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The Upper Famennian Rhynchonellid genus *Trifidorostellum* SARTENAER, 1961 from China, North America and the USSR

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Abstract

A world-wide Upper Famennian *Trifidorostellum* Zone is proposed. It is based on species of the genus found in Canada (Alberta), China (Hunan), USA (Idaho, Montana, New Mexico), USSR (Mugodjary Mountains and North-East). Recall that the following species and subspecies are rejected from the genus : *Liorhynchus depressus* RZHONSNITSKAYA, 1953, *Pseudoleiorhynchus* (*Pugnax*?) *plana* (= *nomen nudum*), *Liorhynchus plano-ovalis* NALIVKIN, 1937, and *Trifidorostellum posturalicum pennatum* MARTYNOVA, 1970.

Key-words : *Trifidorostellum* - Rhynchonellid - Famennian - China - World.

Résumé

Une Zone à *Trifidorostellum* d'âge famennien supérieur est proposée à l'échelle mondiale. Elle est fondée sur des espèces du genre trouvées au Canada (Alberta), en Chine (Hunan), aux Etats-Unis d'Amérique (Idaho, Montana, New Mexico) et en URSS (Monts Mougodjares et Nord-Est). Les auteurs rappellent que les espèces et sous-espèces suivantes sont à éliminer du genre : *Liorhynchus depressus* RJONSNITZKAIA, 1953, *Pseudoleiorhynchus* (*Pugnax*?) *plana* (= *nomen nudum*), *Liorhynchus plano-ovalis* NALIVKIN, 1937 et *Trifidorostellum posturalicum pennatum* MARTYNOVA, 1970.

Mots-clefs : *Trifidorostellum* - Rhynchonellide - Famennien - Chine - Monde.

摘　要

根据艾伯达、湖南、爱达荷、蒙大拿、木哥扎雷山、新墨西哥和苏联东部发现的材料，本文建立了一个世界分布的上法门阶 *Trifidorostellum* 带。下列各种和亚种：*Liorhynchus depressus* RZHONSNITSKAYA, 1953, *Pseudoleiorhynchus* (*Pugnax*?) *plana* (= *nomen nudum*), *Liorhynchus plano-ovalis* NALIVKIN, 1937 和 *Trifidorostellum posturalicum pennatum* MARTYNOVA, 1970 不应归入此属。

关键词：*Trifidorostellum* 一小嘴贝一法门阶一中国一世界。

I. - Introduction

The late Famennian species *Trifidorostellum longhuiense* TAN, 1987 has been found recently in the central part of the Province of Hunan. This discovery leads the authors to make known the state of knowledge of the genus *Trifidorostellum* SARTENAER, 1961. In order to allow comparisons with the other members of the genus, the Chinese species is described in detail; in particular, transverse serial sections are given. A *Trifidorostellum* Zone is proposed.

When the genus *Trifidorostellum* SARTENAER, 1961 was established, only the type species, *T. dunbarense* (HAYNES, 1916), was included. SARTENAER & ROZMAN (1965, pp. 148-149) added *T. posturalicum* (ROZMAN, 1962) and *T. uralicum* (NALIVKIN, 1947), ALEKSEEVA (1967, pp. 15-18) *T. aldanicum* ALEKSEEVA, 1967 and *T. verchojanicum* ALEKSEEVA, 1967, and MARTYNOVA (1967, p. 20, p. 21) *T. planoovale* (NALIVKIN, 1937) (1) and *T. posturalicum* subsp. nov., which she later (1970, pp. 64-65) named *T. posturalicum pennatum* MARTYNOVA, 1970. The genus was further enriched by SARTENAER (1969, pp. 16-17, 22-28) with *T. cascadense cascadense* (WARREN, 1927), *T. cascadense mugodjaricum* SARTENAER, 1969, *T. uralicum fontis* SARTENAER, 1969.

We had to wait until the present decade for new additions to the genus, which have notably contributed to extend its geographic distribution not only in the United States of America and in the Union of Soviet Socialist Republics, where it was already known, but also in the People's Republic of China : *T. obscurum* COOPER & DUTRO, 1982, *T.* sp. recognized by ERLANGER (*in* SHILO *et al.*, 1984, p. 225, pl. 41, figs. 18a-d), and *T. longhuiense* TAN, 1987, already known since 1983 under the name *T.* sp.

T. aff. *muolensis* (RZHONSNITSKAYA, 1967) mentioned by SIMAKOV (1972, p. 51) and *T. madisonense* (HAYNES, 1916) referred to by COOPER & DUTRO (1982, p. 79) are errors.

(1) ROZMAN (1960, p. 43, p. 47, p. 48, fig. 2, p. 50; 1962, p. 47, p. 48, p. 49, p. 50, table 6, table 8, p. 70, p. 71, table 9, table 10, p. 77, p. 80, p. 82, p. 84, table 11, p. 89, p. 123, pp. 127-129) had already included this species in the genus *Pseudonudirostra* ROZMAN, 1960 = *Pseudoleiorhynchus* ROZMAN, 1962, junior synonyms of the genus *Trifidorostellum*.

II. - Detailed description of *Trifidorostellum longhuiense* TAN, 1987

(Plate 1, Figures 1a-e, 2a-e, 3a-e, 4a-e, 5a-e, 6a-e, 7a-e, 8a-e)

Types

Lectotype : Plate 18, figures 31-35 *in* TAN (*in* TAN *et al.*, 1987).

The following hypotypes have been deposited in the Nanjing Institute of Geology and Palaeontology :

A, 110722 (Pl. 1, figs. 1a-e); B, 110723 (Pl. 1, figs. 2a-e); C, 110724 (Pl. 1, figs. 3a-e); D, 110725 (Pl. 1, figs. 4a-e); E, 110726 (Pl. 1, figs. 5a-e); F, 110727 (Pl. 1, figs. 6a-e); G, 110728 (Pl. 1, figs. 7a-e); H, 110729 (Pl. 1, figs. 8a-e); I, 110730 (Figures 1, 2).

Plaster casts of hypotype I were taken before grinding; a cast as well as the remainder of this specimen are deposited in the Nanjing Institute of Geology and Palaeontology.

Additional plaster casts of the above hypotypes are deposited in the Royal Institute of Natural Sciences of Belgium under the number IG 27514.

Synonymy

1983 *Trifidorostellum* sp. - XU & LIU *in* YU *et al.*, p. 276;
1987 *Trifidorostellum* sp. - LIU, p. 150;
1987 *Trifidorostellum cascadense cascadense* - LIU, p. 150, p. 151;
1987 *Trifidorostellum dunbarense* - LIU, p. 150, p. 151;
1987 *Trifidorostellum longhuiense* Tan (MS) - TAN *in* TAN *et al.*, p. 3, p. 15, p. 20, p. 41, table 3, pp. 42-45, table 5, p. 53, p. 126, p. 169, p. 172, pl. 18, figs. 26-35;
1987 *Trifidorostellum longhuiense uniplicatum* Tan (MS) - TAN *in* TAN *et al.*, p. 15, p. 20, table 3, p. 44, p. 126, pl. 18, figs. 36-40;
1987 *Trifidorostellum longhuiense triplicatum* Tan (MS) - TAN *in* TAN *et al.*, p. 15, p. 20, table 3, p. 44, p. 126, pl. 18, figs. 41-45.

Diagnosis

Small-sized and thick (thickness always greater than length) *Trifidorostellum* with well-marked and strong costae.

Description

The species was briefly described by TAN (*in* TAN *et al.*, 1987, p. 126, pl. 18, figs. 26-35 = *Trifidorostellum longhuiense*, figs. 36-40 = *T. longhuiense uniplicatum*, figs. 41-45 = *T. longhuiense triplicatum*). We now wish to amplify the description. With this restudy, the species is demonstrated to possess all the characters of the genus, and especially the basic internal characters, we compare *T. longhuiense* with the other species and subspecies, and we consider that *T. longhuiense uniplicatum* and *T. longhuiense triplicatum* fall within the variability of the species. LIU (1987, fig. 1, p. 151) merely reproduced the photographs and the transverse serial sections of the holotype of the type species, *T. dunbarense*, given by SARTENAER (1961, pl. I, figs. 4a-e, pl. II, fig. C; *in* SARTENAER & ROZMAN, 1965, fig. 1, p. 148; *in* SCHMIDT & MCLAREN, 1965, figs. 451, 2a-i, p. H577; 1967, pl. I, figs. 13a-d, p. 1055; 1969, text-figure 1, p. 19, pl. I, figs. 1a-e).

GENERAL EXTERNAL CHARACTERS

Small size. Uniplicate to parasulcate. Strongly inequivalve. Transversely subelliptic to suboval in dorsal view; in frontal and cardinal views the contour is a soup plate (pedicle valve) covered by a dish cover (brachial valve), the handhold being the fold. Dorsal umbo inflated and commonly projected posteriorly beyond the pedicle valve. Postero-lateral margins distinctly concave near the commissure. Commissure sharp. Postero-lateral commissure sticking out. Frontal commissure deeply crenulated by the costae. Cardinal line slightly undulated.

PEDICLE VALVE

Contour of pedicle valve sigmoidal in medium longitudinal sections, half an ellipse clearly depressed by the sulcus in transverse median sections. Ventral flanks regularly and moderately convex. Sulcus well marked and deep (three to six times the height of the costae where it passes to the tongue), beginning a very short distance from the beak. Flat-bottomed sulcus. Sulcus widening and deepening abruptly forwards, reaching its greatest width (56 to 66 % of the shell-width) at the junction of the frontal and lateral commissures. Tongue high to very high with sharp borders, standing out clearly, having the shape of a sugar-loaf, generally recurved posteriorly at its crest. Borders of tongue almost always recurved posteriorly. Beak small, acute, slightly incurved, clearly defined; owing to the inflation of the dorsal umbo, it is commonly almost in contact with the brachial valve. Length of the interarea may reach 40 % of the shell-width. Deltidial plates observed in transverse serial sections.

BRACHIAL VALVE

Curve of brachial valve in longitudinal median sections is one quarter of an ellipse of which the major axis lies vertically, and exceptionally one quarter of a circle. Dorsal flanks steep, becoming rapidly abrupt and even sometimes vertical towards the commissure. Fold well-marked and high, beginning a very short distance from the beak, rising abruptly forwards. Top of the fold slightly rounded.

ORNAMENT

Costae wide, well marked, more or less regular, simple. Costae on the fold and the ventral flanks moderately high to high, angular with rounded tops, higher than elsewhere, where they are rounded or obtuse with rounded tops. Median costae start generally very near to the beak, exceptionally at the beak. Lateral costae start from the umbo, the external one confined to the anterior part of the shell.

No parietal costae. Adventitious costae exceptionally present. General costal formula (2) : $\frac{3}{2}$; 0; $\frac{3 \text{ to } 4}{4 \text{ to } 5}$.

DIMENSIONS

Top of pedicle valve located posteriorly at between 36 to 53 % of the shell-length. The greatest thickness of the brachial valve is exceptionally at the frontal commissure, but generally located at a point between 43 and 66 % of the shell-length; from this point the valve curves anteriorly, and, thus, the highest part of the tongue is never the highest part of the shell. Width is the greatest dimension. Thickness always greater than length. Maximum width occurs at a point between 55 and 62 % of the shell-length. Apical angle 120° to 139°.

Discussion of synonymy

LIU (1987, p. 150) collected specimens of the genus in 1976 and 1985, but *T.* sp. was first reported in the Shaodong Formation of central Hunan by XU and LIU. *T. longhuiense uniplicatum* and *T. longhuiense triplicatum*, found in the same beds as *T. longhuiense*, fall within the variability of this species, in which specimens with $\frac{2}{1}$ and $\frac{4}{3}$ median costae are rare.

Comparisons

With the exception of *T. aldanicum* and *T. verchojanicum* for which not enough information is available, all species and subspecies have a smaller relative thickness (shown in t/l and t/w ratios) than *T. longhuiense*.

Measurements of the eight photographed specimens :

in mm	Hypotype A	Hypotype B	Hypotype C	Hypotype D	Hypotype E	Hypotype F	Hypotype G	Hypotype H
l	14.8	13.8	13.5	13.3	12.8	12.8	(12.2)	12
w	20.1	18.7	19	18.3	17.1	(17.2)	18	16.7
lvp unrolled	27	28	25	27	(27.5)	23	(23)	21
t	16.3	17.4	15.4	15.4	16	15.4	14.3	12.3
tpv	4.7	5	4.4	4.8	4.3	4.6	4.2	3.7
tbv	11.6	12.4	11	10.6	11.7	10.8	10.1	8.6
l/w	0.74	0.74	0.71	0.71	0.75	(0.74)	(0.68)	0.72
t/w	0.81	0.93	0.81	0.82	0.94	(0.9)	0.79	0.74
t/l	1.1	1.26	1.14	1.16	1.25	1.2	(1.17)	1.02
apical angle	130°	120°	127°	132°	139°	(125°)	?	125°

l = length; t = thickness; w = width; bv = brachial valve; pv = pedicle valve. Measurements shown in parentheses indicate a reasonable estimate on a damaged specimen. Hypotypes G and H are the smallest specimens among the collection.

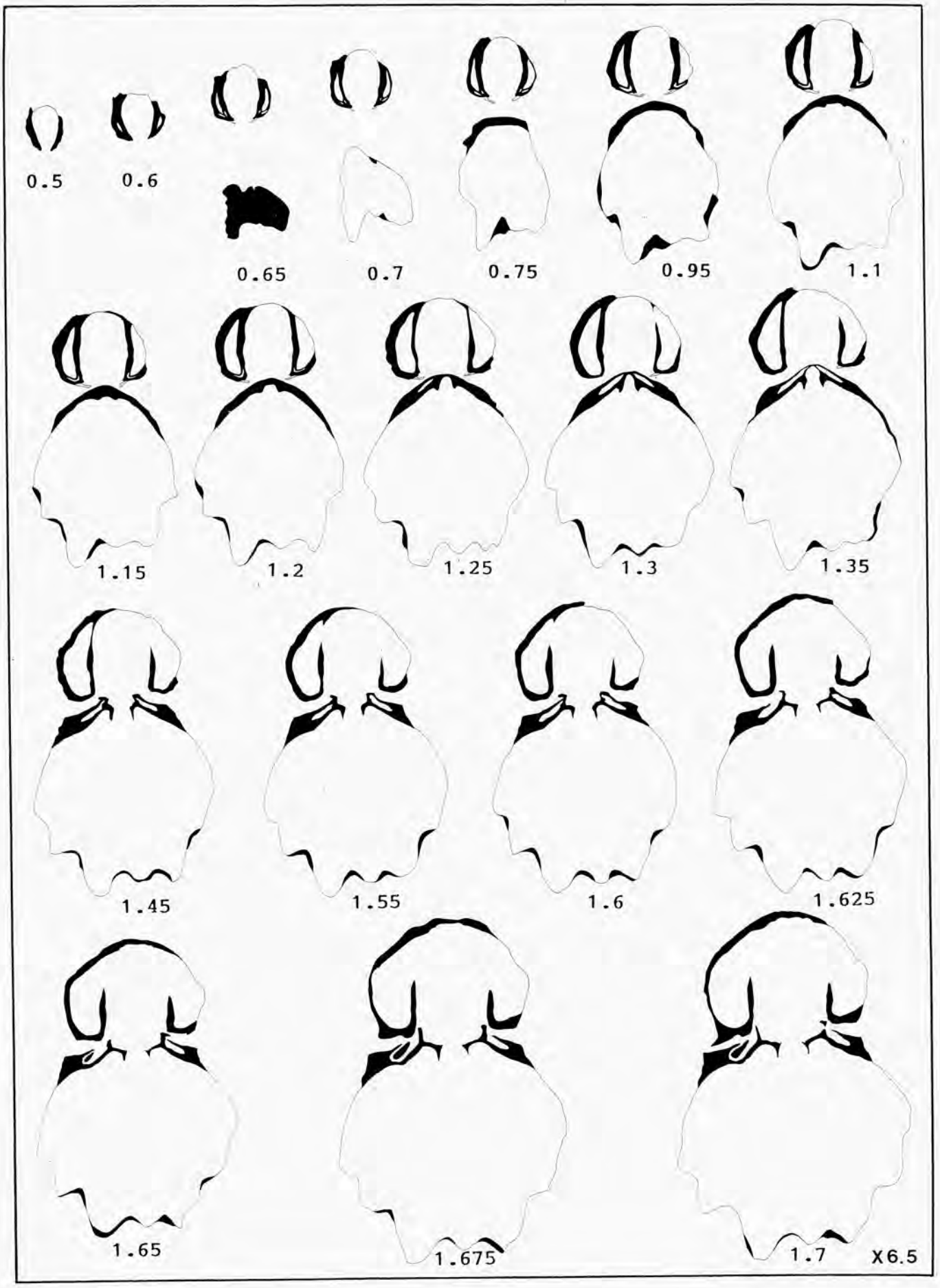
INTERNAL CHARACTERS

Transverse serial sections show the major generic characters : slender internal structures, short dental plates, narrow umbonal cavities, short and robust teeth entering dorsolaterally into the dental sockets, no septum, divided hinge plate with narrow outer plates inclined towards each other; strong crural bases, delicate crura becoming progressively more apart anteriorly, and slightly curved at distal ends.

T. cascadense cascadense and *T. uralicum fontis* are distinguished by their medium to large size, less elevated costae (especially if the difference in size is considered), clearly rounded top of fold, first lateral costae notably rounder or reduced, adventitious, bifurcated and intercalated costae, higher number and greater variability of median costae, frontal commissure often weakly crenulated (especially if the difference in size is considered). *T. cascadense mugodjaricum* and *T. uralicum uralicum* may be distinguished by the same characters related to the costation and to the crenulation of the frontal commissure, and by their small to medium size, smaller thickness, lower tongue, top of fold less rounded, costae distinctly lower.

(2) Grouping of at least 75 percent of the specimens in median, parietal, and lateral categories.

Figure 1. – Trifidorostellum longhuiense *TAN, 1987. Camera lucida drawings of serial transverse sections (continues on Fig. 2); figures are distances in mm of the section forward of the crest of the ventral umbo. Hypotype I. 110730. Measurements : l = 13.5 mm; w = 16.1 mm; t = 13.3 mm.* ▷


0.5
0.6
0.65
0.7
0.75
0.95
1.1
1.15
1.2
1.25
1.3
1.35
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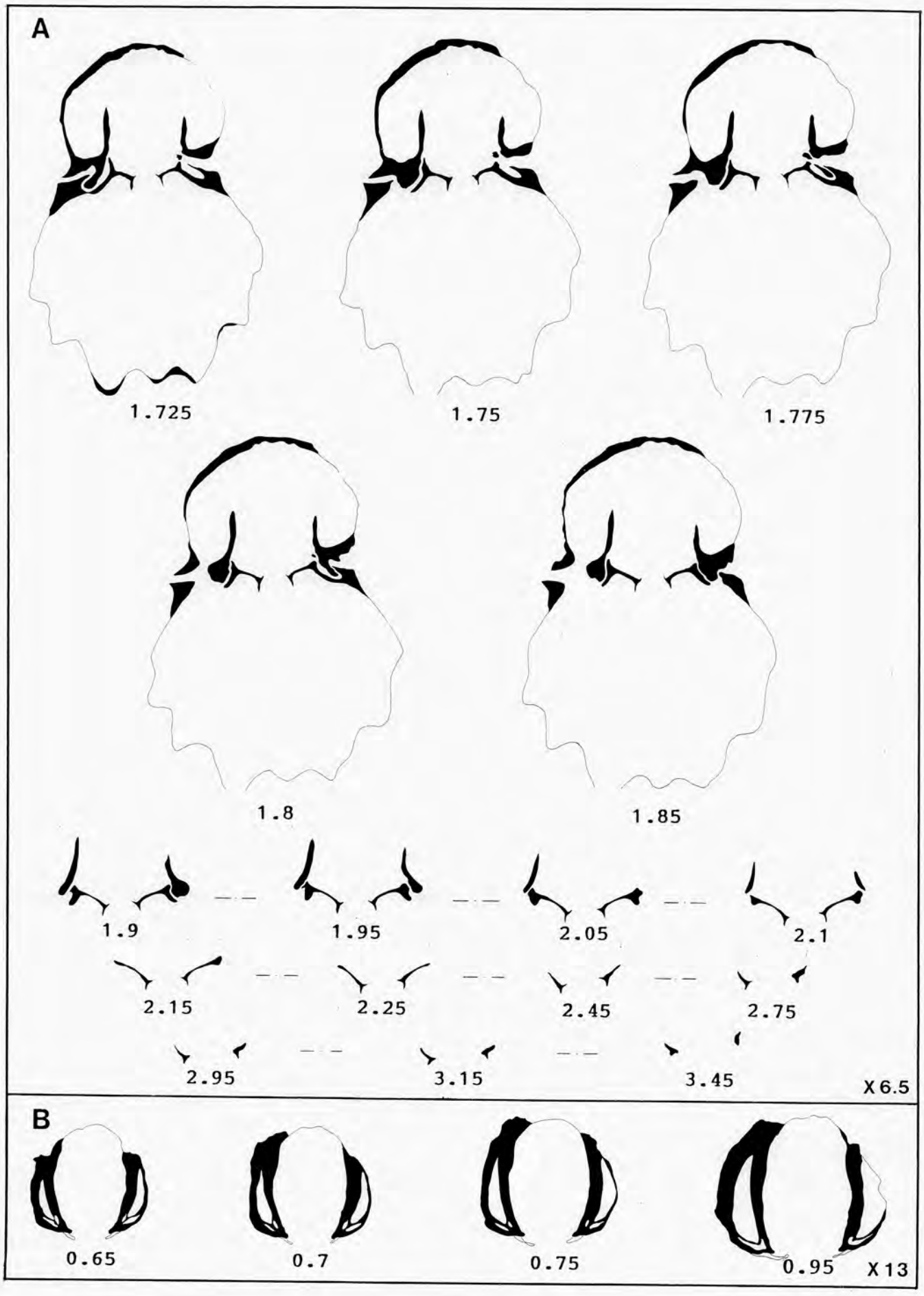
1.625
1.65
1.675
1.7
X6.5


A
1.725
1.75
1.775
1.8
1.85
1.9
1.95
2.05
2.1
2.15
2.25
2.45
2.75
2.95
3.15
3.45
X6.5
B
0.65
0.7
0.75
0.95
X13

The medium-sized *T. posturalicum* is easily distinguished by proportions (distinctly wider, commonly lower), larger size, different general costal formula (usually less lateral cosate, often more median costae), top of shell commonly reached at front, lower tongue, first lateral costae not as wel marked, some — although rare — intercalated and divided median costae.

T. aldanicum and *T. verchojanicum* are represented by few specimens and, thus, not sufficiently known, but they can easily be separated by their larger size and their thick-set aspect.

T. dunbarense, *T. obscurum* and *T. longhuiense* are closely similar in most characters, including the number of median costae. This explains why the Chinese species was first named *T. dunbarense* (and *T. cascadense cascadense*) by Liu (1987, p. 150, p. 151). *T. longhuiense* is smaller than *T. dunbarense* — it means that some specimens of *T. dunbarense*, including the holotype, may reach a larger size — but somewhat larger than *T. obscurum*, the smallest species of the genus. Compared to these other species, *T. longhuiense* is thicker, fold and tongue are usually higher, costae are better marked and generally higher, number of lateral costae is commonly slightly higher. It should be noted that *T. dunbarense* is not "usually multicostate" and does not "have two to five costae in the fold" as stated by Cooper & Dutro (1982, p. 79).

Geographic location and stratigraphic position

T. longhuiense is found in the Shaodong Formation in a restricted area of the central part of the Province of Hunan : Zhouwangpu and Qishi Reservoir in the Longhui county, and Malanbian in the Xinshao county, where the section has been described as follows by Tan [*in* Tan *et al.*, 1987, pp. 14-15, units 22 (top) to 14 (base)] :

Overlying strata : base of the Mengkungao Formation : grey medium-thick bedded bioclastic limestone with intercalated dolomitic limestone containing a rich fauna of brachiopods, corals, etc...

Grey and greyish-yellow medium-bedded argillaceous quartz siltstone . . . . . 5.5 m

Grey and yellowish-grey mudstone and argillaceous siltstone with intercalated lenticular microlithic limestone . . . 2.7 m

Grey thin-medium bedded microlithic dolomitic limestone, yielding brachiopods [*Mesoplica* sp., *Acanthoplecta mesoloba* (Phillips), *Hunanoproductus hunanensis* Hou, *Schuchertella guizhouensis* Yang], a coral [*Complanophyllum minor* Wu & Zhao], a foraminifer [*Earlandia* sp.], and conodonts [*Apatognathus* cf. *cuspidata* Varker, *Spathognathodus* sp., *Ozarkodina* sp. . . . . 3.2 m

Dark grey and brown-yellow thick calcareous siltstone with intercalated silt-microlithic argillaceous limestone . . . 4.1 m.

Grey and dark grey thin-medium bedded argillaceous siltstone, silty mudstone with intercalated lenticular microlithic limestone containing the following spores : *Retispora lepidophyta* (Kedo) Playford, *Cymbosporites formosus* (Naumova) Gao, *Granulatisporites hunanensis* Hou, *Apiculiretusispora plicata* (Allen) Streel, *Microreticulatisporites* sp. . . . . 8.5 m

Grey thin-bedded microlithic limestone with intercalated silt biomicrolithic limestone, rich in brachiopods : *Schuchertella* sp., *Ptychomaletoechia kinlingensis* (Grabau), *P. pleurodon* (Phillips), *Tenticospirifer* sp., *Cyrtospirifer* sp. . . . . 0.8 m

Dark grey thick-bedded siltmudstone, siltstone, intercalated with microlithic silt-limestone, containing brachiopods [*Productella* sp., *Trifidorostellum longhuiense* Tan, *T. longhuiense uniplicatum* Tan, *T. longhuiense triplicatum* Tan, *Ptychomaletoechia* sp., *Tenticospirifer* sp.], conodonts [*Hindeodella subtilis* Bassler, *Ozarkodina* sp.], and spores [*Retispora lepidophyta* (Kedo) Playford, *R. lepidophyta minor* (Kedo) Gao, *Granulatisporites hunanensis* Hou, *Cymbosporites formosus* (Naumova) Gao . . . . . 11.9 m

Grey-yellow, dark-grey argillaceous siltstone, quartz siltstone with intercalated carbonaceous mudstone and fine grained quartz siltstone yielding the following spores : *Retispora lepidophyta* (Kedo) Playford, *Granulatisporites hunanensis* Hou, *Apiculiretusispora* sp., *Microreticulatisporites* sp., *Archaeozonotriletes famenensis* Naumova, *Acanthotriletes* sp. . . . . 13.3 m

Grey and dark-grey calcareous-argillaceous siltstone with intercalated lenticular silt microlithic dolomitic limestone, containing a conodont [*Spathognathodus planiconvexus* Wang & Ziegler], and foraminifera [*Parathurammina* sp., *Lagenammina lagenammina* (sp. nov.)] . . . . . 2.3 m

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Underlying strata : top of the Oujiachong Formation : grey-black thick-bedded carbonaceous siltmudstone.

The best information presently available for assessing the age of the Shaodong Formation is provided by the Zhouwangpu section, although the evaluation of the thickness varies from one author to another : 90 m for Wang (1983, p. 112, fig. 1), 132.4 m for Liu (1987, p. 150), and 70.3 m for Tan *et al.* (1987, pp. 19-20). If the calcareous mudsandstone (unit 4 *in* Liu, 1987, p. 154; unit 13 *in* Tan *et al.*, 1987, p. 19) is considered as the base of the Mengkungao Formation, units 3 and 12 become part of the Shaodong Formation, which, thus, has a thickness of 96.9 m (70.3 + 26.6 m) comparable with the 90 m measured by Wang (1983). The following description of the Shaodong Formation at this locality is extracted from Tan *et al.* (1987), with minor modifications in fossil identifications, and its upper limit moved upwards according to its definition by Wang (1983).

Overlying strata : base of the Mengkungao Formation : medium- to thick-bedded, yellow-brown sandstone and argillaceous siltstone.

◁ Figure 2. – Trifidorostellum longhuiense *Tan, 1987.*

A. – Continuation from Fig. 1 of camera lucida drawings. Hypotype I, 110730.

B. – Four transverse serial sections of the same specimen, magnified two times and showing various stages of the ventral umbonal cavities and the deltidial plates.

3. Grey or dark grey thick-bedded bioclastic limestone intercalated with argillaceous limestone and marls containing corals [*Caninia* sp., *Zaphriphyllum* sp., *Cystophrentis* sp., *Syringopora* sp.], brachiopods [*Schuchertella* sp., *Productella* sp., *Hunanoproductus hunanensis* HOU, *Ptychomaletoechia kinlingensis* (GRABAU), *Cyrtospirifer* sp., *Tenticospirifer vilis* (GRABAU), *T.* sp.], and foraminifera [*Septatournayella rauserae* LIPINA, *Glomospiranella rara* LIPINA, *Septaglomospiranella complanata* CONIL & LYS, *Pricinesphaera* sp.] . . . . . 26.6 m
2. Grey or grey-brown medium- to thick-bedded argillaceous siltstone and continental detrital microlithic limestone yielding a coral [*Zaphrentis* sp.] and brachiopods [*Schuchertella* sp., *Plicochonetes ornatus* (SHUMARD), *Productella* sp., *Ptychomaletoechia* sp., *Cyrtospirinatus* (SHUMARD), *Productella* sp., *Ptychomaletoechia* sp., *Cyrtospirifer* sp., *Tenticospirifer* sp.] . . . . . 41.5 m
1. Grey or dark grey thick-bedded calcareous siltstone intercalated with bioclastic microlithic limestone containing brachiopods [*Productella* sp., *Ptychomaletoechia kinlingensis* (GRABAU), *Trifidorostellum longhuiense* TAN, *T. longhuiense triplicatum* TAN, *T. longhuiense uniplicatum* TAN, *Hunanoproductus hunanensis* HOU, *Cyrtospirifer* sp., *Tenticospirifer minor* (GRABAU)] and an algae [*Kamaena* sp.] . . . . . 28.8 m

Underlying strata : top of the Oujiachong Formation : yellow-brown medium- to thick-bedded argillaceous siltstone, arenaceous shales intercalated with quartzose sandstones including fragments of plants.

The Shaodong Member was first introduced by HOU (*in* YUE & HOU, 1962; 1965, p. 112) as the lowest of the three members of the Mengkungao Formation of Tournaisian age. WU *et al.* (1981, p. 1) elevated the member to a formation, while the middle member, the Mengkungao Member became the Mengkungao Formation.

HOU (1965, p. 132) was the first to consider that the Shaodong Member contained brachiopods of transitional Devonian/Carboniferous age and correlated it with the Etroeungt Limestone of northern France.

Corals from units 3 and 2 have been compared with those of the Etroeungt Limestone by WU, ZHAO & JIANG (1981, p. 5), and again by YU *et al.* (in press). Foraminifera from the third unit were included in the *Septatournayella rauserae-Septaglomospiranella complanata* assemblage and could correspond to the C^{t}_{1a} of the Donets Basin and the western Ural Mountains, and to the Etroeungt Limestone according to WANG (1983, p. 214, p. 221).

In the Zhouwangpu section, conodonts have only been found in the lower part of the Mengkungao Formation : *Icriodus* sp., *Polygnathus* sp., *Apatognathus varians* BRANSON & MEHL, *Ligonodina* sp., *Spathognathodus strigosus* (BRANSON & MEHL), *Hindeodella* sp., *Hibbardella* sp. This conodont fauna is very close to that of the Shaodong Formation at its type locality, Jieling, Shaodong county, where the following conodonts were identified in its lower part :

Polygnathus semicostatus BRANSON & MEHL, *Icriodus costatus* (THOMAS), *Bispathodus aculeatus aculeatus* (BRANSON & MEHL), etc...; these conodonts allow correlation with the Lower *Bispathodus costatus* Zone of Belgium and France or the middle part of the *Palmatolepis gracilis expansa* Zone, following WANG & ZIEGLER (1982, pp. 152-155).

Thus *Trifidorostellum longhuiense* is considered as found in rocks correlatable with the Lower *Bispathodus costatus* Zone.

III. - Stratigraphic position and geographic distribution of the genus *Trifidorostellum*

Figure 3 summarizes the state of our knowledge on the stratigraphic position and the geographic distribution of the various species and subspecies of the genus *Trifidorostellum*.

When first described (SARTENAER, 1961, p. 5) the genus was based on North American species, which were restricted to the upper part of the Lower Famennian. SCHMIDT & MCLAREN (1965, p. H578) considered it to be of Famennian and Lower Carboniferous age — in fact, it should have been of Frasnian to Lower Carboniferous age — because of the various species placed by ROZMAN (1960, p. 43, p. 46, p. 47, p. 48, fig. 2, p. 50; 1962, pp. 122-129) in the genus *Pseudonudirostra* 1960 = *Pseudoleiorhynchus* 1962, junior synonyms of *Trifidorostellum*. For the same reason these authors accepted the presence of the genus in Kazakhstan and in the Kuznetsk Basin. This problem was clarified by SARTENAER & ROZNAN (1965, pp. 148-149), and SARTENAER (1967, p. 1048; 1969, p. 7, p. 17), who restricted the genus *Trifidorostellum* to the Famennian in eliminating *Liorhynchus depressus* RZHONSNITSKAYA, 1953 (Frasnian of the Kuznetsk Basin), *Pseudoleiorhynchus* (*Pugnax*?) *plana* (= *nomen nudum*) (transitional beds between the Upper Famennian and the Lower Tournaisian of the southern Ural Mountains), and *Liorhynchus planoovalis* NALIVKIN, 1937 (Famennian of northeastern Kazakhstan, the Mugodjary Mountains and the northwestern part of the Balkhash region). *Trifidorostellum posturalicum pennatum* MARTYNOVA, 1970 (Famennian of central Kazakhstan) was rejected from the genus by SARTENAER (1982, p. 130). After examination of Russian material, SARTENAER & ROZMAN (1965, pp. 148-149) agreed on the following stratigraphic ranges : upper part of the Lower Famennian (*T. dunbarense*), lower part of the Upper Famennian (*T. uralicum*), upper part of the Upper Famennian (*T. posturalicum*).

T. obscurum and *T. longhuiense* are both Upper Famennian.

With the exception of *T. aldanicum* and *T. verchojanicum* from the lower half of the Famennian, the genus *Trifidorostellum* is confined to the lower and upper parts of the Upper Famennian, but not the uppermost part if we comply to the newly accepted Devonian/Carboniferous boundary. SARTENAER (1967, p. 1048; 1969, p. 7, p. 17) dated the species and subspecies from southwestern Montana, central Idaho, and the Alberta Rocky Mountains as lower Upper Famennian rather than upper Lower Famennian, although

he was quite aware (1969, p. 8, p. 17) that "lower, middle and upper Famennian have been used loosely", and that "divisions such as lower and upper Famennian ... may vary from one region to another".

The Russian species from the Sette-Daban range may be from the upper part of the lower half of the Famennian, with the discrepancy in the cited correlations being due to lack of agreement on the formal subdivision of the Famennian. In any case new light will be shed on the problem by future investigations.

Trifidorostellum is found in : Canada (Alberta), People's Republic of China (Hunan), Union of Soviet Socialist Republics (Mugodjary Mountains and North-East), United States of America (Idaho, Montana, New Mexico).

SPECIES AND SUBSPECIES	TYPE REGION	AGE IN THE TYPE REGION	OTHER REGIONS	AGE IN OTHER REGIONS
aldanicum ALEKSEEVA, R.E., 1967	Sette-Daban Range (North-East)	Famennian (lower half)	[Kolyma river, North-East] aff. *aldanicum* [Omolon Massif, North-East] aff. *aldanicum*	Famennian (lower half) Upper Famennian
cascadense cascadense (WARREN,, P.S., 1927)	Alberta Rocky Mountains	Upper Famennian (lower part) or Lower Famennian (upper part)	~~central Hunan~~	~~Upper Famennian~~
mugodjaricum SARTENAER, P., 1969	southern Mugodjary Mountains	Upper Famennian (lower part)		
dunbarense (HAYNES, W.P., 1916)	southwestern Montana	Upper Famennian (lower part) or Lower Famennian (upper part)	central Idaho ~~central Hunan~~	Upper Famennian (*Scaphignathus subserratus - Pelsekysgnathus inclinatus* Fauna) ~~Upper Famennian~~
longhuiense TAN, Z.-X., 1987	central Hunan	Upper Famennian (Lower *Bispathodus costatus* Zone)		
obscurum COOPER, G.A. et DUTRO, J.T., Jr., 1982	southwestern New Mexico	Upper Famennian (*Clymenia* Zone)		
~~***planoovalis***~~ ~~(NALIVKIN, D.V.,1937)~~				
~~***posturalicum pennatum***~~ ~~MARTYNOVA, M.V.,1970~~				
posturalicum (ROZMAN, Kh.S., 1962)	southern Mugodjary Mountains	Upper Famennian (upper part)	~~western Pomerania~~ [Kolyma river, North-East]	~~Strunian~~ Famennian (upper part ?)
sp. ERLANGER, O.A. *in* SHILO, N.A. *et al.*, 1984	Omolon Massif (North-East)	Upper Famennian		
uralicum fontis SARTENAER, P., 1969	central Idaho	Upper Famennian (*Scaphignathus subserratus-Pelsekysgnathus inclinatus* Fauna)		
uralicum (NALIVKIN, D.V., 1947)	southern Mugodjary Mountains	Famennian (lower horizons) Upper Famennian (lower part)	[eastern,central and northern Ural Mountains] also aff. *uralicum* [northern Ural Mountains] cf. *uralicum* [Volga-Ural region] also aff. *uralicum* Poland (Cracow anticline, Holy Cross Mountains, ~~western~~ Lublin Basin)	Famennian (lower horizons) Upper Famennian Lower Tournaisian (*Quasiendothyra kobeitusana* Zone) Lower Famennian Lower *Cheiloceras* Stufe and Upper (*Platyclymenia* and *Clymenia* Stufen) ~~Famennian~~
verchojanicum ALEKSEEVA, R.E., 1967	Sette-Daban Range (North-East)	Famennian (lower half)	[Omolon Massif, North-East] aff. *verchojanicum*	Upper Famennian

Figure 3. – *Stratigrafic position and geographic distribution of species and subspecies of the genus* Trifidorostellum *Sartenaer, 1961. [ ] means that the material has not been examined. /means rejection;* Liorhynchus depressus *Rzhonsnitskaya, 1953 and* Pseudoleiorhynchus (Pugnax?) plana, *which are also rejected, are not included in the figure, because they are of Frasnian age and a* nomen nudum, *respectively.*

IV. - Conclusions

This paper demonstrates that, since its recognition twenty-eight years ago, the genus *Trifidorostellum* has been documented from a wide geographic distribution, but its stratigraphic range has remained restricted. Therefore, we propose a world-wide *Trifidorostellum* range Zone, which naturally incorporates the already established regional zones : *T. aldanicum* Zone of the Northeastern regional unified stratigraphic scheme of ALEKSEEVA & SIDIACHENKO (1968, table between p. 38 and p. 39), and the central Hunan *T. dunbarenze* Zone of LIU (1987, p. 151), which has been correctly superseded by the *T. longhuiense* Assemblage, the *T.* Assemblage, the *T. longhuiense* Zone, and the *T. longhuiense* Acme-Zone of TAN *et al.* (1987, p. 41, table 3, pp. 42-45, table 5, p. 53, p. 169, p. 172).

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PLATE 1

Trifidorostellum longhuiense *(TAN, 1987)*

All figures are × 1. a = ventral view; b = dorsal view; c = frontal view; d = apical view; e = lateral view.

Figs. 1a-e. – *Hypotype A, 110722. Costal formula :* $\frac{3}{2}$; 0; $\frac{3}{4}$.

Figs. 2a-e. – *Hypotype B, 110723. Costal formula :* $\frac{3}{2}$; 0; $\frac{4}{5}$ *and* $\frac{5}{4}$.

Figs. 3a-e. – *Hypotype C, 110724. Costal formula :* $\frac{3}{2}$; 0; $\frac{3}{4}$.

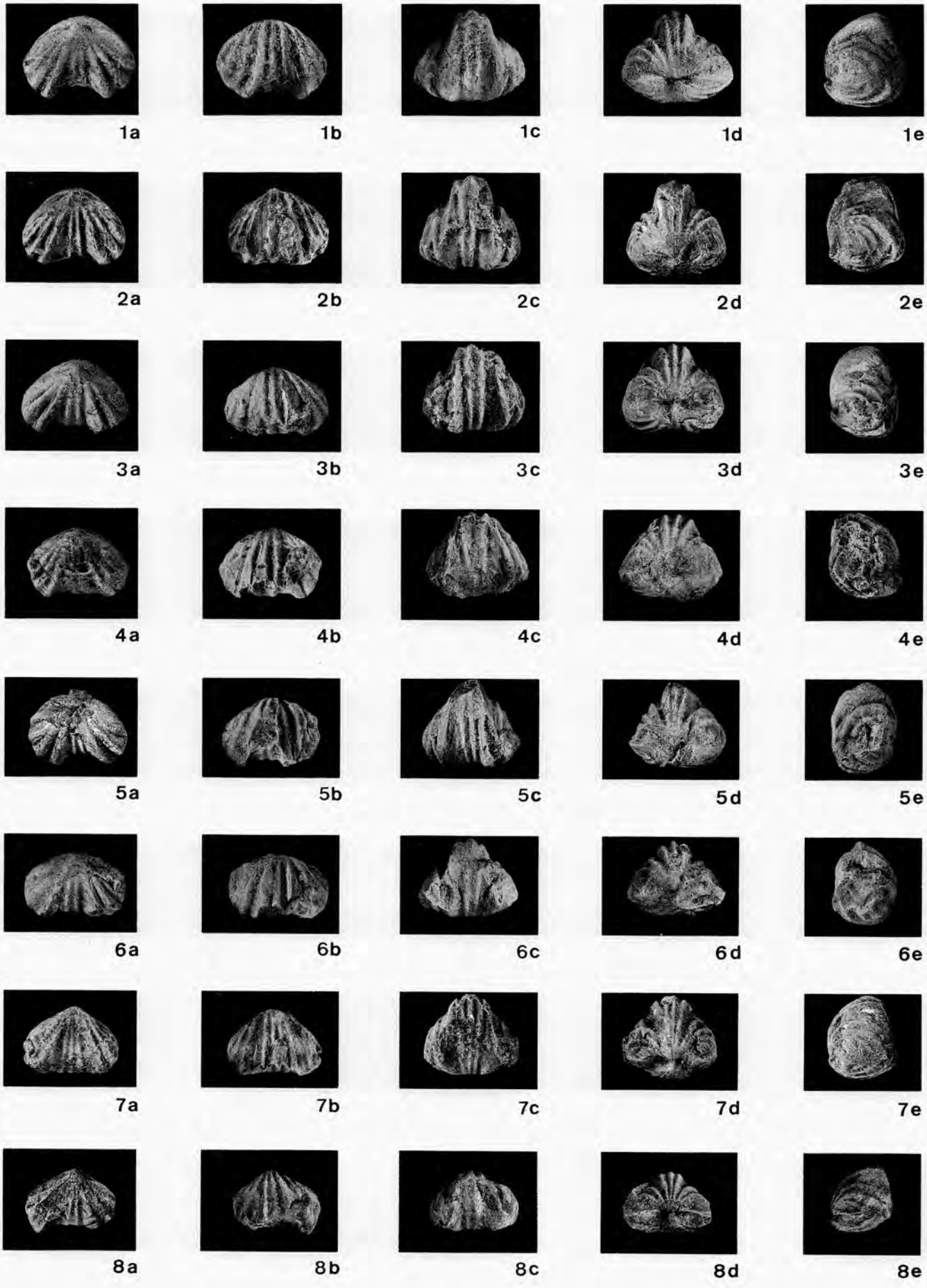
Figs. 4a-e. – *Hypotype D, 110725. Costal formula :* $\frac{3}{2}$; 0; $\frac{4}{5}$.

Figs. 5a-e. – *Hypotype E, 110726. Costal formula :* $\frac{3}{2}$; 0; $\frac{4}{5}$.

Figs. 6a-e. – *Hypotype F, 110727. Costal formula :* $\frac{3}{2}$; 0; $\frac{2}{3}$ *and* $\frac{3}{4}$.

Figs. 7a-e. – *Hypotype G, 110728. Costal formula :* $\frac{4}{3}$; 0; $\frac{4}{5}$.

Figs. 8a-e. – *Hypotype H, 110729. Costal formula :* $\frac{3}{2}$; 0; $\frac{4}{5}$.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