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A New Species of *Triticites* (Fusulinacea, Schwagerininae) from the Limestone in the Cache Creek Terrane of the Fort St. James Area, Central British Columbia, Canada

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Abstract A new species of *Triticites*, *T. douglassi* Igo et Adachi is discovered in the Lower Permian limestone in the Cache Creek Terrane of the Fort St. James area, central British Columbia, Canada. Previous American authors reported the occurrence of the Upper Carboniferous and Lower Permian fusulinacean faunas from this limestone and insisted that these faunas indicate close affinity with those of Japan and southeastern Asia and exclude forms known in the typical North American Craton faunas. The present new species is similar to several *Triticites* species hitherto described from California and characterized by a highly inflated fusiform shell, having three layered spirotheca, very coarse alveolar keriotheca, and development of pseudochomata. We assess that these shell shape and spirothecal structure suggest adaptation to the local sedimentary environments.

Key words : Cache Creek Terrane, British Columbia, fusulinacean, Lower Permian, spirotheca structure, *Triticites*.

Introduction

The senior author made field survey in the Cordillera region of North America in the summer of 1983–1987 in collaboration with colleagues of Japan, Canada, and United States. One of the purposes of this research project is to compare the Upper Paleozoic and Lower Mesozoic microfossil faunas in the terranes of the North American Cordillera region and those in the terranes of the Japanese Islands. Igo *et al.* (1984), Igo and Adachi (1990), and Isozaki *et al.* (1996) already documented part of our study. This paper is also a result of our project and we describe a new peculiar species of *Triticites*, *T. douglassi* Igo et Adachi that has a highly inflated fusiform shell, three layered spirotheca, very coarse alveolar keriotheca, and pseudochomata. We assess that the shell shape and spirothecal structure show adaptation to the local sedimentary environment that merits consideration at this time.

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Geologic Setting and Paleontologic Significance

Thompson *et al.* (1953) and Thompson (1965) described interesting fusulinaceans from the limestone exposed in the Fort St. James area of central British Columbia, Canada. They considered that most of these fusulinaceans are indicative of Desmoinesian age and some of them are similar to fusulinaceans known in the Upper Pennsylvanian and Wolfcampian of the south-central United States. Furthermore, they stressed the occurrence of the characteristic Tethyan genera such as *Akiyoshiella* Toriyama and *Quasifusulina* Chen. Previous to these micropaleontological studies, Armstrong (1949) mapped this area and described in detail the general geology. He already pointed out the occurrence of fusulinaceans in the huge limestone mass ex-

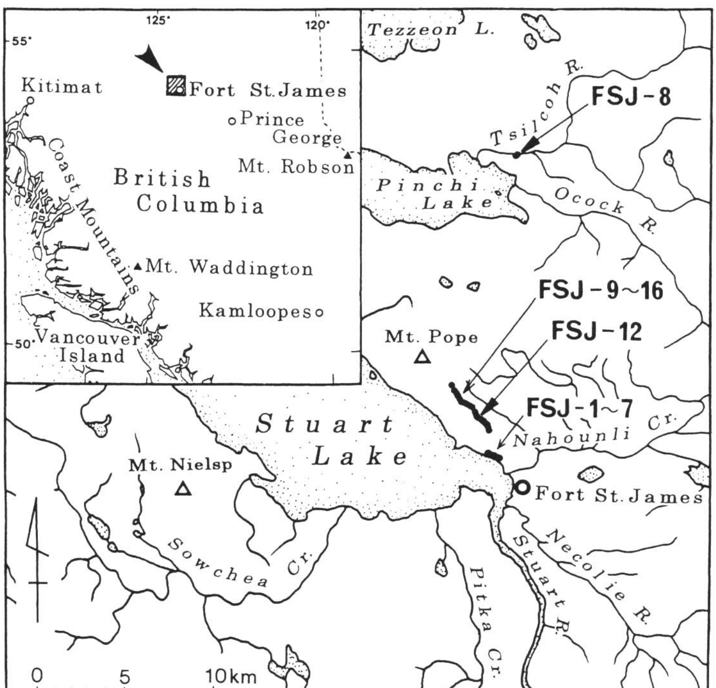


Fig. 1. Map showing locality of *Triticites douglassi* Igo et Adachi, sp. nov. (FSJ-12)

posed along the east shore of Stuart Lake. These fusulinaceans were identified by C. O. Dunbar and cited in his explanatory text.

During field survey of Igo's party in 1986, they collected limestone samples at most of the localities marked by Thompson (1965) in his Text-fig. 1 and some other samples were also collected along the mountain trail in southwestern ridge of Mt. Pope (FSJ-9 to -16, Fig. 1). These collections include the same localities of Thompson (1965) such as BC 13, BC 15, and BC 18. Thompson identified *Fusulina*? *occasa* Thompson from BC 13, *Quasifusulina popensis* Thompson and *Schubertella popensis* Thompson from BC 15, and *Quasifusulina*? sp. and *Schubertella* sp. from BC 18. He assigned that these fusulinaceans came from BC 13 are Desmoinesian?, and BC 15 and BC 18 are Early Permian in age. Our present *Triticites*-limestone is exposed at locality FSJ-12 (Fig. 1), the second ledge of limestone on the trail northwest of Thompson's locality BC 13. Actual stratigraphic position of this *Triticites*-limestone could not be settled in the field, but it represents about 30 m higher level than that of BC 13. We collected limestone from FSJ-10 about 10 m below FSJ-12 that rarely yields primitive forms of *Fusulinella*. We discovered Thompson's *Schubertella popensis* from FSJ-13, about 5 m higher position than that of FSJ-12. As will be discussed later, our present new species of *Triticites* is similar to *T. pinchiensis* Thompson, which occurred in Thompson's BC 21 far northwest of Mt. Pope, but geologic age of both species is considered to be an Early Permian age. Thompson (1965) stated concerning the stratigraphy of the limestone mass based on fusulinaceans as follows "the general stratigraphic sequence on the shores of Stuart Lake has gradual northwest regional dip from Fort St. James toward the village of Pinchi. It is not known how closely this regional attitude corresponds to that on the shores of Pinchi Lake. Faunas that vary in age between those found near Stuart Lake level and those found at the top of Mount Pope, and at the top of the mountain east of the village of Pinchi, can be collected in normal stratigraphic order on the way to the top of these mountains." [sic] Although our study of fusulinaceans is not completed, it shows that the stratigraphic sequence of the limestone mass exposed extensively in this area is considerably complex. Consequently, there may exist folds and faults in the limestone mass and should be separated into many blocks.

Our present new species abundantly occurs in dark gray limestone of which microfacies is packstone that dark gray lime mud supports grains of various organic debris, fusulinaceans, smaller foraminifers, ostracodes, and algae. Sparry calcite cementing is also common as irregular white patches in this limestone. Cordiacean algae, *Eugonophyllum*, are crowded in the cementing part. The calcified thalluses appear as fragmented curved and folded skeletal blades of which length attains more than several centimeters and 0.8 to 2.0 mm in thickness. Most of fusulinacean specimens do not show any strong preferred orientation and their outer surfaces are slightly attrited. Fusulinaceans in the present limestone are monospecific in composition, and there is apt to more crowd in sparry cement part than mud portion. This evidence suggests that the fusulinaceans and cordiacean algae intimately lived together in more or less agitated shallow sea environments. These suggested environments of deposition have influenced the morphology of the present new species of *Triticites*, particularly in spirothecal structure and its outer shape.

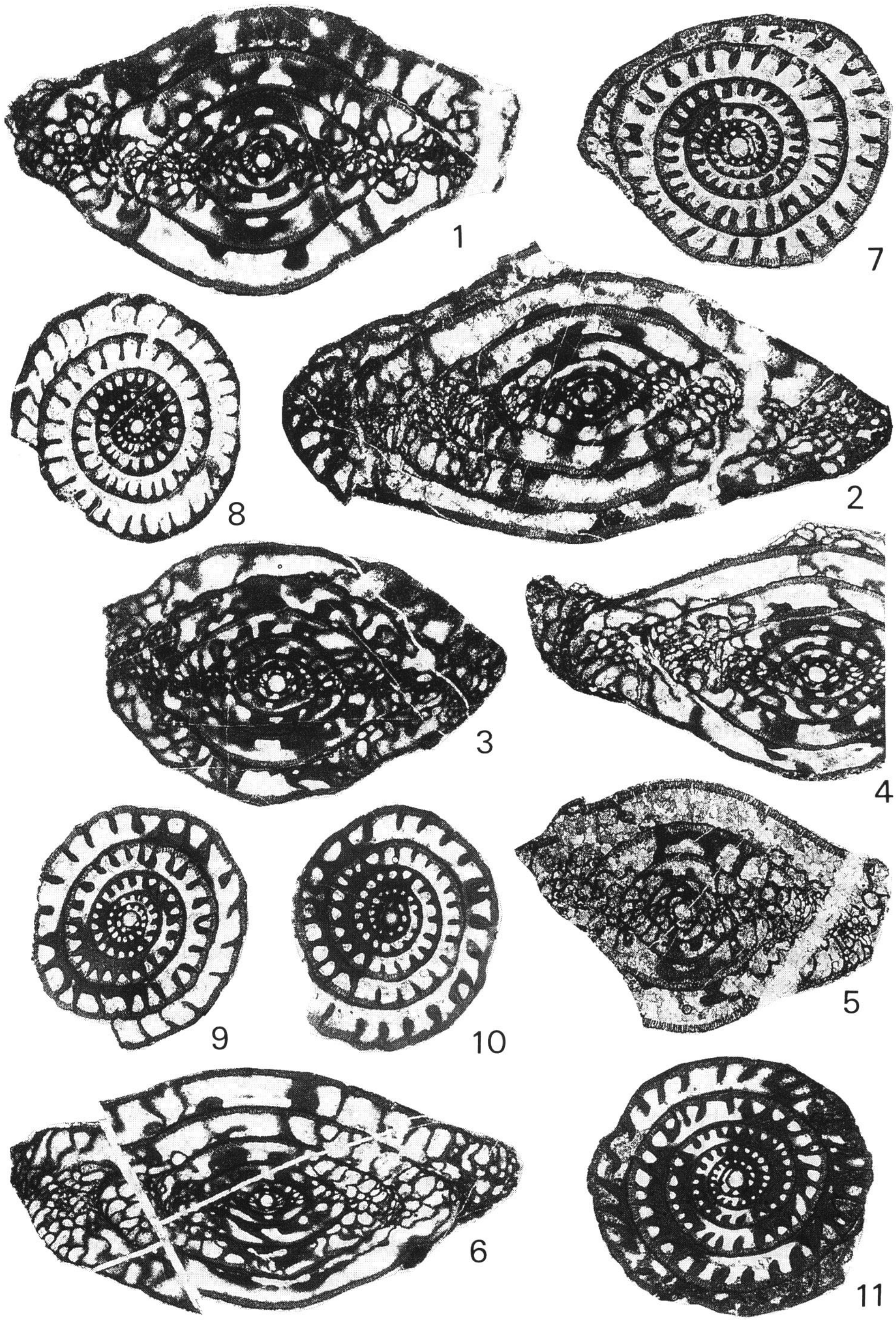
As its name "*triticum*" (=grain of wheat) denotes, shell shape of most species of *Triticites* is small fusiform to short and slightly inflated cylindrical. There are, however, some species groups have highly inflated, fusiform to subglobular shells. In North America, the following species are characterized by these forms of shell shape such as *T. beedei* Dunbar et Condra, *T. capaxoides* Ross, *T. cellamagnus* Thompson et Bissell, *T. consobrinus* White, *T. inflatus* White, *T. pinguis* Dunbar et Skinner, *T. plenus* Kauffman et Roth, *Triticites plummeri plummeri* Dunbar et Condra, *T. plummeri gibsoni* Kauffman et Roth, *T. plummeri maximus* Kauffman et Roth, *T. rhodesi* Needham, *T. rothi* Skinner, *T. tumidus* Skinner, and *T. ventricosus* (Meek et Hayden). The above mentioned species were described from the Upper Pennsylvanian of Texas and some of them were also known in the Upper Pennsylvanian-Lower Permian of Nebraska, Arizona, and other areas in the Midcontinent Region (*e.g.*, Dunbar and Condra, 1927; White, 1932; Sabins and Ross, 1963; Ross, 1965; Kauffman and Roth, 1966). Skinner and Wilde (1965 b) proposed the subgenus *Leptotriticites* of which type species has a highly inflated fusiform shell and well-developed massive chomata. According to them, *Leptotriticites* is an excellent indicator of Wolfcampian and some of the species previously assigned to *Triticites* including the above mentioned ones belong to this subgenus.

In the Cordillera region of the United States, Thompson and Hazzard (*In*, Thompson *et al.*, 1946) described *Triticites californicus*, which has a highly inflated fusiform shell. Skinner and Wilde (1965) described several species of *Triticites* from the McCloud Limestone, northern California and among which *T. tumensis* Skinner et Wilde and *T. viribus* Skinner et Wilde have similar shell shape to our present new species. Douglass *et al.* (1974) illustrated *Triticites* sp. that is characterized by highly inflated shape and occurred in the Upper Pennsylvanian Bingham Mine Formation of Utah. We did not confirm, however, the relationship between the paleoecology and shell morphology of these species because these authors did not describe any particulars of microfacies or depositional environments of the limestone.

Ross (1969) documented interesting consideration concerning this matter in *Triticites* and *Dunbarinella* in the Upper Pennsylvanian of Texas. He assigned several lineages among which Lineages G, H, I, J, and K include *Triticites* species with thickly fusiform, subglobose, and globose shaped large shells. They are mostly thick-shelled and have coarsely alveolar keriotheca than that of other *Triticites* species. In species populations in Lineages I, J, and K, their septal folds are considerably strong and chomata are well developed. Ross confirmed that the species of *Triticites* in Lineages G, H, J, and K are associated with facies changes into micrite and algal micrite beds and he considered that these species lived in and around shallow water algal meadows that were perhaps somewhat similar to portions of Recent Florida Bay. Species of Lineages I are sturdily constructed and have appreciably thicker spirotheca. He interpreted that the species lived in, or were transported by currents, to areas such as tidal passes, spits, off-shore bars, and perhaps beaches.

Our present species has similar shell shape, septal folding, and keriotheca in spirotheca to those of forms in species populations of Lineages J and K. Furthermore, development of chomata and thickness of spirotheca are similar each other. The present new species has another diagnostic character in spirotheca compared with those *Triticites* species. *T. douglassi* Igo et Adachi has thick secondary deposits on the outer surface of tectum in most of volutions. This deposition is clearly differentiated from chomata. Many fusulinid foraminologists have long interpreted that the chomata is apparently secondary deposits formed with dissolution of septa. As a result, a tunnel pierces the septa as a passage of protoplasma from the proloculus to the ultimate volution. In some species of *Triticites*, the polar side slopes of chomata are extended near poles, as a result the outer surface of spirotheca is coated in various degrees. This feature is rather commonly discernible in species of Skinner and Wilde's *Leptotriticites* and *Fusulinella*, *Pseudofusulinella*, and other fusulinellid genera. In our new species, the base of chomata directly covers the upper tectorium-like secondary coating of spirotheca, and the boundary between them is well discernible in all volutions except the outermost volution. These secondary deposits are particularly thick in the adolescent stages. Consequently, thickness of spirotheca in the fourth and fifth volutions becomes thick and excess more than 100 μ. This type of spirothecal structure in *Triticites* species has never been reported by previous authors. There is, however, possibility that some species of *Triticites* such as *T. pinguis* Dunbar et Skinner described and illustrated by Sabins and Ross (1963) has the same spirothecal structure. They merely stated "The wall is formed of a tectum and a keriotheca that thins toward the poles." [sic] *Triticites californicus* Thompson et Hazzard seems to also have similar spirotheca so far as can be seen in their illustrations.

Another distinctive feature in spirotheca of the present species is a character of keriotheca. In the fifth volution of the certain specimens, alveoli are more than 20 μ in diameter and the width of 10 alveoli measures 200 μ or more. Most species of *Triticites* have much finely textured keriotheca than that in the present new species. Adaptation and functional morphology of this spirothecal structure are unanswered. Some species of *Pseudofusulina*, *Schwagerina*, *Chusenella* and other genera of schwagerininae have very coarsely alveolar keriotheca in their spirotheca but its meaning has not been fully interpreted by the previous authors. Thompson (1936), one of the first to consider the problem of this type of spirotheca, showed coarse alveolar spirotheca in *Schwagerina rutschi* Thompson came from the Lower Permian Telok Gedang, Sumatra. Thompson (1951) further discussed the spirothecal structure in detail and described two stories keriothecal structure in *Schwagerina longissimoidea* (Beede), which was obtained from the Camp Creek shale of Texas. Sheng



(1958) described *Schwagerina crassialveola*, which is characterized with very coarse-textured alveoli keriotheca. This peculiar species came from the Maokou Limestone of Chinghai Province, northwestern China. Skinner (1969) illustrated the spirothecae with coarse-textured alveoli in *Schwagerina* and *Chusenella* from Turkey.

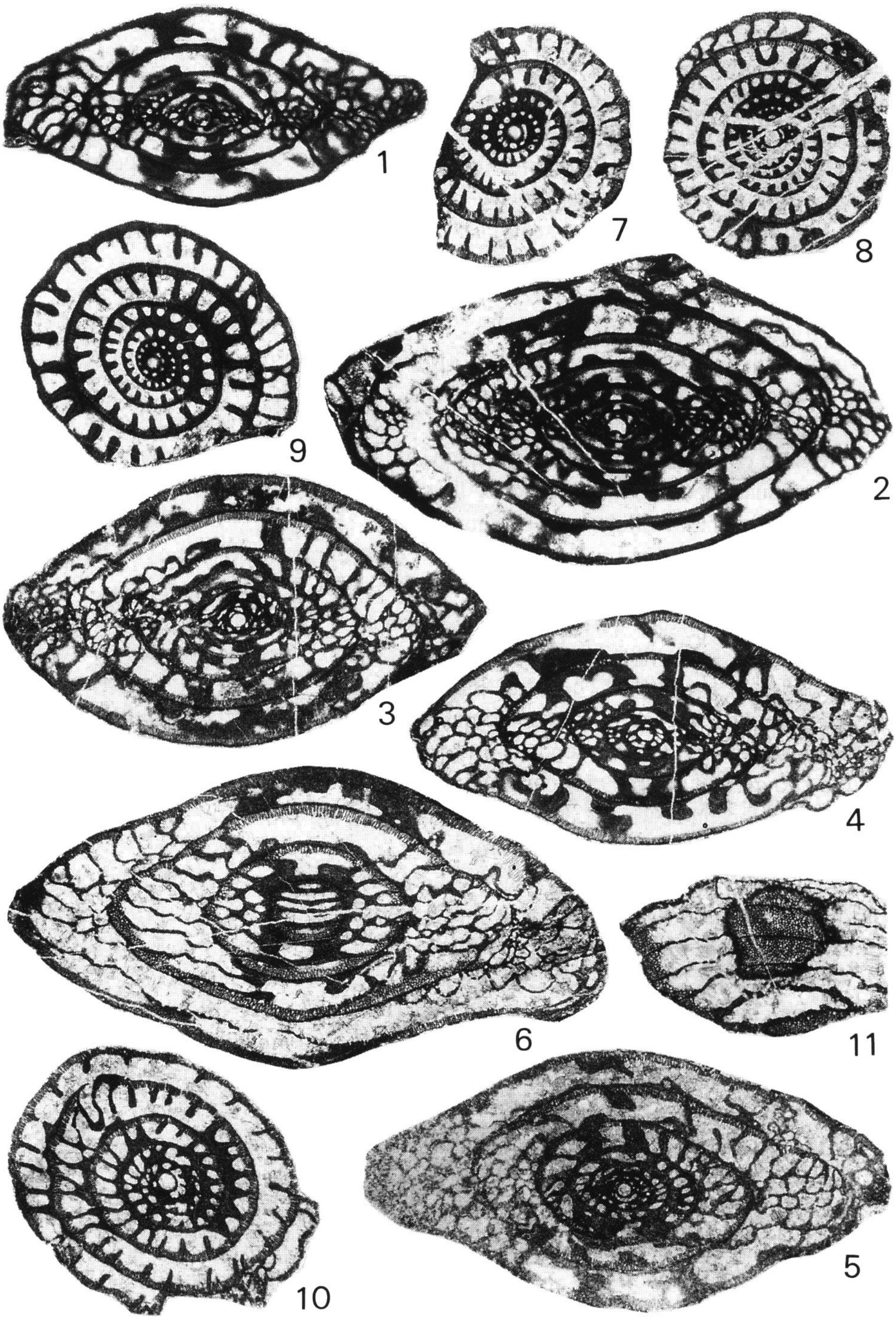
Zhuang (1989) studied fusulinaceans collected from the Lower Permian Taiyuan Formation of North China and Inner Mongolia and discovered schwagerinids with very coarse-textured alveoli keriotheca. He mooted the problem of this coarse keriotheca with thickends similar to septula in shape and he distinguished the keriotheca from other ordinarily keriothecae. He newly introduced the term "stalactotheca" for this type of keriotheca and stressed that the stalactotheca has an important value for a criterion of suprageneric classification. Zhuang (op. cit.) proposed a new subfamily Taiyuaninae including two new genera *Taiyuanella* and *Linxinella*, which are superficially similar to *Triticites* and *Schwagerina*.

The keriotheca in our present species is apparently identical with Zhuang's stalactotheca in composition, size, and shape. His conclusion is worthy to note, however, cannot be sustained because we doubt that this spirothecal structure really has the value as an indicator of generic or suprageneric classification. We assess that this type of keriothecal structure is gradational in development and size of alveoli, and it is not consistent among genera.

Concerning the chomata in our present species, there can been seen peculiarity in composition and development. Skinner and Wilde (1965 a) introduced the term pseudochomata as follows [The term "pseudochomata" is used in this report to designate a marked thickening of the septa immediately adjacent to the tunnel by a deposit of secondary material. Such deposits do not join to form ridges bordering the tunnel, but they do greatly narrow the space between adjacent septa for short distances on either side of the tunnel] [sic]. Most of the chomata developed in our specimens are pseudochomata in origin. They are rimed with layers consisting of fine-textured alveoli and the interspaces made by loops of tight septal folds usually exhibit cemented fabrics. They are completely or partly filled with the secondary deposits as shown in enlarged photographs in Figs. 4, 5. Chomata developed in inner one or two volutions and on the surface of proloculus are probably true chomata, but in some specimens even these chomata also show rims and imperfect secondary filling. In sagittal section, both inner and outer surfaces of lower part of septa are heavily coated with dark secondary deposits, which produce distinct pendant-shape thickends as shown in Fig. 5.

We consider that the present new species was adapted to the environments in

←Fig. 2. *Triticites douglassi* Igo et Adachi, sp. nov. 1, Axial section of the holotype, IGUT 5845; 2–6, axial sections of paratypes; 2, IGUT 5840; 3, IGUT 5843; 4, IGUT 5855; 5, IGUT 5856: 6, IGUT 5842; 7–11, sagittal sections of paratypes; 7, IGUT 5852; 8, IGUT 5846b; 9, IGUT 5853; 10, IGUT 5850; 11. IGUT 5851. ×15.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and around algal meadow suggested by Ross (1969) and thick-shelled highly inflated shape with coarsely textured alveoli in spirotheca is functional morphology and may result from more or less agitated condition and the presence of substantial amounts of carbon dioxide in the water.

In conclusion, morphological changes of shell shape (fusiform to subglobose and globose; short fusiform to elongate fusiform), thickness and structure of spirotheca (thin to thick; fine- to coarse-textured alveoli), and secondary deposits (weak to strong) indicate not only evolutionary trends but also local environmental adaptation. Our present new species is one of the examples of local environmental adaptation.

Description of New Species

Family Schwagerinidae Dunbar et Henbest, 1930

Subfamily Schwagerininae Dunbar et Henbest, 1930

Genus *Triticites* Girty, 1904

Triticites douglassi Igo et Adachi, sp. nov.

(Figs. 2–5)

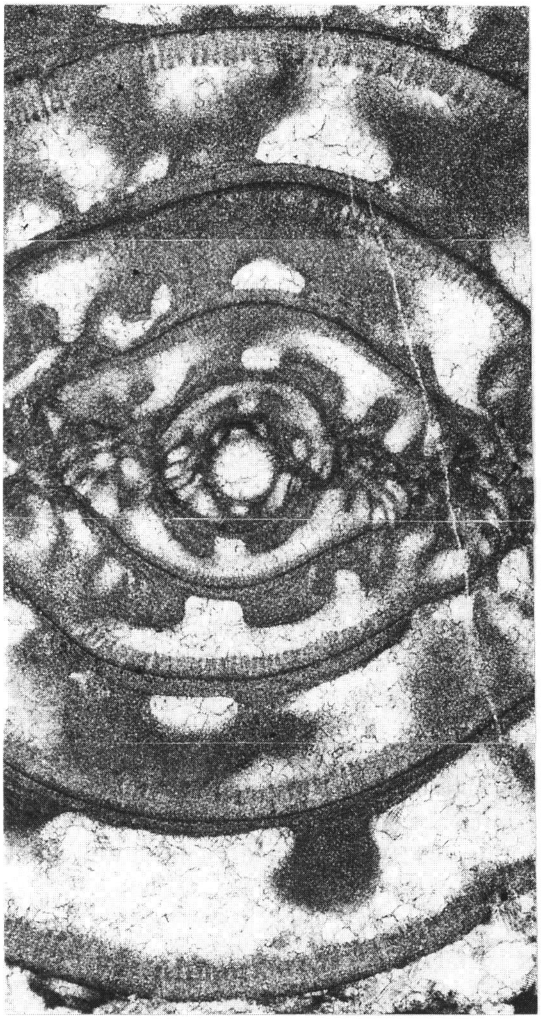
Material studied: Limestone collected from Loc. FSJ-12, the second ledge of limestone on the trail to Mt. Pope from Fort St. James. We prepared 60 thin-sections from this limestone sample.

Diagnosis: *Triticites* with highly inflated fusiform and large shell. Axial length 4.5 to 6.0 mm, median width 2.3 to 3.0 mm, and form ratio 1.8 to 2.2. Spirotheca thick and consists of tectum, coarse-textured alveolar keriotheca, and thick upper tectorium-like layer except last volution. Either chomata or pseudochomata well developed.

Description: Shell large, inflated fusiform having bluntly pointed to rounded poles and slightly concave and convex lateral slopes. Mature shells consist of six to six and one half volutions. Axial length 4.500 to 5.925 mm, median width 2.250 to 2.925 mm, and form ratio 1 : 1.75 to 1 : 2.17 in mature specimens. Average axial length of 7 axial sections 5.12 mm, average median width of 16 axial and sagittal sections 2.49 mm, and average form ratio of 7 axial sections giving 1 : 1.97.

Shell tightly coiled and subglobose to subspherical in early stages, uniformly and rapidly increases and with pointed poles in adolescent stages, and slowly expands in outer two or one and half volutions. Averages of heights of the first to sixth volu-

←Fig. 3. *Triticites douglassi* Igo et Adachi, sp. nov. 1–5, Axial sections of paratypes; 1, IGUT 5861; 2, IGUT 5846a; 3, IGUT 5844; 4, IGUT 5841; 5, IGUT 5857; 6, tangential section of paratype showing coarse-textured keriotheca and pseudochomata, IGUT 5858; 7–10, sagittal sections of paratype; 7, IGUT 5859; 8, IGUT 5860; 9, IGUT 5848a; 10, IGUT 5848b; 11, tangential section of paratype showing coarse alveoli in end-on view, IGUT 5862. ×15.



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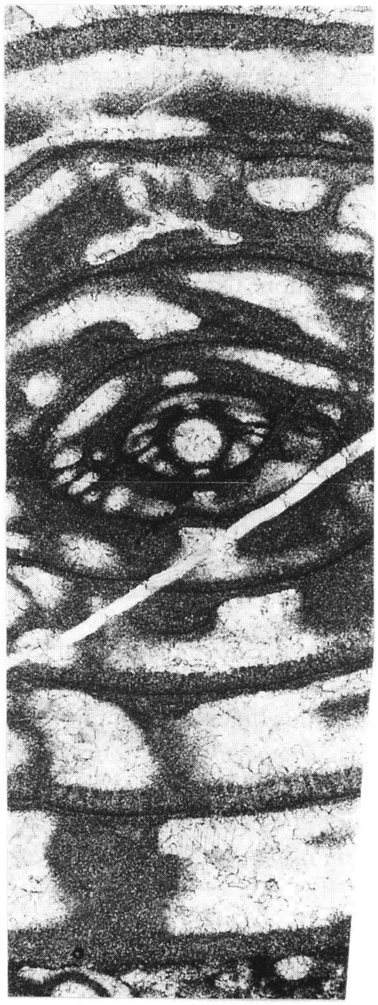

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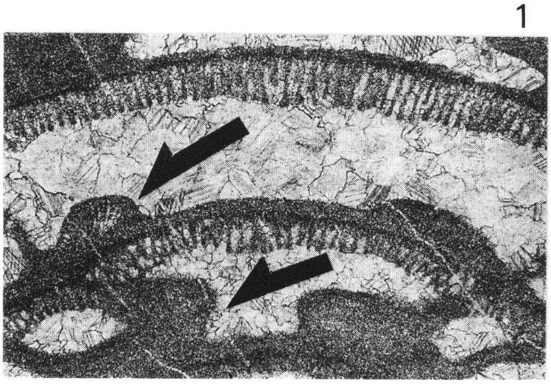

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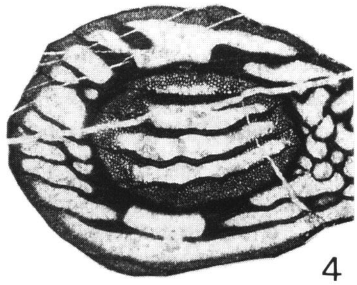

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tions of 16 specimens 0.067, 0.111, 0.176, 0.241, 0.318, and 0.346 mm, respectively. Averages of radius vectors of the first to fifth volutions of 16 specimens 0.140, 0.257, 0.434, 0.685, and 0.993 mm, respectively. Average of the sixth volution of 14 specimens 1.308 mm. Proloculus small, mostly spherical, and its outside diameter ranges from 0.120 to 0.230 mm. Average diameter measured in 16 specimens 0.180 mm. Proloculus always has chomata or pseudochomata on its surface. Minute foramen, proloculus aperture, often discernible.

Spirotheca consists of a thin tectum, thick keriotheca, and upper tectorium-like layer. Keriotheca fine-textured alveoli in inner two volutions, but alveoli become coarse and two stories in outer volutions and consist of shorter upper fine alveoli and longer lower coarse alveoli layers. Upper tectorium-like secondary deposits thickly covers surface of tectum in various degrees. This outer layer finely laminated in axial section and also has alveoli, which much finer than those developed in inner keriothecal layer. This layer generally lacking in the ultimate volution. Alveoli of lower ones in outer volutions about 20 μ in diameter in the fourth to fifth volutions. Each alveolus has thickend and pendant-shape. Gradational honeycomb structure well discernible in end-on view of tangential section of spirotheca of outer volutions.

Thickness of spirotheca variable in this adolescent to mature stages depends on variable thickness of outer layer. Averages of thickness of spirotheca in the first to sixth volutions of 16 specimens 0.024, 0.041, 0.061, 0.079, 0.090, and 0.087 mm, respectively. Thickness of spirotheca of the fourth to fifth volutions unusually thick and measures more than 0.100 mm and attains 0.120 to 0.130 mm in some specimens.

Septa numerous and their average numbers of the first to fifth volutions in nine specimens 9, 17, 21, 25, and 28, respectively. For the sixth volution, septal number averages 18 but it does not have any value. Septa regularly and strongly fluted in polar regions. Coating of secondary material thicken septa, giving false appearance of axial filling in axial sections and pendant shape thickends at lower part of septa in sagittal sections.

Chomata mostly pseudochomata which rimed with thin layers of tight septal folds and filled with dark secondary deposits either completely or incompletely. They asymmetrical, well developed throughout shell except the last volution, and their height attains more than a half to two-thirds as high as chamber. Tunnel sides steep and overhang but polar sides show gentle slope.

←Fig. 4. *Triticites douglassi* Igo et Adachi, sp. nov. 1, Enlarged part of the holotype (IGUT 5845) illustrated in Fig. 2-1 showing three layered spirotheca and development of pseudochomata, ×55; 2, Enlarged part of paratype (IGUT 5842) illustrated in Fig. 1-6 showing three layered spirotheca and development of pseudochomata, ×55; 3, enlarged part of paratype (IGUT 5858) illustrated in Fig. 2-6 showing three layered spirotheca, two stories of upper fine-textured alveoli and coarse-textured lower alveoli layers, and arrows indicate development of pseudochomata, ×15 ; 4, enlarged tangential section showing coarse alveoli in end-on view and cut edge of pseudochomata, ×15.

Table 1. Measurements of *Triticites douglassi* Igo et Adachi, sp. nov. (in mm.)

Reg. no. of specimens	Length	Width	Form ratio	Dia. of proloculus	Height of volution						
					1	2	3	4	5	6	7
1) 5840	5.925	2.925	2.03	0.163	0.050	0.095	0.128	0.228	0.288	0.325	0.325
2) 5841	4.800	2.250	2.13	0.120	0.080	0.110	0.223	0.320	0.360	—	—
3) 5842*	5.000	2.300	2.17	0.140	0.050	0.092	0.180	0.230	0.298	0.358	—
4) 5843	4.503#	2.500	1.80	0.200	0.065	0.130	0.210	0.260	0.320	0.313	—
5) 5844	4.600#	2.625	1.75	0.153	0.050	0.070	0.130	0.166	0.212	0.338	0.348
6) 5845	5.250	2.825	1.86	0.185	0.050	0.110	0.192	0.300	0.370	0.380	—
7) 5846a	5.752	2.800	2.05	0.190	0.075	0.103	0.165	0.220	0.272	0.368	0.180
8) 5847	—	2.250	—	0.220	0.060	0.150	0.200	0.350	0.370	—	—
9) 5848a	—	2.625	—	0.170	0.080	0.103	0.130	0.150	0.252	0.320	—
10) 5846b	—	2.300	—	0.160	0.082	0.090	0.142	0.270	0.348	0.322	—
11) 5848b	—	2.375	—	0.203	0.068	0.110	0.182	0.230	0.302	0.280	—
12) 5849	—	2.750	—	0.190	0.090	0.120	0.180	0.302	0.320	0.310	—
13) 5850	—	2.250	—	0.180	0.062	0.120	0.152	0.251	0.278	0.298	—
14) 5851	—	2.575	—	0.200	0.070	0.132	0.202	0.282	0.340	0.260	—
15) 5852	—	2.450	—	0.230	0.070	0.100	0.170	0.258	0.368	0.320	—
16) 5853	—	2.125	—	0.170	0.072	0.140	0.222	0.300	0.282	—	—

* Holotype # Measured as half length ×2

No. sp.	Radius vector 1	2	3	4	5	6	7	Tunnel angle (degrees) 1	2	3	4	5	6	7
1)	0.130	0.225	0.370	0.595	0.875	1.180	1.500	15	21	28	36	50	—	—
2)	0.071	0.218	0.490	0.800	1.180	—	—	35	45	30	34	43	—	—
3)	0.121	0.210	0.380	0.620	0.920	1.275	—	27	36	31	42	40	—	—
4)	0.160	0.282	0.470	0.715	1.030	1.360	—	21	23	32	23	—	—	—
5)	0.132	0.212	0.325	0.498	0.710	1.060	1.380	20	16	24	23	37	38	—
6)	0.130	0.240	0.440	0.740	1.070	1.450	—	29	34	26	30	34	—	—
7)	0.142	0.240	0.410	0.630	0.900	1.370	1.552	20	26	28	30	40	—	—
8)	0.160	0.282	0.450	0.700	1.050	1.350	—	—	—	—	—	—	—	—
9)	0.130	0.238	0.402	0.650	1.002	1.368	—	—	—	—	—	—	—	—
10)	0.118	0.220	0.380	0.580	0.920	1.281	—	—	—	—	—	—	—	—
11)	0.140	0.280	0.460	0.698	1.000	1.290	—	—	—	—	—	—	—	—
12)	0.150	0.278	0.468	0.722	1.040	1.382	—	—	—	—	—	—	—	—
13)	0.138	0.280	0.430	0.690	0.940	1.220	—	—	—	—	—	—	—	—
14)	0.182	0.312	0.500	0.770	1.120	1.380	—	—	—	—	—	—	—	—
15)	0.170	0.291	0.442	0.700	1.030	1.348	—	—	—	—	—	—	—	—
16)	0.162	0.300	0.530	0.850	1.100	—	—	—	—	—	—	—	—	—

No. sp.	Thickness of spirotheca 1	2	3	4	5	6	7	Septal count 1	2	3	4	5	6	7
1)	0.038	0.038	0.040	0.090	0.110	0.080	0.070	—	—	—	—	—	—	—
2)	0.015	0.038	0.040	0.065	0.072	0.080	—	—	—	—	—	—	—	—
3)	0.018	0.030	0.040	0.068	0.088	0.072	—	—	—	—	—	—	—	—
4)	0.030	0.050	0.080	0.085	0.090	0.103	—	—	—	—	—	—	—	—
5)	0.010	0.020	0.030	0.060	0.072	0.100	0.140	—	—	—	—	—	—	—
6)	0.015	0.030	0.082	0.120	0.130	0.080	—	—	—	—	—	—	—	—
7)	0.028	0.028	0.062	0.070	0.110	0.082	0.050	—	—	—	—	—	—	—
8)	0.035	0.058	0.080	0.090	0.105	0.098	—	7	17	21	22	23	8+	—
9)	0.036	0.043	0.065	0.072	0.118	0.082	—	11	17	18	22	24	9+	—
10)	0.020	0.040	0.050	0.055	0.080	0.070	—	10	19	20	27	29	7+	—
11)	0.028	0.050	0.088	0.092	0.082	0.098	—	9	15	20	24	25	15+	—
12)	0.035	0.046	0.055	0.072	0.075	0.080	—	10	19	26?	31?	43?	23+	—
13)	0.018	0.050	0.073	0.083	0.085	0.110	—	8	16	17	19	24	28+	—
14)	0.021	0.058	0.080	0.100	0.082	0.073	—	9	19	23	27	33	22+	—
15)	0.024	0.032	0.052	0.060	0.080	0.098	—	10	19	23	29	30	16+	—
16)	0.020	0.032	0.063	0.080	0.062	—	—	9	16	21	24	21	7+	—

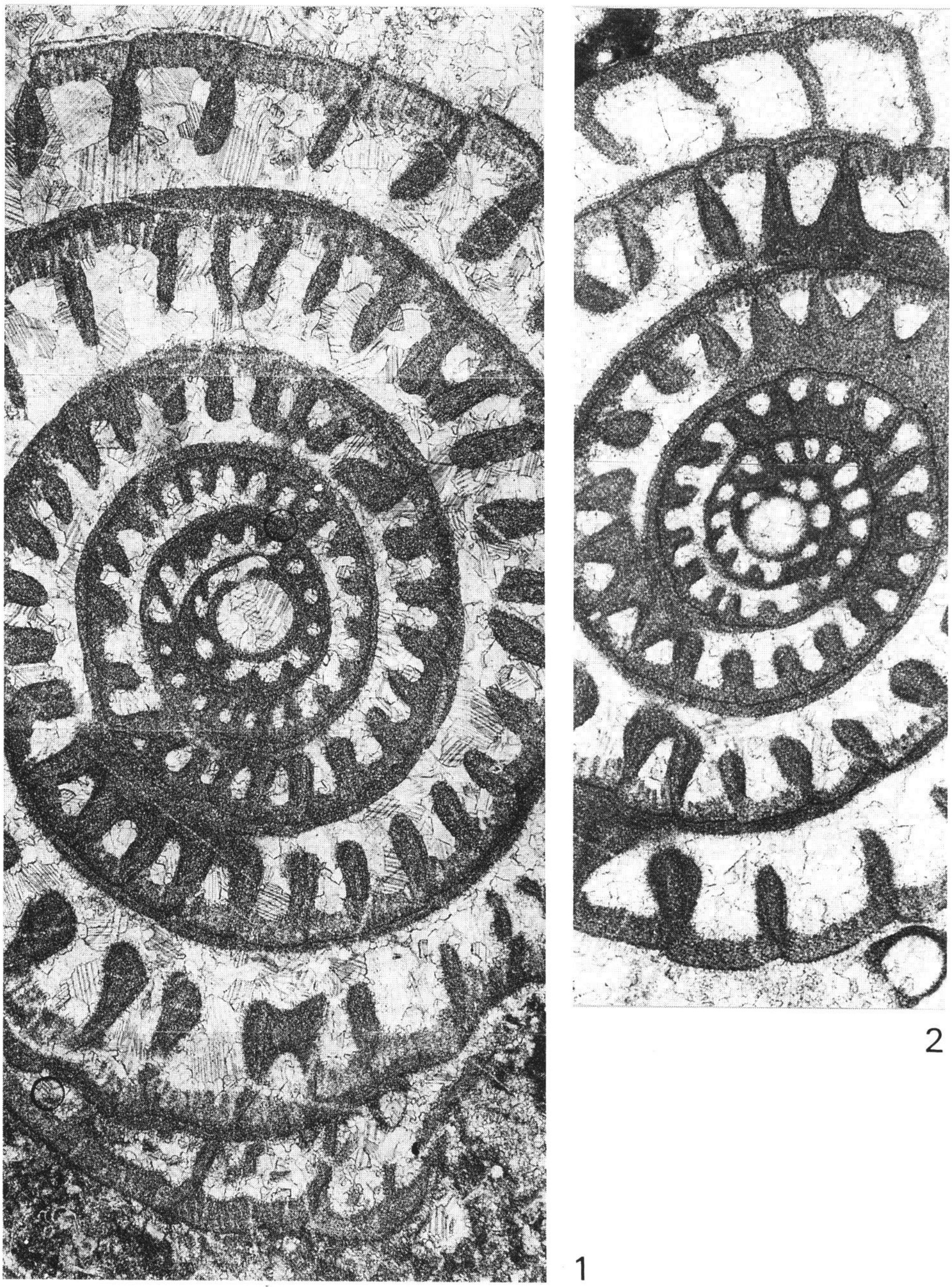

Fig. 5. *Triticites douglassi* Igo et Adachi, sp. nov. 1, Enlarged part of paratype (IGUT 5852) illustrated in Fig. 2-7 showing spirothecal structure and secondary coating of septa; 2, enlarged part of paratype (IGUT 5853) illustrated in Fig. 2-9 showing spirothecal structure and secondary coating of septa, ×55.

Tunnel narrow, low, and path regular. Tunnel angles in the first to fifth volutions average in six specimens 24, 29, 29, 31, and 41 degrees, respectively.

Remarks: The present species shows characteristic feature in shell shape, septal fluting, spirothecal structure, and the presence of pseudochomata. Three layered spirotheca and the presence of pseudochomata in our species differ from other known species of *Triticites*. This form may pertain to a new subgenus, however, we postpone proposal because we need some more species having the mentioned characters. Xia (1992) proposed *Metatriticites* from the Lower Permian of Kuangsi, south China. Our present species is superficially similar to his *Metatriticites characteristicus*, *M. habitus*, and *M. robustus*, but the detailed compositions of spirotheca and chomata (or pseudochomata?) are unclear from his description and illustrations.

The present new species resembles *Triticites pinchiensis* Thompson described from the same limestone. Our species, however, has a more highly inflated fusiform shell, well developed either chomata or pseudochomata, and distinct three layered spirotheca. *Triticites californicus* Thompson et Hazzard (1946) described from the Bird Spring Formation in the Providence Mountains, southern California is similar to our new species, particularly in the secondary deposits on the surface of spirotheca in adolescent stages, but the former has a larger shell, more numbers of volutions, a larger proloculus, and thicker spirotheca. Our present new species of *Triticites* is similar to *T. occidentalis* Skinner et Wilde, *T. tumensis* Skinner et Wilde, *T. usitatus* Skinner et Wilde, and *T. viribus* Skinner et Wilde, which were all described from the McCloud Limestone in northern California (Skinner and Wilde, 1965 a). It can be distinguished from *T. occidentalis* in larger shell and irregular septal fluting of the latter. *T. tumentis* has a slightly larger shell, irregular septal fluting, and finer alveoli keriotheca in spirotheca. *T. usitatus* differs from the present species in larger shell, fine-textured alveoli keriotheca, and irregular and stronger septal folding. Douglass *et al.* (1974) illustrated *Triticites* sp. from the Bingham Mine Formation, Utah is similar to our present species, but the former has a more rounded shell and weaker septal folding.

The specific name, *douglassi*, is dedicated to Dr. Raymond C. Douglass of USGS who contributed to fusulinacean study of the United States and also Japan.

Depository: All specimens described in this paper are housed at the Institute of Geoscience, the University of Tsukuba with prefix IGUT and registered numbers.

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