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| Title | Leptophloeum in the close of the upper devonian in eastern Asia |
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| Citation | 長崎大学学芸学部自然科学研究報告. vol.9, p.31-34; 1959 |
| Issue Date | 1959-01-31 |
| URL | http://hdl.handle.net/10069/33263 |
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This document is downloaded at: 2019-03-22T23:03:16Z

LEPTOPHLOEUM IN THE CLOSE OF THE UPPER DEVONIAN IN EASTERN ASIA.

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1. Introduction.

In Eastern Asia, *Leptophloeum* is widely distributed in China, Australia, and Japan. But, regarding the Upper Devonian formations, its relation to each other has been yet known in details. In 1947, the writer discovered the Devonian plant from Japan. This plant is very characteristic of the Upper Devonian, especially in Australia and China. But, these plant-bearing formations are not always of the same age. In Japan, this plant, namely *Leptophloeum* is found in the Famennian, while in Australia as well as China it occurs also in the Frasnian. Thus, *Leptophloeum* occurs at somewhat various ages and horizons. The writer palaeogeographically considered the relation between these plant-bearing formations.

2. Plant-bearing Upper Devonian formations in Eastern Asia

In Eastern Asia, the Upper Devonian is widely distributed in Australia, China, India, U. S. S. R., and in Japan. Particularly, *Leptophloeum* of the indices of the Upper Devonian frequently occurs in these regions.

In Western Australia, the Upper Devonian has been reported by Teichert from the Kimberley division. In the eastern portion of the Kimberley division, according to Matheson and Teichert, the Upper Devonian is divided into the Upper Burt Range series and Lower Cockatoo series. The former series is further divided into two parts. *Leptophloeum* is included in the Lower Burt Range series and Cockatoo series. The Lower Burt Range series is correlated with the *Productella* limestone of the western portion, which is by Teichert considered to be of the Oberdevon IV, namely *Platyclymenia* zone of German. The *Productella* zone includes 55 species of brachiopods, in which *Cyrtospirifer* cf. *disjunctus* and *Camarotoechia* cf. *pleurdona* are in common with the fauna of the Tobigamori formation, but this zone seems to be slightly earlier in age than the Tobigamori, because of *Indospirifer*, *Theodossia* and *Mesristella* which has not yet been known from the Tobigamori characterized by the mix fauna of the Carboniferous and Devonian types. Thus, though the Low-

er Burt Range series includes *Leptophloeum australe* in the highest portion associated with *Syringopora* and rugose corals, it is slightly older than the Tobigamori. On the other hand, the Upper Burt Range series conformably resting upon the Lower is closely related in age the Tobigamori formation, being characterized by the shallow water deposits. It is thought to be of very young Devonian age, being correlated to Stages V and VI, namely *Oxicylmenia* and *Wocklumeria* zones of Schindewolf., and Matheson and Teichert states as follows. "This conclusion is also supported by the appearance of large productids in this part of the section, heralding the approach of the Carboniferous faunas." Therefore, the Tobigamori formation may be probably correlated with the Upper Burt Range series.

In Eastern Australia, the writer tentatively correlated the Tobigamori formation with the Lambie series of New South Wales, because of the common occurrence of *Cyrtospirifer*, a small species of *Camarotoechia*, and *Leptophloeum australe* in both formations, and these two resemble also in the environment of sedimentation, being a shallow water deposits intercalated with red coloured rocks. But, as already stated, in the Tobigamori formation there seem to be lacking such *Hypothyridina*, *Stropheodonta* and *Atrypa* as collected in the Lambie. These fossils rather indicate lower horizon than the Tobigamori, namely the Frasnian. Benson states as follows. "In Victoria it is known only in the supposed Lower Carboniferous Avon River sandstones, which are believed to overlie the Upper Devonian sandstones with perfect conformity", and furthermore he stated "Indeed there has been considerable doubt as to whether the Avon River beds should not be considered Upper Devonian also." According to Benson, the Avon River Sandstones is considered by Woodward to be Lower Carboniferous by the presence of fish remains and *Lingula*. Though the writer can not determine whether the age of the Avon River Sandstones is of Upper Devonian age or not, if it rests upon the Lambie series of the Frasnian age with perfect conformity as stated by Benson, there is probability that it may be to be included in the Upper Devonian from the abundant occurrence of *Leptophloeum australe*. According to Benson, the Avon River sandstones also have the same lithic character as the Lambie *Leptophloeum australe* also occurs in the Barraba series, which is covered by the basal conglomerates of the Burindi series. Though the Barraba series seems to be considered Lower Carboniferous, the latter Burindi series contains undoubtedly the Tournaisian species in the lower part. Accordingly the Barraba series unconformably overlain by the basal conglomerates of the Burindi may belong to lowest Carboniferous or uppermost Devonian. Though its arcuate age is not determined to the writer, probably it may be of Upper Devon-

ian age. Besides these, Maxwell reported the Famennian fauna of the *Sulcatospirifer* zone from the Mt. Morgan district. But this fauna seems not to be correlated with the Tobigamori formation. The Star series, north-west of Townsville, includes the Upper Devonian brachiopods, but Maxwell states a part of the series may extend into the Lower Carboniferous. Accordingly, a part of this Upper Devonian may be compared with the Tobigamori.

As stated above, though most of the Upper Devonian of Australia contain both plants, especially *Leptophloeum australe* and *Cyrtospirifer*, they are considered to be somewhat older than the Tobigamori. But, the following formations, such as the Upper Burt Range series of Western Australia, the Avon River Sandstone of Victoria, the Barraba series of New South Wales and the Star series of Queensland may be closely near the age of the Tobigamori.

In China, the Upper Devonian marine deposits have hitherto been reported from the various places of South China, being characterized by *Cyrtospirifer sinensis*, *Yunnanella* and *Hypothyridina*. Of these fossils, *Yunnanella* has also been reported by Crickmay (1952) from the later Upper Devonian, in Alberta, Canada.

The Frasnian is widespread in South China and clearly indicates that there the Frasnian sea was rather widespread whereas the Famennian sea dwindled and was marked by continental deposits. Thus, as far as the marine Upper Devonian formation is concerned, those of China are thought to be somewhat older than the Tobigamori formation.

On the other hand, *Leptophloeum* also has been reported by Sze from the Upper Devonian of China. But most of marine Upper Devonian in which *Leptophloeum* occurs is older than the Tobigamori, excepted with the terrestrial *Leptophloeum*-bearing formation of the Famennian. Generally speaking, the Famennian regression was remarkable in South China as well as Australia. These *Leptophloeum*-bearing formations must have been deposited in the isolate basins on the Angara continental land which have been widely uplifted in the Famennian time. Judging from the appearance of the large productids of Carboniferous type in the Tobigamori formation, however, the marine transgression which is remarkable in the Carboniferous would have started at a close of the Devonian in some parts of a circumference of the Angara land.

Excepted with the Upper Devonian of China and Australia, the Tobigamori and Sulcifer formations of Kazakhstan are closely related to each other, based upon the fossil evidences. It is supposed that the Famennian sea of Kazakhstan connects with that of Japan through near the Great Khingan region, furthermore extending to Western Australia and Western America.

The Upper Devonian of Western America closely resembles the Tobigamori formation. But, it seems to be slightly older than the Tobigamori. Probably, the Upper Famennian of the Oberdevon V stage seems to be lacking, and it is overlain by the early Kinderhookian with a remarkable unconformity.

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