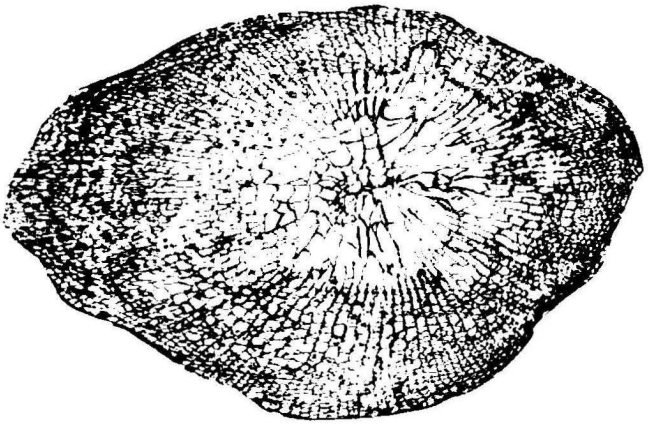
日本古生物学會報告・紀事

Transactions and Proceedings of the Palaeontological Society of Japan

New Series No. 69



日本古生物学会

Palaeontological Society of Japan
April 25th, 1968

CONTENTS

TRANSACTIONS

All Communications relating to this Journal should be addressed to the
PALAEONTOLOGICAL SOCIETY OF JAPAN
Geological Institute, Faculty of Science, University of Tokyo, Japan

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 69, pp. 193–206, pl. 22, April 25, 1968

533. ANADARIDS FROM THE SHIZUKUISHI BASIN, IWATE PREFECTURE, JAPAN*

HIROSHI NODA

Institute of Geology and Paleontology, Faculty of Science,
Tohoku University

and

MOTOHIKO TADA

Department of Mining and Civil Engineering, Faculty of Technology,
Iwate University

岩手県雫石盆地産 Anadarids について：岩手県雫石盆地西部および葛根田川上流に分布する山津田層より採集された *Anadara arasawaensis*, *Anadara iwatensis*, *Anadara makiyamai*, *Anadara ogawai* にもとずき，その層位学的位置づけを行い，従来の層序の検討と山津田層の対比を行なった。同時に従来知られていなかった葛根田川上流に発達する山津田層産の若干の貝化石を報告する。 野田浩司・多田元彦

Introduction

The stratigraphy and structural geology of the Shizukuishi Basin, Iwate Prefecture have been studied by HAYAKAWA (1952), HAYAKAWA *et al.* (1954), HAYAKAWA and KITAMURA (1953) and KITAMURA (1959, 1961). A biostratigraphical study based upon the paleobotany was carried out by MURAI (1957, 1961, 1962a, 1962b, 1963). Fossil fishes have been studied by SATO (1962). However, there is no systematic study on the fossil marine molluscs in spite of the good yield from the basin. There are some sporadic descriptive works on *Dosinia* by MASUDA (1963b) and *Anadara* by NODA (1966), but none of the fauna as a whole. At a glance of the lists of the fossil molluscs published to date, it is interesting to notice that they contain a mixture of some apparent Miocene forms and Pliocene ones. For this reason it is necessary to make a reexamination of the marine fauna to clarify many of the prevailing problems. The writers are progressing studies based upon a systematic research of the marine molluscan fossils. In this paper the writers treat the fossil *Anadara* collected from the Yamatsuda Formation in the western part of the Shizukuishi Basin and from the Yamatsuda Formation at the upper stream of the Kakkonda River. The fossils from the latter locality were collected by Mr. Nobuaki NIITSUMA and Mr. Shinobu MITSUI, both of the Institute of Geology and Paleontology, Tohoku University. The latter locality is a newly discovered one and therefore the fossils from it are described in this paper briefly.

* Received July 13, 1967; read June 18, 1967 at Osaka.

The fauna from the former mentioned area will be described at another opportunity.

Acknowledgements

The writers here wish to express their gratitude to Professor Kotora HATAI of the Institute of Geology and Paleontology, Faculty of Science, Tohoku University for his kind supervision and encouragement during the course of this study.

Deep appreciation is due to Associate Professors Nobu KITAMURA and Tamio KOTAKA of the same Institute and Associate Professor Koichiro MASUDA of the Department of Geology, Miyagi University of Education for their kind suggestions and encouragements. Acknowledgements are due to Professor Sadamasa MURAI of the Department of Mining and Civil Engineering, Faculty of Technology, Iwate University for his kind informations on the geology and stratigraphy of the Shizukuishi Basin. Thanks are also due to Messers Nobuaki NITSUMA and Shinobu MITSUI for their kind offer of the fossils from the Kakkonda River, and to Messers Kimiji KUMAGAI and Shohei OTOMO for photographic work, all of the Institute of Geology and Paleontology, Faculty of Science, Tohoku University. Thanks are also due to the Ministry of Education of the Japanese Government for financial support.

Stratigraphic Occurrence of the Anadarids

The stratigraphic sequence of the strata in the Shizukuishi Basin established by HAYAKAWA and KITAMURA (1953) is shown in Table 1 with those of MURAI (1961, 1962a) and SATO (1962).

Table 1. Correlation in the Shizukuishi Basin.

HAYAKAWA and KITAMURA (1953)	MURAI (1961, 1962a)	SATO (1962)
Hashiba Formation ±110 m	Hashiba Formation 150 m	Hashiba Formation 150 m
Yumoto Formation 80-100 m	Masuzawa Formation 100 m±	Masuzawa Formation 250 m
Yamatsuda Formation ±520 m	Sakamotogawa Formation 450 m	Arasawa Formation 400 m
Osuke Formation ±450 m	Osuke Formation 400-450m	Osuke Formation 1150 m
Koshitomae Formation 230 m	Koshitomaezawa Formation 400-450 m	Koshitomaezawa Formation 500 m
Sakamoto Formation ±270 m	Ryukawa Formation 400 m±	Sakamotogawa Formation 500 m
Kunimi Formation ±600 m	Kunimitoge Formation 850 m±	Kunimitoge Formation 1000 m
Obonai Formation ±600 m	Rentaki Formation 500 m+	Obonai Formation 450 m±
Granitic Rocks	Metamorphic Rocks and Pre-Tertiary Granitic Rocks	Pre-Tertiary: Granites

From the table the correlation between the different stratigraphic names can be seen. The application of the same name to different rocks and different names to the same or similar formation causes misunderstanding and confusing. For example, the Anadarids studied are from the Yamatsuda Formation of HAYAKAWA and KITAMURA (1953), the Sakamotogawa Formation of MURAI (1962a) and the Arasawa Formation of SATO (1962). These three formations were established in the Shizukuishi Basin. The stratigraphic units established by HAYAKAWA and KITAMURA (1953), MURAI (1961, 1962a) and SATO (1962) and shown in the table should be subjected to stratigraphic nomenclature in order to avoid confusion.

The writers consider that from stratigraphic nomenclature, priority and usage, it seems best to use HAYAKAWA and KITAMURA's stratigraphic names in this basin for the reasons given below.

MURAI (1962a) used the name of the Rentaki Formation for the Obonai Formation of HAYAKAWA and KITAMURA (1953) because the type locality of the latter was not established in the Shizukuishi Basin. But, traced in the field the formations are really the same and continuous from the Back-Bone Range to the Basin. The Kunimitoge Formation named by MURAI (1962a) is the same as the Kunimi Formation of HAYAKAWA and KITAMURA (1953). Their type localities and distributions are the same and the only differences are in the spelling, the word "toge" or "pass" being added, Kunimi and Kunimitoge. For the Sakamoto Formation of HAYAKAWA and KITAMURA (1953), MURAI (1961) proposed the name of Ryukawa Formation and he selected the type locality along the Ryukawa (River) because the type locality of the Sakamoto Formation of HAYAKAWA and KITAMURA (1953) is intruded by Basalt layers. SATO (1962) used the name of the Sakamotogawa Formation for the Sakamoto Formation of HAYAKAWA and KITAMURA (1953). The Sakamotogawa Formation of SATO (1962) differs from the Sakamotogawa Formation of MURAI (1962a) in stratigraphic horizon and geological significance. The difference between the Koshitomae Formation and the Koshitomaezawa Formation is in the spelling only. And, as pointed by MURAI (1962a) the local name of Koshitomae does not exist and the correct geographical name is Koshitomaezawa. The Yamatsuda Formation of HAYAKAWA and KITAMURA (1953) slightly differs from the Sakamotogawa Formation of MURAI (1962a), but both have two or three fossil beds in their upper part, whereas the contents of their lower parts are not the same. From the fossil beds just mentioned many marine molluscs were recorded by MURAI (1962b) and SATO (1962). *Anadara arasawaensis* and *Anadara iwatensis* were collected from this bed. The Arasawa Formation of SATO (1962) corresponds to the Yamatsuda Formation of HAYAKAWA and KITAMURA (1953).

Fossil Locality of the Anadarids

At the up-stream of the Kakkonda River (Loc. no. 1) in the northern part of the Shizukuishi Basin, both the Koshitomae and Yamatsuda Formations of HAYAKAWA (1952) and HAYAKAWA *et al.* (1954) are developed. From this locality (Loc. no. 1), Messers N. NITSUMA and S. MITSUI collected some marine molluscs from the Yamatsuda Formation. Those fossils were collected from a dark gray to black mudstone intercalated in the acidic tuff overlying the Koshitomae Formation with conformity. *Anadara arasawaensis*, *Anadara makiyamai* and *Anadara ogawai* were collected from

mudstone in association with *Callista* sp. *Anadara* and *Callista* are abundant though their shells are slightly deformed. *Serripes muraii* and *Dosinia* sp. were collected from an acidic tuff at Loc. no. 2 sporadically.

The Yamatsuda Formation used here is the same as mentioned by HAYAKAWA and KITAMURA in the western part of the Basin. Many specimens of *Anadara arasawaensis* were collected from the bluish gray coarse grained sandy tuff, pumice grains bearing coarse grained tuff and very fine muddy tuff of the forma-

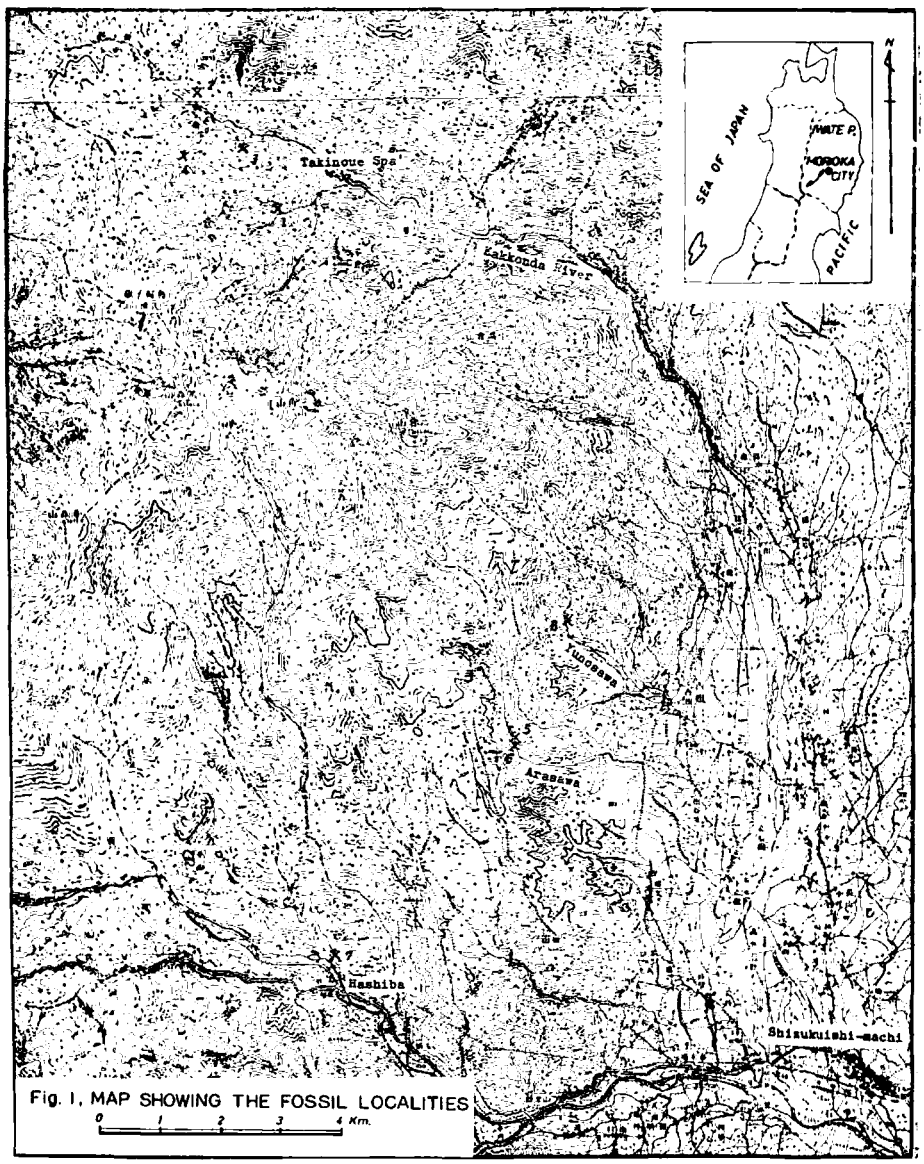


Fig. 1. MAP SHOWING THE FOSSIL LOCALITIES

tions in association with other shallow water marine molluscs. The upper part of the Yamatsuda Formation, composed mainly of coarse grained sandstone and pumice tuff yielded molds and casts of *Anadara arasawaensis* and *Anadara iwatensis* and rarely specimens with hte originally shell materials were collected by SATO from the upper stream of the Arasawa and these have been recorded as *Anadara arasawaensis* and *Anadara iwatensis* by NODA (1966). *Anadara* from Locality no. 6 was collected from the *Anadara* bed which is composed of *Anadara arasawasesis* and *Macoma tokyoensis*. The *Anadara* bed is overlain by pumice bearing coarse grained sandy tuff which yielded some *Anadara* and other marine molluscan fossils. More than a hundred specimens of molds or casts of both young and adult forms of *Anadara arasawaensis* were collected from the *Anadara* bed and next younger pumice bearing sandy tuff.

The Anadarids: Classification

In the case of Anadarids with dichotomous radial ribs, it is necessary to identify the species by the comparison with the related species of the same or similar size. TANAKA (1960a) published on the development of the dichotomous radial ribs of *Anadara amicula*. And in this section, the writers will point out the differences between *Anadara arasawaensis* and its related species such as *Anadara ogawai* and *Anadara tatunokutiensis*. *Anadara ogawai* is characterized by its distinct dichotomous radial ribs covering the whole shell surface at the adult stage and the same structure is observed in the young form of 1.5 cm in shell length. This is different from the radial sculpture on *Anadara arasawaensis* which is characterized by having distinct dichotomous radial ribs on the posterior side but with indistinct ones on the anterior side of the shell in the adult form. In general, the degree of the dichotomy in *Anadara arasawaensis* is not conspicuous as compared with that of *Anadara ogawai*. In the case of poor development of the dichotomous radial ribs or when the shell surface is slightly worn or weathered, the radial ribs appear as non dichotomous ones. When the shell is weathered or worn, *Anadara arasawaensis* much resembles *Anadara ninohensis* originally described from the Kadonosawa Formation though the former differs from the latter in having more elongated form and produced posterior side. *Anadara tatunokutiensis* originally described from the Pliocene Tatsunokuchi Formation in Sendai City is another allied species but differs from *Anadara arasawaensis* in having distinct double dichotomous radial ribs when the shell is well preserved. In the case of molds or casts, *Anadara arasawaensis* differs from the Pliocene *Anadara tatunokutiensis* in having narrow radial ribs and produced posterior side and when the hinge or ligamental area is preserved, the arrangement of the teeth of the former is II type of NODA (1966) and that of the latter is IV type of NODA (1966) and has v shaped teeth on both anterior and posterior sides. In the case of the inner molds, discrimination among the *Anadara* species is very difficult.

Recently, MIZUNO (1965) reported some marine molluscs from the Hanawa Basin in Akita Prefecture. In this paper, MIZUNO (1965) listed the following marine molluscs from the Oinosawa Formation (Loc. M 1, of MIZUNO, 1965); *Crepidula* sp., *Anadara amicula*, *Dosinia* cf. *tatunokutiensis*, *Macoma calcarea* and *Macoma* sp. He considered those molluscs (Oinosawa Formation by oral information by Dr. Tai-

suke TAKAYASU of the Akita University) may be Pliocene in geological age and correlated them with the Tatsunokuchi Fauna of Sendai. Though, he listed *Anadara amicula* and *Dosinia* cf. *tatunokutiensis* which indicate the Upper Miocene or Lower Pliocene, the fauna from this area is very interesting because of the co-existence of *Anadara amicula* and *Trachycardium shiobaraense* besides *Dosinia* cf. *tatunokutiensis*. The fauna from the Yamatsuda Formation resembles the fauna of the Oinosawa Formation.

The Associated Fossil Molluscs

The marine molluscs associated with the Anadarids in the Yamatsuda Formation in the Shizukuishi Basin will be described at another opportunity. In this paper the fauna associated with the Anadarids in the area of the upper stream of the Kakkonda River are treated. The specimens studied are deposited mainly in the Department of Mining and Civil Engineering, Faculty of Technology, Iwate University whereas the specimens described as new to science and illustrated are deposited in the collection of the Institute of Geology and Paleontology, Faculty of Science, Tohoku University (abbreviation, IGPS coll. cat. no.), Sendai.

Brief Notes and Description of New Species

Anadara (*Anadara*) *arasawaensis* NODA, 1966

Pl. 22, Figs. 1–6, 8–10, 14–16, 23

Anadara (*Anadara*) *arasawaensis* NODA, 1966, p. 86, pl. 4, figs. 13, 15–17.

Type Locality: Arasawa, Gomyojin-mura, Shizukuishi-machi, Iwate Prefecture, Holotype, IGPS coll. cat. no. 90049.

The present species was originally described from the Arasawa Formation of SATO (1962; Sakamotogawa Formation of MURAI, 1962a, b; Yamatsuda Formation of HAYAKAWA and KITAMURA, 1953) by NODA (1966). Among the more than a hundred specimens collected, the majority are from the pumice-grains bearing sandy tuff or muddy tuff in the western part of the basin and the minority from the former locality are preserved as molds or casts but those from the latter locality are free specimens with the original shell material retained though crystalized by calcite.

The species resembles *Anadara ninohensis* and *Anadara ogawai* in the characters of the radial ribs and shell form and the differences were mentioned already. Here the writers distinguished them by plotting the shell length and shell height on a graph which vertical is taken as shell height and the horizontal as shell length with the result that the angle of height and length in *Anadara arasawaensis* is 36°, whereas that of *Anadara ogawai* is 44° and that of *Anadara ninohensis* is 42° (data from NODA, 1966).

Locality: Loc. no. 1, abundant*, Yamatsuda Formation, IGPS coll. cat. no. 88038; Loc. no. 5, abundant, Yamatsuda Formation, IGPS coll. cat. no. 90049; Loc. no. 6, abundant, Yamatsuda Formation, IGPS coll. cat. no. 88039; Loc. no. 7, abundant, Yamatsuda Formation, IGPS coll. cat. no. 88050.

Recorded Formation: Yamatsuda Formation in Iwate Prefecture.

Anadara (*Anadara*) *iwatensis* NODA, 1966

Anadara (*Anadara*) *iwatensis* NODA, 1966, p.

* abundant = more than 10 specimens, common = more than 5 specimens, few = more than 2 specimens, rare = 1 specimen

91, pl. 4, figs. 21-22.

Type Locality: Arasawa, Myojin-mura, Shizukuishi-machi, Iwate Prefecture, Sakamotogawa Formation. Holotype, IGPS coll. cat. no. 90048.

The present species was originally described from the Sakamotogawa Formation of MURAI (1962a; Arasawa Formation of SATO, 1962, Yamatsuda Formation of HAYAKAWA and KITAMURA, 1953) by NODA (1966).

Locality: Loc. no. 5, common, Yamatsuda Formation, IGPS coll. cat. no. 90048.

Recorded Formation: Yamatsuda Formation in Iwate Prefecture.

Anadara (*Anadara*) *makiyamai* HATAI and NISIYAMA, 1938

Pl. 22, Figs. 7, 13

Arca abdita MAKIYAMA, 1926, p. 152-153.

Anadara makiyamai HATAI and NISIYAMA, 1938, p. 143-144, pl. 9, fig. 7.

Anadara makiyamai HATAI and NISIYAMA, TANAKA, 1960b, p. 174-176, pl. 1, figs. 13-14.

Anadara (*Anadara*) *makiyamai* HATAI and NISIYAMA, NODA, 1966, p. 94, pl. 9, figs. 1-9, 11-12, pl. 11, figs. 1-2, table 13.

Type Locality: Nanseki, Meisen-gun, Kankyo-hokudo, North Korea, Heiroku Formation, Holotype, IGPS coll. cat. no. 62430.

The present species was originally described from the Miocene Heiroku Formation in North Korea by HATAI and NISIYAMA (1938). The species was collected from Loc. no. 1, in association with *Anadara arasawaensis* and *Anadara ogawai*. The specimen illustrated is characterized by having 25 non dichotomous radial ribs which are rather narrow, quadrate in cross section and with concentric growth line. The ligamental area and hinge area (Fig. 13) are characteristic. This species resembles *Anadara gentaroensis* originally described from the Miocene Yoshizawa Formation in Miyagi Prefecture by NODA (1966), but differs from the latter in having more higher shell form and distinct ligamental grooves.

Locality: Loc. no. 1, rare, Yamatsuda Formation, IGPS coll. cat. no. 88051.

Recorded Formation: Heiroku Formation in North Korea, Kurosedani Formation in Toyama Prefecture, Kokozura Formation in Fukushima Prefecture, Nakayama Formation in Niigata Prefecture, Yamatsuda Formation in Iwate Prefecture.

Anadara (*Anadara*) *ogawai* (MAKIYAMA, 1926)

Pl. 22, Fig. 19

Arca (*Anadara*) *ogawai* MAKIYAMA, 1926, p. 154-155, pl. 12, fig. 16.

Arca amicula YOKOYAMA, OTUKA, 1934, p. 609, pl. 47, fig. 2fi.

Arca (*Anadara*) *abdita* MAKIYAMA, 1926, pl. 12, fig. 11.

? *Anadara* sp., KANNO, 1955, pl. 6, fig. 2.

Anadara (*Anadara*) *ogawai* (MAKIYAMA), NODA, 1966, p. 97, pl. 4, figs. 12, 14, pl. 7, fig. 11, pl. 8, figs. 4-7, pl. 9, figs. 10, 13, pl. 11, figs. 7, 15, table 7.

Type Locality: Kanchindo, near Kisshu, North Korea, Bankodo Formation, Holotype preserved in the Geological Survey of Chosen (Korea).

The present species was originally described from the Miocene Bankodo Formation in North Korea by Makiyama in 1926. The species is characterized by its 28-30 distinct dichotomous radial ribs. The specimens from the tuffaceous dark gray mudstone of Loc. no. 1, are characterized by 28 dichotomous radial ribs. This species resembles *Anadara amicula amicula* but differs from the latter in

having slender umbonal area, distinct dichotomous radial ribs and distinct ligamental area. The latter has more elongated form and double dichotomous radial ribs on the posterior side of the shell. The differences between *Anadara arasawaensis* and *Anadara ogawai* was already mentioned in earlier lines. *Anadara ogawai* has been known to occur with *Anadara makiyamai* or *Anadara watanabei* but this is first record of its co-existence with *Anadara arasawaensis* from the Japanese Tertiary deposits.

Locality: Loc. no. 1, common, Yamatsuda Formation, IGPS coll. cat. no. 88054.

Recorded Formation: Bankodo Formation, Heiroku Formation both in North Korea; Kurosedani Formation in Toyama Prefecture; Togane Formation in Shimane Prefecture; Kadonosawa Formation in Iwate Prefecture; Ajiri Formation in Miyagi Prefecture.

Callista sp.

Pl. 22, Fig. 18

The present species was collected from a tuffaceous dark gray mudstone in association with *Anadara arasawaensis*, *Anadara makiyamai* and *Anadara ogawai*. The characters of the species are the ovately round form, broadly rounded ventral margin, surface with concentric growth lines without escutcheon or lunule; pallial line unknown. Left valve with two cardinal teeth and strong lateral teeth and right valve with three cardinal teeth. The specimens resemble *Ezocallista brevisiphonata* (CARPENTER) but the present species differs from the latter in having rounded shell form whereas the latter is produced. Though the specimens are abundant, the specific name is undeterminable at present.

Locality: Loc. no. 1, abundant, Yamatsuda Formation, IGPS coll. cat. no. 88054.

Dosinia (*Kaneharaia*) *kaneharai* YOKOYAMA, 1926

Pl. 22, Fig. 25

Dosinia kaneharai YOKOYAMA, 1926, p. 133, pl. 17, figs. 1–5, pl. 18, fig. 2.
Dosinia kaneharai YOKOYAMA, NOMURA, 1935, p. 83–84, pl. 3, figs. 6–8.
Dosinia kaneharai YOKOYAMA, NOMURA and HATAI, 1936, p. 128, pl. 14, fig. 2.
Dosinia kaneharai YOKOYAMA, NOMURA and ONISHI, 1940, p. 183, pl. 17, figs. 2–7.

The present species was originally described from the Miocene Kanomatazawa Formation in Tochigi Prefecture by YOKOYAMA (1926). It is characterized by strong and cord-like concentric growth lines and broad pallial sinus. This species is abundant in the fine tuff at Loc. no. 8 (Yunosawa) but without the original shell materials; the specimens from the shell material preserved were collected from Arasawa near Loc. no. 6.

Locality: Loc. no. 8, abundant, Yamatsuda Formation, IGPS coll. cat. no. 88060.

Recorded Formation: Kanomatazawa Formation in Tochigi Prefecture, Narusawa Formation in Iwate Prefecture, Tanagura Formation in Fukushima Prefecture, Murata Formation in Miyagi Prefecture.

Macoma cf. *tokyoensis* MAKIYAMA, 1927

Pl. 22, Fig. 24

Compared with: *Macoma tokyoensis* MAKIYAMA, YOKOYAMA, 1920, p. 116–117, pl. 7, figs. 19–20.

The present species name was originally proposed for the pre-occupied name described as *Macoma dissimilis* (MARTENS) of YOKOYAMA, (1920) by MAKIYAMA in 1927. The species was collected

abundantly from a siliceous mudstone at Loc. no. 3 in association with *Peronidea* sp. and *Saccella* sp.

Locality: Loc. no. 3, abundant, Yamatsuda Formation, IGPS coll. cat. no. 88059.

Microcallista sp.

Pl. 22, Figs. 11-12

The present undeterminable species is characterized by its elongate oval, inequilateral, prominent beak situated anteriorly, short anterior dorsal margin and produced posterior one. Ventral margin broadly arcuated. Surface sculptured with concentric growth lines. Lunule small and narrow. Pallial line situated rounded at end. Cardinal teeth two or three indistinct. This specimen was collected from a tuffaceous mudstone.

Locality: Loc. no. 4, few, Yamatsuda Formation, IGPS coll. cat. no. 88052.

Mya (*Mya*) *cuneiformis* (BÖHM, 1915)

Pl. 22, Fig. 21

Pleuromya cuneiforimis BÖHM, 1915, p. 577, pl. 29, figs. 1a-c, text-figs. 1-2.

Mya arenaria LINNE, YOKOYAMA, 1926a, p. 241, pl. 30, fig. 1.

Mya cnneiformis BÖHM, NAGAO and INOUE, 1941, p. 151-155, pl. 34, figs. 1-6.

Mya cuneiformis (BÖHM), MINATO, MATSUI and UOZUMI, 1950, p. 6, pl. 10, figs. 90-91.

Mya cuneiformis (BÖHM), FUJIE, 1957, p. 395-397, pl. 3, fig. 5, pl. 4, figs. 1-6.

Mya (*Arenomya*) *cuneiformis* (BÖHM), KAMADA, 1962, p. 141-142, pl. 16, figs. 14-16.

Mya (*Mya*) *cuneiformis* (BÖHM), MACNEIL, 1965, p. 35-37, pl. 7, figs. 2-3, 5-8, 12, 15.

The present species was originally described from Kap Jonquiére in Sakahalin by BÖHM (1915). At the time of description BÖHM considered it to have been derived from the Cretaceous deposits. It is probably from the beds of Middle Miocene (*fide* MACNEIL, 1965). MACNEIL (1965) and FUJIE (1957) studied the Tertiary genus *Mya* in detail. *Mya cuneiformis* is recorded from Alaska, Sakahalin and Northern Japan and ranges from Middle Miocene to Pliocene according to MACNEIL (1965) and FUJIE (1957). The present species was collected from a siliceous mudstone at Loc. no. 4 in association with *Microcallista* sp.

Locality: Loc. no. 4, rare, Yamatsuda Formation, IGPS coll. cat. no. 88057.

Recorded Formation: Wakkanai Formation, Koitoi Formation, Chikubetsu Formation, Togeshita Formation, Takigawa Formation, Kawabata Formation, Atsunai Formation, all in Hokkaido; Kurosawa Formation in Akita Prefecture, Nakayama Formation in Fukushima Prefecture; Shimokurosawa Formation in Iwate Prefecture; Yakataga Formation in Alaska; Unnamed Middle Miocene Formation in Kodiak Island.

Peronidea sp.

Pl. 22, Fig. 17

The present species is characterized by its elongate shell with concentric growth lines on the shell surface and small prominent beak. This species was collected from a siliceous mudstone in association with *Macoma* cf. *tokyoensis* and *Saccella* sp.

Locality: Loc. no. 3, few, Yamatsuda Formation, IGPS coll. cat. no. 88053.

Saccella sp.

Pl. 22, Fig. 20

The present species is characterized by its small, transversely elongate form. Anterior side narrowly rounded and posterior side produced and somewhat attenuated at end. Ventral margin widely rounded. Surface with regular concentric growth lines without any angulation.

Escutcheon area narrow depressed. Small taxodont teeth arranged on both anterior and posterior sides of beak.

The present species was collected from a siliceous mudstone is association with *Macoma* cf. *tokyoensis* and *Peronidea* sp. This resembles *Saccella confusa toyomensis* originally described from the Numanouchi Formation in Fukushima Prefecture by KAMADA (1962) but differs from the latter in having high posterior border and wide posterior side.

Locality: Loc. no. 3, rare, Yamatsuda Formation, IGPS coll. cat. 88056.

Serripes muraii NODA and TADA, n. sp.

Pl. 22, Fig. 22

Type Locality: Small tributary of the Kakkonda River, about 4 kilometers NNW of the Takinoue Spa, Shizukuishi-machi, Iwate Prefecture, Yamatsuda Formation, IGPS coll. cat. no. 88059.

Shell rather large, ovately rounded in form, inequilateral, anterior side acutely rounded and posterior one elongated acute, higher than shell length, ventral margin narrowly rounded, umbonal area narrow, slender. Beak small, prominent situated near center of shell length. Shell surface with rather regular concentric growth lines with bluntly elevated radiating ribs extending from beak to ventral margin on anterior and posterior sides of shell and indistinct on middle part of shell. Posterior radial ribs distinct compared with anterior one. Cardinal teeth obscure. Inner shell characters unknown.

Dimension of Holotype (Right valve): Length of shell 66.2 mm., height of shell 80.1 mm.

Comparison and Affinities: The present new species resembles *Serripes hataii* originally described from the Miocene Shimokurosawa Formation in Iwate Prefecture by NODA (1962) but differs from the latter in having higher shell and radial ribs on anterior and posterior sides of shell. *Serripes yokoyamai* resembles the present new species in having radial ribs on the anterior and posterior sides of shell but differs from the latter by the wide ventral margin and forward curved beak.

Remarks: The new species was collected from a coarse grained sandy tuff in association with *Dosinia* sp. The species is named after Professor Sadamasa MURAI of the Iwate University who kindly suggested the study on the geology of the Shizukuishi Basin.

Locality: Loc. no. 2, (type locality), rare, Yamatsuda Formation, IGPS coll. cat. no. 88059.

Correlation based upon the Anadarids from the Yamatsuda Formation in the Shizukuishi Basin

Fossil Anadarids from the Shizukuishi Basin are abundant and were collected from the localities shown in the locality map. The Yamatsuda Formation which yielded abundant specimens of *Anadara arasawaensis* and some *Anadara makiyamai*, *Anadara ogawai* and *Anadara iwatensis* is overlain by the Yumoto Formation or Masuzawa Formation with unconformity. The latter formation is characterized by the Gosho Flora of MURAI (1957) who correlated it with the Upper Miocene Shirasawa Formation in Miyagi Prefecture or the Akagane Formation in Fukushima Prefecture. The Gomyojin Flora is a name proposed by MURAI (1962b) for the Flora of the Sakamotogawa Formation. MURAI (1962b) stated that the flora indicated a climate much warmer than at the present time and that the flora of the Sakamotogawa Formation can be correlated to the Kadonosawa Formation in Iwate Prefecture

based upon the paleo-temperature shown by the flora and the marine fauna. From the stratigraphic sequence and volcanic activity of acidic tuff, KITAMURA (1957, '58, '59, '61) mentioned that the Yamatsuda Formation and Koshitomae Formation can be correlated with the Funakawa Formation in Akita Prefecture. On the other hand, the Yamatsuda Formation was correlated to the zone of *Anadara tsudai-Anadara tazawaensis* by NODA (1966) from the evolutional trends of the Anadarinae of Japan. This zone is correlated with the *Miyagipecten matsumoriensis/Patinopecten kimurai* Assemblage Zone of MASUDA (1962) and the Upper *Turritella tanaguraensis* Zone or F of KOTAKA (1959). The present record of the joint occurrence of *Anadara arasawaensis*, *Anadara makiyamai* and *Anadara ogawai* is the first in the Japanese Tertiary deposits. *Anadara makiyamai* and *Anadara ogawai* are both characteristic elements of the zone of *Anadara kakehataensis-Anadara makiyamai* which is correlated with the lower part of the Natorian of HATAI (1962) but *Anadara makiyamai* extends up to the zone of *Anadara tsudai-Anadara tazawaensis* which is correlated with the Upper Natorian of HATAI (1962). *Anadara arasawaensis* and *Anadara iwatensis* are both descendants of *Anadara ninohensis* based on the outer and inner characteristics (see NODA, 1966) and *Anadara ninohensis* does not extend to the zone of *Anadara tsudai-Anadara tazawaensis* but is restricted to the zone of *Anadara hataii-Anadara ninohensis* from the zone of *Anadara kakehataensis-Anadara makiyamai*. In conclusion, the geological age of the Yamatsuda Formation which yielded the Anadarids may be the zone of *Anadara tsudai-Anadara tazawaensis* and Upper Middle Miocene or the Upper part of the Natorian of HATAI (1962). In addition to the above mentioned Anadarids, *Dosinia* (*Kaneharaia*) *kaneharai* was collected from the Yamatsuda Formation. This species also confirms the geological age of the Formation. *Dosinia* (*Kaneharaia*) *kaneharai* has been recorded from the Miocene Kanomatazawa Formation in Tochigi Prefecture, Tanagura Formation in Fukushima Prefecture, Narusawa Formation in Iwate Prefecture and Murata Formation in Miyagi Prefecture. *Dosinia kaneharai* from the Miocene Heiroku Formation of MAKIYAMA (1936), Yanagawa Formation of NOMURA and ZINBO (1936), Kadonosawa Group of OTUKA (1934), Moniwa Member of the Hatatate Formation of NOMURA (1940), Saginosu Formation of KANNO (1960) and Ainaigawa Formation of IWAI (1961) are all referred to *Dosinia* (*Kaneharaia*) *kannoi* by MASUDA (1963a). MASUDA (1963a) mentioned that *Dosinia kaneharai* resembles *Dosinia kannoi* but the former differs from the latter in having irregular concentric growth lines and the surface of the adult forms of *Dosinia kannoi* takes the sculpture of the younger form of *Dosinia kannoi*. Therefore *Dosinia kannoi* occurs from a horizon lower than of *Dosinia kaneharai* and this is supported from the evolutional trends and geological horizon of *Dosinia*.

References Cited

BÖHM, J. (1915): Uber Kreideversteinerungen von Sachalin. *Jahrb., d. König. Preuf. Geol. Landesanstalt Berlin*, vol. 36, no. 1, p. 551–558, pl. 29, text-figs. 1–2.

FUJIE, T. (1957): On the Myarian Pelecypods of Japan, Part 1, Summary of the study of the genus *Mya* from Hokkaido. *Jour. Fac. Sci. Hokkaido Univ., Ser. 4*, vol. 9, no. 4, p. 381–413, pls. 1–7, text-figs. 1–4, tabs. 1–3.

HATAI, K. (1962): Mizuho Tô. *Sci. Rep. Tohoku Univ., 2nd Ser., Spec. Vol.*, no. 5,

p. 329-348.

——, and NISIYAMA, S. (1938): Remarks on certain fossils from the borderland of the Japan Sea. *Japan. Jour. Geol. Geogr.*, vol. 16, p. 123-154.

HAYAKAWA, N. (1952): Ore deposits of Sulpher and Pyrite at the Nishiyama-Omyojin district, Iwate Prefecture. (in Japanese with English abstract). *Bull. Geol. Surv., Japan*, vol. 3, no. 2, p. 71-77, text-fig. 1, 1 table.

——, and KITAMURA, N. (1953): Geology of the western border of Shizukuishi Basin, Iwate Prefecture. (in Japanese with English abstract). *Jour. Japan. Assoc. Min. Petr. Econ. Geol.*, vol. 37, no. 1, p. 29-40, text-fig. 1.

——, FUNAYAMA, Y., SAITO, K., and KITAMURA, N. (1954): Geology of the Neogene deposits in the area between the western margin of the Kitakami Mountainland and the Ôu Backbone Range, Iwate Prefecture. (in Japanese with English abstract). *Tohoku Kozan*, no. 10, p. 1-97, text-figs. 1-20, 1 correlation table.

IWAI, T. (1961): The Miocene molluscan fossils from the area south-west of Hirosaki City, Aomori Prefecture, Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, no. 41, p. 1-8, pl. 1, text-fig. 1, 1 table.

KAMADA, Y. (1962): Tertiary marine Mollusca from Joban Coal-field, Japan. *Palaeont. Soc. Japan, Spec. Pap.*, no. 8, p. 1-187, pls. 1-21, text-figs. 1-2, figs. 1-3.

KANNO, S. (1955): Tertiary molluscs from Taishu Mine, Tsushima, Nagasaki Prefecture, Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, no. 18, p. 31-36, pl. 6, 1 text-fig.

—— (1960): The Tertiary System of the Chichibu Basin, Saitama Prefecture, Part II, Paleontology. *Japan. Promot. Sci. Ueno*, p. 123-396, pls. 31-51, text-figs. 21-26, tabs. 5-19, 1 correlation table.

KITAMURA, N. (1957): Stratigraphic consideration on the Dacite from Northern Honshu, Japan. (in Japanese with English abstract). *Earth Science*, no. 28, p. 14-22, text-figs. 1-7, tabs. 1-8.

—— (1958): Sedimentary province and its development in Japanese Cenozoic (6)—Development of Sedimentary Basin in Japan. (in Japanese). *Cenozoic Res.*, no. 26, p. 564-578, text-figs. 1-8, tabs. 1-2.

—— (1959): Tertiary orogeny in northeast Honshu, Japan. (in Japanese with English abstract). *Contrib. Tohoku Univ., Inst. Geol. Paleont.*, vol. 49, p. 1-98, text-figs. 1-23, tabs. 1-10.

—— (1961): Problems on the Osuke Tuff. (in Japanese with English abstract). *Prof. J. Makiyama Mem. Vol.*, p. 115-122, text-figs. 1-2.

KOTAKA, T. (1959): The Cenozoic Turritellidae of Japan. *Sci. Rep. Tohoku Univ., 2nd Ser.*, vol. 31, no. 2, p. 1-135, pls. 1-15, text-figs. 1-10, charts 1-8, appen.-fig. A.

MACNEIL, F. S. (1965): Evolution and distribution of the genus *Mya*, and Tertiary migrations of Mollusca. *Geol. Surv. Prof. Pap., U. S. A.*, 483-G, p. 1-51, pls. 1-11, text-figs. 1-3.

MAKIYAMA, J. (1926): Tertiary fossils from Kankyo-do, Korea. *Kyoto Imp. Univ., Mem. Coll. Sci., Ser. B.*, vol. 2, no. 3, art 8, p. 143-160, pls. 12-13.

—— (1927): Molluscan fauna of the lower part of the Kakegawa Series in the Province of Totomi, Japan. *Ibid.*, vol. 3, p. 1-147, pls. 1-6.

—— (1936): The Meisen Miocene of North Korea. *Ibid.*, vol. 11, p. 193-228, pls. 4-5, text-figs. 1-2.

MASUDA, K. (1962): Notes on the Tertiary Pectinidae of Japan. *Sci. Rep. Tohoku Univ., 2nd Ser., Spec. Vol.*, no. 5, p. 159-193, text-figs. 1-9, tabs. 1-9.

—— (1963a): Remarks on some fossil *Dosinia* of Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S.*, no. 49, p. 29-38, pl. 6, text-figs. 1-2.

—— (1963b): Three Miocene *Dosinia* from near Sendai City, Miyagi Prefecture, Japan with reference to some Miocene *Dosinia*. *Saito Ho-on Kai Mus., Res. Bull.*, no. 32, p. 18-29, pls. 3-4, fig. 1, 1 table.

MINATO, M., MATSUI, M., and UOZUMI, S. (1950): On the genus *Mya* from Hokkaido. (in Japanese). *Cenozoic Res.*, no. 7, p. 106-109, pl. 10.

MIZUNO, A. (1965) : Tertiary molluscan fauna from the environs of Hanawa Basin, North Honshu. (in Japanese). *Bull. Geol. Surv. Japan.*, vol. 16, no. 6, p. 31–36, pls. 1–2, text-fig. 1, tabs. 1–3.

MURAI, S. (1957) : On the fossil Flora from the Shizukuishi Basin (1) —On the Gosho Flora— (in Japanese with English abstract). *Jour. Geol. Soc. Japan*, vol. 63, no. 747, p. 711–720, text-figs. 1–2, tabs. 1–4.

—— (1961) : On the Geology of the Shizukuishi Basin, Iwate Prefecture (II) —On the geology of southern border of the Shizukuishi Basin— (in Japanese with English abstract). *Rep. Tech. Iwate Univ.*, vol. 14, p. 93–106, text-figs. 1–3, 1 table.

—— (1962a) : Geology of the Shizukuishi Basin, Iwate Prefecture, Japan (III)—Geology of the western border of the Shizuku ishi Basin. (in Japanese with English abstract). *Ibid.*, vol. 15, no. 1, p. 51–63, text-fig. 1, tabs. 1–4.

—— (1962b) : Geology and Paleobotany of the Shizukuishi Basin, Iwate Prefecture, Japan, (Part 1). *Ibid.*, vol. 15, no. 1, p. 131–193, text-figs. 1–4, tabs. 1–10.

—— (1963) : Geology and Paleobotany of the Shizukuishi Basin, Iwate Prefecture, Japan, (Part II-3). *Ibid.*, vol. 16, no. 2, p. 46–65, pls. 18–20, text-fig. 20.

NAGAO, T., and INOUE, T. (1941) : Myarian fossils from Cenozoic deposits of Hokkaido and Karahuto. *Jour. Fac. Sci. Hokkaido Imp. Univ., Ser. IV*, vol. 6, no. 2, p. 143–159, pls. 32–34.

NODA, H. (1962) : *Serripes* (*Molluscs*) from Japan and Saghalien. *Sci. Rep. Tohoku Univ., 2nd Ser., Spec. Vol.*, no. 5, p. 219–232, pls. 36–39.

—— (1966) : The Cenozoic Arcidae of Japan. *Sci. Rep. Tohoku Univ., 2nd Ser.*, vol. 38, no. 1, p. 1–161, pls. 1–14, text-figs. 1–16, tabs. 1–35.

NOMURA, S. (1935) : On the Tertiary Mollusca from Northeast Honsyu, Japan, Part 1, Fossil Mollusca from the vicinity of the Narusawa Hot Spring, Northeastern part of the Kurikoma Volcano, Iwate-ken. *Saito Ho-on Kai Mus., Res. Bull.*, no. 5, p. 71–100, pls. 3–4.

—— (1940) : Molluscan fauna of the Moniwa Shell-bed exposed along the Natori-gawa in the vicinity of Sendai, Miyagi Prefecture. *Sci. Rep. Tohoku Imp. Univ., 2nd Ser.*, vol. 21, no. 1, p. 1–46, pls. 1–3.

—— and HATAI, K. (1936) : Fossils from the Tanagura Beds in the vicinity of the Town Tanagura, Hukusima-ken, Northeast Honsyu, Japan. *Saito Ho-on Kai Mus., Res. Bull.*, no. 10, p. 109–155, pls. 13–17.

——, and ONISHI, H. (1940) : Neogene Mollusca from the Sennan district Miyagi Prefecture, Japan. *Japan. Jour. Geol. Geogr.*, vol. 17, nos. 3–4, p. 181–194, pls. 17–19.

——, and ZINBO, N. (1936) : Additional fossil Mollusca from Yanagawa shell-bed in the Hukushima Basin, Northeast Honsyu, Japan. *Saito Ho-on Kai Mus., Res. Bull.*, no. 10, p. 335–345, pl. 20.

OTUKA, Y. (1934) : Tertiary structures of the Northwestern end of the Kitakami Mountainland, Iwate Prefecture, Japan. *Bull. Earthq. Inst. Imp. Univ. Tokyo*, vol. 12, pt. 3, p. 566–638, pls. 47–51, 1 geol. map.

SATO, J. (1962) : Miocene fishes from the western area of Shizukuishi Basin, Iwate Prefecture, Northeastern Japan, (Paleontological study of the Tertiary Fishes from Japan, Part 1). *Earth Sci.*, no. 59, p. 1–29, pls. 1–6, text-figs. 1–32, tabs. 1–14.

TANAKA, K. (1960a) : Some observations on *Anadara* (s. s) *amicula* (YOKOYAMA). (in Japanese with English abstract). *Venus*, vol. 21, no. 1, p. 78–92, pl. 11, text-figs. 1–15, 1 table.

—— (1960b) : Studies on the molluscan fossils from central Shinano, Nagano Prefecture, Japan, Part 4, On some species of the genus *Anadara*. *Shinshu Univ., Fac. Educ. Bull.*, no. 11, p. 173–186, pl. 1, tabs. 1–2.

YOKOYAMA, M. (1920) : Fossils from the Miura Peninsula and its immediate North. *Jour. Coll. Sci. Tokyo Imp. Univ.*, vol. 39, art 6, p. 1–193, pls. 1–20.

—— (1926) : Tertiary Mollusca from Shiobara in Shimotsuke. *Jour. Fac. Sci. Imp. Univ., Tokyo, Sec. C.*, vol. 1, pt. 4, p. 127–138, pls. 16–20.

—— (1926a): Tertiary Mollusca from the oil-Field of Embetsu and Etaibetsu. *Ibid.*, vol. 1 pt. 7, p. 235-248, pls. 30-32.

Shizukuishi	雫石	Osuke	男助
Obonai	生保内	Yumoto	湯本
Rentaki	レン滝	Masuzawa	舛沢
Kunimi	国見	Hashiba	橋場
Sakamoto	坂本	Kakkonda River	葛根田川
Koshitomae	小志戸前	Yunosawa	湯の沢
Yamatsuda	山津田	Arasawa	荒沢
Takinoue	滝の上	Oinosawa	老の沢

Explanation of Plate 22

(All figures in natural size)

Figs. 1, 5, 10, 15. *Anadara* (*Anadara*) *arasawaensis* NODA, Loc. no. 1. Yamatsuda Formation, IGPS coll. cat. no. 88038.

Figs. 2, 4. *Anadara* (*Anadara*) *arasawaensis* NODA, Loc. no. 6, Yamatsuda Formation, IGPS coll. cat. no. 88039.

Figs. 6, 8, 9, 16, 23. *Anadara* (*Anadara*) *arasawaensis* NODA, Loc. no. 7, Yamatsuda Formation, IGPS coll. cat. no. 88050.

Figs. 7, 13. *Anadara* (*Anadara*) *makiyamai* HATAI and NISIYAMA, Loc. no. 1, Yamatsuda Formation, IGPS coll. cat. no. 88051.

Figs. 11-12. *Microcallista* sp., Loc. no. 4, Yamatsuda Formation, IGPS coll. cat. no. 88052.

Fig. 17. *Peronidea* sp., Loc. no. 3, Yamatsuda Formation, IGPS coll. cat. no. 88053.

Fig. 18. *Callista* sp., Loc. no. 1, Yamatsuda Formation, IGPS coll. cat. no. 88054.

Fig. 19. *Anadara* (*Anadara*) *ogawai* (MAKIYAMA), Loc. no. 1, Yamatsuda Formation, IGPS coll. cat. no. 88055.

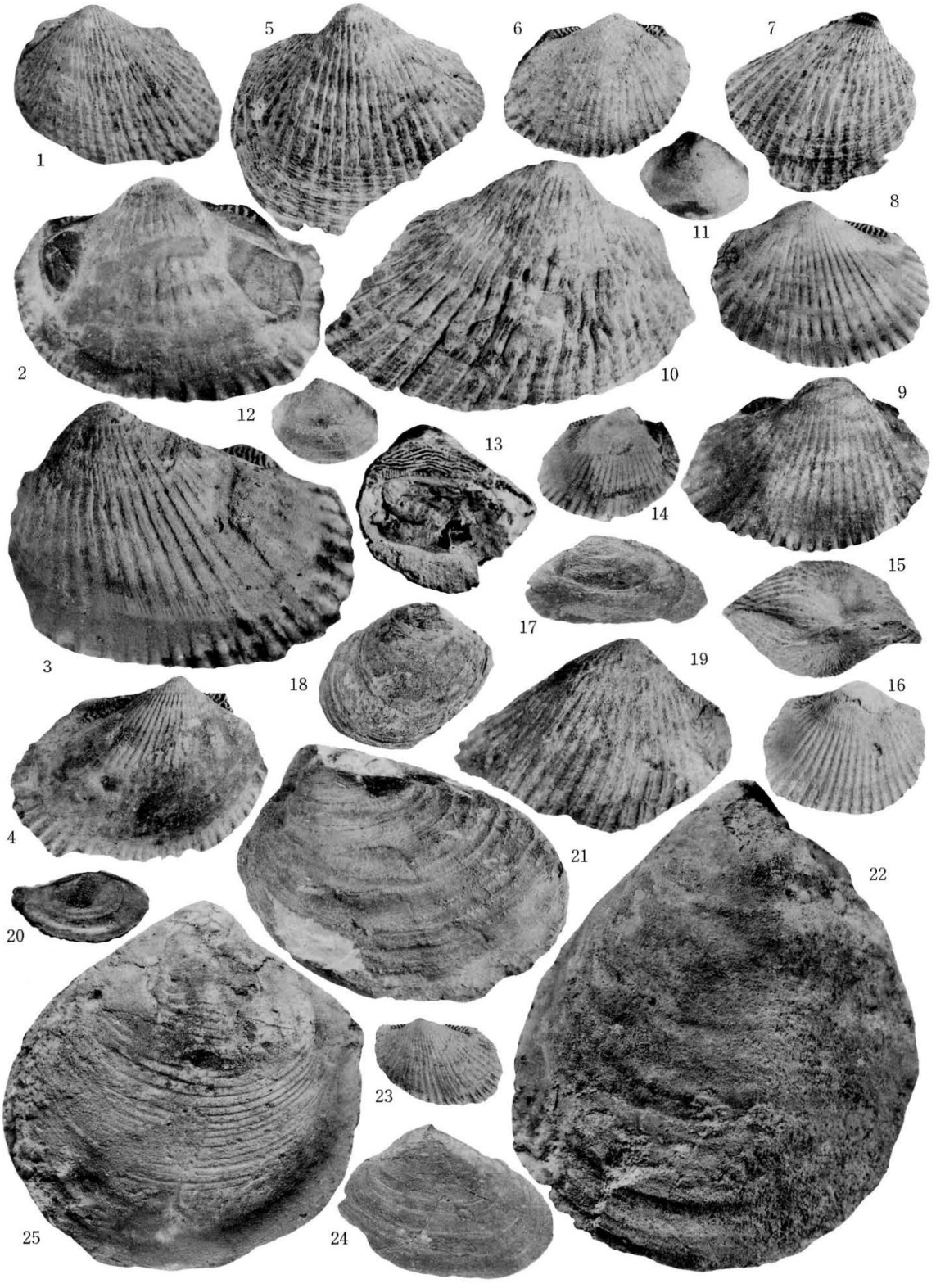
Fig. 20. *Saccella* sp., Loc. no. 3, Yamatsuda Formation, IGPS coll. cat. no. 88056.

Fig. 21. *Mya cuneiformis* (BÖHM), Loc. no. 4, Yamatsuda Formation, IGPS coll. cat. no. 88057.

Fig. 22. *Serripes muraii* NODA and TADA, n. sp., Loc. no. 2, Yamatsuda Formation, IGPS coll. cat. no. 88058 (Holotype).

Fig. 24. *Macoma* cf. *tokyoensis* MAKIYAMA, Loc. no. 4, Yamatsuda Formation, IGPS coll. cat. no. 88059.

Fig. 25. *Dosinia* (*Kaneharaia*) *kaneharai* YOKOYAMA, Loc. no. 8, Yamatsuda Formation, IGPS coll. cat. no. 88060.



KUMAGAI and OTOMO photo.

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 69, pp. 207-210, pl. 23, April 25, 1968

534. A NEW SPECIES OF *CONOCARDIUM* FROM THE CARBONIFEROUS OF AKIYOSHI

(MOLLUSCAN PALEONTOLOGY OF THE AKIYOSHI LIMESTONE GROUP—I)*

TAMIO NISHIDA

Department of Geology, Kyushu University

秋吉台石灰岩層群産二枚貝 *Conocardium* の1新種：山口県美祢市伊佐町山口県立種畜場入口に露出する秋吉台石灰岩層群下部の *Fusulinella biconica* 帯の石灰岩より産出した特異な形態の二枚貝を検討した結果，*Conocardium* (*Conocardium*) 亜属の新種であることが判明した。こゝに秋吉石灰岩層群産軟体動物化石研究の第1報として，その記載を行う。

西 田 民 雄

Introduction and Acknowledgements

Although results of paleontological studies of the Akiyoshi Limestone Group have been published by many authors, little is known of its molluscan fauna. Recently, however, molluscan fossils have been collected in considerable numbers from this group by Dr. J. YANAGIDA of the Department of Geology, Kyushu University, Mr. M. OTA of the Akiyoshi-Dai Science Museum abbreviated in this paper to ASM, and Mr. K. HASHIMOTO, teacher of the Isa Junior High School of Mine City. By courtesy of these persons I was given an opportunity to study them. As the first report of the molluscan paleontology of the Akiyoshi Limestone Group I describe in this paper a new species of *Conocardium*. This is the first record of this genus from Japan.

Before going further I wish to express my sincere gratitude to Professor Tatsuro MATSUMOTO of the Department of Geology, Kyushu University under whose supervision this study has been undertaken. Thanks are also due to Dr. Norman D. NEWELL of the American Museum of Natural History for his instructive suggestions during his stay in Kyushu University in 1963. Mr. Masamichi OTA for his kind guidance to the locality, Drs. Kametoshi KANMERA and Itaru HAYAMI of the Department of Geology, Kyushu University, for their valuable helps, Dr. Juichi YANAGIDA and Mr. Kyoichi HASHIMOTO for their generosity to place the specimens at my disposal.

Geologic Note

The limestone from which the described specimens were obtained is exposed as a small lapie (limestone column) at the entrance of Shuchikujo, Isa-machi, Miné City, Yamaguchi Pref. [Lat. N34°11′21″, long. E131°15′47″]. It is light gray and somewhat recrystallized. The bioclasts

* Received July 22, 1967; read June 18, 1965 at Tokyo.

such as crinoid oseicles and bryozoan remains occupy 45 percent of the whole volume and the recrystallized sparry calcite matrix the rest. *Fusulinella biconica* (HAYASAKA) occurs abundantly and some gastropods and ammonoids are associated.

Systematic Description

? Subclass Cryptodonta NEUMAYR, 1884

Order Conocardioida NEUMAYR, 1891

Superfamily Conocardiacea MILLER, 1889

Family Conocardiidae MILLER, 1889

Remarks:—NICOL (1955) attempted the systematic revision of the taxa at generic level of this family and concluded that the nomenclatorially available genera and subgenera are *Conocardiopsis* BEUSHAUSEN 1895, *Conocardium* BRONN 1834, *Hippocardia* BROWN 1843 and *Rhipidocardium* FISHER 1887.

Genus *Conocardium* BRONN, 1834

Type-species:—*Cardium elongatum* J. SOWERBY, 1815, Lower Carboniferous, Mountain Limestone, Derbyshire, England (monotypy).

Remarks:—As regards its type-species, STOLICZKA (1871) stated *Cardium alaeforme* SOWERBY as a "typical species" WOODWARD (1874) both *Cardium hibernicum* and *Cardium alaeforme* SOWERBY as "types", FISHER (1887) *Cardium hibernicum* SOWERBY as the "genotype" by subsequent designation. However BRONN (1834) had proposed *Conocardium* on the basis of a single species, *Cardium elongatum* SOWERBY, which is nomenclatorially valid, as NICOL (1955) has already admitted.

Since the genus was established, numerous species have been referred to it. According to BRANSON (1942) and COX (1963) this genus appeared in the Middle Ordovician and distributed world-widely and died out in the Permian. The reports of the Triassic species seem to be erroneous.

Subgenus *Conocardium*

Subgeneric Diagnosis:—*See* LA ROCQUE (1950, pp. 317-318).

Conocardium (*Conocardium*) *japonicum* sp. nov.

Plate 23, Figs. 1, 2

Material:—Holotype (ASM 5501), a well preserved specimen, without secondary deformation, paratype (ASM 5502), a fragmentary specimen, both collected by J. YANAGIDA and K. HASHIMOTO respectively.

Diagnosis:—Shell moderate for the subgenus; umbo placed at about one-fourth of hinge-line from front; posterior wing well-defined, trigonal and ornamented with 11, rather coarse radial ribs; anterior rostrum rather small. The proportion of the height to the length approximately 0.5 and that of the thickness to the height approximately 0.9.

Description:—Shell small, about 14.3 mm. in length, 7.3 mm. in height and 6.8 mm. in thickness in the holotype, equivalve, highly inequilateral, acline and somewhat triangular in the lateral views and fusiform in the ventral and dorsal views; umbo placed at about one-fourth of hinge-line from front, comparatively small, orthogyrous and incurved; hinge-line straight, long, occupying the whole shell-lengh; lunule long and narrow; escutheon short and also narrow; valve composed of anterior flank and posterior wing; boundary between them marked with a shallow groove, which forms an angle of approximately 45° with the

hinge-line; flank strongly inflatted, ornamented with 26 or more regular radial ribs of first order and slightly irregular concentric striae; anterior margin almost circular and slightly crenulated; anterior rostrum situated at the anterodorsal extremity and apparently small; posterior wing trigonal in the lateral views, flattened and ornamented with 11, rather coarse radial ribs; postero-ventral margin truncated at approximatly 50° with the hinge-line; broad elliptical gaping observable at the posterior end; internal characters not observable.

Measurements:—

Specimen	Length	Height	Thickness	H/L	T/H
Holotype (ASM5501)	14.2	7.3	6.8	0.51	0.93
Paratype (ASM5502)	10.3+	—	7.2+	—	—

Discussion:—In general characters, the present species is closely similar to *Cardium elongatum* SOWERBY from the Lower Carboniferous Mountain Limestone, Derbyshire, England, but is distinguished by its broader, more flattened and more strongly ornamented posterior wing and apparently smaller anterior rostrum. The present species somewhat resembles *Conocardium subrostrum* DE KONINCK from the Lower Carboniferous (Viséan) of Belgium, but the latter has a smaller proportion of height to length and no concentric striae.

Occurrence:—The holotype and paratype were from the limestone of the *Fusulinella biconica* zone of the Akiyoshi Limestone Group.

Repository:—Type-room of the Akiyoshi-Dai Science Museum, Yamaguchi Pref.

References

BRANSON, C. C. (1942): Correction of homonyms in the lamellibranch genus *Conocardium*. *J. Paleont.*, 16, (2), 247-249.

BRONN, H. C. (1834): *Lethaea Geognostica, oder Abbildungen und Beshreibungen d er für die Gebirgs-Formationen bezeichnensten Versteinerungen*. 1, 1-96. Stuttgart.

COX, L. R. (1963): Thoughts on the classification of the Bivalvia. *Proc. Malacol. Soc. London*, 34, (2), 60-88.

FISHER, P. (1887): *Manuel de conchyliologie et de paléontologie conchyliologique*.

KONINCK, L. G. DE (1885): Faune de carcaire carbonifère de la Belgique. Lamellibranches. *Ann. Mus. Roy. d'Hist. Nat. Belgique*, sér. paléont. 11, 277 pp., 41 pls.

LA ROCQUE, A. (1950): Pre-Traverse Devonian pelecypods of Michigan. *Contr. Mus. Paleont. Univ. Michigan*, 7, (10), 271-366.

NICOL, D. (1955): Nomenclatural review of the Paleozoic pelecypod family Conocardiidae. *J. Paleont.*, 29, (3), 551-553.

SOWERBY, J. (1815): *The mineral conchology of Great Britain*. 1, 234 pp., 102 pls. London.

STOLICZKA, F. (1871): Cretaceous fauna of southern India. The Pelecypoda, with a review of all known genera of this class, fossil and recent. *India Geol. Survey, Mem., Palaeont. Indica*, (6), 3.

WOODWARD, S. P. (1874): *Manual of the Mollusca*. (4th Ed.).

Locality Guide

Entrance of Shuchikujo, Isa-machi, Miné City, Yamaguchi Pref.
[Lat. N34°11′21″, long. E131°15′57″].
山口県美祢市伊佐町種畜場入口

Explanation of Plate 23

Figs. 1, 2. *Conocardium* (*Conocardium*) *japonicum* sp. nov.

1. Holotype (ASM 5501) from the *Fusulinella biconica* zone of the Akiyoshi Limestone Group at the entrance of Shuchikujo, Isa-machi, Miné City, Yamaguchi Pref. Right lateral (a), left lateral (b), dorsal (c), ventral (d) and frontal (e) views, each ×3.
2. Paratype (ASM 5502) from the type-locality. Ventral view, ×3.

Figs. 3-5. *Straparollus* (*Straparollus*) *otai* sp. nov.

3. Holotype (ASM 5025) from the *Millerella* sp. α zone of the Akiyoshi Limestone Group at the eastern slope of the Ryugoho, Akiyoshi, Shuho-cho, Miné-gun, Yamaguchi Pref. Apical (a), umbilical (b) and lateral (c) views, each ×3.
4. Paratype A (ASM 5026) from the type-locality. Apical (a), umbilical (b) and lateral (c) views, each ×3.
5. Paratype B (ASM 5027) from the type-locality. Apical view, ×3.

Figs. 6-9. *Turbonitella yanagidai* sp. nov.

6. Holotype (ASM 5020) from the *Millerella* sp. α zone of the Akiyoshi Limestone Group at Uzura Limestone Quarry, 1200 m E of Yobara, Ofuku, Miné City, Yamaguchi Pref. Apical (a), apertural (b) and lateral (c) views, each ×3.
7. Paratype A (ASM 5021) from the type-locality. Apical (a), apertural (b) and lateral (c) views, each ×3.
8. Paratype B (ASM 5022) from the type-locality. Apical (a), apertural (b) and lateral (c) views, each ×3.
9. Paratype C (ASM 5023) from the type-locality. Apical (a), apertural (b) and lateral (c) views, each ×3.

Fig. 10. *Turbonitella ryugohoensis* sp. nov.

Holotype (ASM 5030) from the *Millerella* sp. α zone of the Akiyoshi Limestone Group on the eastern slope of the Ryugoho, Akiyoshi, Shuho-cho, Miné-gun, Yamaguchi Pref. Apical (a) and lateral (b) views, each ×3.


1a 1b
1e
2
3b
1c 1d
4b
4a
3a
3c
6b
6c
8c
5
6a
7c
8b
7b
7a
8a
10b 10a
9b
9a
9c

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 69, pp. 211-217, pls. 24, 25, April 25, 1968

535. ON SOME SPECIES OF CARBONIFEROUS PLEUROTOMARIACEANS FROM AKIYOSHI

(MOLLUSCAN PALEONTOLOGY OF THE AKIYOSHI LIMESTONE GROUP—III)*

TOKIO SHIKAMA

Institute of Geology, Yokohama National University

and

TAMIO NISHIDA

Department of Geology, Kyushu University

秋吉石灰岩層群産オキナエビスガイ超科の3新種： 山口県美祢市於福江原（オフクヨバラ）のウズラ採石場，美祢市伊佐町正法寺西方および伊佐町山口県立種畜場西方における秋吉石灰岩層群下部より産出したオキナエビスガイ類を検討した結果，*Mourlonia* (*Mourlonia*) 亜属の1新種，*Angyomphalus* 属の新種2を識別した。ここに秋吉石灰岩層産軟体動物化石研究の第3報として，それらの記載を行う。 鹿間時夫・西田民雄

Introduction and Acknowledgements

Pleurotomariacean is one of the most representative groups of gastropods in the Permian and Carboniferous Systems of various parts of the world. However the paleontological studies of them from the Late Paleozoic of this country were made only by HAYASAKA (1925) from the Carboniferous Omi Limestone and HAYASAKA (1943) from the Permian Akasaka Limestone. Recently a considerable number of specimens of this group have been collected from the lower part of the Akiyoshi Limestone Group with many kinds of molluscan fossils. As the third report of the molluscan paleontology of the Akiyoshi Limestone Group, we describe and propose in this paper a new species of the subgenus *Mourlonia* and two new species of the genus *Angyomphalus*. The occurrence of the genus *Angyomphalus* is the first record from Japan.

Before going further we extend our cordial thanks to Professor Tatsuro MATSUMOTO of the Department of Geology, Kyushu University, for his valuable suggestions and critical reading of the typescript. We also wish to express our hearty acknowledgements to Mr. Masamichi OTA of the Akiyoshi-Dai Science Museum, abbreviated in this paper to ASM, for his kind guidance to the localities, Dr. Juichi YANAGIDA of the Department of Geology, Kyushu University, Messrs. Goro OKAFUJI, teacher of the Omine High School of Yamaguchi Pref. and Kyoichi HASHIMOTO, teacher of the

* Received July 22, 1967; read June 18, 1965 at Tokyo.

Isa Junior High School of Mine City, for their generosities to place the specimens at our disposal.

Geologic Note

The localities from which the present specimens were collected are as follows (Text-fig. 1):

Loc. 1. 1200 m E of Yobara, Ofuku, Miné City, Yamaguchi Pref. (Uzura Limestone Quarry, now abandoned) [Lat. N34°14′03″, long. E131°14′45″]. The specimen (ASM 5005) was obtained from the middle horizon of the lower part of the limestone of this quarry. The brief explanation of this limestone was given in the second report of this series by the junior author.

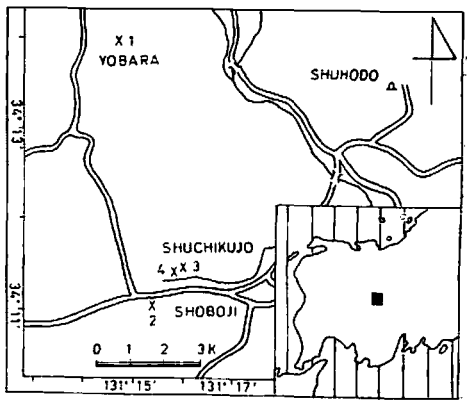
Loc. 2. 150 m W of Shoboji, Isa-machi, Miné City [Lat. N34°11′02″, long. E131° 15′21″]. The specimen (ASM 5006) was from the pale gray and somewhat crystalline limestone. This limestone yields some species of fusulinaceans such as *Profusulinella beppensis* TORIYAMA, *Eostaffella* sp. cf *E. bigemicula* (IGO) and *Nankinella* sp. indet. and some species of aviculopectinids and goniatites.

Loc. 3. 20 m W of the entrance of Shuchikujo, Isa-machi [Lat. N34°11′21″, long. E131°15′46″]. The specimens (ASM 5001-4, 5010-13) were from the pale gray to white and somewhat crystalline limestone, which carries *Fusulinella biconica* (HAYASAKA) abundantly.

Loc. 4. 70 m W of the entrance of Shuchikujo [Lat. N34°11′22″, long. E131° 15′43″]. The specimen (ASM 5015) was the gray limestone, which also carries *Fusulinella biconica* (HAYASAKA) abundantly.

Above four localities respectively correspond to the *Millerella* sp. α zone, *Profusulinella beppensis* zone, *Fusulinella biconica* zone and also *Fusulinella biconica* zone of TORIYAMA (1958).

Pleurotomariaceans rarely occuring from other localities in this group are not dealt with in this paper.



Text-fig. 1. Map showing the collecting localities, indicated by ×.

Systematic Descriptions

Superfamily Pleurotomariacea SWAINSON, 1840

Family Eotomariidae WENZ, 1938

Subfamily Eotomariinae WENZ, 1938

Tribe Ptychomphalides WENZ, 1938

Genus *Mourlonia* DE KONINCK, 1883

Type-species:—*Helix carinata* J. SOWERBY, 1812, Lower Carboniferous Mountain Limestone, Near Settle, Yorkshire, England (original designation).

Generic Diagnosis:—*See* DICKINS (1963, p. 118).

Subgenus *Mourlonia s. s.*

Subgeneric Diagnosis:—*See* DICKINS (1963, p. 118).

Mourlonia (*Mourlonia*) *hayasakai* sp. nov.

Plate 24, Figs. 1-6

Material:—Holotype (ASM 5001) and paratypes A, B, C, D (ASM 5002-5) from loc. 3; paratype E (ASM 5006), from loc. 1; paratype F (ASM 5007) from loc. 2.

Diagnosis:—Shell, except for selenizone, ornamented only with fine numerous growth-lines which are strongly prosocline and slightly convex forward above selenizone and orthocline below it; selenizone concave, slightly above the periphery on the last whorl and slightly sbove the suture on the spire; spire angle approximately 100°.

Description:—Shell moderate to small, turbiniform, slightly higher than long; whorls consisting five and a half volutions in the holotype, rapidly expanded; spire rather low, conical; spire angle 101.5° in the holotype, ranging from 98.0° to 101.5° among specimens; protoconch small, apparently smooth and dextral; base more or less flattened; umbilicus phaneromphalous at younger stage but almost plugged by callus at mature stage; whorl surface gently curved; whorl cross section rounded trapezoid in the paratype D; suture fairly impressed; selenizone considerably wide, slightly concave, delimited by two spiral lirae and not ornamented with corabral lirae, and situated slightly above the periphery on the last whorl and also slightly above the suture on the spire; ornamentation fine, regularly spaced numerous growth lines which are strongly prosocline, slightly convex forward above the selenizone and orthocline below it; aperture and slit not observable.

Measurements:—

Specimen	Number of whorls	Height	Diameter	Spire angle
Holotype (ASM 5001)	5.5	24.3	26.2	101.5°
Paratype A (ASM 5002)	6.0	38.6+	41.7+	98.5°
Paratype B (ASM 5003)	5.0	21.6	—	100.0°
Paratype C (ASM 5004)	—	19.2+	—	—
Paratype D (ASM 5005)	4.8	28.8	28.9	98.0°
Paratype E (ASM 5006)	4.3	11.8	15.2	98.0°
Paratype F (ASM 5007)	—	10.2+	—	99.3°

Discussion:—The holotype is fairly well-preserved, showing clearly the specific characters, although it is slightly deformed in preservation. The paratype E and F are smaller and have rather coarse collabral ornamentation on the outer whorl surfaces. Paratype C has a well flattened base. However, in other characters they are quite similar to the holotype. The present species is fairly similar to *Mourlonia* (*s. s.*) *subconoidea* (DE KONINCK) from the Lower Carboniferous (Tournaisian) of Belgium, but distinguishable in having rather a larger spire angle and unornamented selenizone. The present species can easily be distinguished from other species referred to the subgenus by the situation of the selenizone on the spire and the last whorl.

The present species is dedicated to Professor Ichiro HAYASAKA, a pioneer in the study of the Paleozoic molluscs in this country.

Occurrence:—The present species ranges from the *Millerella* sp. α zone to the *Fusulinella biconica* zone in the Akiyoshi Limestone Group and, as far as is known, seems to be abundant in the latest zone.

Repository:—Type-room of the Akiyoshi-Dai Science Maseum, Yamaguchi Pref.

Family Raphistomatidae KOKEN, 1896

Subfamily Liospirinae KNIGHT, 1956

Genus *Angyomphalus* COSSMANN, 1915

Type-species.—*Euomphalus radians* DE KONINCK, 1843, Lower Carboniferous, Assise 1, Tournai, Belgium (original designation).

Generic Diagnosis:—Shell small to moderately small, lenticular to sub-lenticular; spire low-conical; ealier whorls convex and later ones rather flattened; periphery gently rounded; suture fairly well impressed; base gently rounded or somewhat flattened; umbilicus moderately wide, phaneromphalous or hemiomphalous and often surrounded by narrow circum-umbilical funicule or row of collabral fine costae; aperture sub-lenticular; outer lip thin, sharply angulated at the periphery; inner lip much curved, somewhat thickened; parietal indactura moderately thickened; selenizone narrow, convex and situated slightly above the periphery; ornamentation a series of nodes or pustules which are prominently developed just below the upper suture.

Discussion:—When COSSMANN (1915) established *Angyomphalus* as a subgenus of the *Rotellomphalus* on the basis of *Raphistoma radians* DE KONINCK and *R. junior* DE KONINCK and designated the former as the type-species, he did not notice a slit and a selenizone, the important characters of these species. KNIGHT (1933) at first followed COSSMANN but later (1936), reexamining the holotype of the type-species, stated that the *Angyomphalus* entirely belongs to pleurotomariaceans and that is related to some American Pennsylvanian species of the *Trepospira*. Still later he (1941) placed the *Angyomphalus* to the subgenus of the *Trepospira*.

However we regard that it should be treated as a distinct genus judging from the differences in the umbilical character and surface ornamentation as mentioned in the above diagnosis.

Angyomphalus hashimotoi sp. nov.

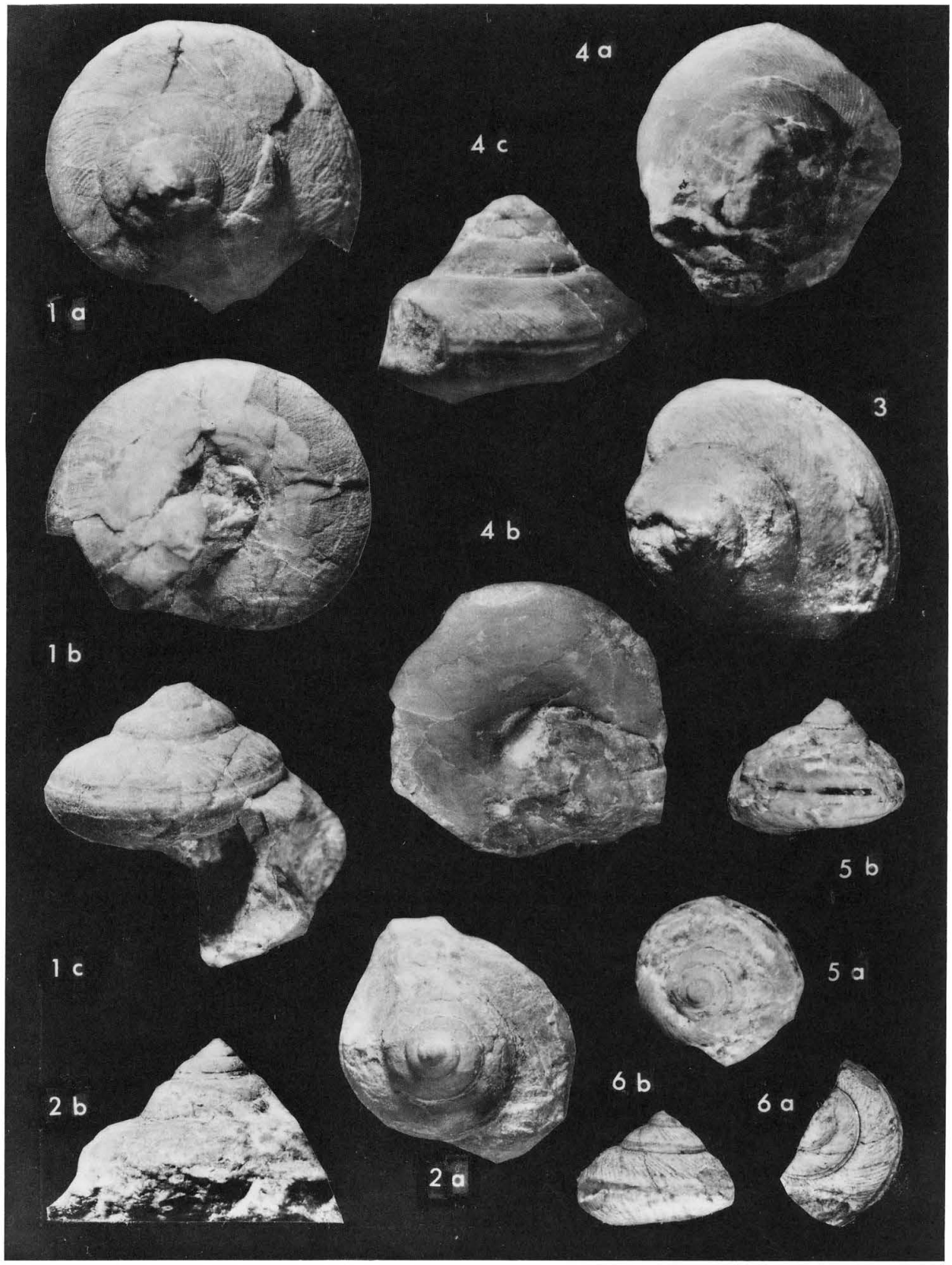
Plate 25, Figs. 1-4

Material:—Holotype (ASM 5015) and paratype A, B, C (ASM 5016-8), collected

Explanation of Plate 24

Figs. 1-6. *Mourlonia* (*Mourlonia*) *hayasakai* sp. nov.

1. Holotype (ASM 5001) from the *Fusulinella biconica* zone of the Akiyoshi Limestone Group at 20 m W of the entrance of Shuchikujo, Isa-machi, Miné City, Yamaguchi Pref.
   Apical (a), umbilical (b) and apertural (c) views, each ×2.
2. Paratype A (ASM 5002) from the type-locality.
   Apical (a) and lateral (b) views, each ×1.
3. Paratype B (ASM 5003) from the type-locality.
   Apical view, ×2.
4. Paratype C (ASM 5004) from the type-locality.
   Apical (a), umbilical (b) and lateral (c) views, each ×2.
5. Paratype E (ASM 5006) from the *Millerella* sp. *α* zone of the Akiyoshi Limestone Group at the Uzura Limestone Quarry, 1200 m E of Yobara, Ofuku, Miné City, Yamaguchi Pref.
   Apical (a) and lateral (b) views, each ×2.
6. Paratype F (ASM 5007) from the *Profusulinella beppensis* zone of the Akiyoshi Limestone Group at 150 m W of Shoboji, Isa-machi, Miné City, Yamaguchi Pref.
   Apical (a) and lateral (b) views, each ×2.


4a
4c
1a
3
4b
1b
5b
1c
5a
6b
6a
2b
2a

by K. HASHIMOTO from loc. 3.

Diagnosis :—Without circum-umbilical funicule; phaneromphalous; spire angle approximately 128°; rather fine pustules collabrally lengthened from just below the upper suture to the position of one-third of the whorl surface.

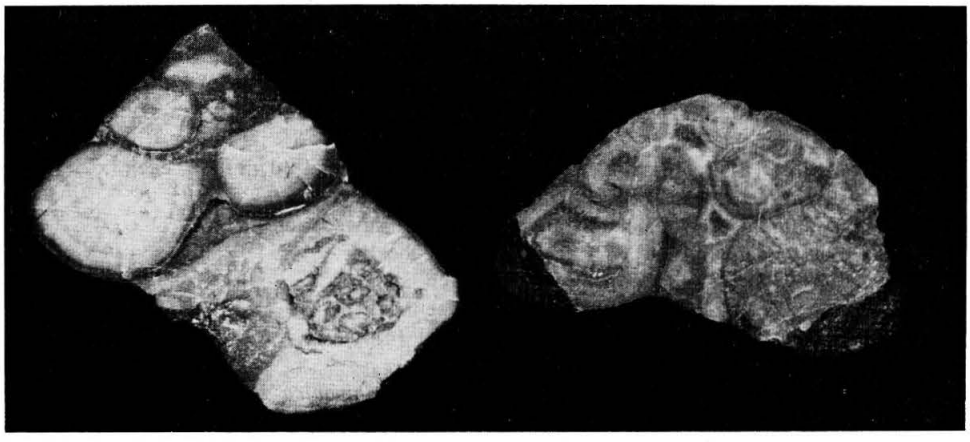
Description :—Shell small in the holotype and moderate in other specimens, sub-lenticular; whorls consisting four and two-fifth volutions in the holotype, rapidly expanded; earlier whorls convex, later ones rather flattened; whorl cross section rounded trapezoid in the paratype B; spire very low, conical; spire angle approximately 128°, constant among specimens; protoconch apparently simple, dextral in the holotype; suture somewhat impressed; base gently rounded; umbilicus rather wide, phaneromphalous; selenizone narrow, convex and situated almost on the peripery on the last whorl but unvisible in the spire view owing of overlapping; ornamentation fine pustules collabrally lengthened from just below the upper suture to the position of one-third of the whorl surface; aperture sub-lenticular; outer lip thin, sharply angulated at the periphery; inner lip much curved, slightly thickened; parietal inductura mederately thickened; slit not observable.

Measurements :—

Specimen	Number of whorls	Height	Diameter	Umbilical diameter	Spire angle
Holotype (ASM 5015)	4.4	10.0	18.5	6.5	128.2°
Paratype A (ASM 5016)	5.5	15.4	27.4+	—	128.2°
Paratype B (ASM 5017)	—	18.9+	31.4+	7.3	127.8°
Paratype C (ASM 5018)	—	19.0+	—	—	126.5°

Discussion :—The holotype is the least specimen, although in well-preservation. The paratype A and B are fragmentary and the paratype C is slightly deformed. The shell size is fairly variable but the spire angle is about constant. The paratype C bears very fine costae on the umbilical margin, which are not observed on the other specimens.

The present species is closely allied to the type-species, *Angyomphalus radians* (DE KONINCK), but readily separated from



Text-fig. 2. Colmellar sections of *Mourlonia* (*Mourlonia*) *hayasakai* sp. nov., paratype D (ASM 5005), left and *Angyomphalus hashimotoi* sp. nov., paratype B (ASM 5017), right. Each ×2.

it by absence of circum-umbilical funicule and having phaneromphalous umbilicus and weaker and longer pustules on the whorl surface. It is also closely related to *Angyomphalus junior* (DE KONINCK), but differs from that species in having much smaller spire angle and larger shell size. The present species is named after Mr. Kyoichi HASHIMOTO, who kindly put all his collections at our disposal.

Occurrence:—The present species occurs in the *Fusulinella biconica* zone of the Akiyoshi Limestone Group.

Repository:—Type-room of the Akiyoshi-Dai Science Museum, Yamaguchi Pref.

Angyomphalus (?) *okafujii* sp. nov.

Plate 25, Fig. 5

Material:—Holotype (ASM 5030) collected by Goro OKAFUJI from loc. 4.

Diagnosis:—Selenizone concave; upper whorl surfaces rather convex; umbilical margin ornamented by collabral costae; spire angle 164°.

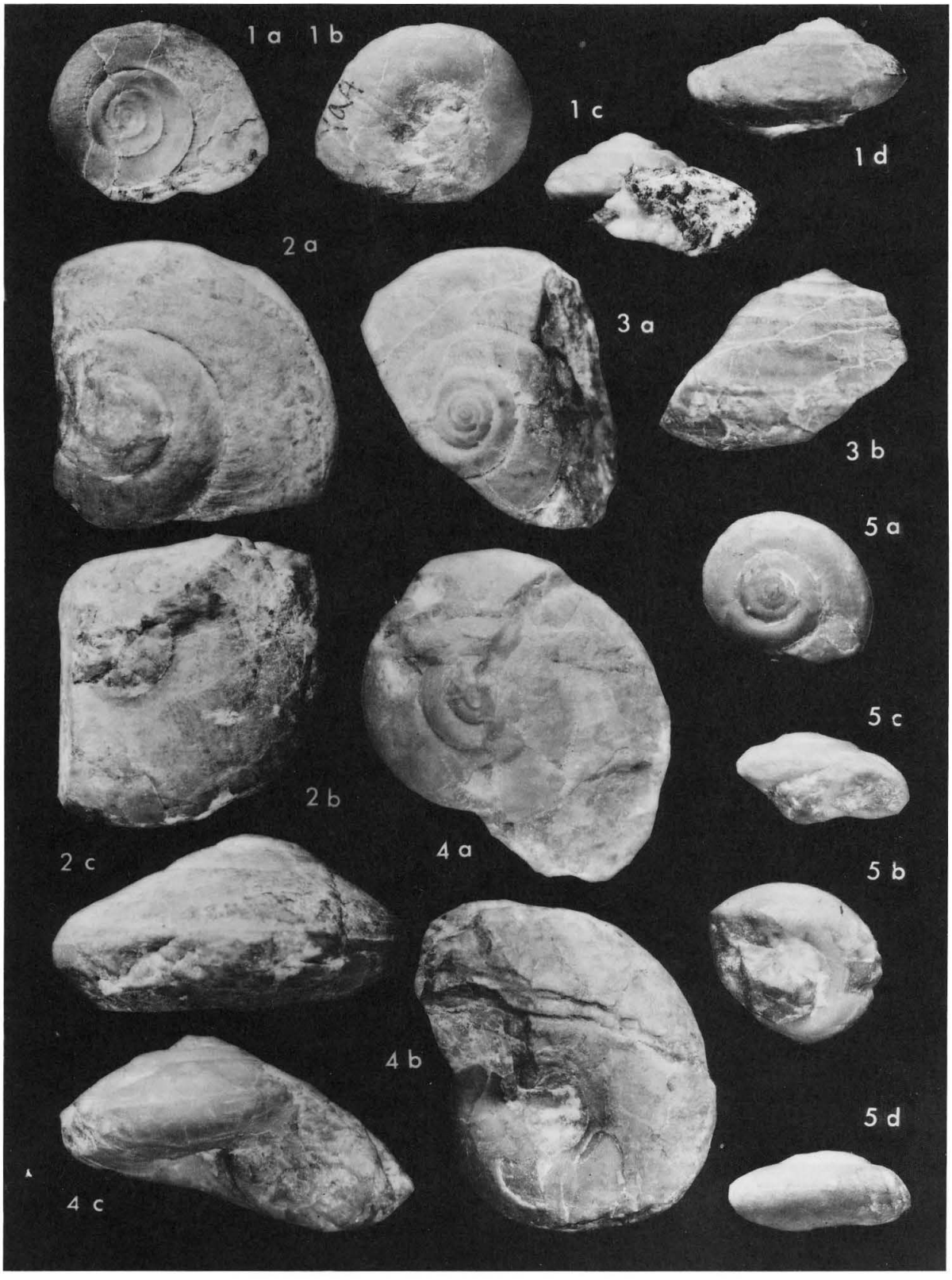
Description:—Shell small, 7.6 mm. in height, 15.2 mm. in diameter, sub-lenticular; whorls consisting of five and a half volutions, rapidly expanded; spire very low-conical; spire angle 164°; upper whorl surface rather convex; suture fairly impressed; base well rounded; umbilicus wide, 4.5 mm. in diameter, phaneromphalous; selenizone narrow, concave, situated almost on the periphery on the last whorl; ornamentation collabrally lengthened fine pustules which are prominent just below the upper suture; umbilical margin with prominent collabral costae; apertural characters not apparently observable.

Discussion:—Only one specimen is available at present. It is, however, so characteristic that the establishment of a new species is warranted. The present species is somewhat similar to *Angyomphalus hashimotoi*, n. sp. (*see* above description) in its sub-lenticular shell form and the mode of ornamentation. It differs, however, in the characters of the selenizone from all the known species of

Explanation of Plate 25

Figs. 1–4. *Angyomphalus hashimotoi* sp. nov.
1. Holotype (ASM 5015) from the *Fusulinella biconica* zone of the Akiyoshi Limestone Group at 20 m W of the entrance of Shuchikujo, Isa-machi, Miné City, Yamaguchi Pref.
   Apical (a) umbilical (b) apertural (c) and lateral (d) views, each ×2.
2. Paratype A (ASM 5016) from the type-locality.
   Apical (a), umbilical (b) and lateral (c) views, each ×2.
3. Paratype B (ASM 5017) from the type-locality.
   Apical (a) and lateral (b) views, each ×2.
4. Paratype C (ASM 5018) from the type-locality.
   Apical (a), umbilical (b) and apertural (c) views, each ×2.

Fig. 5. *Angyomphalus* (?) *okafujii* sp. nov.
Holotype (ASM 5020) from the *Fusulinella biconica* zone of the Akiyoshi Limestone Group at 70 m W of the entrance of Shuchikujo, Isa-machi, Miné City, Yamaguchi Pref.
Apical (a), umbilical (b), apertural (c) and lateral (d) views, each ×2.


1a 1b
1c
1d
2a
3a
3b
5a
5c
2b
4a
2c
5b
4b
5d
4c

Angyomphalus. Although better specimens are necessary for a more definite assignment, we temporarily place the present species under *Angyomphalus*.

Occurrence:—The present species occurs in the *Fusulinella biconica* zone of the Akiyoshi Limestone Group.

Repository.—Type-room of the Akiyoshi-Dai Science Museum, Yamaguchi Pref.

References

COSSMANN, Maurice (1915): *Essais de paléoconchologie comparée*. 10, 1-292, pls. 1-12. Paris.

DICKINS, J. M. (1963): Permian pelecypods and gastropods from Western Australia. *Bur. Min. Resour. Australia Bull.*, 63, 1-202, pls. 1-26.

HAYASAKA, Ichiro (1925): On the fauna of the Anthracolithic limestone of Omi-mura in the western part of Echigo. *Sci. Rept. Tohoku Imp. Univ.* [2], 8, 1-84, pls. 1-7.

—— (1943): On some Permian gastropods from Kinshozan, Akasaka-machi, Gifu Prefecture. Pt. 1. *Mem. Fac. Sci. Taihoku Imp. Univ.* [3], 1, (2), 23-48, pls. 1-5.

KNIGHT, B. J. (1933): The gastropods of the St. Louis, Missouri, Pennsylvanian outlier. V. The Trochoturbinidae. *J. Paleont.*, 7, (1), 30-58, pls. 8-12.

—— (1936): Notes on Paleozoic Gastropoda. *Ibid.*, 10, 7, 520-534.

—— (1941): Paleozoic gastropod genotypes. *Geol. Soc. Amer., Special Paper* 32, 510pp., 96 pls.

KONINCK, L. G. DE (1881): Faune de carcaire carbonifère de la Belgique, 3e partie, Gastéropodes. *Ann. Mus. Roy. d'Hist. Nat. Belgique, Sér. paléont.*, 6, 170pp., 21 pls.

—— (1883): Faune de carcaire carbonifère de la Belgique, 4e partie, Gastéropodes (suite et fin). *Ibid.*, 8, 240pp., 33 pls.

TORIYAMA, Ryuzo (1958): Geology of Akiyoshi, pt. 3. Fusulinids of Akiyoshi. *Mem. Fac. Sci. Kyushu Univ.*, [D], 7, 1-264, pls. 1-48.

Locality Guide

Uzura Limestone Quarry, 1200 m E of Yobara, Ofuku, Miné City, Yamaguchi Pref.
ウズラ採石場，山口県美祢市於福正原東方 1200 m.

150 m W of Shoboji, Isa-machi, Miné City.
美祢市伊佐町正法寺西方 150 m.

20 m W and 70 m W of the entrance of Shuchikujo, Isa-machi.
伊佐町種畜場入口西方 20 m および 70 m.

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 69, pp. 218-229, pls. 26, April 25, 1968

536. A FOSSIL ASSEMBLAGE OF *MACACA* AND *HOMO* FROM OJIKDO-CAVE OF HIRAODAI KARST PLATEAU, NORTHERN KYUSHU, JAPAN*

YOSHIKAZU HASEGAWA

Department of Paleontology, National Science Museum, Tokyo, Japan

HIROSHI YAMAUTI

Faculty of Education, Ehime University, Matsuyama, Japan

and

GORÔ OKAFUJI

Omine High School, Mine City, Yamaguchi Prefecture, Japan

平尾台カルストの牡鹿洞におけるニホンザルとヒトの化石群集：1962・1963年に日本ケイビング協会の主催で平尾台の総合調査を行なった際採集された脊椎動物化石と，その後地元から送られて来た資料をまとめて報告する。牡鹿洞の3個所から発掘された脊椎動物遺骸群集のうち，chamber 2 のニホンザル（17頭）とヒト（1人）だけからなる遺骸群集は，種類が少なく，種構成が特異であること，ニホンザルの個数が目立って多いことなどの点で極めて特殊なものである。現在までにニホンザルの化石に関する報告は数例あるが，いずれも骨格が部分的で少数発見されているにすぎない。現在集積しつつあるニホンザル遺骸群集は，多くの場合 Natural trap として竪穴についらくして形成されたもので，何個体かがそれぞれ完全に保存されていることが多い。牡鹿洞の場合には長骨または頭骨などの大きな骨格に偏っていて，指骨・脊椎骨など小さい部分はほとんど発見されていない。これらの点や堆積状態からみて，この遺骸群集形成の原因は Natural trap に落ちたものが，二次的に再堆積したものであろうと推定される。しかし，種構成の少ない点で Natural trap の一般的な例（chamber 1 または鳩穴）と異なる。ニホンザルとヒトの群集は縄紋時代またはそれ以前に形成されたものと考える。さらに，牡鹿洞からナウマン象およびカワウソの化石が産出したことは注目されることで，平尾台から最初の記録である。　　長谷川善和・山内　浩・岡藤五郎

Introduction

Hiraodai is one of the typical karst plateaus in Japan. The limestone body constituting Hiraodai is widely developed in the south of Kokura Ward of Kitakyushu City, stretching in a NE-SW direction. It abounds in caves and fissures, among which the Seiryukutsu-cave and the Senbutsudo-cave are famous since old days.

Of late, it has become known that there exist a considerable number of caves and fissures, in addition to the above-mentioned ones. Early in January, 1952 the

* Received August 3, 1967; read January 22, 1967 at Tokyo.

Japan Caving Club, supported by Kokura City, carried out a synthetic investigation of Hiraodai. In this investigation abundant animal remains were obtained from the Ojikado-cave, but the investigation was not completed at that time, so that the Ojikado-cave was reinvestigated later, from January 4 to 7, 1963. After that, the Higashidani-mura Agricultural Cooperative Association excavated part of the cave for the purpose of developing the Ojikado-cave as a sightseeing place.

The results of the two investigations and the excavation which was carried out several times revealed that the collected fossils included an unusual abundance of *Macaca* remains, and the writers thought it was certainly worthy of report. The present paper deals mainly with the *Macaca-Homo* assemblage from the Ojikado-cave. HASEGAWA, one of the writers, bears the responsibility of the discussion in this paper.

Acknowledgements

The writers' sincere gratitude is expressed here to Prof. Fuyuji TAKAI of the University of Tokyo and to Prof. Tokio SHIKAMA of the Yokohama National University, for their kind guidance throughout the present study. Thanks are also due to the following institutions and persons for their kind encouragement and valuable suggestions: Kokura Ward Office of Kitakyushu City; Yukuhashi City Office; Higashidani Village Office; Japan Caving Club; Messrs. Atsumaro YAMAZAKI, Yoshio MAEDA of Kokura Ward and Keiji HARADA of Higashidani Village; Prof. Hisashi SUZUKI and Dr. Banri ENDO of the University of Tokyo; Prof. Riozo YOSHI, Prof. Jiro IKEDA, Dr. Jun-ichiro ITANI and Dr. Sugio HAYAMA of Kyoto University; Dr. Masao KAWAI and Dr. Mitsuo IWAMOTO of the Japan Monkey Center; Dr. Minoru ASAHI of Mukogawa Women's College; Itsukushima Shrine Office; Cave Research Group of Yamaguchi University; members of the Expedition Department of Ritsumeikan University; Dr. Kiyotaka CHINZEI and Dr. Yasuhide IWASAKI of the University of Tokyo; Dr. Hiroshi OZAKI, Dr. Yoshinori IMAIZUMI, Dr. Shun-Ichi UÉNO, Dr. Ikuwo OBATA, Dr. Hiroshi UJIIÉ and Miss Reiko FUSEJIMA of the National Science Museum, Tokyo.

Geological background of Hiraodai

The Hiraodai plateau, having a height 400-600 m above sea-level, is considered an uplifted peneplain. Its northwestern part forms steep cliffs as high as 400 m or more. The southeastern part, on the contrary, slopes gently down toward the lowland. The surface of the plateau is marked with numerous dolines, ponors, caves and fissures. Relics of human life since the Jomon period are also known (HAMADA et al., 1952). The limestone forming the Hiraodai plateau is called Hiraodai limestone and is correlated with the Akiyoshi limestone of the Upper Paleozoic system (MATSUMOTO, 1951). Metamorphic rocks, mostly black to green phyllites, occur on the south side and beneath the limestone body with a conformable relation. On the northwest side, the limestone is in fault contact with a weakly metamorphosed Paleozoic formation consisting of muddy, siliceous and tuffaceous rocks. The general strike is N30°-60°E and the dip is 70°-90°NW. Intruding the limestone, hornblende-biotite granite is distributed. On account of this granite intrusion, the limestone was recrystallized and turned white and granular, so that its structure and occurrence of fossils remain unknown. The

area of distribution of the limestone is 7 km NE-SW by 3 km NW-SE.

Shape of Ojikado-cave

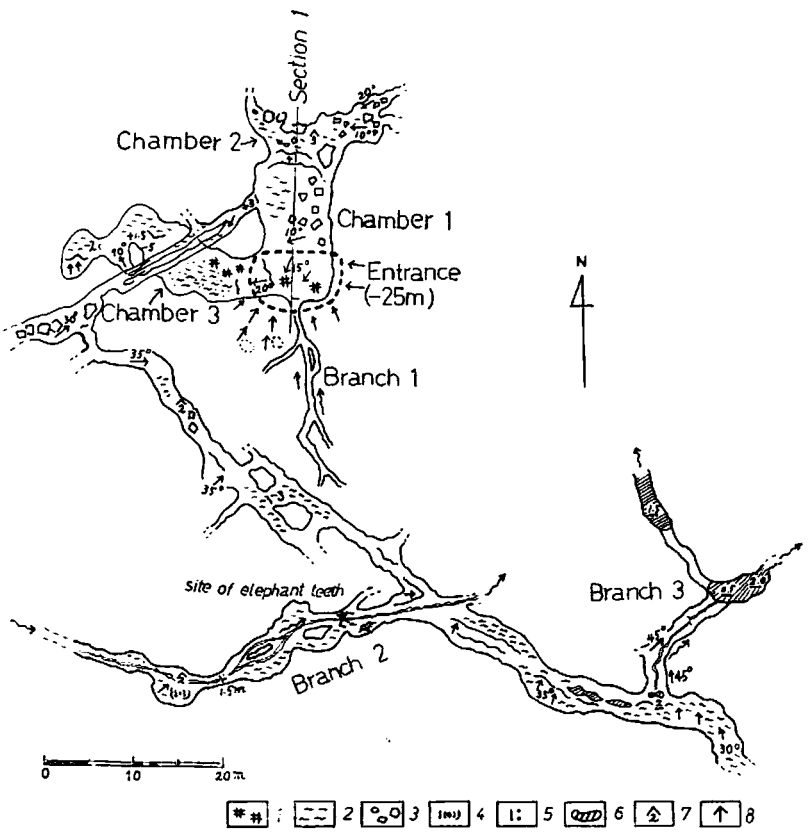
The Ojikado-cave is located at about 300 m south of Hirao Village which stands nearly in the center of the Hiraodai plateau. The cave was developed in a shallow doline about 50 m in diameter. The entrance is fairly large (Fig. 1) and the cave begins with a 25 m deep vertical hole. Just below the entrance spreads chamber 1 which is the largest. The main part of the cave is about 150 m long, and a total extension of explorable passages is about 300 m. Corrosion has advanced in the directions of N-S, NW-SE and NE-SW along faults or joints. Near the middle of the cave, a considerably swift stream is flowing from west to east (branch 2) across the main cave of a NW-SE trend. The innermost part of the main cave is blockaded with residual

Fig. 1. Entrance to Ojikado-cave. It falls directly down to the depth of −25 m. In winter, snow accumulates on the plateau.

clay. Before the cave ends there is another cave (branch 3) developed in a SW-NE direction, and water flows through this branch forming two pools. The pools are 1-2 m deep and the water seems to be sinking into the ground little by little. These branches cannot be entered as they become narrower ahead, so that little is known about them.

Cave deposits

Almost no travertine is developed in this cave, and neither stalactite nor stalagmite is worthy of mention, but residual clay is found from place to place. Humus soil is concentrated just below the entrance, occurring nowhere else. The fall of rocks is remarkable in chamber 2 where the remains of *Macaca* and *Homo* were found.



Map of Ojikado-cave (by Japan Caving Club)

Fig. 2. Map of Ojikado cave. Abbreviations in map: 1, humus; 2, clay; 3, limestone block; 4, stalagmite; 5, waterfall; 6, pool; 7, ceilling height 2 m; 8, surface dip.

A fairly large amount to vertebrate remains were collected from chambers 1 and 2 and branch 2. Branch 2 yielded one fragment of dental plate of *Palaeoloxodon naumanni* (MAKIYAMA), chamber 1 yielded 14 mammalian species and one each species of Aves, Amphibia and Chelonia, one each species of *Macaca* and *Homo* were obtained from chamber 2.

Vertebrate remains and deposits containing them

The remains of vertebrates collected

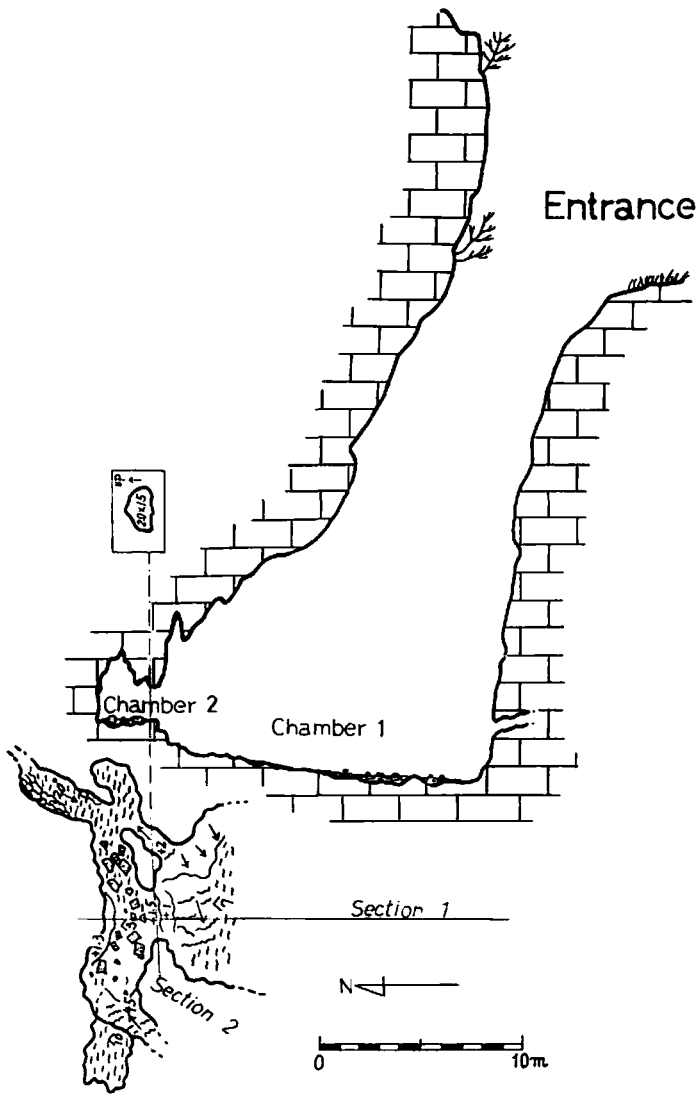


Fig. 3. Profile of Ojikado-cave along section 1 and horizontal section at chamber 2 area by H. YAMAUTI and Membership of Japan Caving Club.

from the Ojikado-cave are classified into three groups, by their locality and mode of occurrence.

1. *Elephant fossil*:—The fossil is a fragment, about one-third, of dental plate lacking its upper and lower ends. It was collected by the villagers, from the stream in branch 2 (Fig. 2), extending E-W across the central part of the main cave, and has been preserved at the Higashidani-mura Agricultural Cooperative Association. The surface of the fossil is smooth and mostly brown, partly milky white, in color. Judging from the width and thickness of the plate and from the state of enamel in the central part, (plate 1, figs. 5a-5b), the fossil is undoubtedly of *Palaeoloxodon naumanni* (MAKIYAMA). Its relation with the sediments is unknown. From the fact that fossils of this species are known in Akiyoshi and a few other areas of Honshu, it is considered that the elephant may have lived in nature, that is, it once inhabited the plateau. Or, its bones may have been brought onto the plateau by man, from the fact that a human bone is found in the same cave. At any rate, occurrence of an elephant fossil on the plateau is an important fact.

2. *Lutra assemblage*:—The deposits are distributed from chamber 1 just below the entrance and westward to chamber 3. The surface inclination is 10-15° in chamber 1, but it becomes rapidly steeper toward chamber 3, attaining to more than 20°. The humus is thin, not exceeding 10 cm, and it grades into the underlying blackish residual clay bed containing angular fragments of limestone; the boundary between the two is indistinct. It is reported that this clay bed was dug down to 1-1.5 m deep in the spring of 1963 when the foundation work of the ladder to be installed for the development of the Ojikado-cave was carried out. Vertebrate remains are found in both the humus bed and the clay bed. Collected specimens are mostly mixtures of the two beds. Accordingly, fossilization is advanced in some of them but not in others. *Macaca* remains are not numerous, but are exceedingly variable in size, and fossilization is far advanced, hardly distinguishable from those collected in chamber 2. The writers consider that these remains were transported by stream from chamber 2. The clay bed yields also *Lutra* remains (plate 26 figs. 4a-c). Since this is the only known occurrence of fossil *Lutra* in Kyushu, the writers decided to call the vertebrate remains in the clay bed by the name of Lutra assemblage. During the exploration of the cave, a wounded fox and two living terrapins were discovered.

These facts indicate that the *Lutra* assemblage occurring just below the cave entrance is fairly complex, including aninals of different ages.

3. *Macaca-Homo assemblage*:— In due north of chamber 1 right below the cave's entrance, chamber 2 is developed in an east-west direction (Fig. 2). It narrows eastward to a dead end. The rock fall to a pretty large scale is observed up to the middle part of this chamber, and as if burying the fallen rocks a sandy residual clay has accumulated. The clay is not stratified but its surface inclines several degrees to the west becoming steeper toward the inner part (Fig. 4). Therefore, the clay must have been deposited from the east to the center of the chamber. This clay bed is only 20-30 cm thick. Near the entrance of the chamber, which is more than 2 m higher than the floor of the main cave, the country rock is exposed (Fig. 5). From the clay and from its surface *Macaca* remains, as many as for 17 individuals, and one human humerus were

obtained. In a narrow branch cave (branch 1) extending on the west side of the main cave, one skull of *Macaca* was collected. This skull must have been deposited during the time when brnach 1 and chamber 2 were on the same level. As these remains occur in the position more than 2 m higher than the floor of chamber 1, they are considered to have been separated when chamber 2 was formed.

Mode of occurrence and preservation of

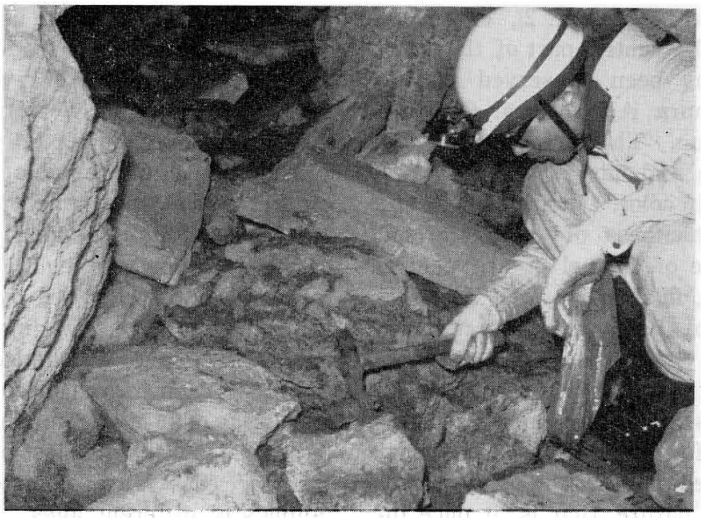


Fig. 4. Entrance to chamber 2. Bed rock is exposed. The passage leads to chamber 1 in the foreground.

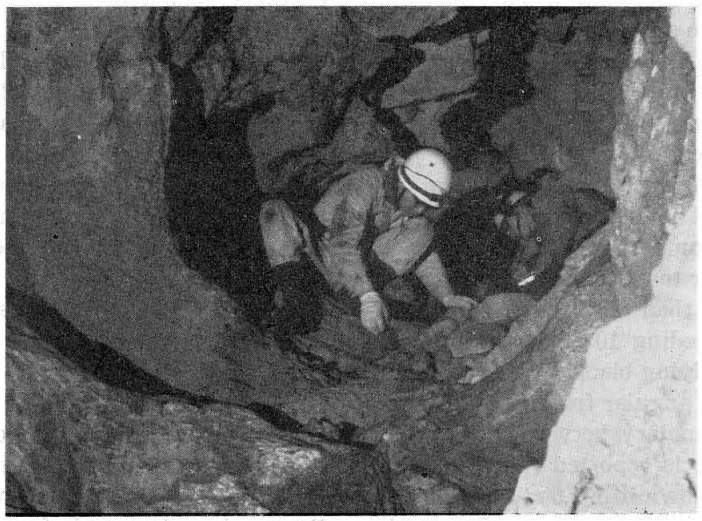


Fig. 5. Midway of chamber 2. Interspaces of large blocks of limestone are filled with residual clay. The blocks are thinly coated with cave tufa.

Macaca and Homo remains:—Most of the fossils obtained in 1962 were of surface collection. In 1963 excavation was carried out by removing the fallen rocks. From the result of the excavation, it is considered that the majority of remains was concentrated on the surface of the cave deposits, and very few were buried in the deposits. This is supported by the fact that many of the bones are

Table 1. List of the vertebrates from the Ojikado and Hato-ana cave, on Hiraodii Karst Plateau.

Species name	Ojikado cave			Hato-ana cave
	branch 2	chamber 2	chamber 1	
Mammalia				
Insectivora				
Mogera wogura (TEMMINCK)	—	—	*	—
Urotrichus talpoides TEMMINCK	—	—	*	—
Chiroptera				
Rhinolophus ferrum-equinum nippon TEMMINCK	—	—	*	*
Lagomorpha				
Lepus brachyurus TEMMINCK	—	—	*	—
Rodentia				
Clethrionomys sp. indet.	—	—	*	—
Petaurista leucogenys TEMMINCK	—	—	*	*
Carnivora				
Canis familialis LINNAEUS	—	—	*	—
Nyctereutes procyonoides viverrinus TEMMINCK	—	—	*	—
○*Vulpes vulpes japonica* GRAY	—	—	*	—
Meles meles anakuma TEMMINCK	—	—	*	*
Lutra lutra LINNAEUS	—	—	*	—
Martes melampus melampus WAGNER	—	—	—	*
Proboscidea				
Palaeoloxodon naumanni (MAKIYAMA)	*	—	—	—
Artiodactyla				
Sus scrofa leucomystax TEMMINCK	—	—	*	*
Cervus nippon TEMMINCK	—	—	*	—
Bos taurus LINNAEUS	—	—	—	*
Primates				
Homo sapiens LINNAEUS	—	*	—	—
Macaca fuscata BLYTH	—	*	*	*
Aves				
Gen. et sp. indet.	—	—	*	*
Amphibia				
Bufo bufo japonica SCHLEGEL	—	—	*	—
Reptilia				
◎*Clemmys japonica* (TEMMINCK et SCHLEGEL)	—	—	*	—

○: living ◎: living and remain *: present

thinly coated with travertine (pl. I). The specimens themselves are fairly well preserved. At least there are no specimens that look as though they were compressed under the fallen rocks. Collection in chamber 2 was conducted twice and the following result was obtained:

Macaca fuscata BLYTH

	Left	Right	
Skull	3+		
Mandible	3	4	(2 of which are combined)
Humerus	17	14	
Ulna	4	7	
Radius	5	8	
Vertebra	12		
Pelvic	4	1	
Femur	16	16	
Tibia	10	10	

Homo sapiens LINNAEUS

Humerus	1

Besides, some fragments of costa and skull were found but they are not worthwhile mentioning. It is noticeable that most of the collected remains are long bones or somewhat large parts of skeletons, and these bones are of different stages of growth, varying from maturity to juvenile. Nearly one half of the individuals are separate from epiphysial line, showing a considerably young stage.

The humerus of *Homo sapiens* is flat and delicate, much smaller than modern Japanese. It is smaller even for a woman. The both ends are missing. Osteologically this bone suggests a Jomon age type or even older (according to Prof. H. SUZUKI and Dr. B. ENDO).

Discussion:—The animal remains from the Hiraodai plateau bear a fairly important meaning when compared with the living fauna. In particular, the writers would like to emphasize here the characteristics and significance of the *Macaca-Homo* assemblage as observed in chamber 2. Such a large amount of *Macaca* remains is quite unique and has never been recorded so far.

Throughout the Japanese Islands, excepting Hokkaido, a large number of *Macaca* are living. Ecological studies of their groups in various parts of the country have much advanced with the efforts of the Primates Research Group of Kyoto University and others. Nevertheless, there still remain some difficulties in discussing the character of fossil remains from the hitherto obtained knowledge about living individuals. Discussion in this paper is based on the depositional environments, with reference to fossil examples observed in some other districts. As to the condition under which the *Macaca* remains were deposited, the surface of the clay bed in chamber 2 is inclining toward chamber 1, apparently showing a state of an inflow. The bones are not destroyed in spite of their occurrence among large blocks of rocks, and this may be explained that after the fall of rocks the clay flowed into the cave and filled the interspaces of rocks. The fact that the remains are mostly long bones and minute fragments are not found may be attributable to a kind of sorting in the depositional process. This is also verified by the occurrence of some small fragments in chamber 1 (supposing the water flowed from chamber 2 into chamber 1). However, the cause of deposition of such abundant remains, as many as for 17 individuals varying from adult to young as if constituting one group, is still unknown.

To explain this aggregation of remains two cases may be considered. One of them is mass dying of a group of monkeys for some reason or other. The other case is a long-term accumulation of dead bodies. In the former case, the following reasons can be given: (1) a contagious disease in the group, (2) starvation due

to shortage of food, (3) death from cold during severs winter months, (4) unforeseen accidents such as flood and landsilde, (5) damage given by human. The latter case implies that the cave served as a natural trap.

According to a personal communication of Dr. Masao KAWAI, a group of monkeys, named K, group inhabiting the vicinity of Kankakei on the island of Shodo-jima, Seto Inland Sea, has been observed, by Mr. Munechika YAMADA and others, to go in and out of caves all the year round. However, existence of remains in a mass has not been reported. As an example of mass death, it is said that the monkeys which inhavited an island of Hiroshima Prefecture, the island where the Itsukushima Shrine is located, were totally annihilated by disease in about 1884 or 1885, and dead bodies were found everywhere. However, this information is nothing but an oral communication and there remains no record that verifies the disaster. One of the femurs shows a sign of caries (Pl. 1, fig. 1r), which is probably due to a fracture of the bone, judging from other similar cases. In the anatomical observations of living individuals, too, fracture of femur is often recognized (according to the talk of Dr. Mitsuo IWAMOTO), so that the above-mentioned sign of caries is not so significant as to point out the existence of any epidemic disease.

An unforeseen disaster or an extreme lowering of temperature can be a cause of mass destruction, but the writers have no positive evidence of such events or comparable references.

As to the possibility of natural trap, there are known cases of a considerable number of *Macaca* remains occurring in the caves in various parts of the country, but in each case the remains were found in a vertical hole, and were mostly located at about just below the hole's entrance. Some examples are given below.

Furen-shindo cave, Oita Prefecture .. .. 2 skulls
Hato-ana cave, Hiraodai, Kitakyushu City ..... 1 skull
Kuriyama-no-ana, Yamaguchi Prefecture ..... 3 skeletons
Sugiedo cave, Yamaguchi Prefecture ..... 2 skeletons
Ōkimigahata-no-ana cave, Mie Prefecture ..... 2 skeletons

These bones were obtained only by surface collection in the course of caving, so the number will increase if excavation is carried out. The above records suggest that the monkeys fellinto vertical holes for some reason or other. Though the reason is unknown, the significance of caves serving as natural trap is important. In the case of the Ojikado-cave also, the writers provisionally hold a view that the cave was a sort of natural trap for the animals, and their remains, once concentrated where they fell, were transported later and secondarily aggregated at the locality of collection, and that during the transportation the bones were subjected to sorting.

Occurrence of *Macaca* remains in Pleistocene cave deposits is known in various parts of the country (SHIKAMA, 1945; SHIKAMA and OKAFUJI, 1958; TAKAI, 1959; SHIKAMA and HASEGAWA, 1962; TAKAI and HASEGAWA, 1966; NAORA, 1954 etc.), but all the reamins are partial and incomplete. It is interesting that coexisting mammalian fossils are also fragmentary. This may indicate that individual bodies were broken into parts and decomposed in a long lapse of time.

However, the above-mentioned view of the writers is not plausible enough. Because, in caves or fissures that are generally regarded as natural traps, animal remains are of fairly variable

kinds and of considerable amounts, as observed in the Hato-ana cave or at the chamber 1 of the Ojikado-cave, whereas the *Macaca-Homo* assemblage consists only of two species, which is quite unusual. It is probable that the existence of *Homo* is a clue to solve the problem, although the writers are unable to give any reasonable explanation.

Age:—So far as known at present, no fossils in the Ojiako-cave point out a definite age. It is still unknown whether tne polished surface of the fragmentary dental plate of elephant is attributable to a natural agency or to human work. The remains in found in chamber 1 include the kinds which were apparently transported from chamber and also the remains of living kinds such as terrapin and fox, making the age determination very difficult.

But, as to the *Macaca-Home* remains in chamber 2, it can be concluded that the remains are older than the living kinds, as inferred from the depositional environment, and that the shape and size of the human humers suggest an age as old as, or even older than, Jomon age. On the basis of the epirical knowledge, the age of the cave deposits is considered to be late Pleistocene or latest stage of middle Pleistocene.

Conclusion—

(1) The assemblages of animal remains at three localities in the Ojikado-cave were described and their characteristics were discussed.

(2) In particular, the peculiarity of the *Macaca-Home* assemblage was pointed out and its significance was discussed. Although the data are deficient for age determination, the assemblage seems to belong to the Jomon period or somewhat older than that.

(3) In some respects, the cave or fissure would be reasonable regarded as natural trap.

(4) The remains from the Ojikado-cave, along with those from the 60 m deep Hato-ana (vertical hole), were listed. the list reveals that considerably variable kinds of vertebrates inhabited the Hiraodai plateau in the past.

References

HAMADA, S. *et al.* (1952): *Hiraodai Karst.* Vol. I, (No. 1-3), 44p. (in Jap.) Rigakkai-shi, Yamaguchi Prefecture.

HASEGAWA, Y. (1964a): Preliminary report on the Gansuiji Formation and Its fauna. *Sci. Rep. Yokohama Natl. Univ.*, Sec. II, pp. 71-78.

—— (1964b): Discovery of the remains of the common otter from Ojika-do (lime-

Explanation of Plate 26

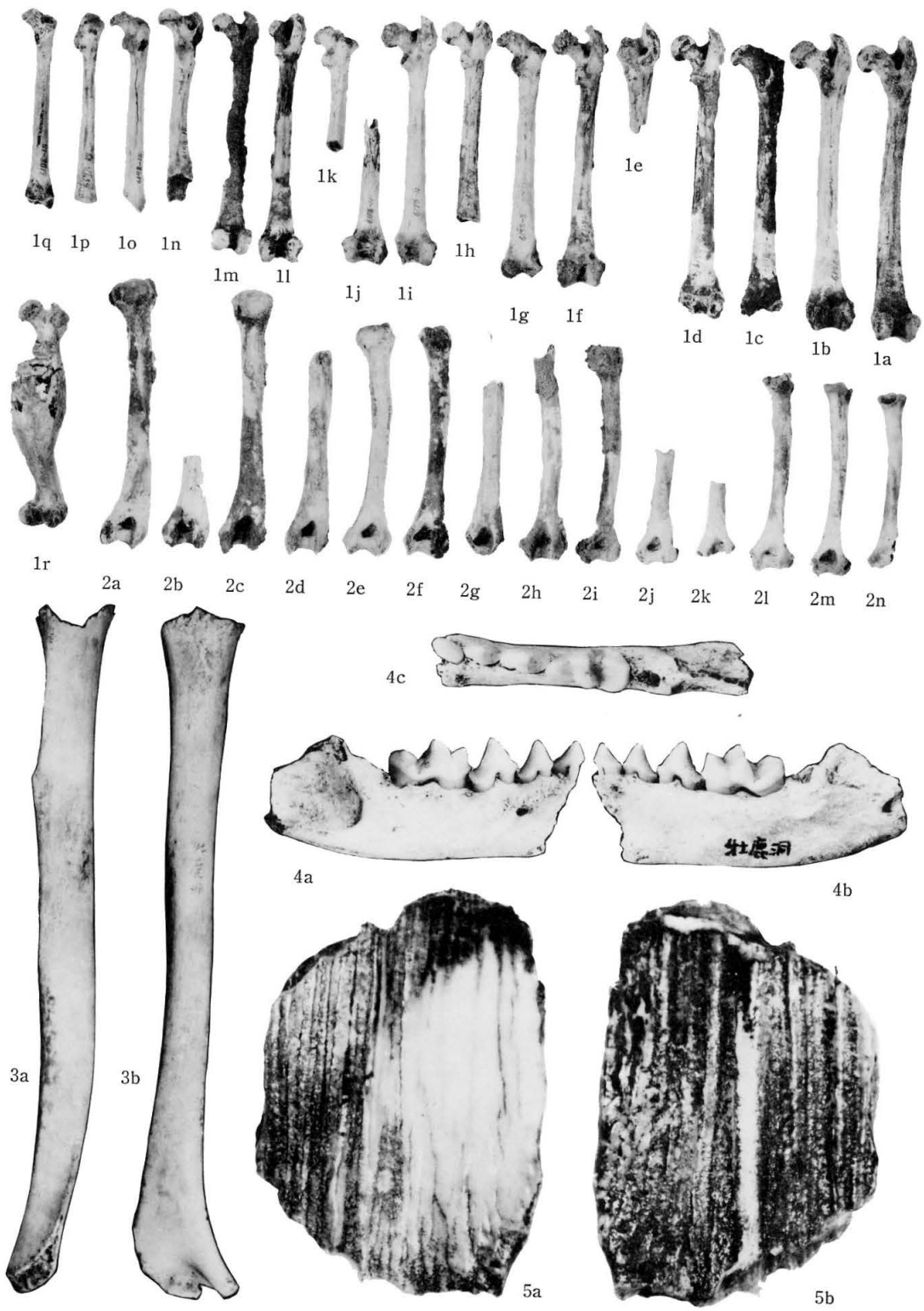
Figs. 1a~1r. Right femur of *Macaca fuscata* BLYTH, (NSMP. No. 6178-1~18). 1a and 1k are collected from the chamber 1, and the other specimens from the chamber 2. 1r is ankylosed femur.

Figs. 2a~2n. Right humerus of *Macaca fuscata* BLYTH, (NSMP. No. 6172-1~14).

Figs. 3a and 3b. Left humerus of *Homo sapiens* LINNAEUS, outer and posterior sides respectively, (NSMP. No. 6641).

Figs. 4a and 4b. Right mandible of *Lutra lutra* LINNAEUS, buccal, ligual and occlusal sides respectively, (NSMP. No. 6165).

Figs. 5a and 5b. Fragmental plate of *Palaeoloxodon naumanni* (MAKIYAMA), anterior or posterior side, (NSMP. No. 6164).


1q
1p
1o
1n
1m
1l
1k
1j
1i
1h
1g
1f
1e
1d
1c
1b
1a
1r
2a
2b
2c
2d
2e
2f
2g
2h
2i
2j
2k
2l
2m
2n
4c
4a
4b
牡鹿洞
3a
3b
5a
5b

stone cave), Hiraodai (Karst plateau), Kyushu, Japan. *Jour. Mamm. Soc. Japan.*, Vol. 2, No. 3, pp. 82–84, 1 text-fig. (in Jap.).

KAWAI, M. (1964) : *Ecology of the Japanese monkey*. Tokyo. (in Jap.).

KINOSHITA, K. *et al.* (1953) : *Hiraodai Karst.* Vol. II (No. 1–4), 48p. Kokura City. (in Jap.).

KIYOHARA, S. (1961) : Geologic structure of Palaeozoic limestone of Kyushu District. *Bull. Geol. Survey Japan*, vol. 12, No. 3, p. 244. (in Jap.).

KOKURA High School (1960) : *Studies of Hiraodai Plateau*. 36p., Kokura High School. (in Jap.).

MATSUMOTO, T. (1951) : An outline of the fundamental geologic structure in North Kyushu and West Chugoku. *Sci. Rep. Fac. Sci., Kyushu Univ., Geol.*, Vol. III, No. 2, pp. 37–48, 1 map. (in Jap.).

—— *et al.* (1961) : *Kyushu District, regional geology of Japan*. Tokyo. (in Jap.).

MIYASHITA, M. and N. KASHIMA (1962) : Geological considerations on the meandered caves of the Hirao-dai Karst, Kyushu., *Mem. Ehime Univ.*, Sec. II (Sci.), Ser. D (Earth Sci.), Vol. IV, No. 3, pp. 27–39. (in Jap.).

NAORA, N. (1954) : *Old stone age in Japan*. 298p. Waseda Univ., Tokyo. (in Jap.).

OKUMI, Y. and H. INOUE, (1953) : Limestone deposit at north-eastern part of Hiraodai, Fukuoka Prefecture. *Bull. Geol. Survey Japan*, Vol. 4, No. 3, pp. 209–214. (in Jap.).

SHIKAMA, T. (1949) : The Kuzuü ossuaries geological and palaeontological studies of the limestone fissure deposits, in Kuzuü, Totigi Prefecture., *Sci. Rep. Tohoku Univ., Sendai, Jap.*, 2nd Ser. (Geol.) Vol. XXIII, 201p. with XXXII pls.

——, and G. OKAFUJI (1958) : Quaternary cave and fissure deposits and their fossils in Akiyoshi District, Yamaguti Prefecture, *Sci. Rep. Yokohama Natl. Univ.*, Sec. II, No. 7, 103p. XV. pls.

——, and Y. HASEGAWA (1962) : Discovery of the fossil giant salamander (*Megalobatrachus*) in Japan, *Trans. Proc. Palaeont. Soc. Japan, N. S.*, No. 45, pp. 197–200.

TAKAI, F. (1959) : Das geologische Alter der Ushikawa-Spalte. (in Entdekung eines pleistozänen hominiden Humerus in Zentral Japan.), *Anthrop. Anz.* Jg. 23, 2/3, 232–235.

——, and Y. HASEGAWA (1966) : Vertebrate fossils from the Gansuiji Formation. (in Hamakita-man and the site of Nekata limestone quarry at Hamakita), *Jour. Anthropological Soc. Nippon*, Vol. 74, Nos. 750–751, pp. 55–67.

Hiraodai	平尾台	Ojikado	牡鹿洞
Seiryûkutsu	青龍窟	Senbutsudo	千仏洞
Furen-shindo	風連新洞	Hato-ana	鳩穴
Kuriyama-no-ana	栗山の穴	Sugiedo	杉江洞
Ōkimigahata-no-ana	大君ケ畑の穴		

PROCEEDINGS OF THE PALAEONTOLOGICAL SOCIETY OF JAPAN

日本古生物学会第97回例会は，1967年9月23日（土）午後1時より，東京上野，国立科学博物館において開催された（参加者35名）。

個　人　講　演

被子植物の起原に関する諸問題 ……浅間一男
Microfossils of the lowest part of the Taishaku Limestone (Studies of the stratigraphy and the microfossil faunas of the Carboniferous and Permian Taishaku Limestone in West Japan, No. 4) ……Kimiyoshi SADA
Distribution of living planktonic Foraminifera in the eastern Indian Ocean ……Hiroshi UJIIÉ
秩父盆地の有孔虫について ……栗原謙二
黄河盆地のカンブリア系化石層序 ……小林貞一
カンブリア紀における黄河盆地の古地理と生物界の変遷 ……小林貞一
Some gastropods from the *Millerella* Zone of the Akiyoshi Limestone Group (Molluscan paleontology of the Akiyoshi Limestone Group. Pt. IV)..Tamio NISHIDA
Upper limit of the Cretaceous Futaba Group. ……Ikuwo OBATA
Some Miocene limid fossils from the area around the Wanibuchi Mine, Izumo Province, Southwest Japan (代読)……Kazuo OKAMOTO & Mitsuo NAKANO
房総・三浦半島，中部更新統からの耳石 ……青木直昭
On Tertiary cyprinid fishes from Mae Sot Basin, Thailand ……Teruya UYENO

日本古生物学会第98回例会，及びシンポジウム「東南アジアに関する地質・古生物」は，1967年11月3日（金）・4日（土）両日にわたり，東北大学理学部地質学教室において開催された（参加者42名）。

シンポジウム「東南アジアに関する地質・古生物」

第1部　地　質

Mountain 州 Baguio の Miraodr 石灰岩 ……橋本　亘・佐藤　正
Marinduque 島の地史への寄与 ……橋本　亘・佐藤　正
ミンドロ島東南海岸の Manslay-Bongabon 付近の第三系 ……橋本　亘・佐藤　正
Reconnaissance survey of the geotectonics around the eastern Philippine Arc and Bisayan Basin……Nobu KITAMURA, Saburo KANNO & Tamio KOTAKA
台湾・琉球列島と本州の更新統の対比に関する二・三の問題……中川久夫・林　朝棨
東南アジアの白亜紀赤色砂岩層について ……小林貞一

第2部　古　生　物

ルソン島の白亜紀浮遊性有孔虫群 ……高柳洋吉
北ルソン Mountain 州の始新統とその化石 ……橋本　亘・佐藤　正
Fusulinacean fossils from Thailand, Pt. III. *Maklayia*, a new Permian Fusulinacean genus from central Thailand ……Kametoshi KANMERA & Ryuzo TORIYAMA
タイ Rat Buri 石灰岩中の蘚虫化石について ……坂上澄夫
Upper Triassic pelecypods from Singapore. ..Teiichi KOBAYASHI & Minoru TAMURA
バナイ島第三系の化石腹足類 ……首藤次男
台湾省屈尺付近産貝化石について ……菅野三郎・張　麗旭
タイワンユメハマグリ ……小高民夫
コラート統の植物化石について ……浅間一男
南西諸島及び台湾の第四紀後期石灰岩の年代測定結果……小西健二・木村敏雄

個　人　講　演

日本各地（主として横倉山）のシルル紀コノドントについて……小池敏夫・猪郷久義
中新世 *Thalassina* ……今泉力蔵
Dosinia kaneharai YOKOYAMA and its related species……Koichiro MASUDA
フィリッピンの地質構造について ……橋本　亘

日本古生物学会 1968 年度総会・年会及びシンポジウム「炭酸塩堆積物（岩）の生相と岩相」は，1968 年 1 月 26 日（金）・27 日（土）両日にわたり，九州大学理学部において行われた。尚シンポジウムを含む一部は，日本地質学会西日本支部と共催で挙行され盛況裡に終了した（参加者 75 名）。

特別講演

オストラコーダ分類の一例 ……花井哲郎

解説講演

有孔虫の系統分類とその殻構造 ……氏家 宏

個人講演

陸中における *Nilssonia* の進化……浅間一男

On a new species of *Dictyophyllum* (Dipteridaceae) from the Upper Triassic Formation in Southwest Japan. …… Gentaro NAITO

秋吉石灰岩層群産 *Codonofusiella* について ……石橋 毅

Lower Permian brachiopods from western central Shikoku, Japan …… Juichi YANAGIDA & Motome HIRATA

Some gastropods from the Middle Permian Takaoka Formation, Shikoku …… Tamio NISHIDA

ミンドロ島産ジュラ紀二枚貝数種について ……速水 格

三角貝の数量分類学的考察 ……速水 格・中野光雄

Evolution of the Nostoceratidae (Cretaceous heteromorph ammonoids) …… Tatsuro MATSUMOTO

A new heteromorph ammonoid genus from the Upper Cretaceous of Hokkaido …… Tatsuro MATSUMOTO & Yasumitsu KANIE

Two interesting heteromorph ammonoids from Hokkaido …… Tatsuro MATSUMOTO & Tatsuo MURAMOTO

Eocene Molluscs from the coal-fields of Kyushu, Japan ……Yasuhiko KAMADA

A revised classification of the group of *Nassarius* DUMÉRIL, 1806, of the family Nassariidae ……Tsugio SHUTO

On some Cenozoic cheloniids from North Kyushu ……Hiroyuki OTSUKA

On a new species of *Elaphurus* from the Akashi Group ……Hiroyuki OTSUKA

Biostrasigraphy of the Upper Carboniferous of the Kitaosoki Formation, Southeast Kanto Massif. ……Tomowo OZAWA

On the geographical and stratigraphical distribution of the Upper Paleozoic algal remains in the Circum-Pacific regions …… Riuji ENDO

フィリピン海深海底コアーの Discoasterids について ……高山俊昭

房総半島大田代層 O_7 直下の有孔虫群 ……青木直昭・栗原謙二

三浦半島からのいくつかの鮮新世－更新世有孔虫について ……青木直昭

腹足類の食性とその古生物学への応用（予報）……首藤次男

Biogenic pyrite from the Cretaceous formation of Sakhalin and Hokkaido …… George KATO

会長講演

微古生物学の最近の動向 ……浅野 清

（以下，日本地質学会西日本支部と共催）

特別講演

アジア東部のカンブリア紀古地理 ……小林貞一

シンポジウム「炭酸塩堆積物（岩）の生相と岩相」

本邦産新生代浅海成石灰岩の堆積相 －"琉球石灰岩"を中心として－ ……小西健二

秋吉石灰岩層群における礁性堆積物の生相と岩相……太田信機・太田正道・杉村昭弘

カンボジア，シソフオン石灰岩の生相と岩相 ……石井健一・加藤 誠・中村耕二

コノドントを伴う石灰質堆積相 ……猪郷久義・小池敏夫

三宝山帯石灰岩の生相と岩相 ……勘米良亀齢

総合討論

日本古生物学会特別号の原稿募集

PALAEONTOLOGICAL SOCIETY OF JAPAN, SPECIAL PAPERS NUMBER 14 を 1969 年度に刊行したく，その原稿を公募します。適当な原稿をお持ちの方は，次の事項に合わせて申込書を作成し，福岡市箱崎町　九州大学理学部地質学教室気付，日本古生物学会特別号編集委員会（代表者　松本達郎）宛に申し込んで下さい。

(1) 古生物学に関する論文で，欧文の特別出版にふさわしい内容のもの。同一の大題目の下に数篇の論文を集めたもの（例えばシンポジュウムの欧文論文集）でもよい。分量は従来発行の特別号に経費上ほぼ匹敵すること。学会から支出できる経費は 35 万円程度です。学会以外からも経費が支出される見込のある場合には，その金額に応じて上記よりも分量が多くてよい。

(2) 内容・文章ともに十分検討済の完成した原稿（または完成間近い原稿）で，印刷社に依頼して正確な見積りを算出できる状態にあること。なるべく原稿の写しを申込書とともに提出して下さい。（用済の上は返却致します）。

(3) 申込用紙は自由ですが，次の事項を明記し，〔　〕内の注意を守って下さい。

(a) 申込者氏名；所属機関または連絡住所・電話番号。〔本会会員であること〕。

(b) 著者名；論文題目。〔和訳を付記すること〕。

(c) 研究内容の要旨。〔800～1,200 字程度〕。

(d) 内容ならびに欧文が十分検討済であることの証明。〔校閲者の手紙の写しでもよい〕。

(e) 本文の頁数（刷上り見込頁数または原稿で欧文タイプ 25 行詰の場合の枚数――ただし，パイカーかエリート字体かを添記すること）；また本文中小活字（8 ポ組み）に指定すべき部分があるときは，そのおよその内訳（総頁に対するパーセント）；挿図・表の各々の数と刷上り所要頁数；写真図版の枚数。

(f) 他からの経費支出の見込の有無，その予算額，支出源。〔その見込の証明となる書類またはその写しを添えて下さい〕。〔1969 年度の文部省の刊行助成金を申請希望の場合も，その旨を上記に準じて添記して下さい〕。

(g) その他参考事項。原稿が未完成の場合には，申込時における進行状況ならびに完成確約年月日を必ず記して下さい。

(4) 申込締切 1968 年 11 月 15 日（消印有効），採否は 1969 年 1 月の評議員会で審議決定の上申込者に回答の予定です。ただしその前または後に，申込者との細部の交渉を，編集委員から求めることがあるかもしれません。

(5) 印刷予定論文が完全な場合には，決定後できるだけ早く印刷にとりかかる予定です。文部省の刊行助成金（「研究成果刊行費補助金」）を申請希望の場合には，学会から申請（例年は 2 月上旬中に申請締切）し，その採否・金額など決定後印刷にとりかかります。その場合は文部省との約束により，その年の秋（前例では 11 月 20 日）までに初校が全部出なければ，補助金の交付が中止されることになっています。

(6) 特別号の投稿規定はとくにありません，会誌に準じ，前例を参考とし，不明の点は編集委員会に問い合わせて下さい。経費がかかるので，特別な場合を除き，別刷は作成せず，本刷 25 部を著者に無料進呈します。それ以上は購入（但し著者には割引）ということになります。いくつかの論文を集めて 1 冊にするときには，世話人の方から指示して，体裁上の不統一のないようにして下さい。印刷上の指示事項が記入できるよう，原稿の左右両側・上下に十分空白をとって，タイプを浄書して下さい。

例　会　通　知

	開　催　地	開　催　日	講演申込締切日
99回　例　会	東　北　大　学	1968年6月22日	1968年5月20日
100回　例　会	金　沢　大　学	1968年9月22,23日	1968年8月20日

第100回例会（金沢大，地質）：コロキアム，化石硬組織内の天然同位体（世話人：小西健二・高柳洋吉）

News

日本古生物学会特別号第13号の発刊

PALAEONTOLOGICAL SOCIETY OF JAPAN, SPECIAL PAPERS NUMBER 13 —— Syôzo Nisiyama: The Echinoid Fauna from Japan and Adjacent Regions Part 2 (B5版，本文491ページ，49挿図，12図版〔Pls. 19-30〕，Pt. 1, 2を通じての索引付）が1968年3月16日出版となった。この出版には，文部省から研究成果刊行費補助金65万円を受けた，ここに発刊を報告し，会員各位の御支持に謝意を表する。なお本号は向う1ケ年間は1部5000円の定価で本会特別号編集委員会から直接購入できる。

学　会　記　事

- 1967年度中に会員大森隆一郎君が逝去された。
- 1967年度中の退会者は，（敬称略）小幡忠宏（特別会員），杉　智光，恒石幸正，松田時彦。
- 1968年度よりの入会者は（申込順・敬称略）荻野繁治，松村　稔，浅見清秀，斉藤　隆，Yin Ee Heng，笹川清一，杉村昭弘，松島義章，福田芳生，米谷盛寿郎，渡辺耕造，小川勇二郎，池辺展生（再入会）。
- 1968年度評議員会の席上，次の諸君が特別会員に推挙された，（敬称略，順不同）長谷川善和，早坂祥三，猪郷久義，石井健一，加藤　誠，松尾秀邦，村田正文，坂上澄夫，鈴木敬二，多井義郎，津田禾粒，氏家　宏。
- 学会誌論文賞が，1968年度総会の席上，鎮西清高・岩崎泰顕両君の「Paleoecology of Shallow Sea Molluscan Faunae in the Neogene Deposits of Northeast Honshu, Japan」に対して贈られた。
- 1968年度本会学術奨励金は，本邦新生代イタヤガイ科分類及び，中新世東印内層産軟体動物の古生態学的研究その他に功績のあった，増田孝一郎君に贈られた。尚本年度より，奨励金額は一件2万円となった。

○ 本会誌の出版費の一部は文部省研究成果刊行費による。

1968年4月20日　印　刷
1968年4月25日　発　行

日本古生物学会報告・紀事
新　篇　第69号
600円

東京大学理学部地質学教室内
日本古生物学会
編集兼発行者　花　井　哲　郎
（振替口座東京84780番）
印　刷　者　東京都練馬区豊玉北2ノ13
学術図書印刷株式会社　富　田　元

Regulations for Publication in Transactions and Proceedings of the Palaeontological Society of Japan

(Jan. 15, 1963)

1. Manuscripts considered for publication should have been read at the General Meeting or the Ordinarp meeting of the Palaeontological Society of Japan.
2. Manuscripts shall be written in European language, they should be typed (Pica) on one of standard-size (22.5×27.5 cm) paper and double-spaced throughout. Biological names should be in italics and be undealined by the author.
3. Manuscripts (including of text-figures, maps and tables) will be limited to 24 printed pages (less than 54 type-written pages).
4. Illustrations will be limited to two plates (14.2×20.0 cm).
5. Text-figures will be limited to 10 in number, not exceeding 60 tsubo in total area (1 tsubo is 1 square sun). They should be drawn carefully on white paper with drawing or Indian ink, letters used in the figures should be either printed or typed letters pasted-in. Figures may be reduced, so authors are requested to carefully select the size and thickness of the lines or letter used.
6. Maps should be accompanied with scale, fractions should not be used.
7. The author is requested to pay for any cost extending beyond the above stated regulations. In short manuscripts not exceeding 4 printed pages, the author is requested to pay the cost of all plates and of text-figures exceeding 2 in number or 12 tsubo in total area.
8. Manuscripts should have the title and a brief abstract in Japanese, (such will be added for persons not familiar with Japanese language).
9. Literature cited or referred to should be listed at the end of the manuscript in the form of bibliography. Bibliography should be arranged in alphabetic order of author and by year. The order will be, Author, Year, Titleof Paper, Name of Journal, Volume, Page, Plate, Figure, Map, Table.
10. The author's official address should be given below his name, under the title.
11. Palaeontological notes which can be fitted into less than one printed page (including figures, maps, tables) will be published in the order recieved as space becomes available.
12. The desired number of reprints should be indicated on the right corner of the front page of the manuscript. 100 reprints without cover, but will reference to volume, number and year will be furnished free of charge to the author (if more than one author is involved they shall be divided). Additional reprints will be furnished at the printers rate.

Editorial Regulations

1. The Editorial Staff will transact, preserve and edit the manuscripts.
2. When the Editorial Staff transacts a manuscript, a notification with date of acceptance will be sent to the author, if the manuscript is clear, and abides with the regulations.
3. Acceptance or non-acceptance of manuscripts will be decided by the Edtorial Council.
4. Manuscripts not accepted for publication will be returned to the author will notification from the Editor of the reason(s) for its rejection.
5. Manuscripts accepted will be published in the order received with the date of accetance indicated thereon.
6. Manuscripts whose contents are altered by the author after being accepted for publication, will have their date of acceptance changed.
7. Proof reading will be done under the responsiblity of the Publication Committee.