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In memoriam Dr. Wolfgang Struve *)

Late Early Devonian (Late Emsian) eospiriferinid brachiopods from Shellabarger Pass, south-central Alaska, and their biogeographic importance; further evidence for a Siberian origin of the Farewell and allied Alaskan accreted terranes

With 3 Text-figures and 1 Plate

ROBERT B. BLODGETT & ARTHUR J. BOUCOT

Abstract

Two eospiriferinid taxa, *Myriospirifer* n. sp. aff. *M. myriofila* HAVLÍČEK 1978 and *Janius* cf. *J. vetulus* (EICHWALD 1860), are described from an unnamed late Emsian (late Early Devonian) limestone unit in the Shellabarger Pass area, Talkeetna C-6 Quadrangle, south-central Alaska. These biogeographically distinctive species, along with other co-occurring brachiopod taxa such as the gypidulinid genus *Ivdelinia* and the rhynchonellid *Sibirirhynchia alata* (KHODALEVICH) indicate strong biogeographic affinities with Emsian faunas of Siberia (including Kolyma, Taimyr, and the Kuznetsk Basin) and the Urals. This Alaskan fauna is from the Farewell Terrane, an accreted terrane, which also shows strong Siberian affinities in the Middle Cambrian, Late Ordovician, Late Silurian-Lochkovian, early Emsian (late Early Devonian), and Permian time-intervals, suggesting that the Farewell Terrane is a continental margin sequence rifted away from the Siberian continent. Based on their close faunal ties with Siberia and with the Farewell Terrane, Siberian origins are also indicated for other major Alaskan terranes: the Alexander Terrane of southeastern Alaska, the Arctic Alaska Superterrane, and the York Terrane of northern Alaska. The only truly North American portion of Alaska is east-central Alaska (including the Nation Arch), bounded on the north by the Porcupine River and on the south by the Yukon River and Tintina Fault. Faunas from the latter area are nearly identical to those from miogeoclinal and cratonic strata of northwestern and Arctic Canada, and are very distinct from those present in the accreted terranes making up the greater portion of Alaska.

Key words: Brachiopods, taxonomy, biogeography, stratigraphy, Devonian, late Emsian, Alaska.

Kurzfassung

[Eospiriferinide Brachiopoden vom spät unterdevonischen (oberes Ems) Shellabarger Pass, südliches Zentral-Alaska, und ihre biogeographische Bedeutung; weitere Belege für eine sibirische Herkunft der Farewell und verwandter Formationen Alaskas.] — Zwei eospiriferinide Taxa, *Myriospirifer* n. sp. aff. *M. myriofila* HAVLÍČEK 1978 und *Janius* cf. *J. vetulus* (EICHWALD 1860) werden von einer nicht weiter benannten Kalkstein Einheit des oberen Ems (spätes Unterdevon) aus dem Gebiet des Shellabarger Pass, Talkeetna C-6 Planquadrat, südliches Zentral Alaska, beschrieben. Diese biogeographisch charakteristischen Arten, zusammen mit anderen Brachiopoden-Taxa aus der Vergesellschaftung, wie Vertreter der gypiduliniden Gattung *Ivdelinia* und der Rhynchonellide *Sibirirhynchia alata* (KHODALEVICH), lassen eine starke biogeographische Beziehung zu Faunen des Ems von Sibirien (einschließlich Kolyma, Taimyr und das Kuznetsk Becken) und des Urals erkennen. Die hier beschriebene Fauna Alaskas stammt aus der Farewell-Formation, einer Formation, die bereits im Mittelkambrium, im oberen Ordoviz, im oberen Silur-Lochkovium, im unteren Emsium (spätes Unterdevon) und in den permischen Zeitabschnitten starke Beziehungen zu sibirischen Faunen aufwies. Dies legt die Vermutung nahe, daß es sich bei der Farewell-Formation um eine randliche, kontinentale Abfolge handelt, die vom sibirischen Kontinent wegdriftete.

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Aufgrund ihrer faunistischen Ähnlichkeiten, lassen auch andere große Formationen Alaskas auf eine sibirische Herkunft schließen: die Alexander-Formation SE-Alaskas, die arktische Alaska-Großformation und die York-Formation N-Alaskas. Der einzige Abschnitt Alaskas mit wirklich nordamerikanischer Herkunft ist das östliche Zentral-Alaska (einschließlich der Nation Arch), umrahmt von den Flüssen Porcupine im N und Yukon im S sowie der Tintina-Verwerfung. Faunen aus diesem letztgenannten Gebiet sind fast identisch mit solchen von miogeoklinalen, kratonischen Lagen des nordwestlichen und arktischen Kanada. Sie sind jedoch deutlich unterscheidbar von Faunen aus den übrigen Formationen Alaskas.

Introduction

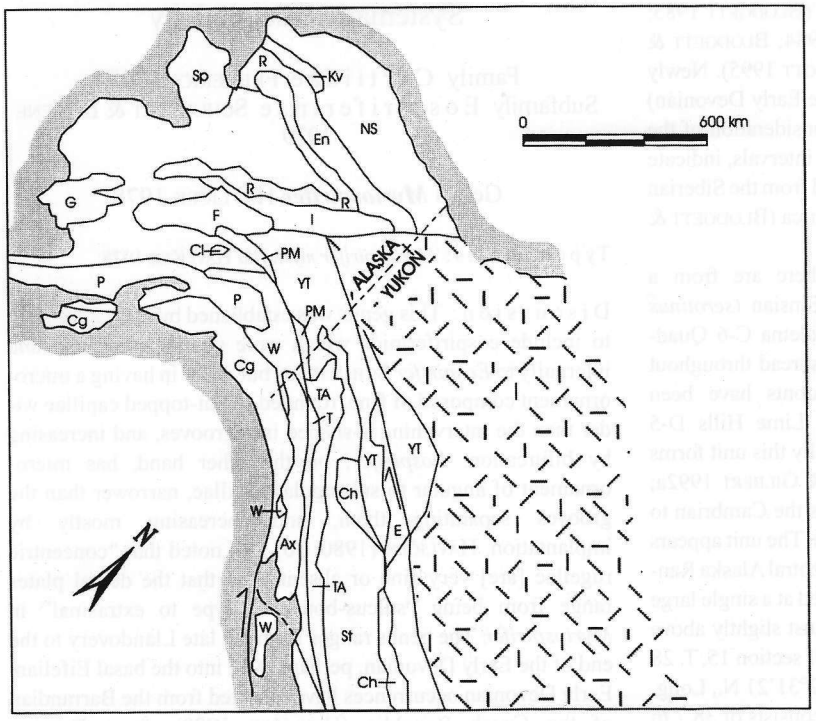
The brachiopod subfamily Eospiriferinae appears first in the Late Ordovician (mid-Ashgill) of South China (RONG & ZHAN 1996), following which they have been recognized in the earlier Llandovery of South China and Tasmania. Beginning with the middle-late Llandovery (late Aeronian to early Telychian), eospiriferinids had an almost global distribution, except for the cool climate Malvinokaffric Realm where they, together with many other brachiopod groups (BOUCOT 1975), are absent. During the Early Devonian the group was restricted to warm water regions of the world; owing to their absence in the South China, and near absence in the Cordilleran Regions of the Old World Realm, and continued to be absent from the cool climate Malvinokaffric Realm. In the Eastern Americas Realm they were present during the earlier half of the Early Devonian, but became extinct by about Oriskany time (approximately Pragian) when the last representative, *Hedeina* (*Macropleura*) cf. *H.* (*M.*) *macropleura* (CONRAD 1840), occurs in the McKenney Ponds Member of the Tarratine Formation in northern Maine (BOUCOT 1973). During the early Middle Devonian (Eifelian), the group is extinct almost everywhere except for the Uralian Region where *Myriospirifer* occurs in the Urals. Localities where Early Devonian-Eifelian age eospiriferinids occur in the Eastern Hemisphere include: Morocco (TERMIER 1936), Algeria (LE MAÎTRE 1952), Brittany (BARROIS 1889; GOURVENNEC 1989; RENAUD 1942); Germany (ASSMANN 1913; KAYSER 1878), Austria (HERITSCH & WOLSEGGER 1935), the Carnic Alps along the Austrian/Italian border (GORTANI 1915; LATZ 1992; SCUPIN 1906), the Czech Republic (BARRANDE 1879; HAVLÍČEK 1959, 1968, 1970), Turkey (PAECKELMANN 1925), the Urals and Novaya Zemlya (CHERNYSHEV 1893; EICHWALD 1860; KHODALEVICH 1951; KHODALEVICH et al. 1959; NALIVKIN 1947, 1960; SAPEL'NIKOV, MIZENS & SHATROV 1987; TYAZHEVA & ZHAVORONKOVA 1972), the Kuznetsk Basin of southwest Siberia (PEETZ 1901; RZHONSNITSKAYA 1952; KUL'KOV 1960; ALEKSEEVA, GRATSIANOVA, ELKIN & KUL'KOV 1970), the Altai Mountains (KHALFIN 1948; GRATSIANOVA 1967), Turkestan (NALIVKIN 1930) and the Kolyma (NIKOLAEV & RZHONSNITSKAYA 1967; SIDYACHENKO 1996). Asian occurrences outside the former Soviet Union include Mongolia (ALEKSEEVA 1993), northwest China [Jin'gerda Formation (Emsian) in East Junggar, Xinjiang Province, 40 45'N, 90 00'E, unpublished data of SUN YUANLIN (written comm. 1998)], and the Yunkai Block of southern China (WANG & YANG 1998), which according to RONG JIA-YU (written comm. 1998) was not part of the South China Plate during Silurian and Devonian time. Antipodal occurrences include New South Wales (SAVAGE 1974; LENZ & JOHNSON 1985), Victoria (GILL 1949), Tasmania (GILL 1950) and the Baton River beds of the South Island of New Zealand (SHIRLEY 1938). Because of the distinctive biogeographic restriction of this subfamily during the Early Devonian-Eifelian interval, the discovery of this group in an accreted terrane (Farewell Terrane) in Alaska provides further evidence in support of earlier assertions that this terrane represents block rifted from the Siberian continent (BLODGETT & BREASE 1997; BLODGETT 1998), from whence its closest faunal analogues have been described.

Geologic Setting

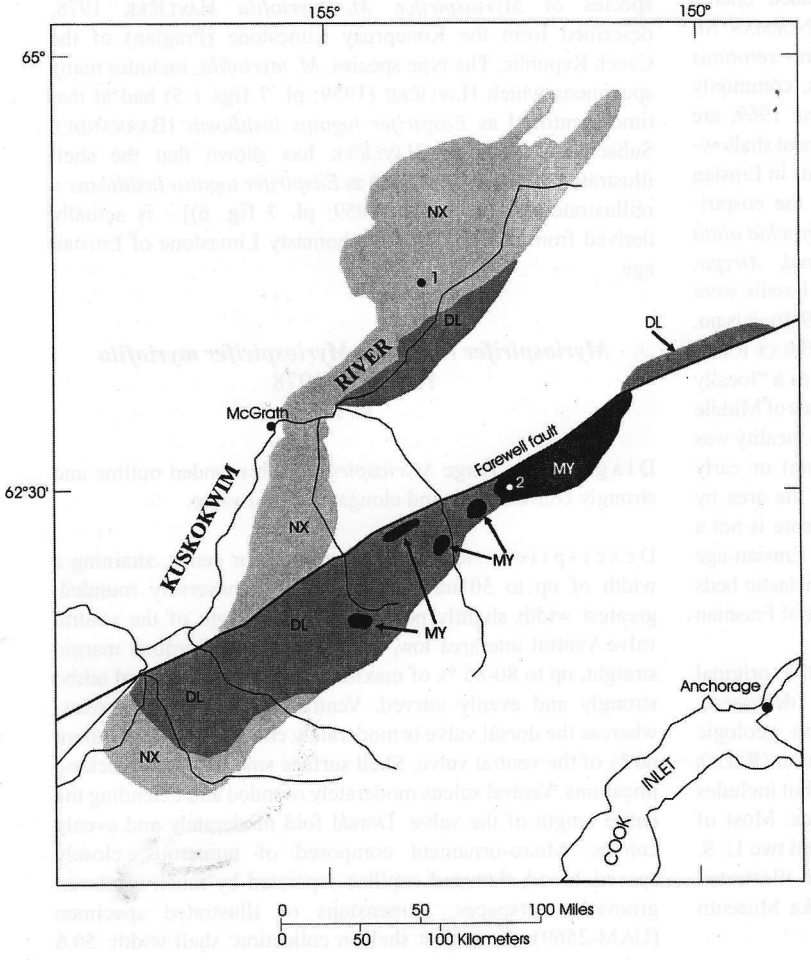
In this paper we report the first occurrence of eospiriferinid brachiopods from the Devonian of Alaska. In recent years, the concept that nearly all of Alaska, as well as much of the western Cordillera of North America, is composed of numerous discrete, accreted tectonostratigraphic terranes (CONEY, JONES & MONGER 1980; JONES, SILBERLING, BERG & PLAFKER 1981; JONES, SILBERLING, GILBERT & CONEY 1982; JONES, SILBERLING & CONEY 1986; JONES, SILBERLING, CONEY & PLAFKER 1987; NOKLEBERG et al. 1994) has gained general acceptance (text-fig. 1). The only exception is the triangular area of east-central Alaska, bounded on the northwest by the Porcupine River and on the southwest by the Yukon River. This region, which includes the Nation Arch, represents a continuation of Precambrian and Paleozoic rocks exposed farther east in the Ogilvie Mountains of the Yukon Territory.

The specimens described here are from the Mystic Subterrane of the Farewell Terrane of southwestern and west-central Alaska. It was originally described (JONES, SILBERLING, BERG & PLAFKER 1981) as a separate tectonostratigraphic entity of full terrane rank. More recently, DECKER et al. (1994) recognized that the Mystic, as well as the Nixon Fork and Dillinger terranes, were genetically related and all were reduced in rank to subterranes of a larger terrane, the Farewell Terrane (text-fig. 1). GILBERT & BUNDTZEN 1984 considered the Dillinger and Mystic Terranes, each of whose type sections were close to one another, to represent a single stratigraphic succession of Paleozoic to Triassic age, preferring to apply the term "sequence" to each. They considered the underlying Dillinger sequence to be a Cambrian to Lower Devonian deep-water succession followed depositionally by the Mystic sequence – laterally variable Devonian to Triassic? shallow-water to nonmarine sedimentary rocks with intrusive and extrusive mafic and ultramafic rocks. The close stratigraphic relationship between the Dillinger and Mystic sequences (or subterranes) was supported by stratigraphic studies by BLODGETT & GILBERT (1992a) to the southwest in the Lime Hills Quadrangle. The Nixon Fork Subterrane, defined originally as a full-rank terrane by PATTON (1978), represents a predominantly shallow-water carbonate platform, mostly laterally equivalent to deeper water Cambrian to Lower Devonian rocks of the Dillinger Subterrane (BLODGETT 1983; BLODGETT & GILBERT 1983; BUNDTZEN & GILBERT 1983; GILBERT & BUNDTZEN 1983).

Until several years ago, most prior interpretations of the gross lithostratigraphy and faunal affinities of the best-studied terrane, the Nixon Fork Terrane, had indicated either fragmentation from



Text-fig. 1. Generalized map showing location of major tectonostratigraphic terranes in Alaska and northwestern Canada (from BLODGETT 1998, modified from CONEY, JONES & MONGER 1980). Dashed pattern, North American autochthonous basement. Barbed arrows indicate direction of major strike-slip movements. – F = Farewell terrane; I = Innoko; R = Ruby; G = Good-news; P = Peninsular; Cg = Chugach; Cl = Chulitna; W = Wrangellia; PM = Pingston and McKinley; Sp = Seward Penisula; En = Endicott; Kv = Kagvik; NS = North Slope: YT = Yukon-Tanana; TA = Tracy Arm; Ax = Alexander; T = Taku; St = Stikine; Ch = Cache Creek; E = Eastern Assemblage. The York Terrane cited in the text corresponds to the western part of the Seward Peninsula Terrane.



Text-fig. 2. Generalized geologic map of southwestern and west-central Alaska showing location of the two cited Emsian age fossil localites and component subterranes (Dillinger, Nixon Fork, and Mystic) of the Farewell Terrane. Map modified from BLODGETT & GILBERT (1992) and BLODGETT (1998). Dillinger Subterrane here includes East Fork terrane of DUTRO & PATTON (1982). – Map symbols: 1 = "Reef Ridge" area, Medfra B-3 Quadrangle; 2 = Shellabarger Pass, Talkeetna C-6 Quadrangle; NX = Nixon Fork Subterrane; DL = Dillinger Subterrane; MY = Mystic Subterrane.

or lithic continuity with northwestern Canada (BLODGETT 1983; CHURKIN, WALLACE, BUNDTZEN & GILBERT 1984; BLODGETT & CLOUGH 1985; ROHR & BLODGETT 1985; ABBOTT 1995). Newly acquired biogeographic data from Emsian (late Early Devonian) strata of the Farewell Terrane, along with reconsideration of the affinities of the faunas and floras of other time intervals, indicate that this continental margin sequence originated from the Siberian continent, rather than northwestern North America (BLODGETT & BREASE 1997; BLODGETT 1998).

The two eospiriferinid taxa described here are from a distinctive, unnamed limestone unit of late Emsian (*serotinus* Zone) age in the Shellabarger Pass area, Talkeetna C-6 Quadrangle, south-central Alaska; this unit is widespread throughout the Mystic Subterrane. Late Emsian conodonts have been described from the unit to the west in the Lime Hills D-5 Quadrangle (SAVAGE & BLODGETT 1995). Locally this unit forms the base of the Mystic sequence (BLODGETT & GILBERT 1992a; GILBERT & BUNDTZEN 1984); the latter overlies the Cambrian to Lower Devonian deep-water Dillinger sequence. The unit appears to be around 50 m in thickness throughout the central Alaska Range. In the Shellabarger Pass area, it was examined at a single large exposure (text-fig. 2, locality 2) on a hillock, just slightly above 2,300 feet in elevation, in the center of NE1/4 of section 15, T. 28 N., R. 18 W., Talkeetna C-6 Quadrangle (Lat. 62°31'21 N., Long. 152°35'33" W.). A measured section shows it consists of 38.7 m (127 feet) of lime mudstone and wackestone with moderately abundant megafossils (mostly brachiopods, rugose and tabulate corals, and trilobites, in order of decreasing abundance). The base of the section is on the north side of the hillock; these beds appear to be stratigraphically or structurally above bedded cherts. Conodonts from this section were identifed by NORMAN M. SAVAGE as belonging to the late Emsian *Polygnathus serotinus* Zone. Distinctive, two-hole cirral crinoid ossicles, commonly ascribed to *Gasterocoma*? *bicauli* JOHNSON & LANE 1969, are common throughout the section; they are typical of most shallow-water, open-marine platform carbonate environ-ments in Emsian strata of Alaska. Brachiopod taxa, in addition to the eospiriferinids, include *Opsiconidion*, *Teichertina*, *Sibirirhynchia alata* (KHODALEVICH), *Gypidula*, *Ivdelinia*, a clorindinid, *Atrypa*, *Spinatrypa*, *Carinatina*, *Punctatrypa (Undatrypa)*. Fossils were noted earlier from this locality by REED & NELSON (1980); it is no. 17 on their geologic map (= Field station 75AR67 of BRUCE REED, and = USGS locality 9589-SD) and was referred to as a "locally derived slump block" of their "Dl" unit with limestones of Middle and Late Devonian age. On the basis of its fauna, this locality was indicated to be either late Early Devonian (Emsian) or early Middle Devonian (Eifelian). Field examination of the area by BLODGETT in late July 1996 indicated that the exposure is not a slump block, but rather an *in situ* outcrop of an Emsian-age limestone unit, separated by a thick section of siliciclastic beds from a much more prominent, thicker limestone unit of Frasnian age.

The material used in this study includes the original collection made by BRUCE L. ("Biff") REED (deceased), formerly of the U. S. Geological Survey, during geologic mapping of the Talkeetna Quadrangle. This collection (REED's locality 75AR67) is small in number of specimens, but includes several well-preserved, free-weathering brachiopods. Most of the studied collection was gathered by BLODGETT and two U. S. Park Service geologists during a 5-day visit. The illustrated specimens are deposited in the University of Alaska Museum (UAM) in Fairbanks/Alaska, USA.

Systematic Paleontology

Family Cyrtiidae FREDERICKS 1924
Subfamily Eospiriferinae SCHUCHERT & LEVENE 1929

Genus *Myriospirifer* HAVLÍČEK 1978

Type species: *Myriospirifer myriofila* HAVLÍČEK 1978.

Discussion: This genus was established by HAVLÍČEK 1978 to include eospiriferinids which were similar externally and internally to *Eospirifer* SCHUCHERT, but differ in having a micro-ornament composed of fine, rounded to flat-topped capillae wider than the intervening V-shaped intergrooves, and increasing by bifurcation. *Eospirifer*, on the other hand, has micro-ornament of angular to subangular capillae, narrower than the grooves separating them, and increasing mostly by implantation. HAVLÍČEK (1980: 36) also noted that "concentric rugellae [are] very fine or absent" and that the dental plates range from being "sulcus-bounding type to extrasinal" in *Myriospirifer.* The genus ranges from the late Llandovery to the end of the Early Devonian, perhaps even into the basal Eifelian. Early Devonian occurrences have reported from the Barrandian of the Czech Republic (HAVLÍČEK 1980), from Brittany (GOURVENNEC 1989), and from the Urals (SAPEL'NIKOV, MIZENS & SHATROV 1987). According to HAVLÍČEK (1980: 39), most eospiriferinids referred to by BOUCOT (1963) and others as belonging to *Eospirifer togatus,* actually belong to the type species of *Myriospirifer, M. myriofila* HAVLÍČEK 1978, described from the Koneprusy Limestone (Pragian) of the Czech Republic. The type species, *M. myriofila,* includes many specimens which HAVLÍČEK (1959: pl. 7 figs 1-5) had at that time identified as *Eospirifer togatus insidiosus* (BARRANDE). Subsequent study by HAVLÍČEK has shown that the shell illustrated by BARRANDE 1879 as *Eospirifer togatus insidiosus* – reillustrated by HAVLÍČEK (1959: pl. 7 fig. 6)] – is actually derived from the overlying Suchomasty Limestone of Emsian age.

Myriospirifer n. sp. aff. *Myriospirifer myriofila* HAVLÍČEK 1978

Pl. 1

Diagnosis: Large *Myriospirifer* with rounded outline and strongly convex, deep and elongate ventral valve.

Description: Relatively large shell for genus, attaining a width of up to 50 mm. Shell outline transversely rounded; greatest width slightly posterior to mid-length of the ventral valve.Ventral interarea low, weakly incurved. Cardinal margin straight, up to 80-85 % of maximum shell width. Ventral umbo strongly and evenly curved. Ventral valve strongly convex, whereas the dorsal valve is moderately convex with depth about 60 % of the ventral valve. Shell surface smooth, totally lacking plications. Ventral sulcus moderately rounded and extending the entire length of the valve. Dorsal fold moderately and evenly convex. Micro-ornament composed of numerous, closely spaced, broad, flattened capillae separated by much narrower, grooved interspaces. Dimensions of illustrated specimen (UAM-2569), the largest shell in collection: shell width: 50.6

mm; shell thickness: 25.3 mm; ventral valve length: 37.3 mm; dorsal valve length: 31.7 mm.

Comparison: *Myriospirifer* n. sp. mostly closely resembles the type species, *M. myriofila* HAVLÍČEK 1978, from the Koneprusy Limestone (Pragian) of the Czech Republic, especially in its large size, but differs from the latter in having a less transverse, more rounded shell outline, in having a more prominent, more elongate ventral valve, and in having a relatively narrower ventral sulcus and dorsal fold. The Alaskan species differs from *Myriospirifer insidiosus* (BARRANDE) from the Suchomasty Limestone (Emsian) of the Czech Republic in being much larger in size and in having a relatively much more inflated ventral valve. *M.* n. sp. differs from *Spirifer (Theodossia) karmanovi* KHODALEVICH 1951 from Emsian/Eifelian boundary beds in the Urals, placed questionably in *Myriospirifer* by SAPEL'NIKOV, MIZENS & SHATROV (1987), in being relatively larger, in having a markedly more convex ventral valve, a more rounded outline, and a deeper sulcus. It differs also from *Myriospirifer ceneratiensis* GOURVENNEC 1989, from the Pragian of Brittany, in attaining greater size, and having a relatively broader ventral sulcus, and a ventral valve which is markedly more convex in posterior view. The Alaskan species compares very closely to *Eospirifer (Havlicekia) pseudosecans kolymensis* RZHONSNITSKAYA in NIKOLAEV & RZHONSNITSKAYA (1967: 491, pl. 3 figs 5a-c) from the Vecherinsk horizon in the Kolyma region of northeast Siberia. The latter species has never been formally described, and thus remains a nomen nudum. The Alaskan form differs from it in having a much more prominently incurved ventral umbo.

Material: One articulated specimen, UAM-2569 [illustrated], from BRUCE REED's locality 75AR67 (= USGS locality 9589-SD). From the collections made by BLODGETT in 1996, this taxon is found in the following intervals – distances above the base of the Emsian limestone exposure – talus derived from beds at or slightly above 13.4 m (44 ft) - 44 articulated specimens and 15 ventral valves; from 13.7-14.0 m (45-46 ft) - 8 articulated specimens and 6 ventral valves; and from 14.9-15.8 m (49-52 ft) - 45 articulated specimens and 14 ventral valves.

Occurrence: This new species of *Myriospirifer* is known only from the unnamed late Emsian limestone unit of the Shellabarger Pass area.

Genus *Janius* HAVLÍČEK 1957

Type species: *Spirifer nobilis* BARRANDE 1848.

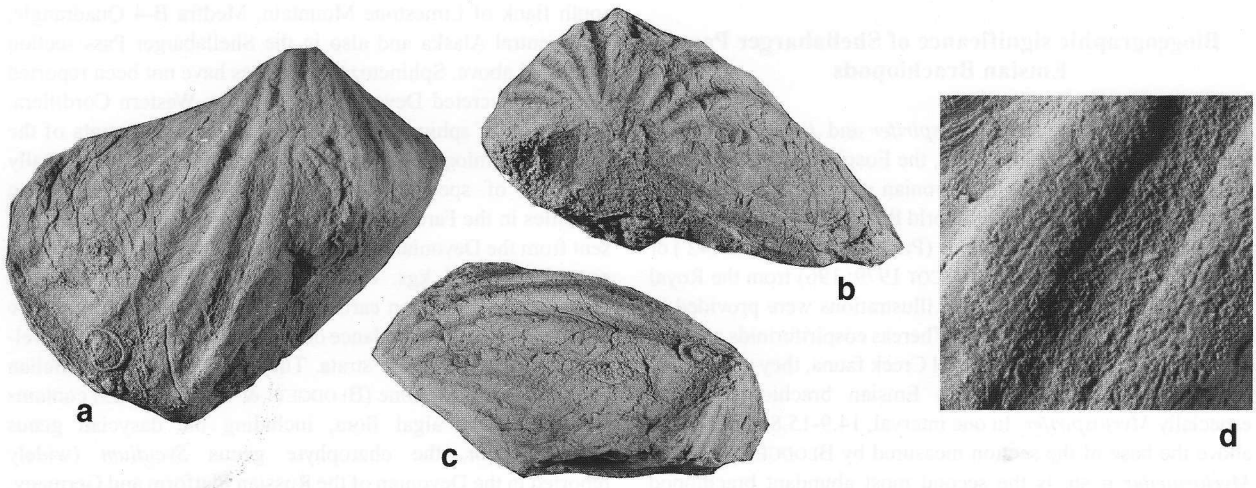
Janius cf. *J. vetulus* (EICHWALD 1860)

Text-fig. 3

cf. * 1860 *Spirifer vetulus* EICHWALD: 719-720, pl. 35 figs 1a-c.
cf. 1930 *Spirifer (Eospirifer) vetulus*. – NALIVKIN: 109, pl. 9 fig. 11.
cf. 1947 *Eospirifer vetulus*. – NALIVKIN: 106, pl. 24 fig. 7.
cf. 1960 *Eospirifer vetulus*. – KUL'KOV: 186-187, pl. 7 figs 1a-d.
cf. 1967 *Janius vetulus*. – NIKOLAEV & RZHONSNITSKAYA: 491, pl. 3 fig. 4.
cf. 1996 *Janius vetulus*. – SIDYACHENKO: 174-175, pl. 18 fig. 14; pl. 19 fig. 1.

Diagnosis: A large, coarsely plicate species of *Janius* with a median plication in the ventral sulcus.

Discussion: The illustrated specimen is the best example of this taxon, but unfortunately it is incomplete and slightly crushed. The shell is relatively wide (half-width approximately 27 mm) with ventral valve much deeper (at least twice the depth) than the dorsal valve. Each side of both valves bears 6-7 coarse lateral plications; these plicae arise by infrequent splitting. The plications are broad, rounded to weakly flattened, and separated by even broader interspaces; plicae curving weakly laterally and



Text-fig. 3. *Janius* cf. *J. vetulus* (EICHWALD 1860); UAM-2570, unnamed late Emsian limestone unit, locality 75AR67 (= USGS locality 9589-SD), Shellabarger Pass area, Talkeetna C-6 quadrangle, south-central Alaska. – a) ventral view (note presence of median plication in sulcus on umbonal portion of valve), × 1.5; b) posterior view, × 1.5; c) lateral view, × 1.5; d) enlargement of ventral shell surface under low lights to better show micro-ornamentation, × 6.0.

anteriorly. Umbonal portion of illustrated ventral valve has a median plication preserved in the sulcus but it could not be observed anteriorly due to sulcus containing indurated sediment, and by breakage of the shell further towards its anterior. Both unillustrated specimens have a poorly preserved, but nonetheless prominent median plication in their ventral sulci. The ventral interarea is broad and weakly incurved. Micro-ornament of numerous, fine capillae, separated by flattened interspaces of roughly equal width. In virtually all significant external features, these poorly preserved shells closely agree with illustrated specimens of *J. vetulus*, but better preserved, uncompressed specimens are needed to confirm the identification.

Material: One articulated specimen, UAM-2570 [illustrated], from BRUCE REED's locality 75AR67 (= USGS locality 9589-SD), and two ventral valves collected from talus derived from beds at or slightly above 13.4 m (44 ft) above the base of the Emsian limestone exposure. This is a relatively rare species in the unnamed Emsian limestone unit of Shellabarger Pass.

Comparison: The presence of a median plication in the ventral sulcus readily distinguishes this species from nearly all other Devonian species referred to *Janius*. The only other Devonian species bearing plications in the ventral sulcus is *J. vetuloides* NALIVKIN 1960 from "Upper Eifelian" reefogenic or indistinctly bedded limestone on the southern island of Novaya Zemlya. The latter differs in being more finely plicate than *J. vetulus*, and in possessing from one to three finer plications in the ventral sulcus.

Occurrence: *Janius vetulus* is widely reported from the Emsian-Eifelian of the Urals (EICHWALD 1860; NALIVKIN 1947), Salair (KUL'KOV 1960), Central Asia (NALIVKIN 1930), and the Kolyma region of northeast Siberia (NIKOLAEV & RZHONSNITSKAYA 1967: 493; SIDYACHENKO 1996). It was established by EICHWALD (1860: 719) on specimens from the "calcaire rouge à Pentamères près du lac de Bogoslovsk et sur le bord de le rivière Yolva." Its range in the former Soviet Union appears to be Emsian-Eifelian. The probable occurrence of this species in Alaska is the first report of the taxon from outside the former Soviet Union.

Biogeographic significance of Shellabarger Pass Emsian Brachiopods

The eospiriferinid genera *Myriospirifer* and *Janius*, as well as the subfamily that includes them, the Eospiriferinae, are nearly unknown anywhere in Early Devonian or Eifelian strata of the Cordilleran Region of the Old World Realm. The only exception is the citation of the genus *Janius* (PERRY & LENZ 1978: 142) or "*Janius*" (SAVAGE, PERRY & BOUCOT 1979: 196) from the Royal Creek area, Yukon Territory. No illustrations were provided in either publication of this taxon. Whereas eospiriferinids are only a very minor element in the Royal Creek fauna, they are a major part of the Shellabarger Pass Emsian brachiopod fauna, especially *Myriospirifer*. In one interval, 14.9-15.8 m (49-52 ft) above the base of the section measured by BLODGETT in 1996, *Myriospirifer* n. sp. is the second most abundant brachiopod taxon. However, in marked contrast to their general absence in the Cordilleran Region, eospiriferinid brachiopods are reported as common elements in Emsian strata of Siberia (Kolyma, Kuznetsk Basin), at numerous localities throughout the Urals and Novaya Zemlya, and in the Central Asia portion of the former Soviet Union (BLODGETT 1998: 57).

The Eurasian aspect of the Shellabarger late Emsian fauna is also indicated by other taxa in the brachiopod fauna. The gypidulinid genus *Ivdelinia* is a typical Old World Realm taxon, and is widely reported from Early Devonian (Lochkovian-Emsian) and early Middle Devonian (Eifelian) age rocks of the Rhenish-Bohemian and Uralian Regions, but is almost totally unknown in the Cordilleran Region of the Old World Realm which, in the Emsian, included areas of Arctic and western Canada and Nevada. Only two species have been described from Emsian-Eifelian strata of the Cordilleran Region: *Ivdelinia grinnellensis* BRICE 1982, and *Ivdelinia (Ivdelinella) ellesmerensis* BRICE 1982, both of which occur in the Canadian Arctic Islands. The Shellabarger Pass *Ivdelinia* is distinct from both of the above species and is more closely related to species described from the Urals. The rhynchonellid brachiopod *Sibirirhynchia alata* (KHODALEVICH 1951) occurs in the Shellabarger Pass late Emsian beds; it has not previously been reported from North America. It occurs in Emsian-Eifelian strata of the Urals and Kolyma. As with the Nixon Fork Subterrane (BLODGETT 1998: 55; BLODGETT & BREASE 1997), the Emsian brachiopod fauna of the Mystic Subterrane, typified by the Shellabarger Pass fauna, also appears biogeographically to be Uralian, rather than part of the Cordilleran Region of the Old World Realm.

Other biogeographically distinctive Farewell Terrane biotas

Many other aspects of the Farewell Terrane Devonian fossil fauna and flora are dissimilar to those of the Canadian Cordillera. The Emsian and Eifelian shallow-water platform carbonate rocks of the Farewell Terrane contain abundant sphinctozoan sponges. RIGBY & BLODGETT (1983) described Eifelian age sphinctozoans from the Cheeneetnuk Limestone of the McGrath A-5 Quadrangle of west-central Alaska (part of the Nixon Fork Subterrane of the Farewell Terrane). Unpublished Emsian occurrences are also known in the Farewell Terrane from south flank of Limestone Mountain, Medfra B-4 Quadrangle, west-central Alaska and also in the Shellabarger Pass section discussed above. Sphinctozoan sponges have not been reported from non-accreted Devonian strata of the Western Cordillera. The dearth of sphinctozoan sponges in Devonian strata of the Cordilleran miogeocline contrasts markedly with the literally hundreds of specimens recovered from several Devonian localities in the Farewell Terrane. They are also completely absent from the Devonian of Nevada where BOUCOT has processed several thousand kgs. of limestone for silicified Devonian brachiopods. Devonian carbonates of the Farewell Terrane are also distinctive for abundance of calcareous green algae in level-bottom, lagoonal facies strata. The upper part of the Eifelian Cheeneetnuk Limestone (BLODGETT & GILBERT 1983) contains a rich, diverse algal flora, including the dasyclad genus *Coelotrochium*, the charophyte genus *Sycidium* (widely reported in the Devonian of the Russian Platform and Germany; not known elsewhere in North America), and the udoteacean alga, *Lancicula sergaensis* SHUYSKY (PONCET & BLODGETT 1987), previously described from the early Emsian of the Urals. None of these algal taxa have been reported in non-accreted,

truly North American Devonian strata. These observations on the general lack of sphinctozoans and calcareous green algae in Early and Middle Devonian strata of the western Cordillera of North America is supported by the examination by BLODGETT of the large paleontological collections made by both the Geological Survey of Canada and the United States Geological Survey in Calgary and Washington, D.C., respectively.

Another aspect in which the Farewell Terrane Devonian rocks differ from contemporaneous, truly North American rocks are the widespread and extensive buildups of algal reef complexes along the entire length of the outer carbonate platform environments of the Farewell Terrane during the earlier part (primarily Lochkovian) of the Early Devonian (CLOUGH & BLODGETT 1985, 1988, 1992; BLODGETT, CLOUGH & SMITH 1984; BLODGETT & CLOUGH 1985; BLODGETT & GILBERT 1992b); these also extend well down into the Silurian. These southwestern Alaskan buildups, with their associated brachiopods, aphrosalpingids (a group of sphinctozoan sponges restricted to the Upper Silurian, see RIGBY et al. 1994), and calcareous green algal flora are very similar to coeval buildups in the Urals. The only other part of present-day North America with similar algal buildups of equivalent age is the Alexander Terrane of southeastern Alaska (SOJA 1994; SOJA & ANTOSHKINA 1997), which also is of accretionary origin.

A biogeographically distinctive brachiopod and coral-rich fauna is present in an unnamed early Emsian (*dehiscens* Zone) limestone unit in the Nixon Fork Subterrane of the Farewell Terrane, west-central Alaska (BLODGETT, SAVAGE, PEDDER & ROHR 1995; BLODGETT 1998). It is from a regionally distinctive marker unit about 150 m thick in the Whirlwind Creek Formation of DUTRO & PATTON (1982). The largest examined collections are from a north-trending ridge, long known informally as "Reef Ridge" by mineral-company geologists, in section 23, T. 24 S., R. 23 E. of the Medfra B-3 Quadrangle (text-fig. 2, locality 1); the marker unit is repeated once by thrust faulting. The fauna consists of over 30 species, of which the most common are rhynchonellids (notably uncinulids). Genera present include *Plicogypa*, *Stenorhynchia*, *Taimyrrhynx*, "*Uncinulus*", *Nordotoechia*?, *Spinatrypa*, *Nucleospira*, *Protathyris*, *Howellella*, and *Aldanispirifer*. Diagnostic species from this include *Plicogypa* cf. *kayseri* (PEETZ), *Taimyrrhynx taimyrica* (NIKIFOROVA), "*Uncinulus*" *polaris* NIKIFOROVA, and *Howellella yacutica* ALEKSEEVA. These species are known from various parts of Siberia (Kolyma, Taimyr, and Kuznetsk Basin) and Arctic Russia (Novaya Zemlya), and are unknown in equivalent age strata of east-central Alaska (Nation Arch area), or northwestern and Arctic Canada. Rugose corals identified by A. E. H. PEDDER, formerly of the Canadian Geological Survey, consist mostly of solitary forms, including *Pseudoamplexus altaicus*, *Lithophyllum* spp., rare *Zonophyllum*, *Rhizophyllum schischkaticum*, new species of *Zelophyllum*, and *Acanthophyllum*. PEDDER noted that this fauna is related to early Emsian Kolymian loop coral faunas of Siberia.

Farewell biotas from time intervals other than Devonian and Silurian also have strong affinities with Siberia, especially during times of heightened global endemism. Two stratigraphically distinct, rich, diverse Middle Cambrian trilobite faunas were discovered in 1984 in Nixon Fork Subterrane strata of the Sleetmute A-2 Quadrangle. These were initially discussed by PALMER, EGBERT, SULLIVAN & KNOTH (1985), who considered both faunas to be representative of an outer-shelf environment and biogeographically of Siberian aspect, with faunal elements previously not recognized in North America. It was later suggested by BABCOCK & BLODGETT (1992) and BABCOCK, BLODGETT & ST. JOHN (1993) that these faunas, showing strong similarity to autochthonous outer-shelf faunas of North Greenland, may have dispersed in cool waters below the thermocline.

Upper Ordovician (Ashgillian) strata of the Lone Mountain area (McGrath C-4 Quadrangle, west-central Alaska), part of the Nixon Fork Subterrane, have a rich, diverse silicified fauna of brachiopods, gastropods, and corals. The most abundant element is the pentamerid brachiopod *Tcherskidium* (ROHR & BLODGETT 1985; POTTER, BLODGETT & ROHR 1988; POTTER & BLODGETT 1992; BLODGETT, ROHR & CLOUGH 1992). This genus has been identified at only two sites of undoubted North America origin (Black River Quadrangle of east-central Alaska and North Greenland), but is characteristic and abundant in Ashgillian faunas from Siberia (Kolyma, Taimyr, and Chukotka). The Lone Mountain form is a new species of this genus; it is also present in the Shublik Mountains of the northeastern Brooks Range (in the Arctic Alaska Superterrane of MOORE 1992). Gastropods from the Lone Mountain section are closest to species from the York Mountains of the Seward Peninsula (BLODGETT, ROHR & CLOUGH 1992), which belongs to the York Terrane.

MAMAY & REED (1984) described Permian plants from the conglomerate at Mt. Dall in the Talkeetna C-5 Quadrangle, central Alaska Range. They considered this flora to be derived from the Mystic Terrane of JONES, SILBERLING, BERG & PLAFKER (1981). Although the flora shares some elements with the southwestern part of the United States, its most distinctive element is the genus *Zamiopteris*. This genus is characteristic of Angaraland (Siberia) and is not known from elsewhere in North America. On this basis, it was suggested that the Mystic Terrane was possibly exotic, accreted to Alaska between post-Early Cretaceous and early Tertiary time. Close alliance between the Upper Triassic faunas of the Nixon Fork Subterrane and Siberia is also apparent from the reported occurrence (GRANT-MACKIE & SILBERLING 1990: 250) of the monotid bivalve, *Monotis (Eomonotis) anjuensis* BYTSCHOV & EFIMOVA from the Medfra C-3 Quadrangle, a species previously known only from Siberia.

Biogeographic evidence from the Cambrian through Triassic now strongly indicates that the Farewell Terrane, as well as its component subterranes (Nixon Fork, Dillinger, and Mystic) are of Siberian, rather than Cordilleran aspect. This is especially true for time intervals of heightened global endemism. During more cosmopolitan intervals (i. e. Early Silurian, Givetian-Frasnian), it is more difficult to distinguish between Siberian or Cordilleran affinities, since more invertebrate genera and species appear to be shared between the two continents. It now seems most reasonable to conclude that this tectonic entity probably represents a rift block which was formerly part of the Siberian paleocontinent.

Biogeographic conclusions about other Alaskan Terranes with significant Paleozoic Age Strata

The Alexander Terrane of southeastern Alaska shares a similar, close connection with the Farewell Terrane, on the basis of identical brachiopod, gastropod, sponge, and algal assemblages in the later part of the Silurian and early Middle Devonian (BLODGETT, personal observation). Extremely close faunal linkages between the Farewell Terrane and northern Alaskan tectonic entities such as the Arctic Alaska Superterrane of

MOORE 1992 (including the Endicott, North Slope, and other northern Alaskan terranes of earlier usage) and the York Terrane of the Seward Peninsula, have been noted in latest Ordovician (Ashgillian) brachiopod and gastropod faunas (BLODGETT, ROHR & CLOUGH 1992). Many of the common, shared genera (*Tcherskidium*, *Siskiyouspira*, *Rousseauspira*, and n. gen. aff. *Tropidodiscus*) are unknown or exceedingly rare in coeval strata of non-accreted Western North America. The pentamerid brachiopod genus *Tcherskidium* is characteristic of Ashgillian faunas from Siberia (Kolyma, Taimyr, and Chukotka – see RONG & BOUCOT 1998 for global distribution), and is now recognized in Ashgillian age strata of the Farewell Terrane in the area near Lone Mountain, McGrath C-4 Quadrangle (ROHR & BLODGETT 1985; BLODGETT, ROHR & CLOUGH 1992) and from the Arctic Alaska Superterrane in the Ashgillian part of the Nanook Limestone of the Shublik Mountains, Mt. Michelson Quadrangle (BLODGETT, ROHR, HARRIS & RONG 1988) and from the northeastern part of the Baird Mountains Quadrangle (BLODGETT, ROHR & CLOUGH 1992). The genus *Tcherskidium* is reported from only two localities belonging undoubtedly to North America during the Late Ordovician: 1) in Ashgillian age beds of the Black River D-1 quadrangle, east-central Alaska (BLODGETT, unpublished data cited in RONG & BOUCOT 1998: 458); and 2) in Ashgillian strata of North Greenland (HURST & SHEEHAN 1982). At neither locality does this genus occur in the great abundance it does in the Alaskan accreted terranes – where it usually occurs in coquinoid accumulations.

ORMISTON & ROSS (1979) have also pointed out that the occurrence of the trilobite *Monorakos* in the Late Ordovician of the western Seward Peninsula (York Terrane) suggests close linkage of the latter area with what they termed the "Siberia-Kolyma continent". The genus had been reported previously only from the northern part of the former Soviet Union (Siberian Platform, Taimyr, New Siberian Islands, Kolyma, and Chukotka). It is considered here that these northern Alaska terranes, like the related Farewell Terrane, also represent rifted blocks of Siberian origin. Thus, it now would appear that the only truly North American part of Alaska during Early and Middle Paleozoic time is represented by the Nation Arch area of east-central Alaska, where strata of the Ogilvie Formation contain species and genera characteristic of similar-age North American miogeoclinal strata in the Yukon and Northwest Territories of Canada.

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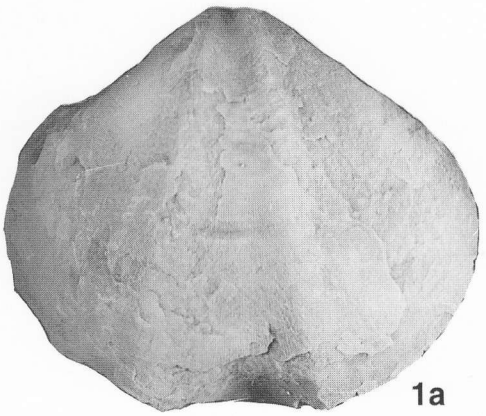
Plate 1

The illustrated specimen is from locality 75AR67 (= USGS locality 9589-SD), Shellabarger Pass, Talkeetna C-6 Quadrangle, south-central Alaska.

Figs 1 a-g. *Myriospirifer* n. sp. aff. *M. myriofila* HAVLÍČEK 1978, UAM-2569, unnamed late Emsian limestone, locality 75AR67 (= USGS locality 9589-SD).

a) ventral view, × 1.5;
b) dorsal view, × 1.5;
c) posterior view, × 1.5;
d) anterior view, × 1.5;
e) lateral view, × 1.5;
f) enlarged view of ventral view under low lights to better show fine micro-ornamentation, × 3.0;
g) further enlargement of previous view showing micro-ornamentation, × 8.0.



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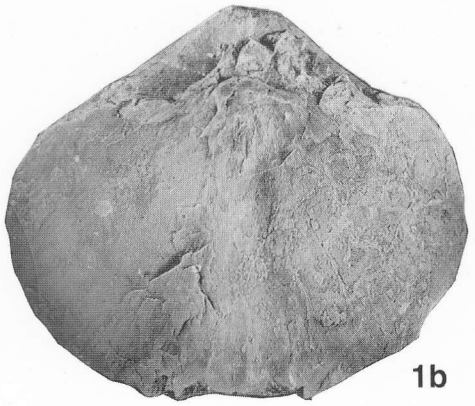

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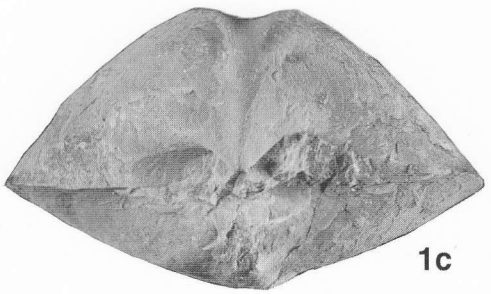

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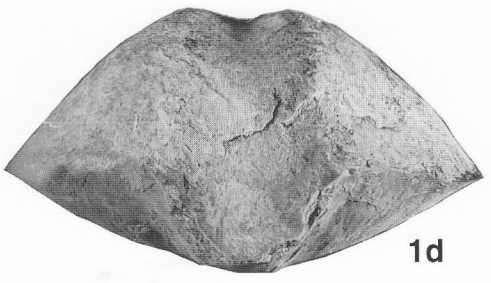

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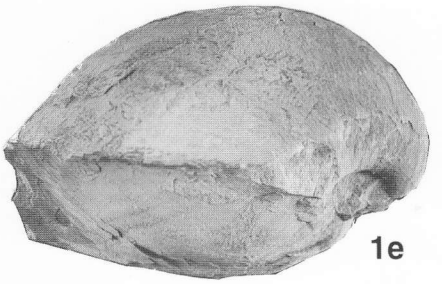

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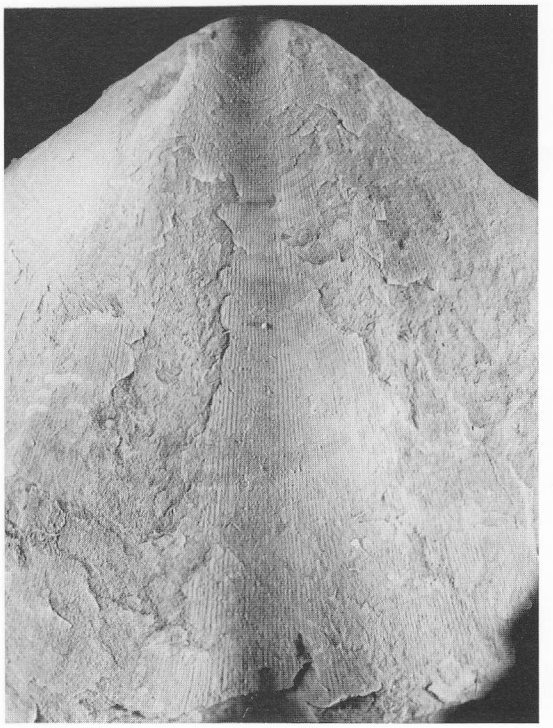

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