495. OCCURRENCE OF NIPPONONAIA RYOSEKIANA FROM THE SANCHU AREA, JAPAN*

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and

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Introduction

Nippononaia SUZUKI, 1911. is a characteristic and important pelecypod genus, which occurs mainly from the Lower Cretaceous non-marine formations of eastern Asia. It is well characterized by the combination of peculiar hinge and surface sculpture, although some different opinions have been presented as to its systematic position and phylogeny. There are, however, some uncertainties with regard to the type-

* Received May 6, 1965; read September 25, 1965 at Nagasaki.
Text-fig. 1. Map showing the locality of *Nipponoia ryosekiana*.

graben in the Kwanto mountainland". No additional specimen of this species had been obtained from these two areas, but recently we found unexpectedly a boulder of black shale at Hachimanzawa in the eastern part of the Sanchu area, in which many individuals of *Nipponoia ryosekiana* were contained together with a few specimens of *Protocyprina* sp. No specimen *in situ* has been found, but the boulder in question was certainly derived from the Sebayashi formation of approximately an Aptian-Albian (Miyakoan) age. The geographic position is indicated in Text-fig. 1.

In this paper we described *Nipponoia ryosekiana* (Suzuki) and *Protocyprina* sp. on the basis of the newly collected material. One of us (I.II.) gives some palaeontological remarks on the genus *Nipponoia*.

Before going into description, we express our sincere thanks to Prof. Tatsuro Matsumoto of the Kyushu University for his kind suggestion and reading of this manuscript. Acknowledgements are also due to Prof. Emeritus Teiichi Kobayashi of the University of Tokyo for his generous criticism, and to Prof. Toshio Kimura of the University of Tokyo and Prof. Yoshihisa Ota of the Fukuoka Gakugei University for their kind encouragement and assistance in various ways.

**Systematic description**

**Order Naiadida**

Cox (1960) distinguished the Anthracosioidea and Unionacea from the Order Schizodontida, and proposed a new order, Naiadida, for them. This procedure is here adopted.
Superfamily Unionacea
Family Trigonioididae

Genus *Nippononaia* SUZUKI, 1941

*Type-species:* *Unio (Nippononaia) ryosekianus* SUZUKI, 1911, Lower Cretaceous (probably Aptian-Albian), Japan (original designation).

*Nippononaia ryosekiana* (SUZUKI)

Pl 17, Figs. 1-8: Text-fig. 2


*Material:* Eight specimens (GK. H6755—GK. H6762) from a boulder of black shale at Hachiman-zawa (HAYAMI and ICHIKAWA coll.). The holotype and paratype preserved in the University of Tokyo are also concerned with the description below. A plaster cast of the holotype is preserved also in the Kyushu University (GK. H6765).

*Description:* Shell of medium size, about 50-60 mm long in the adult stage, equivalve, inequilateral, transversely elongated, about twice or more as long as high, elongate-ovate in outline, rounded in front, tapering posteriorly, pointed at the extremity, moderately inflated; test moderate in thickness; antero-dorsal margin short, passing gradually into the anterior margin; postero-dorsal margin very long, slightly curving downwards; ventral margin gently and broadly arculate but a little concave in its posterior part; umbo orthogyrous, not prominent, unusually broad, placed at about two-sevenths of shell length from the anterior extremity; a rounded carina extends from the umbo to the posterior extremity, delimiting a narrow postero-dorsal area; lunule and escutcheon absent; surface ornamented with numerous characteristic ribs, divided into four areas, i.e. antero-dorsal, anterior, posterior and postero-dorsal areas, by different mode of ornamentation; several ribs on the central part converge on the line just below the umbo and scribe acute Vs, the angle of which is approximately 20 degrees; anterior ribs about 25 in the adult stage, regularly spaced, nearly straight or a little sinuous; posterior ribs about 35 in the adult stage, subvertical, slightly sinuous, as broad as anterior ribs near the Vs but become much broader and more sparse on the posterior area; antero-dorsal and posterior dorsal peripheral areas ornamented with upward curving short riblets; whole surface marked also with numerous concentric growth-lines of irregular interval and prominence; hinge plate moderate in breadth, provided with opisthochline pseudocardinal teeth and posterior lateral teeth of unionoid type; right valve possesses one large and one minute pseudocardinal teeth, while left valve has two large pseudocardinal teeth; large pseudocardinal teeth subparallel to post-umbonal margin, roof-shaped, stout, faintly striated obliquely; posterior lateral teeth, one in the left valve and two in the right, comparatively short, parallel to the postero-dorsal margin, smooth without any crenulation, distinctly separated from the pseudocardinals; adductor scars subequal in size, situated close to the outer ends of the pseudocardinal and posterior lateral teeth; anterior one hemicyrcular, strongly impressed, accompanied with a minute

* See also page 153 for the diagnosis.
pedal scar; posterior one subcircular, not so strongly impressed: ventral, anterior and posterior margins crenulated internally in accordance with the external ribs: umbonal cavity very shallow.

**Measurements in mm:**

<table>
<thead>
<tr>
<th>Specimen</th>
<th>Length</th>
<th>Height</th>
<th>Thickness</th>
<th>L/H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left valve (GK. H6755)</td>
<td>53.5</td>
<td>25.5</td>
<td>6.5</td>
<td>2.10</td>
</tr>
<tr>
<td>Right in. mould (GK. H6756)</td>
<td>35.5</td>
<td>16.5</td>
<td>4.0</td>
<td>2.15+</td>
</tr>
<tr>
<td>Left in. mould (GK. H6757)*</td>
<td>29.0+</td>
<td>14.0</td>
<td>8.0</td>
<td>2.07+</td>
</tr>
<tr>
<td>Right valve (GK. H6758)</td>
<td>49.0</td>
<td>21.0+</td>
<td>5.5</td>
<td>2.38-</td>
</tr>
<tr>
<td>Left valve (GK. H6759)*</td>
<td>50.0</td>
<td>19.5</td>
<td>7.0</td>
<td>2.56-</td>
</tr>
<tr>
<td>Left valve (GK. H6760)*</td>
<td>57.5</td>
<td>18.0+</td>
<td>9.5</td>
<td>3.19-</td>
</tr>
<tr>
<td>Left valve (GK. H6761)*</td>
<td>36.0+</td>
<td>19.0</td>
<td>5.5</td>
<td>1.84+</td>
</tr>
<tr>
<td>Left valve (GK. H6762)*</td>
<td>30.5+</td>
<td>14.5</td>
<td>4.0</td>
<td>2.10+</td>
</tr>
<tr>
<td>Left in. mould (Holotype)</td>
<td>32.3+</td>
<td>16.0</td>
<td>5.0+</td>
<td>2.03+</td>
</tr>
</tbody>
</table>

**Observations and comparisons:**—The holotype of this species (SUZUKI, 1941, text-fig. 1; Pl. 17, Figs. 2a, b) is a left internal mould, revealing the hinge structure and muscle system. The pseudocardinal teeth are feebly crenulated, as mentioned by SUZUKI (1941, p. 413), but the posterior lateral teeth are quite smooth. The paratype (SUZUKI, 1941, text-figs. 2, 3; Pl. 17, Fig. 1) is a left external mould, exhibiting the characteristic surface sculpture on the antero-central part of the shell. The posterior parts of the two original specimens are broken away, so that the general outline is not recognized from them.

Eight specimens (GK. H6755—GK. H6762) and a few fragmentary ones in the present collection are specifically identical with the holotype and paratype of *Nipponoia ryosekiana* in view of the similar surface sculpture and hinge structure, although its test is slightly exfoliated in the posterior part, the remaining part is complete and shows the characteristic ornamentation. In another left valve (GK. H6759) the antero-dorsal peripheral area with upward curving riblets is slightly broader than in other specimens. The hinge structure exhibited in two internal moulds (GK. H6756, GK. H6757) agrees well with that of the holotype. They show similarly smooth posterior lateral teeth and faintly striated pseudocardinal teeth. The subumbonal pseudocardinals are undeveloped in all the moulds.

The present species is clearly distinguishable from *Nipponoia asinaria*.
REESIDE. 1957. from the Lower Creta-
ceous of Colorado, *Nippononaia teroni-
ensis* MAEDA. 1962. from the Upper Ju-
rassic or Lower Cretaceous of central Honshu and *Nippononaia mekongensis*
KOBAyASHI. 1963. from the (?) Lower Cretaceous of east Thailand, by the
much more delicate ribs and more
sharply pointed posterior extremity. *Trigonioides* (Wakinoa) *wakinoensis* (OTA,
1959) and *Trigonioides* (Wakinoa) *sengo-
kuensis* (OTA. 1959) from the Lower Cre-
taceous of north Kyushu, which were
originally described under the generic
name of "*Nippononaia*", are somewhat
similar to the present species in the
surface sculpture, but they are at least
subgenerically distinct from the present
species, because the pseudocardinal and
posterior lateral teeth are strongly crenu-
lated in those species as precisely studied
by OTA (1963). Moreover, the angle of
Vs is distinctly smaller in the present
species than in any other species of *Nip-
pononaia* and *Trigonioides*.

**Occurrence:**—Probably Miyakoan (Apt-
ian—Albian). The present material was
collected from a boulder of carbonaceous
black shale at the middle course (about
300 meters from the mouth) of a small
valley Hachimanzawa, near Sebayashi,
south of Kagahara, Nakazato Village,
Tano County, Gumma Prefecture. It
was about 1 meter long and certainly
derived from the Sebayashi formation
exposed along this valley in view of the
similar lithology. It is interesting that the present species was accompanied by
*Protocyprina* sp. and an indeterminable
ostreid, since *Protocyprina* is generally
regarded as a marine or brachyhaline
water inhabitant. Some fossiliferous
beds containing *Isognomon sanchuensis*
(YABE and NAGAO) and "*Cyrena*" *radi-
tostriata* YABE and NAGAO are exposed
in the valley, but they are distinct from
the boulder in question in the lithology
and fossil assemblage.

It is as yet undecided whether the
type locality of the present species is
in the Katsuuragawa basin or in the
Sanchu area. SUZUKI's specimens, how-
ever, may have occurred also from the
same formation as the present material,
because the mother rock of his specimens
is just comparable with that of these
specimens, and because no additional
specimen has been obtained from the
Katsuuragawa basin. SUZUKI (1941, p.
413) noted that his specimens certainly
came from the "Ryoseki group". The
term of "Ryoseki group" at that time,
however, may have been used not only
for the true Ryoseki group of approxi-
ately Lower Neocomian but also for
the brackish water deposits of Miyakoan
(Aptian—Albian) series, as pointed out by
MATSUMOTO (1947) and others. Further-
more, ARAI et al. (1958) and TAKEI (1963)
clarified that the Sebayashi formation
itself, which had long been assigned to
the Kochian (Ryoseki) series, actually
overlies the Ishido formation which bears
some Upper Neocomian ammonites and
other marine fossils. Therefore, it is
highly probable that the life range of
*Nippononaia ryosekiana* is confined to the
Miyakoan (Aptian—Albian) age.

Order Heterodontida
Superfamily Arcticacea
Family Neomiodontidae
Genus *Protocyprina* VOKES. 1946

**Type-species:**—*Astarte libanotica* FRAAS,
1878. Aptian, Lebanon (original designa-
tion).

*Protocyprina* sp. indet.

Pl. 17, Figs. 9, 10
This species is at present represented by two specimens (GK. H6763, GK. H6764). One of them (GK. H6763) is bivalved and shows subovate outline and surface characters, although it is strongly compressed secondarily (both valves, 46.0 mm. long, 38.5 mm. high, 5.0+ mm. thick). The other is an immature right valve (GK. H6764) and apparently undeformed (20.5 mm. long, 17.0 mm. high, 4.0 mm. thick). The two specimens show several clear concentric ribs on the umbonal surface and more or less conspicuous posterior carinae. From the external feature these specimens are referable to Protocyprina Vokes, 1946, which was recently redefined by Hayami and Nakai (1965). The present species is apparently similar to the immature shells of Protocyprina naumanni (Neumayr, 1890) from the Neocomian Ryoseki group of Japan (Yabe, Nagao and Shimizu, 1926; Hayami and Matsumoto, 1963; Hayami and Nakai, 1965), but differs from the species in having thinner test and more distinct umbonal concentric ribs. In this respect, the present species may be closer to Protocyprina libanotica (Fraas, 1878) from the Aptian of Lebanon (Vokes, 1946). The posterior carina is probably stronger in the present species than in P. naumanni and P. libanotica. The specific denomination of these specimens is deferred until the hinge structure becomes clear, although they probably belong to a new species.

Occurrence:—The present specimens were obtained from the same boulder as the specimens of the preceding species at Hachimanazawa.

Some remarks on the genus *Nippononaia*

by Itaru Hayami

Suzuki (1941) proposed *Nippononaia* as a subgenus of *Union Retzius, 1788*, but subsequently he (1943) transferred it to *Plicatounio Kobayashi and Suzuki, 1936*, regarding it as a subgenus of *Plicatounio*. In fact, the hinge structure of *Nippononaia ryosekiana* is somewhat similar to *Plicatounio (s.s).* However, the right valve of *Nippononaia ryosekiana* possesses only one large pseudocardinal tooth, while two pseudocardinals are distinct in the right valve of *Plicatounio (Plicatounio) naktongensis Kobayashi and Suzuki, 1936*, and probably also in other species of *Plicatounio*. *Nippononaia* is clearly distinguishable from *Trigonioides Kobayashi and Suzuki, 1936*, by the larger ratio of length/height, the undeveloped subumbonal pseudocardinal teeth and the non-crenulated posterior lateral teeth.

The surface sculpture of *Nippononaia* is quite different from that of *Plicatounio*, which is characterized by several broad radial plications on the posterior part instead of clear-cut V-shaped ribs. In this respect *Nippononaia* is much closer to *Trigonioides*. Although superficially similar V-shaped ornaments are seen also in some unrelated marine pelecypods such as *Goniomya Agassiz, 1838*, *Acila H. and A. Adams, 1858*, *Heteroglypta von Martens, 1880*, *Vaugonia Crickmay, 1930*, *Glyptoleda Fletcher, 1945*, *Undulomya Fletcher, 1946*, and *Pentagrammysia Tschernechew, 1950*, the close resemblance of ornamentation indicates an intimate phylogenetical relationship between *Nippononaia* and *Trigonioides*.

Anyhow, *Nippononaia* should be regarded as a distinct genus of the *Trigonioididae Cox, 1952*. The following species have been described under the generic name of *Nippononaia* besides the type-species.


8. *Nippononaia mekongensis* Kobayashi, 1963, (?) Lower Cretaceous, upper (or middle) part of the Khorat series, east Thailand.

Of these species, the third (including the fifth subspecies) and fourth species were excluded by Ota (1963) from *Nippononaia* and considered to constitute *Wakinoa* Ota, 1963, a subgenus of *Trigonioides*. The sixth species may be also assignable to *Trigonioides (Wakinoa)*. The hinge structure of the eighth species is imperfectly known, but it may belong also to *Wakinoa* because the posterior lateral teeth were said to be crenulated (Kobayashi, 1963, p. 39).

There are some different opinions as to the systematic position and phylogeny of *Trigonioides* and *Nippononaia*. Kobayashi and Suzuki (1936) and Kobayashi (1956, 1963) regarded *Trigonioides* as an aberrant and land-locked genus derived from a certain trigoniid. As noted above, Suzuki (1941, 1943) assigned *Nippononaia* as a member of the Unionacea, suggesting that the resemblance between *Trigonioides* and *Nippononaia* might be superficial.

On the other hand, Cox (1952, p. 45) introduced for *Trigonioides* and Hoffetrigonia a new family name Trigonioididae, which was considered by him to be more appropriately placed in the Unionacea than in the Trigonidae. Although the family was once withdrawn by himself (1955, p. 348), it was revived by Kobayashi (1956) and subsequent investigators. Cox (1955) emphasized again the resemblance of the hinge structure between "*Trigonioides*" and some groups of *Unio* and between Hoffetrigonia and Castalia, suggesting that "*Trigonioides*" and Hoffetrigonia bear no intimate relationship to the Trigonidae. Unfortunately his specimen illustrated as "*Trigonioides kodairai*" (Cox, 1955, text-fig. 1A; Kobayashi, 1956, pl. 5, fig. 3) is actually not a true *Trigonioides*, but probably belongs to *Plicatunio (Plicatunio) naktongensis*, as pointed out by Kobayashi (1956, p. 80). It has no strong subumbonal teeth which are characteristically developed in *Trigonioides*.

Kobayashi (1956) described the dentition of *Trigonioides* in detail, and expressed the disposition of hinge teeth by means of the following dentition formula:

...
He compared the dentition with that of the Trigoniidae, suggesting again that Trigonioides was derived from the Trigoniidae. He interpreted the teeth 1a+1b and 1’ of Trigonioides (s.s.) to be terminal products which were added to the hinge of the Trigoniidae, and suggested that *Nippononaia* was possibly derived from *Trigonioides* by the broadening of the shell and by the effacement of the subumbonal pseudocardinal teeth.

Subsequently Kobayashi’s notation on the hinge of *Trigonioides* was followed by Ota (1959) and Maeda (1963) with slight modifications. Ota (1959a) described the dentition of *Wakinoa* (= *Nippononaia* at that time), giving the following notation in correspondence with Kobayashi’s denomination on the hinge of *Trigonioides*:

<table>
<thead>
<tr>
<th>5a</th>
<th>3a (1a+1b)</th>
<th>3b</th>
<th>4a</th>
<th>2a (1’)</th>
<th>2b</th>
<th>4b</th>
</tr>
</thead>
</table>

Maeda (1962) expressed the dentition of *Nippononaia* *leutorerizens* Maeda by means of the following formula:

<table>
<thead>
<tr>
<th>5a</th>
<th>3a</th>
<th>3b</th>
<th>5b</th>
</tr>
</thead>
<tbody>
<tr>
<td>4a</td>
<td>2a</td>
<td>2b</td>
<td>4b</td>
</tr>
</tbody>
</table>

Ota (1963), on the contrary, gave the posterior lateral teeth of *Picatounio* and *Trigonioides* distinct letters from the pseudocardinal teeth as follows**:

| Trigonioides (s.s.) .................. |
|----|----|----|----|----|----|----|----|----|
| (5) | 3a | (1b) | PI | (4) | 2 | 1’a | (1’b) | PII | PIV |

| Trigonioides (Wakinoa) ............ |
|----|----|----|----|----|----|----|----|
| 5 | 3 | (1) | PI | (PIII) | (4) | 2 | 1’ | PII | PIV |

I agree with Ota (1963) in considering that some of the posterior lateral teeth may be actually homologous with those of heterodont pelecypods and not with the posterior cardinal teeth of trigoniids, because the posterior lateral teeth of the Trigonioididae are clearly separated from the pseudocardinals. It is, however, rather impossible to consider that the pseudocardinal teeth of the Unionidae and the Trigonioididae are essentially related to the cardinal teeth of heterodont pelecypods. As observed before (Hayami, 1962), the cardinal teeth of heterodont pelecypods are closely related to the anterior lateral teeth, but in the Trigonioididae there are no anterior lateral teeth. As deemed by Cox (1955), Bernard’s notation of hinge teeth is not applicable for the Unionidae and the Trigonioididae. The letters, which have been individually given to the pseudocardinal teeth in the above cited dentition formulae of the Trigonioididae, should be interpreted to bear no relation to the notation on the cardinal and lateral teeth of heterodont pelecypods, although these formulae may express to a certain extent the general disposition of pseudocardinal and posterior lateral teeth in respective species.

I am of opinion that the teeth of the Trigonioididae are likewise independent of those of the Trigoniidae. The pseudocardinal teeth appear to be generally not so variable in the Trigonioididae as in the Unionidae. The pseudocardinal teeth of the Unionacea are, however,
not so fixed as the cardinal teeth of the Heterodontida and the Schizodontida and probably related to the "primitive lamellae" of Palaeozoic actinodont pelecypods.

OTA (1963) suggested a phylogenetical series, Plicatunio (s. s.)—Plicatunio (Kwanmonia)—Trigonioides (Wakinoa)—Trigonioides (s. s.) as the result of his study on the non-marine pelecypods from the Kwanmon group in north Kyushu. Because the surface ornamentation is quite different between Plicatunio (s. s. and Kwanmonia) and Trigonioides (s. s. and Wakinoa), the evolution from Kwanmonia to Wakinoa is not warranted here. However, I agree with him in considering that the peculiar dentition of Trigonioides (s. s.) may have derived from an unionoid hinge by the enlargement of the subumbonal pseudocardinal teeth. The hinge structure can be regarded as a rapidly evolving character in this case.

In the Kwanmon group, the first appearance of Plicatunio (s. s.), Kwanmonia, Wakinoa, and Trigonioides (s. s.) are almost synchronous (OTA, 1963). In the Tetori group, Nippononnia appeared much earlier than Trigonioides (s. s.). To my regret, the correlation between non-marine formations of different areas is often very difficult owing to the scarcity of guide fossils. The order of stratigraphic occurrence of these genera and subgenera in one sedimentary basin may not always indicate their evolutionary history. Nevertheless, it is certain that the maximum development of Wakinoa and Nippononnia seems to have taken place prior to that of Trigonioides (s. s.).

With regard to the hinge structure and other morphological characters Trigonioides (Wakinoa) appears to be transitional between Trigonioides (s. s.) and Nippononnia. In the type-species of Wakinoa, "Nippononnia" wakinoensis OTA, 1959, the pseudocardinal and posterior lateral teeth are strongly crenulated and the anterior pseudocardinal tooth of the right valve (5 in OTA’s notation) is more clearly demarcated than in Nippononnia ryosehiana. They are, however, very similar in the general disposition of hinge teeth and the surface sculpture. In some respects it might be possible to consider that Wakinoa is a subgenus of Nippononnia. On the grounds of the morphological relationship and available stratigraphic evidence it is reasonable to presume alternatively that Trigonioides (Wakinoa) was a common ancestor of Trigonioides (s. s.) and Nippononnia or that Trigonioides (s. s.) was derived from Nippononnia through Trigonioides (Wakinoa). Hoffetrigonia SUZUKI, 1940 (type-species: Trigonioides kobayashi HOFFET) is, as pointed out by KOBAYASHI (1956), probably a synonym of Trigonioides (s. s.), but it might constitute an infrageneric group for some Senonian species with large dimensions and well developed subumbonal pseudocardinal teeth. The ancestry of the Trigonioididae is still an unsolved problem, but it should be sought in Upper Jurassic and earlier species of the Naiadida instead of the Schizodontida.

Trigonioididae COX, 1952, have been regarded as a distinct and valid family by KOBAYASHI (1954, p. 71; 1956, p. 89), OTA (1959, p. 100), MAEDA (1963, p. 80) and OTA (1963, p. 511), although the name was withdrawn by COX (1955). Unfortunately, COX (1952) and these subsequent authors failed to give any clear diagnosis of the Trigonioididae, although the relationship of this family to certain families of the Unionacea and Trigoniacea were discussed repeatedly by them. The diagnostic characters of the Trigonioididae in my conception can be sum-
Shell commonly medium-sized, sub-trigonal to elongate-ovate, longer than high; lunule and escutcheon not defined, though sometimes a week carina extends along the postero-dorsal margin; umbo low, orthogyrous; ligament opisthodetic, external; surface commonly ornamented with characteristic sculpture scribing Vs on the middle part; antero-dorsal and postero-dorsal peripheral areas commonly provided with upward curving short ribs; hinge of unionoid type, composed of several crenulated pseudocardinal teeth and posterior lateral teeth; posterior lateral teeth clearly separated from the pseudocardinal teeth, never forming an echelon as in some groups of the Unionidae; subumbonal pseudocardinal teeth may or may not developed; umbonal cavity shallow.

The Trigonioididae, as defined above, include *Nippononaia* besides *Trigonioides*. The distribution of this family seems to be confined almost to the Cretaceous non-marine formations of eastern Asia.

**References**


Hase, Akira (1960): The Late Mesozoic formations and their Molluscan fossils in west Chugoku and north Kyushu.

**Explanation of Plate 17**

Figs. 1-8. *Nippononaia ryosekiana* (Suzuki) ......................................................... p. 147

1. Plaster cast from a left external mould (GT. paratype) ×1.5. Loc. uncertain.
2a. Left internal mould (GT. holotype) ×1.5. Loc. uncertain.
2b. Plaster cast from the same specimen (GK. H6765) ×1.5.
3a. Left valve (GK. H6755) ×1.5. Loc. middle course of Hachimanzawa, near Sebayashi, Nakazato village, Tano County, Kumamoto Prefecture.
3b. Upper view of the same specimen. ×1.5.
4. Deformed left valve (GK. H6760) ×1.5. Loc. ditto.
5. Deformed left valve (GK. H6759) ×1.5. Loc. ditto.
6. Deformed left valve (GK. H6762) ×1.5. Loc. ditto.
7. Deformed left valve (GK. H6761) ×1.5. Loc. ditto.
8. Deformed right valve (GK. H6758) x1.5. Loc. ditto.

Figs. 9, 10. *Protocyprina* sp. indet. ................................................................. p. 149

9. Immature right valve (GK. H6764) ×1.5. Loc. ditto.
10. Deformed bivalved specimen (GK. H6763) x1. Loc. ditto. 10a: right view, 10b: left view.

The specimens in Figs. 1 and 2 are preserved in the Geological Institute, University of Tokyo, and those in Figs. 3-10 are kept in the Department of Geology, Kyushu University. Photos by Ichikawa (Figs. 1, 2) and by Hayami (Figs. 3-10).
495. Nippononaia from the Sanchu Area


— (1963): Trigonoides from the Late Mesozoic Tetori group, central Japan. Ibid., N.S., (51), 79-85, pl. 12.


Akad. Wiss., 57, 1-41, pls. 1-5.


Locality guide

Hachimanawa, near Sebayashi, south of Kaga-hara, Nakazato village, Tano County, Gunma Prefecture (138°55′E, 36°01′N) 群馬県多野郡中里村神ヶ原南方頭社八幡沢