BROOKSINA. A NEW PENTAMEROID GENUS FROM THE
UPPER SILURIAN OF SOUTHEASTERN ALASKA.

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The stratigraphy and paleontologic content of the Paleozoic rocks of southeastern Alaska are perhaps less known than those of any other notable Paleozoic section in North America. Fairly extensive collections of fossils are now available from this region. Of considerable importance in southeastern Alaska is a great series of sediments of doubtful stratigraphic position. Within this series are contained some 3,500 feet of limestone, shales of unknown thickness, and more than 1,000 feet of conglomeratic beds considered as of probable glacial origin. Compared with other North American faunas the fossils of this series bear some resemblance to the Upper Monroe of Michigan. The affinities are not close, however, and consist mainly in the common possession of persistent generic types. It should be borne in mind that the greater part of the Alaskan Paleozoic faunas are Asiatic and European in their affinities, and correlations should be sought there rather than elsewhere in North America. The faunas we are now considering appear closely related to the Lower Devonian of the Ural Mountains as described and discussed by Tschernyschew. Until such time as more accurate correlations of these sediments of the Urals shall have been made with the European standard and the Silurian-Devonian boundary itself shall have been more definitely fixed in Europe the age of the Alaskan sediments must remain in doubt.

My personal inclination is toward the assignment of this Alaskan series to the Devonian. However, owing to the Silurian aspect of the faunas as compared with faunas elsewhere in America, and to the fact that certain of the sedimentary units have already appeared in the literature as of Silurian age it has seemed best tentatively to assign the beds to the Upper Silurian. In any event we probably have to deal with a time period unrepresented elsewhere in North


America, at least by normal marine sediments. In this connection it is of interest to note that Ulrich 2 considers the Upper Monroe as possibly Devonian in age, though placing it in the Upper Silurian.

In addition to the organic types known from the Lower Devonian and Upper Silurian of Asia and Europe the faunas of southeastern Alaska contribute several forms of considerable stratigraphic and paleontologic interest. It is purposed in brief papers to describe some of the more striking and characteristic of these fossils mainly that appropriate names be available for discussion of stratigraphic correlations. It is hoped that in the future with more material available a monographic study of the faunas will be made.

Among the novel and interesting types found in the Upper Silurian rocks the pentameroid brachiopods stand out prominently. A large number of species referable to several genera range through several thousand feet of sedimentary rocks. Where found they serve as excellent horizon markers, the species as a rule being well differentiated and having restricted individual ranges. Among these pentameroids is one genus that is represented by a number of species and as known ranges through 3,000 feet or more of calcareous sediments. As the genus is of considerable stratigraphic importance and appears to be new it has seemed desirable to describe the genus, which is here defined under the name Brooksina. As the type species of the genus the species has been chosen which has been found most abundantly and which shows all the characteristic and distinctive features upon which the genus has been established.

**BROOKSINA, new genus.**

The genus in brief may be defined as a Pentameroid of the Conchidium type with the relative convexity and size of the valves reversed. It is to be expected that with a considerable number of species represented forms will be found in which the relative proportions and contours of the valves will approach those of Conchidium. As a matter of fact, there are one or two undescribed species which are at present referred to Brooksina with a question. Even these, however, are far from typical Conchidium. Indeed, it seems probable that Brooksina was derived not from Conchidium, but a distinct and closely related undescribed genus. The characteristics as given below as distinctive of the genus are found consistently in several well defined species represented by several hundred individuals. Variants from the generic diagnosis as given will not at present be considered otherwise than noting that they exist. The variants are represented by a few specimens only which may ultimately with

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more material available be found to represent abnormal types or referable to some other genus. The generic diagnosis will be brief, as the more detailed account of the genotype, Brooksina alaskensis, new species, will be found approximately applicable to all the species of the genus represented in the collections. Specific differences lie chiefly in general form, character of surface sculpture, and other relatively minor features.

In Brooksina the ventral valve in side view ranges from decidedly concave to slightly convex. The beak is sharply everted as a rule and never involute. The beak terminates in a sharp point. A well marked pseudo-area with cross striations is present. The area is sharply marked off from the remainder of the valve. There is usually a median sinus in the ventral valve and lacking this there is a well-marked median concave or flattened area. The delthyrium is broad and triangular in outline. No deltidium has been seen, but in some specimens there is evidence of marginal outgrowths suggesting deltidial plates. The dorsal valve is strongly convex and its apical portion is sharply incurred. The surface of the valves is marked by sharply defined, narrow, rounded plications. These increase in number either by dichotomy, particularly in the earlier stages of growth, or more commonly by intercalation in later stages. There are usually well-marked concentric growth lines. The shell substance is fibrous. In the anterior portion of large specimens the fibers run in various directions, often at right angles to the plications.

The internal structure of Brooksina is similar to Conchidium. In Brooksina the anterior margin of the ventral septum is straight, whereas in Conchidium as known it is concave. The walls of the spondylium in Brooksina are relatively closer together than in Conchidium and converge dorsad instead of diverging, in all but their posterior portions. The same is true of the crural plates. In the posterior part of the valve these plates behave as in Conchidium. Anteriorly, however, they tend to converge ventrad and are often found touching along their ventral margins. The ventral septum reaches to the anterior margin of the valve. The septum in some species is sharply plicated, so that its line of contact with the surface of the valve is strongly crenulate. Between the septa of the dorsal valve is a median ridge, such as is found in Pentamerus and Conchidium.

In the ontogeny of Brooksina alaskensis, as noted elsewhere, very young individuals show a subequality of the valves, with a slight preponderance of the ventral valve over the dorsal. This relation changes rapidly, however, and in moderately young specimens the adult characteristics are well developed. As bearing on the genetic affinities of Brooksina it is of considerable interest to note that at no
stage in the ontogeny is there a strong resemblance to *Conchidium*. This lack of resemblance is striking when young stages of *Brooksina* and *Conchidium* are compared. *Brooksina* may not, I believe, be considered a derivative of *Conchidium* proper. Associated with *Brooksina* are *Conchidium*-like forms that have the general characteristics of *Brooksina* without the reversal of valve proportions and complementary peculiarities. It may be necessary to assign these forms to *Conchidium* for want of precise definable distinctions warranting their separation from that genus. It is hoped that with more material available and a better general knowledge of the Pentameroids it will be possible approximately to establish genetic lines and place these aberrant types in their proper niche.

Undoubtedly the genus to which *Brooksina* bears the closest superficial resemblance is *Capellinia*. This genus was described in 1894 by Hall and Clarke (1894, p. 248) and is represented by one species *Capellinia mira* Hall and Clarke from the Silurian dolomites of Wisconsin. As pointed out by Hall and Clarke, *Capellinia* is clearly a reversed *Pentamerus*. As noted by them: "This remarkable shell is virtually a *Pentamerus oblongus* in which the relative convexity of the valves is reversed and the reversion carried to a great extreme." In this description they state that the convex pedicle valve "shows a tendency to trilobation or obscure radial plication." This tendency toward radial folding is likewise apparent in *Pentamerus oblongus*, sometimes to a marked degree. The figures of *Capellinia mira* show these plications, or better, undulations to be of the same sort as are characteristic of *Pentamerus*, that is, low, broad folds. They are quite distinct from the sharply defined narrow plications of *Conchidium*.

In general conformation and gross structure *Capellinia* and *Brooksina* are similar. This is to be expected. *Capellinia* is essentially a reversed *Pentamerus*, whereas *Brooksina* is a reversed *Conchidium*. *Pentamerus* and *Conchidium* have distinctive characteristics that make their separation imperative. Nevertheless in outward form and gross structure the two genera are often very similar. *Capellinia* and *Brooksina* therefore as somewhat aberrant offshoots from separate but closely related genetic lines are undoubtedly deserving of generic separation. The features which characterize *Conchidium* as opposed to *Pentamerus* are equally applicable to *Brooksina* as compared with *Capellinia*.

The name *Brooksina* is given to this remarkable genus in honor of Dr. A. H. Brooks, of the United States Geological Survey.

So far as known *Brooksina* is restricted to the Upper Silurian of southeastern Alaska. The only fossil suggesting *Brooksina* that has come to my notice outside southeastern Alaska is a form figured by
This form Tschernyschew refers to *Pentamerus op-tatus* Barrande, a species to which it certainly does not seem to belong. So far as the figures go, it is quite possible that the species is referable to *Brooksina*. This species is found in the Lower Devonian of the Urals.

**Brooksina alaskensis,** new species.

This species is represented in the collections by two or three hundred specimens in a fair state of preservation. The specimens were found in residual clay resulting from the surface decomposition of impure limestone along a narrow, slightly shattered fault zone. As a rule the shell substance of the valves is poorly preserved. The leaching of the water either removed the calcareous test or loosened it to such an extent that it exfoliated badly. Patches of the test in good preservation are usually found on each specimen, but individuals which preserve the test in its entirety are relatively rare. The specimens are not distorted, however, and form excellent material for study. The internal structure may easily be examined, either in cross section or by splitting the specimens longitudinally. The material available for study furnishes an unusual series of growth stages. The smallest individual found measures but 3.0 mm. in length by 3.5 mm. in breadth. The largest specimen measures 40.0 mm. in length by 45.0 mm. in breadth. Another large specimen of the same approximate width has a length of 36.0 mm.

*Brooksina alaskensis* in the case of the largest individuals has a suboval outline when viewed either from the dorsal or ventral side. In smaller specimens, and these may be taken as the average, the anterior margin has the outline of an oval segment, but the posterior portion has a subtriangular outline. In side view the ventral valve ranges from decidedly concave to slightly convex in the portion anterior to the beak, the latter condition obtaining in specimens above the average in size. The dorsal valve is highly convex, the outline being a smooth even curve except in the apical portion, which is abruptly incurved. The preponderance of the dorsal valve over the ventral, both in size and convexity, is marked.

The beak of the ventral valve culminates in a sharp point and is sharply reflexed. From the beak and extending to the lateral margins of the valve are lines diverging at somewhat variable angles, but averaging about 120°, that mark a sharply defined offset or shoulder in the valve. Dorsad to these lines is a concave or flattened pseudo-cardinal area. There is usually a well-defined median sinus extending from the beak to the anterior margin of the ventral valve. Lacking

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4 Tschernyschew, Th., Die Fauna des Untern Devon am West-Abhänge des Urals, Mém. Comité Géologique, vol. 3, No. 1, pl. 7, fig. 94, a, b, c.
a sharply incised sinus its place is taken by a well-defined flattened or slightly concave area. As a rule the sinus is most clearly marked near the beak. Toward the anterior margin it widens rapidly and shows as a broad shallow depression.

The cardinal area of the ventral valve is broad and high. The striations on the area parallel the valve margins and meet the margins of the delthyrium at high angles. They do not radiate from the beak as do the plications of the valves. The area apparently can be classed as a cross striated cardinal area of a nontypical sort. The hinge line is not straight but sinuous, therein differing from the characteristic true cardinal areas of typical forms. On this account it might be better to call an area of this sort a pseudo-area rather than a true cardinal area. The delthyrium is broad and apparently lacks a deltidium. There is some evidence of the presence of marginal outgrowths resembling deltidial plates, but the structure is not clear.

The apical portion of the dorsal valve is sharply incurve and partially fills the delthyrium of the ventral valve. The dorsal valve is most highly arched in the posterior portion. In some specimens there is evidence of a slight median flattening, corresponding to the sinus of the ventral valve, but in most specimens this is wanting.

The valves are traversed by numerous fine, sharply marked, rounded plications. As a rule these multiply by dichotomy, but in older individuals, especially near the anterior margin, the number is frequently increased by intercalation. The plications are equally pronounced on both valves. Concentric growth lines are well marked, and between these the plications are crossed by minor lines that break up the individual plication into a series of beadlike nodes. This character is more pronounced in some individuals than others, and is specially well marked in large specimens near the anterior margin. The growth lines are continuous with those in the pseudo-area.

In *Brooksina alaskensis* the median septum of the pedicle valve as a rule reaches quite to the anterior margin of the valve. Its anterior margin is straight. The median septum from its point of inception at the beak gradually grows higher anteriorly, reaching its maximum height at the anterior margin. The spondylium is very broad and deep in the posterior portion. It narrows very rapidly anteriorly and loses its height more gradually in the same direction. In its anterior portion the walls of the spondylium are but slightly separated and in cross section cases have been seen where the dorsal margins of the plates come in contact. The ventral extremity of the spondylium projects but slightly beyond the anterior margin of the ventral septum. As the median septum and spondylium increase in height in opposite directions there is great diversity in the relative
heights of the two along their lengths. Near the beak the septum is low and the spondylium high, while in the anterior portion the relative height is reversed. In the intermediate region the relative height shifts from one extreme to the other. The combined height of the spondylium and septum is three-fourths or more the depth of the combined valves. The median septum is marked by plications parallel to the anterior margin. The plications may remain narrow and inconspicuous or become very pronounced in the anterior portion. Even in the latter case the line of junction of the septum with the ventral valve remains a straight line. The dental plates likewise are finely striated, the striations paralleling the free margin.

The septa of the dorsal valve are low and extend one-half to two-thirds the length of the dorsal valve. They gradually increase in height anteriorly. In relation to one another they diverge slightly from posterior to anterior extremities, but never become widely separated. In the more mature portions of adult individuals the septa appear practically parallel. Internally the septa stand vertical to the surface of the valve or converge slightly inward. The crural plates maintain about the same height throughout their length. In the posterior portion of the valve the crural plates are sharply reflexed so that their margins are apposed to those of the spondylium. Throughout the greater part of their length the ventral margins of the crural plates are approximately in contact with the dorsal margins of the spondylium. It follows, therefore, that anterior to the region in which the crural plates are widely outspread and reflexed they rapidly assume a subparallel attitude and finally become convergent. In cross sections made some distance anterior to the beak the vertical septa are found supporting rapidly converging crural plates that often come practically in contact along their ventral margins. This is quite different from Conchidium, in which the crural plates are prevailingly divergent along their ventral margins so far as known. The crural apophyses are very long, measuring nearly 9.0 mm. in a specimen of average size and extending to a point opposite the anterior extremity of the spondylium. The apophyses are seldom well shown, as in splitting the specimens the line of fracture breaks across them, as a rule. This is due to the fact that the apophyses do not lie in the same planes as the septa, but diverge somewhat laterally. In cross section the apophyses often show where the plane of the section cuts below the level of the spondylium.

The smallest specimen of Brooksina observed, which is probably referable to this species, measures 3.0 mm. in length by 3.5 mm. in breadth. In this specimen the ventral valve is slightly larger and more convex than the dorsal. The sinus is sharply marked on the ventral valve. The plications are well developed and extend to the
extreme tips of the beaks. In individuals measuring 5.0 mm. in length by 7.0 mm. in breadth the ventral valve is still slightly convex and somewhat deeper than the dorsal valve. In specimens 9.0 mm. in length by 12.5 mm. in breadth the convexity of the dorsal valve and its relatively greater size is well shown. In specimens of this size the general outline of the ventral valve in side view is concave. At this stage the relative proportions of the two valves are much as in adult individuals except that in later stages the dorsal valve becomes relatively deeper. As noted above, the largest individuals of the species seen measure 45.0 mm. in breadth by 36.0 mm. in length and 45.0 mm. in breadth by 40.0 mm. in length. The average adult of the species as found in the collections gives measurements of about 36.0 mm. in breadth by 30.0 mm. in length. Throughout the series the breadth is consistently greater than the length. The relative proportions change somewhat, the tendency being toward a relatively greater widening in the adults.

_ Brooksina alaskensis_ was found in great abundance along the banks of a small stream entering Davidson Inlet along the southeast shore of Kosciusko Island, southeastern Alaska.Associated with _Brooksina alaskensis_ is an interesting fauna consisting of a large number of species. The same horizon with approximately the same fauna was found on the north shore of Heceta Island, to the south.

The rocks carrying _Brooksina alaskensis_ are tentatively referred to the Upper Silurian, as noted above.

The type specimens are in the collections of the United States National Museum, Cat. No. 68762.

EXPLANATION OF PLATE.

_Brooksina alaskensis_, new species.

Fig. 1. Young specimen (x2) showing preponderance of ventral valve at this stage.

Fig. 2. Ventral view of larger specimen.

Fig. 3. Young individual (x2) showing internal structure.

Figs. 4, 5. Larger specimen split longitudinally to show septa, spondylium and crural plates. The long crural apophysis and the plication of the ventral septum in the anterior portion are well shown.

Figs. 6, 7, 8. Outlines showing progressive change in relations of septa, crural plates and spondylium. Figure 6 represents a cross section in the posterior portion of a specimen. Figure 7 represents a section about half way between figures 6 and 8, the latter being cut near the anterior margin of the crural plates.

Fig. 9. Lateral view of individual of medium size showing concave profile of ventral valve.

Figs. 10, 11, 12. Lateral, dorsal, and ventral views respectively of a large individual.
Brooksina alaskensis, new species.

For explanation of plate see page 8.