TWO NEW LATE EMSIAN (LATEST EARLY DEVONIAN) PENTAMERIDINE BRACHIOPODS FROM THE SHELLABARGER LIMESTONE (NEW FORMATION), SHELLABARGER PASS, DENALI NATIONAL PARK & PRESERVE, SOUTH-CENTRAL ALASKA

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Abstract—We here establish a new lithostratigraphic unit, the Shellabarger Limestone, from Shellabarger Pass, Denali National Park & Preserve, Talkeetna C-6 quadrangle, south-central Alaska. This late Emsian (latest Early Devonian) limestone body is the oldest fossiliferous Devonian unit recognized within the Dl unit of Reed and Nelson (1977, 1980). It forms the oldest stratigraphic interval within the Mystic sequence of Gilbert and Bundtzen (1984) of the Farewell terrane (Decker et al., 1994). The section, consisting of 38.7 m (127 ft) of lime mudstone and wackestone, was measured in an unnamed late Emsian-age limestone unit, which we here name the Shellabarger Limestone. Neither the base or the top of the formation is exposed at the type section, but regionally it seems to be underlain by deep-water turbiditic sandstone, siltstone, shale, and sparse limestones of the Dillinger sequence of Gilbert and Bundtzen (1984); however, a direct contact with the overlying Mystic sequence has not been observed at the newly designated type section.

In addition, we erect two new pentamidine brachiopod species, *Ivdelinia* (*Ivdelinia*) *tweeti* n. sp. (superfamily Gypiduloidea) and *Clorinda cappsi* n. sp. (superfamily Clorindoidea). These two species occur in the Shellabarger Limestone measured type section. They are part of a diverse brachiopod fauna found in the basal strata of the Mystic sequence of the accreted Farewell terrane. Previous taxonomic studies of other brachiopod species from the Shellabarger Limestone include Blodgett and Brease, 1997; Blodgett, 1998; Blodgett and Boucot, 1999; Garcia-Alcalde and Blodgett, 2001; and Blodgett et al., 2021. The two new species are close in external form to species previously recognized in the Kolyma region of northeastern Russia and elsewhere in Eurasia. The close affinities of these species with related forms in late Emsian strata of Northeast Asia and Eurasia, together with the presence of other brachiopod taxa of Siberian affinities from the Shellabarger Limestone, previously suggested that the Farewell terrane is of rift origin, and probably was originally part of the Siberian paleocontinent (i.e., Blodgett et al., 2002a, 2010; Kanygin et al., 2020). Our continued study of the Emsian brachiopod fauna of the Shellabarger Limestone strongly reinforces this interpretation.

INTRODUCTION

In this paper we describe two new distinctive species of late Emsian age (late Late Early Devonian) pentameridine brachiopods from a previously unnamed limestone unit exposed in the Shellabarger Pass area, Talkeetna C-6 1:63,360 scale quadrangle, Denali National Park & Preserve, south-central Alaska (Figs. 1 and 2). They are part of a diverse brachiopod fauna of late Emsian age found at the base of the Mystic sequence here, and it is deemed critical to document additional biogeographically significant brachiopod taxa from this formation. The host unit consists of 38.7 m (127 ft) of lime mudstone and wackestone and we propose the name Shellabarger Limestone for this stratigraphic interval. Figure 3 presents a stratigraphic column of the proposed type section of the newly established Shellabargar Limestone. Morphologically, the Shellabarger Pass brachiopods exhibit a northeastern Russian character of the fauna, rather than an alliance with northwestern cratonic North America. Figures 4 and 5 give photographic views of the upper part of the type section.

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 (or lithotectonic) terranes (Coney et al., 1980; Jones et al., 1981, 1982, 1986, 1987; Silberling et al., 1992, 1994; Nokleberg et al., 1994) has come into general acceptance within the geologic community. The only exception to this is the triangular area of east-central Alaska, more or less bounded on the northwest by the Porcupine River, on the west by the Cretaceous flysch belt of the Kandik Basin, and on the southwest by the Yukon River. This region, which includes the Nation Arch, represents the westernmost (in present-day coordinates) continuation of Precambrian and Paleozoic rocks of the North American craton exposed farther east in the Ogilvie Mountains of the Yukon Territory in western Canada.

Gilbert and Bundtzen (1984) considered the Dillinger and Mystic terranes 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 that is overlain by the Mystic sequence, which consists of laterally variable Devonian to Triassic (?) shallow-water to nonmarine sedimentary rocks and intrusive and extrusive mafic and ultramafic rocks. The type area of the Mystic sequence is Mystic Pass, near Shellabarger Pass, and is situated approximately 11 mi. (17.7 km) NW of the Emsian limestone outcrop discussed here within Denali National Park and Preserve.

GEOLOGIC SETTING

The specimens described here are from the base of the Mystic sequence of the Farewell terrane of southwestern and west-central Alaska. The Mystic terrane was originally named by Jones and Silberling (1979) and described further by Jones et al. (1981) as a separate tectonostratigraphic entity of full terrane rank. More recently, Decker et al. (1994) recognized that the Mystic terrane, as well as the Nixon Fork and Dillinger terranes, were genetically related, and all were reduced in rank to subterranes of a larger terrane, termed the Farewell terrane. Gilbert and Bundtzen (1984) considered the Dillinger and Mystic



FIGURE 1. Index map of Alaska showing location of Shellabarger Pass.

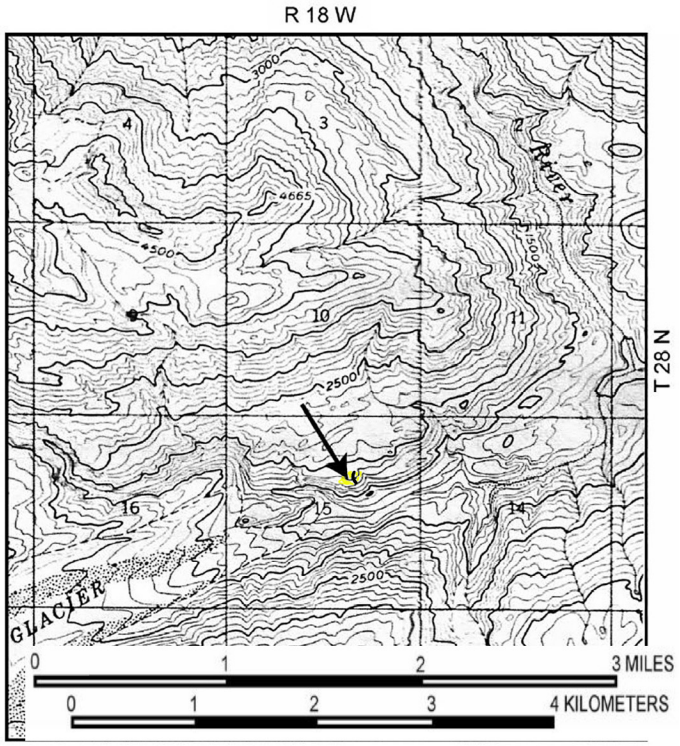


FIGURE 2. Map showing location of Late Early Devonian (Emsian) limestone outcrop in Shellabarger Pass, Denali National Park & Preserve and Preserve, Talkeetna C-6 quadrangle, south-central Alaska. Outcrop shown in yellow color surrounding the measured type section. Line indicates measured section. Base of section located at its north end.

terranes, each of whose type sections are close to one another, to represent a single stratigraphic succession of Paleozoic to Triassic age, assigning the term "sequence" to each. They considered the underlying Dillinger sequence to be a Cambrian to Lower Devonian deep-water succession overlain by the Mystic sequence, consisting of 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 has been documented by stratigraphic studies by Blodgett and

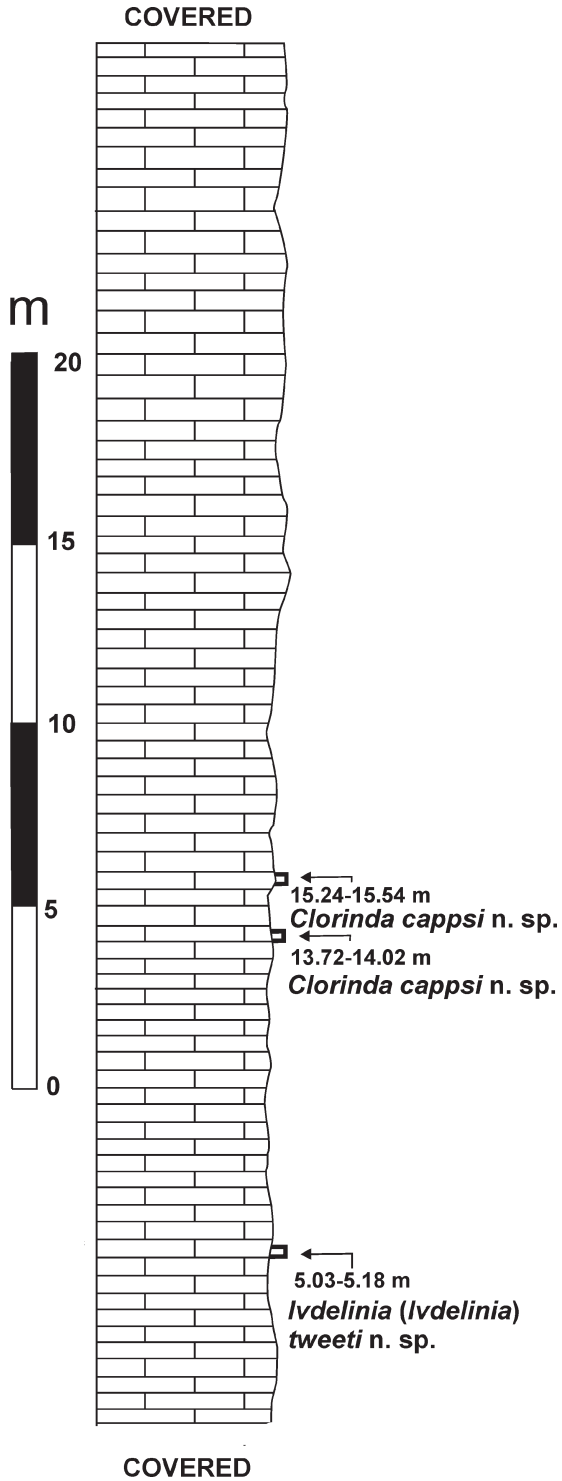


FIGURE 3. Measured type section of the Shellabarger Limestone. Situated at a single isolated limestone outcrop, it constitutes the oldest Devonian interval within the Dl unit of Reed and Nelson (1977, 1980). It forms the oldest stratigraphic interval within the Mystic sequence of Gilbert and Bundtzen (1984). This outcrop is situated on the eastern side of a small hillock situated near the center of the NE¼, SW¼, NE1/4, sec. 15, T28N, R18W, Talkeetna C-6 1:63,360 scale quadrangle, latitude 62°31'21"N., longitude 152°35'32" W. The measured section of the outcrop indicates a minimum thickness of 38.7 m (127 ft) of lime mudstone and wackestone for the unit (Blodgett et al., 2021). Location of the two new species described here are indicated.



FIGURE 4. Outcrop of the upper part of the type section of the Shellabarger Limestone (Late Early Devonian) in Shellabarger Pass (view looking east-northeast). The two people in the photo are Pam Sousanes (NPS) (left) and one of the authors, Robert B. Blodgett (on right).

Gilbert (1992) to the southwest in the Lime Hills D-4 and D-5, 1:63,360 scale quadrangles. The Nixon Fork subterrane, defined originally as a full-rank terrane by Patton (1978), represents a predominately shallow-water carbonate platform whose lower part is mostly laterally equivalent to deeper-water Cambrian to Lower Devonian rocks of the Dillinger subterrane (Blodgett, 1983; Blodgett and Gilbert, 1983; Bundtzen and Gilbert, 1983; Gilbert and Bundtzen, 1983).

Until the late 1990s, most interpretations of the gross lithostratigraphy and faunal affinities of the best-studied subterrane of the Farewell terrane, the Nixon Fork subterrane, had indicated either fragmentation from or lithic continuity with northwestern Canada (Blodgett, 1983; Churkin et al., 1984; Blodgett and Clough, 1985; Rohr and Blodgett, 1985; Abbott, 1995). Newly acquired biogeographic data from Lower Devonian strata of the Farewell terrane, together with reconsideration of the affinities of the faunas and floras of other time intervals, indicate that this continental margin sequence originated by rifting away from the Siberian continent, rather than an origin from northwestern North America (Blodgett and Brease, 1997; Blodgett, 1998; Blodgett et al., 2002a). Much of this rifting appears to have occurred during Late Devonian to early Carboniferous time (Blodgett et al., 2010).

Richly fossiliferous Devonian rocks of the basal part of the Mystic sequence are well exposed in the Shellabarger Pass area, Talkeetna C-5 & C-6 quadrangles of south-central Alaska. The pass is situated in the remote western part of the Preserve portion of Denali National Park & Preserve. Field work was first seriously attempted there in the mid-1970's and was followed by our 1996 summer field work with financial support from the National Geographic Society to study an unnamed limestone unit that forms the ultimate local base of the Mystic sequence. Two separate limestone packages are separated by a siliciclastic/chert unit. The lower limestone interval is of Emsian (late Early Devonian) age and is known from only one outcrop. The upper limestone interval, representing the vast majority of Devonian limestone outcrops in Shellabarger Pass, is of Frasnian (early Late Devonian) age. The fauna from the Emsian limestone includes sponges (Rigby et al., 2009), rugose and tabulate corals, approximately 20 or more species of brachiopods, and trilobites. Common brachiopod genera observed from the Emsian outcrop include *Carinagypa*, *Ivdelinia, Clorinda*, *Myriospirifer*, *Sibirirhynchia*, *Spinatrypa*, *Spinatrypina*, *Punctatrypa*, *Carinatina*, *Opsiconidion*, and *Teichertina*. Previous work (Blodgett and Brease, 1997, Blodgett, 1998, Blodgett and Boucot, 1999, Garcia-Alcalde and Blodgett, 2001, and Blodgett et al., 2002a) indicate a much stronger Eurasian component to the Farewell terrane, as opposed to the Cordilleran fauna known from east-central Alaska and Yukon Territory of westernmost Laurentia. This overwhelmingly Eurasian aspect suggests that the host terrane, the Farewell terrane, was a continental fragment of Siberian origin.



FIGURE 5. Another slightly differing view of the same outcrop in the previous figure, view looking east-northeast. View well demonstrates the rugged mountainous terrain surrounding Shellabarger Pass. The geologist in the view is the late Phil F. Brease (deceased, former NPS geologist, who was an extremely great supporter of paleontology within the park).

The Frasnian limestone fauna has not yet been thoroughly reinvestigated taxonomically, but it is a proposed target for our future study. Preliminary identifications indicated the presence of the brachiopod genera *Schizophoria*, *Productella*, *Atrypa*, *Spinatrypa*, *Allanaria*?, *Tenticospirifer*, *Cyrtospirifer*, *Crurithyris*, *Eleutherokomma*, *Gypidula*, "*Camarotoechia*," *Ladogioides*?, *Theodossia*, *Emanuella*?, and *Tylothyris*, as well as rugose and tabulate corals, the ammonoid *Manticoceras,* and the trilobite *Scutellum*

DESCRIPTION OF THE SHELLABARGER LIMESTONE (NEW FORMATION)

The Shellabarger Limestone is established here as a new lithostratigraphic unit in the Shellabarger Pass region, Talkeetna C-6 1:63,360 scale quadrangle. The type section of the exposed formation is restricted to a small WSW-ENE, elongate ovoid outcrop belt situated atop a small hillock (see Figs. 2 and 3). The outcrop belt is shown as the yellow pattern which surrounds the measured type section in Figure 2. A north-south trending stratigraphic section was measured along the eastern side of a small hillock situated near the center of the NE¼, SW¼, NE1/4, sec. 15, T28N, R18W, Talkeetna C-6 1:63,360 scale quadrangle, latitude 62°31'21"N., longitude 152°35'32" W. (Fig. 2), at an elevation slightly above 700 m (2,400 feet). The section, consisting of 38.7 m (127 ft) of lime mudstone and wackestone, was measured in a then unnamed late Emsian-age limestone unit (Fig. 2). See Blodgett and Boucot (1999) and Blodgett et al. (2002a) for a description of the locality.

In addition, the new formation has equivalent strata which appear to be present to the west and northwest in the Lime Hills 1:250,000 scale Quadrangle. This lithologic unit locally forms the base of the Mystic sequence on the north flank of the Alaska

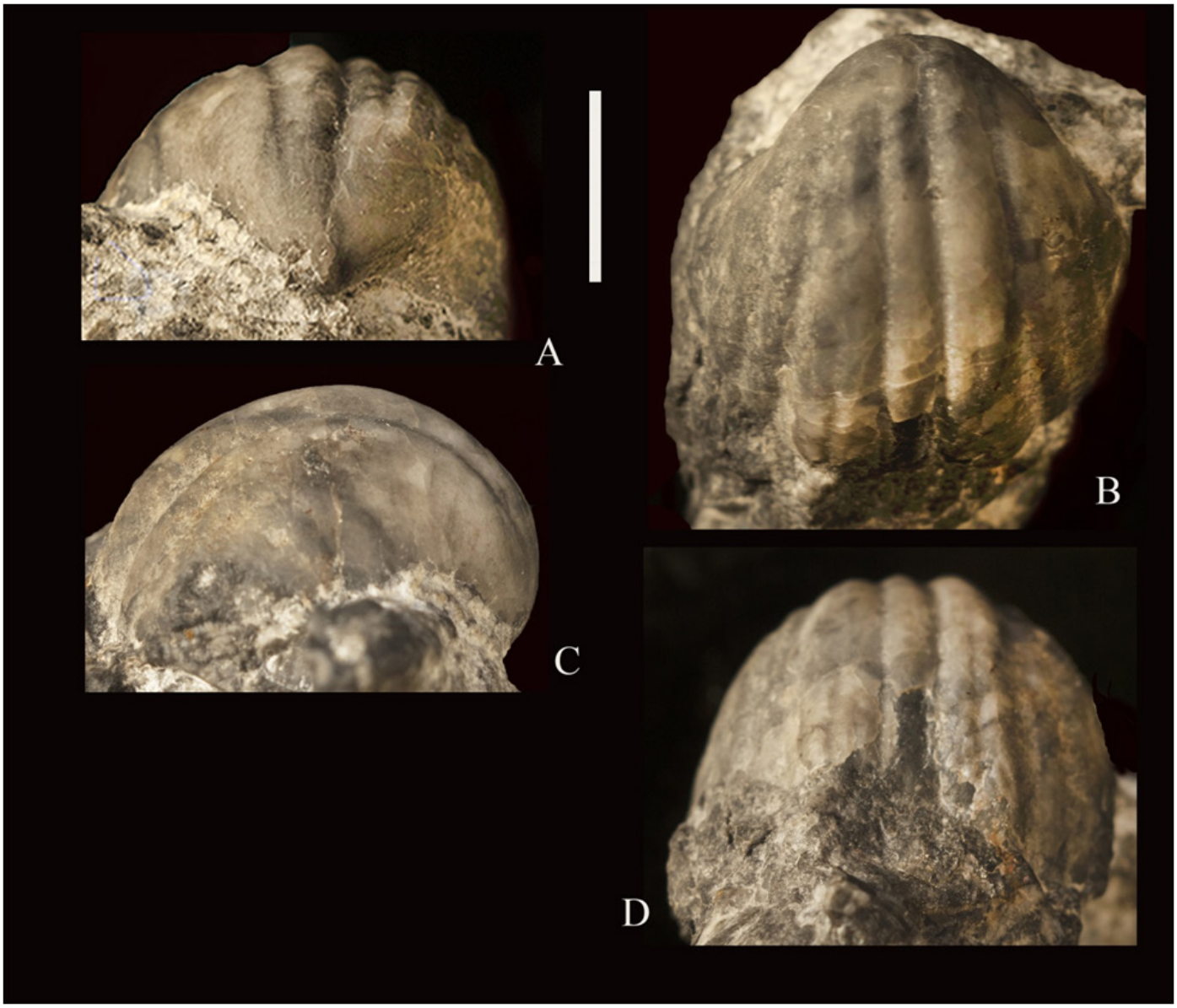


FIGURE 6. A-E, *Ivdelinia* (*Ivdelinia*) *tweeti* n. sp. **A-D**, Holotype, AKGMC-54, ventral valve, posterior, ventral, lateral, and anterior views. Specimen collected 16.5-17.0 feet (5.03-5.18 m) above the base of the measured section of the Shellabarger Limestone, Shellabarger Pass, Denali National Park & Preserve and Preserve, Talkeetna C-6 scale quadrangle, south-central Alaska. Scale bar = 10 mm (applied to all views).

Range (Blodgett and Gilbert, 1992; Gilbert and Bundtzen, 1984, Savage and Blodgett, 1995). Typically, the unit appears to be ~50 m (164 ft) thick through much of the central Alaska Range from Shellabarger Pass and to the west into Lime Hills C-5, C-6, D-4, and D-5, 1:63,360 scale quadrangles (Blodgett and Gilbert, 1992; Bundtzen et al., 1994; Blodgett et al., 2002a). The Emsian limestone is closely associated with underlying strata of the Dillinger sequence in the Lime Hills D-4, 1-63,360 scale quadrangle, composed here of deep-water turbiditic sandstone, siltstone, shale, and sparse limestones; however, a direct contact with the overlying Mystic sequence has not been observed (Blodgett and Gilbert, 1992). The youngest fauna in the local underlying Dillinger sequence is found in a limestone containing a predominately pelagic fauna consisting of abundant dacryoconarid tentaculitids, orthoconic natutiloids, and undetermined bivalves. A single species of conodont, *Pandorinellina optima*, was found, indicative of a Lochkovian (but not earliest Lochkovian) to Pragian age (Blodgett and Gilbert, 1992).

PREVIOUS STUDIES OF LATE EARLY DEVONIAN (LATE EMSIAN) FAUNA OF THE SHELLABARGER LIMESTONE

The Shellabarger Limestone, named herein, is the oldest Devonian interval recognized within the Dl unit of Reed and Nelson (1977, 1980). It forms the oldest stratigraphic interval within the Mystic sequence of Gilbert and Bundtzen (1984). Reed and Nelson (1980) recognized the Dl unit as representing a Middle and Upper Devonian limestone near Shellabarger Pass that is more than 95 m (312 ft) thick. They noted that the Dl unit locally includes discontinuous gray limestone beds of late Early or Middle Devonian age (at their locality 17), which they suggested was a locally derived slump block. Detailed field examination of the surrounding area by Blodgett in late July 1996 indicated that the exposure is actually an in-situ outcrop of a late Emsian age limestone that is separated by a thick section of siliciclastic beds from a much more prominent, thick unit of Frasnian age that forms the majority of the Dl unit of Reed

and Nelson (1977, 1980). Corals, brachiopods, trilobites, and echinoderms were listed in both papers from locality 17, but detailed taxonomic information was not provided. J.T. Dutro, Jr., in an unpublished USGS E&R report dated February 2, 1976 (Shipment number A-75-18), reported on the fauna from this locality (field number 75AR67 (=USGS collection 9589-SD) and listed the following: *Gasterocoma*? *bicaula* Johnson and Lane, 1969 (distinctive two-holed crinoid ossicles); *Dohmophyllum* sp. (rugose coral); horn coral, indet.; the brachiopods *Gypidula* sp., *Havlicekia* sp., *Nikiforovaena* sp., *Carinatina*? sp., and *Atrypa* spp.; and the trilobites *Weberopeltis* sp. and *Dechenella*? spp. Dutro suggested a late Early or early Middle Devonian age for this collection.

The paleontological specimens reported here and previously by the senior author were collected during late July 1996. This additional fossil material allowed for a more detailed taxonomic assessment of the Emsian fauna of Shellabarger Pass. Both Blodgett and Brease (1997) and Blodgett (1998) pointed out the very strong similarities of these collections with collections from Siberia and the Urals, rather than with the North American Cordillera. Blodgett (1998) noted the brachiopods from this exposure included atrypid brachiopods, and the genera *Ivdelinia* and *Janius*, all which were more Uralian in character, rather than Cordilleran. The *Ivdelinia* was noted to be quite distinct from the several North American occurrences, and more closely related to species from the Ural Mountains.

Blodgett and Boucot (1999) described and illustrated two eospiriferinid brachiopod species from the Emsian limestone unit: *Myriospirifer* n. sp. aff. *Myriospifer myriofila* Havlíček (later established as the new species, *Myriospirifer breasei* Garcia-Alcalde and Blodgett, 2001), and *Janius* cf. *J. vetulus* (Eichwald). Both species were noted to indicate a very strong faunal alliance with northeastern Eurasia, suggesting an earlier rift origin from that region. Other notably Eurasian brachiopods were also discussed (but not illustrated), including an unnamed species of the gypidulinid genus *Ivdelinia*. Another distinctive brachiopod discussed was *Sibirhynchia alata* (Khodalevich), a species known from the Emsian of the Urals and lower Emsian (*Sibirirhynchia alata*, *Yanetechia limata* Zone) of Northeast Russian (Baranov, 1988; Al'khovik and Baranov, 2001).

Garcia-Alcalde and Blodgett (2001) formally described and illustrated *Myriospirifer breasei* as a new species from the Emsian limestone, replacing the previously reported *Myriospirifer* n. sp. aff. *Myriospirifer myriofila* Havlíček of Blodgett and Boucot (1999). This species was named in honor of Phil F. Brease, former U.S. National Park Service geologist, who assisted Blodgett during late July 1996 in the collection of the Emsian brachiopod fauna of Shellabarger Pass.

Blodgett et al. (2002a, fig. 8) reillustrated two eospiriferind brachiopod species from this locality: *Myriospirifer breasei* Garcia-Alcalde and Blodgett, 2001 and *Janius* cf. *J. vetulus* Eichwald). As noted earlier, it was remarked that both taxa were much more common at numerous Emsian localities in Siberia (Kolyma and Kuznetsk Basin), the Urals and Novaya Zemlya, and part of Central Asia of the former Soviet Union. In the same paper (Fig. 7 therein) was illustrated an unnamed species of the gypidulinid genus *Ivdelinia*. Also of note is the occurrence of the rhynchonellid brachiopod *Sibirirhynchia alata* (Khodalevich) in the Shellabarger collections, which is known from Emsian-Eifelian strata of the Urals and Kolyma. Other brachiopod taxa noted in Blodgett et al. (2002a) include *Opsicondion*, *Teichertina*, *Carinagypa* (cited as *Gypidula* therein), a clorindinid (*Clorinda cappsi* n. sp. herein), *Atrypa*, *Spinatrypa*, *Carinatina*, and *Punctatrypa* (*Undatrypa*). Rigby et al. (2009) described the calcareous sponge *Hormospongia labyrinthica* Rigby and Blodgett, 1983 from the Shellabarger Limestone. This species had previously by described by Rigby and Blodgett (1983) from the slightly younger (early Eifelian) Cheeneetnuk Limestone of the McGrath quadrangle, west-central Alaska.

Finally, Blodgett et al. (2021) established a new species of the gypidulinid genus *Carinagypa*, *C. robecki*, from the Shellabarger Limestone. Many additional species of brachiopods (mostly atrypoids) remain to be described from the formation, and we intend to publish them in the future. Description of these remaining undescribed elements of the fauna, along with that of the overlying Late Devonian (Frasnian) exposures in Shellabarger Pass, will establish even better the paleobiogeographic ties of the Devonian faunas of the Mystic sequence of the Farewell terrane, and a more complete understanding of the their faunal succession.

SYSTEMATIC PALEONTOLOGY

Repository: The brachiopod specimens described in this paper are deposited at the Alaska Geologic Materials Center (prefix AKGMC), Anchorage, Alaska.

Order Pentamerida Schuchert and Cooper, 1931
Suborder Pentameridina Schuchert and Cooper, 1931
Superfamily Gypiduloidea Schuchert and LeVene, 1929
Family Gypidulidae Schuchert and LeVene, 1929
Subfamily Ivdeliniinae Sapelnikov, 1973 [=Ivdelininae Sapelnikov, 1973, p. 41, original spelling]
Genus *Ivdelinia* Andronov, 1961
Subgenus *Ivdelinia* (*Ivdelinia*) Andronov, 1961

Type species: *Gypidula ivdelensis* Khodalevich, 1951

Diagnosis: *Ivdelinia* with strongly raised costae or plicae and with median septum. (Blodgett et al. (2002b), also Franci et al. (2012).

Stratigraphic range and geographic occurrence: The subgenus was reported by Blodgett et al. (2002b) to have a stratigraphic range of Lower Devonian (Lochkovian)–Middle Devonian (Eifelian), however its upper age limit was extended into the Late Middle Devonian with the description of a Givetian species *Ivdelinia* (*I.*) *pulchra* from Morocco by Franchi et al. (2012). A large number of species have been described, mostly from the Ural Mountains, but as noted by Biernat (1966) many of these may ultimately be rejected, The subgenus is widespread throughout much of the Old World Realm (Blodgett et al., 2002b), and geographic occurrences are known from Europe (Germany (Sandberger, 1842, 1850-1856; Roemer in Bronn, 1850-1856; Torley, 1934), Belgium, Czech Republic (Barrande, 1879), Poland (Biernat, 1966), Urals (Tscheryschew,1885; Khodalevich, 1951; Andronov, 1961), Kuznetsk Basin (Rzhonsnitskaya, 1960, 1975; Gratsianova, 1998), Northeast Russia (Nikolaev and Rzhonsnitskaya, 1968; Alekseeva et al., 1996), Central Asia (Malygina and Sapelnikov, 1973; Nalivkin, 1930; Sapelnikov and Kartaschova, 2003; Sapelnikov and Mizens 2005), and North Africa (Morocco, Franchi et al., 2012). In addition, this subgenus has limited occurrences in present-day North America: from the accreted Farewell terrane of west-central and south-central Alaska (*Ivdelinia* (*Ivdelinia*) *tweeti* n. sp. (described here) and a single species occurring in North America cratonal rocks of the Canadian Arctic Islands (*I.* (*I.*) *grenellensis* Brice, 1982; also reported by Li and Jones (2002). The subgenus *Ivdelinia* appears to have its origin in the Urals, where it attained its highest diversity in Emsian and Eifelian strata. Lengthy species lists of the subgenus can be found in Andronov (1961), Rzhonsnitskaya (1975), Sapelnikov (1985), and Franchi et al. (2012). No occurrences of this subgenus are known from the Eastern Americas or Malvinokaffric realms.

Discussion: The closely related *subgenus Ivdelinia* (*Ivdelinella*) Brice, 1982 differs from *Ivdelinia* (*Ivdelinia*) in lacking a ventral median septum and in having very low costae (Blodgett et al., 2002b). In addition it is restricted in occurrence to strata of Lower Devonian (Emsian)–Middle Devonian (Eifelian)

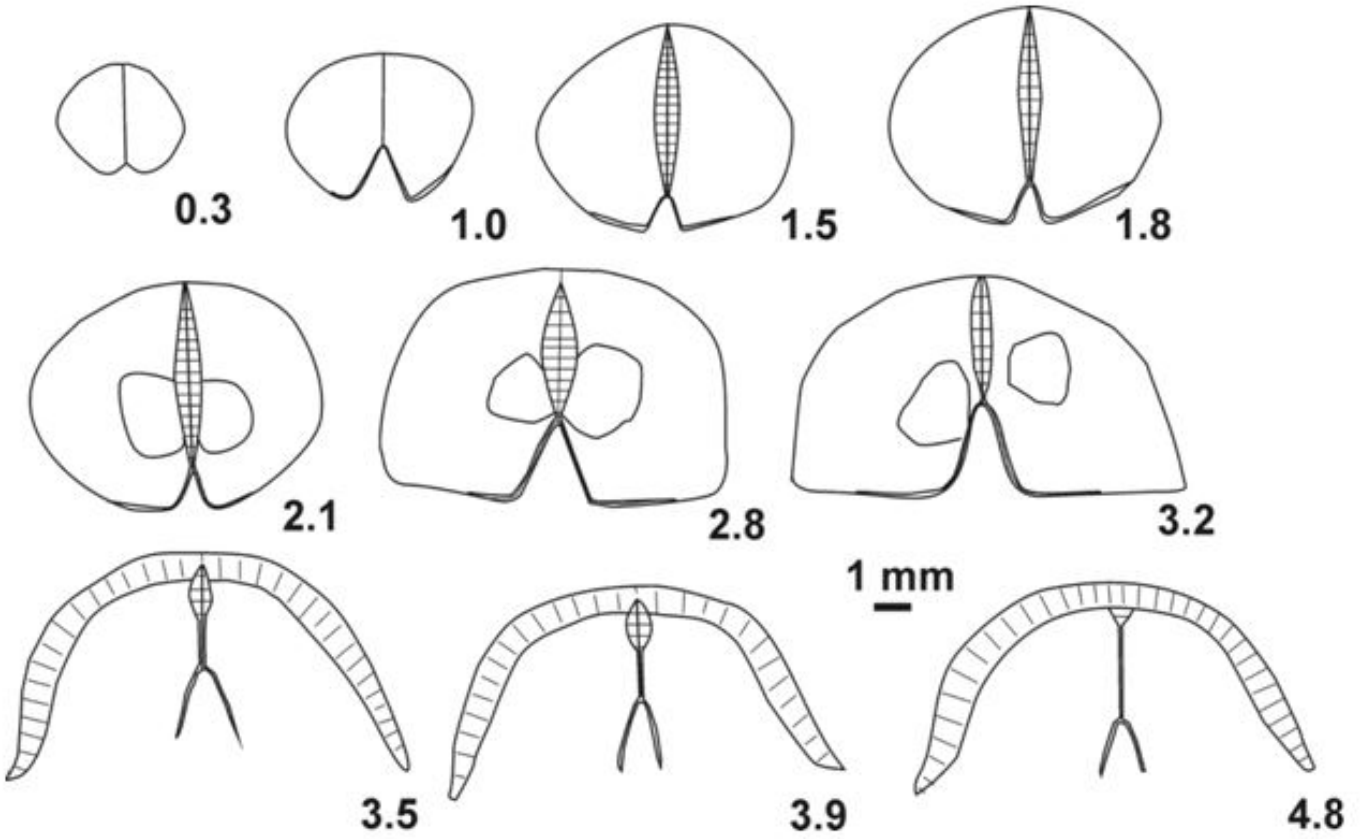


FIGURE 7. Selected transverse serial sections of an isolated ventral valve of *Ivdelinia* (*Ivdelinia*) *tweeti* n. sp. Distances were measured in mm from the ventral umbo; paratype AKGMC-55; late Emsian, Shellabarger Limestone, Shellabarger Pass, Denali National Park and Preserve, Talkeetna C-6 quadrangle, south-central Alaska. Scale bar is 1 mm.

age and known from only North American craton-bound strata of the Canadian Arctic Islands (Blodgett et al., 2002b).

Species: *Ivdelinia* (*Ivdelinia*) *tweeti* n. sp.

Figs. 6-8

Synonmy: 2002 *Ivdelinia* sp. Blodgett, Rohr, and Boucot, 2002a, p. 280, Figs. 7.1-7.5.

Diagnosis: *Ivdelinia* (*Ivdelinia*) with extremely coarse ribbing and smooth umbones.

Description: Medium to large size, galeatiform shells, with low, flattened rounded, coarse costae which bifurcate anteriorly, with ventral medium septum and distinct ventral fold. Ventribiconvex, ventral valve much thicker than dorsal valve. Umbones smooth. Ventral fold clearly expressed, with up to four costae which develop in the smooth umbonal area and gradually widen anteriorly, lateral costae much fainter, numbering up to three on each flank. Major costae on fold are weakly bifurcating anteriorly, separated by very shallow furrows. In lateral profile the ventral valve is strongly and evenly arched, with the umbonal portion smooth

The above description of the Shellabarger species is based primarily on the ventral valves, which number 13 in total. No dorsal valves present. An articulated specimen of the Shellabarger species was illustrated in Blodgett et al. (2002a, figs. 7.1-7.5), but that specimen (from the original USGS locality 9589-SD) is no longer available for study.

Comparison: *Ivdelinia* (*Ivdelinia*) *tweeti* n. sp. can be distinguished from the type species of subgenus, *Ivdelina* (*I.*) *ivdelensis* (Khodalevich, 1951) from the Urals by its slightly fewer costae which do reach unto the umbones. Among the numerous *Ivdelinia* species illustrated in the comprehensive monograph of Andronov (1961), the only two that closely approach our new species are *Ivdelinia* (*I.*) *egorovi* Andronov, 1961, p. 51-52, Pl. VI, figs. 10-14 and *Ivdelinia* (*I.*) *ataevia* Andronov, 1961, p. 70-71, Pl. XI, figs. 6-10. From the former species, our new Alaska form differs in being slightly more coarsely ribbed (four vs. five costae on the ventral fold) and in not having its ribs extend as far posteriorly onto the ventral umbo. From the latter species, our new species differs in being slightly more coarsely ribbed, and with smoother lateral slopes with very faint costae.

Material: 13 ventral valves. No dorsal valves or articulated specimens present. This new species is recognized only in only single collection gathered at 5.03-5.18 m (16.5-17.0 feet) above the base of a measured section of the Shellabarger Limestone, in Shellabarger Pass, Denali National Park & Preserve. A complete articulated specimen of the Shellabarger species was illustrated in Blodgett et al., 2002a, but that specimen was in an old USGS collection (USGS locality 9589-SD) and is no longer available.

Occurrence: This new species is known only from late Emsian strata of the Shellabarger Limestone, a new formation, established here in Shellabarger Pass, Talkeetna C-6 1:63,360 scale quadrangle, south-central Alaska.

Etymology: The species name is in honor of Justin S. Tweet, paleontologist dedicated to the documentation, preservation, and study of National Park Service fossils.

Measurements: The illustrated ventral valve, AKGMC-54 (the holotype and largest specimen in the collection), has a length of 23.3 mm, a width of 22.3 mm, and a height of approximately 12.0 mm.

Types: Holotype, AKGMC-54 and Paratype, AKGMC-55, both from 16.5-17.0 feet (5.03-5.18 m) above the base of the measured section of the Shellabarger Limestone, Shellabarger

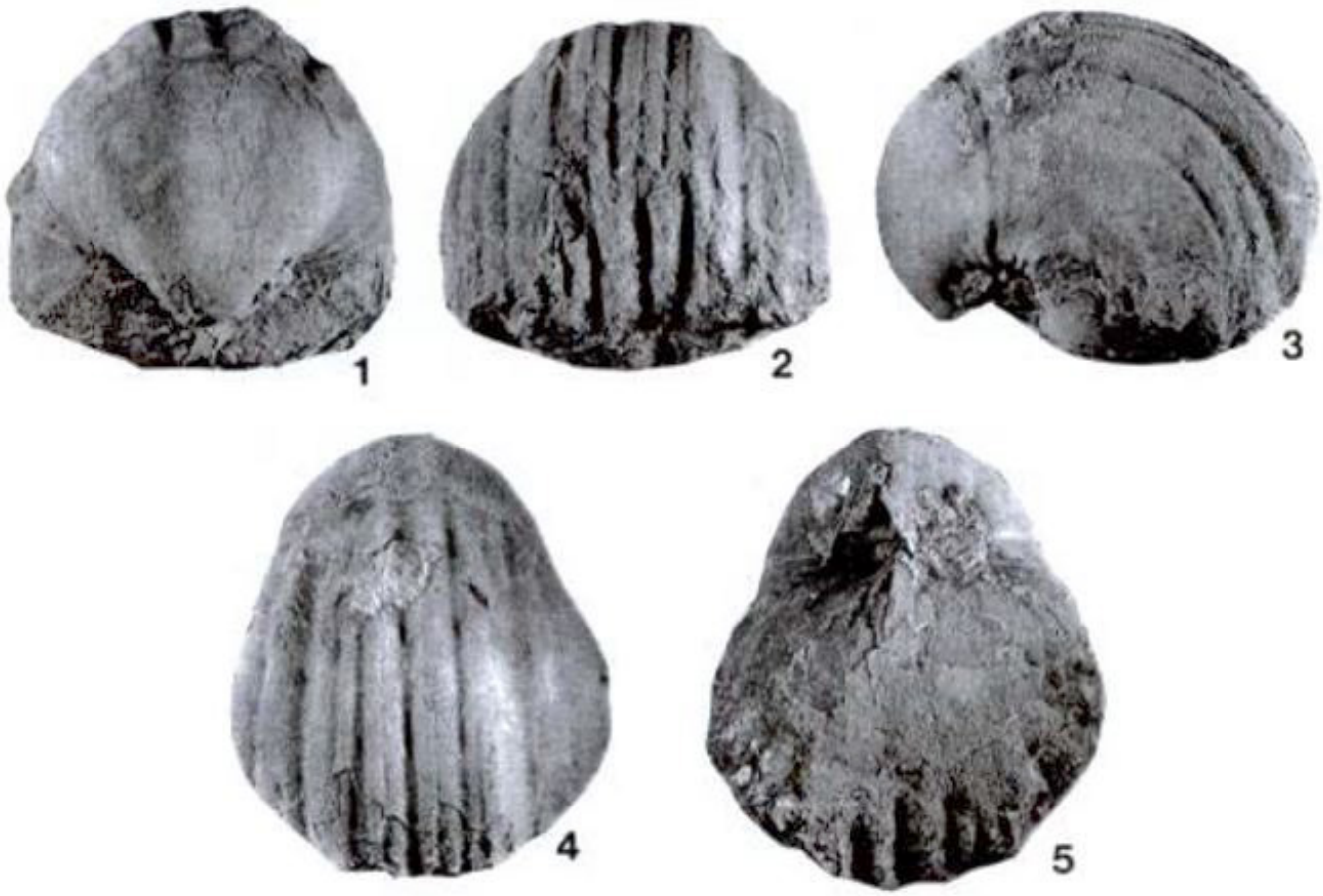


FIGURE 8. *Ivdelinia* (*Ivdelinia*) *tweeti* n. sp. 1-5. Posterior, anterior, lateral, ventral, and dorsal views of an articulated specimen from float in the Shellabarger Limestone. (from Blodgett and Boucot, 1999, and Blodgett et al., 2002a). This articulated specimen, the only one known, was illustrated in Blodgett et al. (2002a, figs. 7.1-7.5), but that specimen (from the original USGS locality 9589-SD) is no longer available for study. Hence, no specimen number is assigned.

Pass, Denali Pass, Denali Park & Preserve, Talkeetna C-6 quadrangle, south-central Alaska.

Superfamily Clorindoidea Rzhonsnitskaya, 1956
Family Clorindidae Rzhonsnitskaya, 1956
Subfamily Clorindinae Rzhonsnitskaya, 1956
Genus *Clorinda* Barrande, 1879
Type species: *Clorinda armata* Barrande, 1879.

Species *Clorinda cappsi* n. sp.
Fig. 9

Diagnosis: Specimens of *Clorinda* with a relatively wide shell and very low, relatively narrow, weakly defined ventral sulcus and dorsal fold.

Description: Small, totally smooth galeatiform shells, with a relatively wide shell and very low, relatively narrow, weakly defined ventral sulcus and dorsal fold. Ventral valve slightly more than twice as thick as dorsal valve.

Comparison: The genus was reported by Blodgett et al. (2002c) to have a stratigraphic range of Silurian (Rhuddanian)-Middle Devonian (Givetian) and to be widespread in Europe, Asia, North America, Greenland, Australia, and North Africa. *Clorinda cappsi* n. sp. differs from the type species, *Clorinda armata* Barrande, 1879, from the Hlubocepy Limestone (Emsian) of the Barrandian region of the Czech Republic in being less transverse and having much shallower ventral sulcus and dorsal fold. In addition, the dorsal fold is clearly much wider and the ventral sinus is clearly visible in earliest growth stage of the latter species, while in the former species is not evident until later growth stages. *Clorinda cappsi* n. sp. differs from *Clorinda garretti* Perry, 1984 from the late Lochkovian to early Pragian of the Delorme Formation in having a much more gently and evenly rounded dorsal fold and sulcus; the dorsal fold in the Delorme Fm. species is strongly and acutely angular (see Perry, 1984, Pl. 14, figs. 15-27). The latter species is the only described species of the genus from the Lower Devonian of North America. Otherwise the genus *Clorinda* is relatively commonly reported from the Devonian of Europe, Asia and even North Africa (Drot, 1969). The new species differs from *Clorinda asiatica* Rzhonsnitskaya, 1975 from late Pragian Malobachatskii horizon of the Kuznetsk Basin in having a much less developed, even very weak dorsal fold and ventral sulcus. It can be differentiated from *Clorinda carnica* (Gortani, 1915) of the Carnic Alps, Gornyi Altai, and Kuznetsk Basin (see also Rzhonsnitkaya, 1975) in having a more evenly rounded shell outline and lower fold and sulcus. It is distinguished from *Clorinda pseudolinguifera* Kozlowski, 1929, from Silurian-Devonian boundary beds of the Ukraine in having a less well developed and shallower ventral sulcus in fully adult-sized shells. A number of Silurian species have been assigned to *Clorinda* and lists of such can be found in Sapelnikov (1985) and Jin et al. (1993). It is distinguished from *Clorinda tumidula* (Billings, 1866) from the Early Silurian age (Llandovery) Gun River Formation of Anticosti Island, Quebec, Canada, in being less transverse and in having a shallower sulcus (compare with specimen shown in Schuchert and Cooper, 1932, Pl. 26, figs. 8-12, 21). Other commonly cited Silurian species include *Clorinda parvolinguifera* Sapelnikov, 1972, *Clorinda*

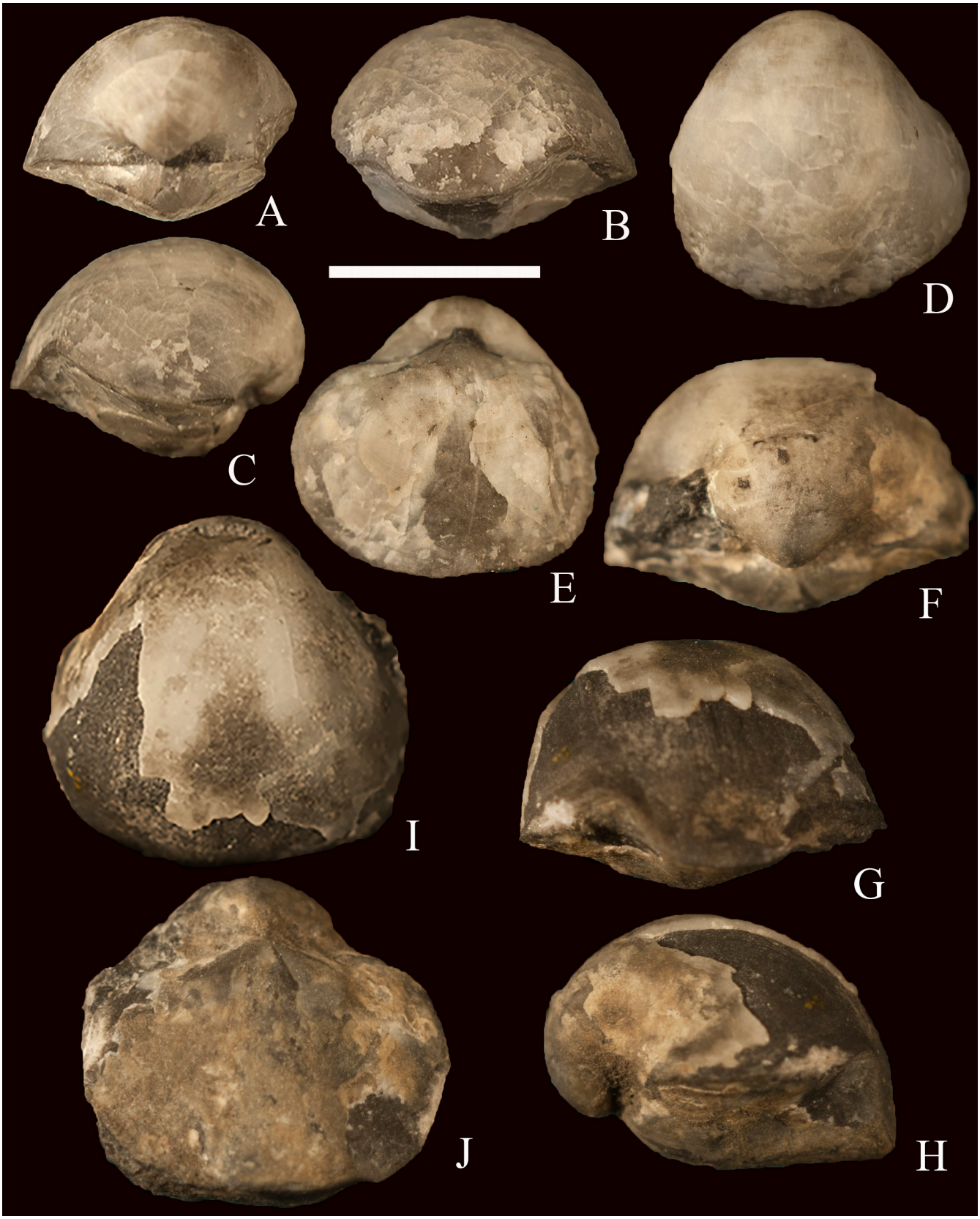


FIGURE 9. **A-J**, *Clorinda cappsi* n. sp.; **A-E**, Holotype (AKGMC-56), articulated shell, posterior, anterior, lateral, ventral, and dorsal views of holotype (nearly complete articulated specimen). Specimen collected 50-51 feet (15.24-15.54 m) above the base of the measured type section of the Shellabarger Limestone, Shellabarger Pass, Denali National Park & Preserve and Preserve, Talkeetna C-6 quadrangle, south-central Alaska; **F-J**, Paratype (AKGMC-57), articulated shell, posterior, anterior, lateral, ventral, and dorsal views of paratype (complete shell). Specimen collected at 45-46 feet (13.72-14.02 m) above base of the type section. Scale bar = 10 mm (applied to all views).

rotunda (Lindström, 1861), *Clorinda mesoplicata* (Parks, 1917), and *Clorinda superundata* Jin and Copper, 2000, but these are all quite dissimilar to our new species.

Occurrence: This distinctive new species is relatively rare in the measured section, consisting of only a few specimens found at 50-51 feet (15.24-15.54 m) above the base of the measured section, as well as a few others lower in the section at 45-46 feet (13.72-14.02 m)..

Measurements: The holotype specimen, AKGMC-56, has the following measurements: length of ventral valve, 14.6 mm; length of dorsal valve, 11.2 mm; width of shell, approx. 15.6 mm (shell incompletely preserved); height of ventral valve, 8.0 mm; height of dorsal valve, 3.0 mm.

Etymology: The species name is in honor of Denny Capps, Park Geologist, Denali National Park & Preserve, Denali Park, Alaska, for his unceasing support of our paleontological studies within the park.

Types: Holotype (nearly complete shell), AKGMC-56 from 50-51 feet (15.24-15.54 m), nearly complete shell above base of measured section of an unnamed limestone unit, Shellabarger Pass, Denali National Park & Preserve, Talkeetna C-6 quadrangle, south-central Alaska. In addition, there is a single paratype (a complete shell), AAKGMC-57 from 45-46 feet (13.72-14.02 m) above base of the type section.

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