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ANIDANTHUS AND *MEGOUSIA* (BRACHIOPODA) FROM THE PERMIAN OF JAPAN AND CAMBODIA

by

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(with 2 text-figures and 2 plates)

(Contribution from the Department of Geology and Mineralogy, Faculty of Science, Hokkaido University, No. 1235)

Introduction

Genera *Anidanthus* and *Megousia* are both distinguishable from the other productids in having a peculiar surface sculpture. Both the genera are ornamented only by costellae in the pedicle valve; whereas in the brachial valve imbricated rugae are developed besides costellae. As to the systematic position of *Anidanthus* there have been diverse opinions. For example, the genus now in question was assigned as Linoproductidae by BOOKER (1932), MUIR-WOOD and COOPER (1960) and GOBBETT (1963), while it was classified as Productidae by SARYTCHEVA LICHAREW and SOKOLSKAJA (1960). Further, WATERHOUSE (1966) suggested that this genus likely belonged to Margiferidae. Under such circumstances, the present author wishes to tentatively place the genus *Anidanthus* into the family Linoproductidae. The genus *Megousia* is distinguishable from the genus *Anidanthus* by the development of considerably large ears.

In this paper, the occurrence of these two genera from the Permian of Japan and Cambodia is first discussed in connection with their world distribution and then the Asian specimens at hand are described in detail. The specimens used in this study were collected by Mr. H. KOIZUMI from the upper part of the Kashiwadaira formation of the Takakurayama group developed in the Abukuma Mountains, together with some other materials collected by Mr. F. SUDO from the Kanokura series of the Kitakami Mountains. Also some more specimens were found by Drs. K. ISHII and M. KATO from the C bed of the Sisophon limestone of West Cambodia during their geologic reconnaissance work there in 1967.

According to YANAGISAWA and NEMOTO (1961) and YANAGISAWA (1967), the Permian Takakurayama group may be lithologically divisible into the following three formations, viz. Iriishikura formation, Motomura formation and Kashiwadaira formation in ascending order. The Kashiwadaira formation

from which the specimens treated in this paper were found to be very fossiliferous. As to the age of this formation, considerably different views have been hitherto held by many paleontologists including HAYASAKA (1957), HANZAWA and MURATA (1963), MURATA (1964), HAYASAKA (1965), ONUKI (1966), TORIYAMA (1967), YANAGISAWA (1967) and NAKAZAWA and NEWELL (1968).

This formation may be further divided into two zones from the association of fossils. The lower horizon of them is characterized by the presence of *Yabeina multiseptata* (DEPRAT) and *Yabeina* sp. according to HANZAWA and MURATA (1963) and MURATA (1964). On the other hand, from the upper zone various kinds of fossils, such as fusulinids, bryozoans, brachiopods, bivalves, nautiloids, ammonoids and corals have been known to exist.

HAYASAKA (1957, 1965) described several cephalopods from this formation and provisionally correlated the Takakurayama group as a whole to the Sosio stage. MURATA (1964) also stated that the Takakurayama group including the Kashiwadaira formation probably corresponds to the Upper Early Guadalupian series (Wordian) of North America, after having reviewed the stratigraphical range of cephalopods described by HAYASAKA. ONUKI (1966) and TORIYAMA (1967) were also of the same opinion as HAYASAKA and MURATA in the correlation of the Takakurayama group in rough estimation. NAKAZAWA and NEWELL (1968), however, considered the age of this formation to be correlatable with the *Yabeina* zone, in spite of the occurrence of bivalves resembling the Lower Kanokuran bivalve faunule.

In the meantime, during a detailed mapping around Kesennuma City in 1970, Mr. F. SUDO succeeded in discovering numerous brachiopod remains from the Kanokura series developing in that area, and in that collection the present author found *Megousia auriculata* MUIR-WOOD and COOPER. According to MINATO, KATO and HASEGAWA (1964), the Kanokura series developed in the Southern Kitakami Mountains may be divided into three stratigraphical units; the *Yabeina* zone, the *Neoschwagerina* zone and the *Monodiexodina* zone in descending order. *Megousia* newly collected by Mr. SUDO probably represent either the *Monodiexodina* or the *Neoschwagerina* zone.

Combodian specimens assigned to *Anidanthus sinosus* (HUANG) were collected from the C bed of the Sisophon limestone, which may correspond to the *Sumatrina longissima* – *Yabeina multiseptata* zone proposed by ISHII (1966).

It is a great pleasure for the author to dedicate this small note to Professor Toshio ISHIKAWA on the occasion of his retirement from Hokkaido University.

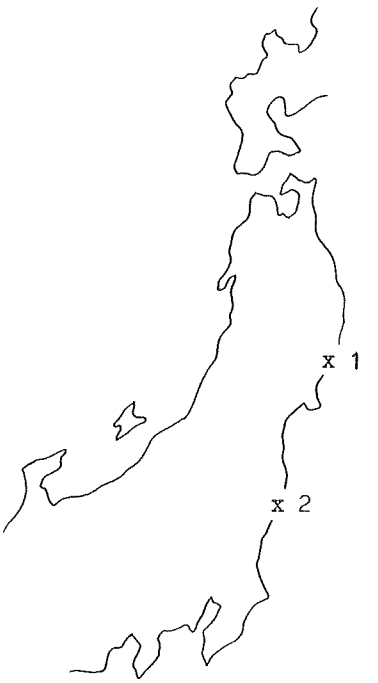

Fig. 1: Index map showing fossil localities in Japan.
1. Kitakami Mountains.
2. Abukuma Mountains.

Acknowledgements

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His special thanks are due to Dr. T. G. SARYTCHEVA of the Palaeontological Institute, Academy of Science of the U.S.S.R. who kindly gave him much useful information on the specimens of *Productus ussuricus*.

Dr. Kenichi ISHII of Osaka City University, Mr. Fumio SUDO of Fudo

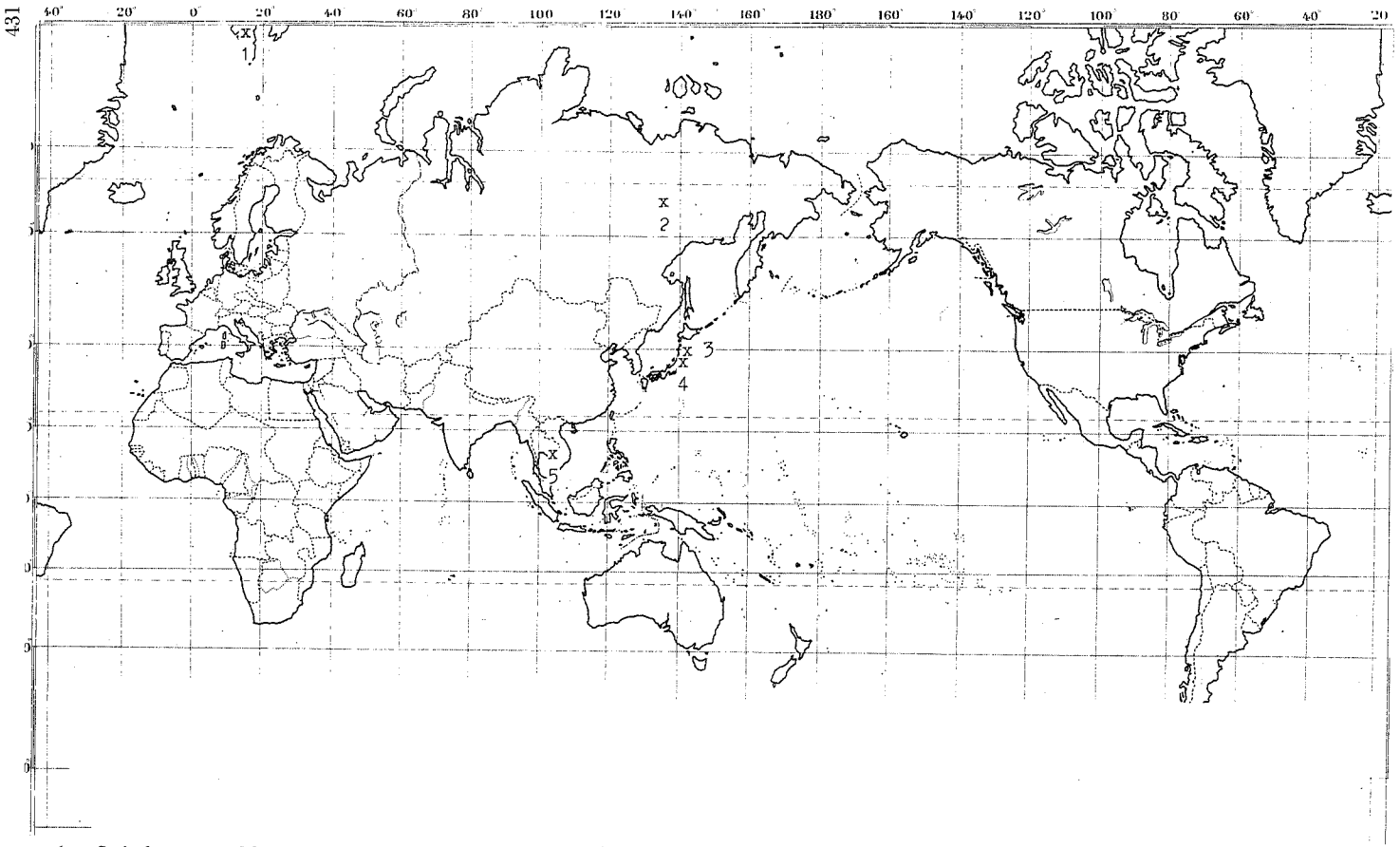
Construction Co. Ltd. and Mr. Hitoshi KOIZUMI kindly supplied the materials used in this study and for this the author is indeed grateful.

Geologic and geographic distribution of Anidanthus and Megousia

WATERHOUSE (1969) gave an outline of geologic and geographic distribution of the genera *Megousia* and *Anidanthus,* when he wrote about the Queensland Productaceans. According to him, *Megousia* has been known from the Permian of North America, Bolivia, the Soviet Arctic, Australia and Tasmania, while *Anidanthus* shows much wider geographic distribution and is known from the Permian (and older) of Australia, South China, Himalaya, Caucasus, Siberia, the Soviet Arctic, Ural, Spitsbergen and North America. At the same time he stressed especially the fact that neither *Megousia* nor *Anidanthus* have ever been reported from Japan and South-east Asia. As a matter of fact, *Anidanthus abukumaensis* n. sp. was already described by YANAGISAWA from the Kashiwadaira formation of the Takakurayama group developed in the Abukuma Mountains, North-east Japan in 1967. Furthermore, from the C bed of the Sisophon limestone in Cambodia, the presence of *Anidanthus* ? *sinosus* (HUANG) was also reported by ISHII, KATO and NAKAMURA in 1969. But, in the author's opinion, YANAGISAWA'S species needs revision, and the Cambodian *Anidanthus* was not described at that time. Now, the presence of *Anidanthus* and *Megousia* becomes evident in Japan, as will be described in detail.

Further, GOBBETT (1963) described and gave the figures of three species of *Megousia* from the Permian Brachiopod chert or *Spirifer* limestone in Spitsbergen. They are *Megousia weyprechti* (TOULA), *M. kulikii* ? (FREDERICKS) and *M. harlandi* GOBBETT. The interiors of the brachial valves identified as *M. weyprechti* or *kulikii* ?, however, possess definite kidney-shaped brachial ridges and the brachial ridges were suggested to be almost lacking in the genus *Megousia* by MUIR-WOOD and COOPER (1960). According to the author's opinion three species described as *Megousia* from Spitsbergen may belong to the genus *Anidanthus* instead of *Megousia.* It must be concluded that *Anidanthus* found by GOBBETT in Spitsbergen unfortunately escaped WATERHOUSE's attention. The presence of *Anidanthus boikovi* (STEPANOV) in the Lower Permian of Sette-Daban, Siberia has been recently recorded by ABRAMOV (1970).

The global distribution of the Permian *Anidanthus* and *Megousia,* except for those already mentioned by WATERHOUSE (1969) will be shown in text-figure 2.



1. Spitsbergen *M. weyprechti, M. kulikii* ?, *M. harlandi.*
2. Sette-Davan Siberia *A. boikovi.*
3. Kitakami Mountains, Japan *M. auriculata.*
4. Abukuma Mountains, Japan *M.* cfr. *auriculata, M. koizumii, A. ussuricus, A.* sp.
5. Sisophon limestone, Cambodia *A. sinosus.*

Fig. 2 Geographic distribution of the Permian *Megousia* and *Anidanthus* (except those already recorded by WATERHOUSE, 1969)

Description of species

Family Linoproductidae STEHLI, 1954
Subfamily Linoproductinae STEHLI, 1954
Genus *Anidanthus* WHITEHOUSE, 1928

1950 *Anidanthus* HILL, p. 9.
1960 *Anidanthus* SARYTCHEVA et al., p. 232.
1960 *Anidanthus* MUIR-WOOD and COOPER, p. 299.
1963 *Anidanthus* GOBBETT, p. 106.
1964 *Anidanthus* WANG et al. (ed.), p. 326.
1966 *Anidanthus* WATERHOUSE, p. 19.

Type species: *Linoproductus springsurensis* BOOKER, 1932.

Discussion: The diagnosis for this genus was thoroughly given by HILL (1950), MUIR-WOOD and COOPER (1960) and WATERHOUSE (1966).

STEPANOV (1934) established *Pseudomarginifera* with *Productus ussuricus* FREDERICKS, 1924 from Ussuriland as a type species. According to the author's view, the genus resembles *Anidanthus*. As a matter of fact, SARYTCHEVA, LICHAREW and SOKOLSKAJA (1960) and GOBBETT (1963) already stated a probable synonymity between *Anidanthus* and *Pseudomarginifera*. According to MUIR-WOOD and COOPER (1960), D. HILL was also of the same opinion as SARYTCHEVA et al. and GOBBETT. MUIR-WOOD and COOPER (1960) are somewhat hesitant to accept the synonymity, until the type specimen of *Productus ussuricus* FREDERICKS is fully examined and described.

WATERHOUSE (1966) states "A second problem relating to *Anidanthus* is the question of its identity or distinction from *Pseudomarginifera* STEPANOV (1934), proposed for *Productus ussuricus* FREDERICKS. In SARYTCHEVA (1960, pl. 38, figs. 3, 4) the ventral valve of *P. ussuricus* seems to have definite low concentric laminae or angular wrinkles over the posterior part of the visceral disc, unlike that of the type or other species referred to *Anidanthus*, so that though not mentioned by SARYTCHEVA, HILL or MUIR-WOOD and COOPER, this might provide a difference between the two forms."

The present author first considered that the specimen figured as *Productus ussuricus* by FREDERICKS (1924) in figure 5 of plate 1 as well as in figure 3 of plate 38 in SARYTCHEVA et al. (1960) represents an external mould of the brachial valve instead of the pedicle valve. According to SARYTCHEVA, however, the specimen of *Anidanthus ussuricus* figured as figure 3 on plate 38 (SARYTCHEVA et al., 1960) really represents a pedicle valve, but its visceral part

is destroyed and a trace of the visceral disk of the brachial valve is exposed there. Further, the absence of imbricated rugae in the other well-preserved pedicle valve of this species is ascertained by her (Dr. SARYTCHEVA, pers. comm.). Accordingly it may be safely concluded that *Pseudomarginifera* is generically synonymous with *Anidanthus*.

Anidanthus sinosus (HUANG)

Pl. 1, figs. 2, 3

1932 *Linoproductus sinosus*, HUANG, p. 43, pl. 2, figs. 15, 16.

Material: Two specimens represented by only the pedicle valve were collected by Drs. K. ISHII and M. KATO from the C bed of the Sisophon limestone, Cambodia. The surface of the valves are considerably exfoliated. Reg. nos.: UHR 19524, 19525.

Description: Shell is small in size, transverse and subrectangular in outline. Hinge-line is nearly straight and may not represent the widest part of the shell.

Pedicle valve with convex ears of moderate size is very strongly inflated in longitudinal direction. Beak is strongly enrolled over the hinge. Lateral and umbonal flanks are rather steep. A shallow but broad sulcus persists over the anterior two-thirds or three-fourths of the valve and gradually increases in its depth and width anteriorly.

Radial costellae are uniformly developed over the surface of the pedicle valve. They number 8 – 9 in 10 mm at the central part of the pedicle valve and increase in number anteriorly by both intercalation and bifurcation. Costellae are straight but round on top and separated by wider interspaces. Concentric wrinkles are faintly developed posteriorly and become more or less conspicuous on the ears and the lateral flanks.

The internal structure of the pedicle valve of the specimens at hand is unknown.

Remarks: The present species is characterized by its small-sized shell, very transverse form and strongly enrolled beak. From size and certain other characteristics, this species is closely allied to the *Anidanthus fusiformis* described by WATERHOUSE (1966) from Napal. The latter is, however, distinct from the former in completely lacking a median sulcus in the pedicle valve. Further, the pedicle valve of the Nepal species is less strongly enrolled than that of the present species.

Anidanthus ussuricus (FREDERICKS)
Pl. 1, figs. 1a – c

1924 *Productus ussuricus* FREDERICKS, p. 8, pl. 1, figs. 1 – 5.
?1967 *Anidanthus abukumaensis* YANAGISAWA, p. 89, pl. 2, fig. 16.

Material: Only a specimen represented by "Steinkern" and mould of a brachial valve. Locality: Yotsukura-cho, Fukushima Prefecture, Northeast Japan. Horizon: Upper part of the Kashiwadaira formation. Reg. no.: UHR 19523.

Description: Shell is moderate in size, subrectangular to alate in outline. Hinge-line is almost straight and nearly equal to the greatest width of the shell. There is neither fold nor sulcus in pedicle valve, which is, however, slightly flattened medially. Beak is strongly incurved and finely costellate. Interior of this valve is hardly observable.

Brachial valve is gently concave in the visceral disk, and geniculated to form a rather short trail. Frontal margin of this valve is slightly embayed medially, although neither sulcus nor fold is present. Ears are not clearly observed. The surface of the valve is uniformly covered by radial costellae numbering 7 – 8 in 5 mm near the anterior margin, in addition to several imbricating rugae developed on the visceral disk. The latter number about 8 – 9 in total. Internal characters in this valve are represented by the "Steinkern" specimen, in which brachial ridges are oval in shape and marginal ridge is low and broad. Median septum is not perfectly observable, because of ill state of preservation.

Remarks: The present species which was once selected as a type species of genus *Pseudomarginifera* by STEPANOV (1934) is closely allied to *Anidanthus fusiformis* described by WATERHOUSE (1966) from the Permian of Nepal. He concluded that the Nepal species was distinguished from the Russian species in the development of some prominent concentric rugae in the pedicle valve of the later. Further, he claimed that this might be a criterion to generically distinguish it from *Pseudomarginifera.* As stated before, the pedicle valve of the Russian species, however, seems to be wanting in such rugae. Accordingly these two species are quite similar to each other in this regard. It must be note-worthy that *A. fusiformis* is smaller than *A. ussuricus* by FREDERICKS, although this may not be a sound characteristic by which to distinguish them in specific rank.

The specimen described as *A. abukumaensis* by YANAGISAWA (1967) from the Kashiwadaira formation of the Abukuma Mountains, Northeast Japan

possibly represents an external mould of the brachial valve, although he believed it to be of a pedicle valve. The specimen may be specifically identified as either *A. ussuricus* or *fusiformis*. However, it is not preserved well enough to make specific identification.

Anidanthus sp.
Pl. 1, figs. 4a – c

Material: A single specimen preserved as "Steinkern" together with external mould of brachial valve. The locality and horizon are the same as in the preceding species. Reg. no.: UHR 19526.

Description: Shell is less transverse and subquadrate in outline. Hinge-line is almost straight and slightly shorter than the greatest width. Beak of the pedicle valve is very strongly incurved and traversed only by fine radial costellae.

Brachial valve is almost flat in the visceral disk and uniformly costellate. Concentric imbricated rugae are developed with rather wide intervals. Ears of moderate size are triangular in shape. Internally there are observable a thin and short median septum, and a low but broad marginal ridge.

Remarks: Although details of the pedicle valve are not known, less transverse brachial valve and abruptly incurved beak of the pedicle valve provide characteristic appearances to the present form. However, the available specimen is not sufficiently preserved for specific identification.

Genus *Megousia* MUIR-WOOD and COOPER, 1960

1960 *Megousia* MUIR-WOOD and COOPER, p. 309.

Type species: *Megousia auriculata* MUIR-WOOD and COOPER, 1960

Discussion: This genus was proposed by MUIR-WOOD and COOPER with *Megousia auriculata* from the Word formation of the Glass Mountains, Texas as a type species in 1960. The description of the genus was thoroughly presented at that time.

Megousia is closely related to *Anidanthus* proposed by WHITEHOUSE in 1928, having similar surface sculptures. The characteristics distinguishing

Megousia from *Anidanthus* have been mentioned by MUIR-WOOD and COOPER (1960) as follows.

"*Megousia* differs from *Anidanthus* in its more alate shell outline with greater development of ears, often forming crescentic extensions, more concave brachial valve, in the development of radial ornament on the ears and alae cutting across the concentric lamellae of remainder of the brachial valve, as well as in the internal characters, such as the difference in form and position of the adductors, less defined brachial ridges, and different cardinal process."

Among the distinct features enumerated by them, one of the most peculiar characteristics of *Megousia* seems to be represented in its ears. The ears of this genus are considerably large, often twisted and recurved anteriorly as well exemplified in the type species. In *Megousia koizumii* n. sp. from Japan they are strongly twisted to form tube-like extensions.

MUIR-WOOD and COOPER (1960) paid attention to the differences in the internal features of *Megousia* and *Anidanthus*. So far as the materials examined by the author are concerned, however, the details of cardinal process and adductors are unfortunately not well observed, since the interiors of the Japanese specimens are poorly preserved. As to brachial ridges, MUIR-WOOD and COOPER (1960) stated that they are well developed in *Anidanthus*, while less defined or obscure in *Megousia*.

Megousia auriculata MUIR-WOOD and COOPER
Pl. 2, fig. 3

1931 *Linoproductus waagenianus*, KING (non GIRTY), p. 77, pl. 17, figs. 11 – 15 only.

1960 *Megousia auriculata*, MUIR-WOOD and COOPER, p. 310, pl. 113, figs. 1 – 11.

Material: A single external mould of brachial valve from the Kanokura series developed near Kesennuma City, Miyagi Prefecture. Reg. no.: UHR 19531.

Description: Weakly concave brachial valve is small in size and almost elliptical to subrectangular in outline. Neither fold nor sulcus is observed but the frontal margin is slightly recessed medially. Surface of the valve is costellate, with overlapping concentric rugae on the visceral disk. Rugae become prominent anteriorly. Costellae number 9 – 10 in 5 mm near the anterior margin of the visceral disk. Ears are large, recurved and hang down as

crescentic extensions, and are ornamented by several radial costellae cutting across the posterior parts of the concentric rugae. Dimensions: width including ears is 12.5 mm, length 8 mm and length of each ear 6.5 mm.

Remarks: Although no pedicle valve is examined, the brachial valve from the Kitakami Mountains is quite similar to that of the holotype specimen of *Megousia auriculata* described by MUIR-WOOD and COOPER (1960) from the Word limestone of the Glass Mountains, Texas, in its size, form and ornamentation respectively. The extension of the ears in the Japanese specimen is slightly shorter than that of the holotype. However, this disagreement may not be enough to separate Japanese and American specimens into two distinct species. Further, it may be due to the breakage of the extension of the ears in Japanese specimen.

Megousia cfr. *auriculata* MUIR-WOOD and COOPER
Pl. 2, figs. 2a – b

Cfr. 1931 *Linoproductus waagenianus,* KING (non GIRTY), p. 77, pl. 17, figs. 11 – 15 only.
Cfr. 1960 *Megousia auriculata,* MUIR-WOOD and COOPER, p. 310, pl. 113, figs. 1 – 11.

Material: Only a single specimen represented by both external and internal moulds of brachial valve was obtained from the Kashiwadaira formation of the Abukuma Mountains. Reg. no.: UHR 19530.

Description: Shell is small in size and almost rectangular to alate in outline.

Brachial valve is gently concave and not geniculated. Trail is considerably short or obscure. Neither fold nor sulcus is recognizable but the front margin is slightly embayed medially. Ears are long and narrow, considerably twisted or distorted and extend almost horizontally, but do not bend down as in the holotype specimen of *M. auriculata.* Surfaces of the ears are ornamented radially. Each ear measures 8 mm long, whereas the entire width of the shell is 32 mm.

The surface of the valve is ornamented by costellae varying from 3 – 4 in 2 mm in number on the central part of the valve. They appear to be exceptionally coarse for linoproductid brachiopods and for its shell size as well. In addition to costellae, some concentric rugae numbering about 8 – 9 are developed throughout the visceral disk.

Although the interior of the brachial valve is not well preserved, the following characteristics are ascertained. The median septum is thin, becomes thicker towards the anterior developing into knife-edge at the very terminus. Moreover, it is slightly shorter than half the length of the visceral disk. Lateral ridges are short and diverging from the hinge margin. A low and broad marginal rim is developed in the brachial valve and connected with the ear baffles at each lateral side. Brachial ridges are obscure.

Remarks: The Abukuma specimen closely resembles the holotype specimen described and figured by MUIR-WOOD and COOPER in 1960 from the lower Word limestone of Texas. The ears of the former, however, extend almost horizontally or only slightly down-turned, in contrast to the latter provided with largely flapped ears. In this concern the present specimen agrees with one of the paratypes (USNM 124108d) from the same limestone as the holotype specimen.

Megousia koizumii n. sp.
Pl. 2, figs. 1, 4, 5

Material: Three individuals, all of which are preserved as impressions and moulds. A specimen designated as the holotype more or less represents characteristics of the present genus and species especially of its peculiar feature of ears, while the other two are preserved only as incomplete external moulds of the brachial valve. Reg. nos.: UHR 19527 (holotype), 19528, 19529. The locality and horizon are the same as for the preceding species.

Description: Shell is small to moderate in size, subquadrate to subrectangular in outline. Hinge with ears is almost straight and nearly equal to the greatest width of the shell.

Pedicle valve is moderately and evenly convex in longitudinal and transverse directions. There is a very shallow sulcus on the trail. The lateral margins of the trail of this valve tend to converge dorsally and then become narrower near the anterior margin. Beak is pointed and considerably incurved. Well developed ears hang down from the hinge and are strongly recurved ventrally to form opened tubiform terminus. Ears are ornamented radially similar to a fish fin. The ends of the ears are not pointed but rounded. Pedicle valve ornament is composed of radial costae or costellae varying 6 – 7 per 5 mm in number before insertion, which starts from the mid-length of the venter. After insertion, the costellae are twice as many as those before insertion. Some concentric growth-lines are

faintly developed. Although no trace of spines on the venter is indicated, two small holes representing the presence of thick spines are observed on the ears of the mould specimen.

Visceral disk of brachial valve is moderately or slightly concave and subrectangular to alate in outline. The visceral disk seems to be followed by trail with slight geniculation. Although one of the brachial valves (UHR 19528) is strongly inflected, it may be due to deformation. There is no sign of development of either sulcus or fold in this valve. The surface of this valve is covered by numerous costae or costellae which increase in number only by intercalation as in the opposite valve. Near the anterior edge of the visceral disk the valve is traversed by several prominent imbricated concentric rugae. The costellae are 7 – 8 per 5 mm in number on the visceral disk, whereas there are 11 – 13 on the trail. The rugae number 8 on the avarage.

The internal structures of both valves are not visible.

Remarks: The present new species is distinguished by its characteristic ears which are large, recurved and hung down. *Megousia koizumii* is suggestive of *Anidanthus ussuricus* (FREDERICKS), but differs from the Russian species in having a more elongate shell with peculiar ears described above and in the difference in coarseness of costellae on trail.

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Explanation of plate 1

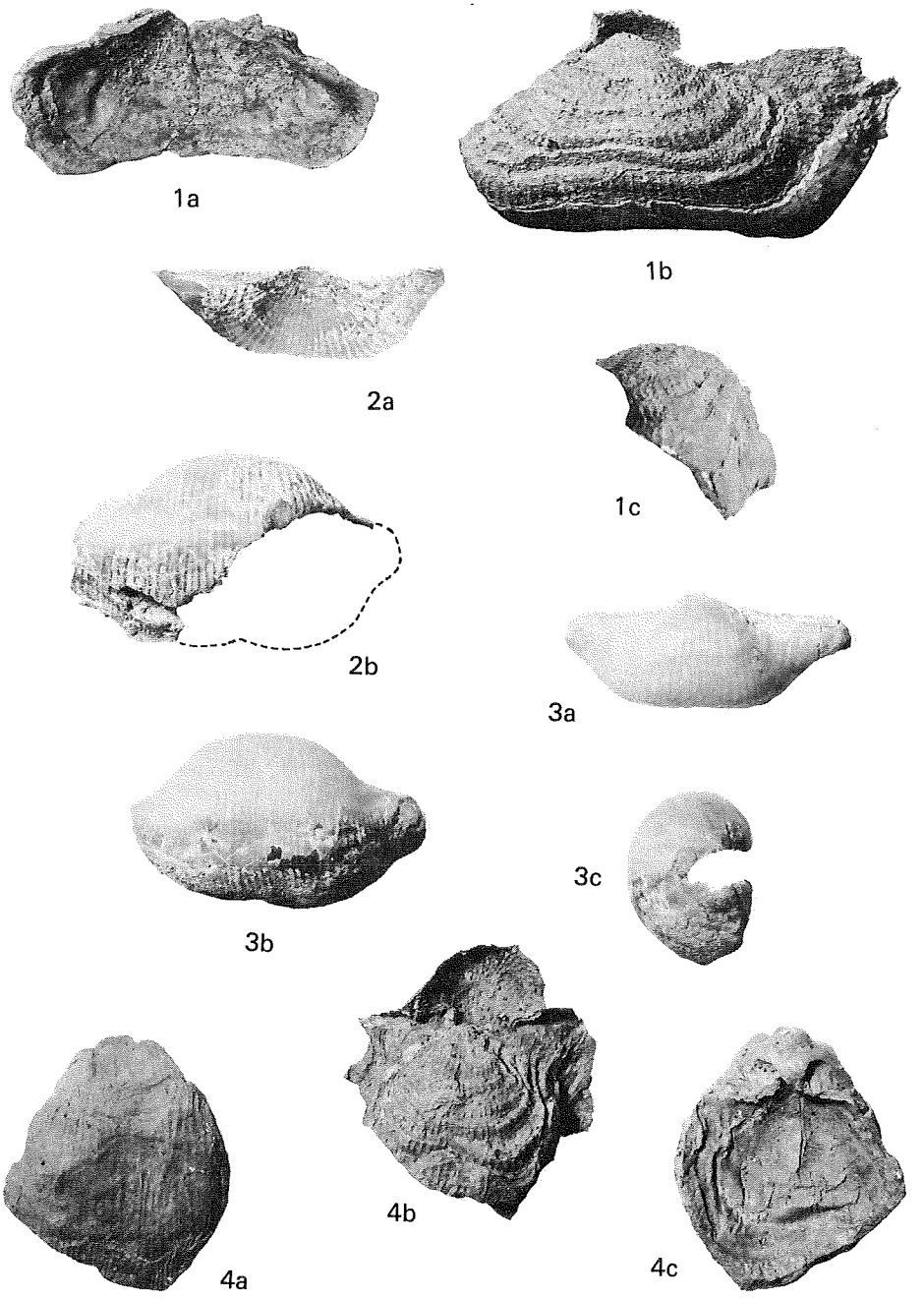
Anidanthus ussuricus (FREDERICKS)
1a. Dorsal view of "Steinkern" showing a pair of oval-shaped brachial ridges.
1b. External mould of brachial valve together with mould of apical region of pedicle valve.
1c. Lateral view of 1b.
Reg. no.: UHR 19523.
Hor. and Loc.: Upper Kashiwadaira formation at Yotsukura-cho, Fukushima Prefecture.

Anidanthus sinosus (HUANG)
2a, b. Cardinal and ventral views of one pedicle valve.
Reg. no.: UHR 19524.
3a, b, c. Cardinal, ventral and lateral views of the other pedicle valve.
Reg. no.: UHR 19525.
Hor. and Loc.: C bed of Sisophon limestone of West Cambodia.

Anidanthus sp.
4a, c. Ventral and dorsal views of "Steinkern".
4b. External mould of brachial valve together with mould of apical region of pedicle valve.
Reg. no.: UHR 19526.
Hor. and Loc.: Upper Kashiwadaira formation at Yotsukura-cho, Fukushima Prefecture.

All figures are twice natural size.

plate 1



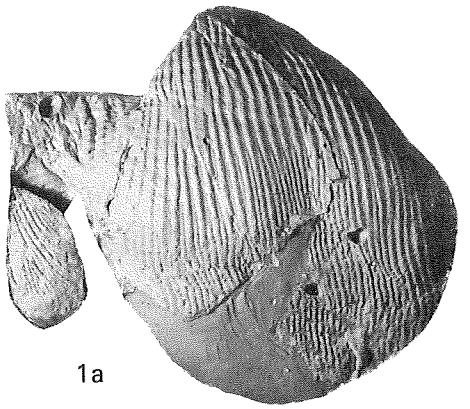
Explanation of plate 2

Megousia koizumii n. sp.
1a. Ratex cast of pedicle valve.
1b. External mould of brachial valve.
1c. Cardinal view of 1b showing imbricated concentric rugae.
Reg. no.: 19527 (holotype).
4a. External mould of brachial valve.
4b. Anterior view of brachial external mould.
Reg. no.: UHR 19528.
5. External mould of brachial valve.
Reg. no.: UHR 19529.
Hor. and Loc.: Upper Kashiwadaira formation at Yotsukura-cho, Fukushima Prefecture.

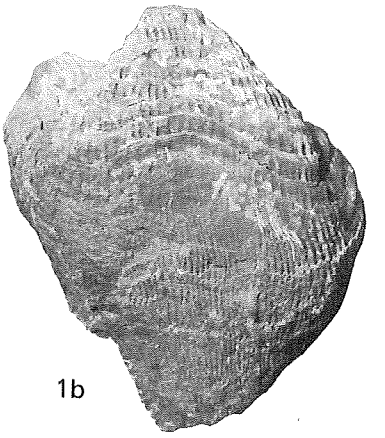
Megousia cfr. *auriculata* MUIR-WOOD and COOPER
2a, b. External and internal moulds of brachial valve.
Reg. no.: UHR 19530.
Same horizon and locality.

Megousia auriculata MUIR-WOOD and COOPER
3. External mould of brachial valve. x 3.
Reg. no.: UHR 19531.
Hor. and Loc.: Kanokura series in Kesennuma City, Miyagi Prefecture.

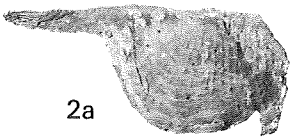
All figures except 3 are twice natural size.



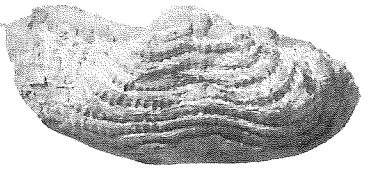
1a



1b



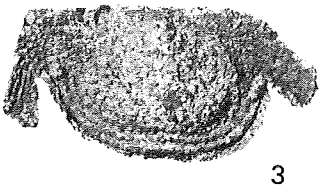
2a



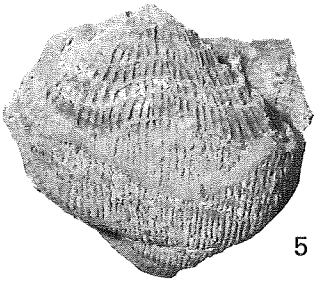
1c

2b

4a



3



5

4b