

Upper Silurian Brachiopods from Southeastern Alaska

GEOLOGICAL SURVEY PROFESSIONAL PAPER 233-C



Erratum

Plate 8, title. Delete Carchidium.

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By EDWIN KIRK *and* THOMAS W. AMSDEN

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*Descriptions and illustrations of a fauna
from the Islands of Kosciusko and Heceta*



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UPPER SILURIAN BRACHIOPODS FROM SOUTHEASTERN ALASKA

By EDWIN KIRK AND THOMAS W. AMSDEN

ABSTRACT

The present paper adds to the yet meager knowledge of the Upper Silurian brachiopod fauna of Alaska.

Of the 21 species of Upper Silurian brachiopods herein considered, 6 are new, 6 were described in earlier publications by Kirk, 3 are referred to species of Barrande, Hortedahl, and Linnaeus, and 6 are neither referable to known species nor sufficiently well understood to be described as new. One new genus, *Alaskospira*, is described.

Although much remains to be done with the fauna in question, it is considered desirable to make the present information available and to call attention to resemblances between this fauna and one from the Upper Silurian of the eastern Urals.

INTRODUCTION

The Silurian fossils herein described were, for the most part, collected by Kirk in 1917 on Kosciusko and Heceta Islands, off the west coast of Prince of Wales Island about 100 miles north of the Alaska-British Columbia line. In earlier papers by Kirk (1922, 1925, 1926), the brachiopod genera *Brooksina*, *Harpidium*, and *Cymbidium* were first described. The present report supplements these earlier works by making known additional elements of the important upper Silurian brachiopod fauna of Alaska. Although it still leaves much of the fauna undescribed, it is considered desirable, because of current interest in the Silurian stratigraphy of Alaska, to make generally available¹ at one source, descriptions of some of the commoner and more important species and genera.

Very little has been published about the stratigraphy of Kosciusko and Heceta islands, or of the general region in which they are situated. A report by Buddington and Chapin on the Geology and Mineral Resources of Southeastern Alaska (1922) contains a brief description of the Silurian stratigraphy of this area, but their work was, of necessity, largely reconnaissance and does not give much information about the faunal sequence. For this reason, and because the fauna is not known elsewhere in North America, the exact stratigraphic position of the beds that yielded present collections is uncertain. It is hoped that further stratigraphic and paleontologic work will reveal the proper relationship of these strata to beds bearing known North American faunal assemblages, so the fauna described can be fitted into the general faunal sequence.

¹ Khodalovich (1939) has published, in Russian but with a good English summary, descriptions of a very similar fauna from the eastern slope of the Urals, but copies of this publication are not generally available in North America.

In addition to the 6 species described earlier by Kirk, 15 are treated in the present paper. These 15 species, of which 6 are new, are referred to 12 genera, of which one is new. The known geographic distribution of the 21 species is tabulated below.

U. S. Geological Survey locality numbers

	1005	987	984	1019	1589	983	2689
<i>Brooksina alaskensis</i> Kirk	×	×					
<i>Harpidium insignis</i> Kirk	×	×					
<i>rotundus</i> Kirk		×					
<i>latus</i> Kirk	×						
<i>Cymbidium acutum</i> Kirk			×				
<i>retorsum</i> Kirk	×						
<i>Conchidium alaskense</i> Kirk and Amsden n. sp.						×	
<i>Atrypella scheii</i> (Hortedahl)?				×	×		×
<i>tenuis</i> Kirk and Amsden n. sp.	×						
<i>borealis</i> Kirk and Amsden n. sp.	×						
<i>Alaskospira dunbari</i> Kirk and Amsden n. gen., n. sp.	×						
<i>Delthyris?</i> sp.	×						
<i>Atrypa</i> cf. <i>A. reticularis</i> (Linn.)	×						×
<i>Nucleospira hecetenis</i> Kirk and Amsden n. sp.							×
<i>Camarotoechia reesidei</i> Kirk and Amsden n. sp.							×
sp.							×
<i>Isorthis</i> sp.							×
<i>Gypidula?</i> sp.							×
<i>Eospirifer</i> sp.							×
<i>Hovelletta</i> sp.							×
<i>Cymostrophia</i> cf. <i>C. costulata</i> (Barrande)							×

Localities in southeastern Alaska from which collections were obtained

Locality 1005. Vermont marble prospect, south shore of Kosciusko Island, between Edna Bay and Holbrook; Kirk 1917.

Locality 987. "Marble Bay." north shore of Heceta Island; Kirk 1917. (Probably the same stratigraphic zone as locality 1005).

Locality 984. South shore of Kosciusko Island, between Edna Bay and Holbrook; Kirk 1917. This is near locality 1005, but from a stratigraphically higher zone.

Locality 1019. Limestone overlying tillite; "Blue Bluff", east end of Heceta Island, north of high cliffs; Kirk 1917.

Locality 1589. East end of Heceta Island; Girty and Waters, 1917.

Locality 983. Limestone above tillite; west shore of "Marble Cove," north shore of Heceta Island; Kirk 1917.

Locality 2689. Northeast end of Heceta Island, northern tip of a small peninsula just across the channel from Tuxekan Island; Eberlein 1947.

As shown in the table, most of the species came from localities 1005 and 2689. These species are represented in collection 987 and only one from each of the others. Only *Brooksina alaskensis* Kirk, *Harpidium insignis* Kirk, *Atrypella scheii* (Hortedahl)? and *Atrypa* cf. *A. reticularis* (Linnaeus) are present in collections from two or more localities. As the stratigraphic relationships of the localities are uncertain, and as little is known about the geology of these islands, it seems best to consider the ages and possible correlations of the various localities separately, rather than to consider the fauna as a whole.

One of the largest and best-preserved faunas comes from locality 1005, on the south shore of Kosciusko Island, which has yielded 9 species, 4 belonging to the pentameroid genera *Brooksina*, *Harpidium* and *Cymbidium*. Locality 987 probably represents a similar zone on Heceta Island. In earlier papers (Kirk, 1922, 1925, 1926) it was concluded that these genera were probably to be referred to the upper Silurian. As was pointed out, however, these brachiopods do not appear to have any close relationship with those known from North America² but seem to have their closest affinities with the upper Silurian faunas of Asia.

The additional brachiopods described in the present work from locality 1005 seem further to substantiate these conclusions. The genus *Atrypella* is not common in North America; Cooper has described *A. shrocki* from the Niagaran of Indiana but this species is quite distinct from *A. tenuis*, *A. borealis*, and *A. scheii* (Holtedahl)? from localities 1019, 1589, and 2689. *Alaskospira dunbari* represents a new genus and species which is known only from locality 1005 on Kosciusko. The only other forms which we record from this locality are *Atrypa* cf. *A. reticularis* (Linnaeus) and *Delthyris*? sp., but these as herein identified can have little diagnostic value.

The genus *Conchidium* is well represented in other North American Silurian faunas, but our species, *C. alaskense* from locality 983 most closely resembles *C. knighti* (Sowerby) from the Aymestry limestone (Ludlovian) of England. It is also somewhat similar to the large *C. vogulicum* (Verneuil; see Tschernyschew 1893, pl. 11, figs. 1a-1d) from the lower Devonian(?) of the Urals.

The fauna of locality 2689 at the northeast end of Heceta Island consists of the following:

- Atrypella scheii* (Holtedahl)?
- Atrypa* cf. *A. reticularis* (Linnaeus)
- Nucleospira hecetensis* n. sp.
- Camarotoechia reesidei* n. sp.
- Camarotoechia* sp.
- Isorthis* sp.
- Gypidula*? sp.
- Eospirifer* sp.
- Howellella* sp.
- Cymostrophia* cf. *C. costulata* (Barrande)

It is rather difficult to compare this fauna with others because the poor preservation makes accurate specific identification impossible in most cases. The species of *Atrypella* herein described is probably conspecific with Holtedahl's species from Ellesmereland and similar *Atrypellas* have been recorded from Asiatic faunas. The *Cymostrophia* from Heceta is much like *C. costulata* (Barrande) from Bohemia, but *Nucleospira hecetensis*, and *Camarotoechia reesidei* are both new species and hence of little value in age determination. The rest of the fauna has not been identified as to species. It is

² Excluding Greenland and Ellesmereland which are discussed separately; these three genera have not been recorded from other areas on this continent with the possible exception of *Brooksina* which G. A. Cooper (1944, p. 305) reported from western Tennessee.

not possible to draw definite conclusions concerning the age of such a poorly known fauna, but the presence of *Atrypella scheii*? suggests that the affinities were closer to late Silurian faunas of Arctic and Asiatic areas than to North American faunas.

In 1914 Holtedahl described a fauna from southwestern Ellesmereland to which he assigned a Ludlovian age. The brachiopods in this assemblage appear to have some similarities with those from southeastern Alaska. Holtedahl's species *Atrypella scheii* is very probably the one present in collections from localities 1019, 1589, and 2689; he also described a new species of *Conchidium* (*C. arcticum*), but this is considerably smaller and more finely ribbed than *C. alaskense* from locality 983. *Cymostrophia patersoni* var. *antiqua* (Holtedahl) is similar to the *Cymostrophia* from locality 2689, although the concentric corrugations appear to be better developed on the Ellesmereland species. In addition, Holtedahl recorded *Gypidula coeymanensis* var. *prognostica* Schuchert, *Camarotoechia litchfieldensis* var. *prognostica* (Schuchert); these genera are present in collection 2689, although the species are different. He has also recorded species of several genera that are not present in the collections discussed in the present reports. These are: *Strophonella* cf. *S. euglypha* Hall, *Schuchertella interstriata* var. *sinuata* Holtedahl, *Stenoschisma deckerensis* var. *arctica* (Holtedahl), and *Spirifer modestus* var. *striatissimus* Holtedahl.

Poulsen (1943) has described a fairly large fauna of brachiopods from northern Greenland. These specimens came from the Offley Island formation, which, Poulsen states is "Upper Llandovery (Middle Clinton)" in age. This fauna carries six species of *Harpidium* including *H. insignis* Kirk. He also records *Eospirifer radiatus* (Sowerby), but this is not like the *Eospirifer* shown on plate 10, figure 6, from locality 2689. The remainder of the Offley Island brachiopods do not appear to have much in common with those from southeastern Alaska.

Probably the Alaska upper Silurian brachiopod fauna most closely resembles one described by Khodalevich (1939) from the eastern slope of the Urals. The strata from which he obtained his specimens was assigned to the Upper Wenlock and Lower Ludlovian on the basis of a faunal study which embraced not only brachiopods, but also corals, gastropods, pelecypods and cephalopods (1939, p. 112). The generic suite seems to be similar to that of the present report, and there are also some specific similarities.

Some features of Khodalevich's paper warrant special notice. He described a large number of pentameroid brachiopods, referring most of them to the genus *Conchidium* and one of them, *C. vogulicum* var. *krutolowskiensis* Kodalevich, is somewhat like our species *C. alaskense* from locality 983. He also recognized three species of *Brooksina*, *B. conjugula* Khodalevich, *B. striata* (Eichwald), *B. (?) crassa* Khodalevich. The

form described as *Pentamerus magnus* Khodalevich is possibly a species of *Harpidium*. Illustrations of the species he referred to the genus *Lissatrypa* strongly suggest the genus *Atrypella*. *Lissatrypa penitus* Khodalevich and *L. penitus* var. *elongata* Khodalevich are similar in their external features to *Atrypella schevi* (Holtedahl) and were compared by Khodalevich with Holtedahl's species. Khodalevich illustrates several species of *Eospirifer* of which *E. irbitensis* (Tschernyshew) has some resemblance to the one which we illustrate on plate 10, figure 6. The species identified by Khodalevich as *Cymostrophia costulata* (Barrande) has an outline and ornamentation suggesting the *Cymostrophia* figured on plate 10, figure 12, of the present report. Another possible point of similarity between the Alaskan fauna and that of the Urals is the presence of a species described by Khodalevich as *Spirifer* (*Martinia*?) *pseudopentameriformis* and which may be a representative of the genus herein described as *Alaskospira*.

Thus there appears to be some basis for considering the brachiopods from the eastern slope of the Ural Mountains closely contemporaneous with those from southeastern Alaska. A comparison of the other faunal elements may help further to substantiate this correlation.

In summary, this Alaskan brachiopod fauna does not appear to have any close relationship with other known North American faunas. Its closest affinities seem to be with the upper Silurian faunas of Asia and of Europe. Until the Asiatic faunas have been described in greater detail, and until the faunal sequences in Asia and Alaska have been more fully studied, it will not be possible to establish detailed correlations.

SYSTEMATIC DESCRIPTIONS

SUPERFAMILY DALMANELLACEA

Genus *Isorthis* Kozłowski, 1929

Isorthis sp.

There is a specimen of a punctate, subequally biconvex shell with moderately fine costellae which is provisionally placed in the genus *Isorthis*. The interior of the pedicle valve shows dental lamellae, but none of the other characters can be determined.

A single specimen from locality 2689, northeast corner of Heceta Island, southeastern Alaska.

SUPERFAMILY STROPHOMENACEA

Genus *Cymostrophia* Caster, 1939

Cymostrophia cf. *C. costulata* (Barrande)

Plate 10, figures 12-13

Strophomena costulata Barrande (1879, pl. 48, figs. 3, 1-13).

We have two incomplete specimens that are similar to *C. costulata* (Barrande) from Etage E in Bohemia.

The brachial valve of our specimens is moderately concave and the pedicle valve is moderately convex. About half of the denticulate cardinal margin is preserved on the most complete specimen. The costellae are in groups of two or three smaller ones alternating with a single, heavier rib. The large ribs are not uniform through their length, but are alternately pinched and swollen, extending forward a few millimeters as strong ribs and then becoming faint for a short distance before enlarging again (pl. 10, fig. 13). In addition, the surface shows faint, irregular, concentric corrugations, although these are not as well developed as in other species of this genus.

Two specimens from locality 2689, northeast end of Heceta Island, southeastern Alaska, U.S.N.M. 116554, 116555.

SUPERFAMILY PENTAMERACEA

Genus *Conchidium* Oehlert

Conchidium alaskense Kirk and Amsden, n. sp.

Plate 8, figures 23-29; plate 9, figures 1-7; plate 10, figures 1, 5, 10, 11, 14

The lateral profile of shells belonging to this species is highly varied, although they are invariably strongly biconvex at maturity. Very young specimens have a pedicle beak which is small, suberect and only slightly hooked over the brachial valve. As the shell increases in size, the beak becomes more prominent and tends to be curved in a brachial direction, but its profile differs considerably between individuals. On some specimens it is sharply curved over the other valve as shown on plate 8, figure 24 (on no specimens does it come in actual contact with the brachial valve); on other shells it is more erect, being only slightly inclined in a brachial direction (pl. 9, fig. 4). Within the collections are specimens showing all gradations between these two types.

The outline of these shells is also varied, but in all specimens the maximum width is attained near the anterior end, making the shell somewhat subtriangular. The differences in outline are due primarily to variations in the ratio of width to length; this ratio ranges from a specimen in which the length is about equal to the width (86 mm. long, 81 mm. wide) to one in which the length greatly exceeds the width (82 mm. long, 55 mm. wide).

Many of the specimens show a definite asymmetrical growth, and are longer on one side of the median plane. These growth irregularities reach maximum development in shells such as that shown in plate 8, figures 26 and 28, where the shell is twisted throughout its length. Such irregularities may be due to the fact that these animals lived in great abundance upon the sea floor and were crowded upon one another during growth.

³ The status of the generic name *Conchidium* is uncertain (St. Joseph 1937, pp. 258-265; Alexander 1948, pp. 145). Alexander (1951, pp. 89-94) has recently submitted a proposal to the International Commission on Zoological Nomenclature to have *Conchidium* Oehlert 1887 added to the *Official List of Generic Names in Zoology*.

Both valves bear coarse costae which become obsolete and disappear toward the lateral margins. The costae are subangular and separated by V-shaped interspaces. The anterior margin of a specimen of average size bears 9 to 14 costae in a space of 40 mm. The shell shown on plate 8, figure 27, has unusually coarse ribs, with 7 in 40 mm.; the largest specimen in the collection (pl. 10, figs. 1, 5, 10) also bears 7 costae in 40 mm.

The collections under study include a large number of specimens, representing almost all growth stages from less than 20 mm. in length to about 120 mm. in length. This series shows that growth took place in the following manner: Commonly the youngest individuals are subtriangular in outline (pl. 8, fig. 23) and weakly biconvex, with the pedicle valve only slightly deeper than the brachial. As the shell increased in size the pedicle valve increased in depth more rapidly than the brachial. This resulted primarily from accelerated growth of the lateral margins, in a zone extending roughly from the delthyrium to the anterior edge. The material deposited in this zone is not costate, but shows only faint growth lines parallel to the lateral edge. By the time the animal was fairly well grown it was strongly biconvex, with the pedicle valve about twice as deep as the brachial. The following measurements are taken from a suite of individuals selected to show different growth stages. Such a selected group does not, of course, show all of the variations present in the species.

Dimensions in millimeters

Length	Width	Thickness
19	22	12
26	30	16
34	36	20
44	49	38
60	63	50
72	57	65
81	82	68
78	66	70
122	116	88

The internal structures of *Conchidium alaskense* agree with the generic diagnosis given by Schuchert and Cooper (1932, p. 181). The pedicle interior possesses a spondylium duplex which is extremely long, narrow and deep. As shown in figure 7 of plate 9 this structure is much extended in an antero-dorsal direction, coming to within a few millimeters of the floor of the brachial valve; this spondylium is supported by a high median septum for about two-thirds of its length. In this respect our specimens differ from the generic diagnosis given by Alexander (1948, p. 149) "spondylium fully supported on a high duplex septum."

The septal plates in the brachial valve are clearly divisible into three parts: the inner and outer plates separated by a flexure and slight thickening (pl. 9, fig. 7). This thickened portion extends beyond the outer and inner plates as brachial supports.

Conchidium alaskense is most similar to *C. knighti* from the Aymestry limestone of England (Sowerby 1813, pp. 73-74, pl. 28, top figure; the type of this species has been redescribed by Alexander 1948, pp. 150-153, pl. 7, fig. 1-3). Both species have a large shell, the Alaskan specimens reaching a length of 122 mm. and those from England as much as 173 mm. Also, both have rather coarse ribbing, although that of *C. knighti* may be a little the finer.

There are some differences between *C. knighti* and the specimens under consideration, however, which clearly warrant establishing the new species *C. alaskense*. Internally, the spondylium of *C. knighti* is fully supported by the median septum as is brought out in Alexander's description and illustration and also in Davidson's illustrations of this species (Hall and Clarke 1894, pl. 64, figs. 14-16, reproduced three of Davidson's illustrations of *C. knighti* from the Aymestry limestone). Several specimens of *C. alaskense* show the interiors clearly and in none of these does the median septum extend to the end of the spondylium. The anterior end of the spondylium hangs free as shown in figure 7 of plate 10.

There are also external differences between *C. alaskense* and *C. knighti*. Commonly, the pedicle valve of *C. alaskense* is curved over the brachial valve, but apparently not as strongly so as in Sowerby's species. According to Alexander there is a strong incurving of the pedicle umbo in *C. knighti*, which in gerontic individuals leads to an inrolling of the pedicle beak until it is so tightly pressed against the opposite valve that the shell cannot be opened. None of the specimens of *C. alaskense* show the pedicle beak in conjunction with the brachial. *C. knighti* appears to have a more rounded shell outline with the maximum width attained some distance back from the anterior margin. Although the shape of *C. alaskense* varies greatly, the maximum width is commonly attained near the anterior end, thus producing a subtriangular shape.

Conchidium alaskense resembles *C. vogulicum* (Verneuil; Tschernyschew, 1893, p. 182, pl. 11, figs. 1a-1d) from the Lower Devonian (?) of the Urals. *C. vogulicum* has a very large shell, even larger than that of *C. alaskense* or *C. knighti*, but it does not have the triangular outline of our species and its ribbing is much finer. Also, Tschernyschew's illustrations show the spondylium completely supported by the median septum.

C. vogulicum var. *krutolowskiensis* (Khodalevitch 1939, p. 27, pl. 12, figs. 1-2) from the upper Silurian of the Urals has a more elongate shell with much finer ribbing than does *C. alaskense*.

Conrad's species *C. laqueatum* from the Niagaran of Indiana (Hall and Clarke 1894, pl. 65, figs. 3-9) has a more elongate shell and the median septum is better developed, extending almost to the anterior end of the pedicle valve.

Holtedahl's species *C. arcticum* (1914, p. 5, pl. 6, figs. 5-7) was based upon very fragmentary remains. Judging from Holtedahl's description and illustrations this species has a smaller shell with much finer ribbing, the ribbing being more like that of *C. vogulicum* var. *krutowskiensis* than of *C. alaskense*.

This species is a common one at locality 983, north shore of Heceta Island, southeastern Alaska.

Holotype, locality 983; U.S.N.M. 116567; paratypes, U.S.N.M. 116556-116566, 116568.

Genus *Gypidula* Hall, 1867

Gypidula? sp.

Fragments of two pedicle valves are tentatively identified as *Gypidula*. They are from locality 2689, northeastern corner of Heceta Island, southeastern Alaska.

SUPERFAMILY RHYNCHONELLACEA

Camarotoechia Hall and Clarke, 1894

Camarotoechia reesei Kirk and Amsden, n. sp.

Plate 8, figures 1-7; text figure 2

This species has a small biconvex shell with the brachial valve more convex. The pedicle beak is small, pointed, and generally erect, although it may be slightly hooked over the brachial. There is a sulcus on the pedicle valve which begins a short distance in front of the beak and becomes deep at the anterior end. This sulcus bears a conspicuous costella in the center; near the anterior end some individuals develop a low, indistinct costella on each side of the central one. The brachial valve bears a fold which begins near the posterior end and which becomes strongly developed at the anterior

end. Generally this fold has two well-developed costellae, but in a few individuals this central pair may be flanked on each side by another low indistinct rib. One specimen in the collection has 3 ribs on the fold and 2 in the sulcus. The lateral slopes of the fold and of the sulcus each bear 4 or 5 costellae; those next to the fold and sulcus are moderately high, but become progressively fainter toward the lateral margins.

The length of an average specimen is about equal to its width, measuring 9 mm. wide, 9 mm. long, and 5.5 mm. thick; one specimen in the collection is slightly wider than long with a measurement of 10 mm. wide, 8.5 mm. long, and 6 mm. thick.

Serial sections have been prepared to show the internal characters of this species (text fig. 2). These show that the pedicle valve has distinct dental plates, although these extend forward for only a short distance. In the brachial valve is a median septum which supports the divided hinge plate; a small portion of the upper side of this cruralium is covered by a plate, as shown in section G of text figure 2. Cooper (1944, p. 311) mentions a similar structure in his discussion of the genus *Camartoechia*. In *C. reesei* this plate extends forward a short distance uniting the proximal ends of the two crura; the crura are fairly long and strongly arched.

In its size and shape this species resembles *C. litchfieldensis* and *C. litchfieldensis* var. *marylandica* (Schuchert 1903, p. 167; Swartz 1923, pp. 441-443, pl. 22, figs. 1-13), but both of these have narrower, more sharply angular costellae. Their internal characters have not been described. *Camartoechia litchfieldensis angustata* Holtedahl (1914, p. 22, pl. 8, fig. 1) is larger and more elongate. *C. reesei* is most similar to the

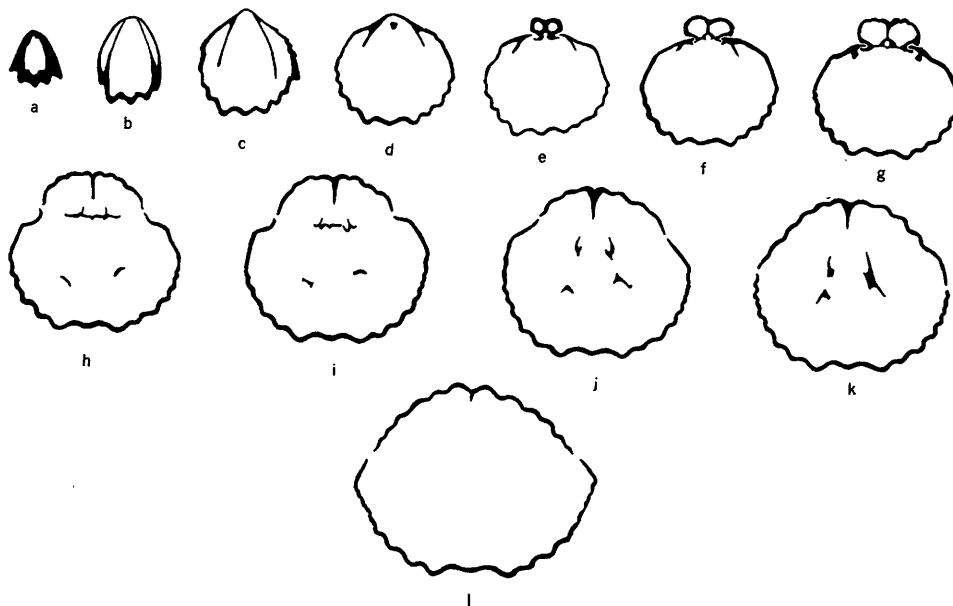


FIGURE 2.—Serial sections of *Camartoechia reesei* Kirk and Amsden n. sp. Brachial valve above, $\times 4$. Peels at U. S. National Museum; U.S.N.M. 116603 a-1. Locality 2689, northeast end Heceta Island. Total length of specimen 8.9 mm. Distance in millimeters from posterior tip of ventral beak: A, 0.1; B, 0.4; C, 0.8; D, 1.1; E, 1.2; F, 1.5; G, 1.6; H, 1.9; I, 2.0; J, 2.1; K, 2.2; L, 3.0.

Brownsport species *C. shannonensis* (Amsden 1949, pp. 56–57, pl. 6, figs. 8, 9–16, 25), but the latter has 4 ribs on the fold and 3 in the sulcus. Internally, *C. shannonensis* (and also the other Brownsport species referred to *Camarotoechia*) has the cruralium uncovered, whereas *C. reesei* has a plate over this structure.

This species is named for Dr. John B. Reeside, Jr., of the U. S. Geological Survey.

Holotype locality 2689 U.S.N.M. 116569; paratypes U.S.N.M. 116570, 116571.

About 18 specimens of this species were obtained at locality 2689, northeastern end of Heceta Island, southeastern Alaska.

Camarotoechia sp.

Plate 10, figures 2–4

Four poorly preserved specimens of a second species of *Camarotoechia* were collected at locality 2689. These are considerably larger than *C. reesei* and have a more pronounced fold and sulcus. Four low and rounded costellae occupy the sulcus and four or five the fold. The fragmentary condition of these specimens precludes specific identification.

Figured specimen U.S.N.M. 116572.

SUPERFAMILY SPIRIFERACEA

(as here used, includes all of the impunctate spire bearers)

Genus *Atrypella* Kozłowski, 1929

Atrypella scheii (Holtedahl)?

Plate 7, figures 12–22; text figure 3

Lissatrypa scheii Holtedahl 1914 (pp. 24–26; pl. 7, figs. 9–12)

This species has both valves strongly, and about equally, convex, but in very large individuals the brachial is usually the greater. The mid-line of the pedicle valve is flattened along the anterior half to form a poorly defined sulcus which is produced into a tongue; the development of this sulcus varies, although it is usually conspicuous on mature valves. The anterior portion of the brachial valve is produced into a corresponding fold, that is poorly marked off from the lateral slopes; this fold and sulcus are best shown in the deflection of the anterior commissure (pl. 7, fig. 14). In outline the shell varies slightly, but generally is subrounded with most individuals having the width about equal to the length. A specimen of average size measures about 23 mm. long, 23 mm. wide and 17 mm. thick; one of the smallest in the collection is 11 mm. wide, 12 mm. long and 6 mm. deep; the largest is 27 mm. wide, 26 mm. long and 19 mm. thick.

The shell of several specimens has been calcined to obtain an internal cast. Because the shell wall is rather thick the attempt was not entirely successful, but sufficiently good preparations have been made to show that this species has an interior similar to that of *A. tenuis*. (See pl. 7, figs. 1, 9, 11; text fig. 5). In addition, serial sections have been prepared as shown in text figure 3. The principal difference between the interiors of *A. tenuis* and *A. scheii*? is that the latter does not have as strongly developed brachial septum and pedicle platform (see description of *A. tenuis*).

The spirulum of this species is similar to that of *Atrypa*; it consists of 7 or 8 volutions with their apices dorsally directed (and tilted slightly toward the mid-line). The jugum is also like that of *Atrypa*.

Holtedahl's detailed description and illustrations reveal no specific differences between the Alaskan specimens and those from Ellesmereland but, because shells of this type are rather difficult to identify from the literature and comparison of specimens from the two localities may well show that they represent different species, our identification is only tentative.

In his detailed description of the brachidium, Holtedahl noted that it is similar to that found in *Atrypa reticularis*, but he did not describe other internal features.

Holtedahl referred this species to *Lissatrypa*, but now there appears to be some question regarding the type of this genus. This name was proposed by Twenhofel with *L. atheroidea* designated as the type (1914, pp. 31–33) and during this same year Holtedahl's paper was published and the generic name *Lissatrypa* was used. Holtedahl (1914, p. 24) noted that the name had been proposed by Twenhofel in a "still unprinted work on the Ordovician and Silurian Faunas of the Anticosti Island near the Mouth of the St. Lawrence River in Eastern Canada." It was also noted that *L. atheroidea* of Twenhofel was the genotype, but if Twenhofel's paper, which appeared in October of 1914, postdates Holtedahl's, then this species is a nomen nudem and the type must be selected from one of the two species which Holtedahl referred to this genus (*L. scheii* and *L. phoca*).

The determination of the genotype is especially important because on the basis of our Alaskan collections it seems very probable that the species *scheii* and *phoca*, as well as *tenuis*, are not congeneric with *atheroidea*.

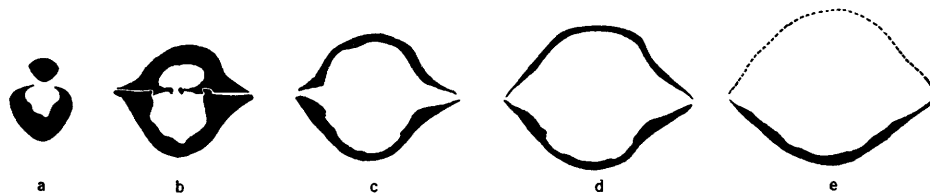


FIGURE 3.—Serial sections of *Atrypella scheii* (Holtedahl)? Brachial valve above, $\times 1.5$. Locality 1019, east end Heceta Island. Peels of these sections are located at the U. S. National Museum; U.S.N.M. 116604 a–e. Total length of specimen 25 mm. Distance in millimeters from posterior tip of pedicle beak: A, 2.0; B, 3.0; C, 4.0; D, 5.0; E, 6.0.

Amsden wrote to Dr. Hortedahl and to The Society of Arts and Sciences of Kristiania in an attempt to determine the exact date of publication of his paper, but it was impossible to obtain the information desired and we are therefore following general usage in accepting *L. atheroidea* as the genotype.

Twenhofel described and illustrated the brachidium of *L. atheroidea* and this seems to be the same as that found in the Ellesmereland species as well as in the Alaskan specimens and in *Atrypa*; it is also the same as that of *Lissatrypa decaturensis* (Amsden, 1949, p. 64, pl. 9, figs. 16-23) from the Brownsport formation. Twenhofel did not, however, discuss the pedicle or brachial musculature. Through the courtesy of Professor C. O. Dunbar the types of *L. atheroidea* were borrowed from Peabody Museum at Yale University. Two paratypes were calcined to obtain internal casts (pl. 7, figs. 23, 30) and a third was serially sectioned (text fig. 4) to reveal internal characters. The brachial valve has a rather ponderous hinge plate which is cleft at the posterior end, and which then gives way to a thick median septum. The pedicle valve has a narrow and deep delthyrial cavity; the diductor scars are narrow, deep, and separated posteriorly by a thick septum. This septum is cleft at the posterior end by a narrow valley which presumably represents the point of attachment of the adductors.

The genotype of *Atrypella* is *A. prunum* Dalman (Kozlowski 1929, pp. 173-176) which is a fairly large species, rather strongly biconvex and with a smooth exterior. It resembles *Atrypa* in general shape, but the pedicle valve is more strongly convex, as in *Atrypella schevi?* and *A. tenuis*. Specimens of *Lissatrypa* are much smaller and not so strongly biconvex.

The brachidium of *Atrypella* is apparently like that of *Lissatrypa* and *Atrypa*. The pedicle musculature

of *Atrypella*, however, seems to be much less deeply impressed than that of *Lissatrypa*; it lacks the strongly indented diductor scars and high separating platform which characterizes *Lissatrypa*. The brachial valve of *Atrypella* has a much more weakly developed median septum and the hinge structures are not as massive (Kozlowski 1929, text fig. 57). The internal structures of the Alaskan specimens of *A. schevi?* and *A. tenuis* are much more like those of *Atrypella* than *Lissatrypa*.

A. schevi? is larger and more strongly biconvex than *A. tenuis*.

Hortedahl's specimens came from "B, lower part, Reindeer Valley, B, lower part, Seal Bay," southwestern corner of Ellesmereland. The specimens in the collections under study are from localities 1019 and 1589, at the east end of Heceta Island, and 2689, northeastern corner of Heceta Island.

Hypotypes U.S.N.M. 116573-116578.

***Atrypella* Kozlowski, 1929**

***Atrypella tenuis* Kirk and Amsden, n. sp.**

Plate 7, figures 1-11; text figure 5

This shell is biconvex with the brachial valve having a convexity which is greater than the pedicle. The pedicle beak is small and only slightly hooked over the brachial; the posterior half of the pedicle valve is rather sharply convex, but toward the anterior end it becomes flattened, developing a shallow sulcus which is produced into a tongue (pl. 7, figs. 2, 7). On the posterior half, the brachial valve is evenly rounded, but toward the anterior end it develops a fold which corresponds to the pedicle sulcus. The surface of both valves is smooth, except for faint growth lines.

The width of the shell is about equal to the length, but some individuals are slightly wider or narrower than

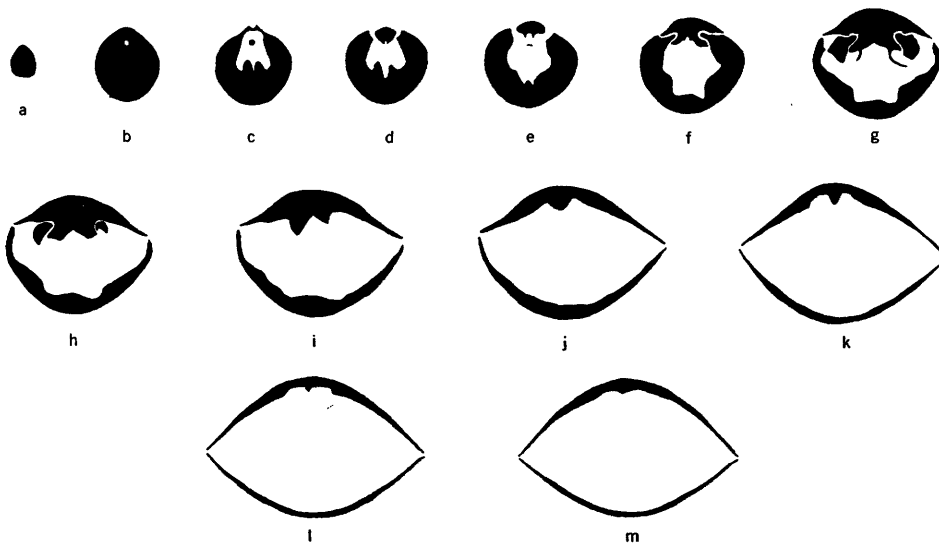


FIGURE 4.—Serial sections of *Lissatrypa atheroidea* Twenhofel. Brachial valve above, $\times 3$. Specimen from which these sections were made came from the Silurian Jupiter formation, West Jupiter Cliffs, Anticosti Island. Peels of sections are at Peabody Museum, Yale University, Cat. No. 17717. Total length of specimen 9.2 mm. Distance in millimeters from posterior tip of pedicle beak: A, 0.1; B, 0.6; C, 1.0; D, 1.1; E, 1.3; F, 1.6; G, 1.9; H, 2.3; I, 2.6; J, 3.1; K, 3.9; L, 4.7; M, 5.2.

long. A specimen of average size measures about 19 mm. long, 19 mm. wide and 11 mm. thick; one of the smallest in the collection measures 7 mm. wide, 8 mm. long and 3.5 mm. thick. The largest is 21 mm. wide, 22 mm. long and 12 mm. thick.

In the pedicle interior (pl. 7, fig. 9; text fig. 5) the teeth are moderately stout and arise from the lateral slopes with no trace of dental plates. There is a broad, low, poorly defined platform which begins in front of the beaks, extending for about one-third the length of the valve; bordering this platform are shallow, poorly defined grooves which may represent the point of attachment for the diductor muscles.

In the brachial interior the muscle scars are poorly developed. The hinge plate of this valve is divided, giving a rather conspicuous notothyrial cavity; a low, median septum appears near the posterior end of this cavity and extends for about a third the length of the valve (pl. 7, figs. 1, 11, text fig. 5; compare to Kozłowski 1929, text fig. 57).

The internal structures of *Atrypella tenuis* are similar to those of the Alaskan specimens of *A. scheii?* On the latter, however, neither the brachial septum nor the pedicle platform is as well developed as on *A. tenuis*. The spirulum and jugum of both species is similar to that of *Atrypa reticularis*.

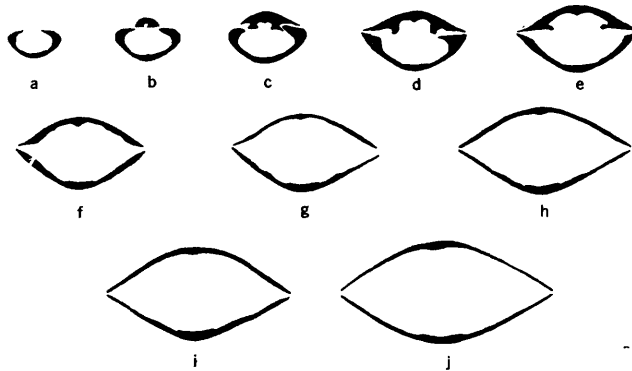


FIGURE 5.—Serial sections of *Atrypella tenuis* Kirk and Amsden n. sp. Brachial valve above, $\times 3$. Peels of sections at U.S. National Museum; U.S.N.M. 116605 a-1. Locality 1005, south shore Kosciusko Island. Distance in millimeters from posterior tip of pedicle beak: A, 0.3; B, 0.6; C, 0.9; D, 1.6; E, 1.7; F, 2.1; G, 2.3; H, 3.0; I, 3.6; J, 4.6.

The shell of this species is smaller and less robust than that of *A. scheii?* Specimens of the latter that are of similar width and length are much thicker, as shown in the following measurements:

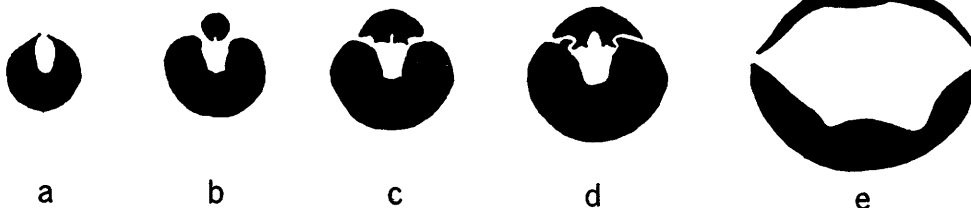


FIGURE 6.—Serial sections of *Atrypella borealis* Kirk and Amsden, n. sp. Brachial valve above. Locality 1005, south shore Kosciusko Island. Peels of sections at U. S. National Museum; U.S.N.M. 116606 a-d. Distance in millimeters from posterior tip of pedicle beak: A, 0.1; B, 0.2; C, 0.9; D, 1.2; E, 2.7.

	Dimensions in millimeters		
	Width	Length	Thick-ness
<i>Atrypa tenuis</i>	21	21	12
<i>Atrypa scheii?</i>	22	22	17

Khodalevich described several new species of *Lissatrypa* from the upper Silurian of the Urals. The shape and size of several of these species suggest that they should be referred to *Atrypella* Kozłowski rather than *Lissatrypa* Twenhofel, but the descriptions (English summary) are very brief and there are no illustrations of interiors. The species which seems to be most similar to *A. tenuis* in its external appearance is *L. penitus* Khodalevich (1939, p. 105, pl. 24, figs. 2, 5), but the latter appears to have a much greater convexity and a more rounded outline.

This is one of the most abundant species in the collections. All specimens from locality 1005, south shore of Kosciusko Island.

Holotype, locality 1005, U.S.N.M. 116579; paratypes 116580-116583.

Atrypella borealis Kirk and Amsden, n. sp.

Plate 8, figures 18-22; text figure 6

The shell is subtriangular in outline with a short hinge line, that is about one-third the maximum width of the shell. Its lateral profile is biconvex, with the pedicle valve slightly deeper than the brachial. The pedicle valve is rather evenly convex except for a shallow but distinct sulcus which appears near the anterior end; the beak of this valve is small and tightly hooked over the brachial. There is only the faintest trace of a fold on the anterior portion of the brachial valve, with the rest of the shell evenly convex. Both valves are completely smooth except for indistinct growth lines.

The collections under study include only a few specimens of this species and only two are well preserved. One of these measures 10.5 mm. wide, 10 mm. long and 8 mm. thick; the other is 11 mm. wide, 10 mm. long and 7 mm. thick.

One imperfect specimen was sectioned to reveal the internal characters. The spires were not preserved, but the other internal structures are shown in text figure 6 and appear to be similar to those of *A. tenuis* and *A. scheii?* (compare text fig. 6 with figs. 3, 5). The shell-wall of *A. borealis* is relatively thick for a

shell of this size and in this respect it is similar to *Lissatrypa atheroidea* (genotype of *Lissatrypa*; see text fig. 4 and also discussion of *A. scheii?*). *A. borealis* differs from *L. atheroidea* in lacking the strong median platform in the pedicle valve, and the brachial hinge plate is much less ponderous.

This is a smaller species than *A. tenuis*. When compared to immature specimens of the latter which are of a comparable size, *A. borealis* is seen to be more strongly convex; also, the immature specimens of *A. tenuis* lack the ventral sulcus which is so clearly defined on *A. borealis*.

A. scheii? is much larger, and does not develop a ventral sulcus until it is about half grown.

The specimens of *Lissatrypa linguata* (Buch) [*Atryppella? linguata*] figured by Khodalevich (1939, pl. 20, figs. 6-7) are more elongate and appear to have a better-developed sulcus than does *A. borealis*.

Atryppella shrocki (Cooper 1942, p. 234) is a larger species with a more prominent fold and sulcus.

Only 5 specimens were obtained at locality 1005, south shore of Kosciusko Island.

Holotype, locality 1005, U.S.N.M. 116584; paratypes 116585.

Nucleospira Hall, 1859

Nucleospira hecetensis Kirk and Amsden, n. sp.

Plate 7, figures 24-29, 31-32

The anterior portion of the shell is rounded in outline, but the hinge line is straight and about two-thirds the maximum width of the shell, thus this portion of the outline is slightly truncate with moderately well-defined shoulders. In lateral profile the shell is biconvex with the convexity of the valves about equal. The pedicle beak is small, pointed, and sharply hooked over the dorsal.

The surface of well-preserved specimens is covered with a mat of fine spines. Where these spines have been abraded away, as is common, the surface appears smooth except for irregularly spaced, concentric growth lamellae; generally the surface shows small pits that mark the places of attachment of the spines.

Six specimens in the collections have been referred to this species; 4 of these average 12 mm. wide, 11 mm. long and 8 mm. deep; the smallest in the collection is 7 mm. wide, 6 mm. long and 4 mm. thick; the largest individual is 18 mm. wide, 14 mm. long and 10 mm. thick.

No interiors have been seen.

Nucleospira hecetensis most closely resembles the Helderberg species *N. ventricosa* (Hall 1857, p. 57; Hall and Clarke 1894, pl. 48, figs. 2-6, 18). A comparison of specimens from the Helderberg group with those from Alaska shows that *N. hecetensis* has a somewhat longer hinge line with moderately prominent shoulders, whereas *N. ventricosa* is more strongly biconvex and has

a shorter hinge with the shell sloping uniformly away from the beaks.

Specimens of *N. swartzi* Maynard (in Swartz 1913, p. 432, pl. 73, figs. 15-17) from the Keyser limestone of West Virginia have a more strongly convex ventral valve and a flatter dorsal valve than *N. hecetensis*.

There are six specimens in the collection from locality 2689 northeast end Heceta Island.

Holotype locality 2689; U.S.N.M. 116586; paratypes U.S.N.M. 116587, 116588.

Alaskospira Kirk and Amsden, n. gen.

Genotype: *Alaskospira dunbari*, Kirk and Amsden, n. sp.

The only known species of this genus, *Alaskospira dunbari*, has a biconvex shell with the pedicle valve deeper than the brachial. The pedicle beak is prominent and hooked at its posterior end; this valve has a fairly well developed palintrope that is not sharply marked off from the rest of the shell. Both pedicle and brachial valves are rather uniformly convex, except for a narrow, poorly defined pedicle sulcus and brachial fold near the anterior end. The shell in outline is somewhat rounded with the greatest width a short distance anterior to the hinge line.

Well preserved specimens bear concentric lamellae (see pl. 7, fig. 47) but some specimens that have had the lamellae removed by abrasion show only faint, widely spaced costellae, especially along the anterior margins. No spines have been observed, perhaps due to lack of preservation.

The pedicle interior has well developed teeth unsupported by dental plates. The diductor scars are narrow, deeply impressed and about one-third the length of the valve; separating them is a thickened platform or ridge that extends nearly to the anterior end of the shell (pl. 7, fig. 39; text fig. 7).

In the brachial valve there are well developed sockets; the ribbon appears to develop on each side of these sockets as flat plates that help to define a deep, notothyrial cavity at the posterior end. A low, rounded septum appears a short distance in front of the beak and extends forward for a few millimeters and is then replaced by a shallow depression. Anteriorly, this depression or trough is bordered on each side by a ridge of shell material (text fig. 7).

There are only about 5 volutions to each spire; the apices of these spires are laterally directed. Jugum not observed.

Externally this genus is similar to *Eoreticularia* (Nalivkin 1930, p. 198; genotype *Spirifer indifferens* Barrande 1879, pl. 3, figs. 4-7). They are closely similar in outline, in lateral profile and possibly in ornamentation. In describing the ornamentation, Nalivkin states "Surface covered with multitudinous thin, densely set, lamellar, concentric growth-ridges.

Spines sometimes absent." The principal difference between *Eoreticularia* and *Alaskospira* lies in the internal characters. Nalivkin does not give a very detailed description of these characters, but he does state that dental lamellae are present; in *Alaskospira* the lamellae are absent. Nalivkin also states that Fredrick's genus *Reticulariopsis* also possesses dental plates.

Externally *Alaskospira* somewhat resembles *Spirinella* (Johnston 1941, p. 161); the only species referred to this genus is the type, *S. caecistriata*, which is described as ornamented with "only very fine radiating striae superimposed on the fine, concentric growth lines." The serial sections which are figured in Johnston's paper show that *Spirinella* has well developed dental plates and lacks the deep, discrete, subparallel muscle scars of *Alaskospira*.

The pedicle interior of *Alaskospira* has some similarities to *Amboecolia* (Hall 1860, p. 71; Hall and Clarke 1894, p. 54), which lacks dental plates and which has a ventral musculature described as "quite restricted, consisting of narrow, elongate diductors enclosing an almost linear adductor" (Hall and Clarke 1894, p. 55). The brachial interiors, however, are different; in *Amboecolia* the muscle scars are located toward the anterior and consist of four well defined scars, whereas in *Alaskospira* this portion of the brachial valve is occupied by a single, narrow trough. *Amboecolia umbonata* appears to lack any trace of radial costellae and the concentric lamellae are irregular and widely spaced whereas those of *Alaskospira dunbari* are closely spaced.

Eospirifer (Schuchert) has better developed radial costellae than *Alaskospira* and lacks the concentric lamellae. Internally, *Eospirifer* has well developed dental plates.

Alaskospira dunbari Kirk and Amsden, n. sp.

Plate 7, figures 33-40, 47; text figure 7

The lateral profile of this shell is biconvex with the pedicle valve about twice as deep as the brachial. The pedicle beak is pointed and sharply hooked at its posterior end; there is a moderately well developed palintrope on this valve that is not sharply marked off from the lateral slopes. Most pedicle valves are uniformly convex except for a faint mid-line flattening, which in a few individuals is developed into a shallow, poorly defined sulcus. The brachial palintrope is narrow; this valve is uniformly convex, except for an indistinct fold on the anterior half.

The surface of most individuals has been worn completely smooth, but a few well preserved specimens show numerous closely spaced concentric lamellae. (See pl. 7, fig. 47.) Some specimens which have been abraded only slightly so that the concentric lamellae are absent will show faint costellae with relatively wide interspaces; where the concentric lamellae are present these costellae are masked and where the shell is more deeply worn, as is commonly the case, this radial ornamentation disappears.

The pedicle and brachial interiors have been described in the generic description.

Specimens of average size measure about 17 mm. wide, 15 mm. long, and 10 mm. deep; the largest individual in the collection is 22 mm. wide, 19 mm. long, and 12 mm. deep.

Externally *Alaskospira dunbari* resembles *Eoreticularia indifferens* (Barrande 1879, pl. 3, figs. 4-7) but the latter has a more prominent fold and sulcus. The internal differences have already been discussed under generic description.

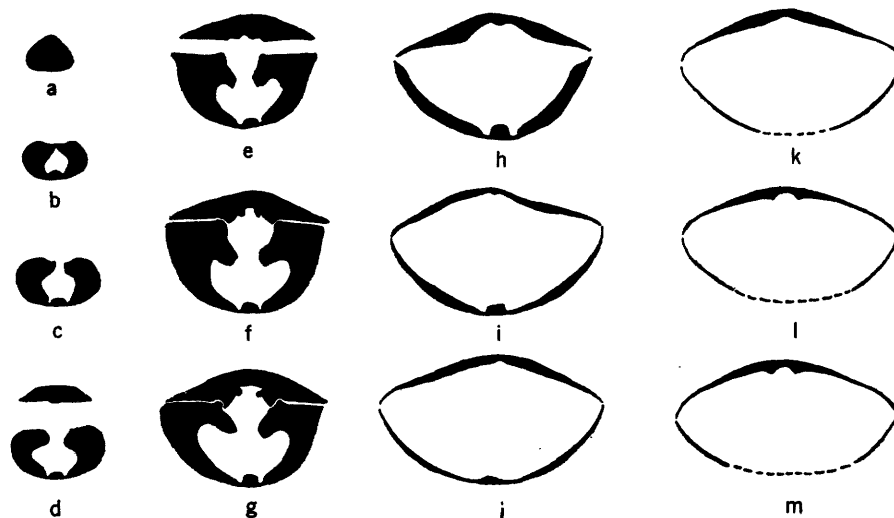


FIGURE 7.—Serial sections of *Alaskospira dunbari* Kirk and Amsden, n. sp. Brachial valve above, X 2. Peels of sections at U. S. National Museum; U.S.N.M. 116607 a-m. Locality 1005, south shore Kosciusko Island. Distance in millimeters from posterior tip of pedicle beak: A, 0.3; B, 1.8; C, 2.3; D, 3.0; E, 3.3; F, 3.8; G, 4.1; H, 4.6; I, 5.5; J, 6.6; K, 7.4; L, 8.4; M, 9.4.

Spirifer (*Martinia*?) *pseudopentameriformis* (Khodalevich 1939, p. 110, pl. 28, fig. 6) is somewhat wider in proportion to its length than is *Alaskospira dunbari*. The ornamentation of this species is said to consist of "simple, close-set growth lamellae. Inner layer showing fine radial costae(?)." Khodalevich does not discuss the internal characters beyond stating that they are similar to *Spirifer pentameriformis* Tschernyschew (1893, p. 168, pl. 6, figs. 5-9; internal characters not discussed).

In general shape *Alaskospira dunbari* resembles *Spirifer modestus* var. *striatissimus* Høltedahl (1914, p. 26-27, pl. 7, fig. 2) from Ellesmereland which, however, is much smaller and has dental plates.

In shape *A. dunbari* resembles immature specimens of *Harpidium*.

This species is named for Prof. C. O. Dunbar, of Yale University.

There are about 25 specimens of this species in the collections from locality 1005, south shore Kosciusko Island.

Holotype locality 1005; U.S.N.M. 116589; paratypes U.S.N.M. 11659-116593.

Genus *Atrypa* Dalman 1828

Atrypa cf. *Atrypa reticularis* (Linnaeus)

Plate 8, figures 8-17

Anomia reticularis Linnaeus (1767, p. 1152)

The specimens of *Atrypa* in the Alaskan collections are moderately strongly biconvex shells with the brachial valve having much the greater convexity. The umbonal area of the pedicle valve is sharply convex, but the lateral slopes become flattened; on the anterior half of mature shells a fairly deep sulcus is commonly produced into a tongue. The posterior half of the brachial valve is strongly and evenly convex; toward the anterior end a fold is developed, but this is not sharply marked off from the lateral slopes. The pedicle beak is small, pointed and sharply hooked over the brachial valve.

The surface is covered with low, rounded costellae, about 9 occupying a space of 5 mm. These costellae are crossed by irregularly spaced concentric lamellae that are best developed on the anterior portion of the shell. Several specimens have well developed spines where the lamellae cross the crests of the costellae.

The ratio of width to length varies considerably: average specimens are about 21 mm. long, 21 mm. wide, and 13 mm. thick, but some individuals are wider than long and some longer than wide. One of the largest specimens is 24 mm. long, 27 mm. wide, and 13 mm. thick; another large one is 26 mm. long, 24 mm. wide, and 13 mm. thick.

This species is common at locality 2689; there are also some specimens from locality 1005; these are poorly

preserved, but seem to be similar to those from locality 2689, although the ribbing may be slightly coarser.

Figured specimens U.S.N.M. 116594-116598.

Delthyris Dalman 1828

Delthyris? sp.

Plate 7, figures 42-46

A specimen in the collections studied has the general shape of the genus *Delthyris*. The spines and concentric lamellae that are characteristic of this genus are not present but the shell is deeply worn and this absence may be due to poor preservation. There is a rather prominent pedicle fold and brachial sinus with about 5 rounded plications on each side. The shell is 10 mm. wide, 7 mm. long, and 6 mm. thick.

One specimen from locality 1005. Figured specimen U.S.N.M. 116599.

Eospirifer Schuchert 1913

Eospirifer sp.

Plate 10, figure 6

A few poorly preserved specimens are referred to the genus *Eospirifer*. This species has a distinct pedicle sulcus with plicated lateral slopes (pl. 10, fig. 6), and resembles *Eospirifer irbitensis* (Tschernyschew; Khodalevitch 1939, pl. 27, figs. 1, 2) from the Urals, although the Alaskan species is much smaller and has less distinct ribs.

The specimens at hand are exfoliated, but one or two have enough of the original shell material to suggest that they bore radial lines.

Locality 2689, northeastern end of Heceta Island; southeastern Alaska.

Figured specimen U.S.N.M. 116600.

Genus *Howellella* Kozłowski 1946

(= *Crispella* Kozłowski 1929)

Howellella sp.

Plate 7, figure 41; plate 10, figures 7-9

Four incomplete specimens are identified as *Howellella*. They are rather strongly biconvex with a narrow but distinct pedicle sulcus and a corresponding brachial fold; the lateral slopes are smooth. None of the specimens show the pedicle beak very clearly but it is probably pointed and erect. The surface has concentric lamellae that bear small spines (pl. 7, fig. 41). The general shape and ornamentation of the species is thus like that of *Crispella*, although it is not a costate shell as is the genotype, *H. crispata*. One individual has the pedicle beak broken and shows well-developed dental lamellae but no median septum. The other internal characters are unknown.

Locality 2689, northeastern corner of Heceta Island; southeastern Alaska.

Figured specimens U.S.N.M. 116601, 116602.

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PLATES 7-10

PLATE 7

Figures 1-11. *Atrypella tenuis* Kirk and Amsden, n. sp. (p. 59).

1. Brachial view of an internal mold ($\times 2$). Locality 1005, south shore Kosciusko Island; U.S.N.M. 116580.
- 2, 4. Anterior and pedicle views of one of the largest specimens ($\times 1$); fig. 2, pedicle valve above. Locality 1005, south shore Kosciusko Island; U.S.N.M. 116581.
- 3, 5, 6, 7. Posterior, lateral, brachial and anterior views of the holotype ($\times 1$); fig. 7, pedicle valve above. Locality 1005, south shore Kosciusko Island; U.S.N.M. 116579.
- 8, 10. Brachial and pedicle views of another individual ($\times 1$). Locality 1005, south shore Kosciusko Island; U.S.N.M. 116582.
9. Pedicle view of an internal mold ($\times 2$). Locality 1005, south shore Kosciusko Island; U.S.N.M. 116583.
11. Oblique view of the same specimen shown in fig. 1 ($\times 2$).

12-22. *Atrypella scheii* (Holtedah!)? (p. 58).

- 12, 19. Lateral and posterior (brachial valve above) views of a specimen ($\times 1$). Locality 1019, east end Heceta Island; U.S.N.M. 116573.
 13. Pedicle view of a large specimen ($\times 1$). Locality 1589, east end Heceta Island; U.S.N.M. 116574.
 - 14, 16, 17. Anterior, brachial and pedicle views of a specimen ($\times 1$); fig. 14, pedicle valve above. Locality 1019, east end Heceta Island; U.S.N.M. 116575.
 15. Pedicle view of a small individual ($\times 1$). Locality 1589, east end Heceta Island; U.S.N.M. 116576.
 - 18, 20, 21. Posterior, brachial and lateral views of a specimen of average size ($\times 1$). Fig. 18, brachial valve above. Locality 1589, east end Heceta Island; U.S.N.M. 116577.
 22. Brachial view of a specimen ($\times 1$). Locality 1019, east end Heceta Island; U.S.N.M. 116578.
- 23, 30. *Lissatrypa atheroidea* Twenhofel (p. 58).
23. Pedicle view of an internal mold ($\times 3$).
 30. Brachial view of an internal mold ($\times 3$).

Both of the above specimens are paratypes of this species that was studied and described by Dr. W. H. Twenhofel (1914, p. 33). They were borrowed from Peabody Museum, Yale University, through the courtesy of Professor C. O. Dunbar; Yale University Peabody Museum Catalogue Nos. 17715 (fig. 23), 17716 (fig. 30); Silurian, West Jupiter Cliffs E3, Anticosti Island.

24-29, 31-32. *Nucleospira hecetensis* Kirk and Amsden, n. sp. (p. 61).

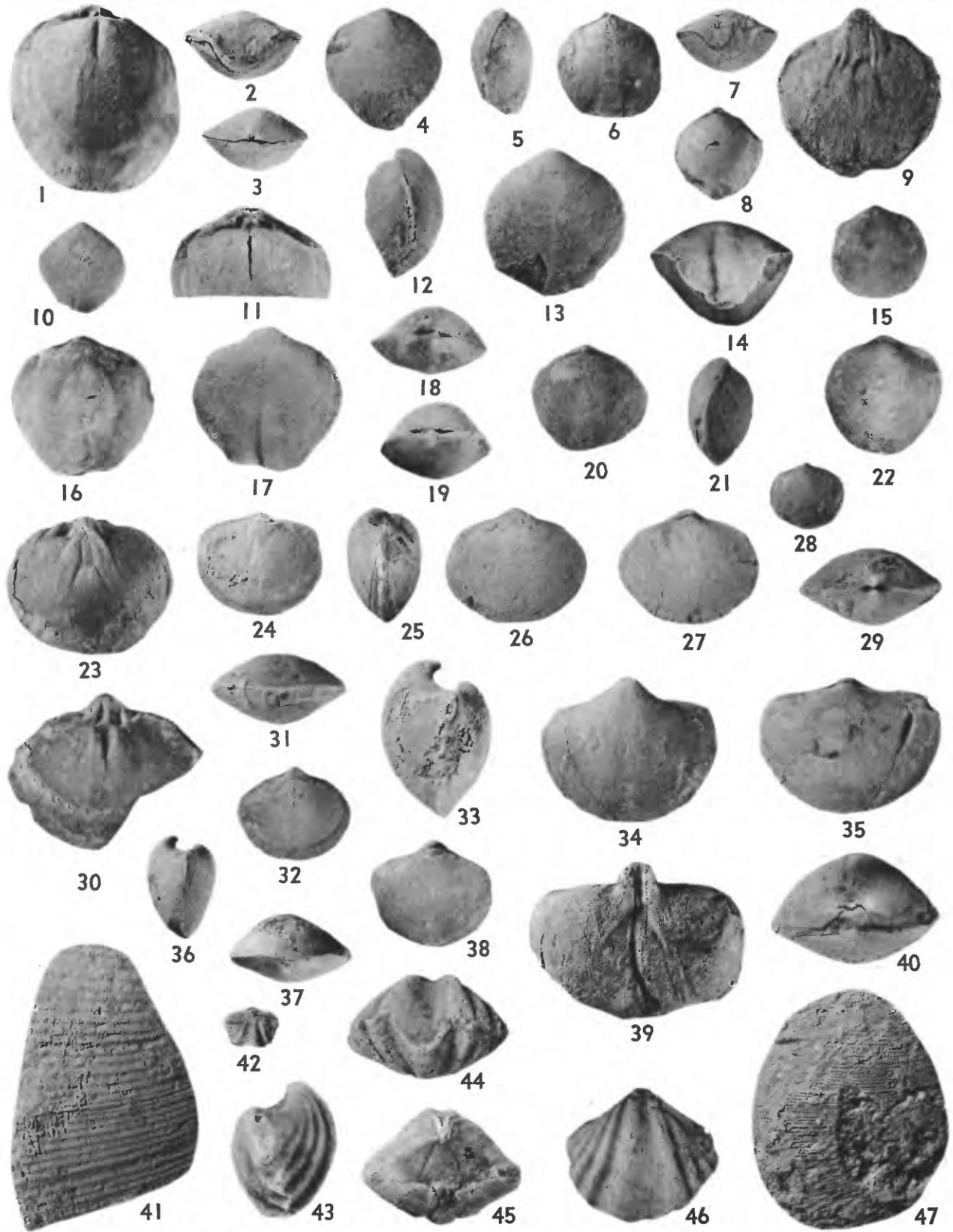
24. Brachial view ($\times 2$). Locality 2689, northeast end Heceta Island; U.S.N.M. 116587.
 - 25, 26, 27, 29, 31. Lateral, pedicle, brachial, posterior and anterior views of the holotype ($\times 2$); in figs. 29 and 31, pedicle valve above. Locality 2689, northeast end Heceta Island; U.S.N.M. 116586.
 28. Pedicle view of the holotype ($\times 1$).
 32. Pedicle view of another specimen ($\times 2$). Locality 2689 northeast end Heceta Island; W.S.N.M. 116588.
- 33-40, 47. *Alaskospira dunbari* Kirk and Amsden, n. gen. and n. sp. (p. 62)
- 33, 40. Lateral and posterior views of a specimen ($\times 2$); in fig. 40, pedicle valve above. Locality 1005, south shore Kosciusko Island; U.S.N.M. 116590. Figure 40 retouched.
 - 34, 35. Pedicle and brachial views of the holotype ($\times 2$). Locality 1005; U.S.N.M. 116589.
 - 36, 37, 38. Lateral, anterior, and brachial views of the same specimen ($\times 1$); in fig. 37, pedicle valve above. Locality 1005, south shore Kosciusko Islands; U.S.N.M. 116591.
 39. Pedicle view of an internal mold ($\times 2$). Locality 1005, south shore Kosciusko Island; U.S.N.M. 116592.
 47. Enlarged surface view of a specimen showing concentric lamellae ($\times 6$). Locality 1005; U.S.N.M. 116593.

41. *Howellevella* sp. (p. 63)

41. Enlarged surface view to show concentric lamellae and spines ($\times 6$). Locality 2689, northeast end of Heceta Island; U.S.N.M. 116601. See Plate 10, figures 7-9, for other illustrations of this species.

42-46. *Delthyris*? sp. (p. 63)

- 42,-46. Brachial ($\times 1$), lateral, anterior, posterior, and pedicle ($\times 3$) views of the same individual; in figs. 44, 45, pedicle valve above. Locality 1005, south shore Kosciusko Island; U.S.N.M. 116599. Figure 45 retouched.



ATRYPELLA, LISSATRYPA, NUCLEOSPIRA, ALASKOSPIRA, HOWELLELLA, AND DELTHYRIS

PLATE 8

Figures 1-7. *Camarotoechia reesidei* Kirk and Amsden, n. sp. (p. 57)

- 1, 2. Pedicle and lateral views of the holotype ($\times 3$). Locality 2689, northeast end Heceta Island; U.S.N.M. 116569.
 3, 4, 5. Anterior ($\times 3$), brachial ($\times 1$) and posterior ($\times 3$) views of a specimen. Locality 2689, northeast end Heceta Island; U.S.N.M. 116570.
 6, 7. Lateral and brachial views of another specimen ($\times 3$). Locality 2689, northeast end Heceta Island; U.S.N.M. 116571.

8-17. *Atrypa* cf. *A. reticularis* (Linnaeus). (p. 63)

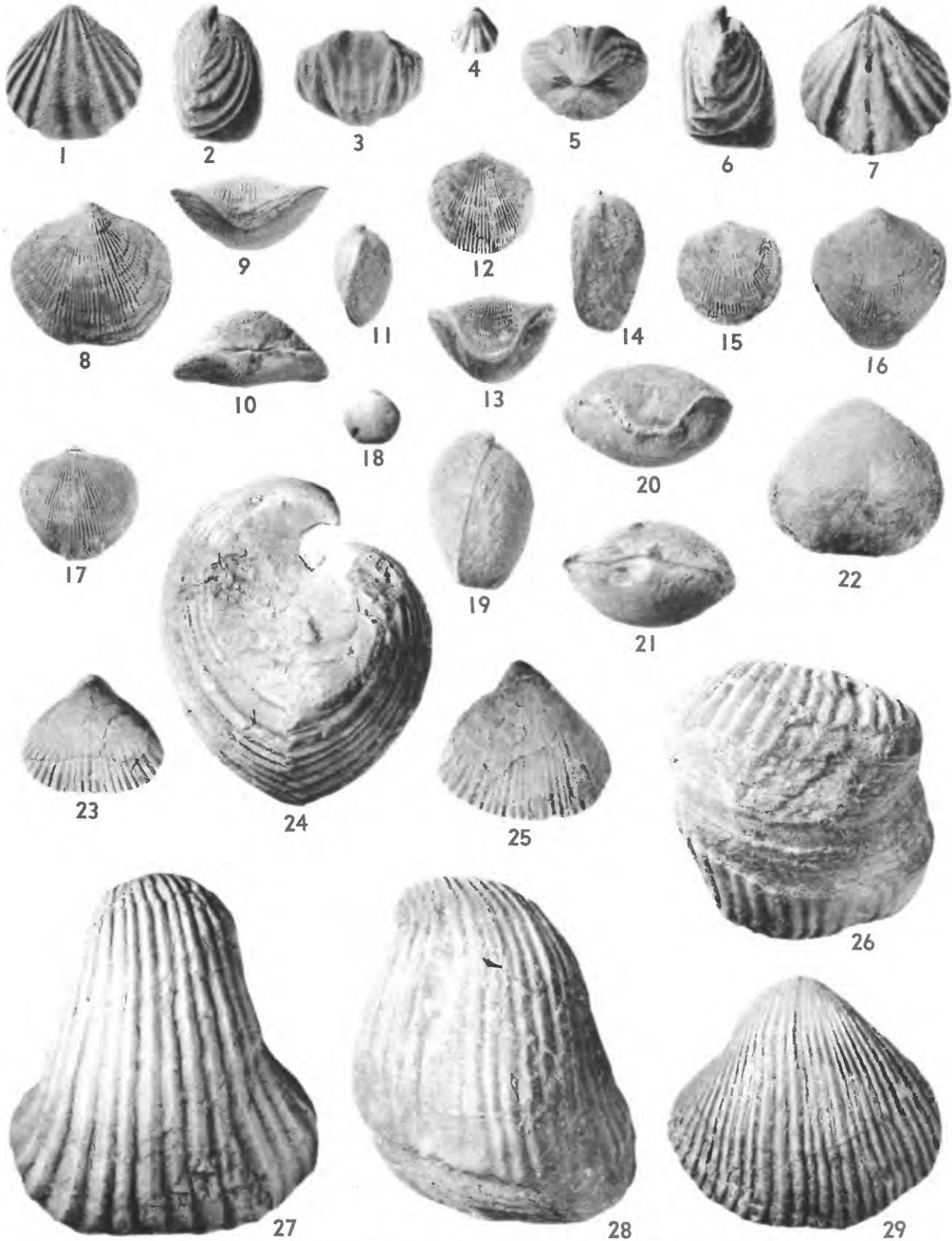
- 8, 9, 10, 14. Pedicle, anterior, posterior, and lateral views of a specimen ($\times 1$). Locality 2689, northeast end Heceta Island; U.S.N.M. 116594. Fig. 8 pedicle valve above; fig. 10 brachial valve above.
 11, 12. Lateral and brachial views of a small specimen ($\times 1$). Locality 2689, northeast end Heceta Island; U.S.N.M. 116595.
 13, 16. Anterior and pedicle views of a large specimen ($\times 1$). Locality 2689, northeast end Heceta Island; U.S.N.M. 116596.
 15. Pedicle view ($\times 1$). Locality 2689, northeast end Heceta Island; U.S.N.M. 116597.
 17. Brachial view ($\times 1$). Locality 2689, northeast end of Heceta Island; U.S.N.M. 116598.

18-22. *Atrypella borealis* Kirk and Amsden, n. sp. (p. 60)

18. Brachial view ($\times 1$). Locality 1005, south shore Kosciusko Island; U.S.N.M. 116585.
 19, 20, 21, 22. Lateral, anterior, posterior and pedicle views of the holotype ($\times 3$); in fig. 20, pedicle valve above; fig. 21, brachial valve above. Locality 1005, south shore Kosciusko Island; U.S.N.M. 116584. Figs. 19, 21 re-touched.

23-29. *Conchidium alaskense* Kirk and Amsden, n. sp. (p. 55).

23. Dorsal view of a young specimen ($\times 1$). Locality 983, north shore Heceta Island; U.S.N.M. 116556.
 24. Lateral view ($\times 1$). Locality 983, north shore Heceta Island; U.S.N.M. 116557.
 25. Pedicle view of an immature individual ($\times 1$). Locality 983, north shore Heceta Island; U.S.N.M. 116558.
 26, 28. Anterior and pedicle views of an individual showing asymmetrical growth development ($\times 1$); in fig. 26, pedicle valve above. Locality 983, north shore Heceta Island; U.S.N.M. 116559.
 27. Pedicle view of an individual showing unusually coarse costae ($\times 1$). Locality 983, north shore Heceta Island; U.S.N.M. 116560.
 29. Pedicle view of a rather small specimen ($\times 1$). Locality 983, north shore Heceta Island; U.S.N.M. 116561.



CAMAROTOECHIA, ATRYPA, ATRYPELLA, AND CARCHIDIUM—CONCHIDIUM

PLATE 9

Figures 1-7. *Conchidium alaskense* Kirk and Amsden, n. sp. All specimens illustrated on this plate from locality 983, north shore Heceta Island. (p. 55).

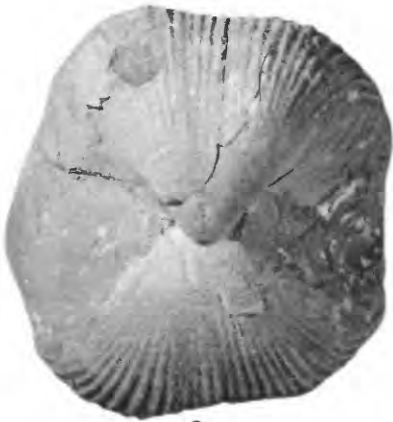
- 1, 2, 6. Anterior, brachial and lateral views of a large specimen ($\times 1$). U.S.N.M. 116562. Fig. 1 pedicle valve above.
3. Posterior view of a specimen showing asymmetrical growth development ($\times 1$). Pedicle valve above; U.S.N.M. 116563.
4. Lateral view of a specimen with an erect pedicle beak ($\times 1$). U.S.N.M. 116564.
5. Anterior view ($\times 1$); a pedicle view of this specimen is shown on Plate 10, fig. 4. Brachial valve above. U.S.N.M. 116565.
7. Interior view of a specimen which has been split longitudinally ($\times 1$). This view shows clearly the inner and outer plates of the brachial valve and the deep spondylium and high median septum of the pedicle valve. U.S.N.M. 116566.



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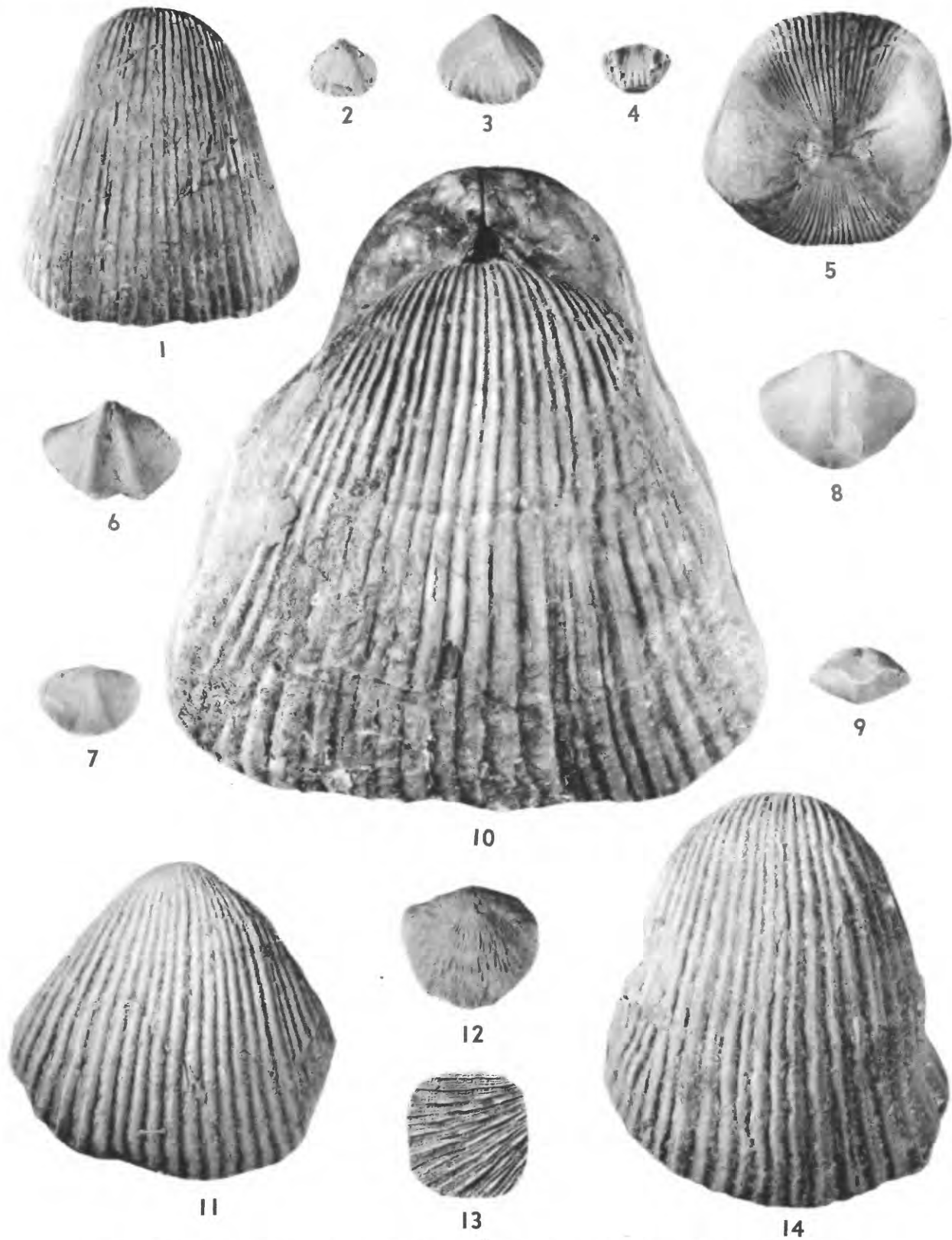


7

CONCHIDIUM ALASKENSE

PLATE 10

- FIGURES 1, 5, 10, 11, 14. *Conchidium alaskense* Kirk and Amsden, n. sp. (p. 55).
1, 5, 10. Pedicle ($\times \frac{1}{2}$), posterior ($\times \frac{1}{2}$) and brachial ($\times 1$) views of the holotype. This is the largest specimen in the collections. Locality 983, north shore Heceta Island; U.S.N.M. 116567.
11. Pedicle view ($\times 1$); an anterior view of this specimen is shown on Plate 9, fig. 5. Locality 983, north shore Heceta Island; U.S.N.M. 116565.
14. Pedicle view of a fairly large specimen ($\times 1$). Locality 983, north shore Heceta Island; U.S.N.M. 116568.
- 2-4. *Camarotoechia* sp. (p. 58).
2, 3, 4. Brachial ($\times 1$), pedicle ($\times 1.5$) and anterior ($\times 1$) views of the same specimen. Fig. 4, pedicle valve above. Locality 2689, northeast end Heceta Island; U.S.N.M. 116572.
6. *Eospirifer* sp. Pedicle view ($\times 1.5$). Locality 2689, northeast end Heceta Island; U.S.N.M. 116600 (p. 63).
- 7-9. *Howellevella* sp. (p. 63).
7, 8, 9. Brachial ($\times 1$), pedicle ($\times 1.5$) and anterior ($\times 1$) views of the same specimen; pedicle beak of this specimen broken. Locality 2689, northeast end Heceta Island; U.S.N.M. 116602. (See pl. 7, fig. 41, for enlarged surface view.)
- 12, 13. *Cymostrophia* cf. *C. costulata* (Barrande). (p. 55).
12. Pedicle view ($\times 1$). Locality 2689, northeast end Heceta Island; U.S.N.M. 116554.
13. Enlarged view ($\times 3$) of the surface of another specimen. Locality 2689. U.S.N.M. 116555.



CONCHIDIUM, CAMAROTOECHIA, EOSPIRIFER, HOWELLELLA, AND CYMOSTROPHIA

