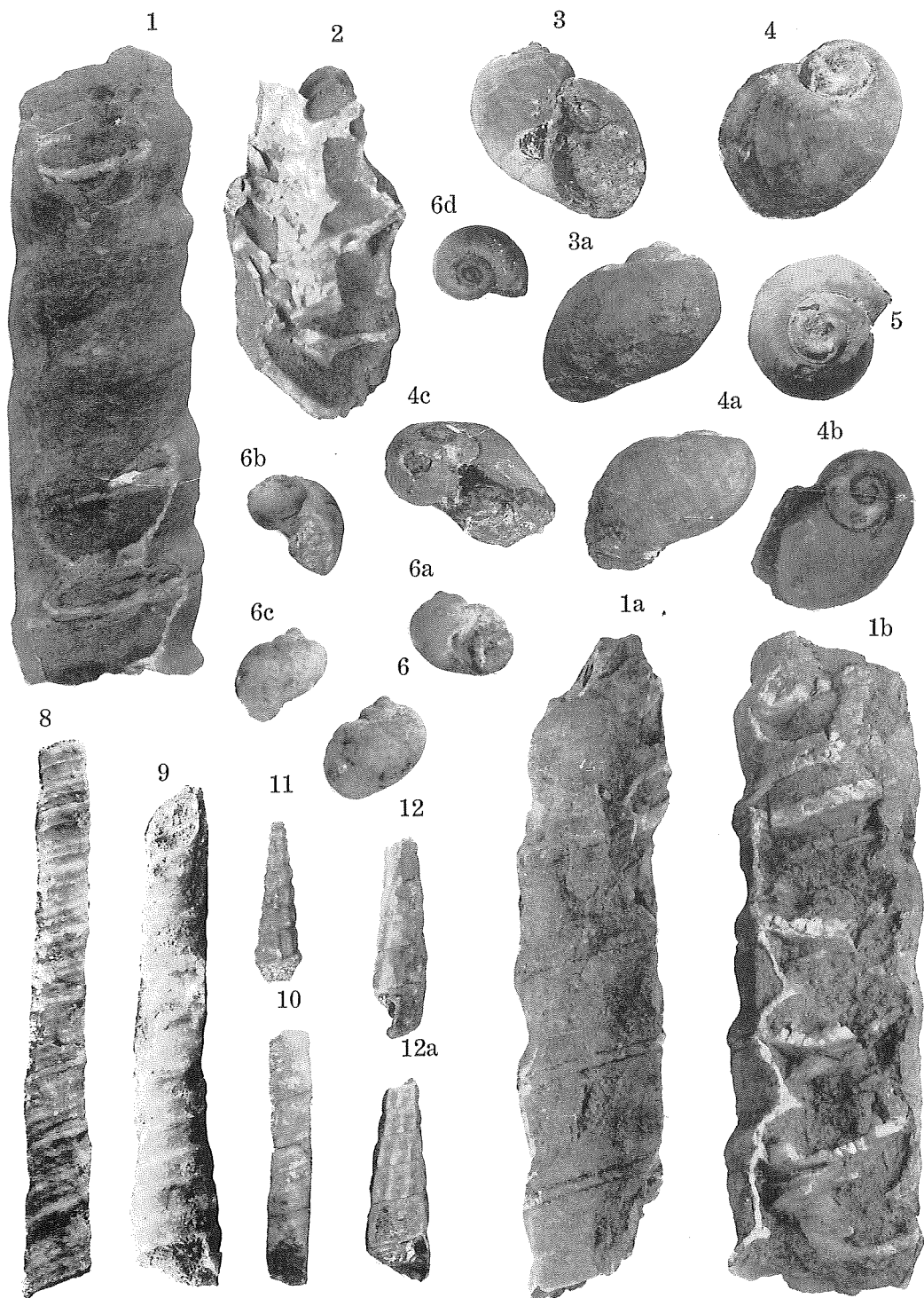
The figures are of natural size, unless otherwise stated.

Figs. 1, 2. *Nerinea rigida* NAGAO. Southern coast of Hiraiga Inlet; Hiraiga Sandstone. 1, type.

Figs. 3-6. *Vanikoroa japonica* NAGAO. 3 (type), 5 ($\times 2$), Haipe near Hiraiga; 4, 6, southern coast of Hiraiga Inlet.

Figs. 8-10. *Nerinella* sp. 8, 10, southern coast of Hiraiga Inlet; 9, Haipe near Hiraiga. Hiraiga Sandstone. 8, 9, $\times 2$.

Figs. 11, 12. *Scala miyakoensis* NAGAO. 11 (type), Hiraiga; 12, Haipe. Hiraiga Sandstone.



(Mashiko and Takeda photo.)

T. Nagao: Cretaceous Mollusca.

Plate XXXIX (XVII)

PLATE XXXIX (XVII)

The figures are of natural size, unless otherwise stated.

Figs. 1, 2, 4, 5. *Trajanella japonica* NAGAO. 1, 2, southern coast of Hiraiga Inlet ;
4, 5 (type), Haipe. Hiraiga Sandstone.

Fig. 3. *Tylostoma miyakoensis* NAGAO. A small specimen from Hiraiga. Hiraiga
Sandstone. $\times 2$.

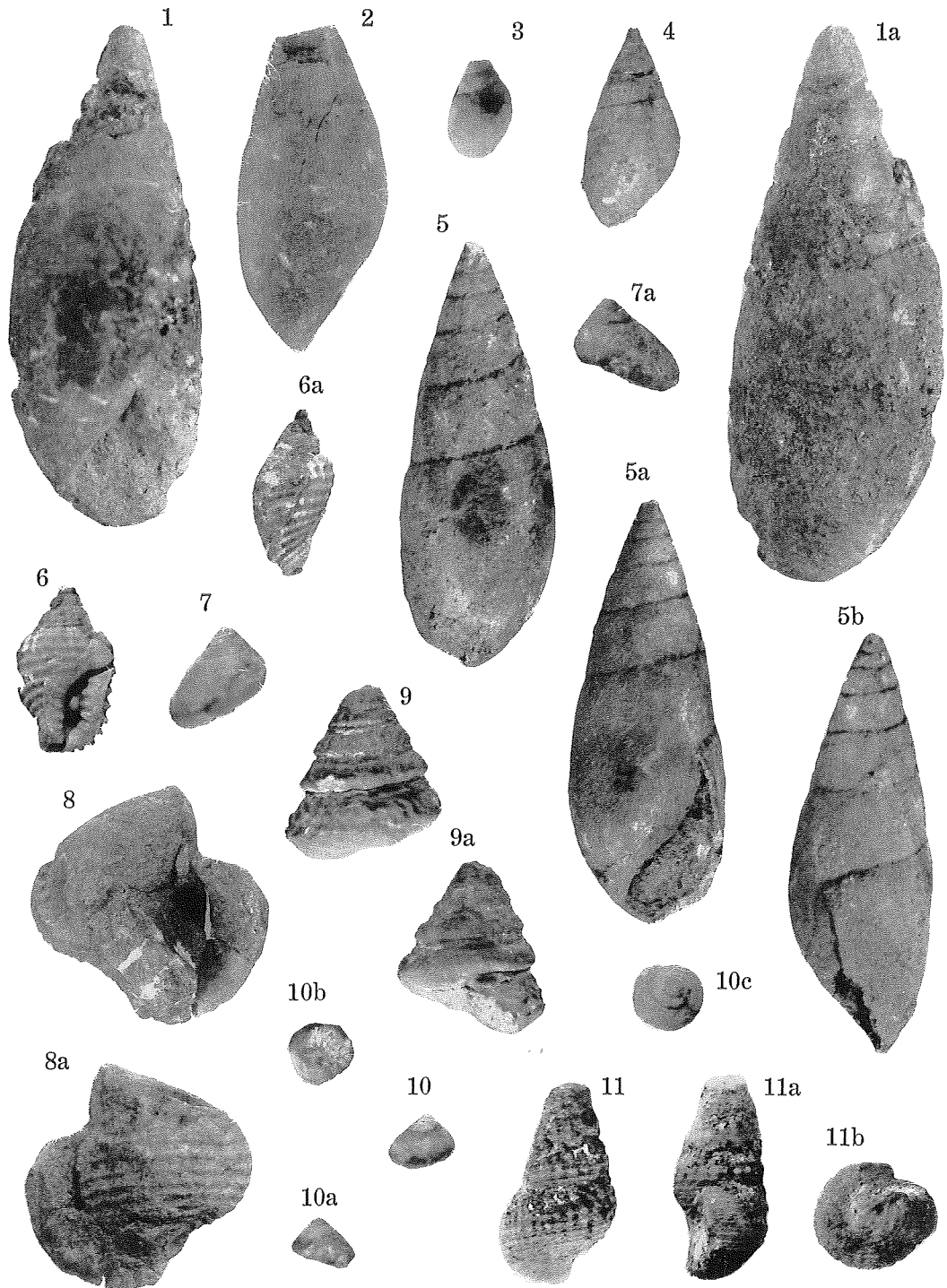
Fig. 6. *Columbellina brevisiphonata* NAGAO. Haipe ; Hiraiga Sandstone.

Figs. 7, 10. *Ataphrus kitakamiensis* NAGAO. Southern coast of Hiraiga Inlet ;
Hiraiga Sandstone.

Fig. 8. *Potamides ? (Excecostoma ?)* sp. Hiraiga ; Hiraiga Sandstone.

Fig. 9. *Tectus crassus* NAGAO. Southern coast of Hiraiga Inlet ; Hiraiga Sandstone.

Fig. 11. *Cerithium (Circocerithium) reticulatum* NAGAO. Haipe near Hiraiga ;
Hiraiga Sandstone. $\times 3$.



(Mashiko and Takeda photo.)