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GERTRUDA BIERNAT

ON *PEREGRINELLA MULTICARINATA* (LAMARCK) (BRACHIOPODA)

Abstract. — Numerous specimens of *Peregrinella multicarinata* (Lamarck) have been studied on Polish and French material, with consideration to the ontogeny and individual variability of this form. The Polish material was collected from the vicinity of Wieliczka and abounds in young individuals, that from France was lent to the author from the collection of the Palaeontological Museum of the Humboldt University in Berlin.

INTRODUCTION

The writer was incited to start work on this paper by a number of specimens of *Peregrinella multicarinata* (Lamarck), a well known brachiopod, which were collected in the years 1936-38 by Dr. J. Burtan from the „Grodziszcze (Grödischter) beds" of the Carpathian Mountains, at the locality of Raciborsko (Wieliczka sheet). The material in question was turned over by the finder to Prof. R. Kozłowski who, in turn, entrusted the writer with the task of working it out.

The presence in the material of fairly numerous juvenile specimens has made it possible to discuss the problem of variations connected with ontogenic development, which has not thus far been studied.

In 1955, during her visit to Berlin, the writer when going through the collection of the Palaeontological Museum at the Humboldt University, came across quite numerous specimens of *Peregrinella* from France. These were kindly lent to her. During the visit to Berlin in 1956 the opportunity offered itself to study at large the most important papers on *Peregrinella,* not available in Poland. Such favourable circumstances led to an all-round study of this interesting brachiopod. It resulted in the present paper, prepared at the Palaeozoological Laboratory of the Polish Academy of Sciences in Warsaw, under the guidance of Prof. Dr. R. Kozłowski to whom the most sincere thanks are due for his suggestions and helpful criticism. To Dr. J. Burtan the writer is grateful for lending her collection of *Peregrinella.* She also wishes to convey warm words of thanks to Professor Dr. W. Gross, Head of the Institute of Palaeontology at the Humboldt University in Berlin, for the hospitality extended at that

Institute and for the loan of comparative material from the Palaeontological Museum. Photographs accompanying the paper were taken by Miss M. Czarnocka to whom words of thanks are also due.

MATERIAL

The material from Poland available to the writer in the course of studies on *Peregrinella multicarinata* (Lamarck) was relatively ample. It consisted of 33 almost complete specimens of juvenile individuals, also of 3 mature, one of which is nearly perfect. In addition, there were numerous fragmentary shells of various size. The shells were partly recrystallised, and have lost their fibrous texture, so characteristic of brachiopods. All the specimens have been prepared from limestone encountered in detached angular blocks, about 20 cm in diameter, at the village of Raciborsko (Wieliczka sheet), 6 km to the south of Wieliczka.

Besides brachiopods the rock yielded calcified sponge spicules. The limestone shows lack of glauconite and the presence of pyrite, suggesting badly aerated environment of sedimentation of the deposits which yielded *Peregrinella*. The fragmentary preservation of the shells of large individuals indicates disturbed conditions of the sedimentation process. It had probably taken place at some distance from the sea shore, as is suggested by the extreme scarcity of terrigeneous material.

The weathered rock has to some extent facilitated the recovery of specimens forming assemblages of individuals of different size lying in most varied positions. The state of preservation of the majority of specimens is quite satisfactory. Most of them have suffered some damage in their umbonal region during the recovery from the rather hard rock matrix. This proved unavoidable in spite of the utmost care exercised.

The material derived from France, available to the writer, consisted of 37 prepared specimens, mostly representing adolescent or mature individuals. It included one of L. Buch's original specimens (syntype). All the specimens were recovered from Lower Cretaceous limestones in south-western France, mostly in the vicinity of Châtillon, dept. Drôme. All the French specimens are satisfactorily preserved, being only slightly damaged in their umbonal region. This, however, has been an obstacle to the closer investigation of the delthyrial plates and the foramen.

Thin microscopic sections, cut from *Peregrinella* limestone from France, show the presence of numerous, fine-grained calcite centres. The organic remains are very sparse.

When studying the external morphology of the shells no great difficulties were encountered owing to the satisfactory state of preservation. Specimens with slightly damaged umbonal region showed partly pre-

served planarea, sometimes also part of delthyrial plates. The triangular delthyrium was as a rule poorly marked and the pedicle-opening not readily recognisable.

In what the internal structure is concerned, its investigation was possible by the method of serial grinding only. The inside of the shell was empty in many specimens and the shell walls incrusted with calcite crystals. Yet, such elements of internal structure as teeth, the cardinal plate, cruna and the dorsal septum, were preserved and well discernible in the serial sections.

HISTORY OF RESEARCHES ON *PEREGRINELLA MULTICARINATA* (LAMARCK)

The interest aroused by this brachiopod dates back to 1819 when Lamarck in his „Histoire naturelle des animaux sans vertèbres" gave a short account of this form. He referred it to the Terebratulae with longitudinal striation. His Latin diagnosis reads: „T. testâ magnâ, rotundatâ, pectiniformi, costis numerosis carinatis, margine non sinuato", while the short French description is as follows: „Grande et belle espèce qui a la forme d'un peigne. Ses côtes sont très nombreuses, rayonnantes et l'angle qui forme leur carène est assez aigu. Longueur 75 mm, largeur 80 mm". Lamarck gave his form the name of *Terebratula multicarinata,* without, unfortunately, accompanying it by any figures.

Independently of Lamarck, L. v. Buch described the same form from Cretaceous limestone deposits at Châtillon in France, in his paper „Über Terebrateln" published in 1835. He established for it a new species under the name of *Terebratula peregrina* Buch. The name assigned by Buch was subsequently accepted in literature, in spite of Lamarck's uncontestable right to priority. Most probably, Buch was not, at that time, acquainted with Lamarck's paper written in 1819, while the specific name of *„peregrina"* has already in 1813 been applied by J. F. Schlotheim to *Terebratulites peregrinus,* another Jurassic brachiopod. The latter species (*fide* F. Toula, 1911), is mentioned as early as in 1717, in J. J. Scheuchzer's work „Naturgeschichte des Schweizerlandes" as *Terebratula gregaria* (biplicate), recorded from Kössener Schichten. It might be here mentioned that H. G. Bronn in his „Index palaeontologicus" of 1848 figures two such widely distant forms as *Terebratula peregrina* Buch and *T. gregaria* Scheuchzer under one specific name of *Terebratulites peregrinus.*

Buch, when describing *Terebratula peregrina,* was not certain about the systematic position of this species. Tentatively he referred it to the group of Terebratulae „plicatae" in which the surface of both valves is plicated, and to the sub-group of „alatae", stressing that this form differs from other recorded Terebratulae. He also suggested that it might be an

Orthis („peut-être est-ce une *Orthis*"). According to Buch's diagnosis *Terebratula peregrina* appears to be an unusually large form, as long as wide, attaining 100 mm, and with thickness up to 45 mm. The outline of the shell is sub-circular. On Buch's description and figures this is certainly a species identical with *T. multicarinata* Lamarck.

In 1847 A. d'Orbigny in his „Paléontologie Française" (p. 16, pl. 496) describes and figures the same species from Neocomian deposits in the vicinity of Châtillon. He refers it to the Rhynchonellacea, then already established, and records it as *Rhynchonella peregrina* Buch. According to d'Orbigny this is perhaps one of the forms with most regular outline, in which the length is equal to the breadth, both attaining or even exceeding 80 mm, while the thickness may be up to 50 mm. One must suppose that d'Orbigny was acquainted with Lamarck's paper, he does not, however, make any mention of it and recognises Buch's species.

In 1850, T. Davidson made a revision of the Terebratulae specified by Lamarck whose paper on that subject was not so very lucid. Namely, he did not publish any information as to the site and deposits from which the fossil remains described by him had been recorded. His data were restricted to short and precise Latin definitions of species, frequently without any figures. Davidson revised Lamarck's original specimens which had been deposited partly at the Jardin des Plantes in Paris, partly in Benjamin Delessert's Museum where Lamarck's private collections were kept. In the course of this revision, T. Davidson sometimes met considerable difficulties in identifying Lamarck's original types. There was no trouble, however, in regard to the identification of *Terebratula multicarinata*. Although Lamarck's diagnosis for this species is very short, yet the appearance of this brachiopod is so characteristic that it provides full certainty as to its identity. Davidson was of the opinion that there can be no doubts as to the priority of the name given by Lamarck, which was not always recognised in papers of later authors. In his considerations, Davidson stresses, as also did earlier authors, that *T. multicarinata* Lamarck recorded from Neocomian deposits in the vicinity of Châtillon, is the largest of all the known Terebratulae. He publishes a drawing of the specimen described by Lamarck (1850, pl. 14, fig. 37, reproduced in the present paper — fig. 1). This specimen is not large, but the author points out that individuals of this species attain considerably greater dimensions.

In 1872 F. A. Quenstedt (p. 154, pl. 40, fig. 96-100) described and figured a specimen of *Terebratula peregrina* Buch from Die, dept. Drôme in France. He stressed that this form had been made popularly known by Buch and that d'Orbigny had assigned it to the Neocomian but that it had been recorded in Lamarck's paper under the specific name of *multicarinata*. The specimen figured by Quenstedt belongs, according to this author,

to an elongate variety of moderate length („...gehört zu den mittelgrossen länglichen Varietäten", pl. 40, fig. 96). He also points out that this form is an unusual, noteworthy fossil, and that it merits the creation of at least a sub-genus.

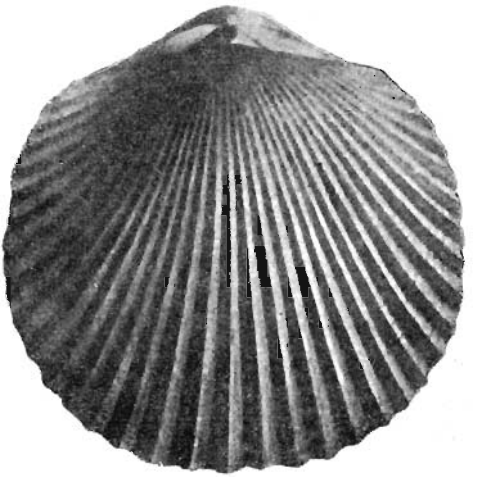

Fig. 1. — *Terebratula multicarinata* as described by J. B. Lamarck (1819) and figured by T. Davidson in 1850; reduced size. (Nat. size of the original is 7.62 cm in length and width, 4.44 cm in thickness).

Upon comparing the figures of Buch with those of d'Orbigny, Davidson and Quenstedt there is not the least doubt that they all had described the same species, all the more so since every one of the specimens mentioned by them was recorded from the same zone and localities.

In 1887, a new genus, *Peregrinella,* is established for *Terebratula peregrina* by D. P. Oehlert in P. Fischer's work „Manuel de conchyliologie", p. 1305). The specific name of *peregrina* is, however, wrongly stated there as being established by d'Orbigny instead of by Buch.

In 1911, in a paper on the Transsylvanian *Peregrinella* from the vicinity of Kronstadt (Brasov) in Rumania, F. Toula refers to that form under Lamarck's specific name of *multicarinata.*

In 1913, W. Kilian also recognises Lamarck's species, figuring a form from Rottier, dept. Drôme, under the name of *Peregrinella multicarinata* Lamarck. He observes close resemblance between this species and the Batonian genus *Eudesia.* On the other hand, it is suggested in the same paper by Ch. Jacob that the position of the pedicle-opening in *Peregrinella,* by him believed to be apical, brings this form near to the family of Magellanidae and not to that of Rhynchonellidae, as maintained by d'Orbigny. Regretfully, it is difficult to determine the position of the

pedicle-opening in *Peregrinella* owing to the very unsatisfactory state of preservation of the umbonal regions. It is not sure if the figure by Davidson (our fig. 1) is not idealised on this point.

Observations made by the present writer lead her to infer that the position of the pedicle-opening is that usual in Rhynchonellacea, i. e. under the apex. In addition, both the nonporous texture of shell and the internal morphology indicate that *Peregrinella* belongs to the Rhynchonellacea.

In 1924, V. Renngarten when describing a *Peregrinella* from the Caucasus uses the name of *multicarinata,* thereby recognising the priority of Lamarck's designation.

Nevertheless, as late as in 1952, the name of *peregrina* Buch was incorrectly used for this species in a paper by J. Roger published in „Traité de Paléontologie" under the editorialship of J. Piveteau (v. II, pl. 4).

To conclude, the correctness of Davidson's view may be pointed out in that he was the first to restore the priority of Lamarck's specific name by revising *Terebratula multicarinata.* Thus, the name of *peregrina* introduced by Buch must be dismissed as synonymous with *multicarinata* Lamarck.

STRATIGRAPHIC CONDITIONS OF THE OCCURRENCE OF GENUS *PEREGRINELLA*

It is from some localities in the department Drôme of south-western France that have been recorded the typical specimens of *Peregrinella,* described and figured by Lamarck, Buch, d'Orbigny and Quenstedt. Beautifully preserved shells of this brachiopod have also been discovered at a number of other places in France, in the departments of Hérault and Gard.

Limestones yielding *Peregrinella* frequently occur as large detached blocks occasionally displaying strong calcification and silification. Within such blocks *Peregrinella* has been observed in crowded assemblages of individuals of various age, mainly associated with ammonites. The latter, after W. Kilian (1931), belong to genera *Phylloceras, Holcodiscus* and *Crioceras.*

This brachiopod — a most interesting one as regards both, its outer appearance and sporadical occurrence — has for a long time attracted the attention of many writers who were interested by its systematic and stratigraphic position and its geographical distribution. Observations thus far have shown *Peregrinella* to occur within Upper Hauterivian deposits. The age, however, of the original specimens collected by Lamarck and Buch was not definitely fixed for quite a long time and presented an open question subject to much discussion. It was a problem somewhat difficult

to clarify inasmuch as quite often numerous, very satisfactorily preserved specimens were recovered not in situ but from detached limestone blocks. Many authors, in fact, regarded *Peregrinella* limestones either as younger or as older than the Hauterivian. New light, however, was continuously shed on the problem as fresh finds of this form were recorded.

In 1853, M. de Rouville (*fide* Renngarten, 1924) refers the *Peregrinella* beds from France to the Neocomian, without, however, assigning it to a precisely determined horizon. In 1868, H. M. Coquand questions their Neocomian age, being inclined to refer them to the Upper Jurassic. E. Hébert (1871) has observed beds crowded with *Peregrinella* in association with ammonites which are in a distinct minority. He believes these beds intermediate between the uppermost Oxfordian and the Lower Neocomian. L. Dieulafait (1871) recorded this form from beds which he referred to the Barremian, at the localities of Rottier, Gigondas and Saint-Trois-Château. Some time after, in the year 1897, F. Roman and M. de Rouville collected it in situ from limestone containing *Serpula recta* Goldfuss, in the vicinity of Montpellier, dept. Hérault. They referred these beds to the Upper Valanginian, without, however, denying the possibility of referring them to the Hauterivian. These authors stress the difficulty in determining the age of beds here considered. In connection therewith they write as follows: „L'âge géologique des couches à *Serpula recta* et *Rhynchonella peregrina* extrêmement difficile à préciser, cependant on peut affirmer par comparaison avec la coupe Castelnau à Clapier et par la nature pétrographique de ses assises, qu'elles appartiennent à un niveau extrêmement élevé du Valanginien, peut-être même à la base de l'Hauterivien".

Finally, detailed geological and stratigraphical studies in southwestern France have led V. Paquier in 1900 (*fide* Renngarten, 1924) to refer limestone blocks with *Peregrinella* to the Hauterivian, equivalent to the *Hoplites angulicostatus* d'Orb. zone and consequently younger than had thereto been believed by previous writers. In such way the contestible age of *Peregrinella* limestones seems to be definitely settled.

The determination of the stratigraphical position of the *Peregrinella* beds from France facilitated the establishment of the age — sometimes also discussed — of beds outside of France, yielding shells of *Peregrinella*.

For example, L. Hohenegger (1861) who investigated North Carpathian areas of Silesia and those bordering Moravia and southern Poland, has recorded *Peregrinella* from the Grodziszcze sandstone (Grödischter Sandstein), then referred to Upper Cieszyn (Teschener) beds. At the time it was difficult to determine the age of the sandstone. The beds from which Hohenegger has recovered *Rhynchonella peregrina* in association with a belemnite and ammonite fauna, constitute a far stretching horizon

within Lower Cretaceous deposits of the Beskidy Range, now referred to the Middle Neocomian. Fossils recovered from sandstone beds consisting of coarse-clastic terrigeneous material, which are the only formation of the kind within Neocomian beds of the Alpino-Carpathian region, were sometimes very fragmentary. This made difficult their identificaton, as stressed by E. Ascher (1906) who has described the fauna from the Grodziszcze (Grödischer) beds, collected and only identified by Hohenegger. In the opinion of the former writer, *Rhynchonella peregrina*, a characteristic form for the Neocomian, is the most diagnostic in matters of stratigraphy, out of all that fauna consisting of gastropods, brachiopods and cephalopods.

As early as in 1901, in a paper on the cephalopod fauna from Cieszyn (Teschener) and Grodziszcze (Grödischter) beds, V. Uhlig mentions *Rhynchonella peregrina* to have been collected there. On this important evidence that author referred the Grodziszcze beds to Middle Neocomian.

In Italy, C. Viola and M. Cassetti (1893) have proved the occurrence of Neocomian beds in Monte Gargano on the presence there of limestones with *Peregrinella*. W. Deecke (1895, p. 485) and E. Haug (1920, p. 1205), as well as others, make mention of this quoting the above named writers.

In 1903, M. Remeš cites *Rhynchonella peregrina* as recorded from Moravia where it had already before been identified by Hohenegger (1861). Remeš collected this form not in situ but from a detached limestone block found in yellow argillaceous soil at a depth of 0.5-0.75 m. The block contained abundant specimens of *Peregrinella* which that author was led to regard as the true „*peregrina*" on comparing it with French specimens in the paleontological collections, at the Vienna University. Finds of this kind were not rare in Moravia.

F. Toula (1911) gives a fairly detailed description of *Peregrinella* from Transsylvania in Rumania. He does not, however, mention the exact age of the limestones from which it was recovered. In later years, G. Macovei (1927, 1934) and N. Oncescu (1943) cited *Peregrinella peregrina* (Buch) from Sinaia Hauterivian beds; L. Bancila (1941) stresses that *P. peregrina* (Buch) collected by F. Herbich (1878) adequately establishes the Valanginian-Hauterivian age of beds which yielded that form.

V. Renngarten (1924) described *Peregrinella* from the western part of Kuban in North Caucasus. The stratigraphy of Kuban limestone beds has been the object of much research work. S. Czarnocki in 1914 (fide Renngarten, 1924) referred them to the Valanginian, without, however, adequate palaeontological argumentation. Renngarten (1924) is of the opinion that they ought rather to be assigned to the Upper Hauterivian as is suggested by the stratigraphical position of *Peregrinella* in Western Europe.

Recently, the presence of a brachiopod most probably referable to *Peregrinella,* has been recorded in Lower Cretaceous beds from Germany, in the district of Werle in Mecklenburg [1].

Outside of Europe, *Peregrinella* occurs in Lower Cretaceous deposits of California in USA. The American form was originally described by W. M. Gabb (1869) under the name of *Terebratella whitneyi.* Deposits yielding this species were at first regarded by him as of Miocene age. Subsequently, however, on evidence supplied by minute investigation of rocks containing *T. whitneyi* he published some supplementary notes in the end part of his paper in which he recognises this form as a true *Rhynchonella,* very closely resembling *Rh. peregrina* from the French Neocomian. He also stresses the undoubtedly near relationship of these two species. W. M. Gabb thus recognises the age of the respective beds as being Lower Cretaceous and assigns them to the Valanginian. His view in this matter was confirmed by the discovery, in addition to *Rh. whitneyi,* of other Lower Cretaceous fossils, such as *Aucella* sp. and some belemnites. In later American literature (J. W. Stanton, F. M. Anderson, L. G. Hertlein & U. S. Grant and others) mention is made of the occurrence in California of *Peregrinella whitneyi.* These authors do not doubt the similarity of *P. whitneyi* to *P. multicarinata* and recognise the age of beds yielding this form as Lower Cretaceous.

In Poland, *Peregrinella* has been discovered in Raciborsko (Wieliczka sheet), as mentioned above.

A brief report follows here on the stratigraphical conditions in which this species was found in this area, based on informations kindly supplied to the writer by Dr. J. Burtan.

Three tectonic units may be differentiated within the Raciborsko area in a north to south direction. They are: 1) the Miocene foreland, 2) the sub-Silesian Unit, 3) the Silesian Unit.

The occurrence of *Peregrinella* is associated with the top part of the Grodziszcze (Grödischter) beds in the Silesian Unit.

The following stratigraphical horizons have been distinguished in this Unit (in descending order):

1) Krosno beds, made up of menilitic shales, hieroglyph layers with variegated shales, and Ciężkowice sandstones with variegated shales at bottom;

2) Istebna beds, differentiated into upper and lower Istebna sandstones;

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[1] Data taken from a manuscript by G. M. Chryploff of the Staatliche Geologische Kommission in East Berlin.

3) Godula beds, with a development of mainly variegated shales containing a thin radiolarite layer;

4) Lgota beds, whose top part displays a characteristic gaize facies, developed as sandstones and hornfelses, while black argillaceous shales constitute the bottom part;

5) Wierzowice beds, developed as argillaceous-marly shales, black coloured, with inclusions of fine and moderately bedded sandstones;

6) Grodziszcze-Cieszyn beds (Grödischter-Teschener Schichten), showing some facial differentiation, namely: a) Cieszyn upper shales facies, b) a facies of calcareous sandstones containing pink quartz and alternating with marly shales, black or ash coloured, c) ash coloured marly shales facies.

The Grodziszcze beds occupy a relatively large area within this differentiated facial development and they may be traced both to the east, to the west and also, as long streaks or patches, to the north.

The specimens of *Peregrinella* described in the present paper has been found in the outcrops of the upper Grodziszcze beds where marly shales occur, coloured dark-ash or black, with fine bedded calcareous sandstones and with occasional calcite veins and lenses of calcareous coarse-grained sandstones. A similar stratigraphic position is occupied by *Peregrinella* in other parts of the Western and Eastern Carpathians.

Specimens of this brachiopod, of different size, have been collected from calcareous sandstone with re-crystallized matrix, showing centres of dark coloured arenaceous marls containing sparsely dispersed quartz grains. This type of sandstones is characteristic of the Grodziszcze beds within the Western Carpathians.

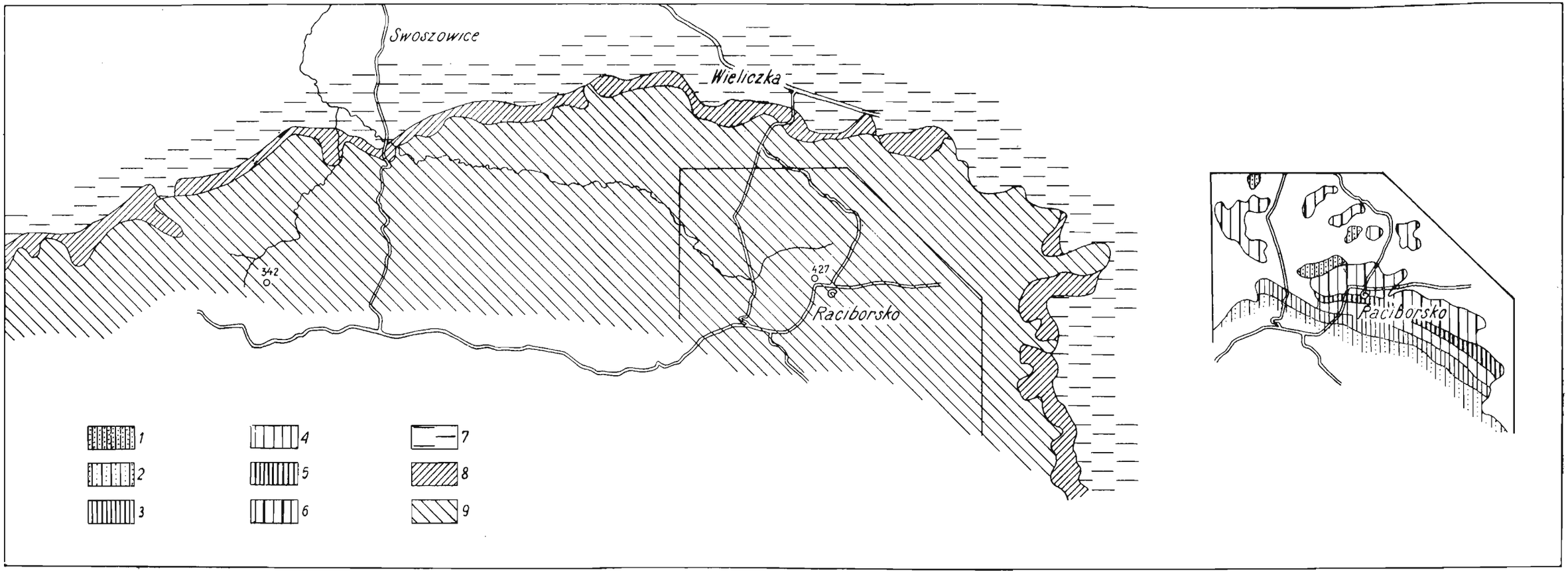
No new finds of this brachiopod have thus far been recorded in Poland, hence the Raciborsko *Peregrinella* provides a link in this respect between the Carpathians of Silesia and Moravia and those of Rumania where it has already been described. At the same time it is to be noted that the site of the *Peregrinella* occurrence in Poland marks the most northerly point of its range within the Carpathians.

DESCRIPTION

Peregrinella multicarinata (Lamarck)

(pl. I-VIII)

1819. *Terebratula multicarinata* Lamarck; J. B. Lamarck, Histoire..., p. 253, 3 éd 1839, III, p. 126.
1835. *Terebratula peregrina* Buch; L. v. Buch, Über Terebrateln, p. 73-74.
1838. *Terebratula peregrina* Buch; L. v. Buch, Essai..., p. 156, pl. 15, fig. 28.
1847. *Rhynchonella peregrina* Buch; A. d'Orbigny, Paléontologie..., p. 16, pl. 493.
1850. *Terebratula multicarinata* Lamarck; T. Davidson, Note..., p. 441, pl. 14, fig. 37



GEOLOGICAL SKETCH OF AREA S OF WIELICZKA 1 : 100.000
(by Dr. J. Burtan)

Legend: 1 Krosno beds, *2* Istebna beds, *3* Godula beds, *4* Lgota beds, *5* Wierzowice beds, *6* Grodziszcze beds; *7* Miocene foreland, *8* sub-Silesian Unit, *9* Silesian Unit

1872. *Terebratula peregrina* Buch; F. A. Quenstedt, Petrefacten..., p. 154, pl. 40, fig. 96-100.
1887. *Peregrinella peregrina* d'Orbigny; D. P. Oehlert, Brachiopodes..., p. 1305.
1903. *Peregrinella peregrina* Buch; M. Remeš, Rhynchonella..., p. 223.
1908. *Rhynchonella peregrina* Buch; E. Ascher, Gastropoden..., p. 135, pl. 14, fig. 11 a-d
1910. *Peregrinella multicarinata* Lamarck; W. Kilian, Handbuch..., p. 205, pl. 4, fig. 4.
1911. *Peregrinella multicarinata* Lamarck; F. Toula, Über Rhynchonella..., p. 27, pl. 3, fig. 2-7.
1924. *Peregrinella multicarinata* Lamarck; V. Renngarten, Sur les Pérégrinelles..., p. 119-127, pl. 2, fig. 1 a-b.
1944. *Peregrinella multicarinata* Lamarck; L. G. Hertlein & U. S. Grant, The cenozoic Brachiopods ..., p. 65.

Thus far, the research work concerning *Peregrinella* has been, on the whole, somewhat superficial and limited to the external morphology of adult individuals. The general contour of the shell, its dimensions and, most particularly, its ornamentation are the external features that have been more closely studied. Another character considered as noteworthy is the rather extensive individual variability, most easily observable in the dimensions of the shell, its thickness, and the number and thickness of radial folds (Toula, 1911; Renngarten, 1924).

Questions concerning the internal morphology has not, thus far, been much studied, the respective information being consequently very inadequate. Such external elements as ventral teeth, dorsal septum, and crura have been mentioned and partly figured, in a few papers only among others in those by Quenstedt (1872) and Toula (1911).

The internal and external morphology of *Peregrinella* have been studied by the present writer on specimens from Poland and France. It should be stressed that the internal morphology of all the studied specimens is uniform and that differences in the external appearance of Polish and French specimens are insignificant.

The entire Polish material available to the writer consisted of 33 adolescent individuals, mostly satisfactorily preserved, the beak portions excepted, four adult individuals of which one almost perfect, the other three with their beak- and antero-lateral portions badly damaged; some shell fragments and finally a few ventral and dorsal valve impressions.

In the next chapter follows a description of the external morphology of the most satisfactorily preserved Polish specimen, also of the internal morphology based on serial grinding of other specimens.

External morphology. Dimensions (in mm): length 59.3, width 58.8, thickness 38.4 (pl. II, fig. 1 a-c).

Shell of medium size, biconvex; general outline sub-circular with rounded antero-lateral margins; maximum thickness below the hinge-line toward the middle of the shell; greatest width at about midlength; hinge-

line long, approximately 41 mm, but a little shorter than greatest shell width; its central part gently curves upward, while the lateral parts descend somewhat obliquely to the cardinal extremities; these are rounded, as also are the lateral and anterior margins.

Ventral valve rather strongly and regularly arched along midline from beak to front; umbo greatly elevated, relatively large, beak incurved; planarea low, about 2.5 mm in height, long, somewhat shorter than the hinge-line, moderately curved, only partly discernible under the bent beak, delimited from the ventral valve by distinct, sharp beak ridges.

Dorsal valve, alike to the ventral one, uniformly convex along its whole length; beak hidden by that of opposite valve.

Ornamentation most regular, marked by about 35 distinct, high and thick radial folds, showing sharp ridges and furrows. The number of folds in each valve is almost the same; the commissure joining the two valves is strongly zigzag (pl. IV, fig. 2 c). The folds begin at about 2 mm from the apex, as fine but distinct striae widening out and growing higher anteriorly. As the shell grows, secondary additions of folds take place in postero-lateral areas, usually only one on each side. The slopes are without radial ornamentation; they are covered by concentric growth lines only, not always readily recognizable in parts with radial ornamentation.

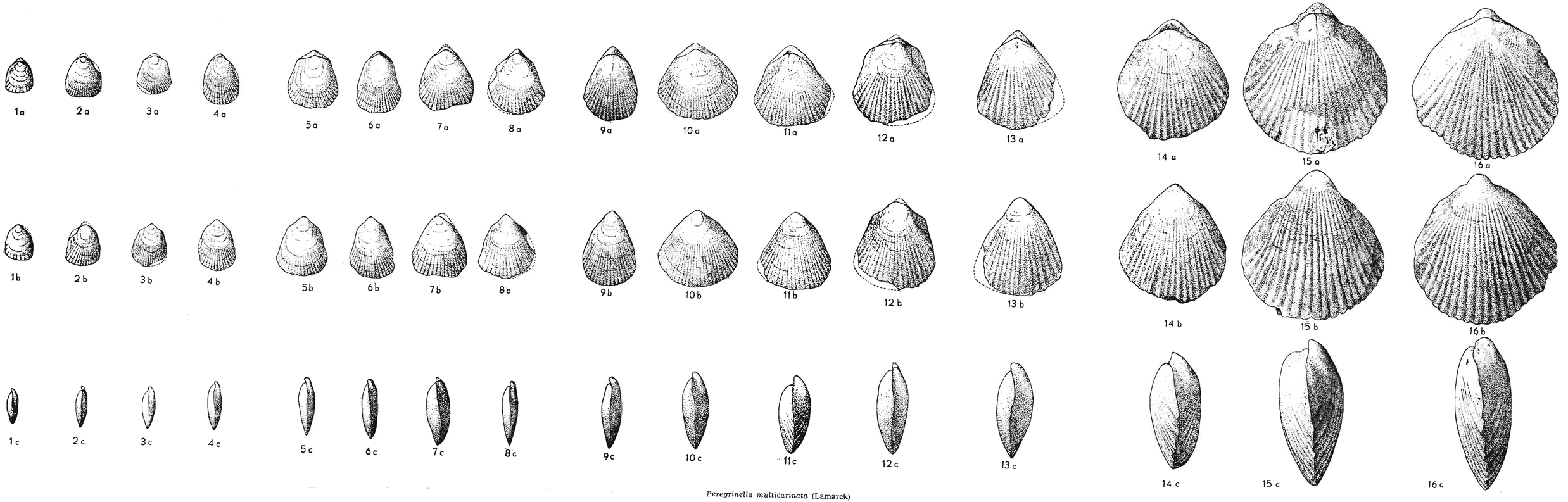
Internal morphology very simple, as is shown by serial grinding of Polish and French specimens. As compared to the size and thickness of valves, it shows relatively poor development of structural features.

Ventral valve: teeth not large, with uneven surface, somewhat longer than broad (fig. 2); dental plates slightly developed; muscle scars not discernible.

Dorsal valve: hinge plates (fig. 2) narrow and long; crural processes pass into narrow crura, running almost parallel to one another, with a barely 2 mm spacing. They are long, usually extending up to nearly mid-length of the valve, and run along both sides of the dorsal septum, slightly diverging to the outside anteriorly (fig. 3 c); hinge-sockets shallow and rounded; dorsal septum extremely narrow and long, stretching beyond the midlength of the valve; muscle scars are not marked.

Ontogeny (pl. I, fig. 1-6; pl. III, fig. 1-4; text-pl. I, fig. 1-16). The material on which the ontogeny was studied, though not perfectly complete, was sufficiently numerous to illustrate the chief changes in morphology occurring during the growth of the shell. The particular stages of ontogeny were each represented by several specimens.

The earliest, nepionic, stage, characterized by smooth surface in both valves (without radial ornamentation), was recognizable in the posterior parts of the larger specimens only.



Peregrinella multicarinata (Lamarck)

Fig. 1-16. Sixteen young Polish specimens in various growth stages: *a* dorsal view, *b* ventral view, *c* lateral view. Note variability in exterior outline of shell, in length of hinge-line and in thickness of shell; × 3.3.

Dimensions of the smallest available specimen (figured in text-pl. I, fig. 1 a-c) are as follows: length 3.8 mm, width 3 mm, thickness 1 mm. Specimen longer than wide, with a distinctly pentagonal outline

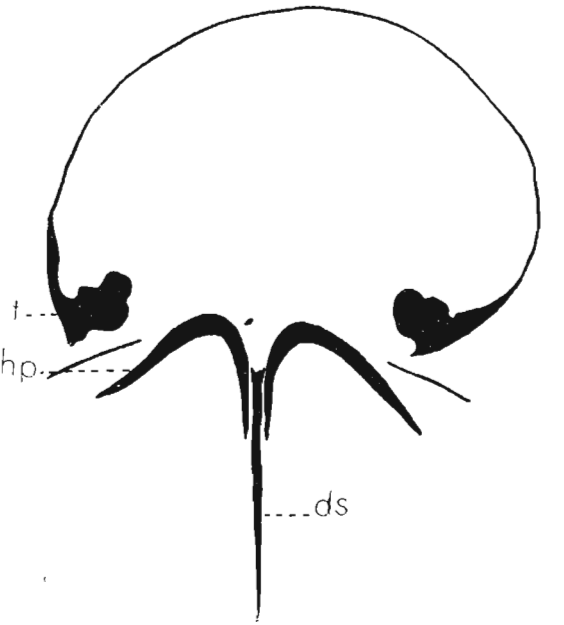


Fig. 2. — *Peregrinella multicarinata* (Lamarck); transverse section of the hinge-line region of a mature Polish specimen showing details of internal structure, *t* tooth, *hp* hinge plate, *ds* dorsal septum; × 7.5.

and almost parallel lateral margins; shell gently biconvex; highest surface of the pedicle valve at midpoint, in the brachial valve it is in the umbonal region. Along the lateral and anterior margins of the valve initial radial ornamentation begins at a distance of 2 mm from the apex. It consists of very fine striae, nearly one and a half millimeter long, 12 on each valve. Subsequently they develop into radial folds. Concentric growth lines, closely and occasionally regularly spaced, particularly on posterior and central portions of both valves. In shells from 4 to 7 mm long (text-pl. I, fig. 2 a-8 a), features of specific morphology are mostly well differentiated; shell displays a stronger length than width-growth. In most cases the outline is pentagonal, posterior margins of the pentagon correspond to the umbonal ridges forming an acute angle; the lateral margins are subparallel or strongly divergent anteriorly, and the base or anterior margin is straight or gently rounded. Shell equally biconvex along whole length; hinge-ears usually present, but not always readily discernible; lateral margins more or less divergent, while anterior margin straight or rounded.

Fig. 3. — *Peregrinella multicarinata* (Lamarck); *a-e* a series of cross sections of a Polish specimen, showing dorsal elements of internal structure, *hp* hinge plate, *cp* crural process, *ds* dorsal septum, *c* crura; × 6.

Radial striae already observable on the surface of both valves at a distance from 1.5 to 2 mm from apex; their number varies from 15 to 18, being usually the same on both valves. Striae though fine, are well marked, the ridges and interstrial spaces being sharp. Postero-lateral slopes of both valves covered by closely spaced, concentric growth lines only, discernible on the whole surface of the shell.

The next group of specimens includes shells from 7 to 11 mm in length (pl. I, fig. 1-3; text-pl. I, fig. 9a to 13a). On the whole, they differ but little from the above described specimens. The presence should be, however, noted of shells with distinctly trigonal outline, in addition to those which are still pentagonal. In the former case strongly divergent lateral margins are the continuation of beak ridges, while cardinal angles are sometimes indistinctly marked. Anterior margin, rounded or rectimarginate, corresponds to greatest width of shell. In this stage too, the shell is longer than wide. Striae are thicker and their number increases to 20 or even 22. As the shell grows, new striae appear by addition on the lateral slopes of both valves only.

Specimens, from 14 to 35 mm long (pl. III, fig. 1a-4a; text-pl. I, fig. 14-16a) are wider than long, in opposition to those in the above considered stage. Outline changes from trigonal to sub-trigonal or to sub-circular. Greatest width of shell shifted from the anterior margin towards the middle; lateral margins as well as anterior margin become rounded. In this stage, distinctly recognizable radial folds appear to replace striae of the former stage. In some specimens their number attains 32 on each valve. The appearance of individuals in this stage of ontogeny resembles quite closely that of adults. This is the final stage of a rather prolonged period of morphogeny. Subsequent changes affecting the adult shell will be connected with growth of dimensions only and thickness of shell. High radial folds will appear to replace the small folds, widening out to the front of the shell, while the sharpness of their ridges and furrows is gradually emphasized; the beak

thickens as the age of the individual advances and strongly curves over the brachial valve. These are gerontic characters.

It may be seen from above that extensive morphologic changes affect the shell in the course of its development. The external characters of the youngest individuals differ so much from those of the adults as to make impossible their specific identification and impede even their generic determination. Stress should be laid, in the first place, on the following characters subject to extensive ontogenic changes: 1) external shell outline altering from pentagonal to trigonal and finally to circular; 2) greatest width of shell which corresponds to the anterior margin during the youngest stages of ontogeny and shifts toward the middle of shell in adults; 3) length/width radio: in juvenile individuals the length exceeds the width while in adolescents the width is equal to or even exceeds its length.

For better illustration a table is here given, with 25 specimens in various stages of ontogeny, listing their length, width and thickness, as well as length of hinge-line and number of folds in the ventral and dorsal valves (see p. 34-35).

The ornamentation changes from tiny radial striae through small folds into distinct, thick folds. It should be stressed that the radial ornamentation is on the whole very regular in all stages of ontogeny. As has already been pointed out, new folds appear independently of the thickness of shell on the slopes of valves only, usually 2 or 4 on each valve. In some very rare cases, however, (observed on 4 specimens), this regularity of arrangement is somewhat disturbed. As a rule, in these cases, one of the folds situated at nearly midlength of shell divides. Naturally, there is correspondence between the bifurcation of fold in the dorsal and ventral valves. Owing, however, to its extreme rarity the bifurcation should be regarded as incidental.

Individual variability. The observation of changes taking place during ontogeny leads to the conclusion that there are only very few characters which do not undergo any changes, others than those connected with growth. To say, the hinge-line is always arcuate, gently curving at midlength in all specimens, whether young or mature. As the width of the shell increases the hinge-line becomes elongated. The lateral and anterior commissures are zigzag in all those stages of ontogeny, the nepionic stage excepted, in which there are no striae. In young specimens the zigzag commissure joining the two valves is not so conspicuous. As the folds thicken, along with advancing growth, the commissure becomes more marked, showing sharp ridges and furrows. The planarea is slightly curved in all the specimens, from the youngest to the oldest. Details of internal morphology as the hinge plates, the dorsal septum and crura are subject to changes of growth only. As individuals attain their maturity,

Dimensions of specimens in various stages of ontogeny (in mm)

No.	Length	Width	Thickness	Length of hinge-line	Number of folds $\frac{v}{d}$
1	3.8	3.0	1.0	1.3	$\frac{12}{12}$
2	5.5	3.8	1.5	1.5	$\frac{18}{18}$
3	6.5	5.6	1.7	2.2	$\frac{18}{18}$
4	7.0	5.2	2.0	2.0	$\frac{20}{21}$
5	8.9	7.7	3.3	3.6	$\frac{19}{19}$
6	9.5	8.4	3.0	4.4	$\frac{16}{16}$
7	10.0	8.5	2.9	4.1	$\frac{22}{22}$
8	10.8	9.6	3.1	5.7	$\frac{23}{23}$
9	12.3	10.4	3.9	6.1	$\frac{22}{22}$
10	13.8	11.5	4.8	6.2	$\frac{22}{22}$
11	15.3	14.8	6.2	8.6	$\frac{24}{24}$
12	17.4	16.6	6.3	8.0	$\frac{25}{24}$
13	21.5	21.8	7.7	15.9	$\frac{35}{33}$
14	30.0	31.0	14.4	19.1	$\frac{34}{32}$
15	31.8	34.0	12.8	20.8	$\frac{35}{33}$
16	38.5	34.9	15.3	26.6	$\frac{26}{26}$
17	40.8	40.0	17.0	26.7	$\frac{32}{32}$

Dimensions of specimens in various stages of ontogeny (in mm)
(continued)

No.	Length	Width	Thickness	Length of hinge-line	Number of folds $\frac{v}{d}$
18	50.9	50.9	26.5	34.3	$\frac{35}{35}$
19	61.0	59.0	30.3	30.2	$\frac{41}{39}$
20	63.4	64.7	36.0	43.7	$\frac{44}{43}$
21	71.6	73.7	44.0	43.2	$\frac{33}{32}$
22	78.7	81.0	44.4	47.5	$\frac{33}{34}$
23	81.8	94.5	50.0	53.2	$\frac{35}{34}$
24	82.0	85.3	47.9	46.9	$\frac{33}{33}$
25	98.6	120.6	56.2	65.0	$\frac{35}{35}$

these structures chiefly increase in length and but slightly in thickness and width. No great morphologic changes take place throughout their ontogeny.

Extensive variability, both ontogenic and individual, indicates the great plasticity of the species connected probably even with minor changes of environment. Some writers have already turned their attention to the great individual variability of this brachiopod. Renngarten (1924), among others, asserted it to be displayed mostly in the ornamentation and thickness of shell.

Our observations lead to the inference that individual variability affects practically all morphological characters. The ornamentation only keeps the same character throughout all stages of ontogeny, namely: striae in young specimens, small folds in older ones, as well as folds in adults, are well marked, moderately high, with rather sharp ridges and furrows. In consequence, the lateral and anterior commissures are always zigzag. But the number of folds on the surface of shell is not uniform, and varies considerably. At a distance of about 2 mm from the apex (as measured in 20 specimens) the number of folds is from 12 to 20; being from 16 to 30 and from 33 to 50 at the respective distance of 10 and 55 mm from the

apex. It should be pointed out that no definite boundary line may be laid down between specimens displaying a smaller or greater number of folds, as intermediate cases also occur. For example, the maximum number of folds in specimens, whose shell length attains from 35 to 60 mm, is up to 50, the minimum being 33. On the other hand, there are also specimens of the same individual age provided with 34, 36, 42, 44 and 46 folds. Consequently, the number and thickness of folds are doubtlessly assignable to individual variability.

When less numerous, the folds are thicker and wider, being slighter and somewhat higher when more numerous.

Differences in the number of folds are also observable in specimens from France and other countries. Among his specimens from Transsylvania, Toula (1911) has observed individuals with more and less numerous folds. All these shells, independently of differences in ornamentation, have by Toula been referred to *Peregrinella multicarinata* (Lamarck). On the other hand, Renngarten (1924) on evidence of two characters: thickness of shell and number of folds, has distinguished two varieties among specimens from the Caucasus. One of these varieties, named *„pinguis"*, is characterized by the thickness and smaller number of folds and considerable thickness of shell. The other one, called *„typica"* by that author, displays thinner and hence more numerous folds, while the thickness of shell is far smaller.

It is on the whole somewhat difficult to select from among the Polish and French specimens available to the writer some feature of morphology associated with the character of folds. Even the thickness of all the shells, independently of the number of folds, is nearly uniformly moderate, contrary to that in specimens from the Caucasus. The French specimens, with more numerous folds, are flattened out to a greater extent posteriorly, contrary to specimens with thicker folds in which the umbonal part of the brachial valve is more arched. In all probability, however, this feature involving the flattening at the umbonal part, is not confined to specimens with thinner folds only. Toula (1911, pl. 3, fig. 2 a) figures a specimen with about 50 thin folds, not displaying any flattened umbonal part, but, on the contrary, rather strongly convex, as in the thickly folded shells.

The variability of the external outline is more conspicuous in adults than in young individuals. This has been shown by measurements carried out in the case of 16 young specimens, suitable for this purpose, with length of shell up to 13 mm, as well as in the case of 25 adults. In juvenile individuals the width/length ratio varies between 0.8 and 0.9, with the predominance of the 0.9. The thickness/width ratio varies between 0.3 and 0.5, the majority of specimens being grouped at the 0.4 index.

In adults the width/length ratio varies between 0.9 and 1.4, the most frequent one being 1.0. The thickness/width ratio is here between 0.4 and 0.7, with most specimens at the 0.5 index.

In the chapter dealing with ontogeny the writer has mentioned that two principal types of outline may be differentiated among youthful individuals: the pentagonal dominating among individuals attaining a length of up to 7 mm, and the trigonal, characteristic of somewhat older individuals, with length up to 15 mm. As is figured in text-pl. I, fig. 1 a-14 a, the young individuals, with length from 4 to 15 mm, display various forms of shell, intermediate between the pentagonal and the trigonal form.

In some youthful individuals the lateral margins are rectilinear or slightly concave. They may be either sub-parallel to each other, or more or less divergent.

The anterior commissure of young individuals may also be either straight or somewhat rounded (text-pl. I, fig. 1 a-11 a).

Considerable oscillation is observed in the length of the hinge-line in young individuals. It depends on the degree of development of ear-like prolongations of the hinge-line. These ears show great lack of uniformity in their development. In some individuals they are barely discernible, while in others they are distinctly marked (text-pl. I, fig. 1 a-13 a).

Comparisons. Upon comparing the Polish specimens with those from France and with descriptions and figures of other specimens recorded from various sites outside of France, it is possible to assert their close resemblance. Although the Polish specimens are few and mostly damaged, yet they provide adequate evidence for the doubtless identification of this characteristic species. This is suggested by the identity of such features as the rounded external form of shell, form of the hinge-line and of beak, details of ornamentation and the development of but few elements of internal morphology, to say dorsal septum, long, thin and almost parallel crura. Taking into consideration the strong individual variability, the material here studied does not lead to the establishment of more than very few features in which the Polish specimens differ from the French. One of the chief differences is the conspicuously smaller size of Polish adult individuals. The length of our specimens from Poland does not exceed 60 mm, while it attains 100 mm in those from France. Besides this the folds in the Polish specimens seem sharper. On these two characters the Polish specimens might perhaps be reasonably established into a new subspecies with the suggestion that the existing differences may have developed owing to environmental conditions prevailing in the Carpathian Basin. Yet, owing to the decidedly small number of adult individuals available to the writer, she cannot ascertain the extent of con-

stancy of the differences and, therefore, considers the Polish form as conspecific with *Peregrinella multicarinata* (Lamarck) from France.

The form figured by Quenstedt (1871, pl. 40, fig. 96-100) differs somewhat in its outward appearance from the typical specimens from both France and Poland. That author himself actually points out that the specimen figured by him belongs to the „longer" variety with moderate dimensions, thereby stressing the existence of a difference in the length/width ratio of the shell. This feature, as has been ascertained on the ontogeny of the Polish specimens, is characteristic of youthful individuals. In adult specimens, on the other hand, the length of shell is equal to its width, many a time it is even less; measurements of 35 French specimens belonging to adult individuals confirm this. But the study of more ample material is needed to determine whether this feature, in which Quenstedt's specimens differs from others, is one of individual variability or if it is a constant feature leading to the establishment of a new variety or species. Besides this feature, the beak in the specimen figured by Quenstedt is considerably larger and stouter than that in the Polish form.

E. Ascher (1906, pl. 14) has described and figured the dorsal valve of a young *Peregrinella peregrina* from the Grodziszcze (Grödischter) beds. As compared to specimens of about the same age, collected from Poland, it differs in having markedly thinner and consequently more numerous folds (about 50) and in the presence of clearly distinct hinge ears. Also, its cardinal angles are almost straight. That writer describes and figures another form which she refers to a new species, *Rhynchonella silesica* Ascher, recorded from the same Grodziszcze beds. Two specimens of this form were available to her. One of them belongs to a mature individual, the other is young. The young specimen of *Rh. silesica* Ascher, which has been figured and displays a most regular pattern of ornamentation, does not at all seem to dissemble the young Polish specimens. Its outward appearance is, in fact, identical. This new form, which its author believes to be very much like *Rh. peregrina*, may perhaps be its variety. The main difference lies in ornamentation. In *Rh. silesica* new folds are mostly due to bifurcation. Consequently the zigzag commissure, so regular in *Peregrinella multicarinata*, loses some of its regularity in *Rh. silesica* (fig. 4). As mentioned before on p. 33, occasional bifurcation of folds has also been observed by the present writer in four French specimens. Considering, however, the extreme rarity of its occurrence the present writer is inclined to regard it as incidental. It is nonetheless interesting in connection with the predominant bifurcation of folds in *Rh. silesica*. Observations of the ornamentation in *Rh. silesica* involving a greater number of specimens might be of some interest.

The Transsylvanian specimens described by Toula (1911) differ considerably from Polish ones. In the first place they are of greater dimensions and exceedingly wide. In the umbonal region the brachial valve is strongly arched in a semicircle, while it is gently convex anteriorly;

Fig. 4. — *Rhynchonella silesica* Ascher as figured by E. Ascher in 1906. Note irregular zigzag anterior commissure; nat. size.

whereas in Polish specimens it is gently convex along the midline from beak to front. The number of folds is almost the same in both, the Polish and the Transsylvanian specimens. Specimens of young individuals figured by Toula (1911) differ considerably from Polish specimens, in the conspicuously thinner and more numerous small folds (about 50), in the greater length of the hinge-line and in the more distinctly marked hinge ears. In Polish specimens, of about the same length as in those from Transsylvania, the number of folds oscillates between 20 and 32. It might also be mentioned here that the three young specimens from France available to the writer, in their outward appearance very closely resemble the shells of the same age figured by Toula.

As compared with specimens from the Caucasus, the Polish specimens come very close to Renngarten's variety of *Peregrinella multicarinata* var. *typica*. The resemblance lies in ornamentation, since the folds in this variety are of a similar thickness. So is the convexity in specimens from Poland and the Caucasus very much the same. The shell is regularly and gently biconvex along the whole length. The main difference is in the considerably larger size of specimens from the Caucasus, its length, as figured, being equal to the width and measuring about 100 mm.

Peregrinella multicarinata var. *pinguis*, another variety differentiated by Renngarten (1924), differs from the Polish specimens in the greater convexity of the shell. Its dorsal valve is strongly inflated along its entire length and arched in the umbonal part, as is also the form from Transsylvania, figured by Toula (1911). The folds of this variety are thicker and their furrows slightly wider. None of all the French specimens stud-

ied by the present writer have a length corresponding to that in *P. multicarinata* var. *pinguis*, their thickness being markedly smaller in specimens with thick folds. The French specimens with thinner folds belong to individuals who have reached their maturity, but are not yet old. Their shells are, therefore, weakly biconvex, the dorsal valves particularly so. The thickness of shell being, however, one of the gerontic characters in the brachiopods, it may be supposed to have increased with age in the French specimens and to be the same as in shells with thicker folds.

In a paper by Hertlein and Grant (1944) short mention is made about the Lower Cretaceous Californian species of *Peregrinella whitneyi* (Gabb) with a figure of the hypotype. On comparing this American species with the Polish specimens it is noted that the differences between them are not great. They consist in the larger size of the shell of *P. whitneyi* and the stronger convexity of both valves.

In summing up, the Polish specimens must be regarded as referable to species *Peregrinella multicarinata* (Lamarck). As has already been stressed here, the features in which the Carpathian form differs from the typical French form or from other forms recorded from Rumania, the Caucasus and elsewhere, are not important. Furthermore, the adult material from Poland is quite inadequate to impart a systematic value to the observed differences.

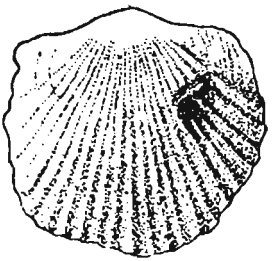
Possibly, the investigation of large numbers of specimens from various geographical areas may lead to the establishment within genus *Peregrinella* of species or varieties which will be assigned a more exact systematic position than has thus far been done.

DEFORMATIONS OF SHELL AND THEIR CONNECTION WITH ECOLOGICAL CONDITIONS

Deformations of shell produced during its life-time are not a rare occurrence in the case of *Peregrinella*. The material investigated by the present writer, though not very abundant, has provided many illustrative examples. These deformations affect: 1) external form of the shell which, occasionally, displays strong asymmetry recorded mainly in immature individuals, where the process of shell-growth was still going on; 2) surface of shell, without distinct alterations of its external shape. This type of deformation is observable on shells belonging to young, adult and old individuals.

The first type of deformation, stated here above, affects young individuals. Traces of it, however, are also discernible in mature individuals. When so, the lateral slopes of shell are not uniformly developed. As seen e. g. in text-pl. II, fig. 3, the left side of shell has developed normally, while the right is underdeveloped. Much more frequent is the under-

1



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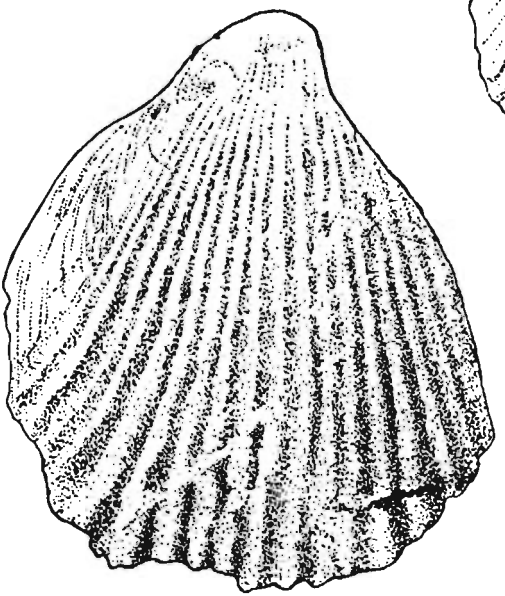

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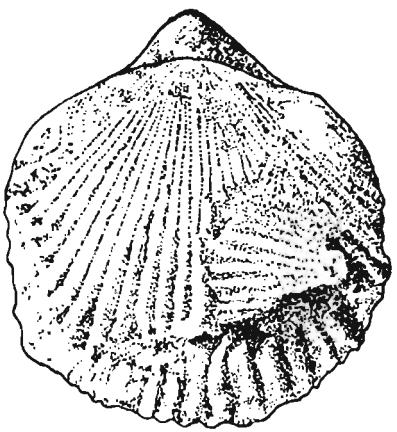
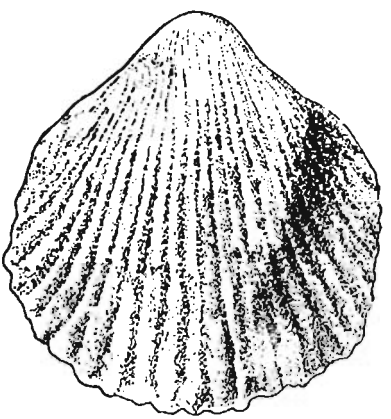


4a



4b

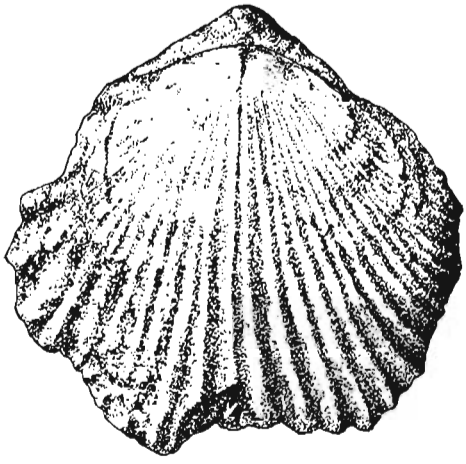
Peregrinella multicarinata (Lamarck)

Fig. 1. Young Polish specimen of asymmetric shape; note interrupted radial ornamentation; nat. size.

Fig. 2. Traces of compressions on surface of ventral valve of Polish specimen; nat. size.

Fig. 3. Deformation of external outline in a young Polish specimen; × 5.5.

Fig. 4. Damaged dorsal *(a)* and ventral *(b)* valves of a French specimen, nat. size.



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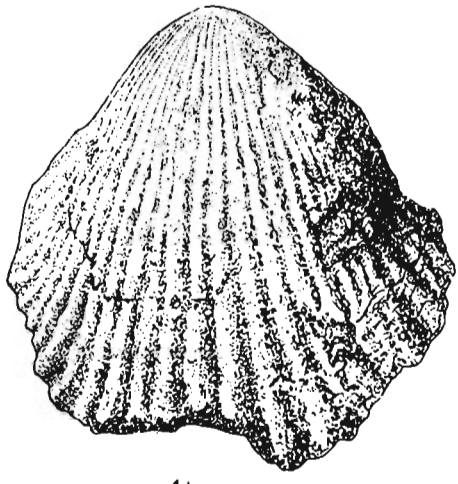

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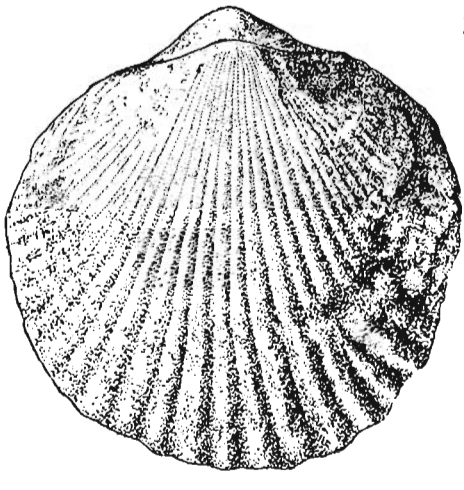
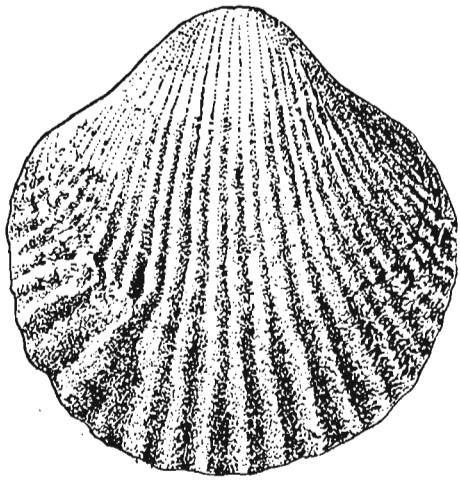


3a



3b

Peregrinella multicarinata (Lamarck)

Fig. 1. Mature Polish specimen with ornamentation conspicuously deformed owing to damages; *a* dorsal view, *b* ventral view; nat. size.

Fig. 2. Traces of compressions on ventral valve of a young Polish specimen; nat. size.

Fig. 3. Specimen from France with ornamentation deformed owing to damage of shell, *a* dorsal valve, *b* ventral valve; nat. size.

development of one of the hinge ears. In some specimens one of the ears is clearly distinguishable, while the other one is only vestigial or altogether absent (text-pl. I, fig. 7 a, 13 a).

In some specimens, one may additionally observe poor development of one side of the planarea, a strongly curved beak etc. Various writers make mention of such like asymmetry in brachiopods. N. Bashmakova (*fide* T. G. Sarycheva, 1949) has, among others, observed and described the irregular development of the planarea and beak in *Choristites*. Irregularities of this kind, developed during the life time of individuals, are easily explained by density of monospecific population.

Many earlier workers have emphasized that some of the Lower Cretaceous limestone beds are crowded with *Peregrinella*. W. Kilian (1913) (1913) mentions the nest-like occurrence of this fossil. It is the same in the case of Polish specimens which were very much crowded in the discovered block. It is to infer that *Peregrinella* formed large and dense clusters with a predominance of young individuals, still attached to the substratum by means of a functional pedicle. The mechanical pressure bearing on any one part of the still growing shell must necessarily have impeded the growth of that part, resulting in the asymmetry of the form. It must also be stressed that deformation is displayed by either the right or the left side of the shell, probably depending on which side of the shell it touched another individual.

Similar examples of shell asymmetry of brachiopods may be encountered in densely crowded assemblages, yielded by *Stringocephalus* or *Bornhardtina* Middle Devonian beds. These forms constituting monospecific assemblages attain, under optimal life conditions, their maximal development as regards both their size and numbers of individuals. They took complete possession of their niche and populated them densely, so much so as to necessitate a struggle for life-space, a restriction which does by no means favour the regular growth of shells. Illustrations of the asymmetry of external form, due to crowded assemblages, are among others also given in a paper on Carboniferous Brachiopods by Sarycheva (1949).

In what regards the deformation of shell surfaces, those cases must of course be only considered that were produced during the life time of the specimens. Many shells belonging to both, young and mature specimens bear traces of considerable damages, subsequently healed up. Observations show these damages to have taken place mostly in the region of lateral and anterior margin and therefore relatively the thinnest parts. The damages are not confined to one valve only, but affect both valves simultaneously (text-pl. III, fig. 1 a, b & 3 a, b). On the shell a fairly large scar, mostly in the shape of a distinct thickenning is to

be seen where the damage occurred. But no check of any importance seems to have taken place and the formation of subsequent radial folds has not been stopped.

Close examination of all shells available has led the writer to detect numerous superficial damages separable into three groups:

1. A fairly distinct scar, consisting of a small thickening, is visible on the shell where the damage had occurred. The further development of radial ornamentation was disturbed. In consequence, the ornamentation differs strongly from the normal pattern. The arrangement of folds and the folds themselves are somewhat different, having an undulatory course, being thicker and less numerous. Many a time, instead of two normal folds, there will be but one (text-pl. II, fig. 4 a; text-pl. III, fig. 1 a, 3 a). Cases like this have been observed in mature individuals.

2. Both in young and mature individuals traces of damages are discernible, seen as very pronounced thickenings (text-pl. II, fig. 2; text-pl. III, fig. 1 b).

These were supposedly places of more intensive excretion of shell substance by the margins of the mantle. No longer interruption, however, occurred in the subsequent formation of radial ornamentation, which was continued in a nearly regular manner.

3. In some juvenile specimens it is to be noted that the development of further radial ornamentation in their anterior or lateral portions had been subjected to a check of short duration. This had involved a small area only, within which, instead of the radial folds, we can see distinct and frequently dilated concentric growth lines. After some time, however, the folds developed quite normally over the next portion of shell. An occurrence of this kind suggests a pressure made on this part of the shell by some foreign body, in consequence of which the radial folds failed to develop. As soon as the pressure had ceased, the development of the radial ornamentation continued quite normally (text-pl. II, fig. 1).

Taking into account all these observations it may be maintained that, outside of some disturbances and very brief checks to the development of ornamentation, growth in the damaged portions of shell continued almost normally if damage had been inflicted in the marginal regions.

In addition to damages of this type, quite numerous traces are sometimes discernible of pressure exercised upon the shell (pl. II, fig. 4 b; text-pl. III, fig. 2). They occur in various parts of the surface of the particular specimens, i. e. in the marginal as well as in the central region. It is not, however, always possible to distinguish these compressions from those formed during the process of diagenesis.

On the strongly curved ventral beak concealing the delthyrium, and on the large dimensions of mature shells, it seems that the functional

pedicle of young individuals was atrophied in the gerontic stage. Such specimens, it may be inferred, rested unattached at the bottom, on their ventral valves, keeping their balance thanks to the dilation of the ventral beak and pronounced elongation of the hinge-line.

Are the cephalopods, so densely populating the Cretaceous seas, to be made responsible for some of the here described damages? It would be difficult to answer this question with full certainty.

GEOGRAPHICAL DISTRIBUTION

Genus *Peregrinella* is commonly known as an important index fossil of the Middle Neocomian, all the more so that it shows a wide geographical distribution. It has been recorded from Lower Cretaceous beds both of Europe and North America.

It occurs mainly in a purely calcareous facies, but is not confined thereto, being also recorded from an arenaceous facies, i. e. from calcareous sandstones of the Cieszyn (Teschener) and Grodziszcze (Grödischter) beds, within the Carpatian Mts. Specimens from these beds differ slightly from the type forms, as has already been noted by some writers (Uhlig, 1901).

Typical specimens of *Peregrinella multicarinata* have been recorded from Middle Neocomian limestones in south-western France, at the localities of Châtillon, Rottier, Gigondas, La Charce, Chalançon etc. It has also been found in beds with *Serpula recta* Gold, at Montpellier and at Monte Gargano in Italy. Their occurrence has furthermore been noted in the north-western areas of the Carpathians, in Cieszyn (Teschin), Moravia, and in the vicinity of Wieliczka, Poland. In Germany they are probably known from the district of Werle in Mecklenburg.

Further to the east of Europe, *P. multicarinata* is found at the locality of Kronstadt (Brasov) in Transsylvania. Finally, fine specimens of this brachiopod have been obtained from western Kuban in northern Caucasus.

Outside of Europe, genus *Peregrinella* has thus far only been recorded from western California in North America (Napa County, Clear Lake, Wilbur Springs, Colusa County).

The occurrence of the same genus within Lower Cretaceous beds of both Europe and California is very interesting, particularly that observed in two such widely distant areas as California and the Caucasus. This has been stressed by Renngarten (1924), Hertlein and Grant (1944). Hertlein emphasizes also the close resemblance of some ammonites in these two regions. Renngarten supposes that the appearance of *Peregrinella* in the Upper Hauterivian sea of Europe was quite sudden. Its ancestors are not, as he states, known to us. The interesting fact of the

occurrence of this form in California, as early as in Valanginian times, makes this writer infer that *Peregrinella* migrated to Europe from the northern boreal sea of which the Californian Basin was a part.

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of the Polish Academy of Sciences
Warszawa, October 1956

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GERTRUDA BIERNAT

O *PEREGRINELLA MULTICARINATA* (LAMARCK) (BRACHIOPODA)

Streszczenie

Praca dotyczy *Peregrinella multicarinata* (Lamarck) — brachiopoda dolno-kredowego ważnego z uwagi na znaczenie stratygraficzne, jego rozwoju ontogenetycznego i zmienności osobniczej. Badania oparto na obfitującym w osobniki młode materiale polskim, odkrytym przez dr J. Burtan w okolicach Wieliczki w postaci kilku luźnych bloków skały ilasto-wapiennej, oraz na okazach z Francji wypożyczonych przez autorkę z Muzeum Paleontologicznego Uniwersytetu im. Humboldta w Berlinie. Zbadany tu rodzaj, spotykany zarówno w facji czysto wapiennej jak i wapienno-piaszczystej, ma duże rozprzestrzenienie geograficzne. Notowany jest w płd.-zachodniej Francji, we Włoszech (Monte Gargano), na Morawach i na Śląsku Cieszyńskim, w Rumunii (Siedmiogród), na Kaukazie (płn.-zachodnia część Kubania) oraz — poza Europą — w Ameryce Północnej, w zachodniej części Kalifornii.

Typowa *Peregrinella* została opisana po raz pierwszy z wapieni hoterywskich płd.-zachodniej Francji (okolice Châtillon) pod dwiema nazwami gatunkowymi: w 1819 r. jako *Terebratula multicarinata* Lamarck, a w 1835 r. jako *T. peregrina* Buch. Nazwa gatunkowa L. Bucha przyjęła się w literaturze późniejszej, chociaż

prawo pierwszeństwa przysługuje bezsprzecznie nazwie Lamarcka. W 1847 r. A. d'Orbigny zaliczył tę formę do wydzielonej już wówczas grupy rynchonel, a w 1887 r. D. P. Oehlert ustanowił dla niej nowy rodzaj — *Peregrinella*.

Z przeprowadzonych badań porównawczych wynika, że okazy polskie należy uznać za przynależne do gatunku *P. multicarinata* (Lamarck). Cechy, odróżniające polską formę od francuskiej typowej czy też od innych, pochodzących z Rumunii, Kaukazu itp., nie są znaczne. Materiał osobników dorosłych, pochodzący z Polski, jest zresztą niewystarczający, aby ewentualnie występujące drobne różnice uznać za cechy mające znaczenie systematyczne. Możliwe, że zbadanie dużej ilości okazów różnego pochodzenia geograficznego pozwoliłoby na wyróżnienie, w obrębie rodzaju *Peregrinella*, gatunków czy też odmian zdefiniowanych dokładniej, niż to uczyniono dotychczas.

Badania rozwoju ontogenetycznego przeprowadzone na okazach od 3,8 mm długości wykazały, że zmiany morfologiczne, jakim podlega muszla w ciągu jej rozwoju osobniczego, są bardzo znaczne. Okazy najmłodszych osobników mają wygląd nie podobny zupełnie do dorosłych. Odbiegają od nich w wielu cechach zewnętrznych tak, że dysponując tylko takimi okazami nie byłoby możliwe ich oznaczenie gatunkowe, a oznaczenie rodzajowe sprawiałoby wielką trudność. Dużym zmianom w ontogenezie podlegają następujące cechy:

1) zarys zewnętrzny muszli, zmieniający się od pięciobocznego poprzez trójkątny do okrągłego;

2) największa szerokość muszli, znajdująca się przy brzegu przednim — w najmłodszych stadiach rozwojowych, a przesuwająca się ku środkowi muszli w kierunku brzegu zawiasowego — u osobników dorastających;

3) stosunek długości do szerokości, długość bowiem osobników młodocianych jest większa niż szerokość, u dorastających zaś różnica ta się wyrównywuje i długość muszli równa się jej szerokości lub też w wielu przypadkach jest od niej mniejsza.

Zmienia się również urzeźbienie radialne na powierzchni muszli, począwszy od delikatnych prążków u okazów najmłodszych, poprzez fałdki, do grubych, wyraźnych fałdów. Urzeźbienie radialne we wszystkich stadiach rozwojowych jest na ogół bardzo prawidłowe. Nowe fałdy pojawiają się, niezależnie od grubości muszli, tylko na bocznych skłonach skorupek, zazwyczaj po 2 lub 4 na każdej.

Zaobserwowana duża zmienność osobnicza *Peregrinella* dotyczy tylko cech zewnętrznych muszli. Elementy struktury wewnętrznej, jak septum dorsalne i krura, ulegają jak się zdaje tylko zmianom wzrostowym, powiększa się bowiem ich długość oraz nieco szerokość i grubość. Duża zmienność osobnicza świadczyć może o wielkiej plastyczności gatunku, zależnie od drobnych odchyleń środowiskowych. Zmienność ta dotyczy prawie wszystkich cech morfologii zewnętrznej, a w szczególności urzeźbienia, tj. liczby fałdów oraz ich grubości. Zmienność zarysu zewnętrznego u okazów dorosłych jest również dość duża, u młodszych — mniejsza. Z pomiarów, wykonanych na 16 okazach młodych o długości muszli dochodzącej do 13 mm oraz na 25 okazach dorosłych, wynika, że stosunek szerokości muszli do dłu-

gości okazów młodych waha się w granicach od 0,8 do 0,9, przy czym najczęstszy jest 0,9. Stosunek grubości do szerokości mieści się w granicach 0,3—0,5, najwięcej zaś okazów grupuje się przy wskaźniku 0,4. U okazów dorosłych natomiast wskaźnik szerokości znajduje się w granicach 0,9—1,4, najczęstszy jest 1,0. Wskaźnik grubości waha się od 0,4 do 0,7 i przy wskaźniku 0,5 grupuje się najwięcej osobników.

Bardzo częste są przyżyciowe deformacje muszli. Dotyczą one jej zarysu zewnętrznego, wyrażonego niekiedy silną asymetrią. Zachodzi to głównie wśród okazów młodych, u których trwa jeszcze proces wzrostu muszli. Prócz tego obserwuje się je na powierzchni skorupek, bez wyraźnego zniekształcenia wyglądu zewnętrznego muszli, zarówno u osobników młodych jak też u dorosłych i starych. Deformacje te są wynikiem uszkodzeń zachodzących przeważnie w okolicach brzegów bocznych i przednich muszli, a więc w częściach najmłodszych, a tym samym stosunkowo najcieńszych. Uszkodzenia te można ująć w trzy grupy:

1) w miejscu uszkodzenia widoczna jest na muszli blizna w postaci niewielkiego zgrubienia (text-pl. II, fig. 4 a; text-pl. III, fig. 1 a, 3 a). W dalszym tworzeniu radialnego urzeźbienia nastąpiło zaburzenie, przebieg więc fałdów jak i same fałdy są nieco inne, biegną bowiem faliście, są grubsze i mniej liczne;

2) na muszli widnieją ślady uszkodzenia w kształcie niekiedy mocno zaznaczonego zgrubienia (text-pl. II, fig. 2; text-pl. III, fig. 1 b). Prawdopodobnie w tym miejscu wydzielanie węglanu wapnia przez brzegi płaszcza było intensywniejsze. W dalszym tworzeniu się fałdów nie było jednak dłuższej przerwy i były one kontynuowane w sposób prawie zupełnie regularny;

3) krótkotrwałe zahamowanie w tworzeniu dalszego radialnego urzeźbienia, co zachodzi na niewielkiej przestrzeni (text-pl. II, fig. 1).

Na podstawie dokonanych obserwacji można twierdzić, że dalszy wzrost w uszkodzonej części muszli, w przypadku uszkodzeń w okolicach brzeżnych, odbywał się na ogół prawie normalnie. Działo się to być może dlatego, że zranienie przypadło na brzeżną część muszli, a więc tam, gdzie brzeg płaszcza wydziela ciągle substancję skorupkową. Prócz wymienionych uszkodzeń, można zaobserwować dość liczne ślady wgnieceń skorupki w różnych miejscach na powierzchni okazów. Nie zawsze jednak można odróżnić wgniecenia przyżyciowe od tych, które powstały w procesie diagenezy. Wgniecenia przyżyciowe przypisać należy zapewne nadmiernemu zgęszczeniu osobników młodych w pewnych niszach ekologicznych.

OBJAŚNIENIA DO ILUSTRACJI

Fig 1 (p. 23)

Terebratula multicarinata opisana przez J. B. Lamarcka (1819) i zilustrowana przez T. Davidsona w 1850 r.; rys. nieco zmniejszony. (Wielk. natur. oryginału: dług. i szer. 7,62 cm, grub. 4,44 cm).

Fig. 2 (p. 31)

Peregrinella multicarinata (Lamarck). Przekrój poprzeczny w okolicy brzegu zawiasowego okazu dorosłego, pochodzącego z Polski, ilustrujący elementy struktury wewnętrznej; *t* zęby, *hp* płytka zawiasowa, *ds* septum dorsalne; × 7,5.

Fig. 3 (p. 32)

Peregrinella multicarinata (Lamarck). *a-e* seria szlifów, wykonanych na okazie pochodzącym z Polski, ilustrujących elementy dorsalne struktury wewnętrznej; *hp* płytka zawiasowa, *cp* listewka kruralna, *ds* septum dorsalne, *c* krura; × 6.

Fig. 4 (p. 39)

Rhynchonella silesica Ascher, ilustrowana przez E. Ascher w 1906 r. Widoczna nieregularnie zygzakowata komisura przednia; wielk. nat.

Tabl. I (p. 28/29)

Szkic geologiczny na S od Wieliczki, wg Dr J. Burtan (1 : 100.000)

1 warstwy krośnieńskie, *2* w. istebniańskie, *3* w. godulskie, *4* w. lgockie, *5*. w. wierzowickie, *6* w. grodziskie; *7* Miocen, *8* jednostka podśląska, *9* jednostka śląska.

Text-Pl. I (p. 30/31)

Fig. 1-16. Szesnaście młodych okazów *Peregrinella multicarinata* (Lamarck) w różnych stadiach wzrostu, pochodzących z Polski; *a* od strony dorsalnej, *b* od strony wentralnej, *c* z profilu. Widoczna zmienność w zarysie zewnętrznym muszli, długości brzegu zawiasowego i grubości muszli; × 3,3.

Text-Pl. II (p. 40-41)

Peregrinella multicarinata (Lamarck)

Fig. 1. Asymetryczny w kształcie młody okaz pochodzący z Polski, widoczne zahamowanie w urzeźbieniu radialnym; wielk. nat.

Fig. 2. Widoczne ślady wgnieceń na powierzchni skorupki wentralnej okazu z Polski; wielk. nat.

Fig. 3. Deformacja w zarysie zewnętrznym młodego okazu z Polski; × 5,5.

Fig. 4. Uszkodzenia muszli pochodzącej z Francji, widoczne na skorupce dorsalnej (*a*) i wentralnej (*b*); wielk. nat.

Text-Pl. III (p. 40/41)

Peregrinella multicarinata (Lamarck)

Fig. 1. Okaz dorosły pochodzący z Polski, z wyraźnymi zaburzeniami w urzeźbieniu wskutek uszkodzenia; *a* od strony dorsalnej, *b* od strony wentralnej; wielk. nat.

Fig. 2. Widoczne ślady wgnieceń na skorupce wentralnej okazu z Polski; wielk. nat.

Fig. 3. Okaz z Francji, widoczne zaburzenia w urzeźbieniu wskutek uszkodzenia muszli; *a* od strony dorsalnej, *b* od strony wentralnej; wielk. nat.

Plansze poza tekstem

(wszystkie okazy w wielkości naturalnej)

Pl. I

Peregrinella multicarinata (Lamarck), Polska

Fig. 1-6. Sześć muszli różnego wieku; 1 *a* - 3 *a*, 4, 5, 6 *a* od strony wentralnej, 1 *b* - 3 *b*, 6 *b* od strony dorsalnej, 6 *c* z profilu.

Pl. II

Peregrinella multicarinata (Lamarck)

Fig. 1. Okaz dorosły z Polski: *a* od strony wentralnej, *b* od strony dorsalnej, *c* z profilu.

Fig. 2. Okaz dorosły z Francji: *a* od strony wentralnej, *b* od strony dorsalnej.

Pl. III

Peregrinella multicarinata (Lamarck), Francja

Fig. 1-4. Seria okazów różnego wieku; 1 *a* - 4 *a* od strony wentralnej, 1 *b* - 4 *b* od strony dorsalnej, 2 *c* - 3 *c* z profilu; 1 *c* okaz z profilu, ilustrowany również na pl. IV fig. 1 *a*, *b*.

Pl. IV

Peregrinella multicarinata (Lamarck), Francja

Fig. 1. Okaz dorosły: *a* od strony wentralnej, *b* od strony dorsalnej.

Fig. 2. Jeden z oryginalnych okazów L. Bucha: *a* od strony wentralnej, *b* od strony dorsalnej, *c* z profilu, *d* od strony brzegu zawiasowego, *e* od strony brzegu przedniego.

Pl. V

Peregrinella multicarinata (Lamarck), Francja

Fig. 1, 2. Dwa okazy dorosłe: *a* od strony wentralnej, *b* od strony dorsalnej.

Pl. VI

Peregrinella multicarinata (Lamarck), Francja

Fig. 1. Okaz dorosły: *a* od strony wentralnej, *b* od strony dorsalnej.

Fig. 2 *b*. Okaz dorosły z pl. V (2 *a*) od strony dorsalnej.

Pl. VII

Peregrinella multicarinata (Lamarck), Francja

Fig. 1. Okaz dorosły: *a* od strony wentralnej, *b* od strony dorsalnej.

Pl. VIII

Peregrinella multicarinata (Lamarck), Francja

Fig. 1 *c*. Okaz dorosły z pl. VII (1 *a*, *b*), widziany z profilu.

Fig. 2. Okaz dorosły: *a* od strony wentralnej, *b* z profilu.

ГЕРТРУДА БЕРНАТ

PEREGRINELLA MULTICARINATA (LAMARCK) (BRACHIOPODA)

Резюме

В статье приведены результаты исследований над видом *Peregrinella multicarinata* (Lamarck). Были учтены как онтогенетическое развитие так и изменчивость особей этой формы. Исследования производились на польском материале из окрестностей Велички, извлеченном из нескольких мергелисто-известняковых блоков богатых молодыми особями, а также на экземплярах происходящих из юго-западной Франции. Этот брахиопод встречается в нижнем мелу в чисто известняковой и известняково-песчанистой фациях. Он имеет большое

географическое распространение. Впервые *Peregrinella multicarinata* была описана из готеривских известняков юго-западной Франции, окрестности Шатийон (Châtillon) Ламарком (J. B. Lamarck) в 1819 г. под названием *Terebratula multicarinata* Lamarck. В 1835 г. ее описал Бух (L. v. Buch) как *T. peregrina* Buch. Видовое название Буха принялось в позднейшей литературе, хотя право приоритета принадлежит бесспорно Ламарку. В 1887 г. Элерт (D. P. Oehlert) установил для этой формы новый род *Peregrinella*. Сравнительное изучение показывает, что польские экземпляры следует считать принадлежащими виду *P. multicarinata* (Lamarck), а немногие черты отличающие их от экземпляров из Франции можно признать проявлением индивидуальной изменчивости. Проведенные исследования онтогенетического развития выявили, что морфологическая изменчивость раковины в течение развития особи очень значительна. Экземпляры наиболее молодых особей по внешнему виду совершенно не похожи на раковины взрослых особей так, что только на их основании не было бы возможности видового определения, а родовое определение было бы связано с большими трудностями. Большим изменениям в онтогенезе подвержены: 1) внешнее очертание раковины, 2) ее максимальная ширина, 3) отношение длины к ширине. Также радиальная скульптура изменяется значительно; начиная с тонких полосок у молодых особей, через этап мелких ребрышек и кончая грубыми и отчетливыми складками у взрослых особей. Индивидуальная изменчивость рода ограничивается лишь внешними признаками раковины. Элементы внутренней структуры подвергаются лишь ростовым изменениям — увеличивается их длина, в некоторой степени ширина и толщина. Большая изменчивость особей может свидетельствовать о значительной пластичности вида в зависимости даже от незначительных изменений среды.

PLATES

Pl. I

Peregrinella multicarinata (Lamarck), Poland

Fig. 1-6. Six shells of various age: 1 *a*-3 *a*, 4, 5, 6 *a* ventral view, 1 *b*-3 *b*, 6 *b* dorsal view, 6 *c* lateral view.

Pl. II

Peregrinella multicarinata (Lamarck)

Fig. 1. Mature Polish specimen: *a* ventral view, *b* dorsal view, *c* lateral view.
Fig. 2. Mature French specimen: *a* ventral view, *b* dorsal view.

Pl. III

Peregrinella multicarinata (Lamarck), France

Fig. 1-4. Series of specimens of various age: 1 *a*-4 *a* ventral view, 1 *b*-4 *b* dorsal view, 2 *c*-3 *c* lateral view, 1 *c* lateral view, also figured in pl. IV fig. 1 *a*, *b*.

Pl. IV

Peregrinella multicarinata (Lamarck), France

Fig. 1. Mature specimen: *a* ventral view, *b* dorsal view.
Fig. 2. One of L. v. Buch's original specimens: *a* ventral view, *b* dorsal view, *c* lateral view, *d* hinge-line view, *e* anterior margin view.

Pl. V

Peregrinella multicarinata (Lamarck), France

Fig. 1, 2. Two mature specimens: *a* ventral view, *b* dorsal view.

Pl. VI

Peregrinella multicarinata (Lamarck), France

Fig. 1. Mature specimen: *a* ventral view, *b* dorsal view.
Fig. 2*b*. Mature specimen from pl. V (2 *a*) seen dorsally.

Pl. VII

Peregrinella multicarinata (Lamarck), France

Fig. 1. Mature specimen: *a* ventral view, *b* dorsal view.

Pl. VIII

Peregrinella multicarinata (Lamarck), France

Fig. 1 *c*. Mature specimen from pl. VII (1 *a*, *b*), lateral view.
Fig. 2. Mature specimen: *a* ventral view, *b* lateral view.

All figures in natural size.

1a

2a

3a

1b

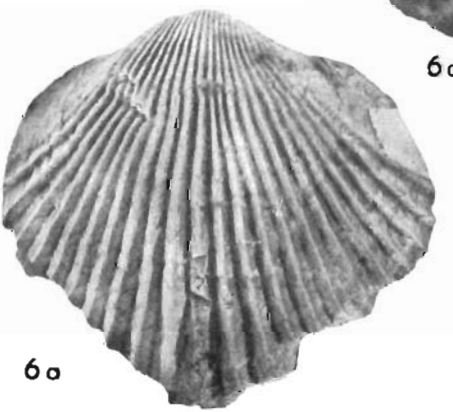
2b

3b

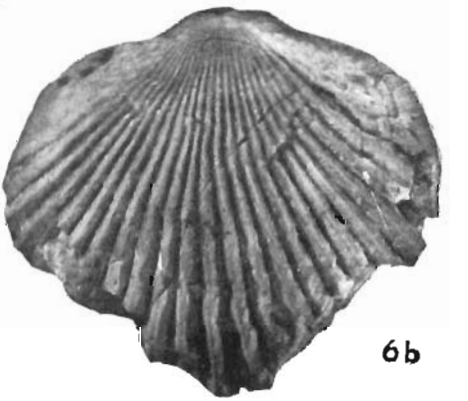
4

6c

5



6a



6b

1a

1b

1c

2a

2b

1a

2c

1b

2a

3c

2b

3a

3b

4a

1c

4b

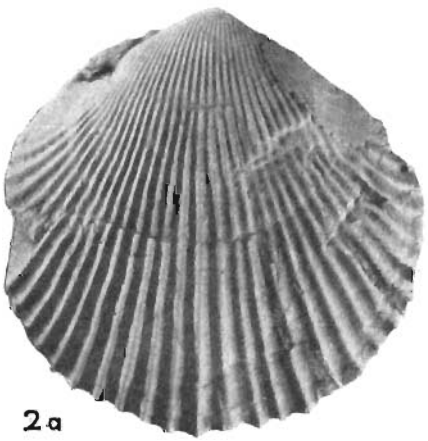
1a

1b

2c

2d

2e

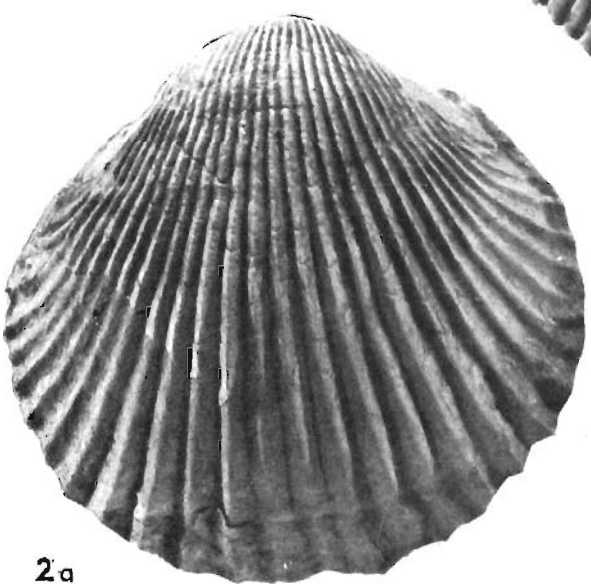


2a

2b

1a

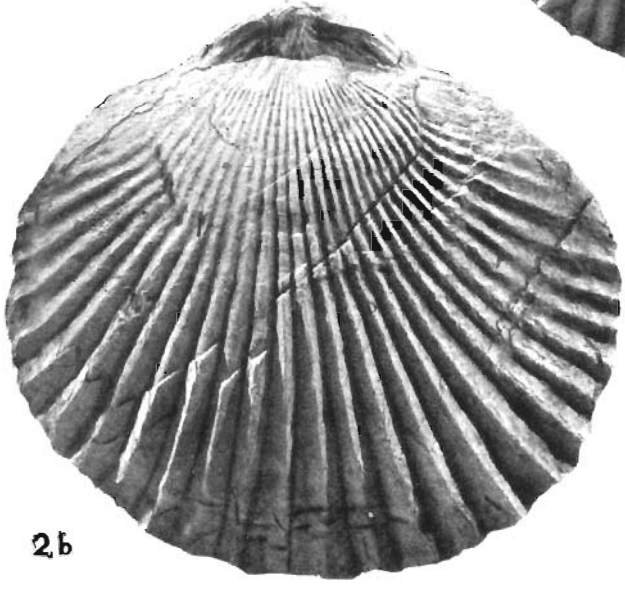
1b



2a

1a

1b



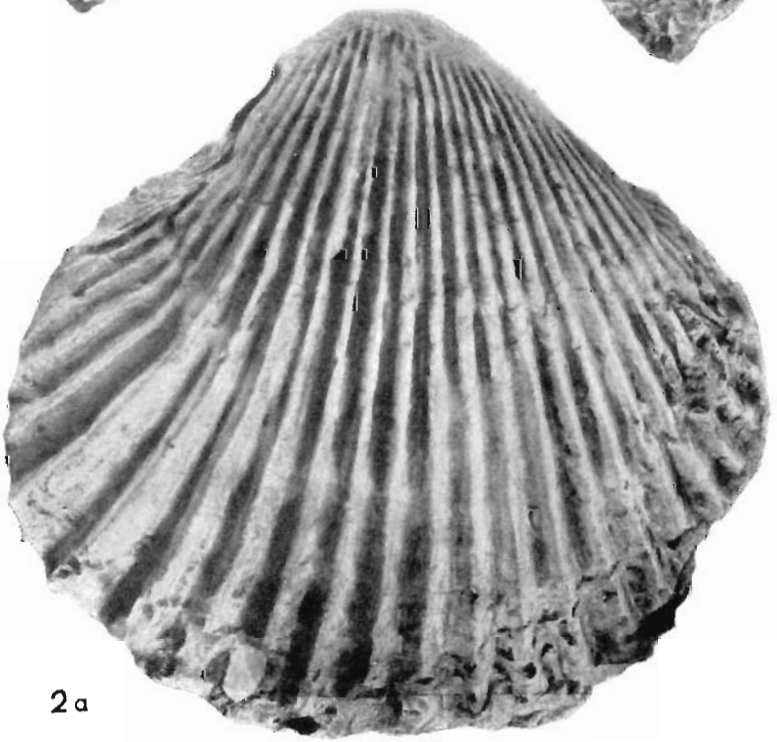
2b

1a

1b

1a

2b



2a