MONOPLACOPHORA (MOLLUSCA) FROM THE UPPER ORDOVICIAN OF NORWAY

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Monoplacophora are rare fossils; only 15 specimens are known from the 4c–5b stratigraphic interval in Norway. Nevertheless, eight species assigned to five genera are recognized. All previously named species have been re-illustrated and reassigned; one specific name is placed in synonymy. A new species of *Patelliconus* is named; this is the first report of the genus above the Middle Ordovician. *Pygmaeoconus* is questionably recognized in the Upper Ordovician for the first time, and a Norwegian Middle Ordovician species is assigned to it.


Among other fossils, representatives of a small group of molluscs are found in the Upper Ordovician rocks of the Oslo area. The purpose of this paper is to redescribe and reillustrate those specimens known earlier and to add some specimens overlooked in earlier descriptive work and others found in half a century of collecting. It follows an earlier study (Yochelson 1963) of Norwegian Middle Ordovician Monoplacophora.

Taxonomic scope

For nearly two decades it has been generally accepted by paleontologists and neontologists that there is a class of molluscs whose soft parts are in a bilateral arrangement without any torsion, within a somewhat low-conical, bilaterally symmetrical shell. Evidence for symmetry of the soft parts is based on half a dozen living species and on extrapolation from paired muscle scars preserved in some early Paleozoic fossils. Some present-day limpets, which cling to rocks, show a bilaterally symmetrical cap-shaped shell, but their soft parts have the characteristic torsion of gastropods, and, where muscle scars in the shell are present, they are unlike those of monoplacophorans.

The group of Monoplacophora was first recognized from Paleozoic fossils that showed paired muscle scars. It is appropriate to examine all Norwegian cap-shaped fossil molluscs in the hope of obtaining more data on the soft parts of these phylogenetically interesting animals. As so often happens with a scientific investigation, no striking new discoveries have been made; only a few additional facts on morphology of the shell have been documented. In the absence of muscle scars, it is impossible to state categorically whether a simple cap-shaped shell is that of a monoplacophoran or a limpet gastro-
pod. Because of the age of these shells and similarity to others described which have scars, I assume that all are monoplacophorans but it is an assumption, not a fact, and for some species my interpretation may be spurious.

Classification

Since publication of the classification of Monoplacophora, in the 'Treatise' (Knight & Yochelson 1960), naming of additional genera has been at a rapid rate and the class has approximately doubled in taxonomic size. Several different schemes of subclass and ordinal arrangement have been proposed for the Monoplacophora. Thus Rosov (1975) recognizes four orders, whereas Runnegar & Jell (1976) place two of these orders in synonymy and add another. The content of the orders varies markedly from one author to the next.

I have deliberately used the ordinal subdivisions of Knight & Yochelson in this paper. First, I am not convinced of the validity of any of the newer schemes of phylogeny, though this does not mean that I accept that of Knight & Yochelson unchanged; any classification becomes obsolete after publication. Second, the Norwegian taxa redescribed do not contribute any data germane to the issue of high-level classification and thus should not be preceded by speculative writings on phylogeny; current alternative arrangements within the Monoplacophora are all rather long on theory but rather short on new facts. These fossils all have a low-conical to cap-shaped shell, characteristic of typical monoplacophorans. Koken (1925: 56–57) described one species of Cyrtolites from Norway; some workers place this coiled genus within the Monoplacophora. Examination of the type material has convinced me that this species is a bellerophontacean gastropod and it is not treated herein.

The problem of defining the class Monoplacophora is not simple and needs to be explored in detail when appropriate material is available. The significance of paired muscle scars in identifying representatives has been noted, but the spacing and number of scars vary. Not all molluscs having paired muscle scars are monoplacophorans; some bivalves and some cephalopods show them. The trend of several recent authors to transfer bellerophontacean gastropods to Monoplacophora may be based on a spurious homology of paired scars. My view, unchanged by some current speculation on phylogeny (Runnegar & Jell 1976; earlier papers cited therein) is that there are a few taxa of coiled monoplacophorans, but that the overwhelming preponderance of Paleozoic bilaterally symmetrical shells belong to bellerophontacean gastropods.

Because most fossil molluscs do not show muscle scars, identification is based on the external form. Extreme caution should then be used in assigning fossils to the Monoplacophora. The shell should look reasonably like that of Silurian Tryblidium and Ordovician Archaeophialia. Too much deviation from this general shape can result in the Monoplacophora be-
coming a term that loses all significance. As noted above, univalve molluscan shells without muscle scars preserved need not be monoplacophorans.

Previous studies

Yochelson (1963: 138–140) reviewed the history of Ordovician gastropod and monoplacophoran studies in Norway. In effect, except for the posthumous major work of Koken (1925), edited by Perner, there is no literature. Kiær (1897: 75) noted, but did not describe, the occurrence of two monoplacophoran species in unit 5 b, late Upper Ordovician of the Norwegian standard stratigraphic classification.

My aim has been to illustrate the types of Koken photographically and to redescribe them, thus bringing the work of Koken up to date. Regardless of how meticulous an artist may be, drawings always reflect some degree of interpretation. Although photographs do not always convey all the information on shape that an investigator can obtain by actually examining a specimen, they are more objective than drawings. It is a sad fact of nature that photographs of the Norwegian specimens reveal more of what is not there than of what is. For most species, critical details of growth lines on the exterior or muscle scars on the steinkern are not preserved.

Several species named by Koken are based on material inadequate by present standards. I do not feel that each entity described by a paleontologist must have a specific name. The criteria of what is adequate material upon which to base a specific name changes from genus to genus and is highly subjective. I would prefer to leave material unnamed that has an uncertain stratigraphic position or is poorly preserved, rather than burden the literature with additional names. Nevertheless, the names are in the literature, and it is better to know what these names are based upon than to use them without a clear understanding.

This study is of taxa that are found in units 4c through 5b, as used in the Norwegian standard stratigraphic classification. All Upper Ordovician specimens of monoplacophorans reported by Koken from Norway are preserved in Paleontologisk Museum in Oslo and have been examined. In addition to specimens previously figured, I have studied those specimens that were either not examined, or at least not noted by Koken or Perner, plus those that have accumulated in the half century since publication of that work. Few new specimens of monoplacophorans have been collected.

The available Upper Ordovician monoplacophorans constitute little more than a dozen specimens, yet five genera are easily recognized. The diversity of the Monoplacophora is amazing. Most specimens are in old collections, making it impossible to determine their association with other fossils. Almost all specimens are in dark fine-grained limestone, a common rock in the Oslo area.

Except that these molluscs were rare, little more may be said concerning their paleoecology. During life, Archaeophalia might have clung to
rocks. Peel (1975: 121) presents strong inferences that Pilina was mobile, or at least not a clinging form. The mode of life of other genera remains enigmatic. As is so often the case with a paleontologic study, additional and better preserved material would be helpful; perhaps another half century of collecting in the Oslo Region will provide such fossils.

Systematic descriptions

Class Monoplacophora

Superfamily Tryblidiacea Pilsbry in Zittel-Eastman, 1899.
Family Tryblidiidae Pilsbry in Zittel-Eastman, 1899.
Subfamily Tryblidiinae Pilsbry in Zittel-Eastman, 1899.

Genus Pilina Koken, 1925

Pilina esthonum (Koken), 1897

Fig. 1, E, G, H.

Holotype. – PMO 40430.

Description. – Spoon-shaped, strongly arched monoplacophorans; apex known mainly from steinkern. Shell on apex thin, represented by an apical swelling of the steinkern. Apex distinctly anterior, slightly overhanging margin. Shell relatively high, about two-thirds maximum width, and long, about one and one-half times maximum width. Anterior slope short, steeply

Fig. 1. A-D. Archaeophialia antiquissima (Hisinger).
A. Left side view of original of Koken, pl. 39, fig. 16; the upper part of the specimen is covered with matrix; ×2. PMO 20510.
B. Left side view of original of Koken, pl. 39, fig. 18a; ×2. PMO 20508.
C. Top view of same specimen; compare this broad shape with the compressed one in D.
D. Rubber replica of the interior of PMO 20510, showing multiple paired muscle scars. E, G, H. Pilina esthonum (Koken).
E. Top view of holotype; this is the original of Koken, pl. 39, fig. 5; ×1½. PMO 40430.
G. Apical view of holotype, oriented with the shell downward; ×3.
H. Slightly oblique view of right side of holotype, showing ‘fingerprints’ near margin; ×3.
F, I. Tryblidium sp. indet.
F. Top view of a steinkern; ×1½. PMO 14566.
I. Left side view of same specimen.
J. Side view of plesiotype; this is the original of Koken, pl. 39, figs. 19a–19c; ×3. PMO 20730.
K. Top view of same specimen.
L. Side view of same specimen.
M. Archinacella? species. Right side view of steinkern; ×3. PMO 9716.
concave but not known in detail; posterior slope long and correspondingly little curved; lateral slopes constricted near apex, but smoothly curved on posterior. Maximum width at posterior half of shell, well behind apical constriction; anterior part of margin near apex unknown; posterior part in one plane. Interior possibly with several small ridges and grooves subparallel to margin and a little posterior of apex on lateral slopes; muscle scars otherwise unknown. Shell moderately thick, steinkern slightly flaring at margins. Ornamented by closely spaced growth lines which are distinct and slightly lamellose.
Discussion. — The present location of the specimen or specimens discussed by Lindström (1884:57) is unknown. The 'variety' of Pilina unguis from Borkholm, Estonia, mentioned by him, was never figured, and until the missing specimens are found the characters of this species must remain ambiguous. In 1897 Koken named the species and gave its occurrence as unit Fz on Borkholm.

Koken in 1925 illustrated a specimen that is here taken as the lectotype, even though there is a slight chance that it is not from the material he had in 1897. In this later work he again reported the species as occurring only in the Fz unit from Borkholm, but the illustrated specimen is from Norway; the species has not been reported from this country heretofore, but it is the occurrence in Estonia that is in doubt!

The figured specimen is a partial steinkern, preserving shell on the posterior part. No muscle scars are evident, and the shell shows no perforations as in Tryblidium. The apex is blunter and less elongate than in the Lower Ordovician genus Proplina. Pilina is an appropriate generic reference.

Lindström (1884:57) noted that this form was 'only a little more elongate and not so enlarged as the specimens from Gotland.' These slight differences are still the only ones that can be observed between the Norwegian specimen of P. esthonum and Lindström's illustrations of the Silurian species P. unguis (Lindström). Tryblidium lindstroemi Koken, from unit Fz at Borkholm, Estonia, has the characteristic reticulate ornament near its apex and has the proper generic reference. T. acuminatum Perner in Koken, from the same area, is poorly illustrated but again may be a more flattened shell than Pilina.

Muscle scars are not obvious; the shell is about half the thickness of that of Archaeophialia, even though specimens are more than twice as large. Internal features which are preserved are difficult to interpret. A vague suggestion of an elongate wide band may be seen on either side of the shell as in Archaeopraga (Horný 1963), but it is not clear enough to warrant reference of the species to that genus. Peel (1977) described a strikingly similar shell from the Late Ordovician of Oklahoma which preserved the paired muscle scars; I consider this further evidence that the Norwegian species should be assigned to Pilina rather than Archaeopraga.

The constrictions posterior to the apical region are a mystery, though Peel (1977:121) has suggested that this may be a delineation of the head region of the animal from the main body mass. Parallel ridges superficially resembling fingerprints are found here near the margin and these, too, are a mystery. In some species of Pilina a slight geniculation is found along the margin at this general shell area, but the Norwegian specimen is broken, and I cannot determine whether P. esthonum has the margin entirely in one plane.

The apical filling shown on the steinkern (Fig. 1, F) is particularly interesting. The illustrations of Pilina unguis (Lindström) show an internal
depression near the apex exactly as in this species. Lemche & Wingstrand (1959) have suggested that this might be the result of the protoconch being overgrown and have interpreted this supposed protoconch as slightly asymmetrical. The specimen at hand shows no apparent deviation from bilateral symmetry, and nothing suggests that it is anything more than a simple cap-shaped protoconch. The feature is better interpreted as a tiny shell with a more compressed cross section which expanded upon reaching an appropriate size. Perhaps this expansion marked a change from pelagic life to a benthonic habit. Peel (1977:118) found a similar, though longer protoconch on his specimen.

**Occurrence.** – 5b, Husbergøya, Oslo.

**Genus Tryblidium Lindström, 1880**

*Tryblidium* sp. indet.

Fig. 1, F, I.

**Discussion.** – Only one specimen (PMO 14566) is available; this was collected from Ullemtangen, Ringerike. The labels with it strongly suggest that this is the *Tryblidium* sp. discussed but not figured by Perner in Koken (1925: 269), cited as being from unit 5a. The specimen is entirely a steinkern that has the apex broken. It is nearly twice as large as the specimen of *Pilina esthonum* and differs from it in being a higher shell. Although the margin is broken, one can infer some geniculation from the preserved parts. Finally, an abrupt flaring of the steinkern near the margin suggests a thick shell. The specimen resembles steinkerns of Silurian *Tryblidium* from Gotland (J. S. Peel, pers. commun. January 1975).

**Occurrence.** – 5b, Ullemtangen, Ringerike.

**Subfamily Archaeophialinae Knight & Yochelson, 1958**

**Genus Archaeophialia Perner, 1903**

*Archaeophialia antiquissima* (Hisinger), 1837

Fig. 1, A–D

[No attempt has been made to provide earlier synonymy]. □ 1897 *Patella antiquissima* Hisinger, Koken: 114, fig. 1. □ 1923 *Scapha antiquissima* (Markl.), Hedström: 19–12, pl. 1, figs. 15–19. □ 1925 *Archaeophialia antiquissima* Marklin, Perner in Koken: 270, pl. 39, figs. 16–18a, b. □ 1925 *Archaeophialia suecica*, Koken: 271. □ 1930 *Paterella antiquissima* (Markl.), Hedström: 7–8. □ 1938 *Archaeophialia antiquissima* (Hisinger), Wenz fig. 54. □ 1941 *Archaeophialia antiquissima* (Hisinger), Knight: 42–44, pl. 3, figs. 3a, b. □ 1952 *Archaeophialia antiquissima* (Hisinger), Knight pl. 1, figs. 3a, b. □ 1959 *Archaeophialia antiquissima* (Hisinger), Lemche & Wingstrand: 45, pl. 53, figs. G. H. □ 1960 *Archaeophialia antiquissima* (Hisinger), Knight & Yochelson: 1-79, figs. 48, 4.
Material. – PMO 20506–20510. (PMO 20508 and 20510 figured by Koken).

Discussion. – The excellently preserved type of this species has been described in detail by Knight (1941: 42). The species has also been figured diagrammatically several times since that description, partly in connection with investigations of the recent monoplacophoran Neopilina. No redescriptions are needed on the basis of the material at hand.

The Norwegian material available to Koken consisted of five specimens, two of which he figured. One, the original of pl. 39, figs. 18a, 18b, is a low, broad cone ornamented by strongly lamellose growth lines; the interior is filled with matrix. The second (pl. 39, figs. 16, 17) is a rather compressed and elongate high cone, showing similar lamellose ornament. The interior of this larger specimen was partly filled with matrix, but I have been able to excavate some of the muscle scars. All matrix could not be removed, and the process, unfortunately, left several tool marks on the shell. The arrangement of muscle scars is similar to that in the holotype (Knight 1941, pl. 3 figs. 3a, 3b). Principal scars are deeply incised into the shell, but no secondary scars are to be seen.

The difference in shape between this elongated specimen and the more rounded margin of the holotype figured by Knight may be attributed in part to individual variation. The two specimens figured by Koken differ so much that superficially the lower conical specimen resembles a calcified operculum of Oriostoma rather than a shell. Ontogenic shape change is suggested if one considers all five specimens as representatives of one population. A low cone subcircular in outline is characteristic of the early growth stages, whereas in the later growth stages, the anterior and especially posterior margins continue to expand relative to the lateral margins. However, the lateral slopes becoming steep are not typical, and I am inclined to think that the specimen figured was crowded during its growth.

The shell is quite thick and in this feature is similar to Tryblidium. This thick shell may account for the preservation of muscle scars. Lamellae vary considerably in strength, even allowing for some diagenetic effects. All the shells are faulted or cracked, a feature not seen in other Norwegian monoplacophorans. This phenomenon is most likely to have taken place if the shell were free of matrix, a position that this flat, low shell could assume after death. I suspect, though cannot prove, that Archaeophialia was well adapted for clinging and was sedentary. If so, this would aid in interpretation of the variation in shape, for present-day clinging molluscs commonly show a higher degree of variation in shape than those that are free living.

Koken in 1925 excluded his 1897 reference to this species from the synonymy. I can see no reason for this change. The text figure shown in 1897 seems to be characteristic of the species, although I have not examined the specimen upon which it is based. Hedström (1930) pointed out that Koken’s new species of Archaeophialia and the type species were both based
on specimens from Borenshult, Östergötland, Sweden. I am following him in placing Koken’s name in synonymy.

*Occurrence.* – 5b, Hovedøya, Oslo.

*Superfamily* Archinacellacea Knight, 1956  
*Family* Archinacellidae Knight, 1956

*Genus Archinacella* Ulrich and Scofield, 1897

*Archinacella approximans* Perner *in* Koken, 1925

Fig. 2, L. M.

1925 *Archinacella approximans* Perner *in* Koken: 279, pl. 37, fig. 9.

*Holotype.* – PMO 40439.

*Description.* – Low conical shells with a strongly curved apex and broad elliptical-shaped aperture. Apex distinctly anterior, its tip unknown. Maximum width about two-thirds of maximum length. Aperture margin elongate and in one plane, essentially straight on sides, smoothly curved on anterior and posterior so that its outline is elliptical. Anterior slope concave, strongly arched, extending well forward of apex; posterior slope gently convex little arched. The greater length of slope inclined less than twenty degrees from vertical; steinkern without any flaring at edge of apertural margin.

*Discussion.* – The original lot of this species consists of only the figured specimen. The holotype is accurately illustrated and is a steinkern that has the top of the apex broken. Part of the left margin is also broken. No muscle scars can be observed. Faint rugosities are on the posterior slope.

*Archinacella approximans* differs from the Middle Ordovician *A. norwegica* (Perner *in* Koken) in being more elongate in front and posterior to the apex but more compressed laterally, so that the outline of the margin approaches a lozenge shape. This species differs from the Middle Ordovician *A. stoermeri* Yochelson in being much lower, though the shape of the margin and position of the apex are nearly identical in both species. The absence of muscle scars preserved in a relatively fine-grained matrix and the lack of any sort of apertural flaring on the profile of the steinkern suggest that the shell was extremely thin in *A. approximans*, *A. norwegica*, and *A. stoermeri*, as well as in unnamed Middle and Upper Ordovician species from Norway. Two Middle Ordovician *Archinacella* species from Czechoslovakia, *A. ovala* Perner and *A. tarda* Perner, both redescribed by Horný (1961a), differ from all these species in having the apex overhanging the margin.

*Archinacella suborbicularis* Koken, from unit B₄ in Estonia, differs in having more of a semicircular margin. *Archinacella rostrata* (Eichwald), from unit F₁ in Estonia, and *A. media* Koken, from unit D₅, cannot be compared until their early growth stages are better known.
Horny (1961a) distinguished the genus *Archinacellina* from *Archinacella* because of the presence of a continuous muscle scar rather than a horseshoe-shaped ring open away from the apex. As the Norwegian material shows no trace of muscle impressions, assignment to genus could be argued. However, so few specimens of monoplacophorans preserve the muscle scar that it is better to use *Archinacella* in a wide sense rather than question the placement of virtually every species. In any event, *Archinacellaria modesta*, the type species of that genus, has the apex overhanging the margin and is distinct from *A. approximans* on the specific level.

Occurrence. – Lindøya, Oslo. Perner in Koken reports this species from 4d, although a label on the specimen (PMO 40439) gives the horizon as 4\beta\gamma. This stage on Lindøya is now placed in 5a.

*Archinacella* species

Fig. 2, I, J.

Material. – PMO 11847.

Discussion. – Another monoplacophoran in the collections studied is a single distorted steinkern, collected in 1891 by Kiær. It is from the same general locality as *A. approximans*, but there is no certainty that these two were collected at the same time or from the same stratum.

The specimen differs from the type of *A. approximans* in being a higher cone, more laterally compressed. The anterior slope is longer but the apex is even closer to the margin. These are distinct shapes. However, observations of about a dozen specimens from one locality on Öland, Sweden, and an-
other equally large sample from Utah, both of Middle Ordovician age, suggest much variability in some limpet shells, though whether in the absence of muscle scars they or the specimen discussed can be placed in the monoplacophorans is a matter of uncertainty. For the present, this Norwegian specimen is better treated as a representative of a distinct specific-level taxon, but, if additional specimens of small monoplacophorans are collected, the possibility of intergradation should be seriously considered.

Troedsson (1929, pl. 3, fig. 5) illustrated a *Scenella* sp. from the Cape Calhoun Formation in northern Greenland. Although it superficially resembles an *Archinacella*, it has a semicircular outline rather than a more
oval one, and the apex is not so obviously interior. Further, it has prominent radial ornament and fainter concentric threads. The specimen is a craniid brachiopod, according to David Worsley (pers. commun. January 1975).

Occurrence. – 5a, Lindøy, Oslo.

Archinacella? species
Fig. 1, M

Material. – PMO 9716.

Discussion. – One specimen collected by W. C. Brøgger in 1886 is partly exfoliated and in a hard limestone matrix. It is questionably referred to this genus, but may represent a new genus. The protoconch is unknown, but the apical part which is preserved gives the illusion of being pointed. From this apex, the shell expands and curves at a moderately rapid rate; there is considerable expansion, though far less curvature below the apex, so that the apex does not overhang the margin. The specimen is thus relatively high. The lateral slopes are only slightly inflated and the width is relatively slightly increased near the center of the apertural margin, so the impression is that of a nearly flat-sided shell. Several concentric indentations low on the steinkern increase the superficial similarity to the Cambrian Helcionella. Although the material is inadequate to name formally, the material is fully adequate to show the conchological variety within the basic low conical shell of the monoplacophorans.

Occurrence. – 4cβ, Terneholmen, Asker.

Family Hypseloconidae Knight, 1956

Genus Pygmaeoconus Horný, 1961

Pygmaeoconus? compressus (Koken), 1925
Fig. 1, J-L, Fig. 2 2A, C–E.

Lectotype. – PMO 20728.

Paralectotype. – PMO 20729, 20730.

Description. – Small, moderately high-conical shells. Margin oval. Apex known only from steinkern, simple, relatively wide and uncurved, subcentral in position but clearly closer to one edge, arbitrarily designated anterior. Anterior slope inclined about twenty to twenty-five degrees from vertical;
posterior slope inclined about thirty to thirty-five degrees from vertical but having a slight bulge near midwhorl; lateral slopes inclined about twenty degrees from vertical in early growth stages, abruptly curving outward so that in the mature stage the slope is about forty-five degrees. Juncture of posterior with lateral slopes along a sharp angulation during early growth slopes but angulation disappearing in more mature stages so that apertural margin is curved; width at maturity about three-fourths of length, the margin a wide oval, smoothly curved throughout its length. Muscle scars unknown; shell thin, seemingly without ornament.

Discussion. — Many small errors mar the pages of Koken's work on Ordovician gastropods. In a short note, Heintz (1933) was able to correct two of these errors. First, he located the type lot of two specimens and figured the lectotype of *Palaeacmaea compressa*, one of Koken's unfigured species. Second, he showed that the locality cited for the specimen of *Palaecmaea constricta* Eichwald, figured by Koken, was in error, and he corrected it.

According to Heintz (1933), all three specimens come from the same locality on Vestre Svartøy, Ringerike. I prefer to consider them as samples of a single population rather than representatives of two taxa. The lectotype of *P. compressa* is somewhat smaller and more compressed anteriorly than the specimen referred by Koken to Eichwald's species, but the differences do not appear significant to me. Eichwald's species is not well known; it is better to refer all specimens to Koken's species.

Neither of the steinkerns of *P. compressa* shows any trace of muscle scars, as the matrix has a relatively coarse texture. The shell on the largest specimen is recrystallized and partially exfoliated. Closely spaced concentric growth lines are still present. When moistened, the anterior part of the shell shows radial lines, but these may be related to poor preservation rather than an indication of ornament.

The sharp posterior angle, which was used by Koken as a specific character, clearly is confined to the earliest growth stages. It seems to be related to a steeper angle of the slopes. Both features have been observed on steinkerns; probably if the shell were preserved, their effect would be less obvious. Although the specimen referred to *P. compressa* lacks the apex, enough remains of the upper part of the shell to indicate an abrupt change in curvature of the lateral slopes.

This species does not belong to *Palaeacmaea*; that genus is best described as a large, very low cone. Horný (1961: 301) proposed *Pygmaeoconus* for small, relatively high shells having subcentral apex. However, he indicated an elaborate muscle scar low on the cone. In the absence of this scar, I prefer to use the generic name in a questionable sense rather than extend it above the Middle Ordovician.

Yochelson (1963: 149-150) assigned the Middle Ordovician *Pollicina conoidea* Koken, with question, to *Hypseloconus*. Simply from the form, size, and age of this species, it is more appropriately transferred to *Pygmae-
E. L. YOCHELSON

*Oconus.* That species has a much higher cone than *P.? compressus.* I have reexamined the type of *Pygmaeoconus conoideus* to determine whether any muscle scars are present. Very low on the presumed right side of the steinkern, a raised band is present. It is not present on the other side of the shell, which is equally well preserved. This species has been refigured (Fig. 2, B, F) for comparison with *Pygmaeoconus compressus,* but mainly to show this band. It may be interpreted as a muscle scar, but an alternative explanation is that this is the impression of a pallial line, that is, the attachment of mantle edge to shell. The position of the feature so low on the shell makes this alternative plausible. The scar illustrated by Horný is far more irregular and shows pinch and swell at several intervals. It is more convincing as a muscle scar than is the welt on the steinkern in *Pygmaeoconus conoideus.*

The original specimen or specimens of *Palaeacmaea humulis* Koken from unit F₁ in Estonia were never figured; no comparisons with that species can be made, and no generic reassignment of it should be considered.

**Occurrence.** – 5a, Vestre Svartøy, Ringerike.

**Genus** *Patelliconus* Horný

*Patelliconus Osloensis* sp. nov.

Fig. 2 G, H, K.

**Holotype.** – PMO 5527.

**Paratype.** – PMO 5526.

**Description.** – Low, oval, concentrically ribbed shells. Apex virtually central, blunt on interior and without pronounced accentuation of anterior or posterior slopes. Shell low, height about one-third of width. Margin oval, continuous curved, and with one end very slightly narrower than other, but not approaching an egg shape. Shell moderately thin, periodically extending outward to form concentric ridges, their spacing increasing slightly with age, and the larger coordinate with a slight flattening of slope around margin. Interior with many closely spaced fine ridges on lower third of slopes and extending almost to margin, their length, weight, and spacing somewhat irregular.

**Discussion.** – This identification is based on two specimens thought to be from unit 4c. One is a steinkern; the other preserves some of the shell. *Patelliconus* was known from a single Middle Ordovician species in Bohemia (Horný 1961:35), and this material extends slightly both the geographic and geologic ranges.

Horný noted a circular, bandlike impression on the interior of the shell. After observing the lamellose exterior of the Norwegian form, I suspect that
he may have observed a concentric crenulation in the shell rather than a true muscle scar. A band is present around part of the shell, but it is obscure, and it is crossed by many fine ridges on the steinkern. However, the apparent absence of such a scar in the Norwegian species does not preclude its being present in another species. As regards the markings on the steinkern, there are many faint, closely spaced, irregular ridges near the margin. One may guess that these may have been the areas between blood vessels to the mantle margin or may, in some way, have been connected with attachment of the mantle to the shell. Because the apex is subcentral, I am unable to determine anterior and posterior ends of either specimen in the type lot.

In addition to the lack of a muscle scar, P. osloensis differs from P. primulus (Perner), the type species, in being much lower and showing less of a change in slope near the margin.

Occurrence. — 4c, Hovedøya, Oslo.

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