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447. BRACHIOPODS FROM THE LATE JURASSIC NAKANOSAWA FORMATION IN FUKUSHIMA PREFECTURE, JAPAN*

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北部阿武隈山地の上部ジュラ系中ノ沢層産腕足類3種：上部ジュラ系相馬層群中ノ沢層の小池石灰岩から産した腕足類3種 "*Terebratula*" *hataii* MORI, n. sp., "*Terebratula*" *iwaii* MORI, n. sp., "*Terebratula*" sp. について記載した。 森 啓

Introduction

It is known that the upper Jurassic Soma Group** distributed in the Soma District, Fukushima Prefecture, has yielded abundant fossils such as of corals, mollusks, brachiopods, and plants. The Soma Group which comprises chiefly sandstone, shale and limestone, can be classified into the following seven formations, from the older to the younger, namely, Kitazawa***, Awazu, Yamagami, Tochikubo, Nakanosawa, Tomizawa, and Koyamada formations. Among these seven formations the Nakanosawa consists mainly of dark gray medium grained sandstone overlain with white coarse grained sandstone in the lower, succeeded upwards with calcareous sandstone and impure limestone. The latter rock yielded the brachiopods described in this article.

Although paleontological studies have been published on the fossils from the Jurassic Soma Group, this may be the first systematic work on the brachiopod fauna of the Nakanosawa formation. This formation was correlated with the Oxfordian to Kimmeridgian by MASATANI (1950) from the occurrence of *Aulacosphinctoides* cf. *steigeri* (SHIMIZU), *Virgatosphinctes* sp. besides others.

Little is known of the brachiopod fauna of the Mesozoic Era of the Japanese Islands except for the works of TOKUYAMA (1957, 1958, 1959) who studied the brachiopods from Shikoku in Southwest Japan.

Concerning classification of the brachiopods, it was already pointed out by MUIR-WOOD (1936, 1937) that a natural classification of the Mesozoic Telotremata should be based upon the external and internal characters. Although this is well known, the collection of brachiopods at hand comprises only a few specimens. According to this reason the internal characters could not be studied. However, it is thought that their descriptions may be a contribution to the upper Jurassic brachiopod-fauna of the

* Received June 14, 1962; read June 2, 1962.

** The name of the Soma Group although first proposed for the Tertiary formations, is in general usage and popular as a unit of the Jurassic. For this reason the name will be retained for the Jurassic System in the present area.

*** New stratigraphic term proposed for the preoccupied Hatsuno formation of KITAMURA, SHIBATA and UEDA (1955).

Japanese Islands.

So far as the external characters are concerned, the specimens at hand could not be identified with previously described species reported from abroad or from the Japanese Islands. Among the three species of brachiopods described in this article from the limestone of the Nakanosawa formation, two are considered to be new to science and one is specifically indetermined.

Acknowledgements

The writer wishes to express his sincere gratitude to Professor Kotora HATAI of the Institute of Geology and Paleontology, Tohoku University, for his kind guidance and constant encouragement throughout this work. He also thanks Professor Jun-ichi IWAI of the same Institute for his kind offer of the specimens upon which this article is based. Deep appreciation is due to Dr. Kunihiro ISHIZAKI of the same Institute for his valuable suggestions. Thanks are expressed to Mr. Kimiji KUMAGAI for taking the necessary photographs.

Systematic Descriptions

Superfamily Terebratulacea WAAGEN, 1883

Family Terebratulidae GRAY, 1840

Genus *Terebratula* MÜLLER, 1776

"Terebratula" hataii MORI, n. sp.

Pl. 7, figs. 1-5.

Description:—Shell biconvex, subpentagonal, moderate in size, somewhat longer than wide, maximum width at middle of length. Commissures straight posteriorly, curved gradually dorsally; anterior commissure with sharp uniplicate fold. Dorsal or brachial valve subcircular, less convex than ventral, sculptured with periodic, weak concentric growth lines. Hinge-line arched rather acutely. Ventral valve nearly twice as deep as dorsal, evenly convex, maximum convexity slightly posterior to middle of length, rather sharply curved dorsally near beak. Beak pointed, pierced with small, circular foramen, mesothyrid, erect, separated from hinge-line with conjunct deltidial plates or symphytium which is both curved and short; surface with obscure concentric growth lines. Shell structure punctate and more or less fibrous. Weak, obscure radial threads exposed on undersurface. Length (in mm) 34.6, width 32.0, thickness 15.4 (Holotype).

Remarks:—Judged from the dorsal valve which has lost most of the original shell layer, there seems to have been a sharp, thin, median septum extending anteriorly to near the middle of dorsal-valve length, and a short longitudinal median depression below the beak in the ventral valve. The beak ridges are not sharp although narrowly rounded. Since no radial sculpture can be observed on the dorsal valve and only faintly on the anterior half of the ventral valve, it appears as if the radials were not originally external but internal.

This species is similar to *"Terebratula" richardsoni* MUIR-WOOD (MUIR-WOOD, 1936, p. 83, pl. 3, fig. 11) from the Fuller's Earth Rock in outline of the shell, but the former is distinguishable from the latter by the erect and less projecting beak, and shape of the ventral valve.

"Terebratula" insignis SCHÜBLER (DAVIDSON, 1851-2, pp. 47-48, pl. 13, fig. 1) from the Coralline Oolite of Malton, which was referred to the genus *Neu-*

mayrithyris TOKUYAMA (TOKUYAMA, 1958, p. 120) is another species resembling the present one, but differs from the latter in having more convex and ovate shaped valves, and in lacking a median septum.

From the faint radial threads observed on the anterior half of the shell resemblance is found with the genus *Somalithyris* MUIR-WOOD (1935, p. 124), which is stated to range from Divesian to Argovian. However, the characters of both beak and foramen of that genus are apparently different from those of the present species. The genus *Weldonithyris* MUIR-WOOD (1952, p. 130) is another related genus to the present species from the Soma District, being similar in the possession of the thread-like median septum but differing in external features. Therefore, the present species, *hataii* and *iwaii*, although showing resemblance with the genera *Somalithyris* and *Weldonithyris*, are referred to the genus "*Terebratula*" in broad sense because the internal characters could not be studied.

Occurrence:—The limestone of the upper part of the Nakanosawa formation at Koike, Kashima-machi, Soma-gun, Fukushima Prefecture. IGPS coll. cat. no. 79324 (Holotype).

"*Terebratula*" *iwaii* MORI, n. sp.

Pl. 7, figs. 6-9.

Description:—Shell biconvex, oval, longer than wide, widest near middle of shell length, nearly equally convex, but the ventral deeper than dorsal. Lateral commissures straight, anterior one rectimarginate. Both valves sculptured with obscure concentric growth lines and with faint radials on anterior half observed by reflected light. Test finely punctate. Beak moderately swollen, suberect, symphytium or deltidial plates short, conjunct, beak ridges rounded, foramen subcircular. Hinge-line broadly acute. Dorsal valve with short, slender median septum extending anteriorly to about one fourth length of dorsal valve. Length (in mm) 20.0, width 18.4, thickness 7.9.

Remarks:—Among the species reported from the Japanese Islands, the present one is similar to *Neumayrithyris torinosuensis* TOKUYAMA (1958, pp. 122-126, pl. 9, figs. 1-6) from the Sakawa Basin in Kochi Prefecture in the shell outline, but it is distinguished by having more straight anterior commissure.

"*Terebratula*" *anaiwensis* TOKUYAMA (1958, pp. 126-128, pl. 9, figs. 7-8) also from the Kochi Prefecture is also similar to the newly described species, but can be distinguished from the present one by having more plano-convex valves and more projected beak. Because the internal structures of the present specimen remain unknown further comparison is not possible.

Occurrence:—The limestone of the upper part of the Nakanosawa formation at Hayama, Kashima-machi, Soma-gun, Fukushima Prefecture. IGPS coll. cat. no. 79325 (Holotype).

"*Terebratula*" sp. indet.

Pl. 7, figs. 10-12.

Description:—Shell ovate, plano-convex, longer than wide, maximum width near middle of shell length. Dorsal valve nearly flat, sculptured with obscure concentric growth lines. Test finely and densely punctate. Lateral commissure slightly curved ventrally, anterior commissure almost rectimarginate. Ventral valve about two times or a little more convex than dorsal, maximum thickness or depth near or slightly posterior to

length of ventral valve. Beak moderately swollen, fractured. Hinge-line broadly arcuate. Surface smooth except for obscure concentric growth lines. Length (in mm) about 20.0, width about 15.0, and thickness 8.8.

Remarks:—The present specimen is fractured at its posterior part and thus details of beak, foramen and symphytium remain unknown. However, from the rectimarginate folding, slightly curved lateral commissure, convexity of the valves and similarity with the specimen described as "*Terebratula*" *iwaii*, it is thought to belong to the same genus.

Occurrence:—The limestone of the upper part of the Nakanosawa formation at Koike, Kashima-machi, Soma-gun, Fukushima Prefecture. (IGPS coll. cat. no. 79326).

References cited

BUCKMAN, S. S. (1917): The Brachiopoda of the Namyau Beds, Northern Shan States, Burma. *Palaeont. Indica, N.S., Vol. 3, No. 2*, 299 pp., 21 pls.

DAVIDSON, T. (1851-2): A Monograph on the British Fossil Branchiopoda, pt. 3, the Oolitic and Liassic Brachiopoda. *Palaeont. Soc. London*, 100 pp., 18 pls.

KIMURA, T. (1954): The Sandstone and Limestone of the Nakanosawa Formation. *Jour. Geol. Soc. Japan, Vol. 60, No. 701*, pp. 67-80. (in Japanese)

KITAMURA, N., SHIBATA, T. and UEDA, A. (1955): Geology and Tectonics in the Environs of Matsukawa-Ura, Soma City, Fukushima Prefecture. *Tohoku Univ., Inst. Geol. Pal., Contr., No. 45*, pp. 84-96. (in Japanese)

MASATANI, K. (1950): A Study of the Jurassic Formations in the Soma District, Fukushima Prefecture. *Jour. Geol. Soc. Japan, Vol. 56, No. 662*, pp. 499-505. (in Japanese)

—— and TAMURA, M. (1959): A Stratigraphic Study on the Jurassic Soma Group on the Eastern Foot of the Abukuma Mountains, Northeast Japan. *Japan. Jour. Geol. Geogr., Vol. 30*, pp. 245-257.

MUIR-WOOD, H. M. (1935): Jurassic Brachio-

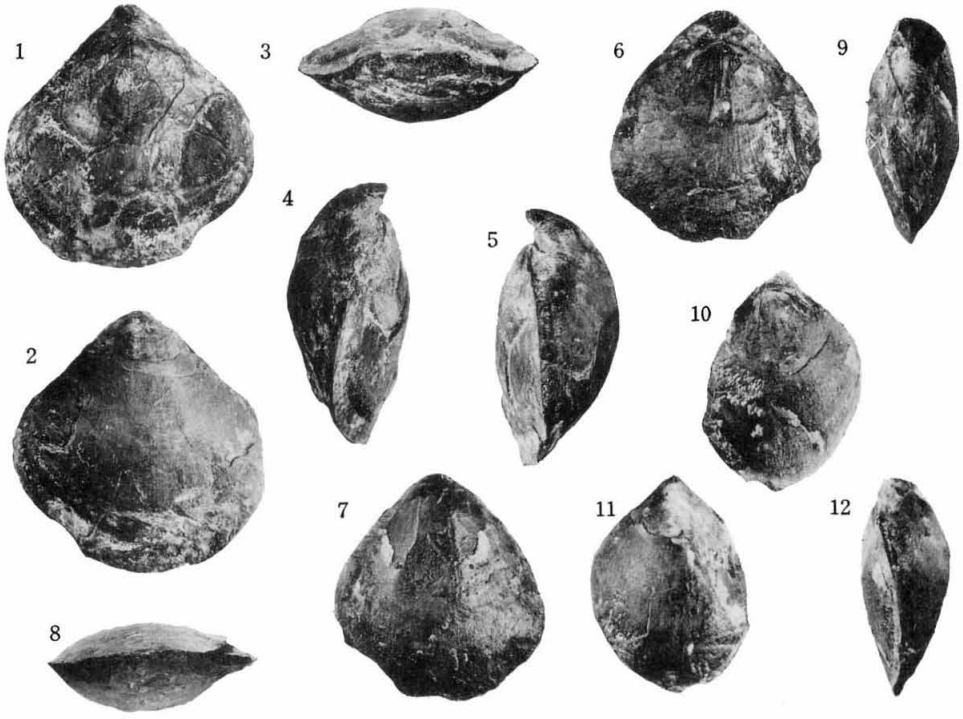
Explanation of Plate 7

Figs. 1-5: "*Terebratula*" *hataii* MORI, n. sp.; ×1, Loc. Koike, Kashima-machi, Soma-gun, Fukushima Prefecture.
1: Dorsal view of the specimen, Holotype
2: Ventral view of the same specimen
3: Anterior view of the same specimen
4-5: Lateral view of the same specimen

Figs. 6-9: "*Terebratula*" *iwaii* MORI, n. sp.; ×1.5, Loc. Hayama, Kashima-machi, Soma-gun, Fukushima Prefecture.
6: Dorsal view of the specimen, Holotype
7: Ventral view of the same specimen
8: Anterior view of the same specimen
9: Lateral view of the same specimen

Figs. 10-12: "*Terebratula*" sp. indet.; ×1.5, Loc. Koike, Kashima-machi, Soma-gun, Fukushima Prefecture.
10: Dorsal view of the specimen
11: Ventral view of the same specimen
12: Lateral view of the same specimen

Fig. 13: Photograph showing the occurrence of limestone in the upper part of the Nakanosawa formation at Koike.



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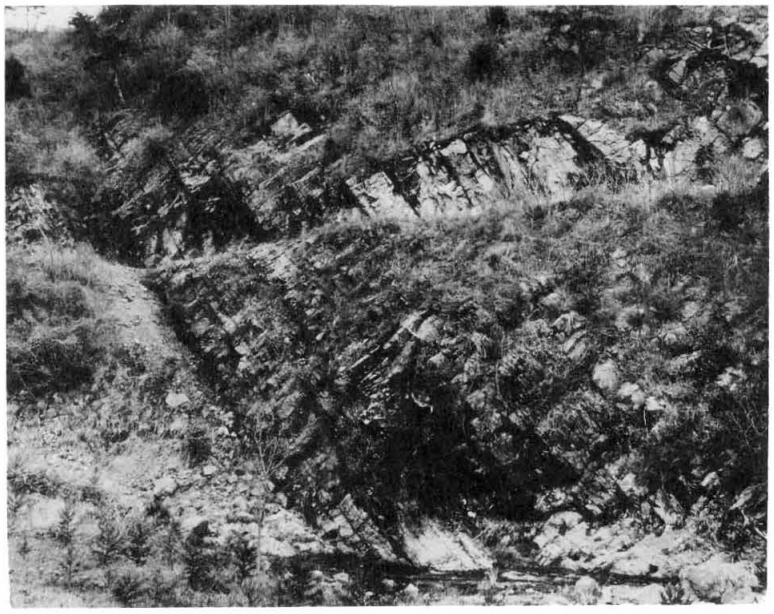

KUMAGAI photo

poda. *Geol. Pal., British Somaliland*, pp. 75-147, pls. 8-13, 33 figs.

—— (1936) : A Monograph on the Brachiopoda of the British Great Oolite Series, pt. 1, the Brachiopoda of the Fuller's Earth. *Palaeont. Soc. London*, 142 pp., 5 pls.

—— (1937) : The Mesozoic Brachiopoda of the Attock District. *Palaeont. Indica, Vol. 20, No. 6*, 34 pp., 1 pl.

—— (1952) : Some Jurassic Brachiopoda from the Lincolnshire Limestone and Upper Estuarine Series of Rutland and Lincolnshire. *Proc. Geol. Assoc., Vol. 63, pt. 2*, pp. 113-142, pls. 5-6, 5 figs.

SHIMIZU, S. (1927) : A Tithonian Species of *Perisphinctes* from the Torinosu Limestone of Koike, Province of Iwaki, Japan. *Japan. Jour. Geol. Geogr., Vol. 5, No. 4*, pp. 219-222.

—— (1930) : Notes on two Tithonian Species of *Perisphinctes* from Torinosu Limestone of Koike Province of Iwaki. *Ibid., Vol. 7, No. 2*, pp. 45-48, pl. 6.

TOKUYAMA, A. (1957) : On Some upper Triassic Spiriferinoids from the Sakawa Basin in Prov. Tosa, Japan. *Trans. Proc. Palaeont. Soc. Japan, N. S., No. 27*, pp. 99-106, pl. 17.

—— (1957) : On Some Jurassic Rhynchonellids from Shikoku, Japan. *Ibid., No. 28*, pp. 128-136, pl. 21.

—— (1958a) : On Some Terebratuloids from the Middle Jurassic Naradani Formation in Shikoku, Japan. *Japan. Jour. Geol. Geogr., Vol. 29*, pp. 1-10, pl. 1.

—— (1958b) : On some Terebratuloids from the Late Jurassic Torinosu Series in Shikoku, Japan. *Ibid., Vol. 29*, pp. 119-131, pl. 9.

—— (1959) : Bemerkungen über die Brachiopodenfazies der Oberjurassischen Torinosuserie Sudwestjapans, mit Beschreibungen einiger Formen. *Ibid., Vol. 30*, pp. 183-194, pl. 15.

Awazu	粟津	Nakanosawa	中ノ沢
Hayama	羽山	Tochikubo	栃窪
Kitazawa	北沢	Tomizawa	富沢
Koike	小池	Yamagami	山上
Koyamada	小山田		

Trans. Proc. Palaeont. Soc. Japan, N.S., No. 50, pp. 46-50, pl. 8, June. 10, 1963

448. A DIBRANCHIATE CEPHALOPOD FROM THE RIFU FORMATION (TRIASSIC) NEAR HAMADA, SHIOGAMA CITY, MIYAGI PREFECTURE, JAPAN*

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宮城県塩釜市西北方，利府，浜田附近の中部三畳系利府層の筒石類：*Atractites* 属の発見，記載を行った。 坂東祐司

Introduction and Acknowledgements

The Dibranchiate Cephalopoda described in this article was found in a dark colored fine-grained sandstone or coarse-grained siltstone which makes up the major part of the Rifu formation. This fine-grained rock is being quarried for construction purposes. The quarry is situated at about one kilometer northwest of the Hamada station along the Senseki Electric Car Line, Shiogama City, Miyagi Prefecture, and is well known for its yield of fossil cephalopods, pelecypods, gastropods, and brachiopods.

The Rifu formation has been described as to its geology and paleontology by YABE and SHIMIZU (1927-29), who determined the geological age to be Ladinic. Among the many fossils described by those authors the following should be mentioned because of their importance with the determination of the geological age of the formation, namely, *Myoconcha hamadaensis* YABE and SHIMIZU, *Daonella kotoi multistriata* YABE and SHIMIZU, and *D. densisulcata* YABE and SHIMIZU among the pelecypods, *Ptychites compressus* YABE and SHIMIZU, *Beyrichites chitanii* YABE and SHIMIZU, *Paraceratites* cf. *wardi* SMITH, *P. orientalis* YABE and SHIMIZU, *Nevadites* (?) *japonicus* YABE and SHIMIZU of the cephalopods, *Spiriferina kaneharai* YABE and SHIMIZU and *S.* cf. *lilangensis* STOLICZKA of the brachiopods, and besides, gastropods and drift woods also occur from the quarry above mentioned. The drift wood more or less resembles the genus *Lepidodendron*.

Subsequently, the present writer reported on the occurrence of *Protrachyceras reitzi* (BOECKH) from the same formation in 1958, and its detailes were reported by ONUKI and BANDO (1959), who added the following Ladinic fauna, *Ptychites* aff. *cognatus* (OPPEL), *Protrachyceras reitzi* (BOECKH), *Tropigastrites* aff. *halli* (MOJSISOVICS), *Japonites* aff. *ugra* (DIENER), and *Danubites* sp. They stated that this fauna should be correlated to the Ladinic ammonite zone represented by *Protrachyceras reitzi* Zone of the Alpine Muschelkalk.

With regard to the Triassic dibranchiate cephalopods from Japan only one species, *Dictyoconites nipponicus* SHIMIZU and MABUTI, has been described from the lowermost horizon of the *Monotis* beds of the Saragai group in the Kita-

* Received June 14, 1962; read at 81st annual meeting of the society at Kumamoto, June 2, 1962.

kami massif (SHIMIZU and MABUTI, 1940-41).

At present fossil organisms are frequently found from the quarry now being worked, but at the abandoned quarry it is difficult to find any organic remains. However, fortunately the specimen described in this article was found in the lower part of the quarry at the side of a small ditch almost covered with vegetation. At first it was thought to be some kinds of cylindrical sedimentary structures, but when it was sectioned longitudinally and transversally all characters as well as the peculiar very faint external sculpture led to identifying it as a dibranchiate cephalopod as described later.

Before entering into the description of the dibranchiate cephalopod the writer expresses his sincere thanks to Professor Kotora HATAI of the Institute of Geology and Paleontology, Tohoku University for kind submittance of the specimen collected by him to the writer's study. Acknowledgements are also due to Mr. Kimiji KUMAGAI and Mr. Akio ISHIKAWA, both of the same Institute for their photographic works and sectioning of the specimen.

Description of the Coeloidea

Family Belemnitidae de BLAINVILLE

Genus *Atractites* GUEMBEL, 1861

Genotype: *Atractites alveolaris* QUENSTEDT

1861. *Atractites*. GUEMBEL. *Gotha*, p. 475.
1882. *Atractites*. MOJSISOVICS. *Abhandl. d. k. k. Geol. Reichsanst., 10*, p. 299.
1886. *Atractites*. MOJSISOVICS. *Mem. Acad. St. Petersbourg, ser. 7*, T. 33, no. 6, p. 101.
1888. *Atractites*. HAUER, *Denkschr. Akad. Wiss. Wien, Bd. 54*, p. 3.
1896. *Atractites*. TOULA, *Beitr. Pal. und Geol. Oest.-Ung. u. des Orients, vol. 10, pt. 4*, p. 185.
1900. *Atractites*. HYATT, Text-Book of Palaeont. in Zittel, *vol. 1*, p. 595.
1902. *Atractites*. MOJSISOVICS, *Supplem. Ht.*, p. 192.
1905. *Atractites*. HYATT and SMITH, *U.S.G.S. Prof. Paper 40*, p. 204.
1907. *Atractites*. DIENER, *Mem. Geol. Surv. India, Pal. Indica, 15th ser. no. 2*, p. 21.
1920. *Atractites*. BÜLOW-TRUMMER, *Fossilium Catalogues. 1. Animalia, par. 11*, p. 64.

The Genus *Atractities* resembles *Aulacoceras* in the shape of phragmocone, but is distinguishable therefrom by having a large rostrum, smooth sides, and lacking lateral or longitudinal furrows. The phragmocone is divided by several septa into a number of chambers which are slightly concave towards the apical region. HYATT (1900) mentioned that the phragmocone is either smooth or with fine asymptotic lines, and that the dorsal area is marked with extremely fine growth-lines, convex toward the front. But in our specimen there could not be observed such ornamentation on the phragmocone. The rostrum and phragmocone sometimes occur detached. Therefore, from an only detached specimen of the phragmocone it may be mistaken for some other orthocone. The rostrum consists of calcareous matter which invests the conotheca. HYATT and SMITH (1905) designated this material as the calcareous sheath. The transverse section of the phragmocone, as stated by MOJSISOVICS, shows either a complete circle or elliptical shape. In the case of an elliptical transverse section, the ventrodorsal diameter is a little longer than the lateral diameter.

Most of the species of *Atractities* have been described from the Triassic, and are especially common in the Middle and Upper Triassic, but they have also been reported from the Lias.

Atractites hatai BANDO, n. sp.

Pl. 8, figs. 1–6.

The material described in this article comprises several fragments of the rostrum, some of which preserve the phragmocone. They all belong to a single species.

Rostrum with sides parallel, nearly straight, more or less oval in cross-section, surface retaining faint concentric undulations; about 160 mm in length, diameter about 21×18 mm in the broadest part and 17×15 mm in the narrowest part; wall thickness about 1 mm, inner wall with layer of calcitic material. Polished longitudinal section shows within a rapidly tapering internal cone, flaring at one end and terminating in rather sharp point at the other. Wall of internal cone, conotheca, consisting of calcitic layer. Four rather well defined, posteriorly concave, very thin partitions extending from one wall to the other, situated at middle to posterior part of cone. Cross section of specimen under microscope shows more or less eroded outer wall of calcareous material, whereas that of inner wall with better defined calcareous prismatic layer and a small circular siphuncular tube separated from but near to inner wall of conotheca. Siphuncular tube consisting of light brownish colored layer of calcium carbonate and almost perfectly circular in shape.

Length of phragmocone preserved 42 mm in cross-section, 9.5 mm in ventro-dorsal diameter and 9 mm in lateral diameter. Cross-section of phragmocone not a complete circle; unfortunately, larger portion of apical region missing. Angle of divergence 12°30′ along ventro-dorsal of phragmocone.

Cross-section of phragmocone shows conotheca to gradually increase in thickness dorsally. Longitudinal section shows septal space to be considerably larger than previously known species of *Atractites*.

Explanation of Plate 8

Atractites hatai BANDO, n. sp.

Fig. 1. Side view (natural size).

Fig. 2. Side view of same specimen with Fig. 1. Surface are ornamented with faint concentric undulations (natural size).

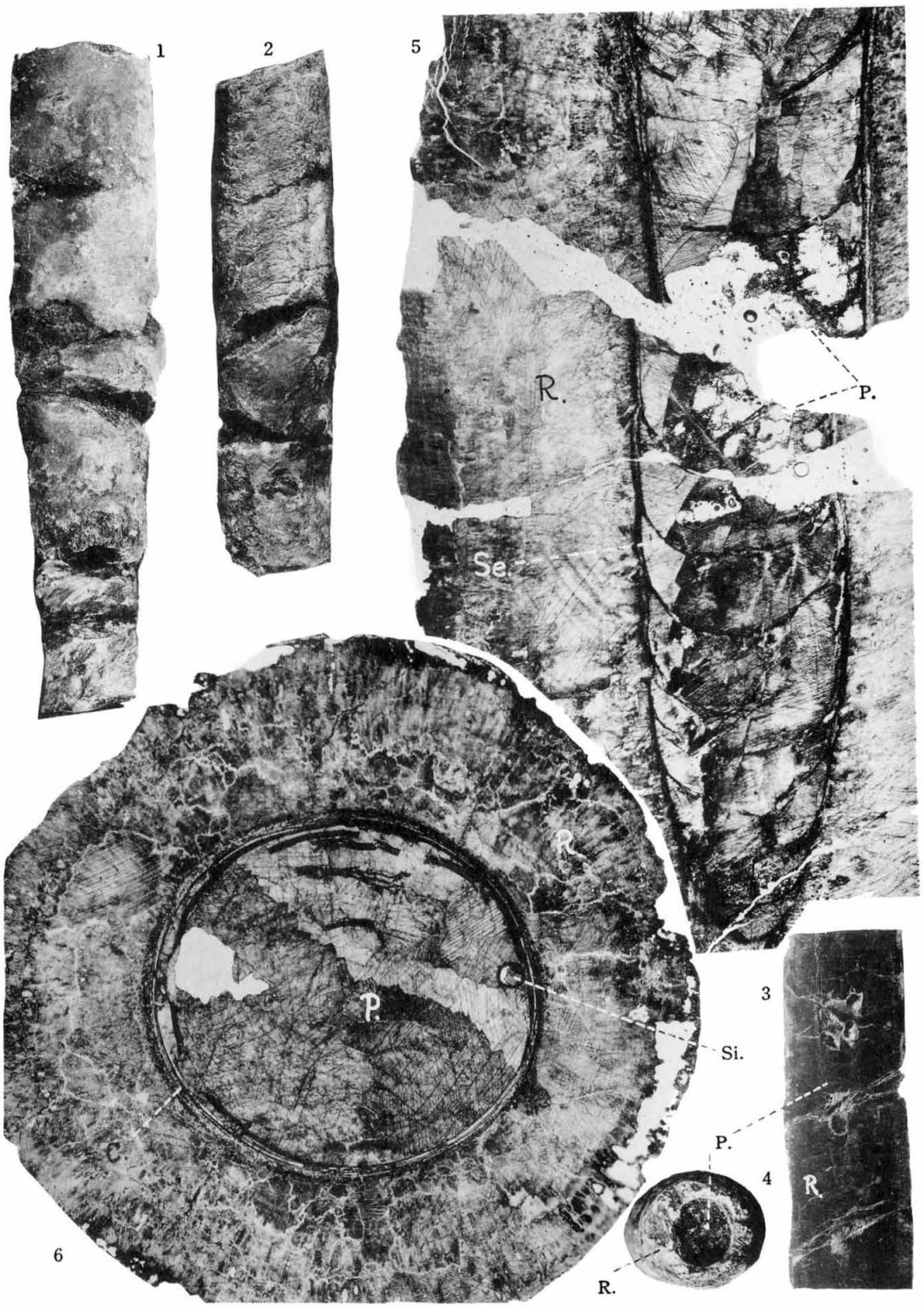
Fig. 3. Longitudinal section showing phragmocone and rostrum (natural size). (P: Phragmocone, R: Rostrum)

Fig. 4. Cross section of the above (natural size). (P: Phragmocone, R: Rostrum)

Fig. 5. Under microscopic view by longitudinal thin section showing phragmocone, rostrum, and septa. (×6) (P: Phragmocone, R: Rostrum, Se: Septa)

Fig. 6. Under microscopic view by tangential (ventro-dorsal) thin section showing siphuncle, phragmocone, rostrum, and conotheca. (×6) (P: Phragmocone, R: Rostrum, Si: Siphuncle, C: Conotheca)

From the Rifu Formation at about one Kilometer northwest of Hamada station along the Senseki Electric Car Line, Shiogama City, Miyagi Prefecture, Japan. Lower Ladinian, zone of *Protrachyceras reitzi* (BOECKH). All specimens here illustrated are preserved in the Institute of Geology and Paleontology, Tohoku University, Sendai, Japan. Coll. cat. no. IGPS 79170. Collection of K. HATAI.



KUMAGAI photo

Remarks:—This specimen is refered to the genus *Atractites* on the basis of the considerably larger guard, its smooth surface, no side furrows, and the features of the detachment of the rostrum and phragmocone. There is no lateral groove in this species as found on the rostrum as in *Aulacoceras*. Furthermore, there are no longitudinal ribs or furrows on the side as in the genera *Aulacoceras* and *Dictyoconites*. The situation of the siphuncle is marginal in the phragmocone as in those genera. Specifically the present specimens seem to be closely related to *Atractites cylindricus* HAUER* (HAUER, 1888) from the Bosnian Muschelkalk of Han Bulog in the form of rostrum, in cross-section and the length of the phragmocone, but HAUER's type species shows the divergent angle 9°-10° of the phragmocone.

In the ornamentation of the guard, *Aulacoceras* and *Dictyoconites* are related with one another in having numerous longitudinal furrows and ribs, but in *Atractites* the features are more similar to those of *Orthoceras* than to the above mentioned genera.

This species also resembles *A. solidus* SMITH from North America in the shape of phragmocone, especially in the divergence angle, but is distinguished from that species in the form and length of the rostrum.

The specific name is given in honor of Professor Kotora HATAI, who collected this specimen and encouraged the writer in this study.

Locality, geological formation and age:—Lower part of abandoned quarry at about one Kilometer northwest of Hamada station along the Senseki Electric Car Line, Shiogama City, Miyagi Prefecture. Rifu Formation (Upper Anisic to Lower Ladinic). *Protrachyceras reitzi* zone, associated with *Protrachyceras reitzi* (BOECKH), *Monophyllites wengensis* (KLIPSTEIN), "*Ptychites*" *compressus* YABE and SHIMIZU, *Daonella densisulcata* YABE and SHIMIZU, *Spiriferina* cf. *lilangensis* STOLICZKA, and other species.

Repository:—In the collection of the Institute of Geology and Paleontology, Tohoku University, Sendai, Japan. IGPS coll. cat. no. 79170. Coll. K. HATAI, July, 1958.

* *Atractites cylindricus* has been reported from the Alps by MOJSISOVICS (1882), HAUER (1888), MARTELLI (1904), KRAUS (1914, '16), and from the Himalayas by DIENER (1901).

References

BANDO, Y. (1958): On the Discovery and its Meaning of *Protrachyceras* from the Rifu Formation in the Kitakami Massif, Northeastern Japan. *J. Geol. Soc. Japan, vol. 64*, pp. 348-349.

BÜLOW-TRUMMER, E. von (1920): Cephalopoda dibranchiata, in DIENER. *Fossilium Catalogues. 1. Animalia, par. 11*, pp. 1-313.

DIENER, C. (1907): The fauna of the Himalayan Muschelkalk, Himalayan fossils. *Mem. Geol. Survey India, Pal. Indica, 15th ser. vol. 5, no. 2*, pp. 1-140, pls. 1-17.

GUEMBEL, C. W. v. (1861): Geognostische Beschreibung des bayrischen Alpengebirges und seines Vorlandes. *Gotha*, p. 475.

HAUER, E. v. (1888): Die Cphalopoden des bosnischen Muschelkalkes von Han Bulog bei Sarajevo. *Denkschr. Akad. Wiss. Wien, Bd. 54*, pp. 1-50, 8 pls.

HYATT, A. (1900): Cephalopoda. Text-Book of Palaeontology in ZITTEL, translated and edited by EASTMAN, vol. 1, p. 595.

HYATT, A. and SMITH, J. P. (1905): The Triassic Cephalopod Genera of North America. *U. S. G. S. Prof. Paper 40*, pp. 1-394, pls. 1-85.

KRAUS, R. (1914): Cefalopodi ljusturnoga vapnenca kraj Gacka u Hercegovini. Glasnik Zemaljskog Muzeja u Bosni i Harcegovini. *Anzeiger des Landesmuseums f.*

Bosnien und Herzegowina, vol. 26, p. 369-441, u. 495-550.

MARTELLI, A. (1904) : Cefalopodi triassici di Boljevici presso Vir nel Montenegro. *Palaeontogr. Italica vol. 10*, pp. 75-140, pls. 5-14 (1-10).

MOJSISOVICS, E. v. (1882) : Die Cephalopoden der mediterranen Triasprovinz. *Abh. geol. Reichsanst. Wien, 10*, pp. 1-322, pls. 1-94.

—— (1886) : Arktische Triasfaunen. Beiträge zur palaeontologischen Charakteristik der Arktisch-Pacifischen Triasprovinz. *Mem. Acad. Imp. Sci. Nat. St. Petersb., 7, vol. 33*, pp. 1-159, pls. 1-20.

ONUKI, Y. and BANDO, Y. (1959) : On the Inai Group of the Lower and Middle Triassic System. *Contr. Istitute Geol. Pal. Tohoku Univ., no. 50*, pp. 1-66.

—— and —— (1959) : On Some Triassic Ammonites from the Rifu Formation. *Ibid.*, pp. 67-80, pls. 1-3.

SHIMIZU, S. and MABUTI, S. (1940-41) : First Discovery of *Dictyoconites* from the upper Triassic of the Kitakami Mountainland, northeast Japan. *Jubilee Pub. in the Commemoration of Prof. H. YABE Sixtieth Birthday, vol. 2*, pp. 919-926, pl. 48.

SMITH, J. P. (1914) : The Middle Triassic Marine Invertebrate Faunas of North America. *U. S. G. S., Prof. Paper 83*, pp. 1-148, pls. 1-99.

TOULA, F. (1896) : Eine Muschelkalkfauna am Golfe von Ismid in Kleinasien. *Beitr. z. Geol. und Pal. Oesterreich-Ungarns u. des Orient, Bd. 10*, pp. 153-191.

YABE, H. and SHIMIZU, S. (1927) : The Triassic Fauna of Rifu near Sendai. *Sci. Rep. Tohoku Imp. Univ., 2nd ser. (Geol.) vol. 11*, pp. 101-136, pls. 10-14.

Hamada 浜田
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Saragai 皿貝

Trans. Proc. Palaeont. Soc. Japan., N.S., No. 50, pp. 51-64, pl. 9, June. 10, 1963

449. VERBEEKININAE FROM THE INFERRED UPPER WOLFCAMPIAN LIMESTONE IN THE WEST OF RYOSEKI, KOCHI PREFECTURE*

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高知県領石西方の Upper Wolfcampian 相当と思われる石灰岩より産出した Verbeekininae について：先に筆者 (1960) が報告した論文における新改層の，とくにその南翼について，より詳細な生層序学的検討を試みた。これより *Brevaxina* 1 種と *Misellina* 4 種を識別し，記載した。更に，生層序学的，並びに岩石層序学的な考察をなし，従来報告されている属種のそれらと比較検討した。

石 崎 国 熙

Introduction

In 1960, the writer described the geology and tectonics of the Paleozoic rocks distributed in the area northeast of Kochi City, and recognized eight formations.

In the present paper, brief accounts are given on the stratigraphy of the Shingai formation, one of the eight above mentioned, and of the stratigraphic succession of its fusuline fauna discriminated from the limestone which forms the larger part of the formation there.

Paleontologically, a total of five species of fusulinids distributed among the two genera, *Misellina* and *Brevaxina* are described, and two of them are considered to be forms undescribed to the present. Furthermore, an attempt is made to compare the species from the present area with those of other regions both in Japan and Indo-China where extensive studies on the genera have been made, and also to conjecture the time when the genera *Brevaxina* diverged from *Misellina*.

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Synopsis of the Genera *Misellina* and *Brevaxina*

Misellina claudiae (DEPRAT) was first described by DEPRAT (1912) from Indo-China in association with his "distinct ouralien" fauna which is said to be characterized by the assemblage of *Parafusulina multiseptata* (SCHELLWIEN), *Pseudofusulina complicata* (SCHELLWIEN), *Pseudof. tenuissima* (SCHELLWIEN), *Pseudof. globosa* (DEPRAT), *Pseudof. subcylindrica* (DEPRAT), *Misellina termieri* (DEPRAT), and *Mis. minor* (DEPRAT), etc.

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Subsequently, the species has been reported from various horizons of many other regions in Japan and foreign countries. DEPRAT also, in 1915, reported many other species of *Misellina* and *Brevaxina* such as, *Brevaxina compressa*, *Mis. ovalis*, *Mis. parvicostata*, *Mis. termieri*, *Mis. minor*, and *Mis. subelliptica* from the Permian limestone of Cam-mon in Indo-China. *Brevaxina compressa* and *Misellina ovalis* occurred in association with one another. *Misellina parvicostata* was reported in association with *Schwagerina japonica* (GÜMBER) and *Pseudofusulina paraumvoluta* (DEPRAT), etc. *Misellina subelliptica* (DEPRAT) was found by him from the Permian limestone of Cammon in association with *Schwagerina japonica* and *Misellina parvicostata*. Briefly speaking, according to him, the majority of the species of *Misellina* and *Brevaxina* were found from the *Pseudofusulina* zone or the upper part of the Wolfcampian to the lower part of the *Parafusulina* zone or Artinskian series in current sense.

In South China, the *Misellina claudiae* zone which is subjacent to the *Parafusulina multiseptata* zone was discriminated in the lower part of the Chihsia limestone of the Nanking Hills and central and eastern Kwangsi by LEE (1931) and CHAO (1947).

In Japan, according to OZAWA (1927) and TORIYAMA (1958), *Misellina claudiae* has been known only from the *Pseudofusulina ambigua* subzone and not from the horizon subjacent and superjacent to it in the Akiyoshi limestone. On the contrary, in the Kwanto massif, *Misellina claudiae* was recorded from a horizon equivalent to the *Neoschwagerina* zone, which is represented by *Neoschwagerina margaritae* DEPRAT and also from a horizon inferred to be lower than that which yielded *Neoschwagerina craticulifera* (SCHWAGER), and *Schwagerina japonica* (GÜMBER). In Shikoku, according to SUYARI (1961), the *Misellina* zone occurs above the *Schwagerina* zone, and is characterized by the occurrence of *Brevaxina* sp., *Misellina iisakai* (TORIYAMA), *Mis.* cfr. *termieri* (DEPRAT), *Mis.* sp., and *Parafusulina ?* sp.

On the other hand, MORIKAWA and ISOMI (1961) reported *Misellina ibukiensis* KOBAYASHI from the east of Lake Biwa. According to them, the species is common in the *Pseudoschwagerina* zone which may be the earliest horizon in Japan so far as known.

In short, so far as known to date, the genus *Misellina* and especially, *Misellina claudiae* (DEPRAT) has been reported from the inferred upper Wolfcampian, from where it ranges to the lower part of the *Neoschwagerina* zone in the Tethys regions, although some authors considered that *Misellina claudiae* (DEPRAT) is an indicative species restricted to the zone subjacent to the *Neoschwagerina* zone or to the upper part of the Wolfcampian series which is characterized by the occurrence of *Pseudofusulina ambigua* (DEPRAT), etc.

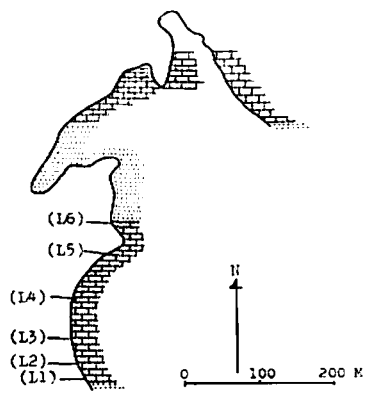
Stratigraphic Relationships

The genus *Brevaxina* was first reported as a subgenus of *Misellina* by SCHENCK and THOMPSON (1940) on the basis of DEPRAT's materials of *Doliolina compressa* and only one formally named species and *Brevaxina* sp. A from Kochi Prefecture have been known to date.

The writer studied the fusuline foraminifers of the Shingai formation as the continuation of his previous work (ISHIZAKI, 1960, etc.) and found several forms of *Brevaxina* and *Misellina* from the limestone composing the formation.

As already reported by the writer,

judging from the contained fusulinids, the Shingai formation under consideration comprises strata which range from the Wolfcampian to the Socioian or in part to the Basleoian in age. The formation is characterized by a synclinal structure with the axis trending in the midst of the limestone of the formation in nearly east-west direction. The southern wing of the syncline was studied to make clear the faunal succession of the fusulinids, the samples of which were collected horizon by horizon along the route northwards from Takinoshita, Shirakidani, Nangoku City, Kochi Prefecture (text-fig. 1). The thickness of the



Text-fig. 1. Route map northwards from Takinoshita, Shirakidani, Nangoku City. The southern limestone yielded the several fusulinids described in this work.

formation along the route is estimated to be about 260 meters. The lower part consists of a 140 meters thick non-crystalline whitish grey massive fusulinid bearing limestone, overlain by the middle part of about 140 meters thick dark grey to dark blue sandstone which is barren of micro- and megalo-fossils throughout. The upper part of the formation consists of crystalline whitish grey massive limestone from which no fusulinids were found. This limestone is distributed rather widely as seen from the route map but its thickness is less than apparent because of the synclinal structure already mentioned.

In this section, the writer deals with the fusulinid bearing limestone distributed in the lower part of the Shingai formation. The limestone composing the lower part of the formation under consideration is rich in fusuline foraminifers although their preservation is rather poor—less mineralization throughout but the majority of the organisms have been subjected to secondary deformation and are crushed in many cases—this makes specific identification often difficult. The uppermost part of the fossiliferous limestone is of amber colour, oolitic in texture and yielded abundantly fusuline foraminifers as, *Brevaxina* and *Misellina* in association with smaller foraminifers and *Schubertella* spp., all of which are well preserved.

The fusulinid assemblages discriminated in the fossiliferous limestone are as follows, in downward sequence:

L6: *Brevaxina hataii* ISHIZAKI, n. sp.
Misellina aff. *ibukiensis* KOBAYASHI
Misellina cylindrica ISAIZAKI, n. sp.
Misellina subelliptica (DEPRAT)
Misellina aliciae (DEPRAT)
Schubertella spp.

Among them, the species of *Brevaxina* and *Misellina* will be described.

L5: Very few fragmental specimens of *Pseudofusulina* spp.

L4: *Schubertella melonica* DUNBAR and SKINNER
Schwagerina cfr. *exigua* (DYHRENFURTH)
Dunbarinella sp.

L3: *Schubertella haginoensis fusiformis* SUYARI
Schubertella? sp.
Schwagerina cfr. *magna* (ROSOVSKAYA)

Rugosofusulina aff. *serrata* RAUSER-CERNOUSSOVA

L2: *Paraschwagerina*? sp.
Triticites spp.

L1: *Pseudoschwagerina*? sp.
Triticites sp.

(each numeral corresponds with the ones given in text-fig. 1)

So far as field and laboratory studies are concerned no physical break was detected between L6 and the horizons lower than L5, and no fusulinids referable to the genus *Parafusulina* or suggestive of the Leonardian could be found to date. Therefore, it is quite probable that the horizon which yielded *Misellina* and *Brevaxina* may be equivalent to the upper part of the Wolfcampian or so in age.

Divergence of the Genus *Brevaxina*

The majority of the previous workers on fusuline foraminifers have considered that the genus *Brevaxina* evolved from *Misellina* phylogenetically but no decisive explanations have been given. Virtually, THOMPSON (1948) considered it to have evolved during Guadalupian time. SUGI (1960) assumed it to have developed during the time characterized by the flourishing of *Parafusulina* as indicated in his phylogenetic tree of the Verbeekininae, although this was not explained literally.

On the other hand, the information on the limestone of Cam-mon, Indo-China by DEPRAT (1912, 1915) and the results of the present work seem to conflict seriously with the above stated. That is to say, the genus *Brevaxina* is known from the inferred upper Wolfcampian limestone as its earliest occurrence and the genus *Misellina* is known from the *Pseudoschwagerina* zone or Wolfcampian series of different regions. Therefore, the earliest known occurrences of both genera seem to be hardly different. Therefore, from the known occurrences, the stratigraphical evidence may not fully support the opinions expressed by many previous workers that the genus *Brevaxina* evolved from *Misellina*.

On the other hand, as well known, *Brevaxina* is paleontologically distinguished from *Misellina* by much laterally compressed shell form and narrower but higher parachomata, especially in the median part of the profile. *Misellina subelliptica* (DEPRAT) which was reported from Cam-mon in association with *Schwagerina japonica* (GÜMBER) holds a position intermediate between the typical *Brevaxina* and *Misellina* morphologically. That is to say, this species has rather narrower and higher parachomata in the median part of the shell, and is moderately laterally compressed, but not so strongly as in *Brevaxina compressa*.

It is more probable, so far as known data are concerned, that both genera which have their first appearance at nearly the same time, developed progressively parallel with one another phylogenetically. Judging from the facts hitherto known of both the genera in question it might be suggested that they should better not be separated generically in a natural classification of the fusulinids or be treated as two independent taxons in the procedure of zoological classification. The writer assumes that there are two working hypotheses under the circumstances stated above as stated in the following, namely;

1) Both genera were derived from a common ancester at nearly the same time but developed as independent taxons. This suggests that both genera had different processes in their phylogeny. Therefore, the genus *Brevaxina* should not be considered to have diverged from

Misellina.

2) Both genera were derived from a common ancester but developed as a single or in unity in a more natural ecological classification. As well known, in taxonomy the paleontological procedure is based upon the bio-morphological features of the organisms. From such reasons as well as from the characters of the two mentioned genera it is more likely that *Brevaxina* is not an independent unit in the natural ecological classification but only in the paleontological sense.

The writer recognized that both genera are intimately related with one another in many important bio-characters except that *Brevaxina* has much more laterally compressed outer shell form throughout which suggests that the second mentioned working hypothesis should be accepted.

Systematic Description

Family Fusulinidae MÖLLER, 1878

Subfamily Verkeekininae STAFF and WEDEKIND, 1910

Genus *Misellina* SCHENCK and THOMPSON, 1940

Misellina aliciae (DEPRAT)

Pl. 9, figs. 1-2.

Doliolina aliciae DEPRAT, 1912, *Mém. Serv. Géol. Indochine, vol. 1, fasc. 3*, pp. 43-44, pl. 5, figs. 11-14.

Shell quite small, thickly inflated ovoidal, with straight axis of coiling. Lateral slopes convex, poles rather broadly rounded to umbilicated. Shell of five volutions 0.52 mm in half length and 0.36 mm in half width, giving form ratio of 1.44. First two or a half and two volutions nearly spherical with rounded poles, axis of coiling nearly at right angle to outer volutions. From subsequent outer volution to maturity axis extends gradually outwards.

Proloculus small, almost spherical, with an outside diameter of 0.054 mm. Proloculus wall thin, seemingly structureless, consisting of a single homogeneous dense layer. Shell expands slowly and uniformly throughout. Radius vector of first volution to maturity 70, 120, 180, 240, and 330 microns, respectively.

Spirotheca rather thin, consisting of an alveolar keriotheca, rather thick upper dense layer (or extension of parachomata) and thin lower dense layer in parts. Thickness of spirotheca of first to fifth volutions 4?, 7, 10, 8, and 13 microns, respectively.

Parachomata rather distinctly developed in third to fourth volution; reach to about a half or less of each chamber height, semi-circular shape with well rounded tips. But in remaining volutions almost obscure or in rudimentary form. Counts of parachomata of second to fourth volutions 7, 11, and 16, respectively.

Measurements:—see Table 1.

Remarks:—Only one rather well oriented axial section is examined here. But the important bio-characters of the present species concord with those of *Misellina aliciae* which was first reported by DEPRAT from the limestone of Ien-Seu-Tong, Yun-Nan, except for that the former has somewhat larger proloculus than the latter. The present species is also somewhat similar with *Misellina termieri* (DEPRAT) in some bio-characters but differs from the latter in having less rapid expansion rate of the corresponding volutions and less developed parachomata.

Occurrence:—Abundant in the upper

part of the limestone which may be equivalent to the upper Wolfcampian or so in age and composing the larger part of the Shingai formation, at about 400 meters north of Takinoshita, Shirakidani, Nangoku City, Kochi Prefecture (Loc. 6). IGPS coll. cat. no. 78878 (specimen 302-1-c).

Associated fauna:—*Brevaxina hataii* ISHIZAKI, n. sp., *Misellina cylindrica* ISHIZAKI, n. sp., *Misellina subelliptica* (DEPRAT), *Misellina* aff. *ibukiensis* KOBAYASHI, and *Schubertella* spp.

Misellina cylindrica ISHIZAKI, n. sp.

Pl. 9, figs. 3-5.

Shell small, subquadrate or cylindrical, with straight axis of coiling. Lateral slopes stoutly convex, poles broadly rounded throughout. Mature shell of five volutions 0.54 mm in half length and 0.36 mm in half width, giveng form ratio of 1.5. First two or a half and two volutions nearly spherical or somewhat umbilicated, axis of coiling at high angles to outer volutions. From subsequent outer volution subquadrate and axis becomes to extend gradually outwards. Polar regions vary from broadly rounded to somewhat umbilicated in juvenile volutions to rounded in outer volutions.

Proloculus rather large for genus, almost spherical, with an outside diameter of 80 to 85 microns, averaging 83 microns for two specimens. Spirotheca of proloculus thin, structureless, consisting of a single homogeneous dense layer. Thickness of spirotheca of proloculus 65 to 100 microns, averaging 83 microns for two specimens. Shell expands slowly and uniformly in first to penultimate volutions, and rather rapidly in last volution. Average radius vectors of first volution to maturity 93, 158, 233, 343, and 365 microns, respectively.

Spirotheca rather thin, composed of apparently structureless rather thick lighter layer (but in some parts of sagittal section keriothecal structure observable), thicker upper dense layer (or extension of parachomata), and less thicker lower dense layer throughout. Average thickness of spirotheca of first to fifth volutions 10, 15, 14, 15, and 30 microns, respectively.

Septa moderately thick, composed of downward deflection of lower dense layer and apparent keriotheca. Septa V-shaped, decreasing in thickness from base to tips in many cases, but clubbed with somewhat thickened tips in remaining parts; fundamentally unfluted throughout. Counts of septa unknown, but seemingly moderate in number.

Parachomata well developed throughout except in inner volution where almost obscure; reach to about a half to a fourth of each chamber height, semicircular shaped with rather broadly rounded tips in median part but rather conic-like with narrowly pointed tips in lateral slopes. Counts of parachomata of first to fourth volutions in one axial section 7?, 11, 15, and 17, respectively.

Measurements:—see Table 2.

Remarks:—The present species is characterized by the typical cylindrical shell form and rather widely rounded tips of the parachomata. There have been described no species identical with the present one to date. Therefore, here, a new specific name should be proposed for it. *Misellina cylindrica* ISHIZAKI, n. sp. is somewhat similar to *Misellina ovalis* which was reported by DEPRAT from the Permian limestone of Cam-mon, but differs from the latter in that the former has more rapid expansion rate of the corresponding volutions, larger proloculus, wider and distinctly developed

Table 1. Measurements (in mm) of *Misellina aliciae* (DEPRAT).

Specimen	Radius vector								
	prol.	1	2	3	4	5	H. L.	H. W.	F. R.
302-1-c	0.054	0.07	0.12	0.18	0.24	0.33	0.52	0.36	1.44
	Thickness of spirotheca								
	?	.004	.007	.010	.008	.013			
	No. of parachomata								
		?	7	11	16				

Table 2. Measurements (in mm) of *Misellina cylindrica* ISHIZAKI, n. sp.

Specimen	Radius vector								
	prol.	1	2	3	4	5	H. L.	H. W.	F. R.
302-3-a	0.085	.085	.145	.195	.255	.365	0.54	0.36	1.50
302-4-d	0.080	.100	.170	.270	.430				
	Thickness of spirotheca								
302-3-a	.0065	.007	.015	.013	.015	.030			
302-4-a	.0100	.013	.014	.015	.015				
	No. of parachomata								
302-3-a		7?	11	15	17				

Table 3. Measurements (in mm) of *Misellina* aff. *ibukiensis* KOBAYASHI

Specimen	Radius vector									
	prol.	1	2	3	4	5	6	7	H. L.	H. W.	F. R.
302-1-a	.060	0.06	0.10	0.15	0.23	0.31	0.41		0.68	0.41	1.65
302-1-d	.060	0.06	0.10	0.16	0.22	0.30	0.41	0.55			
	Thickness of spirotheca										
302-1-a	.008	.010	.010	.010	.008	.008	.010				
302-1-d	?	.009	.010	.010	.010	.009	.010	.010			
	No. of septa										
302-1-d		?	7	11	13	18	?				
	No. of parachomata										
302-1-a			12?	12?	16?	16?					

Table 4. Measurements (in mm) of *Misellina subelliptica* (DEPRAT)

Specimen	prol.	1	2	3	4	5	6	7	8	H. L.	H. W.	F. R.
					Radius vector							
302-2-a	0.060	.050	.120	.190	.290	.460	.650			0.69	0.65	1.10
302-3-c	0.080	.085	.165	.265	.410					0.70	0.50	1.40
302-4-c	0.080	.070	.140	.260	.420	.570	.720			1.00	0.72	1.38
302-5-a	0.055	.070	.125	.190	.260	.400	.500	.680		0.98	0.66	1.48
302-5-b			.105	.165	.285	.410	.530			0.70	0.62	1.13
302-6-b	0.055	0.70	.110	.175	.240	.340	.460	.600	.840	0.76	0.84	0.90
302-1-b	0.045	.060	.115	.195	.310	.450	.600					
302-5-c		.065	.120	.175	.235	.345	.415					
302-6-a	0.030	.035	.060	.110	.175	.255	.375	.535				
302-6-c	0.060	.060	.085	.135	.195	.300	.440	.580				
302-7-a	0.080	.080	.120	.220	.320	.440						
					Half length							
302-2-a	0.110	.100	.170	.260	.360	.500	.690					
302-5-a	0.050	.038	.060	.110	.175	.270	.420	.600	.810			
302-5-b			.115	.195	.300	.445	.600					
302-6-b	0.040	.040	.085	.115	.200	.300	.420	.580	.760			
					Form ratio							
302-5-a	0.910	0.54	0.47	0.58	0.67	0.68	0.84	0.88				
302-5-b			1.09	1.18	1.06	1.09	1.13					
302-6-b	0.730	0.57	0.77	0.66	0.83	0.88	0.91	0.97	0.90			
					Thickness of spirotheca							
302-2-a	0.015	.010	.020	?	.025	.025	.025					
302-3-c	0.008	.015	.015	.018	.013							
302-4-c	0.005	.010	.010	.015	.020	.025	.025					
302-5-a	0.008	.008	.008	.013	.015	.010	.020	.023	.023			
302-5-b	0.009	.009	.015	.018	.015	.015	.015					
302-6-b	0.009	.008	.010	.010	.010	.015	.015	.025				
302-1-b	0.005	.005	.013	.010	.030	.030	.035					
302-5-c		.010	.008	.015	.020	.020	.025					
302-6-a	0.005	.005	.008	.010	.014	.025	.025	.038				
302-6-c	0.005	.010	.018	.015	.015	.020	.025	.018				
302-7-a	0.008	?	.010	.010	.013	.018						
					No. of parachomata							
302-2-a		8?	10	13	18?	22?						
302-5-a				8	11	19	22					
302-5-b			8?	13	15	16	?					
					No. of septa							
302-1-b		3	8	10	11	15	16					
302-5-c			?	10	11	15	17					
302-6-a		6	10	10	13	15	15					
302-6-c			?	10	13	15	16					
302-7-a			?	11	12	14						

Table 5. Measurements (in mm) of *Brevaxina hataii* ISHIZAKI, n. sp.

Specimen	prol.	1	2	3	4	5	6	7	H. L.	H. W.	F. R.
	Radius vector										
302-4-a	0.035	.075	.105	.185	.275	.360	.410				
302-4-b	0.060	.060	.100	.160	.220	.310	.430		0.48	0.54	0.89
302-5-d	0.030	.035	.075	.130	.200	.285					
	Half length										
302-4-a	0.035	.035	.065	.105	.190						
302-4-b	0.050	.030	.045	.080	.150	.220	.340	.500			
	Form ratio										
302-4-a	1.00	0.47	0.62	0.58	0.69						
302-4-b	0.82	0.50	0.45	0.50	0.68	0.71	0.79				
	Thickness of soirotheca										
302-4-a	0.008	.009	.014	.015	.013	.015	.013				
302-4-b	0.005	.007	.008	.010	.019	.015	.020				
302-5-d	?	.005	.008	.013	.015	.020					
	No. of parachomata										
302-4-a				11?	15?	19?					
302-4-b				15?							
	No of septa										
302-5-d		7	7	11	12	14					

parachomata, and somewhat quadrate or cylindrical shell form with much broadly rounded poles. The species is also somewhat similar to *Misellina iisakai* TORIYAMA from Tosayama, Kochi Prefecture, but differs from the latter in the shell forms; the latter is ellipsoidal with rather pointed poles whereas the former has a subquadrate or cylindrical shell form with much broader polar ends.

Occurrence:—Same as the former. Holotype, pl. 9, fig. 3, IGPS coll. cat. no. 78879 (specimen 302-3-a) and paratype, pl. 9, fig. 4, IGPS. coll. cat. no. 78880 (specimen 302-4-d).

Associated fauna:—Same as the above.

Misellina aff. *ibukiensis* KOBAYASHI

Pl. 8, figs. 6-7.

compare with:—

Misellina ibukiensis KOBAYASHI, 1957, *Sci. Rept., Tokyo Kyoiku Daigaku, Sec. C. vol. 5. nos. 47-48*, pp. 297-298, pl. 1, figs. 20-27.

Misellina ibukiensis, MORIKAWA and ISOMI, 1961. *Geol. Surv. Japan, Rept. No. 191* (*A. c. X.*), pp. 25-26, pl. 21, figs. 1-18.

Shell small, ovoidal, with straight axis of coiling. Lateral slopes distinctly convex in outer volutions but more straight and almost at right angle to axis of coiling, rather broadly rounded or somewhat umbilicated polar ends. Mature

shell of six to seven volutions 0.68 mm in half length and 0.41 to 0.55 mm in half width, giving form ratio of 1.65 in adult stage. First two or three volutions nearly spherical or somewhat staffelloid form, axis of coiling divergent to outer volutions. From subsequent outer volution axis becomes extended gradually outwards. Polar regions vary from broadly rounded or almost straight and with high angle to axis of coiling in juvenile volutions to rounded or slightly umbilicated in outer volutions.

Proloculus small, almost spherical in shape, with an outside diameter of 60 microns in two specimens. Spirotheca of proloculus thin, apparently structureless, consisting of a single thin homogeneous dense layer. Thickness of spirotheca of proloculus 7.5 microns in one specimen. Shell expands slowly in inner two volutions and slightly more rapid but almost uniformly in subsequent outer volutions. Average radius vectors of first to seventh volutions for two specimens 60, 100, 155, 225, 305, 410, and 550 microns, respectively.

Spirotheca quite thin, its structure hardly observable in detail in inner two or three volutions, but seems to be composed of a thin alveolar keriotheca, rather thick upper dense layer (or extension of parachomata) and thin lower dense layer in subsequent outer volutions. Average thickness of spirotheca of first to seventh volutions for two specimens 9, 10, 10, 9, 8, 10, and 10 microns, respectively.

Septa essentially unfluted throughout, rather thick at base but thin in the upper part, composed of downward deflection of keriotheca at base extending to a fourth of height of each chambers and extension of thinner dense deposits in remaining parts. Counts of septa of second to fifth volutions in one sagittal section 7, 11, 13, and 18, respectively.

Parachomata developed in rudimentary form throughout except in first one or two volutions where almost obscure; reach to about one-fifth or one-third of height of each volution, conic-like to knoll-shaped with narrowly to widely rounded tips. Apparent counts of parachomata of second to sixth volutions in one specimen 12, 12, 16, and 16, respectively, although somewhat obscure in many cases.

Measurements:—see Table 3.

Remarks:—The specimen in hand is closely allied to *Misellina termieri* described by DEPRAT from Cam-mon but differs from the latter in having more slender shell form, less developed parachomata throughout shell length, much smaller shell, and thinner spirotheca. The present species is also somewhat similar to *Misellina minor* (DEPRAT) but differs in that the former is somewhat smaller in shell size and thicker shell form. The species is somewhat similar to *Misellina tosensis* (TORIYAMA) in the shell form but differs from the latter in the more slender shell form of the juvenile volutions. The present species is most closely allied to *Misellina ibukiensis* described by KOBAYASHI from the Ibukiyama limestone but slight difference is found between them as, the former has slightly thinner spirotheca and less developed parachomata. But both may be identical with one another, and the trifle difference stated above may be considered to be within specific variation.

Above all, the present species is a typical form characterized by thin spirotheca throughout, less developed parachomata, and small shell size.

Occurrence:—Same as the former. IGPS coll. cat. no. 78878 (specimen 302-1-a, and 302-1-d).

Associated fauna:—Same as the above.

Misellina subelliptica (DEPRAT)

Pl. 9, figs. 8-18.

Doliolina subelliptica DEPRAT, 1915, *Mém. Serv. Géol. Indochine, vol. 4, fasc. 1*, pp. 19-20, pl. 3, figs. 5-6.

Misellina cfr. *termieri* SUYARI, 1962, *Jour. Gakugei, Tokushima Univ., Nat. Sci., vol. 12*, p. 33, pl. 10, figs. 6-8.

Shell moderate in size for genus, stoutly inflated fusiform, rather strongly depressed laterally, and rather asymmetrical with almost straight axis of coiling. Lateral slopes stoutly convex in outer volutions but more slightly convex or well rounded in juvenile volutions. Polar ends broadly rounded in inner few volutions but somewhat umbilicated in outer volutions. Juvenile volutions coil in staffelloid form. Mature shell of four to eight volutions 0.41 to 0.84 mm in half width and 0.60 to 1.00 mm in half length, giving form ratio of 0.90 to 1.48. Average ratio of half length to radius vector of first to eight volutions in three specimens 0.56, 0.78, 0.81, 0.86, 0.88, 0.97, 0.93, and 0.93, respectively.

Proloculus small, almost spherical to somewhat ellipsoidal, with an outside diameter of 30 to 110 microns, averaging 61 microns in nine specimens. Proloculus wall seemingly structureless, consisting of a thin homogeneous dense layer; averaging 8 microns thick. Shell expands slowly in inner two or three volutions but more rapidly but almost uniformly from the subsequent outer volution to maturity. Average radius vectors of first to eighth volution for nine specimens 65, 115, 189, 286, 396, 521, 599, and 840 microns, respectively.

Spirotheca thin, consisting of rather thick lighter layer (in parts keriothecal structure seen), upper dense layer, and much thinner lower dense layer. Average thickness of spirotheca of first to eighth volutions for 11 specimens 9, 12, 13, 17, 20, 32, 26, and 23 microns, respectively.

Septa unfluted throughout, rather thick at the base but decreasing in thickness towards tips; composed of downward deflection of keriotheca extending to a fifth of height of each chamber at base and thinner dense deposits in remaining inner parts. Average counts of septa of first to sixth volutions in five specimens 5, 10, 12, 15, and 16, respectively.

Parachomata distinctly developed throughout except in juvenile one to two volutions; V-shaped narrower but higher with narrowly pointed tips in median part of profile, reaching to a half to a third of height of each volution, whereas semi-circular with broadly well rounded tips reaching to a half or so of height of each chamber in remaining parts of profile. Average counts of parachomata of first to sixth volutions in three specimens 8?, 9, 11, 15, 19, and 22, respectively.

Measurements:—see Table 4.

Remarks:—The species in hand deems to be a form transitional between *Misellina* and *Brevaxina*, judging from the rather strongly laterally depressed shell form and the developing of the parachomata in the median part of the profile where the much narrower and higher parachomata with tips quite narrowly pointed prevail.

The present specimens coincide with *Misellina subelliptica* from Cam-mon in many important bio-characters. The present specimens are also similar to *Misellina termieri* reported by DEPRAT from the same region as the above. But the formers are somewhat more stoutly inflated fusiform and somewhat laterally depressed, and asymmetrical in shape, with much more rapid expansion rate of the corresponding each volution, and

possess essentially narrower and higher parachomata than those of the latter. *Misellina termieri* reported by SUYARI from Tosayama, Kochi Prefecture resembles the present specimens in many biocharacters, and may be identical.

Occurrence:—Same as the former. IGPS coll. cat. no. 78881 (specimen 302-2-a), 78879 (302-3-c), 78880 (302-4-c), 78882 (302-5-a), 78882 (302-5-b), 78883 (302-6-b), 78878 (302-1-b), 78882 (302-5-c), 78883 (302-6-a), 78883 (302-6-c), and 78884 (302-7-a).

Associated fauna:—Same as the above.

Genus *Brevaxina* SCHENCK and THOMPSON, 1940

Brevaxina hataii ISHIZAKI, n. sp.

Pl. 9, figs. 19-22.

Brevaxina sp. A SUYARI, 1962, *Jour. Gakugei, Tokushima Univ., Nat. Sci., vol. 12*, p. 34, pl. 10, fig. 13.

Shell small, subspherical, strongly depressed laterally, with almost straight axis of coiling. Lateral slopes stoutly convex and well rounded median part with broadly rounded to rather strongly umbilicated polar ends. Juvenile volutions (inner one to two volutions) coil in staffelloid form, depressed strongly with broadly rounded or rather strongly umbilicated polar ends. Axis of coiling with smallest diameter throughout. Mature shell of seven volutions 0.48 mm in half length and 0.54 mm in half width, giving form ratio of 0.89 in outer volution. Average ratio of half length to radius vector of first to sixth volutions in two specimens 0.49, 0.54, 0.54, 0.69, 0.71, and 0.79, respectively.

Proloculus small, almost spherical to somewhat ellipsoidal, with an outside diameter of 35 to 60 microns, averaging 43 microns in three specimens. Form ratio of proloculus 0.83 to 1.00, averaging 0.92 for two specimens. Proloculus wall seemingly structureless, consisting of a thin homogeneous dense layer; averaging 7 microns thick. Shell expands slowly and almost uniformly throughout. Average radius vectors of first to sixth volutions for three specimens 57, 93, 158, 232, 318, and 420 microns, respectively.

Spirotheca thin, consisting of rather lighter thick layer (or upper dense layer as the extension of parachomata), thin tectum, and lower dense thinner layer. Average thickness of spirotheca of first to sixth volutions for three specimens 7, 10, 13, 16, 17, and 17 microns, respectively.

Septa unfluted throughout. V-shaped, rather thick in outer volutions; rather thick at base but decreasing in thickness toward tips; composed of downward deflection of keriotheca extending to a fifth of height of each chamber at base and thinner dense deposits in remaining inner parts; rather clubbed and thinner almost same in thickness throughout length in inner juvenile volutions. Septal counts of first to fifth volutions 7, 7, 11, 12, and 14, respectively.

Parachomata distinctly developed throughout except in juvenile one to two volutions; V-shaped narrower but higher with narrowly pointed tips in the median part of profile, reaching to a half or more than a half of chamber height of each volution, but somewhat knoll-shaped with rounded tips in lateral slopes, reaching to a third or less than a third of chamber height of each volution. Average counts of parachomata of third to fifth volutions 13, 15, and 19, respectively, although counts of them difficult throughout shell owing to preservation.

Measurements:—see Table 5.

Remarks:—The genus *Brevaxina* was

first designated by SCHENCK and THOMPSON (1940) with only one representative species, in which the shell is small, subspherical, and laterally compressed with the axis of coiling having the smallest diameter. Consequently, the form ratio of it is about 0.6. Moreover, the shell has much higher and narrower parachomata which reach almost to more than a half of chamber height. With those criteria, the genus can be separated from *Misellina*. Judging from the many bio-characters of the present specimens in hand, the specimens should be referred to *Brevaxina* without question, although they have larger form ratio and smaller shell than the type-species *Brevaxina compressa* (DEPRAT).

The present species is somewhat similar to *Misellina* sp. described by SUYARI from Kochi Prefecture, but differs from the latter in having much strongly depressed shell form of the juvenile volution. The species more closely resembles *Brevaxina* sp. A described by SUYARI from Takinoshita, Shirakidani, Kochi Prefecture, and the only slight difference found between them is that the latter has much less form ratio than the former, although unfortunately, the larger part of the outer volution of his materials are broken and the details remain unknown. Nevertheless, both should be referred to the same species. The species described previously as *Brevaxina* sp. A was not named, therefore, the writer, here, proposes a new specific name for them on the basis of the present specimens in hand.

Occurrence:—Same as the former. Holotype, IGPS coll. cat. no. 78880 (specimen 302-4-b), paratypes, IGPS. coll. cat. nos. 78880 (specimen 302-4-a), and 78882 (specimen 302-5-d).

Associated fauna:—Same as the above.

Reference Cited

CHAO, King-Koo (1947): Stratigraphical development in Kwangsi. *Bull. Geol. Soc. China, vol. 27*, p. 338.

DEPRAT, J. (1912): Etude Geologique du Yun-Nan Oriental. Etude des Fusulinidés de Chine et d'Indochine et Classification des Calcaires à Fusulines. *Mém. Serv. Géol. Indochine, vol. 1, fasc. 3*, pp. 1-76, pls. 9.

—— (1915): Etude des Fusulinidés de Chine et d'Indochine et Classification des Calcaires à Fusulines. Les Fusulinidés des Calcaires Carbonifériens et Permiens du Tonkin, du Laos et du Nord-Annam. *Ibid., vol. 4, fasc. 1*, pp. 1-30, pls. 1-3.

HUZIMOTO, H. (1936): Stratigraphical and Paleontological Studies of the Titibu System of the Kwanto-mountainland. Part 2. Paleontology. *Sci. Rept., Tokyo Bunrika Daigaku, Sec. C, vol. 1, no. 2*, pp. 29-125, pls. 1-26.

ISHIZAKI, K. (1960): On the Geology and Tectonics in the Area Northeast of Kochi City, Shikoku—On the Unconformable Relationship between the Upper Paleozoic and the Lower Cretaceous. *Jour. Geol. Soc. Japan, vol. 66, no. 780*, pp. 553-565.

KOBAYASHI, M. (1957): Paleontological Study of the Ibukiyama Limestone, Shiga Prefecture, Central Japan. *Sci. Rept., Tokyo Kyoiku Daigaku, Sec. C, vol. 5, nos. 47-48*, pp. 247-311, pls. 1-10.

LEE, J. S. (1931): Distribution of the Dominant Types of the Fusulinoid Foraminifera in the Chinese Seas. *Bull. Geol. Soc. China, vol. 10*, pp. 273-288, pl. 1.

—— (1937): Foraminifera from the Donetz Basin and their Stratigraphical Significance. *Ibid., vol. 16*, pp. 57-107, pl. 2.

MORIKAWA, R. and ISOMI, H. (1961): Studies of Permian Fusulinids in the East of Lake Biwa, Central Japan. *Geol. Surv. Japan, Rept. No. 191 (A. c. X.)*, pp. 1-30, pls. 1-21.

OZAWA, Y. (1925): Paleontological and Stratigraphical Studies on the Permo-Carboniferous Limestone of Nagato. Part

2. Paleontology. *Jour. Coll. Sci., Imp. Univ. Tokyo, vol. 45, Art. 6*, pp. 1-90, pls. 1-14.

—— (1927): Stratigraphical Studies of the Fusulina Limestone of Akasaka, Province of Mino. *Jour. Fac. Sci., Imp. Univ. Tokyo, sec. 2, vol. 2, pt. 3*, pp. 121-164, pls. 34-45.

SCHENCK, H. G. and THOMPSON, M. L. (1940): *Misellina* and *Brevaxina*, New Permian Fusulinid Foraminifera. *Jour. Paleont., vol. 14, no. 6*, pp. 584-589.

SHENG, J. C. (1956): Permian Fusulinids from Liangshan, Hanchung, Southern Shensi. *Acta Paleont. Sinica, vol. 4, no. 2*, pp. 175-227, pls. 1-8.

SUGI, T. (1960): Evolution of the Verbeekininae. *Fossils, no. 1*, pp. 29-33.

SUYARI, K. (1961): Geological and Paleontological Studies in Central and Eastern Shikoku, Japan. Part 1. Geology. *Jour. Gakugei, Tokushima Univ., Nat. Sci., vol. 11*, pp. 11-76.

—— (1962): Geological and Paleontological Studies in Central and Eastern Shikoku, Japan. Part 2. Paleontology. *Ibid., vol. 12*, pp. 1-64, pls. 1-12.

THOMPSON, M. L. (1948): Studies of American Fusulinids. *Univ. Kansas, Paleont. Contr., Protozoa, Art. 1*, pp. 1-184, pls. 1-38.

TORIYAMA, R. (1945): On Some Fusulinids from Tosayama, Kochi-ken, Shikoku, with a Note on the Stratigraphical Range of *Neoschwagerina*. *Japan. Jour. Geol. Geogr., vol. 20*, pp. 63-82, pls. 16-17.

—— (1958): Geology of Akiyoshi, Part 3. Fusulinids of Akiyoshi. *Mem. Fac. Sci., Kyushu Univ., Ser. D (Geol.), vol. 7*, pp. 1-264, pls. 1-48.

Akiyoshi	秋吉	Shingai	新改
Kwanto massif	関東山地	Shirakidani	白木谷
Lake Biwa	琵琶湖	Takinoshita	滝ノ下
Ryoseki	龍石	Tosayama	土佐山

Explanation of Plate 9

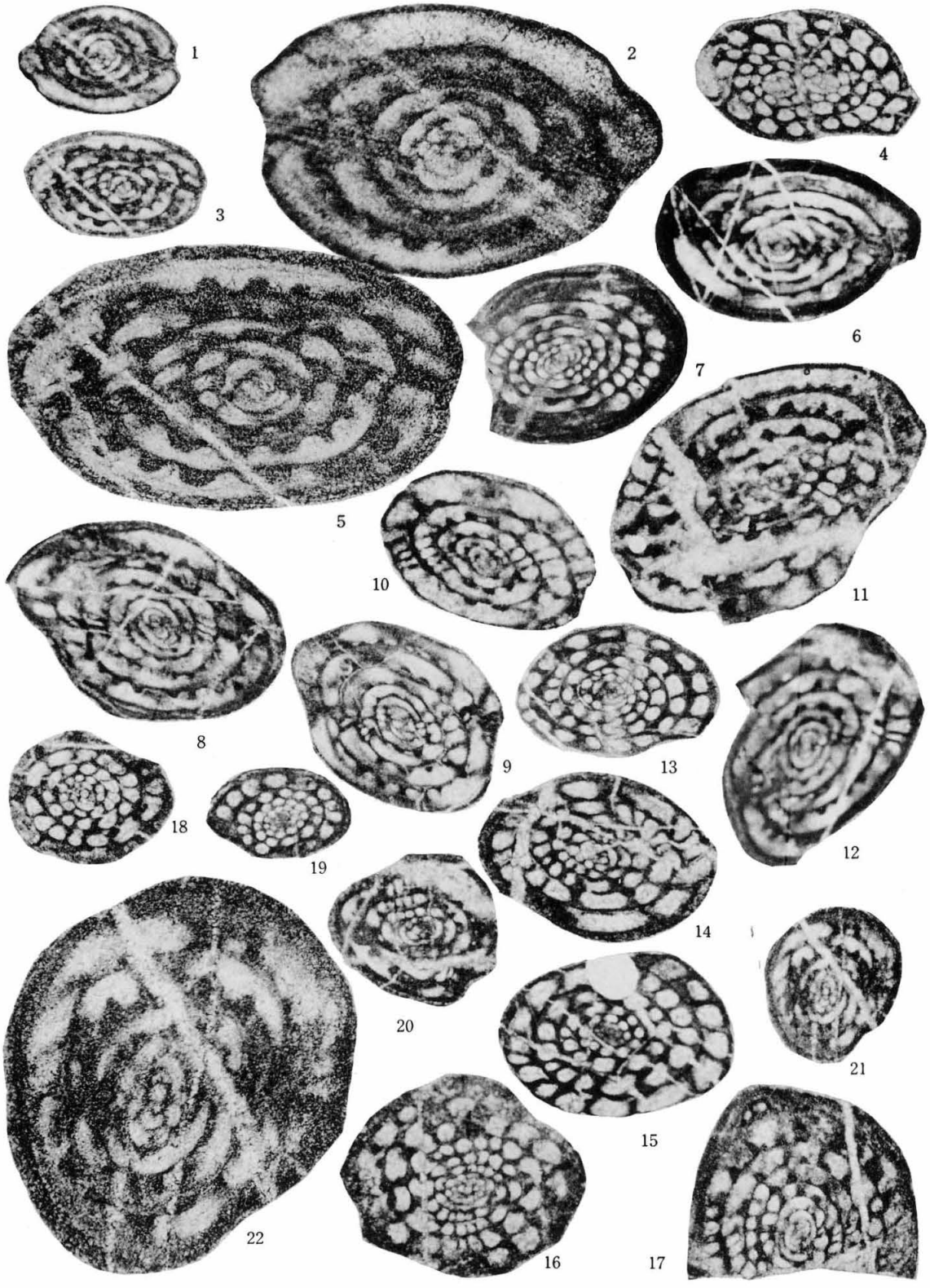
Figs. 1-2. *Misellina aliciae* (DEPRAT).
1-Axial section, specimen 302-1-c, IGPS coll. cat. no. 78878, ×30.
2-Enlarged figure of the above, ×73.3

Figs. 3-5. *Misellina cylindrica* ISHIZAKI, n. sp.
3-Axial section, holotype specimen 302-3-a, IGPS coll. cat. no. 78879, ×30.
4-Sagittal section, specimen 302-4-d, IGPS coll. cat. no. 78880, ×30.
5-Enlarged figure of the above (specimen 302-3-a), ×73.3.

Figs. 6-7. *Misellina* aff. *ibukiensis* KOBAYASHI.
6-Axial section, specimen 302-1-a, IGPS coll. cat. no. 78878, ×30.
7-Sagittal section, specimen 302-1-d, IGPS coll. cat. no. 78878, ×30.

Figs. 8-18. *Misellina subelliptica* (DEPRAT).
8, 9-Axial section, specimen 302-5-a, IGPS coll. cat. no. 78882 and specimen 302-5-b, IGPS coll. cat. no. 78882, ×30.
10-Slighlly oblique axial section, specimen 302-3-c, IGPS coll. cat. no. 78879, ×30.
11, 12-Crushed and ill oriented axial sections, specimen 302-4-c, IGPS coll. cat. no. 78880 and 302-2-a, IGPS coll. cat. no. 78881.
13-18-Sagittal section; 13-specimen 302-5-c (IGPS coll. cat. no. 78882), 14-302-6-a (78883), 15-302-1-b (78878), 16-302-6-c (78883), 17-302-6-b (78883), and 18-302-7-a (78884), all. ×30.

Figs. 19-22. *Brevaxina hataii* ISHIZAKI, n. sp.
19-Sagittal sections, specimen 302-5-d, IGPS coll. cat. no. 78882, ×30.
20, 21-Axial sections, 302-4-a (78880) and holotype specimen 302-4-b (78880), ×30.
22-Enlarged figure of the holotype 302-4-b (IGPS coll. cat. no. 78880), ×73.3.



KUMAGAI photo

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 50, pp. 65-69, pl. 10, June. 10, 1963

450. ON THE GENUS *ACER* WITH DESCRIPTION OF NEW SPECIES*

SEIDO ENDO

カヘデ属について，及び新種の記載：カヘデ属は日本群島の新生代地層から普通にかつ多量に産出する植物化石の一つである。この属には約300種あり，その中約150種は化石として報告されて居る。そして (1) *Acer arcticum* は古第三紀層，(2) *Acer protorufinerve* は中新世，(3) *Acer micranthum* は更新世の各々重要な化石種である。是等の葉縁を見るに (1) は簡単で鋸歯の先端はとがっておらないが (2) はその先端がとがった二重鋸歯で，(3) は最も複雑な先端がとがった二重鋸歯である（図版参照）。是等葉縁の鋸歯の変化は気候状態の変化によるものであろう。

遠藤誠道

The genus *Acer* is one of the most abundant and common fossil plants in the Cenozoic formations of Japanese Islands. The fossils and existing species of the genus are more than 300 species in number.

Among the species, about 150 were recorded by the many authors from the Tertiary period in the World. In these fossil species *Acer arcticum* is one of the most characteristic fossil plants in the Paleogene formations; and *Acer protorufinerve* is in the Miocene of Japan; *Acer micranthum* is in the Pleistocene Shiobara formation. As already stated in the palmately lobed leaves of the genus *Acer*, the number of lobes increases with advancing geological ages (ENDO, 1935). Next, in the marginal changes, *Acer arcticum* is most simple and the apex of dentation (or serration) is obtuse and not pointed, while *Acer protorufinerve* is duplicate serration and the apex of serration is acute. In *Acer micranthum*, the marginal serration is more complex and duplicate (ENDO, 1934, p. 245, pl. 28, fig. 1; pl. 29, figs. 1, 2; pl. 30, fig. 5) than the above species. It seems to me that these changes of marginal serration are due to climatic conditions; namely, *Acer arcticum* grows, probably, at warm temperate, *Acer rufinerve*, at mild temperate, and *Acer micranthum* grows at cold temperate.

Among the 60 species of the principal forest trees at the Tropical Philippines (WHITFORD, 1911), there are none of the species, which has the leaves with serrated or serrurated margins, and among the 189 species of the trees and shrubs of the Tropical Micronesia (KANEHIRA, 1933), only 10 species have the leaves with fine and indistinct serrurated margins, about 5 percent, the other 179 species, about 95 percent, are the leaves with entire margins, while the 74 species of the essential forest trees at cold temperate, Hokkaido (MIYABE and KUDO, 1929-31), only 9 species, about 12 percent, have the leaves of entire margins, and 20 species, about 27 percent, have the leaves of duplicate serrations.

Acer rufinerve is now existing in the mountains of Japanese Islands (Honshu, Shikoku, Kyushu), Korea and Manchuria. In the mountains of Central Honshu, it grows most luxuriantly at an altitude of 1000±m (500—1300 m) above sea level,

* Received June 16, 1962; read June 2, 1962.

while *Acer micranthum* grows luxuriantly at an altitude of 1500 m (1100-2000 m) above sea level, and *Acer protorufinerve* is quite similar in the features to *Acer rufinerve*. It may, probably, be a immediate ancestor of *Acer rufinerve* S. et Z. as it will be in detail, afterwards.

In the serrations of the dicotyledonous leaf margin, *Acer protorufinerve* is one of the most characteristic serration type in the Miocene and in the later age, and it is very rare in the Japanese Paleogene age.

Such developed serration type may not be appeared in the Pre-Miocene age, there are many species, which have the leaves of such developed serration type; namely: *Betula protoermanni* (ENDO, 1955, pl. 28, fig. 4), *Betula Ootanii* (SUZUKI, 1961, p. 28, pl. 7, figs. 5, 6), *Betula mioluminifera* (HU and CHANEY, 1940, p. 30, pl. 5, figs. 5, 6; pl. 7, figs. 1-3; pl. 9, fig. 1), *Betula miomaximowicziana* (TANAI, 1962, p. 289, pl. 10, figs. 6, 8), *Betula maximowicziana* (OKUTSU, 1940, p. 159, pl. 8, figs. 1, 2; pl. 9, fig. 4; pl. 10, fig. 4) and *Alus maximowiczii* (OKUTSU, 1940, p. 158, pl. 10, fig. 3; pl. 12, figs. 2, 3), etc., these are the most characteristic Miocene species, and they are very rare in the Paleogene age of Japanese Islands.

Descriptions of Species

Acer arcticum HEER

Pl. 10, fig. 5

Description:—Leaves orbicular in outline, length and width 4 to 5 cm., respectively; margins with irregular or sinuate dentate, apex of dentations obtuse or rather rounded, truncate or cordate at base; palmately 3-5 nerved, midrib stout, branching 4 secondaries diverging from the midrib at angles of 40± degrees and branching few secondaries on outer sides, basal primaries diverging from the midrib at angles of about 60± degrees and branching 4 to 7 secondaries on outer sides. All secondaries, craspedodrome. Tertiaries percurrent between the secondaries and curving outwards. Areolation thin and polygonal texture coriaceous.

Remarks:—The present species is one of the most common and characteristic plants (NATHORST, 1888, p. 11, pl. 3, fig. 1; OISHI and HUJIOKA 1943, p. 87, pl. 9; KONSTANTOW, 1914, p. 8, pl. 4, fig. 1; ENDO, 1941, p. 129; ENDO, 1942, p. 40, pl. 16, fig. 11; pl. 17, fig. 10) in the Paleogene floras of East Asia. The present material is quite similar to the species from the materials of Alaska (HOLLICK, 1938, p. 133, pl. 77, fig. 1; pl. 79, figs. 7, 8), Greenland (HEER, 1876, p. 86, pls. 22-25; 1883, pl. 84, fig. 2) and Spitzbergen etc., and the features are quite identical with the species, and the characteristic samaras with the leaves are quite agreeable with the Spitzbergen's material (HEER, 1877, p. 86, pl. 22, fig. 2). The species is one of the most abundant and characteristic plants in the *Woodwardia* zone at Shimizusawa, Yubari-city, Hokkaido, Japan.

Samara of *Acer arcticum* HEER

Pl. 10, fig. 4

Description:—Samara, about 3.5 cm. in length, wing about 1.5 cm. in maximum width; gradually narrowed upwards, outer margin straight, inner more or less rounded; veins about 13 in number at basal part near seed, veins in outer part strongly thick, inner part one thin, curving inwards and irregularly branching; seed, acute-angled triangle in shape, about 6 mm. long, and 4 mm. wide; angle

between the outer margin and contact line of fruits, about 30 degrees.

Remarks:—The present samara is quite identical with the samaras of *Acer arcticum* HEER which was illustrated and described by HEER (1877, p. 86, pl. 22, fig. 2) from Cap Lyell, Spitzbergens. As already stated, the leaves and samaras from the bank of the river Yubari, Shimizusawa, Yubari-city, Hokkaido, are quite identical with *Acer arcticum* HEER.

Horizon:—Woodwardia formation, Ishikari Series, Hokkaido.

Acer protorufinerve ENDO, n. sp.

Pl. 10, fig. 2

Description:—Leaf five lobed, ovate in general outline, length 11 cm., maximum width 8.5 cm., middle lobe large and prolonged and pointed at apex, margins duplicate-serrate, apex of serrations sharply pointed, basal lobes small and indistinct; base slightly cordate. Texture membranaceous. Petiole stout 3.5 cm. in length, midrib stout and generally straight, lateral primaries diverging from the midrib at angles of about 45± degrees, basal primaries diverging from the midrib at angles of about 80 ± degrees. All primaries run to the tip of the lobes. Secondaries diverging 11 alternate pairs from the midrib, at angles of about 45± degrees, stout and curving upwards; secondaries from the lateral primaries, 8 on outer side and 5 on upper part of inner side, somewhat curving upwards; secondaries from basal primaries 6 or 7, on outer side. All secondaries, craspedodrome. Tertiaries and areolation, polygonal or quadrangular, thin and indistinct.

Remarks:—The present fossil is quite similar to some* of the fossile leaves of *Acer rufinerve* S. et Z., which is now exist in Japanese Islands (Honshu, Shikoku and Kyushu). It may be a progenitor of the species. Among our collections from the same formation, there are quite identical leaves and samaras to the species (ENDO, 1951, p. 53, pl. 8, figs. 4, 5). From the formation, there are many occurrences of fossil leaves and samaras belonged to the genus *Acer*. Among them, *Acer Yobei* ENDO (ENDO, 1950, p. 13, pl. 3, fig. 7) is a most characteristic samara. This samara is quite identical to some of the samaras of *Acer Osmonti* KNOWLTON from the Miocene of Latah formation (see Jour. Washington Acad. Sci., Vol. 27, p. 510, fig. 1, 1937). Among the samaras, which were described by many authors as a *Acer Osmonti*, it seems to me, that it contains many different species.

Locality and formation:—Nishizawa, Akyu-mura, near Sendai, Japan, Shirasawa formation (Miocene).

Acer micranthum S. et Z.
(ENDO, 1934, 1955)

Pl. 10, figs. 1, 2

Description:—Leaves medium size, orbiculate in outline, about 7 cm. in length, and about 6 cm. in maximum width, palmately quinque-lobate; lobes lanceolate elliptical or ovate-lanceolate with incised duplicately serrulated margin, basal lobes smallest; apex of lobes greatly prolonged and sharply pointed; base slightly cordate. Texture coriaceous. Petiole long, slender, about 4 to 6 cm. long. Middle primary rib slender, thin distad, making with lateral primaries an angle of about 45 degrees, and with basal primaries an

* *Acer rufinerve* (OKUTSU, 1940, p. 164, pl. 4, figs. 1, 2; ENDO, 1951, pl. 40, fig. 1) are the same species to *Acer protorufinerve*.

angle of about 90 degrees. All primaries thin, slender and run to the tips of the lobes. Secondaries diverging from the midrib about 7 subalternate paris at angles of about 50 degrees. Secondaries from the lateral primary ribs diverging about 6 alternate pairs at angle of about 40 degrees. Secondaries from the basal primary ribs thin diverging, about 2 or more pairs. All secondaries craspedodrome. Tertiary veins and areolation thin and indistinct.

Remarks:—These fossils are quite identical to the leaves of the existing species *Acer micranthum* S. et Z. The remains are common in the Shiobara Pleistocene plant beds, generally with complex duplicated serrulations of the leaf margin, which the writer believes, is one of the most characteristic features of the leaves at the Pleistocene age of Japanese Islands. Such a highly specialized leaf margins gradually evolved from a simple entire margin under certain physical conditions, probably low temperature, seeing that we have a great number of trees in cold temperate flora, bearing leaves with such duplicated serrulations but almost none is the warm temperate (ENDO, 1931, 1932, 1935). This species is now living in the mountains of Japanese Islands (Honshu, Shikoku, Kyushu), Korea and Manchuria. In the mountains of central Honshu, it grows most luxuriantly at an altitude of 1500± (1100–2000) meters above sea level.

References Cited

ENDO, S. (1931): On the relation between the climatic zones and the leaf margin of dicotyledonous trees. *Jour. Geogr. Soc. Tokyo, Vol. 43*, pp. 231–321.

—— (1932): *Ibid.* (Abstract) *Japan. Jour. Geol. Geogr., vol. 9*, pp. 4, 5.

—— (1934): Some Japanese Cenozoic Plants (1). On the Fossil *Acer* from Siobara Pleistocene Plant Beds. *Ibid., Vol. 11, Nos. 3–4.*

—— (1935): A Pleistocene Flora of Japan as an indicator of climatic condition. *Jour. Geol. Soc. Japan, Vol. 43, No. 505*, pp. 668–673.

—— (1941): The fossil plants from the Paleogene formation of the East Asia. *Jour. Geol. Soc. Japan, Vol. 48, No. 570*, pp. 129–130.

—— (1942): On the Fossil Flora from the Shulan Coal-Field, Kirin Province and the Fushun Coal-Field, Fengtien Province. *Bull. Cent. Nat. Mus. Manchoukuo. No. 3.*

—— (1950): On the fossil *Acer* from Japan.

Explanation of Plate 10

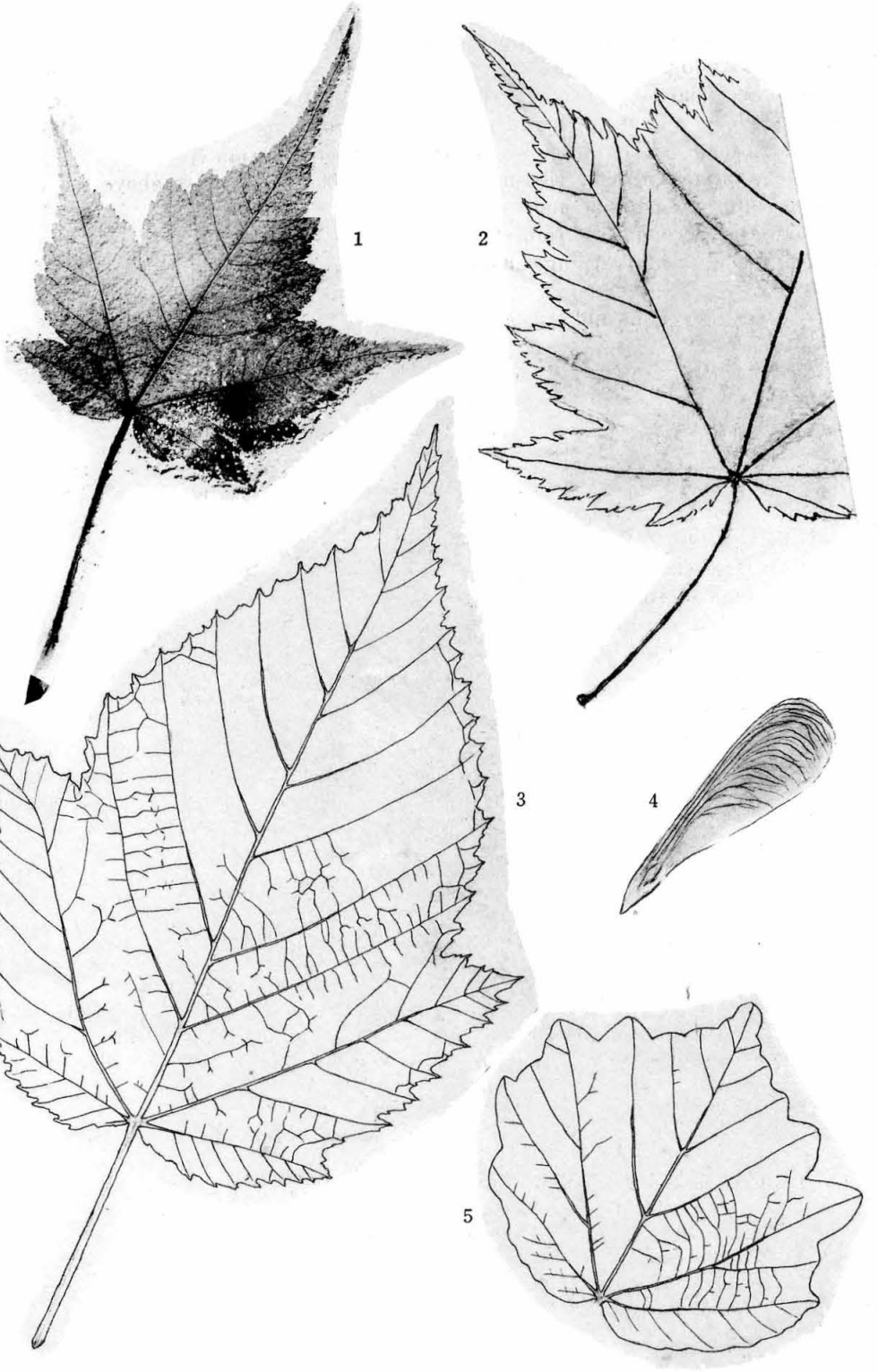
Fig. 1. *Acer micranthum* S. et Z. (×1)
Locality: Shiobara formation (Pleistocene), Shiobara, Shioya-gun, Totigi Prefecture, Honshu, Japan.

Fig. 2. *Acer micranthum* S. et Z. (slightly enlarged)
Locality: same with fig. 1.

Fig. 3. *Acer protorufinerve* ENDO (n. sp.) (slightly enlarged)
Locality: Shirasawa formation (Upper Miocene), Nishizawa, Natori-gun, Miyagi Prefecture, (Near Sendai city), Honshu, Japan.

Fig. 4. *Acer arcticum* HEER (Samara, slightly enlarged)
Locality: *Woodwardia* formation (Eocene), The river bank of the river Yubari; Shimizusawa, Yubari-city, Hokkaido, Japan.

Fig. 5. *Acer arcticum* HEER (×1)
Locality: same with fig. 4 (Eocene).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4
5

Korea, and South Manchuria. *Short Pap., I.G.P.S., No. 1*, pp. 11-17.
—— (1950) : *Ibid., No. 2.*
—— (1951) : On the fossil *Acer* from Japan Korea and South Manchuria II. *Ibid., No. 3.*
—— (1950) : *Op. cit., No. 3*, pp. 52-58, pl. 2.
—— (1955) : Icones of Fossil Plants from Japanese Islands.
HEER, O. (1877) : Beiträge zur fossilen flora Spitzbergens. *Kogl Svensks Vetensks—kademiens Handligar Bandet 14, No. 5*, p. 86, pl. 22, figs. 2c, f.
—— (1883) : Flora Fossilis Grunlandica. p. 126, pl. 94, fig. 2.
—— (1883) : " Flora Fossils Arctica. *Vol. 7.*
HOLLICK, A. (1938) : The Tertiary Floras of Alaska. *U.S. Geol. Surv., Prof. Pap. 182*, p. 33, pl. 77, fig. 1 ; pl. 78, figs. 7, 8.
HU, H.H. and CHANEY, R.W. (1940) : A Miocene Flora from Shantung Province, China. *Carnegie Inst. Wash. Publ. No. 507*, pp. 30, 31, pl. 5, figs. 5, 6 ; pl. 7, figs. 1-3 ; pl. 9, fig. 1.
KANEHIRA, R. (1933) : Flora Micronesia 1933. *South Seas Bureau, under the Japanese Mandate.*
KONSTANTOW, S.W. (1914) : Die Tertiare Flora des Bielogorje Ausschlusses am Unterlauf des Fl. Bureja, *Mem. Commite Geol., Noun. Ser., Livr, 113*, p. 8, pl. 4, fig. 1.
MIYABE, K. et KUDO, Y. (1920-1931) : Icones of the essential forest trees of Hokkaido. *Vol. 1, 1920-1923, Vol. 2, 1925-1928, Vol. 3, 1929-1931.*
NATHORST, A.G. (1888) : Zur Fossilen Flora Japan's. *Palaeont. Abhandl., Bd. 4.*
OKUTSU, H. (1940) : Fossil Plants from the Nenosiroisi Plant Bed near Sendai (1). *Saito Ho-on Kai, Mus. Res. Bull., No. 19*, pp. 153-169, pls. 7-14.
OISHI, S. and HUJIOKA, K. (1943) : Studies on the Cenozioc Plants of Hokkaido and Karahuto. V. Tertiary Acers from Hokkaido and Karahuto. *Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. 4, vol. 7, no. 1*, pp. 81-101, pls. 9-14.
PAX, F. (1902) : Aceracea. *In A. Engler, Das Pflanzenreich IV*, 163.
SUZUKI, K. (1961) : The Important and Characteristic Pliocene and Miocene Species of Plants from the Southern Part of the Tohoku District, Japan. *Sci. Rep. Fac. Art and Sci., Fukushima Univ., No. 10*, pp. 38, 39, pl. 7.
TANAI, T. (1962) : Neogene Floral Change in Japan. *Jour. Fac. Sci., Hokkaido Univ., Ser. 4, Vol. 11, No. 2.*
TANAI, T. and SUZUKI, N. (1960) : Miocene Maples from Southwestern Hokkaido, Japan. *Jour. Fac. Sci., Hokkaido. Univ., Ser. 4, vol. 10, no. 3*, pp. 551-570, pls. 1-9.
WHITFORD, H.N. (1911) : The Forest of the Philippines. Part II, The Principal Forest Trees. *Dept. Inter. Bur. Forest., Bull. No. 10*, pp. 1-113, pls. 1-103.

Akiho-mura	秋保村	Shiobara-Machi	塩原町
Nishizawa	西　沢	Shioya-gun	塩谷郡
Simizusawa	清水沢	Shirasawa-mura	白沢村

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 50, pp. 70-80, p'. 11, June. 10, 1963

451. TWO NEW SPECIES OF *OPIS* FROM THE CRETACEOUS OF JAPAN*

YOSHIRO UEDA

Geological Survey of Japan

白堊系産 *Opis* の2新種：北海道および九州の白堊系からの *Opis* 2新種を記載し，あわせて白堊系から産出の知られている *Opis* 類の分類を吟味した　　植田芳郎

Introduction

The purpose of this paper is mainly to describe two new species of *Opis* from the Cretaceous of Kyushu and Hokkaido, with some remarks on the definition and the taxonomic position of the genus.

Genus *Opis* characteristically occurs in the Mesozoic of Tethys and Circum Pacific regions and no species have as yet been found in the Tertiary rocks. It is, however, rather rare in the Japanese Mesozoic strata, only four species having been recorded from the Mesozoic, of which three are Jurassic species, namely *Opis* (*Coelopis*) *torinosuensis* KIMURA (1956), *Opis* (*C.*) *tanourensis* TAMURA (1959) and *Opis* (*Trigonopis*) *trigonalis* TAMURA (1959), and one is Cretaceous, that is *Opis* (*Trigonopis*) *haginoensis* AMANO (1957).

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Remarks on the genus *Opis* and its allied group

Genus *Opis* was established by DEFRANCE in 1825 on the basis of *Trigonia cardissoides* LAMARCK. According to MUNIER-CHALMAS (1887, in FISCHER, p. 1019), the generic diagnosis is described as follows.

"Coquille cordiforme-trigone, convexe, solide, obliquement carénée; crochets trés élevés, saillants, recourbés en avant ou subspirax lunule large, plus ou moins deprimee; bord posterieur court, surface presque toujours sillonée concentriquement; bord des valves plus ou moins denticlé; charnière portant á droite; une longue dent cardinale etroite, allongée, saillante, verticale; a gauche: une dent cardinale anterieure trés et une forte dent cardinale posterieure saillonnée á sa face extreme; dents latérales mulles

* Received June 1962; read April 6, 1961.

ou obsolétes; ligne palléale simple."

To quote partly from BIGOT (1895, p. 156), the teeth of the genus is described as follows.

"Charniére de la valve α (droit) portant une grosse dent cardinale cannelée sur sa face postérieure ou sur ses deux faces. Charniére de la valve β portant deux dents cardinales divergentes, dont la postérieure est trés développee, quelquefois cannelee sur ses deux faces ou sur la face postérieure, et l'antérieure est rudimentaire ou nulle."

Subfamily *Opisinae* CHAVAN (1952) consists of a number of genera and subgenera, such as *Opis*, *Trigonopis*, *Pachyopis*, *Coelopis*, *Cryptocoelopis*, *Protopis*, *Heteropis*, *Myophoricardium*, *Opisoma*, *Trigonoastarte* and *Seebachia*. Among the above, the six genera and subgenera, *Opis*, *Trigonopis*, *Pachyopis*, *Coelopis*, *Opisoma* and *Seebachia*, commonly occur in the Cretaceous deposits and here deserve special treatment.

The criteria to distinguish them are mainly in the shape of the shell, the feature of the lunule and disposition of the hinge teeth. MUNIER-CHALMAS, BIGOT and ARKELL (1934) hold that the striae or grooves on the side of the cardinal teeth are the most important character to separate the subgroups (subgenera or sections) of the genus *Opis*. I am agreeable with them, although the biological meaning of the striae may not be perfectly clear.

The definition of the generic and subgeneric diagnosis may be given in the following way:

Disposition of the hinge teeth

1. One cardinal tooth in the right valve and two in the left valve. genus *Opis*
   - 1.1. striate on both sides of the cardinal tooth in the right valve. subgenus *Opis*
   - 1.2. striate on the posterior side of the cardinal tooth in the right valve. subgenus *Trigonopis*
   - 1.3. not striate. subgenus *Pachyopis*
2. Two cardinal teeth in each valve.
   - 2.1. striate on the both sides of the cardinal tooth. genus *Opisoma*
   - 2.2. not striate. genus *Coelopis*
3. One cardinal tooth in the right valve and a divergent V-shaped cardinal tooth in the left valve. genus *Seebachia*

From the description by BIGOT (1895), it is evident that *Opis cardissoides*, the type-species of *Opis*, has one cardinal in the right valve and two in the left valve. Moreover, the cardinal of the right valve is very large, erect and striate on both sides. In the left valve the posterior cardinal is relatively large and striate on its anterior side, while the anterior is small or rudimentary and not striate.

MUNIER-CHALMAS (1887) established the two sections, *Coelopis* and *Trigonopis*, in the genus. Distinction between *Coelopis* and *Trigonopis* is clear. The former has a very large and deeply excarvated lunule and not striate on the sides of the teeth. The latter has a shallow lunule and the cardinal tooth of the right valve is striate on the posterior side.

From the foregoing remarks, *Opis* (s.s.) is to be defined as follows.

In shell-form *Opis* (s.s.) follows the general characters of usually understood *Opis* (s.l.), but it has the most diagnostic feature in the hinge structure. The cardinal tooth in the right valve is very large, trigonal, erected and located at the anterior part of the hinge plate. The tooth is striate on both sides as in Trigonians. The left valve has two divergent long cardinal teeth, anterior of which is small, anteriorly inclined and more or less rudimentary. The posterior one is large, stout, striate on its anterior side and located nearly parallel to the

postero-dorsal margin.

Genus *Opisoma* was established by STOLICZKA (1871, p. 276) on the basis of *Opis paradox* BUVIGEIER. It is characterized by the following features. "Shell trigonal, much higher than long, with long attenuated slightly incurved and approached beaks; lunule large and deep: hinge with the cardinal elongated teeth in each valve, and a small posterior lateral tooth situated above the posterior muscular impression, which is only slightly larger than the anterior one, both being deeply excaveted" and "In the form, they perfectly resemble some species of *Opis*, but the hinge is considerably different, possessing more cardinal teeth than are to be observed in that genus."

The description of the type-species of *Opisoma* is partly quoted from BIGOT (1895, p. 161) in the following lines.

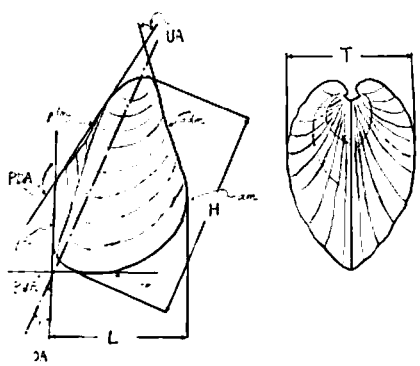
"Plateau cardinal épais portant à la valve α (droite) une grosse dent cardinal striée sur ses deux faces une dent antérieure plus ou moin développée, à la valve β (guche) une forte dent cardinale postérieure striée sur ses deux faces et une dent antérieure, plus ou moin dédeloppée, striée sur sa face postérieure."

ANDERSON (1958, p. 122) in describing *Opisoma pacifica* says, "In the interior feature of the shell, the species departs farther from the Indian type (*Opisoma geinitziana*, figured and described by STOLICZKA in 1871), having in part more prominent but shorter teeth, of very unequal size and length; in the right valve, the anterior tooth is shorter, and more prominent than in the Indian type, and more prominent and longer than the posterior in the same valve, the latter being only one-third the length of the former, and it rises to only half the height the anterior tooth. In the left valve the teeth are also of unequal size, though their respective length and prominence are reversed; the posterior tooth greatly exceeds the anterior in length and prominence."

The above quoted ANDERSON's specific diagnosis of the interior feature is essentially the same as proceeding BIGOT's subgeneric diagnosis. I am inclined to believe that *Opisoma* has two cardinal teeth in each valve.

Method of Measurements

Because the shell outline of *Opis* is generally very oblique, the usual method of measurement is inadequate for expressing the true shape of the shell, I have employed the following method for the measurements; (Text-fig. 1):



Text-fig. 1.

Height (H): Maximum distance from the tip of the umbo to the farthest point of the ventral margin.

Length (L): Maximum distance from the anterior to the posterior margin between the most produced points.

Thickness (T): Maximum dimension of the shell measured normal to plane of commissure.

Umbonal Angle (UA): Angle between the antero-dorsal margin and the postero-dorsal margin.

Postero-dorsal Angle (PDA): Angle between the postero-dorsal margin and the

posterior margin.

Postero-ventral Angle (PVA): Angle between the posterior and the ventral margin.

Oblique Angle (OA): Angle between the posterior margin and the line from the tip of the umbo to the postero-ventral edge.

Systematic description

PELECYPODA

Family Astartidae D'ORBIGNY

Subfamily Opisinae CHAVAN

Genus *Opis* DEFRANCE, 1825

Opis (Opis) amakusensis UEDA, sp. nov.

Pl. 11, figs. 1-4, 15

Material:—Holotype: GK-H. 6098, right valve collected by myself from Loc. K-20, the grey silty sandstone of Member Id, Himenoura group.

Measurement:—Length: 31 mm, height: 44 mm, thickness (1/2): 13.5 mm, umbonal angle: 48°, postero-ventral angle: 84°, postero-dorsal angle: 146°, oblique angle: 22°.

Diagnosis:—The shell is relatively large for the genus, trigonally sub-quadrilateral in outline, very inequilateral, equivalve and considerably inflated. The test is thick. The height of the shell is much larger than the length. The anterior margin is rounded, passing gradually into the slightly curved ventral margin; the posterior margin straight, slightly concave, forming an angle of about 84° with the ventral margin and also an obtuse angle of about 146° with the long and straight postero-dorsal margin.

The beak is very prominent, orthogyrate or slightly prosogyrate and situated at one-third the length of the shell from the anterior extremity. The umbo is very prominent and inflated.

A radial ridge, which extends from the umbo to the postero-ventral angle, has a sharp angle of about 87° in section on the umbonal area and a rounded angle of about 110° in section near the postero-ventral margin. The surface is divided by the radial ridge, of which the posterior one is nearly plane and so abruptly deflected that it is scarcely visible from the side view, although it embraces about one-third of the total surface of the valve. The posterior area is divided into two parts by an obvious but dull carina which ends at the postero-dorsal angle. The outer part of the area is nearly plane and slightly concave, while its inner part is well defined and depressed forming an escutcheon which resembles a lunule, but is not so deep nor so cordate. The umbonal angle is about 48°.

The surface of the shell is ornamented by closely spaced fine lines of growth and more distant and irregular concentric undulations.

The hinge plate is heavy, wide and of trigonal outline and shows the characteristic structure of the genus. In the right valve there are a single very large trigonal tooth and two smaller and elongated sockets. The cardinal is coarsely striate at right angle to the hinge plane on both sides of the tooth. The hinge of the left valve and the inner feature of the shell are not observed. The inner margin of the shell may be crenulated.

Comparison:—*Opisoma geinitiziana* STOLICZKA (1871, p. 288, pl. 10, figs. 11, 11a, 11b) from the Ootatoor group of South India and *Opisoma pacifica* ANDERSON (1958, p. 122, pl. 26, figs. 5, 6) from the Upper Cretaceous of the Pacific Coast of California, are apparently similar to the

present species in general aspects, but they are distinguished from the present species in having more cardinal teeth in each valve, a more curved anterior margin, a straighter and slightly more concave ventral margin and larger size.

The present species more or less resembles *Opis neocomiensis* D'ORBIGNY, figured and described by WOOD (1906, p. 118, pl. 17, figs. 8-12), from the Lower Greensand of Upware and Seed in England, but the former is easily distinguished from the latter in having larger umbo, a larger size, and irregular concentric undulations.

Occurrence:—The locality of the described specimen is K 20, Furukojiro in Amakusa-Kamishima, Kumamoto Prefecture, Kyushu. It was found in fine sandstone belonging to Member Ib of the Lower formation of the Himenoura group. The present species is associated with *Nucula formosa* NAGAO, *Inoceramus* sp., *Polyptychoceras* sp., *Gaudryceras* sp., and *Platycyathus* cf. *kawakamiensis* EGUCHI. Member Ib of the Himenoura group is assigned to the lower part of Upper Urakawan, approximately Lower Santonian (see UEDA and FURUKAWA, 1960).

Opis (*Opis*) *hokkaidoensis* UEDA, sp. nov.

Pl. 11, figs. 5-14, 16

Material:—Holotype: GK-H 6101; Paratypes: GK-H 6099, 6100, 6105, and many other specimens are at hand. They were collected by T. MATSUMOTO, H. KIDO and J. IWAMOTO from Loc. KU 1055 and 1060, in eastern part of Hokkaido. Their preservation is good but the shell material is partly removed.

Measurements:—

Specimens	Height	Length	Thickness	OA	UA	PDA	PVA
GK-H 6101	37.5	28.0	27.0	38°	62°	130°	90°
GK-H 6099	27.0	20.7	21.8	42°	60°	115°	110°
GK-H 6100	29.2	23.4	25.0	—	—	—	—
GK-H 6105	30.0	23.0	23.0	34°	61°	130°	—
GK-H 6106	29.0	23.0	22.0	34°	65°	130°	92°

Diagnosis:—The shell is of medium to large size, trigonal to subquadrate in outline, inequilateral, equivalve and very convex. The test is thick. The height of the shell is larger than the length. The anterior margin is rounded, passing gradually into the moderately curved ventral margin. The postero-ventral angle is about 90° to 110°, being regularly curved from the posterior to the ventral margin; the postero-dorsal angle about 130°, being abruptly curved from the posterior to the postero-dorsal margin.

The umbo is very prominent, approximated and slender. The beak is incurved, approximated, slightly prosogyrate and situated at about middle of the shell length. The umbonal angle is about 60° to 65°.

A ridge extends from the umbo to the postero-ventral angle. It shows a well-defined angle of about 110° in section on the umbonal area and a rounded and dull angle of about 120° in section near the postero-ventral margin.

The surface is divided by the radial ridge, of which the posterior area is further divided into two parts by a distinct and rounded carina ending at the postero-dorsal angle. The part between

the ridge and carina is flattened and slightly concave. The part behind the carina, escutcheon, is moderately depressed.

The lunule is cordate, very deep and bordered by a very elevated and rounded ridge.

Surface ornamentation consists of many fine lines of growth and more widely and regularly spaced concentric rings.

The hinge shows the characteristic structure of the genus, having a single very large triangular tooth in the right valve and two elevated ones in the left valve, of which the anterior is small, more or less rudimentary and fused with the edge of the shell; the posterior one is large, stout with obliquely striate inner surface and located nearly parallel to the postero-dorsal margin. In the right valve, the arrangement of the grooves on both sides of the tooth is very oblique to the hinge plane.

The inner margin of the shell is crenulated; other inner features are not well observed.

Comparison:—*Opis neocomiensis* D'ORBIGNY figured and described by WOOD (1904b, p. 118, pl. 17, figs. 8-12) from the Lower Greensand in England, closely resembles the present species in size, sculpture and other general feature but the former is oblique and has a different form of the posterior margin.

Opis glareosa P. DE LORIOL and *Opis hugardiana* D'ORBIGNY figured and described by P. DE LORIOL (1882, p. 92, pl. 11, figs. 5-10), from the Gault of Cosne in France, resembles the present species, but they are distinct from the present species in having a more slender umbo, a more angular antero-ventral angle and larger in height.

Opis repleta STOLICZKA (1871, p. 288, pl. 10, figs. 9-10), from the Ootatoor group in southern India, is smaller than the present species and differs from it in every specific features.

Opis (*Trigonopis*) *haginoensis* AMANO (1957, p. 97, pl. 2, figs. 25, 26), from the Miyakoan beds near Hagino, Kochi Prefecture, closely resembles the present species in the general feature and the disposition of the teeth but differs in the form of the ventral margin and the crenulation of the inner margin of the shell.

Opis (*Opis*) *amakusensis* n. sp. (see p. 73 of this paper) from the Lower formation of the Himenoura group in Amakusa-kamishima closely resembles the present species but it differs from the latter in having an irregular spaced concentric undulations and grooves on the cardinal tooth which are perpendicular to the hinge plate.

Occurrence:—Localities KU 1055 and 1060, Ponporoto, Hamanaka-mura, Akkeshi-gun, in eastern Hokkaido. The stratigraphic position is the Lower formation of the so-called Hamanaka formation: The associated species are, according to T. MATSUMOTO, *Gaudryceras* (*Vertebrites*) *kayei* (FORBES), *Glycymeris shimonadaensis* ICHIKAWA & MAEDA, *Rhynchonella* sp. and *Halymenites* sp.. The geological age is probably Lower Maestrichtian or Upper Campanian.

Synoptic list of the Cretaceous species rearranged by the author

Opis DEFRANCE, 1825

Type-species: *Opis cardissoides* DEFRANCE (*Trigonia cardissoides* LAMARCK) by monotype, from the Jurassic of Germany (DEFRANCE, 1825, Dictionnaire des Sciences naturelles Conchyliologie, tom. 36, p. 219, pl. 70, figs. 3a, 3b; pl. 100, fig. 1) (BIGOT, A., 1895, Sur les *Opis*, p. 94).

Opis coquandiana D'ORBIGNY, 1843, p. 54-55, pl. 257, figs. 7-8. France, Albian

Opis galliennei D'ORBIGNY, 1843, (no description), pl. 257bis, fig. 5. France, ?

Opis Ligeriensis D'ORBIGNY, 1843, (no description), pl. 257bis. France, ?

Opis repleta STOLICZKA, 1871, p. 288, pl. 10, figs. 9-10. South India, Turonian

Opis triangulata, (COOPER), STANTON, 1895, p. 59. California, Maestrichtian

Opis rosarioensis ANDERSON & HANNA, 1935, p. 31, pl. 10, figs. 2, 3. California, Maestrichtian

Opis rosarioensis, ANDERSON, 1958, p. 122. California, Maestrichtian

Opis shastalis ANDERSON, 1938, p. 121, pl. 4, figs. 4-5. California, Aptian

Opis woodsi COLLIGNON, 1939, p. 14, pl. 1, fig. 20, 20a. Madagascar, Turonian

Opis (*Opis*) *neocomiensis* D'ORBIGNY, 1843, p. 51-52, pl. 253, figs. 1-5. France, Neocomian

Opis (*Opis*) *hugardiana* D'ORBIGNY, 1843, p. 52-53, pl. 253, figs. 6-8. France, Albian

Opis (*Opis*) *sabaudiana* D'ORBIGNY, 1843, p. 53-54, pl. 254, figs. 1-3; pl. 257, figs. 4-6. France, Albian

Opis (*Opis*) *elegans* D'ORBIGNY, 1843, p. 55-56, pl. 254, figs. 4-9. France, Turonian

Opis (*Opis*) *glareosa* LORIOL, 1882, p. 92-94, pl. 11, figs. 5-10. France, Albian

Opis (*Opis*) *hugardiana* D'ORBIGNY, LORIOL, 1882, pl. 11, figs. 11-12. France, Albian

Opis (*Opis*) *californica* STANTON, 1895, p. 58-59, pl. 7, figs. 1-4. Californica, Neocomian

Opis (*Opis*) *neocomiensis* WOODS, 1904, p. 118-119, pl. 17, figs. 8-12. England, Aptian

Opis (*Opis*) *haldonensis* WOODS, 1904, p. 119-120, pl. 18, figs. 1a-b. England, Cenomanian

Opis (*Opis*) *bruni* COSSMAN, 1916, p. 413, pl. 17, fig. 1. France, Aptian

Opis (*Trigonopis*) MUNIER-CHALMAS, 1887, in FISCHER, p. 1019, pl. 19, fig. 24.
Type-species: *Opis lunulata* MILLER

?*Opis* (*Trigonopis* ?) *haginoensis* AMANO, 1957, p. 97, pl. 2, figs. 25, 26. Japan, Albian

Opis (*Trigonopis*) *dubisiensis* PICTET et CAMPICHE, 1864, in GILLET, 1925, p. 108, pl. 2, fig. 16. France, Neocomian

Opis (*Pachyopis*) BIGOT, 1894
Type-species: *Opis ponderosa* DESLONGCHAMPS, Bajocien.

Coelopis MUNIER-CNALMAS, 1887, in FISCHER, p. 1019.
Type-species: *Opis lunulata* SOWERBY Bajocien

Coelopis Lorioli PICTET et CAMPETICHE, 1864, in GILLET, 1925, p. 108, fig. 67. France, Neocomian

Coelopis Isarae GRAS, 1852, in GILLET, 1925, p. 108, fig. 67. France, Neocomian

Opisoma STOLICZKA, 1870
Type-species: *Opis paradox* BUVIGNIER Oxfordian

Opisoma genitziana STOLICZKA, 1870, p. 288, pl. 10, figs. 11a-c. South India, Albian

Opisoma pacifica ANDERSON, 1958, pp. 122-123, pl. 26, figs. 5, 6. California, Maestrichtian

Opisoma vancouverensis (WHITEAVES) ANDERSON, 1958, p. 123. California, Senonian

Opisoma vancouverensis WHITEAVES, p. 158, pl. 18, fig. 4, 4a. California, Senonian

References

AMANO, M. (1957): The Lower Cretaceous Fauna from Hagino in southern Shikoku, Japan. *Kumamoto Jour. Sci., Ser. B., Sec. 1, Geol.*, vol. 2, pp. 77-113, pls. 1-2.

ANDERSON, F. M. (1938): Lower Cretaceous Deposits in California and Oregon. *Geol. Soc. America, Special Paper, No. 16*, p., includ., pls. 1-83.

—— (1958): Upper Cretaceous of the Pacific coast. *Geol. Soc. America, Memoir 71*, 378 p., includ., pls. 1-75.

ARKELL, W. J. (1934): A Monograph of the British Corallian Lamellibranchia, Pt. VI. *Paleontographical Society, London, 1932*, pp. 229-276, pls. 29-36.

BIGOT, A. (1895): Memoire sur les *Opis*, Faune Jurass de Normandie. *Mem. Soc. Linneenee Normandie, Tom. 18, 2e fasc.*, pp. 155-191, pls. 10-11.

CHAVAN, A. (1952): Mélanges Paléontologiques, III et IV. *Cahiers Géol. Thoiry, N°. 15*, pp. 123-128.

COSSMAN, M. (1916): Les Coquilles des Calcaires D'Orgon. *Bull. Soc. Géol. France,*

4 Serie, Tom. 16, pp. 336-431, pl. 10-17.

FISCHER, P. (1880-1887): Manuel de Conchyliologie et de Paleontologie Conchyliologique, pp. 1369, pls. 24 (Paris).

GILLET, S. (1924-25): Etudes sur les lamellibraches neocomiens. *Mémoires Soc. Géol. France. Neuvelle Serie, Tom. 3, Mém. N°. 3*, pp. 1-224, pls. 1-2 (1924); pp. 225-339, maps 1-2 (1925).

KIMURA, T. (1956): Some Pelecypods from the Upper Jurassic Torinosu Group in Kochi Prefecture, Japan. *Jour. Earth Sci., Nagoya Univ., Vol. 4, No. 2*, pp. 80-90, pl. 1.

LORIOL, P. (1882): Etudes sur la Fauna des Couches du Gault de Cosne (Nievre). *Mem. Soc. Pal. Suisse, Tom. 9*, pp. 1-118, pls. 1-13.

ORBIGNY, A. d' (1843-47): Description des Mollusqus et Rayonnes Fossiles, *Pal. Franc. Terr. Cret., Tom. 3 (Lamellibranchia)*, pp. 1-807, pls. 237-270, 242bis, 257bis, 266bis (1943); pls. 271-489, 283bis (1844-1847).

STANTON, T. W. (1895): Contributions to the Cretaceous Paleontology of Pacific Coast, The fauna of the Knoxville Beds. *U. S. Geol. Surv., Bull. 133*, pp. 1-132, incl. pls. 1-20.

STEPHENSON, L. W. (1952): Larger Invertebrate Fossils of the Woodbine Formation (Cenomanian) of Texas. *U. S. Geol. Surv., Prof. Paper, No. 242*, pp. 1-226. pls. 8-59.

STOLICZKA, F. (1871): Cretaceous fauna of south India, vol. 3, *Paleontologia Indica. Pts. 1-4*, pp. 1-222, pls. 1-12 (1870); Pts. 5-8, pp. 223-409, pls. 23-28 (March, 1871); Pts. 9-13, pp. 409-537, pls. 24-50 (Aug. 1871).

TAMURA, M. (1959): Some pelecypods from the Upper Jurassic Sakamoto formation in Central Kyushu, Japan. *Trans. Proc. Paleont. Soc. Japan, N. S., No. 35*, pp. 113-120, pl. 12.

UEDA, Y. and FURUKAWA, N. (1960): On the Himenoura group of Amakusa-kamishima and adjacent islets, Kumamoto Prefecture. *Sci. Rep. Fac. Sci., Kyushu Univ., Geol. Vol. 5, No. 1*, p. 14-35 (in Japanese with English abstract).

WARING, C. A. (1917): Stratigraphic and fauna relations of the Martinez to the Chico and Tejon of southern California. *Proc. California Acad. Sci., 4th Ser., Vol. 7, No. 4*, pp. 41-134, pls. 7-16.

WHITEAVES, J. F. (1879): Mesozois Fossils. *Vol. 1, No. 2*, pp. 93-190, pls. 11-20.

WOODS, H. (1906): A Monograph of the Cretaceous lamellibranchia of England. vol. 2, pt. 3, Pinnidae, Astartidae, Carditidae, Crassatellitidae, and Cyprinidae. *Paleontographical Society, London, 1906*, pp. 97-132, pls. 12-18.

Akkeshi-gun	厚岸郡	Hagino	萩野
Amakusa-Kamishima	天草上島	Hamanakamura	浜中村
Furukojiro	古神代	Ponporoto	奔幌戸

Explanation of Plate 11

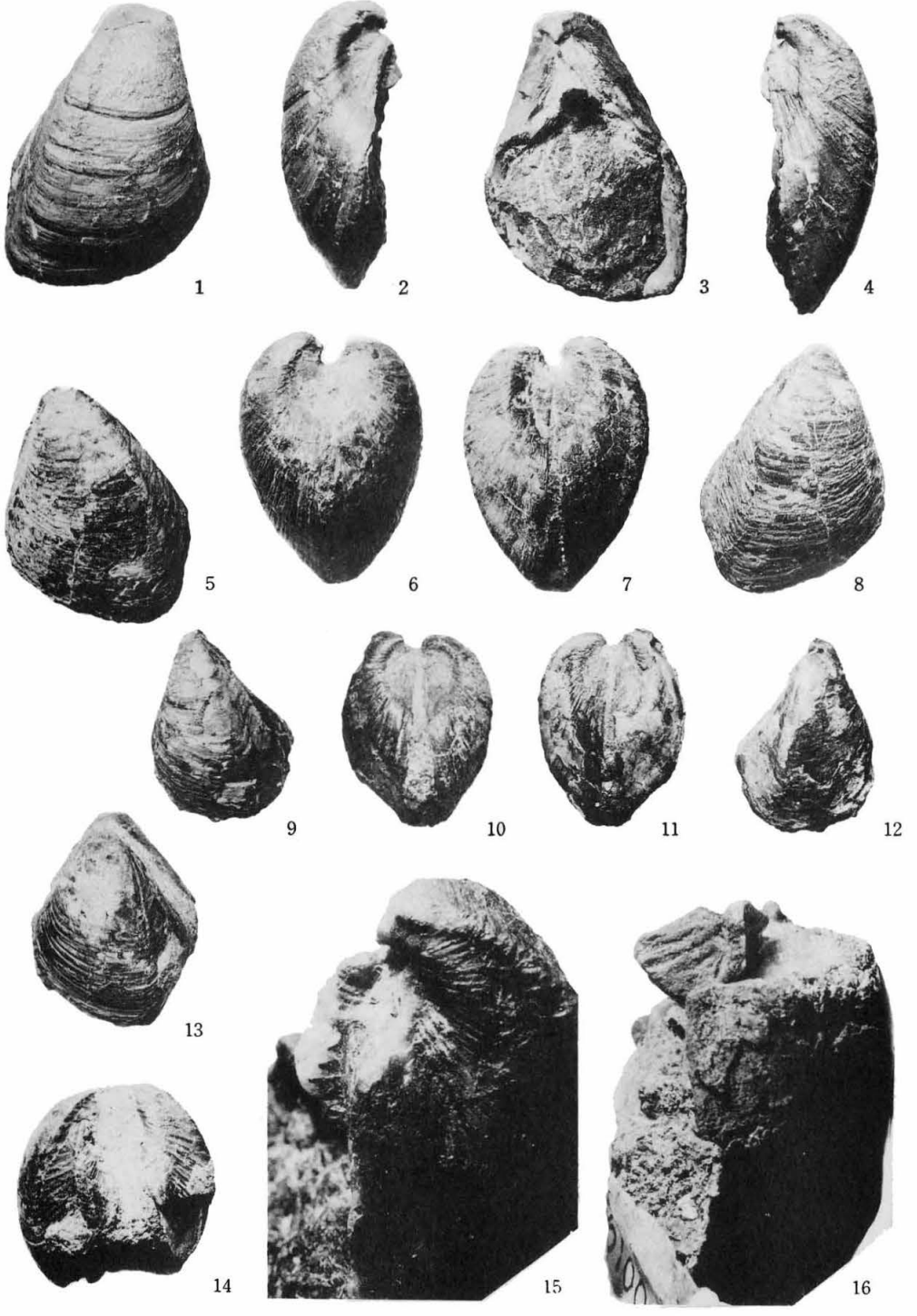
Figs. 1–4, 15. *Opis* (*Opis*) *amakusensis* UEDA, sp. nov.

1. Exterior of a right valve, ×1
2. Anterior side view, ×1
3. Interior side view, ×1
4. Posterior side view, ×1
15. Showing the hinge character, ×3 of a Holotype, GK-H 6098, from Loc. K 20, Amakusa-kamishima, Kyushu, Japan.

Figs. 5–14, 16. *Opis* (*Opis*) *hokkaidoensis* UEDA, sp. nov.

5. Exterior of a left valve, ×1
6. Anterior side view, ×1
7. Posterior side view, ×1
8. Exterior of a right valve, ×1 of a Holotype, GK-H 6101.
9. Exterior of a left valve, ×1
10. Anterior side view, ×1
11. Posterior side view, ×1
12. Exterior of a right valve, ×1 of a Paratype, GK-H 6099.
13. Posterior side view, ×1
14. Exterior of a right valve, ×1 of GK-H 6105.
16. Showing the hinge character, ×3 of GK-H 6100.

All from Loc. Ku 1055, 1060, Hamanaka-mura, Kushiro Province, Hokkaido, Japan



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例会・年会通知

	開催地	開催日	講演申込締切日
第85回例会	地質調査所（川崎）	1963年9月7・8日	1963年8月10日
第86回例会	大阪市立大学 大阪市立自然科学博物館	1963年11月9・10日	1963年10月10日
1964年総会年会	九州大学	1964年1月18・19日	1963年12月1日

第85回例会（地質調査所）：「応用古生物」に関する特別講演会及び多摩丘陵溝ノ口南方の三浦層群上部と下末吉層の見学（世話人，地質調査所　徳永重元）

第86回例会（大阪市立大）：「古生物を中心として見た日本の第四紀」についてのシンポジウム（日本第四紀学会と共催）（世話人，大阪市立大　池辺展生）

1964年総会年会（九州大学）：「進化と個体発生」（Ontogeny and Evolution）に関するシンポジウム（世話人，九州大学　松本達郎・首藤次男）

参加を希望する人は早目にそれぞれの世話人まで連絡されたい。

News

Tenth International Botanical Congress は Edinburgh で 1964年8月3日より12日にわたって開催される。この会議には古植物学関係では次の様な会合及び野外巡検が行なわれる。

Nomenclature.

Palaeobotany (1. Earliest records of plant life. 2. The evolution of seeds and ovules. 3. Evolutionary trends in Triassic and Jurassic floras in N. and S. hemispheres. 4. Palaeoecology and plant geography. Tertiary. Quaternary. 5. General palynology. 6. Morphology of Mesozoic, Carboniferous and pre-Carboniferous vascular plants.)

General Systematics.

Taxonomy and Evolution (The Quaternary glaciation and the evolution of the north temperate flora: Evolutionary trends and convergence etc.)

Plant Sociology and Phytogeography, etc.

野外巡検. (S.6) Palaeobotany-Quaternary, (S.7) Palaeobotany-Scottish Palaeozoics, etc.

連絡先は，The Secretary (Executive Committee), X International Botanical Congress, 5 Hope Park Square, Edinburgh 8, Scotland.

購読御希望の方は本会宛御申込下さい

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