DOI:10.19800/j.cnki.aps.1987.06.002

NOTES ON CHINESE ORDOVICIAN AGNOSTIDS

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Summary

Before 1985 some 54 Ordovician agnostid species and subspecies had been described from China. They were assigned to the following eleven genera and subgenera: *Geragnostus, Trinodus, Pseudagnostus, Corrugatagnostus, Pseudoperonopsis, Girvanagnostus, Geragnostella, Peziziopsis, Sphaeragnostus, Leiagnostus* and *Micragnostus*. Most of them were based on inadequate material and the range of morphological variation in these forms largely unknown. After comparison, the present author tentatively retain 43 of the 54 species pendingfu rther material becoming available. They are now reassigned to the following nine genera: *Geragnostus, Arthrorhachis, Corrugatagnostus, Dividuagnostus, Neoagnostus, Micragnostus, Sphaeragnostus, Leiagnostus* and *Lotagnostus* (s. l.)

Texa of Metagnostidae are the most abundant of all Chinese Ordovician agnostids, whereas the glyptagnostines, pseudagnostines and agnostines which flourished in the Late Cambrian are rare in the Ordovician of China, and occur only in the Tremadoc of those areas which are believed to have formed part of the continental slope at this time (SE Guizhou, W. Hunan, W. Zhejiang, Qilian, and Kuruktag of E Tianshan).

The Chinese Ordovician agnostids often occur in association with nileid, raphiophorid, cyclopygid and trinucleid trilobites, with a sharp increase in abundance from the shelf towards and onto the slope area. A few agnostids appear in the outer sites of the shelf only during the transgressive phase, for example, in the easter Yangtze Paraplatform during the middle Tremadoc, late Arenig, and early Ashgill, and in the present western margin (that is the Shaanxi—Gansu—Ningxia—Inner Mongolia Border area) of the North China Platform during the late Arenig. Agnostids have, however, hardly been found in the inner shelf or the area within where the sea was restricted (for example, the North China Platform proper), or in the interior sites of the shelf (for example, the western Yangtze Paraplatform, including a vast area of E. Yunnan, W. Guizhou, W. Sichuan and S. Shaanxi), except in the Caradoc when transgressive sedimentary regimes were introduced worldwide (Fortey, 1984). During this period of great transgression agnostids penetrated over the former shallow shelf and became widely distributed in China. However, as a result of prolonged erosion before the middle Carboniferous, deposits of the Caradoc age are almost completely missing in the North China Carbonate Platform (exclusive of its western marginal belt), and there are no Caradoc agnostids known from this area.

The distributional pattern of Ordovician agnostids is comparable with that of Cambrian forms, the occurrence of which has been noted by Lochman-Balk and Wilson (1958), Jago (1973) and Lu *et al.* (1975), and suggests that Ordovician agnostids were pelagic and has a marked preference for the open-marine environment as suggested for the Cambrian examples (see Robison, 1970).

Given below is emended list of previously described agnostid species with indications of their synonyms and occurrences, each Chinese reference quoted in the list with a brief English translation only where it appears for the first time. The type specimens referred to in this paper are deposited at the institutions designated by the following abbreviations: NI, Nanjing Institute of Geology and Palaeontology, Academia Sinica; BGM,

Geology Museum of Beijing, Ministry of Geology and Mineral Resources; XI, Xi'an Institute of Geology and Mineral Resources; HGM, Geology Museum, Bureau of Geology and Mineral Resources of Hunan; 8TG, 8th Petroleum Prospecting Team of Guizhou; GTX, Geological Surveying Team of Xinjiang; and ZI, Zhejiang Institute of Petroleum Geology.

The author wishes to express his thanks to J. R. Laurie, J. H. Shergold and Sun Xia-wen for advice, and to Zhang Wen-tang, W. T. Dean, Lin Huan-ling, Lu Yan-hao and R. A. Robison for discussion. Preliminary drafts of the English version were read by D. J. Siveter to whom the author is greatly obliged. Thanks are also due to Li Ge-jun for technical assistance.

Family Agnostidae M'Coy, 1849
Genus *Micragnostus* Howell, 1935

Type species: *Agnostus calvus* Lake, 1906

Remarks: As noticed by Robison & Pantoja-Alor (1968, p. 776) and Zhou & Zhang (1984, p. 66, 67), a faint vestige of the median preglabellar furrow is present in some specimens of the Late Cambrian and Pre-Tremadoc species of *Micragnostus*, such as *M. intermedius* (Palmer) and *M. chiushuensis* (Kobayashi). This transitional character indicates that *Micragnostus* is closely related to and may be derived from *Homagnostus*, as pointed out by Öpik (1961a) and Fortey (1980).

The genus *Rudagnostus* Lermontova, 1951 was considered as a junior synonym of *Geragnostus* by Pokrovskaya (*in* Chernysheva, 1960, p. 61). However, the type species of *Rudagnostus*, *Agnostus rudis* Salter (see Lake, 1906, p. 21, pl. 2, figs. 13—16), has a strong resemblance to *Agnostus calvus* Lake (1906, p. 23, pl. 2, fig. 18; Fortey, 1980, pl. 1, fig. 15), and it seems more likely that *Rudagnostus* is synonymous with *Micragnostus*.

Micragnostus circularis (Liu in Zhou *et al.*, 1977)

1977 *Geragnostus* (*Micragnostus*) *circularis* Liu; in Zhou *et al.*, Trilobita *in* Atlas of Palaeontology of Central and South China, (1), p. 110, pl. 36, figs. 16, 17.

1982 *Geragnostus* (*Micragnostus*) *circularis* Liu; Trilobita in Atlas of Palaeontology of Hunan, p. 291, pl. 212, figs. 1, 2.

Holotype: HGM IV13002, pygidium (Zhou *et al.*, 1977, pl. 36, fig. 17).

Occurrence: Madaoyu Formation, late Tremadoc, Jiuxi, Taoyuan, W. Hunan.

Micragnostus kobayashi (Troedsson, 1937)

1937 *Geragnostus kobayashi* Troedsson, p. 30, pl. 5, figs. 11, 12.

1965 *Geragnostus kobayashi* Troedsson; Lu et al., Trilobites of China, p. 26, pl. 1, figs. 32, 33.

Holotype: NI 177a, cephalon (Troedsson, 1937, pl. 5, fig. 11).

Occurrence: Lower Tremadoc, western Kuruktag, E. Tianshan.

Micragnostus chiushuensis (Kobayashi, 1931)

1931 *Agnostus chiushuensis* Kobayashi, p. 173, pl. 22, figs. 1—4.

1978 *Geragnostus* (*Micragnostus*) *chiushuensis* (Kobayashi); Zhou & Zhang, Acta Palaeont. Sin., 17, p. 6, pl. 1, figs. 1, 2.

1978 *Geragnostus* (*Micragnostus*) sp.; Zhou & Zhang, p. 7, pl. 1, fig. 3.

1984 *Geragnostus* (*Micragnostus*) *chiushuensis* (Kobayashi); Lu & Lin, p. 48, pl. 1, figs. 4—8.

1984 *Geragnostus* (*Micragnostus*) *chiushuensis* (Kobayashi); Peng, p. 315, pl. 1, figs. 3—7.

1984 *Geragnostus* (*Micragnostus*) *chiushuensis* (Kobayashi); Zhou & Zhang, p. 65, pl. 1, figs. 6—9; pl. 2, figs. 8—12; pl. 13, figs. 1—4; pl. 15, figs. 1—5; pl. 18, figs. 1, 2; pl. 20, figs. 1—4; pl. 22, figs. 16—18; pl. 26, figs. 1—3; pl. 27, figs. 8—14.

1985 *Geragnostus* (*Micragnostus*) *chiushuensis* (Kobayashi); Qian in Chen et al., p. 65, pl. 9, figs. 5—7, 12b; pl. 19, fig. 3b; pl. 20, fig. 5a.

Holotype: Cephalon (Kobayashi, 1931, pl. 22, fig. 1).

Occurrence: Uppermost Cambrian, North and Northeast China, and W. Zhejiang; uppermost Cambrian to basal Tremadoc, Cili and Taoyuan, W. Hunan.

Micragnostus sp.

1984 *Geragnostus* sp. 3, Lu & Lin, p. 51, pl. 1, figs. 11—14.

Occurrence: *Hysterolenus* Zone and *Dichele-*

pyge sinensis Zone, Yinchupu Formation (Tremadoc), Changshan and Jiangshan, W. Zhejiang.

Family Glyptagnostidae Whitehouse, 1936
Genus *Lotagnostus* Whitehouse, 1936

Type species: *Agnostus trisectus* Salter, 1864

Remarks: The Chinese species *Pseudoperonopsis orientalis* Lu & Lin and *P. oblongus* Lu & Lin bear a great resemblance to *Pseudoperonopsis zoninoi* Harrington & Leanza (1957, p. 75, fig. 19; 21—6a, c). They constitute a closely knit group in the early Tremadoc, and are quite different from the type species of *Pseudoperonopsis* Harrington, *Agnostus sallesi* Muni-Cholmas & Bergeron, 1889 (see Howell, 1935, p. 226, pl. 22, figs. 17, 18, as *Peronopsis sallesi*) from the Middle Cambrian of France. In the opinion of Shergold (pers. comm.), species like *zoninoi* cannot be referred to *Pseudoperonopsis*, but "represent a long-axis species of *Micragnostus* like *M. calviformis* Harrington & Leanza, or a derivative of the *Lotagnostus* Stock, probably similar to *Trilobagnostus*." Judged from the shape of the cephalon, glabella and pygidial axis of the three species, they are rather close to the species of *Lotagnostus*, for example, such as *Lotagnostus* (*Trilobagnostus*) *irretitus* Shergold (1975. p. 49, pl. 14. figs. 1—6, Text-figs. 17, 18) and *L.* (*T.*) *ejingensis* Lu, Zhou & Zhou (1986, p. 81, pl. 1, figs. 2—4). the present author therefore, considers this group of three species to be effaced members of *Lotagnostus*.

Lotagnostus (s. l.) *orientalis* (Lu & Lin, 1984)

1984 *Pseudoperonopsis orientalis* Lu & Lin, p. 67, pl. 5, figs. 1—8.

Holotype: NI 83446, cephalon (Lu & Lin, 1984, pl. 5, fig. 1).

Occurrence: *Hysterolenus* Zone, Yinchupu Formation (Tremadoc), Changshan and Jiangshan, W. Zhejiang.

Lotagnostus (s. l.) *oblongus* (Lu & Lin, 1984)

1984 *Pseudoperonopsis oblongus* Lu & Lin, p. 68, pl. 5, figs. 9, 10.

Holotype: NI 83455, cephalon (Lu & Lin, 1984, pl. 5, fig. 10).

Occurrence: *Hysterolenus* Zone, Yinchupu Formation (Tremadoc), Changshan, W. Zhejiang.

Family Diplagnostidae Whitehouse, 1936
Genus *Neoagnostus* Kobayashi, 1955

Type species. *Neoagnostus aspidoides* Kobayashi, 1955

Neoagnostus perquadratus (Lu & Chien in Yin *et al.*, 1978)

1978 *Pseudagnostus perquadratus* Lu ü Chien in Yin *et al.*, Trilobita in Atlas of Palaeontology of SW China, Guizhou (1), p. 389, pl. 144, fig. 20.

1983 *Pseudagnostus perquadratus* Lu & Chien; Lu & Qian, p. 18, pl. 1, figs. 4—6, pl. 5, fig. 11c.

Holotype: NI 54048, cephalon, originally assigned by Lu & Chien in Yin *et al.* (1978, p. 799, pl. 144, fig. 20); Non NI 59050, pygidium, as subsequently selected by Lu et Qian (1983, pl. 1, fig. 6).

Occurrence: Guotang Formation (Tremadoc), Pudun, Sandu, SE. Guizhou.

Family Metagnostidae Jaekel, 1909
Genus *Arthrorhachis* Hawle & Corda, 1847

Type species: *Battus tardus* Barrande, 1846

Remarks: As the holotype cephalon of the type species of *Trinodus*, *T. agnostiformis* M'Coy, 1846 (see Whittington, 1950, pl. 68, figs. 1—3), showed a striking resemblance to that of *Arthrorhachis tarda* (Barrande) (Whittington. 1950, p. 535; Ingham, 1970, p. 10), Kielan was inclined to consider them to be synonyme. However, since the pygidium of *T. agnostiformis* was unknown, and for Dean (1966, p. 274), Whittington (1968, p. 97) and Fortey (1980, p. 27) it was difficult to decide whether *Trinodus* should be regarded as synonymous with *Arthrorhachis* or *Geragnostus* Howell, 1935. For the time being, *Trinodus* is restricted to the type specimen as Fortey (1980) suggested.

Girvanagnostus Kobayashi, 1939 was considered by Dean (1966) to be a junior synonym of *Teinodus*, and later by Fortey (1980) as synonymous with *Arthrorhachis*. However, the Chinese species *Girvanagnostus sinensis* Xia, 1978, with a glabella typical of *Corrugatagnostus*, has been reassigned to *Corrugatagnostus jiangshanensis* Lu in this paper (see below).

Arthrorhachis sinensis (Sheng, 1964)

1964 *Geragnostus sinensis* Sheng, Acta Palaeont. Sin., 12, p. 546, pl. 1, fig. 1a—e, *non* 1f, g(=*Corrugatagnostus jiangshanensis*).

1974a *Corrugatagnostus chekiangensis* Sheng, Subdivision and correlation of the Ordovician System in China, p. 75, pl. 2, fig. 10, *non* 11—13 (=*Corrugatagnostus jiangshanensis*).

1974b *Geragnostus sinensis* Sheng; Sheng, Ordovician trilobites from western Yunnan and its stratigraphical significance in Subdivision and correlation of the Ordovician System in China, p. 98, pl. 1, fig. 1c, d, h, *non* 1a, b, e—g (=*Corrugatagnostus jiangshanensis*).

1975 *Trinodus cylindricus* Chen in Li *et al.*, Stratigraphical Gazetteer of Lower Palaeozoic, western Dabashan, p. 148, pl. 18, figs. 8. 9.

1975 *Trinodus corrugatus* Chen in Li *et al.*, p. 149, pl. 18, figs. 10—12.

1975 *Trinodus ovatus* Chen in Li *et al.*, p. 149, pl. 18, figs. 13, 14.

1978 *Geragnostus furcatus* Xia, Ordovician trilobites in Sinian to Permian Stratigraphy and Palaeontology of E Yangtze Gorge area, p. 157, pl. 28, figs. 3—5.

1981 *Trinodus* cf. *corrugatus* Chen; Lu & Zhou, Bull. Nanjing Inst. Geol. Palaeont. Acad. Sin., 3, p. 4, pl. 3, figs. 3, 4.

1982 *Trinodus cylindricus* Chen; Zhou *et al.*, Trilobita in Atlas of Palaeontology of Northwest China, Shaanxi, Gansu and Ningxia, (1), p. 216, pl. 57, figs. 5, 6.

1983 *Trinodus latilimbatus* Ju in Qiu *et al.*, Trilobita in Atlas of Palaeontology of East China, (1), p. 33, pl. 11 fig. 14.

1983 *Trinodus carinatus* Ju in Qiu *et al.*, p. 33, pl. 11, fig. 15, *non* 16 (=*Corrugatagnostus jiangshanensis*).

Lectotype: BGM 3702, cephalon (Sheng, 1964, pl. 1, fig. 1a), selected herein; from the Pagoda Formation of Liangshan, S. Shaanxi.

Remarks: Several species from Caradoc to early Ashgill as listed in the above synonymy agree well with *A. sinensis*. As compared with *A. sinensis*, they exhibit limited variations in the length of the glabella and pygidial axis, but these apparent distinctions may be due to different preservation and sizes of the specimens. The holotype of *Corrugatagnostus chekiangensis* Sheng was not designated when the species had been erected, and a dorsal shield (BGM OT66-25) (Sheng, 1974a, pl. 2, fig. 10) is herein selected as the lectotype. Consequently, *C. chekiangensis* should now be considered a junior synonym of *A. sinensis*.

The lectotype and topotype specimens of *A. sinensis* are comparable to the lectotype of *A. tarda* as figured by Pek (1977, pl. 8, fig. 2), and differ only in having a slightly longer glabella. According to Dean (1971) and Zhou & Dean (1986), the length of the glabella and pygidial axis is very variable in *A. tarda* and its allied forms from Europe and Central Asia. *A. tarda* may well be a senior synonym of *A. sinensis*, but further evidence is required regarding the pattern of glabellar furrows and muscle scars which are poorly known in both species.

Occurrence: Pagoda Formation (Caradoc), S. Shaanxi and W. Hubei; Yenwashan Formation (Caradoc), W. Zhejiang; Huangnehkang Formation (early Ashgill), W. Zhejiang; Upper Pupiao Formation (early Ashgill), W. Yunan; Linhsiang Formation (early Ashgill), SE. Sichuan; Tangtou Formation (early Ashgill), Nanjing, Jiangsu.

Arthrorhachis hupehensis (Lu, 1975)

1975 *Trinodus hupehensis* Lu, Palaeont. Sin. N. S. B, 11, p. 93, pl. 1, figs. 12—15.

1977 *Trinodus hupehensis* Lu; Zhou et al., p. 110, pl. 36, figs. 18, 19.

1985 *Trinodus hupehensis* Lu; Duan, J. Stratigr. 9. p. 123, pl. 1, figs. 1, 2, 12.

Holotype: NI 16373, cephalon (Lu, 1975, pl. 1, fig. 12).

Occurrence: *Glyptograptus austrodentatus* Zone (late Arening), Dawan Formation, Fenxiang, W. Hubei; Upper Dawan Formation, Dongtai, N. Jiangsu.

Arthrorhachis? *suni* (Troedsson, 1937)

1937 *Trinodus suni* Troedsson, p. 29, pl. 1, figs. 17, 18.
1957 *Trinodus suni* Troedsson: Lu, Trilobita in Index Fossils of China, Invertebrates (3), p. 260, pl. 138, figs. 8, 9.
1963 *Trinodus suni* Troedsson; Lu & Chang, Lower Ordovi-

cian trilobites in Handbook of index fossils of NW. China, p. 35, pl. 8, figs. 2, 3.

1965 *Trinodus suni* Troedsson: Lu *et al.*, p. 30, pl. 2, figs. 11, 12.

Holotype: NI 177c, cephalon (Troedsson, 1937, pl. 1, fig. 17).

Remarks: The specimens are poorly preserved, providing no evidence of pygidial ring furrows. The species might be a pseudagnostine, but it still remains questionable. At present it is with reservation, provisionally referred to *Arthrorhachis*.

Occurrence: Lower Tremadoc, western Kuruktag, E. Tianshan.

Other Chinese forms belonging to *Arthrorhachis* under open nomenclature are; *Trinodus* sp. of Lu (1975, p. 93, pl. 1, fig. 16) from Panho Formation (Tremadoc), Yanjing, NE Yunnan; *Trinodus* sp. of Xia (1978, p. 158, pl. 28, fig. 7) from Dawan Formation (Arenig), Fenxiang W. Hubei; *Trinodus* sp. (cf. *T. mobergi* Tjernvik, 1956) of Chang & Fan (1960, Geological Gazetteer of Qilianshan 4(1), p. 100, pl. 1, figs. 6, 7; Lu *et al.*, 1965, p. 31, pl. 2, figs. 13, 14) from L. Arenig, Yumen, Gansu; and ?*Trinodus* sp. of Chang & Fan (1960, p. 100, pl. 1, fig. 8; Lu *et al.*, 1965, p. 31, pl. 2, fig. 15) from L. Arenig, Yumen, Gansu.

Genus *Geragnostus* Howell, 1935

Type species: *Agnostus sidenbladhi* Linnarsson, 1869

Remarks. Since *Geragnostus* was essentially indistinguishable from *Arthrorhachis*, Fortey (1980, p. 27) only tentatively referred to *Geragnostus* those species which have the terminal lobe of the pygidial axis longer than the postaxial region (sag.) inside the border. Intermediate forms between the two genera have been known; for example, the Chinese species *Trinodus* cf. *mobergi* Tjernvik (Chang & Fan, 1960, pl. 1, figs. 6, 7). which shows the pygidial terminal lobe as long as the postaxial region. As Dean (1973, p. 290) and Fortey (1980, p. 26) concluded, the length of the pygidial axis in agnostids is usually variable, and this single character is of no generic importance. Therefore, *Geragnostus* may eventually best be regarded as a junior synonym of *Arthrorhachis* (cf. Dean, 1966).

Geragnostella Kobayashi, 1939 was considered by Dean (1966), and *Geratrinodus* Kobayashi & Hamada, 1978 and *Neptunagnostus* Pek. 1977 by Fortey (1980), to be synonyms of *Geragnostus*, theis procedure is followed here.

Geragnostus carinatus Lu, 1975

1975 *Geragnostus carinatus* Lu, p. 91, pl. 1, figs. 5—8.

1977 *Geragnostus carinatus* Lu; Zhou et al., p. 109, pl. 36, figs. 12, 13.

Holotype: NI 16366, cephalon (Lu, 1975, pl. 1, fig. 5).

Occurrence. *Glyptograptus austrodentatus* Zone (late Arenig), Dawan Formation, Tangya, Yichang, W. Hubei.

Geragnostus fenhsiangensis Lu, 1975

1960 *Geragnostus* sp. (cf. *Geragnostus wimani* Tjernvik, 1956), Chang & Fan, p. 99, pl. 1, fig. 5.

1975 *Geragnostus fenhsiangensis* Lu, p. 92, pl. 1, fig. 9, 10.

1977 *Geragnostus fenhsiangensis* Lu; Zhou et al., p. 109, pl. 36, figs. 14, 15.

Holotype: XI Tr002, cephalon (Zhou *et al.*,) 1, fig. 9).

Occurrence: *Glyptograptus austrodentatus* Zone (Late Arenig), Dawan Formation, Fenxiang, W. Hubei; late Arenig, NE Qaidam, Qinghai.

Geragnostus symmetricus Zhou in Zhou et al., 1982

1982 *Geragnostus symmetricus* Zhou in Zhou et al., p. 215, pl. 57, figs. 2, 3.

Holotype: XI Tr002, cephalon (Zhou *et al.*, 1982, pl. 57. fig. 2a, b.

Occurrence: Top part (late Arenig) of Tianjingshan Formation, Tongxin, Ningxia.

Geragnostus yangtzeensis Lu, 1975

1948 *Agnostus* sp. undet.: Hsü, p. 19, pl. 5, fig. 1a, b.

1965 *Geragnostus* sp. indet.; Lu *et al.*, p. 28, pl. 2, figs. 6, 7.

1975 *Geragnostus yangtzeensis* Lu, p. 90, pl. 1, figs. 1—4, Text-fig. 21.

1977 *Geragnostus yangtzeensis* Lu; Zhou *et al.*, p. 109, pl. 36, figs. 10, 11.

Holotype: NI H1, cephalon (Hsu, 1948, pl. 5, fig. 1a; Lu, 1975, pl. 1, fig. 1).

Occurrence: *Asaphopsis immanis* Zone and *Asaphellus inflatus-Dactylocephalus dactyloides* Zone, Nantsinkuan Formation (Tremadoc), Yidu and Changyang, W. Hubei.

Other Chinese forms of *Geragnostus* under open nomenclature are: *Geragnostella* sp. of Lu (1975, p. 92, pl. 1, fig. 11) from *Azygograptus suecicus* Zone (late Arenig), Dawan Formation, Fenxiang, W. Hubei; *Geragnostus* sp. (cf. *G. sidenbladhi* Linnarsson, 1869) of Chang & Fan (1960, p. 98, pl. 1, fig. 1; Lu *et al.*, 1965, p. 27, pl. 2. fig. 3) from U. Tremadoc, Yumen, Gansu; *Geragnostus* sp. (cf. *Geragnostus crassus* Tjernvik, 1956) of Chang & Fan (1960, p. 98, pl. 1, figs. 2, 3; Lu et al., 1965, p. 27, pl. 2, figs. 1, 2) from U. Tremadoc, Yumen, Gansu; and *Geragnostus crassus* (?) Tjernvik of Chang & Fan (1960, p. 99, pl. 1, fig. 4; Lu *et al.*, 1965, p. 28, pl. 2, fig. 5) from L. Llanvirn, Yumen, Gansu.

Genus *Corrugatagnostus* Kobayashi, 1939

Type species: *Agnostus morea* Salter, 1864

Remarks: The holotype of the type species, *C. morea* from the Llanvirn of Shropshire, has two tiny median glabellar tubercles placed close to the transverse furrows (Whittard, 1940, p. 155, pl. 5, fig. 1), but the Llandeilo specimens from Bohemia (Pek, 1977, p. 27, pl. 6, figs. 1, 2, 5, 6) show only one large tubercle in the mid-line of the anterior transverse furrow. Other species of *Corrugaragnostus*, Sue's as *C. jiangshanensis* Lu, 1964, *C. sol* Whittard, 1955, *C. refragor* Pek, 1969, and *C. convergens* Weir, 1959, bear only one glabellar tubercle each of a different size. Additionally, species assigned to *Corrugatagnostus* are also very intraspecifical or interspecifical in the strength of the genal scrobicules and the posterior glabellar furrow. For example, the genal scrobicules and posterior glabellar furrow are well-developed in *C. morea*, but rather weak in *C. refractor*. In the lectotype of *C. jiangshanensis* Lu, the gena is faintly scrobiculate and the posterior glabellar furrow is obsolete (see Lu *et al.*, 1976, pl. 9, fig. 3), but one can trace indications of the posterior glabellar furrow in some well-preserved specimens of this species, and many specimens have almost smooth genae (Text-fig. 6).

Segmentagnostus Pek, 1977 was erected on the basis of *Agnostus caducus* Barrande. The holotype cephalon of this species has been figured by Barrande (1872, pl. 14, figs. 12, 13), Whittard (1955, p. 9, Text-fig. 2a) and Pek (1977, pl. 1, fig. 7). As interpreted by Fortey (1980, Text-fig. 4F), its glabella compores well with that of the *Corrugatagnostus* species although its posterior glabellar furrow is fairly weak. The pygidium of *caducus* recently figured by Pek & Prokop (1984, pl. 1, fig. 6) is imperfectly preserved, but according to the description given by Pek (1977, p. 18) and judging from the figures shown by Novak (1884, pl. 10, figs. 20—23), it is very similar to that of *Corrugatagnostus*. This view is supported by the well-preserved pygidia of *Segmentagnostus stubblefieldi* Rushton & Hughes (1981, pl. 1, figs. 1, 5, 6). In the present Author's view, *Segmentagnostus* is no more than an effaced *Corrugatagnostus*, and its diagnostic characters fall within the range of variation of the latter. They are, therefore, regarded herein as synonymous.

Corrugatagnostus transitus Lu, 1975

1975 *Corrugatagnostus transitus* Lu, p. 94, pl. 1, fig. 17.

Holotype: NI 16378, pygidium (Lu, 1975, pl. 1, fig. 17).

Occurrence: Pagoda Formation (Caradoc), Liangshan, Hanzhong, S. Shannxi.

Corrugatagnostus salebrosus Ju in Qiu et al., 1983

1983 *Corrugatagnostus salebrosus* Ju in Qiu et al., p. 32, pl. 11, fig. 9.

Holotype: ZI 0073, pygidium (Qiu *et al.*, 1983, pl. 11, fig. 9).

Remarks: The pygidium of this species is strongly scrobiculate, otherwise it is identical with that of *C. jiangshanensis* Lu. As mentioned above, the definition of the genal scrobicules varies even in a single species. Both species may, there-

fore, be synonymous, but specimens of the cephalon of *C. salebrosus* are required before making this conclusion.

Occurrence: Yenwashan Formation (Caradoc), Quxian, W. Zhejiang.

Corrugatagnostus jiangshanensis Lu, 1964

1964 *Corrugatagnostus jiangshanensis* Lu, Late Ordovician trilobites in Handbook of index fossils of SE China, p. 52, pl. 17, fig. 1.

1964 *Geragnostus sinensis Sheng*, p. 546, pl. 1, fig. 1f, g, *non* 1a—e (=*Arthrorhachis sinensis*).

1964 *Geragnostus* sp.; Sheng, pl. 1, fig. 6b.

1974a *Corrugatagnostus chekiangensis Sheng*, p. 75, pl. 2, figs. 11—13, *non* 10 (=*Arthrorhachis sinensis*).

1974b *Geragnostus sinensis* Sheng; Sheng, p. 98, pl. 1, fig. 1a, b, e—g, *non* 1c, d, h (=*Arthrorhachis sinensis*).

1974 *Geragnostus sinensis* Sheng; Luo Trilobita in Atlas of Fossils of Yunnan, p. 600, pl. 28, figs. 3, 4.

1976 *Corrugatagnostus jiangshenensis* Lu; Lu in Lu *et al.*, p. 59, pl. 9, figs. 3.

1978 *Geragnostus sinensis* Sheng; Xia, p. 157, pl. 28, figs. 1, 2.

1978 *Girvanagnostus sinensis* Xia, p. 157, pl. 28, fig. 6.

1981 *Corrugatagnostus jiangshanensis* Lu; Lu & Zhou, p. 5, pl. 1, figs. 1—6.

1981 *Geragnostus sinensis* Sheng; Zhang, Trilobita in Atlas of Palaeontology of NW China, Xinjiang (1), p. 136, pl. 54, figs. 9, 10.

1983 *Corrugatagnostus jiangshanensis* Lu; Qiu *et al.*, p. 31, pl. 11, fig. 8.

1983 *Trinodus carinatus* Ju, Qiu *et al.*, p. 33, pl. 11, fig. 16, non 15 (=*Arthrorhachis sinensis*).

Loctotype: NI 23901, dorsal shield (Lu, 1964, pl. 17, fig. 1), selected by Lu *et al.*, (1976, explanation of pl. 9), from the Huangnehkang Formation of Jiangshan, W. Zhejiang.

Occurrence. Upper Pupiao Formation (early Ashgill), Baoshan, W. Yunnan; Huangnehkang Formation (early Ashgill), W. Zhejiang; Linhsiang Formation (early Ashgill), W. Hubei, SE Sichuan and NE Guizhou; Tangtou Formation (early Ashgill), Nanjing, Jiangsu; Qilang Formation (Caradoc), Keping, Xinjiang.

Corrugatagnostus sp.

1960 *Corrugatagnostus* sp., Chang & Fan, p. 101, pl. 1, fig. 10.

1965 *Corrugatagnostus* sp., Lu *et al.*, p. 30, pl. 2, fig. 10.

Occurrence: Nanshimenzi Group (Caradoc—Ashgill), Yumen, Gansu.

Genus *Dividuagnostus* Koroleva, 1982

Type species: *Dividuagnostus minus* Koroleva, 1982

Diagnosis: Metagnostids with an inverted trepezoidal cephalic outline. Glabella broadly rounded anteriorly with large anterior lobe well defined by deep, inverted, V-shaped transverse furrow. Pygidial axis having a broad, backwardly expanded terminal lobe. Anterior ring furrow obliquely extending forwards to cut half-ring furrow by median tubercle. Posterior ring furrow gently arched backwards.

Remarks: *Dividuagnostus* is similar to *Corrugatagnostus*, but the latter differs in having a proportionally smaller anterior glabellar lobe, the presence of a second glabellar furrow, and a pygidial axis which tapers evenly backwards with the almost straight transverse ring furrows and short terminal lobe. *Peziziopsis* Ju in Qiu *et al.*, 1983 seems to be generically indistinguishable from *Dividuagnostus* and it considered as a junior synonym of Korolova's genus.

Three of the Chinese species of *Dividuagnostus*, that is *D. merus* (Zhou), *D. typicus* (Ju) and *D. longus* (Ju) are from the same horizon (the Huangnehkang Formation), and are morphologically similar although the cephalon appears longer in *D. longus* and the anterior glabellar lobe is comparatively larger in *D. typicus*. However, specimens of all three species are slightly crushed, and it is difficult to decide whether they are synonymous on the basis of the inadequate material presently available.

In addition to the type species, and the Chinese species listed below, the following forms belong to *Dividuagnostus*: *Agnostus maccoyi* Slater (see Whittard, 1955, p. 8, pl. 1, figs. 5, 6; 1966, p. 265, pl. 46, fig. 2; Hughes, 1969, p. 56, pl. 1, figs. 1—12); *Geragnostus scoltonensis* Whittard (1966, p. 266, pl. 46, figs. 3—5); *Agnostus hirundo* Hicks (see Whittard, 1955, p. 7, pl. 1, figs. 1—4); *Anglagnostus? pradesensis* Capera *et al.* (1978, p. 84, pl. 5, fig. 9), and *Geragnostus* (*Micragnostus*) *neumanni* Harrington & Leanza (1957, p. 69, fig.

13: 9—11). Laurie (pers. comm.) has suggested that the material described by Webby (1973, p. 447, pl. 51, fig. 1) as *Geragnostus*? sp. from New South Wales, Australia is also referable to this genus.

Dividuagnostus merus (Zhou in Lu *et al.*, 1976)

1976 *Geragnostus merus* Zhou in Lu *et al.*, p. 58, pl. 9, figs. 1, 2.

Holotype: NI 23900, pygidium (Lu *et al.*, 1976, pl. 9, fig. 2)

Occurrence: Huangnehkang Formation (early Ashgill), Wuning, Jiangxi.

Dividuagnostus typicus (Ju in Qiu *et al.*, 1983)

1983 *Peziziopsis typica* Ju in Qiu *et al.*, p. 29, pl. 11, fig. 3.

Holotype: ZI 007b, dorsal shield (Qiu *et al.*, 1983, pl. 11, fig. 3)

Occurrence: Huangnehkang Formation (early Ashgill), Quxian, W. Zhejiang.

Dividuagnostus longus (Ju in Qiu *et al.*, 1983)

1983 *Peziziopsis longa* Ju in Qiu *et al.*, p. 30, pl. 11, figs. 4, 5.

Holotype: ZI 0077, cephalon (Qiu *et al.*, 1983, pl. 11, fig. 4)

Occurrence: Huanghehkang Formation (early Ashgill), Quzian, W. Zhejiang.

Dividuagnostus mirabilis (Zhou in Zhou *et al.*, 1982)

1982 *Geragnostus mirabilis* Zhou in Zhou *et al.*, p. 216, pl. 57, fig. 4.

Holotype: XI Tr004, cephalon (Zhou *et al.*, 1982, pl. 57, fig. 4).

Occurrence: Caradoc—Ashgill, Subei, Gansu.

Dividuagnostus xiyangshanensis (Lu & Lin, 1984)

1984 *Geragnostus* (*Micragnostus*) *xiyangshanensis* Lu & Lin, p. 47, pl. 1, figs. 1—3.

Holotype: NI 83393, cephalon (Lu & Lin, 1984, pl. 1, fig. 1).

Occurrence: *Dichelepyge sinensis* Zone (early Tremadoc), Yinchupu Formation, Changshan, W. Zhejiang.

Dividuagnostus? *subcylindriticus* (Zhang, 1981)

1981 *Geragnostus subcylindriticus* Zhang, p. 136, pl. 54, fig 8.

Holotype. GTX Tr009, cephalon (Zhang, 1981, pl. 54, fig. 8).

Remarks: The inverted V-shaped glabellar furrow and the broad anterior glabellar lobe suggest that this species is referable to *Dividuagnostus*. However, the surface of the holotype cephalon is granular, and this character recalls that of the type species of *Granuloagnostus* Pek, 1970, *G. dusli* (Novák, 1884, p. 58, pl. 1, fig. 12a—d; Pek, 1977, p. 20, pl. 4, figs. 10, 11). As no cephalon of *G. dusli* and no pygidium of *D.*? *subcylindriticus* have been found yet, further comparison between both species is impossible.

Dividuagnostus sp.

1984 *Geragnostus* (*Micragnostus*) sp. 3; Lu & Lin, p. 51, pl. 1, fig. 10.

Occurrence: *Hysterolenus* Zone, Yinchupu Formation (Tremadoc), Changshan, W. Zhejiang.

Family Sphaeragnostidae Kobayashi, 1939
Genus *Sphaeragnostus* Howell & Resser in Cooper & Kindle, 1936

Type species: *Sphaeragnostus similaris* Barrande, 1872

Sphaeragnostus cerus Zhou in Lu *et al.*, 1976

1976 *Sphaeragnostus cerus* Zhou in Lu *et al.*, p. 59, pl. 9, fig. 3.

1983 *Sphacragnostus gaspensis quxianensis* Ju in Qiu *et al.*, p. 34, pl. 12, fig. 16.

Holotype: NI 23902, pygidium (Lu *et al.*, 1976, pl. 9, fig. 3)

Occurrence: Huangnehkang Formation (early Ashgill), Wuning, Jiangxi, and Quxian, W. Zhejiang.

Sphaeragnostus subcircularis Zhou in Zhou *et al.*, 1982

1982 *Sphaeragnostus subcircularis* Zhou in Zhou *et al.*, p. 218, pl. 57, fig. 13.

Holotype: XI Tr011, pygidium (Zhou *et al.*, 1982, pl. 57, fig. 13).

Occurrence: Caradoc—Ashgill, Subei, Gansu.

Sphaeragnostus sp.

1977 *Sphaeragnostus* sp., Zhou *et al.*, p. 114, pl. 37, fig. 15.

Occurrence: Modaoxi Formation (Caradoc), Taojiang, Hunan.

Family Incertae Sedis

Genus *Leiagnostus* Jaekel, 1909

Type species: *Leiagnostus erraticus* Jaekel, 1909

Leiagnostus bexelli Troedsson, 1937

1937 *Leiagnostus bexelli* Troedsson, p. 32, pl. 5, figs. 13, 14.

1965 *Leiagnostus bexelli* Troedsson; Lu et al., p. 39, pl. 3, figs. 27, 28.

Holotype: NI 176a, pygidium (for discussion see Peng, 1984, p. 317) (Troedsson, 1937, pl. 5, fig. 13).

Occurrence: Lower Tremadoc, western Kuruxtag, E. Tianshan, Xinjiang.

Leiagnostus sanduensis Zhou, 1981

1981 *Leiagnostus sanduensis* Zhou, Acta Palaeont. Sin., 20, p. 242, pl. 1. figs. 7b, 17.

1984 *Leiagnostus sanduensis* Zhou; Lu & Lin p. 64, pl. 4, fig. 2.

Holotype: 8TG SD204, dorsal shield (Zhou, 1981, pl. 1, fig. 17).

Occurrence: Guotang Formation (Tremadoc), Sandu, SE Guizhou; *Hysterolenus* Zone, Yinchupu Formation (Tremadoc), Changshan, W. Zhejiang.

Other Chinese Ordovician species of *Leiagnostus* under open nomenclature: *Leiagnostus* cf. *bexelli* Troedsson (Peng, 1984, p. 316, pl. 1, figs. 8—12) from the basal Tremadoc, Cili and Taoyuan, W. Hunan; *Leiagnostus* sp. 1, 2 and 3 of Lu & Lin (1984, p. 66, 67, pl. 4, figs. 9—13) from *Hysterolenus* Zone, Yinchupu Formation (Tremadoc), Changshan and Jiangshan, W. Zhejiang; *Leiagnostus* (?) sp. of Chang & Fan (1960, p. 100, pl. 1, fig. 9; Lu *et al.*, 1965, p. 40, pl. 3, fig. 29) from L. Llanvirn, Yumen, Gansu.