CRETACEOUS MOLLUSCA FROM THE SANCHU-GRABEN
IN THE KWANTO MOUNTAINLAND, JAPAN

BY

HISAKATSU YABE, TAKUMI NAGAO, and SABURÔ SHIMIZU

With 4 Plates and 2 Text-Figures

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1. INTRODUCTION AND STRATIGRAPHICAL NOTES

Whereas the most part of the Kwantō Mountainland 1 (Text-Figs. 1, 2) is built of Palæozoic rocks belonging to the Chichibu Formation and older rocks belonging to the Mikabu and Sambagawa Series, there is a narrow area occupied by Cretaceous rocks, 40 km. long and 2-6 km. broad, which extends from Ōhinata (Minami-Saku-gun, province of Shinano) 2 southwestwards through a point a little south of Kagahara (Tano-gun, province of Kōzuke) 3 to Ōgano (Chichibu-gun, province of Musashi), 4 in a direction subparallel to the general strike of the Palæozoic and other rocks. This narrow belt of Cretaceous rocks represents a geological ditch or Graben, the Sanchu Graben, as Dr. T. Harada, 5 who first recognized its geotectonical significance, appropriately called it. It is bordered on both sides by two principal faults and traversed by many subordinate ones. These are products of the latest Cretaceous disturbance which affected the Kumakiiland (the outer zone of southwest Japan plus the Kwantō Mountainland) 6 everywhere, and separated the Mesozoic block of the Sanchu Graben into numerous smaller ones. It is natural that there the tracing of the precise stratigraphical succession of zones among the blocks is not easy. As far as we are now informed

3 上野國多摩郡."Kōzuke.
4 大藏國和田郡."Kōzuke.
from various sides, the greater part of the Cretaceous rocks occupying the Sanchū-Graben belong to
to the Lower Cretaceous and is marine in origin, though there are occasionally intercalated brackish
and fresh-water deposits with plants and mollusks.

One of the best localities for fossils in the Sanchū-Graben is Ishidō near Ôhinata, where black
sandy shale and sandstone with numerous molluscan remains, including *Trigonopsis pocillum*, are
exposed along a brook. In the neighbourhood of Ishidō there is another fossil locality, Bōmeiki,
discovered by Yabe some thirty years ago, where a fine-grained sandstone, with abundant *Cyrena
naumannii* NEUMANN, other brackish water mollusca, and plant remains (Zamiophyllum bachianum
ETT. amongst others) is developed. The same *Cyrena* bed, associated with a plant bed, is also
exposed in the vicinity of Ōhiro (about 12 km. east of Koya), Ueno-mura, Tano-gun, province of
Kōzuke, and overlaid by a group of rocks intercalating a fossil bed equivalent to that of Ishidō;
hence the latter two are regarded to be younger than the *Cyrena naumannii* bed.

The *Cyrena naumannii* bed is exposed at two other localities: Kagikake, Ôhinata-mura, Minami-
Saku-gun, province of Shimano, and Hachimanzawa, south of Kagahara, Tano-gun, province of
Kōzuke. At Kagikake, about 1 km. northwest of Bōmeiki, *Cyrena naumannii* itself has not yet been
found, but there is a sandy shale containing numerous fossils, most of which are identical with those
from Bōmeiki. Hachimanzawa is a small side valley of the Ōzawa-gawa, which is itself a tributary of
the Kannagawa, and there is exposed in the valley a set of strata consisting of shale and sand-
stone, which intercalates the *Cyrena naumannii* bed and a plant bed. Whereas the *Cyrena
naumannii* bed contains innumerable remains of *Cyrena* and other brackish water mollusks, the dark micaceous
sandy shale of the plant bed encloses abundant plant remains which are mostly in a state of bad
preservation. Hachimanzawa, however, is one of the type localities of the Ryōseki plant bed,
and Yokoyama cited *Onychopoa elongata* (GEYER), *Pteris(?)* sp., *Sphenoptera tenuicula* YOK.,

1 石道;
2 稲目水;
3 上野倉上野倉村外;
4 稲田倉佐久郡大日向村高根;
5 八樫澤;
6 松窪川;
7 神鏡川;
Podocamites pusillus Vel., ZamiaMyllium buchianum (ETT.), Nilsonia schaumburgensis (DKR.), and Cyartissium? japonicum Yok. from this very spot. His Sphenopteris tenaxcula is hardly distinguishable from Raffordia gipterti DKR., while Pteris (?) sp. is a Cladophlebis in modern literature.

Furthermore, there is a thick series of sandstone with interbedded layers of conglomerate, which is believed by SHIMIZU and ŌISHI to occupy a position considerably higher than the fossiliferous rocks of Ishida. Fossiliferous beds belonging to this series are exposed in the vicinity of the village of Kawaraizawa1 along the valley of the same name (Chichibu-gun), at Ōzeki2 near Kagahara, and Dōdokoro3 north of Ōshiro. While Ammonites and Belemnites are obtained by ŌISHI from Dōdokoro, lamellibranchiate mollusca are dominant in the other two localities.

The series of rocks just mentioned above is overlaid by another thick complex of thin-bedded sandstone and shale in alternation. In this group Mr. H. FUJIMOTO once obtained a Lytoterus at Otomo,4 about 5 km. west of Kagahara, and Mr. ŌISHI Nilsonia schaumburgensis DKR. at Narasawa5 about 2 km. northeast of Ōshiro.

ŌISHI is now undertaking a precise stratigraphical study of the Cretaceous rocks developed in the Sanchū Graben. The following information kindly supplied to us concerning the order of succession of these rocks is of course only his preliminary scheme and must be regarded as suscriptive to more or less alteration in the further progress of his field work.

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1 写真（図）。
2木戸
3伊勢
4石原
5橋本市
Enumerating in ascending order, the stratigraphical sequence is:

I. The Miyakozawa Group. This, and the next group, occupy the westernmost part of the Sanchü-Graben (Ōhinata-mura). The Miyakozawa Group consists of sandstone, shale, and conglomerate; along the Miyakozawa,¹ a small tributary of the Nukii-gawa,² an alternation of sandstone and shale occupies its lower and upper parts and a thick conglomerate the middle. South of Koya,³ along the Nukii-gawa, a greenish shale containing ill-preserved ammonites, echinoids and bivalves, is exposed. This shale is believed to belong to the upper part of this group.

II. The Ōnosawa Group. An alternation of sandstone and shale intercalating thick layers of conglomerates; fossiliferous. Being separated from the preceding rock series by a fault running along the course of the Nukii-gawa, the stratigraphical relation of the Ōnosawa Group to the Miyakozawa is still unsettled, though Ōishi tends to believe the former occupies a little higher position than the latter. The main part of the present group is well exposed along the Ōno-sawa,⁴ at about 2 km. east of Koya and comprises sandstone and conglomerate, with subordinate shale; a plant bed and a shell bed are intercalated in its lower part, while another plant bed is in a sandstone of the upper part. The lower plant bed contains Cladophlebis browniana (Dkr.), Nilsomia, and Podocamites, and the upper Cladophlebis browniana. The molluscan remains derived from the shell bed are usually far from perfect, only Turricella, Natica, Nerineat (?), Glaucoma (?), Ostrae, and Astaria being distinguished among them.

III. The Shiroi Group. In the vicinity of Shiroi, about 12 km. east of Koya, a thick series of rocks consisting mainly of dark coloured shale, with subordinate, sandstone, is developed. It is divided into two groups, the lower division being the Shiroi Group, well distinguished by the intercalation of a Cyrena nasunani bed and also often a plant bed. Bômeiki-zawa and Kagikake in Ohinata-mura, and Hachimana-zawa south of Kagahara are three other localities of the fossiliferous deposits, as already cited above.

IV. The Ishidō Group. A complex of dark-coloured sandy shale overlying the Shiroi Group at Shiroi and also exposed at Ishidō near Bômeiki-zawa, where several layers are found to be very rich in molluscan remains. The Ishidō Group of Ishidō merges downwards into the Shiroi Group of Kagikake.

V. The Kawara-zawa Group. The uppermost division of the Cretaceous deposits in the present district is a thick complex comprising two divisions. The lower part is composed of sandstone intercalating conglomerate layers, and the upper of sandstone and shale in thin-bedded alternations. In the vicinity of the village of Kawara-zawa, the lower division is well developed and many molluscan remains enclosed in a dark coloured sandy shale are found. To this same division belong also the fossiliferous bed of Ōze, near Kagahara, and that of Dōdokoro, north of Shiroi, as already alluded to above. The upper division is fossiliferous at Otomo, about 5 km. west of Kagahara, and at Narasawa, about 2 km. northeast of Shiroi.

In an early work by Harada,⁵ the Cretaceous rocks of the Sanchü Graben, excluding the plant bed with Ryōsei flora, are divided into three parts, which are in descending order:

Dark gray platy shale and sandstone in alternation, the former containing many calcareous nodules; barren of megascopic fossils.

¹板深
²板井川
³吉野
⁴大野郎
Dark-coloured shale intercalating a few sandstone and conglomerate beds. Rarely fossiliferous;
*Lecteina* and ammonites are reported to have been obtained from Sebayashi¹ and at Bandō-pass, near Kagahara.

A thick complex of sandstone, fine- to coarse-grained and sometimes even conglomeratic, black to greenish-gray in colour, very micaceous and also sometimes calcareous.

In comparing this statement with the information given by Ōishi, cited above, all the Cretaceous rocks represented by the three divisions of Harada seem to fall into the Kawarazawa Group of Ōishi. The first discovery of Cretaceous fossils in the Sanchū Gräben is due to Mr. T. Kochibe, former Director of the Imperial Geological Survey, who obtained several fossils near Kagahara along the Kanna-gawa, which were subsequently described by M. Yokoyama as

*Alectryonia* cfr. carinata Lam.

*Exogyra* sp.

*Avicula karadae* Yok.

*Cucullaea* cfr. striatella Mich.

*Trigonia pocilliformis* Yok.

*Crassatella kagakahensis* Yok.

*Capulus annulatus* Yok.

*Phylloceras* sp. resembling *P. velleula* Mich.

*Anisoceras* sp. resembling *A. indicum* Forbes.

Of these fossils, *Exogyra* sp. and the two species of ammonites are not figured and it is consequently impossible to make a comparison between them and our new fossils from the Sanchū-Gräben. We have, however, no scruples in referring the fossil fauna described by Yokoyama to the Kawarazawa Group, as five of the six figured species are known from the Kawarazawa Group and Ōze, near Kagahara, is now reported by Ōishi to be a fossil locality of this group.

The present paper deals with the fossil mollusks derived from the Kawarazawa, Ishidō, and Shiroi Groups, comprising descriptions of eleven species of Ammonites, six species of Gastropods, and twenty-eight species and two varieties of Lamellibranchs. From the Shiroi Group, we have

| *Arica shinanoensis* nov. | + | - | + | - |
| *Cyrena shiroiensis* nov. | + | - | + | - |
| " shiroiensis var. alata nov. | + | - | + | - |
| " radiatostriata nov. | - | + | + | + |
| " ostukai nov. | + | + | + | - |
| " naumann Neumayr | + | - | + | + |
| *Corbicula (Veloritina ?) sanchuenensis* nov. | + | + | + | + |
| *Pharella (?) sp* | + | + | + | - |
| *Homomya (?) dubia* nov. | - | - | + | + |
| *Myopholas cfr. semicostata* (Ag.) | + | + | - | - |
| *Perna sanchuenensis* nov. | - | - | - | + |
| *Gerovilia shinanoensis* nov. | + | + | - | - |

¹ 関谷
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Anomia pseudostruncata nov. + − + +
Nama (Namaopsis) sanchuensis nov. ? ? + +
Glauconia sp. − − − +
Melania cancellata nov. + − + −

Of these twelve species and one variety of Lamellibranchs and three species of Gastropods, Cyrena radiostriata, C. olshaei, C. naumannii, Corbicula (Veloculina?) sanchuensis, Perna sanchuensis, Anomia pseudostruncata, and Nama (Namaopsis) sanchuensis are very common, though sometimes wanting in one or another of the four localities. None of the species is yet found in the overlying Ishidō and Kawarazawa Groups.

From the Ishidō Group, we have now thirteen species of Lamellibranchs, two species of Gastropods, and seven species of Ammonites, as the following list shows:

<table>
<thead>
<tr>
<th>Ishidō</th>
<th>Shiroi</th>
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<tbody>
<tr>
<td>Nucula ishidoensis nov.</td>
<td>+</td>
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<tr>
<td>Nuculana sanchuensis nov.</td>
<td>+</td>
</tr>
<tr>
<td>Trigonocera (?) obsolete nov.</td>
<td>+</td>
</tr>
<tr>
<td>Grammatodon yokoyamai nov.</td>
<td>+</td>
</tr>
<tr>
<td>Trigonia pocilloformis Yok.</td>
<td>+</td>
</tr>
<tr>
<td>Astarte sanchuensis nov.</td>
<td>+</td>
</tr>
<tr>
<td>&quot; subseptata nov.</td>
<td>−</td>
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<tr>
<td>Cardium ishidens nov.</td>
<td>+</td>
</tr>
<tr>
<td>Panopea aii. gurgites (Brong.)</td>
<td>+</td>
</tr>
<tr>
<td>Gervillia harada (Yok.)</td>
<td>+</td>
</tr>
<tr>
<td>Lima (Limatula) ishidensis nov.</td>
<td>+</td>
</tr>
<tr>
<td>Pecten (Neithia) cfr. atavus Roem.</td>
<td>+</td>
</tr>
<tr>
<td>Moliola ishidensis nov.</td>
<td>+</td>
</tr>
<tr>
<td>Cerithium sanchuense nov.</td>
<td>+</td>
</tr>
<tr>
<td>Surcula sp.</td>
<td>+</td>
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<tr>
<td>Simbrishites kochii nov.</td>
<td>+</td>
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<tr>
<td>Desmoceras (?) pseudodifficile nov.</td>
<td>+</td>
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<tr>
<td>Ancyloceras (?) sp.</td>
<td>+</td>
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<tr>
<td>Crioceras yagi nov.</td>
<td>+</td>
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<tr>
<td>Leptoceras cfr. pumilum Uehlig</td>
<td>+</td>
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<tr>
<td>&quot; asiaticum nov.</td>
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<tr>
<td>Pulchelitia ishidensis nov.</td>
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</table>

Of these twenty-two species, Nucula ishidoensis, Nuculana sanchuensis, Grammatodon yokoyamai, Trigonia pocilloformis, Cardium ishidensis, and Cerithium sanchuense are very common. Ammonites are rather rare. Three species (Grammatodon yokoyamai, Trigonia pocilloformis, and Gervillia harada) are also found in the overlying Kawarazawa Group, while one (Astarte subseptata) is replaced by its variety (var. costata).

The Kawarazawa Group contains six species and one variety of Lamellibranchs, one species of Gastropod, and four species of Ammonites, namely:

<table>
<thead>
<tr>
<th>Kawarazawa</th>
<th>Ōze</th>
<th>Otomo</th>
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<tbody>
<tr>
<td>Grammatodon yokoyamai nov.</td>
<td>+</td>
<td>+</td>
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<tr>
<td>Trigonia pocilloformis Yok.</td>
<td>?</td>
<td>+</td>
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<tr>
<td>Trigonia hokkaidoana Yehara?</td>
<td>+</td>
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<tr>
<td>Astarte subseptata var. costata nov.</td>
<td>+</td>
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<tr>
<td>Gervillia forbesiana D'Orb.</td>
<td>+</td>
<td>+</td>
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<tr>
<td>&quot; harada (Yok.)</td>
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<td>+</td>
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</table>
Of these twelve species, one alone is obtained in the upper division, while all the others are derived from the lower. The ammonite and *Capulus (?) annulatus* are rare and all the others are common.

The Lower Cretaceous fauna from the other districts of Japan are not yet well known to us, except *Trigonia*. *Trigonia* is represented by numerous allied types; the species and varieties distinguished by previous authors, however, need revision, and are not taken into account at this place. *Trigonia* excluded, there are at least thirteen species common to the Sanchū Graben and the other districts, as the following list shows:

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<tr>
<td><em>Cyrena shiraiensis</em></td>
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<td><em>Cyrena radiodistriata</em></td>
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<tr>
<td><em>Cyrena osukhai</em></td>
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<tr>
<td><em>Corbicula (Velorina ?) sanchuensis</em></td>
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<td><em>Gervillia shinoensis</em></td>
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<td><em>Pharellia (?) sp.</em></td>
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<td><em>Peclen (Neithia) cf. alatus</em></td>
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<td><em>Ostrea diluviana</em></td>
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<tr>
<td><em>Gervillia forbesiana</em></td>
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<td><em>Lakeda</em></td>
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<tr>
<td><em>Asarte subsenecta var. costata</em></td>
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<tr>
<td><em>Grammatolen yokoyamae</em></td>
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</table>
II. DESCRIPTION OF FOSSILS

LIST OF THE FOSSILS DESCRIBED

Lamellibranchiata

_Nucula ishidoensis_ YABE and NAGAO, sp. nov.
_Nuculana sanchuensis_ YABE and NAGAO, sp. nov.
_Arca shinanoensis_ YABE and NAGAO, sp. nov.
_Trigonocarca (?) obsoleta_ YABE and NAGAO, sp. nov.
_Grammatodont yokoyamae_ YABE and NAGAO, nom. nov.
_Trigonia pociliformis_ YOKOYAMA
    _hokkaidoana_ YEHARA (?)
_Astarte shinanoensis_ YABE and NAGAO, sp. nov.
    _subsenecta_ YABE and NAGAO, sp. nov.
    _subsenecta var. estolia_ YABE and NAGAO, var. nov.
_Cardium ishidoense_ YABE and NAGAO, sp. nov.
_Cyrena nasumanni_ NEUMAYR
    _ostulai_ YABE and NAGAO, sp. nov.
    _radiatostriata_ YABE and NAGAO, sp. nov.
    _shiroiensis_ YABE and NAGAO, sp. nov.
    _shiroiensis var. alfa_ YABE and NAGAO, var. nov.
_Corbicula (Velorbitina ?) sanchuensis_ YABE and NAGAO, sp. nov.
_Pharella (?) sp. indet.
_Homoqua (?) dubia_ YABE and NAGAO, sp. nov.
_Panopaea sp. aff. P. gurgites_ (BRONGN.)
_Myophoka cfr. semicosata_ (AG.)
_Perna sanchuensis_ YABE and NAGAO, sp. nov.
_Gervillia forbesiana_ D'ORB.
    _karada_ (YOKOYAMA)
    _shinanoensis_ YABE and NAGAO, sp. nov.
_Lima (Lina) ishidoensis_ YABE and NAGAO, sp. nov.
_Pecten (Neitha) sp. cfr. P. (N.) atavus_ ROEMER
_Anonia pseudotruncata_ YABE and NAGAO
_Ostrea diolithiana_ L.
_Modiola (?) ishidoensis_ YABE and NAGAO, sp. nov.

Gastropoda

_Natica (Amauroopsis) sanchuensis_ YABE and NAGAO, sp. nov.
_Sureula_ sp. indet.
_Glaucocina_ sp. indet.
Cretaceous Mollusca from the Sanchū-Graben in the Kwantō Mountainland, Japan

Cerithium sanchuense YABE and NAGAO, sp. nov.
Capulus (?) annulatus YOKOYAMA
Melanita cancellata YABE and NAGAO, sp. nov.

Cephalopoda

Lytoceras sp. indet.
Hamites sp. indet.
Pseudoaynella otsukai YABE and SHIMIZU, sp. nov.
Simbristes kohibei YABE and SHIMIZU, sp. nov.
Desmoceras (?) pseudodiscile YABE and SHIMIZU, sp. nov.
Amyloceras (?) sp.
Toxoceras (?) sp.
Cruciceras yagi YABE and SHIMIZU, sp. nov.
Leptoceras cfr. pumilum UEHLIG

... asiaticum YABE and SHIMIZU, sp. nov.

Psilohelia ishidoiensis YABE and SHIMIZU, sp. nov.

Lamellibranchiata

Nucula, LAM.

Nucula ishidoiensis YABE and NAGAO, sp. nov.

Pl. XIII (11), Figs. 46, 47

Dimensions:

<table>
<thead>
<tr>
<th>Height</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 mm.</td>
<td>16 mm.</td>
</tr>
</tbody>
</table>

Shell obliquely ovate, obliquely truncated behind, relatively short, convex; posterior part short; postero-dorsal margin deeply excavated beneath umbo, the cardinal slightly arched, the anterior narrowly rounded, and the ventral broadly curved, passing with an abrupt curvature into the posterior. Umbo subterminal, not prominent; area deep, broadly ovate; lunule narrow-lanceolate, limited by a ridge; adductor muscle-scars deep, semicircular; pallial line distinct, simple; inner margin smooth. Surface ornamented with fine concentric lines of growth. Hinge strong, with about 19 anterior and about 5 strong posterior teeth. Test thick.

The present species seems to resemble N. meijeri GARDN.1 from the Lower Greensand of England, but its posterior margin is more broadly rounded, N. gabbii STANTON2 from the Upper Knoxville Group of California and N. abbensii d'OHR.3 from the Gault of France and England are two

species allied to ours, but the first of these foreign forms is distinguished by its more elongated shell with the anterior margin more gently sloping backwards, and the second by its less convex shell.

Locality: Ishidô.

Horizon: The Ishidô Group.

Nuculana, Link.

Nuculana sancruensis Yabe and Nagao sp. nov.

Pl. XII (1), Figs. 21–23

Dimensions:

<table>
<thead>
<tr>
<th>HEIGHT</th>
<th>LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 mm.</td>
<td>17 mm.</td>
</tr>
<tr>
<td>10 mm.</td>
<td>14 mm.</td>
</tr>
<tr>
<td>6 mm.</td>
<td>11 mm.</td>
</tr>
</tbody>
</table>

Shell elongate ovate, inequilateral, posterior side being a little longer than anterior, convex, with compressed posterior portion; anterior margin rounded, the ventral broadly convex, and the antero-dorsal slightly arcuate; postero-dorsal a little concave, the posterior prominently ascending, pointed above; umbo rather broad, not prominent, with rounded ridge extending from it to the postero-ventral extremity and bordering a slightly concave posterior area; lunule indistinct; escutcheon elongate-lanceolate; inner margin of valve smooth; surface smooth, except for fine, crowded concentric lines. Test thin.

The present species does not show pallial sinus as is often the case in fossils of this group, and it is not certain to which of Yoldia or Leda the present species may belong.1 Yoldia striatula Forbes² from the Arrialur Group of S. India somewhat resembles ours, but is less arcuated along the ventral margin and less prominent at the umbal part. Nuculana subrecuva (Phil.)³ from the Neocomian of England is more inflated and has a narrower umbal angle.

Localities: Ishidô and Shirôi.

Horizon: The Ishidô Group.

Area, Lam.

Area shinacoensia Yabe and Nagao sp. nov.

Pl. XIII (II), Figs. 33–35

Dimensions:

<table>
<thead>
<tr>
<th>HEIGHT</th>
<th>LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0 mm.</td>
<td>10.0 mm.</td>
</tr>
<tr>
<td>4.5 mm.</td>
<td>9.0 mm.</td>
</tr>
</tbody>
</table>

1 Nuculana is here used after H. Woods, in a broad sense including Yoldia and Leda.
2 R. Stoliczka: “Cretaceous Pelmepods of S. India,” Palaeontologia Indica, Vol. III, p. 3-23, Pl. IV, fig. 2; Pl. XVII, fig. 6.
Cretaceous Mollusca from the Sanchū-Graben in the Kwantō Mountainland, Japan

Shell subquadrate, transversely elongate, length being nearly twice the height, inequilateral, anterior part being shorter than the posterior, convex in the umbonal region but flattened ventrally; a rounded, but distinct, posterior carina extending from the umbo to the postero-ventral extremity, posteriorly to it the shell is flattened; an anterior carina less distinct than the posterior, running from the umbo to the antero-ventral extremity; a broad, very indistinct, depression extending near the umbo to the middle of the ventral margin; anterior margin slightly convex, nearly forming a right angle with the hinge-line; ventral margin subparallel with hinge-line, a little sinuated at the middle part; posterior margin nearly straight, slightly oblique; postero-ventral extremity narrowly rounded; unmo prominent, incurved, lying one-third of the length from the anterior extremity. Hinge-plate nearly straight, with numerous, relatively strong teeth; teeth diverging, becoming distinctly oblique near both ends; surface ornamentation unknown.

Although the ornamentation is unknown, the present species resembles A. sancta-crucis PICT. & CAMP. from the Valanginian of Ste. Croix, Switzerland, the Lower Greensand of England, and A. casteloni d'ORB. from the Neocomian of France and Switzerland and the Lower Greensand of England, but is distinguished from the first of these foreign species by having a less convex shell with the ventral margin and hinge line subparallel, and from the second by having a shorter shell and a sinuous ventral margin. A. flistrina STOL. from the Utatur Group of S. India and A. tehannensis STANTON from the Upper Knoxville of California are two other examples of allied species, the former, however, being larger and more rounded at the postero-ventral extremity, and the latter not having a sinuated ventral margin. A. aquigranensis MÜLLER, reported by HOLZAPFEL from the Senonian of Aix la Chapelle, bears some resemblance to ours, but is distinguished by its shell being transversely more elongate and its posterior margin less oblique, while the angle between its anterior margin and hinge line is more acute.

Localities: Bōmeiki and Shiroi.

Horizon: The Shiroi Group.

Trigonoarea, CONRAD.

Trigonoarea (?) obsoleta YABE and NAGAO sp. nov.

Pl. XII (1), Fig. 24

Dimension:

<table>
<thead>
<tr>
<th>Height</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 mm.</td>
<td>38 mm.</td>
</tr>
</tbody>
</table>

Shell moderately convex, subquadrate, transversely elongate, inequilateral; anterior margin rounded, the ventral very broadly convex and nearly straight at its posterior half, forming an acute angle with the posterior; posterior margin straight, oblique, and slightly sinuate at its lower portion; hinge-line shorter than the length of the valve, forming an obtuse angle with posterior margin; umbo

---

prominent, curved inwards and forwards, with a sharp keel extending from it to the postero-ventral extremity; posterior area compressed, and concave along its median line. Ligamental area narrow; hinge-plate gently curved, probably with numerous teeth, of which the anterior ones are unknown, and a few on the posterior end are decidedly oblique; surface ornamented all over with fine concentric lines of growth, besides fine, crowded radial ribs on the posterior area and about ten or more slightly stronger radial ribs on and along the umbalonal keel.

The present species resembles *T. gamma* FORBES\(^1\) from the Utatur Group and *T. trichinopolytensis* FORBES\(^2\) from the Trichinopoly Group, both of S. India, but differs from the first of the latter two by its shell being more elongated, less inflated and provided with radial ribs on the posterior area, and from the second by its shell having a less oblique posterior margin, a more rounded postero-ventral extremity and being quite smooth, except the posterior portion. *T. szaboi* PETHO\(^3\) from the Upper Cretaceous of Eastern Slavonia is another example of a similar species, but it is provided with a more sharply angulated postero-ventral extremity and a radially sculptured antero-dorsal surface.

Locality: Ishidō. A specimen of a left valve, lacking a part of hinge and posterior extremity.

Horizon: The Ishidō Group.

**Gammamatodon, Meek.**

**Gammamatodon yokoyamae** YABE and NAGAO nom. nov.

Pl. XII (1), Figs. 12-13, 25


Dimensions:  

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>HEIGHT</th>
<th>LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 mm.</td>
<td>26 mm.</td>
<td></td>
</tr>
<tr>
<td>17 &quot;</td>
<td>25 &quot;</td>
<td></td>
</tr>
<tr>
<td>16 &quot;</td>
<td>24 &quot;</td>
<td></td>
</tr>
</tbody>
</table>

Shell subquadrate, transversely elongated, being longest along the hinge-line, inequilateral, anterior part being a little shorter, convex; anterior margin oblique, slanting downwards and backwards, passing gradually into the ventral in a broad curve, and upwards forming an acute angle with the hinge-line; ventral margin nearly straight, subparallel to the hinge-line; posterior extremity truncated almost vertically or but slightly oblique, above forming an angle a little greater than 90° with the hinge-line, and below a rounded angle less than 90° with the ventral. Umbo relatively prominent, incurred, with a sharp, smooth carina extending from it to the postero-ventral extremity; the postero-dorsal area behind the carina excavated. Hinge-area rather broad with numerous, fine, crowded, inverted v-shaped grooves. Surface of the right valve ornamented with numerous, distinct, fine radial ribs in alternation with much narrower interspaces, as well as with fine lines of growth; ribs on the median part of valve usually alternated with one or two narrower interstitial striae; ribs on the anterior part about 5, slightly broader, very sharp, elevated, finely crenulated, and separated by broad, flat interspaces with one or more very fine interstitial striae;

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1 P. STOLICZKA: Op. cit., p. 354; Pl. XX, fig. 45; Pl. L, fig. 7.
2 P. STOLICZKA: Op. cit., p. 355; Pl. XX, figs. 3, 8, 9, 10.
posterior part of valve behind the carina bearing numerous crowded, fine, radial strie crossed by fine concentric lines, and of these strie usually three are broader and more prominent than the others. Inner margin of valve smooth. Teeth curved obliquely outwards from under the umbo, 3 very long posterior teeth parallel to the hinge-line, 3 or 4 oblique, short anterior teeth, and a few slightly oblique, fine central teeth under the umbo.

YOKOYAMA reported the occurrence of a species of Cucullaea in his material derived from near Kagahara. He compared it with C. striatella Mich., which is now usually regarded as a synonym of Grammatodon carinatus (Sow.). Though his figured specimen does not show the anterior portion of the valve, yet it is apparently identical, we believe, with the present specimens before us from Ishidō, Ōze, and Kawarazawa, which differ a little from G. carinatus in having a relatively shorter shell, narrower ribs, and broader interspaces intervened by fine strie. Moreover, in ours the posterior margin seems to be less oblique and the posterior area to bear finer strie. There are, however, certain specimens of the foreign form approaching ours in having three distinct ribs on the posterior area, as those figured by A. WOLLEMMANN from the Neocomian of Brunswick.

G. carinata ranges from the Upper Greensand to the Cenomanian in England; it is also known from the Gault of France and Switzerland, as well as the Neocomian of Germany.

G. sacaris (LEYMERIE) from the Neocomian of England, France, and Switzerland, and G. jonesi (TATE) from the Lower Cretaceous of S. Africa are two other examples of allied species, which are distinguished from ours in their shorter shell and less acute angles sustained between the anterior and the hinge-line. G. jonesi is, moreover, provided with broader radial ribs than ours.

Locality: Ishidō, Shiroi, Kawarazawa, and Ōze.

Horizons: The Ishidō and Kawarazawa Groups.

Trigonia, BRUG.

Trigonia pociliformis YOKOYAMA


Locality: Ishidō, Ōze, and Shiroi; doubtful specimens from Ōze and Kawarazawa.

Horizons: The Ishidō and Kawarazawa Groups.
Trigonia hokkaidoana Yehara?

Pl. XIV (III), Fig. 3

Compare:


Locality: Kawarazawa and Ōze.

Horizon: The Kawarazawa Group.

Trigonia hokkaidoana and T. pociliformis are two closely allied species belonging to the section Scabre. The distinction between the typical example of T. hokkaidoana derived from Miyako and those of T. pociliformis derived from Soyama and Sendaihito, province of Tosa in Shikoku, is relatively easy, the former having the anterior border of the valve vertically more elongated, costae and costelle more numerous, and the crenulations on the costae relatively finer than the latter species. Moreover, the posterior costae are arranged obliquely to the external margin of area in T. hokkaidoana and usually almost perpendicularly in T. pociliformis, and the costae on the middle part of valve diverge conspicuously near the anterior and antero-ventral border in the former and less so in the latter.

T. pociliformis is reported from several localities other than the two in Tosa, and the specimens from the Katsura-gawa district in the province of Awa (Shikoku) are very variable in the course and the number of the costae, some of the specimens having relatively more numerous, oblique costae than the typical specimens from Tosa, and being related to T. hokkaidoana. Thus it is sometimes very difficult, or even impossible, to distinguish T. hokkaidoana from T. pociliformis when the specimens are deformed or eroded on the surface.

Mr. Yehara extended the species T. pociliformis to include specimens from the Goshonoura Group of Goshonoura-jiima in Kyushu,1 which resemble T. hokkaidoana more than T. pociliformis in the arrangement of the costae. The specimens from Goshonoura-jiima, however, represent a distinct species, being characterized by having the posterior part of the area finely pustulated and the costae sharp and finely crenulated. Nagao distinguished them from either T. hokkaidoana or T. pociliformis under a new specific name, T. pustulosa.2

T. pociliformis var. sashinensis Yabe and Nagao3 from the Cape Khoi Bed on the west coast of North Sakhalin is quite similar to T. pociliformis in outline and sculpture, and is distinguished from the latter by its lower shell which has narrower and more distant costae and a narrower area.

The specimens of Trigonid from Ishidō and Shiroi are quite indistinguishable from the typical T. pociliformis, and almost identical with those found in the Trigonid Sandstone of the Katsura-gawa district. On the other hand, some of the specimens from Kawarazawa and Ōze, which are all imperfect, being represented by more or less deformed external and internal casts, seem to be indistinguishable from the typical hokkaidoana, though some others show rather an affinity to T. pociliformis from the Katsura-gawa.

2T. Nagao: "On Some Cretaceous Fossils from the Islands of Amakusa, Province of Higo" (manuscript), 1915.
YOKOYAMA early described Trigonia sp. from the vicinity of Kagahara and subsequently pointed out its identity with his T. pocilliformis; and YEHARA cited the occurrence of T. pocilliformis in the Cretaceous of Kawarazawa, Ishidō, and Kagahara in one of his papers on Japanese Trigonia. 1

Astarte, Sow.

Astarte shinanoensis YABE and NAGAO sp. nov.

Pl. XIII (II), Figs. 29, 30

<table>
<thead>
<tr>
<th>Dimensions:</th>
<th>HEIGHT</th>
<th>LENGTH</th>
<th>THICKNESS OF ONE VALVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 mm.</td>
<td>13 mm.</td>
<td>5 mm.</td>
<td></td>
</tr>
<tr>
<td>12 &quot;</td>
<td>10 &quot;</td>
<td>? &quot;</td>
<td></td>
</tr>
</tbody>
</table>

Shell evenly convex all over the surface, orbicular in outline, almost equilateral, slightly higher than long; antero-dorsal margin concave, steeply sloping downwards, and the postero-dorsal long, a little convex; anterior, ventral, and postero-ventral margins well rounded; umbo large, very prominent, curved inwards and forwards; lunule deep, but not distinctly circumscribed; escutcheon narrow, limited by a sharp ridge; adductor muscle-scars distinct, of which the anterior one is semicircular and the posterior almost circular; pallial sinus simple; inner margin of valve coarsely crenulated. Hinge-plate rather narrow, with two diverging cardinal teeth in each valve. Test moderately thick.

The present species recalls some forms of Cardita and Cardium in the external features, but its dentition is that of Astarte. It resembles A. nupharenensis Woods 3 from the Lower Greensand and A. senecta Woods 3 from the Speeton Clay of England, but the first of the latter two is lower and crenulated along the inner margin, and the second is not only likewise lower, but less inflated, being provided with a less prominent umbo, and has strong concentric ribs on the surface.

Locality: Ishidō. Five internal moulds with test still attached.

Horizon: The Ishidō Group.

Astarte subsenecta YABE and NAGAO sp. nov.

Pl. XIII (II), Figs. 14–16; Pl. XIV (III), Figs. 10, 11

<table>
<thead>
<tr>
<th>Dimensions:</th>
<th>HEIGHT</th>
<th>LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>ca. 16 mm.</td>
<td>19 mm.</td>
<td></td>
</tr>
<tr>
<td>15 &quot;</td>
<td>18 &quot;</td>
<td></td>
</tr>
<tr>
<td>9 &quot;</td>
<td>12 &quot;</td>
<td></td>
</tr>
</tbody>
</table>

Shell subtrapezoid, slightly longer than high, compressed, very inequilateral, posterior part being much shorter than the anterior; anterior extremity narrowly rounded and the posterior truncated almost vertically; antero-dorsal margin nearly straight or slightly concave, steeply sloping downwards; postero-dorsal margin straight, very gently sloping backwards, forming an obtuse angle.

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with the posterior; ventral margin very broadly convex, passing evenly into the anterior and more abruptly into the posterior. Umbil small, compressed, not prominent, with a rounded carina extending from it to the postero-ventral extremity, limiting the flattened postero-dorsal part of valve. Inner margin of valve crenulated. Surface ornamented with very strong, broad, concentric ribs in alternation with broad concave grooves as broad as the ribs; covered by numerous fine concentric lines of growth. Ribs sharp near the umbo, these and the intervening grooves becoming obsolete towards the ventral margin where the surface is concentrically undulated; usually the ribs confined only to a small portion near the umbo, being obsolete elsewhere.

We have a number of specimens from the Kawarazawa Group exposed at Kawarazawa and Ōze, which have many features in common with this species, but differing in having a little more convex shell and in being provided with prominent concentric ribs almost all over the surface. We are intending at present to distinguish them from the type species as a varietal form under a name var. costata (Pl. XIV (III), Fig. 10).

The present species, especially the variety, closely resembles A. senecta Woods¹ from the Neocomian of England, but is distinguished by its more compressed shell, with the postero-dorsal margin less arcuated and the posterior extremity more sharply truncated.

Localities: The type species from Ishidō and the variety from Kawarazawa and Ōze.

Horizons: The Ishidō (the type species) and Kawarazawa Group (the variety).

Cardium, LIN.

Cardium ishidoense Yabe and Nagao sp. nov.

Pl. XII (I), Figs. 9, 16, 18

Dimensions: Height Length

<table>
<thead>
<tr>
<th></th>
<th>mm.</th>
<th>ca. 30 mm.</th>
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</thead>
<tbody>
<tr>
<td>17</td>
<td>&quot;</td>
<td>15 &quot;</td>
</tr>
<tr>
<td>16</td>
<td>&quot;</td>
<td>12 &quot;</td>
</tr>
<tr>
<td>10</td>
<td>&quot;</td>
<td>9 &quot;</td>
</tr>
</tbody>
</table>

Shell variable from ovate to subtrapezoid, higher than long, nearly equilateral, very convex, thickness of both valves united being sometimes greater than height of valve; anterior margin rounded, the posterior vertically truncated, and the ventral moderately convex; postero-dorsal margin almost straight, forming a right angle with the posterior; postero-ventral extremity bluntly angulated; umbo very prominent, much incurved; median part of the valve very convex and limited by the concave posterior and anterior; inner margin of valve finely crenulated. Surface ornamented with very fine, crowded, slightly elevated, flat, radial ribs and narrow grooves in alternation; ribs on the concave posterior portion of valve narrower, more elevated, and separated by broader grooves than elsewhere. Test thin.

Though all the specimens are deformed and the contour of valves is much obliterated, yet they seem to represent a new species which resembles C. ibbotsoni Forbes² from the Lower Greensand

of England and the Lower Aptian of Switzerland, and C. cotulidum d’Orb., from the Lower Greensand of England and the Neocomian of France, Germany, and Switzerland, but differs from the latter two in its shell being more inflated, with the posterior extremity more sharply truncated and posterior portion more concave. C. constanti d’Orb., from the Gault of France is another allied form, but has its radial ribs stronger and more distant, while C. remondianum Gabb 3 from the Chico of California is more rounded along the ventral margin and has its umbo less prominent than ours.

Localities: Shiroi and Ishidō.

Horizon: The Ishidō Group.

Cyrena, Lam.

Cyrena naumannii Neumayr.

Pl. XII (I), Figs. 6, 17, 28; Pl. XIII (II), Figs. 25, 25a; Pl. XIV (III), Figs. 23, 23a, 24, 26, 29, 30, 31.


Dimensions:

<table>
<thead>
<tr>
<th>Height</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>27 mm.</td>
<td>40 mm.</td>
</tr>
<tr>
<td>30 &quot;</td>
<td>40 &quot;</td>
</tr>
<tr>
<td>47 &quot;</td>
<td>58 &quot;</td>
</tr>
<tr>
<td>77 &quot;</td>
<td>? &quot;</td>
</tr>
</tbody>
</table>

Three large species of Cyrena have been described by Neumayr, as early as 1890, from the Cyrena bed of the Ryoseki Series exposed in the valley of Yanagidani, Menuiki, in the Katsura-gawa district of Awa (Shikoku); they are

Cyrena naumannii Neumayr

... gravida Neumayr

... lithocardium Neumayr

Of these, the first and second forms are closely allied, and Neumayr already stated the possibility of their being varieties of one and the same species. On the other hand, C. gravida is distinguished, according to him, from C. naumannii in having its umbo more anteriorly and more curved forwards, and its valve more elongated posteriorly. We have a number of more perfect specimens of Cyrena collected from the original locality, Yanagidani in Shikoku. Most of them are found to agree with the figures of C. naumannii Neumayr, but there is a small specimen closely related to C. gravida. All the specimens from Shinano and Kōzuke also conform well with the figures of C. naumannii given by Neumayr, though very variable in relative height of valve; the differences in outline among these specimens may partly be individual variation, though no doubt they are due to some extent to preservation.

The following description is based on our materials now on hand from Shinano and Kōzuke, as well as from Yanagidani, Shikoku, to amend the specific diagnosis given by Neumayr.

Shell equivale, moderately or slightly inequilateral, rounded trigonal to ovate, moderately longer than high or sometimes higher than long; anteriorly somewhat produced or short, flattened; posteriorly inflated and sloping down more or less steeply to acute margin; posterior end usually truncated but often narrowly rounded, and the anterior evenly curved; ventral border slightly convex in its anterior half and nearly straight, or sometimes showing a tendency to be a little concave in its posterior half; umbones large, prominent, and usually lying at about one-third of the length of valve from the anterior end, curved inwards and forwards. Surface almost smooth, only provided with rude lines of growth. Test thick. Hinge-plate large; dentition \( \frac{3}{2} + \frac{3}{2} \); middle cardinal broadest and posterior one slender in both valves; lateral teeth not transversely striated. Lunule sometimes limited with indistinct ridge; escutcheon not well defined; pallial line simple; inner margin of valve smooth.

Localities: Bōmeki, Shiroi, and Hachimanzawa.

Horizon: The Shiroi Group.

**Cyrena osukai** Yabe and Nagao sp. nov.

Pl. XIII (II), Figs. 20-24

<table>
<thead>
<tr>
<th>Dimensions:</th>
<th>HEIGHT</th>
<th>LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12 mm.</td>
<td>20 mm.</td>
</tr>
<tr>
<td></td>
<td>12 &quot;</td>
<td>17 &quot;</td>
</tr>
<tr>
<td></td>
<td>11 &quot;</td>
<td>18 &quot;</td>
</tr>
<tr>
<td></td>
<td>10 &quot;</td>
<td>15 &quot;</td>
</tr>
<tr>
<td></td>
<td>8 &quot;</td>
<td>13 &quot;</td>
</tr>
</tbody>
</table>

Shell small, equivale, compressed, trapezoidal, very inequilateral, anterior side being about one-third of the length of the valve; much longer than high, the ratio of height to length being very variable; antero-dorsal margin almost straight, slightly concave beneath umbo, the postero-dorsal long, also straight and nearly as oblique as the antero-dorsal; anterior end rounded and posterior truncated vertically; ventral margin broadly convex, though usually situated near its posterior end and sometimes being nearly straight in its posterior half; umbo small, pointed, lying at about one-third of the length of the valve from the anterior end, with a rounded but distinct carina extending from it to the postero-ventral end and limiting a flattened posterior area; lunule lanceolate, and escutcheon narrow, elongate, both being deep and bordered by a sharp ridge; inner margin smooth; pallial sinus simple. Surface ornamented with distant, regular, narrow, elevated, somewhat crenulated concentric ribs, separated by broad, flat interspaces with a number of crowded, very fine, concentric lines which are prominent on the umbonal carina and the posterior area; lunule and escutcheon smooth except for fine concentric lines. Hinge-plate narrow, with three cardinal teeth in each valve, of which the left posterior and right anterior are very small or nearly obsolete; as well as a very elongated anterior and a posterior lateral tooth.

The present species certainly belongs to *Cyrena*, though it externally resembles *Crassatella, Astarte*, and some species of *Corbula*, for instance *Corbula manleyei* Weller\(^1\) from the Raritan Clays, and

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Cretaceous Mollusca from the Sanchi-Graben in the Kwanto Mountainland, Japan 51 (19)

*C. inflexa* (Römer)*2* and *C. suberis* (Römer), both from the Wealden of Germany. Among *Cyrena*, reported by Oppenheim*2* from the Upper Cretaceous of Provence, *C. concinna* Sow. resembles our forms in the outline of the shell, but is smaller and seems to have a different ornamentation, the concentric ribs being relatively broader and less distant than ours. Our species is allied to *C. marioni* Chopf*4* from the Senonian of Portugal, but has a relatively longer shell with its umbo more compressed and smaller and its posterior umbonal carina less distinct.

Localities: Bômeki, Kagikake, and Shiroi.

Horizon: The Shiroi Group.

**Cyrena radiatostriata** Yabe and Nagao sp. nov.

Pl. XII (1), Figs. 29-35; Pl. XIII (1) Fig. 45

<table>
<thead>
<tr>
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<th>Height</th>
<th>Length</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td>17.0 mm.</td>
<td>19.0 mm.</td>
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</tbody>
</table>

Shell trigonally ovate, moderately inequilateral—a little longer than high, convex; antero-dorsal margin slightly concave beneath umbo, steeply sloping down, and the postero-dorsal indistinctly arcuated; anterior margin rounded, and the ventral broadly convex and faintly sinuated in its posterior portion; posterior extremity shortly truncated. Umbo convex, prominent, curved inwards and forwards, with a rounded, indistinct carina extending from it to the postero-ventral extremity; valve faintly depressed in front of the carina. Lunule broad, flat, limited by an impressed line; escutcheon narrow-lanceolate, long, bounded by a sharp ridge; inner margin of valve smooth. Surface, except the smooth lunule and escutcheon, ornamented with distinct, elevated, sharp, narrow, granulated, regular concentric ribs alternated with broad, flat interspaces which bear a number of very fine concentric lines; also, with rather distant radial strie which give rise to a lattice sculpture on the concentric ribs and lines.

The present species differs from *C. otsukai* Yabe and Nagao in having a more convex shell with a more prominent and more incurved umbo, and radial sculpture. *C. paraoda* Steinmann*8* from the Middle Cretaceous of Peru (the Albion in age according to Steinmann and the Gault according to Gerhardt*6* who doubted the validity of its generic identification) is provided with a similar sculpture, but is more inequilateral and has more concave concentric ribs. *C. mantelli* Dunk*7* and *C. angulata* Römer*1* from the Wealden of Germany are allied to ours, but are transversely more

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3 F. Oppenheim: "Beiträge zur Binnenfauna der provenzalischen Kreide, Palaeontographica, Vol. XLII, 1895, p. 356, Pl. XVIII, figs. 21, 22.
Hisatsune Yabe, Takumi Nagao, and Saburo Shimizu

eelongated without the radial sculpture. On the other hand, C. solitaria ZITTEL \(^1\) and C. marioni CHOFFAT \(^2\) from the Senonian of Portugal are other examples of species similar to ours, but the first of these foreign forms has a less produced anterior part of valve with more crowded, finer concentric ribs, and the second has a shell which is more elongated and posterior extremity more distinctly rostrate.

Localities: Hachimanzawa, Shiroi, and Kagikake.

Horizon: The Shiroi Group.

Cyrena shiroensis YABE and NAGAO sp. nov.

Pl. XIV (III), Figs. 4–6, 19, 20, 22, 25

Dimensions: 

<table>
<thead>
<tr>
<th>HEIGHT</th>
<th>LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 mm.</td>
<td>21 mm.</td>
</tr>
<tr>
<td>18 &quot;</td>
<td>20 &quot;</td>
</tr>
</tbody>
</table>

Shell trapezoid, convex, with flattened sides, longer than high, inequilateral, anterior part being moderately shorter; anterior extremity evenly rounded; posterior extremity obliquely or vertically truncated, the margin forming above a blunt angle with the postero-dorsal, and downwards passing into the ventral in an abrupt curvature; postero-dorsal margin long, nearly straight, and the ventral slightly convex in its anterior portion, but almost straight in its posterior; umbo convex, moderately prominent, curved inwards and forwards, with a prominent carina extending from it to the postero-ventral extremity and limiting a flat postero-dorsal part of the valve; lunule deep, broad, cordate, not depressed; escutcheon long, lanceolate, excavated and limited by a ridge; adductor muscle-scars ovate, distinct; pedal muscle-scar deep; pallial line simple. Inner margin of valve smooth. Hinge of the right valve with strong middle and nearly obsolete anterior and posterior cardinal teeth; that of the left valve with strong middle, narrow posterior, and obsolete anterior cardinal teeth; anterior lateral tooth in both valves not well developed, the posterior very elongated. Surface ornamented with fine concentric lines of growth all over, and with distinct, rounded concentric ribs, alternating with concave grooves nearly as broad as the ribs, on the anterior and posterior-dorsal parts, as well as near the umbo.

The present species recalls in its external features certain species of Crassatellites and Corbulina, for instance, Crassatellites candala GABB \(^3\) (Cyrena dufeldii STEINMANN) \(^4\) from the Gault of Peru and Corbulina sublittoralis MEKK and HAYDEN \(^5\) from the Upper Cretaceous of North America. It is distinguished from C. otsukai YABE and NAGAO in its shell's being more smooth and more inflated and in being provided with a more prominent umbo.

Localities: Bōmeki and Shiroi.

Horizon: The Shiroi Group.

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2 P. CHOFFAT: Ibid., p. 97, Pl. 1, figs. 61-67.
Cyrena shiroensis \textit{Yabe and Nagoa} var. \textit{alta} \textit{Yabe and Nagoa} var. nov.

Pl. XIII (II), Fig. 26; Pl. XIV (III), Figs. 15, 28

Dimensions: \begin{tabular}{lll}
          & \textsc{Height} & \textsc{Length} \\
          & 14 mm.        & 13 mm.        \\
          & 15 "          & 15 "          \\
          & 21 "          & 20 "          \\
\end{tabular}

There are a number of specimens closely resembling the preceding species and yet being sufficiently distinguished from it by the shell’s being almost equilateral, nearly equal in height and length, and provided with a more prominent umbo and, usually, more concave antero-dorsal margin. These are, we believe, better regarded as representing a varietal form of the preceding species rather than as a distinct species.

Localities: Shiroi and Bômeiki.

Horizon: The Shiroi Group.

\textbf{Corbicula, Megerle}

(Velortina, Meek)

\textit{Corbicula} (\textit{Velortina} ?) \textit{sancheusensis} \textit{Yabe and Nagoa} sp. nov.

Pl. XII (I), Figs. 8, 8a; Pl. XIII (II), Figs. 8–10, 17, 17a

Dimensions: \begin{tabular}{llll}
          & \textsc{Height} & \textsc{Length} & \textsc{Thickness of one valve} \\
26 mm. & 28 mm.        & 8 mm.        \\
25 "   & 24 "          & ? "          \\
21 "   & 23 "          & 6 "          \\
15 "   & 16 "          & ? "          \\
9 "    & 10 "          & 3 "          \\
5 "    & 5 "           & ? "          \\
\end{tabular}

Shell trigonally ovate, moderately inequilateral, anterior part being shorter; nearly as high as long, very convex; anterior extremity evenly rounded; posterior extremity narrowly rounded or faintly truncated, with its margin passing upwards in a rather gentle curve into the postero-dorsal, and downwards in an abrupt curve into the ventral; postero-dorsal margin short, slightly arcuate, and the antero-dorsal excavated beneath umbo, sloping more steeply down; ventral margin broadly convex. Umbo very convex, prominent, much curved inwards and forwards, not eroded. Luniule deep, broad; pallial sinus deep, acute, ascending; anterior adductor muscle-scar narrow-lanceolate, and the posterior one broad-lanceolate; inner margin of valve smooth. Hinge with three diverging cardinal teeth and two elongated, narrow lateral teeth; the anterior cardinal short, strong, and the anterior lateral rather short and adjacent. Surface ornamented with finely granulated, crowded, narrow concentric striae in alternation with faintly concave grooves.

An internal mould shows that the posterior lateral tooth is finely cross-striated.
Though the present species has a deep sinus, it resembles in many features certain forms of Meek’s Velocirina \(^1\) (which is regarded by Meek and Dall \(^2\) as belonging to Corbicula), for instance, C. (V.) securiis Meek \(^3\) and C. (V.) occidentalis Meek and Hayden \(^4\) from the Upper Cretaceous of North America. The first of these foreign species is, however, more narrowly rounded along the posterior margin, and the second more equilateral than ours.

**Localities:** Bōmeki, Kagisake, Shiroi, and Hachimanzawa.

**Horizon:** The Shiroi Group.

### Pharella, Gray

**Pharella ? sp. indet.**

Pl. XII (I), Figs. 7, 14, 38; Pl. XIII (I), Figs. 12, 13

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>LENGTH</th>
<th>HEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>27.0 mm.</td>
<td>6.5 mm.</td>
</tr>
<tr>
<td></td>
<td>44.0? ..</td>
<td>10.0</td>
</tr>
</tbody>
</table>

Shell very elongated, compressed; inequilateral, the posterior part being moderately longer than the anterior, gaping at both extremities: dorsal and ventral margins nearly straight and parallel; anterior extremity more narrowly rounded than the slightly truncated posterior: umbo small, indistinct from the dorsal margin. No trace of internal oblique ribs beneath umbo.

Surface ornamented with fine lines of growth, otherwise smooth.

There are a number of specimens at our disposal, but they are all very imperfect and do not show the exact features of the hinge, pallial sinus, and muscular impressions. Though the reference of them to a definite genus is thus prevented, yet there is no doubt that they bear a close resemblance to certain forms of Pharella, for example, P. dakotensis Meek and Hayden \(^4\) from the Dakota Group of North America. This American species is distinguishable from ours in being more inequilateral and provided with a narrowly rounded, subtruncated posterior extremity. *P. delicatula Stol.* \(^5\) from the Trichinopoly Group bears also some resemblance to ours, but differs by its posterior extremity being more obliquely truncated and by having an elevated line extending from the umbo to the postero-ventral extremity.

**Localities:** Bōmeki, Kagisake, and Shiroi.

**Horizon:** The Shiroi Group.

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Homomya, AG.

Homomya? dubia YABE and NAGAO sp. nov.

Pl. XII (I), Figs. 11, 39, 39a, 39b; Pl. XIV (III), Fig. 1

Dimensions:

<table>
<thead>
<tr>
<th></th>
<th>HEIGHT</th>
<th>LENGTH</th>
<th>THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>? mm.</td>
<td>26+ mm.</td>
<td>30 mm.</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>43</td>
<td>?</td>
<td></td>
</tr>
</tbody>
</table>

Shell transversely elongated, very inequilateral, posterior part being about three times as long as the anterior, moderately convex; anterior margin well rounded, the ventral broadly convex ascending to the narrowly rounded, but slightly gaping (?) posterior extremity; postero-dorsal margin long, almost straight; umbones not prominent, approximate; no lunule; escutcheon not well defined, long, lanceolate, and shallow; posterior adductor muscle-scars shallow, subcircular; palial sinus moderately broad, deep, and rounded at its apex. Surface almost smooth, except for crowded, delicate lines of growth. Hinge unknown, but apparently very feeble. Test very thin.

We have two imperfect specimens from Hachimanawa and one internal mould from Shiroy. The reference of the present species to Homomya leaves some doubt, as it does not show the hinge peculiar to the genus. It is more elongated than the allied *H. austiensis* SHATTUCK¹ and shorter and less inequilateral than *H. vulgaris* SHATTUCK,² both from the Lower Cretaceous of Texas.

Localities: Hachimanawa and Shiroy.

Horizon: The Shiroy Group.

Panopaea, MÉNARD DE LA GROYE

Panopaea sp. aff. P. gurjites (BRONG.)

Pl. XII (I), Figs. 10, 15, 19, 20

Compare:


Dimensions:

<table>
<thead>
<tr>
<th></th>
<th>HEIGHT</th>
<th>LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>17+ mm.</td>
<td>48 mm.</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>27 ?</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Shell transversely elongate, convex, moderately inequilateral, gaping posteriorly; anterior part inflated, and posterior more or less compressed; anterior margin rounded, posterior subtruncated, the antero-dorsal nearly straight, sloping gently toward the anterior end, the postero-dorsal, slightly concave; ventral margin almost straight, subparallel with the dorsal; umbo small, incurved with a rounded ridge running from it to the postero-ventral end; surface ornamented with strong concentric ribs, and numerous minute granules more or less irregularly disposed.

² G. B. SHATTUCK: Ibid., p. 29, Pl. XVI, figs. 4-5; Pl. XVII.
The present specimens are essentially similar to P. gurgites (Brong.), especially to the variety plicata Sow., from the Lower Greensand, Gaut and Upper Greensand of England and the Lower Cretaceous of continental Europe, and P. clausa Wilck. from the Upper Cretaceous of New Zealand, which is believed by Woods 1 greatly to resemble P. gurgites var. plicata Sow. Owing to bad preservation, our material cannot be brought into detailed comparison with these foreign species, but we believe their affinity to be intimate.

Localities: Ishidō and Shiroy.  
Horizon: The Ishidō Group.

**Myopholas, Douville**

*Myopholas cfr. semicostata* (Ag.)

Pl. XII (I), Fig. 5; Pl. XIII (II), Figs. 1', 11a; Pl. XIV (III), Figs. 21, 27, 27a, 27b

**Compare:**


**Dimensions:**

<table>
<thead>
<tr>
<th></th>
<th>LENGTH</th>
<th>HEIGHT</th>
<th>THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>43 mm.</td>
<td>23 mm.</td>
<td>20 mm.</td>
</tr>
<tr>
<td></td>
<td>37 ()</td>
<td>27? ()</td>
<td>? ()</td>
</tr>
</tbody>
</table>

Shell transversely elongate, ovate, equirevex; very inequilateral, anterior part being one half the length of the posterior; anterior part convex, and the posterior compressed; anterior and posterior margins rounded; antero-dorsal margin concave beneath umbo, sloping steeply downwards, and the postero-dorsal nearly straight, sloping gradually backwards; ventral margin very broadly convex. Umbones curved inwards, and forwards. Surface ornamented with fine lines of growth and narrow, sharp radial ribs separated by broad, concave or flat interspaces, except near the postero-dorsal part of valve. 5 or 6 ribs on the posterior one-third of the surface broadly separated and usually becoming very obsolete toward the smooth area along the posterior border; about 7 ribs on the middle part narrower and rather crowded; 9 ribs on the anterior part most distant. A curved carina runs from the posterior side of umbo to the postero-ventral extremity.

Several more or less imperfect specimens. They represent a species very closely allied to, and almost inseparable from, *M. semicostata* (Ag.) from the Neocomian of Switzerland.

Localities: Bōmeiki, Kagikake, and Hashikubo.  
Horizon: The Shiroy Group.

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Perna, BRUG.

**Perna sanchuensis** YABE and NAGAO sp. nov.

Pl. XII (I), Figs. 1-4

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Height</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ca. 48 mm.</td>
<td>30 mm.</td>
</tr>
<tr>
<td>95 &quot;</td>
<td></td>
<td>&quot;?&quot;</td>
</tr>
</tbody>
</table>

Shell large, subquadrate, higher than long, compressed; left valve more convex than the right. Posterior margin slightly convex or nearly straight, forming an angle a little greater than 90° with the straight hinge-line; ventral margin evenly convex; dorsal part of the anterior margin concave. Valves moderately convex anteriorly and flattened posteriorly; convex anterior part rather broad, running from the umbo to the ventral margin, and more or less distinctly separated from the flattened triangular posterior part. Dorsal half of the anterior marginal parts deeply infected and concave, separated by a sharp ridge from the rest of valve. Umbones acute, close together, projecting beyond the rest of the anterior margin of valve; inner margin of the umbo making an angle of about 50° with the hinge-line and then sweeping forwards at an angle of about 100°. Ligamental grooves closely set, rather shallow, narrow, elongated, alternated with slightly narrower, flat interspaces. Surface ornamented with growth-lamelae at more or less regular intervals. Test thick.

The present species is very closely allied to *P. ricordiana* D'ORB., from the Neocomian of Switzerland, France, and Germany, and the Lower Greensand of England. Our species seems, however, to be provided with an umbo less acutely produced and to be more convex in its anterior part, which is more distinctly limited from the postero-dorsal portion than the European form.


Horizon: The Shiroi Group.

Gervilia, DEFRANCE

**Gervilia forbesiana** D'ORB.

Pl. XII (I), Figs. 36, 37; Pl. XIV (III), Figs. 8, 9


Shell compressed, elongate, sabre-shaped, tapering posteriorly; posterior extremity narrowly rounded; dorsal margin slightly concave; ventral margin slightly convex, except at the anterior part, where it is strongly curved upwards; somewhat narrowly wedge-shaped in cross section, with depressed dorsal border and slightly convex sides; umbo terminal, acute; posterior ear large, triangular, with its dorsal margin almost straight, and posterior margin making an acute angle with

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the dorsal border of the valve. Surface of the valve smooth, except for the lines of growth; that of the posterior ear striated parallel to its posterior margin. Hinge showing three or four small ligamental pits, and 5–7 long, narrow, slightly oblique teeth near the posterior end.

Our specimens quite agree with *G. forbesiana* D’Orb. from the Gault of England figured by Woods; they appear also to resemble very much *G. solenoides* of some authors, for instance, the specimens from the Lower Senonian of Brunswick described by Müller and from the Senonian of Aix la Chapelle by Holzapfel. Böse also figured an imperfect specimen from the Lower Cenomanian of Mexico under *G. cfr. solenoides* Söhle (non Depr.). This is, however, characterized by the antero-dorsal margin being more gently curved than in ours.

*G. forbesiana* is found, according to Woods, from the Lower Greensand, Gault and Upper Greensand.

**Localities:** Kawarazawa and Ōze.

**Horizon:** The Kawarazawa Group.

**Gervillia haradae** (Yokoyama)

Pl. XIII (II), Figs. 1–3, 7, 7a; Pl. XIV (II1), Fig. 2


**Dimensions:**

<table>
<thead>
<tr>
<th></th>
<th>Height</th>
<th>Length of Hinge Line</th>
<th>Thickness of Left Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>ca. 90 mm.</td>
<td>ca. 80 mm.</td>
<td>ca. 25 mm.</td>
<td></td>
</tr>
<tr>
<td>ca. 22 &quot;</td>
<td>ca. 30 &quot;</td>
<td>ca. 8 &quot;</td>
<td></td>
</tr>
</tbody>
</table>

Shell large, much inflated, triangular, oblique; anterior part of both valves more or less vertical to the plane of the valves; marginal part of the valves sometimes concave around the byssal opening; umbo situated near the anterior extremity. Hinge-area large, with 5 or 6 large ligamental pits; teeth numerous, narrow, and oblique.

Left valve large, more inflated than the right, with its umbo much incurved; posterior part expanded and flattened, and anterior part much inflated, being convex along the curved line extending from umbo to postero-ventral extremity, which bends forwards dorsally and a little backwards ventrally; posterior expanded portion large, triangular, and flattened in small specimens, but somewhat convex along its anterior border in older examples, being separated by a narrow linear depression from the convex part of the valve; anterior ear rather small, triangular, convex, limited by

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a narrow groove; anterior margin broadly convex; posterior margin very concave in young specimens, only slightly so in older forms, forming an acute angle with the long, straight hinge-line; postero-ventral margin rounded.

Right valve similar to the left, but less convex, with its umbo not much incurved.

Surface of two valves sometimes almost smooth, except for lines of growth, but usually ornamented with crowded, narrow, radial ribs, besides seven or more strong ones at regular intervals over the convex anterior part; concentric lines of growth crowded, being more or less elevated and sometimes even scaly at the intersection with the ribs; ribs tending to become obsolete towards the ventral margin where the incremental lines become more conspicuous.

YOKOYAMA early described *Avicula haradae* from the vicinity of Kagahara. It is a small shell, 15 mm. in height, but resembles the present materials so closely in general outline and sculpture that we feel warranted to consider them specifically identical. If our identification is correct, then the species should be transferred to *Gervillia*.

The present species is an ally of *G. aleiformis* Sow.,¹ from the Neocomian and Aptian of England, France, and Switzerland; the latter is, however, more inflated and shows a straight posterior margin in older specimens. *Aviculacottaldina* d'Orb.,¹ and *A. carteroni* d'Orb.,² from the Neocomian of France also resemble ours, but are distinguished by their stronger radial ribs.⁴

Localities: Kawarazawa, Ōze and Ishidō.

Horizons: The Ishidō and Kawarazawa Groups.

**Gervillia shinanoensis** YABE and NAGAO sp. nov.

Pl. XIV (III), Figs. 17, 18, 18a

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Height</th>
<th>Length of Hinge-line</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ca. 36 mm.</td>
<td>ca. 25 mm.</td>
</tr>
<tr>
<td>60 ? &quot;</td>
<td>50 + &quot;</td>
<td></td>
</tr>
</tbody>
</table>

Shell obliquely elongated, triangular, moderately convex; ventral and postero-ventral margins rounded, and the posterior broadly arcuated, forming an obtuse angle with the long hinge-line. Left valve more convex than the right, with the umbo moderately curved inwards and forwards; median part very convex, distinctly separated from the large triangular, wing-like anterior car and less distinctly from the rather narrow, flattened, obtusely triangular posterior part. Ligamental grooves large, small in number. Test thick.

⁴ We do not know the hinge of these two species.
We have two imperfect internal moulds which are distinguished from \textit{G. karadæ} (Yok.). The shell is more oblique, with a narrower, flattened posterior part and a large anterior wing-like ear. The sculpture of the shell is not visible on the present specimens, but there is before us an external cast of the same species derived from Yusa, province of Ki, which is provided with fine concentric lines of growth and numerous, crowded, narrow radial ribs, a stronger one and 1–3 weaker in alternation.

The present species is allied to \textit{G. alaformis} Sow.\textsuperscript{1} from the Neocomian and Aptian of England, France, and Switzerland, but has a less convex valve with its anterior wing-like ear broader and posterior flattened part narrower than in the European form.

Localities: Kagikake and Bômeki.

Horizon: The Shiroi Group.

\textbf{Lima, Brug.}

\textit{(Limatula, Wood)}

\textbf{Lima (Limatula) ishidoensis Yabe} and \textbf{Nagao sp. nov.}

\textit{Pl. XIV (III), Figs. 7, 7a, 16, 16a}

<table>
<thead>
<tr>
<th>Dimensions:</th>
<th>HEIGHT</th>
<th>LENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.0 mm.</td>
<td>3.5 mm.</td>
<td></td>
</tr>
<tr>
<td>6.5 &quot;</td>
<td>4.0 &quot;</td>
<td></td>
</tr>
</tbody>
</table>

Shell ovate, convex, much higher than long, subequilateral; margins rounded, the anterior being slightly less convex than the posterior. Surface ornamented with very fine concentric lines and radial ribs; ribs rounded and 15–18 in number, being confined to the median part of the valve; interspaces between the ribs concave, a little broader than the ribs, and becoming more and more broad from the anterior to the posterior.

The present species is similar, in many features, to \textit{L. trombechiana} d'Orb.\textsuperscript{2} from the Valanginian, Neocomian, and Urgonian of Europe, and especially to those specimens from the Lower Greensand of England, but ours is higher and has narrower radial ribs than the foreign species. \textit{L. fatoni} d'Orb.\textsuperscript{3} from the Upper Greensand of England is also closely allied to ours, but is less convex, longer, and has a more unsymmetrically placed ribbed area. \textit{Stoliczka} reported a similar species, \textit{L. persimilis} Stol.\textsuperscript{4} from the Upper Utatur Group of S. India, which is, however, much larger, more inequilateral, and has narrower radial ribs than the Japanese one.

Locality: Ishidō. Two specimens.

Horizon: The Ishidō Group.

\textsuperscript{1} See foot-note \textsuperscript{1} of the description of the preceding species.
Pecten, MÜLLER

(\textit{Neithea}, DROUET)

\textbf{Pecten (Neithea)} sp. cfr. \textit{P. (N.) atavus} RÖMER

\textit{Pl. XIII (II), Figs. 18, 19}

\textbf{Compare:}


We have three imperfect specimens of a small Pecten, two moulds of the left valve (one internal and the other external) and one external cast of the right valve. The shell is roughly triangular and more or less inequilateral; ventral margin convex, crenulated, with incisions between the main ribs; anterior and posterior margins nearly straight; anterior ear long (?) and the posterior ear triangular, with its outer margin almost vertical and slightly concave.

The right valve is convex, with the umbo considerably incurved and pointed; the six main ribs prominent and rounded, separated by much broader, concave interspaces; each interspace bearing usually 3-4, but sometimes 6, narrow, slightly raised ribs; antero-dorsal area in front of the outermost main rib has no riblet. Furthermore, the surface shows numerous, fine, equal, regular, concentric striae.

The left valve is flat or slightly concave, with an apical angle of about 100°, and ornamented with 6 very broad, rounded, radial main ribs and slightly raised interstitial riblets which are usually 3 or 4 in number in each interspace between two main ribs. The concentric ornamentation is similar to that on the right valve.

The present specimens represent a species closely allied to \textit{P. neoconcanis} D'ORB. from the Neocomian of France, which is regarded by Woods and WOLLEMPENN as identical with \textit{P. atavus} RÖMER from the Neocomian of France, Switzerland, Germany, and Mexico, and the Lower Greensand of England. Though in our specimens the apical angle is slightly larger than \textit{P. atavus} described by Woods from England, and the antero-dorsal area of the right valve is smooth, yet the differences do not seem to us to be significant, and we believe we are dealing here with a form closely allied to this foreign species. It is to be noted that we have another specimen of a right valve derived from the Lower Cretaceous deposits exposed near Hanoura-machi, Naka-gun, province of Awa in Shikoku.

\textbf{Localities:} Ishidō and Shiroi.

\textbf{Horizon:} The Ishidō Group.
Anomia, LIN.

**Anomia pseudotruncata** Yabe and Nagao sp. nov.

Pl. XII (I), Figs. 26, 27; Pl. XIII (II), Figs. 27, 28, 36, 37

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Height</th>
<th>Length</th>
<th>Thickness of Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 mm.</td>
<td>16 mm.</td>
<td>4 mm.</td>
<td>(left valve)</td>
</tr>
<tr>
<td>18 &quot;</td>
<td>15.5 &quot;</td>
<td>6 &quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>15 &quot;</td>
<td>12.5 &quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>14 &quot;</td>
<td>11 &quot;</td>
<td>&quot;</td>
<td>(right valve)</td>
</tr>
<tr>
<td>12 &quot;</td>
<td>11 &quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>11 &quot;</td>
<td>9 &quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

Shell variable in form, usually ovate and higher than long, but sometimes nearly equal in height and length. Left valve moderately convex; margins uniformly curved, except the straight dorsal and obliquely truncated postero-dorsal; postero-dorsal marginal part compressed; ornamented with fine concentric lines and numerous, crowded, very fine, usually granulated, radial striae which are obsolete near the umbo and more distinct near the ventral margin. Right valve flat, evenly curved along the margins, except the truncated postero-dorsal.

The present species resembles *A. pseudoradiata* D'Orb. from the Lower Greensand of England, and *A. subtruncata* D'Orb. from the Turonian and Senonian of Germany, but is distinguished from the first in having a more convex shell with its postero-dorsal margin more sharply truncated and its radial striae more crowded, and from the second in being higher and less regularly ovate. *A. lavignata* Sow. from the Lower Greensand of England and the Neocomian of France is another species allied to ours, but is smooth and more orbicular.

**Localities:** Bōmeki, Shiroy, and Hachimanawa.

**Horizon:** The Shiroy Group.

Ostrea, LAM.

**Ostrea diluviana** L. sp.

Pl. XIII (II), Figs. 4-6

1857. *Ostrea carinata* RÖMER: "Kreidebild. v. Texas," p. 73, Pl. IX, Fig. 5.
1871. *Ostrea (Actinonyx) carinata* STÖRCKEN: "Cret. Paunia S. India," Palaeont. Indica, Vol. III, p. 468, Pl. XLVIII, Fig. 5; Pl. XLIX, Figs. 1, 2.
1871. O. (A.) *diluviana* STÖRCKEN: *Hdb.,* p. 466, Pl. XLVI, Figs. 1, 2; Pl. XLVII, Figs. 1, 2.

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2 H. H. GEHRITZ: "Das Einheitsgeb. Sachsen," Tei II, p. 30, Pl. VIII, Figs. 21, 22. H. SCUPIN: "Die Löwenberger Kreide," p. 239, Pl. XIII, Fig. 3.
YOKOYAMA once reported an occurrence of *Alcyonidea* cf. *carinata* L. from the Cretaceous deposits exposed near Kagahara, province of Kōzuke. We have a number of specimens belonging to this type of *Ostrea* from Ōze near Kagahara, including almost perfect external and internal moulds, and one very imperfect external mould from Gotōsawa, near Kawarazawa.

In 1913, Woods, on a very close and laborious examination of a large series of specimens belonging to this type of *Ostrea*, came to the conclusion that numerous specimens, bearing various specific names, from numerous different localities and various geologic formations ranging from the Lower Cretaceous to the Upper Senonian, might be considered as belonging to one and the same species. The outline and curvature of the shell, the size of its posterior wing, the number and coarseness of the ribs and other features are in all very variable, and every gradation is found among several extreme types which appear to be at first sight quite distinct species. Thus the Lower Cretaceous species, *O. macropera* Römer and *O. rectangularis* Römer, and the Upper Cretaceous forms, *O. frons* Parkinson, *O. carinata* Lam., *O. colubrina* Lam., *O. serrata* Brown, *O. plicata* Goldfuss, *O. millelana* d’Orb., *O. ricordiana* d’Orb., and *O. zelleri* (Bayle) were included by him in a single species—*O. diluviana* L.

The Japanese specimens now before us have a more or less elongated, curved shell, being *frons* type; the ribbing of the surface is on some specimens coarse, and fine in the others. They are also variable in height, curvature, and in the outline of the posterior ear; the depth is usually small but in one specimen moderately great.

Though the umbonal part of the shell is very imperfectly preserved in all our materials, yet judging from all other features, we believe that we are treating here the specimens belonging to *O. diluviana* L. in the sense of Woods. It is also to be noted that a few imperfect specimens of this species, derived from the Cretaceous deposits of Ōshima, Motoyoshi-gun, and the Miyako district, province of Rikuzen, are in the G. I. S. Collection.

Localities: Ōze and Kawarazawa.

Horizon: The Kawarazawa Group.

**Modiola, Lam.**

**Modiola (? ishidoensis** Yabe and Nagao sp. nov."

Pl. XIII (II), Fig. 42

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Height</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 mm.</td>
<td></td>
<td>29 mm.</td>
</tr>
</tbody>
</table>

Shell narrow, much elongated and nearly straight, a little expanded posteriorly; convex near the umbo, flattened towards the ventral margin and the posterior end; anterior margin narrowly rounded, passing with rather abrupt curvature into the almost straight ventral margin which is subparallel to the dorsal; dorsal margin slightly arcuate; posterior margin semicircular, passing evenly into both dorsal and ventral margins; no distinct umbo, small, subterminal; surface ornamented with irregular concentric lines of growth. Test thin.
Hisakatsu Yabe, Takumi Nagao, and Saburo Shimizu

The present species reminds us of Lithodomus in general features, though provisionally referred to the genus Modiola, on account of its much compressed shell. It resembles *M. attenuata* (M. & H.)¹ and *M. meeki* (E. & S.)² from the Upper Cretaceous of N. America, but differs from the first in its anterior part being more inflated and ventral part not sinuated, and from the second in its outline being more elongated and dorsal margin less arcuated. The Japanese form is also closely allied to *M. rector* WOLLEMAN ³ from the Neocomian of Brunswick, but is distinguished by the posterior part being slightly less expanded, with its margin more evenly rounded.

Locality: Ishidō. A left valve.

Horizon: The Ishidō Group.

Gastropoda

Naticea, Lam.

*(Amauropsis, Mörch)*

*Naticea (Amauropsis) sanchuenis* Yabe and Nagao sp. nov.

Pl. XIII (II), Figs. 31, 31a, 32, 32a, 48, 49, 50

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Height</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>ca. 40 mm.</td>
<td>ca. 25 mm.</td>
<td></td>
</tr>
<tr>
<td>ca. 50 mm.</td>
<td>ca. 30 mm.</td>
<td></td>
</tr>
<tr>
<td>45 ? mm.</td>
<td>33 ? mm.</td>
<td></td>
</tr>
</tbody>
</table>

Shell globose; spire relatively high, acute, consisting of 6 convex whorls with narrow depressed and canaliculated posterior portion along the deep suture. Body whorl ventricose, very large and high, convex, occupying more than 2/3 of the height of shell. Aperture elongated or semicircular, narrow posteriorly; no umbilicus and no callosity; outer lip internally slightly thickened. Surface smooth, except for fine, sometimes distinct, lines of growth.

One specimen from Hachimanzawa is longitudinally sulcated on the internal mould, recalling certain species of *Tylostoma*, but this may be accidental. The holotype is provided with an elevated spire and an elongated body whorl, while more common forms associated with it are characterized by a low spire and a broader, more ventricose, and shorter body whorl with a semicircular aperture. The latter ones may be varietal forms of the type species.

The present species resembles *"Euspira" spissata* Stoliczka ⁴ from the Utatur Group, and *Amauropsis bulbiformis* Sow. ⁵ from the Arrisur Group of S. India and the Upper Cretaceous of Europe, but these foreign forms are distinguished by the shell's having a more sharply flattened posterior portion

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⁴ P. Stoliczka: *op. cit.*, p. 309, Pl. XXII, figs. 3-4.
along the suture and the spire less acute. Moreover, the first of these foreign forms is provided with a more excavated columella, and the second with a prominent calloidity.

Localities: Hachimanzawa and Shirai; doubtful specimens from Bōmeki and Kagikake.

Horizon: The Shirai Group.

**Sureula, ADAMS**

**Sureula** sp. indet.

Pl. XIII (II), Figs. 39-41

There are a number of external moulds belonging to this genus from Ishidō and Shirai. The shell is fusiform, consisting of about 9 whorls; spire high, acute, with an apical angle of about 30°; whorls convex, separated by distinct sutures and ornamented with spiral striæ and transverse ribs; spiral striæ numerous, fine and crowded, alternating with finer interstitial ones; transverse ribs about 11 in number on the lower whorls, discontinuous from one whorl to the next, slightly oblique, prominent, separated by much broader, concave interspaces. The body whorl is large, long, nearly as long as the spire, distinctly angulated at the shoulder, inflated above and convex below, and ornamented, beside fine spiral striæ, with sinuate lines of growth which are strongly recurved on the flattened surface above the shoulder. The aperture is long, with a long, straight canal and smooth inner lip.

Localities: Ishidō and Shirai.

Horizon: The Ishidō Group.

**Glaucina, GIER**

**Glaucina** sp. indet.

Pl. XIII (II), Figs. 51, 52

We have a few imperfect specimens, probably belonging to *Glaucina*. The shell is conical, turreted, about 30° in its apical angle; whorls flat, low, separated by distinct sutures, nearly smooth except for two very indistinct spiral ribs lying near the upper and lower margins, with a faintly concave interspace between them; ribs becoming almost obsolete on the lower whorls, which are then slightly concave at the upper portion and convex below. The lines of growth are bisinuated.

The present specimens represent a species closely resembling *G. obvoluta* (SCHLÖTH.) from the Lower Senonian of Germany, but as our specimens do not show the aperture, their exact comparison with this foreign form is not possible.

Locality: Hachimanzawa.

Horizon: The Shirai Group.

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Cerithium, Adanson

Cerithium sanchuense Yabe and Nagao sp. nov.

Pl. XIV (III), Figs. 12-14

Shell small (ca. 15 mm. in height), turreted; spire high with an apical angle of about 10°; whorls more than 15 in number, relatively low, flattened, but angulated at shoulder a little below suture; ornamented with about 20 narrow, granulated, transverse ribs and three spiral ones; upper spiral rib, lying on shoulder broadest, the middle narrowest, and the lower, lying near the lower margin, moderately broad. The upper and lower ribs relatively more prominent on the lower whorls, while the middle becomes much narrower and finally splits into two striae. Body whorl moderately large; base flatly convex, with two or three small spiral ribs; columella apparently short, with curved canal.

Though all the specimens we have of this species are external moulds, yet they seem to represent a species closely resembling C. gottfriedi Wollemann,1 from the Neocomian of Brunswick, Germany. They differ, however, in having the base of the body whorl less convex and whorls with three spiral ribs, instead of four.

Locality: Ishidō.
Horizon: The Ishidō Group.

Capulus, Montef.

Capulus (?) annulatus Yokoyama


Two deformed specimens which are quite similar to the one first described by Yokoyama under the name *Capulus annulatus*.

Locality: Kawarazawa.
Horizon: The Kawarazawa Group.

Melania, Lam.

Melania cancellata Yabe and Nagao sp. nov.

Pl. XIII (II), Figs. 43, 44

Shell turreted, consisting of about 6 or 7 whors separated by distinct sutures; spire rather low, apical angle being about 25°-30°; each whorl almost flat, but shouldered a little below the suture; surface cancellated, ornamented with about 13 narrow, elevated, transverse ribs in alternation with flat interspaces which are twice or thrice as broad as the ribs, and with about 7 narrow, elevated

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spiral strike. Body whorl twice as high as the next upper one, and ornamented with its transverse ribs abruptly obsolete near the base; base convex, bearing 3 or 4 spiral lines slightly broader than those on the upper part; inner lip concave; columnella short, straight.

We have a number of specimens of this species collected from Shiroi and Bômeiki, all of which are external moulds. They represent a species closely resembling *M. ? whiteness* Stanton and *Hatcher* from the Judith River bed of North America, only differing from it in having less convex whorls with less numerous, narrower spiral ribs.

Localities: Bômeiki and Shiroi.

Horizon: The Shiroi Group.

Cephalopoda

Lytoceras, Suess

*Lytoceras* sp.

Pl. XV (IV), Figs. 1, 2, 3

A single specimen, much deformed, but exhibiting suture-lines characteristic of the genus *Lytoceras* in a strict sense, with approximately the following dimensions:

Dimensions:
- Diameter of shell: ca. 35 mm.
- Width of umbilicus: 11 "
- Height of the last whorl: 12 "
- Breadth of the last whorl: -- "

Shell discoidal, composed of several slowly enlaiging whorls; umbilicus wide and shallow; lateral surface of the shell ornamented with numerous very fine, straight, transverse strike and periodic grooves, of which 6 are visible on the last voluption. Suture-lines partly preserved, showing siphonal lobe decidedly shorter than the first lateral, which is symmetrically bipartite; external saddle relatively narrow, somewhat oblique, and symmetrically bipartite.

Too deformed for an accurate specific comparison with foreign species.

From the marine Lower Cretaceous of Japan, we already have two species of *Lytoceras*, namely, *L. exoense Yabe* and *L. imperiale Yabe*. Each of these two being represented by specimens much larger than the present one, the direct comparison between them gives us no clue for even approximately judging their relationship.

Locality: Otomo, Tano-gun, province of Kōzuke.

Horizon: The Kawarazawa Group.

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3 H. Yabe: *Loc. cit.*, p. 11, Pl. II, fig. 1; Pl. IV, fig. 1.
Hamites, PARK.

Hamites sp.

Pl. XV (IV), Fig. 4

A fragment of the straight body chamber of an ammonite, about 55 mm. long and ca. 30 mm. broad, showing a tendency to make a strong curve at an extremity; provided with 14 transverse ribs, which are narrow and prominent, but rounded on top, somewhat broader on the ventral side than on the dorsal, and separated by intervals measuring 5 mm. along the median line of the lateral side of the whorl. Outline of whorl in transverse section may probably be either oblong or oval, though not exactly known, owing to a secondary deformation the specimen suffered.

This specimen bears external features more or less resembling H. decurrens RÖMER1 from the Aptian and H. rotundus SOW.2 from the Gault, both of Europe. The Aptian species has more acute and narrower ribs than ours, and the Gault form shows less acute ribs, which are more prominent on the dorsal side.

Locality: Kawarazawa, Chichibu-gun, province of Musashi.

Horizon: The Kawarazawa Group.

Pseudosaynella, SPATH

Pseudosaynella otukai YABE and SHIMIZU, sp. nov.

Pl. XV (IV), Figs. 5-8

This species is represented by five specimens, most of which are much weathered on the surface and imperfect. The largest and best one of them is selected as the holotype, and is here figured and measured:

Dimensions:

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>36 mm.</td>
</tr>
<tr>
<td>Width of umbilicus</td>
<td>6</td>
</tr>
<tr>
<td>Height of the last whorl</td>
<td>17</td>
</tr>
<tr>
<td>Breadth of the last whorl</td>
<td>8</td>
</tr>
</tbody>
</table>

Shell consisting of few whorls, much compressed; very involute. Umbilicus very narrow, distinctly shouldered. Whorls considerably higher than broad, being broadest near the umbilical border; flanks almost flat, though slightly convex, subparallel and somewhat converging toward the narrowly arched venter. Surface nearly smooth, being ornamented only with numerous obsolete falciiform ribs, which are usually simple and occasionally bifurcate, and likewise faintly impressed periodic grooves, of which about five are on the last one half volution. Suture-lines not distinctly preserved.

Cretaceous Mollusca from the Sanchi-Graben in the Kwantō Mountainland, Japan

Although suture-lines are not visible on the present specimens, yet their resemblance in outline and ornamentation to certain forms of Pseudosaynella is so great that we feel warranted in assigning them to this genus. For instance, P. bicarinata (Mich.)¹ and P. heimi (SARASIN)² from the Aptian of France closely resemble ours, though distinguished by much broader whorls; furthermore, in P. heimi, periodic grooves are absent and the ribs are somewhat different in nature.

Locality: Kawarazawa, Chichibu-gun, province of Musashi.

Horizon: The Kawarazawa Group.

Simbirskites, Pavlow

Simbirskites kochibei Yabe and Shimizu, sp. nov.

Pl. XV (IV), Figs. 9, 10

The holotype is a slightly distorted, small, internal mould, in a black sandy shale.

Dimensions:

<table>
<thead>
<tr>
<th>Diameter</th>
<th>16 mm.</th>
<th>(100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width of umbilicus</td>
<td></td>
<td>(31)</td>
</tr>
<tr>
<td>Height of last whorl</td>
<td>6 &quot;</td>
<td>(37)</td>
</tr>
<tr>
<td>Breadth of last whorl</td>
<td>6 &quot;</td>
<td>(37)</td>
</tr>
</tbody>
</table>

Shell small, discoidal, involute; whorls slightly convex on the flanks and rounded on the venter; umbilicus moderate in size, surrounded with a steep wall which passes gradually upward into the flanks. Surface ornamented with numerous radial ribs. Ribs on the flanks narrow, elevated, and usually trifurcating (occasionally bifurcating) near the middle; very narrow and less elevated on the umbilical wall; continuous, broader, and rounded on the venter. Suture-lines unknown.

The characteristic outline and the ornamentation of the shell point to its affinity with the group Simbirskites dochei, to which SPATH³ lately proposed to restrict the use of the generic name. The Japanese form is closely related to S. mutabilis STANTON⁴ from the upper part of the Knoxville of California, but it differs from the latter by its broader umbilicus, want of periodic grooves, and a somewhat different kind of ornamentation. It also reminds us of some Himalayan forms, as S.(?) nepaulensis (GRAY) and S.(?) sp. indet. figured by Uhlig from the Neocomian Spiti Shales. These two, however, are more or less different from ours in sculpture. All these three foreign species are considerably larger in size.

Simbirskites, in the sense restricted by SPATH, is Upper Haetirivan in its geological range, being previously known from England, Russia, California, Eastern Australia, and New Caledonia.

Locality: Ishidō, Minami-Saku-gun, province of Shinano.

Horizon: The Ishidō Group.

²SARASIN: Ibid., p. 162, Pls. IV et V; figs. 7 a, b.
Desmoeras, ZITTEL

Desmoeras (?) pseudodifficile YABE and SHIMIZU sp. nov.

Pl. XV (IV), Fig. 11

This species is based on a somewhat deformed external cast, which is here figured. It shows the following dimensions:

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter</td>
<td>37 mm</td>
</tr>
<tr>
<td>Width of umbilicus</td>
<td>8</td>
</tr>
<tr>
<td>Height of the last whorl</td>
<td>17</td>
</tr>
<tr>
<td>Breadth of the last whorl</td>
<td>—</td>
</tr>
</tbody>
</table>

Shell laterally compressed, composed of a few gradually growing whorls and provided with a narrow umbilicus, surrounded by nearly vertical walls; flanks flattened and but slightly converging towards the narrowly arched venter, the whorl being thus broadest near the umbilical border; surface almost smooth, though ornamented with broad, flat ribs and grooves, counting two on the last one-third volute and running parallel to the delicate falciform strie of growth, which disappear near the umbilical border; both the ribs and growth lines make a marked narrow forward prolongation on the venter.

The suture-line being invisible, the generic determination of the present species cannot be carried out with confidence, but in external features it reminds us of one of the ammonites belonging to either Desmoeras (s. s.) or Barremites (a subgenus of the former). For instance, D. difficile d'OBRR.

the type species of Barremites — from the Barremian of France, shows a great similarity to our form, though distinguished by narrower whorls, which are broadest on the middle of the flanks. D. (s. s.)strictedoma ÜTTIG, ranging from the Barremian to the Aptian, Saynella grossouervi NICKLÉS, from the Barremian, also resemble our form, but these two foreign species are provided with whorls somewhat broader than ours.

Also there are similar forms known from the west coast Cretaceous of North America, namely, "Desmoeras" haydeni GABB and D. brevleri GABB, from the Horsetown of California. In the collection of our Institute, we have a specimen of the first species and four of the latter, all of which are nearly the same size as ours. The resemblance between the two North American forms and the Japanese in external feature is great, but the former show no periodic grooves, which are characteristic of the latter. While D. brevleri appears to be a typical Desmoeras, D. haydeni may, we think, not belong to the genus, as its sutural-lines are quite different from the typical ones.

Locality: Ishidō, Minami-Saku-gun, province of Shinano.

Horizon: The Ishidō Group.

4 Saynella grossouervi, the genotype of Saynella, KILLIAN, is, according to SPATH, certainly a Barremite, though provided with sutural-lines simpler than those of typical forms of the difficile group, — an opinion which we hesitate to accept.
6 GABB: Ibid., p. 61, Pl. X, fig. 7.
Ancyloceras, d'Orbigny

Ancyloceras? sp. indet.

Pl. XV (IV), Figs. 12, 13

There are several small fragmental specimens, in an unfavorable state of preservation, but believed to represent a species of *Ancyloceras*.

Whorls higher than broad, subquadrate in cross section and marked by simple, sharp, straight transverse ribs with broad interspaces; ribs continuous on the dorsum, and interrupted on the venter by a rather narrow median groove, and provided with a small prominent tubercle along the groove. Suture-lines unknown.

This form, though imperfect, reminds us strongly of such type of *Ancyloceras* as *A. obovatum* Koënen\(^1\) and *A. breispina* Koënen\(^2\) from the Barremian of North Germany.

Locality: Ishidō, Minami-Saku-gun, province of Shinano.

Horizon: The Ishidō Group.

Toxoceeras, d'Orb.

Toxoceeras? sp. indet.

Pl. XV (IV), Figs. 14, 15

A small specimens, about 20 mm. long, poorly preserved, showing no trace of suture-lines; furthermore, the outline of whorl in transverse section not being accurately determinable, its generic and specific determination is almost impossible. Nevertheless in its broadly arcuate whorl with transverse ribs—thicker one alternating with two narrower ones and bearing two tubercles on the flank of whorl—it reminds one of certain forms of *Toxoceeras*, as *T. requienianum* d'Orb.\(^3\) ranging from the Aptian to the Barremian of France.

Locality: Kawarazawa, Chichibu-gun, province of Musashi

Horizon: Kawarazawa Group.

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\(^1\) A. V. Koënen: "Die Ammoniten Norddeutschen Neokom," Abhandl. Preuss. Geol. Landesanst., Neue Folge, Heft 24, 1902, p. 340, Pl. XXXIX, figs. 5, a, b, c.

\(^2\) Koënen: ibid., p. 365, Pl. XXXIX, figs. 1, a, b; 2.

Hisahatsu Yabe, Takumi Naga, and Saburo Shimizu

Cricoceras, Lévillé emend. Uhlig

Cricoceras yagi Yabe and Shimizu

Pl. XV (IV), Figs. 16-19

A fragment of body-chamber belonging to an evolute form of ammonites is represented by an internal mould and an external cast, which is the counterpart of the former. In spite of the very imperfect state of these specimens, we believe we have a new species of Cricoceras before us.

Whorl subcircular in transverse section, flattened along the dorsal side, slightly broader than high, being about 60 mm. broad and 56 mm. high; surface ornamented with numerous transverse ribs of two kinds, a broad and prominent rib alternating with three to six narrower interstitionial ones; larger ribs 5 mm. broad, rounded on top, and bearing six long spines placed almost equidistant on the lateral and ventral sides; narrower ribs simple, rather varied in their breadth, though always conspicuously narrower than the others; all ribs uninterrupted, making a narrow forward curve on the dorsal side, where they are very weakly developed, and another broad, but shallow, one on the ventral, after crossing over the lateral sides straight and somewhat obliquely backwards from the dorsal border to the ventral.

This species is closely allied to C. latus Gabr.1 from the Lower Horsetown and Knoxville Beds of California, which is, however, characterized by its whorls being rounded trapezoidal in transverse section. C. duvali Lév.2 from the Hauterivian of France is another ally, though easily distinguishable by the possession of more numerous interstitional ribs, beside the different outline of whorls in transverse section; C. molasi Kilian3 (C. duvali d'Orr.) from the same stage of France and the almost contemporaneous C. roemeri Neumayr and Uhlig4 from North Germany have higher whorls, the latter being, moreover, characterized by two rows of ventral spines lying much nearer than the corresponding ones on our form. At any rate, our species seems to belong to the C. duvali group rather than to the C. emericci group, in the sense of Kilian.5

The specific name is dedicated to Mr. Teisuke Yagi, to whom we owe the present material. He is well known by his numerous contributions to our knowledge of the geology of the province of Shinano.

Locality: Ishidō, Minami-Sakai-gun, province of Shinano.

Horizon: The Ishidō Group.

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1 W. M. Gabr.: "Palaeontology of California," Vol. I. 1864, p. 74, Pl. XV, fig. 25.
Leptoceras, Uhlig

Leptoceras cfr. pumilum Uhlig

Pl. XV (IV), Fig. 20


An external mould, 20 mm. in diameter and composed of one and one-third volutions, and a small fragment of its internal mould, now at our disposal, represent an ammonite allied closely to *L. pumilum* Uhlig from the Wernsdorf Beds of Moravia.

Shell loosely coiled in a plane, with a broad open central space and with the greater part of the last volution closely approaching the next inner. Whorls higher than broad, rather rapidly enlarging. Surface ornamented with numerous narrow elevated radial ribs, almost straight and extending over the dorsum and venter without interruption; interspaces between the ribs twice or thrice as broad as the ribs on the outer volution and nearly equal to those on the next inner. Also two stronger grooves impressed on the distal end of the outer volution. Suture-lines not preserved.

*L. pumilum* is stated to be characterized by its ribs, which are not quite straight, being slightly but regularly flexuous on the middle of the flanks. This feature, however, is not well exhibited by the present specimen.

Locality: Ishidō, Minami-Saku-gun, province of Shinano.

Horizon: The Ishidō Group.

Leptoceras asiaticum Yabe and Shimizu, sp. nov.

Pl. XV (IV), Fig. 21

Holotype: an external mould, 18 mm. in diameter.

Shell loosely coiled in a plane, with a broad, open, central space and with a part of the last voluition closely approaching the next inner one. Whorls rapidly enlarging, nearly flat on the flanks and rounded on the venter. Surface bearing simple, almost straight, narrow, elevated radial ribs and interspaces, twice or thrice as broad as the ribs, both counting about 20 on the last half volution; neither periodic ribs nor grooves present.

This specimen resembles the preceding species, though easily distinguished from it by the absence of periodic grooves and by the almost straight ribs. A foreign species to which the present material bears a close resemblance is *L. beyrichi* Karsten,1 from the Wernsdorf Beds of Moravia, which is, however, more lax in coiling.

Locality: Ishidō, Minami-Saku-gun, province of Shinano.

Horizon: The Ishidō Group.

1 Uhlig: Loc. cit. (1883), p. 273, Pl. XXXII, figs. 4–6, 8.
Pulchellia, Uhlig emend Gignoux

Pulchellia ishidoensis Yabe and Shimizu, sp. nov.

Pl. XV (IV), Figs. 22-24

There are four fragmental specimens of this form now at our disposal, three in external mould and one in internal. The latter (holotype) is a body whorl, much obliterated, occupying about two-thirds of a whorl, which, after restoration, measures:

Dimensions:

| Diameter | 23 mm.  | 100 |
| Width of umbilicus | 16 |
| Height of the last whorl | 12  |

Shell compressed, flattened on flanks; highly involute and very narrowly umbilicated. Whorls considerably higher than broad; venter narrow, depressed between two rows of sharp, spirally elongated tubercular crests (clavates). Surface ornamented with flexuous radial ribs and intervening furrows, both counting about 16 on the last two-thirds volutions. Ribs prominent on the flanks; extremely depressed but not interrupted on the venter; tuberculated along the ventro-lateral and ventral border, but never on the middle of the flanks. Between the two rows of tubercles ribs run obliquely forwards. Tubercles on the ventro-lateral border gradually become somewhat indistinct with age. Suture-lines unknown.

The present specimens represent a species evidently belonging to the genus Pulchellia and especially to the group of Pulchellia in the strict sense of Gignoux,¹ that is, the series of P. galeatoides Karsten in the sense of W. Kilian.² It does not decidedly belong to Carstenia, as the whorls are narrow and free from the median row of the tubercle on the flanks.

The present species is a near ally of P. provincialis d'Orbigny³ from the Barremian of Europe and P. cf. provincialis d'Orbigny,⁴ described by Nicklès, from the Barremian of Southeast Spain. It differs, however, from P. provincialis by the narrower umbilicus, and from P. cf. provincialis by the narrow interspaces between the ribs and the broader ventral depression. P. galeatoides Karsten⁵ also is not provided with the ventro-lateral row of tubercles.

All these foreign species being derived from the Barremian, our fossils seem likely to point to the same age of the Japanese rocks containing them.

Locality: Ishidô, Minami-Saku-gun, province of Shinano.

Horizon: The Ishidô Group.

³ Collet: *Loc. cit.* (1926), Pl. XV, figs. 7, 7b.
⁵ Collet: *Loc. cit.* (1926), p. 401, Pl. XV, figs. 12, 12b.
III. GEOLOGICAL AGE OF THE FOSSILIFEROUS DEPOSITS

It is clear from the evidence of the ammonites that several stages of the Lower Cretaceous are represented in the Sanchū-Graben, corresponding to the stratigraphical divisions actually recognized in the field. All the ammonites, except the two species of *Crioceras* and *Simbirsites*, from the Ishidō Group point to the Barremian age in the affinity of the species and genera. This reference is most decisive in *Desnoceras pseudodificile* nov., which has its nearest affinity in *D. difficile*, the two species of *Leptoceras* (*L. cfr. pantium* Uhlig and *L. asiaticum* nov.), and *Pulexellia ishidoensis* nov. On the other hand, we have in *Simbirsites hachibei* nov. an ammonite of the Upper Hauterivian type, and in *Crioceras yagii* nov. a form belonging to the *C. duvali* Group ranging from the Hauterivian to the Barremian. These two, hence, give an aspect slightly older than the Barremian to the Ishidō Group.

The ammonites fauna from the Kawarazawa Group is evidently younger than that of the Ishidō, *Pseudosaynella otsukai* nov. being an ammonite of the Lower Aptian type and *Toxoceras* (?) sp. a form like *T. requienianum* d’Orb. of France extending from the Barremian to the Aptian. The Kawarazawa Group, at least in its fossiliferous zone, may tentatively be correlated with the European Aptian, as in the case of the *Trigonia* Sandstone of Chōhi Peninsula, with *Phylloceras aff. onoense Stanton, Colombiceras satol* SHIMIZU, *Crioceras* (?) sp., and *Ancyloceras chūshiense SHIMIZU*.

The other molluscan remains are less effective for deciding the geological age of the Ishidō and Kawarazawa Group, but it is quite certain that there are none contradictory to, and many affirmative for, the above correlation. *Panopea aff. gurgites* from the Ishidō Group closely resembles *P. gurgites* (Brongn.) from the Lower Greensand and Gault of England. *Pecten (Neitha) cfr. atavus Römer* is an ally of *P. (N.) neocomensis* d’Orb. from the Neocomian of France and *P. (N.) atavus* from the contemporaneous deposits of France, Switzerland, Germany, and Mexico. The two foreign species are often regarded as identical. *Gervilla forbesiana* from the Kawarazawa Group has a range from the Lower Greensand to the Gault in England, while the closely allied *G. solenoides* Depr. appears in the Upper Cretaceous strata of continental Europe. *Grammatodon yokoyamae* nov. from the Ishidō and Kawarazawa Group is very like *G. carinatus* (Sow.) = *Cuculina striatella* Mich. This is perhaps the very form which was early described by YOKOYAMA as *C. cfr. striatella* from the neighbourhood of Kagahara. *G. carinatus* is reported from the Upper Greensand, Gault, and Cenomanian of England, the Gault of France, and the Neocomian of Germany. The type from the last locality most nearly approaches our samples, *Asturla subsecetia* nov., from the Ishidō Group, and especially its variety from the Kawarazawa Group, considerably resembles *A. secetia* Woods from the Neocomian of England. Finally, *Gervilla karadae* (Yok.), which is common both in the Ishidō and Kawarazawa Groups and was once described by YOKOYAMA as an *Articula*, shows a close affinity to *G. aleformis* Sow., from England, France, and Switzerland, which ranges from the Neocomian to the Aptian.

The Shiroyi Group, underlying the Ishidō, has not yet yielded any remains of ammonites. Judging from its stratigraphical relation to the Ishidō Group, the Shiroyi must be as old as the Hauterivian, or a little older. Most common and characteristic to the Shiroyi Group are *Perna*
Sanchoensis nov. closely allied to *P. ricordiana* D'Orb. from the Lower Greensand of England, and the Neocomian of France, Switzerland, and Germany; *Myopholus cfr. semicostata*, almost identical with *M. semicostata* (Ag.) from the Neocomian of Switzerland; *Arca shinanoensis* nov. akin to *A. sanct crucis* Pictet et Campiche from the Valangian of Switzerland, and the Lower Greensand of England, and to *A. carteroni* D'Orb., from the Lower Greensand of England. Although this group is rich in *Cyrena* as *C. nawunani* Neumayr, *C. radiotostriata* nov., *C. osukai* nov., along with *Corbicula* (*C. sanchoensis* nov.), these brackish water mollusca serve little for the intercontinental correlation of geological age. Taken as the whole, the molluscan fauna of the Shiroi Group is evidently a Neocomian type. It is noteworthy that no species has yet been found to be common to the Shiroi Group and the overlying Ishidō and Kawarazawa Group.
PLATE XII (I)

The figures are natural size

Fig. 1. *Perna sanchuensis* YABE and NAGAO. **Loc.**: Hachimanawa near Kagahara, Tano-gun, province of Kōzuke; the Shiroi Group. A left valve, lateral view.

Figs. 2, 2a. *Perna sanchuensis* YABE and NAGAO. **Loc.**: Hachimanawa; the Shiroi Group. A left valve, lateral view (2) and dorsal view (2a).

Figs. 3, 3a, 3b. *Perna sanchuensis* YABE and NAGAO. **Loc.**: Hachimanawa; the Shiroi Group. A left valve, internal view (3), lateral view (3a), and anterior view (3b).

Fig. 4. *Perna sanchuensis* YABE and NAGAO. **Loc.**: Hachimanawa; the Shiroi Group. External mould of a left valve.

Fig. 5. *Myopholus* cfr. *semicosiiata* (AG). **Loc.**: Hashikubo near Ishidō, province of Shinano; contained in a block derived from the Shiroi Group. External cast of a left valve, lateral view.

Fig. 6. *Cyrilla naumannii* NEUMAYR. **Loc.**: Yanagidani, Takahoko-mura, Katsura-gun, province of Awa (Shikoku). Internal mould of a right valve, lateral view.

Fig. 7. *Pharella*? sp. **Loc.**: Shiroi, Ueno-mura, Tano-gun, province of Kōzuke; the Shiroi Group. Internal mould of a right valve, lateral view.

Figs. 8, 8a. *Corbicula* (Veloritina?) *sanchuensis* YABE and NAGAO. **Loc.**: Komō, Honouro-machi, Naka-gun, province of Awa (Shikoku). Internal mould, lateral view (8) and anterior view (8a).

Fig. 9. *Cardium ishidoense* YABE and NAGAO. **Loc.**: Ishidō, Ōhinata-mura, Minami-Saku-gun, province of Shinano; the Ishidō Group. A right valve, posterior view.

Fig. 10. *Panopaea* aff. *gurges* (BRONG.). **Loc.**: Ishidō; the Ishidō Group. External cast of a left valve.

Fig. 11. *Honomya? dubia* YABE and NAGAO. **Loc.**: Hachimanawa; the Shiroi Group. Internal mould of a right valve, lateral view.

Figs. 12, 12a, 12b. *Grammatodon yohayamae* YABE and NAGAO. **Loc.**: Ishidō; the Ishidō Group. Internal mould; a right side view (12), a left side view (12a), and a posterior view (12b).

Fig. 13. *Grammatodon yohayamae* YABE and NAGAO. **Loc.**: Ishidō; the Ishidō Group. Internal mould of a left valve, lateral view.
Fig. 14. *Pharella?* sp. Loc.: Kagikake near Bômeki, province of Shinano; the Shiroi Group. Internal mould of a left valve, lateral view.

Fig. 15. *Panopaea aff. gurgites* (BRONG.). Loc.: Shiroi; the Ishidô Group. External cast of a right valve, lateral view.

Fig. 16. *Cardium ishidoense* YABE and NAGAO. Loc.: Ishidô; the Ishidô Group. A right valve, lateral view.

Fig. 17. *Cyrena naumanni* NEUMAYR. Loc.: Yanagidani in Shikoku. A left valve, lateral view.

Fig. 18. *Cardium ishidoense* YABE and NAGAO. Loc.: Ishidô; the Ishidô Group. A right valve, lateral view.

Fig. 19. *Panopaea aff. gurgites* (BRONG.). Loc.: Ishidô; the Ishidô Group. External cast of a right valve, lateral view.

Fig. 20. *Panopaea aff. gurgites* (BRONG.). Loc.: Ishidô; the Ishidô Group. External cast of a right valve, lateral view.

Fig. 21. *Nuculana sanchuensis* YABE and NAGAO. Loc.: Ishidô; the Ishidô Group. Internal mould of a right valve, lateral view.

Fig. 22. *Nuculana sanchuensis* YABE and NAGAO. Loc.: Ishidô; the Ishidô Group. Internal mould of a right valve, lateral view.

Fig. 23. *Nuculana sanchuensis* YABE and NAGAO. Loc.: Ishidô; the Ishidô Group. Internal mould of a right valve, lateral view.

Fig. 24. *Trigonoarcha? obsolata* YABE and NAGAO. Loc.: Ishidô; the Ishidô Group. A left valve, lateral view.

Fig. 25. *Grammatodon yokoyamai* YABE and NAGAO. Loc.: Kawarazawa, Chichibu-gun, province of Musashi; the Kawarazawa Group. External cast of a right valve, lateral view.

Fig. 26. *Anomia pseudoturnscata* YABE and NAGAO. Loc.: Bômekizawa, Ôinata-mura, Minamisakura-gun, province of Shinano; the Shiroi Group. Internal mould of a left valve, lateral view.

Fig. 27. *Anomia pseudoturnscata* YABE and NAGAO. Loc.: Bômekizawa; the Shiroi Group. Internal mould of a left valve, lateral view.

Fig. 28. *Cyrena naumanni* NEUMAYR. Loc.: Bômekizawa; the Shiroi Group. Internal mould of a right valve, lateral view.

Fig. 29. *Cyrena radiostriata* YABE and NAGAO. Loc.: Kagikake near Bômekizawa; the Shiroi Group. External cast of a right valve, lateral view.
PLATE XII (I) (Cont.)

Fig. 30. *Cyrena radiostriata* YABE and NAGAO. **Loc.**: Hachimanzawa; the Shiroi Group. Internal mould of a left valve, lateral view.

Figs. 31, 31a. *Cyrena radiostriata* YABE and NAGAO. **Loc.**: Hachimanzawa; the Shiroi Group. Lateral view (31) and posterior view (31a).

Fig. 32. *Cyrena radiostriata* YABE and NAGAO. **Loc.**: Hachimanzawa; the Shiroi Group. Internal mould of a right valve, lateral view.

Fig. 33. *Cyrena radiostriata* YABE and NAGAO. **Loc.**: Hachimanzawa; the Shiroi Group. A left valve, lateral view.

Fig. 34. *Cyrena radiostriata* YABE and NAGAO. **Loc.**: Hachimanzawa; the Shiroi Group. A right valve, lateral view.

Fig. 35. *Cyrena radiostriata* YABE and NAGAO. **Loc.**: Hachimanzawa; the Shiroi Group. A right valve, lateral view.

Fig. 36. *Gervilia forbesiana* D'Orb. **Loc.**: Kawarazawa; the Kawarazawa Group. Internal mould of a right valve, lateral view.

Fig. 37. *Gervilia forbesiana* D'Orb. **Loc.**: Kawarazawa; the Kawarazawa Group. Internal mould of a right valve, lateral view.

Fig. 38. *Pharella?* sp. **Loc.**: Shiroi; the Shiroi Group. Internal mould of a right valve, lateral view.

Figs. 39a, 39b. *Honomysa? dubia* YABE and NAGAO. **Loc.**: Shiroi; the Shiroi Group. Internal mould; right side view (39); left side view (39a), and dorsal view (39b).
PLATE XIII (II)

The figures are natural size

Fig. 1. *Gervillia haradae* (YOK.). Loc.: Kawarazawa; the Kawarazawa Group. A left valve, lateral view.

Fig. 2. *Gervillia haradae* (YOK.). Loc.: Ishidō; the Ishidō Group. External cast of a left valve, lateral view.

Fig. 3. *Gervillia haradae* (YOK.). Loc.: Ishidō; the Ishidō Group. Showing the hinge of a left valve.

Fig. 4. *Ostrea diluviana* L. Loc.: Ōze near Kagahara; the Kawarazawa Group. Internal mould of a left valve, lateral view.

Fig. 5. *Ostrea diluviana* L. Loc.: Ōze near Kagahara; the Kawarazawa Group. Internal mould of a right valve, lateral view.

Fig. 6. *Ostrea diluviana* L. Loc.: Ōze; the Kawarazawa Group. External cast of a right valve, lateral view.

Figs. 7, 7a. *Gervillia haradae* (YOK.). Loc.: Ishidō; the Ishidō Group. External cast of a left valve, lateral view (7) and dorsal view (7a).

Figs. 8, 8a. *Corbicula* (Velortitina?) *sachuenesis* YABE and NAGAO. Loc.: Hachimanzawa; the Shiroi Group. A right valve, lateral view (8) and anterior view (8a).

Fig. 9. *Corbicula* (Velortitina?) *sachuenesis* YABE and NAGAO. Loc.: Bōmekizawa; the Shiroi Group. Internal mould of a right valve, lateral view.

Fig. 10. *Corbicula* (Velortitina?) *sachuenesis* YABE and NAGAO. Loc.: Bōmekizawa; the Shiroi Group. Internal mould of a left valve, lateral view.


Fig. 12. *Pharella*? sp. Loc.: Shiroi; the Shiroi Group. External cast of a right valve, lateral view.

Fig. 13. *Pharella*? sp. Loc.: Bōmekizawa; the Shiroi Group. Internal mould of a right valve, lateral view.

Fig. 14. *Astarte subaenecta* YABE and NAGAO. Loc.: Ishidō; the Ishidō Group. Internal mould of a right valve, lateral view.
PLATE XIII (II) (Cont.)

Fig. 15. *Astarte subsecuncta* YABE and NAGAO. Loc.: Ishidō; the Ishidō Group. Internal mould of a left valve, lateral view.

Fig. 16. *Astarte subsecuncta* YABE and NAGAO. Loc.: Ishidō; the Ishidō Group. Internal mould of a right valve, lateral view.

Figs. 17a. *Corbicula (Veloptina?) sancienesis* YABE and NAGAO. Loc.: Bōmekizawa; the Shiroi Group. Internal mould of a right valve, lateral view (17) and dorsal view (17a).

Fig. 18. *Pygoea (Neithrea) sp. cfr. P. (N.) atavus* RÖMER. Loc.: Shiroi; the Ishidō Group. Internal mould of a left valve, lateral view.

Fig. 19. *Pygoea (Neithrea) sp. cfr. P. (N.) atavus* RÖMER. Loc.: Ishidō; the Ishidō Group. External mould of a left valve, lateral view.

Fig. 20. *Cyrena otsukai* YABE and NAGAO. Loc.: Bōmekizawa; the Shiroi Group. External cast of a left valve, lateral view.

Fig. 21. *Cyrena otsukai* YABE and NAGAO. Loc.: Bōmekizawa; the Shiroi Group. External cast of a left valve, lateral view.

Fig. 22. *Cyrena otsukai* YABE and NAGAO. Loc.: Bōmekizawa; the Shiroi Group. Internal mould of a left valve, lateral view.

Fig. 23. *Cyrena otsukai* YABE and NAGAO. Loc.: Bōmekizawa; the Shiroi Group. Internal mould of a left valve, lateral view (deprived of umbonal part in order to show the hinge).

Fig. 24. *Cyrena otsukai* YABE and NAGAO. Loc.: Bōmekizawa; the Shiroi Group. Internal moulds, lateral view (the right valve being deprived of the umbonal part in order to show the hinge).

Figs. 25, 25a. *Cyrena naumanni* NEUMAYR. Loc.: Yanagidani in Shikoku; a right valve, lateral view (25) and anterior view (25a).

Fig. 26. *Cyrena shirionensis* YABE and NAGAO var. *alta* YABE and NAGAO. Loc.: Shiroi; the Shiroi Group. Internal mould of a right valve, lateral view.

Fig. 27. *Anomia pseudotruncata* YABE and NAGAO. Loc.: Hachimanzawa; the Shiroi Group. A left valve, lateral view.

Fig. 28. *Anomia pseudotruncata* YABE and NAGAO. Loc.: Hachimanzawa; the Shiroi Group. A left valve, lateral view.

Fig. 29. *Astarte shiinanaensis* YABE and NAGAO. Loc.: Ishidō; the Ishidō Group. Internal mould of a right valve, lateral view.

Fig. 30. *Astarte shiinanaensis* YABE and NAGAO. Loc.: Ishidō; the Ishidō Group. Internal mould of a right valve, lateral view.

Figs. 31, 31a. *Natica (Amiaupiosis) sancienensis* YABE and NAGAO. Loc.: Hachimanzawa; the Shiroi Group. Apertural view (31) and dorsal view (31a).
PLATE XIII (II) (Cont.)

Figs. 32, 32a. *Natica (Amauroopsis) sanchuensis* YABE and NAGAO. Loc.: Hachimanzawa; the Shiroi Group. Dorsal view (32) and apertural view (32a).

Fig. 33. *Arca shinanoensis* YABE and NAGAO. Loc.: Bómekizawa; the Shiroi Group. Internal mould of a left valve, lateral view.

Fig. 34. *Arca shinanoensis* YABE and NAGAO. Loc.: Bómekizawa; the Shiroi Group. Internal mould of a left valve, lateral view.

Fig. 35. *Arca shinanoensis* YABE and NAGAO. Loc.: Bómekizawa; the Shiroi Group. Internal mould of a left valve, lateral view.

Fig. 36. *Anomia pseudotruncata* YABE and NAGAO. Loc.: Shiroi; the Shiroi Group. External moulds of right valves, lateral views.

Fig. 37. *Anomia pseudotruncata* YABE and NAGAO. Loc.: Shiroi; the Shiroi Group. External mould of a right valve, lateral view.

Fig. 38. *Surculus* sp. Loc.: Ishidô; the Ishidô Group. External cast of body whorl and external mould of upper whorls, apertural view.

Fig. 39. *Surculus* sp. Loc.: Ishidô; the Ishidô Group. External cast, apertural view.

Fig. 40. *Surculus* sp. Loc.: Ishidô; the Ishidô Group. External cast, dorsal view.

Fig. 41. *Surculus* sp. Loc.: Ishidô; the Ishidô Group. External cast, apertural view.

Fig. 42. *Mottola ishidoensis* YABE and NAGAO. Loc.: Ishidô; the Ishidô Group. A right valve, lateral view.

Fig. 43. *Melania cancellata* YABE and NAGAO. Loc.: Bómekizawa; the Shiroi Group. External cast.

Fig. 44. *Melania cancellata* YABE and NAGAO. Loc.: Bómekizawa; the Shiroi Group. External cast, apertural view.

Fig. 45. *Cyrena radiates* YABE and NAGAO. Loc.: Hachimanzawa; the Shiroi Group. External cast of a left valve, lateral view.

Fig. 46. *Nucula ishidoensis* YABE and NAGAO. Loc.: Ishidô; the Ishidô Group. Internal mould of a left valve, lateral view.

Fig. 47. *Nucula ishidoensis* YABE and NAGAO. Loc.: Ishidô; the Ishidô Group. Internal mould of a right valve, lateral view.

Fig. 48. *Natica (Amauroopsis) sanchuensis* YABE and NAGAO. Loc.: Shiroi; the Shiroi Group. Apical view.

Fig. 49. *Natica (Amauroopsis) sanchuensis* YABE and NAGAO. Loc.: Shiroi; the Shiroi Group. Dorsal view.

Fig. 50. *Natica (Amauroopsis) sanchuensis* YABE and NAGAO. Loc.: Hachimanzawa; the Shiroi Group. Dorsal view.

Fig. 51. *Glaucus* sp. Loc.: Hachimanzawa; the Shiroi Group.

Fig. 52. *Glaucus* sp. Loc.: Hachimanzawa; the Shiroi Group.
PLATE XIV (III)

The figures are natural size, unless otherwise stated.

Fig. 1. *Homomya? dubia* YABE and NAGAO. Loc.: Hachimanzawa; the Shiroi Group. Internal mould of an imperfect left valve, with a part of test preserved, lateral view.

Fig. 2. *Geroilla karadae* (YOK.). Loc.: Kawarazawa; the Kawarazawa Group. A left valve without the anterior ear and the postero-dorsal extremity of the posterior expansion, lateral view.

Fig. 3. *Trigonia hokkaidoana* YEH. Loc.: Kawarazawa; the Kawarazawa Group. External cast of a right valve, lateral view.

Fig. 4. *Cyrena shiroiensis* YABE and NAGAO. Loc.: Shiroi; the Shiroi Group. External cast of a right valve, lateral view.

Fig. 5. *Cyrena shiroiensis* YABE and NAGAO. Loc.: Shiroi; the Shiroi Group. Internal mould of a right valve, lateral view (deprived of umbonal part in order to show the hinge).

Figs. 6, 6a. *Cyrena shiroiensis* YABE and NAGAO. Loc.: Shiroi; the Shiroi Group. External cast; lateral view (6) and posterior view (6a).

Figs. 7, 7a. *Limn (Limbata) ishidoensis* YABE and NAGAO. Loc.: Ishidō; the Ishidō Group. External mould of a right valve, lateral view. 7a × ca. 4.

Fig. 8. *Geroilla forbesiana* d'ORB. Loc.: Kawarazawa; the Kawarazawa Group. Internal mould of a right valve, lateral view.

Fig. 9. *Geroilla forbesiana* d'ORB. Loc.: Kawarazawa; the Kawarazawa Group. Internal mould of a left valve, lateral view.

Fig. 10. *Astarte subseceta* YABE and NAGAO var. *costata* YABE and NAGAO. Loc.: Ôze; the Kawarazawa Group. External cast of a left valve, lateral view.

Fig. 11. *Astarte subseceta* YABE and NAGAO. Loc.: Ishidō; the Ishidō Group. External cast of a right valve, lateral view.

Figs. 12, 12a. *Cerithium sanchuense* YABE and NAGAO. Loc.: Ishidō; the Ishidō Group. External mould. 12a × ca. 4.
PLATE XIV (III) (Cont.)

Figs. 13, 13a. *Cerithium ishidoense* YABE and NAGAO. Loc.: Ishidō; the Ishidō Group. External mould. 13a x ca. 4.

Fig. 14. *Cerithium ishidoense* YABE and NAGAO. Loc.: Ishidō; the Ishidō Group. External mould.

Fig. 15. *Cyrena shiroiensis* YABE and NAGAO var. *afia* YABE and NAGAO. Loc.: Shiroi; the Shiroi Group. Internal mould of a left valve, lateral view.

Fig. 16, 16a. *Lima (Limatula) ishidoensis* YABE and NAGAO. Loc.: Ishidō; the Ishidō Group. External cast of a right valve, lateral view. 16a x ca. 4.

Fig. 17. *Gervillia shinanoensis* YABE and NAGAO. Loc.: Kagikake; the Shiroi Group. Internal mould of a left valve, lateral view.

Figs. 18, 18a. *Gervillia shinanoensis* YABE and NAGAO. Loc.: Bōmekizawa; the Shiroi Group. Internal mould; a left valve (18) and a right valve (18a).

Fig. 19. *Cyrena shiroiensis* YABE and NAGAO. Loc.: Bōmekizawa; the Shiroi Group. Internal mould of a left valve, lateral view (deprived of the umbonal part in order to show the hinge).

Fig. 20. *Cyrena shiroiensis* YABE and NAGAO. Loc.: Bōmekizawa; the Shiroi Group. Internal mould of a right valve, lateral view.

Fig. 21. *Myopholus cfr. semicostata* (Ag.). Loc.: Bōmekizawa; the Shiroi Group. External cast of a right valve, lateral view.

Fig. 22. *Cyrena shiroiensis* YABE and NAGAO. Loc.: Shiroi; the Shiroi Group. Internal mould of a left valve, lateral view.

Figs. 23, 23a. *Cyrena naumanni* NEUMAYR. Loc.: Yanagidani in Shikoku. Lateral view of a left valve (23); posterior view (23a).

Fig. 24. *Cyrena naumanni* NEUMAYR. Loc.: Bōmekizawa; the Shiroi Group. Internal mould of a right valve, lateral view.

Fig. 25. *Cyrena shiroiensis* YABE and NAGAO. Loc.: Bōmekizawa; the Shiroi Group. Internal mould of a left valve, lateral view (deprived of the umbonal part in order to show the hinge).

Fig. 26. *Cyrena naumanni* NEUMAYR. Loc.: Yanagidani in Shikoku. A right valve, lateral view.
PLATE XIV (III) (Cont.)

Fig. 27, 27a, 27b. *Maiopholus cfr. semicosatula* (Ag.). Loc.: Shiroi; the Shiroi Group. External cast, lateral view (27), dorsal view (27a), and anterior view (27b).

Fig. 29. *Cyrena naumannii Neumayr*. Loc.: Yanagidani in Shikoku. A right valve, lateral view.

Fig. 30. *Cyrena naumannii Neumayr*. Loc.: Bómekizawa; the Shiroi Group. Internal mould of a left valve, lateral view.

Fig. 31. *Cyrena naumannii Neumayr*. Loc.: Yanagidani in Shikoku. A left valve, lateral view.
PLATE XV (IV)

Figs. 1-3. Lytoceras sp. Loc.: Otomo, Tano-gun, province of Kōzuke; the Kawarazawa Group. Fig. 1, side view, nat. size; Fig. 2, side view, × 2, to show the extremely fine strie on the flank; fig. 3, a suture line, × 2.

Fig. 4. Hamites sp. Loc.: Kawarazawa, Chichibu-gun, province of Musashi; the Kawarazawa Group. Side view; nat. size.

Figs. 5-8. Pseudosayella otsukai YABE and SHIMIZU. Loc.: Kawarazawa, Chichibu-gun, province of Musashi; the Kawarazawa Group. Fig. 5, side view, and fig. 6, ventral view, of the holotype; fig. 7, side view, and fig. 8, ventral view, of a paratype. Nat. size.

Figs. 9, 10. Simbirkites kochoi YABE and SHIMIZU. Loc.: Ishidō, Minami-Saku-gun, province of Shinano; the Ishidō Group. Fig. 9, side view; fig. 10, ventral view. Nat. size.

Fig. 11. Desmooceras? pseudodificile YABE and SHIMIZU. Loc.: Ishidō, Minami-Saku-gun, province of Shinano; the Ishidō Group. Side view; nat. size.

Figs. 12, 13. Ancyloceras sp. Loc.: Ishidō, Minami-Saku-gun, province of Shinano; the Ishidō Group. Fig. 12, side view; fig. 13, ventral view. Nat. size.

Figs. 14, 15. Toxoceras? sp. Loc.: Kawarazawa, Chichibu-gun, province of Musashi; the Kawarazawa Group. Fig. 14, side view, nat. size; fig. 15, side view, × 2, to show the two rows of tubercles on ribs.

Figs. 16-19. Crioceras yagi YABE and SHIMIZU. Loc.: Ishidō, Minami-Saku-gun, province of Shinano; the Ishidō Group. Fig. 16, side view; fig. 17, ventral view; fig. 18, dorsal view; fig. 19, hind view. Nat. size. Figs. 16, 17, and 18 should be reversed.

Fig. 20. Leptoceras cfr. pumilum UHLIG. Loc.: Ishidō, Minami-Saku-gun, province of Shinano; the Ishidō Group. Side view; nat. size.

Fig. 21. Leptoceras asiaticum YABE and SHIMIZU. Loc.: Ishidō, Minami-Saku-gun, province of Shinano; the Ishidō Group. Side view; nat. size.

Figs. 22-24. Pulchellia ishidovensis YABE and SHIMIZU. Loc.: Ishidō, Minami-Saku-gun, province of Shinano; the Ishidō Group. Fig. 22, side view, and fig. 23, ventral view, of the holotype; fig. 24, side view of a paratype. Nat. size.