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NEW MATERIAL OF AZYGOGRAPTIDAE AND ITS SIGNIFICANCE

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Summary

Among the graptolites collected by Unit 734 from the Lower Ordovician Qiaotingzi Formation (corresponding to the Ningkou Formation) at Xiayanzhai of Jishou, Hunan, more than ten specimens particularly chosen from the collection were handed over to the writer for study. These specimens preserved as mere carbonaceous films in grey green slate belong to one new genus and the same new species named by the writer *Jishougraptus mui* gen. et sp. nov. in association with *Didymograptus* cf. *praenuntius* Törnquist.

The rhabdosome of this new genus is composed

of only one deflected and uniseriate stipe, and the initial bud of *Jishougraptus* gen. nov. is identical in morphology and development with that of *Azygograptus*, especially of *Azygograptus fluitans* Ge. The stipe extends from the sicula to form a deflexion with the slightly wavy dorsal margin without folding and the development of the initial bud is of the modified dichograptid type (Mu En-zhi and Lee Ji-jin, 1960, p. 34). But this new genus differs strikingly in the character of the thecae which are of the elaborate leptograptid type characterized by the thin, slight geniculation

of the ventral wall, introversion of the apertural part and pouched apertural excavation.

In thecal character, *Jishougraptus* gen. nov. is essentially identical with *Nicholsonograptus* Boucek et Pribyl, 1951 and *Pseudazygograptus* Mu, Lee et Geh, 1960. All of them are similar in the thecae of the elaborate leptograptid type, but differ from each other in the mutated level and the character of the initial bud. According to Wang Xiao-feng (1975, pp. 7—8), in *Paradidymograptus* the development of the initial bud is of the modified isograptid type and the first pair of thecae presents a similar L-form. It is quite evident that in the development of the initial bud deflected obviously outwards, *Nicholsonograptus* is different from *Paradidymograptus* and is alike to *Azygograptus* and *Jishougraptus* gen. nov. But it is questionable that the development of the initial bud in *Nicholsonograptus* is higher than in *Sinograptidae* (Wang Xiao-feng, 1975, p. 8).

This new genus closely resembles *Sinazygograptus* Wang et Wu, 1977 and *Hemiholmograptus* Hsü et Chao, 1976 in the morphological character of the rhabdosome, but differs obviously in the thecal character. According to Wang Xiao-feng and Wu Zhao-tong (1977), the thecae of *Sinazygograptus* with dorsal folds and ventral folds belong to the sinograptid type. The thecae of *Hemiholmograptus* Hsü et Chao, 1976 also presented dorsal folds and ventral folds as well considered by Hsü Jie and Chao Yu-ting (1976). However, *Azygograptus falciformis* Ekström, 1937 assigned by Hsü Jie and Chao Yu-ting (1976) to the type species of *Hemiholmograptus* have not been found to possess dorsal folds and ventral folds. It is a common knowledge that *Azygograptus falciformis* Ekström belongs to the genus *Nicholsonograptus*. Thus, the two genera *Hemiholmograptus* and *Nicholsonograptus* are synonymous. According to ICZN, the name of *Hemiholmograptus* should be deposed.

The mutation of the thecae is an important nature in the evolution and taxonomy of graptolites, while the differentiation of thecal morphology is a reflection of the various genetic and ecological characteristics of the graptolitic zooid. al-

though the differentiation of thecal morphology is also considered as one of the marks indicating the evolution and taxonomy of graptolites (Lapworth, 1876; Elles and Wood, 1901—1918; Bulman, 1938, 1955, 1970; Mu En-zhi, 1950; Mu En-zhi and Lee Ji-jin, 1960; Jaanusson, 1960; Rickards, 1976; Rickards, Hutt and Berry, 1977, etc.). Especially, this has gradually drawn attention to the thecal mutation of the *Axonolipa Graptoloidea* since Mu En-zhi (1957) made a study of *Sinograptidae* (Skevington, 1965, 1966; Jaanusson, 1965; Bulman, 1969; Archer and Skevington, 1973; Wang Xiao-feng, 1975; Hsü Jie and Chao Yu-ting 1976; Mu En-zhi et al., 1979). But the differences in the examination and understanding of thecal mutation have usually led the researchers to lay undue stress on the importance of thecal mutation but put so far as on all of the thecal mutation of the Lower Ordovician graptolites to the family *Sinograptidae* (Skevington, 1965, 1966; Jaanusson, 1965; Boucek, 1973; Hsü Jie and Chao Yu-ting, 1976).

According to Mu En-zhi and Lee Ji-jin (1960), the tendency of thecal mutation in the Lower Ordovician graptolites fell into two principal types, namely, a) folded type; and b) outward curved type. Mu En-zhi (1963) further pointed out that the elaborate thecae in the Chilianshan graptolites fell into three principal types, namely, a) inward curved type, b) outward curved type and c) folded type. Moreover, Wang Xiao-feng (1975) put forward that thecal mutation in the Lower Ordovician *Graptoloidea* presented three principal types, namely, a) folded type, b) outward curved type, and c) bundle-shaped type. As mentioned above, thecal mutation of the Lower Ordovician *Graptoloidea* fall into four principal types, namely a) folded type, e.g. *Sinograptidae*; b) outward curved type, e.g. *Atopograptidae*; c) inward curved type, e.g. *Dicellograptus praesextans* Mu, Geh et J. X. Yin; and d) bundle-shaped type, e.g. *Nicholsonograptus* and *Jishougraptus* gen. nov.

Bulman (1969, p. 9) pointed out that "This presumably represents either the formation of abnormally large zooidal buds or a delay in produ-

ction of the protheca relative to the preceding metatheca (since the configuration of the metatheca, may in some instance influence the form of the succeeding protheca), or both." That is to say, owing to the secretion by the graptoloid zooid in life, the ventral folds or elaborate metatheca might have formed the difference in the fusellar tissue. From modern biology, it is known that the growth rate resulting from gene control and environmental influences has something to do with the growth hormone. It may be assumed that due to the action of the growth hormone, various graptoloid zooids are enabled to form the same or similar thecae, indicating a convergence process; conversely, the graptoloid zooids of the same genetic material are enabled to form various forms of thecae, indicating a divergence process. The thecal differentiation in the shape between *Azygograptus succicus* and *Azygograptus underinus* is a result of divergence, and the similar thecal form between *Paradidymograptus* and *Nicholsonograptus*, *Jishougraptus* gen. nov. of the same elaborate leptograptid type may well be considered as a result of convergence, but differs in the form, the development and the budding ability of the initial bud. It is quite evident that *Paradidymograptus* can not be regarded as an ancestor of the primitive species of *Jishougraptus* gen. nov. and *Nicholsonograptus*. Based on the Law of growth correlation, the variability between the development and characteristic of the stipe, the thecal feature and the initial bud, are of mutual relation and with influence on each other. Thus, the evolution with interrelation to the various genera may be shown in Table 1, but *Azygograptidae* and *Sinograptidae* may be parallel in evolution (Rickards, 1977).

Fossil description

Azygograptidae Mu, 1950

Genus *Jishougraptus* gen. nov.

Type species: *Jishougraptus mui* gen. et sp.

nov.

Diagnosis: Rhabdosome composed of one deflected and uniseriate stipe. Dorsal margin of the stipe slightly undulate but without folds. Thecae long and thin, with no presence of bundle shape, belonging to the elaborate leptograptid type. Development of dichograptid type.

Jishougraptus mui gen. et sp. nov.

(Pl. I, figs. 1—14)

Rhabdosome with only one stipe, curved downward and slightly concave toward dorsal margin. Stipe 19 mm in length, gradually widening outwards from 0.23 mm at the first apertural part of thecae to 0.4 mm at the fifth apertural part, and to 0.5 mm at the distal end.

Sicula 1.1—1.2 mm in length, 0.2 mm in width, with its apex tapering upwards and connected with the nema, which is 1 mm in length. Aperture of sicula curved opposite to the first thecae. Virgella slightly visible. First theca growing at about one-third of sicula, rapidly extending downward along the wall of sicula and finally diverting just 0.3 mm below sicula's aperture at an angle of 20°.

Thecae 2 mm long in proximal part of rhabdosome lengthening to 3.2 mm at the distal end, numbering 2.5 in proximal 5 mm, and 6 in 10 mm, with the first theca 0.15 mm in width, and distal ones up to 0.23 mm in width. Dorsal margin of the theca's initial portion (prothecae) slightly convex but not forming dorsal folds; ventral margin slightly curved and geniculate in the middle portion, but slightly straight and parallel to an axis of the stipe in the distal portion. Thecal aperture introverted, possessing a tiny spine or process in the curved ventral margin. Excavation pouch-shaped or crevice-formed. Overlap one-half.

