UPPER CAMBRIAN OF KAIPING BASIN.

BY Y. C. SUN.

CONTENTS.

The Cambrian of China is developed in Yunnan, Shantung, Chihli and Manchuria. The first collection of Cambrian fossils was made by Von Richthofen and described by Dames and Kayser. Dames studied the trilobites and Kayser described the brachiopods.

In 1905, the Carnegie Institution of Washington sent the Willis Expedition to China to study the geology and palæontology, and they collected many specimens from the Cambrian of China; and these were studied and described by Dr. Ch. D. Walcott.* (Research in China Vol. 3, 1913). This is one of the most important palæontological works on China that has yet appeared.

In 1912 Mansuy's work on the Palæontology of Yunnan appeared, in which Lower Cambrian fossils are among the species described from that region. Yabe and Hayasaka in 1920 published their Palæontology of S. China. This includes a brief summary of the Cambrian but without description of new species.

All the fossils, however, which so far have been studied by those different authors include only the lower, the middle and the lower part of the upper division of the Cambrian.

Two years ago, a Survey expedition went to Ma Chia Kou (馬家溝) and Chao Kou Chuang (趙各莊) to study the stratigraphy of the Kaiping Coal Basin. The party included Professors Grabau, and Barbour, Mr. Chean and myself, and we were joined in the field by Dr. F. F. Mathieu and Mr. Jacques Gerard. During that trip we collected many fossils from that basin. The fossil plants were sent by the Survey to Sweden for study; and when

Prof. A. W. Grabau described the Ordovician fossils, he asked me to study the Cambrian fossils. Although I planned to take up this work more than one year ago, pressure of other studies has prevented it until now.

This year we are giving a course in Chinese index fossils to the fourth year students of the geological department of the National University, and in connection with this I have taken the opportunity to go over all the Cambrian materials in our collection. As I went over the materials before assigning each student his share, I was surprised to find that the Cambrian fossils which we collected in the Kaiping Basin represent an entirely new fauna. It is quite a distinct fauna from any so far known in China, and from its stratigraphic position as well as its palæontological character it clearly belongs to the uppermost part of the upper Cambrian. Two new genera and several new species are found in the material so far collected from this region.

Stratigraphy.

The upper Cambrian of the Kaiping Basin is divided into two divisions. The lower one we call Changshankou Formation, being well developed at Chang Shan Kou (長山溝) north of Chao Kou Chuang, and the upper one the Fêngshan (鳳山) Formation found in the Ma Chia Kou region.

Chongshankou Section.

This section is exposed in a small ravine on the northern outer rim of the basin near Chang Shan in the Chao Kou Chuang region.

It was measured by Prof. Grabau and Mr. Barbour. The following is the succession in descending order.

25.	Ordovician limestone		
24.	Covered (possible disconformity)	160 ft.	
23.	Brown fossiliferous shale (128)	3 ft.	
22.	Covered	8 ft.	
21.	Intraformational conglomerate	2 ft.	8 in.
20.	Fossiliferous green shale and limestone alternating ¼″-1½″ (127)	5 ft.	2 in.
19.	Intraformational conglomerate	4 ft.	3 in.
18.	Brown to purple shale (126)	3 ft.	
17.	Intraformational conglomerate	1 ft.	10 in.

16.	Purple shale (125)		6 in.
15.	Covered interval	4 ft.	3 in.
14.	Intraformational conglomerate	4 ft.	
13.	Purple shale (124)	2 ft.	8 in.
12.	Edgewise conglomerate		8 in.
11.	Shale	1 ft.	
10.	Covered	3 ft.	
9.	Edgewise conglomerate	7 ft.	
8.	Covered	9 ft.	
7.	Edgewise conglomerate	2 ft.	
6.	Covered	8 ft.	
5.	Brown shale	2 ft.	
4.	Covered	11 ft.	
3.	Edgewise conglomerate	8 ft.	
2.	Alternating thin bedded limestone and shale	30 ft.	
1.	Covered		

This formation consists of several beds of conglomerates and shales. The shales are fossiliferous and of purple color. They suggest the possibility that the series is lower upper or even late middle Cambrian which would indicates that there is a great hiatus between the top of this series and the Ordovician. The following fossils are found.

Trilobites:

Agnostus hoi Sun sp. nov.

Changshania truncata Sun gen. and sp. nov.

Changshania conica Sun gen. and sp. nov.

Anomocarella transversa Sun sp. nov.

Anomocare cf minus Dames

Anomocarella sp.

Brachiopods:

Obolus mollisonensis Walcott

Obolus (*Bröggeria*) *salteri*? (Hall)

Obolus sp.

BRIEF CHARACTERIZATION OF NEW SPECIES*

Agnostus hoi Sun.

This species differs from Agnostus douvillii Bergeron described by Dr. Walcott, in its narrower anterior border, its subconical glabella, the median tubercle of the glabella and also in size, being only half that of Walcott's specimens.

Changshania Sun:

This genus is represented by several cranidia and pygidia. Glabella subconical either truncated or not; Occipital furrow well pronounced. Pygidium transverse with axis lobe strongly segmented.

Changshania truncata Sun:

This is characterized by its truncated glabella.

Changshania conica Sun:

This species is characterized by its conical glabella while the pygidium is characterized by its transverse form.

Anomocarella transversa Sun:

This species is characterized by its transverse pygidium which is distinct from that of other species.

Anomocare cf minus Dames:

This specimen differs from the type species figured by Walcott in size and also in its narrower frontal limb.

Obolus mollisonensis Walcott:

This is in external form similar to *Obolus* (*Bröggeria*) *salteri* of the upper Cambrian of Europe. The surface is marked by fine, irregular, concentric lines and striæ of growth.

Obolus (*Bröggeria*) *salteri*? (Hall).

This is grooved concentrically by a few inequidistant, strongly marked lines of growth and by numerous fine lines.

FÊNGSHAN SECTION.

In the region NE of Ma Chia Kou, (馬家溝) near the small village of

*The fossils will be more fully discussed in Palæontologia Sinica, series B, Vol I fascicle 4 (in preparation).

Yeh Li, (冶里) the Fêngshan formation is well exposed at the foot of Fêngshan. This formation consists of two parts. The lower part is shale standing nearly vertical and chacterized by the following two species *Changia chinensis* Sun (gen. and sp. nov.) and *Ptychaspis* sp. The upper part is limestone diping from 38° to 48° westward. (fig. 1.)

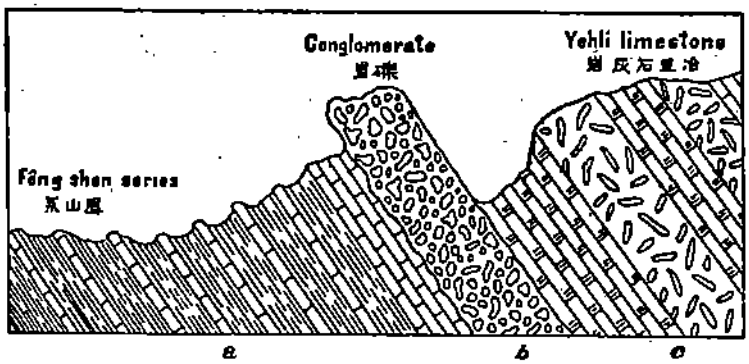

Fig. 1. Section of Uppermost Cambrian of Fêng Shan near Yeh Li, Chihli. a. Fêngshan Series, b. based conglomerate, c. Yehli limestone. (From Museum Handbook)

Above this Fengshan limestone lies disconformably the basal conglomerate of the lower Ordovician.

The significance of this conglomerate lies in the fact that it marks a period of distinct emergence, followed by erosion and resubmergence of the region. In this region, the uppermost beds of upper Cambrian (Fêngshan limestone) were followed disconformably by only 1 meter of conglomerate according to our measurements in that region. (fig. 2) But it nevertheless indicates a long exposure, because the pebbles are not only wel rounded buti

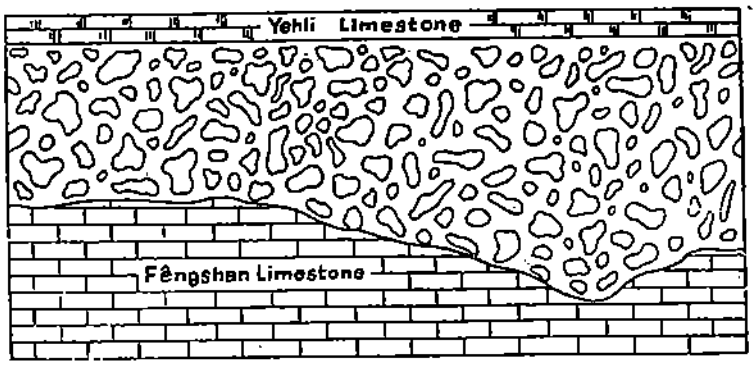

Fig. 2. Diagrammatic section to show the disconformable contact of ordovician on uppermost Cambrian at Fêng Shan, near Yeh Li, Chihli. (From Museum Handbook)

each is surrounded by an oxidation zone which was clearly formed before the pebbles were inbedded in the rock. The amount of erosion during this period of exposure was probably not very great. When the conglomerate dies out, the disconformity is scarcely recognizable.

The Fêngshan limestone is a thin-bedded slightly argillaceous calcilutite weathering into a yellowish clay upon the surface where the fossils are exposed. Many of the fossils are weathered upon the surface, and therefore not readily determinable specifically. The fauna consists entirely of trilobites and brachiopods. The following fossils were found.

Brachiopods:

Lingulella kayseri Grabau sp. nov.

Obolus kuanhsiensis Graban sp. nov.

Trilobites:

Anomocare punctatus Sun sp. nov.

Ptychaspis subglobosa Grabau sp. nov

Ptychaspis suni Grabau sp. nov.

Ceratopyge orientalis Grabau sp. nov.

Illaenurus canens Walcott

Teinistion? sp.

BRIEF CHARATERIZAEI ON NEW SPECIES.

Changia Sun:

This genus is characterized by its elongate glabella and its broad convex frontal limb.

Changia chinensis Sun:

This species is represented by one cranidium from Kaiping. It is common in Chaumitien limestone of Shantung.

Anomocare punctatus Sun sp. nov.

This species is characterized by the punctate character of its glabella and in its broad limb.

Lingulella kayseri Grabau:*

This appears to be the same as the specimen, noted and figured as

*Described in Manuscript.

Lingulella sp. by Kayser and which was obtained by von Richthofen from Liautung. But Kayser's specimens are larger than our specimens and apparently without their ornamentation.

Obolus luanhsiense Grabau:*

This species is very similar to *Lingula potalon* Hick in size and form.

Ptychaspis subglobosa Grabau:*

This species approaches *Ptychaspis calyce* Walcott from the upper Cambrian Ch'aumitien limestone of Shantung, in the form of the glabella but the anterior lobe is longer and more nearly subglobose, while the second furrow is more deflected backwards medially and less continuous than in that species.

Ptychaspis suni Grabau.*

This resembles *Ptychaspis campe* Walcott from the upper Cambrian Ch'aumitien limestone of Shantung in the form of the gabella, fixed cheeks and palpebral lobes, and in the pustulose character of the carapace. The occipital furrow of our species is however very much deeper than in that species being moreover continuous while it is interrupted in the center in the Shantung species. Our species is also nearly twice as large as *Ptychaspis campe*.

Ceratopyge orientales Grabau.*

This species differs from *Ceratopyge forficula* in the less tapering character of the axis of the pygidium.

Conclusion.

I do not want to take the time to mention each species in detail. The descriptions of the species will appear in time in the Palæontologia Sinica. The few points I am going to emphasize are as follows:

So far only two species of *Ceratopyge* have been found. One of them, *Ceratopyge forficula*, found in NW. Europe and the other discovered in Canada and called *C. canadensis*. Both European and American species were found in the lower Ordovician beds of these respective contries, but our species *C. orientalis* is found in the upper Cambrian of the Kaiping Basin below the Cambro-Ordovician disconformity. This suggests that our

*Described in Manuscript

species was the ancestor of the other two and that the genus migrated, on the one hand, into Europe and on the other to America. That is the reason why foreign species occur at a higher stratigraphic position than our species.

As we know, the lower Cambrian of China is characterized by *Redlichia*, the middle by *Dorypyge*, *Drepanura* and *Crepicephalus* and the upper by *Ptychaspis*, *Obolus* and *Lingulella*. The lower Cambrian of N. America on the other hand is characterized by *Olenellus* and *Holmia*, the middle by *Paradoxides* and *Olenoides* and the upper by *Olenus* and *Dicellocephalus*. The Redlichia fauna occurs in the Salt Range of northwest India and in west Australia. This means that during lower Cambrian time the sea in which the *Redlichia* lived, entered China from the south and then retreated.

The middle Cambrian fauna is quite distinct from the lower and has its nearest analogue in western North America and perhaps northern Siberia. This indicates that during middle Cambrian time the sea entered the Chinese geosyncline from the northeast extending to Shantung and even to Indo China and bringing in the new fauna.

Finally in upper Cambrian time the sea spread northwestward permitting the migration into western Europe of the derivatives of the Chinese upper Cambrian fauna. In spreading, the upper Cambrian sea covered regions previously unsubmerged thus depositing upper Cambrian beds directly upon the older rocks. That is the reason why we find the middle Cambrian followed by the lower part of the upper Cambrian in some sections as in Shantung and only the upper part of the upper Cambrian in others as in Fengtien where the lower part of the upper Cambrian the middle and the lower cambrian are wanting. This indicates that the upper Cambrian sea did not extend very far until at the end of the upper Cambrian.

Towards the end of this period, however, the Chinese Cambrian sea was connected with the west American sea on the one hand and the European on the other. But the connection with the Atlantic was only local in eastern North America and western Europe. In China there are no Atlantic elements in any division of the Cambrian.