

Lower Permian Arthropods from the Taishaku Limestone, Southwest Japan

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I. Introduction

During the geological survey of the Taishaku Limestone, the writer collected some arthropod remains from a white massive limestone of the Miharano formation exposed on the southern slope at Miharano near Tojo town, Hiroshima Prefecture.

The Miharano formation has yielded many kinds of invertebrate fossils; such as fusulinids, corals, brachiopods, molluscs, etc. The arthropod remains occur in association with these fossils. The geological age of this formation is referable to the Early Permian.

In 1960 a preliminary report on the discovery of *Cyclus* was made by the present writer. Hayasaka and Nishikawa (1962) reported the occurrence of megafossils from the same locality. Some arthropods, *Ditomopyge* aff. *meridionaris* Teichert, *Griffithides* sp., Phillipsiidae gen. et sp. indet. and ostracods, are included in their lists, but no description has been given in detail.

In this paper are described these arthropods on hand and discussed on their geological and paleontological significances.**

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II. Notes on the Paleontology of the Fossil Arthropods

1. Trilobites

To date, 4 genera and 6 species of phillipsid trilobites were reported from the Japanese Permian System as follow:

genus *Paladin*: *P. yanagisawai* Endo et Matsumoto, *P.* sp.

genus *Ditomopyge*: *D.* aff. *meridionalis* Teichert

genus *Neoproetus*: *N.* sp.

genus *Pseudophillipsia*: *P. obtusicauda* Kayser, *P.* sp.

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** All of the specimens are deposited in the Laboratory of Earth Sciences, Faculty of Education.

Formerly almost all the Japanese trilobites collected from the Permo-Carboniferous formations were identified as *Phillipsia* or *Griffithides*, but the identification was not correct owing to lack in cephalic parts.

Endo and Matsumoto (1962) re-examined the whole specimens which were identified as *Griffithides* or *Phyllipsia*, and the result has ascribed most of them to *Pseudophyllipsia*, *Paladin*, or undetermined Phillipsids. Consequently, the occurrence of the genus *Griffithides* is yet to be confirmed in Japan.

The genus *Griffithides* Portlock was established by Portlock in 1843 on the basis of *G. longiceps* Portlock from the lower Carboniferous in England. Harrington et al. (1959) summarized the characteristics of the genus *Griffithides* as follows: Cephalon semioval, eyes small, central or slightly posterior; like *Phyllipsia* but glabella expanding forward, reaching or nearly reaching anterior margin, basal lobes of glabella long. Pygidium as in *Phillipsia* but few segments. The geological range of the present genus is from the late Upper Carboniferous to the Lower Permian, predominant in the Middle Carboniferous.

The Genus *Paladin* Weller, 1936 was first described by Mather in 1915 under the name *Griffithides morrowensis* Mather from the Morrow (lowest Pennsylvanian) group of Arkansas. The geological range of the present genus is from the Upper Mississippian Chester series to the Lower Permian Sakmarian.

In Japan, Endo and Matsumoto (1962) described *Paladin yanagisawai* from the Takakurayama formation, *Yabeina* zone, the Upper Permian. Later, Koizumi and Araki (1968) added the occurrence of *Paladin* sp. collected from Omotematsukawa, Kesenuma city, Miyagi Prefecture. The Japanese species *Paladin yanagisawai* has 8 to 9 axial and 6 to 7 pleural segments in the pygidium, respectively, while the type of the genus *Paladin* is composed of 14 to 16 axial, 9 to 10 pleural segments.

2. Genus *Cyclus* and the Uncertain Crustacean Fossils

Cyclus de Koninck was first described by Phyllips in 1836, under the name of *Agnostus? radialis* from the Carboniferous Limestone of Yorkshire. Later, de Koninck established the genus *Cyclus* with *C. radialis* as their species. Twelve species of this genus have been known. The phylogenetical position of the Family Cyclidae Packard has long been discussed by several workers, but the position remains unsolved. Trümpy has mentioned that certain representatives of the paleozoic Phyllocaria are reminded of by the cyclid. On the other hand, Hopwood has an opinion that there is some relationship between the family Cyclidae and the Copepoda. Glaessner, in the "Invertebrate Paleontology, part R", has concluded that systematic position of the Cyclidae is still uncertain. The geologic distribution of *Cyclus* may be continuous from the lower Carboniferous to the lower Permian. The genus *Cyclus* is distributed in the two areas. One is the area over England and Ural, and the other is North America.

During the recent 40 years, the genus *Cyclus* has been given no attention to by paleontologists. Kamarenko, however, reported in 1961 a new species of *Cyclus*

miloradowitchi from the lower Permian of the Urals. While, Goldring (1966) described a new species *Cyclus martimmensis* from the blocks of highly fossiliferous Carboniferous Limestone near Compton Martin. The discovery of *Cyclus* in Japan is of great interest not only because of its being the first occurrence in the Orient but also because the biohermal occurrence in the Permian Limestone.

Cyclus is the characteristic crustacean of the Coal Measures found distributed from North Europe to North America, but the present material was found in the beds of the lowest Permian in Japan. This is the first instance of the occurrence in the Orient, although its affinities, such as *Euproops jidoensis* Kobayashi, *Eurypteris chinensis* Grabou and *Coreocaris eishunensis* Kobayashi, have been reported from China and Korea. Such a displacement of the time may be possible when the distance involved in its migration either from Europe or from America is considered. The specimen of the genus *Cyclus* on hand differs from all the known species in having the well-developed bosses in anterior margin and strong Y-shaped ridge on the carapace, but their general features coincide with those of *C. simulans* Reed, *C. harknessi* Woodward and *C. wrighti* Woodward. The present specimen represents a new species on which the writer expects to make further study in the future.

The arthropods belong to the most ancient of all the known organic lineages. The Ordovician period was the time of maximum development of the trilobites, and here begins the fossil record of ostracods and malacostracans. They are found especially abundantly and in various kinds in the Younger Paleozoics. In the writer's collections, there are some large leaflike carapaces with calcified chitinous exoskelton pigmented in brownish color. These are undoubtedly arthropod remains, probably crustaceans. Some of the peculiar specimens from Miharano may be identified with such ancestral malacostracans as *Colpocaris* Meek which occurs from the Cambrian to the Permian (Pl. I, Figs. 15, 16).

In his collections there are different kinds of groups having suboblong valves like those of *Drepanella* Ulrich or *Drepanellina* Ulrich & Bassler with straight hingeline, sickle-shaped marginal ridge, common in the Ordovician to the Silurian. They look very much like ostracods, but are considerably large in size, reaching 3 to 5 mm in length (Pl. I, Figs. 17-21). The writer leaves a detailed discussion and systematic descriptions on these fossils in the future.

III. Descriptions and Remarks

Griffithides sp.

Pl. I, Figs. 1-5, 9.

The material on hand includes one incomplete cephalon, one pygidium and one enrolled specimen.

Glabella pyriform covered with chitinous exoskelton pigmented in brownish

color, swollen, expanding forward, overhanging front margin; reaching anterior margin.

Preoccipital lateral glabellar lobes large, slightly twisted quadrangle, but no median lobe.

Pygidium broadly rounded semicircular in outline. Axis composed of 9 to 11 segments, less than one-third as pygidium anteriorly, slightly decreasing in posterior elevation narrowing behind to blunt, round, elevated termination. Pleural lobes nearly horizontal above, composed of about 9 segments separated by shallow furrows. Border of pygidium narrow, distinctly separated from pleural lobes. Surfaces of the Pygidial lobes ornamented with rather fine granules.

Thorax incomplete, 6 segments visible. Axis of thorax a little more than one-third as wide as whole width of thorax, uniformly well-arched transversely.

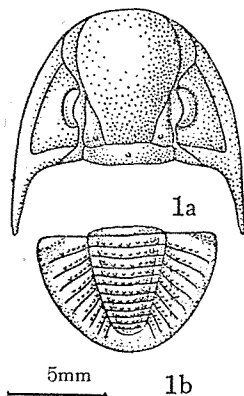


Fig.1. *Griffithides longiceps*
Vogdes;

a. cephalon b. pygidium

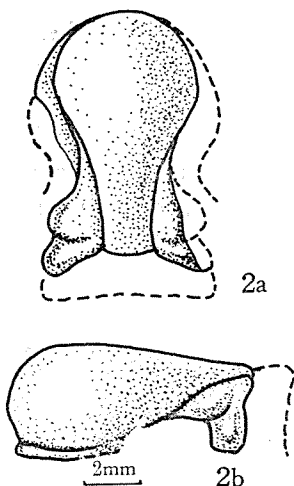


Fig.2. Glabella and occipital
lobes of *Griffithides* sp.
described in this paper.

a. dorsal view b. lateral view

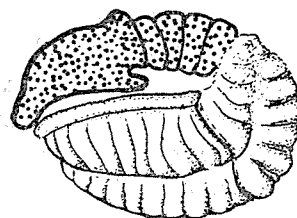


Fig.3. Spheroidal enrollment
of *Griffithides* sp. lateral
view.

Dimensions:

	specimen		
	No. 1	No. 2	No. 3
length of glabella (mm)	9		
basal width of glabella (mm)	7.5		
anterior width of glabella (mm)	6		
width of axial lobes (mm)		4	
number of segment of thorax		5	
number of axial segment of pygidium		11	9
number of pleural lobe of pygidium		9	8

Remarks: This genus may be closer to *Paladin* Weller than to the others, but this glabella reaches anterior margin, and has more distinct lateral occipital lobes than those of *Paladin* Weller, encroaching on anterior border but not reaching

anterior margin. The genus *Griffithides* is easily distinguished from *Delaria* Weller and *Ditomopyge* Newell by their lacking median preoccipital lobes. The present genus differs from *Pseudophillipsia* Gemmellaro, *Paladin* Weller in having fewer segments. *Bollandia* Reed resembles *Griffithides* Portlock in having overhanging front margin, but later glabella parallel-sided, with very large lateral preoccipital lobes. The genus *Griffithides* is common in the Carboniferous, but the present material were yielded in the lower Permian limestone. It might be a very interesting fact that the Miharano formation yields a large number of fossils common in the Carboniferous strata, such as *Mesolobes* sp., *Stylidophyllum* sp., *Carniaphyllum* sp., *Cyclus* sp., *Spirifer* sp., and so on. It is regarded as marine relicts separated from outside.

Locality: Hillside of Miharano, Tojo town, Hiroshima Prefecture, Northwest Japan.

Formation and age: The Miharano formation, *Pseudoschwagerina* Zone, The Lower Permian.

Paladin sp.

Pl. I, Figs. 6-8.

The material on hand includes one complete pygidium and one inner mould of an incomplete pygidium.

Pygidium broadly rounded behind. Axis composed of 8 to 12 segments, about one-third as wide as pygidium anteriorly, slightly decreasing in elevation posteriorly, narrowing behind to blunt, round, elevated termination. Pygidium framed by inflated wide marginal border. Border is well defined, becoming ambiguous and narrowed towards the anterior end. Crest of median axis arched transversely; furrows narrow and shallow, moderately impressed.

Dimensions:

	No. 1	No. 2
length of pygidium (mm)	13	8
number of segments of pygidium	12	8?
width of pygidium (mm)	17	
number of pleural lobes of pygidium	8?	

Locality: Hillside of Miharano, Tojo town, Hiroshima Prefecture, Northwest Japan.

Formation and age; Miharano formation, *Pseudoschwagerina* Zone, the Lower Permian.

Remarks; The number of pygidial segments of the present material resembles that of the type of the genus. On the contrary, *Paladin yanagisawai* which Endo & Matsumoto discovered in the upper horizon has fewer segments than

those of the type of the genus. Pygidial shape, flange of pygidium and crest of axis are closely akin to the general features of this genus.

Summary

The arthropod remains obtained from the Miharano formation, the Lower Permian System have been treated in this paper. Among them *Griffithides* sp. and *Paladin* sp. are described. A specimen of the genus *Cyclus* (crustacean) is the first occurrence in the Orient. Notes are also included on some malacostracan fossils and ostracods.

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Explanation of Plate

Figs. 1-5, 9. *Griffithides* sp.

1, 2, 3. Dorsal (1), rear (2) and lateral (3) views of an enrolled specimen. Chepalon is uncertain.

4, 5. Dorsal (4) and lateral (5) views of a fragmental glabella.

9. Dorsal view of a complete pygidium showing the axis and lateral lobes.

Figs. 6-8. *Paladin* sp.

6, 7. Dorsal (6) and rear (7) views of a complete pygidium showing the axis and lateral lobes.

8. Inner mould of an incomplete pygidium showing the axis and broad border.

Fig. 10 *Phillipsiidae* gen. et sp. indet.

Dorsal view of a fragmental pygidium showing the axis.

Figs. 11-14. *Cyclus* sp.

Dorsal (11), lateral (12), frontal (13) and rear (14) views showing the anterior bosses and Y-shaped ridge.

Figs. 15,16. *Crustacea* gen. et sp. indet.

Dorsal views of a incomplete carapace (15) and another specimen (16) showing the leaf-like outline and chitinous exoskelton.

Figs. 17-21 *Ostracoda* ?, gen. et sp. indet.

17, 21. Dorsal (17) and lateral (21) views of a carapace showing the straight hingeline, spines, nodes and pitted surface.

18, 19, 20. Dorsal views of the other specimens.

