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## EARLY AND MIDDLE DEVONIAN BOUNDARY STRATA OF HOBOKSAR, WEST JUNGGAR AND THEIR BRACHIOPODS

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### Summary

Devonian strata are well distributed and exposed in the Hoboksar district of west Junggar, Xinjiang, containing abundant fossils. This is one of the most important areas to study the Devonian strata and their fauna of Xinjiang.

The Lower Devonian of this district was divided into the Utublake, Mangeer and Mangkelu Formations (Hou, 1981). Among them, the Utublake Formation has recently been assigned to the Upper Silurian based on graptolites. The Mangkelu Formation is mainly composed of argillaceous limestone, marl and calcareous sandstone, with a thickness of 210m, and contains rich fossils; it is considered as of the Lower Devonian due to the absence of typical Middle Devonian genera and the occurrence of many typical middle Lower Devonian taxa of other countries (Hou, 1981). In this district, only the late Middle Devonian Hujiersite Formation composed of sandstone, siltstone and silty mudstone contains abundant plants. Therefore, the early Middle Devonian strata are recognized as lacking in west Junggar; on the contrary, the early Middle Devonian marine strata and their fauna are developed in east Junggar. This serves as one of the important features to distinguish west Junggar from east Junggar.

In 1985, there has been found a series of strata consisting of sandstone and siltstone intercalated with marl, argillaceous limestone and biotrital limestone between the Mangkelu and Hujiersite Formations and yielding rich brachiopods and corals, about 140m in thickness; the strata are very different not only from the Hujiersite Formation, but also from the Mangkelu Formation in

lithologic and biotic characters, suggesting that it is necessary to establish a new stratigraphic name—the Hefeng Formation—for these strata.

The corals from the Mangkelu and Hefeng Formations were studied by Liao and Cai (1987), who pointed out that these corals could be referred to the late Siegenian-early Emsian *Orthopaterophyllum sharburens* Assemblage and the Givetian *Endophyllum zhifangense* Assemblage respectively.

A few brachiopod genera and species from the Mangkelu Formation had been described by Zhang and others in 1983. As a matter of fact, this formation contains abundant and highly diversified brachiopods (see Table I in Chinese Text). Among them, the stropheodontids are very important and characteristic, only occurring in Lower Devonian, such as *Gladistrophia* and *Rhyistrophia*; *Cymostrophia* and *Leptodonta* mainly appear in Lower Devonian, with only a few species extending into Eifelian; *Leptaenopyxis* of strophomenids are widespread in late Early Devonian, while *Meristella* of athyrids is rather common in the Mangkelu Formation, and occurs in the Lower Devonian over the world. However, *Meristella* was wrongly reported in the Middle Devonian of South China (Tien, 1938; Wang *et al.*, 1964; Yang *et al.*, 1977; Liu *et al.*, 1982). Spiriferids are also very common and remarkable for this formation. For example, *Paraspirifer* is defined within Upper Emsian—Lower Eifelian by Solle (1971); *Xinjiangospirifer moriensis* Hou et F. M. Zhang is very similar to *Acrospirifer kazakhstanica* Kaplun of upper Lower Devonian of Kazakhstan; “*Megakozłowskiellina*” is very close to *Megakozłowskiella* which only occurs in Lower Devonian and Eifelian; *Howellella* is a very common taxon in Silurian and Lower Devonian, with only a few species possibly extending into Eifelian.

To sum up, the brachiopod fauna of the Mangkelu Formation should be assigned to the upper Lower Devonian or the Emsian of Europe in age, and can be completely correlated with those of the Jinshui and Helongmeng Formations in Northeast China, the Wendueraobaote Formation of Inner Mongolia, and the Sardjar and Kazah beds of Kazakhstan.

The brachiopods from the Hefeng Formation are represented by astonishingly rich individuals and monotonous genera and species. Among them, *Kymatothyris* is the most abundant in individual, which ranges from the latest Early Devonian to early Middle Devonian in Germany based on previously known record. *Fallaxispirifer* Su, 1976 from late Early Devonian—early Middle Devonian and *Puanospirifer* Jiang, 1978 from early Middle Devonian might be the synonym of *Kymatothyris*, while *Acrospirifer korovini* (Khalfin) and *A. houershanensis* Hou et Xian of early Middle Devonian are also very similar to *Kymatothyris simplex* sp. nov.

It is worth notice that one evolutionary orientation of the plicae in acrospiriferids is from coarse and strong in Early Devonian *Acrospirifer*, *Hysterolites*, etc., to plain and weak or disappearing in Middle Devonian *Kymatothyris*, *Undispirifer* to *Renothyris*, etc., indicating that the appearance of numerous *Kymatothyris* in the Hefeng Formation is actually not occasional, and may be closely related to the age of the strata.

It is necessary to point out that some beds of the Hefeng Formation bear a remarkable resemblance to the Mangkelu Formation in lithological characters, such as marl, argillaceous limestone, biodetrital limestone, especially in its lower part, but they are quite different from each other in brachiopod fauna. Most brachiopod genera and species from the Mangkelu Formation disappear in the Hefeng Formation, with only a few elements extending into the Hefeng Formation (see Table I), and a few new taxa appearing in the new strata.

All these indicate that the Hefeng Formation should be referred to early Middle Devonian; especially, the brachiopods mentioned above are associated with the coral *Endophyllum*, which has never been found in the Lower Devonian, but might occur in early Middle Devonian. In addition,

many brachiopods from the Hefeng Formation could not extend into the late Middle Devonian, either.

As mentioned above, the Lower Devonian strata and biota are very developed in Kazakhstan, Xinjiang, Mongolia, Inner Mongolia and Northeast China, and can be entirely compared with each other. However, the lower Middle Devonian strata are not well-known until now; Struve (1982) also pointed out that the lower Middle Devonian marine strata could not be completely developed from the eastern Ural Mountains.

In west Junggar, the lower Middle Devonian strata and fauna have been reported (Hou, 1981; Zhang, 1988), but no description has been given up to now. The lower Middle Devonian Yikewusu Formation and its brachiopod fauna in Inner Mongolia have been published by Zhang in 1985; this brachiopod fauna is very different from that of the Hefeng Formation, except for the *Endo-phyllum* which has been found in both formations.

The lower Middle Devonian strata and brachiopods of western Mongolia were published by Alekseeva (1977) and Mendbayar (1975); however, it seems very difficult to correlate these brachiopods with those of the Hefeng Formation. It is very clear that in lithological characters the lower Middle Devonian strata of both localities mentioned above are obviously different from those of the Hefeng Formation.

## DESCRIPTION OF NEW TAXA

### *Leptaenidae* Hall et Clarke, 1894

#### *Leptaenopyxis* Havlicek, 1967

#### *Leptaenopyxis* (*Hefengia*) subgen. nov.

**Type species** *Leptaenopyxis* (*Hefengia*) *hefengensis* sp. nov.

**Diagnosis** Shell medium-sized; pedicle valve evenly convex, with dorsally directed trail; lateral margin highly raised in ventral direction as in *Leptaenopyxis*. Dorsal valve strongly convex, with greatest convexity in front; disc even, with anterior and flanks tending to bend angularly toward opposite valve; ornamentation consisting of costellae and concentric rugae. Ventral muscle platform circular, occupying nearly one-half of disc; dorsal cardinal processes stout; brachiophores broadly divergent; muscle field large and long, halved by a low longitudinal ridge.

**Discussion** Since *Leptaenopyxis* reported from the upper Lower Devonian of Europe, USSR, Mongolia and China includes several different forms, it is necessary to establish some subgenera for this genus as follows:

Subgenus I. *Leptaenopyxis* (*Leptaenopyxis*), with *L. (Leptaenopyxis) bouei* (Barrande) as the type species. The diagnosis can be given as: Shell large-sized, moderately convex, with long trail in dorsal direction, high diaphragm in dorsal valve and moderate muscle field in both valves. Besides the type species, this subgenus includes *L. Louei* form *rara* Astashkina, 1974; *L. bouei* morpha subquadrata Gratsianova, 1973; *L. bouei* morpha bata Gratsianova, 1973; *L. planus* Astashkina, 1974 and *L. rectangulata* Ushatinskaya, 1969. This subgenus ranges from Belgium, France, Germany, Czechoslovakia, the East Ural, Kazakhstan, Altai, Xinjiang, Mongolia, Inner Mongolia to Northeast China.

Subgenus II. *Leptaenopyxis* (*Yujiangia*), with *L. (Yujiangia) intermedia* Hou et Xian as the type species which might come from South China only. This subgenus is characterized by its medium size, long dorsally directed trail, equally moderate biconvexity, undeveloped diaphragm and medium-sized muscle platform.

Subgenus III. *L. (Hefengia)*. This subgenus differs from the above two subgenera in its me-

dium-sized shell, short ventral trail with dorsal trail lacking, gently convex ventral valve, highly convex dorsal valve, particularly large muscle field in both valves, and absence of diaphragm, often with a complete shell, which is very rare in other subgenera, probably caused by its large muscle in both valves and trail of ventral valve closely encompassing the curved part of dorsal valve in front of the valve. The subgenus comprises one species, *L. (Hefengia) hefengensis* sp. nov.

Subgenus uncertain *Leptaenopyxis asperatus* Su, 1976; *L. egentis* Su, 1980.

**Distribution and geological age** Northern Xinjiang, late Early Devonian.

## Chonetidae Bronn, 1862

### *Xinjiangochonetes* gen. nov.

**Type species** *Xinjiangochonetes pygmaeus* sp. nov.

**Diagnosis** Shell medium-sized in chonetids, semicircular in outline, with costellae; valve moderately concavo-convex; three to five spines; angle low. Ventral teeth large; median ridge of ventral valve wide and long. Dorsal cardinal process bilobed; hinge sockets large and round; inner and outer socket ridges obscure and almost connected together; median ridge of dorsal valve short and very weak.

**Discussion** The new genus *Xinjiangochonetes* may bear affinities to Chonetidae; however, it is distinct from any of the previously described genera of this family in its wide and long median ridge in ventral valve, particular in its large and round hinge sockets encompassed by ambiguous inner and outer socket ridges which are connected together. This character is not seen in any other genera so far described.

**Distribution and geological age** Northern Xinjiang, late Early Devonian? and Eifelian.

## Trigonirhynchiidae McLaren, 1965

### *Mangkeluia* gen. nov.

**Type species** *Mangkeluia extensa* sp. nov.

**Diagnosis** Shell medium-sized, subpentagonal; beak small; interarea absent; dorsal fold and ventral sulcus beginning at the beak; commissure uniplicate. Costae few in number, covering entire shell, with some of them bifurcations, arranged in formula of  $(4-5/3-4):0:(5-7/5-7)$ . Concentric growth lamellae possibly developed in whole shell. Ventral dental plates developed. Dorsal septum springing from notothyrial cavity or near the beak; septalium very shallow or almost absent, which is united with the hinge plate supported by septum.

**Discussion** In dorsal interior structure, the new genus recalls Uncinulinae Rzhonsniskaya and Eatonidae Schmidt, but it has no cardinal process. In ornamentation, the new genus seems more related to *Athyrisina* Hayasaka rather than to rhynchonellids, since only very few genera of rhynchonellids have bifurcated costae and concentric lamellae.

In the outline, sulcus-fold, costae, dental plates and interstructure, the genus bears some similarities to the members of Trigonirhynchiidae, especially to *Hemiplethorhynchus* von Peetz, even the latter have no bifurcated costae and concentric lamellae but have septalium. Therefore, the new genus has been attributed to Trigonirhynchiidae.

**Distribution and geological age** Northern Xinjiang, late Early Devonian.

## Atrypidae Gill, 1871

### *Perihustedia* gen. nov.

**Type species** *Perihustedia perplexa* sp. nov.

**Diagnosis** Shell small, oval and impunctate; ventral interarea less high; beak erect; deltidium and foramen possibly present; dorsal beak small and curved; anterior commissure rectimarginate; surface with some subequal, coarse and round costae (see Pl. III, fig. 10). Dental plates short; hinge plates divergent; cardinal process absent.

**Discussion** At first sight, the new genus is closely similar to *Hustedia* Hall et Clarke of Carboniferous—Permian in shell size, outline and costae, but the latter bears some significant differences, such as the particularly large and conspicuous cardinal process, the punctate shell, etc. *Zygospira* Hall of the Middle and Upper Ordovician is another genus very close to the new genus in outline, ornamentation and interior features, but the former commonly has ventral fold and dorsal sulcus. In interior structure, the *Megaplectatrypa* Zhang, 1981 of Lower Devonian is very similar to the new genus, but they are very different in configuration.

**Distribution and geological age** Northern Xinjiang, late Early Devonian.

## 图 版 说 明

标本均采自和布克赛尔蒙古族自治县芒克鲁;图版 I—图版 IV 的层位均是下泥盆统芒克鲁组,图版 V、图版 VI 除注明者外,其余均产于中泥盆统和丰组。标本保存于中国科学院南京地质古生物研究所。

### 图 版 I

- 1,2. *Aulacella biconvex* F. M. Zhang  
1a,b. 腹视,背视,×1;采集号: AEj 189,登记号 111503。2a,b. 腹内模,背内模,×1;采集号: AEj 189,登记号: 111504。
- 3,4. *Levenea multicostella* F. M. Zhang  
3a—c. 背视,腹视,前视,×1;采集号: AEj189, 登记号: 111505。4a,b. 腹和背内模,×1; 采集号: AEj 189, 登记号: 111506。
- 5—7. *Leptodonta xinjiangensis* sp. nov.  
5a,b. 背视,腹视,×2, holotype;采集号: AEj190, 登记号: 111507。6. 腹内模,×1.5, paratype; 采集号: AEj190, 登记号: 111508。7. 背内模,×2;采集号: 190,登记号: 111509。
- 8,9. *Leptaena asiatica* F. M. Zhang  
8a,b. 背和腹内模,×1;采集号: AEj189,登记号: 111510。9a,b. 背视,腹视,×1;采集号: AEj189,登记号: 111511。
- 10—13. *Leptaenopyxis (Hefengia) hefengensis* subgen. et sp. nov.  
10a,b. 腹和背内模,×1, paratype;采集号: AEj189,登记号: 111512。11a—c. 腹视,背视,前视,×1, holotype; 采集号: AEj189,登记号: 111513。12a—c. 侧视,背视,前视,×1, holotype; 采集号: AEj190, 登记号: 111514。13. 腹视,×1;采集号: AEj190,登记号: 111515。
14. *Schuchertella* sp.  
14. 背视,×2,采集号: AEj189;登记号: 111516。
- 15,16. *Gladiostrophia balaensis* Kaplun  
15. 腹视,×1;采集号: AEj190,登记号: 111517。16. 腹视,×1;采集号: AEj190,登记号: 111518。
- 17,18. *Mangkeluia extensa* gen. et sp. nov.  
17a—c. 前视,腹视,背视,×1.5; 17d. 腹壳部分壳饰,×3, holotype; 采集号: AEj189, 登记号: 111519。18. 背视,×1.5;采集号: AEj 189,登记号: 111520。

### 图 版 II

- 1—5. *Cymostrophia hefengensis* sp. nov.  
1. 腹内模,×1;采集号: AEj190,登记号: 111521。  
2. 背视,×1;采集号: AEj189,登记号: 111522。  
3. 腹视,×1, paratype;采集号: AEj189,登记号: 111523。  
4. 壳饰,×5;采集号: AEj189;登记号: 111524。5. 背内模, holotype;采集号: AEj191, 登记号: 111525。
- 6—8. *Rhytistrophia tenuilirata* sp. nov.  
6. 壳饰,×1.5;采集号: AEj189,登记号: 111526。