

SOME UPPER CARBONIFEROUS FUSULINIDS FROM THE VICINITY OF BEIYIN OBO, INNER MONGOLIA

J. C. SHENG

(Institute of Palaeontology, Academia Sinica)

The fusulinids dealt with in this paper were collected in 1955 by Mr. L. S. Wong of a field party sent by the Ministry of Geology in the vicinity of Beiyin Obo, Inner Mongolia (formerly province Suiyuan). The fusulinid-bearing bed of this area was named by Mr. Wong the Lalaotu limestone. No data of stratigraphical sequence of this region are readily available. Since no information of the fusulines in this region has been hitherto known, the present discovery affords therefore some interest.

The material contained in present study came from two different localities as follows:—

1. Lalaotu—about 35 km northeast of Beiyin Obo and about 70 km to the southwest of Jisu-honguer. Here the following species are found:

Triticites pygmaeus Dunbar and Condra

T. laxus Sheng (sp. nov.)

T. lalaotuensis Sheng (sp. nov.)

?*Schwagerina nathorsti* var. *laxa* (Lee)

Ozawainella sp.

2. Amushan—about 22 km northwest of Beiyin Obo and about 30 km to the west of Lalaotu. Fusulinds collected from this locality are:

Pseudoschwagerina borealis (Tscherbovich)

Quasifusulina spatiosa Sheng (sp. nov.)

Schwagerina amushanensis Sheng (sp. nov.)

?*Schwagerina nathorsti* var. *laxa* (Lee)

Judging from the foregoing lists, it appears clear that the fusulinids in these two localities represent probably two different horizons of the Upper Carboniferous. The assemblage of the first locality characterized by *Triticites* belongs to the *Triticites* zone, representing the lower part of the Lalaotu limestone, and that of the second locality with the leading fossil *Pseudoschwagerina* belongs to the *Pseudoschwagerina* zone, representing the upper part of the limestone series. The Lalaotu limestone as a whole is therefore undoubtedly Upper Carboniferous in age; it is equivalent to the Taiyuan series of North China, the Chuanshan limestone of southeastern and the Mapping limestone of southwestern China.

The writer is much indebted to Profs. S. Chen and H. C. Sze for their critical reading of the manuscript. Best thanks are also due to Mr. Wong for offering him the specimens for study.

DESCRIPT ON OF SPECIES

Family Fusulinidae Möller

Subfamily Ozawainellinae Thompson and Foster, 1937

Genus *Ozawainella* Thompson, 1935*Ozawainella* sp.

(Pl. II, fig. 12)

We have only one para-axial section of the genus *Ozawainella* in our collection from Lalaotu of Beiyin, Inner Mongolia. The following description is based entirely on our figured specimen.

Test very small, lenticular, periphery subangular; axis of coiling short and straight. Length, 0.43 mm, width, 1.04 mm, form ratio, 0.41:1. The widths of first to sixth volution are 0.18, 0.32, 0.48, 0.68, 0.90 and 1.04 mm, respectively. Number of whorls about 6.

Spirotheca relatively thick, composed of three layers—a tectum and upper and lower tectoria. The upper tectorium or the chomata-like process is usually more thicker than the lower one and extends from the neighbourhood of the tunnel to the umbilical regions.

Septa thinner than spirotheca, unfluted.

Chomata triangular; tunnel slit-like.

Proloculus not seen.

Remarks: The form here referred to *Ozawainella* sp. represents probably a new species. It differs from the genotype chiefly in having larger form ratio, less angulate periphery and more tightly coiled whorls.

Cat. No. 9029 (holotype).

Subfamily Fusulininae Rhumbler, 1895

Genus *Quasifusulina* Chen, 1934*Quasifusulina spatiosa* Sheng (sp. nov.)

(Pl. II, figs. 9—10)

Shell very large, highly elongately cylindrical, median portion slightly recurved, poles rounded. The largest specimens in our collection having $5\frac{1}{2}$ whorls about 12.7—15.5 mm long and 2.51—2.70 mm wide, form ratio 5.08—5.57:1.

Spirotheca exceedingly thin, measuring 0.016 mm in the inner 2—3 volutions and gradually increasing to about 0.032 mm in the outer ones. The spirotheca is composed of a discontinuous and indistinct tectum and a lower layer which only here and there presents a vague impression of finely alveolar structure.

Septa rather thinner than spirotheca, highly and rather regularly fluted throughout the length of the shell.

Chomata not seen.

Tunnel low and narrow.

Axial fillings thin, only developed in the inner two chambers.

Proloculus large, spherical, about 0.35—0.48 mm in the outer diameter.

Measurements (in mm) for *Quasifusulina spatiosa* Sheng

Specimen	L	W	F. R.	Diam. prol.	Width of successive volutions					
					1	2	3	4	5	5½
9027	15.05	2.70	5.57	0.48	0.78	1.05	1.42	1.83	2.52	2.70
9026	12.7	2.51	5.08	0.35	0.80	1.07	1.40	1.82	2.30	2.51

Remarks: This species recalls strongly *Quasifusulina longissima* (Möller), but the largest specimen of our form is 4 mm longer than the longest one observed by Möller. The more thinner axial fillings and slightly intensely septal fluting of our forms can also easily be distinguished from Möller's species.

Quasifusulina spatiosa Sheng differs from *Q. longissima* (Möller) described by Profs. Lee and Chen from the Taiyuan Series of N. China and the Chuan-shan and Maping limestones of S. and SW China in the much longer and wider shell, much thinner axial fillings and slightly larger proloculus. It is possible that our species represents the largest form of all known species of the genus *Quasifusulina*.

Cat. Nos. 9026 (paratype), 9027 (holotype).

Subfamily Schwagerininae Dunbar and Henbest, 1930

Genus *Triticites* Girty, 1904

Triticites pygmaeus Dunbar and Condra

(Pl. II, fig. 11)

1927. *Triticites cullomensis* var. *pygmaeus* Dunbar and Condra, The Fusulinidae of the Pennsylvanian System in Nebraska, pp. 95–96, Pl. V, figs. 3–4.
 1950. *Triticites pygmaeus* Thompson, Verville and Bissell, Journal of Palaeontology, Vol. 24, p. 446, Pl. 58, figs. 16–18.

Shell small, fusiform, median portion vaulted, poles bluntly pointed. Axis of coiling straight. Mature specimen attaining 6 volutions about 3.9 mm long and 1.72 mm wide. The widths of the first to the sixth volution are 0.15, 0.28, 0.43, 0.67, 1.04 and 1.72 mm, respectively. The form ratios for the first to the sixth volution are 1.3, 1.6, 1.72, 1.9, 2.2 and 2.27:1, respectively.

Spirotheca thin, composed of a tectum and a finely alveolar keriotheca. The spirotheca in the inner two volutions is more thinner than in the outer ones.

Septa gently folded, their median portions almost plane; only a few nearly rounded loops are observed in the polar regions.

Chomata well developed in all of the volutions.

Tunnel relatively low and narrow.

Proloculus not seen.

Remarks: The present specimen is identical with *Triticites pygmaeus* Dunbar and Condra figured by Thompson, Verville and Bissell from the Oquirrhu formation of the southcentral Wasach Mountains of Utah in the shape and size, in the form ratio and chomata, in the number of whorls and in the characters of the septal fluting.

Triticites pygmaeus Dunbar and Condra closely resembles the paratypes of *Triticites matsumotoi* described by Kanmera (1955, p.184—186, Pl.XI, figs. 6,7) from the Yayamadake limestone of the Hikawa valley of Japan, but differs in having less inflated shell, less prominent chomata and more intensely fluted septa in the polar regions.

Cat. No. 9028 (plesiotype).

***Triticites laxus* Sheng (sp. nov.)**

(Pl. I, figs. 1—6)

Shell large, highly elongately fusiform. Axis of coiling straight. Lateral slopes low straight to slightly irregular, poles bluntly pointed.

Mature specimens contain 5 volutions and attain a length of about 9.9—10.56 mm and a width of 2.11—2.38 mm; form ratio 4.1—4.43:1, averaging 4.31:1 for 4 specimens. The first three whorls short and compactly coiled, whereas the succeeding whorls lengthen and increase in height rapidly. The shell attaining an exceptionally large size for so small a number of volutions.

Spirotheca exceedingly thin in the inner two volutions and composed seemingly only of a compact, dense and dark layer. In the outer volutions, the spirotheca is thicker and composed obviously of a tectum and a finely alveolar keriotheca.

Septa thinner than spirotheca, broadly and highly fluted in the polar regions, the fluting rapidly decreases, however, from the poles toward the tunnel.

Chomata well developed throughout, symmetrical, very low and wide, about 1/5 as high as the respective chambers.

Tunnel low and wide, about 0.12 mm high and 0.98 mm broad in the third volution and 0.13 mm high and 1.5 mm wide in the fourth volution.

Proloculus small, spherical, about 0.08 mm in the outside diameter.

Measurements (in mm) for *Triticites laxus* Sheng

Specimen	L	W	F. R.	Diam. prol.	Width of volutions					Thickness of spirotheca				
					1	2	3	4	5	1	2	3	4	5
9006	10.56	2.38	4.43	0.09	0.16	0.30	0.56	1.35	2.38	0.013	0.016	0.018	0.064	0.064
9007	9.91	2.11	4.22	0.08	0.17	0.32	0.56	1.30	2.11	0.015	0.018	0.03	0.064	0.064
9010	9.90	2.18	4.10	—	—	0.32	0.68	1.50	2.18	—	0.016	0.03	0.064	0.064
9011	6.40	1.30	4.50	0.08	0.15	0.29	0.52	1.30		0.015	0.016	0.03	0.064	

Remarks: As implied by its specific name our species is characterized by the extraordinary looseness of coiling in this shell. This feature will distinguish it readily from any other described species. *Triticites laxus* Sheng resembles *Triticites irregularis* (Schellwien and Staff) emended by Dunbar and Condra (1927, p.108—111, Pl.VIII, figs. 7—10) somewhat closely, but differs from the latter in having smaller form ratio, fewer whorls, wider tunnel, less intensely septal fluting and especially in having much broader coiling of the last whorls.

Cat. Nos. 9006 (holotype), 9007, 9008, 9009, 9010, 9011 (paratypes).

***Triticites lalaotuenensis* Sheng (sp. nov.)**

(Pl. I, figs. 7—12)

Shell large, elongately fusiform, one side of the median portion is slightly vaulted and the other slightly depressed. Mature specimen of the typical form (Pl. I, fig. 7) containing $5\frac{1}{2}$ whorls about 10.43 mm in length and 2.77 mm in width, with a form ratio about 3.77:1. Whorls rather closely coiled in inner two volutions thence gradually expanded outward. The widths of the first to the last volution are 0.34, 0.61, 1.07, 1.76, 2.42 and 2.77 ($5\frac{1}{2}$) mm, respectively. The form ratios for the first to last volution are 1.3, 1.73, 2.29, 2.88, 3.8 and 2.77 ($5\frac{1}{2}$):1.

Spirotheca comparatively thin in the inner volutions, but grows to be thicker towards the outer ones. The spirotheca is composed of a tectum and a finely alveolar keriotheca. The thickness of the spirotheca about 0.03 mm in the first two volutions, 0.05 mm in the third and fourth and 0.065 mm in the fifth and last volutions.

Septa thinner than spirotheca, highly and irregularly fluted in the polar regions but broadly folded across the tunnel areas.

Chomata well developed in the inner volutions, wider in the outer ones.

Proloculus spherical, about 0.17—0.21 mm in the outside diameter.

Remarks: In shape, in the number of whorls and in the character of its septal folds, the present species is allied to *Triticites* (*Motiparus*) *sinuosus* Rosovskaya, but the size of our species is much larger; it has also a larger form ratio of the volutions and a slightly incurved shell. *Triticites lalaotuenensis* Sheng differs from *Triticites plicatulus* Merchant and Keroher in having smaller number of whorls, smaller form ratio of the volutions and larger proloculus.

Cat. Nos. 9012 (holotype), 9013, 9014, 9015, 9016, 9017 (paratypes).

Genus *Schwagerina* Möller, 1877**? *Schwagerina nathorsti* var. *laxa* (Lee)**

(Pl. II, figs. 3—5)

1927. *Schellwienia nathorsti* var. *laxa* Lee, Palaeontologia Sinica Ser. B, Vol.4, fasc. 1, p.101, Pl. XIX, figs. 1—5, 7—10.

Shell comparatively large, fusiform; median portion vaulted, poles bluntly pointed. Axis of coiling straight. Shells of 5 volutions about 8.98—9.9 mm long and 2.5—2.73 mm wide. Form ratio 3.26—3.58:1. The form ratios of the first to the fifth volution of a typical specimen are 1.8, 2.3, 2.38, 3.25 and 3.26:1, respectively.

Spirotheca relatively thick and composed of a tectum and a rather coarsely alveolar keriotheca.

Septa thin, highly and strongly fluted for the whole length of the shell up to the fourth volution, but in the outer volutions the septa only slightly fluted across the central part.

Chomata small, semi-elliptical in cross-section and present only in the inner 2—3 volutions, about $\frac{3}{4}$ as high as the respective chambers. Tunnel high and

narrow, tunnel path straight.

Proloculus, small, spherical, about 0.2 mm in outside diameter.

Measurements (in mm) for ?*Schwagerina nathorsti* var. *laxa* (Lee)

Specimen	L	W	F. R.	Diam. prol.	Width of volutions					Thickness of spirotheca				
					1	2	3	4	5	1	2	3	4	5
9020	9.9	2.73	3.26	0.20	0.52	0.87	1.44	2.07	2.73	0.03	0.035	0.06	0.07	0.10
9021	8.98	2.5	3.58	0.21	0.55	0.90	1.45	2.15	2.50	0.03	0.035	0.055	0.07	0.08

Remarks: The specimens here referred with a question mark to *Schwagerina nathorsti* var. *laxa* (Lee) differ from the type specimens in their more larger shell, larger proloculi and smaller number of whorls. They may not be conspecific with the types; the writer prefers to determine the specimens as ?*Schwagerina nathorsti* var. *laxa* (Lee) until more material is available.

Cat. Nos. 9020, 9021, 9022 (Plesiotypes).

Schwagerina amushanensis Sheng (sp. nov.)

(Pl. II, figs. 6—8)

Shell relatively large, fusiform, one side of the central part vaulted and another flated or slightly depressed. Mature specimen containing $5\frac{1}{2}$ volutions measuring 7.66—8.38 mm in length and 2.4—2.5 mm in width; form ratio 3.19—3.35:1.

Spirotheca rather thick, composed of a tectum and a rather coarsely alveolar keriotheca. The thickness of spirotheca for the first to the last volution in a typical form (Pl. II, fig. 7) about 0.033, 0.033, 0.034, 0.05, 0.065 and 0.08 ($5\frac{1}{2}$) mm, respectively.

Septa thinner than spirotheca, highly and intensely fluted. They are closely but irregularly fluted in the polar regions and are loosely and broadly fluted across the central part of the shell, even in the outer volutions. Septal counts for the first to the last volution are 16, 19, 24, 28, 28 and 26 ($5\frac{1}{2}$), respectively.

Chomata small, well developed in the inner 2—3 volutions, about one-half as high as the chambers.

Tunnel narrow in the inner two or three volutions but wider in the outer ones. Tunnel path not straight.

Proloculus spherical, about 0.27—0.3 mm in outside diameter.

Measurements (in mm) for *Schwagerina amushanensis* Sheng

Specimen	L	W	F. R.	Diam. prol.	Width of volutions						Form ratio of volutions					
					1	2	3	4	5	$5\frac{1}{2}$	1	2	3	4	5	$5\frac{1}{2}$
9024	7.66	2.4	3.19	0.27	0.45	0.70	1.07	1.57	2.16	2.4	1.63	2.05	2.30	3.11	3.05	3.19
9025	8.38	2.5	3.35	0.30	0.40	0.71	1.08	1.60	2.22	2.5	1.48	1.58	2.00	2.50	3.40	3.35

Remarks: The present form closely resembles *Schwagerina comatifera* (Rauser) but differs from the Russian species in having larger shell, larger

proloculi and in having more conspicuous chomata in the inner volutions.

Our specimens are also similar to *Schwagerina kiangsuensis* Chen var. *occidentalis* (Rauser) in the shape and size, in the form ratio and in the diameter of the proloculus. However, the septa in the latter are less intensely fluted and the chomata are less conspicuous.

Cat. Nos. 9024 (holotype), 9023, 9025 (paratypes).

Genus *Pseudoschwagerina* Dunbar and Skinner, 1936

Pseudoschwagerina borealis (Tscherbovich)

(Pl. II, figs. 1—2)

1949. *Schwagerina borealis* Tscherbovich, *Фораминиферы верхнекаменноугольных и артинских отложений башкирского приуралья*, стр. 83, табл. V, фиг. 8; табл. VI, фиг. 1.

Shell large, subspherical. The small extremities extended and subacutely rounded. Mature specimen attaining 7 volutions about 7.39 mm long and 5.28 mm wide with a form ratio 1.4:1. The juvenarium consisting of 3 fusiform and closely coiled volutions, from the end of the third volution onward the coiling becomes rapidly more evolute and the shell looks subspherical in profile.

Spirotheca very thin in the juvenile volutions where it is about 0.01 mm thick in the first volution, 0.025 mm in the second and 0.03 mm in the third. Thence, the spirotheca gradually increasing in thickness, about 0.032 mm in the fourth volution, 0.042 mm in the fifth, 0.08 mm in the sixth and 0.11 mm in the seventh. The spirotheca is composed distinctly of a tectum and a very finely alveolar keriotheca in the outer volutions; in the inner one or two volutions, the alveolar structure is however indistinct and the spirotheca seems to be composed only of a dense and dark layer.

Septa thinner than spirotheca, slightly fluted, the very simple network only seen in the polar regions. Number of septa in successive volutions are 7, 10, 14, 12, 13, 16 and 24.

Chomata small, well developed in all of the volutions, appearing as two small spots in cross section.

Tunnel low and narrow in the juvenile whorls but wider in the inflated outer ones.

Proloculus minute, spherical, about 0.064 mm in outside diameter.

Measurements (in mm) for *Pseudoschwagerina borealis* (Tscherbovich)

Specimen	L	W	F. R.	Diam. prol.	Width of volutions							Form ratio of volutions						
					1	2	3	4	5	6	7	1	2	3	4	5	6	7
9018	7.39	5.28	1.40	0.064	0.18	0.36	0.61	1.26	2.60	4.12	5.28	1.5	2.0	2.25	2.0	1.58	1.47	1.40

Remarks: The present specimen is identical with *Pseudoschwagerina borealis* (Tscherbovich) in the shape and size, and in the characters of septal fluting, but differs from the original types in having larger proloculus, slightly larger form ratio and fewer volutions. The points of difference may not be of specific value.

Cat. Nos. 9018, 9019 (Plesiotypes).