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A PRELIMINARY STUDY ON THE GRAPTOLITES IN THE TAITZEHO VAILLEY, LIAOTUNG

A. T. Mu

Institute of Palaeontology, Academia Sinica

During the course of the stratigraphical studies of the Taitzeho valley Liaotung Province, N. E. China in April-September 1950, the members of the Taitzeho party were able to make a considerable collection of graptolites in association with trilobites, brachiopods and ostracods from the Cambro Ordovician beds. The graptolites, chiefly the Dendroids, seem to be entirely new to science. They are derived from four areas along the Tzitze river, namely, the Yentai, Penchi, Hsiaoshih and Tienshihfu areas counting from west to east. The first one belongs to the Liaoyang district and the remainder to the Penchi district. The age of the lower Palaeozoic rocks of this region has not yet been definitely settled. The present discovery affords therefore a considerable interest.

Stratigraphically, the graptolites in the Taitzeho valley range from the Upper Cambrian Yenchou formation up to the Yehli formation of Tremadocian age. The Yenchou formation is overlain by the Ellesmereoceroids-bearing Wanwankou limestone, which is succeeded by the Chiushukou formation characterized by the presence of abundant trilobites *Tellerina*, *Calvinella*, etc. Above the Chiushukou, there is a massive, dark, crystalline dolomite formation, namely the Hsiapingchou dolomite, in which only Piloceroids- and graptolite-remains have obtained. Upon this dolomite, lies a series of thin-bedded limestone, dolomite and "wurmkalk" intercalated with layers of shales rich in graptolites. This is known as the Yehli formation, but formerly it was regarded by the Japanese geologists as the lower part of the so-called Wolung or Santo formation of Canadian age. The three formations between the Yenchou and the Yehli are the Kobayashi's Wanwanian series, considered by that author as Tremadocian according to the Ellesmereoceroid fauna. On the other hand, Prof. Y. C. Sun had assigned this series to the Upper Cambrian based on trilobites. It seems to the writer that the Yenchou, Wanwankou and Chiushukou formations may be regarded as belonging to the Fengshanian of Upper Cambrian, and the Hsiapingchou and Yehli formation

as belonging to the Yehlian of Tremadocian. The Hsiapingchou dolomite is better to be considered as a basal member of the Yehli formation.

The graptolites in the region concerned may be roughly grouped into four zones. In ascending order, they are (1) *Dictyonema wutingshanense* zone, (2) *Dendrograptus lotolatzensis* zone, (3) *Dictyonema flabelliforme liaotungense* zone and (4) *Callograptus? taitzehoensis* zone. The first named zone represents the uppermost part of the Yenchou formation, while the remainder are all in the Yehli formation. The first zone is probably corresponding to the Lodi shale graptolite zone of Trempealeau formation, North America. The second and third zones may be correlated with the zone of *Dictyonema flabelliforme* of Europe and N. America. The fourth zone, the zone of *Callograptus? taitzehoensis*, may be the equivalent of the *Bryograptus* zone of Britain, the *Staurograptus dichotomus* zone of N. America, and the *Bryograptus victoriae* and *Staurograptus-Dictyonema* zones of Victoria, Australia.

The detailed descriptions of the Taitzeho graptolites will be reserved for a later report. The purpose of the present account is to describe briefly only those forms which have been determined with a reasonable degree of certainty.

(1) *Dictyonema flabelliforme liaotungense* var. nov. (Pl. I, fig. 1). This species bears the essential characters of *Dictyonema flabelliforme typica*. It only differs from the latter in the close arrangement of the stipes and rare dissepiments.

(2) *Airograptus* sp. aff. *A. furciferus* Ruedemann (Pl. I, fig. 2). It closely resembles *Airograptus furciferus* figured and described by Ruedemann. The stipes of the former are much broader than the latter. Ruedemann referred this species to *Dictyonema* in 1904, and later in 1916 regarding the peculiar apertural process as its characteristic feature, he established the genus *Airograptus*. Bulman, however, considered this genus a synonym of *Dictyonema*. It seems to the present writer that this genus is more closely related to *Callograptus* than to *Dictyonema*, because the characteristic apertural spines of the former are quite different from the cross bars or dissepiments of the latter. In spite of the fact that a mesh-like structure may be formed by the apertural spines, it cannot be compared with the meshes of *Dictyonema*.

(3) *Callograptus? taitzehoensis* sp. nov. (Pl. I, fig. 4), and (4) *Callograptus? yentaiensis* sp. nov. These two species have entirely no dissepi-

ments. They represent probably a new generic type that is derived from *Callograptus*.

(5) *Dendrograptus odontocauloides* sp. nov. (Pl. I, fig. 3). This species is in "*Odontocaulis* condition" with thecate stem. (6). Another species *Dendrograptus ptilograptoides* sp. nov. (Pl. I, fig. 6) represents probably a transitional form between *Dendrograptus* and *Ptilograptus*.

(7) *Anisograptus lui* sp. nov. (Pl. I, fig. 5). The species resembles *Clonograptus tenellus clavei* Elles et Wood at first glance, but differs therefrom only in the triate "funicle". It is not impossible that some species of *Anisograptus* have been formerly wrongly referred to *Clonograptus*. Ruedemann considered the genus *Anisograptus* a primitive form, and later Bulman transferred it to Dendroidea, because of the presence of bithecae.

From the foregoing account, it appears clear that the majority of the Taitzeho graptolites falls within Dendrograptidae. A few words must be said, in this connection, concerning this comprehensive family Dendrograptdae.

The unknown ancestor of Dendrograptids is, in the writer's opinion, probably a *Dictyonema*-like form, for many of the Cambrian graptolites have dissepiments and parallel and subparallel branches. This *Dictyonema*-like ancestor may probably give rise to three series of graptolites, the *Dictyonema* series, the *Callograptus* series and the *Dendrograptus* series.

(1) The dissepiments of the irregularly branched *Dictyonemas* may remain unchanged (i. e. the "*Dictyodendron*" group) or changed into anastomosis (*Desmograptus*). (2) The regularly branched *Dictyonemas* (i. e. the "*Dictyograptus*" group) may evolve into *Callograptus* and at least a part into Graptoloidea by losing the dissepiments and bithecae, and (3) the *Callodendrograptus*-form may link the *Dendrograptus* to the *Dictyonema*-like ancestor.

The family Dendrograptidae may be thus divided into three subfamilies:

1. Dictyoneminae. Stipes united by dissepiments or anastomosis forming meshes.
2. Callograptinae. Stipes dichotomous, parallel or subparallel, with very few dissepiments or absent.
3. Dendrograptinae. Stipes irregularly branched without dissepiment.

For their phylogenetic relationships, see diagram given in page 31.