PYCNODESMA, A NEW MOLLUSCAN GENUS FROM THE SILURIAN OF ALASKA

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Widely distributed in Alaska is a series of predominantly calcareous sediments that seems to represent a high upper Silurian horizon. It is known with certainty in the Seward Peninsula and in southeastern Alaska and probably is present in the upper Yukon Valley in the Fairbanks region. Fossils from this horizon have at various times been referred to the Devonian, Silurian, and even the Mesozoic, the latter tentative determination being made on the evidence of huge fragmentary pelecypods referable to *Pycnodesma*, the genus described in this paper.

The best section of this part of the upper Silurian in southeastern Alaska is on the south shore of Freshwater Bay, Chichagof Island. Here Middle Devonian rocks are found at each end of the section, and although it can not be told with certainty it appears that both contacts are due to faulting. Some miles northeast of this exposure, between False Bay and Iyoukeen Cove, is another faulted block of the upper portion of the series, bounded on the north by what is taken to be Middle Devonian and on the south by Mississippian. In Glacier Bay the isolated exposures of Willoughby and Drake Islands furnish the best collecting grounds for the fossils of the lower part of the series. The limestone appears elsewhere in the bay but as a rule is considerably metamorphosed. On the south shore of Kosciusko Island, off the west coast of Prince of Wales Island, *Pycnodesma* was collected but without the associated forms found elsewhere. It probably represents a somewhat earlier horizon than is present at the localities noted above.

This horizon represents the uppermost stratigraphic unit of the Silurian in southeastern Alaska and consists of approximately 3,000 feet of calcareous sediments. The basal portion of this series consists of some 1,200 feet of massive limestone, followed by 1,800 feet or more of argillaceous limestone with an occasional intercalated layer of greenstone. So far as known this series is underlain by

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the limestones carrying the *Brooksina* fauna and is overlain by Middle Devonian. Within the series itself is found a fairly large and varied fauna, which ranges with considerable uniformity from top to bottom. Collections of fossils from the lower portion were made in Glacier Bay and in Freshwater Bay. The fauna of the upper half is chiefly known from the exposures in Freshwater Bay and along the shore between False Bay and Iyoukeen Cove. Among several unusual molluscan types the new pelecypod genus *Pycnodesma* is of particular interest and stratigraphic value.

PYCNODESMA, new genus

This huge pelecypod has a wide range in the Pacific coastal regions of Alaska. It has been found in Seward Peninsula and at various points in southeastern Alaska, including Glacier Bay, Freshwater Bay, Chichagof Island, and the south shore of Kosciusko Island. A pelecypod doubtfully referred to the genus has been collected on Quail Creek in the Rampart region, Alaska. An excellent series of specimens of this Alaskan pelecypod is now available for study. These specimens come in the main from Glacier Bay on the mainland and Freshwater Bay, Chichagof Island, both in southeastern Alaska. It is of interest to note that during the field season of 1926 sections of a large thick-shelled pelecypod were found in the high Middle Devonian near Gold Hill, Utah. The horizon is above one carrying *Stringocephalus*. The largest specimen seen had a height of approximately 10 centimeters. The thickness of the shell at the umbones and the structures indicating the presence of a large hinge ligament comparable to that of *Pycnodesma* suggest the possibility that the genus ranges up into the Devonian.

In the past this pelecypod has at various times been identified as *Megalomus*. Preparations of the Alaskan material and of typical *Megalomus* from the Guelph of Canada show that the Alaskan pelecypod is not referable to *Megalomus* but constitutes a new genus. Two species are here described, one coming from the massive limestones of Glacier Bay and the other from Freshwater Bay, Chichagof Island, in argillaceous limestone 1,000 feet or more stratigraphically above the Glacier Bay horizon. The pelecypod is an excellent horizon marker, as owing to its tremendously thick shell it can often be recognized in sections on weathered rock surfaces where metamorphism and shearing has destroyed other organic remains beyond the possibility of accurate determination.

Pycnodesma is notable in being perhaps the largest and most massive Paleozoic pelecypod. The individuals here figured are small to medium in size, as owing to the exigencies of collecting in Alaskan localities it was impossible to extract the larger specimens from the

massive limestone in which they were embedded. In Glacier Bay I have seen a section of *Pycnodesma giganteum* in the limestone measuring more than 12 inches (30 centimeters). This may or may not have been the greatest dimension of the individual. As noted under the description of *P. giganteum*, it is probable this is the height rather than the length of the individual in question. The shell itself is very massive. In the umbonal region a thickness of 2.5 centimeters (1 inch) is common, and shells having a thickness of nearly 5 centimeters (2 inches) have been seen. The shell becomes thinner toward the posterior and ventral margins but at all times is heavy. The surface is ornamented by low concentric growth lines. The lunule is small and inconspicuous. In *P. giganteum* there is a large well-marked escutcheon. The escutcheon is narrower and less conspicuous in *P. benjamini*.

The shell is obliquely ovate, with the greatest height in the posterior portion. The hinge line is short and straight except in its posterior part, where it flexes abruptly downward. The anterior margin is nearly straight or with a slight anterior flare in the ventral portion as viewed from the side and has approximately twice the length of the hinge. The ventral and posterior margins are smoothly and evenly curved. The greatest dimension of the shell is from the umbones to the posterior-ventral margin. There is no sharply defined umbonal ridge, but there is a smoothly rounded area of greatest convexity running from the umbones to the posterior-ventral margin. From this area the shell curves abruptly to the anterior margin, which is flattened or even incurved. To the dorsal margin the shell drops off less abruptly but more so than to the ventral and posterior margins. The umbones are highly arched and as noted elsewhere the shell is greatly thickened in this region. The beaks are relatively small and inconspicuous. They are sharply incurved toward the anterior end of the shell.

The hinge plate is massive and straight on the dorsal margin except in the extreme posterior portion, where it flexes abruptly downward. There are four or more massive, long, parallel cardinal teeth in each valve which lie at nearly right angles to the dorsal margin. There is always one well-defined posterior-lateral tooth which takes the form of a long narrow ridge, with a complementary groove on the opposite valve. In addition to this ridge there is a variable development of more or less amorphous interlocking structures of low relief. In the posterior portion of the hinge plate there may be two or more short ridges paralleling the downward flexed portion of the dominant posterior-lateral. These auxiliary teeth show particularly well in moderately young individuals. In large specimens, aside from the long lateral tooth, there is a variable development of lumps and ridges of low relief, with the complementary depres-

sions on the other valve. These are scattered more or less promiscuously along the posterior portion of the hinge plate.

Of great interest in the hinge structure of the genus and an outstanding structure differentiating it from the genera with which it might be confused is the presence of an unusually large opisthodetic ligament. This extends from the beaks to the posterior extremity of the hinge line. The ligament lies in a deep trough which as a rule is V-shaped in cross section. Specimens have been seen in which the dorsal margins of the shell are somewhat incurved, giving the ligamental fossa a suboval cross section. In moderately large specimens the trough in which the ligament lies has a depth of about 1 centimeter, while in a large fragmentary specimen it has a depth of more than 2 centimeters. The walls of the fossa are striated longitudinally.

The posterior muscle scar is inconspicuous but appears to be fairly large and situated high up in the valve below the posterior end of the hinge. The anterior muscle is relatively small and varies in size in individuals of approximately the same size. The scar is deeply impressed and lies at the lower anterior extremity of the hinge plate, closely apposed to the group of anterior teeth. The pallial line is simple. No pedal scar has been identified.

Pycnodesma may well be referred to the Megalodontidae. In this family there are but two genera with which *Pycnodesma* need be compared—*Megalomus* and *Megalodon*. *Megalodon* is thoroughly known, but the structure of *Megalomus* has never adequately been figured and described. The figure given by Hall [1] is inadequate and somewhat misleading. *Megalomus* and *Megalodon* are intimately related and may only be separated on minor structural features.

Pycnodesma may readily be distinguished from *Megalodon* and *Mewalomus*, figures of which may be seen on Plate 2, Figures 6 and 7. An outstanding character is the enormous development of the ligament in *Pycnodesma*. The hinge plate in *Megalodon* and *Megalomus* is a massive anteriorly situated platform sharply cut off from other shell structures and extending backward as an attenuated strip. In *Pycnodesma* the hinge plate is a broad, well-defined structure extending to the posterior end of the hinge. The cardinal teeth in *Pycnodesma* are more numerous and less massive than in *Megalodon*. In *Pycnodesma* they are subequal in size, fairly straight and parallel. In *Megalodon* and *Megalomus* the cardinal teeth are of variable form and variously curved and oriented. In *Pycnodesma* the teeth lie at approximately right angles to the hinge, while in *Megalodon* they are subparallel to it. This feature as

[1] Hall, James, Paleontology of New York, vol. 5, pt. 1 (2), pl. 52.

well as the relative position of the anterior adductor is, of course, determined by the very different degree of torsion in the shells. In *Pycnodesma* there appears to be no pedal scar, which is present in both *Megalodon* and *Megalomus*. In *Pycnodesma* the beaks are much smaller and less conspicuous, the hinge line shorter and the anterior margin longer, all of which give the genus a general aspect quite at variance with *Megalodon* and *Megalomus*.

As genotype, *Pycnodesma giganteum*, new species, has been chosen.

The genus as yet is known only from the high upper Silurian strata of Alaska but doubtless will be found in Asiatic faunas of equivalent age.

PYCNODESMA GIGANTEUM, new species

This species is found in great abundance in the massive Silurian limestone of Glacier Bay, notably on Willoughby and Drake Islands. It is also probably the species found in the Silurian limestone of Seward Peninsula and in the massive limestone at the base of the Silurian section in Freshwater Bay, Chichagof Island.

Extremely large specimens of the species are often seen. On Drake Island, Glacier Bay, I saw a weathered cross section of an individual measuring more than 12 inches (30 centimeters). Judging by the thickness of the shell it is probable that this section did not lie along the line of greatest length but gave the approximate height of the shell. The specimens here figured are of small to medium size, as it was not possible to collect the largest specimens in other than a fragmentary condition.

The shell is obliquely ovate, with the greatest height in the posterior portion. The longest dimension of the shell is an oblique line from the beaks to the posterior-ventral margin. In a small individual, reasonably well preserved, the following measurements obtain: Straight portion of hinge, 2 centimeters; total length of hinge, about 3 centimeters; anterior margin, 4.5 centimeters; height, 6+ centimeters; and greatest length, 7+ centimeters. The greatest transverse dimension of this individual is 4 centimeters. These relative proportions seem approximately to hold in the larger specimens.

The hinge line is short and straight except in its posterior portion where it flexes abruptly downward, meeting and merging with the smoothly and evenly curved posterior margin. The anterior margin is straight and at approximately right angles to the hinge line, or forms an acute angle with it. The ventral margin is relatively short and smoothly curved. The valves are highly ventricose. The umbonal region is prominent and highly arched. The beaks proper are small and sharply incurved. The valve is most highly arched along a line running obliquely from the umbones to the posterior-ventral margin. From this line the shell pitches rather abruptly to the anterior and

dorsal margins. In all other directions the slope is more gradual. As shown in an anterior view, the anterior portion of the shell is decidedly flattened. Along the line of contact of the valves is a well-marked depression due to a decided incurving of the valves along their anterior margins.

The shell itself is very thick, especially in the umbonal region and along the line of greatest arching. In the umbonal region of large individuals the shell may be 5 centimeters (2 inches) or more in thickness, while specimens of medium size have a thickness of an inch or more in this part of the shell. The shell becomes thinner toward the margins but at all times is heavy. The surface of the shell is marked by fine concentric lines, which become much coarser in the flattened anterior portion of the valves. An inconspicuous lunule and a large, well-defined escutcheon are present.

The hinge plate is very broad in the anterior portion of the valve, narrowing posteriorly and then becoming wider again. In its posterior part it flexes abruptly downward. The anterior teeth are five or six in number in each valve and are usually subequal in size. They are long, nearly straight, narrow and parallel. They lie at nearly right angles to the hinge or slope somewhat posteriorly. Rarely two of the teeth partially fuse laterally, giving the effect of fewer, more massive teeth, as shown in Plate 1, Figure 4. This appears to be an individual variation and is only partially to be correlated with ontogenetic change. In the posterior portion of the hinge plate is a variable development of posterior-lateral teeth. Usually there is one well-defined tooth which shows as a low narrow ridge. This may start near the group of anterior teeth or much farther back on the hinge plate. Always it appears to be present in the downward flexed portion of the hinge plate. In addition to this long narrow posterior-lateral there may or may not be present one or more linear, short, more massive teeth, usually restricted to the downward flexed portion of the plate but occasionally anterior to the flexure. In addition to these fairly well-defined teeth there is a variable development of amorphous elevations and depressions posterior to the group of anterior teeth.

The anterior muscle scar lies at the lower anterior angle of the group of anterior teeth. In all but one specimen seen the scar lies in a small inconspicuous pit. In this one exception (pl. 2, fig. 5) the muscle scar is far larger than in any other specimen observed, irrespective of size, and may be an individual abnormality. Possibly the specimen is referable to another species. It is to be noted that the specimen is referred to this species with a question, as it has other characters, such as a longer hinge line, more projecting anterior portion of the shell, and more pronounced surface sculpture than

is characteristic of the typical specimens of the species. The posterior muscle scar is very poorly known, as the posterior portion of the shell is usually broken away, and only indifferent internal molds of the shell are available for study. The posterior muscle appears to have been large and situated high up on the shell, below the posterior end of the hinge.

The type specimens were collected in the massive upper Silurian limestones of Drake and Willoughby Islands, Glacier Bay, southeastern Alaska. Collector, E. Kirk.

Cotypes.—Cat. No. 71275, U.S.N.M.

PYCNODESMA BENJAMINI, new species

This species is common in the upper portion of the upper Silurian section as exposed in Freshwater Bay, Chicagof Island, southeastern Alaska. Occurring as it does in argillaceous limestone which is much checked and fractured it is, however, difficult to secure reasonably perfect specimens. Enough material was seen and collected, however, to prove that the form is specifically distinct from *Pycnodesma giganteum* which is found 1,000 feet or more stratigraphically lower in the section.

The species, though of large size, apparently does not reach the great dimensions of *Pycnodesma giganteum.* Unfortunately no individual has all the margins sufficiently well preserved to get the relative proportions of the shell and thereby estimate the maximum dimensions of large fragmentary specimens.

In general outline the shell appears to be subquadrate, with the height somewhat in excess of the length, and with the greatest dimension the line running from the beak to the posterior-ventral border. The general slope of the shell is very different from *Pycnodesma giganteum.* The hinge is proportionally longer, as is the anterior margin. The anterior margin of *P. giganteum* is at approximately right angles to the hinge line or forms an acute angle with it. In *P. benjamini* the anterior margin carries forward, making a decided obtuse angle with the hinge line.

The hinge line as noted above is proportionally longer than in *P. giganteum.* In its posterior portion it curves gently downward instead of being sharply flexed. The anterior margin is straight in its upper portion, but ventrad it flares outward. The valves are much less ventricose than in *P. giganteum.* The umbonal region is the most highly arched portion of the shell. The beaks are small and incurved. The valves are most highly arched along a line running from the beaks to the posterior-ventral margin, but this arched area is not sharply differentiated from the remainder of the valve. Toward the anterior margin the shell pitches off rather abruptly, particularly in the dorsal part. In all other directions the shell

slopes off gradually. The anterior portion of the shell is slightly flattened in its upper part but not so decidely as in *P. giganteum*, nor is there the incurving of the valves as in the latter species.

The shell itself is relatively thinner than in *P. giganteum*. As in that species the thickest portion of the shell is at the umbones, and continuing backward and downward along the line of greatest convexity. The surface of the shell is marked by fine concentric growth lines. The lunule is small and the escutcheon narrow and relatively inconspicuous.

The internal shell structures are inadequately known owing to the poor preservation of the material. The hinge plate is proportionally longer than in *P. giganteum* and straighter. The anterior teeth seem to be similar in all respects to those of *P. giganteum*, as is the anterior muscle scar. The posterior teeth and muscle scar are unknown.

The species may readily be distinguished from *P. giganteum*. It has a thinner shell. The beaks are more prominent owing to the fact that the umbones are less highly arched. The valves are less highly arched than in *P. giganteum*, giving a much narrower shell. The most striking difference is the general outline. The obtuse angle formed by the anterior margin with the hinge line and outward flare of the lower portion of the anterior margin is a very striking feature. The relatively longer and straighter hinge line is also characteristic.

The specific name is given in honor of Dr. Marcus Benjamin, of the United States National Museum.

Pycnodesma benjamini was collected in the upper portion of the upper Silurian section on the south side of Freshwater Bay, Chichagof Island, southeastern Alaska, near the head of the bay. Collector, E. Kirk.

Holotype.—Cat. No. 71276, U.S.N.M.

EXPLANATION OF PLATES

PLATE 1

Pycnodesma giganteum, new species

FIG. 1. Anterior view.
2. Dorsal view of same specimen.
3. Exterior, left valve of same specimen.
4. Interior, left valve of same specimen.
5. View of right side of another specimen showing almost complete outline. Cat. No. 71275, U.S.N.M.

Pycnodesma giganteum, new species?

6. Portion of right valve of a specimen showing growth lines. Cat. No. 71277, U.S.N.M.

All figures approximately × 2/3.

PLATE 2

Pycnodesma benjamini, new species

FIG. 1. View of right side of the type specimen. Cat. No. 71276, U.S.N.M.
2. Anterior view of same specimen.

Pycnodesma giganteum, new species

3. Interior of left valve showing posterior portion of hinge plate.
4. Interior of right valve of another specimen showing anterior portion of hinge plate, teeth, and small muscle scar. Cat. No. 71275, U.S.N.M.

Pycnodesma giganteum, new species?

5. Interior of right valve of same specimen figured as Pl. 1, fig. 6, showing striated wall of ligamental fossa, teeth, and large muscle scar. Cat. No. 71277, U.S.N.M.

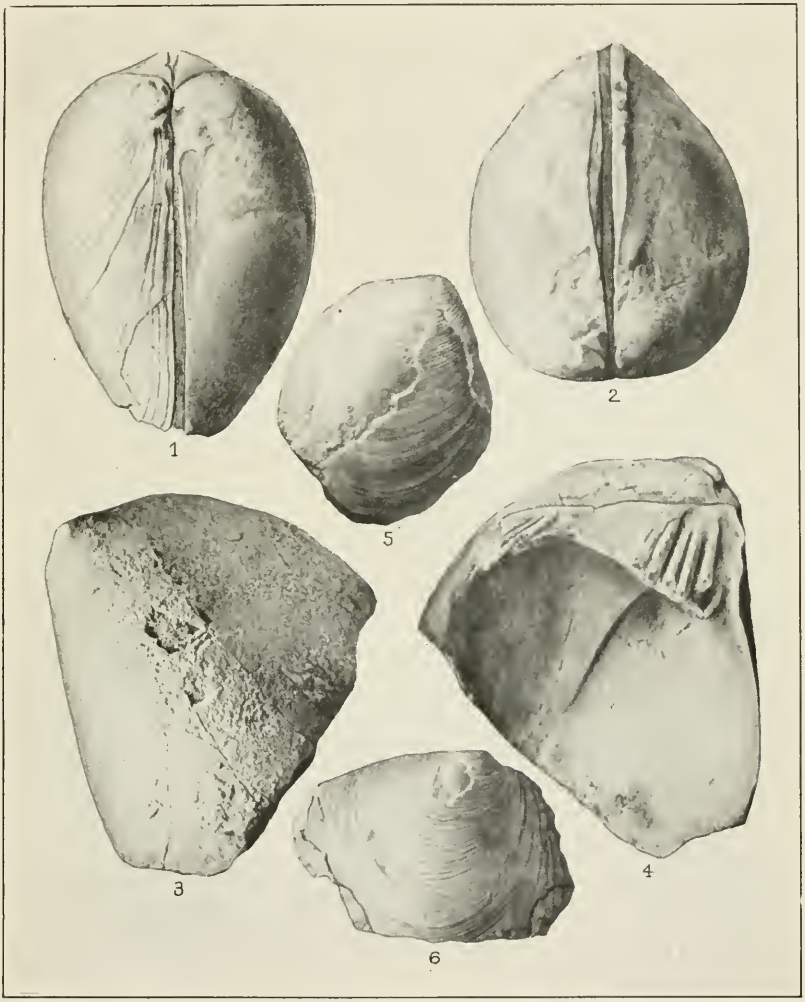
Megalodon (*Eumegalodon*) *cucullatus* (Goldfuss)

6. Interior view of left valve.
Middle Devonian, Paffrath, near Cologne, Germany. Cat. No. 15527, U.S.N.M.

Megalomus canadensis Hall

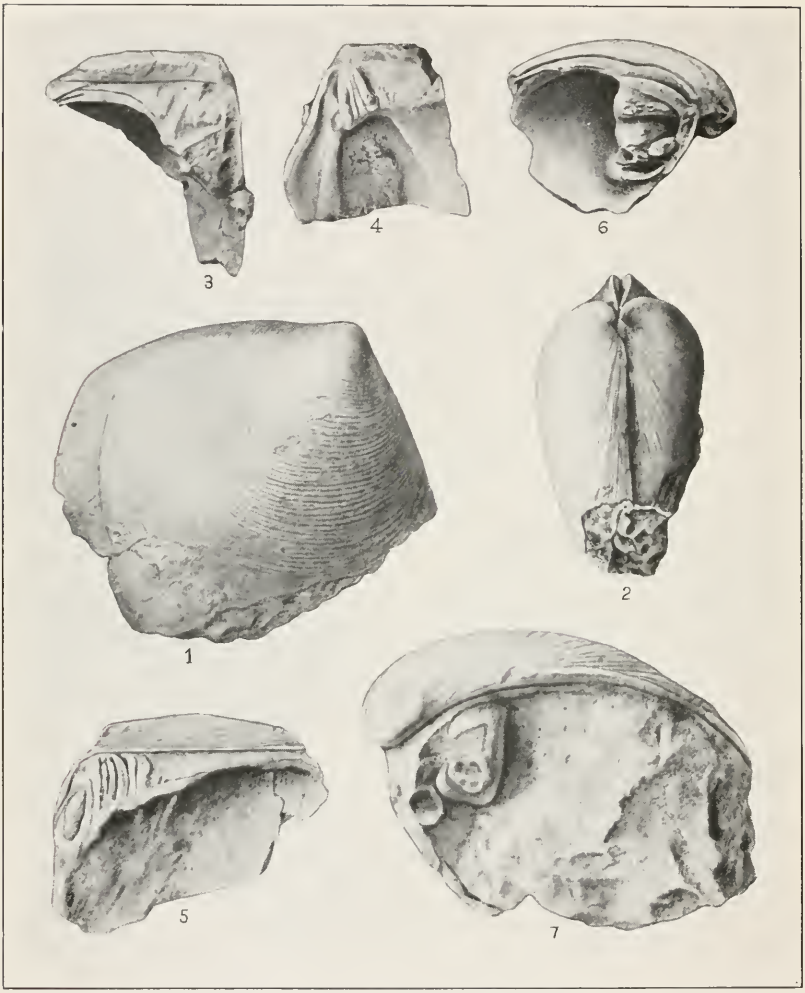
7. Interior view of right valve.
Guelph (middle Silurian), Elora, Ontario. Cat. No. 71278, U.S.N.M.

All figures approximately × 2/3.



VIEWS OF PYCNODESMA GIGANTEUM, NEW SPECIES

FOR EXPLANATION OF PLATE SEE PAGE 3



PYCNODESMA BENJAMINI, P. GIGANTEUM, MEGALODON CUCULLATUS AND MEGALOMUS CANADENSIS

FOR EXPLANATION OF PLATE SEE PAGE 9