

TWO LATERALLY BRANCHED GRAPTOLITES

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It is known that the branching of the graptolite stipes falls into two types, the dichotomous and the lateral. In the former type the two branches split off simultaneously and symmetrically with equal magnitude in position; whereas in the latter type the main stipes and the lateral ones differ considerably.

The branching of all the primitive forms of the true graptolites belong to the dichotomous type. Those of laterally branching stipes began to become abundant in the late Lower Ordovician time. It seems probable that the laterally branching forms were derived from the dichotomous type. *Goniograptus* is a genus representing the transitional form between the two types, as is shown in textfigure 1 (p. 92).

The lateral branches in the laterally branched graptolites may originate either from two sides of the main stipe or from one side only. The two graptolites described in the present paper branch in the manner of the first kind. In *Pterograptus* the lateral branches are arranged alternately; whereas in *Amphigraptus* they are arranged in pairs. Both of them include a few species of a world-wide distribution. *Pterograptus* has been found in Europe, Australia and South America; and *Amphigraptus* was known to occur in Europe and North America. The two new species described in the present paper are the Asiatic representatives of these two genera. They are *Pterograptus sinicus* sp. nov. and *Amphigraptus asiaticus* sp. nov. The former was procured by Messrs. C. S. Wang and H. T. Piên from the Yenchi slate near Yenchi, Anhua district, central Hunan; and the latter was collected by Messrs. T. Y. Tien, C. K. Chang and C. S. Liang from the Pingliang shale at Kuanchuang, Pingliang district, eastern Kansu.

Description of Species

Genus *Pterograptus* Holm

Pterograptus sinicus sp. nov.

Pl. I, Figs. 1, 2.

This species is represented by some ten specimens, including two complete rhabdosomes. The sicula is short, about 0.8 mm in length. The two main

stipes diverge first at an angle of 60° and then downward, becoming parallel to one another. The rhabdosome measures 22.5 mm long from the sicular apex to the distal end of the rhabdosome with a breadth of 6.8 mm. Each main stipe bears five simple lateral branches, which originate alternately from the left and the right sides of the main stipes. The lateral branches grow first outwards and then downward becoming parallel to each other, and even parallel to the distal portion of the main stipes. Both the main stipes and the lateral branches are 0.5 mm in width. There are 8 thecae in a length of 10 mm. The thecae are narrow and cylindrical, very steeply inclined towards the axis of the stipes. The apertures of the thecae are slightly concave with a rather sharp apertural edge. The overlap of the thecae is very small, only $1/6-1/5$ of the thecal length.

In the laterally preserved specimens the alternate arrangement of the lateral branches may be distinctly observed. The kind of arrangement of the lateral branches is one of the characteristic features of this genus.

Remarks: This new species strongly resembles the genotype, *Pterograptus elegans* Holm^[5] in the form of the rhabdosome, but it differs therefrom in the less number of the lateral branches, in the loose arrangement of the thecae, and in the narrower width of the rhabdosome. From the other known species of the genus, such as *Pterograptus scanicus* Moberg and *P. indistinctus* Monsen of northern Europe^[3, 7, 8], *Pterograptus lyricus* Keble et Harris and *P. incertus* Harris et Thomas of Australia^[4], and *Pterograptus* sp. Bulman and *P. longissimus* Rusconi of South America^[12], it can be easily distinguished by the form of the rhabdosome. At first glance our species bears some resemblance to *Adelograptus* (*Bryograpti* with two primary stipes)^[1], but the character and the arrangement of the lateral branches are different.

In 1947 R. Ruedemann described a new species of *Syndyograptus*, *S. bridgei*, from the Ledbetter shale of Washington, N. America. In the writer's opinion, it is most probably a *Pterograptus*. Ruedemann writes: "Stipes form angle of about 340° and are slightly curved inward towards the extremities. The sicula is inconspicuous, 0.8 mm long. The thecae are little projecting," (1947, p. 374-375)^[11]. But the figures of the same species (1947 pl. 61, figs. 24-28)^[11] clearly show that the stipes are *declined*, forming an angle of about 50° and the sicula is *conspicuous*. The lateral branches are alternately arranged and occasionally paired. The thecae are of Dichograptid

type. If the figures of that species are correct, it is obviously not a *Syndyograptus*; for the characteristic features of *Syndyograptus*, such as the reclined main stipes, the erect and paired lateral branches and the Leptograptid thecae as defined by Ruedemann himself^[10] are all right away from his new species *Syndyograptus bridgii*.

Horizon and locality: *Pterograptus sinicus* sp. nov. was found from the Yenchi slate near Yenchi of Anhua district, central Hunan in association with *Didymograptus* sp., *Climacograptus* (*Pseudoclimacograptus*) *scharenbergi* Lapw., etc. This assemblage indicates the Llanvirnian age of late Lower Ordovician not Tremadocian as Wang and Pien stated (1949, p. 65)^[13].

Cat. No. 6627 a-b (holotype), 6628 (Paratype).

Genus *Amphigraptus* Lapworth
Amphigraptus asiaticus sp. nov.

Pl. I, fig. 3, 4.

This species is represented by one complete rhabdosome and several stipe fragments. The rhabdosome is composed of two rigid main stipes, each of which measures about 5 cm in length with a uniform width of 1.2 mm. Each main stipe bears a pair of lateral branches, which originate about 5 mm apart from the sicula. All the lateral branches are rigid and arranged in radiating position. They resemble the main stipes in essential characters. The thecae are of Leptograptid type. They are 2 mm in length, about 3-4 times as long as wide. The apertural margin of the thecae is straight and introverted with a rather deep excavation. There are 10 thecae in a length of 10 mm. The overlap of the thecae is 1/3 or more.

In the sicular portion only a simple tube or a "funicle" is seen. The detailed structure of the sicula is unknown. All the main stipes and the lateral branches grow horizontally. Thus, they are frequently seen in the dorsal or ventral view. Their true profile can be hardly observed. In the ventrally preserved specimens the straight apertural margins and the apertural excavations may be distinctly seen. The free part of the thecae shows a spine-like appearance in the obliquely lateral view.

Remarks: Two species of *Amphigraptus* were reported from the Normanskill shale of North America^[11] known as *Amphigraptus divergens* (Hall) and

A. multifasciatus (Hall). The former seems to comprise two different species. Whether the latter is an *Amphigraptus* or not is still an open question. In Europe Lapworth, Elles and Wood^[2] had described three *Amphigrapti* from the Upper Ordovician Hartfell shale, namely, *Amphigraptus divergens* (Hall), *A. radiatus* Lapworth, and *A. distans* Elles et Wood. The European *Amphigraptus divergens* (1901-1918, p. 122, Pl. 18, fig. 1)^[2] is not identical with that originally figured by Hall. In the European specimen the lateral branches are crowded together; while in the Hall's original drawing (1947, pl. 59, fig. 27)^[1] the lateral branches are given off typically in pairs. Therefore, the European form may represent a new species. *Amphigraptus radiatus* Lapworth was regarded as a variety of *Amphigraptus divergens* by Elles and Wood^[2]. The writer is of the opinion that it is a species of *Pleurograptus*^[3], for the lateral branches of that species are not arranged in pairs, and each main stipe bears one lateral branch only. Recently C. Rusconi described an *Amphigraptus*-like graptolite from Mendoza, Argentine, South America. It is identified by that author as a new species of *Dichograptus*, *D. quebradensis* Rusconi (12, p. 119, fig. 7). The paired lateral branches and the Leptograptid thecae are all similar to those of *Amphigraptus* and quite different from *Dichograptus*.

Comparing with the forms mentioned above, the writer noticed that the present new species *Amphigraptus asiaticus* is more related to the genotype, *Amphigraptus divergens* (Hall) of N. America. From that species our form differs in the more simple rhabdosome, in the robust stipes and in the longer distance between the lateral pairs.

Horizon and Locality: *Amphigraptus asiaticus* sp. nov. occurred in the Pingliang shale at Kuanchuang of Pingliang district, eastern Kansu Province in association with *Nemagraptus gracilis* (Hall), *N. exilis* (Lapworth), *Dicellograptus divericatus* (Hall), *Climacograptus bicornis* (Hall), etc. The Pingliang shale is Middle Ordovician in age.

Cat. No. 6629 a-b (holotype).