

EARLY ORDOVICIAN GASTROPODS FROM THE OSLO REGION, NORWAY

By

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Abstract: *Bellerophon? norvegicus* Brøgger, from the Ceratopyge Limestone (3a γ) is redescribed and designated the type species of *Sinuitella*, new genus. Seven specimens of *Pararaphistoma* (*Pararaphistoma*) *qualteriatum* (Schlotheim) and one specimen of *Proturritella* sp. are described from the "transition beds" immediately overlying the Orthoceras Limestone (3c). Scattered information on the stratigraphic distribution of these two genera elsewhere in Scandinavia suggests that they may indicate beds older than Middle Ordovician.

Introduction and acknowledgements

In contrast to parts of Sweden and Estonia, gastropods are extremely rare in Lower Ordovician rocks of the Oslo region. In the classic paper by BRØGGER (1882) on stages 2 and 3 of the Oslo region, only one species is described. This species, *Bellerophon? norvegicus*, from the Ceratopyge Limestone (3a γ) is redescribed.

Brøgger also reported several rare gastropods from the overlying Orthoceras Limestone (3c). He identified only one species and did not present any illustrations. Only nine identifiable specimens are known from this general level in Norway, but because they have stratigraphic and biologic significance, they are described herein.

Dr. Gunnar Henningsmoen, Paleontologisk Museum of the University in Oslo, kindly provided information on the geographic and stratigraphic occurrences of the gastropods and showed the writer important localities during several days in the field. Professor Per Thorslund and Dr. Valdar Jaanusson, Palaeontologiska Institutionen, University of Uppsala, Sweden, and Professor Gerhard Regnéll, Paleontologisk-

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Geologiska Institutionen, University of Lund, Sweden, lent specimens for comparison. Dr. Jaanusson kindly discussed the stratigraphic significance of the Swedish material. Stud. real. Frank Nikolaisen searched the collections of the Paleontologisk Museum for specimens and Frk. Bergljot Mauritz prepared the photographs.

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Systematics

SUPERFAMILY BELLEROPHONTACEA, M'COY, 1851
FAMILY SINUITIDAE DALL IN ZITTEL-EASTMAN, 1913
SUBFAMILY BUCANELLINAE KOKEN, 1925
GENUS *Sinuitella* YOCHELSON, NEW GENUS

Type species: Bellerophon? norvegicus Brøgger, 1882.

Description: Small, partially uncoiled bellerophontiform gastropods; shell expanding rapidly for approximately two whorls, the coiling of the body whorl then becoming open; umbilicus shallow; dorsum smooth and well rounded; aperture with a wide, shallow emargination.

Discussion: The open umbilicus and relatively shallow sinus of *Sinuitella* strongly suggest placement in the Bucanellinae. (Definitions of genera and suprageneric categories follow those given by Knight and others, 1960). The rounded dorsum and open coiling of the mature whorl distinguish this genus from others in the subfamily; within the Bucanellinae, *Sinuitella* is most similar to *Sinuella* in size, but its dorsum is quite distinct from the slightly depressed dorsum of that genus. A partially open coiling is characteristic of some members of the Cyrtolitidae, but the angular emargination culminating on a median keel, which is characteristic of all members of the family, is strikingly different from the well rounded dorsum and emargination in *Sinuitella*.

As early as 1884, Lindström (1884, p. 70) questioned the generic placement of *Bellerophon? norvegicus*, suggesting that it might be «A new generic type, intermediate between *Bellerophon* and *Cyrtolites*—». Koken (1925, p. 55) referred the species to *Temnodiscus*. That genus, however, is entirely open coiled, much larger, and most importantly, has a narrow prominent selenizone.

Except for the type, no described species are known to the author that can be referred to *Sinuitella*.

Sinuittella norvegica (Brøgger), 1882

Plate 1, figures 7–11.

Bellerophon? *norvegicus* Brøgger, 1882, p. 53, pl. 10, figs. 15a, b.*Capulus?* (*Bellerophon?*) *norvegicus* Brøgger, Moberg and Segerberg, 1906, p. 74.

Description: Small bellerophonitiform gastropods with periodic thickenings of growth lines at maturity; protoconch bulbous; whorls expanding at a rapid but seemingly uniform rate; umbilici without umbilical ridges, the walls only being flattened into the umbilici; dorsum extremely well rounded, essentially following the arc of a circle; growth lines orthocline in the umbilici, gently prosocline from point of maximum width to near center of dorsum, where they are flattened to form a wide shallow sinus before proceeding gently opisthocline on the other side of the dorsum; shell thin, ornamented by many closely spaced growth lines, but smooth except in the open coiled portion of the body whorl where there are closely spaced, periodic thickening of growth lines making the shell surface faintly rugose.

Discussion: The specimen figured by Brøgger is preserved in the collections of the Paleontologisk Museum, Oslo (P. M. O. no. 19115), and is reillustrated on plate I, figure 11. The early growth stages of this specimen apparently were destroyed after Brøgger's drawings were prepared. The apertural view figured by him (1882, pl. 10, fig. 15a) suggests a depressed dorsum as in *Sinuella*, but I have not been able to find any evidence of this feature in either the original specimens or those subsequently collected. Brøgger also expressed some uncertainty about the bilateral symmetry of the species, but again I have found no specimens which suggest deviation from the plane of symmetry.

In addition the figured specimen, two others are preserved in the type lot. To avoid any possibility of future confusion, the figured specimen is designated as *lectotype* (P. M. O. no. 19115) and the unfigured specimens as *paralectotypes* (P. M. O. nos. 19114, 19114a).

Moberg and Segerberg (1906, p. 73) described *Capulus?* *simplex* and *C.?* *ceratopygarum* from the Ceratopyge Limestone in Sweden. The latter species does show distinctive sinuate growth lines and both deviate very slightly from bilateral symmetry. Because of Brøgger's uncertainty about the symmetry of *B. norvegicus*, they assumed that it too was not bilaterally symmetrical. Transfer of *B. norvegicus* to *Capulus?* seems to have been based entirely on this misunderstanding.

The authors did note that the figured specimen of *C.?* *ceratopygarum*, the only specimen preserving growth lines, differed from *B. norvegicus* in having thicker growth lines.

I have examined the type lots of both Swedish species and am convinced that they are best placed in *Pelagiella*. A few specimens of *Pelagiella* occur in the Ceratopyge Limestone in Norway but they have not yet been studied.

Specimens in black limestone from either the «transition beds» or 4aa at Hovindsholm, Helgøya, Hamar—Nes and Hovstangen, Gran Hadeland, were at first thought to belong to *S. norvegica* because they were of the same size range, showed a sinus, and appeared to be bilaterally symmetrical. One specimen was prepared, however, and it was found to be asymmetrically coiled. After seeing how slightly the mature whorl deviates from a plane of symmetry, it is easy to understand Moberg and Segerberg's reason for thinking *S. norvegica* was not symmetrical. These younger specimens may be *Pelagiella* or an allied genus. The close similarity between the mature stages of this taxon and *Sinuitella* necessitates having all whorls exposed before specimens can be identified.

Moberg and Segerberg also described *Trochus atavus* from the Ceratopyge Limestone in Sweden. I have examined the type of this species. It is here referred tentatively to *Mimospira*. This form has not been found in Norway.

Occurrence: The original specimens and one later collection (P.M.O. no. 1501) come from the Ceratopyge Limestone (3aγ) at Vestfossen, Eiker. Nearly a dozen additional specimens have been collected from the Slemmestad area, south of Oslo (P.M.O. nos. 1149, 1188, 20050, 40754), most specimens coming from Bjerkåsholmen (P.M.O. nos. 1192, 1221, 1223, 1224, 1270, 20044, 72783). According to Dr. Henningsmoen, in both areas, the specimens occur rarely in a zone of nodules just below the main bed of Ceratopyge Limestone, the nodules being composed of hard, dark gray, extremely fine-grained limestone. The gastropods are associated with an orthocone cephalopod, inarticulate brachiopods and abundant trilobites, most commonly *Triarthrus*. The overall character of the fauna is that of one which may have been either pelagic or clinging to an algal substratum. Whether the gastropods lived in either of these environments cannot be determined.

SUPERFAMILY PLEUROTOMARIACEA SWAINSON, 1840

FAMILY RAPHIATOMATIDAE KOKEN, 1896

SUBFAMILY OPHILETINAE KNIGHT, 1956

GENUS *Pararaphistoma* VOSTOKOVA, 1955

Type species: Helicites qualteriatum Schlotheim, 1820.

Discussion: Vostokova (1955, p. 83) proposed *Pararaphistoma* just at the time the manuscript on Paleozoic Gastropoda classification was being completed for the Treatise on Invertebrate Paleontology (Knight and others, 1960). The generic name was included at the last moment and by error, for which the writer takes full responsibility, was referred to the subfamily Raphistomatinae. The phaneromphalous umbilicus of the genus is characteristic of the allied Ophiletinae.

Vostokova at the same time proposed the subgenus *Pararaphistoma* (*Climacoraphistoma*). This subgenus was placed in the synonymy of the genus (Knight and others, 1960, p. 1201). Further investigations have suggested to me that it may be convenient to differentiate those species of *Pararaphistoma* which have a step-like upper whorl surface. It should be pointed out that my change in attitude is not based directly on further study of *Climacoraphistoma*, but rather a feeling that any effort to divide the indiscriminate species groupings under *Raphistoma* employed by Koken (1925) should be welcomed at this time.

Pararaphistoma (*Pararaphistoma*) *qualteriatum* (Schlotheim), 1820

Plate 1, figures 1–4.

Pleurotomaria obvallata (Wahlenberg), Brøgger, 1882, p. 52.

Pleurotomaria qualteriata Schlotheim, Lindström, 1884, p. 108–110, pl. 13, figs. 15–16. (A complete earlier synonymy is given in this paper.)

Raphistoma qualteriatum Schlotheim, Koken, 1896, p. 396; Koken, 1897, p. 163–164, fig. 19; Koken, 1925, p. 75–76, pl. 5, figs. 1–3, 11, 12.

Pararaphistoma (*Pararaphistoma*) *qualteriatum* (Schlotheim), Vostokova, 1955, pl. 1, fig. 1.

Description: Extremely low-spined lenticular gastropods with a wide flattened peripheral selenizone; sutures distinct but nearly smooth; earliest whorls flattened and depressed; upper whorl surface at maturity generally inclined downward and strongly outward but arched in a low curve, the point of maximum curvature being above the center of the whorl, at the outer part of the upper whorl surface

abruptly flattening to nearly horizontal for about one-sixth of the total width of this upper surface; periphery sharp; outer whorl face inclined strongly downward and gently inward so that the bulk of the shell is below the periphery, ending at a sharp circumbilical ridge; umbilicus deep with straight, inclined and steplike walls; growth lines strongly prosocline on the upper surface, sweeping back, smooth from suture, the amount of curvature increasing rapidly near the outer edge so that the lines are nearly parallel to the selenizone; inner edge of selenizone marked by a faint lira; growth lines continuing prosocline but swinging back sharply just before periphery; growth lines unknown on lower part of selenizone and base; ornamented only by growth lines, these being coarse and widely spaced near suture, but crowded and much fainter near periphery.

Discussion: Lindström made a careful study of this species and *Helicites obvallatus* Wahlenberg named two years earlier than Schlotheim's species. He concluded that there was a slight but real difference between the two species, the most important being that *Pararaphistoma* (*Pararaphistoma*) *qualteriatum* had most of the selenizone on the upper surface. I have not been able to study the types of either of these species, but am following Lindström in applying Schlotheim's specific name. It has also been impossible to prepare an earlier synonymy with any degree of confidence, but Lindström was such a meticulous worker that the probability is high that his synonymy is accurate.

The description is based only on the Norwegian specimens. Larger specimens from Estonia suggest that there is a flattening of the upper surface in the mature stage, thereby making the upper surface overall gently sinuate.

All Norwegian specimens, except for the one illustrated, are steinkerns. I have compared these with steinkerns from Estonia. Fortunately, there is also available an excellent topotypical specimen from Unit B₃ at Tallinn (Reval), Estonia, which has the upper shell surface preserved. I am convinced that the Norwegian specimens are correctly identified.

Koken in 1897 and 1925 complicated understanding of this species by the proposal of five names which he designated as *mut.* (mutation). Since each one of these is briefly diagnosed, the names must be considered as nomenclatorially valid. I am not convinced that all

these names are zoologically valid but in the absence of type specimens, I am in no position to discuss this matter further. Some of the other species of *Raphistoma* named by Koken seem to be based on exceedingly poor material; it is possible that some of these may eventually be placed in the synonymy of Schlotheim's species. *Pararaphistoma* (*Pararaphistoma*) *qualteriatum* (Schlotheim) has not been found in the Middle Ordovician of Norway.

Occurrence: The species is quite rare in Norway, one specimen only being known from each of the following localities: Krekling in Eiker (P.M.O. no. 72785); small quarry on State road 195 about 1.5 km south of Brandbu, Hadeland (P.M.O. no. 72787); Hov, Hadeland (P.M.O. no. 68454); strand southwest of Nes Kirke, Røykenvik, Hadeland (P.M.O. no. 33215); large railroad cut southwest of Vassjø, Jevnaker, Hadeland (P.M.O. no. 35455); Bilitt, Toten (P.M.O. no. 1040); Tøyen, Oslo (P.M.O. no. 3367). At all localities, except the last one, the gastropod is associated with trilobites of the group of *Megistaspis gigas*. The last occurrence is based on an isolated specimen from the collections with no additional locality data.

SUPERFAMILY TROCHONEMATACEA ZITTEL, 1895

FAMILY TROCHONEMATIDAE ZITTEL, 1895

GENUS *Proturritella* KOKEN, 1889

Type species: *Proturritella gracilis* KOKEN, 1889.

Proturritella sp.

Plate 1, figures 5, 6.

Description: Turboform gastropods with an elaborate reticulate ornament; shell moderately high-spired; apical angle near fifty-seven degrees; sutures smooth; whorl profile gently concave from suture to a prominent lira, more strongly curved downward and outward to another lira at upper edge of outer surface, concave strongly outward and downward below periphery, gently convexly arched below lira marking transition to basal surface, with the amount of arching decreasing near the base of the columella; lowest part of base unknown, but probably anomphalous; growth lines orthocline from suture to first carina; straight, gently prosocline to edge of upper whorl surface; more steeply prosocline on upper part of outer whorl face, curving to form a shallow sinus, the center of which is at the periphery, below

the periphery steeply opisthoclinal to base and orthoclinal on base; ornamented by numerous spiral lirae as follows: a prominent lira near the suture with a somewhat smaller one below, two extremely faint lirae on the upper whorl surface and a prominent lira at the outer edge of this lira, just above the periphery, a strong lira at the periphery, and two fairly strong lirae below it, two strong lirae just above the base and at least fifteen moderately strong lirae on the base, the basal lirae being more or less equally spaced, with closely spaced prominent growth lines so that the entire surface and especially the base bears a reticulate ornament.

Discussion: The species described has more prominent angulations than *Proturritella gracilis* Koken. It differs from *P. bicarinata* (Wahlenberg) in having four spiral lirae near the periphery and spiral lirae near the upper shoulder. It is not possible to compare the Norwegian taxon with the other species described by Koken with any degree of assurance. Koken's illustrations are so generalized that until good photographs of the type specimens have been published all are *nomina dubia*. This point is well illustrated by comparing Koken's illustrations of *Gonionema bicarinatum* with the photographs of the same specimen provided by Knight (1941, pl. 39).

Judging from Koken's drawing, *Proturritella acuta* (Koken) seems to have a more angular periphery; *P. angulosa* (Koken) seems to have a higher spire and *P. granata* (Koken) seems to lack the numerous spiral lirae of this species. *Proturritella angulosa cingulata* (Koken) may have about the same number of spiral lirae as this species, but their distribution is not clear; *P. reticulata* (Koken) shows an ornament similar to the Norwegian form, but the growth lines are not sinuate. Under the circumstances of such uncertainty about earlier named species, I prefer neither to assign the Norwegian specimen nor to name yet another species.

There is no reason for believing that *P. piersalense* (Koken) from unit F₁ in Estonia and the specimen of *P. angulosa*, illustrated from F₂ are correctly assigned to this genus. If they are removed, *Proturritella* in Estonia is restricted to the B₃ and the C zones.

Occurrence: A single external mold is available from Norway (P.M.O. no. 33218). The specimen was collected in 1893 by Th. Münster on the road north from Grinaker farm, Gran, Hadeland. No trilobites are associated with the specimen, but it is almost certainly from the

“transitional beds” overlying the *Orthoceras* limestone. The locality was reinvestigated by Henningsmoen and Yochelson and even though no additional specimens were collected, rocks of identical lithology were found near the base of a hill just north of the Grinaker farm house.

Discussion of the fauna

The new genus from the *Ceratopyge* limestone serves to fill in a gap between the most primitive member of the *Bucanellinae* and the more typical Middle Ordovician genera. The other two species, in addition to suggesting certain problems of synonymy to be investigated in the future, have some stratigraphic implications worth further discussion.

Although Brøgger (1882, p. 52, 53) reported gastropods from the *Orthoceras* Limestone, it seems likely that he was using it in a wider sense than is currently followed. I have examined all collections from the *Orthoceras* Limestone proper in the Paleontologisk Museum and have observed about a dozen outcrops throughout the Oslo region without seeing any gastropods. On the other hand, in every case, except two, the gastropods described herein are associated with trilobites of the *Megistaspis gigas* group. All gastropods apparently came from the “transition beds” above the *Orthoceras* Limestone and below unit 4a, as it is used in the field.

One specimen of *Pararaphistoma* (*Pararaphistoma*) *qualteriatum* (Schlotheim) in the collections was labeled as *Pleurotomaria obvallata* Wahlenberg, a species reported by Brøgger (1882, p. 53). It is likely that *Proturritella bicarinata* is the same as Brøgger’s “turbo (?) — Art”. Brøgger also reported bellerophonitiform and euomphaloid gastropods from unit 3c. I have not been able to find any specimens in collections made prior to 1882 and these identifications may be based on field observations. One later collection from the “transition beds” does contain an indeterminate euomphalid gastropod and a specifically indeterminate *Sinuities*, so that all the forms reported by Brøgger can be confirmed. No other reports of gastropods from the *Orthoceras* Limestone or “transitional beds” in the Oslo region are known.

Since the publication of Koken’s (1925) paper, little attention has been paid to the Ordovician gastropods in Sweden. There have been refinements in stratigraphy since that time and many of the strati-

graphic occurrences given by Koken cannot now be relied upon. The only recent paper that I have been able to find which reports the occurrence of gastropods in the Ordovician of Sweden is that of Jaanusson and Mutvei (1951). The authors list several gastropods from unit "b" of the "Unteren grauen Orthocerenkalkstein", at Vikarby, in the Lake Siljan area, Dalarna, some feet below beds containing *Megistaspis gigas*.

The specimens identified by them as *Raphistoma qualteriatum applanatum* Koken belong to *Pararaphistoma* (*Pararaphistoma*). Two specimens have the shell preserved and have the upper surface more flattened than in the Norwegian material. Four other specimens are almost completely steinkerns. Two show a flattened upper surface; the other two show a more lenticular profile and cannot be distinguished from the Norwegian steinkerns. At the nearby locality Amtjärn, one smaller flattened specimen and a larger lenticular steinkern of this species were also collected.

It is possible that this species has much individual variation. An alternative explanation, which is partially supported by Estonian specimens examined and Koken's work, is that there is more than one species from this zone. Not only is the second species lower, but is also thinner. In any case, several of the Lake Siljan specimens are conspecific with *P. (P.) qualteriatum* from both Norway and Estonia.

Proturritella bicarinata (Wahlenberg) was reported by these authors from Vikarby and is represented by nine specimens. Most show a sharp peripheral carina but at least one of them shows a wider, more elaborate periphery and is conspecific with the type (Knight, 1941, p. 39). The topotypical specimen lacks the elaborate ornament of the Norwegian specimen and is not conspecific with it. Knight (1941, p. 137) commented on the fact that at least two species seem to occur in the original type lot and it is probable that most of their specimens belong to another species. Whether this is an undescribed species or falls within the limits of one of Koken's species cannot be determined without restudy of the type specimens.

Jaanusson and Mutvei also reported *Salpingostoma cristatum* Koken from this zone and no comment need be made on this identification. They also found several specifically indeterminate *Lytospira*, *Subulites* (*Cyrtospira*), which I have not examined, and a *Lesueurilla*, which may be *L. granata* Koken. None of these four forms occur in the Early

Ordovician of Norway and only *Lytospira* occurs in the Middle Ordovician. In summary, although the gastropod faunule from Vikarby, Dalarna, Sweden, is more diversified and possibly specifically distinct from the Norwegian material, it does have genera in common with those from the "transition beds" in Norway; it is not at all like the typical Middle Ordovician gastropod fauna of Norway.

In the Baltic area of Russia, Vostokova (1953, p. 307) reports *Gonionema reticulatum* Koken (= *Proturritella*) as confined to unit B₃ and indicates that *Pararaphistoma* (*Pararaphistoma*) *qualteriatum*, including several variant forms, is most common in this zone. The B₃ unit is generally considered to be of Early Ordovician age, at least as the term is employed in Europe.

In Estonia, lists of Middle Ordovician fossils (Kaljo and others, 1956) show only one tentatively identified species of *Proturritella* in C_{2a}, in the lower part of the Middle Ordovician. These authors report only two species of *Pararaphistoma* (*Pararaphistoma*), neither of which is likely to be confused with *P. (P.) qualteriatum*.

Størmer (1953, pp. 118–119) suggested that the "transition beds" overlying the *Orthoceras* limestone were more properly referred to the Middle Ordovician. Jaanusson (1960, p. 343), however, has recently suggested that they might better be referred to the Early Ordovician.

It is clear that a good deal more work is necessary on the stratigraphic distribution of gastropods within the Ordovician of the Baltic area before they can be relied on for correlation. My impression is that the gastropods of the Norwegian "transition beds" have more in common with the underlying units than with the Middle Ordovician faunas, but specimens are so rare that the question of the age of the transition beds must be resolved from study of other groups of fossils.

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PLATE 1

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- Fig. 1—4. *Paraphistoma* (*Paraphistoma*) *qualteriatum* (Schlotheim)
(Fig. 1, 2) Top view and oblique side view showing natural section
from Hov, Hadeland. P. M. O. no. 68454. x 1. 6.
(Fig. 3, 4) Apertural and oblique basal views, respectively, of stein-
kern from Bilitt, Toten. P.M.O. no. I 040. x 1.
- Fig. 5, 6. *Proturritella* sp.
Oblique top and side views, respectively, of a latex impression of
an external mold from road north of Grinaker farm, Gran, Hade-
land. P.M.O. no. 33218. x 4.
- Fig. 7—11. *Sinuitella norvegica* (Brøgger)
(Fig. 7) Slightly oblique side view of early whorls, from Bjerkåsholmen,
Slemmestad. P.M.O. no. 1192. x 10.
(Fig. 8, 9, 10) Side, dorsal and oblique side views, respectively from
Bjerkåsholmen, Slemmestad. Note in fig. 9 that marks from pre-
paration in front of aperture superficially resemble growth lines
but are not sinuate. P.M.O. no. 72784a. x 6.
(Fig. 11) Side view of lectotype from Vestfossen, Eiker. During
photography several small threads adhered to the shell. P.M.O. no.
19115. x 8.



1



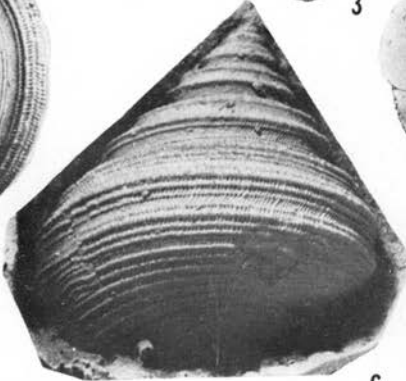
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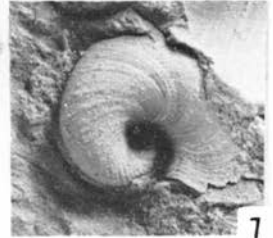
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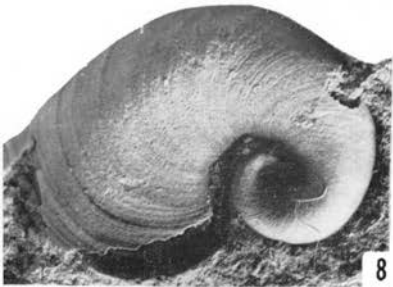
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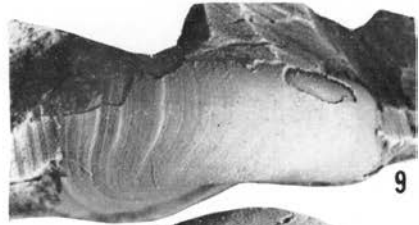
4



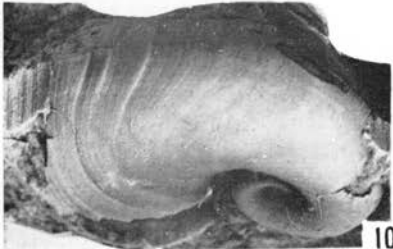
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