A FURTHER NOTE ON THE LOWER CARBONIFEROUS FOSSILS OF THE KITAKAMI MOUNTAINLAND, NORTHEAST JAPAN

By

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(With 1 Figure and 10 Plates)

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Introduction

The Carboniferous formations in the Kitakami Mountainland have been known for a long time. Some fossils also, especially corals contained in these formations, were studied by H. YABE and I. HAYASAKA[1] as early as in 1915. But since then no noticeable progress had been made in the knowledge of the formations either in stratigraphy and paleontology until Y. ONUKI[2] carried out a detailed study of Southern Kitakami Mountainland, where Palaeozoic formations are well developed. The results of his field survey and palaeontological study appeared in 1937, in which he summarized the stratigraphical order of the Carboniferous deposits in this area as follows:

Fusulinella Zone
Kueichouphyllum Zone
Lophophyllum Zone

T. SUGIYAMA[3] who succeeded ONUKI in the study of Kitakami Geology came to the conclusion that the part of the formation under the *Kueichouphyllum* zone has to be divided into two series in the Hikoroiti-mura district, namely, the Tyoanji and Ohmori series, the former, according to him, being the lowest member of the Lower Carboniferous of Japan, and the latter probably the Upper Devonian. To our great regret, however, much expected studies of SUGIYAMA suddenly came to an end by his too early decease. Except for a short summary[4] report

on the stratigraphy and a note on the discovery of *Conularia* from Tyoanji series,[5] no account on the detailes of his extended studies has been left printed.

It is in 1938 that the writer began his study on the Palaeozoic formations in the Kitakami Mountainland, under the leadership of the late Prof. Dr. T. NAGAO. I have been able to establish the stratigraphical order of the Lower Carboniferous deposits in the Setamai-mura district some 9km, westward of the Hikoroiti-mura, where ONUKI and SUGIYAMA engaged in the study of the Lower Carboniferous succession. A series of papers concerning in the Carboniferous stratigraphy and palaeontology[6] have been issued already and a brief summary of these was published in German language a short time ago.[7]

His Ohdaira as well as Arisu Series, were been not known, at least on the basis of palaeontological evidences, in the Hikoroiti-mura district,[8] while the lower half of the writer's Hikoroiti Series was considered to almost correspond to the Tyoanji Series of SUGIYAMA. Namely, in the Hikoroiti-mura district, Onimaru Series lies apparently above the Tyoanji series, and nowhere we see such thick formations as Ohdaira- and Arisu-Series between them and this seems to represent an unconformity above the Onimaru Series. The presence of an unconformity and stratigraphical break under the base of the Onimaru Series was previously clearly proved by the writer in the Setamai-district several years ago.[9] The same stratigraphical condition may well be expected in the Hikoroiti-mura between the Onimaru and Tyoanji Series, lacking therein the major part of the Ohdaira and Arisu Series.

The writer has been in suspicion on SUGIYAMA'S notion that his Ohmori Series is stratigraphically lower than the Tyoanji. The writer collected various kinds of fossils from the type locality of the Ohmori Series all representing the Lower Carboniferous type, without any Devonian element, in association. The noteworthy among them are *Actinocrinus ohmoriensis*, *A. higuchisawaensis*, *Spirifer ohmoriensis*, *Kitakamithyris semicircularis* and *Leptaena analoga*, of which the last mentioned two being also found in the collection from the Tyoanji Series at its type locality.

Besides, the similarity in the succession of beds and lithological characters between the Tyoanji Series at Tyoanji and Ohmori Series at Ohmori has always been an attractive feature to the writer.

Meanwhile, OKUBO[10] following the steps of SUGIYAMA in the field survey around Hikoroiti-mura, came the same conclusion as the writer concerning the stratigraphical position of the Ohmori Series. After

careful study of the Carboniferous formations in the said area, he claimed the Ohmori-Series to be wholy in a complete stratigraphical equivalent of the Tyoanji Series at Tyoanji. At the same time OKUBO[11] materially realized the unconformable relation between the Tyoanji (=Ohmori) series (—the lower half of the Hikoroiti Series of the writer) and the underlieing formations.

As far as the present knowledge goes, the Hikoroiti Series is relatively widely distributed in the Southern part of the Kitakami Mountainland, viz, in the western part, the Itinoseki-Nagasaka region, this series lies above the Upper Devonian formation of the Tobigamori[12] Series, containing such fossils as *Spirifer verneuili* in a wider sense, *Chonetes hardrensis* PHILLIPS, *Rhynchonella pleurodon* PHILLIPS, *Cammarotoechia* sp, together with such plant remains as[13] *Leptophloeum* cf. *australe* (McCOY) and *Cyclostigma* sp.; in the Setamai-Arisu-district, in the central part of the Southern Kitakami Mountainland, also, this series is widely traceable in the regions of Ohmata, Kasiwari, Hinozuti, and Okuhinozuti, but the stratigraphical relation between it and the underlieing formations is as yet not well founded. While in the Hikoroiti-mura district, in the eastern part of the Southern Kitakami Mountainland it lies unconformably above the Lowest Upper Devonian or the uppermost of the Middle Devonian formations, as before mentioned, without accompanying the Tobigamori-Series.

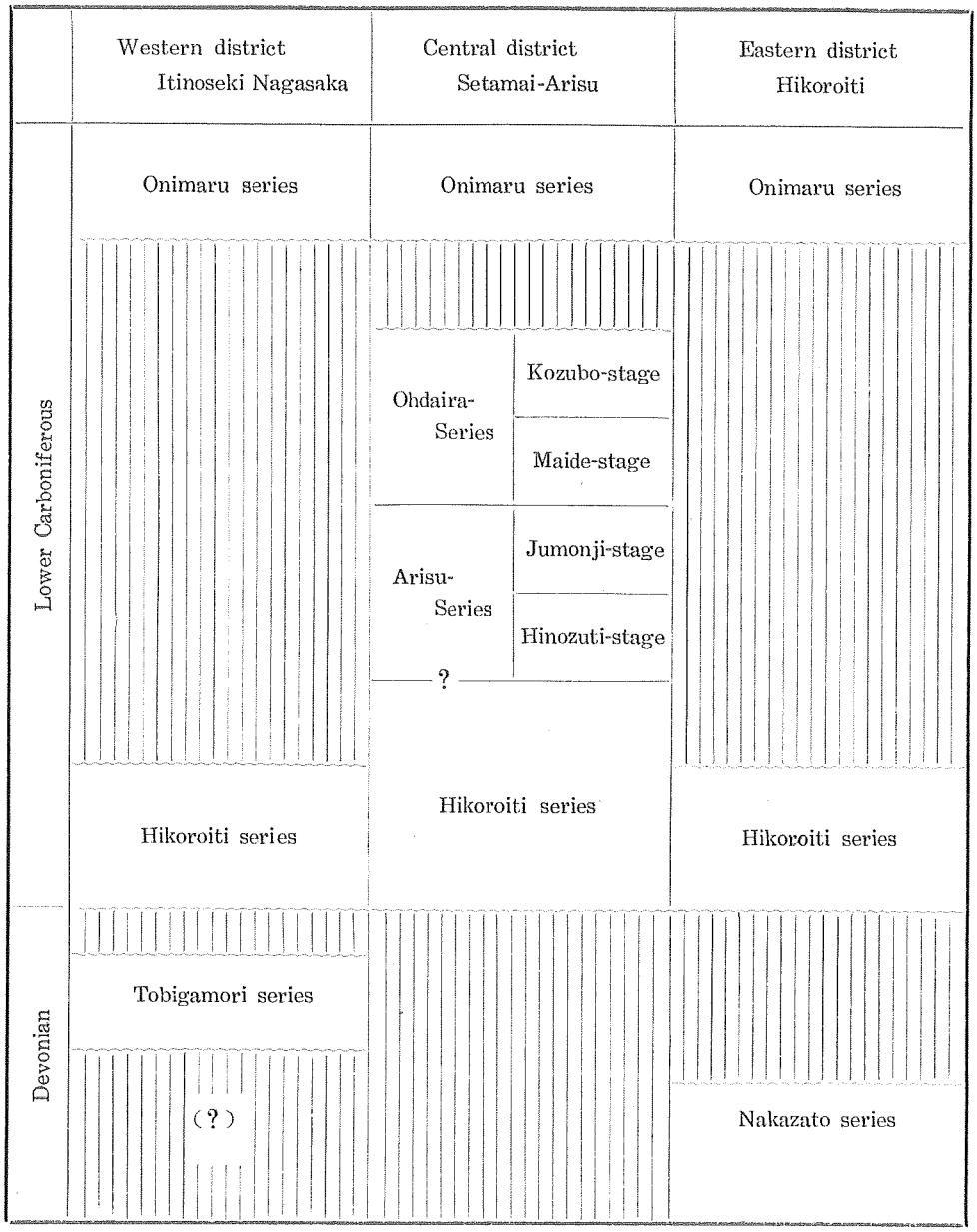
Although the stratigraphical relation between the Hikoroiti and Arisu Series is not settled at present, nowhere we find the Arisu Series immediately lies above the Hikoroiti Series.

The Arisu Series is divisible into two stages from lithological nature and fossil contents, namely the Hinozuti and the Jumonji stages. And the Ohdaira Series is also separated into two parts; the lower is the Maide stage and the Upper the Kozubo: all of these stages are quite richly fossiliferous.

The Onimaru Series is relatively widely distributed throughout the Southern Kitakami Mountainland, consisting mainly of limestones and alternating beds of slates and limestones; it is very fossiliferous.

The Lower Carboniferous deposits above mentioned are overlain also by those of the Nagaiwa Series with *Fusulinella* fauna, which in turn is covered unconformably by the Sakamotosawa Series of the Lower Permian. The relation between the Nagaiwa Series and the Onimaru is not as yet clearly known, although it may also be unconformable as H. YABE suggested before.

Lower Carboniferous of the Kitakami Mountainland



Up to present the Lower Carboniferous formations of the Kitakami region have been seldom investigated palaeontologically. From Onimaru Series YABE and HAYASAKA[14] described several corals in 1915 without illustrating them: they are

Diphyphyllum flexuosum YABE et HAYASAKA
Siphonodendron pseudomartini (YABE et HAYASAKA)
Stylidophyllum japonica (YABE et HAYASAKA)

About thirty years later YABE and SUGIYAMA[15] added the following corals in the faunule of the Onimaru Series:

Heterophyllia kitakamiensis YABE et SUGIYAMA
Heterophyllia elegans YABE et SUGIYAMA
Hexaphyllia japonica YABE et SUGIYAMA
Hexaphyllia sp.

And the Writer[16] described the following species in 1943 from the same series, including species formerly made known by YABE and HAYASAKA, namely,

Cyathophyllum sp.
Dibunophyllum yiii MIMATO
Dibunophyllum bristolense GARWOOD et GOODYEAR
Dibunophyllum inugasirayamensis MINATO
D. sp. a
D. sp. b
Setamainella hayasakai MINATO
Rhodophyllum yokoyamai MINATO
Rhodophyllum sugiyamai MINATO
Siphonodendron inugasirayamensis MINATO
Siphonodendron pseudomartini (YABE et HAYASAKA)
Siphonodendron aff. *martini* (EDWARDS et HAIME)
Siphonodendron sp.
Caninia juddi (THOMSON) var. *ozawai* MIMATO
Dorlodottia sp.
Kueichouphyllum yabei MINATO
Kueichouphyllum yabei var. a
Kueichouphyllum yabei var. b
Pseudocaninia sp.

Besides, YABE and the writer described one species of *Amygdalophyllum*,[17] and NAGAO and the WRITER[18] reported the occurrence of *Yuanophyllum* in this Series: The species are

Amygdalophyllum kitakamiensi YABE et MINATO
Yuanophyllum yabei NAGAO and Minato

while the occurence of foraminiferal remains[19] such as

Saccaminopsis cartei (BRADY)
Mirellella sp.

were made known by YABE and the writer from the same formation.

From Kozubo stage, only a peculiar coral,

Sugiyamaella carbonarium YABE et MINATO

was described by YABE and the writer,[20] while from Maide stage

Brachythyris aff. *pinguis* (SOWERBY)
Brachythyrina nagaoi MINATO
Productus sp.
Phillipsia ? sp.

were described by the writer.[21]

From Jumonji stage the following braciopods and echinoids were described by the writer in the paper previously published in this[22] journal:

Fusella nipponotrigonalis MINATO
Syringothyris jumonjiensis MINATO
Syringothyris transversa MINATO
Cliothyridina royssii (L'EVILLE)
Actinoconchus cf. *lamellosa* (L'EVILLE)
Platycrinus asiatica MIMATO
Blastoidea gen. et sp. indet.

The Hinozuti stage is also fossiliferous but as yet investigated. From the Hikoroiti Series, SUGIYAMA[23] once made known the occurrence of a *Conularia* and two trilobita[24] which are:

Conularia tyoanjiensis SUGIYAMA
Palaeophillipsia japonica SUGIYAMA and OKANO
Palaeophillipsia ? *kitakamiensis* SUGIYAMA and OKANO

while OKUBO[25] recently discovered a trilobita

Phillipsia ohmoriensis OKUBO

The writer also described several brachiopods and other fossils: in a previous paper appered in this[26] journal: they are

Actinocrinus higuchisawaensis MIMATO
Actinocrinus ohmoriensis MIMATO

Amphoracrinus sp.
Leptaena analoga (PHILLIPS)
Leptaena convexa WELLER
Leptaena cf. *convexa* WELLER
Schellwienella izirii MINATO
Schellwienella ? sp.
Planoproductus gigantoides MINATO
Productella aff. *caperata* (SOWERBY)
Spirifer cf. *logani* HALL
Brachythyris kitakamiensis MINATO
Brachythyris ? sp.
Kitakamithyris tyoanjiensis MINATO
Kitakamithyris hikoroitiensis MINATO
Actinoconchus planosulcata (PHILLIPS)

In this note the writer intends to describe the following species yeilded from the Lower Carboniferous deposits of Southern part of the Kitakami Mountainland, including those that have previously reported and the others that have not been known.

From Onimaru Series:

Palaeosmilia kitakamiensis MINATO, sp. nov.

From Kuzubo Stage:

Sugiyamaella carbonarium YABE et MINATO
Pustula sp.

From Maide Stage:

Amplexus nipponensis OISHI et. MINATO, sp. nov.
Syringopora sp.
Cyathophylloid coral

From Jumonji Stage:

Schizophoria resupinata (MARTIN)
Crthotetes keokuk (HALL)
Orthotetes sp.
Derbyia depressa DEMANET var. *transversa* MINATO, var. nov.
Pustula cf. *tenuipustulata* THOMAS
Spirifer kozuboensis MINATO, sp. nov.
Fusella nipponotrigonalis MINATO
Fusella nipponotrigonalis MINATO var. *minor* MINATO var. n.
Syringothyris kitakamiensis MINATO, sp. nov.
Syringothyris sp.

Syringothyris transversa MINATO
Plicatosyrinx singulare MINATO, gen. et. sp. nov.
Plicatosyrinx ? *kumanoi* MINATO, sp. nov.
Kitakamithyris semicircularis MINATO, sp. nov.
Cliothyridina royssii (L'EVILLE)
Actinoconchus lamellosa (L'EVILLE)
Amplexus ? sp.

From Hikoroiti Series:

Spirifer ultratransversa MINATO sp. nov.
Spirifer ohmoriensis MINATO, sp. nov.
Spiriferina paratransversa MINATO, sp. nov.
Delthyris aff. *clarksvilensis* (WINCHEL)
Delthyris sp.
Kitakamithyris tyoanjiensis MINATO
Kitakamithyris hikoroitiensis MINATO
Kitakamithyris ? sp.
Actinoconchus planosulcata (PHILLIPS)

This note is by no means the complete outcome of the study concerning the Lower Carboniferous of the Kitakami Mountainland. The detailed description on stratigraphy accampanied by a geological map in 1/5000, and the descriptions of all the fossils collected until up to present, is under preparation to be published as soon as the printing conditions are improved.

In carrying out this study the writer has experienced difficulties arising, on the one hand, from the very unfavourable state of preservation of the fossils in general, being strongly deformed owing to crustal pressure, and, on the other hand from the lack of certain important reference works near at hand. The identification of certain species in this note, therfore, may have to be regarded rather provisional. Notwithstanding, the writer publish this note in this form, with the hope of contributing something to our extremely poor knowledge on the Lower Carboniferous palaeontology of Japan. As to the taxonomic identification of those fossils dealt with in this note the writer can not but expect kind criticism and discussions by the colleagues concerned with the palaeontology and stratigraphy of the Carboniferous.

On the basis of data available at present, the writer is disposed to draw the following conclusion as to the biostratigraphical correlation of the succeeding series of the Carboniferous formation of the Kitakami

Mountainland; namely, the Onimaru series may be almost equivalent to the Upper Viséan of Europe and the *Yuanophyllum* zone of Southern China; the Hikoroiti series to the Etroeungtian or Lowest Tournaisian; the succession from the Arisu series to the Ohdaira to that including the Tournaisian and Lower Viséan.

The writer likes in this place to refer to the fact that the coral fauna of the Onimaru series is closlely related to that of Southern China, suggesting that the two faunas belonged to one and same palaeozoological province. It is interesting and important, however, that the fanule from the horizones below the Onimaru series does not show any symptom of an intimate relation with that of Southern China.

It is an open question with what ocean the Kitakami basin was in free communication during the early stages of the Lower Carboniferous.

The writer takes this opportunity to express his warmest thanks to Profs. J. SUZUKI and I. HAYASAKA for their earnest encouragement given to him during the course of this study. Especially Prof. HAYASAKA take the trouble of kindly reading the manuscript and criticising the work. Thanks are also due to Messrs H. TAKEDA, N. KIMURA, Y. SUZUKI, K. YAMADA, H. KAKIMI and H. SUETOMI who collaborated with the writer in his recent field works, and helped him collect fossils. For preparing illustrations of this paper the writer greately owes to Mr. S. KUMANO who provided photographs of specimens and last but not the least to the writer's wife (CHIYOKO MINATO) who willingly helped him by making sketches of those specimens photography can not give better effect.

References

1) H. YABE and I. HAYASAKA: Palaeozoic corals from Japan, Korea and China, Jour. Geol. Soc. Japan, vol. 22-23, **1915-1916.**
2) Y. ONUKI: On the Palaeozoic formation near Sakamotosawa, Kitakami Mountainland, (in Japanese) Jour. Geol. Soc. Japan, vol. 44, **1937.**
3) T. SUGIYAMA: On the Japanese Trilobites, (in Japanese), Studies from the Geological and Mineralogical Institute, Tokyo Bunrika Daigaku, no. 1. **1944.**
4) T. SUGIYAMA: Stratigraphy and palaeontological studies of the Gotlandian deposits of the Kitakami Mountainland. Sci. Rep. Tohoku Imp. Univ. 2nd ser. (Geol.) vol. 36, **1942.**
5) T. SUGIYAMA: A new Lower Carboniferous Conularia from the Kitakami Mountainland. Jour. Geol. Soc. Japan, vol. 45, **1938.**
6) M. Minato: On the Lower Carboniferous deposits at Setamai, Kesen-gori, Iwate Prefecture, (in Japanese). Jour. Geol. Soc. Japan vol. 48. **1941.**

M. Minato : Phasenanalyse der Gebirgebildungen der palaeozoischen Aera im Kitakami-gebirge. Jour. Geol. and Geography of Japan, vol. 19, **1944.**

7) M. Minato : Zur Orogenese und zum Vulkanismus in jungeren Palaeozoikum des Kitakami-Gebirges, Honshu, Japan. Jour. Faculty of Sci. Hokkaido Univ. Ser. IV, vol. 7, **1950.**

8) M. Minato : Stratigraphische Stellung der Hikoroiti-Serie (in Japanese with German resume) Jour. Geol. Soc. Japan vol. 56, **1950.**

9) M. Minato : Die Transgression der Ober-Vise-Stufe im Kitakami-Gebirge, Japan, Proc. Imp. Acad. Tokyo, vol. 20, **1944.**

10) M. Okubo : On the Gotlandian and Devonian deposits of Hikoroiti, Kesendistrict, (in Japanese with English reseume) Jour. Geol. Soc. Japan vol. 56. **1950.**

11) M. Okubo : Zur Hikoroiti-Serie und der bedeuntenden Diskordanz vor der Hikoroichi-Epoche (in Japanese with German resume) Jour. Geol. Soc. Japan vol. 57, **1951.**

12) H. Yabe and M. Noda : On the discovery of *Spirifer verneuili* Murchison in Japan. Proc. Imp. Acad. Japan vol. 9, **1933.**

13) K. Tachibana : Devonian plants first discovered in Japan. Proc. Japan Acad. vol. 26, **1950.**

14) H. Yabe and I. Hayasaka : **1915–1916.**

15) H. Yabe and Y. Sugiyama : Discovery of Hexaphyllia in the Lower Carboniferous of Japan. Jour. Geol. Soc. Japan vol. 46, **1939** ; Notes on *Heterophyllia* and *Hexaphyllia.* Jour. Geol. Soc. Japan, vol. 47, **1940.**

16) M. Minato : New forms of *Kueichouphyllum* from the Lower Carboniferous Coral limestone of the Kitakami Mountainland, etc. Jour. Sigenkagaku Kenkyusyo. vol. 1, no. 1, **1943.**

M. Minato : On some Upper Visean Coral fauna from the Coral limestone of the Kitakami Mountainland, etc. Jour. Sigenkagaku Kenkyusyo, vol. 1, no. 2, **1943.**

17) H. Yabe and M. Minato : *Amygdalophyllum* from the Lower Carboniferous of the Kitakami Mountainland, North-east Honsyu, Japan. Proc. Japan Acad. vol. 22, **1946.**

18) T. Nagano and M. Minato : An interesting coral from the Lower Carboniferous of the Kitakami district, Japan. Jour. Fac. Science, Hokkaido Imp. Univ. ser. IV, vol. VI, **1941**

19) H. Yabe : The zone of *Millerella* in Japan. Proc. Japan Academy, vol. 25, **1945.**

20) H. Yabe und M. Minato : *Sugiyamaella carbonarium* Yabe et Minato, Gen. et Sp. nov. aus den unterkarbonischen Ablagerungen des Kitakami-Gebirges. Jour. Geol. Geogr. Japan, vol. 19, **1944.**

21) M. Minato : On the Lower Carboniferous fossils of the Kitakami Massif, Northeast Honsyu, Japan. Jour. Faculty of Science, Hokkaido Univ., Ser, IV, vol. VII, **1951.**

22) M. Minato : ibid, **1951.**

23) T. Sugiyama : **1938.**

24) T. Sugiyama : **1944.**

25) M. Okubo : On Japanese Trilobita (in Japanese), Earth Science (Chikyu Kagaku) no. 4, **1951.**

26) M. Minato : **1951.**

DESCRIPTION OF SPECIES

Class Anthozoa
Order Tetracoralla HAECKEL
Family Zaphrentidae M. EDWARDS and J. HAIME
Genus *Amplexus* SOWERBY, 1814.

Considerable number of specimens of solitary corals are in the writer's collection. They are somewhat unsatisfactorily preserved, often strongly deformed. But there are among them forms that no doubt belong to the genus *Amplexus*, and the majority of specimens represent a new species to which *Amplexus nipponesis* was given by OISHI and the writer sometime ago.[1]

Amplexus nipponensis OISHI et MIMATO sp. nov.

Pl. 2, figs. 1, 4, 5, 8, 10, 11, 13, 14; Pl. 4, figs. 1, 2, 3, 5–24.

External features: Corallum simple, generaly cylindrical or rarely almost ceratoid in form. The holotype (Pl. 2, fig. 4), missing proximal and distal ends, measures at least 7.8 cm. in length and 1.7 cm. in diameter, covered externally by epitheca with fine longitudinal, parallel striae. Periodic invagination, a characteristic feature of most species of *Amplexus* clearly observable. In the holotype, expansion appears to occur at every ca. 6 mm.

Internal features: In transverse section walls and septa fairly thick, much strengthed by stereoplasmic deposits. About 36 (33–37) major septa alternating with the same number of minor ones. In a younger stage, 9 mm across. Major septa count 26. They are almost half as long as radius of the corallites or less; the minor ones almost rudimentary. Dissepiments none. Fossulae obscure, seldom clearly recognized. In central area, sometimes edges of tabulae (Pl. 4, fig. 6a) recognized to form an imperfect ring.

In longitudinal section tabulae slightly thinner than wall, and appear almost horizontal and complete.

Remarks: It is believed that the genus *Amplexus* ranges from the Silurian to the Permian, and therefore, is likely a polyphyletic genus.[2]

1) This species was studied by late Prof. Dr. S. OISHI and me; maunscripts were prepared as early as 1940.

2) A. W. GRABAU: Palaeozoic corals of China, Palaeontologia Sinica, Ser. B, vol. 2, Fasc. 2, p. 61, 1922.

But the question would be not settled, until the early stages of the genotype of this genus will have been studied more in detail. Unfortunately, however, no developmental study of *Amplexus coralloides*, the genotype of this genus, seems to have been made up to present.

Meanwhile, most of the species are believed to be intimately related to some primitive species of *Streptelasma*, in the absence of the dissepements and of the distinct fossulae. According to GRABAU, a young stage of *A. coralloides* shows close affinity to the adult of *A. hamiltonae* from the Hamilton of New York State, the latter being a typical streptelasmoid form in the young stage.

Although we could not make any developmental studies because the specimens now in consideration lack the proxiamal portion of the corallites, it is evident that the Japanese specimens are quite akin to *Amplexus collaroides*[1] at least in appearance. However, in our specimens definite fossulae are not observed if not absent. In British Isles *Amplexus coralloides* is flourishing in the Upper Tournaisian.[2]

Horizon : Maide Stage.
Locality : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No : 15491, 15495, 15496, 15497, 15500, 15501, 15502, 15504, 15505, 15506, 15508, 15509.
Coll. : M. MINATO.

Amplexus sp. indet.

Pl. 2, figs. 7a, 7b ; Pl. 4, fig. 4.

Remarks : This species is distinguished from the preceding species in form of corallite. *Amplexus nipponensis* is cylindrical, while the species, now in disposal is ceratoid in form. Moreover the species has minor septa besides the major septa.

Horizhn : Jumonji stage.
Locality : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 17306.
Coll. : M. MINATO.

1) M. EDWARDS and J. HAIME : Description of the British fossil corals. Chapter XIVI, Corals from the Mountain limeston p. 174 1852.
2) T. FRANKLIN : On the Carboniferous limestone (Avonian) of the Mendip Area (Somberest), with special reference to the palaeontological sequence. Q.J.G.S. vol. 62, p. 324, 1906.

Family Cyathophyllidae EDWARDS et HAIME

Genus *Palaeosmilia* EDWARDS et HAIME, 1848

Palaeosmilia kitakamiensis MINATO, sp. nov.

Pl. 3, figs. 1-4.

Corallum simple ? (or fasciculate), very large, more than 24 mm in calicular diameter and more than 240 mm in length. Corallites cylindrical in mature stage and ceratoid in early stage. Calyx very shallow. Septa thin, in two orders, quite numerous, increasing their number gradually as corallite grows.

Number of major septa	calicular diameter
32	7 mm
50	9 mm
51	11 mm
82	20 mm
82	23 mm
84	24 mm

Major septa reach nearly to center, some of them uniting with each other, while the minor ones are thinner and far shorter, being a little more than 1/2 of the former.

Dissepimental area broad, with more than ten rows of dissepiments arranged concentrically, surrounded by an outerzone of lonsdaleoid dissepiments or cysts, usually not traversed by septa. The lonsdaleoid dissepiments are larger and more loosely arranged in young stages but become smaller and densely in mature stages. Outer wall thin. Septal break indistinct.

In longitudinal section outer zone is formed by unequal vesicles arranged obliquely, with convexity upwards and inwards, becoming steeper in inclination inwards. Tabulae not complete, slightly arched at center of tabularium, but sag marginally. Tabule count 8–11 in a distance of 10 mm.

Remarks: As a *Palaeosmilia*, this species is quite unique, differing from others in point that it has a peripheral dissepimental area free of septa. *Palaeosmilia regia*[1] has a peripheral area of the same type, but it is massive in growth.

1) D. HILL: A monograph of the Carboniferous rugose corals of Scotland, Palaeontographical Society, p. 121, pl. VI, figs. 14-18, 1940.

It is possible that the present species represents a subgenus, if not a genus, but the material at hand not being sufficient, on the one hand, and following the authority of DOROTHY HILL[2] who unites *"Cyathophyllum" regia* into the genus *Palaeosmilia* on the other, the writer places the Kitakami species in *Palaeosmilia*, taking the definition of the genus rather broadly.

Horizon: Onimaru Series.
Locality: Usagisama, Setamai-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 15518, 15253, 15254, 15255, 15256, 15257, 15258, 15259, 15260,.
Coll.: M. MINATO.

Cyathophylloia coral

Gen. et. sp. indet.

Pl. 2, fig. 2.

An imperfect specimen on the weatherd surface of the impure limestone; thin section not available. No axial structure but with numerous thin septa. The specimen is considered to belong to Cyathophyllidae.

Family Lophophyllidae

Genus *Sugiyamaella* YABE et MINATO, 1944

Sugiyamaella carbonarium YABE et MINATO

Pl. 2, fig. 9

1941. *Lophophyllidium* ? sp. MINATO: On the Lower Carboniferous deposits at Setamai, Kesen-gori, Iwate Prefecture, in Japanese. Jour. Geol. Soc. Japan, vol. 48, p. 477.
1944. *Sugiyamella carbonarium*, YABE et MINATO: *Sugiyamella carbonarium* YABE et MINATO, gen. et sp. nov. aus den unterkarbonischen Ablagerungen des Kitakami-Gebirges, Japanese, Jour. Geol. Geogr. vol. 19, p. 143, pl. XII, figs. 1-9.
1947. *Sugiyamella carbonarium*, MINATO (pars) New locality of *Sugiyamella carbonarium*, Jour. Geol. Soc. Japan, vol. LIII, p. 22.
1951. *Sugiyamella carbonarium*, MINATO: On the Lower Carboniferous fossils of the Kitakami Massif, Northeast Honsyu, Japan, Jour. Fac. Sci. Hokkaido Univ. Ser. IV, vol. VII, p. 381, Pl. 1, fig. 13, pl. III, fig. 4.

New topotypes of this species were found newly in a state of mould at Kozubo. The figured specimen is not well preserved, but

2) D. HILL: op. cit. p. 116.

shows the all characteristics of the peculiar coral, *Sugiyamaella*.

Horizon : Kozubo Stage.
Locality : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture, Stored at the Tokyo Science Museum.
Coll. : M. Minato.

Order Aseptata Grabau
Family Syringoporidae Edwards and Haime
Genus *Syringopora* Goldfuss 1826

Syringopora sp.

Pl. 2, figs. 3, 6, 12

The specimens of this genus were obtained together with *Amplexus nipponensis* from the same block an impure limestone of the Ohdaira Formation. Corallum are mostly embeded in a hard matrix and in only a small part of them corallites are weathered out on the surface of the rock. Corallites are variable in size, and are irregularly arranged.

Transverse section: Corallum compound, corallites 1–3 mm in diameter, arranged rather loosely, spaced variably from less than 1 mm to more than 2 mm. Walls of the corallites also variable in thickness, occasionally much thickend. Septal ridges observable in some corallites, the number being 18.

Longitudinal section: All the corallites are filled with calcite crystalls so that the structure is entirely obscured.

Remarks: These specimens are characterized by the irregular arrangement of the corallites, thickend wall and rather numerous septal ridges. But the characters in longitudinal section are unknown, and accordingly comparison with the known species is almost impossible.

Horizon : Maide Stage.
Locarity : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 15496.
Coll. : M. Minato.

Class Brachiopoda Cuvier
Order Protremata Beecher
Family Schizophoriidae Schuchert and Le Vene
Genus *Schizophoria* King 1850

Schizophoria resupinata (Martin)

Pl. 5, fig. 3; Pl. 6, fig. 4.

1836. *Spirifera resupinata*, Phillips Geol. Yorkshire, vol. II, p. 220, pl. II,

fig. 1.

1853. *Orthis resupinata*, DAVIDSON: Brit. Foss. Brachiopoda, Pl. VII, fig. 135.

1861. *Orthis resupinata*, DAVIDSON: British Carb. Brachiopoda. p. 130, pl. XXIX, fig. 1-4, et pl. XXX, figs. 1-5.

1892. *Orthis* (*Schizophoria*) *resupinata*, CLARKE and HALL, Paleontology, vol. VII, part p. 211.

1906. *Schizophoria resupinata*, VAUGHAN: Carb. Rocks at Longshinny, Q. J. G. S. vol. 64, p. 470, pl. L, fig. 7.

1909. *Orthis resupinata* SOMMER, Fauna Culms Giessen, J. Jb, XXVII, Beil. Bd., p. 625, pl. XXVII, fig. 8; pl. XXIX, fig. 13.

1914. *Schizophoria* sp., WELLER: The Mississippian Brachiopoda, Monogr. 1, Illinois State Geol. Surv., pl. XXI, figs. 33, 34.

1930. *Orthis* (*Schizophoria*) *resupinata*, PAECKELMANN: Die Brachiopoden der deutsch. Unterkarb., Abhand. Preuss. Geol. Land. A.N.F. Heft 122, p. 158, pl. IX, fig. 7 et 8; pl. XIII, fig. 3-9.

1932. *Schizophoria resupinata*, CALLAWEYX, Orthiden ··· etc. Abhand. Preuss. Geol. Lands. A. N. F. Heft 141, p. 92, pl. VI, fig. 11-14.

1934. *Schizophoria resupinata*, DEMANET: Les Brachiopodes du Dinantien de la Belgique. Mem. muse. Royal d' hist. nat. Belgique, Mem. no. 61, p. 45, pl. III, figs. 1-5, test-fig. 9.

Remarks: Although the specimens as a whole are not in a perfect state of preservation, it is easy to identify them with *Schizophoria resupinata*, one of the most common species of the Lower Carboniferous, as the more important specific features are recognized in them.

Horizon: Jumonji Stage.
Locarity: Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 16039.
Coll.: M. MINATO.

Family Strophomenidae KING

Genus *Orthotetes* FISHER 1850

Orthotetes keokuk (HALL)

Pl. 11, fig. 1, 2, 4.

1892. *Derbya keokuk*, HALL and CLARKE, Pal. M. Y. vol. 8, pt. 1, pl. 2, figs. 1-3.

1914. *Orthotetes keokuk*, WELLER: The Mississippian Brachiopoda. p. 75. pl. 8, figs. 1-4.

Shell large, strongly deformed and compressed, transversely sub-elliptical or sub-circular in outline, broader than long, the greatest width near the middle of the shell length; the hinge line straight, shorter than the greatest width. The cardinal extremities rounded or obtusely angular. The dimensions of a nearly complete but somewhat deformed and compressed specimen are: length of ventral valve 44 mm, of dorsal

valve 36 mm, greatest width 65 mm, height of cardinal area 8 mm., thickness of shell 13 mm.

Ventral valve almost flat, only slightly convex in the umbonal region and concave elsewhere, median sinus obsolte, cardinal extremity obtusely angular, cardinal area flat, delthyrium not quite twice the length wide, deltidium not observed.

Internally a strong median septum is indicated as a slit which stretches out from the beak anteriorly for about one-third the length of the valve; short dental plates join with the median septum near the beak to form a small spondilium.

Dorsal valve is markedly convex in contradistinction from the ventral valve: although much compressed, its greatest convexity is clearly recognized to be near the middle.

Surface of both valves covered by fine, sub-angular, radiating costae of irregular size, usually 12 occupying the space of 5 milimeter. There are also irregularly developed concentric wrinkle-like lines of growth, crossing the radiating costae.

Remarks: The present form is almost indistinguishable from specimens described and figured by WELLER under the name of *Or. keokuk* (HALL), except for relatively smaller size of the Japanese material. The Mississippian representative comes from Keokuk limestone, while the Japanese form is obtained from Jumonji-stage: both of them come from the horizons stratigraphical far lower than the Upper Visean.

Horizon: Jumonji Stage.
Locarity: Miyojin-sawa, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 17278, 17279, 17280, 17283
Coll.: S. KIMURA.

Locarity: North of Kasiwari, Setamai-mura Kesen-gun, Iwate Prefecture.
Reg. No.: 17283.
Coll.: M. MINATO.

Locarity: Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 15970.
Coll.: M. MINATO.

Orthotetes sp.

Pl. 5, figs. 4a-c; Pl. 6, fig. 7.

Remarks: Several specimens of ventral valves obtained together with the preceding species are smaller in size, and wider than the preceding species.

The apical apparatus of these specimens are not observed except

for a short median septum. Area is low. and delthyrium may be wider than in the preceding species. Hinge-line is straight and slightly less longer than the greatest width of the shell. Cardinal extremity is obtusely angular. The valve is a little elevated in the umbonal region towards the beak, and almost flat around. Surface sculpture is almost like that the preceding species.

Such being the case these specimens may have to be considered different from the preceding species in the form and size, but it may be not guaranteed that these specimens do not show the young stage of the preceding species. The writer, therefore, mentions it as an unnamed species of *Crthotetes*.

Horizon : Jumonji Stage.
Locarity: Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 16036.
Coll. : M. MINATO.

Genus *Derbyia* WAAGEN 1884

Derbyia depressa DEMANET var. *transversa* MINATO var. nov.

Pl. 8, fig. 1

Shell of large size, transversely semi-elliptical in form, the umbonal region of the ventral valve partly broken off, but it may be originally small, where the convexity of the shell attains maximum. Most part of the ventral valve flat. Hinge line quite long, a little shorter than the greatest width of the shell. Cardinal extremities obtusely angular. Median sinus obsolete. Cardinal area very narrow and moderately high, where very fine striae are observable. Delthyrium not observed.

Whole surface covered by numerous fine, subangular, radiating costae, fine concentric growth lines and deeply impressed, occasionally interrupted corrugations. The first of them increase their number anteriorly by forking and intercalations.

Internally distinct median septum recogneizable, being about one fourth the length of the shell.

Width : 60 mm
Length : 32 mm
Length of the median septum : 8 mm

Remarks: The present form represent a type being quite ally to a species described and figured by DEMANET as *D. depressa* from the

Visean of Belgium.[1] In these two forms, characteristic concnetric corrugations are well observable and the median septum is commonly short. But the Japanese form is slightly more transversely elongate than in Belgium species.

Speciemens described and figured by WELLER as *Orthotetes keokuk*[2] resembles the present form, now in disposal from shell form, but the internal strucutre of both shells are never congeneric with each other. Moreover the Japanese form have costae being regular in size, against the irregular sized costae of the former.

Horizon : Jumonji stage.
Locarity : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 16271.
Coll. : M. MINATO,

Family Productidae GRAY

Genus *Pusutula* THOMAS 1914

Pusutula cf. *tenuipustulata* THOMAS

Pl. 11, fig. 7

Compare with
1931. *Productus* (*Pustula*) ? *tenuipustulat*, PAECKELMAN, Die Productinae und Productus ähnlichen Chonetinae, Abhand. Preuss. Geol. L.-A. N. F. Heft 136, p. 146, pl. 15, figs. 2 and 3.

Only a single ventral valve was obtained. Shell is rather large, and strongly deformed, but the original form is conjectured to be very convex, as wide as, or slightly shorter than long, the hinge line straight, a little shorter than the greatest width, which is posterior to the middle, the cardinal extremity obtusely angular, and slightly auriculate. Umbonal region is compressed, but beak is not preserved ; median sinus is very narrow and shallow near the beak, becoming deeper and a little wider anteriorly. Surface covered by indefinite concentric bands and numerous fine spines, which are very closely set with each other. Dimensions of this shell are : length 40 mm and width 39 mm.

Remarks : *Pustula tenuipustula* THOMAS is characterized by an elongate shell form, strong convexity of the ventral valve, indefinite concentric bands and irregular numerous spines. All such characteristics

1) F. DEMANT : Brachiopodes du Dinantien de la Belgique. Mém. Muse Royal d'Historie Naturalle de Belgique. Mém. 61, p. 89, pl. VIII, figs. 1-4, 1933.
2) S. WELLER : The Mississippian Brachiopopa of the Mississipi valley Basin, p. 75, pl. VII, figs. 1-4. 1914.

are well recognized in the Japanese specimen now at disposal, that the identification is held back for the time being.

Horizon : Jumonji Stage.
Locarity : Miyojin-sawa, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 17288.
Coll. : S. KIMURA

Pustula sp.

Shell large, as wide as long, or slightly narrower than long ; width 60 mm, length ca. 62 mm. Ventral valve moderately convex, with the point of the greatest convexity lying posterior to the middle ; mesial sinus shallow but wide, originating at the umbonal region; beak slightly incurved. Shell surface scaled off in most specimens, existing of one row of pustles and concentric lamellose striae being suggested only on a small area of surface of a shell, pustles very fine, longitudinally ellongate ; the dorsal valve slightly concave but details are not accessible because it is embeded in the matrix.

Remarks : A specific determination is not possible because of the imperfection of the material. But it seems to be worth-while to record here its occurrence in association with the aberant coral *Sugiyamella carbonarium* YABE et MINATO in one and the same block of schalstein ; the horizon of *Sugiyamella* is quite destitute of other fossils.

The present specimen resembles *Pustula pustulosus* (PHILLIPS)[1] in the shell form, which has wide and shallow median sinus.

Horizon : Maide Stage.
Locarity : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefectur.
Reg. No. : 15994.
Coll. : M. MINATO.

Family Spiriferidae

Genus *Spirifer* SOWERBY 1818

Spirifer kozuboensis MINATO, sp. nov.

Pl. 5, figs. 7a, 7b

Shell rather large in size, wider than long, the greatest width along the hinge-line, nearly equally biconvex, cardinal extremities

1) The writer, on comparing the speceimen with the figures of PHILLIPS, BROWN, DAVIDSON etc., is strongly inclined to regard the specimen illustrated in A. H. SUTTON's work (Taxonomy of Mississippian Productidae, pl. 66, figs. 8, 9) most closely related to the former, although the sinal depression is quite irregular in the latter.

acutely angular in mature stage, becoming more obtuse with age. Dimensions of shell, though they are slightly reduced by compression, are : length 28 mm, width 40 mm, and thickness 11 mm.

Ventral valve slightly convex, becoming compressed anteriorly and toward the cardinal extremities, beak small, pointed and incurved ; cardinal area of moderate height, sloping gently from beak to cardinal extremities, bearing on each lateral slope about twenty, narrow, rounded, plications, which become progressively obscure towards the cardinal extremities, the first two or three immediately adjacent to the sinus bifurcated ; mesial sinus sharply defined at the beak and become indistinct and shallower anteriorly. In sinus there is a median plication which originates near the beak and continues without division to anterior commissure; on each side of which there are two strong lateral plicae of equal length as the median plication, and far shorter than other lateral plications : thus the sinal formula is : $1+I+1+IX+1$.

Dorsal valve nearly as convex as the ventral, more convex near beak, with a narrow, linear cardinal area ; mesial fold narrow at beak, bounded by two definite furrows, becoming broader and illdefined from laterals at anterior margin, lateral slopes convex towards center of shell, somewhat compressed towards cardinal extremities.

Surface of both valves moreover sculptured by regular, somewhat, crowded, sub-imbricated concentric markings and by occasional stronger growth lines.

Remarks : Though the internal structure of this specimen is unknown, it is well characterized by its shell form and plications. Comparable species may be *Spirifer clathratus* M' Coy, first of all, especially as is figured by Douglas[1] and Vaughan.[2] However, *Spirifer clathratus* may be not conspecific with the specimen now in concern because of the size of the shell, and the number of plicae.

Specimens described by Scupin[3] under the name of *Spirifer tornacensis* de Kon, may be synonymous with the specimen described by Davidson[4] under the name of *Spirifer striata* in pl. III, fig. 6 and pl. IV, fig. 4 in his monograph (not fig. 2 and 5 on pl. III) ; both of them

1) J. A. Douglas : The Carboniferous limestone of County Clare. Q.J.G.S. vol. 65, p. 574, pl. 26. fig. 6, **1909**.

2) A. Vaughan : The Palaeontological sequence in the Carboniferous limeston of the Bristole area, Q J G.S. vol. 61, p. 300, pl. XXVI, fig., 5, **1905**.

3) H. Scupin : Die Spiriferen Deutschlands, Palaeontologische Abahandlumgen N.F. Bd. IV, Ht. 3, pl. X, figs. 8a-c, 9a c, **1900**.

4) T. Davidson : British Carboniferous Brachiopoda, Palaeontolographica Soc. **1856**.

may be perhaps identical with the one called *Spirifer clathratus* by both VAUGHAN and DOUGHLAS and they are also nearly related to the Japanese specimen now under consideration, however, they may also be distinguishable from the Japanese form by the same reason.

Of the American *Spirifer*, *Spirifer marionensis* SHUMARD of the lowest Mississippian, described and figured by WELLER[1] belongs to the same category with SCUPIN's so-called *Spirifer tornacensis* DE KON., both possessing same shell form, similar plications and cardinal area of a similar type. SCUPIN's *Spirifer tornacensis* and WELLER's *Spirifer marionensis* have similar cardinal area, which are essentially parallel almost to their very extremities, giving the appearance of very narrow parallelogram.

Spirifer semicircularis figured by PHILLIPS[2] and DAVIDSON[3] resembles Japanese species also but the former has less numerous plicae, and in addition has a far higher cardinal area.

Spirifer attenuata SOWERBY[4] figured by DAVIDSON, and *Spirifer coplowensis* PARKINSON, described by PARKINSON[5] are somewhat similar to the Japanese species in shell form, but the plicae of the lateral slopes of both European Species are quite different.

Horizon : Jumonji Stage.
Locarity : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 15991, Holotype.
Coll. : M. MINATO.

Spirifer ultratransversa MINATO, sp. nov.

Pl. 6, figs. 1, 2a-c ; Pl. 9, fig. 3

Shell moderate in size, strongly transverse, very much wider than long, hinge line straight, representing the greatest width. Dimensions of the largest specimen are : width 75 mm, length 13 mm. No dorsal valve obtained.

Shell moderately convex, abruptly inclined towards the antero-lateral and anterior margins. Beak pointed, slightly incurved. Cardinal extremities acutely angular ; cardinal area low and narrow, delthyrium twice as wide as long. Major part of shell weathered away, but plication on remaining part simple, covering also the mesial sinus, which

1) S. WELLER : Mississippian Brachiopoda of the Mississippi valley basin. p. 308, pl. XXXVII, figs. 1-7, **1914**.
2) J. PHILLIPS : Geology of Yorkshire, Pt. II, p. 217, pl. IX, figs. 15, 16, **1836**.
3) T. DAVIDSON : British Carboniferous Brachiopoda, pl. VI, figs. 1, 2, 3, 4, 5, **1856**.
4) T. DAVIDSON : British Carb. Brach. pl. III, figs. 2 and 4, **1856**.
5) D. PARKINSON: The faunal succession in the Carboniferous limestone and etc., Q.J.G.S. vol. 82, p. 233, pl. XV, figs. 1a-1e, **1926**.

is very shallow and ill-defined from lateral slopes of shell. Internally muscular scars subquardrate in outline, sharply defined from the other parts of shell, rather large, protruded.

Remarks: The present form may be referred to some species of *Fusella*, especially *Spirifer convoluta*, described and figured by PHILLIPS,[1] and DAVIDSON,[2] but the plications of the latter is stronger than in the common species of *Fusella*.

In the transversely elongate form, the acute cardinal extremities, the high and strong muscular scars of the ventral valve, this form may be also comparable with some species of *Euryspirifer*. However, *Euryspirifer* has usually non-plicate sinus and fold. Therefore, this form should not be regarded conspecific nor congeneric with any species of *Euryspirifer*. In the first appearance, however, such *Euryspirifers* as *Spirifer paradoxus* (SCHLOTHEIM)[3] and *Spirifer arduennensis* SCHNUR[4] seem to resemble, the former two have less transversely elongate shell and far stronger plicae. *Spirifer latus*[5] may also be comparable with the present form, but the former possess a wider sinus, which, in adition, is non-plicate.

Such being the case, the species, now at disposal is quite unique. So far the writer is concernd, it is quite safe to separable as distinct from all the known species, in having quite and extraordinary width of the shell.

Horizon : Hikoroiti Series.
Locarity : Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 16027, 16028.
Coll. : M. MINATO.

Spirifer ohmoriensis MINATO, sp. nov.

Pl. 8, fig. 3; Pl. 10, fig. 1

Shell rather large in size, much broader than long, the greatest

1) J. PHILLIPS : Geol. York. p. 217, pl. IX, fig. 7, **1836**.
2) T. DAVIDSON : Brit. Carb. Brach. pl. IV, figs. 9-11, figs. 12-13, pl. L,figs. 1-2, **1856**.
3) BECLARD : Spirifers du Coblenzien Belge, Bull. Soc. Belge de Geol. de Paleont. et d'Hydrol. vol. IX, p. 199, pl. XIV, **1895**.
LAVERDIERE : Contr. a l'etude des terrains paleozoi. dans les Pyrenes. Mem. Soc. Geol. du Nord, vol. X, Mem. 2, p. 99, pl. V, figs. 1, 3, 6, 10, **1930**.
4) J. SCHNUR : Zusammenstellung und Beschreibung samtlicher im Uebergangsgebirge der Eifel. etc. Paleontographica, vol. III, p. 199, pl. XXXII, figs. 3a-c, pl. XXXII b, figs. 2a-d, **1853**.
5) FOORD : Note on the Paleontology of Western Australia. Geol. Mag. vol. VII, pl. VI, p. 145, **1890**.

width along the hinge line, cardinal extremities acutely angular. Dimensions of a nearly perfect specimen, the holotype, are : length 21 mm, width 77 mm., the thickness 12 mm.

Ventral valve moderately convex, the greatest convexity near the small pointed and slightly incurved beak ; cardinal area low. Mesial sinus narrow, with four or five very fine plicae. Each lateral slope with more than fifteen simple plicae. Internally, muscular scars often large, subcircular or elliptical in outline, sharply defined from the surrounding parts of the shell, and slightly protruded, with ill-defined median groove in the middle, ornamented by numerous longitudinal lines.

Dorsal valve much less convex than the ventral, surface sloping gently from the umbonal region to margins in all directions, slightly resupinate near cardinal extremities. Mesial fold well defined, gradually broader towards anterior margin.

Remarks: The present form seem to be in the intimate relation with some *Spirifers* of the *Hysterolites* group of the Devonian age, especially it may be comparable with *Euryspirifer*.

In the *Hysterolites* group, the writer wishes to include such genus as *Hysterolites* Schlotheim, em. Dall (*Spirifer hystericus* group), subgenera as *Acrospirifer* Wedekind (*Spirifer primaevus* group), *Brachyspirifer* Wedekind (*Spirifer ostiolatus-carinatus* group), *Paraspirifer* Wedekind (*Spirifer cultrijugatus* group), and *Euryspirifer* Wedekind (*Spirifer paradoxus-speciosus* group).

The subgenus *Euryspirifer* includes the *Spirifers* of Scupin's "Gruppe des *Spirifer hercyniae* Gieb." Scupin[1] defined this group as follows :

Die gruppe enthält eine Reihe unter-und mitteldevonischer, meist flugelförmig verbreiterter Formen mit stärker, zur Stütze der Schlosszähne dienender Verdickung der Schale, mehr oder weniger zahlreichen Rippen auf den Seitentheilen und relativ breitem Sinus und Sattel, von denen nur der erstere gelegentlich eine Falte aufweist, neben der nur im Ausnahmefalle zwei weitere äusserst schwache Falten beobachtet werden können. Area stets niedrig. Schnabel gekrümmt. Die Sculptur besteht durchweg aus gleichmässigen Anwachsstreifen.

In the writer's opinion, this subgenus is characterized by its greater width, acute cardinal extremities, non-plicate mesial sinus and fold, and high protruded muscular scars of the ventral valve.

1) H. Scupin : Die Spiriferen Deutschlands. Paleontolog. Abhand. N. F. Bb. IV, Heft 3, p. 86, 1900.

In the meantime, the present form has plicated fold and sinus, and thus *Euryspirifer* and the present form, though apparently very close must be only superficial. Apical structure of the present form is of different kinds from that of *Cyrtospirifer "verneuili"* but it shows some resemblace to the latter in the external feature except narrower mesial sinus as well as fold of the former.

Horizon : Hikoroiti Series.
Locarity : Ohmori, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 5998, 15999, 15940.
Coll. : M. MINATO.

Genus *Fusella* M'COY, 1844

Fusella nipponotrigonalis MINATO

Pl. 5, fig. 1 ; Pl. 6, fig. 6 ; Pl. 11, fig. 3

1951. *Fusella nipponotrigonalis*, MINATO : On the Lower Carboniferous fossils of the Kitakami Massif, Northeast Honsyu, Japan. Jour. Fac. Science, Hokkaido Univ. Ser. IV, vol. VII, no. 4, p. 372, pl. II, fig. 5.

Specimens referable to this species were collected from the same localities formerly mentioned, and from another locality, with *Orthotetes keokuk* (HALL), *Kitakamithyris semicircularis* MINATO and *Syringothyris transversa* MINATO.

Horizon : Jumonji Stage.
Locarity : New Loc. Miyojin-sawa, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 17281, 17282.
Coll. : S. KIMURA.

Known locality : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 16016, 16017, 16018.
Nasirosawa Jumonji, Simoarisu-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 16054.
Coll. : M. MINATO.

Fusella nipponotrigonalis var. *minor* MINATO var. nov.

Pl. 6, fig. 3

The specimen shown on pl. 6 fig. 3 may be almost identical with the preceding species in all respects but for the smaller size of the shell. The concentric striae covering the whole surface of the shell in the case of the preceding species are not obseved in this form ; however, it may perhaps be due to the illpreservation but not mean the absence.

Although it is not firmly established what has been regarded in respect to the variation of size of shell in this group of brachiopoda, the writer who collected numerous specimens of this group in a few localities, had not yet find any intermediate type concerning the size between the specimens now in hand and the preceding species.

Horizon : Jumonji Stage to Maide Stage ?
Locality : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 16227.
Coll.: M. MINATO.
: Maide, Setamai-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 16254.
Coll.: M. MINATO.

Genus *Spiriferina* D' ORBIGNY 1847

Spiriferina paratransversa MINATO, sp. nov.

Pl. 7, fig. 4; Pl. 8, fig. 2

Shell spiriferoid, transversely elongate, far wider than long, moderately convex: cardinal extremities acutely angular. Hinge-line straight, representing the greatest width. Beak of the ventral valve small, pointed, and slightly incurved: area rather low.

Lateral plicae more than 13 in number, sometimes but more numerous in each laterals. Sinus and fold quite narrow, without indication either sulcies or ribs on them.

Shell structure punctate. Lamellose lines covering whole surface, which are especially well preserved near anterior margin. Internal features unknown.

Dimensions:	Width	Length	
	34.5 mm,	13.0 mm,	Ventral valve
	30.0 mm,	9.5 mm,	Dorsrl valve
	46.0 mm,	14.0 ? mm,	Ventral valve
	42.7 mm,	14.5 mm,	Ventral valve

Remarks: The present form represents a type allied to *Spiriferina*[1] *transversa* described and figured by WELLER from the Chester group, but the former is far larger in size, and wholly lacks median complex composed of ribs and sulcies on sinus and fold. Therefore these two forms have to be regarded as two distinct species.

The so-called *Spiriferina cristata* var. *octoplicata*, described and figured

1) S. WELLER: The Mississippian Brachiopoda of the Mississippi valley basin, p. 297, pl. XXXV, figs. 41-49, 1914.

by G. F. Whidborne[1] from the Devonian of England may perhaps be synonymous with the American species, *transversa*, from which the present form is easily distinguished on the same reason.

It must also be noted that the Japanese form has characteristiccally narrow sinus and fold.

Horizon : Hikoroiti Sevies.
Locality : Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 16013, 16273, 16275, 16267, 16278.
Coll. : M. Minato.

Genus *Delthyris* Dalman 1828

Delthyris. aff. *clarksvilensis* (Winchel)

Pl. 7, figs. 2, 5

Compare :
1914. *Delthyris missouriensis*, Weller : Illinois Geol. Surv. Monogr. 1, p. 301, pl. 36, figs. 9-14.
1938. *Delthyris clarksvilensis*, Branson, University of Missouri, Studies, vol. 13, no. 3, p. 137, pl. 16, fig. 9-10.

Incomplete, deformed dorsal valves were obtained as cast and mould : ventral valve lacking. Hinge-line straight, about 17.6 mm in length which may be the greatest width of shell. Shell spiriferoid in external form, slightly convex, with blunt and acute cardinal angles. Median fold clearly distinguished from other plicae, each ornamented with 6 plicae that become gradually obsolete toward cardinal angles. Whole surface covered by concentric lamellose lines : no punctation on shells.

Remarks : From the outer configuration of the shell, number and size of ribs, the present form is judged to most closely resemble Weller's *Delthyris clarksvilensis*, and may probably be conspecifc ; however, it seems to the wrier the Japanese form is more transversely elongate than the other.

As Branson mentioned, Weller's se-called *D. missouriensis* may be synonymous with *clarksvilensis* ; the figured specimens of Weller also are quite indistinguishable from the Japanese form, as is represented especially by the specimen, fig. 14 on pl. 36 which is almost identical.

The specimen figured by Branson, fig. 10, pl. 16, is also quite analogous with the present form, except for the existence of sulcation at the top of the median fold.

1) G. F. Whidborn : Devonian fauna. Pal. Sco. vol. 11, p. 159, pl. XIX, figs. 10-11, 1897.

Sometime ago PAECKELMAN[1] pointed-out that WELLER's Mississippian *Delthyris* may be *Quadrifarius* but not true *Delthyris*: however, the internal structure of his species is unknown, and the validity of the genus *Quadrifarius* may can not be beyond the question.

Horizon : Hikoroiti Series.
Locality : 808 m. hill, Okuhinozuti, Simoarisu-mura, Kesen-gun Iwate Prefecture.
Reg. No. : 16165.
Coll. : M. MINATO.

Delthyris sp.

Shell medium in size, spiriferoid in form, with blunt and protruded cardinal extremities. Hinge-line straight and long, showing the greatest width of shell. Beak not pointed. Plicae flat, counted as many as 18, some obsolete near the cardinal margin, alternate with very narrow interspaces. No bifurcation nor intercalation of plicae recogneized. Fold almost smooth except for a distinct sulci near the beak, which is about one third the length of fold, with two other indefinite sulcies are recognized near anterior commisure.

Fine lamellose concentric lines covering the whole surface, which are especially well preserved on median fold. No punctation upon shell surface.

Remarks: This species is referable to some measure to *Delthyris* ? sp. (Reg. no. 16145) of 808 m hill, Okuhinozuchi, both of which are represented by imperfect shells hardly determinable specifically, but showing the characteristic outline of the shell and the shell structure which show a close affinity to the genus *Delthyris*.

Horizon : Hikoroiti Series.
Locality : Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 16269, 16270.
Coll. : M. MINATO.

Syringothyris WINCHEL 1863

This genus is characterized by a high cardinal area, a punctate shell structure, the presence of a syrinx in the apical aparatus and the absence of plications on the fold and the sinus.

NORTH[2] once traced the evolutional series of this genus mainly

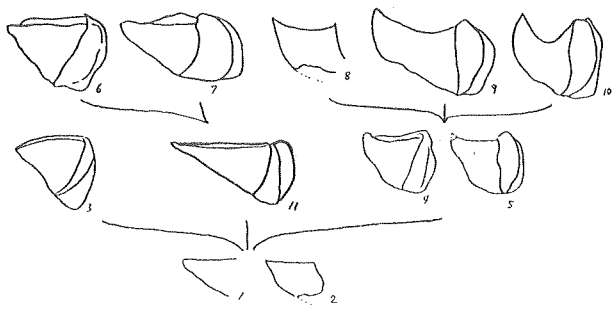
1) W. PAECKELMAN: Versuch einer zusammenfassenden Systematik der Spiriferidae King, N. Jb. f. Min. etc. 67, Beil. Bd. Abt. B, p. 1, 1932.
2) F. G. NORTH: On Syringothyris Winchel, etc. Q.J.G.S. vol. 76, p. 162.

with British species. According to him the phylogenetically earlier forms of this genus are small in size, and possess an almost flat cardinal area, while such phylogenetically later forms as are represented in Z and C horizons are larger in size, and have a slightly incurved or a rather resupinate area: and the phylogerontic forms as are in D horizon attains to the greatest shell size.

Although the specimens of D horizon mentioned by NORTH have flat cardinal area, there are also many possessing strongly incurved area in D horizon in various localities in the world. Namely, the specimens recorded by FRECH[1] under the name of *S. cuspidata* var. *curvata* from Asia Minor, and that described by DIENER[2] as *S. cuspidata* from Kashimir are large in size and have a strongly incurved area.

Meanwhile, the Japanese species described in this paper come from the Jumonji stage, the equivalent of the Tournasian. Some of them are very large in size as *S. jumonjiensis* but with a flat cardinal area, while many other species are variable in size, and have a slightly incurved area.

Therefore Syringothyris might have started its phylogenetic series as a small shell with flat cardinal area, then branching abruptly into forms of three directions as large shells with flat cardinal area, with slightly resupinate area and incurved area.



Text fig. 1

1. *Syringothyris principalis* ····· K
2. *S. plana* ····· Tournasian
3. *S. cuspidata* mut. *exolata* ····· C
4. *S. cuspidata* mut. *exolata* ····· C
5. *S. cuspidata* mut. *cyrtorhyncha* ··· Z
6. *S. cuspidata* mut. *cuspidata* ····· D
7. *S. cuspidata* mut. *cuspidata* ····· D
8. *S. cuspidata* mut. *curvata* ····· D
9. *S. cuspidata* ····· D
10. *S. cuspidata* ····· D
11. *S. jumonjiensis* ····· Jumonji Stage

1, 3, 4, 5, 6, 7: from NORTH 2, 8: from FRECH
1, 10: from DIENER 11: from MINATO

1) F. V. FRECH: Geologie Kleinasien in Bereich der Bagdadbaha, Zt. d. D.G.G. vol. 68, p. 1.
2) C. DIENER: The Anthracolithic fauna of Kashmir, Pal. Indica. N.S. vol. V, no. 2.

Syringothyris kitakamiensis MINATO, sp. nov.

Pl. 5, fig. 5

Shell rather large, deformed by pressure, wider than long, the greatest width at hinge line, cardinal extremities blunt, acute. Dimensions of valve are: length of hinge-line 70 mm., length of dorsal valve, 28 mm., height of area 25 mm., width of delthyrium 12 mm at hinge line.

Ventral valve sub-pyramidal in form, cardinal area slightly concave, clearly differentiated into three regions by a pair of divergent lines extending from apex to hinge line: delthyrium narrowly triangular, a littel less than twice its width high; apical angle 125° and delthyrial angle about 25°.

Dorsal valve spiriferoid in form, median fold originating at the beak, vary narrow but sharply defined from the lateral slopes or wings, non-plicated except for short and fine sulci near the beak. Wings ornamented with sixteen very fine, simple radiating plicae. Cardinal area linear. Shell substance minutely punctate.

Remarks: It is beyond doubt that the present specimens belong to the genus *Syringothyris*. Among the known species of this genus, *Syringothyris plana* HALL[1] described by FRECH from the Tournasian of Asia Minor may be comparable with the prerent form. The writer cannot find any difference between them, except in the broader and stronger plicae on lateral slopes of FRECH's specimen.

Another comparable species is *S. jourdii* DOUVILLE[2] described by DOUVILLE which, however, has a delthyrium much wider than in the Japanese specimens.

Horizon : Jumonji Stage.
Locality : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 15994, holotype.
Coll. : M. MINATO.

Syringothyris sp.

Pl. 5, figs. 2a-b; Pl. 9, fig. 1

Only one internal mould of the ventral valve was obtained, the anterior part of which had been broken off, the external surface is

1) F. V. FRECH: Geologie Kleinasiens in Bereich des Bagdadbahn. Zt. d. D.G.G. vol. 68, p. 234, pl. V, figs. 2a, b, **1916**.

2) H. DOUVILL: Sur quelques Brachiopoden a test perfore: Syringothyris etc. Bull. Soc. Geol. France, vol. 9, p. 145, pl. IV, figs. 3a, b, c, 4, **1909**.

not known.

Shell extraordinarily large, cardinal area high, measuring more than 48 mm, delthyrium 8mm wide near hinge line. Apical angle about 100°, delthyrial angle 18°. Area almost flat, or rather slightly concave; maximum concavity at about middle. Beak slightly incurved. Cardinal extremity assumed to be rounded. Syrinx well observed in delthyrium, extending about 1/3 of distance between delthyrial apex and hinge line. Dental plates divergent. Median septum about 8 mm. long. Median septum and its low and less conspicuous prolongation bisects muscular scars. Muscular scars as a whole sub-rounded; adductors narrow, central in position: divaricator very large, covered by anastomosing or dendritic surface markings. Cardinal area finely striated horizontally.

Remarks: This specimen may at a glance be referble to *Syringothyris elongata* NORTH[1] by its smaller apical and delthyrial angle, but they are specifically distinct from each other, because the latter has a lower cardinal area, and possesses sub-parallel dental plates in addition, while the reverse is the case with the Japanese specimen.

Syringothyris cuspidata mut. *cuspidata*, a highly specialized form also described and figured by NORTH[2] may be more nearly allied to the specimen, now at hand, in being a larger in size, having a very high cardinal area, and similar apical and delthyrial angles: however, the British specimens have dental plates-arrangement subparallel, while such feature is not observed in the Japanese specimen.

It must also be remembered that the cardinal area of *cuspidata* is almost flat, and occasionally resupinate. Belgian specimen illustrated by WELLER[3] under the specific name of *S. cuspidata* is also quite near to the Japanese species, but is not likely to be identical with the latter with respect to the similar distinctive points, as above mentioned.

Syrongothyris cuspidata, figured and described by HAYASAKA from the Lower Carboniferous of Ômi-mura region some thirty years ago[4] is a very large shell and has a very high cardinal area but it also

1) F. G. NORTH: On *Syringothyris* WINCHELL, and certain Carboniferous Brachiopoda refered to *Spiriferina* D'ORB. Q. J. G. S. London, vol. p. 183, text fig. 1e, 1f, 3h and 3j, pl. XII, figs. 3-5, **1920**.

2) F. G. NORTH: ibid, p. 186, pl. XI, figs. 7, 8, pl. XII, figs. 1a-2b, text fig. 3g, **1920**.

3) S. WELLER: The Mississippian Brachiopoda of the Mississippi valley Basin, State Geol. Surv. Illinois, Monogr. 1, pl. LXXIII, figs. 1-5, **1914**.

4) I. HAYASAKA: On the fauna of the Anthracolithic limestone of Omi-mura in the Wertern part of Echigo, Sci. Rep. Tohoku Imp. Univ. Sendai, Japan, Second Ser. (Geol.) vol. VII, no. 1, p. 45, pl. VI, figs. 10-13, **1924**.

seems quite different from the specimen, now in concern, in having a far larger apical angle.

Lastly, *Syringothyris platypleurs* WELLER[1] illustrated and described by WELLER from the Burlington limestone of the Mississippi Valley region, may most resemble the Japanese specimen most in all such respect, as the delthyrial and apical angles, the large size of the shell, very high cardinal area, and the divergence of the dental plates. From the last mentioned feature this species must be regarded more nearly allied to the present Japanese specimen than to *cuspidata* and *elongata*. However, the American species is also different from the Japanese form in having relatively narrow muscular scars, as a whole, and in possessing median septum, shorter than that of the Japanese specimen in addition. Also the muscular scars of *S. platyoleurs* bears quite different in outline from those of the Japanese form.

Horizon : Jumonji Stage.
Locality : Kozubo, Yokota-mura, Kesen-gun, Iwate prefecture.
Reg. No. : 16062.
Coll. : M. MINATO.

Syringothyris transversa MINATO

Pl. 6, fig. 8 ; Pl. 11, figs. 5a b

1951. *Syringothyris transversa*, MINATO : On the Lower Carboniferous fossils of the Kitakami massif, Northeast Honsyu, Japan. Jour. Fac. Science, Hokkaido Univ. Ser. IV, vol. VII, no. 4, p. 377, pl. V, figs. 1a-1f.

This species had been known from two localities in the Kitakami Mountainland, while one well preserved specimen was newly obtained from another locality : All the specimens are from the same stratigraphical horizon.

Horizon : Jumonji Stage.
Locality ; Nasirosawa, Jumonji, Simoarisu-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 16925.
Coll. : H. TAKEDA.

Hinozuti, Simoarisu-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 15995, 16017, 16018.
Coll. : M. MINATO.
New Loc. : Obatakitasawa, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 17289.
Coll. : S. KIMURA.

1) S. WELLER : ibid, p. 397, pl. LXXII, figs. 1-4, 1914.

Genus *Plicatosyrinx* MINATO, gen. nov.

Shell rather large size, broader than long, semi-pyramidal in form, with plicated mesial fold and sinus, and plicated lateral slopes. Ventral valve with a high cardinal area which is not clearly defined from the laterals of shell, delthyrium narrowly triangular. Dorsal valve with linear cardinal area. Internally devoid of both dental plates and median septum, with a syrinx inside delthyrium. Shell structure impunctate.

Remarks: This genus is closely related to the genus *Syringospira* KINDLE[1] 1909, both having impunctate shell structure and plicated mesial fold and sinus; the latter, however, has a different kind of apical apparatus. SCHUCHERT once established a genus *Syringopleura*,[2] with *Syringothyris randalli* SIMPSON as the genotype. This genus was proposed by him on the assumption that the fossil is a syrinx-bearing spiriferoid shell with plicated fold and sinus. He considered that *Syringothyris* would be synonymous with the genus *Syringopleura* but for the presence of plications on fold and sinus.

On the other hand, *Syringothyris randalli* SIMPSON was regarded by GIRTY,[3] nothing but a true *Syringothyris*; the identification of the former by SIMPSON was erroneous; there seems to have been a confusion owing to the imperfect state of his material. That is, he seems to have mixed up two different forms occurred together, to be one; i. e., as a *Syringothyriod* species which named *randalli* and a shell with the external characters of a true *Spirifer*.

The present genus *Plicatosyrinx* possesses the diagnostic characteristics ascribed by SCHUCHERT to his genus *Syringopleura* which is now abandoned. But the former is characterized by the shell being impunctate.

Genotype: *Plicatosyrinx singulare* MINATO

Plicatosyrinx singulare MINATO. sp. nov.

Pl. 10, figs. 5a-b

Shell above medium in size, strongly deformed; cardinal extremities folded upon cardinal area, but they might originally have been acute; the greatest width along hinge line. Cardinal area high with narrow

1) E. M. KINDLE: The Devonian fauna of the Ouray Limestone, U.S.G.S. Bull. p. 28, 1909.
2) C. SCHUCHERT: On the Brachiopod genus *Syringothyris* in the Devonian of Missouri, Amer. Jour. Sci., Ser. 4, vol. 30, p. 224, 1910.
3) G. H. GIRTY: On the genus *Syringopleura* SCHUCHERT, Jour. Geol. vol. XIX, p. 548, 1911.

delthyrium, with a syrinx insinde. Mesial sinus deep, but narrow, and plicated. Muscular scars of ventral valve raised high and longitudinally striated.

Of dorsal valve, beak small, a little incurved, cardinal area narrow, mesial fold plicated, not distinct from the lateral slopes.

The surface of the lateral slopes of the shell is covered by simple, rather broad plications and inbricating concentric markings, the former counting 13 in a space of about 8 mm.

Horizon : Jumonji Stage.
Locality : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 15981.
Coll.: M. MINATO.

Plicatosyrinx ? kumanoi MINATO, sp. nov.

Pl. 5, fig. 6; Pl. 7, figs. 1a–c; Pl. 9, fig. 5

Shell much deformed, wider than long, the greatest width along hinge line; cardinal extremities blunt, angular. Dimensions are: length of pedicle valve 30 mm, height of cardinal area 30 mm, width over 50 mm.

Entire surface, including both mesial sinus and fold, is ornamented by radial plicae and concentric lamellose wrinkles. Shell structure impunctate ?.

Ventral valve sub-pyramidal in form, with a high cardinal area, which is nearly flat; delthyrium rather narrow, delthyrial angle 30°, syrinx not observed. Sinus originating perhaps at beak, rather narrow and deep, in which 7 or 8 plications are counted at anterior commissure.

Dorsal valve, with a narrow area. Median fold narrow. Internally without dental plates, neither median septum. Muscular impressions with a longitudinal striation raised high. Spirialia laterally directed.

Remarks: As the syrinx is not observed the assignment of the present specimen to the genus *Plicatosyrinx* is only provisional, but the probability is great that it is a *Plicatosyrinx*. The present specimen is far larger than the genotype and its plication is much stronger.

Horizon : Jumonji Stage.
Locality : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 15992.
Coll.: S. KUMANO.

Kitakamithyris MINATO, gen. nov.

In the former[1] report the writer dealt with two species of Brachiopoda giving a subgeneric rank in the genus *Torynifer*. As was thoroughly discussed already, the two species are quite similar to the said genus both in the outer form, and in the ornamentation, but they are devoid of whatever kind of apical plates in the dorsal valve, in contradistinction to the presence of a median septum in the genus *Torynifer*.

The presence or the absence of apical plates in valves may not be insignificant for the classification of this group of Brachiopoda; and the writer intends to raise this group of Japanese species to a rank of a genus which eventually is new to science.

In the more recent investigations the writer has found another additional species of this genus which ranges from the Hikoroiti Series up to the Jumonji Stage, and thus we now have three species of this genus.

All these species are characterized by the brachythyrid shell form, the ornamentation consisting of spines and concentric bands, the presence of dental plates and median septum in the ventral valve, and the absence of any plates in the dorsal valve. In addition, the spine bases of this group always show a biromous feature.

Genotype: *Torynifer* (*Kitakamithyris*) *tyoanjiensis* MINATO

Kitakamithyris tyoanjiensis (MINATO)

Pl. 6, figs. 5a-d; Pl. 9, fig. 4a d

1951. *Torynifey* (*Kitakamithyris*) *tyoanjiensis*, MINATO: On the Lower Carboniferous fossils of the Kitakami massif, Northeast Honsyu, Japan. Jour. Fac. Science, Hokkaido Univ., Ser. IV, vol. VII, no. 4, p. 374,pl. i, figs. 3a, 3b; pl. IV, fig. 7.

In this note well preserved specimens are figured on pl. 6 and the spine bases of this species are shown in text-fig. of pl. 9.

Horizon : Hikoroiti Series.
Locality : Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 15990.
Locality : 808 m. hill, Okubinozuti, Simoarisu-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 16161.

1) M. MINATO: On the Lower Carboniferous fossils of the Kitakami Massif, Northeast Honshu, Japan. Jour. Fac. Sci. Hokkaido Univ., Ser. IV, Geol. and Min., vol. VII, no. 4, p. 374, 1951.

Locality : Natsuyama, Takozu-mura, Higasiiwai-gun, Iwate Prefecture.
Reg. No.: 16214.
Coll.: M. MINATO.

Kitakamithyris hikoroitiensis (MINATO)

Pl. 7, fig. 3; Pl. 8, fig. 6

1951. *Torynifer* (*Kitakamithyris*) *hikoroitiensis*, MINATO: On the Lower Carboniferous fossils of the Kitakami Massif, Northeast Honsyu, Japan. Jour. Fac. Science, Hokkaido Univ. Ser. IV, vol. VII, no. 4, p. 375, pl. 1, fig. 1.

Figures show the outer form of this species, and the characteristic spine bases, these features are quite different from those of the preceding species.

Horizon : Hikoroiti Series.
Locality : Tyoanji, Hikoroiti-mura, Kesen-gun Iwate Prefecture.
Reg. No.: 16187.
Coll.: M. MINATO.

Kitakamithyris semicircularis MINATO, sp. nov.

Pl. 7, fig. 6; Pl. 8, fig. 5; Pl. 10. fig. 3

Shell brachythyrid, semi-circular in outline, hinge-line curved, shorter than the greatest width, which is at the middle; moderately biconvex, the maximum convexity of ventral valve in umbonal region; ventral beak pointed, strongly incurved above hinge-line; area narrow.

Whole surface non-plicate, covered by concentric lamellae and closely set fine spines, giving the reticulated appearance. Spine bases of pustules biramous. In some specimens spines are observed to be about 4 or 5 mm long.

Remarks: This species very closely resembles the genotype in the general configuration of the shell, but it may be easily distinguished from the latter in the more sporadically arranged spine bases. From *K. hikoroitiensis* this species is also distinguishable on account of the convexity of shell.

Number of pustules in a distance of 5 mm in each species of this genus

K. tyoanjiensis	13–15
K. hikoroitiensis	6–7
K. semicircularis	6–7

This species comes from two different stratigraphical horizons, the Hikoroiti Series and the Jumonji stage.

Horizon : Hikoroiti Series.

Locality : Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 16222, 16224.
Coll.: M. Minato.
Higutisawa, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 16231.
Coll.: M. Minato.
Ohmori, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 16769.
Coll.: M. Minato.
Horizon : Jumonji Stage.
Locality : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 16225.
Coll.: M. Minato.
Miyojinsawa, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 17284.
Coll.: S. Kimura.

Kitakamithyris ? sp.

Pl. 10, fig. 2

An imperfect ventral valve was obtained, which is farily large, 46 mm in width, 25 mm in length. Whole shell surface is covered by fine spines, appering like a fine striation, while the concentric lamellae are almost obsolete. Convexity of shell is maximum at the umbonal region, gradually flattening away both anteriorly and laterlally. Cardinal area narrow. Delthyrium relatively wide, delthyrial angle large, reaching up to 105°. Dental plates 7 mm in length, diverge towards floor of shell, median septum between them long also, fully twice as long as the former.

Remarks: This species resembles *Kitakamithyris semicircularis*, but the hinge-line of the former is relatively long, and accordingly it may be quite a different species.

Horizon : Hikoroiti Series.
Locality : 808 m. hill, Okubinozuti, Simoarisu-mura, Kesen-gun, Iwate Prefecture.
Reg. No.: 16137.
Coll.: M. Minato.

Family Athyridae Phillips

Genus *Cliothyridina* Buckmann 1906

Cliothyridina royssii (L'Eveille)

Pl. 9, figs. 2 a-b

1951. *Cliothyridina royssii*, Minato : On the Lower Carboniferous fossils of the

Kitakami massif, Northeast Honsyu, Japan, Jour. Fac. Sci. Hokkaido Univ. Ser. IV, vol. VII, p. 378.

In the Kitakami Mountainland three localities of this species have been known until the present. In all these each localities this species occurs at the same stratigraphical horizon, i. e., the basal part of the Jumonji stage.

Horizon : Jumonji Stage.
Locality : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 16019.
Coll. : M. MINATO.
Hinozuti, Simoarisu-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 16021.
Coll. : M. MINATO.
Nigensawa, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 17286.
Coll. : S. KIMURA.

Genus *Actinoconchus* McCOY 1844

Actinoconchus lamellosa (L'EVEILLE)

Pl. 11, fig. 6

1951. *Achinoconchus* cf. *lamellosa*, MINATO : On the Lower Carboniferous fossils of the Kitakami Massif, Northeast Honsyu, Japan. Jour. Fac. Science, Hokkaido Univ. Ser. IV, vol. VII, no. 4, p. 380, pl. I, figs. 6a, 6b.

Specimen figured in Pl. 11 is imperfect but not so strongly deformed as the one described some time ago in this journal; the cardinal extremities of the latter are strongly folded upon the dorsal valve. The specimen now in concern is doubtlessly conspecific with the well known Carboniferous species, *A. lamellosa*. This species comes in the Kitakami Mountainland from the basal part of the Jumonji stage.

Horizon : Jumonji Stage.
Locality : Hinozuti, Simoarisu-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 16093.
Coll. : M. MINATO.
Miyojin-sawa, Yokota-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 17289.
Coll. : S. KIMURA.

Actinoconchus planosulcata (PHILLIPS)

Pl. 8, fig. 4; Pl. 11, fig. 4

1951. *Actinoconchus planosulcata*, MINATO: On the Carboniferous fossils of the Kitakami Massif, Northeast Honsyu, Japan. Jour. Fac. Science, Hokkaido Univ., Ser. IV, vol. VII, no. 4, p. 379.

Horizon : Hikoroiti series.
Locality : Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Reg. No. : 15973.
Coll. : M. MINATO.

Explanation of Plate

2

Explanation of Plate

Plate 2

(All figures are approximately natural size, unless otherwise stated)

page

Figs. 1. 4, 5. 8. 10, 11, 13 and 14. *Amplexus nipponensis* Oishi et Minato ··· 146
Hor. : Maide stage.
Loc' : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefectur.
Coll. : M. Minato.
Now stored at the Tokyo Science Museum, specimen of fig. 4 designated as a holotype.

Fig. 2. Cyathophylloid coral ····· 149
Hor. : Maide stage.
Loc. : Maide, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. Minato.
Reg. no. : 17305.

Figs. 3, 6, 12. *Syringopora* sp. indet ····· 150
Hor. : Maide stage.
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. Minato.
Reg. no. : 15496.
Figs. 3 and 12 ×2.0.

Figs. 7a, 7b. *Amplexus* sp. indet. ····· 147
Hor. : Jumonji stage.
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. Minato.
Reg. no. : 17306.

Fig. 9. *Sugiyamaella carbonarium* Yabe et Minato ····· 149
Hor. : Kozubo stage.
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. Minato.
Now stored at the Tokyo Science Museum.

M. Minato : Further note on Carboniferous fossils Kumano Photo

Plate 3

Plate 3

(All figures are twice in size)

Page

Figs. 1, 2, 3, and 4. *Palaeosmilia kitakamiensis* MINATO, sp. nov. 148

Hor. : Onimaru series.

Loc. : Takenohara, Setamai-mati, Kesen-gun, Iwate Prefecture.

Coll. : M. MINATO.

Reg. no. : 15518, 15520, 15521, 15236.

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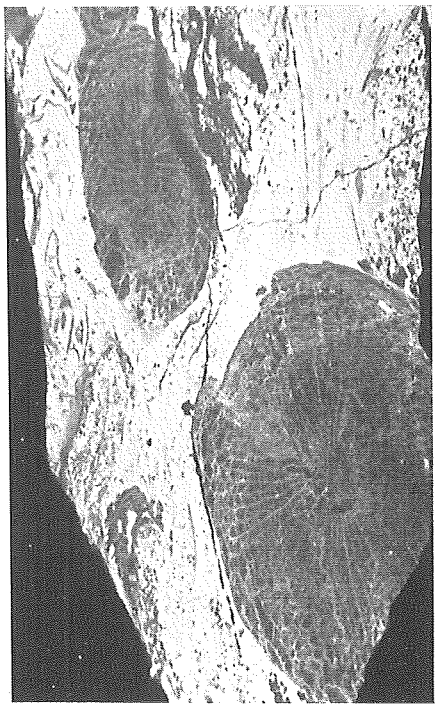
3



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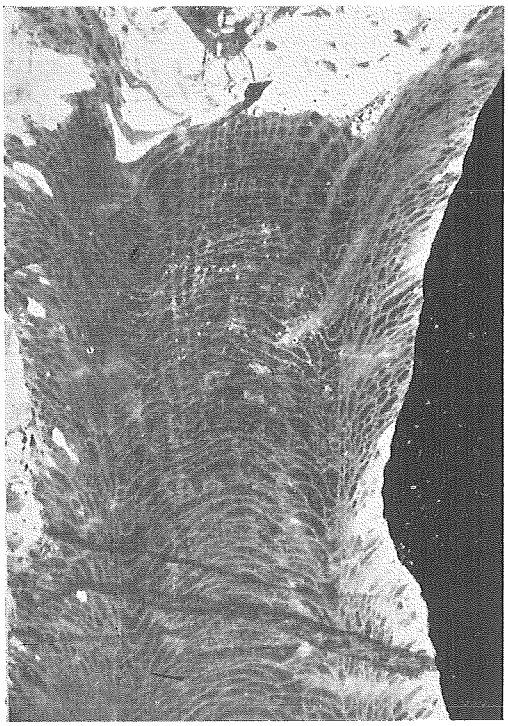

4

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Plate 4

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Page

Fig. 1–3, 5–24. *Amplexus nipponensis* Oishi et Minato sp. nov. 146

Hor. : Maide stage.

Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.

Col. : M. Minato.

Fig. 1. × 1.2 (Reg. no. 15484), Fig. 2. × 1.0 (Reg. no. 15487)
Fig. 3. × 1.2 (Reg. no. 15494), Fig. 5a. × 1.5 (Reg. no. 15508)
Fig. 5b. × 1.0 (Reg. no. 15508), Fig. 6a. × 1.2 (Reg. no. 15530)
Fig. 6b. × 1.0 (Reg. no. 15530), Fig. 7. × 1.2 (Reg. no. 15495)
Fig. 8. × 1.5 (Reg. no. 15496), Fig. 9a. × 2.0 (Reg. no. 15500)
Fig. 9a! × 1.0 (Reg. no. 15500), Fig. 10–13. × 1.0 (Reg. no. 15476)
Fig. 14. × 1.0 (Reg. no. 15496), Fig. 15. × 1.0 (Reg. no. 15479)
Fig. 16. × 2.0 (Reg. no. 15482), Fig. 17. × 1.5 (Reg. no. 15497)
Fig. 18. × 1.5 (Reg. no. 15477), Fig. 19. × 1.5 (Reg. no. 15483)
Fig. 20. × 2.0 (Reg. no. 15490), Fig. 21. × 1.0 (Reg. no. 15501)
Fig. 22. × 1.0 (Reg. no. 15495), Fig. 23. × 1.0 (Reg. no. 15477)
Fig. 24. × 1.0 (Reg. no. 15479)

Fig. 4. *Amplexus* sp. 147

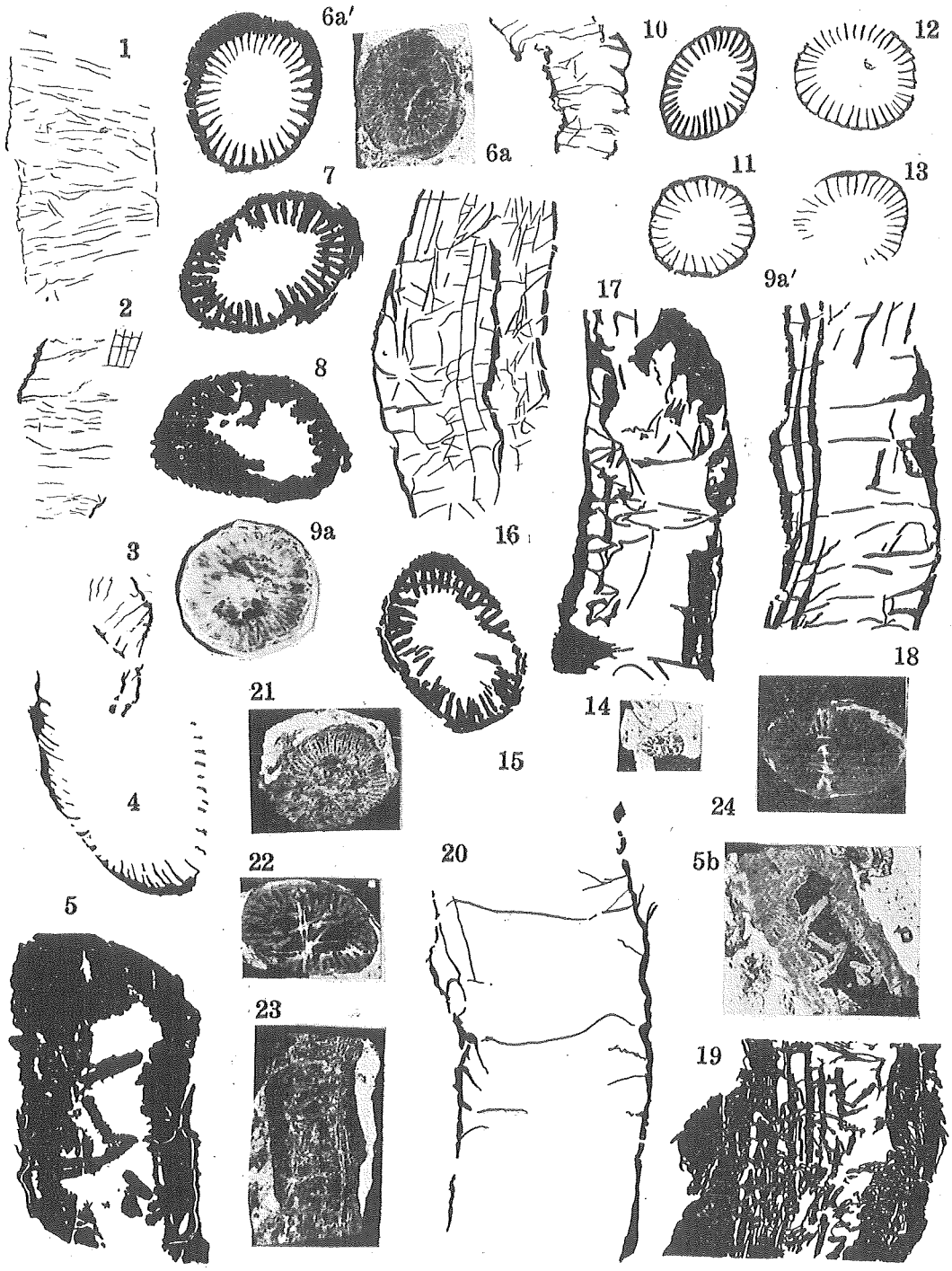
Hor. : Jumonji stage.

Loc. : Kozubo, Yokota-mura Kesen-gun, Iwate Prefecture.

Coll. : M. Minato.

Reg. no. : 17306.

Fig. 4. × 3.0.



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Minato del, Kumano photo.

Plate 5

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(All figures are natural size, unless otherweise stated)

page

Fig. 1. *Fusella nipponensis* MINATO 160
Hor. : Jumonji stage.
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 16018.

Figs. 2a, 2b. *Syringothyris* sp. indet 165
Hor. : Jumonji stage.
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 16062.

Fig. 3. *Schizophoria resupinata* (MARTIN) 150
Hor. : Jumonji stage.
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 17307.

Figs. 4a, 4b, 4c. *Orthotetes* sp. indet 152
Hor. : Jumonji stage.
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 16036.

Fig. 5. *Syringothyris kitakamiensis* MINATO, sp. nov. 165
Hor. : Jumonji stage.
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 15994.

Fig. 6. *Plicatosyrinx ? kumanoi* MINATO, sp. nov. 169
Hor. : Jumonji stage.
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : S. KUMANO.
Reg. no. : 15992.

Figs. 7a, 7b. *Spirifer kozuboensis* MINATO, sp. nov. 155
Hor. : Jumonji stage.
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO,
Reg. no. : 15991.
enlarged × 2.0.

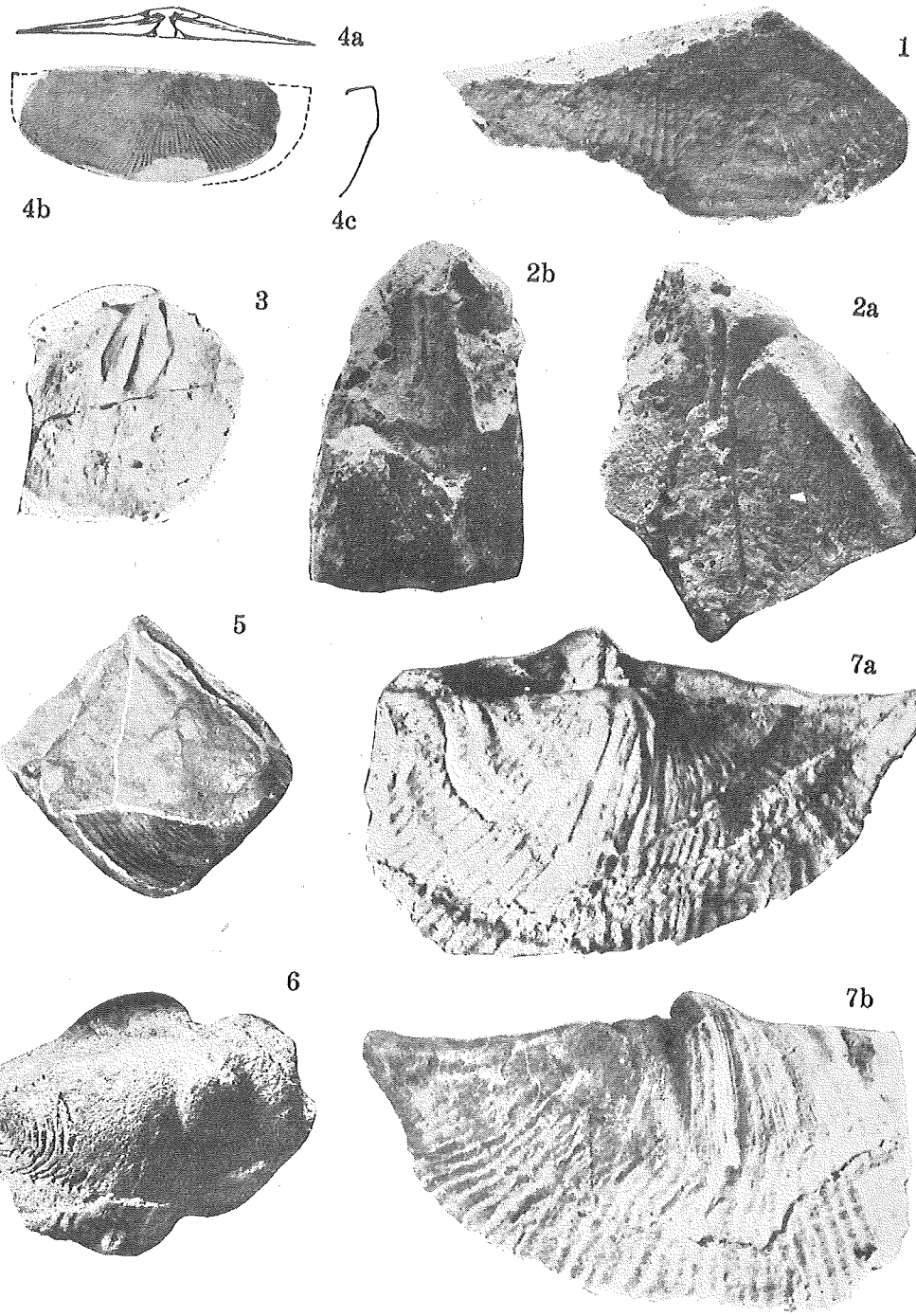

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Plate 6

Plate 6

(All figures are natural size, unless otherweise stated)

page

Figs. 1. 2a, 2b, and 2c. *Spirifer ultratransversa* MINATO, sp. nov. ····· 157
Hor.: Hikoroiti series.
Loc.: Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Coll.: M. MINATO.
Reg. no.: 16027, 16028.

Fig. 3. *Fusella nipponotrigonalis* var. *minor* MINATO, var. nov. ····· 160
Hor.: Jumonji stage.
Loc.: Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll.: M. MINATO.
Reg. no.: 16227.

Fig. 4. *Schizophoria resupinata* (MARTIN) ····· 150
Hor.: Jumonji stage.
Loc.: Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll.: M. MINATO.
Reg. no.: 16039.

Figs. 5a, 5b, 5c, 5d. *Kitakamithyris tyoanjiensis* (MINATO), gen. nov. ····· 170
Hor.: Hikoroiti series.
Loc.: Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Coll.: M. MINATO.
Reg. no.: 15990.
Fig. 5 d enlarged × 2.0.

Fig. 6. *Fusella nipponotrigonalis* MINATO ····· 160
Hor.: Jumonji stage.
Loc.: Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll.: M. MINATO.
Reg. no.: 16018.

Fig. 7. *Orthotetes* sp. indet ····· 152
Hor.: Jumonji stage.
Loc.: Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll.: M. MINATO.
Reg. no.: 16036.

Fig. 8. *Syringothyris transversa* MINATO ····· 167
Hor.: Jumonji stage.
Loc.: Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll.: M. MINATO.
Reg. no.: 15995.

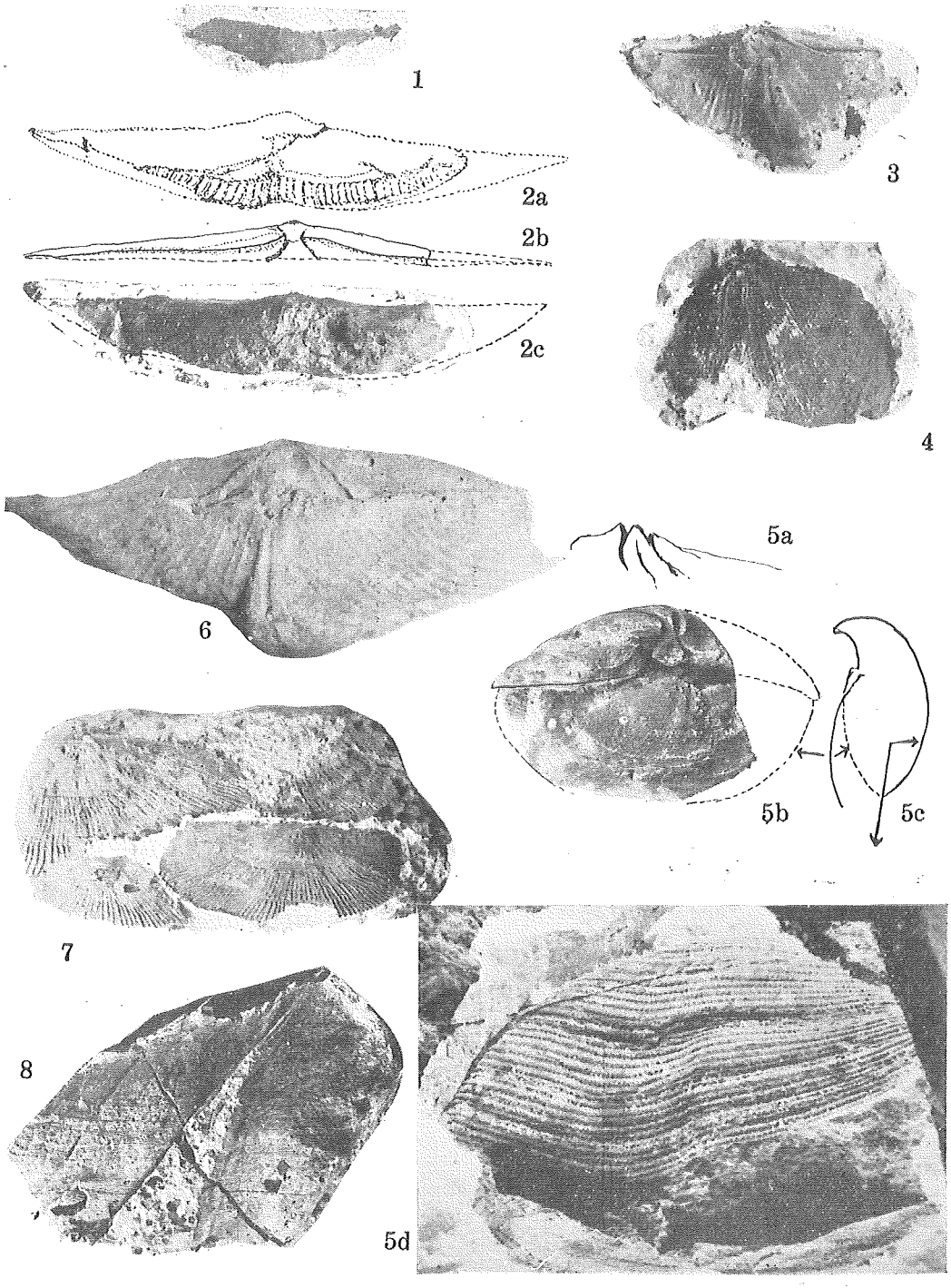

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Plate 7

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(All figures are twice in size)

page

Figs. 1a, 1b, 1c. *Plicatosyrinx ? kumanoi* MINATO, sp. nov. 169
Hor. : Jumonji stage.
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : S. KUMANO.
Reg. no. : 15992.

Figs. 2, 5. *Delthyris* aff. *clarksvilensis* (WINCHEL) 162
Hor. : Hikoroiti series.
Loc. : 808 m hill, Okuhinozuti, Simoarisu-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Now stored at the Tokyo Science Museum.

Fig. 3. *Kitakamithyris hikoroitiensis* (MINATO) 171
Hor. : Hikoroiti series.
Loc. : Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 16187.

Fig. 4. *Spiriferina paratransversa* MINATO, sp. nov. 161
Hor. : Hikoroiti series.
Loc. : Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 16267.

Fig. 6. *Kitakamithyris semicircularis* MINATO, sp. nov. 171
Hor. : Jumonji stage (Hikoroiti series).
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 16225.

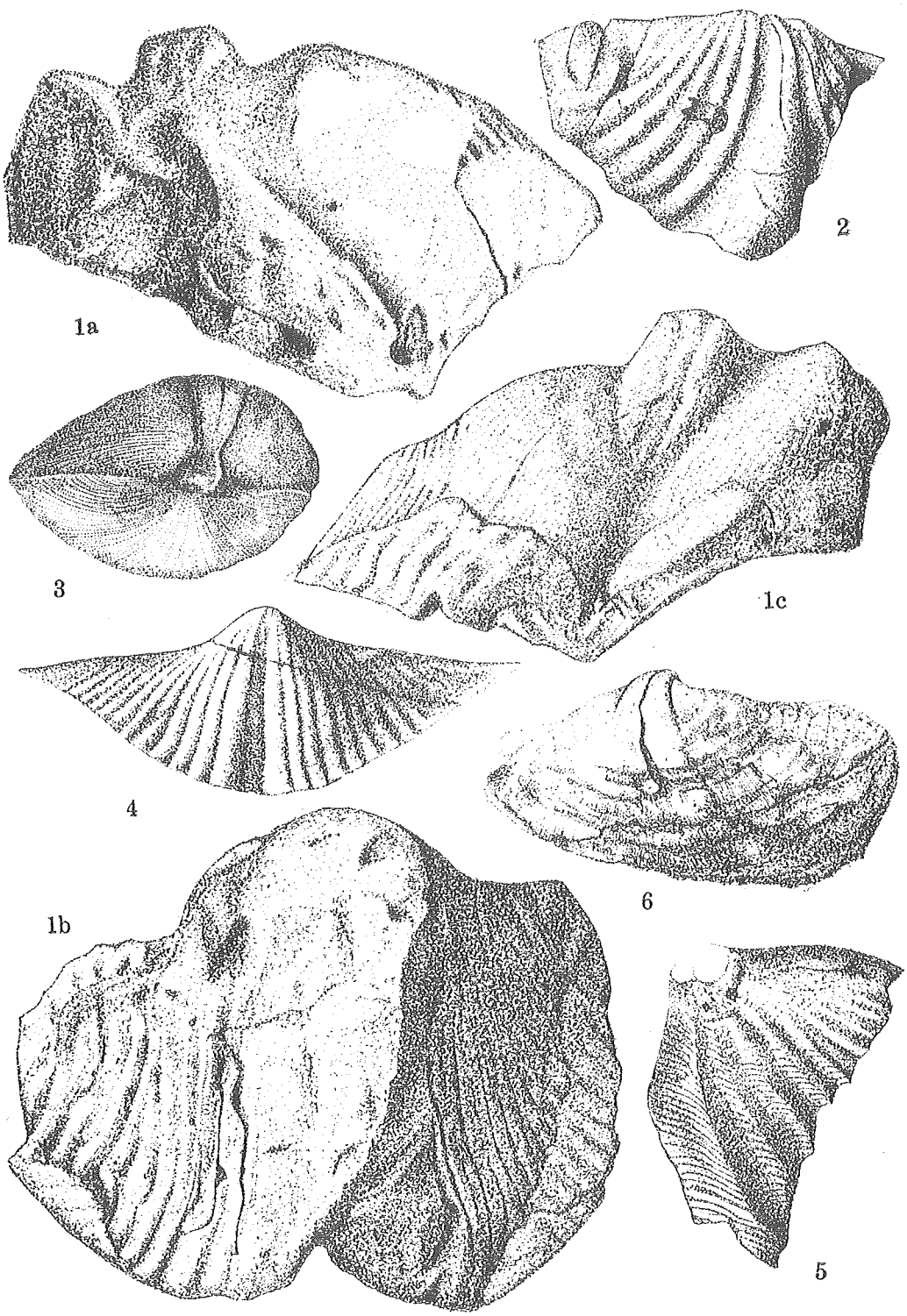

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Plate 8

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(All figures are twice in size, unless otherweise stated)

page

Fig. 1. *Derbyia depressa* DEMANET var. *transversa* MINATO, var. nov. 153
Hor. : Jumonji stage.
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 16271.

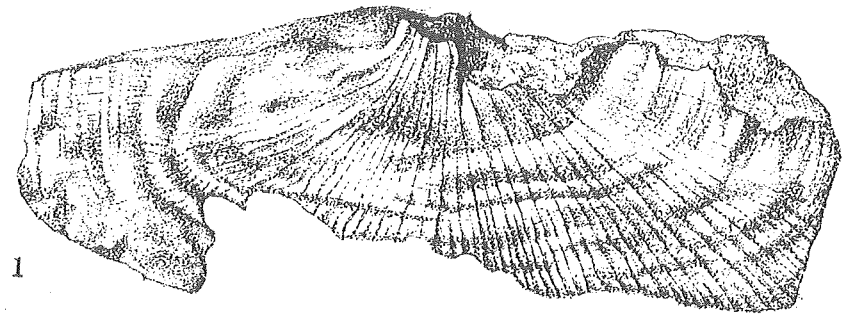
Fig. 2. *Spiriferina paratransversa* MINATO, sp. nov. 161
Hor. : Hikoroiti series.
Loc. : Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. Minato.
Reg. no. : 16271.

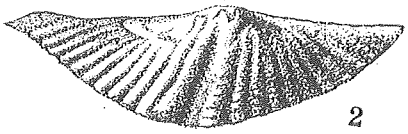
Fig. 3. *Spirifer ohmoriensis* MINATO, sp. nov. 158
Hor. : Hikoroiti series.
Loc. : Ohmori, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 15998.

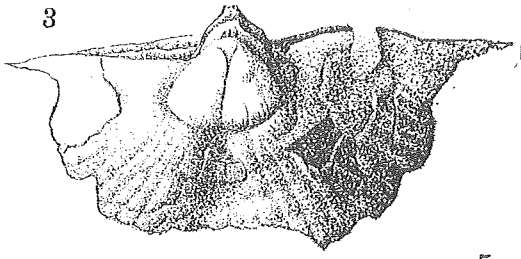
Fig. 4. *Actinoconchus planosulcata* (PHILLIPS) 174
Hor. : Hikoroiti series.
Loc. : Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 15973.

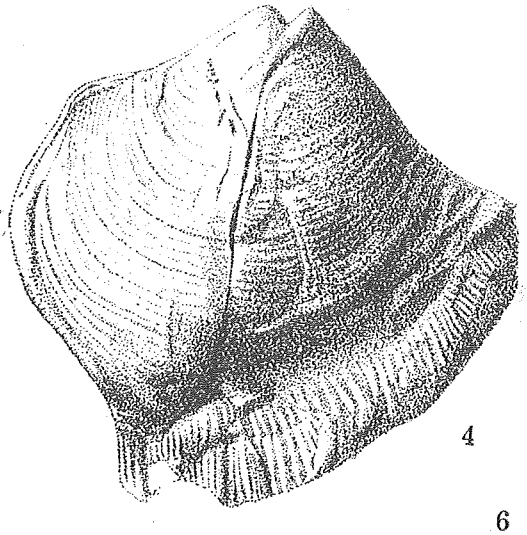
Fig. 5. *Kitakamithyris semicircularis* MINATO, sp. nov. 171
Showing the spine bases on the shell surface. much enlarged, ca 25 times.
Hor. : Hikoroiti series (Jumonji stage).
Loc. : Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 16224.

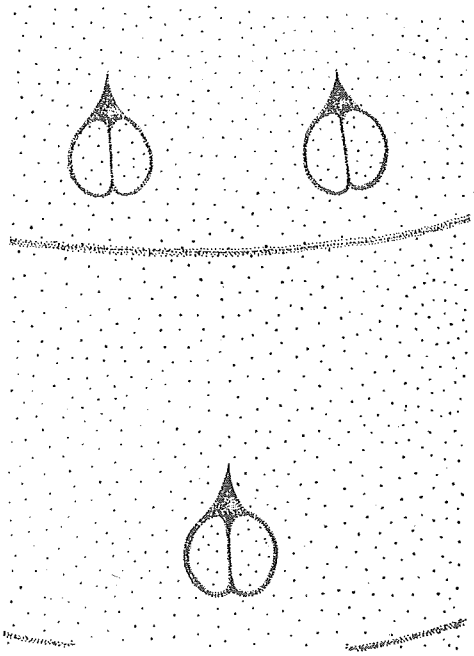
Fig. 6. *Kitakamithyris hikoroitiensis* (MINATO) 171
Showing the spine bases on the shell surface, much enlarged, ca. 25 times.
Hor. : Hikoroiti series.
Loc. : Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 16187.

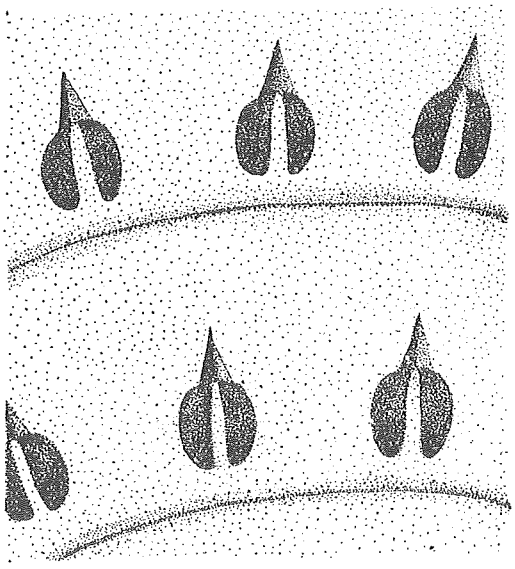












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(All figures are twice in size, unless otherweise stated)

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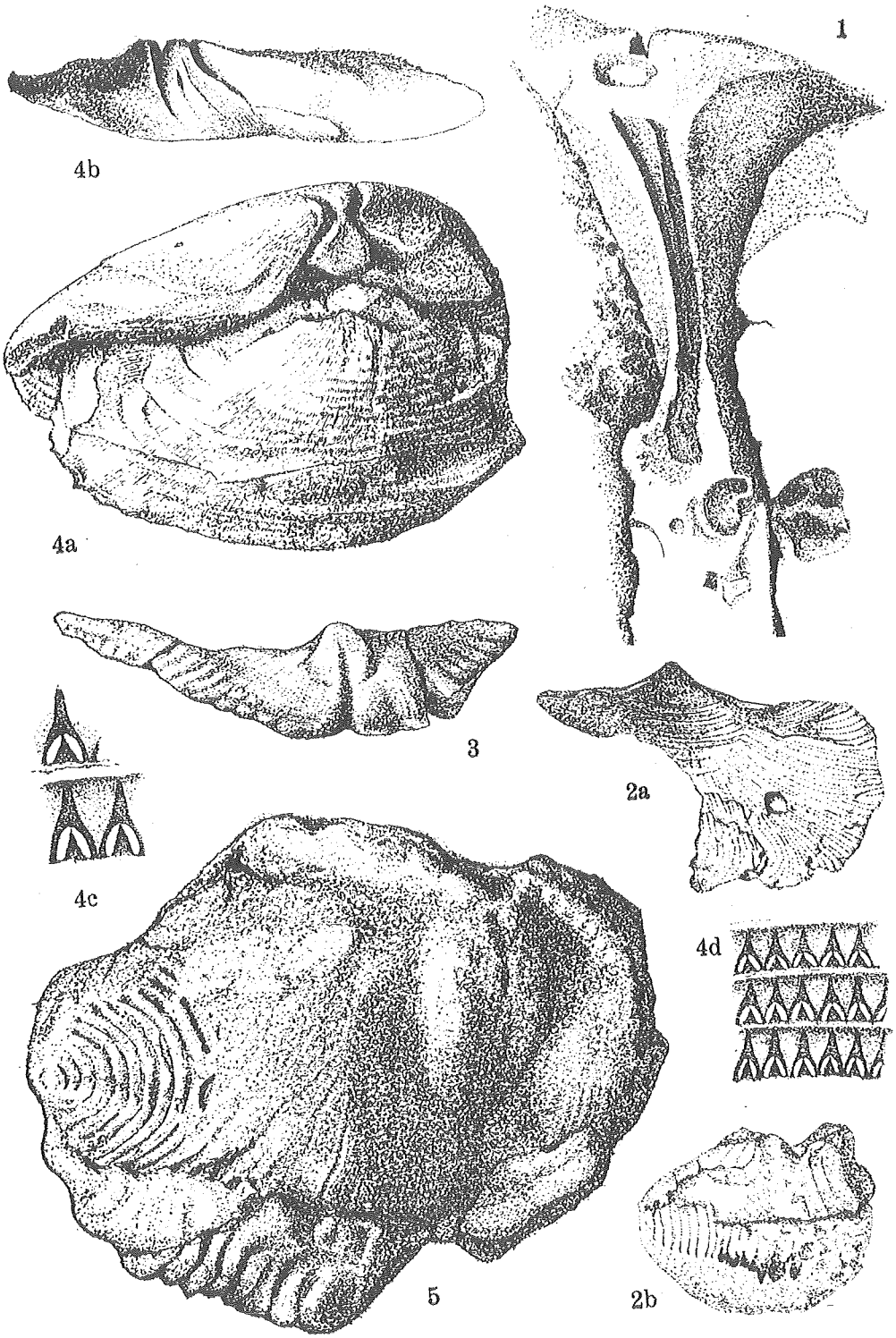
Fig. 1. *Syringothyris* sp. indet. 165
Enlarged ca 3 times.
Hor. : Jumonji stage.
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. nov. : 16062.

Figs. 2a, 2b. *Cliothyridina royssii* (L' EVILLE) 172
Hor. : Jumonji stage.
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 16021.

Fig. 3. *Spirifer ultratransversa* MINATO, sp. nov. 157
Hor. : Hikoroiti series.
Loc. : Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. Minato.
Reg. no. : 16027.

Figs. 4a, 4b, 4c, 4d. *Kitakamithyris tyoanjiensis* (MINATO) 170
4c enlarged ca. 20 times, 4d enlarged ca. 10 times.
Hor. : Hikoroiti series.
Loc. : Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 15990.

Fig. 5. *Plicatosyrinx* ? *kumanoi* MINATO, sp. nov. 169
Hor. : Jumonji stage.
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. Minato.
Reg. no. : 15992.



M. Misato : Further note on Carboniferous fossils Chiyoko del

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(All figures are twice in size, unless otherweise stated)

page

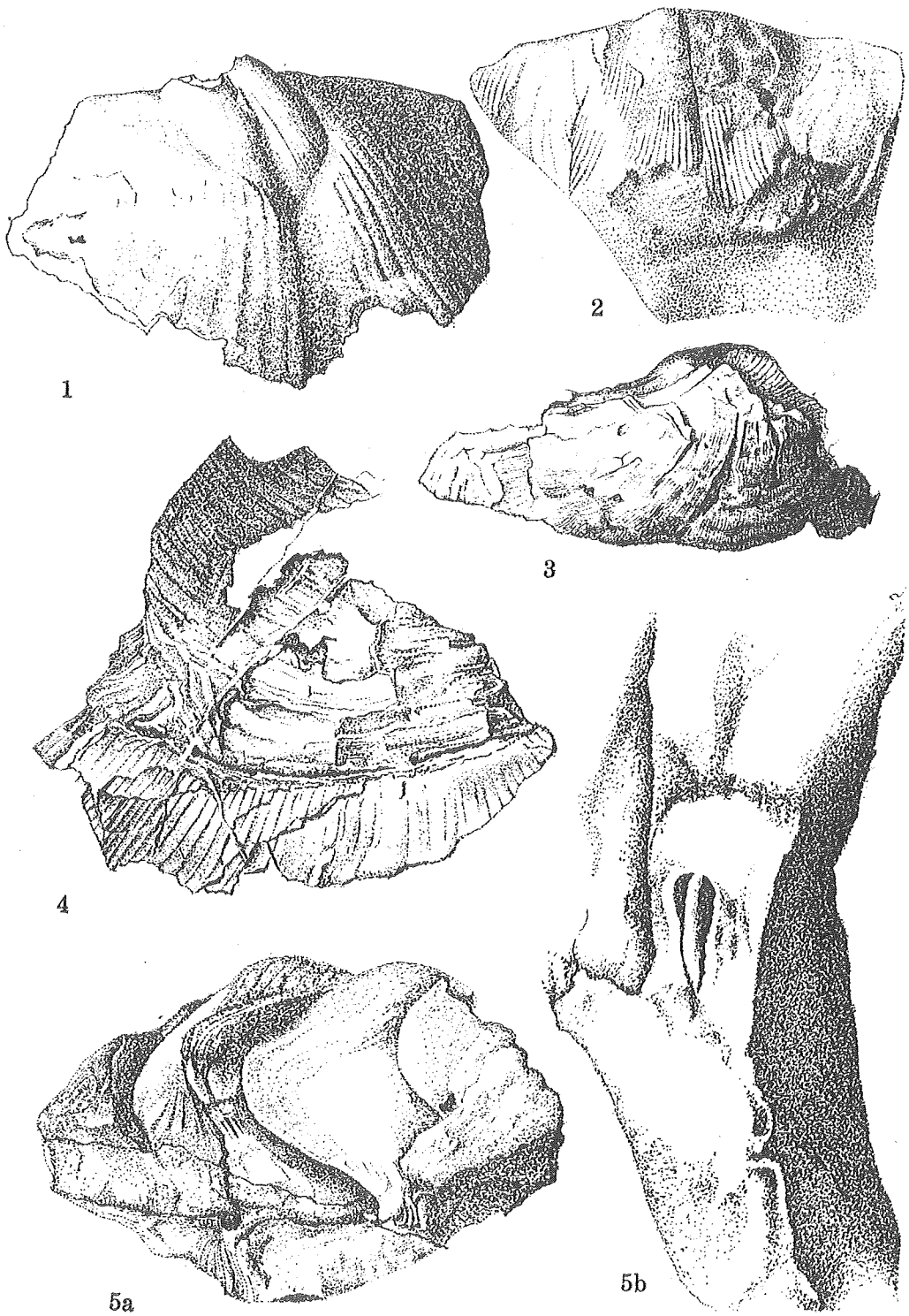
Fig. 1. *Spirifer ohmoriensis* MINATO, sp. nov. 158
Hor. : Hikoroiti series.
Loc. : Ohmori, Hikoroiti-mura, Kesen-gun, Iwate Prefecture
Coll. : M. MINATO.
Reg. no. : 15992.

Fig. 2. *Kitakamithyris* ? s. idndet. 172
Hor. : Hikoroiti series.
Loc. : 808 m. hill, Okubinozuti, Simoarisu-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 17137.

Fig. 3. *Kitakamithyris semicircularis* MINATO, sp. nov. 171
Hor. : Hikoroiti series (Jumonji stage).
Loc. : Ohmori, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 16769.

Fig. 4. *Actinoconchus planosulcata* (PHILLIPS) 174
Hor. : Hikoroiti series.
Loc. : Tyoanji, Hikoroiti-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 15973.

Figs. 5a, 5b. *Plicatosyrinx singulare* MINATO, gen. et sp. nov. 168
5b much enlarged, ca. 10 times.
Hor. : Jumonji stage.
Loc. : Kozubo, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : M. MINATO.
Reg. no. : 15981.



M. Minato : Further note on Carboniferous fossils Chiyoko del

Plate 11

Plate 11

(All figures are natural size)

page

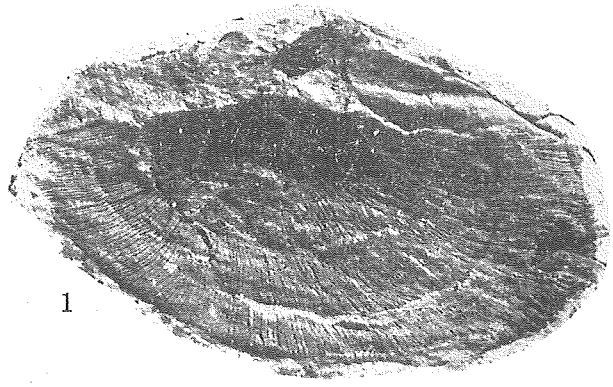
Figs. 1, 2, 4. *Orthotetes keokuk* (HALL) 151
Hor. : Jumonji stage.
Loc. : Miyojin-sawa, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : S. KIMURA.
Reg. no. : 17278, 17279, 17280.

Fig. 3. *Fusella nipponotrigonalis* MINATO 160
Hor. : Jumonji stage.
Loc. : Miyojin-sawa, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : S. KIMURA.
Reg. no. : 17281.

Figs. 5a, 5b. *Syringothyris transversa* MINATO 167
Hor. : Jumonji stage.
Loc. : Ohata-kita-sawa, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : S. KIMURA.
Reg. no. : 17289.

Fig. 6. *Actinoconchus lamelloso* (L'EVILLE) 173
Hor. : Jumonji stage.
Loc. : Miyojin-sawa, Yokota-mura, Kesen-gun, Iwate Prfeecture.
Coll. : S. KIMURA.
Reg. no. : 17287.

Fig. 7. *Pustula* cf *tenuipustulata* THOMAS 154
Hor. : Jumonji stage.
Loc. : Miyojin-sawa, Yokota-mura, Kesen-gun, Iwate Prefecture.
Coll. : S. KIMURA.
Reg. no. : 17288.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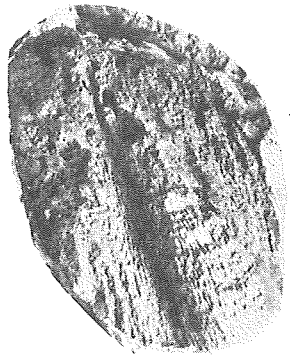
7


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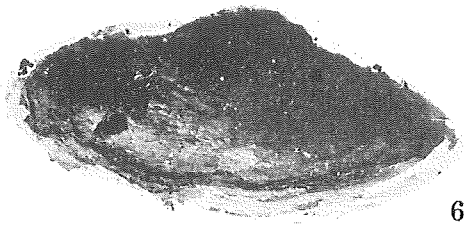
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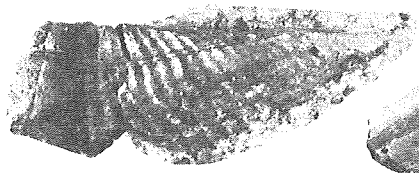
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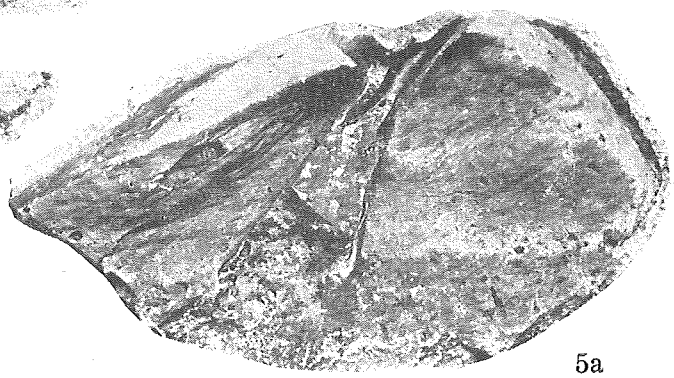
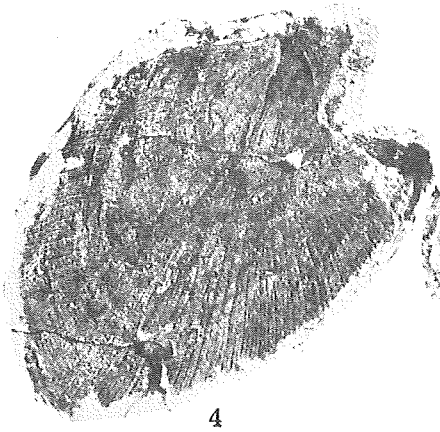
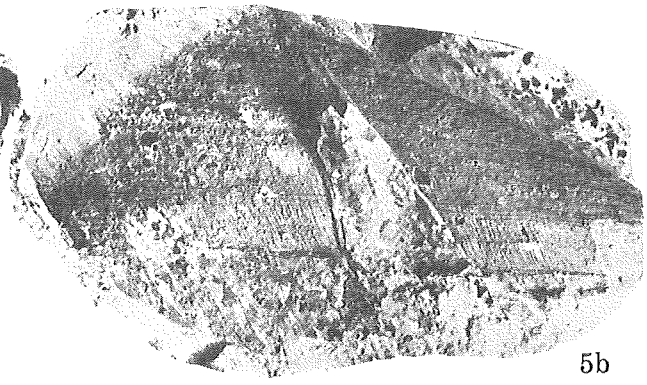

5a


4


5b

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