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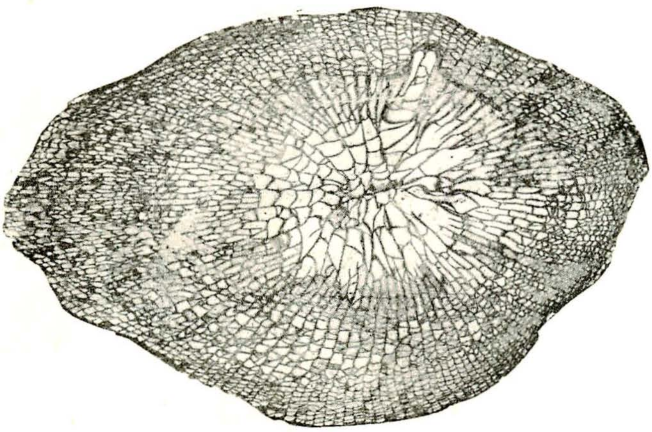

日本古生物学会

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Geological Institute, Faculty of Science, University of Tokyo, Japan

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544. CARBONIFEROUS BRACHIOPODS FROM AKIYOSHI, SOUTHWEST JAPAN PART III *DELEPINEA* FROM A PYROCLASTIC ROCK NEAR THE LOWEST PART OF THE AKIYOSHI LIMESTONE GROUP*

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西南日本秋吉産石炭紀腕足類 その3，秋吉石灰岩層群最下部付近の火山砕屑岩より産出した *Delepinea* について：山口県美祢郡美東町赤郷付近に分布する，秋吉石灰岩層群最下部付近の，紫赤色玄武岩質凝灰岩類の最上部付近から，それぞれ巨大型および大型 *Delepinea* の二新種，*Delepinea sayamensis, D. sinuata* が発見されたので報告する。*Delepinea* 属はヨーロッパやオーストラリアの下部石炭系からはすでに13種が報告されているが，アジアにおける産出はまだ確認されていなかった。秋吉産の二新種のうち *D. sayamensis* はヨーロッパの Lower Visean の *D. destinezi* (VAUGHAN) と非常に近縁であり，*D. sinuata* はオーストラリアの Middle—Upper Visean の *D. gloucesterensis* CAMPBELL and ROBERTS, *D. aspinosa* (DUN), および *D. cannindahensis* MAXWELL と類縁関係をもつ。これら腕足類を産する火山砕屑岩類の時代は Early—Medial Visean と考えられ，なかでも Early Visean の可能性が強い。

柳　田　寿　一

Introduction

It is well known that the lowest parts of Carboniferous-Permian thick limestone groups in the Inner zone of Southwest Japan consist mainly of pyroclastic rocks. The Akiyoshi limestone Group ranging from Lower Carboniferous to Upper Permian also contains thick bedded pyroclastic rocks partly including thin cherts, shales, and limestones at its basal portion. The details of petrological and sedimentological studies of the pyroclastic rocks are still incomplete. However, the stratigraphic succession and age of them became increasingly clear with the help of palaeontological study of some kinds of fossil partly well preserved in limestones and pyroclastic rocks. The biostratigraphical study of the lower portion of the Akiyoshi limestone Group was tried by OKIMURA (1966) in the Okubo- Hirabaru area, immediately south to the Akiyoshi limestone plateau. He treated the smaller foraminifers in limestones and established some foraminiferal zones. He correlated the age of the lowest limestone bed of the Akiyoshi limestone Group to the Early Visean. Prior to OKIMURA, MINATO and KATO (1963) described some brachiopods and corals from a reddish tuffaceous shale near the uppermost part of the pyroclastic rocks in the Okubo area. However, the greater part of the thick

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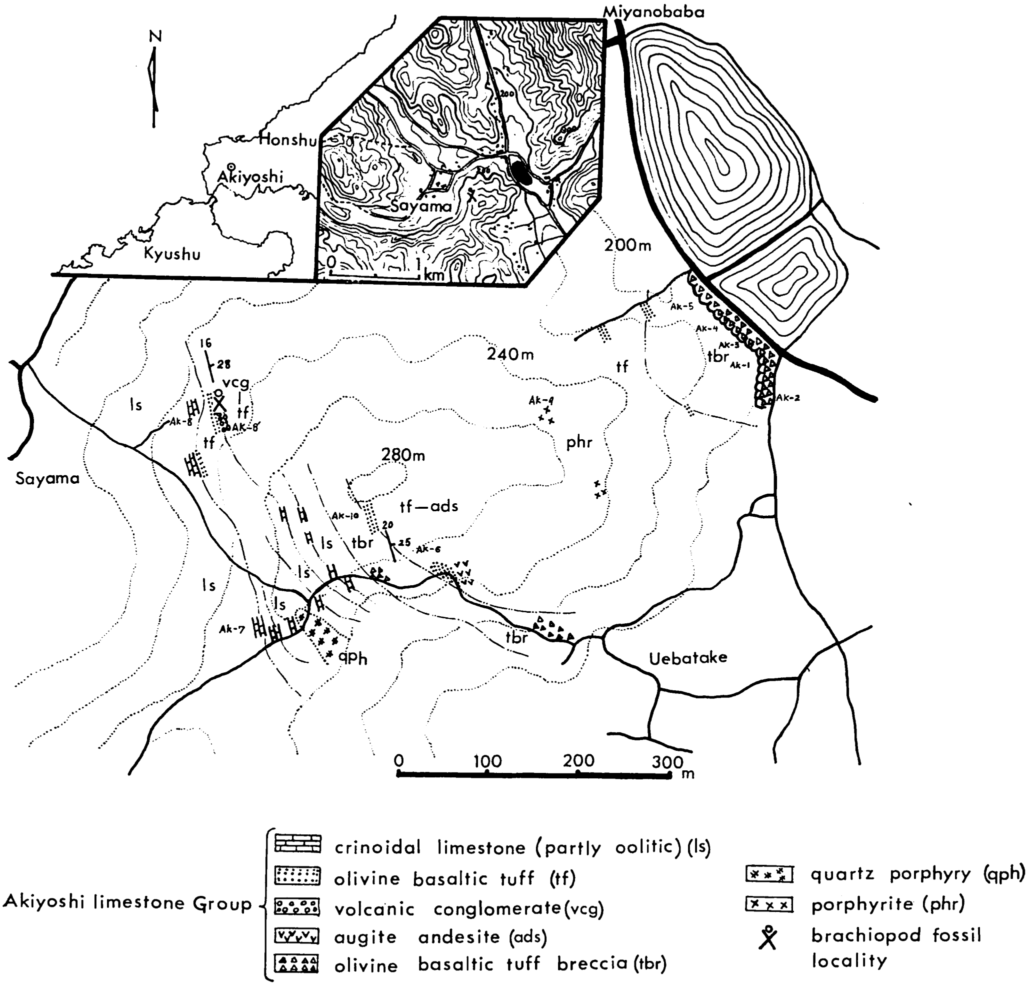


Fig. 1. Route map of the Sayama area showing brachiopod locality.
(by J. YANAGIDA, M. OTA and A. SUGIMURA)

pyroclastic rocks which conformably underlies the limestone is still uncertain in age because of the deficiency of well preserved fossils in different horizons.

The brachiopods herein described were collected from the northeastern margin of the Akiyoshi limestone plateau and from a horizon about 10 m below the lowest limestone bed. The pyroclastic rocks of this area have hitherto been regarded as diabase or basic intrusion. The Akiyoshi limestone Group in this area is completely reversed, being homoclinal with the general attitude of N15°W and NE30°±dip. The pyroclastic rocks are more than 100 m in thickness. The lower to middle part of them are composed mainly of dark green basaltic tuff breccia and dark brown basaltic lapilli tuff partly including a extruded sheet of dark brown augite andesite. Porphyritic intrusive rocks are partly observable near the middle part of the pyroclastic rocks sporadically distributed along the half way up a hill. It is dark green and completely altered. The uppermost part of the pyroclastic rocks consists of purplish basaltic calcareous tuff of more than 2 m thick, which includes a number of *Delepinea*. Well rounded pebbles of basaltic rocks are partly aggregated densely in the tuff and this part is more calcareous than the other parts. The lowest part of this basaltic tuff is conglomeratic with large

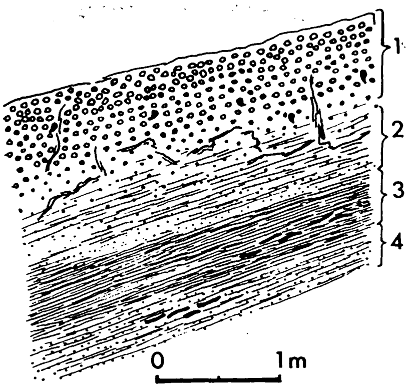


Fig. 2. Sketch showing the occurrence of brachiopod shells and an example of sedimentary features of pyroclastic rocks (completely reversed).

1) volcanic conglomerate often associating with small solitary corals (pebbles, olivine basalt; matrices, limestone).
2) purplish basaltic lapill tuff.
3) purplish basaltic tuff with brachiopod shells.
4) purplish basaltic lapilli tuff with sporadic brachiopod shells.

number of rounded pebbles of basaltic rocks and the tuffaceous limestone as the matrix. The conglomeratic part gradually merges into the upper tuff. The pebbles and granules in the conglomeratic part and tuff clearly show the graded bedding. The conglomeratic part abundantly contains the fragments of bryozoans and crinoids in the matrix. Small and well preserved solitary corals and brachiopod-fragments often associate with volcanic pebbles. Most of shells of *Delepinea* are disarticulated and disposed parallel to the bedding plane. Though its direct contact with the basaltic tuff is not ascertained, the lowest part of limestone is slightly tuffaceous near the contact and consists of nothing else than the fragments of crinoids and bryozoans. This suggests that tuffs and limestones are laterally and vertically changeable with each other near their boundary. The smaller foraminifers are very rare and consit of very small endothyrids. At a horizon about 50 m above the lowest limestone, where the smaller foraminifers occur abundantly with fine fragments of crinoids and bryozoans. The limestone of this horizon is more or less oolitic in texture.

Between the two new species of *Delepinea*, *D. sayamensis* and *D. sinuata*, the former is gigantic, being one of the largest species of this genus. The latter attains also the large size. Each of them has closely allied or related to the Lower Carboniferous species of Europe and Australia respectively.

It is concluded that the brachiopod assemblage consists of Early to Medial Visean elements and their age is highly referable to the Early Visean.

I wish to express my sincere appreciation to Professor Ryuzo TORIYAMA and Associate Professor Tsugio SHUTO of Kyushu University for reading the typescript; to Dr. Masamichi OTA and Mr. Akihiro SUGIMURA of Akiyoshi-dai Science Museum for their valuable discussions and kind helps in giving me every facility for field work; and to Mr. Kiyoshi ISHIBASHI of Kyushu University for his kind help of distinguishing the pyroclastic rocks.

Systematic descriptions

Family Daviesiellidae SOKOLSKAYA, 1960

Subfamily Delepineinae, MUIR-WOOD, 1962

Genus *Delepinea* MUIR-WOOD, 1962

Type-species.—Productus comoides SOWERBY, 1823

Delepinea sayamensis, sp. nov.

Pl. 33, figs. 1, 2, Pl. 34, fig. 1; Text-figs. 3, 4, 5

Material.—Holotype, GK-D 30209 (Pl. 33, fig. 1); paratypes, GK-D 30200 (Pl. 34, fig. 1), GK-D 30201, GK-D 30202. Fragmentary specimens are also refered to the species. Internal structures of pedicle valve are shown by the serial sectionas of GK-D 30203 and those of brachial valve are shown by a paratype, GK-D 30202.

Description.—(Exterior). Pedicle valve very large, transversely subelliptical, weakly inflated, with slight geniculation at about a third of length from posterior margin or more posteriorly; posterior side of geniculation very slightly convex and anterior one almost flat; greatest width at straight hinge line; cardinal extremities at early stages more acute than those of adult; lateral slopes almost flat or slightly concave; interarea low, flat or weakly concave, slightly apsacline; delthyrium wide and low, pseudodeltidium not preserved; spines not recognizable on cardinal ridge; mode of increment of numerous and fine rounded costellae not ascertained as they completely decorticated.

Brachial valve concave with largest concavity at about a half of valve-length; interarea low, slightly hypercline; surface ornamentation same to opposite valve.

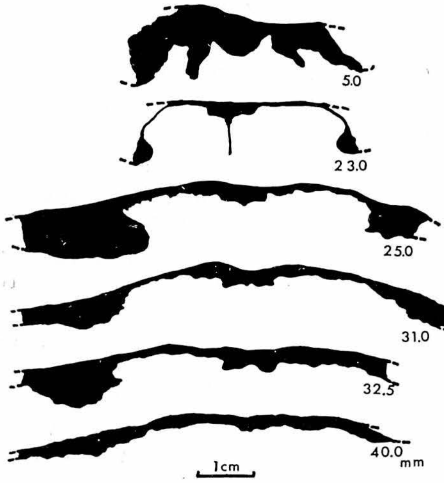


Fig. 3. Serial sections of a pedicle valve, GK-D 30203, showing massive posterior callus thickening, long and slender median septum, narrow adductor scars, and broad diductor scars.

(Interior). Pedicle valve interior characterized by a large posterior callus thickening, stout short teeth, slender median septum, narrow adductor scars, and broad diductor scars; massive callus thickening in delthyrium tightly contacting valve-floor with stout teeth on each side of it and anteriorly continuing to median septum; median septum very thin and short reaching about a sixth of length of pedicle valve from posterior margin; very low and round-topped ridge anteriorly continuous from median septum reaching a length of 8 mm and gradually tapering down strength; adductor muscle scars elevate about 1 mm from diductor muscle scars, anterior mid part of it longitudinally sulcate; diductor muscle scars anteriorly attains about a half of shell-length with remarkably rough appearance of surface in transverse section suggesting irregularly

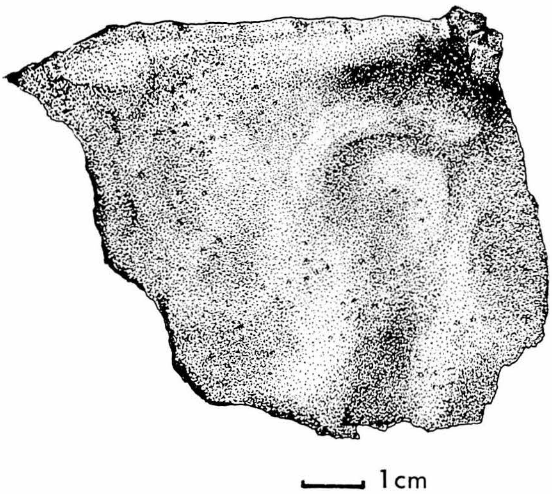


Fig. 4. Inked drawing of internal surface of a partly preserved brachial valve, a paratype, GK-D 30202, showing a remarkable alveolus, weak lateral septum, and weak socket ridge.

arranged longitudinal ridges on them.

Brachial valve interior with a large cardinal process; low broad socket ridge subparallel to hinge extending about a half of length from cardinal process to cardinal extremity; immediately anterior to cardinal process apparent concavity distinguishable suggesting alveolus; incomplete breviseptum at about 15 mm anterior to cardinal process, anterior characters of it unknown; lateral septa broad diverging from breviseptum at right angle and gradually fading out anteriorly; internal surface papillose.

Dimensions of four specimens in mm and degree.—

(pedicle valve)	1 GK-D 30203	2 GK-D 30209 holotype	3 GK-D 30200 paratype
width	>125	>171 (est. 196)	>95 (est. 138)
thickness	>20	21	est. 11
length	est. 90	85	52
height of interarea	>5	5	3
width of delthyrium	est. 18	19.5	26
number of costellae in 10 mm on anterior surface	16–18	15–16	12–14
angle of cardinal extremity		est. 60°	est. 50°
median septum: length	est. 18		
median septum: height	est. 10		
median septum: width of base	0.7		
diductor muscle scar: largest width	est. 18		
diductor muscle scar: length	>32		
adductor muscle scar: largest width	4.6		
adductor muscle scar: length	est. 30		
adductor muscle scar: height	est. 5		

(brachial valve)		1 GK-D 30202 paratype
width		>75 (est. 150)
length		68
thickness		est. 10
height of interarea		5
angle of cardinal extremity		est. 60°
cardinal process	height	10
	width	8
socket ridge	length	28
	angle to hinge line	20°
breviseptum	length	est. 22
	width	3
angle of lateral ridge to breviseptum		est. 90°

Remarks.—Among the species of *Delepinea* the Akiyoshi species is closely related with *Delepinea destinezi* (VAUGHAN) from the Middle Visean V_1b subzone of Belgium in its large size, external and internal characters. Unfortunately *Delepinea* was not originally described by VAUGHAN (1915). He only gave its brief external character and recorded its occurrence from C_2S_1 subzone in various regions of British isles. SIMPSON (1953) described the species in detail on the materials from C_2S_1 subzones of Ireland, however, the true nature of the Belgian original specimen is still unknown. Such being the case, I compared the Akiyoshi species with the English materials mainly based on the description of SIMPSON. Externally both English and Akiyoshi species resemble each other in having the flat posterior part and weak geniculation at about a third

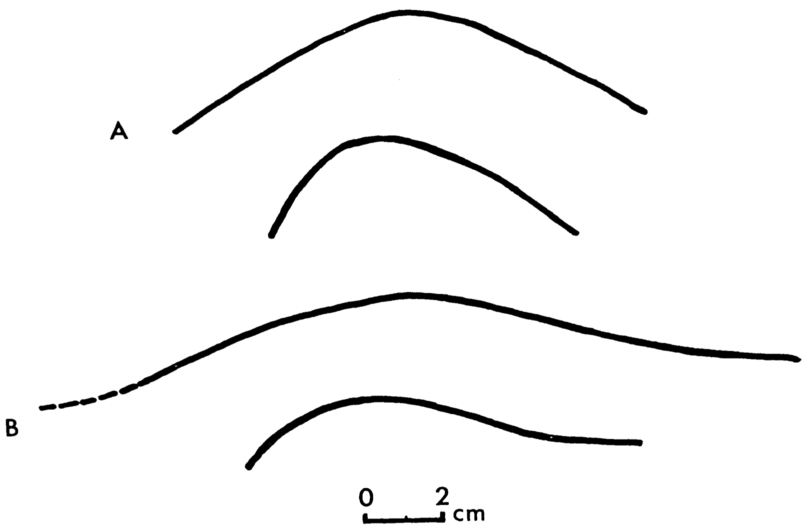


Fig. 5. Comparison of the transverse and longitudinal profiles of pedicle valves between *Delepinea destinezi* (VAUGHAN) (A, after I. M. SIMPSON, 1953) and *D. sayamensis* sp. nov. (B).

of the length of pedicle valve from umbo. But the geniculation is more distinct in the former than the latter. Posterior side of the geniculation of *D. destinezi* is almost flat. That of the Akiyoshi species is very slightly convex. The transverse profile of the Akiyoshi species is uniformly arched in the median part but are flatly spreading the ear regions. That of another species figured by SIMPSON shows the moderately arched median part and uniformly inclined lateral slopes and ear regions. The thickness of pedicle valve of *D. destinezi* is larger than another. The proportions of thickness to length and width of pedicle valve of both species are respectively as follows: 0.36 and 0.23 in *D. destinezi*, 0.26 and 0.11 in the Akiyoshi species. In the Akiyoshi specimens it was impossible to observe spines or tubules on interareas because of their unfavourable state of preservation.

The pedicle valve interior of the Akiyoshi species is characterized by a large callus thickening and a median slender septum in short length. The character of cardinal process of the Akiyoshi species is only known about its large size. Other characteristics of the brachial valve interior are very similar to those of *D. destinezi* described by SIMPSON.

Delepinea sayamensis is one of the largest species of this genus. According to MUIR-WOOD (1962) the largest specimen of *D. destinezi* appears to be 8 in. wide. The adult specimens of the Akiyoshi species all suggest the width of coming near or more than 200 mm. The holotype of which the ear region of right side is lost shows 98 mm width from the delthyrium to the cardinal extremity suggesting the complete width of nearly 200 mm. Other incomplete pedicle valves of adult specimens all have the larger dimensions of their lengths than the holotype.

Delepinea sinuata, sp. nov.

Pl. 34, figs. 2, 3; Text-figs. 6, 7, 8

Material.—Holotype, GK-D 30204 (Pl. 34, fig. 2); paratypes, GK-D 30205, GK-D 30206. Other five specimens are also available under the heading. Internal structures are shown by serial sections of GK-D 30207 and GK-D 20208, and by the inked drawing of a paratype, GK-D 30206.

Description.—(Exterior). Pedicle valve large, transversely subelliptical with widest part at hinge line, and uniformly convex with the largest convexity at umbo; umbo very slightly inflated with nearly pointed beak; broad shallow median sulcus at about a quarter of shell-length from posterior margin rapidly increasing width and depth anteriorly with low rounded folds on both sides of sulcus; interarea low, anacline with small delthyrium; spines or tubules not preserved on cardinal ridge; mode of increment of costellae not ascertained; rows of very fine numerous pseudopunctae on slightly weathered shell surface.

Brachial valve moderately concave with very low interarea; ornament of same with opposite valve.

(Interior). Pedicle valve interior with moderately thick umbonal callus thickening continuing to blunt low median ridge; median ridge extends anteriorly about a quarter of length of pedicle valve gradually tapering height; adductor muscle scars slightly elevated and broadly dendritic; diductor scars longitudinally finely striated on its surface.

Brachial valve interior with prominent cardinal process with nearly vertical

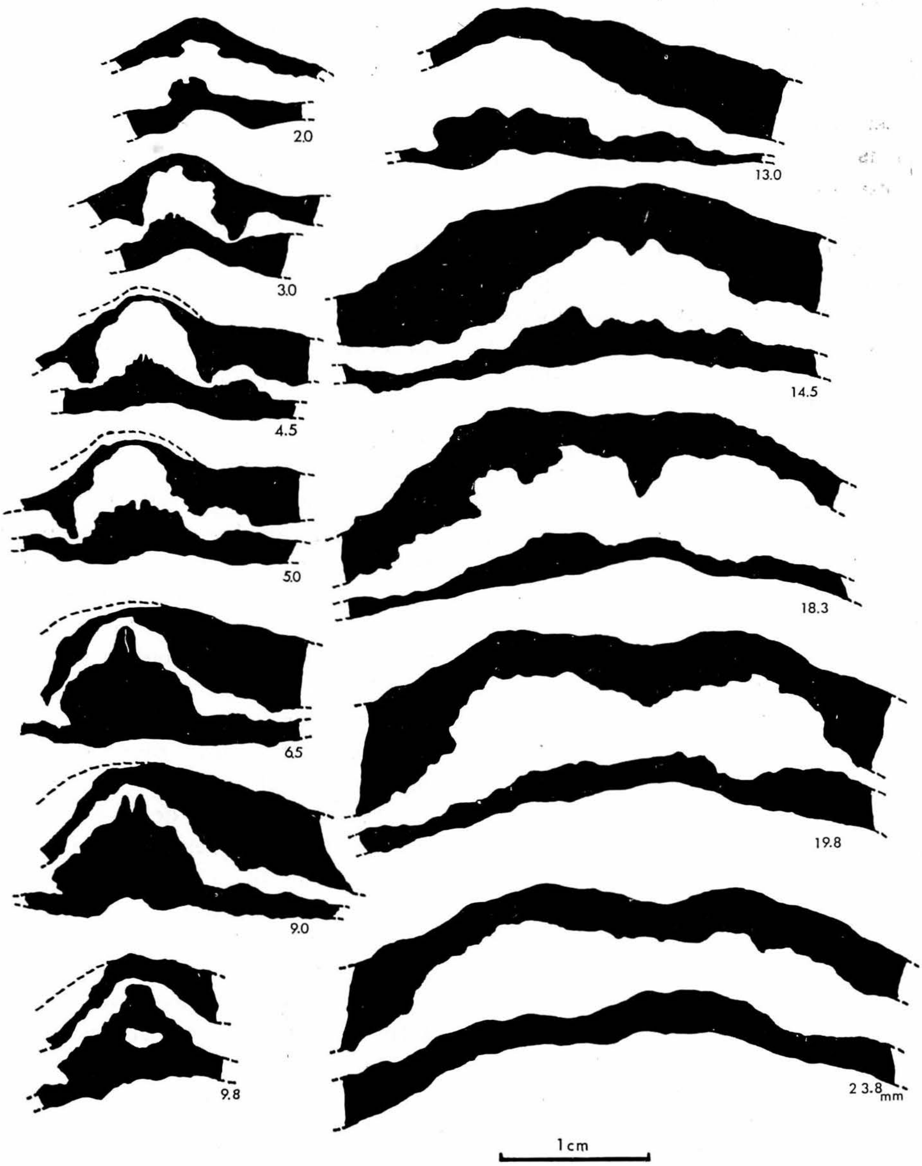


Fig. 6. Serial sections of a slightly deformed shell, GK-D 30207.
Note massive and large cardinal process.

posterior face and anterior one of fairly undercut; median lobe narrow and high increasing height anteriorly with very deep, narrow median incision; it nearly extends to anterior end of median lobe; anterior margin of median lobe broad and massive with shallow median depression; lateral lobes blunt; sockets moderately concave receiving short stout teeth; socket ridge weakly developed;

distinct alveolus at immediately anterior to cardinal process; anteriorly alveolus continues to low broad platform with three very low short ridges on it; anterior surface with numerous pustules; muscle scars undistinguishable.

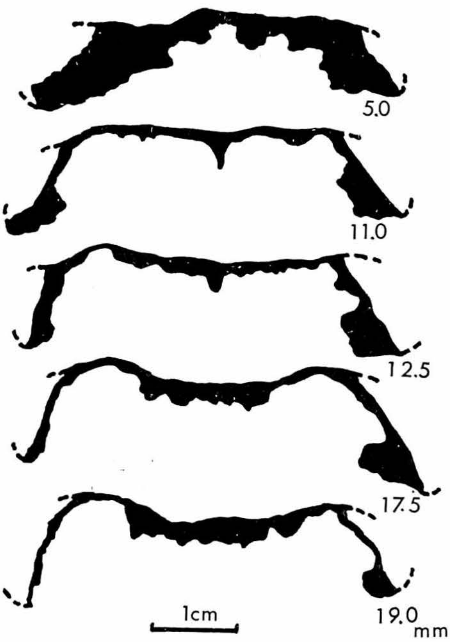


Fig. 7. Serial sections of a pedicle valve, GK-D 30208, showing posterior callus thickening, massive median septum, and conspicuous adductor scars.

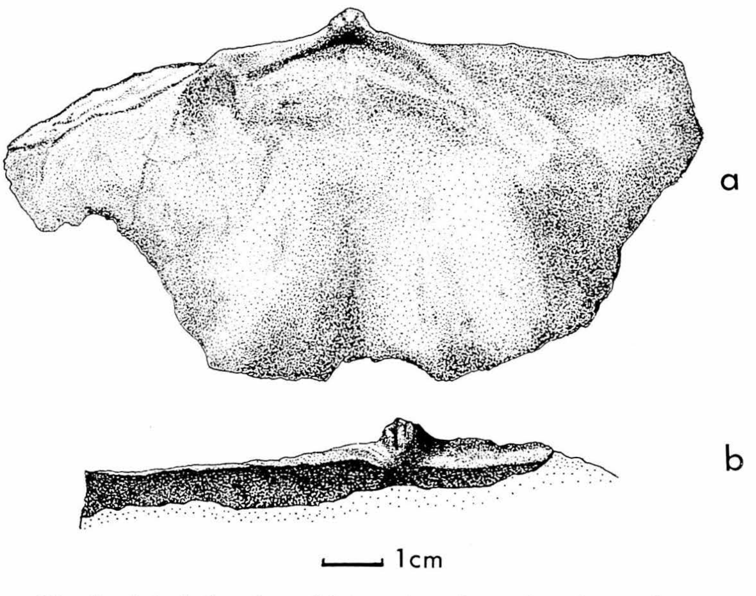


Fig. 8. Inked drawing of internal surface of an incomplete brachial valve, a paratype, GK-D 30206.

a: Ventral view with a distinct alveolus.

b: Posterior view with incomplete cardinal process and low socket ridges.

Dimensions of three specimens in mm and degree.—

(pedicle valve)	1 GK-D 30204 holotype	2 GK-D30207
length	53.0	est. 52
width	est. 102	est. 102
thickness	est. 20	est. 25
width of median sulcus at anterior margin	30.5	20
height of interarea	3.5	est. 3
width of delthyrium	est. 4	est. 3
number of costellae in 10 mm at anterior margin	22–24	20–22
angle of cardinal extremity	est. 70°	
median septum: length		est. 11
median septum: height		2.5
median septum: thickness of its base		3.5

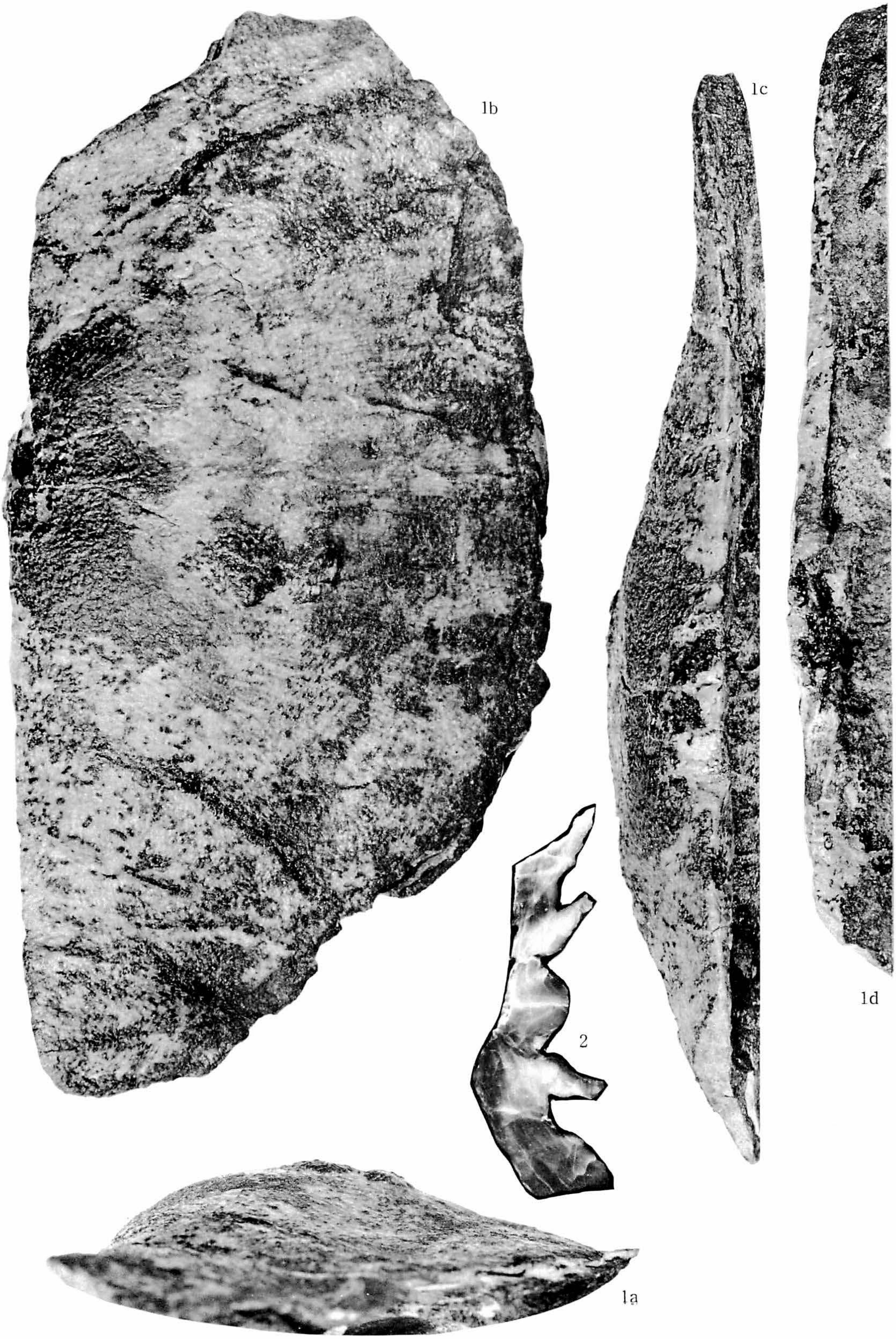
(brachial valve)	1 GK-D 30206 paratype
length	59.0
width	105.0
thickness	20.0
cardinal process: height	est. 8
cardinal process: width	est. 7
socket ridge: length	est. 7
socket ridge: width	3.0
socket ridge: angle to hinge line	est. 20°
height of interarea	est. 2
angle of cardinal extremity	est. 70°

Remarks.—The Akiyoshi species is most characterized by its broad median sulcus, very low interarea, massive, low and short median septum in the pedicle valve and the large cardinal process and distinct alveolus in the brachial valve. So far as the external and internal characters are concerned, the Akiyoshi species is closely related to the Australian Lower Carboniferous species *Delepinea aspinosa* (DUN), *D. gloucesterensis* CAMPBELL and ROBERTS, and *D. cannindahensis* (MAXWELL). All of them have the sulcate pedicle valve, though that of *D. aspinosa* is weak or sometimes absent. In external characters of pedicle valve the Akiyoshi species is much similar to *D. cannindahensis* and *D. gloucesterensis*. Especially *D. cannindahensis* strongly resembles the Akiyoshi

Explanation of Plate 33

(All figures natural size, unless otherwise stated)

Figs. 1, 2. *Delepinea sayamensis*, sp. nov.
- 1a–d. Respectively lateral, ventral, posterior, and dorsal views of the holotype, GK-D 30209.
- 2. Transverse section of beak region showing posterior callus thickening and hinge teeth, GK-D 30203, ×1.5.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species by its low folds on both sides of sulcus. The Akiyoshi species, however, is posteriorly less inflated and the beak is more pointed than the other. Internally the Australian species are clearly distinguished from *D. sinuata* in having the fairly slender median septa in pedicle valves. CAMPBELL and ROBERTS (1964) noticed a pair of thickening-extensions from the umbonal callus in *D. gloucesterensis*. In the Akiyoshi species similar textures are sometimes observable near the umbonal callus thickening. Although the characters of cardinal process of the Akiyoshi species are only partly known from the transverse section it is much similar to those of *D gloucesterensis* and *D. aspinosa* in its principal characters. *D. aspinosa* is also closely similar to the Akiyoshi species in having blunt and thick median septum of the pedicle valve. However, the latter is apparently distinguished from the former by its transverse outline and strongly sulcate pedicle valve.

Correlation

Delepinea has never been recorded in the Carboniferous of Japan. Once HAYASAKA (1933) described a large brachiopod under the name of ?*Daviesiella comoides* (SOWERBY) from a black bituminous limestone of the Nabeyama Formation, Kwanto massif in association with some other brachiopods. At that time HAYASAKA refered the age of the brachiopod faunule to the Uralian. But this correlation was emended by NAGAO and MINATO (1943) and FUJIMOTO (1961) by the discoveries of the Permian fusulinaceans from the same horizon in which brachiopods occur. HAYASAKA identified with a query this large specimen to *Daviesiella comoides*, the type species of *Delepinea*, because only an unfavourably preserved pedicle valve was available at that time. The Akiyoshi specimens are quite different in external characters from the Nabeyama specimen which belongs to a distinct genus from *Delepinea*.

Delepinea has never been recorded in the Asian continent. However, it is well known in the Lower Carboniferous of Europe, North Africa and Australia. Among the European species *Delepinea destinezi* (VAUGHAN) is the closest species to *Delepinea sayamensis* of Akiyoshi. *Delepinea destinezi* is one of the largest species of this genus and its occurrence is restricted in the Belgian Lower Visean V_1b subzone and the Lower Visean C_2S_1 subzones of N. W. Ireland and S. Wales. It is also recorded from the Lower Visean of Morocco. *Delepinea sayamensis* is a distinct species from *D. destinezi*, though these two species are fundamentally very close with each other. Their gigantic sizes and external morphologies are the remarkable characteristics distinguishing them from other chonetacean brachiopods.

In the circum-Pacific region *Delepinea* has been known from the Visean of southeastern Australia. It is represented by *Delepinea cannindahensis* (MAXWELL) from the Baywulla Formation of Queensland, *D. aspinosa* (DUN) and *D. gloucesterensis* CAMPBELL and ROBERTS from New South Wales. Comparing with *D. sinuata*, *D. cannindahensis* and *D. gloucesterensis* have affinities, especially in having a distinct median sulcus on the pedicle valve. The Akiyoshi species, however, has the strongest sulcus among them and it is also distinct from others in its internal characters. *D. cannindahensis* was described by MAXWELL (1961) from the uppermost oolitic limestone of Baywulla Formation correlating the age with the Late Visean. Although the biostratigraphy seems to be still incomplete in the Lower Carboniferous of New South Wales the age of *D. gloucesterensis* from the McRae limestone was correlated with the Medial-Late Visean by CAMPBELL and ROBERTS (1964).

As stated above *Delepinea sayamensis* and *D. sinuata* respectively has affinities to Early Visean and Medial to Late Visean species of Europe and Australia. Concerning the age of the Akiyoshi species a special attention has been paid on the close affinity of *D. sayamensis* to *D. destinezi* and its abundant occurrence. Taking account of the clear distinction of internal characters between *D. sinuata* and the Australian two species, *D. gloucesterensis* and *D. cannindahensis*, the age of the Akiyoshi species under consideration may be referable to the Early Visean.

Apart from brachiopods I examined foraminifers in limestones of the surveyed area. They consist only of the smaller foraminifers. Moreover it is very characteristic that the limestone immediately above the tuff rarely contains only *Endothyra*. This fact is in harmony with that found by OKIMURA (1966) in Okubo-Hirabaru area, about 6 km southwest of Sayama. He established *Endothyra* sp. A zone in the lowest part of limestones and correlated the species assemblage to that of the Lower Visean of Russia and Lower Meramecian of North America. The thick pyroclastic rocks of the lowest part of the Akiyoshi limestone Group are slightly different in thickness and rock facies between Sayama and Okubo—Hirabaru areas. But the age determined by brachiopods and the smaller foraminifers is quite common in both areas.

Delepinea sinuata and *D. sayamensis* occur near the uppermost horizon of thick pyroclastic rocks. Therefore it is highly possible that the lowest part of the Akiyoshi limestone Group is older than the Early Visean.

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Explanation of Plate 34

(All figures natural size, unless otherwise stated)

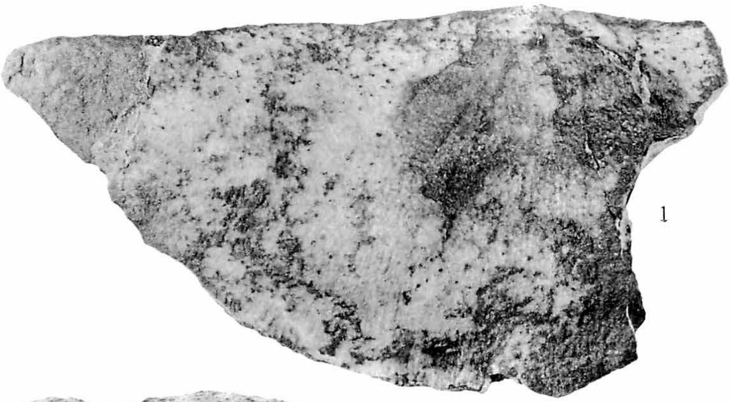
Fig. 1. *Delepinea sayamensis*, sp. nov.
A pedicle valve in immature stage, a paratype, GK-D 30200.

Figs. 2, 3. *Delepinea sinuata*, sp. nov.
2a–e. Respectively lateral, posterior, anterior, ventral, and dorsal views of the holotype, GK-D 30204.
3a, b. Posterior views of transverse sections of cardinal process of a specimen, GK-D 30207, respectively showing immediately posterior part of anterior margin with broad and massive median lobe and fairly undercut anterior face (3a, ×3) and a section at about 0.8 mm posterior from 3a with sharply projected median lobe having narrow and deep median incision (3b, ×2).

The type-specimens and other illustrated specimens are kept in the Department of Geology, Faculty of Science, Kyushu University.

Photos by YANAGIDA


2a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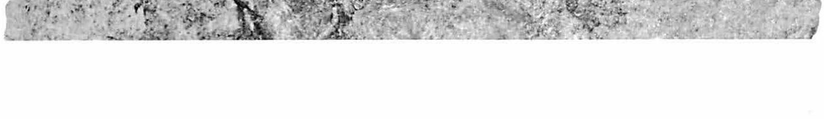
3b


2e

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Akiyoshi	秋 吉	Okubo	大久保
Hirabaru	平 原	Sayama	佐 山
Miyanobaba	宮馬場	Uebatake	植 畠

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 72, pp. 340-344, pls. 35, 36, Dec. 30, 1968

545. MIOGYPSINID POPULATION FROM THE TUNGLIANG WELL TL-1 OF THE PENGHU ISLANDS, CHINA*

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白沙島 TL-1 号井産の Miogypsinid 個体群： 澎湖諸島通梁に層位学的調査の為，初めておろされた TL-1 号井のボーリング・コアー中に *Miogypsina* 石灰岩が報告されたので，同石灰岩中の *Miogypsina* 種の同定と記載をした。これらの *Miogypsina* は C. W. DROOGER による Miogypsinidae 科独自の系統発生上の位置とそれから得られる時代論から basal Burdigalian にあたり，また日本列島各地から多産する Miogypsinid 個体群より，わずかに古い個体群と判定した。 松 丸 国 照

Introduction

Since MICHELOTTI described the first form of the family Miogypsinidae in 1841, many investigations have been reported from the Mediterranean, Central America and western Pacific regions. Among the abundant publications, the one by TAN SIN HOK (1936) on the Indonesian Miogypsinidae is of particular importance. He emphasized the necessity and importance of the "nepionic acceleration", a theoretical idea, to understand the classification and phylogeny of the family.

DROOGER (1952), influenced by TAN's idea, investigated on the basis of statistical analysis the miogypsinid populations of different ages from separate localities of Central America. As the result and by treating with TAN's "nepionic acceleration" he succeeded to make a tentative phylogenetic scheme of the family Miogypsinidae. Subsequently, he was able to apply the same procedure to the miogypsinid populations from the different regions in Europe, north Africa, Indonesia and recognized the same succesion of the nepionic acceleration.

In 1963, DROOGER reported on the tentative relationships of the *Miogypsina* species in the three main regions of the Mediterranean, Central America and western Pacific regions, and he (1964) was able to point out the same phylogenetic lineage of the miogypsinid populations from the type localities of the Chattian, Aquitanian and Burdigalian stages in Europe. Therefore, from the phylogeny of the miogypsinids the geological ages of the respective occurrences could be determined.

Recently, UJIIÉ (1966) published the new idea of "Evolutionary Line" from a statistical treatment obtained by the distribution of the values of the three parameters from the figures given by those absolute measurements of the miogypsinid specimens and this "Evolutionary Line" was found to be in good agreement with the tentative phylogeny proposed by DROOGER.

The purpose of the present paper is

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to report on the specific determination and to describe the miogypsinid populations from the Tungliang Well TL-1, Penghu islands, China, and to mention on the age-determination induced by the miogypsinids. This is the first report on the occurrence of *Miogypsina globulina* in the Penghu islands. The materials studied by the writer are pieces of massive, compact, light gray *Miogypsina* bearing limestone (sparite) taken at 500 m depth in the Tungliang Well TL-1, located at about 850 m northeast of the village of Tungliang, Paisa island of the Penghu islands.

Acknowledgements

Mr. Tunyow HUANG of the Chinese Petroleum Cooperation kindly sent to the writer the *Miogypsina* limestone samples from the drill core of Tungliang Well TL-1. Professors Kiyoshi ASANO and Kotora HATAI of the Institute of Geology and Paleontology, Tohoku University, kindly encouraged the writer in his work and reviewed the manuscript. Dr. Shoshiro HANZAWA, Professor emeritus of the Tohoku University, kindly discussed with the writer many foraminiferal problems. Mr. Teruo ISHIKAWA of our Institute assisted the writer in making thin sections. The writer expresses his deep gratitude to those persons. Deep appreciation is expressed to the Chinese Petroleum Corporation for the specimens and information concerning them.

Description, Determination and Discussion

The Tangliang miogypsinids show two kinds of nepionic characters; i. e. one with more advanced forms (A form) having two nepionic spirals along the outer side of the protoconch and the other of primitive single-spiralled forms (B form). The description of the present forms follows the parameters given by DROOGER, but X factor (number of nepionic chambers) of the symmetrical chamber belongs to a chamber of the main spiral.

Description:

Family Miogypsinidae VAUGHAN, 1928

Genus *Miogypsina* SACCO, 1893

Miogypsina globulina (MICHELOTTI), 1841

Pl. 35, figs. 1–6; pl. 36, figs. 1–6

A form.—Test usually fan-shaped, but sometimes with a protruding apical portion, frontal margin irregularly rounded. Mature specimens usually with biconvex to plano-convex vertical section, thickest portion between center and apex of test, with range of 0.36 to 0.77 mm. Diameter 0.81 to 1.69 mm in 11 observed equatorial sections.

Diameter of protoconch 90 to 125 μ (MI=111 μ, σMI=3.7 μ) in 11 sectioned individuals. The slightly large diameter of kidney-shaped deuteroconch exceeds that of protoconch with an average value of 25 percent. Proportion between protoconch-diameter (I) and deuteroconch-diameter (II) giving mean value of about 1.02. Angle ($\gamma°$) between axis of two embryonic chambers and apical-frontal line varies between 0° and 35°, mean value being about 15°.

Two principal auxiliary chambers of unequal size ascertained, each single along outer side of protoconch. Symmetrical chamber lying about axis of embryonic chambers. Average value for 200 α/β is about 35. Spirals absent along circumference of deuteroconch. All separate nepionic chambers of commonly smaller size, but occasionally larger than individual embryonic chambers.

Equatorial chambers in equatorial sections ogival to rhombic in shape, with maximal dimensions of $140 \times 155\,\mu$.

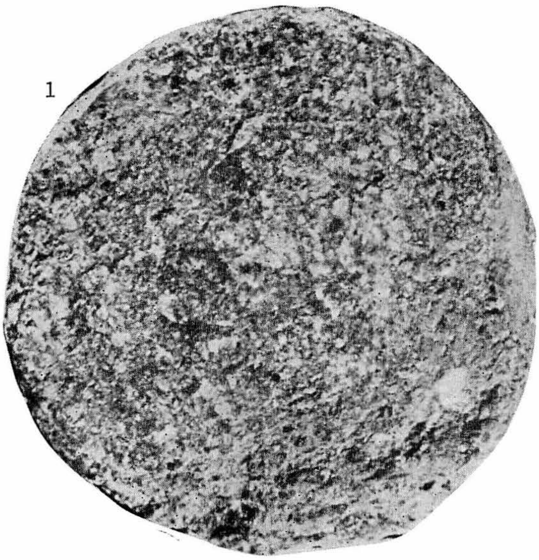
Equatorial layer in vertical sections with flat roof and floor, height average $200\,\mu$. Later lateral chambers arranged in regular layers and tieres, about 5 layers in mature specimens in vertical succession from equatorial layer to more convex side of test.

Eld's value calculated by UJIIÉ's method in 11 specimens is 84.

B form.—Test generally like A form. Diameter 0.90 to 1.59 mm and thickness 0.32 to 0.80 mm.

Diameter of protoconch 65 to $150\,\mu$ (MI$=108\,\mu$, σMI$=7.0\,\mu$) in 32 individuals. Deuteroconch with diameter larger than protoconch, slightly kidney-shaped. Proportion between I and II giving mean value of about 1.10. $\gamma°$ is average value of 15°.

Nepionic chambers arranged in single, peripherally situated, distinctly trochoid

1

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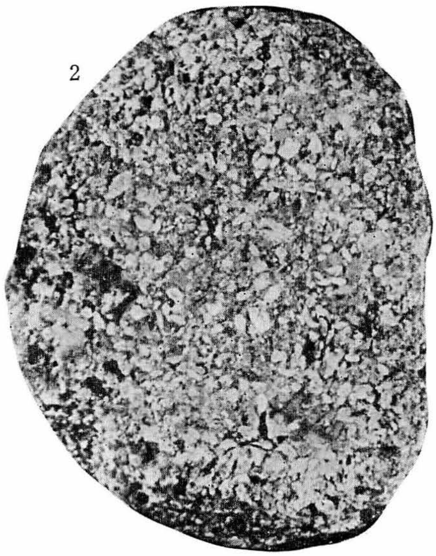


Text-figs. 1–2. Latitudinal sections of the core TL-1 showing the crowded arrangement of the *Miogypsina* specimens. ×1.45

Explanation of Plate 35

Miogypsina globulina (MICHELOTTI)

A form:

Figs. 1–4. Equatorial sections.

Fig. 1. ×79. IGPS coll. cat. no. 90921.

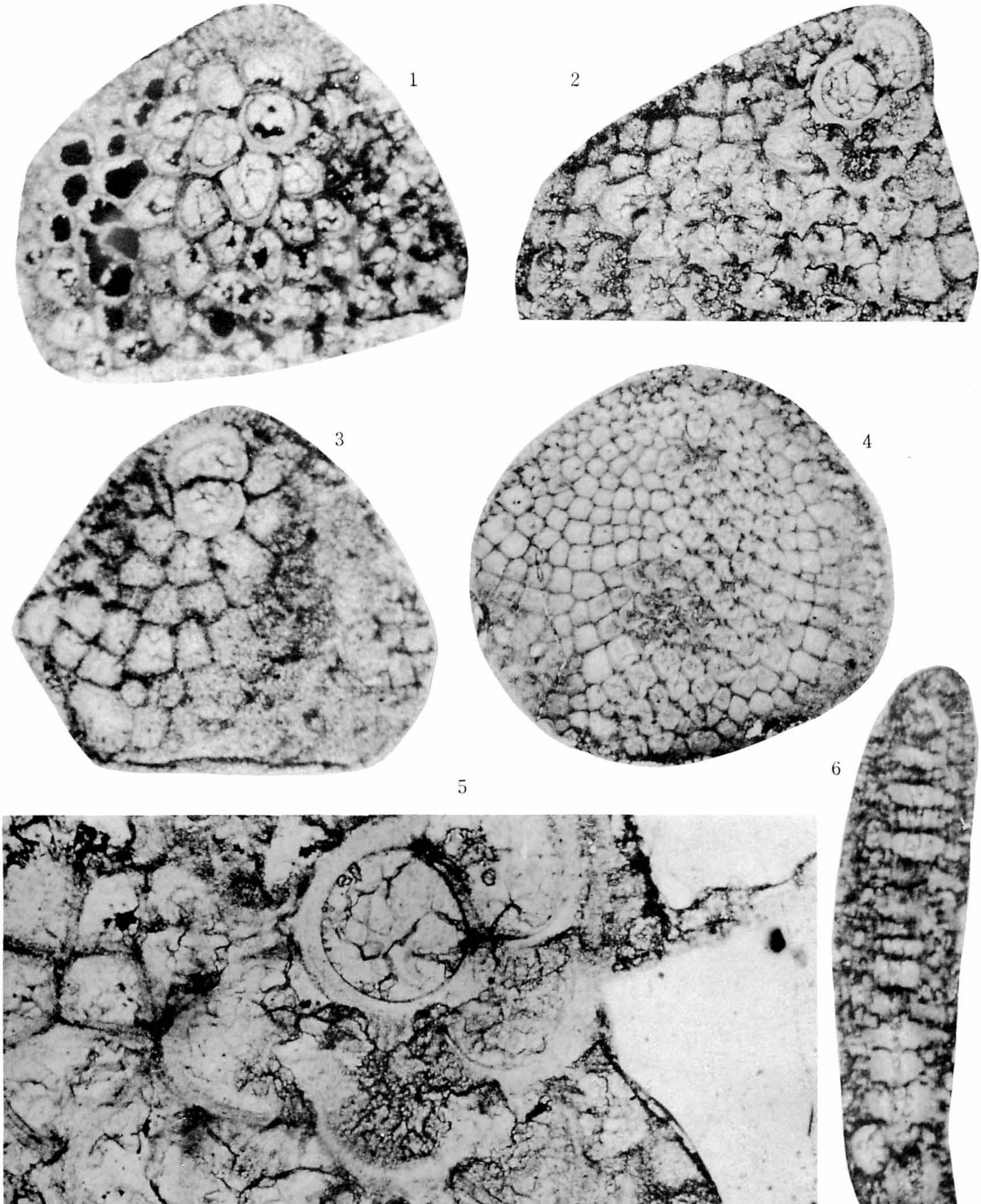
Fig. 2. ×68. IGPS coll. cat. no. 90922.

Fig. 3. ×73. IGPS coll. cat. no. 90923.

Fig. 4. ×35. IGPS coll. cat. no. 90924.

Fig. 5. ×175. Fig. 2 enlarged to show the canal system in the wall.

Fig. 6. Vertical section. ×37. IGPS coll. cat. no. 90925.



MATSUMARU and KUMAGAI photo.

spiral. X found to vary between 5 to 7 (MX=6.2 μ, σMX=0.11 μ). Spiral chambers increase gradually in size closing to 1/2 X and gradually decrease to final one.

Equatorial chambers in equatorial sections arcuate to rhombic in shape with maximal dimensions of $140 \times 180\ \mu$.

Equatorial layer in vertical sections with flat roof and floor, height average 115 μ. Lateral chambers arranged in regular layers and tiers, about 5 layers in mature specimens.

Eld's value in 32 specimens is 70.

Determination and Discussion.—

According to DROOGER'S MX and M 200 α/β scales, the Tungliang miogypsinid populations could be determined as *Miogypsina globulina.* Based on UJIIÉ's Eld's value, A form would be determined as *Miogypsina globulina,* whereas B form as *Miogypsina tani-globulina.*

The writer based upon statistical measurements holds the view that *Miogypsina tani-gloubulina* of DROOGER should be included within the limits of *M. globulina* even though stratigraphically it occupies the lower part of the chronological range of the species. Therefore the Tungliang miogypsinids, should be named *Miogypsina globulina.*

Therefore, the age should be basal Burdigalian of the Tungliang miogypsinids considering from the view point of DROOGER's Mid-Tertiary correlation.

According to DROOGER (1963, fig. 25), *Miogypsina globulina* includes *Miogypsina kotoi* HANZAWA as its synonym. All the miogypsinids from the Japanese Islands have been identified as *Miogypsina kotoi* by HANZAWA (1931, 1935) who considered it to range from the *Nephrolepidina-Miogypsina* zone up to the *Miogypsina* zone (HANZAWA, 1964).

From the report on the restudy of the Japanese miogypsinids by UJIIÉ (1966), the miogypsinid populations from widely scattered localities in Japan are classified into 3 groups from the comparison of the three main parameters of MX-200 M α/β, M II/I, M $\gamma°$. These groups correspond roughly with horizons of their stratigraphical occurrences and from the "Evolutionary Line" proposed by UJIIÉ all of the Japanese miogypsinids fall within the range from *Miogypsina intermedia* up to *Miogypsina cushmani.*

DROOGER (1952) once considered *Miogypsina intermedia* to be a synonym of *Miogypsina kotoi.* UJIIÉ and OSHIMA (1960) from their study on the miogypsinid populations from the Mizunami District, Central Japan, stated that the populations there fall within the range of *Miogypsina globulina* to *Miogypsina intermedia.*

Although there still remains room for paleontological study of the specific relation existing between *Miogypsina globulina* and "*Miogypsina kotoi*" from Japan the *Miogypsina globulina* of the Tungliang miogypsinid populations may be from statistics considered to be more primitive than the "*Miogypsina kotoi*" of the Japanese miogypsinids so far as DROOGER's scale and UJIIÉ's Eld's value of the miogypsinids are concerned.

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Tunglian	通 梁
Paisa island	白 沙 島
Penghu islands	澎湖諸島

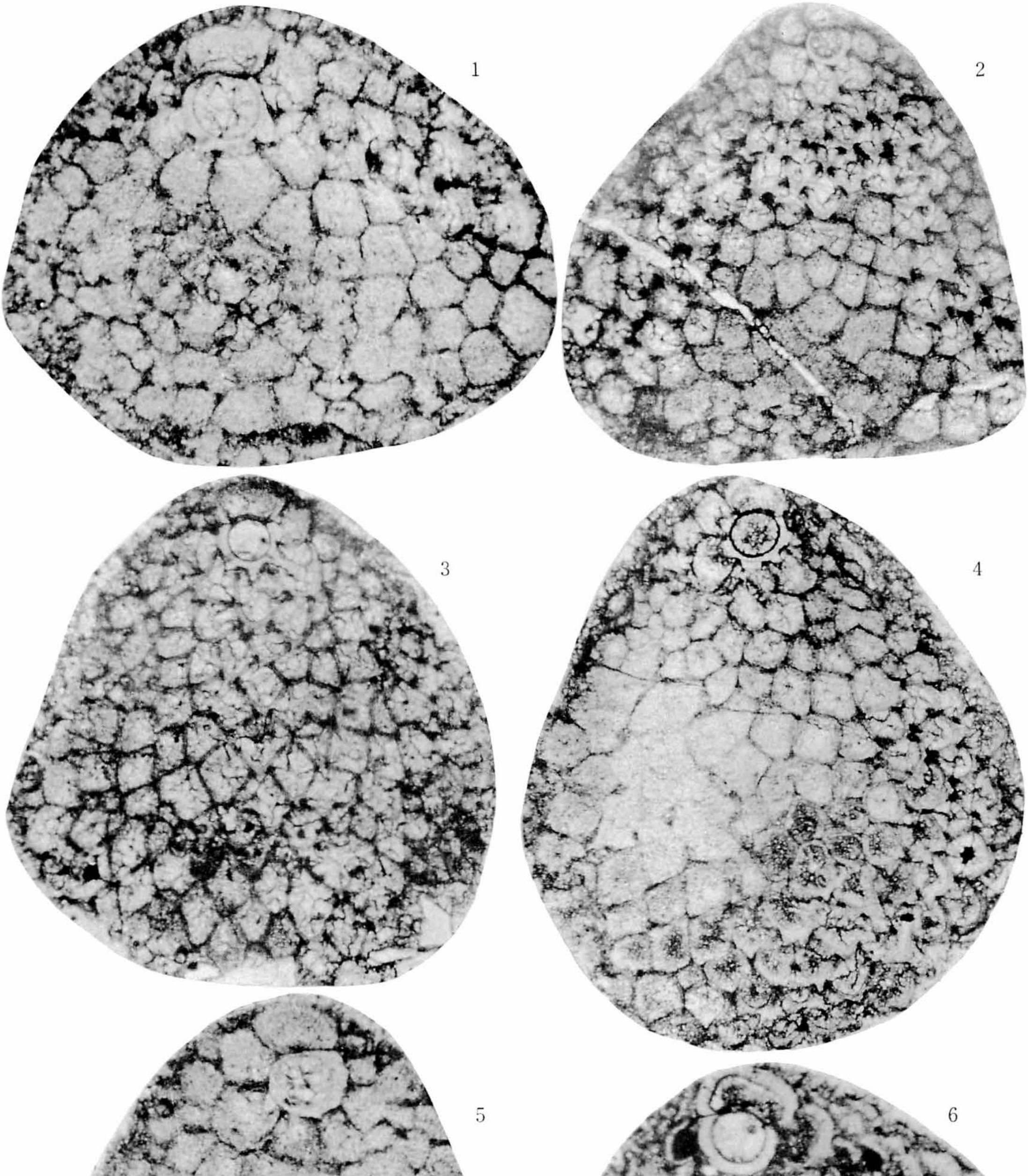
Explanation of Plate 36

Miogypsina globulina (MICHELOTTI)

B form:

Figs. 1-6. Equatorial sections.

Fig. 1. ×75. IGPS coll. cat. no. 90926.
Fig. 2. ×59. IGPS coll. cat. no. 90927.
Fig. 3. ×54. IGPS coll. cat. no. 90928.
Fig. 4. ×54. IGPS coll. cat. no. 90929.
Fig. 5. ×77. IGPS coll. cat. no. 90930.
Fig. 6. ×52. IGPS coll. cat. no. 90931.



MATSUMARU and KUMAGAI photo,

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 72, pp. 345-350, pl. 37, Dec. 30, 1968

546. CYLINDRICAL STRUCTURES FROM THE TATSUNOKUCHI FORMATION (EARLY MIYAGIAN) IN SENDAI CITY, MIYAGI PREFECTURE*

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宮城県前期宮城階龍の口層産円筒状物について：仙台市前期宮城階龍の口層より産した無彫刻，長さ 6~8 mm，直径 1 mm 大の短円筒状物について検討した結果，その形態的特徴よりアメリカ大西洋沿岸に現棲する *Callianassa major* SAY の糞に近似している *Callianassa* sp. の糞化石であると結論した。 畑井小虎・野田浩司

Introduction

During stratigraphical work in the Sendai area the junior writer collected from the lower part of the Tatsunokuchi Formation (HANZAWA *et al.*, 1953; HATAI and OKUTSU, 1941; SHIBATA, 1963) exposed in the small valley of Sankyo-zawa, a rock sample preserving many short, rod-like cylindrical specimens in association with an external mold of *Tellina sendaica* NOMURA (NOMURA, 1938, p. 263, pl. 34, figs. 1a, 1b), a small marine bivalve.

From the association of the marine bivalve and also from the stratigraphic position of the peculiar shaped specimens midbetween two marine shell beds (Fig. 1), it is proved that the rod-like specimens are of marine origin. The lower shell bed of the two just mentioned lies on the Kameoka Formation which is superjacent to the Mitaki Andesite; both shell beds belong to the Tatsunokuchi Formation. The stratigraphic position of the Tatsunokuchi Formation in the geologic column of the Sendai area is shown in Fig. 1 together with the stratigraphic position of the cylindrical specimens in the sequence of rocks developed in the Sankyo-zawa velley.

The Tatsunokuchi Formation is of particular interest because of the yield of a wide variety of fossils, such as marine pelecypods, gastropods and scaphopods (NOMURA, 1938; NOMURA and HATAI, 1936; MASUDA, 1962; NODA, 1966; YABE and HATAI, 1940), shallow water marine crabs (NAGAO, 1940), benthonic foraminifers (TAKAYANAGI, 1950), whale otoliths (HATAI, HAYASAKA and MASUDA, 1963), shark-teeth (HATAI, 1938; HATAI, HAYASAKA and MASUDA, 1963), elephant teeth (MATSUMOTO, 1926; HATAI, 1966), skull of *Delphinus* (not yet described or figured), plant remains as leaves, fruits, stems, pollen, etc. (KOIWAI, 1914; OKUTSU, 1955-with bibliography), marine diatoms (HANZAWA *et al.*, 1953; SHIBATA, 1962), besides others, and many interesting sedimentary structures (SHIBATA, 1962) occur in the Formation. Sand-pipes have also been described from the for-

* Received Sept. 28, 1968; read Sept. 22, 1968 at Kanazawa.

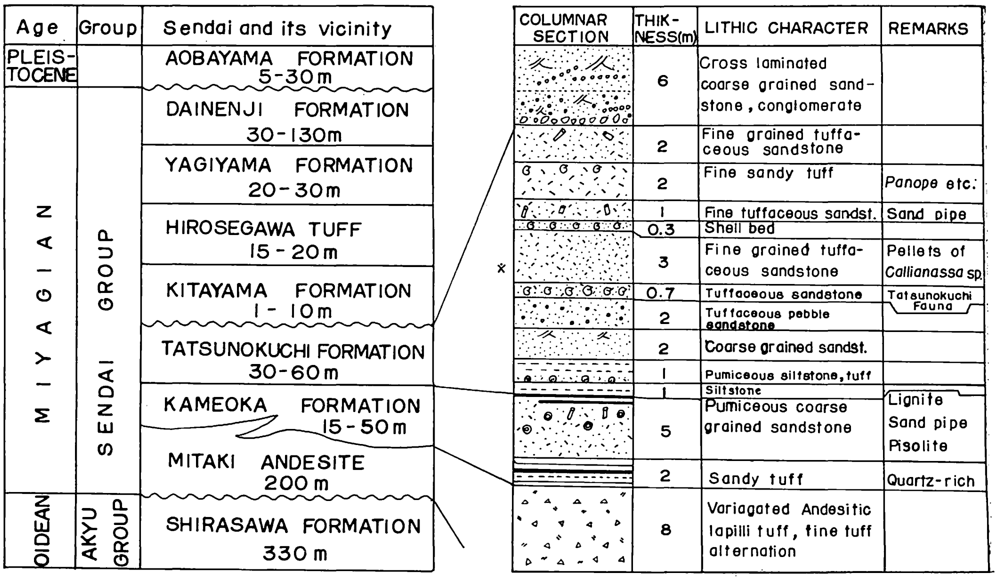

Fig. 1. Stratigraphic Sequence of the Formations and Columnar Section of the Rocks in the Sankyo-zawa Valley.

mation (NOMURA and HATAI, 1937).

Paleogeographic features and maps of the Tatsunokuchi sea have been described by HANZAWA (1950). As to the geologic age of the Tatsunokuchi Formation several opinions have been expressed (OTUKA, 1940; HATAI, 1940; YABE and HATAI, 1940; HANZAWA *et al.*, 1953; HATAI, 1966; ASANO and HATAI, 1967). However, at the present time the geologic age is generally accepted as Early Miyagian (HATAI, 1962). And, from the paleogeography of the formation, it is accepted that the Tatsunokuchi sea distributed along the eastern part of Iwate, Miyagi and Fukushima Prefectures as well as the bordering area of the Kitakami River in Iwate and Miyagi Prefectures, represented an embayment or inland sea widely open to the paleo-Pacific Ocean at the central eastern part, where it had best connection with the open sea.

The Tatsunokuchi sea being of the nature just mentioned was favorable for the deposition of fine grained sediments as silts to sandy silts in the larger part and of coarse grained sands and conglomerates at certain marginal parts. Areas of brackish water sediments and molluscs that can live under such conditions are also found at several marginal parts of the Tatsunokuchi sea in the southwestern part of the Sendai area. Lignitic materials are common in certain marginal (SHIBATA, 1962) or local basinal areas of the paleo-sea.

From the stratigraphical position as well as undisturbed tuffaceous muddy sandstone preserving the simple shaped short rod-like specimens, it is thought that the environment at the time of burial of the short cylinders must have been quiet and the water depth shallow as will be stated later.

The Short Cylindrical Specimens

Description. — The short cylindrical specimens are all of nearly the same length, measuring from about 6 mm to a maximum to 8 mm, and their diameter is about 1 mm, although some are more flattened than others. The rods are all straight with the terminal parts rather sharply rounded as if suddenly pinched. The surfaces of the cylinders exhibit no particular markings and appear smooth. The cylinders are arranged parallel with the bedding plane of the deposits and although the majority are scattered or without definite orientation some are parallel with one another. These rods seem to have accumulated to a thickness of about several times their diameter. The rods are preserved in a tuffaceous and muddy sandstone.

Comparison and remarks.—Rod-shaped faecal pellets are known to be produced by several kinds of marine organisms (MOORE, 1955), among which those of the molluscs (ARAKAWA, 1962, 1963, 1965) resemble the cylindrical structures under consideration. ARAKAWA (1962) has presented a classification of the molluscan faecal pellets.

The faecal pellets of cylindrical shape made by most marine organisms are characterized by their more or less curved, irregularly extended, pinch-and-swell and not straight shapes, their terminal parts may be pinched-rounded, appear more or less squarely cut or at times extended narrowly, and moreover, there always seems to be some kind of sculpture on their surfaces, such as spiral markings, longitudinal striations, pits, small triangular breaks at the sides, and these features which characterize most of the cylindrical faecal pellets of the invertebrates serve to distinguish them from the fossil ones under consideration.

Cylindrical faecal pellets almost indistinguishable from the present ones in shape, arrangement, general size, and other features, are the one figured by WEIMER and HOYT (1964). The rods figured by them are the faecal pellets of *Callianassa major* SAY, a decapod crustacean living along the Atlantic coast of the United States of America. According to WEIMER and HOYT (1964, p. 762), "Discharged water carries faecal pellets to the surface where they collect around the burrow opening until removed by waves and currents. The faecal pellets are cylindrical in shape averaging slightly less than 1/16 inch in diameter and 1/8 to 3/16 inch in length. Wave action commonly concentrates the pellets along the beach to form thin laryers of clay".

Although the fossil faecal pellets are larger than the ones reported by WEIMER and HOYT, larger crustaceans may have been the cause. In the case of the writer's specimens no burrow or sand-pipe was found or noticed at the site of the fossil faecal pellets, possibly because the pellets may have been removed from their original position and also to the possibility that the burrow (sand-pipe) may be preserved but was not visible at the horizon of the pellets at the outcrop of the formation.

The fossil faecal pellets are almost indistinguishable from the Recent ones (WEIMER and HOYT, 1964), except for the size, and are considered to be of the decapod crustacean genus *Callianassa.* This genus is most common of the distribution of the genus in the Early Miyagian of Japan.

It should be stated that sand-pipes occur in horizons both above and below the one of the faecal pellets. The sand-pipes are rare in the fine grained tuff superposed about three meters above that which yielded the pellets, whereas in the lower about eight meters below the horizon of the faecal pellets the pipes are more common. However, both horizons with the sand-pipes just mentioned are too remote from the faecal pellet horizon to be considered their burrows. Sand-pipes are, however, quite common (NOMURA and HATAI, 1937) at places, being most abundant in the upper part of the Tatsunokuchi Formation where no crabs or other kinds of fossils have been found, and also rather common at several localities of the middle and lower parts of the formation. The sand pipes just mentioned are usually circular in crosssection, generally rather straight or with only gentle pinching or swellings along the length, fairly long and sometimes rather short ones are found. Whether the sand-pipes were made by the genus *Callianassa* or by some other kind of decapod crustacean or marine organism remains to be settled by future study.

IMAIZUMI (1967) described from a siltstone of the middle or lower part of the Tatsunokuchi Formation exposed in the Tatsunokuchi gorge, many foot-prints which he stated to belong to crabs such as *Helice tridens tridens* (DE HAAN). These fossil foot-prints were compared by IMAIZUMI with foot-prints of crabs left on dried sand or silt and with the linear and scratches left on wet silt of the intertidal zone. As crabs occur from the formation (NAGAO, 1940) the preservation of foot-prints is to be expected should the conditions be favorable. However, no sand-pipes or faecal pellets have been recorded from the locality where either the crab or its foot-prints were found.

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Tatsunokuchi	龍の口	Iwate	岩手
Mitaki	三瀧	Miyagi	宮城
Kameoka	亀岡	Fukushima	福島
Sankyo-zawa	三居沢	Sendai	仙台

Explanation to Plate 37

Figs. 1, 2. Faecal pellets of *Callianassa* sp. IGPS. coll. cat. no, 90766, from the Tatsunokuchi Formation at Sankyo-zawa, Sendai City. Fig. 1. Broad view of the fossil specimens as entombed in the marine sediments. Fig. 2. An enlarged view (ca. ×4) of Fig. 1. Note the long cylindrical shape of the specimens and their mode of accumulation.

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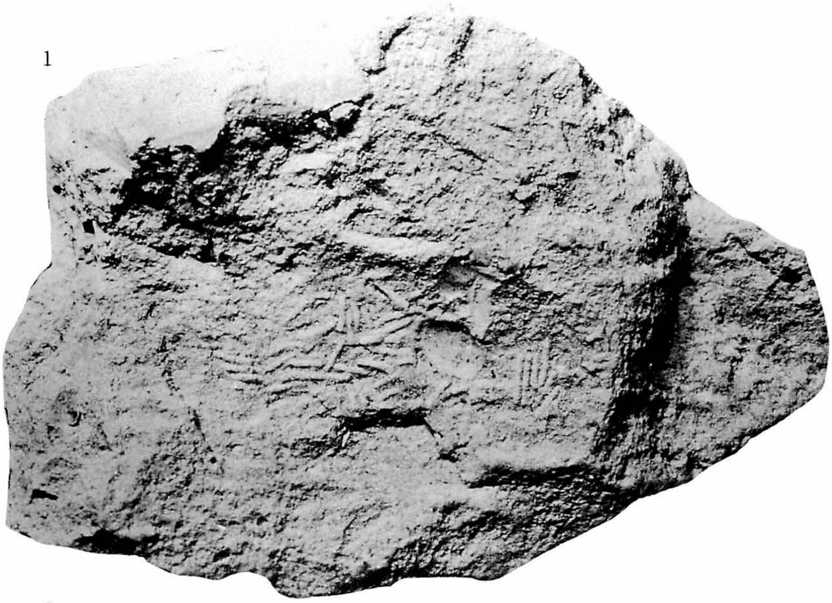

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KUMAGAI photo.

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 72, pp. 351-362, pls. 38, 39, Dec. 30, 1968

547. SANDPIPES PENETRATING IGNEOUS ROCKS IN THE ENVIRONS OF SENDAI, JAPAN*

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仙台付近の火成岩中のサンドパイプ：穿孔貝が火成岩に穿孔することは，現生，化石共に従来全く知られていなかったが，筆者は仙台付近に分布する茂庭部層の直下にくる，高館安山岩の石英安山岩，安山岩などの表面に，穿孔貝によって掘られた多くの巣穴を発見した。完全に近い状態の巣穴は，砂で埋められイチジク状のサンドパイプになっていて，*Pholadidea* sp. を内在しているが，多くの巣穴はその上端が削られて皿状になっている。これらのサンドパイプは，堆積岩中に見られるものと大体の形態的特徴は同じであるが，長さが短く軸が著しく曲っている点が違っている。これらは高館安山岩に見られる他，茂庭部層，綱木層，七北田層などの礫岩中の，安山岩，石英安山岩の巨礫の表面にも多く認められ，その分布も限られているので，地層の堆積環境の解釈や，含有化石群集の解析のために，極めて有効な手掛りとなる。なお，仙台付近以外にもこのようなサンドパイプの発見が期待される他，火成岩中に穿孔している現生の穿孔貝の発見が予想される。　増田孝一郎

Introduction

The holes made by boring organisms and preserved in the bed rock in the geological column indicate that such organisms once lived in the environment and probably also in the one in which they were buried. For this reason those organisms are interesting and important to interpret the environmental conditions of the area at the time they lived. Among the borers the bivalve molluscs, commonly referred to as boring shells, are the largest and most specialized rock borers. The holes made by the boring shells usually show very conspicuous and specialized features and are easily distinguishable from those of other boring organisms. Usually their holes are filled with the sediments after their death and decay to make sandpipes.

In the Recent seas the rocks into which the shells bore are usually soft ones such as the sedimentary rocks in the tidal zone, though rarely the shells bore into concrete, brick, gneiss, etc. (AMEMIYA and OHSHIMA, 1933, YONGE, 1949, 1951, SUYAMA and UTASHIRO, 1955, TURNER, 1954, MENZIES, 1957, etc.). Consequently, the sandpipes due to the boring shells are usually found in sedimentary rocks (mostly of the Tertiary) such as sandstone, mudstone or shale (UOZUMI and FUJIE, 1956, WATANABE and IIJIMA, 1959, MASUDA and TAKEZAWA, 1961, ITOIGAWA, 1963a, b, KASENO and MATSUURA, 1964, ADEGOKE, 1966).

Several years ago the writer discovered many sand-filled burrows, commonly referred to as sandpipe, in the igneous rocks in the vicinity of Watari-machi, Watari-gun, Miyagi Prefecture in the southern border of Sendai City. Sub-

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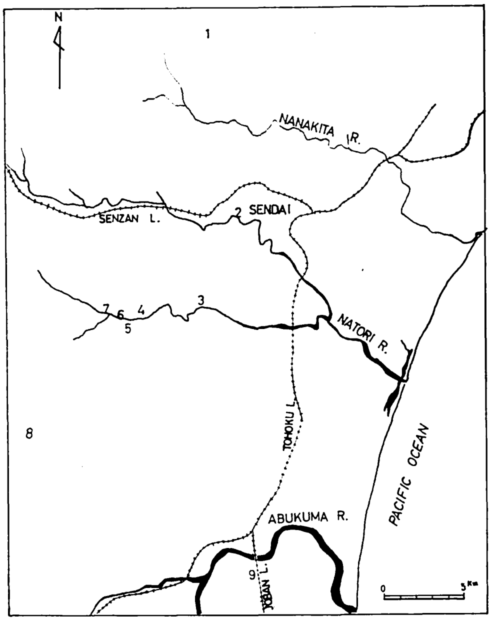
sequently, Ken-ichi KUMAGAI and Rentarô TAKEZAWA collected numerous sandpipes from the igneous rocks exposed in the vicinity of Kita-Akaishi, Sendai; these were offered to the writer for examination.

An examination of these sandpipes revealed that they were probably made by boring shells, as their morphological features were quite similar with those made by Recent boring shells. However, because of their preservation, the kind of boring shells responsible for them could not be determined.

Lately the writer examined numerous sandpipes some of which contained the boring shells within the igneous rocks developed in the environs of Sendai (text-fig. 1). Taking this opportunity the characteristics of the boring shells and their sandpipes in the igneous rocks are described and their geological significances discussed.



Text-fig. 1. Locality map. 1, Dôdokoro, Izumi-machi; 2, Kashikobuchi, Sendai City; 3, Hagurodai, Sendai City; 4, Kamegamori. Sendai City; 5, Minami-Akaishi, Sendai City; 6, Kita-Akaishi, Sendai City; 7, Nakayachi, Sendai City; 8, Ashitate, Murata-machi; 9, Shimogôri, Watari-machi.

The present record of boring shells in igneous rocks may be the first both fossil and Recent. Therefore, it is expected that the Recent boring shells will be found in igneous rocks and that igneous rock boulders with holes of boring shells will be found in geological formations other than reported in this article.

Acknowledgements

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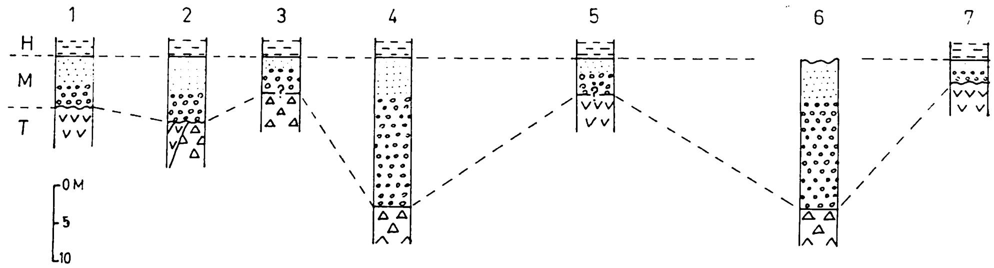
Outlines of Geology

The Miocene marine strata distributed in the environs of Sendai are classified into the Takadate Andesite, Hatatate and Tsunaki formations (SHIBATA, 1962) in ascending order.

The Takadate Andesite comprises two-pyroxene andesite, hyperthene, augite and hornblende andesite, augite andesite, dacite, tuff breccia, volcanic breccia, lapilli tuff, etc. The volcanic rocks occur as lava flows or dikes.

The Hatatate Formation consists of conglomerate, coarse- to fine-grained sandstone, tuffaceous fine-grained sandstone, tuffaceous siltstone and an alternation of tuffaceous sandstone and siltstone in ascending order. The lower part of conglomerate and coarse-grained sandstone is called the Moniwa Member (HATAI, 1960); its thickness varies as shown in text-fig. 2. Molluscs, echinoids, corals, balanids, bryozoans, brachiopods and foraminifers are common in the member. Molluscs, sponges, foraminifers, etc. are found in the fine-grained sandstone and siltstone of the Hatatate Formation proper. The holes of the boring shells are found in the volcanic rocks of the Takadate Andesite and in the andesite boulders or cobbles in the conglomerate of the Moniwa Member.



Text-fiig. 2. Columnar sections of the Moniwa Member of the Hatatate Formation. H, Hatatate Formation proper; M, Moniwa Member of the Hatatate Formation; T, Takadate Andesite; 1, Minami-Akaishi; 2, Kita-Akaishi; 3, Kamegamori; 4, Moniwa; 5, Hagurodai; 6, Kumanodô; 7. Shimogôri.

The Hatatate Formation is overlain with conformity by the Tsunaki Formation of conglomerate, sandstone, tuff breccia, etc. Bore-holes are also found in the andesite or dacite boulders in the conglomerate of the Tsunaki Formation and its equivalent Nanakita Formation.

Occurrence of Sandpipe

As mentioned above the boring shell sandpipes occur in the hard lava flows and dikes of the Takadate Andesite and in the igneous rock boulders of the conglomerate of the Moniwa Member of the Hatatate Formation, Tsunaki Formation and some of their correlatives.

The sandpipes in hard rock commonly occur in the dacite of the Takadate Andesite at a roadside cutting at Minami-Akaishi in Sendai City, in the two-pyroxene andesite dike of the Takadate Andesite of a roadside cutting at Kita-Akaishi in Sendai City, in the augite andesite lava near a tunnel of the Jôban Railway Line at Shimogôri, Watari-machi, south of Sendai and also in the two-pyroxene andesite lava near Ashitate, Murata-machi, southwest of Sendai.

At Minami-Akaishi the Moniwa Member is composed of cross-bedded granule conglomerate to very coarse-grained sandstone sometimes with huge andesite boulders which lies with very irregular eroded surface on the dacite. Usually the sandpipes are found more commonly on the marginal surface than on the upper surface. The sandpipes extend 10 to 45 mm down into the underlying hard dacite. They are arranged in almost upright position, open at the top, regularly and broadly rounded at the base, and none were observed to intercept another.

No molluscs or other kinds of fossils were found in the overlying sediments, but ill-preserved boring shell remains are usually found in the fig-like shaped sandpipes. The majority of the sandpipes have their upper parts eroded away and covered by the overlying layers, thus only their lower parts are preserved without remains of the original boring shell. The incomplete bore-holes are often occupied by hard bottom dwelling molluscs such as *Barbatia*, *Phlyctiderma* and *Irus*. Also molluscan shell fragments, corals, bryozoans and worm tubes are sometimes found in the holes. Moreover, the worm tubes sometimes occur attached to the walls of the small cracks or cavities in the dacite.

The andesite dike cutting the Takadate Andesite is covered with unconformity by the Moniwa Member at Kita-Akaishi. At this locality the Moniwa Member is composed of pebble conglomerate with a few boulders penetrated sporadically by the boring shells at the lower part but the sediments tend to become finer upwards. Numerous deep to shallow dish-shaped burrows are found in the irregular surface of the andesite dike. No boring shells were found in the bore-holes. They occur in almost upright position and extend about 10 mm down into the andesite dike.

The sandpipes in the eroded surface of andesite at Shimogôri all have their upper parts eroded away by the overlying granule to conglomeratic very coarse-grained sandstone with some huge andesite boulders and cobbles. The sandpipes occur in almost upright position and they are shallow dish-like in shape. The sediments overlying the coarse clastics may be equivalent to a part of the Hatatate Formation from stratigraphic relations, though no fossils were found.

Near Ashitate the Moniwa Member which is composed of sponges and brachiopods bearing conglomeratic, coarse- to medium-grained tuffaceous sandstone with huge andesite boulder, unconformably overlies the andesite lava of the Takadate Andesite. The bore-holes of the molluscs occur in the irregular surface of the andesite lava and all have their upper parts partly eroded away by the overlying sediments.

Another type of sandpipes is observed in the andesite boulders of the lower part of the Moniwa Member. These sandpipes are found at Kita-Akaishi, Nakayachi, Kamegamori and Hagurodai all in Sendai City and at Shimogôri in Watari-machi and Ashitate in Murata-machi. The sandpipes are usually found on the upper surface of the boulders but sometimes also on the basal parts.

The sandpipes from Kita-Akaishi are usually of fig-shape and retain the boring shells within, but those from the other localities all have their upper parts eroded and are jar- to dish-shape and do not preserve the boring shell.

The holes bored into andesite or dacite boulders are also found from the conglomerate of the Tsunaki Formation and from the conglomerate of the lowermost part of the Nanakita Formation in the northern border of Sendai.

Description of Boring Shell

Family Pholadidae

Genus *Pholadidea* TURTON, 1819

Pholadidea sp.

Pl. 38, figs. 5a–c, 6

Medium in size, oblong, moderately inflated; separated into two parts by distinct, narrow, nearly straight, oblique furrow running from beak to ventral margin; posterior part longer than anterior, gradually becoming slender towards rounded posterior margin, sculptured with coarse concentric lines; anterior part rather distinctly separated into two parts, anterior half sculptured with somewhat imbricated radiating riblets and concentric lines and rather smooth callum.

Dimensions (in mm).—

Height	22	23.5	17
Length	35.5	—	—
Thickness	22	22	19

Remarks.—The specimens are not well preserved but their preserved characters serve to identify them with the genus *Pholadidea*. In general features they resemble *Pholadidea* (*Penitella*) *kamakurensis* (YOKOYAMA), a Recent species of Japan, but the naming is held until better preserved specimens are obtained. From *Pholadidea kotakae* KANNO and MATSUNO described from the lower part of the Miocene Chikubetsu Formation in Hokkaido (KANNO and MATSUNO, 1960) the present ones can be distinguished by the smaller size and narrow anterior part.

Usually, after attaining full size *Pholadidea* ceases to bore. Therefore, it is evident that the described specimen having a callum has attained full size.

Locality, geological formation and age.—River floor of the Natori-gawa, Kita-Akaishi, Sendai City, Miyagi Prefecture. Moniwa Member of the Hatatate Formation. Early Miocene.

Description of Sandpipe

So far as examined the numerous sandpipes found in the igneous rocks from the environs of Sendai are all sand-filled bore-holes made by *Pholadidea*. Their morphological features are as follows.

1) Sandpipe from Minami-Akaishi

The nearly perfectly preserved sandpipes are small, fig-like in shape, and retain the original boring shell. The boring shells have very little freedom of movement in their tight burrow. The bore-holes usually are filled with rather poorly sorted sandstone, being in general of very coarse-grained sandstone in the inner part and with a tendency of becoming grained finer outwards. But when the upper parts of the sandpipes are worn away the contents of the bore-hole usually consist of poorly sorted very coarse-grained sandstone with subangular granules, shell fragments or rarely with coral fragments. The inner surface of the bore-holes is usually rather smooth but sometimes faint impressions are visible. The uppermost parts of the holes are subcircular in section with diameters of 8 to 11 mm; the diameter varies according to the state of preservation. The length of the holes varies with the state of preservation but usually measures 33 to 45 mm. The holes gradually expand towards the lower end and usually attain 20 to 24 mm in diameter near the base, but sometimes exceed 26 mm. The profile of the sandpipes near the base is subcircular. The longitudinal axis of the burrows is usually bent irregularly.

2) Sandpipe from Kita-Akaishi

At Kita-Akaishi the sandpipes are found in the andesite boulders of the basal part of the Moniwa Member on the river floor of the Natori-gawa. Sandpipes-bearing huge boulders are rather rare in the conglomerate. They are found in the andesite dikes cutting the Takadate Andesite. The burrows in the andesite boulders are rather well preserved and contain the original boring shell, none were found in the underlying vol-

Table 1.

Loc.	Length	Max. diameter	Min. diameter (in mm.)
A	33.5	22.5	11
A	43	24.5	10
A	38	18	8
A	45	21.5	9
A	39	20.5	9
A	40.5	23	—
A	20	22	—
A	36	26	—
A	25	13	—
A	37	21.5	—
A	28	19	—
A	40	26.5	—
A	27	18	—
A	28	18	—
A	25	13	—
B	49.5	23.5	8.5
B	49.5	25.5	9.5
B	38	21.5	6.5
B	36	23	7
B	50	28	—
B	51.5	27.5	9.5
B	40	28	—
B	42	25.5	—
C	—	26	—
C	50	25	10

A: Minami-Akaishi (basement); B: Kita-Akaishi (boulder);
C: Kashiko-buchi (boulder).

canic breccia and tuff breccia. The burrows are filled with the calcareous coarse- to very coarse-grained sandstone the same as the cementing materials of the conglomerate. Sometimes crystallized calcite occurs in small cavities at the lower part of the sandpipes. The contents of the well preserved sandpipes as well as those lacking their upper parts are analogous to the ones from Minami-Akaishi as already described. No organisms seem to have occupied the bore-holes after death of the original boring shell.

The morphological features of the burrows from the present locality are nearly the same as those from Minami-Akaishi, except for the somewhat larger size (Table 1). Their longitudinal axis is usually bent irregularly and sometimes twisted extremely.

As the bore-holes in the andesite dikes have their upper parts eroded away, they are shallow dish-like in shape and contain poorly sorted very coarse- to coarse-grained sandstone with some subangular granules.

3) Sandpipe from Shimogôri

The sandpipes from Shimogôri occur in the eroded surface of the andesite lava of the Takadate Andesite and also in the andesite boulders or rarely in the large andesite cobbles of the conglomerate of the Moniwa Member of the Hatatate Formation. They all have their upper parts eroded away and are shallow dish-like in shape, therefore, the original boring shells are not observed within. The lower end of the burrows in the basement rocks have subcircular profile of 25 mm or a little more in diameter. No fossil shells or worm tubes were found in the sand-filled burrows.

4) Sandpipe from Ashitate

Near Ashitate numerous sandpipes are found in the huge andesite boulders cemented by the conglomeratic, coarse- to medium-grained, tuffaceous sandstone of the Moniwa Member. Burrows are found in the andesite lava of the Takadate Andesite but their details are unknown, because their upper parts have been eroded away and they are all dish-like in shape. The sandpipes contain poorly sorted sandstone.

5) Sandpipe from the other localities of Moniwa Member

The sandpipes from Nakayachi, Kamegamori and Hagurodai occur in huge andesite boulders of the conglomerate, all have their upper parts eroded and are associated with other molluscs. They are jar- to dish-like in shape and their morphological features are similar to those already described.

6) Sandpipe from the Tsunaki Formation

The sandpipes from the Tsunaki Formation occur in the andesite and dacite boulders of the conglomerate at Kashikobuchi in the western margin of Sendai City. Most of them have their upper parts eroded and thus are jar- to dish-like in shape. Some rather well preserved ones attain about 50 mm in length and have irregularly bent longitudinal axis. None retained the original boring shell. The largest diameter of the lower end measured 26 mm. The morphological characters of burrows are quite similar to those from the Moniwa Member. The burrows are filled with poorly sorted very coarse-grained sandstone with subangular granules or pebbles. No fossil shells were found in either the burrows or conglomerate.

7) Sandpipe from the Nanakita Formation

Sandpipes in the andesite and dacite boulders of the conglomerate of the Nanakita Formation are very common in the vicinity of Dôdokoro, Izumi-machi, north of Sendai City. All of them are filled with very coarse-grained sandstone with some subangular granules. Sometimes the original boring shell is found within but most have their upper parts eroded. The boring shell remains in the sandpipes are not well preserved. The morphological characters of the burrows are quite similar to those from the Moniwa Member.

Remarks

From the characteristics of the sandpipes found in the igneous rocks in the environs of Sendai it can be said that, (1) they are fig-like in shape when well preserved and jar- to dish-like in shape when their upper parts are eroded, (2) they occur in almost upright position, open at the top and gradually expanding towards the rounded basal part, (3) the diameter of the lower part usually exceeds twice that at the top, (4) the present sandpipes in the igneous rocks from the different localities show nearly the same morphological characters; they are all considered to have been made by the genus *Pholadidea*, (5) the longitudinal axis of the burrows is usually bent and sometimes even twisted extremely, (6) the sandpipes usually contain rather poorly sorted coarse-grained sandstone when the original shell is retained, but of generally very coarse-grained sandstone in the inner part and somewhat finer ones outwards; the imperfect boreholes contain poorly sorted very coarse-grained sandstone with subangular granules throughout.

Small pits produced by honeycomb weathering somewhat resemble the present burrows but they can be distinguished from the present ones by possessing a rim bordering the cavity and by the non-uniform morphological features.

It is interesting to notice that the sandpipes in the igneous rocks are different from those in the sedimentary rocks in several features. With regard to the boring method of the boring shells it is believed at present that all members of the Pholadidae bore into the rocks by purely mechanical means (TURNER, op. cit., MORTON, 1964). Therefore, it is considered that the lithological characters of the volcanic rocks may be responsible for the irregularly bending of the longitudinal axis. The smaller size of the burrows in the volcanic rocks compared with those in the soft sidimentary rocks may be largely due to the hardness, composition and texture of the volcanic rocks. That the burrows in the andesite are somewhat larger in size than those in the dacite may be explained, at least in part, by the differerences in their lithological characters.

The veligers of the boring shells after becoming attached to the rocks begin boring and with growth the holes become larger. In the Recent seas the boring shells are commonly found on the side or marginal surface of the sedimentary rocks more than on the upper surface. Similarly, the burrows occurring in the basement rocks of the Takadate Andesite are found more commonly on the marginal surface than the upper. The frequent occurrence of many small cracks or cavities on the marginal surface of andesite and dacite favors the settling of the veligers to these rocks. After the veligers of the boring shells settled in the cavities of relatively soft weathered surface or of the hard parts of the rocks they begin boring. Differential weathering of the rocks results in the different natures of the rocks such as hardness or texture, which are not always uniform throughout the rock body. Therefore, when boring into the unweathered hard parts by mechanical action, the shells had to change their boring direction towards the relatively softer parts. Thus, it appears that the longitudinal axis may have been twisted extremely.

TURNER (op. cit.) stated that "when they are boring into a harder rock such as gneiss, there must be some elements in the rocks which are softer than the shell itself or else the rocks must be of a friable nature". Considering from the general features of the present burrows occurring in the volcanic rocks it is evident that the genus *Pholadidea* can bore by purely mechanical means into the igneous rocks. Therefore, it seems that the boring activity of the genus *Pholadidea* is not hindered by the composition of the rocks. It is believed that the Recent *Pholadidea* can bore into igneous or metamorphic rocks and that such kind will be found.

As mentioned in the earlier lines numerous burrows were found commonly in the andesite boulders but not in the small cobbles or pebbles. In the Recent seas the boring shells are found commonly in boulders to large cobbles but not in small cobbles or pebbles. This may be related with the movements of the gravels. That is to say, because the small gravels are easily moved by water action, the veligers of the boring shells would have little chance for settling.

Holes of boring shells are sometimes found in large cobbles at Shimogôri but elsewhere they are usually found in ones larger than cobbles. Rarely the burrows are found both on the upper surface and on the basal part of the boulders but usually they are not found on the basal part. At Shimogôri the burrows are found to occur on the upper surface of the boulders and large cobbles and none were observed on the basal parts. At Kita-Akaishi, Nakayachi and Kamega-mori a few burrows were found on the basal part of small boulders.

The presence of bore-holes on the upper and lower surfaces of the boulders can be explained as follows. During some time the boulders or large cobbles must have been exposed on the sea bottom, and this favored the settling of the boring shells. Therefore, the presence of burrows on both the upper surface and basal part of the boulders indicates that the boulders may have been subjected to the action of currents or waves by which each surface was reversed to allow the settling of the veligers which later made the bore-holes. Boulders or cobbles with the burrows only on the upper surface suggests that they remained stationary on the sea bottom. The mode of occurrences of the bore-hole bearing boulders or cobbles in the geological formations may give some clue for the interpretation of the environmental conditions at the time of deposition.

Sometimes *Barbatia*, *Phlyctiderma* and *Irus* are found in the sandpipes which lack their upper parts. They occupied the holes made by the boring shells after the mollusc died, therefore they are not found in the burrows in which the original boring shells are preserved. As the holes in the volcanic rocks were originally bored by *Pholadidea*, it is evident that *Barbatia*, *Phlyctiderma* and *Irus* are subsequent occupants.

With regard to the boring action of the genus *Irus* UTASHIRO (1961) has discussed in detail and pointed out that it can bore holes in mudstone. But from the facts mentioned above *Irus* can not be considered to have originally bored holes into the igneous rocks. Similarly, worms, bryozoans, etc. that were found in the holes are apparently subsequent occupants.

When the bore-holes are excellent in preservation their contents usually consist of rather poorly sorted sandstone, being generally very coarse-grained in the inner part and somewhat fine outwards. Such differences in grain size have already been pointed out by HATAI (1938) and MASUDA and TAKEZAWA (op. cit.). HATAI, in the case of sandpipes due to crustaceans, stated that the coarse sediments are on the outer surface and finest at the core. HATAI's sandpipe from the Byoritsu Formation in Formosa is known as Ophiomorpha. On the other hand, the writer and TAKEZAWA have pointed out that in the sandpipes containing *Barnea* (*Umitakea*) *japonica* (YOKOYAMA) from the Pliocene Yagiyama Formation at Sendai City the coarse sediments are in the inner part and finer ones at the outer part.

Geological Significance

The burrows of the boring shells penetrating the basement rocks of the Neogene sedimentaries are found in the dacite and andesite lavas and in the andesite dikes of the Takadate Andesite. The majority of them have their upper parts eroded irregularly by the overlying Moniwa Member of the Hatatate Formation. From the occurrences of the burrows made by the boring shells it is evident that the intertidal zone of the rocky shores consisted of volcanic rocks in the vicinities of Kita-Akaishi, Minami-Akaishi, Ashitate and Shimogôri. From the preserved conditions of the burrows and of the sediments developed in those areas, it is thought that strong waves or currents may have prevailed.

With regard to the stratigraphic relations between the Takadate Andesite and Moniwa Formation, HANZAWA *et al.* (1953) have pointed out that the Moniwa interfingers with the Takadate. But OIDE (1961) and SHIBATA (1962) have pointed out that the relation between them is an unconformity in the western region and that they interfinger with each other in the eastern region in the environs of Sendai.

From the accounts given in the earlier lines the writer considers that the Moniwa Member overlies the Takadate Andesite with unconformity in the western and southwestern regions and also in the vicinity of Shimogôri in the southeastern part but in other regions they may interfingers with one another. That is to say, it is evident that the Takadate Andesite in the western and southwestern regions and also in the southeastern part have been uplifted and eroded before the major transgression of the Moniwa sea.

It appears that the variation of the thickness of the Moniwa Member may have relation with the relief of the sea bottom at the time of deposition. This inference is based upon, as shown in text-fig. 2, the thickness of the Moniwa Member is generally less in the vicinities of Kita-Akaishi, Minami-Akaishi, Ashitate and Shimogôri and also in the vicinities of Kamegamori and Hagurodai than in the other regions. In these areas the burrows of the boring shells are found to occur in the volcanic rocks of the Takadate Andesite and in the boulders of the Moniwa Member. Therefore, it is considered that the areas in which occur the boulders or cobbles bored by the boring shells may have been influenced by the activity of waves or currents. As the sea bottom of the Takadate Andesite may have been very irregular, the low or deeper parts were covered by coarse-grained sediments and the high or shallower parts may have been exposed, but with the progress of

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Explanation of Plate 38

Figs. 1-4. Sandpipes collected from the andesite boulder of the Moniwa Member of Hatatate Formation, ×1. Loc. River floor of the Natori-gawa, Kita-Akaishi, Sendai City.

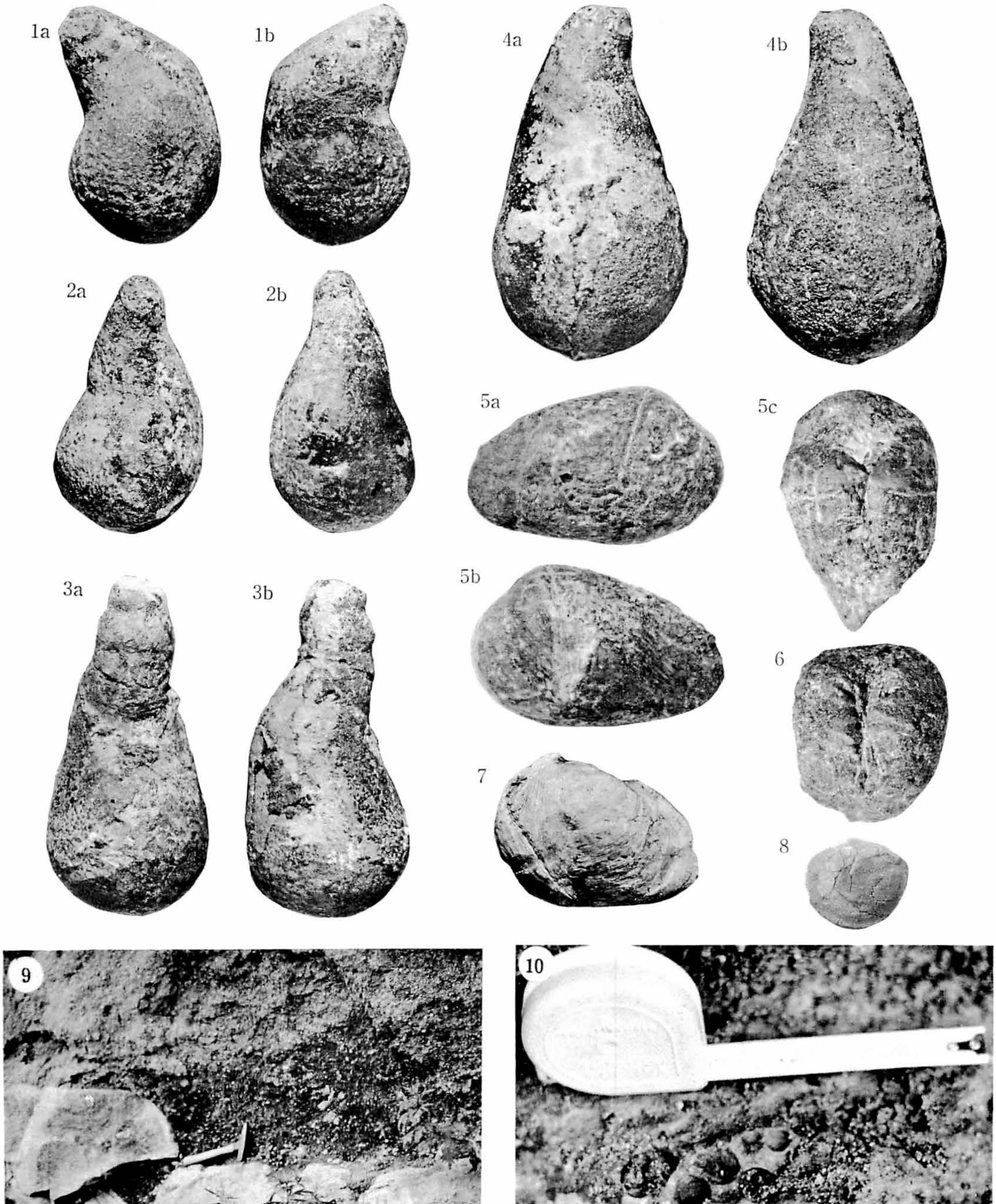
Figs. 5a-c, 6. *Pholadidea* sp. ×1. a, right valve, b, left valve, c, dorsal view. 6, dorsal view. Loc. Same as above.

Fig. 7. *Pholadidea kamakurensis* (YOKOYAMA), ×1. Left valve. Loc. Ohya, Motoyoshi-machi, Motoyoshi-gun, Miyagi Prefecture (from a Permian calcareous slate boulder). Recent.

Fig. 8. *Phlyctiderma* sp. ×1. Loc. Roadside cutting at Minami-Akaishi, Sendai City (from the burrow of the boring shells).

Fig. 9. Unconformity between the dacite of the Takadate Andesite and the conglomerate of the Moniwa Member of the Hatatate Formation. Loc. Same as above.

Fig. 10. Burrows found on the plane of uncomformity. Loc. Same as above.


1a
1b
4a
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2b
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5c
5b
6
3a
3b
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transgression and deepening of the basin the sediments became finer upwards.

The fossil localities of the Moniwa marine fauna are very widely distributed and their fossil assemblages are very different among the localities (NOMURA, 1940, OYAMA, 1954). Therefore, it is evident that these differences in the fossil assemblages may have been due to the differences in the environmental conditions at the time of deposition.

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Ashitate	足 立	Dôdokoro	堂 所
Hagurodai	羽黒台	Hatatate	旗 立
Izumi-machi	泉 町	Kamegamori	亀ケ森
Kashiko-buchi	賢 渕	Kita-Akaishi	北赤石
Moniwa	茂 庭	Minami-Akaishi	南赤石
Nakayachi	中 谷	Nanakita	七北田
Shimogôri	下 郡	Takadate	高 館
Tsunaki	綱 木	Watari-machi	亘理町

Explanation of Plate 39

Fig. 1. Burrows found in the dacite of the Takadate Andesite. Loc. Roadside cutting at Minami-Akaishi, Sendai City.

Fig. 2. Burrows found in the andesite of the Takadate Andesite. Loc. Roadside cutting at Kita-Akaishi, Sendai City.

Fig. 3. Unconformity between the andesite dike of the Takatate Andesite and the Moniwa Member of the Hatatate Formation. Loc. Same as above.

Fig. 4. Burrows found in the andesite boulder of the Tsunaki Formation. Loc. Kashiko-buchi, Mitaki, Sendai City.

Fig. 5. Burrows found in the andesite boulder of the Nanakita Formation. Loc. Dôdokoro, Izumi-machi, Miyagi-gun, Miyagi Prefecture.

Fig. 6. A hand specimen of the dacite with the sandpipes. ×3/4. *Barbatia* sp. can be seen in the sandpipe and worm tubes in the cavity. Loc. Minami-Akaishi, Sendai City.

Fig. 7. A hand specimen of the dacite with the sandpipes. ×3/4. *Pholadidea* sp. can be seen in the sandpipe at right side. Loc. Same as above.

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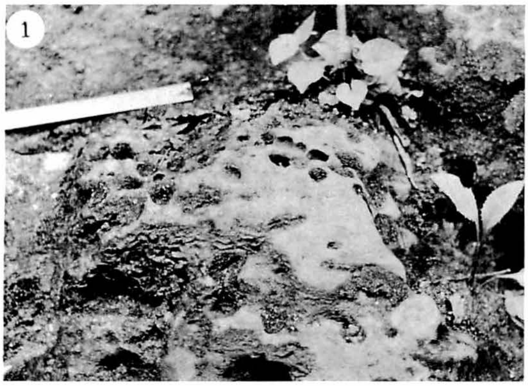

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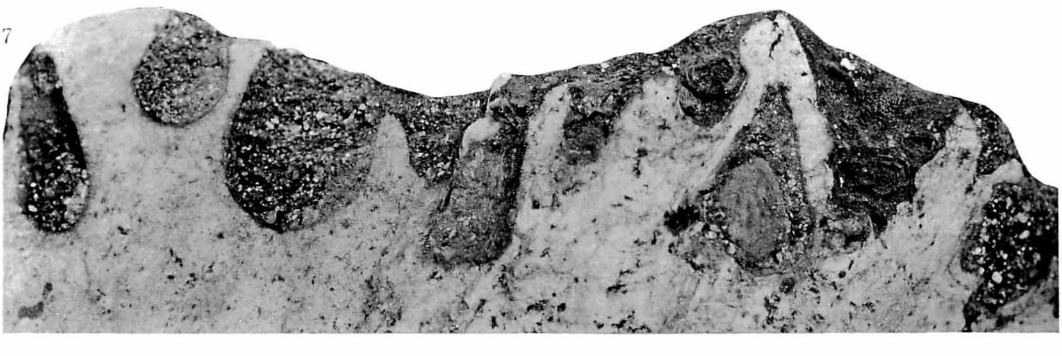

Trans. Proc. Palaeont. Soc. Japan, N. S., No. 72, p. 363, Dec. 30, 1968

SHORT NOTE

14. *URALNEVADAPHYLLUM*, A NEW SUBGENERIC NAME FOR *PORFIRIEVELLA* MINATO AND KATO, 1965

MASAO MINATO and MAKOTO KATO

Department of Geology and Mineralogy, Hokkaido University, Japan

The authors (1965, p. 71) proposed *Porfirievella* as a subgenus of the genus *Kleopatrina* for a group of massive corals from the so-called boreal province in Lower Permian. The subgeneric name has been in use by some authors (STEVENS, 1967; FEDOROWSKI, 1967).

However Prof. H. FLÜGEL of Graz, Austria recently informed us that the name was a junior homonym of *Porfirieviella* IVANOVSKY, 1963, an Ordovician coral genus.

In as much as they are both dedicated to the same person, the late Prof. G. PORFIRIEV with the same suffix *-ella*, and are both representing rugose corals, although of different ages, it is thought advisable not to maintain *Porfirievella* in order to avoid future confusion which might be arisen, even if this name differs from *Porfirieviella* by one letter.

Thus authors, therefore, hereby propose *Uralnevadaphyllum*, a new substitution name for "*Porfirievella*".

We cordially thank Prof. H. FLÜGEL for his kind information upon the problem concerned here.

Received Nov. 25, 1968

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PROCEEDINGS OF THE PALAEONTOLOGICAL SOCIETY OF JAPAN

日本古生物学会第100回例会は，1968年9月22日（日）午前9時より金沢大学理学部および教養部において開催された。なお100回を記念して23日（月）午前9時より記念講演，同日午後12時30分よりコロキアム「化石硬組織内の同位体」（世話人：高柳洋吉・小西健二）が開かれた。（参加者64名）24日（火）には能登中島付近山戸田層（中新世植物化石），和倉付近の和倉含珪藻泥岩などの化石および海緑石などの見学・採集旅行が行なわれた（案内者：松尾秀邦）。

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炭酸塩を生ずる生物体液の化学系 ―結晶型と微量元素含量―.....................北野 康

コロキアム

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水温変化と酸素同位体比 (Paleotemperature scale) ....堀部純男・大場忠道・新妻信明

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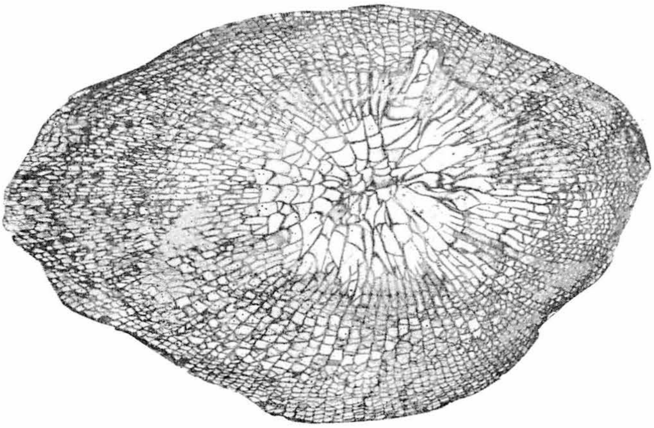
日本古生物学會 報告・紀事

Transactions and Proceedings of the Palaeontological Society of Japan

New Series

No. 65～No. 72

1967-1968



日 本 古 生 物 学 会

Palaeontological Society of Japan

The heading in Japanese commemorates the handwriting of Prof. Matajiro YOKOYAMA, father of Japanese Palaeontology, who was Professor of Stratigraphy and Palaeontology at the Geological Institute, Imperial University of Tokyo.

The fossil on the front page is *Kueichouphyllum yahagiense* MINATO, 1955.

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例 会 通 知

	開催地	開催日	講演申込締切日
1969年総会，年会	国立科学博物館	1969年1月25,26日	1968年12月10日
102回 例 会	横浜国立大学	1969年6月 下 旬	1969年5月10日

1969年年会（国立科博）：シンポジウム，新生代貝類化石群の時空分布。

（世話人：小高民夫，鎮西清高，岩崎泰頴）

日本古生物学会特別号第号の原稿公募

1969年度に発行予定の特別号第14号の原稿は，去る11月15日〆切で公募していましたが，期日までに完成したものの申し込みがなく，作成中の原稿がある旨の申し出が2件ありました。よって常務委員会の議をへて，〆切を1969年5月15日に延期して，上記2件に限らず，広く公募することに決めました。ただしこの場合は，1969年度の文部省刊行助成金の申請はできませんので，学会の予算（35万円＋α）程度で出版できるものが，実際には採択の対象となると思われます。このことをお含みの上，適当な原稿をお持ちの方は，前回の公示（学会誌第69号，232ページ）の注意事項に従って，編集委員（〒812，福岡市箱崎町，九州大学理学部内　松本達郎）宛に申し込んで下さい。なお，1969年11月15日〆切の第15号の原稿公募も，例年どおり致したい予定ですが，第14号の募集採否決定後，いずれまた公示します。

特別号編集委員会

NEWS

◎ 来年開催を予定されている主な関係国際会議（期日，開催地，連絡先）は次の通りである。

Intl. Field Symposium on British Jurassic, celebrating bicentenary of birth of William SMITH.
April 9–24, London; Dr. D. V. AGER, Dept. Geol., Imp. Coll. Sci. Tech., Prince Consort Rd., London SW7, England.

I. U. G. S., Commission on Geochronology with Colloquium on the Geochronology of Phanerozoic Orogenic Belt.
August 28–September 3, Bern: Dr. M.E. ROUBAULT, Centre de Recherches Pétrographiques et Geochimiques, Rue N-D des Pauvres, Vandoeuvre, B. P. 682, 54- Nancy, France

Intl. Congress of the Intl. Union for Quaternary Research.
August 30–September 5, Paris: Dr. Henri ELHAI, 8th Congress of Inqua, 191 rue St. Jacques, Paris 5^{e}, France.

Colloquium on Mediterranean Jurassic Stratigraphy.
September 4–8, Budapest: Hungarian Geological Institute, Nepstadion ut 14, Budapest, XIV, Hungary.

Colloquium on Eocene Stratigraphy.
September 6–8, Budapest: Hungarian Geological Institute, Nepstadion ut 14, Budapest, XIV, Hungary.

North American Paleontological Convention & Field Trips.
September 5–7, Chicago, Dr. Rainier ZANGERL, Field Museum of Natural History, Roosevelt Rd & Lake Shore Drive, Chicago, Ill., 60605, USA.

◎ 本会誌の出版費の一部は文部省研究成果刊行費による。

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日本古生物学会会則　　(1964, 1, 18)

第 1 条　本会は日本古生物学会という。
第 2 条　本会は古生物学およびこれに関係ある諸学科の進歩および普及を計るのを目的とする。
第 3 条　本会は第2条の目的を達するため次の事業を行う。
1. 会誌そのほかの出版物の発行。 2. 学術講演会の開催。
3. 普及のための採集会・講演会そのほかの開催。
4. 研究の援助・奨励および研究業績ならびに会務に対する功労の表彰その他第2条の目的達成に資すること。

第 4 条　本会の目的を達するため総会の議を経て本会に各種の研究委員会を置くことができる。
第 5 条　本会は古生物学およびこれに関係ある諸学科に興味を持つ会員で組織する。
第 6 条　会員を分けて普通会員・特別会員・賛助会員および名誉会員とする。
第 7 条　普通会員は所定の入会申込書を提出した者につき評議員会の議によって定める。
第 8 条　特別会員は本会に10年以上会員であり古生物学について業績のあるもので，特別会員5名の推薦のあったものにつき評議員会の議によって定める。
第 9 条　賛助会員は第2条の目的を賛助する法人で評議員会の推薦による。
第10条　名誉会員は古生物学について顕著な功績のある者につき評議員会が推薦し，総会の決議によって定める。
第11条　会員は第12条に定められた会費を納めなければならない。会員は会誌の配布を受け第3条に規定した事業に参加することができる。
第12条　会費の金額は総会に計って定める。会費は普通会員年1,000円，特別会員年1,500円，賛助会員年10,000円以上とする。名誉会員は会費納入の義務がない。在外の会員は年4弗とする。
第13条　本会の経費は会費・寄付金・補助金などによる。
第14条　会費を1ケ年以上滞納した者および本会の名誉を汚す行為のあった者は，評議員会の議を経て除名することができる。
第15条　本会の役員は会長1名，評議員15名とし，うち若干名を常務委員とする。任期は総て2年とし再選を妨げない。
会長の委嘱により本会に幹事および書記若干名を置くことができる。
常務委員は評議員会において互選される。評議員は特別会員の中から会員の通信選挙によって選出される。
第16条　会長は特別会員の中から評議員会において選出され，本会を代表し会務を管理する。
会長に事故ある場合は会長が臨時に代理を委嘱する。
第17条　本会には名誉会長を置くことができる。名誉会長は評議員会が推薦し総会の決議によつて定める。名誉会長は評議員会に参加することができる。
第18条　本会は毎年一回定例総会を開く。その議長には会長が当り本会運営の基本方針を決定する。
総会の議案は評議員会が決定する。
会長は必要があると認める時は臨時総会を召集する。総会は会員の十分の一以上の出席をもつて成立する。
会長は会員の三分の一以上の者が会議の目的たる事項および召集の理由を記載した書面をもつて総会召集の請求を受けた場合は臨時総会を召集する。
第19条　総会に出席しない会員は他の出席会員にその議決権の行使を委任することができる。但し，欠席会員の議決権の代行は1人1名に限る。
第20条　総会の議決は多数決により，可否同数の時は議長がこれを決める。
第21条　会長および評議員は評議員会を組織し，総会の決議による基本方針に従い運営要項を審議決定する。
第22条　常務委員は常務委員会を組織し評議員会の決議に基づいて会務を執行する。
第23条　本会の会計年度は毎年1月1日に始まり12月31日に終る。
第24条　本会会則を変更するには総会に付議し，その出席会員の三分の二以上の同意を得なければならない。
付　則　1) 評議員会の議決は総て無記名投票による。