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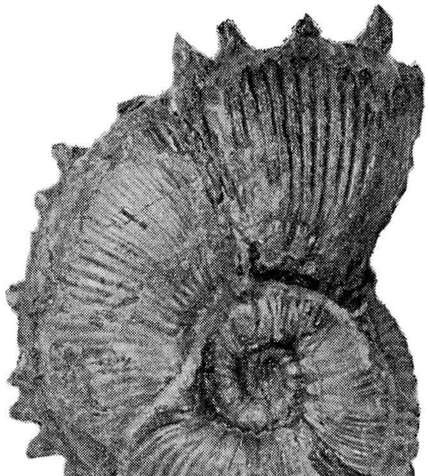

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The fossil on the cover is an adult example (T. TAKAHASHI coll.) of *Mikasaites orbicularis* MATSUMOTO (subfamily Marshallitinae, family Kossmaticeratidae) from the Lower Cenomanian (Cretaceous) of the Mikasa area, central Hokkaido. (photo by M. NODA, natural size)

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725. *CRASSICORBISEMA*, A NEW SILICOFLAGELLATE GENUS, FROM THE SOUTHERN OCEANS AND PALEOCENE SILICOFLAGELLATE ZONATION*

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Abstract. A new silicoflagellate genus, *Crassicorbisema*, is proposed from deep-sea sediments of the southern oceans. Unusually thick siliceous skeletal components bearing a characteristic corrugate surface microstructure permit the specimens to be differentiated readily from the related forms. This genus occurs in abundance but is limited to Lower Paleocene sediments, thus enhancing its biostratigraphic significance. Taxa newly proposed herein are: *Crassicorbisema disymmetrica disymmetrica* and *C. disymmetrica dumitricae*. Based on the present analysis, a revised Paleocene silicoflagellate zonation is proposed. The newly proposed zones are: *Crassicorbisema disymmetrica dumitricae, C. disymmetrica disymmetrica, Corbisema constricta,* and *Naviculopsis constricta*, in ascending order.

Introduction

In the geological history of silicoflagellates, assemblages representing the Paleocene age have not been positively recognized until recently except for brief descriptions from Russia (SCHULTZ, 1928; GLEZER, 1966). Therefore when the documentation of this group of siliceous microplanktons was attempted earlier (LING, 1972), the Paleocene interval was left completely untouched. As D/V *Glomar Challenger*, under the Deep Sea Drilling Project (DSDP), continues the drilling operation throughout the major parts of the world's oceans, submarine deposits of various ages have successfully been recovered including silicoflagellate-bearing sediments of a Paleocene age. One Paleocene silicoflagellate taxon deserves special attention because of its distinctive skeletal appearance, its limited biostratigraphic occurrence, and its paleobiogeographic distribution aparently limited only to the middle and high latitudes of the southern oceans. This paper presents the details of this investigation.

Material Studied

Cored submarine sediments analyzed during the present investigation were recovered from the following DSDP Holes:

208: 26°06.61′S; 161°13.27′E; water depth, 1,545 m.
327 A: 50°52.28′S; 46°47.02′W; water depth, 2,401 m.

The methods of sample preparation for microscopic examination, and of description of the location of illustrated specimens in strewn slides are the same as those given in my earlier investigations.

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Furthermore, morphologic terminology employed herein was also presented earlier (LING, 1972). All the slides examined for the present study will be deposited in the Micropaleontology Collection of the Department of Geology, Northern Illinois University.

Systematic Micropaleontology

Phylum Chrysophycophyta

Class Chrysophyceae

Subclass Silicoflagellatophycidae

Order Siphonotestales LEMMERMANN, 1901

Genus *Corbisema* HANNA, 1928, emend. FRENGUELLI, 1940

Corbisema inermis inermis (LEMMERMANN)

Plate 1, Figs. 1, 2

Dictyocha triacantha var. *inermis* LEMMERMANN, 1901, p. 259, pl. 10, fig. 21.—SCHULTZ, 1928, p. 249, fig. 30a, b (?) ; p. 281, fig. 75.—GEMEINHARDT, 1930, p. 43, fig. 33.—DEFLANDRE, 1932, fig. 31.—TSUMURA, 1963, p. 48, pl. 8, fig. 17.

Corbisema geometrica HANNA, 1928 (in part), p. 261, pl. 41, fig. 1 (only).—MANDRA, 1968 (in part), p. 248, fig. 3 (?) (only).—LING, 1972 (in part), pp. 153-155.

Corbisema apiculata var. *inermis* LEMMERMANN: DEFLANDRE, 1950 (in part), p. 32/82, fig. 86 (only).

Dictyocha triacantha var. *inermis* f. *inermis* GLEZER, 1966 (in part), p. 230, pl. 8, fig. 1(?), 2(?) (only).

Corbisema inermis inermis (LEMMERMANN): BUKRY, 1976, p. 892, pl. 5, figs. 1-3.

Description: Basal body rings, trilobate, with smoothly rounded apices but without radial spines; three lateral rods, slightly arched in lateral view, extend straight inward and perpendicularly from middle of basal ring to join in Y at center; neither apical accessory spine nor apical bar present; basal accessory spines, relatively long, originate from abapical side of junction of lateral rods and basal ring, pointed inward.

Remarks: When HANNA (1928) described *Corbisema geometrica* from California, he included specimens (1928, pl. 4, fig. 1) without a hyaline apical plate and wavy lateral rods, although he regarded them as an irregular form occurring rarely. As has already been pointed out in my earlier publication (LING, 1972) and in the later examination of *C. geometrica* from the topotypic material of the California Academy of Science Collection (MCPHERSON and LING, 1973), no such HANNA's irregular specimen was encounted. Results of subsequent observations by numerous authors mainly from DSDP sediments seem to suggest that it is best to apply the species, *C. geometrica,* in its strict sense to those specimens possessing a hyaline apical plate; thus common geological occurrence of *C. geometrica* is in the Late Cretaceous (Maastrichtian), but ranges rarely to the Early Paleocene.

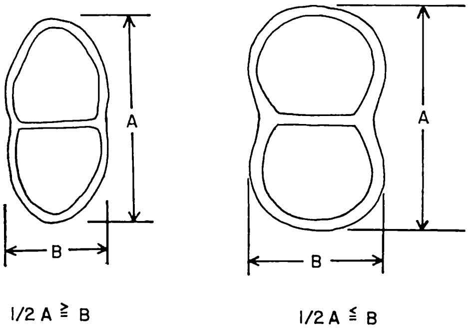
As for *Corbisema inermis inermis,* LEMMERMANN's original illustration (1901, pl. 10, fig. 21) is from Fuur Island of Denmark, and the specimens illustrated here are from my reference samples collected from the same area (S130-135: sample between ash layer 130 and 135 from Sydklinten, Thy; 514/3, sample from ash layer 11, Knudeklint, Fuur Island) with the assistance of Dr. Katharina PERCH-NIELSEN and Ms. Ella HOCH. In her study of the area, PERCH-NIELSEN (1976) did not report the presence of this species. The surface of skeletal components of this species is either smooth (as shown by LEMMERMANN and DEFLANDRE from Fuur Island and SCHULTZ from Simbirsk), or bears granulation (as shown by SCHULTZ and GEMEINHARDT from Mors Island, GLEZER from the Urals, and TSUMURA, from his unspecified locality).

Corbisema naviculoidea (FRENGUELLI)

Plate 1, Fig. 3; Text-figure 1 (left)

Dictyocha navicula EHRENBERG: LEMMERMANN, 1901 (in part), p. 257, pl. 10, fig. 11 (only). —DEFLANDRE, 1932, fig. 13.
Corbisema apiculata f. *naviculoidea* FRENGUELLI, 1940, fig. 12 i.
Corbisema apiculata var. *inermis* LEMMERMANN: DEFLANDRE, 1950 (in part), fig. 88 (only).
Dictyocha naviculoidea (FRENGUELLI): MARTINI, 1974, p. 528.
Corbisema naviculoidea (FRENGUELLI): PERCH-NIELSEN, 1976, p. 33, figs. 7, 19, 22.
Corbisema navicula navicula (EHRENBERG): BUSEN and WISE, 1977, p. 712, pl. 2, figs. 7(?), 8, 9.

Description: Basal body ring, naviculoid with generally narrowly rounded apices; lateral bar, often thinner than that of basal ring, slightly arched in lateral view, joins the basal ring where a slight construction in outline of basal ring is often shown; neither apical accessory spine nor radial spine present; basal accessory spines, short, originate from the abapical side where basal ring and lateral bar meet.



Text-fig. 1. Schematic diagram of *Corbisema naviculoidea* (left) and *C. constricta* showing differneces in proportions which are useful for taxonomic differentiation.

Remarks: Thus far all the previous occurrences for the present taxon from land outcrops have been limited to Fuur Island of Denmark and the specimen illustrated (plate 1, figure 3) is from sample (539/1) at about ash layer 15 or 16 of Holmboes Grav of the island. The specimens with relatively shorter length of the major axis show some resemblance to those of *C. constricta,* but can be differentiated from the latter by its narrowly rounded apices and its general appearance (see figure 1 and further remarks under *C. constricta*).

Corbisema cuspis BUSEN and WISE

Plate 1, Fig. 4

Dictyocha navicula EHRENBERG: SCHULZ, 1928 (in part), p. 243, fig. 16a (only).—MUKHINA, 1974, pl. 2, fig. 13.—MUKHINA, 1976, pl. 2, fig. 13.
Corbisema disymmetrica angulata BUKRY, 1976, p. 891, pl. 1, figs. 1-4.
Corbisema cuspis BUSEN and WISE, 1977, p. 711, pl. 1, figs. 4-6.

Description: Basal body ring, bilobate or naviculoid with distinct acute angle at both apices on major axis; lateral bar, often thinner than that of basal ring, slightly arched in lateral view, joins the basal ring where a slight construction in outline of basal ring is often shown; no apical, basal accessory nor radial spine present.

Remarks: Geological occurrence of this species is thus far limited only to Late Paleocene. When BUKRY (1976) raised DUMITRICA's *Corbisema inermis disymmetrica* (1973) to the rank of species as *C. disymmetrica,* he recognized three subspecies: (a) those with skeletal components of smooth, and regular thickness, *C. disymmetrica angulata* (=*C. cuspis* in this paper), and *C. disymmetrica communis* (=*C. constricta* in this paper); and (b) those possessing a rather thick and unique corrugate microstructure, *C. disymmetrica disymmetrica* (=*Crassicorbisema disymmetrica disymmetrica* in this paper). Differences in thickness and characteristic surface microstructure of its skeletal components coupled with a rather limited geological occurrence of *Crassicorbisema disymmetrica disymmetrica* are significant enough to warrant its taxonomic differentiation from its allied forms which will be discussed later.

It should be emphasized here that although BUKRY's *Corbisema disymmetrica angulata* has priority over *C. cuspis* (BUSEN and WISE, 1977, p. 716) it is apparent from the above discussion that BUKRY's *C. disymmetrica* includes two distinctly different forms. Furthermore, the term *disymmetrica* was originally applied by DUMITRICA (1973) to a subspecies possessing unusually thick and corrugated skeletal components, and its biostratigraphic significance is also clearly amplified in this paper (see below). Thus in order to avoid any further taxonomic confusion among closely allied forms (LANJOUW et al., 1966, ICBN Art. 24: Recommendation 24B), an epithet proposed by BUSEN and WISE is adopted here.

Corbisema constricta BUSEN and WISE

Plate 1, Figs. 5-7; Text-figure 1 (right)

Dictyocha apiculata var. *inermis* (LEMMERMANN), DEFLANDRE, 1941 (in part), p. 102, figs. 20(?), 22.

Dictyocha navicula EHRENBERG, TSUMURA, 1963 (in part), pp. 43, 44, pl. 7, fig. 4—GLEZER, 1966, pp. 233-234, pl. 9, figs. 4, 5; text-fig. 6(6).

Corbisema disymmetrica communis BUKRY, 1976 (in part), p. 891, pl. 1, figs. 7-9 (only).

Corbisema navicula constricta BUSEN and WISE, 1976, p. 712, pl. 3, figs. 1, 2.

Description: Basal body ring, oblong or bilobate, with smooth, broadly rounded apices; lateral bar, often thinner than that of the basal ring, also slightly arched in lateral view, joins the basal body ring where generally definite constriction in outline of basal ring occurs; neither apical accessory spine nor basal radial spine present; basal accessory spines either present or absent.

Remarks: The present species is characterized by its broadly rounded apices and a prolate spheroidal appearance, and generally a distinct stracture in its outline. Some broader specimens of *C. naviculoidea* show a resemblance to those of the present species, but can be differentiated from each other by the nature of the apices as well as by the proportion of major and minor axes as shown in figure 1. Due to the constriction of the specimen in the middle where the lateral rod is located, the widest dimension generally lies in the distal half between apices and the lateral bar on the major axis.

Holotype: USNM 241298, specimen described as *Corbisema navicula constricta* by BUSEN and WISE, 1977, pl. 3, fig. 1.

Paratype: USNM 241229, specimen described as *Corbisema navicula constricta* by BUSEN and WISE, 1977, pl. 3, fig. 2.

Genus *Crassicorbisema* LING, n. gen.

Diagnosis: Relatively large silicoflagellates with unusually thick skeletal components with characteristic corrugate surface microstructure throughout; basal body ring, either well-shaped trilobate, bilobate or widely irregular outline; lateral rod, equal to or frequently thinner than that of basal body ring with corrugate or smooth surface microstructure; basal accessory spines, also thick and short, originate generally on the abapical side where the lateral rod joins the basal ring, frequently bifurcate at the distal end or form two divergent spines from the proximal end; apical accessory spine, generally absent, but if present, short and thick; radial spines absent.

Remarks: Specimens belonging to the present genus demonstrate a rather broad range of irregularities in the outline of its basal body ring, and the presence of one or two additional accessory spines on the basal ring are also common (DUMITRICA, 1973). However, the combination of unusually thick skeletal components and distinct corrugate surface microstructure are consistant and thus readily differentiate specimens of the genus from all the other related forms thus far published even in the lower (e.g. 200 times) magnification.

It may be argued that their unusually thick skeleton and corrugated surface microstructure are due to some environmental conditions, but this is considered to be unlikely at least at the present time, because abundant specimens of the present species are observed with other "normal"-formed silicoflagellates in the same slides.

Until now their abundant occurrence (acme) is observed only in Lower Paleocene sediments recovered from middle to higher latitudes of the southern oceans.

Type species: Crassicorbisema disymmetrica (DUMITRICA) LING, n. comb.

Derivation of generic name: From *crassus*, (Latin, for thick), referring to the unusually thick and corrugate skeletal components of the specimens belonging to this genus.

Crassicorbisema disymmetrica (DUMITRICA) LING, n. comb.

Crassicorbisema disymmetrica dumitricae LING, n. subsp.

Dictyocha triacanth var. *inermis* f. *inermis* GLEZER, 1966 (in part), p. 230, pl. 8, fig. 1(?), 2(?) (only)

Corbisema inermis DUMITRICA (not LEMMERMANN), 1973, p. 845, pl. 12, figs. 7-9.

Corbisema inermis (GLEZER): BUKRY, 1975, p. 854.

Corbisema inermis crenulata BUKRY, 1976, p. 892.

Corbisema inermis inermis (LEMMERMANN): BUSEN and WISE, 1977, p. 711, pl. 2, fig. 5.

Description: Basal ring, commonly triangular, large, robust or thick, consisting of minute crests or tubercles in transverse or irregular forms showing characteristic rough outline; radial spines generally absent at rounded corners; lateral rods, thinner than that of basal ring, gradually tapering off their thickness inward where they join in a form of Y; apical accessory spine absent; basal accessory spine, thick and short, located at abapical side where lateral rods originate from basal ring, though completely absent sometimes.

Remarks: This subspecies was discussed in detail and is well illustrated by DUMITRICA (1973) based on submarine deposits, cores 29 through 31 of Site 208, DSDP Leg 21 from the western flank of the crest of the northern Lord Howe Rise of the Southwest Pacific. Therefore his description is largely adopted here. DUMITRICA (1973, p. 846) listed the present triangular form as constituting 100% for 31 CC, 92% for 30 CC, but its abundance declines rather sharply to only 2% in 29 CC of the *Crassicorbisema* specimens. The present author's examination certainly conforms this observation of DUMITRICA noting only a few specimens in sample 30-2. The section, cores 29 through 31, is considered to be Early to Middle

Paleocene in age by DUMITRICA, whereas BUKRY (1976, p. 887) assigned it to the Early Paleocene *Cruciplacolithus tenuis* (calcarous nannoplankton) Zone.

PERCH-NIELSEN (1975) observed the present taxon from the cored sections 11 through 14, of Hole 277A (Southern Campbell Plateau in the Southwest Pacific, 52°13′43″S; 166°11′48″E; water depth, 1,214 m) of Leg 29 and assigned to the Oligocene *Dictyocha medusa* to *Corbisema hastata-C. apiculata* Zones. Reexamination of these Hole 277A sections, samples 11-2, 12-2, 13-2 and 14-2, all taken at 70-71 cm interval, reveals that only core 13-2 contains a very few specimens of the present taxon, but age of the assemblage is definitely younger consisting of *Naviculopsis constricta, N. biapiculata,* and *N. trispinosa.* Therefore the occurrence of the present species in Hole 277A is here considered to be reworked specimens or contaminants. Nevertheless, its occurrence points out that the source area is either from the Paleocene section of the same site, cores 44-46 CC consisting of nannofossil chalk (KENNETT, HOUTZ, *et al.*, 1975), or from a nearby oceanic area. GLEZER (1966) recognized Paleocene specimens from Russia noting considerable variations for their skeletal contour, and they have unusually large dimensions, 70-100 μm long (vs. 36-63 μm in Cretaceous forms). Her specimens (pl. 8, figs. 1, Early Paleocene; 2, Late Cretaceous) further show a distinctly rough (crenulate?) surface microstructure. Although her specimens have pointed abapical accessory spines and a basal body ring having a regular thickness, there is a possibility that the present taxon may occur in Russian sediments.

Derivation of name: The present subspecies is named after Dr. Paulian DUMITRICA of Romania who first recognized this characteristic silicoflagellate and who is contributing much to the field of siliceous microfossils.

Holotype: Plate 12, figure 9 of DUMITRICA, 1973.

Paratypes: Plate 12, figures 7 and 8 of DUMITRICA, 1973.

Measuremants: Maximum diameter, 93-109 μm (according to BUKRY, 1976, p. 892).

Type locality: Site 208, 31 CC (561 m), southwestern Pacific Ocean.

Crassicorbisema disymmetrica disymmetrica (DUMITRICA) LING

Plate 1, Figs. 8-12

Corbisema inermis disymmetrica DUMITRICA, 1973 (in part), p. 846, pl. 12, figs. 1, 2, 4-6 (only); plate 13, figs. 1-8.—PERCH-NIELSEN, 1975, p. 685, pl. 8, figs. 1, 2.—BUSEN and WISE, 1977, p. 711, pl. 2, fig. 6.

Corbisema disymmetrica disymmetrica (DUMITRICA): BUKRY, 1976 (in part), p. 891, pl. 1.

Description: Basal body ring, generally elliptical to bilobate, but shows a wide range of irregularities in the outline with slight constriction in the outline where lateral rods join; thick skeletal components and corrugate surface microstructure as *C. disymmetrica dumitricae*; radial spine absent; short apical accessory spine occasionally present; lateral bar, similar to but often thinner than that of basal ring, slightly arched upward in lateral view; basal accessory spines either completely absent or thick and short, frequently terminated with blunt end or bifurcate at the distal end; or two divergent spines.

Remarks: Similar to the above subspecies, the present subspecies has well been documented by DUMITRICA (1973). The silicoflagellate flora of the oldest (deepest) sample examined during the present study, 30-2, 112-114 cm (subbottom depth 550.6 m), comprises more than 90% of this subspecies. As noted by DUMITRICA, there is a sharp microfloral change from the *Corbisema inermis disymmetrica* (=*Crassicorbisema distymmetrica disymmetrica*, in this paper) rich sediments above to his *Corbisema inermis* (=*Crassicorbisema disymmetrica dumitricae*, in this paper) dominant sediments below, and apparently this change takes place between section 30-2 and 30 CC. (551-557 m). It is therefore quite possible that this microfloral change corresponds to that of lithologic change recognized at 552.5 m (between 30-3 and 30-4) from a radiolarian and sponge spicule rich nannochalk above to the underlying diatom bearing radiolarian, sponge spicule nannochalk.

The sporadic occurrence with a low frequency of this taxon as well as the above type of species from Hole 327A samples does not negate their biostratigraphic potential. On the contrary, their biostratigraphic value is enhanced by realizing: (a) their wide geographical occurrence in both the Pacific (Site 208) and Atlantic (Hole 327A) sectors of southern oceans; (2) the total range of this species is apparently limited only to the Paleocene; but (3) for a practical biostratigraphic purpose, their common occurrence should limit only the Early Paleocene.

Holotype: Plate 12, figure 2 of DUMITRICA, 1973.

Paratype: Plate 12, figures 4-6 of DUMITRICA, 1973.

Measurements: Maximum diameter on major axis, based on 20 specimens, 90-115 μm.

Type locality: Site 208, 29 CC. (557 m), southwestern Pacific Ocean.

Discussion and Paleocene Silicoflagellate Zonation

The geological occurrence of the aforementioned silicoflagellate taxa can be discussed by correlating the cores and sections of the two DSDP sites to respective zonations based on other planktonic microfossils at these sites. The biostratigraphic framework adopted here is that of the recently improved time scale of HARDENBOL and BERGGREN (1978, see table 1). For the following comparison of different zonations within respective planktonic groups, readers are referred to the articles by BUKRY (1978) and MÜLLER (1974) for calcareous nannoplankton and to BOLLI and KRASHENINNIKOV (1977) for planktonic foraminifers.

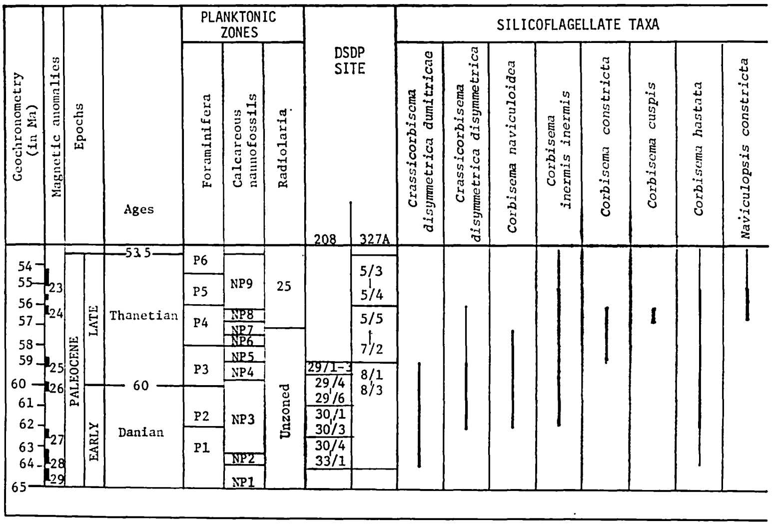
Site 208:

1. 29-1 (below 50 cm) through 29-3: *Heliolithus kleinpellii* (NP 6) Zone (BURNS, ANDREWS *et al.*, 1973).
2. Top of 29-4: Beginning of *Fasciculithus tympaniformis* (NP 5) Zone (BURNS, ANDREWS *et al.*, 1973).
3. Between 29-6, 53-55 cm and 30-1, 34-36 cm: boundary between *Globorotalia pusilla pusilla* (P 3) and *Globortalia uncinata* (P 2) Zones (WEBB, 1973).
4. Between 30-3, 112-114 cm and 30-4, 29031 cm: boundary between *Globigerina uncinata* (P 2) and *Globigerina pauciloculata* (=*G. trinidadensis*, P 1 d) Zones (WEBB, 1973).
5. Between 21-23 cm and 91-93 cm of 33-1: boundary between Paleocene *Conococcolithus panis* Zone and Maastrichtian *Nephrolithus frequens* Zones (EDWARDS, 1971: BURNS, ANDREWS *et al.*, 1978).

Hole 327A:

1. Between 4 CC and 5-1, 3 cm: boundary between *Discoaster multiradiatus* (NP 9) and *Discoaster nobilis* (NP 8) (WISE

Table 1. Paleocene time scale, planktonic zonations (after HARDENBOL and zontaion of silicoflagellates.



and WIND, 1977)

2. 7-2, 147 cm: the bottom of *Fasciculthus tympaniformis* (NP 5) (WISE and WIND, 1977).
3. Between 43-44 cm and 70-71 cm of 8-3: Boundary between silicoflagellate bearing sediments above (BUKRY, 1976) and the underlying microfossil poor sediments of the present investigaiton. The entire cores are described as a zeolite clay (BARKER, DALZIEL, *et al.*, 1977). The absence of *Corbisema inermis crenulata* BUKRY (=*Crassicorbisema disymmetrica dumitricae*, in this paper) in the sample of 43-44 cm suggests that the sample is within the newly proposed *Crassicorbisema disymmetrica disymmetrica* Zone (see below).

Geological occurrence of the taxa is presented in table 1 arranged according to the stratigraphic positions of those cored sediments as just discussed. It is immediately evident that silicoflagellate taxa show a distinct sequence of events which provide the basis for a proposed new zonation based on silicoflagellates. Therefore, a brief review of the silicoflagellate zonation for the Paleocene interval is in order.

The recovery of silicoflagellates from the cored sediment, 31-3, 110-111 cm (561 m) at Site 208, the northern end of the Lord Howe Rise, led BUKRY (1973) to recognize the first Paleocene (Danian) silicoflagellate assemblage. In his analysis the sedimentary section from 29-5 through 31-3 was assigned (but with question in his figure 2) to *Cruciplacolithus tenuis*, calcareous nannofossil, Zone. In addition, an assemblage of similar age was recorded from the cores 37-3 through 40-2 (343-381 m), Site 214 (11°20′21″S, 88°43′08″E, water depth 1,665 m) from the eastern Indian Ocean (BUKRY, 1974). These findings are the basis for establishing the *Corbisema hastata* Zone by BUKRY and FOSTER (1974, Table 1), of whicn base is defined by the initial apperance of *Corbisema hastata*, at its top by the first appearance of *Naviculopsis constricta*. Although they cited the first occurrence of *N. constricta* in the late Paleocene or and BERGGREN, 1978) geological distribution possibly in early Eocene time (1974, p. 305), the zone was considered to encompass the entire Paleocene Epoch at that time. This zonal scheme is followed by later (BUKRY, 1975, also see figure 4) discussion of Leg 29 samples from the southwest Pacific Ocean, although no Paleocene sediments were recovered during the cruise. Note here, however, the upper boundary of the zone was drawn within Late Paleocene in his figure 3 (BUKRY, 1975, p. 847).

SILICOFLAGELLATE ZONES				
Bukry & Foster (1974) Bukry, (1975) Leg 29	Bukry (1976) Leg 36	Busen & Wise (1976) Leg 36	Bukry (1977) Leg 39	Ling this paper
Corbisema hastata	*Naviculopsis constricta*	*Nav. const.*	*Nav. const.*	*Naviculop. constricta*
	Nav. const. *C. hastata*	*Corbisema hastata*	*Corbisema hastata*	*Corbisema constricta*
	Corbisema hastata			*Crassicorb. disymmatr. disymmetr.*
				Crassicorb. disymmetr. dumitricae

It is from Hole 327A of Leg 36 from the South Atlantic Ocean that BUKRY (1976) formally lowered the upper limit of the *Corbisema hastata* Zone to the initial common occurrence of *Naviculopsis constricta* below the Paleocene-Eocene boundary (1976, 1977). According to him, this occurs within core 5 and is associated with the coccolith guide species, *Heliolithus riedelii*. The zonation of Paleocene section for Hole 327A is:

5-1 through 5-4: *Naviculopsis constricta*

5-5 through 7-2: *Naviculopsis constricta* or *Corbisema hastata*

8-1 through 8-3: *Corbisema hastata* Zone

This same interval was investigated by BUSEN and WISE (1977) and their results are: 5-1 through 6-1 (14-16 cm): *Naviculopsis constricta*

6-1 (102-103 cm) through 8-3: *Corbisema hastata*

They considered the *Corbisema hastata* Zone to range from the beginning of Paleocene to middle Late Paleocene, whereas the overlying *Naviculopsis constricta* Zone extends up to Middle Eocene (see their table 2 on p. 703). An interesting, unexpected point emerges from the above comparison: increase in abundance of *Naviculopsis constricta* did not show a sharp break but rather a steady upward increase in abundance throughout the zone (BUSEN and WISE, 1977; BUKRY, 1976) following its initial appearance at the beginning of the *Corbisema hastata* Zone. Therefore, BUSEN and WISE suggested that the initial appearence of *Corbisema cuspis* in conjunction with the increase in abundance of *Naviculopsis constricta* delimits the base of the *N. constricta* Zone. The initial appearance of *Corbisema cuspis* between 14-16 cm and 102-103 cm of 6-1 from Hole 327A by BUSEN and WISE (1977) agrees with that of BUKRY as well as the present author's investigation.

The observations that the *Corbisema hastata* Zone thus far defined encompases from Early to at least a part of Late Paleocene is well documented. The results of the present investigation reveal that silicoflagellate taxa discussed above possess a definite geological range as well as morphological characteristics which would be useful for biostratigraphic subdivision of the Paleocene Epoch; consequently a new zonation is proposed as follows.

Crassicorbisema disymmetrica dumitricae Zone

Top: Initial common occurrence of *Crassicoribisema disymmetrica disymmetrica*

Bottom: Initial appearence of the nominated species

References Section: Cores 30-4 through 33-1 of Site 208

Remarks: The zone is characterized by the predominance of *C. disymmetrica dumitricae* as observed by DUMITRICA (1973). During the present investigation the bottom of this zone was not observed. It is quite conceivable that *Corbisema hastata* is present, and some Cretaceous index species, such as those belonging to *Vallacerta* and *Lyramula* may extend their ranges to early Cenozoic. The zone is here regarded as coeval to Pl Planktonic foraminiferal Zone.

Crassicorbisema disymmetrica disymmetrica Zone

Top: Initial apperance of *Corbisema constricta*

Bottom: Initial common occurrence of the nominated subspecies.

Reference section: Cores 29-5 through 30-3 of Site 208

Remarks: A change of predominance from *Crassicorbisema disymmetrica dumitricae* to the nominated subspecies limit the base of the zone. The earliest appearance of *Corbisema naviculoidea* also occurs at this level or slightly later. The upper limit of the zone here defined can also be considered as the top of local acme zone of the nominated species.

Corbisema apiculata, C. hastata hastata and *C. tricantha* are also present.

Corbisema constricta Zone

Top: Initial appearance of *Corbisema cuspis* and initial common occurrence of *Naviculopsis constricta*

Bottom: Initial appearance of the nominated species

Reference section: Core 5-4, between 100-103 cm and 138 cm through 7-2 of Hole 327A

Remarks: The upper boundary of the zone defined herein based on the results my investigation is in agreement with that of BUSEN and WISE (1977). As for the base, the following observations provide a convenient guide for its recognition: (1) initial appearance of *Corbisema? falklandensis* of BUKRY (=*Pseudomicromarsupium gombosum* of BUSEN and WISE); (2) the last common occurrence of *Crassicorbisema disymmetrica disymmetrica); and* (3) the only limited occurrence of *Naviculopsis dancia* in this part of southern ocean. Other members of the assemblage consist of: *Corbisema hastata hastata C. hastata cunicula, C. hastata glabela, C. glezerae, C. inermis inermis, C. inermis minor,* and *C. triacantha.*

Naviculopsis constricta Zone

Top: First common occurrence of *Dictyocha hexacantha* (not observed in this study)

Bottom: Initial common occurrence of *Naviculopsis constricta* and initial appearance of *Corbisema cuspis*

Reference sections (for the lower part): Cores 5-1 through 5-4, between 100-102 cm and 138 cm of Hole 327A.

Remarks: The zone is essentially the same as recognized previously by BUKRY (1976, 1977) except with the modification of the base as defined above. The local range of *Corbisema cuspis* seems to be limited only to the lower part of this zone.

Acknowledgements

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Explanation of Plate 1

All illustrations are ×400 unless otherwise indicated

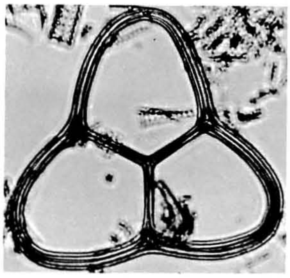
Figs. 1-2. *Corbisema inermis inermis* (LEMMERMANN).
1: S130-135, R-2 (L6/0); 2: 514/3, L-2, (×23/0), abapical view oblique showing rather long basal accessory spines.

Fig. 3. *Corbisema naviculoidea* (FRENGUELLI). 539/1, L-2, (D39/0).

Fig. 4. *Corbisema cuspis* BUSEN and WISE. 327A, 5-4, 70-71 cm, L-2 (M19/0).

Figs. 5-7. *Corbisema constricta* BUSEN and WISE
5, 6: 327A, 5-4, 70-71 cm, L-2 (S14/1). 7: same specimen as Figs. 5, 6, with higher magnificantion, ×1020, showing the surface microstructure.

Figs. 8-12. *Crassicorbisema disymmetrica disymmetrica* LING, n. comb.
8, 9: 208, 30-2, 112-114 cm, L-2 (P32/0). 208, 30-2, 112-114 cm, L-2 (P43/3). Specimen as illustrated in Figs. 10, 11, with higher magnification, ×1020, showing the surface microstructure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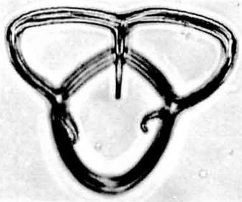
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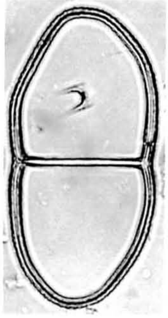
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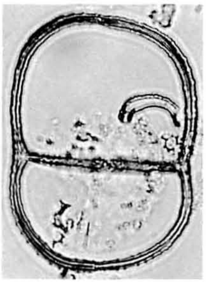
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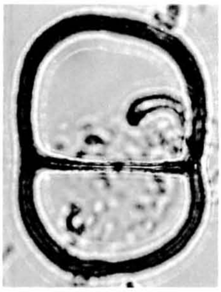
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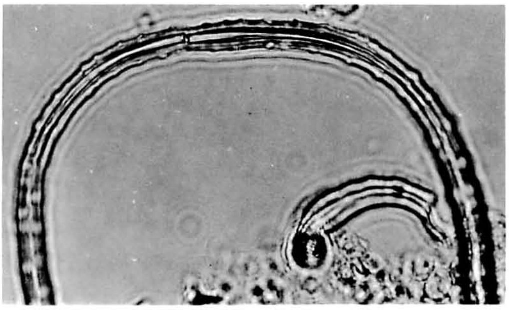
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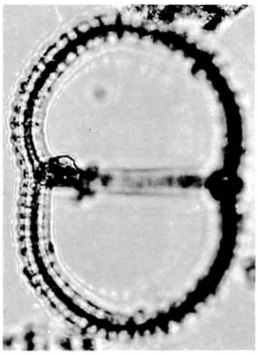
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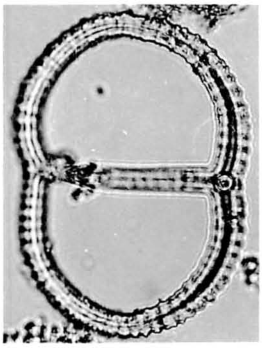
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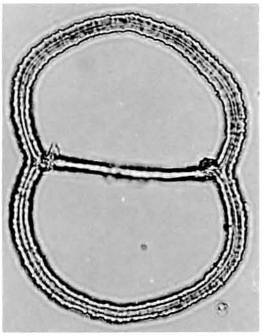
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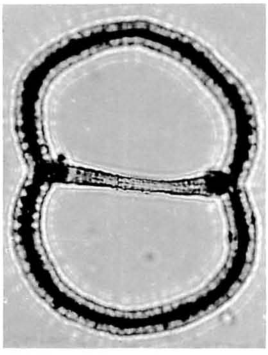

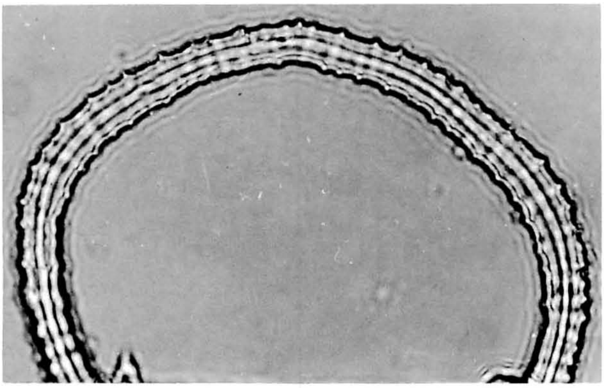
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珪質鞭毛藻 (Silicoflagellate) の新属 *Crassicorbisema* とその暁新世の分帯への役割：深海海底掘削計画 (DSDP) 中南半球の 208 と 327 A 地点で採集した暁新世の堆積物中から，珪質鞭毛藻 (Silicoflagellate) の一属 *Crassicorbisema* を新設した。異常に厚い珪質骨格各部と，顕著な粗いひだ（或はしわ）状の表面の微細構造は極めて特徴的で，低倍率でも容易にその存在が認められる。現在までの所，この属は一種二亜種からなり，南半球にのみ分布が確認されているが，その地質時代は主として早期暁新世にのみ限られている事から少くともこの地域の生層序の示準化石として役立つものと期待される。又この研究の結果，珪質鞭毛藻から暁新世を下から *Crassicorbisema disymmetrica dumitricae*, *C. disymmetrica disymmetrica*, *Corbisema constricta*, *Naviculopsis constricta* の四つに分帯した。 林 信 一

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 121, pp. 14-28, pls. 2, 3, April 30, 1981

726. CORBICULID MOLLUSCA FROM THE URAHORO GROUP, KUSHIRO COAL FIELD, EASTERN HOKKAIDO*

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Abstract. *Corbicula* (Mollusca: Corbiculidae) is one of the most common non-marine mollusks in the Urahoro Group. A total of three species is recorded: *Corbicula (Batissa) sitakaraensis* SUZUKI, *C.* (*Corbicula*) *tokudai* (YOKOYAMA) and *C.* (*Corbicula*) *kotakai*, n. sp. *C. sitakaraensis* is considered to be a more saline water dweller than both *C. tokudai* and *C. kotakai*, which are probably brackish or fresh water species.

Introduction

The Urahoro Group developed in the Ombetsu district, in the western part of the Kushiro coal field, eastern Hokkaido, can be divided into four formations. These are the Rushin, Yubetsu, Shitakara and Shakubetsu Formations in ascending order. All four are in conformably contact.

The group is composed mainly of conglomerate, poorly sorted sandstone and gray siltstone. The conglomerate consists predominantly of chert pebbles. Coal seams are well developed in the Yubetsu and Shakubetsu Formations throughout the Ombetsu district, but poorly developed in the Rushin Formation at its northwestern extremity in the district along the Muri-gawa.

The Urahoro Group is distributed in a NNE-SSW trend in such rivers and valleys as the Chambetsu-gawa, the Tankono-sawa, the Yatatoshino-zawa, the Shakubetsu-gawa, the Chokubetsu-gawa, the Rubeshube-zawa, the Sango-zawa, the Otobe-gawa, etc.

The group ranges in thickness from about 400 to 600 m. It is unconformably overlain by the Omagari Formation of the Ombetsu Group, and rests unconformably on the Kawaruppu Formation of the Nemuro Group. Table 1 shows the stratigraphic classification in the Ombetsu district.

The Urahoro Group contains molluscan fossils which are shallow marine or brackish water dwellers, and are called the upper Ishikarian fauna (MIZUNO, 1964). The fauna includes such species as *Mytilus mabuchii* OYAMA and MIZUNO, *Chlamys shitakaraensis* HONDA, *Ostrea eorivularis* OYAMA and MIZUNO, *Corbicula* (*Batissa*) *sitakaraensis* SUZUKI, *C.* (*Corbicula*) *tokudai* (YOKOYAMA), *C.* (*Corbicula*) *kotakai*, n. sp., *Nemocardium ezoense* TAKEDA, *Hubertschenckia ezoensis* (YOKOYAMA), *Macoma sejugata* (YOKOYAMA), *Mya grewingki* MAKIYAMA, *Thracia* n. sp., "*Ampullina*" *asagaiensis* MAKIYAMA, etc.

Corbicula is one of the most common non-marine mollusks in the Urahoro

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* Received September 2, 1980.

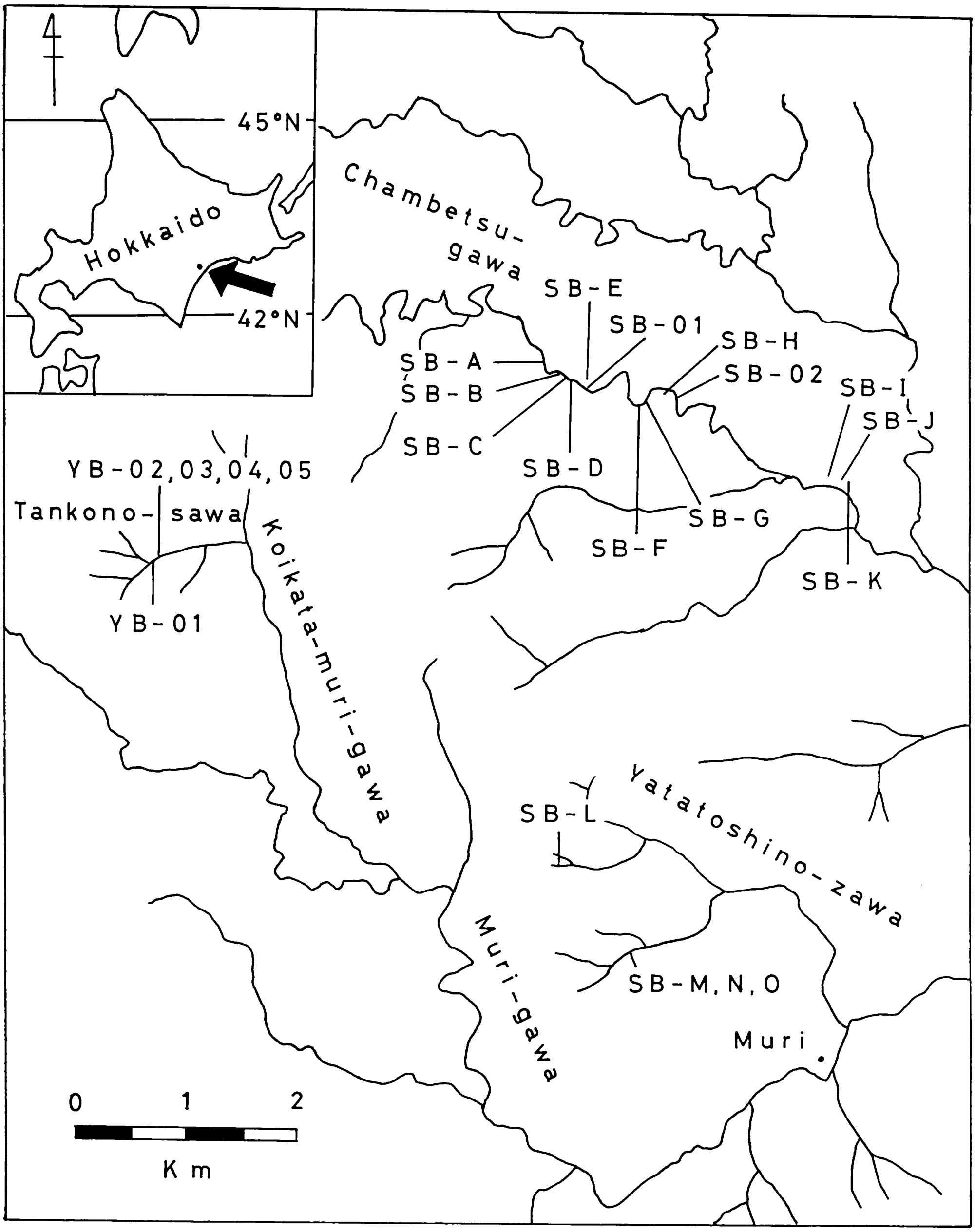

Fig. 1a. Map of the northern Ombetsu district indicating fossil localities.

Group of the Kushiro coal field, as well as that in the Naibuchi Group of southern Sakhalin, USSR, the Ishikari Group of the Ishikari coal field and the Uryu Group of the Rumoi coal field, central Hokkaido.

MIZUNO (1964) reported a total of three

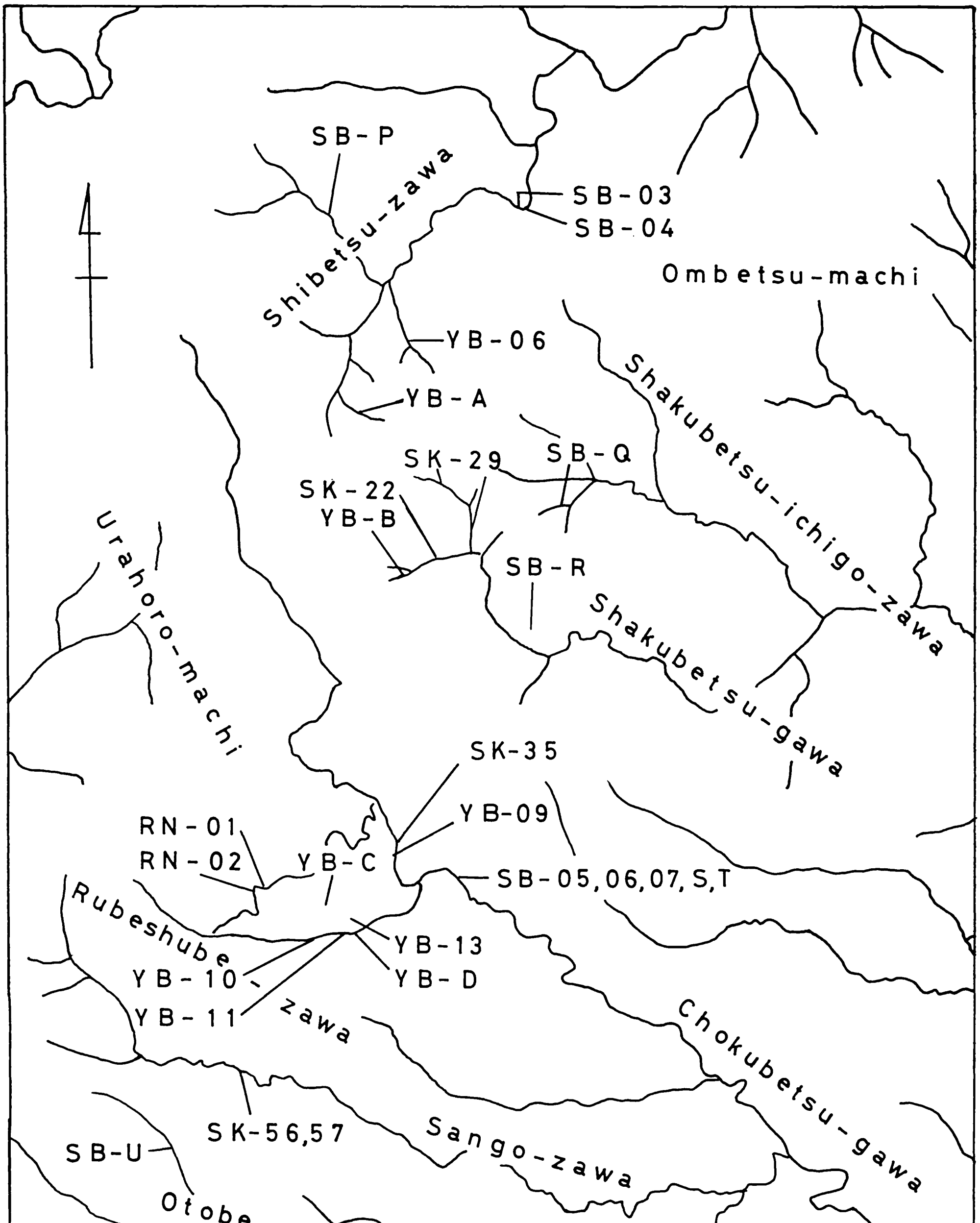

Fig. 1b. Map of the southern Ombetsu district indicating fossil localities.

Table 1. Stratigraphic classification in the Ombetsu district (Honda, 1977MS, *partly revised*).

AGE	GROUP	FORMATION
Holocene		Alluvium
Pleistocene		Terrace deposits
Miocene	Atsunai Group	Shiranuka Formation
		Atsunai Formation
		Tokomuro Formation
Oligocene	Ombetsu Group	Nuibetsu Formation
		Charo Formation
		Omagari Formation
	Urahoro Group	Shakubetsu Formation
		Shitakara Formation
		Yubetsu Formation
		Rushin Formation
Late Cret.- Paleocene	Nemuro Group	Kawaruppu Formation

species of *Corbicula* from the Urahoro and Ombetsu Groups in the Kushiro coal field. The three are *Corbicula* (*Batissa*) *sitakaraensis* which is found abundantly in the "Tenneru Formation" in the Semposhi area at the eastern extremity of the coal field, the Soun Coal-bearing Member of the Teshibetsu Formation, and the Shitakara Formation ; *C.* (*Cyrenobatissa*) *sakakibarai* (Ôtatume) which is also found abundantly in the upper part of the Shakubetsu Formation in the Yubetsu and Akan districts of the central part of the coal field; *C.* (*Corbicula*) *tokudai* which is very rare in the Urahoro Group; and *C.* (*Batissa*) *sitakaraensis*, subsp. which is found abundantly in the Omagari Formation of the Ombetsu Group.

The "Tenneru Formation" is a correlative of the upper part of the Rushin Formation, and the Soun Coal-bearing Member is a correlative of the upper part of the Yubetsu Formation in the Kushiro coal field.

Mizuno (1964) mentioned that the stratigraphic occurrence of *Corbicula* in the Urahoro Group is similar to that in the Hiragishi and Ashibetsu Formations of the upper part of the Ishikari Group in the Ishikari coal field, central Hokkaido. He concluded that *C. tokudai* represents his lower and middle Ishikarian faunas, and *C. sitakaraensis* and *C. sakakibarai* represent the upper Ishikarian fauna.

Corbicula (*Corbicula*) lives in brackish water as well as in fresh water in the Japanese Islands (Habe, 1977). On the other hand, *Batissa* and *Cyrenobatissa* do not live in Japan at present, but they live in brackish water, south of the Philippines, and south of Taiwan or the Ryukyu Islands, respectively (Suzuki, 1949).

Corbicula (*Corbicula*) *japonica* Prime, is one of the most abundant corbiculid mollusks living in Japan, and has been reported from sandy, muddy and gravelly bottoms of brackish lakes in Hokkaido (Asahina, 1941), and from sand and mud bottoms of the Lake Shinji-ko on the Japan Sea coast, Southwest Japan (Mizuno, Sumi and Suzuki, 1966). These different substrates inhabited by *Corbicula* today were apparently also inhabited in the past, as shown by the various grain sizes of sedimentary rocks where *C. tokudai* and *C. sitakaraensis* are obtained, if these are autochthonous and the specimens have not been transported from habitats of different grain size. The lithology from which specimens of *C. tokudai* and *C. sitakaraensis* were collected is described below.

In this paper, the author describes and discusses three species of the genus *Corbicula*, among which one is new and was collected from the Urahoro Group in the Ombetsu district, in the western part of the Kushiro coal field. Maps of the Ombetsu district indicating fossil localities are shown in Figs. 1a, b.

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Systematic Description

Family Corbiculidae

Subfamily Corbiculinae

Genus *Corbicula* MERGELE VON MÜHLFELD, 1811

Subgenus *Batissa* GRAY, 1853

Corbicula (*Batissa*) *sitakaraensis* SUZUKI, 1941

Pl. 2, Figs. 11, 19; Pl. 3, Figs. 1-8

Corbicula sitakaraensis SUZUKI, 1941a, p. 57, pl. 4, figs. 1a-b.

Batissa sitakaraensis (SUZUKI): ÔTATUME, 1943a, p. 241, pl. 5, figs. 1-10; ÔTATUME, 1943c, p. 23, pl. 4, figs. 7-9.

Corbicula (*Batissa*) *sitakaraensis* (SUZUKI): MINATO, 1950, p. 18, text-figs. 13, 13a-b.

Corbicula (*Batissa*) *sitakarensis* SUZUKI: OYAMA, MIZUNO and SAKAMOTO, 1960, p. 160, pl. 48, figs. 3a-h (3a-c, f, reproduced from ÔTATUME, 1943a; 3d-e, ÔTATUME, 1943c; 3g-h, from SUZUKI, 1941a).

Dimensions:—Dimensions are shown in Table 2.

Remarks:—Several hundred more or less broken specimens with conjoined or separated valves were collected. They frequently form beds attaining several tens of cm in thickness, and occur in groups in pebbly to granular conglomerate, or poorly sorted fine-grained sandstone bearing pebbles and granules, at 22 localities of the Rushin, Yubetsu, Shitakara and Shakubetsu Formations of the Urahoro Group in the Ombetsu district, in the western part of the Kushiro coal field.

This species was originally described by SUZUKI (1941a, p. 57, pl. 4, figs. 1a-b) from the Shitakara Formation at Karisyo, Shiranuka-machi, Shiranuka-gun, in the central part of the Kushiro coal field. It has also been reported from the Naibuchi Group of southern Sakhalin, USSR, the Omagari and Charo Formations of the Ombetsu Group, and the Hiragishi Formation of the Ishikari Group, Ishikari coal field, central Hokkaido (ÔTATUME, 1943a; MATSUI, 1962; MIZUNO, 1964). It shows fairly variable outlines; for instance, height/length ratio varies from 77.3 to 107.3 percent and width/length ratio varies from 14.3 to 26.9 percent (Table 2).

The present species is characterized by three divergent cardinal teeth in each valve, two anterior and two posterior lateral teeth in the right valve, and one anterior and one posterior lateral in the left valve. The anterior cardinal tooth of the right valve is the shortest and weakest of the three, and continues anteriorly to the cardinal plate, the middle one is bifid, the strongest of the three, and shorter than the posterior one. The anterior cardinal tooth of the left valve

Table 2. Measurements (in mm) of *Corbicula* (*Batissa*) *sitakaraensis*.

IGPS coll. cat. no.	Loc. no.	Height	Length	Width	H/L(%)	W/L(%)	Valve
96762-1	RN-02	30.9	34.0	5.8	90.9	17.1	Left
96760-1	YB-09	26.5	32.9	6.6	80.5	20.1	Left
96760-2	YB-09	——	37.7	6.6	——	17.5	Right
96760-3	YB-09	35.8	41.0	14.5/2	88.3	17.7	Both
96760-4	YB-09	43.4	——	8.8	——	——	Right
96760-5	YB-09	41.8	——	11.0	——	——	Right
96760-6	YB-09	——	45.2	6.5	——	14.4	Right
96760-7	YB-09	35.0	37.3	7.5	93.8	20.1	Right
96760-8	YB-09	38.5	41.0	6.9	93.9	16.8	Right
96760-9	YB-09	41.0	38.2	16.8/2	107.3	22.0	Both
96760-10	YB-09	39.5	43.1	18.0/2	91.6	20.9	Both
96760-11	YB-09	38.1	——	8.4	——	——	Right
96760-12	YB-09	39.3	41.0	14.0/2	95.6	17.1	Both
96760-13	YB-09	46.0	——	10.0	——	——	Left
96760-14	YB-09	33.2	38.2	5.8	86.9	15.2	Right
96760-15	YB-09	33.3	——	6.8	——	——	Right
96759-1	SK-56	43.5	48.1	——	90.4	——	Both
96759-2	SK-56	36.8	——	7.5	——	——	Right
96759-3	SK-56	43.3	50.9	14.6+/2	85.1	14.3	Both
96765-1	SK-57	32.4	——	6.1	——	——	Right
96765-2	SK-57	17.0	18.6	5.0	91.3	26.9	Right
96765-3	SK-57	43.9	——	8.1	——	——	Right
96761	SB-01	33.9	44.0	18.0/2	77.0	20.5	Both
96770	SB-03	41.3	49.6	10.0	83.3	20.6	Right
96764-1	SB-A	30.9	37.9	15.3/2	81.5	20.2	Both
96766	SB-F	6.5	7.2	3.7/2	90.3	25.7	Both

is bifid, the shortest of the three and almost as strong as the middle one; the middle one is bifid and shorter than the posterior one; the posterior one is the longest but the weakest of the three, and continues posteriorly to the cardinal plate. Both the anterior and the posterior laterals extend to the anterior and posterior muscle scars, respectively; the anterior laterals about two-thirds as long as the posterior. The lateral teeth are compressed and serrated.

The present species resembles *Corbicula* (*Batissa*) *hukayai* ÔTATUME (1943c, p. 26, pl. 4, figs. 10-17), originally described from the Nayoshi Formation (Naibuchi Group, *vide* OYAMA, MIZUNO and SAKAMOTO, 1960), southern Sakhalin, USSR, but it is distinguished from *C. hukayai* by its less inflated and larger shell, and by the anterior laterals being shorter than the posterior ones.

It also resembles *C.* (*Corbicula*) *tokudai* (YOKOYAMA, 1932, p. 240, pl. 2, figs. 3-4, *non* fig. 2) in outline, but *C. sitakaraensis* differs in having; 1) bifurcated cardinal teeth, 2) different relations between the length and strength of the three cardinals, 3) the anterior laterals shorter than the posterior ones, 4) a much larger and less inflated shell, 5) much more variable outlines. However, in immature specimens of one or two centimeters height (or length) of shell, *C. sitakaraensis* is hardly distinguishable from *C. tokudai* in outline.

Associated fauna:—The present species is commonly associated with *Ostrea eorivularis, Mytilus mabuchii, Nemocardium ezoense* and/or "*Ampullina*" *asagaiensis,* and rarely with *Chlamys shitakaraensis, Bellamya* (*Sinotaia*) *mabutii* or *Turritella* sp.

Locality and Formation:—RN-01, RN-02, Rushin Formation; YB-09, YB-A, YB-C, Yubetsu Formation; SK-22, SK-29, SK-35, SK-56, SK-57, Shitakara Formation; SB-01, SB-03, SB-04, SB-A, SB-B, SB-D, SB-F, SB-G, SB-H, SB-O, SB-P, SB-R, Shakubetsu Formation.

Subgenus *Corbicula* s. s.

Corbicula (*Corbicula*) *tokudai* (YOKOYAMA, 1932)

Pl. 2, Figs. 1-5, 7, 8, 12, 18

Cyrena sp., JIMBO, 1890, p. 42, pl. 1, fig. 5 (*fide* SUZUKI, 1941d).

Circe tokudai YOKOYAMA, 1932, p. 240, pl. 2, figs. 3, 4 (*non* fig. 2).

Corbicula atrata tokudai (YOKOYAMA): SUZUKI, 1941b, p. 9, text-figs. 1, 2 on page 10, pl. 1, figs. 11, 12, pl. 2, figs. 1-26; SUZUKI, 1941c, p. 32, pl. 2, figs. 6-18.

Corbicula atrata tokudai (YOKOYAMA)?: SUZUKI, 1941d, p. 524, text-figs. 1a, b on page 521 (reproduced from Jimbo, 1890).

Corbicula tokudai (YOKOYAMA): NAGAO and ÔTATUME, 1943, p. 7, pl. 3, figs. 4-9; ÔTATUME, 1943b, p. 16, text-fig. 4 on page 18; MINATO, 1950, p. 19, text-figs. 16, 16a-b; *non* KAMADA, 1955, p. 21, pl. 4, figs. 4-9.

Corbicula (*Corbicula*) *tokudai* (YOKOYAMA): OYAMA, MIZUNO and SAKAMOTO, 1960, p. 166, pl. 50, figs. 6a-k (6a-c, reproduced from SUZUKI, 1941c; 6d-k, from SUZUKI, 1941b).

Dimensions:—Dimensions are shown in Table 3.

Remarks:—Several hundred specimens were collected, mostly with valves closed. They frequently form beds attaining several tens of cm in thickness, and occur in groups in fine-grained sandstone, gray siltstone and granular conglomerate at 24 localities of the Yubetsu and Shakubetsu Formations of the Urahoro Group in the Ombetsu district, in the western part of the Kushiro coal field.

Some specimens lack umbonal areas, or have been deformed by pressure after burial. The specimens are generally one or two cm in height (or length) of shell, and show less variable outlines than those of *C. sitakaraensis*; for instance, height/length ratio varies from 76.3 to 93.4 percent and width/length ratio varies from 19.9 to 28.7 percent (Table 3).

The present species was originally described by YOKOYAMA (1932, p. 240, pl. 2, figs. 3, 4, *non* fig. 2) from the Numata Formation of the Uryu Group and the Miocene Okada Formation of the Rumoi coal field, central Hokkaido. It has also been reported from: the Yubari, Wakkanabe, Bibai, Akabira, Ikushumbetsu, Hiragishi and Ashibetsu Formations of the Ishikari Group (SHIMOKAWARA, 1963); the Tachibetsu Formation of the Uryu Group (OHARA and KANNO, 1969); and the Yubetsu, Shitakara and Shakubetsu

Table 3. Measurements (in mm) of *Corbicula* (*Corbicula*) *tokudai*.

IGPS coll. cat. no.	Loc. no.	Height	Length	Width	H/L(%)	W/L(%)	Valve
96768-1	YB-03	17.1	20.8	10.1/2	82.2	24.3	Both
96768-2	YB-03	17.9	19.6	9.3/2	91.3	23.7	Both
96772-1	YB-05	19.1	22.5	9.2/2	84.9	20.4	Both
96772-2	YB-05	16.8	18.2	9.1/2	92.3	25.0	Both
96772-3	YB-05	17.5	18.8	10.8/2	93.1	28.7	Both
96772-4	YB-05	14.7	16.3	7.9/2	88.3	24.2	Both
96772-5	YB-05	15.1	17.1	9.1/2	88.3	26.6	Both
96753-1	YB-D	16.8	20.5	9.1/2	82.0	22.2	Both
96753-2	YB-D	17.5	21.9	8.7/2	79.0	19.9	Both
96753-3	YB-D	15.1	19.8	7.7/2	76.3	25.5	Both
96753-4	YB-D	16.0	19.3	9.0/2	82.9	23.3	Both
96753-5	YB-D	15.2	18.6	9.0/2	81.7	24.2	Both
96753-6	YB-D	15.3	18.9	8.9/2	81.0	23.5	Both
96753-7	YB-D	15.0	19.1	8.8/2	78.5	23.0	Both
96753-8	YB-D	15.0	18.3	8.9/2	82.0	24.3	Both
96753-9	YB-D	14.5	17.5	8.7/2	82.9	24.9	Both
96753-10	YB-D	13.7	17.2	7.5/2	79.7	21.8	Both
96753-11	YB-D	14.2	16.3	8.1/2	87.1	24.8	Both
96753-12	YB-D	13.9	16.0	8.0/2	86.9	25.0	Both
96753-13	YB-D	13.9	16.3	8.0/2	85.3	24.5	Both
96753-14	YB-D	13.8	15.9	7.9/2	86.8	24.8	Both
96753-15	YB-D	12.2	15.5	7.5/2	78.7	24.2	Both
96753-16	YB-D	13.4	15.3	7.0/2	87.6	22.9	Both
96753-17	YB-D	12.4	14.6	7.7/2	84.9	26.4	Both
96753-18	YB-D	11.9	15.0	6.5/2	79.3	21.7	Both
96753-19	YB-D	12.3	15.1	7.6/2	81.5	25.2	Both
96753-20	YB-D	12.8	14.5	7.0/2	88.3	24.1	Both
96753-21	YB-D	12.0	14.5	6.9/2	82.8	23.8	Both
96753-22	YB-D	11.5	14.4	7.3/2	80.0	25.2	Both
96753-23	YB-D	11.4	13.9	6.1/2	82.0	25.5	Both
96753-24	YB-D	11.0	13.8	6.7/2	79.7	24.3	Both
96753-25	YB-D	11.5	13.3	6.6/2	86.5	24.8	Both
96753-26	YB-D	11.6	13.2	6.5/2	87.9	24.6	Both
96753-27	YB-D	10.7	11.7	6.0/2	91.5	25.6	Both
96753-28	YB-D	10.0	12.5	6.4/2	80.0	25.6	Both
96753-29	YB-D	10.0	11.6	5.8/2	86.2	25.0	Both
96753-30	YB-D	9.9	11.9	5.9/2	83.2	24.8	Both
96753-31	YB-D	9.2	11.8	4.9/2	78.0	20.8	Both
96753-32	YB-D	9.4	11.0	4.7/2	85.5	21.4	Both
96753-33	YB-D	9.0	10.8	4.5/2	83.3	20.8	Both
96753-34	YB-D	9.0	10.0+	5.0/2	90.0	25.0	Both
96753-35	YB-D	8.5	10.0	4.1/2	85.0	20.5	Both
96753-36	YB-D	7.9	9.0	4.0/2	87.8	22.2	Both
96753-37	YB-D	6.5	7.3	3.0/2	89.0	20.5	Both
96754-1	SB-02	11.3	12.1	6.4/2	93.4	26.4	Both
96754-2	SB-02	10.5	12.1	5.9/2	86.8	24.4	Both
96769	SB-K	19.0	20.6	5.2	92.2	25.2	Right

Formations of the Urahoro Group, and the Omagari Formation of the Ombetsu Group (MATSUI, 1962).

The present species has three divergent cardinal teeth in each valve, two anterior and two posterior lateral teeth in the right valve, and one anterior and one posterior lateral in the left valve. The anterior cardinal tooth of the right valve is the shortest and weakest of the three, and continues anteriorly to the cardinal plate; the middle one is the longest and strongest of the three; the posterior one is shorter and weaker than the middle one. The anterior cardinal tooth of the left valve is the strongest of the three and nearly as long as the middle one; the posterior one is the shortest and weakest of the three, and continues posteriorly to the cardinal plate. The anterior and posterior lateral teeth extend to the anterior and posterior muscle scars, respectively; the anterior lateral is as long as the posterior. The lateral teeth are compressed and serrated.

The present species resembles *Corbicula* (*Corbicula*) *iburica* (YOKOYAMA, 1931, p. 194, pl. 11, fig. 8), originally described from a Neogene bed at Mukawa, Yufutsu-gun, central Hokkaido, but *C. tokudai* is distinguished from *C. iburica* by its less inflated and more rounded shell.

It is allied also to *C.* (*Corbicula*) *japonica* PRIME (1864, p. 68, fig. 15, *fide* KURODA, 1938, p. 34), living in Japan, but it differs from the latter by its less inflated and more rounded shell, and less inflated umbonal area.

KAMADA (1955, p. 21, pl. 4, figs. 4-9) described *C. tokudai* from the Shiramizu Formation of the Uchigo Group, Joban coal field, Northeast Japan, but the species he called *C. tokudai* differs from *C. tokudai* in its more inflated and more trigonal shell. It is allocated here to *C. iburica*, as was treated by OYAMA, MIZUNO and SAKAMOTO (1960).

KANNO (1971, p. 83, text-fig. 13 on page 83; pl. 17, figs. 13-15) described *C.* (*Corbicula*) sp. from the upper part of the Kulthieth Formation (Eocene) of the Yakataga district, southern Alaska, USA, and considered that the indeterminable form is closely related to *C.* (*Corbicula*) *tokudai*. But KANNO's specimens differ from *C. tokudai* in having the posterior cardinal tooth of the left valve longer than the others.

Associated fauna:—The present species is not generally associated with other molluscan species, but rarely with *Melanoides* ? sp. or *Mytilus* sp.

MATSUI (1960) reported that *C. tokudai* occurs together with *C. sitakaraensis* in the Hiragishi Formation of the Ishikari Group, Ishikari coal field, central Hokkaido. ÔTATUME (1943b) also reported that it is associated with *C.* (*Cyrenobatissa*) *nisikawai* (ÔTATUME) in the Uryu Group, Rumoi coal field, central Hokkaido.

Locality and Formation:—YB-01, YB-03, YB-04, YB-05, YB-06, YB-13, YB-B, YB-D, Yubetsu Formation; SB-02, SB-05, SB-06, SB-07, SB-C, SB-E, SB-I, SB-J, SB-K, SB-L, SB-M, SB-N, SB-Q, SB-S, SB-T, SB-U, Shakubetsu Formation.

Corbicula (*Corbicula*) *kotakai* HONDA, n. sp.

Pl. 2, Figs. 6, 9, 10, 13-17

Descrpition:—Shell small, subpentagonally rounded, moderately inflated, inequilateral and rather thick. Antero- and posterodorsal margins broadly arched, ventral margin well-rounded. Posterior margin obliquely subtruncated. Beaks situated anteriorly. Height a little shorter than length. A weak ridge runs from umbo to posteroventral corner. Surface sculptured with numerous, rather fine and

Table 4. Measurements (in mm) of *Corbicula* (*Corbicula*) *kotakai*, n. sp.

IGPS coll. cat. no.	Loc. no.	Height	Length	Width	H/L(%)	W/L(%)	Valve
96758 (Holotype)	YB-10	20.8	23.8	12.9/2	84.0	27.1	Both
96757-1 (Paratype)	YB-10	19.2	21.0	11.0/2	91.4	26.2	Both
96757-2 (Paratype)	YB-10	16.0	19.0	10.1/2	84.2	26.6	Both
96757-8	YB-10	16.9	18.8	11.0/2	89.9	29.3	Both

irregular concentric lines of growth. Hinge plate rather wide and thick, with widely arched lower margin. Teeth with three divergent cardinals in each valve, two anterior and two posterior laterals in right valve, and one anterior and one posterior lateral in left valve.

Anterior cardinal tooth of right valve the shortest and weakest of the three, and continues anteriorly to the cardinal plate; middle one the longest and strongest of the three; posterior one shorter and weaker than the middle one. Anterior cardinal tooth of left valve the strongest of the three and nearly as long as the middle; posterior one the shortest and weakest of the three, and continues posteriorly to the cardinal plate. Lateral teeth compressed. Inner surface unknown.

Dimensions:—Dimensions are shown in Table 4.

Depository:—Holotype (IGPS* coll. cat. no. 96758) and four paratypes (IGPS coll. cat. nos. 96757-1, 96757-2, 96757-3, 96757-4) in the Institute of Geology and Paleontology, Tohoku University, Sendai, Japan.

Comparison:—The new species resembles *Corbicula* (*Corbicula*) *tokudai* (YOKOYAMA, 1932, p. 240, pl. 2, figs. 3, 4, *non* fig. 2) in outline and the dentition of the cardinal teeth. It differs from *C. tokudai* in its more inflated shell, more prominent ridge running from umbo to posteroventral corner and somewhat more rounded ventral margin.

It also resembles *C.* (*Cyrenobatissa*) *sakakibarai* (ÔTATUME, 1943c, p. 24, pl. 4, figs. 1-6), originally described from the Naibuchi Group, southern Sakhalin, USSR, but differs from *C. sakakibarai* in having the simple, unbifurcated cardinal teeth in the hinge plate having a more widely arched lower margin.

It is allied also to *C.* (*Corbicula*) *iburica* (YOKOYAMA, 1931, p. 194, pl. 11, fig. 8), but differs in having a more prominent ridge running from umbo to posteroventral corner, and a more rounded shell.

Remarks:—Several tens of specimens having well-preserved conjoined valves, but unfortunately lacking beaks, were examined. They form beds attaining several tens of cm in thickness, and also occur in groups in poorly-sorted fine-grained sandstone with granules, at three localities of the Yubetsu Formation. The occurrence of the new species is restricted to the Yubetsu Formation of the Urahoro Group in the Ombetsu district. The stratigraphic occurrence of the species must be further studied in the Urahoro Group throughout the Kushiro coal field, together with other corbiculid mollusks reported from the Kushiro coal field.

Associated fauna:—Only the new species was collected from the Yubetsu Formation, and it is not associated with

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* Abbreviation for the Institute of Geology and Paleontology, Tohoku University, Sendai, Japan.

other molluscan species.

Locality and Formation:—YB-02, YB-10 (Type locality), YB-11, Yubetsu Formation.

Concluding Remarks

Corbicula (*Batissa*) *sitakaraensis* is considered to be a brackish water inhabitant, because it is commonly associated with such shallow marine or brackish water species as *Ostrea eorivularis*, *Mytilus mabuchii*, *Nemocardium ezoense* and/or "*Ampullina*" *asagaiensis*, and also because *Corbicula* (*Batissa*) lives in brackish waters of Southwest Asia (SUZUKI, 1949).

On the other hand, *C.* (*Corbicula*) *tokudai* is not generally associated with other molluscan species, but rarely occurs with such fresh water or shallow marine inhabitants as *Melanoides* ? sp. or *Mytilus* sp., and *Corbicula* (*Corbicula*) lives now in brakcish or fresh waters of the Japanese Islands (HABE, 1977). Therefore, it is considered to have inhabited less saline water than did *C. sitakaraensis*. *C.* (*Corbicula*) *kotakai*, n. sp. probably inhabited the same brackish or a fresh water as did *C. tokudai*.

This conclusion is consistent with the fact that *C. tokudai* was collected from the Yubetsu and Shakubetsu Formations, and *C. kotakai*, n. sp., from the Yubetsu Formation, in both of which coal seams are well developed; whereas only *C. sitakaraensis* was collected from the Shitakara Formation, which is not intercalated with coal seams but contains abundant shallow marine or brackish water molluscan species such as *Mytilus mabuchii*, *Chlamys shitakaraensis*, *Ostrea eorivularis*, *Nemocardium ezoense*, *Macoma sejugata*, *Mya grewingki*, etc.

The temporal and spatial distribution of corbiculid mollusks in the Urahoro and Ombetsu Groups in the Kushiro coal field, should be investigated further, to determine paleoenvironmental conditions during the deposition of the Urahoro and Ombetsu Groups.

List of Localities

RN-01: roadside cutting along a national road forest, north of the Rubeshube-zawa, a tributary of the Chokubetsu-gawa, Urahoro-machi, Tokachi-gun, Hokkaido (Lat. 42°53′2″N, Long. 143°46′40″E).

RN-02: ditto (about 150 m SW of RN-01) (Lat. 42°52′59″N, Long. 143°46′38″E).

YB-01: riverside cliff along the Tankono-sawa, a tributary of the Koikata-muri-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 42°59′52″N, Long. 143°45′58″E).

YB-02: ditto (about 4 m upper horizon of YB-01) (Lat. 42°59′52″N, Long. 143°46′0″E).

YB-03: ditto (about 1 m upper horizon of YB-02) (Ditto).

YB-04: ditto (about 20 cm upper horizon of YB-03) (Ditto).

YB-05: ditto (about 120 cm upper horizon of YB-04) (Ditto).

YB-06: riverside cliff along a south-southeastern tributary of the Shibetsu-zawa, a tributary of the Muri-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 42°55′36″N, Long. 143°47′38″E).

YB-09: riverside cliff along the Chokubetsu-gawa, Urahoro-machi, Tokachi-gun, Hokkaido (Lat. 42°53′10″N, Long. 143°47′32″E).

YB-10: riverside cliff along the Rubeshube-zawa, a tributary of the Chokubetsu-gawa, Urahoro-machi, Tokachi-gun, Hokkaido (Lat. 42°52′45″N, Long. 143°47′1″E).

YB-11: ditto (Lat. 42°52′47″N, Long. 143°47′13″E).

YB-13: roadside cutting along a logging road, north of the Rubeshube-zawa, Urahoro-machi, Tokachi-gun, Hokkaido (Lat. 42°52′51″N, Long. 143°47′15″E).

YB-A: boulder on river bed of the upper-stream of the Shibetsu-zawa, a tributary of the Muri-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 42°55′15″N, Long. 143°47′19″E).

YB-B: riverside cliff along the upperstream of the Shakubetsu-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 42°54′29″N, Long. 143°47′26″E).

YB-C: boulder below a roadside cutting along a logging road, north of the Rubeshubezawa, a tributary of the Chokubetsu-gawa, Urahoro-machi, Tokachi-gun, Hokkaido (Lat. 42°52′55″N, Long. 143°47′5″E).

YB-D: riverside cliff along the Rubeshubezawa, a tributary of the Chokubetsu-gawa, Urahoro-machi, Tokachi-gun, Hokkaido (Lat. 42°52′47″N, Long. 143°47′17″E).

SK-22: riverside cliff along the upperstream of the Shakubetsu-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 42°5′34″N, Long. 143°47′52″E).

SK-29: river bed of the upperstream of the Shakubetsu-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 42°54′45″N, Long. 143°48′2″E).

SK-35: riverside cliff along the Chokubetsu-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (about 100 m NNE of YB-09) (Lat. 42°53′13″N, Long. 143°47′36″E).

SK-56: riverside cliff along the Sango-zawa, a tributary of the Chokubetsu-gawa, Urahoro-machi, Tokachi-gun, Hokkaido (Lat. 42°53′8″N, Long. 143°42′32″E).

SK-57: ditto (about 2.5 m upper horizon of SK-56) (Ditto).

SB-01: riverside cliff along the Chambetsu-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 43°0′41″N, Long. 143°48′51″E).

SB-02: ditto (Lat. 43°0′37″N, Long. 143°49′26″E).

SB-03: riverside cliff along the Shibetsu-zawa, a tributary of the Muri-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 42°56′14″N, Long. 143°48′23″E).

SB-04: ditto (about 50 m ESE of SB-03) (Lat. 42°56′13″N, Long. 143°48′24″E).

SB-05: riverside cliff along the Chokubetsu-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 42°53′3″N, Long. 143°47′58″E).

SB-06: ditto (about 10 m lower horizon of SB-05) (Ditto).

SB-07: ditto (about 5.5 m lower horizon of SB-06) (Ditto).

SB-A: riverside cliff along the Chambetsu-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 43°0′49″N, Long. 143°48′33″E)

SB-B: boulder on river bed of the Chambetsu-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 43°0′45″N, Long. 143°48′39″E).

SB-C: ditto (Lat. 43°0′44″N, Long. 143°48′40″E).

SB-D: ditto (about 100 m SE of SB-C) (Lat. 43°0′42″N, Long. 143°48′43″E).

SB-E: riverside cliff along a logging road along the Chambetsu-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 43°0′44″N, Long. 143°48′50″E).

SB-F: riverside cliff along the Chambetsu-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 43°0′36″N, Long. 143°49′11″E).

SB-G: boulder on river bed of the Chambetsu-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (about 50 m E of SB-F) (Lat. 43°0′36″N, Long. 143°49′13″E).

SB-H: boulder on logging road, along the Chambetsu-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (about 70 m NE of SB-G) (Lat. 43°0′39″N, Long. 143°49′19″E).

SB-I: boulder on river bed along a small northern tributary of the Chambetsu-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 43°0′15″N, Long. 143°50′26″E).

SB-J: ditto (about 100 m E of SB-I) (Lat. 43°0′15″N, Long. 143°50′31″E).

SB-K: ditto (about 25 m SE of SB-J, approximately the same horizon as SB-J) (Lat. 43°0′14″N, Long. 143°50′33″E).

SB-L: riverside cliff along the uppermost stream of the Yatatoshino-zawa, a tributary of the Muri-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 42°58′24″N, Long. 143°48′37″E).

SB-M: riverside cliff along the upperstream of the Yatatoshino-zawa, a tributary of the Muri-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 42°58′0″N, Long. 143°49′7″E).

SB-N: ditto (about 10 m lowerstream of SB-M) (Ditto).

SB-O: ditto (about 5 m lowerstream of SB-N) (Ditto).

SB-P: riverside cliff along the Shibetsu-zawa, a tributary of the Muri-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 42°56′11″N, Long. 143°47′6″E).

SB-Q: riverside cliff along a tributary of the Shakubetsu-ichigo-zawa, a tributary of the Shakubetsu-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 42°54′50″N, Long. 143°48′40″E).

SB-R: riverside cliff along a northern small valley of the Shakubetsu-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (Lat. 42°54′15″N, Long. 143°48′28″E).

SB-S: riverside cliff along the Chokubetsu-gawa, Ombetsu-machi, Shiranuka-gun, Hokkaido (about 0.5 m lower horizon of SB-07) (Lat. 42°53′3″N, Long. 143°47′58″E).

SB-T: ditto (about 4 m lower horizon of SB-S) (Ditto).

SB-U: riverside cliff along the Otobe-gawa, Urahoro-machi, Tokachi-gun, Hokkaido (Lat. 42°51′47″N, Long. 143°46′7″E).

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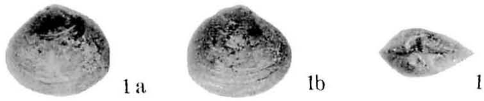
Explanation of Plate 2

(All figures in natural size, unless otherwise stated)

Figs. 1-5, 7, 8, 12, 18. *Corbicula* (*Corbicula*) *tokudai* (Yokoyama)
1a-c, IGPS coll. cat. no. 96753-20, Loc. YB-D; 2a-c, IGPS coll. cat. no. 96753-18, Loc. YB-D; 3a-c, IGPS coll. cat. no. 96753-11, Loc. YB-D; 4a-c, IGPS coll. cat. no. 96753-3, Loc. YB-D; 5a-c, IGPS coll. cat. no. 96753-2, Loc. YB-D; 7, IGPS coll. cat. no. 96756, Loc. SB-I; 8a-c, IGPS coll. cat. no. 96753-1, Loc. YB-D; 12, ×2, IGPS coll. cat. no. 96755-1, Loc. SB-S; 18, ×2, IGPS coll. cat. no. 96755-2, Loc. SB-S.

Figs. 6, 9, 10, 13-17. *Corbicula* (*Corbicula*) *kotakai* Honda, n. sp.
6a-b, IGPS coll. cat. no. 96757-4 (Paratype), Loc. YB-10; 9a-c, IGPS coll. cat. no. 96757-2 (Paratype), Loc. YB-10; 10a-c, IGPS coll. cat. no. 96757-1 (Paratype), Loc. YB-10; 13a-c, IGPS coll. cat. no. 96758 (Holotype), Loc. YB-10; 14a-b, IGPS coll. cat. no. 96757-3 (Paratype), Loc. YB-10; 15a-c, IGPS coll. cat. no. 96757-5, Loc. YB-10; 16a-b, IGPS coll. cat. no. 96757-6, Loc. YB-10; 17a-c, IGPS coll. cat. no. 96757-7, Loc. YB-10.

Figs. 11, 19. *Corbicula* (*Batissa*) *sitakaraensis* Suzuki
11, IGPS coll. cat. no. 96759-2, Loc. SK-56; 19, IGPS coll. cat. no. 96762, Loc. RN-02.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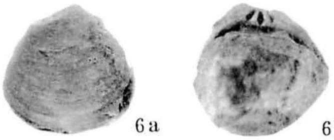
2a 2b 2c

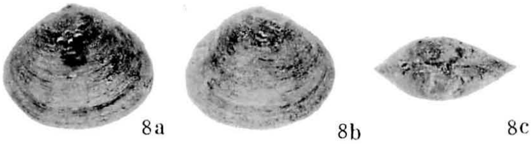

3a 3b 3c


4a 4b 4c


5a 5b 5c


6a 6b


7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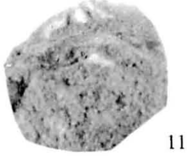
9a 9b 9c


10a 10b 10c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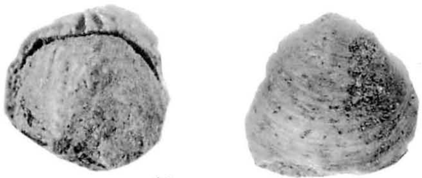
12


13a 13b 13c


14a 14b


15a 15b 15c


16a 16b


17a 17b 17c


18


19

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北海道東部釧路炭田浦幌層群産シジミ科（斧足類）化石：釧路炭田に発達する古第三系は下位の浦幌層群と上位の音別層群とに区分される。釧路炭田西部の音別地域に分布する浦幌層群は下位から留真層，雄別層，舌辛層，尺別層の四層に区分され，礫岩，砂岩，シルト岩などから成り，炭層を挾在する。各層からは浅海ないし汽水生の軟体動物化石を多産し，上部石狩動物群（MIZUNO, 1964）と呼ばれシジミ科 (Corbiculidae) は代表的な非海生軟体動物化石の一つである。筆者は *Corbicula* (*Batissa*) *sitakaraensis*, *C.* (*Corbicula*) *tokudai* の二種の記載を行ない，*C.* (*Corbicula*) *kotakai*, n. sp. を新種として記載した。*Corbicula sitakaraensis* は *Ostrea eorivularis*, *Mytilus mabuchii*, *Nemocardium ezoense*, "*Ampullina*" *asagaiensis* などの浅海ないし汽水性の種と共産する。*C. tokudai* は通常，他種を随伴せず，*C.*

kotakai, n. sp. は随伴種を持たない。これら三種の随伴種，現生の *Batissa* 及び *Corbicula* 亜属の生息環境から，*C. sitakaraensis* は汽水性の，*C. tokudai* 及び *C. kotakai*, n. sp. は汽水〜淡水性の種であり，前者は後二者よりもより高鹹水性の種と考えられる。　本田　裕

Atsunai 厚内, Chambetsu-gawa チャンベツ川, Charo 茶路, Chokubetsu-gawa 直別川, Karisyo 加利庶, Kawaruppu 川流布, Koikata-muri-gawa コイカタ霧里川, Muri-gawa 霧里川, Noyoshi 名好, Nuibetsu 縫別, Omagari 大曲, Ombetsu 音別, Otobe-gawa 乙部川, Rubeshube-zawa ルベシュベ沢, Rushin 留真, Sango-zawa 三号沢, Semposhi 仙鳳趾, Shakubetsu 尺別, Shakubetsu-ichigo-zawa 尺別一号沢, Shibetsu-zawa シベツ沢, Shiranuka 白糠, Shitakara 舌辛, Soun 双運, Tankono-sawa 炭鉱ノ沢, Tenneru 天寧, Urahoro 浦幌, Yatatoshino-zawa ヤタトシノ沢, Yubetsu 雄別

Explanation of Plate 3

(All figures in natural size)

Figs. 1-8. *Corbicula* (*Batissa*) *sitakaraensis* SUZUKI

1a-b, IGPS coll. cat. no. 96764-2, Loc. SB-A; 2, IGPS coll. cat. no. 96764-3, Loc. SB-A; 3, IGPS coll. cat. no. 96762-2, Loc. RN-02; 4, IGPS coll. cat. no. 96760-15, Loc. YB-09; 5a-c, IGPS coll. cat. no. 96761, Loc. SB-01; 6, IGPS coll. cat. no. 96764-5, Loc. SB-A; 7a-c, IGPS coll. cat. no. 96759-1; Loc. SK-56; 8, IGPS coll. cat. no. 96760-13, Loc. YB-09.

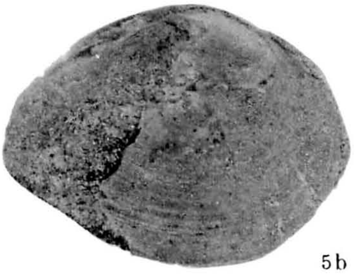

1 a


2

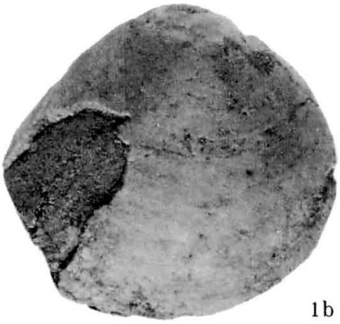

3


4


5 a


5 b


6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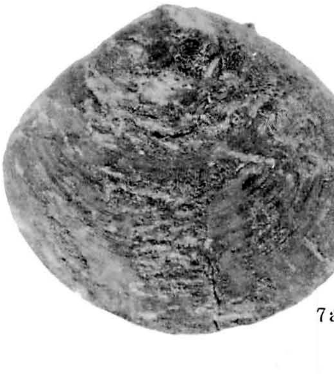
5 c


7 c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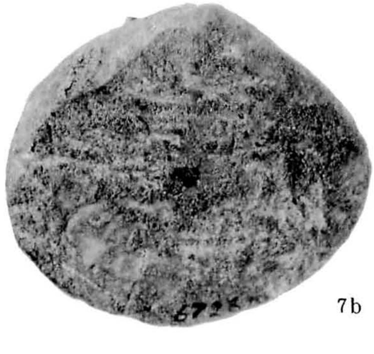
7 b


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Trans. Proc. Palaeont. Soc. Japan. N.S., 121, pp. 29-50, pls. 4, 5, April 30, 1981

727. CENOMANIAN MOLLUSCS IN A SANDSTONE BLOCK FROM THE SEA BOTTOM OFF THE SOUTHERN COAST OF KUJI, NORTHEAST JAPAN*

ITARU HAYAMI

University Museum, University of Tokyo, Hongo, Bunkyo-ku, Tokyo 113

and

TOMOKI KASE

National Science Museum, Hyakunin-cho, Shinjuku-ku, Tokyo 160

Abstract.—A block of calcareous fossiliferous sandstone, which was dredged by a fisherman from the sea bottom about 30 km off the southern coast of Kuji, Iwate Prefecture, was paleontologically examined. Eleven bivalves and three gastropods, including *Inoceramus* (*Birostrina*) sp. cf. *I.* (*B.*) *concentricus nipponicus*, *Pterotrigonia* (*Pterotrigonia*) *brevicula*, *Thetis japonica*, *Goshoraia crenulata*, *Margarites*? *funiculatus* and *Drepanochilus minimus* sp. nov. were identified and are described here. The specific assemblage is quite similar to the shallow marine fauna in the lower part of the Mikasa Formation in central Hokkaido, and a Cenomanian age is strongly suggested. In the Kitakami mountains Miyakoan (Aptian-Albian) and Urakawan (Coniacian-Santonian) deposits are represented by the Miyako and Kuji Groups, respectively, whereas Gyliakian (Cenomanian-Turonian) sediments have not been found. The present discovery seems to justify the interpretation that the sea retreated to the east from the Kitakami mountains in Gyliakian times and also to suggest that the marginal facies of the large sedimentary basin, called "Yezo Geosyncline", extended southwards for more than 250 km from the south coast of Hokkaido.

Introduction

A few years ago, Mr. Kozo SASAKI, a fisherman of Miyako City, Iwate Prefecture, dredged a sandstone block from the sea bottom at about 30 km east of Cape Kurosaki, southeast of Kuji City, north Honshu. He and his relative, Mr. Fukuji SASAKI, thoughtfully kept the block, because it bears numerous fossils. At the request of T. KASE who knew their collection during a field trip, they generously donated it to the National Science Museum, Tokyo.

The sandstone is dark grey, fine-grained, more or less stratified and well sorted with remarkably calcareous cement. The surface is roundly abraded, but its interior is fresh and very hard. Numerous individuals of a serpulid and colonies of bryozoans, though it is unknown whether they were living or dead at the time of dredging, attach themselves to the eroded surface. Three species of bryozoans, namely, *Tegela armifera* (HINCKS), *Porella*

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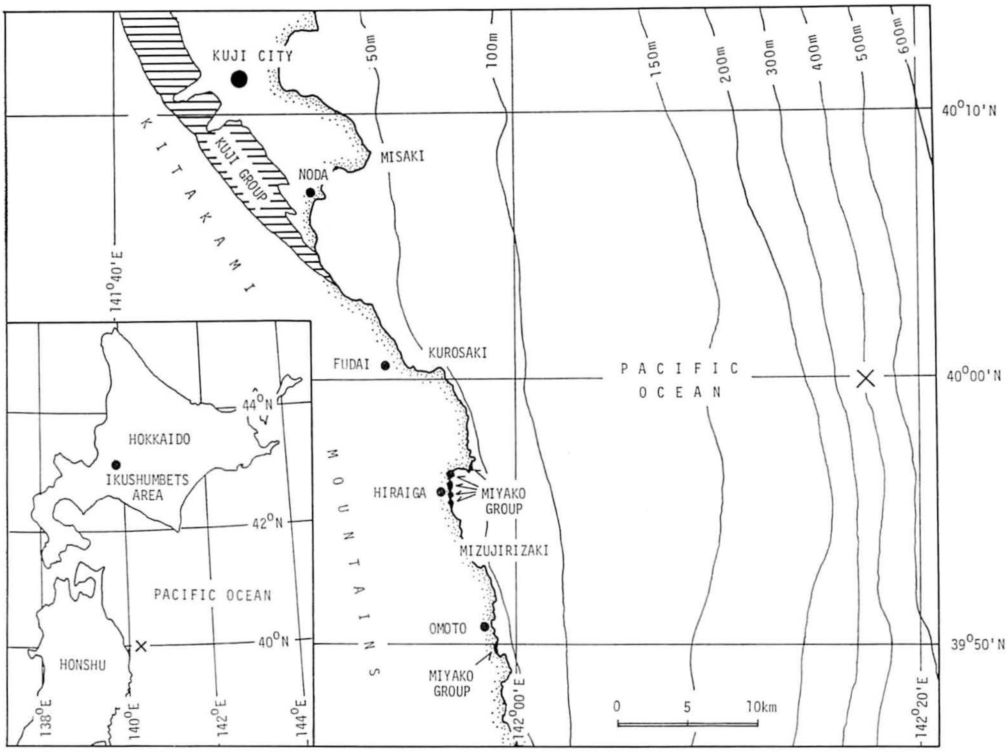
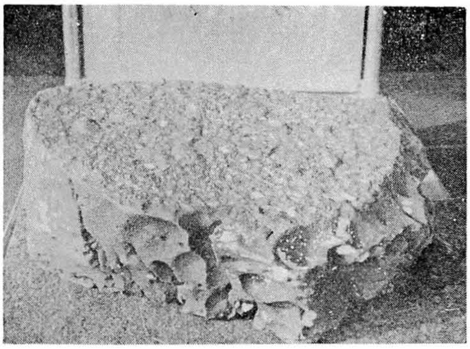
* Received September 10, 1980; read January 23, 1981 at Sendai.



Text-fig. 1. Map showing the locality of the fossiliferous sandstone block.

porifera (HINCKS) and *Dakaria dawsoni* (HINCKS), were identified.* Molluscan fossils are contained abundantly in a thin layer near the surface of the block and sporadically in other part. They are scarcely deformed and generally well-preserved, but their tests are apt to be broken, when the sandstone is split. Observations of surface and internal characters by etching were tried in vain owing to the calcareous cement.

The fossils in this block show a great diversity; the following eleven bivalves and three gastropods were identified, although each species is generally represented by a small number of specimens:



Text-fig. 2. Fossiliferous sandstone block (Maximum length about 50 cm).

Glycymeris (*Glycymerita*) sp. aff. *G.* (*G.*) *hokkaidoensis* (YABE and NAGAO)

Inoceramus (*Birostrina*) sp. cf. *I.* (*B.*) *concentricus nipponicus* NAGAO and MATSUMOTO

Entolium sp. cf. *E. obovatum* (STOLICZKA)

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* We express our sincere thanks to Mr. Shinji ARAKAWA of the Chiba University for his identification of these bryozoan specimens.

Pterotrigonia (*Pterotrigonia*) *brevicula* (YEHARA)
Pterotrigonia (*Acanthotrigonia*) sp. cf. *P.* (*A.*) *longiloba* (JIMBO)
Pterotrigonia (*Acanthotrigonia*) sp.
Thetis japonica (YABE and NAGAO)
Anthonya sp. cf. *A. apicalis* NAGAO
Cymbophora sp.
Goshoraia crenulata (MATSUMOTO)
Goniomya sp.
Margarites? *funiculatus* (YOKOYAMA)
Drepanochilus minimus KASE, sp. nov.
Avellana sp.

In addition to them, a nuculid, a nuculanid, a lucinid and a corbulid, each represented by one or a few minute specimens, were found in association, but their generic references are uncertain owing to the insufficient materials.

In the present article the above listed molluscan fossils are described and their faunal significances are discussed. As to the systematic descriptions, HAYAMI and KASE are responsible for the bivalves and the gastropods, respectively.

Repository

All the specimens described in this paper as well as the remaining material of this block are preserved in the Department of Geology, National Science Museum, Tokyo, with the abbreviation NSM. Comparative studies are also based on the specimens kept in the following institutions:

GMH: Department of Geology and Mineralogy, Faculty of Science, Hokkaido University, Sapporo.
IGPS: Institute of Geology and Palaeontology, Faculty of Science, Tohoku University, Sendai.
UMUT: Department of Historical Geology and Palaeontology, University Museum, University of Tokyo, Tokyo.
GK: Department of Geology, Faculty of Science, Kyushu University, Fukuoka.

Systematic descriptions

All the described specimens occurred in a sandstone block (about 40 kg in total weight) landed from the sea bottom (about 400 meters in depth) about 30 km east of Cape Kurosaki (approximately 40°00′N, 142°17′E). The specimens of *Inoceramus* (*Birostrina*) sp. cf. *I.* (*B.*) *concentricus nipponicus*, *Pterotrigonia* (*Acanthotrigonia*) sp. cf. *P.* (*A.*) *longiloba* and *Thetis japonica* were taken out from various parts in the block, whereas most specimens of other species occurred in the thin fossiliferous layer near the surface.

Bivalva

[by Itaru HAYAMI]

Order Arcoida STOLICZKA, 1871

Family Glycymerididae NEWTON, 1922

Genus *Glycymeris* DA COSTA, 1778

Subgenus *Glycymerita* FINLAY and MARWICK, 1937

Glycymeris (*Glycymerita*) sp. aff. *G.* (*G.*) *hokkaidoensis* (YABE and NAGAO)

Plate 4, Figs. 1, 2

Only two left valves are at hand. The smaller specimen (NSM-PM 15097, 13.2 mm long, 11.7 mm high, ca. 4.5 mm thick) is nearly complete, showing external characters. The larger specimen (NSM-PM 15098, 22.5+mm long, 19.9+mm high, 7.0+mm thick) is composed of incomplete internal and external moulds with broken shell fragments.

These specimens look similar to *Glycymeris* (*Glycymerita*) *hokkaidoensis* (YABE and NAGAO, 1928), but the shell is seemingly more elongated transversely and the umbonal area may be narrower. In the original description of *Pectunculus hokkaidoensis*, YABE and NAGAO (1928, pl. 17, fig. 22) illustrated only one specimen (IGPS no. 22613) from the "*Trigonia* sandstone" at Ponhorokabets of Yubari, central Hokkaido. Although the illustrated specimen was treated as "holotype by monotypy" in my previous article (HAYAMI, 1975, p. 33), it should be regarded as lectotype, because two different localities were indicated in the original description.

The smaller specimen also resembles some young specimens of *Glycymeris* (*Glycymerita*) *multicostata* NAGAO, 1932, from the Upper Yezo Group of Teshio (e. g. TASHIRO, 1971, pl. 27, figs. 31, 32), but the larger specimen shows less orbicular outline and weaker convexity than its adult specimens. The present specimens may be also similar to some specimens of *Glycymeris* (*Glycymerita*) *amakusensis* NAGAO, 1930, from the Himenoura Group of Kyushu in the relatively low shell form. The radial ribs on the surface, however, are much weaker than those of the Himenoura species.

Order Pterioida NEWELL, 1965

Family Inoceramidae GIEBEL, 1852

Genus *Inoceramus* J. SOWERBY, 1814

Subgenus *Birostrina* J. SOWERBY, 1821

Inoceramus (*Birostrina*) sp. cf. *I.* (*B.*) *concentricus nipponicus* NAGAO and MATSUMOTO

Plate 4, Figs. 3-6

Compare.—

?1928. *Inoceramus* sp.: YABE and NAGAO, *Sci. Rep. Tohoku Imp. Univ.*, ser. 2, vol. 9, no. 3, p. 84, pl. 16, fig. 13, a, b.

1939. *Inoceramus concentricus* var. *nipponicus* NAGAO and MATSUMOTO, *Jour. Fac. Sci. Hokkaido Imp. Univ.*, ser. 4, vol. 4, nos. 3-4, p. 267, pl. 24, fig. 2a-c, pl. 25, figs. 1a-c, 2a, b, 3-5, 6a-c.

1959. *Inoceramus concentricus nipponicus* NAGAO and MATSUMOTO: MATSUMOTO, *Mem. Fac. Sci. Kyushu Univ.*, ser. D, vol. 9, no. 2, p. 84, pl. 11, fig. a.

1971. *Inoceramus concentricus nipponicus* NAGAO and MATSUMOTO: NODA, *Kagaku-Oita*, no. 24, p. 28, pl. 1, figs. 1, 2.

1974. *Inoceramus concentricus nipponicus* NAGAO and MATSUMOTO: TAMURA and MATSUMURA, *Mem. Fac. Educ. Kumamoto Univ.*, no. 23, sec. 1, p. 49.

1975. *Inoceramus* (*Birostrina*) *concentricus nipponicus* NAGAO and MATSUMOTO: HAYAMI, *Bull. Univ. Mus. Univ. Tokyo*, no. 10, p. 51.

1976. *Inoceramus concentricus nipponicus* NAGAO and MATSUMOTO: NODA and MATSUMOTO, *Atlas of Japanese Fossils*, no. 45-265, pl. Cr-31, figs. 1, b, 2.

1977. *Birostrina nipponica* (NAGAO and MATSUMOTO): KAUFFMAN, *Palaeont. Soc. Japan, Spec. Papers*, no. 21, p. 175.

Type of Inoceramus concentricus nipponicus.—A left valve (GMH no. 7167) from Hakkinzawa of Ōyubari, central Hokkaido, which was originally listed and illustrated as one of the syntypes (NAGAO and MATSUMOTO, 1939, p. 267, pl. 25, fig. 6a-c), is here designated as the **lectotype.** NAGAO and MATSUMOTO (1939, p. 297) regarded this specimen as belonging to "the typical form", and TAMURA and MATSUMOTO *in* TAMURA and MATSUMURA (1974, p. 49) also considered that it shows "typical characters of *I. concentricus nipponicus*". These procedures, however, are not regarded here as constituting any valid type designation.

Material.—Three right valves (NSM-PM 15071—15073) and one left valve (PM 15074).

Table 1. Measurements in mm [*Inoceramus* (*Birostrina*) sp. cf. *I.* (*B.*) *concentricus nipponicus* NAGAO and MATSUMOTO]

Specimen	Length	Height	Thickness
Right valve (NSM-PM 15071)	24.4	21.9+	7.0
Right valve (NSM-PM 15072)	21.0+	26.4+	7.0
Right valve (NSM-PM 15073)	11.1+	13.0	3.7
Left valve (NSM-PM 15074)	10.4+	7.9+	4.2

Description.—Shell relatively small for genus, highly inequivalve, roundly subtrapezoidal but somewhat irregular in outline; test thin; left valve strongly convex, with extremely prominent and incurved umbo and slightly concave anterior and dorsal margins; right valve only moderately convex, mytiliform, with terminal and pointed umbo and nearly straight anterior and dorsal margins; apical angle of right valve ranging from 70 to 90 degrees; hinge line moderate in length; surface of two valves nearly smooth except for weak concentric rings of irregular interval and fine growth-lamellae.

Remarks.—All the present specimens are incomplete, but their umbonal areas are well exhibited and scarcely deformed. The shell is partly preserved in the left valve (PM 15074) but almost entirely exfoliated away in other specimens.

These specimens are comparable with *Inoceramus* (*Birostrina*) *concentricus nipponicus* by the highly inequivalve outline and weak and irregular concentric rings, though there is a shortage of good material showing the specific and subspecific characters.

As pointed out by TAMURA and MATSUMURA (1974, p. 49) and KAUFFMAN (1977, p. 174), the original specimens of *I. concentricus* var. *nipponicus* may be a heterogeneous mixture of two or more species from various localities and horizons, but specific separation may be difficult unless a more extensive survey on the morphology and stratigraphic occurrence is carried out at the population level. At present I think that the subspecific distinction of most of these specimens from the European ones of *I. concentricus* (s. s.) is appropriate, because the left valve in the former has generally less prominent umbo. Incidentally, the occurrence of this species is restricted to the Albian in Europe (WOODS, 1911; etc.), while in Japan *I. concentricus nipponicus* and *I. concenticus costatus* seems to characterize K4a_2 (upper Lower Cenomanian) and K4a_3 (lower Upper Cenomanian), respectively.

As mentioned by NAGAO and MATSUMOTO (1939), the outline of *I. concentricus nipponicus* is considerably variable; the original specimens were classified into three forms; namely, typical form, higher form and lower form. The present left valve (PM 15074), though very small and incomplete, is similar to one of the paralectotype (IGPS no. 22783; NAGAO and MATSUMOTO, 1939, pl. 25, fig. 4) from Bibai, which was included in lower form, in the outline, especially in the broadly concave dorsal margin and comparatively large apical angle. A small right valve (PM 15073) looks similar to the specimen (GK H4; NODA, 1971, pl. 1, fig. 2) from Abeshinai in the relatively large apical angle and the presence of a shallow diagonal sulcus extending from the umbonal area to the postero-ventral margin.

Family Entoliidae KOROBKOV, 1960

Genus *Entolium* MEEK, 1865

Entolium sp. cf. *E. obovatum* (STOLICZKA)

Plate 4, Fig. 7

1928. *Pecten* (*Syncyclonema*) cf. *obovatus* STOLICZKA: YABE and NAGAO, *Sci. Rep. Tohoku Imp. Univ.*, ser. 2, vol. 9, no. 3, p. 87, pl. 17, figs. 3-6.
1938. *Pecten* (*Syncyclonema?*) aff. *obovatus* STOLICZKA: NAGAO, *Jour. Fac. Sci. Hokkaido Imp. Univ.*, ser. 4, vol. 4, nos. 1-2, p. 128, pl. 16, figs. 1, 2.
1975. *Entolium* sp. cf. *E. obovatum* (STOLICZKA) : HAYAMI, *Bull. Univ. Mus. Univ. Tokyo*, no. 10, p. 73.
1975. *Entolium* sp. cf. *E. obovatus* [sic] (STOLICZKA) : TAMURA, *Mem. Fac. Educ. Kumamoto Univ.*, no. 24, sec. 1, pl. 3, fig. 9.

Only one right valve (NSM-PM 15075, 17.2 mm long, 18.0+mm high, ca. 3.0 mm thick) was obtained. The shell is almost entirely exfoliated from the internal mould. Judging from the relatively tall outline and internal characters, the present specimen is referable to *Pecten* (*Syncyclonema*) cf. *obovatus* by YABE and NAGAO (1928) from the Mikasa Formation in central Hokkaido. The generic validity of *Syncyclonema* and its distinction from *Entolium* and other related pectinacean genera were much clarified by SPEDEN (1967). The present species as well as its comparable species, *Pecten obovatus* STOLICZKA, 1871, from the Upper Cretaceous of India, is referable to *Entolium* instead of *Syncyclonema*, as was already treated by HAYAMI (1975) and TAMURA (1975). Further comparative studies between the present Japanese form and the Indian species should be done on the basis of better preserved specimens from Hokkaido.

Order Trigonioida DALL, 1889

Family Trigoniidae LAMARCK, 1819

Genus *Pterotrigonia* VAN HOEPEN, 1929

Subgenus *Pterotrigonia* VAN HOEPEN, 1929

Pterotrigonia (*Pterotrigonia*) *brevicula* (YEHARA)

Plate 4, Figs. 8-14

1915. *Trigonia brevicula* YEHARA, *Sci. Rep. Tohoku Imp. Univ.*, ser. 2, vol. 2, no. 2, p. 42, pl. 2, figs. 18, 19.
1954. *Pterotrigonia brevicula* (YEHARA) : KOBAYASHI, *Japan. Jour. Geol. Geogr.*, vol. 25, nos. 1-2, p. 76.
1961. *Pterotrigonia brevicula* (YEHARA) : NAKANO and NUMANO, *Trans. Proc. Palaeont. Soc. Japan*, n. s., no. 43, p. 91, pl. 13, figs. 4-8.
1975. *Pterotrigonia* (*Pterotrigonia*) *brevicula* (YEHARA) : HAYAMI, *Bull. Univ. Mus. Univ. Tokyo*, no. 10, p. 118.
1976. *Pterotrigonia brevicula* (YEHARA) : TAMURA, *Atlas of Japanese Fossils*, no. 44-264, pl. Cr-30, fig. 16.

Type.—An incomplete left valve (IGPS no. 4329; YEHARA, 1915, pl. 2, fig. 18) from the Ikushumbets River, about 3 km above the Ikushumbets Coal Mine, Mikasa City, central Hokkaido, was designated by NAKANO and NUMANO (1961, p. 91) as the lectotype.

Material.—Seven right valves (NSM-PM 15077—15083) and three left valves (NSM-PM 15084—15086).

Description.—Shell small- or medium-sized for genus, crescentic, rostrated posteriorly, much longer than high, moderately inflated; test comparatively thick; anterior margin rounded, passing gradually into venter; ventral margin a little concave below posterior rostrum; postrodorsal margin rounded and moderate in

Table 2. Measurements in mm [*Pterotrigonia* (*Pterotrigonia*) *brevicula* (YEHARA)]

Specimen	Length	Height	Thickness
Right valve (NSM-PM 15077)	36.9	25.4	10.2
Right valve (NSM-PM 15078)	25.9+	19.8+	7.0+
Right in. mould (NSM-PM 15079)	44.0	33.6	11.0+
Right valve (NSM-PM 15080)	16.5	10.9	4.5
Right valve (NSM-PM 15083)	22.4+	24.3	9.3
Left in. mould (NSM-PM 15084)	19.7	13.7	3.8+
Left valve (NSM-PM 15086)	21.6+	15.6	7.2

length; umbo rather low, opisthogyrous, situated at about one-third of length from front; flank ornamented with a dozen or more (if adult), widely spaced, subequidistant oblique costae, which are slightly sinuous, weakly tuberculated, somewhat abruptly strengthened toward antero-ventral side, not impressed on internal surface and separated from posterior carina by a shallow ante-carinal sulcus; posterior carina sharp near umbo but gradually becoming obscure toward posterior end; area (posterior area) undeveloped, very narrow even in adult, nearly smooth except for a sharp and narrow median furrow; escutcheon considerably wide, deeply excavated, steeply inclined to commissure plane, ornamented with coarse transverse costae; sharp internal ridge running subhorizontally on posterior rostrum; adductor muscle scars strongly impressed; pallial line simple; umbonal cavity narrow but conically and profoundly excavated.

Remarks.—Of the ten specimens at hand, the test is, though not completely, preserved in one left valve (PM 15086) and four right valves (PM 15077, 15078, 15080, 15083). The outline is best shown by two specimens (PM 15079, 15084). The mode of weakly tuberculated oblique costae on the flank is well observed in the left valve (PM 15086) and two right valves (PM 15077, 15078), while the narrow and smooth area and excavated escutcheon with coarse transverse costae are recognized only in the left valve (PM 15086) and the immature right valve (PM 15080). The muscle structure is partly observed in a broken right valve (PM 15083),

As originally described by YEHARA (1915) and subsequently studied by NAKANO and NUMANO (1961) on the basis of many specimens from the Mikasa Formation in central Hokkaido, the present species seems ot be characterized by the thick test, very narrow and unornamented area with a distinct median furrow, slightly sinuous and weakly tuberculated oblique costae on the flank and deeply excavated and steeply inclined escutcheon. The unusually narrow and profound umbonal cavity seems to constitute another diagnostic character of this species. The lectotype and paralectotype of *Trigonia brevicula* (YEHARA, 1915, pl. 2, figs. 18, 19) show at a glance relatively short outline, but it is probably because the posterior marginal part is incomplete like one of the present specimens (PM 15086). NAKANO and NUMANO (1961) studied the ontogenetic transformation of *P. brevicula*, describing that the outline changes from subtrigonal to crescentic and that the form ratio (length/height) gradually increases with growth. Such a tendency of allometric growth is also recognized in the present material.

The slightly sinuous and antero-ventrally thickened costae on the flank are not much different from those in certain species of the subgenus *Acanthotrigonia*, especially *P.* (*A.*) *mashikensis* (TAMURA and TASHIRO, 1967) and *P.* (*A.*) *higoensis* (TAMURA and TASHIRO, 1967) from the Cenomanian Mifune Group of central Kyushu. The present specimens, however, differ from them in the much narrower area and steeply inclined escutcheon. Another problem arises about the relation between *P.* (*P.*) *brevicula* and *Pterotrigonia* (*Acanthotrigonia*) *longiloba* (JIMBO, 1894), since the present specimens looks similar to the paralectotype of the latter species (UMUT MM4465; JIMBO, 1894, pl. 8, fig. 3; KOBAYASHI and NAKANO, 1957, pl. 17, fig. 5). However, the two species are regarded as distinct, even if the paralectotype is conspecific with the present specimens (See also the taxonomic remarks on *P.* (*A.*) sp. cf. *P.* (*A.*) *longiloba*).

Subgenus *Acanthotrigonia*
VAN HOEPEN, 1929

Pterotrigonia (*Acanthotrigonia*) sp. cf. *P.* (*A.*) *longiloba* (JIMBO)

Plate 4, Fig. 15

Only a left valve (NSM-PM 15088, 28.9 mm long, 23.5 mm high, ca. 6.0 mm thick) is available for this study. The test is preserved but mostly attached to the external mould. The outline is nearly complete, and the oblique costae on the flank are clearly impressed on the internal mould.

It is clearly distinguishable from the specimens of *P.* (*P.*) *brevicula* from the same block by the much thinner test, slender and somewhat flattened posterior rostrum, highly prominent umbo, longer internal ridge and steep anterior slope. Clearly impressed oblique costae and weakly impressed adductor muscle scars on the internal surface are also distinct characters from those specimens.

The present specimen is probably conspecific with the lectotype of *P.* (*A.*) *longiloba* from Ponhorokabets of Yubari (JIMBO, 1894, pl. 8, figs. 2, 4), because the outline and flank ornamentation are quite similar. KOBAYASHI and NAKANO (1957, p. 235) indicated a specimen (JIMBO, 1894, pl. 8, fig. 3) as the lectotype, but the "fig. 3" is interpreted to be a misprint of fig. 2, as pointed out by MATSUMOTO (1963. p. 45). The specific characters of *P.* (*P.*) *longiloba* are, however, still debatable, because the paralectotype (JIMBO, 1894, pl. 8, fig. 3) and most of subsequently described specimens (YEHARA, 1915, 1923; KOBAYASHI and NAKANO, 1957) are considerably different from the lectotype in the less prominent umbo and broader posterior rostrum. Unfortunately, the lectotype specimen, which is to be preserved in the University Museum, University of Tokyo, is now missing (ICHIKAWA and HAYAMI, 1978, p. 52). Although MATSUMOTO (1963, p. 45) regarded the wax cast (UMUT MM4466), which was illustrated by KOBAYASHI and NAKANO (1957, pl. 17, fig. 6) as "the type left valve", as taken from the lectotype, it is quite different from the original figure of the lectotype in the outline and mode of oblique costae. Judging from the old label annexed to the wax cast, its original specimen (in Preussian Geological Survey at that time) came from the Sorachi district of Hokkaido and was possibly treated by JIMBO, but it is certainly unrelated to the lectotype, because their dimensions and recorded localities are quite different. There are much uncertainty about the morphological variation and specific characters of *P.* (*A.*) *longiloba*, but the present specimen is tentatively compared with this species owing to the close resemblance with the figure of its lectotype.

Pterotrigonia (*Acanthotrigonia*) sp.

Plate 4, Fig. 16

Only internal and external moulds of a small (probably immature) right valve (NSM-PM 15087, 9.3 mm long, 7.8 mm high, 2.5+mm thick) are available for this study. The characteristic chevron-shaped oblique costae on the flank and area are clearly observed on the external mould, while the general outline is better shown by the internal mould. The ornamentation seems to indicate that the present specimen belongs to *Acanthotrigonia.* It looks especially similar to the small trigoniid specimen from the Mikasa Formation of Ikushumbets, which was illustrated by YEHARA (1915, pl. 2, fig. 11) as a young individual of "*Trigonia longiloba*", though his specific identification is not warranted here by the reason stated before. It is actually possible that the present specimen is conspecific with the specimen of *P.* (*A.*) sp. cf. *P.* (*A.*) *longiloba* from the same block, but further comparison is now difficult owing to the different ontogenetic stages. The present specimen shows somewhat similar outline to the coexistent specimens of *P.* (*P.*) *brevicula,* but is clearly different from them in the densely spaced oblique costae on the flank, wide and costated area and probably much narrower escutcheon.

Order Veneroida ADAMS and ADAMS, 1856

Family Mactromyidae COX, 1929

Genus *Thetis* J. de C. SOWERBY, 1826

Thetis japonica (YABE and NAGAO)

Plate 5, Figs. 2-4

1927. *Thetironia affinis* (WHITEAVES) var. *japonica* YABE and NAGAO *in* YABE, *Sci. Rep. Tohoku Imp. Univ.*, ser. 2, vol. 11, no. 1, pl. 5, fig. 7a-d. [no written description]

1928. *Thetironia affinis* (WHITEAVES) var. *japonica* YABE and NAGAO: YABE and NAGAO, *Sci. Rep. Tohoku Imp. Univ.*, ser. 2, vol. 9, no. 3, p. 89, pl. 17, figs. 14, a, b, 15, a.

1975. *Thetis japonica* (YABE and NAGAO): HAYAMI, *Bull. Univ. Mus. Univ. Tokyo*, no. 10, p. 122.

1976. *Thetis affinis japonica* (YABE and NAGAO): TAMURA and TASHIRO, *Atlas of Japanese Fossils*, no. 43-258, pl. Cr-24, figs. 17, 18.

Type.—YABE (1927) illustrated only one specimen (IGPS no. 22602) under the name of *T. affinis* var. *japonica* YABE and NAGAO. Although the verbal description of this variety was first made by YABE and NAGAO (1928), the name seems to be available since 1927 according to ICZN (Articles 12 and 16 (vii)). Because YABE and NAGAO (1928) noted "Numerous specimens were examined", the illustrated specimen (YABE, 1927, pl. 5, fig. 7a-d; YABE and NAGAO, 1928, pl. 17, fig. 14,a, b) is here designated as the **lectotype.** It was obtained from the *Trigonia* Sandstone [=Mikasa Formation] at the middle course of the Ikushumbets River, Mikasa City, central Hokkaido.

Material.—Three right valves (NSM-PM 15089—15091).

Description.—Shell small- or medium-sized for genus, globose, slightly inequilateral, a little longer than high, strongly inflated; test very thin; antero-dorsal margin a little concave in front of umbo, but valve margin of other parts roundly arcuate and not differentiated; umbo prominent, incurved, slightly prosogyrous, placed subcentrally; lunule and escutcheon

Table 3. Measurements in mm [*Thetis japonica* (YABE and NAGAO)]

Specimen	Length	Height	Thickness
Right in. mould (NSM-PM 15089)	20.5	19.6	8.1
Right in. mould (NSM-PM 15090)	19.8	18.3	6.9
Right valve (NSM-PM 15091)	16.0	14.9	6.0

not clearly impressed; surface smooth except for fine growth lines and weak radial threads on anterior and posterior peripheral areas; internal surface wholly marked with numerous faint radial striae, which suggest the presence of radial structure of shell; anterior adductor scar somewhat larger than posterior; pallial line simple; umbonal cavity deep.

Remarks.—The first specimen (PM 15089) consists of internal and external moulds of a right valve, and the second (PM 15090) is represented only by a right internal mould. The test is partly preserved in the third specimen (PM 15091). The shell material is fragile, and the surface is commonly tinged with green by some unknown reason. This state of preservation is very similar to that of the specimens of the same species in the Mikasa Formation. The hinge structure is difficult to observe both in the Mikasa and present specimens, because the hinge plate is very narrow.

As described by YABE and NAGAO (1928), a curiously inflected "rib" runs on the surface of two valves in the lectotype specimen. Somewhat similar structure, especially a tongue-shaped relief between two inflections on the postero-dorsal surface, is clearly observed in some paralectotype specimens and also in one of the present specimens (PM 15089). It is, however, unknown whether the relief is of primary origin or not.

It is an interesting but unsolved problem how intimately the present form is related to *Thetis affinis* (WHITEAVES) from the Upper Cretaceous of Queen Charlotte Islands. They are tentatively regarded as specifically distinct, because the Japanese specimens show less prominent umbo and more developed anterior part of shell.

Family Crassatellidae FÉRUSSAC, 1822

Genus *Anthonya* GABB, 1864

Anthonya sp. cf. *A. apicalis* NAGAO

Plate 4, Fig. 17

Only an external mould of right valve (NSM-PM 15069, 36.5+mm long, 16.5+mm high, 3.0+mm thick) was obtained. Its anterior part is broken, but the external characters of post-umbonal part are well exhibited. Its original outline is roughly recognizable from the impressed growth-lines, but the apical angle is actually not measurable. Though the hinge and ligament structures are unknown, it is referable to *Anthonya* by the blade-shaped, elongated and compressed outline. The weak and rounded diagonal carina extending from the umbo to the postero-ventral angle is also characteristic of this genus.

As listed by TAMURA and PACKARD (1972) and additionally described by TAMURA (1977), there are four species and one subspecies of *Anthonya* in the Cretaceous of Japan (more than 16 species in the world). The present specimen is, if not identical with, closely similar to *Anthonya apicalis apicalis* NAGAO, 1938, from the Mikasa Formation of central Hokkaido in the general outline, especially in the truncated posterior margin and irregular growth-lamellae on the surface. On this occasion a left internal mould (GMH no. 8203) illustrated by NAGAO (1938, pl. 15, fig. 1, la) from the *Trigonia* Sandstone (=Mikasa Formation) at Ponhorokabets-zawa of Poronai near Ikushumbets is designated as the **lectotype** of *A. apicalis.* In comparison with the lectotype and paralectotypes, the present specimen is somewhat larger and has more or less broader posterior part. Its identification with *A. apicalis apicalis,* however, might be confirmed in the future, if the morphological variation of this subspecies were examined on adequate material from the type area.

Anthonya apicalis shishijimensis AMANO, 1956, from the Goshonoura Group at Shishijima of west Kyushu may be also similar in the outline, but the concentric lines on the surface are seemingly regular and more prominent in comparison with the present specimen. *Anthonya mifunensis* TAMURA, 1977, from the lower part of the Mifune Group of central Kyushu is probably a closely related species to *A. apicalis.* Although further comparative studies may be needed, the Mifune species seems to be distinguishable from *A. apicalis* by the more rounded posterior margin. Moreover, the present specimen has slightly larger and broader shell than *A. mifunensis. Anthonya subcantiana* NAGAO, 1934, from the Aptian-Albian Miyako Group in north Honshu (HAYAMI, 1965b) has decidedly a smaller and shorter shell and more conspicuous regular concentric ribs on the surface.

Family Mactridae LAMARCK, 1809

Genus *Cymbophora* GABB, 1869

Cymbophora sp.

Plate 5, Fig. 1

This species is here represented only by a right valve (NSM-PM 15070, 12.7 mm long, 10.4 mm high, ca. 3.5 mm thick). It is nearly complete, but nothing is known about the internal characters. Its subtrigonal outline and densely spaced concentric lamellae on the surface remind me those of *Cymbophora ezoensis* (YABE and NAGAO) from the Mikasa Formation of central Hokkaido. HANZAWA, ASANO and TAKAI (1961) listed one of the original specimens of *Spisula* (*Cymbophora*) *ezoensis* (IGPS no. 22614; YABE and NAGAO, 1928, pl. 16, fig. 5) as the "holotype". This procedure is regarded here as constituting a valid lectotype designation. In comparison with the lectotype and paralectotypes, the present specimen seems to have somewhat longer antero-dorsal margin. TAMURA (1977) also described *C. ezoensis* from the Mifune Group of central Kyushu, but the Mifune specimens have a stronger posterior carina than the present specimen and probably also than the Mikasa specimens of *C. ezoensis.*

Family Veneridae RAFINESQUE, 1815

Genus *Goshoraia* TAMURA, 1977

Goshoraia crenulata (MATSUMOTO)

Plate 5, Figs. 5-8

1938. "*Callista*" (*Pseudamiantis*) *crenulatus* [sic] MATSUMOTO, *Jour. Geol. Soc. Japan*, vol. 45, no. 532, p. 19, text-figs. 12, 13, pl. 1, figs. 5, 6.
1956. *Pseudamiantis crenulatus* (MATSUMOTO): AMANO, *Kumamoto Jour. Sci.*, ser. B, sec. 1, vol. 2, no. 1, p. 78, pl. 1, fig. 26, pl. 2, figs. 13-19.
1963. "*Callista*" (*Pseudamiantis*) *crenulatus* [sic] MATSUMOTO: IWASAKI, *Trans.*

Proc. Palaeont. Soc. Japan, n. s., no. 51, p. 94, pl. 15, figs. 4-7.

1975. *Pseudamiantis? crenulata* (MATSUMOTO): HAYAMI, *Bull. Univ. Mus. Univ. Tokyo*, no. 10, p. 144.

1976. *"Callista" (Pseudamiantis) crenulatus* [sic] MATSUMOTO: TAMURA and TASHIRO, *Atlas of Japanese Fossils*, no. 43-257, pl. Cr-23, figs. 19-22.

1977. *Goshoraia crenulata* (MATSUMOTO): TAMURA, *Mem. Fac. Educ. Kumamoto Univ.*, no. 26, p. 139, pl. 9, figs. 9-16.

Type.—A right valve (UMUT MM7751) illustrated by MATSUMOTO (1938, pl. 1, fig. 5) from the Goshonoura Group at Kobunenosako, northeast of Enokuchi, Goshonoura (=Goshora) Island, Kumamoto Prefecture of Kyushu, was designated by IWASAKI (1963) as the "holotype". This procedure is here regarded as constituting a valid lectotype designation.

Material.—Three right valves (NSM-PM 15092—15094) and two left valves (NSM-PM 15095, 15096).

Description.—Shell medium in size, equivalve, inequilateral, subovate, about 1.3 times longer than high, moderately inflated, not carinated; test moderate in thickness; antero-dorsal margin a little concave in front of umbo, while other part of valve margin is continuously arcuate without any angulation; umbo moderate in prominence, incurved, prosogyrous, placed at about two-fifths of length from front; lunule moderate in width, distinct, deeply excavated; surface marked with irregularly spaced growth-lamellae and also numerous (more than 80) subinternal radial riblets which correspond with fine crenulations along inner ventral margin; adductor muscle scars subequal in size, clearly impressed; pallial line deeply and angularly sinuated; umbonal cavity moderate in depth.

Remarks.—The largest specimen (PM 15092) consists of right internal and external moulds exhibiting the surface and muscle characters. The hinge is only partly observable in the same specimen; the presence of three cardinal teeth of veneroid type is recognized. The subinternal radial riblets were probably not exposed on the exterior of the original shell, and their limited distribution on the present external moulds is regarded as due to the partly preserved shell material or slightly eroded surface of shells. These specimens are variable in size, but every essential character is quite the same.

The present specimens are undoubtedly referable to *Callista (Pseudamiantis) crenulata* MATSUMOTO, 1938, from the Goshonoura Group of Kyushu, on which TAMURA (1977) established the genus *Goshoraia*. This species was redescribed by him in some detail on the basis of many specimens from the Mifune Group. All the important characters of the present specimens agree well with those of TAMURA's specimens as well as the type material.

Order Pholadomyoida NEWELL, 1965

Family Pholadomyidae GRAY, 1846

Table 4. Measurements in mm [*Goshoraia crenulata* (MATSUMOTO)]

Specimen	Length	Height	Thickness
Right in. mould (NSM-PM 15092)	34.5	25.7	8.5
Right ex. mould (NSM-PM 15093)	23.0+	19.7	5.6
Right ex. mould (NSM-PM 15094)	20.0+	15.9	4.7+
Left ex. mould (NSM-PM 15095)	25.9+	21.6+	6.4
Left in. mould (NSM-PM 15096)	19.3	15.4	4.0

Genus *Goniomya* AGASSIZ, 1841

Subgenus *Goniomya* AGASSIZ, 1841

Goniomya (*Goniomya*) sp.

Plate 5, Fig. 9

Only an external mould of a fragmentary right valve (NSM-PM 15076) was obtained. The characteristic U-shaped ornament impressed on the mould indicates that it certainly belongs to *Goniomya*. The considerably long and persistent median horizontal ribs may remind one of those of *Goniomya* (*Goniomya*) *subarchiaci* NAGAO, 1934, from the Aptian-Albian Miyako Group in north Honshu (HAYAMI, 1966), but the triangular part with the median ribs is more prosoclinally inclined in comparison with that species. This is the first occurrence of *Goniomya* in the Upper Cretaceous of Japan, but the material is too poor to be specifically determined.

Gastropoda

[by Tomoki KASE]

Order Archaeogastropoda THIELE, 1925

Family Trochidae RAFINESQUE, 1815

Genus *Margarites* GRAY, 1847

Margarites ? *funiculatus* (YOKOYAMA)

Plate 5, Fig. 10

1890. *Margarita funiculata* YOKOYAMA, *Palaeontographica*, vol. 36, p. 197, pl. 20, fig. 13a-d.

1963. *Margarites funiculatus* (YOKOYAMA): MATSUMOTO, HAYAMI and ASANO, *A Survey of Fossils from Japan illustrated in Classical Monographs*, p. 30, pl. 46, fig. 13a-d.

1977. *Margarites funiculatus* (YOKOYAMA): HAYAMI and KASE, *Bull. Univ. Mus. Univ. Tokyo*, no. 13, p. 35.

Type.—Holotype by monotypy (Bayerische Staatsammlung für Paläontologie und Historische Geologie, München; YOKOYAMA, 1890, pl. 20, fig. 13a-d). As interpreted by NAGAO (1939, p. 216), it probably came from the *Trigonia* Sandstone (Mikasa Formation) near Poronai, central Hokkaido.

Material.—Only one small specimen (NSM-PM 15099) and a few fragments (NSM-PM 15108).

Description.—Shell very small, broadly phaneromphalous, thin-tested, turbiniform with height slightly smaller than width. Incremental angle in neighbourhood of penultimate whorl about 90 degrees. Spire comprising at least two volutions and occupying slightly less than a half of total shell height. Spire whorls slightly shouldered, angularly inflated and separated by weakly impressed sutures. Protoconch missing. Body whorl large, shouldered and rather flat-sided. Its side nearly vertical and delimited above and below by weak angulations. Base weakly convex with broad umbilicus. Umbilical margin covered by well delimited heavy callus. Ornamentation of spire whorls unknown. On body whorl, surface ornamentation consisting of closely spaced round-topped spiral threads and collabral ribs. Spiral threads wider than their interspaces, becoming obscure toward whorl side. Collabral ribs low and strong near suture, dying out on side but again strengthened near umbilical margin. Below suture, two prominent spiral grooves intersected by collabral ribs. Growth-lines steeply prosocline. Aperture incompletely known, subcircular in outline.

Remarks.—This species seems to be represented by several specimens in this collection, but they are mostly incomplete. The width of the largest specimen may attain 10 mm in view of the fragmentary specimen (PM 15108), and, therefore, the described specimen (PM 15099, 3.5+mm high, 4.4 mm wide) is considered to be juvenile.

The present specimen is probably conspecific with the specimen once described by YOKOYAMA (1890) as *Margarita funiculata*, which is the most common gastropod in the Mikasa Formation. YOKOYAMA's description on the umbilical structure is somewhat incomplete, but he stated "Die Basis ist gewölbt, weit genabelt". Several well preserved specimens from the Mikasa Formation near the type locality deposited in the National Science Museum, Tokyo, agree well with the description and illustration of YOKOYAMA's specimen. The umbilical margin in these specimens is covered by thick and well delimited callus as in the case of the present specimen. By the general shell outline the present species seems to be referable to *Margarites* or *Atira*, though such thick umbilical callus is unfamiliar in these genera.

Order Caenogastropoda COX, 1959

Family Aporrhaidae ADAMS, 1858

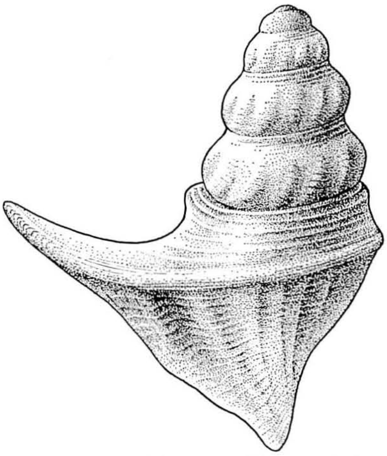
Genus *Drepanochilus* MEEK, 1864

Drepanochilus minimus KASE, sp. nov.

Plate 5, Figs. 13-17, Text-fig. 3

Type and material.—The holotype (NSM-PM 15100) is the largest specimen which lacks the shell of spire whorls. The paratypes (NSM-PM 15101—15105) are all incomplete specimens.

Diagnosis.—A very small species of *Drepanochilus* with only one spiral keel on body whorl. Spire whorls five in number including protoconch. About a dozen of axial ribs weak, moderately inclined and obscure below sutures. Anterior siphonal canal short.



Text-fig. 3. *Drepanochilus minimus* KASE, sp. nov. (restored). ca. ×8

Description.—Very small aporrhaid shell with height slightly larger than width. Spire turriculate, about five in whorl number including protoconch and slightly cyrtoconoid as a whole, occupying about two-fifths of total shell height. Sutures impressed. Protoconch consisting of smooth naticiform whorls with about one volution and separated from teleoconch by a sigmoidal groove. Apical angle about 60 degrees but incremental angle in neighbourhood of penultimate whorl about 45 degrees. First and second whorls of teleoconch smooth with a weak spiral keel slightly above suture. Third and fourth whorls of teleoconch well rounded with width more than 1.5 times of height and surface ornamentation comprising axial ribs and spiral cords. Axial ribs about a dozen in number per a whorl, rather weak, opisthoclinally opisthocyrt and most prominent at middle but obscure below sutures. Spiral cords fine and regularly spaced. Body whorl angularly inflated above and abruptly becoming narrower anteriorly, forming a short, pointed and nearly straight siphonal canal, and prominently unicarinated at two-thirds from anterior end. Body whorl sculptured by fine spiral cords, sometimes with weak axial rugae on basal area near aperture. Axial ribs abruptly appearing near boundary between penultimate and body whorls, where a spiral ridge exists. Spiral cords on body whorl about seven and fifteen above and below spiral keel, respectively, and gradually becoming stronger towards anterior end. Outer lip forming a simply tapered and gently upturned spike.

Measurements.—No specimen is perfectly preserved. The holotype is at least 7.3 mm in height and 6.3 mm in width including the extended outer lip spike.

Remarks.—The dredged sandstone block contains a large number of specimens of this species. Owing to the very small shell size and fragility of shell, only six imperfect specimens were prepared for this study. The holotype shows perfectly the simple and upturned short outer lip spike and the surface ornamentation of body whorl. The early teleoconch whorls are best observed in a silicone rubber cast of a paratype (Pl. 5, Fig. 13). The delicate ornamentation of early whorls in this specimen is somewhat obliterated, but it reveals two post-embryonic whorls which possess a distinct spiral keel slightly above the anterior sutures. Similar characteristics of the early teleoconch whorls are found in some species from the Gault of England described by GARDNER (1875), such as *Dimorphosoma calcarata* (SOWERBY), *D. toxochila* GARDNER and *D. doratochila* GARDNER, whereas such Uppermost Cretaceous species from North America as *Drepanochilus evansi* COSSMANN, *D. scotti* SOHL and *D. nebrascensis* (EVANS and SHUMARD) described by SOHL (1967) possess different kind of sculptures.

D. minimus is one of the smallest species of the genus and is easily distinguishable from other species by the smaller size, smaller number of whorls and simple outer lip spike. It resembles *Drepanochilus muleti* (D'ORBIGNY, 1850) sensu DE LORIOL (1882, pl. 4, figs. 1-3) [=*Drepanocheilus* sp. *in* KOLLMANN, 1978, p, 184] from the Gault of Cosne in France, but differs decidedly in the smaller shell size, short and simple outer lip spike, shorter anterior siphonal canal, more numerous axial ribs on the spire whorls and smaller number of whorls. Compared with *D. calcaratus* (SOWERBY, 1823) (GARDNER, 1875; KOLLMANN, 1978) from the Gault of England and the Upper Albian of Austria, the present species is smaller and has larger apical angle, only one spiral keel on the body whorl, short and simple outer lip spike and less prominent axial ribs on the spire whorls.

Order Cephalaspidea FISCHER, 1883

Family Ringiculidae MEEK, 1863

Genus *Avellana* D'ORBIGNY, 1842

Avellana sp.

Plate 5, Figs. 11, 12

Two incomplete specimens are available for this study. One specimen (NSM-PM 15106; 4.3 mm high, 3.8+mm wide) well exhibits the surface ornamentation and two folds on columellar lip, but it lacks the outer lip and parietal region. The other specimen (NSM-PM 15107; 4.2 mm high, 4.3 mm wide), on the other hand, has poorly preserved outer lip and parietal region. The shell is small for this group and has height nearly equal to width.

The volution is two and a half including the protoconch. The surface ornamentation consists of 23 spiral rows of punctation on the body whorl. The outer lip is reinforced, much thickened by callus and denticulated internally. The parietal area is much thickened by callus and has an obtuse denticle. The columellar lip has two simple folds.

The outer and inner lip characteristics suggest that these specimens can probably be assigned to the genus *Avellana*, but the fragmentary material prevents me from their comparison with hitherto known species of this genus.

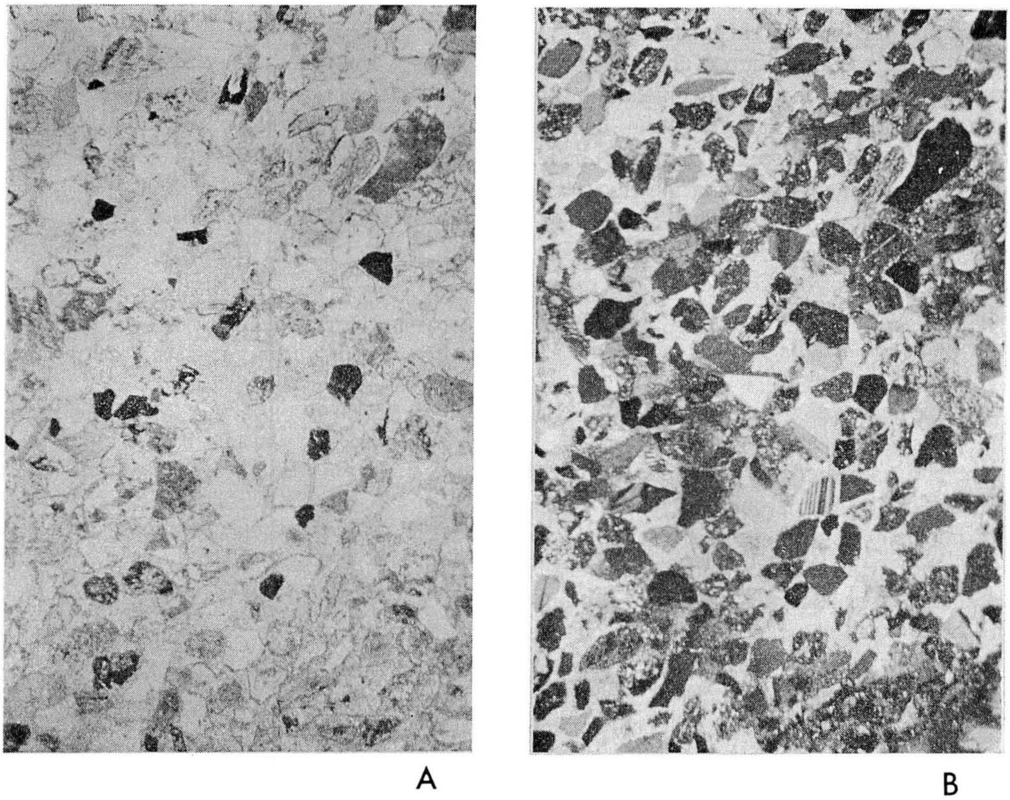
Concluding remarks

The sandstone block, which happened to be dredged from the sea bottom off the east coast of north Kitakami mountains, seems to be significant for the consideration of geologic history as well as palaeobiogeography, because it contains a number of characteristic molluscan fossils. Of the fourteen molluscs described here, six species are actually common with and three species are comparable with the fauna of the Mikasa Formation (formerly called "*Trigonia* Sandstone") of the Middle Yezo Group in central Hokkaido. On the other hand, there is no common species with the molluscan fauna of the Miyako Group described by NAGAO (1934), HAYAMI (1965a, b, 1966) and others.

According to up-to-date biostratigraphic scheme (e.g. MATSUMOTO, 1977), *Inoceramus* (*Birostrina*) *concentricus nipponicus* can be treated as a zone fossil indicating the upper part of Lower Cenomanian ($K4a_2$). *Pterotrigonia* (*Pterotrigonia*) *brevicula* and *Thetis japonica* also seems to be important, because their known occurrences are restricted to the *Mantelliceras japonicum* Zone—*Eucalycoceras pentagonum* Zone, which corresponds to the lower part of the Mikasa Formation. Along the classical standard section of the Ikushumbets valley (eastern wing) of central Hokkaido, such a molluscan assemblage is found in the lower part, especially IIb Member by MATSUMOTO (1959) and OKADA (1965), of this formation. *Goshoraia crenulata* is a characteristic venerid species originally described from the Goshonoura Group (later also from the Mifune Group) of central Kyushu, but, as noted by MATSUMOTO (1938, 1954) and also confirmed by us, it also occurs commonly in the lower part of the Mikasa Formation in the Ikushumbets area. Judging from the assemblage of these fossils, a Cenomanian age as well as some shallow marine sedimentary environment is conclusive for this sandstone block.

Petrographically, the present sandstone may be called calcareous lithic arenite. It actually looks similar to some calcite-cemented sandstone of the Mikasa Formation, which was studied in detail by OKADA (1965). Subangular quartz and subrounded chert grains of various colours are characteristically abundant, and feldspars and other rock fragments are not rare. These grains are well sorted and almost entirely cemented with sparry calcite (more than 40 percent in weight) instead of clay matrix. The present sandstone block is more calcareous than most examples of the Mikasa Sandstone treated by OKADA (1965, Table 2), but it is highly probable that the present block is as a whole a large concretion in a less calcareous sandstone, since such a fossiliferous part is often nodular in the Mikasa Formation.

In the Kitakami mountains Miyakoan (Aptian-Albian) and Urakawan (Coniacian-Santonian) marine deposits are represented by the Miyako Group and the Kuji Group,



Text-fig. 4. Thin section of the sandstone block: calcite-cemented fine-grained lithic arenite with abundant chert grains, ×25. A: under open nicol, B: under crossed nicol.

respectively, whereas Gyliakian (Cenomanian-Turonian) sediments have not been found. The strata of the two groups, which are separately distributed along the coastal region of the mountains, abut against the basement complex on the west and tilt gently to the east without any strong folding. Since the Gyliakian is generally regarded as a regressive stage in this region, the distribution of marine sediments of this stage, if present, may be well anticipated off the coast of the mountains. The present discovery seems to substantiate this expectation.

The submarine geology off the coast of northern Kitakami mountains was recently investigated by the staff of the Geological Survey of Japan. According to the submarine geologic map published by the Geological Survey of Japan (TAMAKI, 1978), which was made mainly on the basis of the results of seismic reflection profiling survey, Cretaceous and Paleogene sedimentary rocks are distributed on the upper (western) part of the continental shelf in this sea area. Some samples of fine-grained sandstone dredged from the sea bottom (39°50.2′N, 141°07.4′—08.1′E, depth 134-137 m) off the coast of Omoto were palynologically correlated to the Kuji Group. On the other hand, the lower part of the shelf and the continental slope aresaid to be covered by

Neogene and Quaternary sediments. Since the locality of the present block is situated in the distributed area of these younger sediments, our conclusion is apparently inconsistent with the seismic result. We are, however, putting belief in the fishermen's information about the locality, which is supported by the operational record of the fishing boat, although it is, of course, by no means scientifically accurate. Judging from the outline and lithology of the block, we presume that it is actually a nodular mass which was washed out from the mother rock on the sea floor.

In the meridional backbone range of Hokkaido, the sandstones of the Mikasa Formation merge eastwards into muddy sediments (MATSUMOTO and OKADA, 1973; etc.) and have been regarded as representing the western marginal facies, at the Gyliakian times, of a large sedimentary basin called "Yezo Geosyncline". Although much should be done about the submarine geology off the Kitakami mountains, the present find of Mikasa-type sandstone seems to suggest that the marginal facies of this basin extended southwards at that time for more than 250 km from the present southern coast of Hokkaido.

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Explanation of Plate 4

Figs. 1, 2. *Glycymeris* (*Glycymerita*) sp. aff. *G.* (*G.*) *hokkaidoensis* (YABE and NAGAO)....p. 31
1. Left valve (NSM-PM 15097) ×2.
2. Left valve (NSM-PM 15098) ×1.2.

Figs. 3-6. *Inoceramus* (*Birostrina*) sp. cf. *I.* (*B.*) *concentricus nipponicus* NAGAO and MATSUMOTO ....p. 32
3. Left valve (NSM-PM 15074) ×2.
4. Right internal mould (NSM-PM 15073) ×2.
5. Right internal mould (NSM-PM 15071) ×1.2.
6. Right internal mould (NSM-PM 15072) ×1.2.

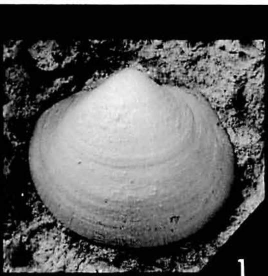
Fig. 7. *Entolium* sp. cf. *E. obovatum* (STOLICZKA)....................p. 34
7. Right internal mould (NSM-PM 15075) ×1.2.

Figs. 8-14. *Pterotrigonia* (*Pterotrigonia*) *brevicula* (YEHARA) ....p. 34
8. Left valve (NSM-PM 15086) ×2. 8a: left side view, 8b: upper view.
9. Immature right valve (NSM-PM 15080) ×1.2.
10. Immature left internal mould (NSM-PM 15084) ×1.2.
11. Right valve (NSM-PM 15078) ×1.2.
12. Right valve (NSM-PM 15077) ×1.2.
13. Right valve (NSM-PM 15083) ×1.2.
14. Right internal mould (NSM-PM 15079) ×1.2.

Fig. 15. *Pterotrigonia* (*Acanthotrigonia*) sp. cf. *P.* (*A.*) *longiloba* (JIMBO)....................p. 36
15. Left internal mould (NSM-PM 15088) ×1.2.

Fig. 16. *Pterotrigonia* (*Acanthotrigonia*) sp....................p. 37
16. Right valve (NSM-PM 15087) ×2. 16a: internal mould, 16b: silicone rubber cast from external mould.

Fig. 17. *Anthonya* sp. cf. *A. apicalis* NAGAO .... p. 38
17. Silicone rubber cast from right external mould (NSM-PM 15069) ×1.2.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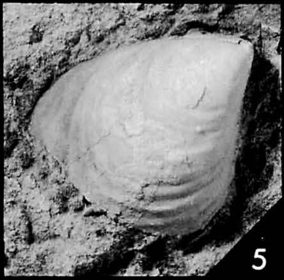
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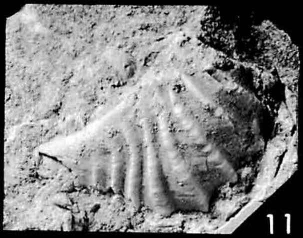
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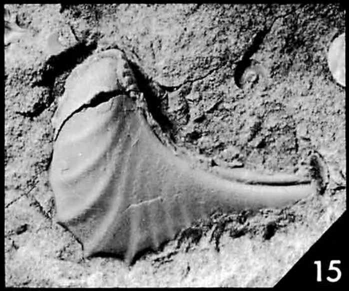
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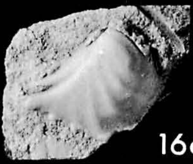
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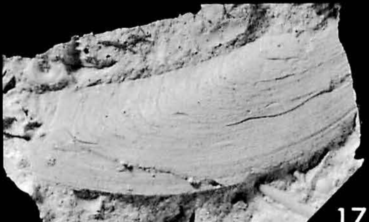
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Abeshinai アベシナイ, Bibai 美唄, Enokuchi 江の口, Goshonoura (Gosyonoura, Goshora) 御所浦, Hakkinzawa 白金沢, Ikushumbets 幾春別, Kobunenosako 小舟の迫, Kuji 久慈, Kurosaki 黒崎, Mifune 御船, Mikasa 三笠, Miyako 宮古, Omoto 小本, Ōyubari 大夕張, Ponhorokabetsu ポンホロカベツ, Poronai 幌内, Sorachi 空知, Yubari 夕張

久慈市沖の海底から採取された砂岩中のセノマニアン軟体動物化石：岩手県久慈市南方の“黒崎沖約30 km, 深度約400 m”の海底から漁業者によって陸揚げされた含化石砂岩塊を検討した結果, *Inoceramus* (*Birostrina*) sp. cf. *I.* (*B.*) *concentricus nipponicus*, *Pterotrigonia* (*Pterotrigonia*) *brevicula*, *Thetis japonica*, *Goshoraia crenulata*, *Margarites? funiculatus*, *Drepanochilus minimus* sp. nov. を含む11種の二枚貝・3種の腹足類を同定したので記載する。この種構成は北海道中軸部の中部エゾ層群の三笠層（三角貝砂岩）下部に知られる軟体動物群に酷似し，セノマニアンの時代と浅海性の堆積環境が強く示唆される。北上山地では，宮古世（アプチアン―アルビアン）と浦河世（コニアシアン―サントニアン）の海成堆積物はそれぞれ宮古層群と久慈層群で代表されるが，中間のギリアーク世（セノマニアン―チューロニアン）の海成層は知られていない。今回の発見は，この時代に海岸線が北上山地から東方に退いていたことを立証するとともに，“エゾ地向斜”の縁辺相が現在の北海道南岸から250 km以上も南方にまで分布していたことを暗示するものである。

速水　格・加瀬友喜

Explanation of Plate 5

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Figs. 2-4. *Thetis japonica* (Yabe and Nagao) .... p. 37
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3. Silicone rubber cast from right external mould (NSM-PM 15089) ×1.2.
4. Right valve (NSM-PM 15091) ×1.2.

Figs. 5-8. *Goshoraia crenulata* (Matsumoto) .... p. 39
5. Right valve (NSM-PM 15092) ×1.2. 5a: internal mould, 5b: silicone rubber cast from external mould.
6. Left internal mould (NSM-PM 15096) ×1.2.
7. Silicone rubber cast from right external mould (NSM-PM 15093) ×1.2.
8. Silicone rubber cast from right external mould (NSM-PM 15094) ×1.2.

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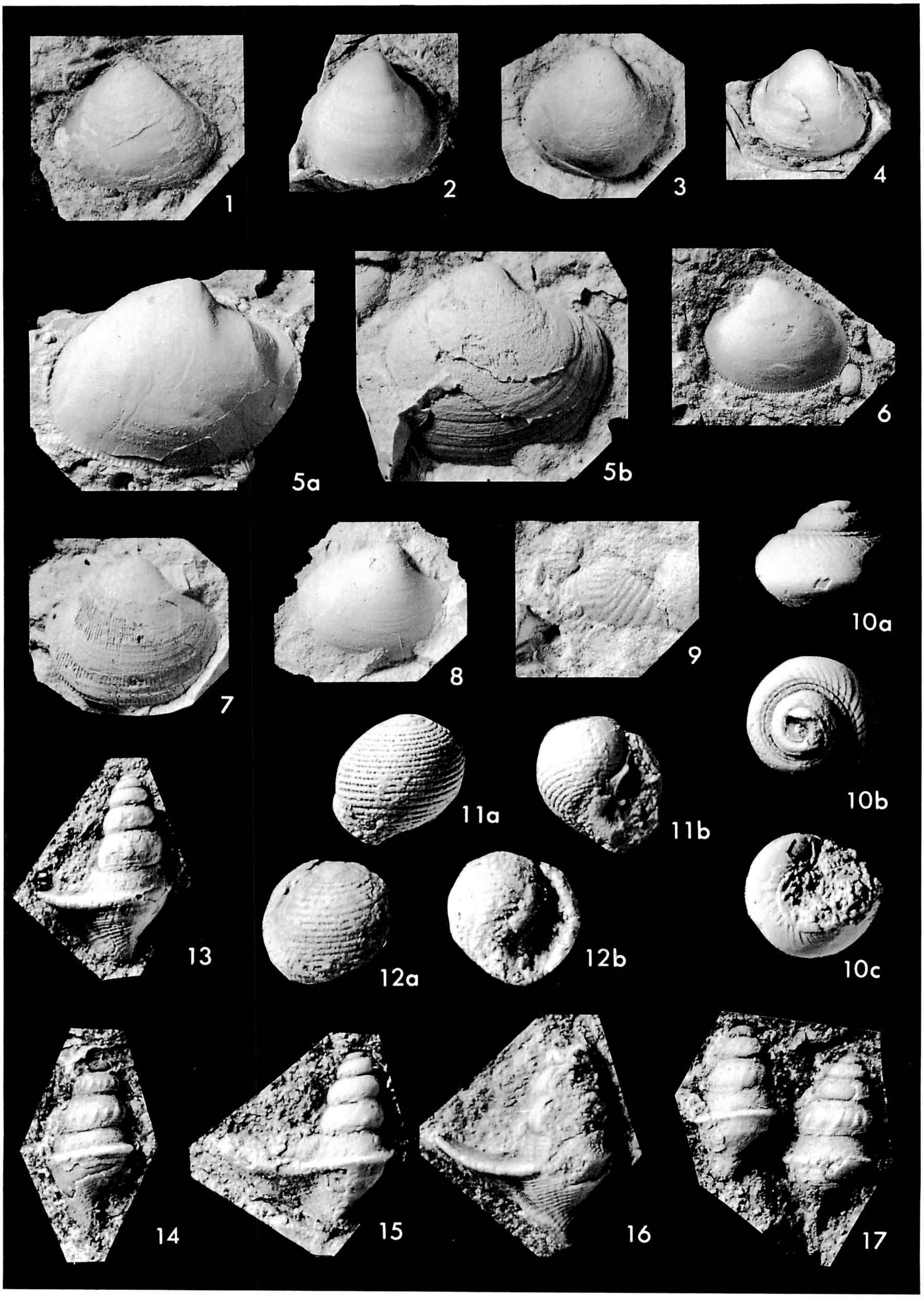
15. Back view of a paratype (NSM-PM 15103) ×5.
16. Back view of the holotype (NSM-PM 15100) ×5.
17. Back view of two paratypes; left (NSM-PM 15104), right (NSM-PM 15105) ×5.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Trans. Proc. Palaeont. Soc. Japan, N. S., No. 121, pp. 51-73, pls. 6-8, April 30, 1981

728. SOME CONIACIAN AMMONITES FROM HOKKAIDO*

(STUDIES OF THE CRETACEOUS AMMONITES FROM HOKKAIDO**—XL)

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Abstract. In this paper four species of Coniacian ammonites are described to supplement previously published monographs (MATSUMOTO, 1965-1971). They are two new species of *Peroniceras*, which are allied to *P. stefaninii* VENZO and *P. besairiei* VAN HOEPEN respectively, *Sornayceras* cf. *proteus* MATSUMOTO, which is based on a large specimen, and *Barroisiceras onilahyense* BASSE. The localities and stratigraphic positions of the described specimens are explained at length.

As an appendix, remarks are given by one of us (T. M.) on the Coniacian biostratigraphy in western Europe and other selected regions and also on the zonation and correlation of the Coniacian equivalent in Japan.

Introduction

To cooperate with the Coniacian to Maastrichtian Working Group (Leader Dr. F. SCHMID) of the IUGS Subcommission on the Cretaceous Stratigraphy (Chairman Professor Tove BIRKELUND), one of us (T. M.) has been studying ammonites from the Japanese province to compare them with those from northwest Europe and other well studied regions. For the purpose of inter-regional correlation, ammonites of the Collignoniceratidae are the most useful.

One of us has already published a monograph of that family in series (MATSUMOTO, 1965a, b, 1969, 1970a, 1971).

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* Received Sept. 14, 1980; read Jan. 26, 1980 at Tsukuba Univ. (Part I) ; June 30, 1980 at Kochi Univ. (Part II) ; April 2, 1980 at Shimane Univ. (Appendix).

** Numbering follows that of the title "Studies of the Cretaceous ammonites from Hokkaido & Saghalien".

Recently some additional ammonites have been obtained by several persons who have worked in cooperation with T. M. One of them, a Santonian species of Texanitinae, has been described by MATSUMOTO and HARAGUCHI (1978), in the appendix of which the problem of Santonian zonation has been discussed. In this paper some Coniacian ammonites are described by coauthorship of relevant persons in two parts and the problem of Coniacian zonation is discussed by one of us (T. M.) as an appendix.

Acknowledgements:—Before going further, we thank Mr. Hisayoshi TANIGUCHI and Mr. Fumio SUZUKI, who have kindly provided fine specimens for our study, and also Drs. Kazushige TANABE and Masayuki NODA, who have friendly helped us. Thanks are extended to Drs. H. SUMMESBERGER (Vienna), E. SEIBERTZ, S. KELLER (both Hannover), J. WIEDMANN (Tübingen) and W. J. KENNEDY (Oxford) for their kind replies to the inquiries from one of us (T. M.). Miss Kazuko HARA has assisted us in preparing the typescript.

This is a contribution to the "International Correlation of the Cretaceous System" which has been supported by the Science Research Fund (No. 334043) of the Ministry of Education, Science and Culture [Monbusho].

Palaeontogical Description

Part I

Additional Ammonites of the Peroniceratinae from Hokkaido

T. MATSUMOTO and K. MURAMOTO

The ammonites belonging to the subfamily Peroniceratinae from the Cretaceous of Hokkaido were monographed by one of us (MATSUMOTO, 1965b), in which ten species were described. Among the subsequent collections there are three large interesting specimens. We describe them below. Although one of us (T. M.) is mainly responsible for the palaeontological description, coauthorship is taken because the other of us (K. M.) is responsible for collecting and cleaning the specimens.

Family Collignoniceratidae WRIGHT, 1952

Subfamily Peroniceratinae HYATT, 1900

Remarks:—Pending the issue of the paper by KENNEDY and KLINGER (1975) on the Peroniceratinae from South Africa, we would not discuss too much on the relationships between the genera and subgenera proposed or redefined by VAN HOEPEN (1965) with those of MATSUMOTO (1965b).

Genus *Peroniceras* DE GROSSOUVRE, 1894

Type species:—*Peroniceras moureti* DE GROSSOUVRE, 1894 (original designation).

Remarks:—The two species to be described below are certainly referred to *Peroniceras.*

Peroniceras latum sp. nov.

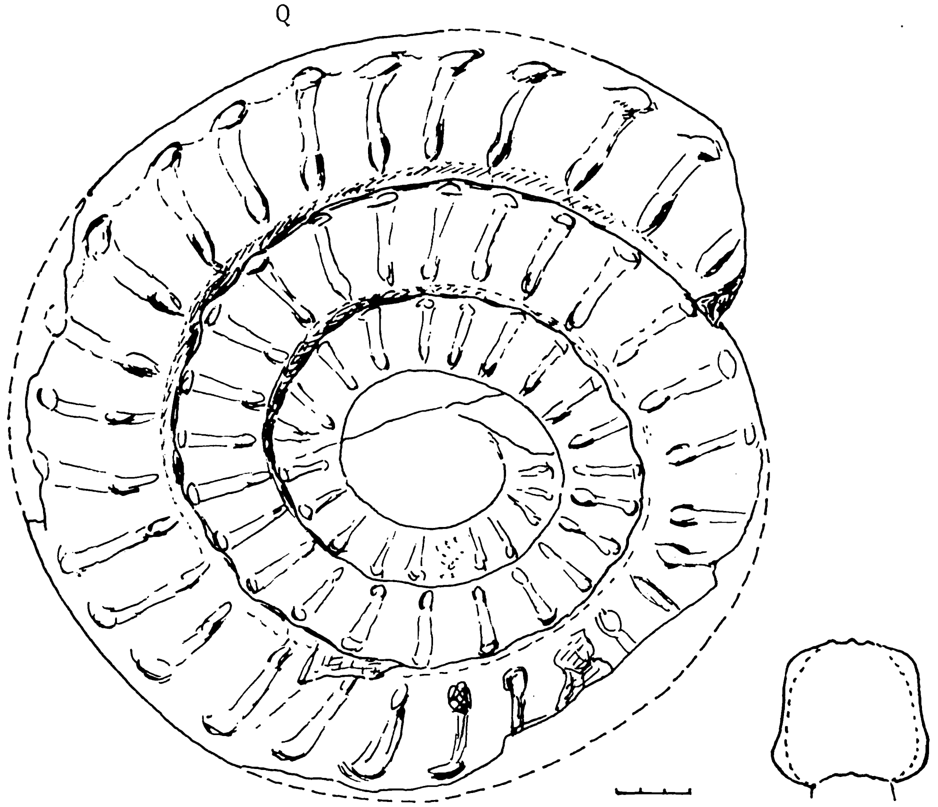
Pl. 6, Fig. 1; Pl. 7, Fig. 1; Text-fig. 1

Material:—Holotype, "HCS. 73", obtained from loc. Ik 1540, main stream of the Ikushumbets, by H. TANIGUCHI and K. MURAMOTO in July 1965.

Description:—The shell is very large in the adult stage, somewhat over 300 mm in diameter. It is much evolute, consisting of slowly enlarging polygyral whorls with little overlap. The diameter of the umbilicus is about 63 per ct. of that of the entire shell. The body-chamber is very long, occupying somewhat more than one full volution, although the very apertural margin is not preserved.

The whorl is nearly as high as broad in the intercostal section; thickest at some distance from the abruptly rounded umbilical shoulder in its lower part (accordingly between the umbilical tubercles in the costal section); the umbilical wall is low but nearly vertical. The venter is broadly arched and weakly to moderately tricarinate; the ventrolateral shoulders are sloping on the intercostal parts, but subangular along the costae.

The ribs are moderately broad, fairly distant, but numerous, numbering 28 on the outer whorl and 24 on the next inner one and about 20 on the still inner one. They are mostly simple on the outer two whorls but occasionally bifurcate on the inner ones. They are nearly rectiradiate on the septate whorls and slightly prorsiradiate or gently flexuous on the body whorl. Each of them has a bullate tubercle around the umbilical margin and a rather clavate one at the ventrolateral shoulder; the former is highest slightly above the umbilical shoulder; the latter is typically clavate on the inner whorls but obliquely rounded and thickened on the body-whorl.



Text-fig. 1. *Peroniceras latum* sp. nov. Diagrammatic sketch of the holotype.
Lateral view and whorl-section at Q.
Bar: 30 mm. (T.M. *delin.*)

Measurements (in mm) of *Peroniceras latum*:—

Specimen	Diameter	Umbilicus	Height	Breadth (costal)	Breadth[B'] (intercostal)	B/H	B'/H
HCS. 73	323.0(1)	206.0(.64)	62.0(.19)	70.0(.22)	62.0(.19)	1.1	1.0
For comparison: *P. stefaninii*							
VENZO's	240.0(1)	134.0(.56)	62.0(.26)	60.0(.25)	50.0(.21)	0.97	0.8

The suture follows the general pattern of *Peroniceras* suture (as explained by MATSUMOTO, 1965b, p. 212), but the stem of its lateral lobe (L) has some breadth and is not so extremely narrowed as in *Peroniceras* aff. *platicostatum* VAN HOEPEN (see MATSUMOTO, 1965b, pl. 36, fig. 1; text-fig. 2), or in *P. westphalicum* var. *australis* VENZO (1936, pl. 11, fig. 8).

Comparison and discussion:—This specimen resembles the holotype of *Peroniceras stephaninii* VENZO (1936, p. 102, pl. 9, fig. 8; pl. 10, fig. 10; pl. 12, fig. 6), from the Coniacian of Zululand (South Africa) in many respects. The latter is 240 mm in diameter, but the body-chamber seems to be incompletely preserved. Should its body-chamber completely preserved, it would be 310 mm or so in diameter, that is nearly the same size as the present specimen.

The specimen from Hokkaido is likewise similar to the illustrated specimen from the Coniacian of Armenia, which was identified with *Peroniceras haasi* YOUNG by ATABEKIAN and AKOPIN (1972, p. 8, pl. 2, fig. 4a; pl. 3, fig. 1b). That Armenian form has coarser, stronger and more rounded ribs than *P. haasi* YOUNG (1963, p. 72, pl. 34, figs. 3, 4; pl. 35, figs. 1-3), from the Lower Coniacian of Texas, and is closer to or possibly identical with *P. stefaninii.*

In the holotype of *P. stephaninii,* as in the specimen from Armenia, the umbilicus is about 55 per ct. of the shell diameter and the ribs number about 20-22 per whorl. The specimen from Hokkaido has much wider umbilicus, i.e. about 63 per ct. of the shell diameter, more slowly enlarging whorl and more numerous ribs, numbering 28 on the outer whorl despite their fairly wide intervals.

YOUNG (1963, p. 75) thought that *P. stephaninii* would be placed in synonymy with *P. westphalicum* of SCHLÜTER (1867, 1872). As YOÜNG himself mentioned, the figured examples from Texas described under *P. westphalicum* closely resemble the holotype of *P. stephaninii.*

Unless examining the original specimens (syntypes) of *Ammonites westphalicus* VON STROMBECK (1859, p. 56), and its topotypes from the "Grauer Mergel" (Coniacian) of Westphalia (West Germany), it seems me difficult to understand definitely this "famous" species. SCHLÜTER's earlier paper (1867, p. 30, pl. 6, fig. 2) is also ambiguous in that he did not illustrate the lateral view of his specimen. He described, however, that the ribs number 19 around the umbilicus and 24 at the ventrolateral part. STROMBECK recognized "rarely and irregularly intercalated ribs in the late growth-stage" of his specimen. According to SCHLÜTER's later paper (1872, p. 45, pl. 13, figs. 5, 6), *Ammonites westphalicus* has fairly frequently intercalated or bifurcated secondary ribs, with the result to have more numerous ventrolateral tubercles than the umbilical ones (e.g. the former counted 27 in contrast to 19 or 21 of the latter). In this and other respects, one of the illustrated specimens of DE GROSSOUVRE (1894, p. 98, pl. 12, fig. 4), from the Coniacian of France, is a good example of *P. westphalicum* in the sense of SCHLÜTER, but the other (DE GROSSOUVRE, 1894, pl. 12, fig. 1) differs from "the type", as GROSSOUVRE himself mentioned. We hesitate to identify the latter to the same species.

If the above discussion is warranted, then it follows that "*Peroniceras westphalicum*" of YOUNG (1963, p. 74, pl. 28, figs. 2-4; pl. 29, figs. 1, 2; text-fig. 15d), from Division A of the Austin Chalk (Texas), may not be the named species. We suggest that YOUNG's *P. westphalicum* is probably *P. stefaninii* and that *P. stefaninii* and *P. westphalicum* are distinguishable.

Coming back to the specimen from Hokkaido, we hesitate to decide conclusively whether the described differences deserve specific or subspecific distinction from *P. stefaninii*. If we consider the resemblance in essential points but for the extremely wide umbilicus and the consequent increase of rib numbers, the Hokkaido specimen could possibly regarded as representing a subspecies of *P. stefaninii* in the Japanese province. YOUNG (1963, p. 74), however, has shown that the umbilicus size ranges from 43 to 58 per ct. of the diameter in the Texas specimens (of his *P. westphalicum*). This variation is of large extent, but the Hokkaido form (63 per ct.) distinctly exceeds that range. Therefore, at least for the time being, we describe it as representing a new species.

Should the extent of variation in our province be made clear on more specimens to overlap slightly with that of the Texas or South African form, then the new name *latum* might be ranked down to subspecific. Be that as it may, it cannot be denied that there is a discrepancy in geological age (i. e. Late Coniacian of our species as compared with Early Coniacian of Texas or South African species) as well as the difference in geographical distribution.

Occurrence:—Loc. Ik 1540, dark grey mudstone of the Upper Yezo Group exposed on the left bank of the main stream of the River Ikushumbets, about 100 m downstream from the confluence with the tributary Samatazawa (Text-fig. 4). In the same mudstone unit *Inoceramus* (*Platyceramus*) *yubarensis* NAGAO et MATSUMOTO occurs and this part is assigned to the upper part of Lower Urakawan [K5a2], approximately Upper Coniacian.

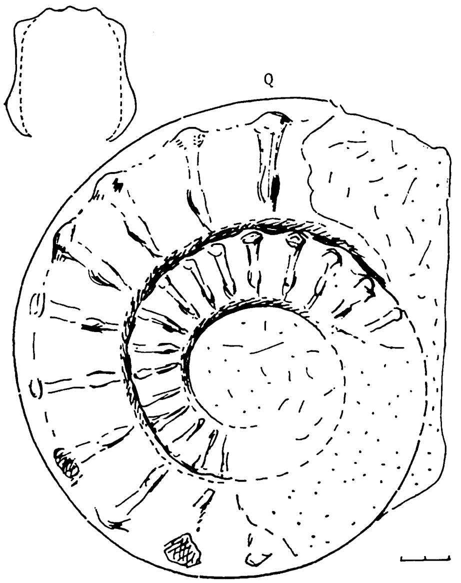
Peroniceras yubarense sp. nov.

Pl. 6, Fig. 2; Pl. 7, Fig. 2; Text-fig. 2

Material:—Holotype, Yb5152 of K. MURAMOTO's Collection in a calcareous nodule from the River Shiyubari.

Description:—The shell is 197 mm in diameter at the last septum. The body-chamber is only partly and poorly preserved and its actual length is unknown. Should it be assumed to occupy two thirds whorl, the entire shell diameter would be about 350 mm, which can be said very large. It is fairly evolute, consisting of moderately enlarging whorls with a slight overlap. The umbilicus is about 52 per ct. of the entire shell diameter.

The whorl is somewhat higher than broad in the intercostal section but broader than high in the costal section, being broadest between the umbilical tubercles. The venter is tricarinate, with the highest keel in the middle. It is broadly arched in the intercostal section. On the interspaces of the ribs the flanks are nearly parallel and only gently convex, with the maximum breadth at about the middle of the flank. The umbilical shoulder is abruptly rounded; the umbilical wall is



Text-fig. 2. *Peroniceras yubarense* sp. nov. Diagrammatic sketch of the holotype. Lateral view and whorl-section at Q. Bar: 20 mm. (T. M. *delin.*)

low but almost vertical.

Ribs are all simple, long and nearly rectiradiate or sometimes slightly rursiradiate, so far as the observable parts are concerned. They are broadly rounded and distant on the outer whorl, numbering 8 in a half whorl of the last septate stage; on the inner whorl of an earlier stage, about 100 mm or so in diameter, they are less distant, being separated by the interspaces nearly as wide as or only slightly broader than the ribs.

The umbilical tubercles are more or less bullate and highest at a point slightly below the middle of the flank instead of near the umbilical shoulder. The ventrolateral tubercles are clavate at their base and on the outer whorl moderately elevated and rounded.

The suture is of the *Peroniceras* pattern (see Matsumoto, 1965b, p. 212) (also de Grossouvre, 1894, figs. 37-39). The second lateral lobe [U2] is rather gently oblique. In the late stage the branches (lobules) of the first lateral lobe (L) are deep and much narrowed.

Comparison and discussion:—With respect to the shell-form and the strength of the ornamentation, this specimen resembles one of the illustrated specimens of *Peroniceras westphalicum* of Schlüter (1872, pl. 13, fig. 6), but that specimen has more frequently intercalated or branched ribs, as has been mentioned in the foregoing page.

Taking account of the predominant simple ribs, without or with only occasional intercalation of the secondary ribs, and the highest elevation of the umbilical tubercles slightly below the middle of the flank, we consider that the present specimen is closer to the holotype from Zululand (South Africa) and another example from Madagascar of *Peroniceras besairiei* van Hoepen (1965, p. 4, pl. 1; text-fig. 1a) (Collignon, 1965, p. 54, pl. 437-438, fig. 1803). These specimens from South Africa and Madagascar differ from the Hokkaido specimen in their wider umbilicus, slower rate of whorl-growth and more numerous ribs.

Again it might be possible to regard

Measurements (in mm) of *Peroniceras yubarense:*—

	Diameter	Umbilicus	Height	Breadth (c.)	B′(ic.)	B/H	B′/H
Yb 5152	197.0 (1)	102.0 (.52)	56.0 (.28)	58.0 (.29)	48 (.24)	1.05	0.86
For comparison: *P. besairiei*							
Hoepen's	132 (1)	73 (.55)	34 (.26)	37 (.28)		1.07	
Collignon's	220 (1)	135 (.61)	52 (.24)	55 (.25)		1.05	

the present form as representing a subspecies of *P. besairiei* in the Japanese province, if the extents of variation were overlapped between the forms from Japan and South Africa-Madagascar. So far as the available material is concerned, the distriction is so clear that we regard, at least provisionally, the Hokkaido specimen as representing a new species which is closely allied to *P. besairiei.*

Incidentally, the ammonite from Madagascar, which was described under *Peroniceras subtricarinatum* (D'ORBIGNY) by BESAIRIE (1930, p. 634, pl. 66, figs. 4-6), was regarded as another example of *P. besairiei* by VAN HOEPEN (1965). We are in favour of BESAIRIE, because it has more frequently intercalated or branched secondary ribs and because its umbilical nodes are highest at or near the umbilical shoulder.

Occurrence:—The calcareous nodule containing this ammonite was obtained by one of us (K. M.) as one of the transported boulders on the gravel of the main stream of the Shiyubari, at a point close to loc. Y102 of MATSUMOTO (1942, route map of pl. 15). For a considerable distance upstream from this point along the river, Coniacian strata consisting of the Zone of *Inoceramus uwajimensis* and the Zone of *Inoceramus mihoensis* are exposed repeatedly on account of minor thrusts (see geological map and profile of MATSUMOTO, 1942, pls. 13, 14 and map of MATSUMOTO and HARAGUCHI, 1978, fig. 1). Therefore this nodule is presumed to have been derived from either of these two zones. We should confirm the precise stratigraphic position of this species through further field work.

Genus *Sornayceras* MATSUMOTO, 1965

Type-species:—*Sornayceras proteus* MATSUMOTO, 1965 (original designation).

Remarks:—This genus was established with a clear definition by MATSUMOTO (Nov. 20, 1965b, p. 226), as a relative of *Gauthiericeras* and *Peroniceras.* Nomenclaturally, however, it may be synonymous with one of the genera (or subgenera) established independently by VAN HOEPEN (July, 1965). Further discussion about this point will be given by KENNEDY and KLINGER. I use for the time being the generic name *Sornayceras* until the issue of their forthcoming paper.

Sornayceras sp. cf. *S. proteus* MATSUMOTO

Pl. 7, Fig. 3; Text-fig. 3

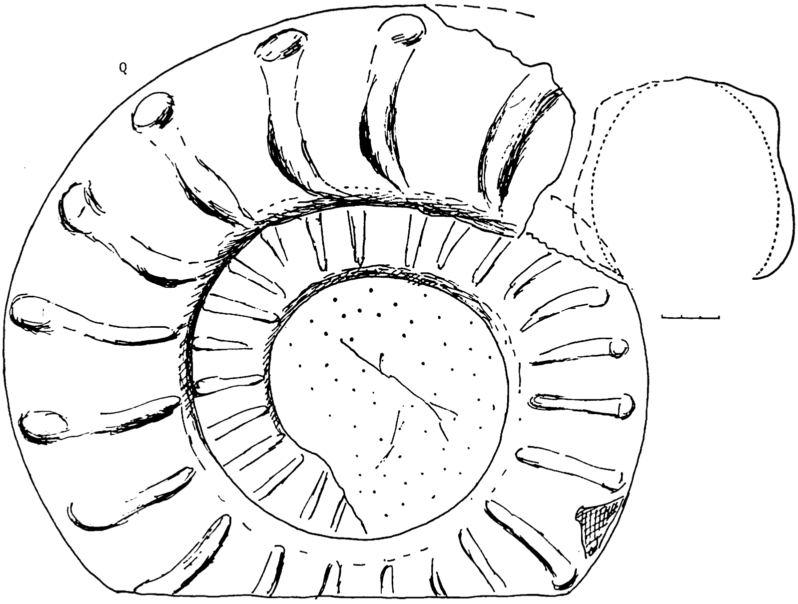
1960. *Sornayceras proteus* MATSUMOTO, *Mem. Fac. Sci., Kyushu Univ.*, [D], vol. 16, no. 3, p. 227, pl. 40, fig. 1; pl. 41, fig. 1; text-fig. 11, 12.

Material:—A large specimen of K. MURAMOTO's Collection, figured in this paper, is concerned with the present description.

Description:—The specimen is somewhat deformed into an elliptical form and its right side is dissolved into the rock matrix. The measurements (in mm) at about 90° behind the preserved end are as follows in the deformed state:

Diameter	340(1)
Umbilicus	170(.50)
Height	100(.29)
Breadth(costal)	*ca.* 58×2
B′.(interc.)	*ca.* 50×2

The shell is large, rather evolute and widely umbilicate. The whorl is nearly as high as broad in the intercostal section, but the proportion of B/H cannot be accurately measured on account of the half dissolved condition. It is broadest in its lower part and its flank is gently inflated. The venter is broad and low roof-shaped. The keel at the middle of the venter is low and there is a smooth



Text-fig. 3. *Sornayceras* sp. cf. *S. proteus* MATSUMOTO, from loc. Ik 1509, diagrammatic sketch. Lateral view and whorl-section at Q. Bar: 30 mm. (T. M. *delin.*)

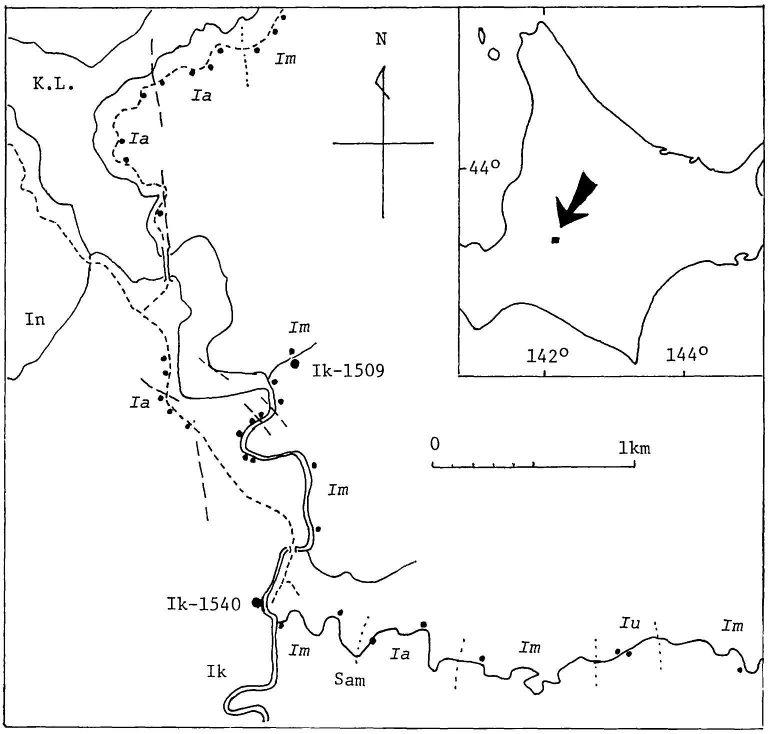
zone on either side of it instead of a groove.

The radial ribs are distant, coarse, mostly simple and provided with an umbilical and a ventrolateral rows of tubercles. They are nearly rectiradiate on the main part of the flank, but on the body-whorl they show a backward curvature around the umbilical margin. The umbilical tubercles are bullate and on the body-chamber they are thickened and highest at some distance from the umbilical margin. The ventrolateral tubercles are rounded to somewhat clavate and also thickened on the body-chamber.

There are 9 ribs on the preserved part of the body-whorl, that is a half volution. On the preceding septate whorl there are 24 ribs, of which only two are shorter than others. Still inner whorls are not well shown.

The suture is as complex as that of *S. proteus* (MATSUMOTO, 1965b, text-fig. 12). The last suture is at about 280 mm in diameter.

Comparison:—This specimen essentially resembles the holotype of *Sornayceras proteus* MATSUMOTO (cited above), but is much larger and its ribs are mostly simple, without intercalated shorter rib on the outer whorl. On the inner whorl there are a few shorter ones. In the original description (MATSUMOTO, 1965b), another large fragmentary whorl was described, on which no shorter rib is shown. It was called *Sornayceras* sp. cf. *S. proteus*. The present specimen is better preserved than that fragmentary one and seems to show the change in the mode of ribbing with growth. Unfortunately, its inner whorl as large as the holotype, about 95 mm in diameter, is not well preserved. Therefore we call it for the time being *Sornayceras* sp. cf. *S.*



Text-fig. 4. Route map of the River Ikushumbets around the localites of *Peroniceras latum* (Ik-1540) and *Sornayceras* cf. *proteus* (Ik-1509). Ik: main stream of the Ikushumbets, In: Inari-zawa, K.L.: Katsura-zawa Lake, Sam: Samata-zawa. *Ia*: Zone of *Inoceramus amakusensis* (lower Santonian), *Im*: Zone of *I. mihoensis*, *Iu*: Zone of *I. uwajimensis*, *Im*+*Iu*: Coniacian, ●: mega-fossil locality, broken thick line: fault. Inset at the upper right corner is the index map of Hokkaido. (Geol. Surv. by T. MATSUMOTO)

proteus MATSUMOTO.

Occurrence:—Loc. Ik 1509, mudstone in a small stream running to the right side of the main stream of the River Ikushumbets, immediately above the artificial lake of the Katsura- zawa dam (see Text-fig. 4). In the mudstone and contained calcareous nodules there are *Inoceramus* cf. *mihoensis* MATSUMOTO and *I.* (*Platyceramus*) cf. *yubarensis* NAGAO et MATSUMOTO. Therefore, the host bed is certainly assignable to the Zone of *I. mihoensis*, as in the case of the holotype. It is upper part of the Lower Urakawan [K5a2], approximately Upper Coniacian.

Part II

A New Record of *Barroisiceras* from Hokkaido

T. MATSUMOTO, H. HIRANO
and T. TAKAHASHI

When one of us (MATSUMOTO, 1969) monographed the Barroisiceratinae, no example of *Barroisiceras* in a strict sense was known from Hokkaido and only *B.* (*Basseoceras*) *inornatum* MATSUMOTO was described. On the basis of recent acquisitions, we now can describe a species of

B. (*Barroisiceras*) from our province.

Subfamily Barroisiceratinae BASSE, 1947

Genus *Barroisiceras* DE GROSSOUVRE, 1894

Type-species:—Ammonites haberfellneri HAUER, 1866 (subsequent designation by SOLGER, 1904).

Remarks:—Pending the issue of the revision of *Ammonites haberfellneri* HAUER by KENNEDY and SUMMESBERGER now in preparation, we temporarily follow MATSUMOTO (1969) for the generic diagnosis and the subdivision into the subgenera, *Barroisiceras* and *Basseoceras* COLLIGNON, 1965.

Barroisiceras (*Barroisiceras*) *onilahyense* BASSE

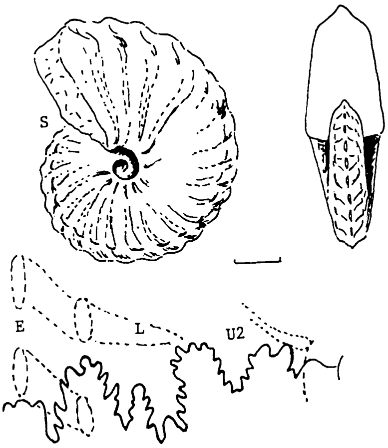
Pl. 8, Figs. 1-3; Text-figs. 5, 6

1907. *Schloenbachia* (*Barroisiceras*) *haberfellneri* et var., BOULE, LEMOINE & THÉVENIN, *Ann. Paléont.*, vol. 2, p. 43-45, pl. 11, figs. 2-4.

1947. *Barroisiceras onilahyense* BASSE, *Ann. Paléont.*, vol. 33, p. 100-109, pls. 1-5; pl. 6, figs. 1-4; pl. 7, fig. 1, 1a; pl. 8, figs. 1, 2; text-figs. 1-3.

1965. *Barroisiceras onilahyense*, COLLIGNON, *Atlas de Fossiles Caractéristiques de Madagascar* (Ammonites), fasc. 13, p. 68, pl. 444, figs. 1815-1817; p. 69, pl. 445, fig. 1819.

Material:—GK. H5733, obtained by H. HIRANO, in a field-work with K. TANABE, from loc. R2638j, now kept at Geological Type Collections of Kyushu University, and T. TAKAHASHI's Collection (TTC. 79-7-1) obtained by Fumio SUZUKI in a field-work with T. TAKAHASHI, from another exposure along the main course of the River Obirashibe, Rumoi district, Hokkaido.



Text-fig. 5. *Barroisiceras onilahyense* BASSE. Diagrammatic sketch of GK. H5733. Right side and frontal views and external suture at S (on left side). Bar: 10 mm. (T. M. *delin.*)

Description:—The two specimens look so dissimilar that the individual characters are described at first.

GK. H5733 (Pl. 8, Fig. 2; Text-fig. 5) has a tight involution (i. e., the growth ratio of the umbilical radius to the spiral is very small), a narrow umbilicus, much compressed whorl, weak and gently flexuous and somewhat prorsiradiate ribs and weak umbilical bullae.

The whorl is broadest at a point slightly outward from the umbilical margin and the flanks are convergent toward the shouldered, roof shaped venter. The ventral keel is serrated and provided with narrow clavae which correspond to the ribs. The long ribs start from low, slightly rursiradiate bullae, which number 7 or 8 per half whorl. At a short distance from the umbilical margin, the ribs are curved forward and then gently prorsiradiate on the main part of the flank, sometimes showing a gentle flexuosity. As a rule, the long ribs are alternated with shorter ribs on the outer part of the flank. The ribs are low and somewhat broad, being separated by narrower interspaces. At the ventrolateral shoulder all the ribs have distinct, somewhat clavate tubercles, from which they run forward toward the ventral clavae, showing chevrons. The ventrolateral tubercles are 13 or 14 per half whorl.

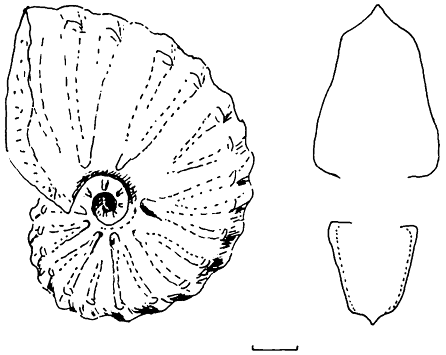
The suture, exposed on the part at whorl-height of about 16 mm, has rather massive saddles, irregularly subdivided lobes and rather shallow minor incisions.

The specimen has the incompletely preserved body-chamber and is only 56 mm in diameter. On the body-chamber the ribs become broader and lower and the umbilical bullae and ventrolateral tubercles are much weakened. Lirae and striae may be discernible on the surface. They run in parallel with the ribs. They show some irregularity at about the ocular sinus on the preserved last part of the left side (Pl. 8, Fig. 3). This is probably an injury.

The other specimen (Pl. 8, Fig. 1; Text-fig. 6) is stouter in shell-form and ornamentation than GK. H5733. It is also fairly involute and narrowly umbilicate, but U/D is 0.14-0.15 as compared with 0.12 of the latter. The umbilical wall is nearly vertical or somewhat overhanging. The whorl is higher than broad, but broader than in GK. H5733, showing B/H =0.77 as compared with 0.53 in the latter. It is broadest a little outside the subrounded or abruptly rounded umbilical shoulder and the flanks are convergent toward the shouldered and keeled venter.

The ribs are moderately coarse and strong. Strong umbilical tubercles are only 3 or 4 per half whorl. Some of the ribs arise from those umbilical tubercles but others start from near the umbilical margin without tubercles or from a weak bulla. The ribs are normally bifurcated at or near the umbilical margin and occasionally still shorter ones are intercalated on the outer half.

The ribs are gently flexuous on the flank of the outer whorl and projected forward on the venter, forming chevrons. The ribs are gradually broadened outward. The clavate tubercles at the ventrolateral shoulder and on the ventral keel are moderately strong. They number 12-13 per half whorl.



Text-fig. 6. *Barroisiceras onilahyense* BASSE. Diagrammatic sketch of TTC. 79-7-1. Lateral view and cross-section. Bar: 10 mm. (T.M. *delin.*)

This specimen also has the incompletely preserved body-chamber. The ornament tends to be somewhat weakened on the body-chamber, if not so remarkably weakened as in GK. H5733. Lirae and striae are in places discernible on the ribs and the interspaces in parallel with the ribs. Again, there is a slight injury at about the last portion of the phragmocone on the middle of the left flank. This is soon recovered on the body-chamber.

Measurements (in mm) of *Barroisiceras* (*Barroisiceras*) *onilahyense*:—

		Diameter	Umbilicus	Height	Breadth	B/H
GK. H5733	(last)	55.6(1)	6.7(.12)	29.8(.54)	—	—
〃	(−90°)	45.0(1)	5.2(.12)	24.4(.54)	13.0(.29)	0.53
TTC. 79-7-1	(last)	69.0(1)	10.0(.14)	38.0(.55)	28.6+α	0.75+α
〃	(−30°)	59.0(1)	9.2(.15)	32.4(.55)	25.0(.42)	0.77

Comparison:—The two specimens look so dissimilar to each other that they might be regarded as representing distinct species. However, in view of the great variability of *B. onilahyense* demonstrated by BASSE (1947) on the material from Madagascar, careful comparison is required. In fact, GK. H5733 is fairly similar to certain very involute, much compressed and weakly ornamented examples from Madagascar (e.g., BASSE, 1947, pl. 5, figs. 3, 3a; pl. 3, fig. 3, 3a). Although the umbilical tubercles of GK. H5733 are weaker than those of BASSE's pl. 5, fig. 3, those of BASSE's pl. 3, fig. 3 are as weak as ours. Therefore, GK. H5733 can well be regarded as an extreme variant along the same line.

On the other hand, TTC. 79-7-1 closely resembles another example from Madagascar (i.e., BASSE, 1947, pl. 2, fig. 6). Although the former is somewhat less compressed than the latter, there are examples from Madagascar (e.g., BASSE, 1947, pl. 2, figs. 4, 4a; 5, 5a; 1, 1a) whose whorls are as broad as or somewhat broader than ours.

There could be a possibility of subspecific separation between Madagascar and Japan, seeing that some of the ribs in our two examples are slightly more flexuous than those in many Madagascar examples. To examine this possibility we need more specimens from our province. At the moment this is left undecided and we regard the two specimens at our disposal as being within the extent of variation of *B. onilahyense*.

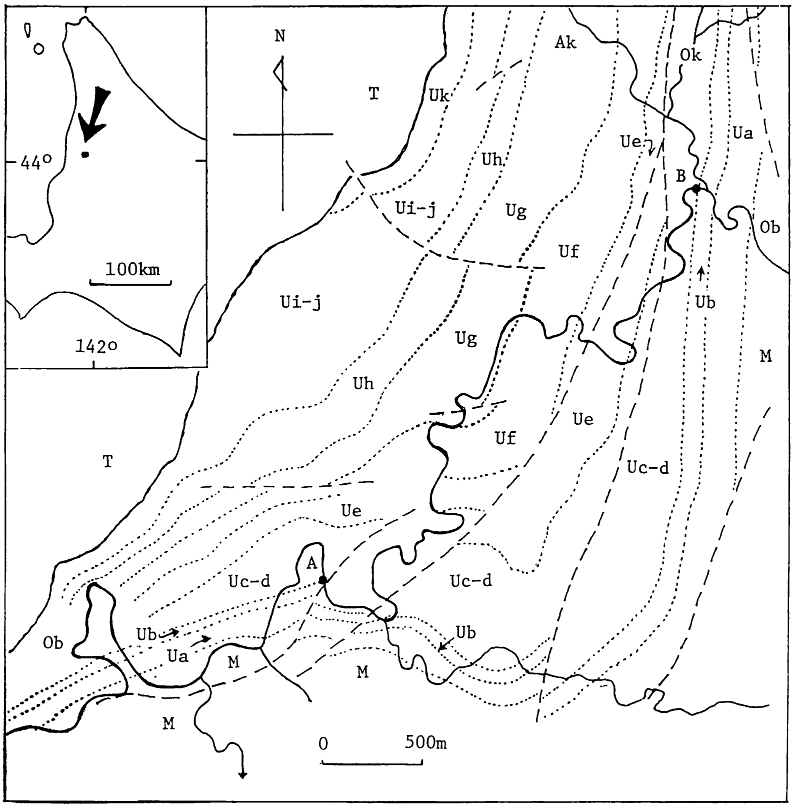
In addition to Madagascar, *B. onilahyense* has recently been reported from the Coniacian of the Middle East (LEWY and RAAB, 1978), although it is only listed without detailed description.

Occurrence:—GK. H5733, from a nodule contained in the sandy siltstone of loc. R2638 j, exposed on the left bank of the River Obirashibe (point A in Text-fig. 7). This siltstone is assignable either to the upper part of Unit Ub or to the lower part of Unit Uc in the TANAKA's (1963) lithostratigraphic subdivision. From the same bed *Damesites damesi* (JIMBO), *Gaudryceras denseplicatum* (JIMBO), *Otoscaphites* (*Hyposcaphites*) *matsumotoi* TANABE, *Inoceramus uwajimensis* YEHARA, *Didymotis akamatsui* (YEHARA), etc. have been obtained.

TTC. 79-7-1 was in a calcareous nodule contained in a bed of siltstone exposed on the floor of the main stream of River Obirashibe at a point (indicated as B in Text-fig. 7), 8 m upstream from the bridge, about 150 m downstream from the confluence with the tributary Okufutamatagawa. This siltstone is probably assigned to the lower part of Unit Uc, close to the Uc-Ub boundary. From the same nodule, *Inoceramus* cf. *uwajimensis* was obtained.

In short, the two specimens came from the middle part of the Lower Urakawan [K5a] of the Obira area.

In Madagascar *B. onilahyense* is characteristic of the "Middle Coniacian" (COLLIGNON, 1965).



Text-fig. 7. Geological map of the Obira area (part) (adapted from TANAKA, 1963 and TANABE et al., 1977). Ak: Akano-sawa, Ob: main stream of the Obirashibe, Ok: Okufutamata-gawa, M: Middle Yezo Group, Ua-Uk: subdivided units of Upper Yezo Group, T: Tertiary. ● (A, B): locality of *Barroisiceras onilahyense*, thick broken line: fault. Inset at the upper left corner is the index map of Hokkaido.

Appendix

Notes on the Coniacian Biostratigraphy

Tatsuro MATSUMOTO

The nomenclatural type locality of the Coniacian stage is at Cognac in the northern part of the Aquitaine basin of southwestern France. The stage was proposed and defined by COQUAND (1856, 1857) as the lowest unit of the quadripartite Senonian in this area. He subdivided the Coniacian of this area into two parts, A (lower) and B (upper). Subsequently ARNAUD (1877) described the stratigraphy comprehensively, but essentially kept COQUAND's idea.

For a long time the type Coniacian had been little studied, until SÉRONIE-VIVIEN (1960, 1972) restudied it. According to SÉRONIE-VIVIEN, the type Coniacian is made up of glauconitic sandstone (6 m) in the lower part (i. e. A of COQUAND) and sandy limestone (8 m) in the upper part (i. e. B of COQUAND). The former lies unconformably on the Turonian *Hippurites* limestone. Recently VAN HINTE (1979) has stated that the fossil contents and the sections in the type Coniacian are fully satisfactory for a definition of the stage and that they deserve standard for inter-regional correlation. This statement may be adequate for the microfossils, but the lower unit (A) at Cognac has no fossils of correlative value and the mega-fossil fauna from the upper unit (B) has few species which are useful for inter-regional correlation. Moreover, there is some difficulty as to *Micraster coranguinum* (KLEIN), which otherwise may be a valuable index species of a certain level (see LEWY, 1975, p. 22; RAWSON et al., 1978, p. 25).

The subdivison of the Coniacian stage into the lower Zone A, i. e., "Zone of *Barroisiceras haberfellneri*" and the upper Zone B, i. e. "Zone of *Paratexanites emscheris*" was proposed by GROSSOUVRE (1894, 1901) on the basis of the ammonites from "Craie de Villedieur (Touraine)" on the southwestern side of the Paris basin. This place is about 230 km distant from Cognac, but the sequence represents the lower part of D'ORBIGNY'S Senonian in a general sense. The scheme of ammonite zonation by GROSSOUVRE for the Senonian were cited frequently by many subsequent authors up to RAWSON et al., (1978) and the sequence of Craie de Villedieur has become practically a standard reference section of the Coniacian for mega-fossil biostratigraphy.

It should be pointed out that the names of the above two zones are misleading, if not entirely incorrect. The reasons are as follows: (1) The ammonites which GROSSOUVRE (1894) called *B. haberfellneri* are mostly other species, such as *Forresteria* (*Reesideoceras*) *galica* (BASSE), *Harleites harlei* (GROSSOUVRE) etc., as pointed out by BASSE (1947) and other authors. (2) The exact stratigraphic position of the holotype of *B. haberfellneri* (HAUER) in the Gosau basin (the East Alps) is not clear (H. SUMMESBERGER in lit., 1980-2-15). (3) GROSSOUVRE (1894, p. 69) regarded *Ammonites emscheris* SCHLÜTER, 1867 as a synonym of *Ammonites serratomarginatus* REDTENBACHER, 1873, although I do not agree with his conclusion (MATSUMOTO, 1970, p. 262). (4) The original locality (Glanegg) of *A. serratomarginatus*, which species is now referred to *Paratexanites* (*Parabevahites*), is not in a sequence and isolated from the other Gosau localities (SUMMESBERGER in lit. 1980-2-15), although the species is of Coniacian age from the evidence of associated ammonites and its occurrence in other regions. (5) The stratigraphic range of *P.* (*Parabevahites*) *emscheris* in Germany is not very clear, although it is presumed to be Middle to Upper Coniacian (E. SEIBERTZ *in lit.*, 1980-4-16).

If I were admitted to select other species from the assemblages of the GROSSOUVRE'S zones, I would propose to call as follows:

Zone of *Protexanites bourgeoisi* (upper)
Zone of *Peroniceras subtricarinatum* (lower)

As to the Coniacian in the British Isles, RAWSON et al. (1978) have given adequate remarks. Ammonites are very few there and inoceramid species are preliminarily allocated stratigraphically (KAUFFMAN, 1978).

The Coniacian equivalent in Germany is defined and subdivided clearly by several species of *Inoceramus*, although the lower part of the Coniacian had long been erroneously called "Oberturon", until SEIBERTZ (1979a) gave correction. According to SEITZ (1959), TRÖGER and HALLER (1966), SEIBERTZ (1979b also *in lit.* 1980-4-16) and TRÖGER (oral comm. at Dresden 1980, through S. KELLER *in lit.*, 1980-4-25), the following zones are recognized:

Above: Zone of *I.* (*Platyceramus*) *undulatoplicatus* (Lower Santonian)

(3) Zone of *Gonioteuthis praewestfalica*
(2b) Z. of *I.* (*Volviceramus*) *involutus*
(2a) Z. of *I.* (*Volviceramus*) *koeneni*
(1) Zone of *I. schloenbachi*
Below: Z. of *Mytiloides striatoconcentricus* (Upper Turonian)

The subdivisions (1), (2a+2b) and (3) are called the Lower, Middle and Upper Coniacian in the revised German scheme. Besides the zonal indices, *I.* (*Magadiceramus*) *subquadratus* SCHLÜTER occurs in the Zone of *G. praewestfalica*, though less abundantly. *I.* (*I.*) *kleini* MÜLLER and *I.* (*Platyceramus*) *mantelli* MERCEY (BARROIS) occur along with *I.* (*V.*) *koeneni* MÜLLER and *I.* (*V.*) *involutus* SOWERBY may range slightly upward. The true ranges of ammonite species in terms of the above zones are not exactly determined, because ammonites are mostly of older collections. According to WIEDMANN (1979) and SEIBERTZ (1979 and *in lit.*, 1980-4-16), *Peroniceas subtricarinatum* and *P. westphalicum* (VON STROMBECK) seem to occur in the Lower to Middle Coniacian, whereas *Gauthiericeras margae* (SCHLÜTER), *Paratexanites* (*Parabevahites*) *emscheris* (SCHLÜTER) and *P.* (*Paratexanites*) *pseudotexanus* (ANDERT) seem to occur in the Middle and/or Upper Coniacian.

Incidentally, *I. schloenbachi* BÖHM, 1912 could either be synonym of *I. deformis* MEEK, 1876 (see SEITZ, 1959) or a later descendant of the latter (SEIBERTZ, 1979b). *I. rotundatus* FIEGE seems to be the earliest form of the same lineage. The last form is at or near the Turonian-Coniacian boundary and its age may be said as either the basal Coniacian or top of the Turonian or the transition of Turonian-Coniacian, depending on the definition of the stage boundary. For the definition of the stage boundary the sequence in the type Cognac area lacks sufficient evidence, because there is an unconformity and because the basal sandstone is poor in fossil contents. The succession of inoceramid species in the Senonian of France does not seem to have been well correlated with that of Germany.

Turning to the North American Interior province, the succession of inoceramid species is well studied (but not yet fully described) by KAUFFMAN (in KAUFFMAN et al., 1978) and can be approximately correlated with that of Germany. To cite from him, with some simplification, the zones in the Coniacian are as follows:

Upper Coniacian: Zone of *Scaphites ventricosus*
(7) Zone of *I.* (*Magadiceramus*) *subquadratus* (with *I.* (*V.*) *involutus* in the upper part of its range)
Middle Coniacian: Zone of *Scaphites preventricosus*, upper half
(6) Zone of *"I." wandereri* (with *I.* (*V.*) *koeneni* in the middle part of its range)
(5) Zone of *"I." schloenbachi* (with *I.* (*V.*) *koeneni* and *I.* (*V.*) *involutus* in the early part of their ranges)
(4) Zone of *"I." browni* CRAGIN
Lower Coniacian: Zone of *Scaphites preventricosus*, lower half
(3) Zone of *"I." deformis* (which can be subdivided into two subzones by subspecies)
(2) Zone of *"I." erectus* (which again can be subdivided into two subzones by subspecies)
(1) Zone of *"I." rotundatus*

KAUFFMAN et al. (1978, p. 15) discussed at length about the Turonian-Coniacian boundary. Their opinion is acceptable in principle.

The ammonite zones of the Coniacian through Maastrichtian in the Interior province of North America are indeed very fine, but the zonal indices are mostly endemic species, with occasional intermingling of more widespread species. The top of the Turonian in this province may be defined by the extinction of *Prionocyclus* and the base of the Coniacian by the first appearance of the genera of Barroisiceratinae. KAUFFMAN et al. (1978) record the lowest occurrence of *Forresteria* sp. in the Zone of *"I." rotundatus*, although without palaeontological description and illustration.

In the Gulf Coast province, ammonites of wider geographical distribution occur more commonly. According to YOUNG (1963) the equivalent of the Coniacian in Texas is biostratigraphically subdivided as follows:

(3) Zone of *Prionocycloceras gabrielense*
(2) Zone of *Peroniceras westphalicum*
(1) Zone of *Peroniceras haasi*

Peroniceras haasi YOUNG resembles *P. platycostatum* VAN HOEPEN from South Africa. As has been discussed in the main text of this paper "*Peroniceras westphalicum*" from Texas is better transferred to *P. stefaninii*. In the second zone *Peroniceras moureti* GROSSOUVRE occurs and in the third zone *Protexanites planatus* (LASSWITZ), *Paratexanites sellardsi* YOUNG and *Prionocycloceras hazzardi* YOUNG are associated. YOUNG correlated the first and the second zones to the Lower Coniacian and the third to the Upper Coniacian of GROSSOUVRE.

Tripartite biostratigraphic subdivision is proposed by COLLIGNON (1965) for the Coniacian of Madagascar as follows:

Upper: Zone of *Prionocycloceras guyabanum—Gauthiericeras margae*
Middle: Zone of *Kossmaticeras theobaldianum—Barroisiceras onilahyense*
Lower: Zone of *Peroniceas dravidicum*

The Coniacian ammonite fauna of Madagascar contains many species which are identical or closely allied to those from Japan.

The biostratigraphic records for the Coniacian of Natal and Zululand (South Africa) have been described by KENNEDY and KLINGER (1975) and KENNEDY (1978). The sequences seem to yield some species which are identical or allied to those from the Japanese province. I omit, however, to review them here, because their palaeontological monographs have not yet been completed.

In the epicontinental shallow sea of the Tethys realm the Coniacian is finely subdivided by ammonites but the predominant faunal elements are different from those of the north temperate region. An example in the west is the zonation in northern Spain by WIEDMANN (1960, 1979; also in WIEDMANN and KAUFFMAN, 1978):

(5) Zone of *Hemitissotia lenticeratiformis* WIEDMANN
(4) Zone of *Hemitissotia turzoi* KARRENBERG
(3) Zone of *Gauthiericeras valleri* CIRY
(2) Zone of *Reymentoceras hispanicum* WIEDMANN
(1) Zone of *Tissotioides haplophyllus* (REDTENBACHER)

The first three zones were grouped into the Lower Coniacian and the rest into the Upper Coniacian in WIEDMANN's earlier paper but later the third zone was assigned to the Middle Coniacian.

Tissotia (*Metatissotia*) *ewaldi* (BUCH) occurs in the first zone, *Barroisiceras* spp. in the second, *Protexanites bourgeoisi* (D'ORBIGNY) in the second and the third, and *Paratexanites* (*Parabevahites*) *emscheris* in the fourth (WIEDMAMM, 1979).

Another example in the central Tethys is the zonal succession of ammonites in the Middle East reported by LEWY and RAAB (1978) as follows:

(5) *Tissotia* (*Metatissotia*) *ewaldi—T.* (*M.*) *fourneli* (BAYLE)
(4) *Heterotissotia neoceratites* PERON-

Buchiceras bilobatum HYATT

(3) *Allotissotia galeppei* (PERVINQUIÈRE) —*Barroisiceras onilahyense* BASSE

(2) *Plesiotissotia sinaitica* LEWY—*Roemeroceras parnesi* LEWY

(1) *Placenticeras tamulicum* (BLANFORD) —*Proplacenticeras eboroense* COLLIGNON

The authors grouped units (1)-(3) into the Lower Coniacian and units (4) and (5) into the Upper Coniacian, without using the Middle Coniacian. I am rather surprised to see the great difference in the stratigraphic occurrence of *T.* (*M.*) *ewaldi* between Spain and the Middle-East.

Now in Japan what we call the Lower Urakawan is the approximate equivalent of the Coniacian. It is biostratigraphically bipartite on the basis of several well studied sections in Hokkaido, Futaba area of Northeast Japan, Onogawa basin of Kyushu and Uwajima area of Shikoku. They are called

(2) Zone of *Inoceramus mihoensis*

(1) Zone of *Inoceramus uwajimensis*

In some sections, such as those in the Ikushumbets, Futaba and Onogawa areas, the two species are stratigraphically clearly separated, with *I. uwajimensis* YEHARA below and *I. mihoensis* MATSUMOTO above, as in the Naibuchi district of South Saghalien (where the type locality of *I. mihoensis* is situated). In some other sections, as in the Obira area of Hokkaido, the ranges of the two species are overlapping, with later appearance of *I. mihoensis*.

It should be noted that *I. uwajimensis* is similar to *I. kleini* and *I. stantoni* SOKOLOW (=*I. acuteplicatus* STANTON) and that *I. mihoensis* is allied to, if not identical with *I. deformis* and *I. erectus*. Consequently, there is discrepancy in the zonal succession of these allied species between Japan and Euramerica.

I. (*Platyceramus*) *yubarensis* NAGAO et MATSUMOTO occurs commonly in the Zone of *I. mihoensis* but appears already in the Zone of *I. uwajimensis*. This species is, in my opinion, allied to *I.* (*P.*) *mantelli*, which occurs in the Middle to Upper Coniacian of Germany. KAUFFMAN (1977, p. 182) holds the view that *I. yubarensis* is a subspecies of *I. walterdorfensis* ANDERT from the highest Turonian and Lower Coniacian of Germany and North America. If this is correct, the age discrepancy is again distinct. I do not, however, agree with KAUFFMAN's taxonomic assignment, because in *I.* (*P.*) *yubarensis* the growth-axis is not so oblique as in *I. walterdorfensis* but upright in the late growth-stage and the hinge-line is shorter.

Likewise, an ancestral form (species or subspecies) of *I.* (*Cordiceramus*) *cordiformis* SOWERBY (s.l.), with shallower sulcae than in the typical form, occurs fairly commonly in the Zone of *I. mihoensis* and is occasionally found together with *I. uwajimensis*. The typical representatives of *I.* (*C.*) *cordiformis* occurs in the Santonian of Japan as in Euramerica. Dr. NODA has coworked with me for this preliminary knowledge of the *cordiformis* group and will eventually give full descriptions of these forms from Japan. *Sphenoceramus yokoyamai* (NAGAO et MATSUMOTO) begins to appear in the Coniacian.

Among long-ranging ammonites, *Anagaudryceras limatum* (YABE) marks the later half of its range in the Coniacian and *Gaudryceras tenuiliratum* YABE begins to appear in the same stage. *Baculites yokoyamai* TOKUNAGA et SHIMIZU are common in the Coniacian of Japan, but *B.* cf. *yokoyamai* is reported from the Turonian of North America (COBBAN and SCOTT, 1972). *B. schencki* MATSUMOTO, whose original locality is in the Coniacian of California, occurs also in Japan, though less frequently (MATSUMOTO and OBATA, 1963). TANABE (1977) has recently made clear that the scaphitid species of the Coniacian of Japan are distinct from those of the Turonian. The Coniacian group is represented by *Scaphites pseudoaequalis* YABE, *S. formosus* YABE, *Otoscaphites klamathensis* (ANDERSON), *O.* (*Hyposcaphites*) *matsumotoi* TANABE and *Clioscaphites* (?) sp. The last species looks similar to *S. arnaudiformis* COLLIGNON from the Middle Coniacian of Madagascar (COLLIGNON, 1965), whereas the first species (*S. pseudoaequalis*) is reported from the Upper Turonian Chalk Rock of England (WRIGHT, 1979).

An aberrant ammonite species *Nipponites bacchus* MATSUMOTO et MURAMOTO ranges from the Upper Turonian to the lower part of the Coniacian (see MATSUMOTO and MURAMOTO, 1967). I have not yet confirmed an unmistakable example of *Eubostrychoceras indicum* (STOLICZKA) in Japan, but *E. indopacificum* MATSUMOTO is fairly common in the Coniacian of Japan, southern India and Madagascar (see MATSUMOTO, 1967, p. 333). Another species, *E. muramotoi* MATSUMOTO is allied to *E. saxonicum* (SCHLÜTER) from the English Chalk Rock but occurs in the Zone of *I. uwajimensis.*

Yezoceras nodosum MATSUMOTO and *Y. miotuberculatum* MATSUMOTO, among other nostoceratids, occurs in the Zone of *I. uwajimensis* and range somewhat upwards within the Coniacian (see MATSUMOTO, 1977).

Another species which characterizes the Coniacian of southern India and Madagascar is *Kossmaticeras theobaldianum* (STOLICZKA), which occurs also in the Zone of *I. uwajimensis.* There are some other species of *Kossmaticeras* (see MATSUMOTO, 1955, 54). Several species of *Yokoyamaoceras,* bituberculate microforms, range from the Upper Turonian to Coniacian or even to Lower Santonian. Similarly *Mesopuzosia yubarensis* (JIMBO) ranges from the Turonian to the Coniacian. More long-ranging species *Gaudryceras denseplicatum* (JIMBO), *Tetragonites glabrus* (JIMBO), *Hypophylloceras* (*Neophylloceras*) *subramosum* (SPATH) occur commonly in the Coniacian of Japan.

Among species of less frequent or rare occurrence, there are following species which are useful for inter-regional correlation. In the list (1) means the Zone of *I. uwajimensis* and (2) that of *I. mihoensis;* allied species are also indicated.

Lewesiceras kawashitai MATSUMOTO (1 or 2) (allied to *L. elmii* COLLIGNON, from the Middle Coniacian of Madagascar)
Nowakites mikasaensis MATSUMOTO (1) (allied to *N. tallavignesi* (D'ORBIGNY) from the Coniacian of France)
Prionocycloceras wrighti MATSUMOTO (1) (allied to *P. guayabanum* (STEINMANN), from the Coniacian of Colombia and Venezuela)
Prionocycloceras sigmoidale MATSUMOTO (1) (allied to *P. maarfiaense* SORNAY, from the Coniacian of Algeria)
Prionocycloceras sp. aff. *P. lenti* (GERHARDT) (1) (Coniacian of Venezuela)
Niceforoceras japonicum(?) MATSUMOTO

Explanation of Plate 6

Fig. 1. *Peroniceras latum* MATSUMOTO et MURAMOTO, sp. nov. .... Page 52
Holotype, lateral view, ×1/3.
Fig. 2. *Peroniceras yubarense* MATSUMOTO et MURAMOTO, sp. nov. .... Page 55
Holotype, lateral view, ×1/2.
Kyushu Univ. (K. TANABE) photos, without whitening.

1

2

(2 ?)

Peroniceras latum sp. nov. (2) (allied to *P. stefaninii* VENZO, from the Lower Coniacian of South Africa and Texas)

Peroniceras yubarense sp. nov. (1 or 2) (allied to *P. besairiei* VAN HOEPEN from the Lower Coniacian of South Africa)

Peroniceras sp. aff. *P. platycostatum* VAN HOEPEN (1 or 2) (Coniacian of South Africa)

Sornayceras proteus MATSUMOTO (2)

Sornayceras omorii MATSUMOTO (2) (allied to *S. bajuvaricum* (REDTENBACHER), from the Gosau beds and *S.* aff. *isamberti* (FALLOT) from the Lower Coniacian of France)

Sornayceras cf. *propoetidum* (REDTENBACHER) (2 ?) (Coniacian of the East Alps)

Ishikariceras binodosum MATSUMOTO (1) (allied to *I. schneeblii* (BOULE, LEMOINE et THÉVENIN) from the Coniacian of Madagascar)

Paratexanites (*Paratexanites*) *orientalis* (YABE) (2) (allied to *P.* (*P.*) *zeilleri* (GROSSOUVRE), from the Lower Coniacian of France and *P.* (*P.*) *umkwelanensis* (CRICK) from the Senonian of South Africa)

Paratexanites (*Paratexanites*) *mikasaensis* MATSUMOTO (2 ?) (allied to *P.* (*P.*) *canaensis* (GERHARDT), from the Lower Senonian of Venezuela)

Paratexanites (*Parabevahites*) *serratomarginatus* (REDTENBACHER) (1)

Pseudobarroisiceras nagaoi SHIMIZU (1)

Barroisiceras onilahyense BASSE (upper part of 1) (Middle Coniacian of Madagascar)

Barroisiceras (*Baseoceras*) *inornatum* MATSUMOTO (1) (allied to *B.* (*B.*) *colcanapi* COLLIGNON from the Upper Coniacian of Madagascar.)

Forresteria (*Forresteria*) *alluaudi* BOULE, LEMOINE et THÉVENIN) (1) (Middle Coniacian of Madagascar; Coniacian of South Africa, Peru, Utah)

Forresteria (*Forresteria*) *armata* MATSUMOTO (1)

Forresteria (*Muramotoa*) *yezoensis* MATSUMOTO (1) (allied to *F.* (*M.*) *ampozaloakensis* (BASSE), from the Coniacian of Madagascar)

Forresteria (*Muramotoa*) *muramotoi* MATSUMOTO (1)

Yabeiceras orientale TOKUNAGA et SHIMIZU (1) (allied to *Y. bituberculatum* COLLIGNON, from the Middle Coniacian of Madagscar)

Harleites cf. *harlei* (GROSSOUVRE) (1)

Hourquia hataii HASHIMOTO (1 and 2)

(Readers may refer to MATSUMOTO, 1965a, 1965b, 1969, 1970a, 1971, 1979 and HASHIMOTO, 1973 for the descriptions of the species listed above.)

As is clearly shown in the above list, some species occur in Japan in an unit which corresponds approximately to that of the extra-Japanese province(s) where the same or allied species occur, whereas others show disharmony in stratigraphic occurrences. Therefore, the zone by zone correlation is fairly difficult between Japan and other remote provinces. It may be generally concluded from the comprehensive viewpoint that the Zone of *I. uwajimensis* is approximately correlated with the Lower and Middle Coniacian of Madagascar and the Zone of *I. mihoensis* is so with the Upper Coniacian of the same area. Anyhow, the Lower Urakawan of Japan is certainly correlated with the Coniacian stage of Europe and other well studied areas by means of diagnostic species. Therefore, we can use the stage name Coniacian in the Japanese province.

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Explanation of Plate 7

Fig. 1. *Peroniceras latum* MATSUMOTO et MURAMOTO, sp. nov. .... Page 52
Holotype, ventral view, ×3/8.

Fig. 2. *Peroniceras yubarense* MATSUMOTO et MURAMOTO, sp. nov. .... Page 55
Holotype, ventral view, ×1/2.

Fig. 3. *Sornayceras* sp. cf. *S. proteus* MATSUMOTO .... Page 57
Muramoto Coll., from loc. Ik 1509, lateral view, ×1/4.

Kyushu Univ. (K. TANABE) (1, 2) and Mikasa Museum (3) photos, without whitening.

1

2

3

chapt. 18, p. 1-29.

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Akano-sawa 赤ノ沢，Futaba 双葉，Ikushumbets [=Ikushunbetsu] 幾春別，Inari-zawa 稲荷沢，Katsura-zawa 桂沢，Mikasa 三笠，Obira 小平，Obirashibe 小平蘂，Okufutamata-gawa 奥二股川，Onogawa 大野川，Rumoi 留萌，Samata-zawa 左俣沢，Shiyubari シユーバリ [主夕張]，Uwajima 宇和島

Explanation of Plate 8

Figs. 1-3. *Barroisiceras onilahyense* Basse ....Page 60

1. TTC. 79-7-1 (hypotype), two lateral (a, b), ventral (c) and frontal (d) view, ×1.
2. GK. H5733 (hypotype), right lateral (a), frontal (b) and ventral (c) view, ×1.
3. *Ditto*, part of left side, showing an injury, enlarged (×2.8).
4. *Inoceramus* cf. *uwajimensis* Yehara, which occurred with TTC. 79-7-1. Waseda Univ. (H. Hirano) photos, without whitening.


1a


1b


1c


2a


2b


2c


1d


4


3

北海道から産したコニアシアン期アンモナイトの若干：北海道白亜系産のアンモナイトでコニアシアンを特徴づける主要種は，すでに Collignoniceratidae 科のモノグラフ（MATSUMOTO, 1965-1971）中に記載したが，ここに補足として4種を記載した。その中の2種は新種で，それぞれ *Peroniceras stefaninii* VENZO と *P. besairiei* VAN HOEPEN に類似する。第3は *Sornayceras* cf. *proteus* MATSUMOTO で，これも前2種と同様大型である。第4は *Barroisiceras onilahyense* BASSE で，原産地マダガスカルで究められた変異の範囲に入る。これらの産地と層位についての調査結果も併記した。

松本達郎・村本喜久雄・平野弘道・高橋武美

付録として西欧その他のよく調べられている海外のコニアシアンの代表地域について，その化石層序（メガ化石）の現在の知識を紹介しながら論評し，日本におけるコニアシアン相当層の化石帯区分と国際対比の問題について論述した。

松本達郎

Postscript: After the manuscript of this paper was received by the editor, Dr. H. G. KLINGER (from Tübingen) sent me a photograph of SCHLÜTER's *Ammonites westphalicus* in lateral view, which shows that SCHLÜTER's description cited in p. 54 of this paper is correct. Dr. KLINGER was unable to trace VON STROMBECK's original material. I thank Dr. KLINGER for his kind help.

PROCEEDINGS OF THE PALAEONTOLOGICAL SOCIETY OF JAPAN

学会記事

○1980年11月に行なわれた評議員選挙の結果，次の諸君が当選した（敬称略 ABC 順）。浅間一男，鎮西清高，浜田隆士，花井哲郎，長谷川善和，速水格，猪郷久義，糸魚川淳二，亀井節夫，松本達郎，小畠郁生，斎藤常正，首藤次男，高柳洋吉，棚井敏雅。なお，松本達郎君が名誉会員に推され評議員を辞退したことに伴なって，同君の代りに次点の木村達明君が当選となり，1981・82年度の本会評議員会は上記の15名で構成されることとなった。

○1981年1月22日に東北大学で行われた新評議員会で選挙の結果，会長に花井哲郎（再選），常務委員として，庶務委員に鎮西清高，外国庶務委員に猪郷久義，会計委員に浅間一男，編集委員に小畠郁生・速水格，行事委員に木村達明，会員委員に浜田隆士，特別号編集委員に首藤次男，“化石”編集委員に高柳洋吉の各君が選出された。また庶務幹事として山口寿之，会計幹事に植村和彦，編集幹事に上野輝弥・小沢智生，行事幹事に猪郷久治，特別号幹事に柳田寿一，藤山家徳，“化石”幹事に石崎国熙の諸君がきまった。

○同評議員会で賞の委員の半数改選を行い，高柳洋吉・木村達明の両君にきまった。1981年度賞の委員会は会長のほか上記2名および小畠郁生，斎藤常正の5名で構成される。

○1981・82年度の会計監査を，栗原謙二君に依嘱した。

○同日行なわれた1980年度定例評議員会において，古生物学の分野で多大の功績があり本会の発展につくされた松本達郎，鳥山隆三，尾崎博の3君を本会名誉会員に推戴したいという決議がなされ，同1月23日の総会において承認された。

○同評議員会において，次の諸君の入退会，および特別会員への推薦が認められた（敬称略）。

〔入会〕H. Rieber，竹山憲市，宮本隆実，永広昌之，木下善行，Carlos Avecilla-G.，榎本朋男，守屋成博，久間裕子，古谷裕，李鍾徳，久田健一郎，井上繁廣，進藤哲也，里見和久，高橋理佳子，高橋宏和，西園幸久（18名）

〔退会〕小倉謙，伊藤真，井上武，加藤進（4名）

〔特別会員〕磯見博，植村和彦，北里洋，小林文夫，棚部一成，徳山明，西田民雄，福田芳生，松岡数充，水谷伸治郎，紺田功，秋葉文雄，尾田太良，加藤道雄（14名）

○1980年度中の逝去会員は菊地勘左エ門，片山敏男，石島渉，松下久道，波多江信広，河合正虎，植田房雄（7名）であった。

○1981年1月24日現在の会員数は，名誉会員10，特別会員184，普通会員368，在外会員44，賛助会員10，計616名である。

○1980年10月に行われた関連5学会の協議の結果，昭和56年度の科学研究費配分委員候補として，地質学2段委員：棚井敏雅（本会推薦），層位古生物学1段委員：小畠郁生（本会推薦），沖村雄二，地質学一般1段委員：田口一雄の諸君が推薦されることとなった。なお層位古生物学1段委員として斎藤常正（本会推薦），また地質学一般1段委員として柴崎達雄，光野千春の諸君が留任している。

○1980年度日本古生物学会論文賞は，田代正之君の“A study of the pennatae trigoniids from Japan”（報告・紀事116号）に，1980年度日本古生物学会学術賞は，小泉格君（上部新生界の珪藻化石による生層序学的研究）と野田浩司君（新生代二枚貝化石の系統分類学的研究）にそれぞれ授与された。

○日本古生物学会学会賞（横山賞）を長年にわたり古生物研究に顕著な成果をあげ，本会の会務に献身された松本達郎君に贈呈した。

日本古生物学会1981年年会・総会

日本古生物学会1981年年会・総会が1981年1月23，24日に東北大学理学部で開催された。（参会者128名）

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Mid-Carboniferous ammonoids from the Akiyoshi Limestone Group (Molluscan Paleontology of the Akiyoshi Limestone Group—VI)...........NISHIDA, T. and KYUMA, Y.

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大栃地域楮佐古層の放散虫化石の層位的分布 .. .. 中野啓二・岡村　真・田代正之

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和泉山脈から *Steinmanella* (*Yeharella*) *japonica obsoleta* の産出とその層序学的意義 .... 両角芳郎・田代正之

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中新世フジツボ類 *Balanus sendaicus* HATAI, MASUDA and NODA について ......山口寿之

日本新第三紀の示準化石 *Kewia* について .... 森下 晶

A Miocene Cetothere from the Ashiya Group, Kitakyushu City ......OKAZAKI, Y.

宮古島の琉球石灰岩裂罅堆積物中より産出したヤマネコ化石 ....長谷川善和・大城逸朗

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高水圧下におけるオウムガイの行動と破壊実験 .... 蟹江康光・服部陸男

Function of pellicle, de-coupling space and septal prismatic zone in ammonites: comparison with modern *Nautilus*........ ..OBATA, I., TANABE, K. and FUKUDA, Y.

Adaptive morphology of siphuncular system in Cephalopoda ....TANABE, K., FUKUDA, Y. and OBATA, I .

Ultrastructure of siphuncular epithelium in modern *Nautilus*: its paleobiological implications ....FUKUDA, Y., TANABE, K. and OBATA, I.

チリー上部白亜系層産 *Pacitrigonia* について .... 前田四郎・川辺鉄哉, Carlos RUIS, F. and CORVALAN J.

ボリビア上部白亜系産 *Charophytes* について.. .... 川辺鉄哉・前田四郎・Jose PONCE, V. and Angel ESCOBAR

なお，講演終了後「**古生物学の研究所**」第2回懇談会が行われ，古生物学の研究所計画小委員会が配布した検討資料その他の問題について活発な討議がなされた（世話人：高柳洋吉・速水 格，参会者36名）。

日本古生物学会学会賞贈呈文

松本達郎殿

九州大学名誉教授松本達郎先生は長年にわたり古生物学の研究—特にアンモナイトの系統分類学的研究ならびに白亜紀の地史の研究—に顕著な成果をあげ，国際的に高い水準の研究を行い，わが国の古生物学研究の水準を著しく高めるのに貢献されました。昭和19年に西日本文化賞，昭和35年に朝日文化賞，昭和44年に学士院賞を受賞され，その評価は国内外において充分に定着し，なお活発に研究を続けておられます。その間多くの優れた研究者を養成され，本学会に対しては評議員として32年，会長として4年にわたって会務に献身されました。日本古生物学会は先生の功績をたたえ，ここに学会賞を贈呈して感謝の意を表します。

昭和56年1月23日

日本古生物学会

1980年度日本古生物学会論文賞推薦文

田代正之君：A study of the ”pennatae trigoniids“ from Japan. *Trans. Proc. Palaeont. Soc. Japan* N. S. No. 116, pp. 179-222, pls. 25, 26, 1979.

本論文はいわゆる *Trigonia pennata* グループの白亜紀三角貝の系統分類に関する総括的な研究成果である。日本では1894年に神保小虎氏が *Trigonia subovalis* を記載して以来，北海道中軸部，福島県双葉，兵庫県淡路島，熊本県宇土—天草などの上部白亜系から，このグループに属する多くの化石種の産出が知られ，本邦はこの三角貝類の分類進化を究明する上に最も重要な地域の一つと考えられるようになった。

この論文では，日本産の *Apiotrigonia* 13種・

Heterotrigonia 3種を多数の標本に基づいて正確に記載して種の特徴と識別点を明らかにするとともに，北米・中南米・オーストラリア・トルキスタン・西ヨーロッパなど，世界各地の白亜系から知られている本グループの既知種を広く検討して分類上の位置づけを行っている。すなわち，全体を新亜科 Apiotrigoniinae とし，*Apiotrigonia* 属を2新亜属を含む4亜属，*Heterotrigonia* 属を1新亜属を含む2亜属に分類し，それぞれの属・亜属に対して明確な定義を与え，それらに含まれる種と時空的な分布を明示した。したがって，この論文は国内産の *Apiotrigonia* 類三角貝の同定にはもちろん，外国産の種の分類についても重要な指針を与えるモノグラフである。

本論文の末尾には，これらの資料に基づいて，*Apiotrigonia* と *Heterotrigonia* を2つの並行的なストックとする進化系統が推定されている。一般に開放的な進化の場をもつ海生生物の系統復元は局地的な資料にとどまらず，広く分布域全体の資料調査に基づくことが望まれるようになってきている。この論文で2つのストックにおける表面彫刻の時間的変化の方向性（前中部の共心円肋の退化と亜放射肋の発達）を，世界中の種を対象として結論したのはきわめて妥当であり，説得性をもつものと考えられる。なお，田代君が化石のスケッチに抜群の能力をもつことは衆目の一致するところであるが，その描画力がここできわめて有効に生かされ，論文の価値を一層高めている。

要するに本論文は日本産の良好な資料の持味を生かし，伝統的な化石二枚貝の記載・分類の基本にしたがいつつ，三角貝研究の水準を高めた意欲的な業績と考えられる。よって日本古生物学会は田代正之君に論文賞を贈り，今後の一層の発展を期待する。

1980年度日本古生物学会学術賞推薦文

小泉格君：上部新生界の珪藻化石による生層序学的研究

珪藻のつくる殻の表面にみられる微細構造は，光学顕微鏡が考案された16世紀末から19世紀後半にかけて，鏡の分解能をテストする絶好の対象とされたために，珪藻の研究は19世紀にすでにその最盛期に達した感がある。ところが市井の人々による無秩序な研究にともなって，命名規約に従わない多くの新種が生れ，層準を無視した群集記載は，珪藻種の生層序学的な価値を極端に失わせる結果をまねいた。

そのため，微化石のなかでも，珪藻類は，最も早く研究が始められたにもかかわらず，生層序学的な応用やその進化系統の解明などについては，後に研究が開始された有孔虫やココリスなどに格段の遅れをとることになった。このような中にあって，まず金谷太郎君が1957年カリフォルニアのKellog および Sidney 頁岩層の始新世珪藻群を，分類・層序学的に再検討することにより，珪藻による層序区分の可能性を世界にさきがけて示した。金谷君は，つづいて，男鹿半島女川層に同じ手法を適用した。

小泉君は，1966年青森県鯵ヶ沢地域の第三系の岩相層序区分を試みる過程で，化石珪藻に注目し，北太平洋の V20-130 コアーの解析を，金谷君と共同作業することなどで，しだいに日本列島中新統の珪藻化石による帯区分の樹立を目指すようになった。同君の男鹿半島女川層の珪藻化石群の研究は，金谷君がかつて層序区分を試みた同じ地層を，分布のより広い浮遊性種を重視して帯区分の可能性を検討したものである。1972・1973年には鮮新世竜の口層，1975年の2つの論文では，北太平洋全域の新第三系の浮遊性珪藻種による帯区分を確立するに至った。

最近では小泉君の研究は，日本海盆や，化石に乏しい東北日本から北海道へかけての地層の層序区分にも成功し，さらにこの帯区分と古地磁気層序や放射年代区分との比較も試みている。

新生代後期の地層の，汎世界的に適用できる帯区分を，確かな珪藻種の認識にもとづいて樹立した業績は，学術的に国の内外で高く評価されており，日本古生物学会は学術賞を贈り，同君の今後の研究のいっそうの発展を期待する。

野田浩司君：新生代二枚貝化石の系統分類学的研究

灰爪層産 *Pecten* の地質学的意義（1961）に始まる野田君の新生代軟体動物の研究は，西南日本の化石 *Anadara* の検討（1965）を機にして大きく発展した。

フネガイ科とくにリュウキュウサルボウ亜科の諸属・種は新生界の浅海堆積物から豊富に産出し，かつ，時代指示者として有効なものも少なくないことが知られていた。野田君は日本各地の新生界から産出するフネガイ科化石を現生種と比較しながら，その系統分類と時空分布とを検討した。そのさい，殻に見られるさまざまの形質をきわめて詳細に観察，比較して，分類群の再編成を試み，*Tosaarca*, *Hataiarca*, *Angulararca* ほどを新設した。同時に，フネガイ科諸種の時空分布を整理して，これらの化石によって上部新生界に化石帯を設けうる可能性を示した（1962-1966）。その後，フィリピン，沖縄などで得られた資料を加えたが，この中には新亜属 *Philippinarca* も含まれている。

これらの資料に基づいて東アジア・東南アジアにおける新生代リュウキュウサルボウ亜科の諸種の時空分布についての知識を整理した。そのさい，分布に関して生態的側面を重視し，arcid-potamid fauna の地史的意義を明らかにした。

同君の研究はフネガイ科にとどまらず，他の分類群にも及んでいる。とくにニシキウズ科の日本産 *Turcicula* 属の再検討では，形態発達を重視して系統分類を試み，かつ，種の分布関係を詳しくチェックした。また，日本南部の新生界産翼足類の記載（1972）はこの分野の研究の先鞭をつけるものである。増田孝一郎君に協力して編集した日本の第三紀・第四紀軟体動物の目録及び文献集（1950-1974年）の重要さは申すまでもない。

野田君のこれらの研究は堅実かつ精細な分類手法に基づき，系統分類を行い，進化や時空分布などを解明したものであり，新生代後期の古生物学的研究にきわめて貴重な貢献をしたものである。よって日本古生物学会はここに学術賞を贈り，今後のいっそうの発展を期待するものである。

日本古生物学会会則　(1978, 1, 20 改訂)

第1条　本会は日本古生物学会という。

第2条　本会は古生物学およびこれに関係ある諸学科の進歩および普及を計るのを目的とする。

第3条　本会は第2条の目的を達するため次の事業を行なう。
1. 会誌そのほかの出版物の発行。2. 学術講演会の開催。3. 普及のための採集会・講演会そのほかの開催。4. 研究の援助・奨励および研究業績ならびに会務に対する功労の表彰その他第2条の目的達成に資すること。

第4条　本会の目的を達するため総会の議を経て本会に各種の研究委員会を置くことができる。

第5条　本会は古生物学およびこれに関係ある諸学科に興味を持つ会員で組織する。

第6条　会員を分けて普通会員・特別会員・賛助会員および名誉会員とする。

第7条　普通会員は所定の入会申込書を提出した者につき評議員会の議によって定める。

第8条　特別会員は本会に10年以上会員であり古生物学について業績のあるもので，特別会員5名の推薦のあったものにつき評議員会の議によって定める。

第9条　賛助会員は第2条の目的を賛助する法人で評議員会の推薦による。

第10条　名誉会員は古生物学について顕著な功績のある者につき評議員会が推薦し，総会の決議によって定める。

第11条　会員は第12条に定められた会費を納めなければならない。会員は会誌の配布を受け第3条に規定した事業に参加することができる。

第12条　会費の金額は総会に計って定める。会費は普通会員年4,500円，特別会員年6,000円，賛助会員年1口10,000円以上とする。名誉会員は会費納入の義務がない。在外の会員は年6,000円(または等価のU.S.ドル)とする。

第13条　本会の経費は会費・寄付金・補助金などによる。

第14条　会費を1ケ年以上滞納した者および本会の名誉を汚す行為のあった者は，評議員会の議を経て除名することができる。

第15条　本会の役員は会長1名，評議員15名，および常務委員若干名とする。任期は総て2年とし再選を妨げない。
会長の委嘱により本会に幹事および書記若干名を置くことができる。
常務委員会は評議員会において互選された者で構成される。但し会務上必要とする場合は，特別会員の中から常務委員若干名を評議員会の議を経て加えることができる。

第16条　会長は特別会員の中から評議員会において選出され，本会を代表し会務を管理する。
会長に事故ある場合は会長が臨時代理を委嘱する。

第17条　本会には名誉会長を置くことができる。名誉会長は評議員会が推薦し総会の決議によって定める。名誉会長は評議員会に参加することができる。

第18条　本会は毎年1回定例総会を開く。その議長には会長が当たり本会運営の基本方針を決定する。
総会の議案は評議員が決定する。
会長は必要があると認める時は臨時総会を召集する。総会は会員の十分の一以上の出席をもって成立する。会長は会員の三分の一以上の者から会議の目的たる事項および召集の理由を記載した書面をもって総会召集の請求を受けた場合は臨時総会を召集する。

第19条　総会に出席しない会員は他の出席会員にその議決権の行使を委任することができる。但し，欠席会員の議決権の代行は1人1名に限る。

第20条　総会の議決は多数決により，可否同数の時は議長がこれを決める。

第21条　会長および評議員は評議員会を組織し，総会の決議による基本方針に従い運営要項を審議決定する。

第22条　常務委員は常務委員会を組織し評議員会の決議に基づいて会務を執行する。

第23条　会計監査1名をおく。監査は評議員会において評議員および幹事をのぞく特別会員の中から選出される。任期は2年とし再選を妨げない。

第24条　本会の会計年度は毎年1月1日に始まり12月31日に終る。

第25条　本会会則を変更するには総会に付議し，その出席会員の三分の二以上の同意を得なければならない。

付　則　1) 評議員会の議決は無記名投票による。

日本古生物学会報告・紀事 編集出版規約

（1980年1月 25日）

Ⅰ 出版・編集

ⅠA 発 行

—1 日本古生物学会報告・紀事（以下報告・紀事と略称）は，年4回発行される。

ⅠB 掲 載

—1 報告・紀事には，本会の会則第2条の目的にかなう原著論文，短報および学会紀事，古生物学界ニュース等を掲載する。

—2 投稿された論文は，原則として受理順に掲載される。

ⅠC 配 布

—1 報告・紀事は，本会のすべての会員ならびに評議員会の認める若干の機関に配布され，会員外の者はこれを購読することができる。

ⅠD 編集委員会

—1 報告・紀事の編集は，会の編集出版規約にもとづき，編集委員会がこれを行なう。

—2 編集委員会は，評議員である編集長1名および常務委員会で認められる若干の委員から構成され，編集会議は編集長の召集により開かれる。

—3 編集長は，必要に応じて受付原稿のコピーを編集委員以外の適切な人に示し，その意見を徴することができる。

—4 原稿の採否は，編集会議において編集委員会の責任で決定し，編集長はその結果を常務委員会に報告する。

—5 不採用原稿は，その理由を付して著者に返却する。

—6 編集委員会の決定に不服の著者は，評議員会に対して異議申立を行なうことができる。編集委員会および著者は，評議員会の裁定にしたがう。

ⅠE 校 正

—1 校正は，原則として編集委員会がこれを行なう。ただし，著者は初校について1回限り著者校正をとることができる。このとき正規の原稿は著者に返送されない。

Ⅱ 投 稿

ⅡA 資 格

—1 本会の会員は，報告・紀事に投稿する権利を有する。ただし，常務委員会で認める特例については，非会員でも投稿できる。

—2 投稿論文は欧文（英・仏・独のいずれかが望ましい）で書かれたものとする。

ⅡB 執筆制限

—1 原稿はタイプスクリプトとする。原著論文では，挿図，表などを含めて24印刷頁，および図版3葉を限度とする。ただし，5～8印刷頁の論文は図版2葉を限度とし，4印刷頁以内の論文については，とくに認められた場合を除いて図版を付さない。短報類は1印刷頁以内とし，かつ図版を用いないものとする。

—2 挿図は，1論文につき10図，あるいは印刷延面積で $600\ \mathrm{cm}^2$ を限度とする。ただし，4印刷頁以内の論文では2図，あるいは合計面積 $200\ \mathrm{cm}^2$ までとする。挿図は印刷時に，1つの図の幅が本文の1段幅（6.4 cm）か2段幅（=1頁幅，13.4 cm）のいずれかの大きさに縮小されるので，原図はそれに適した大きさと鮮明さを備えたもので，原稿本文とは別紙に画かれたものとする。

—3 上に示されたそれぞれの執筆制限をこえる場合には，超過分の印刷出版に要する実費を著者自身が負担する。

ⅡC 原稿の体裁

—1 属種名などの学名や特殊な語についての字体の指定は，原稿中に著者自身が行なう。

—2 挿図・表等の挿入希望箇所を，原稿の欄外に指定する。

—3 挿図・表の題および説明，ならびに図版説明等は，本文とは別紙にまとめる。

—4　引用文献は本文の最後の部分にまとめ，著者名の姓のアルファベット順および発表年代順に配列し，原則として下記の要領にしたがう。

著者名，年，論文表題，雑誌名（斜体指定のため下線をほどこす），巻，号，頁数，図版数，その他。

—5　日本など漢字でかく地名を含む論文については，ローマ字表現と漢字とを対照した表を本文の末尾に付すことが望ましい。

—6　著者の現所属機関名とその所在地，あるいはそれらに代わる住所を，タイトル頁の著者名の下に完記する。

—7　短報類以外の論文には，邦題，著者名を含めて800字以内にまとめた邦文要旨を別紙として付ける。（日本語を常用しない著者の論文については，英文要旨を付しておけば，それにもとづいて編集委員会が邦文要旨を作成する。）

ⅡD　著者の責務

—1　著者は，編集上の諸事項に関して可能な限り編集委員会の指示にしたがわなければならない。

—2　原稿の受付後に，著者が大幅改訂を希望する場合は，原稿は返却されるが，改訂した原稿は新規の投稿とみなされる。

—3　投稿に際しては，正規の論文原稿の他に，図，表，図版等を含む完全なコピー1組を付して下記へ送付する。

113　東京都文京区弥生 2—4—16
日本学会事務センター気付
日本古生物学会　編集長

—4　投稿に際しては，別に定める投稿カードに必要事項を記入し，原稿類とは別便で上記事務局宛に送付する。

ⅡE　別刷

—1　別刷は，無表紙120部までを無償で著者（複数の場合は分配）に供与する。それ以上の部数または表紙等に要する費用は，著者自身の負担とし，直接印刷所に支払うものとする。

付則

i)　本規約の発効・改訂・廃止に関しては，評議員会の議を経て，総会の承認を得なければならない。

ii)　本規約の発効により，従来の「日本古生物学会報告・紀事出版規定」は失効する。

◎日本古生物学会報告・紀事投稿案内（1973年1月）の一部訂正。

日本古生物学会賞表彰規則

（昭和55年6月28日）

（総則）

第1条　日本古生物学会会則第2条の目的を達成するため，会則第3条第4項に基づき，本規則第2条に該当する者を表彰し，これに本学会の賞を授与する。

（賞の種類）

第2条　賞は学会賞，学術賞，論文賞の3種とする。

（対象者）

第3条　賞の対象者は本会会員で次の各項に掲げるものとする。

（1）　学会賞（横山又次郎先生を記念し，横山賞とも呼ぶ）長年にわたり古生物学の研究に顕著な成果をあげ，また本会に対し著しく貢献した者。

（2）　学術賞　優れた研究成果をあげ，古生物学の進歩に寄与し，将来の発展が期待される者。

（3）　論文賞　本会報告紀事に優れた研究を発表し，古生物学の発展に寄与した者。

（選考の方法）

第4条　学会賞の受賞候補者は学会賞選考委員会で，また学術賞および論文賞の受賞候補者は賞の委員会で選考する。

（表彰の決定）

第5条　学会賞選考委員会および賞の委員会は，受賞候補者を選定し，評議員会に報告する。評議員会はこれを審議の上受賞者を決定する。

（表彰の方法）

第6条　表彰は賞状およびメダル等の授与とし，総会において受賞理由を公表して贈呈する。

（運営）

第7条　学会賞選考委員会および賞の委員会の組織と運営については，運営内規の定めるところによる。

（規則の改正）

第8条　本規則および内規の改正は評議員会の決議によらなければならない。

化石30号刊行のお知らせ

化石30号が刊行されました。シンポジウム「新第三紀における日本の海洋生物地理――中新世を中心として」に関する原著論文14編をはじめ論壇，回想などが収録されています（定価 2,000 円）。化石は1冊ごとの販売もいたしますが，発行の都度雑誌をお送りし，誌代を後払いしていただく継続予約をおすすめします。申込み・送金先は次の通りです。

〒980 仙台市荒巻字青葉　東北大学理学部　地質学古生物学教室内　化石編集部（振替口座　仙台17141）

日本古生物学会特別号 No. 23

日本古生物学会特別号 No. 23 Kobayashi, T. and Hamada, T.: Carboniferous Trilobites of Japan in Comparison with Asian, Pacific and other Faunas（132ページ，22図版，1980年12月15日発行）が文部省の刊行助成金を受けて出版されました（定価5000円，送料300円）。購入申込は特別号の他の号と同じく日本古生物学会特別号編集委員会（福岡市東区箱崎九州大学部地質学教室内）（送金先：三和銀行福岡支店普通預金口座 12172；振替口座　福岡19014）にお願いします。郵送によらない直接販売は東京大学総合研究資料館（速水格）および国立科学博物館分館（藤山家徳）でも取扱います。

なお，特別号バックナンバーの表題と国内販売価格（および郵送料）は次の通りです。

No. 11 (1966)	Nishiyama, Syozo: The Echinoid Fauna from Japan and Adjacent Regions. Part I.	8,400円	（〒300円）
No. 12 (1966)	Shikama, Tokio: Postcranial Skeletons of Japanese Desmostylia	3,600円	（〒250円）
No. 13 (1968)	Nishiyama, Syozo: The Echinoid Fauna from Japan and Adjacent Regions. Part II.	6,000円	（〒300円）
No. 15 (1971)	Hamada, Takashi: Early Devonian Brachiopods from the Lesser Khingan District of Northeast China	3,000円	（〒200円）
No. 16 (1971)	Kanno, Saburo: Tertiary Molluscan Fauna from the Yakataga District and Adjacent Areas of Southern Alaska.	4,200円	（〒250円）
No. 17 (1973)	Oyama, Katsura: Revision of Matajiro Yokoyama's Type Mollusca from the Tertiary and Quaternary of the Kanto Area.	4,700円	（〒300円）
No. 18 (1974)	Kobayashi, Teiichi and Hamada, Takashi: Silurian Trilobites of Japan in Comparison with Asian, Pacific and other Faunas	3,700円	（〒350円）
No. 19 (1976)	Tashiro, Masayuki: Bivalve Faunas of the Cretaceous Himenoura Group in Kyushu.	3,300円	（〒250円）
No. 20 (1977)	Kobayashi, Teiichi and Hamada, Takashi: Devonian Trilobites of Japan in comparison with Asian, Pacific and other faunas.	5,500円	（〒300円）
No. 21 (1977)	Matsumoto, Tatsuro (org.): Mid-Cretaceous Events—Hokkaido Symposium, 1976.	4,400円	（〒300円）
No. 22 (1978)	Kanmera, Kametoshi and Ujiié, Hiroshi: Bibliography of Palaeontology in Japan, 1961-1975.	5,500円	（〒300円）

編集委員会より

○1980年度に投稿の校閲に尽力された諸兄に感謝します（御氏名は申合わせにより公表いたしません）。

Palaeontologica Society of Japan Special Papers No. 23

Carboniferous Trilobites of Japan in Comparison with Asian, Pacific and other Faunas

By Teiichi KOBAYASHI and Takashi HAMADA

Issued December 15, 1980, vii+132 pp., 22 pls.

Price (postage and handling incl.) ¥6,400 or equivalent US dollars

This is the third monograph in the series of studies on the Japanese trilobites, following "Silurian Trilobites of Japan" (Spec. Papers No. 18, 1974, ¥5,100) and "Devonian Trilobites of Japan" (Spec. Papers No. 20, 1977, ¥6,900) by the same authors.

In the present paper Carboniferous trilobites of Japan are considerably enriched as much as 41 species belonging to 21 genera in the Brachymetopidae and Proetidae. 28 species are new, and *Schizophillipsis* and *Parvidumus* are two new genera.

The Carboniferous trilobites of Japan reveal their intimate relationship to other Eurasian faunas. Their affinities are evidently closer to the Australian trilobites than the North American ones, though a few American genera occur exceptionally in west Japan. In adding some 20 species of China and Southeast Asia to the Japanese species the Oriental trilobites attain more than sixty species which are distributed in about thirty genera including some indigenous ones. As the result of comparative study of the Oriental trilobites the Carboniferous provinciality is clarified to distinguish two realms and five provinces.

This volume as well as two preceding ones would be indispensable for geological and paleontological libraries as well as persons who may have interests in trilobitology and Paleozoic historical geology.

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The following **Back Numbers** of the Special Papers are also on sale at the Society. Orders must be accompanied by remittance made payable to Dr. Tsugio SHUTO, Editor of the Special Papers of the Palaeontological Society of Japan, c/o Department of of Geology, Faculty of Science, Kyushu University, Hakozaki, Fukuoka 812, Japan. Standing orders for future issues, both private and official, are also invited.

Number 11 (Feb. 20, 1966) : The Echinoid Fauna from Japan and Adjacent Regions. Part I.
By Syozo NISHIYAMA .... ¥9, 800 or equivalent US dollars

Number 12 (Sept. 20, 1966) : Postcranial Skeletons of Japanese Desmostylia.
By Tokio SHIKAMA .... ¥5, 000 or ditto

Number 13 (March 16, 1968) : The Echinoid Fauna from Japan and Adjacent Regions.
Part II. By Syozo NISHIYAMA .... ¥7, 400 or ditto

Number 15 (Feb. 25, 1971) : Early Devonian Brachiopods from the Lesser Khingan
District of Northeast China. By Takashi HAMADA .... ¥4, 400 or ditto

Number 16 (Dec. 25, 1971) : Tertiary Molluscan Fauna from the Yakataga District
and Adjacent Areas of Southern Alaska. By Saburo KANNO .... ¥5, 600 or ditto

Number 17 (Nov. 30, 1973; reprinted May 30, 1930) : Revision of Matajiro YOKOYAMA's
Type Mollusca from the Tertiary and Quaternary of the Kanto Area.
By Katsura OYAMA .... ¥6, 100 or ditto

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世界の古生物学者の名簿

国際古生物学協会では，活動の一環として，世界の古生物学者の名簿を作成することになりました。この名簿に登録を希望する方は，以下の質問票をコピーして英語で記入の上，本年中に下記にお送り下さい。

Vivianne Berg-Madsen, Department of Palaeobiology,
Box 564, S-751 22, Uppsala, Sweden

INTERNATIONAL PALAEONTOLOGICAL ASSOCIATION

World Directory of Palaeontologists

QUESTIONNAIRE (complete in typescript or block letters)

Entry name (family or other surname, фамилия, etc.): 姓

____

Individual name (at least one 'first' name in full, имя и отчество полностью, etc.): 名

______________________________ (F/M). Year of birth __________

Address (institution if any, street number or post office box, city, state/country; add 'zip' or other postal code at the appropriate place): 連絡先

____

____

____

Maximum of three specializations on fossil groups, with stratigraphical range and geographical area of interest: 専門分類群 時代 地域

(1) __________ Range: __________ Area: __________

(2) __________ Range: __________ Area: __________

(3) __________ Range: __________ Area: __________

Approaches (taxonomy, ecology, biostratigraphy, etc.): 分野

____

Offices of interest to international palaeontology and related sciences, held in 1981 or at least part of the period 1981–1985: 国際古生物学関係役職

____

____

Example of entry (abbreviation and punctuation system yet to be finally decided):

IVANOVA, ELENA ANDREEVNA (F), 15, Institut geologii i geofiziki SO AN SSSR, SU-630090 NOVOSIBIRSK, USSR; Arthropoda, cam, Siberia; Trilobita, cam, Eurasia; Agnostidea, cam-ord, world. Biostratigraphy, palaeoecology. Chairman, IGCP Project Black Shales, 1980–.

行事予定

	開催地	開催日	講演申込締切
第127回 例会	横浜国立大学	1981年6月21日	1981年4月20日
第128回 例会	広島大学	1981年10月3,4日	1981年8月3日

第128回例会ではシンポジウム「白亜紀非海成層の対比」が予定されている。（世話人：田代正之・松本達郎・木村達明）

講演申込先：〒113 東京都文京区弥生2-4-16 日本学会事務センター 日本古生物学会行事係

お知らせ

今春から常務委員などの役割分担が一部変更になりました。会務の円滑を期するため，1981-82年度の本会関係の連絡先を用務別に記しておきますのでよろしく御協力下さい。

○会費の払込→お送りしている銀行振込用紙で日本学会事務センター

○会費に関する問合せ→会計係：浅間一男・植村和彦（国立科学博物館分館地学研究部）

○本会の常務委員会への連絡一般→庶務係：鎮西清高・山口寿之（東京大学理学部地質学教室）

○住所変更・入退会申込・報告紀事および特別号バックナンバー購入申込→日本学会事務センター内日本古生物学会

○講演申込→日本学会事務センター内日本古生物学会，または行事係：木村達明・猪郷久治（東京学芸大学地学教室）

○報告紀事への投稿→なるべく書留便で日本学会事務センター内日本古生物学会，または編集係：速水格（東京大学総合研究資料館）〔原稿コピーと投稿カードを同封または別送して下さい。〕

○報告紀事編集・出版に関する問合せ・投稿カードの請求→編集委員会：速水格（同上），小沢智生（東京大学理学部地質学教室），小畠郁生・上野輝弥（国立科学博物館分館地学研究部）

○本会所蔵の図書閲覧の問合せ→速水格（同上），小沢智生（同上）〔本誌120号付録の案内・目録を参照して下さい。〕

○特別号に関する問合せ・購入申込→特別号編集委員会：首藤次男・柳田寿一（九州大学理学部地質学教室）（送金先：三和銀行福岡支店普通預金口座 12172；振替 福岡 19014 日本古生物学会特別号編集委員会）〔郵送によらない直接販売は東大総合研究資料館（速水格），国立科学博物館分館（藤山家徳）でも取扱います。〕

○"化石"に関する問合せ・投稿・購入申込→化石編集部：高柳洋吉・石崎国熙（東北大学理学部地質学古生物学教室）（送金先：振替 仙台 17141 化石編集部）〔誌代を送本後にお支払いただく継続予約の申込みをおすすめします。〕

○会員名薄（120号付録）の訂正の申入れ→会員係：浜田隆士（東京大学教養学部宇宙地球科学教室）

○各種の賞に関する問合せ，推薦依頼→賞の委員会幹事：小畠郁生（同上）（81年度のみ）

◎ 文部省科学研究費補助金（研究成果刊行費）による。

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TRANSACTIONS