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ISOGRAMMA FROM THE PERMIAN KANOKURA SERIES OF THE KITAKAMI MOUNTAINS, JAPAN

by

Koji NAKAMURA

(with 1 table, 2 text-figures and 2 plates)

(Contribution from the Department of Geology and Mineralogy, Faculty of Science, Hokkaido University, No. 1134)

Introduction

MINATO reported, in his paper of 1955, on the occurrence of *Isogramma*, specifically identified as *I. paotechowensis* (GRABAU et CHAO) by himself, from the Middle Permian Kanokura series of the Kitakami Mountains, at Hosoo-sawa, Kamiyasse, Kesennuma City, Miyagi Prefecture, Northeast Japan.

Apart from the discovery of *Isogramma* sp. from the Lower Permian Sakamoto-sawa series of the Kitakami Mountains (MINATO et al., 1954), it was the first reliable record of *Isogramma* from the Japanese Permian. As the specimen was, however, unfavorably preserved, it was almost impossible to examine the details, especially of the internal structures of the both valves. Since then, no species belonging to this genus has been described from the Permian System developing in our country.

Two years ago, the author was successful in collecting several well-preserved materials of *Isogramma* also from the Lower Kanokura series at Imo, Yahagi-machi, Rikuzen-takada City, Iwate Prefecture, not very far from the previously known locality. As a result, it becomes possible to observe the characters of the genus more exactly. They appear to represent two distinct species; namely, *I. paotechowensis* (GRABAU et CHAO) widely distributed in the Permian of Eurasia, and the other species which may be new to science. One of the specimens once described as *I. paotechowensis* by AIGNER and HERITSCH from the *Cora* formation of the Carnic Alps in 1931 may be akin to the species newly proposed herein.

The frequency of the occurrence of the genus *Isogramma* is considerably lower in Permian than in Carboniferous. However, three species in all have been hitherto described from the Permian of Eurasia, including the species here newly introduced.

In this short note, nomenclatorial problem, specific classification, and geographic and stratigraphic distributions of the genus *Isogramma* are briefly reviewed, in addition to the descriptions of two species collected from the Kitakami Mountains.

Before going into discussion, the author is especially grateful to Prof. Masao MINATO for his warm guidance during the course of this study and reading this paper

in manuscript. His acknowledgement is also due to Dr. Makoto KATO, who read the manuscript and made many valuable suggestions.

On the genus Isogramma

Isogramma is one of the most unusual brachiopods with umbonal plate in the apical region of the pedicle valve. The present genus was erected by MEEK and WORTHEN with *Chonetes? millepunctatus* MEEK and WORTHEN as type species in 1870. Two years after the establishment of this genus, the name *Aulacorhynchus* was proposed as a genus with *Aulacorhynchus pachti* by DITTMAR in 1872 as type, but it was pointed out by BARROIS that the latter was generically synonymous with the former in 1882.

The shell of *Isogramma* is always extremely thin, fragile and punctate; and is very variable in size; for instance it is rather small in *pachti*, *ussensis*, or *licharevi*, while fairly large in *paotechowensis* as well as in *renfrarum*. The shell is almost transversely semicircular or semielliptical in outline and concavo-convex as in Producti or Choneti. The hinge-line is almost straight and nearly equal or slightly shorter than the greatest width. The most characteristic feature of this genus is a triangular, smooth and depressed area called umbonal plate in the apical region of the pedicle valve. The inner surface of this plate has been said to be functional for the attachment place of the muscles.

A cardinal area was said to be absent in the pedicle valve of American *I. millepunctatus*, but, it has been definitely shown by CHAO that his *I. paotechowensis* possesses a narrow but well marked cardinal area. Further, the presence of a cardinal area in American species was also supposed by him. On the other hand, he denied the presence of an area in the brachial valve of Chinese species. However, his miscomputation was later revised by AIGNER and HERITSCH in 1931, as well as by MINATO in 1955, and the presence of a cardinal area in the brachial valve was ascertained in *I. paotechowensis* by them. As to the other species, discussion on the presence or absence and the characters of this part have been scarcely held until the present day.

Comparatively little is known about the internal structures of this genus owing to the fragility of the shell. The cardinal process is well developed, the shaft thick and the myophore strong. The myophore is triangular in shape in *paotechowensis* or *davidsoni*, while it is rhombic or pentagonal in certain species such as *renfrarum*. The dorsal median septum is somewhat long and posterior end of that is always enclosed by bilobed anterior end of the cardinal process.

In almost all species, the surface ornamentations are composed of fine concentric lirae and minute punctures. In addition to them, strong concentric rugae or band are observed as in *germanica*, while rather weak rugae as in *heritschi* or *chernyschevi*. Moreover, both concentric rugae and radial plicae or costae are found in *paeckel-*

manni which shows most peculiar surface features among *Isogramma*-group. Although *I. germanica* closely resembles the genus *Semenovia* belonging to the Chonetida in its surface sculpture, the latter is fundamentally different from the former in the nondevelopment of the umbonal plate in the pedicle valve. On the other hand, *I. paeckelmanni* resembles in the presence of radial plicae the genus *Megapleuronia* which was first described by COOPER with type species *Productus fabianii* GRECO in 1952, but the latter can be distinguished from the former in its very thick shell substance, in having large muscular platform in the interior of the pedicle valve and in difference of the nature of radial plicae.

The systematic position of the genus *Isogramma* has been a question upon which there was much controversy for long years and unsettled yet even at present day. As previsouly mentioned, this genus is distinguished by possessing an umbonal plate. From this point of view, there is no denying fact against the present genus is most allied to *Eichwaldia* and *Dictyonella*, which are Ordovician or Silurian representatives. As a matter of fact, ROWELL (1965) has temporalily settled the systematic position of *Isogramma* and its allied genera as enumerated below:

Class Articulata
  Order Uncertain
    Suborder Dictyonellidina COOPER, 1956
      Superfamily Eichwaldiacea SCHUCHERT, 1893
        Family Eichwaldiidae SCHUCHERT, 1893
          Genus *Eichwaldia* BILLINGS, 1858
          Genus *Dictyonella* HALL, 1868
        Family Isogrammidae SCHUCHERT & LEVENE, 1929
          Genus *Isogramma* MEEK & WORTHEN, 1870
          Genus *Megapleuronia* COOPER, 1952

But certain specialist, such as GORYANSKY (1960) had a different opinion. He placed the Isogrammidae in the Articulata, while the Eichwaldiidae in the Inarticulata. In the author's opinion, the Isogrammidae and the Eichwaldiidae are not closely related in surface sculpture and shell convexity. They must be distinct to one another at least in more than family rank.

Geographic and stratigraphic distributions of Isogramma, especially in Permian Period.

The genus *Isogramma* geographically distributes both in Eurasia and North America, and stratigraphically occurs in Carboniferous to Permian.

As shown in text-figure 1 and table 1, three Permian species of *Isogramma* have been described only from Eurasia up to the present. The occurrence of *I. paotechowensis* has been recorded from the *Cora* formation with the so-called Waidegger-fauna in the Carnic Alps, from the Bryanchebrian series in the Donetz basin, the

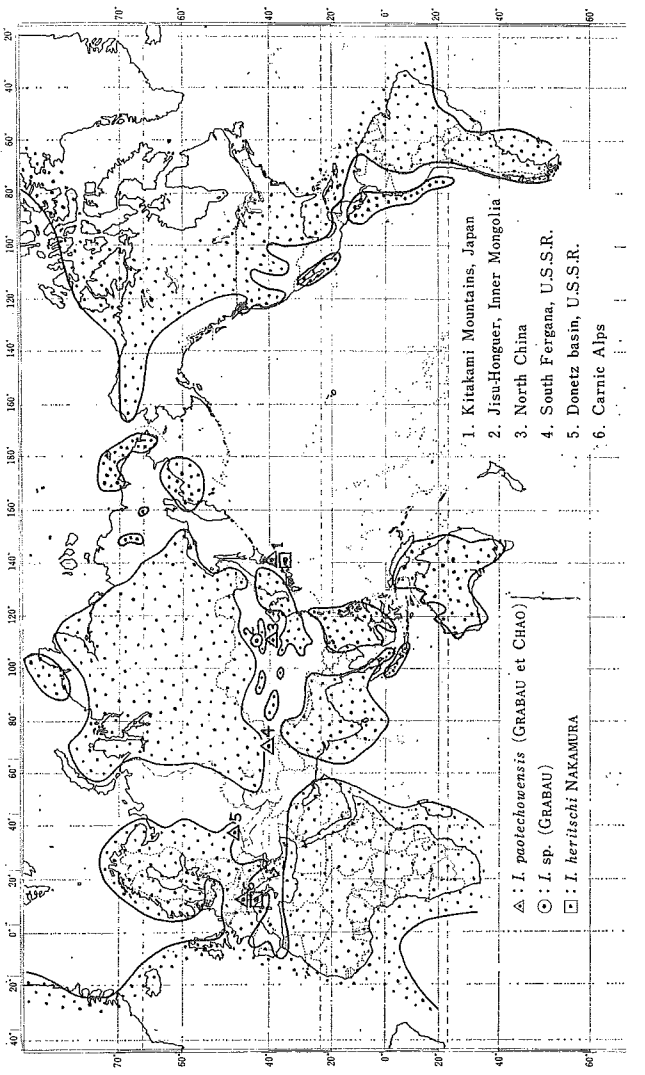


Fig. 1
Geographic distribution of the Permian *Isogramma*. (Palaeogeographic map is adopted from MINATO and KATO, 1965. Dotted area : land)

upper division of the Karachatyrian series in the southern part of Fergana, the Taiyuan series in North China and the lower Kanokura series in the Kitakami Mountains, Japan. All of these occurrences are estimated to be Asselian to Artinskian in its geologic time. Among them the Japanese specimen may be the youngest in its geologic occurrence. *I.* sp. was also once described and figured by GRABAU from the Jisu-Honguer limestone of Inner Mongolia. Now, as the third species of the Permian *Isogramma*, the discovery of *I. heritschi* are newly recorded from the

Table 1. Geographic distribution and Geologic range of species belonging to genus *Isogramma*

Species \ Geographic distribution and geologic range	Geographic distribution								Geologic range			
	Scotland	Austria	Germany	U.S.S.R.	Inner Mongolia	North China	Japan	U.S.A.	Carboniferous		Permian	
									Lower	Upper	Lower	Upper
I. pachti (DITTMAR)				×				×	—	—		
I. ussensis (DITTMAR)				×						—		
I. germanica PAECKELMANN			×	×					—	—		
I. davidsoni BARROIS		×								—		
I. sp. (DAVIDSON)	×								—			
I. millepunctata MEEK & WORTHEN								×		—		
I. paotechowensis (GRABAU & CHAO)		×		×		×	×			—	—	
I. paeckelmanni AIGNER & HERITSCH			×	×					—			
I. texanum COOPER								×		—		
I. renfrarum COOPER								×		—		
I. sp. (GRABAU)					×							—
I. licharevi AIZENVERG				×						—		
I. cheryshevi AIZENVERG				×					—			
I. heritschi NAKAMURA		×					×				—	
I. paeckelmanni donbassica AIZENVERG				×						—		
I. sp. 1 (AIZENVERG)				×					—			

Cora formation of the Carnic Alps and the Lower Kanokura series of the Kitakami Mountains.

As may be seen in the map showing the geographical distribution of *Isogramma*, all the species belong to this genus have been found only along the northern margin of the Tethys sea province, but not in any other regions, such as in South China and the Salt-Range, Pakistan, etc. in Permian Period.

The fact has been firmly established by the present study and is very deeply interesting and important in examining the problem on the palaeogeography and palaeo-faunal province in Eurasia during Permian time.

Description of species

Isogramma paotechowensis (GRABAU et CHAO)

Pl. 3, figs. 1–2; Pl. 4, figs. 1–2

1928. *Aulacorhynchus paotechowensis*, GRABAU et CHAO, p. 33, pl. 1, fig. 27; pl. 4, figs. 1–5.
1931. *Isogramma paotechowensis*, AIGNER und HERITSCH, p. 307, pl. 2, figs. 32–36; pl. 3, figs. 37–44; pl. 4, figs. 45–51; pl. 5, figs. 53, 67, 71 (excl. 52).
1936. *Isogramma paotechowensis*, METZ, p. 171, pl. 5, fig. 17.
1955. *Isogramma paotechowensis*, MINATO, p. 29, text-fig. 1.

Material: Three specimens collected from the Lower Kanokura series at Imo, Yahagi-machi, Rikuzentakada City, Iwate Prefecture. Two of them are preserved as external and internal moulds of brachial valve together with external mould of cardinal area region of pedicle valve; the other only as imperfect internal mould of brachial valve. Reg. nos.: UHR 19040, 19041, 19042.

Description: The shell is large in size for the genus, and transversely semicircular or semielliptical in outline. The width is almost double the length. The hinge-line is straight and may be nearly equal to the greatest width.

The pedicle valve is gently convex on the whole, and the greatest but not so strong convexity is located at the umbonal region. The beak is obtuse and not at all extending beyond the hinge-line. The latter is marked below by a rather low but well-defined cardinal area which is interrupted by a triangular delthyrium at the middle and ornamented with faint traces of numerous vertical lirae and minute punctures. The maximum height of the cardinal area is situated at the middle and 6 mm. in one specimen measured. Then it is gradually reducing in its height to-

wards the cardinal extremities. No median sinus is observed in this valve. The surface scupltures can be traceable in part and seem to be similar to those in the brachial valve. Other characters in the pedicle valve are scarcely observed in the specimens at hand.

The brachial valve is slightly concave in the postero-median area, and nearly flat at both lateral and anterior regions. Although no notothyrium is recognizable, the presence of dorsal cardinal area is ascertained. The interiors of the brachial valve are more or less ill preserved. There can be seen details of a median septum and a cardinal process. The latter is moderately long-shafted and the myophore is almost flat, somewhat triangular in outline and concentrically ornamented by some growth-lines. The position facing the pedicle valve is broad and rounded in front but the opposite side tapering to a blunt point. The cardinal process is connected with a median septum which extends for about two-thirds or a half of the length of the brachial valve. The median septum becomes considerably thicker in posterior portion where it represents an appearance of a club. Then, it is considerably and abruptly reduced in its thickness towards the anterior end. In one specimen at my disposal, the clubbed part occupies about one fourth of the whole median septum in length. A shallow and narrow depression in the posterior part of the median septum facing the pedicle valve is not definitely recognized, although having been clearly observed in case of almost all of the Chinese and Carnic Alpine materials.

The surfaces of both pedicle and brachial valves are concentrically marked by fine but conspicuously elevated ridges which are separated by slightly wider spaces. About ten of the concentric ridges occupy a space of 5 mm. on the central part of the brachial valve. Further, numerous punctures are concentrated in the flattened bottom of the furrows. They are rounded, closely adjoined with each other and more or less regularly disposed in two to four rows along the furrows. Ten to twelve of them are counted within the distance of 2 mm. and its diameter can be roughly estimated to be 0.15 mm. in average.

It is almost impossible exactly to estimate the measurements for the specimens now in concern, because the reconstruction of the fossils are more or less subjective.
Remarks: The present species is most allied to *Isogramma renfrarum* of American Pennsylvanian described by COOPER in 1952 from the Gonzales Shale of Texas in size and surface sculpture, but is distinguished from the latter by differences in general outline and internal structure of brachial valve. The former is constantly less transverse than the latter in form. In *paotechowensis* the cardinal process is proportionately larger and the shape of the myophore is triangular with roundness. While in *renfrarum* the size of the cardinal process is considerably smaller in proportion to its gigant shell size, and the myophore is rhombic or pentagonal in outline. Moreover, the posterior end of the median septum suddenly becomes thicker in the Eurasian species, while rather gradually increase its thickness in the American species.

Isogramma millepunctata, another American Pennsylvanian species, also strongly recalls the present species, but the latter is less transverse in form and has stronger surface ornamentations.

In almost all specific characters the Kitakami specimens at hand completely accord with those figured by CHAO from the Taiyuan series of North China, and by AIGNER and HERITSCH from the *Cora* formation of the Carnic Alps. In the latter two, however, the anterior end of the cardinal process is forked and thus there can be seen a shallow and narrow depression in the part of the shaft facing the pedicle valve. On the other hand, in Japanese specimens, such a feature is hardly recognized, presumably owing to its bad preserved condition.

Isogramma heritschi n. sp.

Pl. 4, figs. 3–7

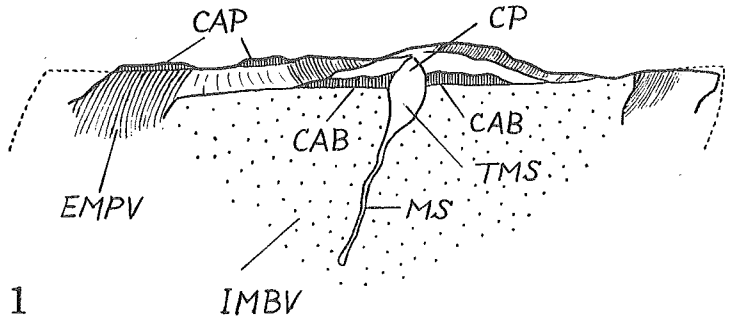
1931. *Isogramma paotechowensis*, AIGNER und HERITSCH, p. 307, pl. 5, fig. 52 only.

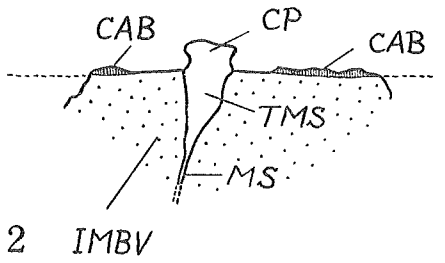
Material: Reg. nos.—UHR 19043, 19044, 19045, 19046, 19047. Holotype, UHR 19045, which is represented by external and internal moulds of brachial valve. Four other specimens referred to this species consist of external mould of pedicle valve, external and internal moulds of brachial valve respectively. The locality and the horizon of all specimens are same as in the preceding species.

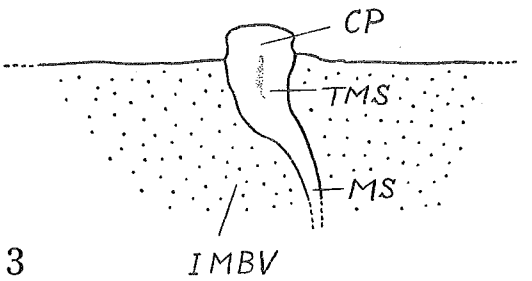
Description: The shell is medium in size and its outline is transversely semielliptical with straight posterior margin. The greatest width of the shell is about two times the length and is slightly longer than the hinge-line. The cardinal extremities are not pointed but rather obtuse.

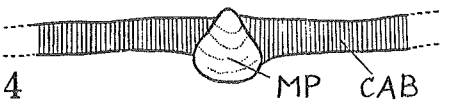
The pedicle valve is moderately convex in the postero-median region, and is otherwise nearly flat. The beak is small and slightly incurved. The pedicle valve is umbonally impressed by an elongate triangular area which is smooth, slightly depressed and divided medially by a narrow, weak ridge. This umbonal plate has an apical angle of about 20°, a length of more than 16 mm. and a maximum width of 6 mm. The presence of a cardinal area is possible, but not ascertained, owing to ill state of that part in the specimens studied here.

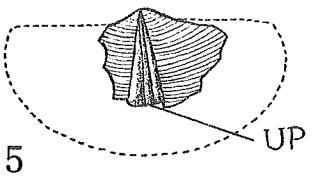
The brachial valve is gently concave on the whole, but the umbonal region is more or less strongly excavated, while the lateral and anterior regions are almost flat. Further, a very broad and shallow depression is recognized. The brachial interior with a cardinal process and a median septum is not so well observed. The cardinal process is small and any particular feature of that can not be examined.











CAB ··· Cardinal area of brachial valve
CAP ··· Cardinal area of pedicle valve
CP ····· Cardinal process
EMPV··· External mould of pedicle valve
IMBV ··· Internal mould of brachial valve
MS ····· Median septum
TMS ··· Thickening of median septum
UP ····· Umbonal plate
MP ····· Myophore

Fig. 2 Diagrammatic sketches of *Isogramma paotechowensis* (1–4) and *I. heritschi* (5). Refer each figure shown on the plates 3 and 4.
1. Features of internal structures of brachial valve and a part of apical region of pedicle valve. . . . pl. 3, fig. 1c.
2. Dorsal view of cardinal process. . . . pl. 4, fig. 2a.
3. Dorsal view of cardinal process. . . . pl. 4, fig. 1.
4. Posterior view of cardinal process and cardinal area of brachial valve. . . . pl. 3, fig. 2.
5. External surface of umbonal plate. . . . pl. 4, fig. 4.

The median septum is rather long and extends about three fourth the whole length from the hinge towards the anterior margin. It is thinly developed with almost uniform thickness and width. The whole internal surface of the brachial valve is minutely covered by numerous punctures.

The ornamentation of the external surface in the pedicle valve seems to be similar to that of the brachial valve in which it can be more clearly observed than in the former. The brachial valve is uniformly ornamented by extremely fine concentric lirae being enumerated five to seven in the distance of 1 mm. The lirae are separated by narrow spaces with the same width, on the bottoms of which many minute punctures can be traced by about ten in number within the distance of 1 mm. at the central part of the valve. Moreover, the surface is more or less regularly decorated by some weak concentric rugae which appear every 2 or 3 mm. in interval at the anterior half of the brachial valve.

Remarks : The characteristic features of this species consist in its surface sculptures with extremely fine concentric lirae and some rugae developing parallel to the shell margins.

The present species differs from the preceding one in its smaller shell dimension, more transverse outer configuration, in the development of weak concentric rugae and much finer concentric lirae, as well as in such internal characters as the differences in form of the median septum, and the cardinal process. The specimens figured by AIGNER and HERITSCH from the *Cora* formation of the Carnic Alps in 1931 (pl. 2, figs. 32–36 ; pl. 3, figs, 37–44 ; pl. 4, figs. 45–51 ; pl. 5, figs. 52–53, 67 and 71) as *Isogramma paotechowensis* (GRABAU et CHAO) seem to represent two distinct species. One (pl. 5, fig. 52) is small in size and evidently having some concentric rugae. Accordingly it may not be specifically identified with *I. paotechowensis* but may be cospecific with the present species here newly proposed.

References

AIGNER, G. und HERITSCH, F. (1931): Das Genus *Isogramma* im Carbon der Südalpen. Denkschr. Akad. Wiss. Wien. Nath.-Naturwiss. Kl., Bd. 102.

AIZENVERG, D. E. et al. (1963): Stratigraphy of the Carboniferous deposits in the Donetz Basin. (in Russian) Acad. Sci. Ukrainian S.S.R., Inst. Geol. series on Stratigraphy and Palaeontology, Bull. 37.

AIZENVERG, D. E. (1964): Representatives of the genus *Isogramma* MEEK and WORTHEN from the Lower Carboniferous of the Donetz Basin and Ukraine, S.S.R. (in Russian) Acad. Sci. Ukrainian S.S.R., Inst. Geol. series on Stratigraphy and Palaeontology, Bull. 48.

CHAO, Y. T. (1928): Productidae of China, pt. 2. Chonetinae, Productinae and Richthofeninae. Palaeont. Sinica, ser. B, vol. 5, fasc. 3.

COOPER, G. A. (1952): Unusual specimens of the brachiopod family Isogrammidae. Jour. Paleont., vol. 26, no. 1.

DAVIDSON, T. (1862): A monograph of the British Carboniferous brachiopoda, vol. 5. Palaeont. Soc., vol. 14.

DAVIDSON, T. (1884): A monograph of the British fossil brachiopoda, vol. 5, pt. 3. Palaeont. Soc. vol., 38.

GORYANSKY, V. YU. (1960): Inarticulata, in Основы Палеонтологии, Мшанки, Брахиоподы.

GRABAU, A. W. (1931): The Permian of Mongolia. Nat. Hist. Central Asia, vol. 4.

LICHAREW, B. K. (ed.) (1966): Permian System, Stratigraphy of S.S.S.R. (in Russian)

METZ, K. (1936): Eine Fauna aus den untersten Schichten des Oberkarbons der Karnischen Alpen (Waidegger Fauna). Neues Jb. f. Miner. Geol. Paläont., Beil. Bd. 75.

MINATO, M. et al. (1954): Zur Biostratigraphie der Permischen Formation des Setamai-Geländes in Süd-Kitakami-Gebirge. Jour. Geol. Soc. Japan, vol. 60.

MINATO, M. (1955): *Isogramma paotechowensis* (GRABAU et CHAO) from the Permian of Japan. Trans. Proc. Palaeont. Soc. Japan, N.S., no. 18.

MINATO, M., KATO, M. and HASEGAWA, Y. (1964): A note on the boundary between *Pseudofusulina* and *Parafusulina* zones in Japan. Proc. Japan Acad., vol. 40, no. 10.

MINATO, M. and KATO, M. (1965): Durhaminidae (Tetracoral). Jour. Fac. Sci. Hokkaido Univ., ser. IV, vol. 13, no. 1.

PAECKELMANN, W. (1930): Die Brachiopoden des deutschen Unterkarbons, pt. 1. Abhandl. d. Preuss. Geol. Landesanst., N. F., Heft 122.

ROWELL, A. J. (1965): Dictyonellidina in R. C. MOORE (ed.). Treatise on Invertebrate Paleontology, pt. H. Brachiopoda.

SARYCHEVA, T. G., LICHAREW, B. K. and SOKOLSKAJA, A. N. (1960): Productida in Основы Палеонтологии, Мшанки, Брахиоподы.

SEMENOW, P. (1854): Ueber die Fossilien des Schlesischen Kohlen-Kalkes. Zeitschr. deutsch. geol. Gesellsch., Bd. VI.

(Manuscript received on 21 May, 1969)

PLATE 3 AND EXPLANATION

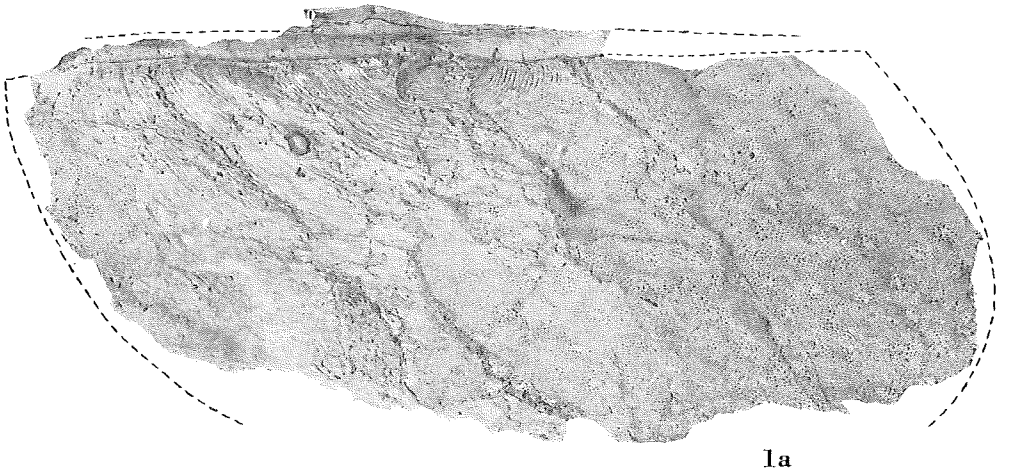
Explanation of Plate 3

Isogramma paotechowensis (GRABAU et CHAO)

1a. External mould of brachial valve together with mould of cardinal area of pedicle valve. Most surface of valve is covered with bryozoan fossils.
1b. Ratex cast of a part of fig. 1a. Boundary between cardinal area and delthyrium is made visible with whitening.
1c. Internal mould of brachial valve.
Reg. no. UHR 19040.
2. Posterior view of ratex cast of fig. 1 on plate 4. Myophore and area of brachial valve are clearly shown.
Reg. no. UHR 19041.

All specimens from the Lower Kanokura series at Imo, Yahagi-machi, Rikuzen-takada City, Iwate Prefecture.

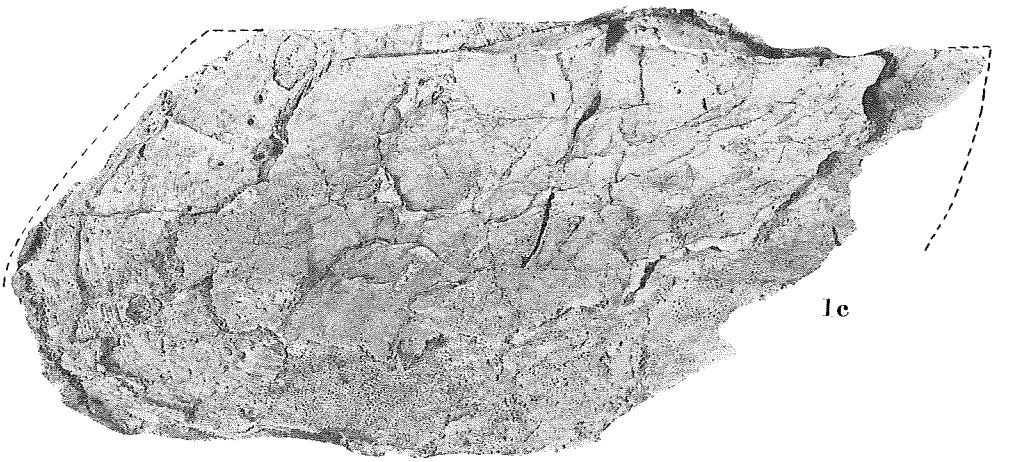
Plate 3



1a

1b

2



1c

PLATE 4 AND EXPLANATION

Explanation of Plate 4

Isogramma paotechowensis (GRABAU et CHAO)

1. Ratex cast of brachial interior. Dorsal view of cardinal process is observed.
   Reg. no. UHR 19041.
2a. Internal mould of brachial valve.
2b. External mould of the same valve.
   Reg. no. UHR 19042.

Isogramma heritschi n. sp.

3. Ratex cast of pedicle valve.
   Reg. no. UHR 19043.
4. Ratex cast of pedicle valve in other specimen. Feature of umbonal plate is more clearly shown.
   Reg. no. UHR 19044.
5a. Internal mould of brachial valve.
5b. External mould of the same valve.
   Reg. no. UHR 19045.
6. Internal mould of brachial valve.
   Reg. no. UHR 19046.
7. External mould of brachial valve in other larger specimen.
   Reg. no. UHR 19047.

All specimens were collected from the Lower Kanokura series at Imo.

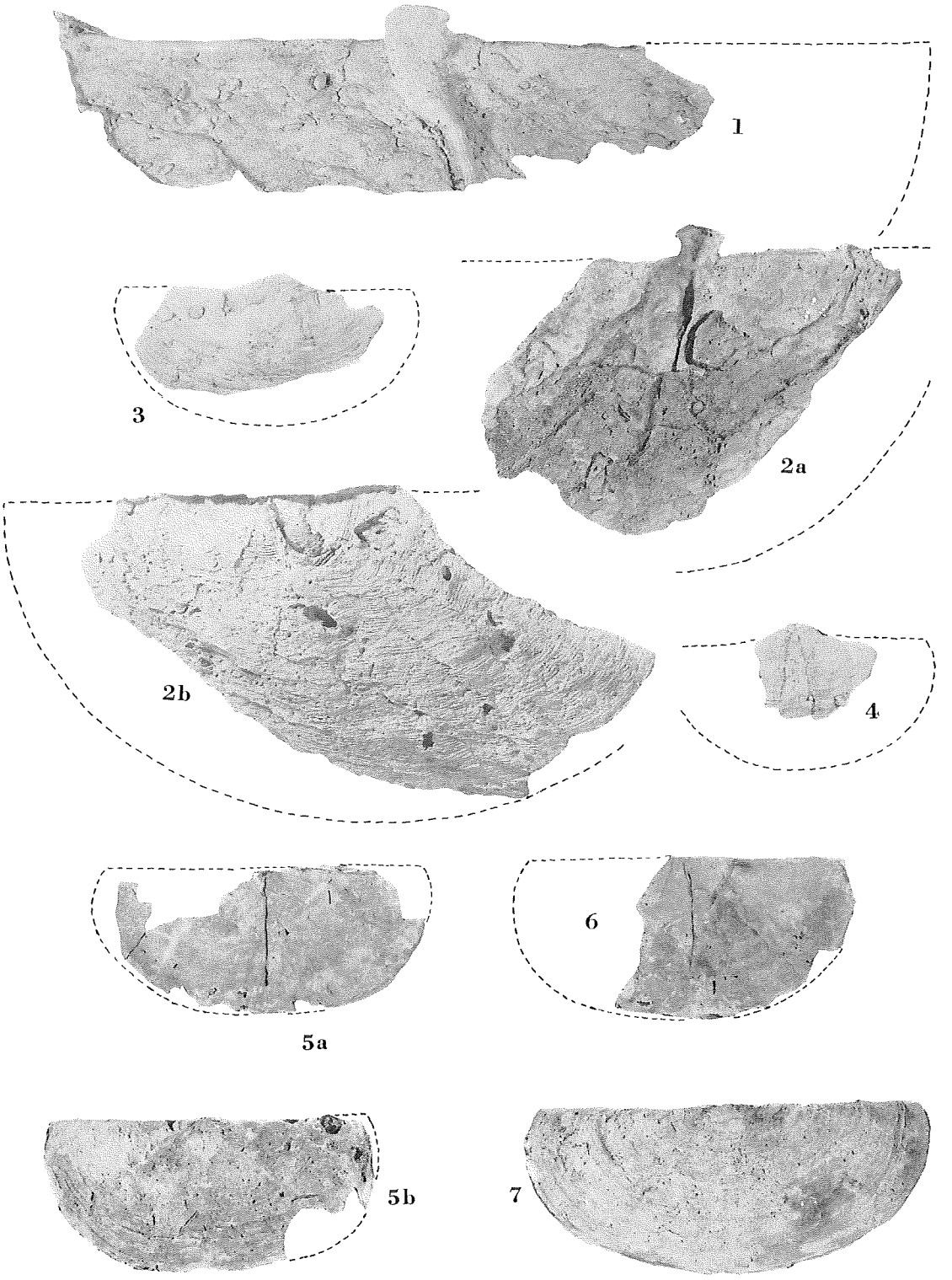



Plate 4