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Upper Silurian non-graptolite fauna from the Chełm borehole (eastern Poland)

ABSTRACT: Upper Silurian faunal assemblages are differentiated and tentatively correlated with graptolite zones. A description is given of 45 forms belonging to 19 families, 21 genera, 5 subgenera; 9 species of lamellibranchs are new. The above fauna shows close similarities with a synchronous fauna from the Barrandian of Czechoslovakia. The investigation of the non-graptolite fauna has permitted a more accurate determination of boundaries of some graptolite zones previously recognized in the borehole here under consideration.

INTRODUCTION

The aim of the present paper is to give a detailed description of the non-graptolite Upper Silurian fauna from borehole Chełm drilled in 1956 by the Geological Institute in Warsaw.

The Silurian series in this borehole occurs between 1207.7 and 1611.7 m. and has not been bottomed. It extends from the top of the *Monograptus formosus* zone (Upper Ludlow) to the bottom part of the *M. uniformis* zone (Upper Silurian).

All the faunal assemblage from the above borehole was worked out by L. Teller (1960) with the main object to establish the stratigraphy of the Silurian series reached in that borehole. A comprehensive description of the graptolite fauna from Chełm, in which a number of new species have been differentiated, was prepared by the same author in 1960—1961 (in print). This facilitated a detailed stratigraphic comparison with the information previously published.

A detailed study of the remaining fauna was undertaken in 1962, in which the lamellibranchs are given special attention and their earlier identifications are revised. The preparation of this work was badly hampered by the scarcity of literature, since the knowledge of the Silurian lamellibranchs is still very inadequate. The meagre literature that is available consists of papers from the last century, while the

more recent items are incomplete contributions describing only one or a few species.

As has already been stated in Teller's previous paper (1960), the Silurian assemblage of lamellibranchs from the Chełm borehole shows close similarities with that from the Barrandian of Czechoslovakia. Hence, the present paper is largely based on the work by J. Barrande (1881). Unfortunately, however, he does not individually describe the genera and species presented in his drawings and this naturally greatly impedes the identifications. The more modern Czech authors B. Ružička, F. Prantl and J. Kříž have lately revised only a part of Barrande's genera and species.

In order to avoid grosser errors all the forms here considered have been compared with Barrande's original specimens at the National Museum in Prague.

The investigation of the available materials by the writers has permitted a detailed description of 45 forms belonging to 19 families, 21 genera and 5 subgenera. The meagreness of the material forbids conclusive suggestions of a phylo- or astogenetic nature.

The lamellibranchian fauna from the Chełm borehole has provided evidence for a tentative differentiation of certain faunal assemblages and their correlation with graptolite zones. If these data are confirmed by future studies of more copious material they will be useful in the determination of the stratigraphy and correlation of Upper Silurian non-graptolite series. It seems noteworthy that the Upper Silurian series in Poland, both in the Lowlands and the Holy Cross Mts. contain a rich lamellibranchian fauna that has not so far been adequately investigated. The present account is, therefore, the first study on this faunal group from the Silurian of Poland.

The writers wish to convey their grateful thanks to the following persons and institutions: to the management of the Institute of Geology in Warsaw, particularly to Professor Dr. W. Pożaryski for facilities in the access to the Chełm borehole material; to Professor Dr. E. Passendorfer, under whose guidance this paper was prepared, for much valuable advice and assistance; to Dr. V. Zazvorka, head of the Division of Palaeontology and Geology of the National Museum in Prague, and to Dr. R. Horny, curator of that division, for the access to the monographic collections of J. Barrande, and the friendly help during the writers' visit in Prague. The work has been carried out in the Stratigraphic Laboratory of the Institute of Geological Sciences of the Polish Academy of Sciences in Warsaw. The drawings are by the writers. Thanks are also due to Mr. R. Adamik for the photography and to Mrs. J. Humnicka for the English translation of the Polish text.

STATE OF PRESERVATION OF THE FOSSIL MATERIAL

The lamellibranchian remains from the Chełm borehole are mostly badly preserved. They occur chiefly as moulds, sometimes as impressions, occasionally flattened or slightly distorted. The calcareous valves are as a rule resorbed. This state of preservation hampers the examination of such important systematic characters are the structure of the hinge area and the interior of the shell. The descriptions are, therefore, based mainly on the grosser external morphology, i.e. on the shape of valves and their ornamentation which is so readily discernible in the moulds. In most specimens only the right or the left valve is presented; individuals with both valves preserved are extremely rare. Some species display a mass occurrence and cover the entire surface of the strata. Such accumulation has been noted in the case of *Lunulicardium evolvens* at 1395.5 m. (pl. IX, fig. 6) and of *Leiopteria* (*Actinopteria*) *innotata* at 1421.3 m. (pl. V, fig. 7).

With a few exceptions all the faunal remains here considered are of small dimensions. They do not, however, represent only the juvenile stages since both mature and immature forms of the same species are found side by side; in the latter forms the prodissoconch is still discernible.

SYSTEMATIC DESCRIPTIONS

SCYPHOZOA

Fam. **Conulariidae** Walcott, 1886

Gen. *Conularia* Miller, 1818

Conularia sp.

(pl. I, fig. 1a, b)

Description. — One specimen from 1259.0-1259.1 m., represented by a flattened fragment. This form has the shape of a 4-sided pyramid whose sides consist of strongly elongated equilateral triangles. Fragments of longitudinal marginal furrows separate the sides. Ornamentation consists of closely spaced regular ribs, arcuately bent in the centre, with the arch directed towards the outlet. In the apical part the curvature of the arch is gentle, but grows more pointed in the centre and near the outlet. The ribs are extremely narrow, the furrows separating them are twice their width. Delicate, densely arranged longitudinal striae occur between the ribs.

Stratigraphic position and distribution. — Chełm borehole — in the top of the *Pristiograptus transgrediens* zone.

CRINOIDEA

Fam. **Scyphocrinidae** Jaekel, 1921

Gen. *Scyphocrinus* Zenker, 1833

Scyphocrinus sp.

(pl. II, fig. 1)

Material. — 1 specimen from 1533.6-1533.8 m.

Description. — Fragmentary arms deprived of the calyx occur all over the surface of the core. The arms consist of brachial plates which are convex dorsally and concave ventrally. One margin of the plate is broader than the other; they are alternately arranged in one row. The arms branch dichotomously. A pinnula is attached to the broader margin of each plate.

Remarks. — The lack of the calyx impedes an accurate specific identification of the preserved fragments. The fragmentary arms here described most probably belong to *Scyphocrinus elegans* Zenker. This is reasonably suggested by their close similarity to forms which J. Barrande (vol. VII, 1899) referred to *S. excavatus* Schloth. and *Scyphocrinites elegans*? Zenker. It is noteworthy that the species *excavatus* was created by Schlotheim on unidentifiable fragments of arms and, therefore, it is not accepted by later authors. The species *excavatus* and *elegans* are synonyms.

Stratigraphic position and distribution. — Chełm borehole — *Pristiograptus bugensius* zone (numerous segments of crinoids are encountered throughout the profile).

LAMELLIBRANCHIATA

Fam. **Ctenodontidae** Wöhrmann, 1893

Gen. *Cleidophorus* Hall, 1847

Cleidophorus unisulcus nov. sp.

(pl. III, figs. 1-3; text fig. 1)

Name — after the Latin word *unisulcus*, meaning with one furrow.

Material. — 8 right and 4 left valves collected from 1208.5-1211.8 m.

Holotype. — Right valve from 1208.6-1208.8 m. (pl. III, fig. 1; text fig. 1).

Description. — Valve rectangularly ovate, elongated, posteriorly narrowed, moderately convex; maximum convexity occurs at about mid-height, thence gently descending towards the margins. Anterior and posterior margin oblique, gently arching into the slightly rounded lower margin. Umbo blunt, slightly protruding above the hinge line, anteriorly distinctly shifted. Hinge line straight and shorter than maximum length of valve. Taxodont hinges fragmentarily preserved. A distinct

furrow, running over 2/3 of the height of the valve slopes perpendicularly from the umbo towards the lower margin. Surface of valve smooth, showing faintly indicated growth lines.

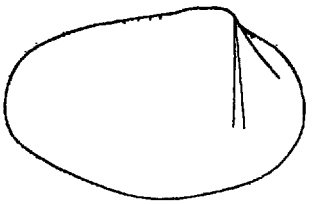

Fig. 1

Cleidophorus unisulcus nov. sp.

Right valve × 10; depth 1208.6-1208.8 m.
Skorupka prawa × 10; głębokość 1208,6-1208,8 m

Dimensions: height 2.5 mm., length 3.6 mm.

The left valve differs in no way from the right one.

Stratigraphic position and distribution. — Chełm borehole — the *Monograptus uniformis* zone.

Fam. **Ledidae** Dall, 1898

Gen. *Leda* Schumacher, 1817

Leda sp. *1*

(pl. III, fig. 4; text fig. 2)

Material. — 3 left valves from 1207.9-1209.5 m.

Description. — The left valve from 1207.9-1208.3 m. (pl. III, fig. 4; text fig. 2), posteriorly strongly elongated. Apex near the centre, protruding above the hinge line. Maximum convexity in the umbonal

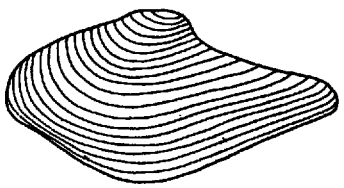

Fig. 2

Leda sp. *1*

Left valve × 10; depth 1207.9-1208.3 m.
Skorupka lewa × 10; głębokość 1207,9-1208,3 m

area. Posterior part of valve strongly elongated and tapering into a kind of rostrum. Ornamentation consists of delicate concentric striae.

Dimensions: height 2.2 mm., length 5.0 mm.

Stratigraphic position and distribution. — Chełm borehole — the *Monograptus uniformis* zone.

Leda sp. *2*

(pl. III, fig. 5; text fig. 3)

Material. — One specimen from 1265.0-1266.3 m.

Description. — Left valve, strongly convex, posteriorly elongated. The posterior narrowing of the valve is less prominent than that in *Leda 1.* Ornamentation consists of delicate concentric striae.

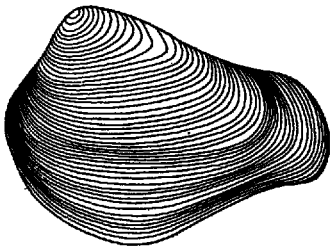

Fig. 3

Leda sp. 2

Left valve × 6; depth 1265.0-1266.3 m.
Skorupka lewa × 6; głębokość 1265,0-1266,3 m

Dimensions: height 4.2 mm., length 5.2 mm.

Stratigraphic position and distribution. — Chełm borehole — top of the *Pristiograptus transgrediens* zone.

Fam. **Parallelodontidae** Dall, 1898

Gen. *Parallelodon* Meek & Worthen, 1866

Parallelodon "a" nov. sp.

(pl. III, figs. 6-7; text fig. 4)

Material. — 2 right valves and one left valve from 1247.9-1248.9 m.

Holotype. — Right valve from 1248.4-1248.9 m. (pl. III, fig. 7; text fig. 4).

Description. — Valve rectangularly-ovate in shape, posteriorly elongated, moderately convex. Maximum convexity occurs at mid-height of valve. Umbo blunt, considerably protruding above the straight hinge

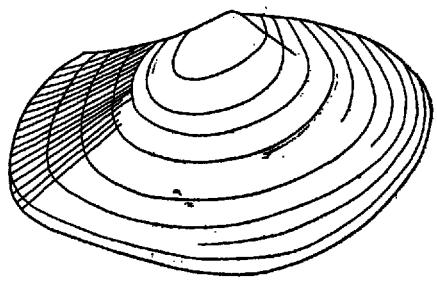

Fig. 4

Parallelodon "a" nov. sp.

Right valve × 5; depth 1248.4-1248.9 m.
Skorupka prawa × 5; głębokość 1248,4-1248,9 m

line, slightly anteriorly shifted. Hinge and lower margin sub-parallel, the lower margin rounded. Anterior and posterior margin oblique. The lower margin fuses arcuately with the anterior margin and at a sharp angle with the posterior margin. A faintly indicated keel runs down posteriorly from the umbo and forms with the hinge line an angle of 15°. Ornamentation consists of poorly discernible densely arranged delicate concentric striae and of growth lines. Delicate closely spaced, somewhat undulated radial striae also occur on the posterior part of the valve; they are most conspicuous between the hinge line and the keel.

Dimensions: height 6.2 mm., length 10.2 mm.

Stratigraphic position and distribution. — Chełm borehole — *Monograptus angustidens* zone.

Parallelodon insignis, nov. sp.
(pl. III, figs 8-10; text fig. 5)

Name. — after the Latin word *insignis* meaning distinct.

Material. — 10 right and 8 left valves from 1207.9-1241.2 m.

Holotype. — A right valve from 1211.8-1212.0 m. (pl. III, fig. 8; text fig. 5).

Description. — Valve rectangular in shape, posteriorly strongly elongated, moderately convex, highest convexity in the umbonal part. Umbo blunt, very near to the anterior margin and protruding above

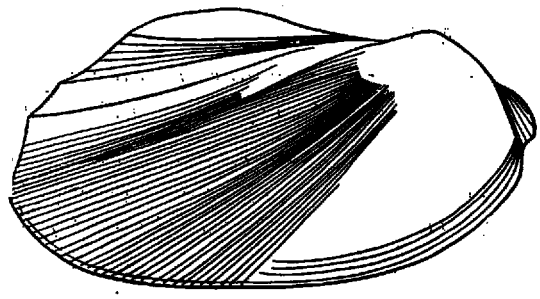

Fig. 5.
Parallelodon insignis nov. sp.
Right valve × 8; depth 1211.8-1212.0 m.
Skorupka prawa × 8; głębokość 1211,8-1212,0 m

the hinge line. Lower margin and hinge line subparallel. Anterior margin oblique, it meets the hinge line at an obtuse angle. The flat anterior part of the valve is small and distinctly separated from the convex part by a shallow furrow. A deep byssoid incision is visible in the lower part of the anterior margin. A distinct keel runs down posteriorly from the umbo at an angle of 30° to the hinge line; it also represents the axis of the highest convexity of the valve. Three distinct thick ribs, directed from the umbo towards the posterior margin, are seen on the flattened postero-dorsal part of the valve, between the keel and the hinge line. The course of the posterior margin is irregular because of the incisions formed between these ribs. The hinge line straight, nearly twice shorter than the length of the valve. Ornamentation consists of delicate radial dense striae; they are very distinct in the posterior and lower part of the valve but grow less conspicuous near the umbo and the anterior margin. Crowded, delicate concentric striae and irregular faintly indicated growth lines are also visible.

Dimensions: height 4.5 mm.. length 8.5 mm.

The left valve does not differ in shape from the right one, except that the ribs are less sharply marked.

Stratigraphic position and distribution. — Chełm borehole — *Monograptus angustidens* and *M. uniformis* zones.

Fam. **Leiopteriidae** Maillieux, 1931

Subfam. **Leiopteriinae** Maillieux, 1920

Gen. *Leiopteria* Hall, 1882, emend. Spriesterbach, 1909
Subgen. *Leiopteria* (*Leiopteria*) Hall, 1882
Leiopteria (*Leiopteria*) *opportuna* (Barr.)
(pl. IV, figs. 1-2; text fig. 6)

1881. *Avicula* ? *Pterinea opportuna* — Barrande, Syst. silur., vol. VI, tab. 223/III, 1-7.

1906. *Pterinea opportuna* — Siemiradzki, Monografia warstw paleoz. Podola (Monograph of the Palaeozoic beds of Podolia), tab. V, fig. 3.

1950. *Leiopteria* (*Leiopteria*) *opportuna* — Ružička, Leioptriidae Maillieux česk. siluru a devonu, p. 216.

Material. — 3 right valves and one left valve from 1208.3-1241.7 m.

Description. — The left and right valve of one specimen from 1241.6-1241.7 m. (pl. IV, fig. 1; text fig. 6), posteriorly strongly obliquely

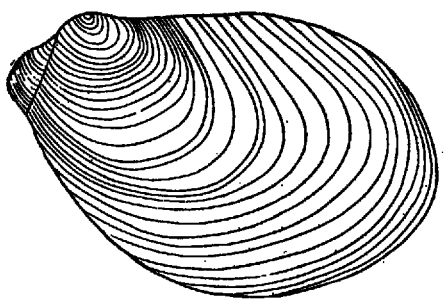

Fig. 6

Leiopteria (Leiopteria) opportuna (Barr.)

Left valve × 3; depth 1241.6-1241.7 m.
Skorupka lewa × 3; głębokość 1241,6-1241,7 m

elongated. Highest convexity in the umbonal part. Umbo shifted anteriorly and somewhat protruding above the straight hinge line. Posterior part of hinge line is rolled and thickened. Auricle small, subtriangular, wing rather large, subtriangular, flat. The auricle is separated from the body of the valve by a furrow, the wing by a faintly indicated depression. Ornamentation consists of concentric ribs and closely spaced delicate growth lines.

Dimensions: height 12.5 mm., length 15.5 mm.

Comparisons. — The form described above approaches those figured by Barrande in table 223/III, 3, 7.

Stratigraphic position and distribution. — Chełm borehole — *Monograptus angustidens* and *M. uniformis* zones; the Přidol beds in the Barrandian basin and in Podolia.

Leiopteria (Leiopteria) contraria (Barr.)
(pl. IV, figs. 3-5; text fig. 7)

1881. *Avicula contraria* — Barrande, Syst. silur., vol. VI, tab. 229/IX, 1-2.

Material. — 25 right valves and one left valve from 1208.4-1443.6 m.

Description. — Right valve from 1248.4-1248.9 m. (pl. IV, fig. 3; text fig. 7), irregularly shaped, moderately convex, obliquely posteriorly elongated. Highest convexity occurs in the upper 1/3 of the height of the valve. The axis of the maximum convexity descends slantingly from

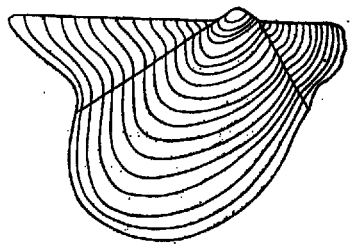

Fig. 7

Leiopteria (Leiopteria) contraria Barr.

Right valve × 10; depth 1248.4-1248.9 m.
Skorupka prawa × 10; głębokość 1248,4-1248,9 m

the umbo towards the lower margin and meets the posterior part of the hinge line at an angle of 50°. The anterior and posterior margin oblique, the lower one arcuate. Umbo blunt, shifted anteriorly and situated in the anterior one third of the length of the hinge line; it slightly protrudes above the hinge line which is straight and longer than the valve. The auricle broad, triangular, strongly convex and separated from the body of the valve by a distinct depression. The wing large, subtriangular, elongated, flat and separated from the posterior margin by a faintly marked furrow; the furrow forms an angle of 25° with the posterior part of the hinge line. The wing ends in a spur, the embayment of the posterior part of the wing is moderately deep. Ornamentation consists of distinct, regularly arranged concentric ribs which also occur on the auricle and on the wing. Growth lines are visible, too.

Dimensions: height 3.0 mm., length 4.8 mm.

The left valve (pl. IV, fig. 4) is more convex than the right valve and it is analogously ornamented.

Remarks. — *Avicula contraria* Barr. and *Avicula? Pterinea migrans* Barr. are regarded by B. Ružička (1950) as synonyms.

In tabl. 229/IX, 1-2 of Barrande's monograph are figured two right valves of *Avicula contraria* Barr. bearing only concentric ribs, while the numerous forms belonging to *Avicula? Pterinea migrans* Barr. figured in tab. 229/XII, 1-2 are shown to have a very characteristic network ornamentation both on the right and the left valve.

Our material contains one right valve of the *migrans* species with typical network ornamentation and a distinct spur on the wing. In view

of the difference in ornamentation which is concentric in our specimen and a shorter spur in the above described form, it is being assigned to the species *contraria*, since the fusion of these two species postulated by B. Ružička does not seem reliably justified. It is interesting to note that ornamentation was the criterion used by E. Maillieux for the separation of the genus *Leiopteria* into two subgenera: *Leiopteria* (*Actinopteria*) with a markedly regular network pattern of ornamentation, among others including *L.* (*Actinopteria*) *migrans migrans*, and *Leiopteria* (*Leiopteria*) with a regularly concentric ornamentation i. al. containing *L.* (*Leiopteria*) *opportuna*. On this evidence it is supposed reasonable to retain the species *contraria* and to include it into the genus *Leiopteria* (*Leiopteria*).

Comparison. — The form described by the writers shows very close similarity with that figured by Barrande in tab. 229/IX,1-2.

Stratigraphic position and distribution. — Chełm borehole — from the zone of *Monograptus boučeki* to the zone of *M. uniformis*; the Přidol beds in the Barrandian basin.

Leiopteria (*Leiopteria*) sp. „*a*"
(pl. IV, fig. 6; text fig. 8)

Material. — 1 right valve from 1248.9-1249.9 m.

Description. — Valve irregularly shaped, moderately convex, obliquely posteriorly elongated. Maximum convexity occurs in the upper 1/3 of the height of valve. The axis of maximum convexity descends obliquely

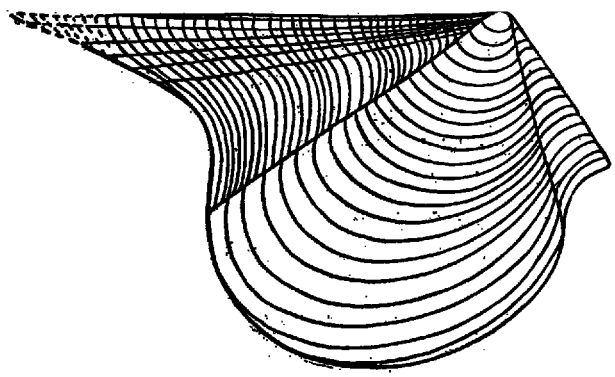

Fig. 8

Leiopteria (*Leiopteria*) sp. "*a*"

Right valve × 8; depth 1248.9-1249.9 m.
Skorupka prawa × 8; głębokość 1248,9-1249,9 m

from the umbo towards the posterior and forms with the posterior part of the hinge line an agle of ca. 60 degrees. The anterior and posterior margin oblique, the lower margin rounded. Umbo pointed, slightly protruding above the hinge line and completely shifted to the anterior. Hinge line straight and longer than the body of the valve (7.8 mm.). The auricle small, subtriangular, convex and delimited from the body of the

valve by a distinct depression. The wing large, subtriangular, slightly concave, separated from the valve by a distinct furrow which forms an angle of 30° with the hinge line. It ends in a prominent long spur. The ornamentation consists of well marked regularly arranged concentric ribs. They are not so well visible on the wings. A few delicate radial striae occur on the posterior wing.

Dimensions: height 5.9 mm., length 6.0 mm.

Remarks. — The above described form differs from *Leiopteria* (*Leiopteria*) *contraria* in the size and outline of the wings and in greater length of the spur.

Stratigraphic position and distribution. — Chełm borehole — *Monograptus angustidens* zone.

Subgen. *Leiopteria* (*Actinopteria*) Hall, 1883

Leiopteria (*Actinopteria*) *migrans migrans* (Barr.)

(pl. IV, figs. 7-11; text fig. 9)

1881. *Avicula*? *Pterinea migrans* — Barrande, Syst. silur., vol. VI, tab. 229/XII,1-12.

1898. *Pterinea migrans* — Venjukov, Fauna siłurijskich otłoženij, pl. V, fig. 2.

1906. *Pterinea migrans* — Siemiradzki, Monografia warstw paleoz. Podola (Monograph on the Palaeozoic beds of Podolia), p. 240.

1950. *Leiopteria* (*Actinopteria*) *migrans migrans* — Ružička, Leiopteridae Maillieux česk. siluru a devonu, p. 221.

Material. — 25 left valves and 1 right valve from 1222.75-1439.0 m.

Description. — Left valve from 1235.8-1236.9 m. (pl. IV, figs. 11a,b; text fig. 9) irregular in shape, obliquely elongated toward the posterior. Anterior part of valve more convex than the posterior which is nearly flat. The greatest convexity occurs in the upper 1/3 of the height of valve. The axis of the maximum convexity forms an angle of 50° with the posterior part of the hinge line. The anterior and posterior margin

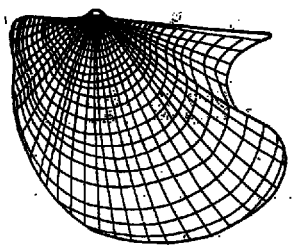

Fig. 9

Leiopteria (*Actinopteria*) *migrans migrans* (Barr.)

Left valve × 6; depth 1235.8-1235.9 m.
Skorupka lewa × 6; głębokość 1235,8-1235,9 m

oblique, the lower margin arcuately curved. Umbo blunt, anteriorly bent, slightly protruding above the hinge line and placed at about 1/3 of the length of the hinge line. Hinge line straight, its posterior end pro-

vided with a spur. The auricle subtriangular, convex, separated from the body of the valve by a well marked furrow descending from the umbo to the anterior margin. The wing large, subtriangular, flat, separated from the valve by a distinct furrow which forms an angle of 25° with the posterior part of the hinge line. The ornamentation very distinct both on the valve, the auricle and the wing; it consists of a network of intersecting radial and concentric ribs. Locally the surface is marked by growth lines.

Dimensions: height 4.5 mm., length 6.0 mm.

The right valve (pl. IV, fig. 7) is more flat and is less distinctly ornamented.

Comparisons. — In shape of valve and in character of ornamentation the above form as well as the remaining ones closely resemble those figured by Barrande in tab. 229/XII,1-12, and described by B. Ružička (1950).

Remarks. — *Avicula contraria* Barr. has also been included by B. Ružička into *Leiopteria* (*Actinopteria*) *migrans migrans* (Barr.). The writers think that the species *contraria* should be retained and included into the subgenus *Leiopteria* (*Leiopteria*), as already has been suggested in the description of this species on p. 241.

From the Silurian of the Rhine Schiefergebirge W. Kegel has described (1953, p. 37) *Leptodesma* (*Ptychopteria*) *migrans* (Barr.), stressing its analogy with the form illustrated by Barrande in table 229/XII,12. Kegel's assignment of that form to the subgenus *Leptodesma* (*Ptychopteria*) does not seem correct since the appurtenance of the forms *Avicula*? *Pterinea migrans* Barr. to the subgenus *Leiopteria* (*Actinopteria*) has been very reliably proved by B. Ružička (1950).

Stratigraphic position and distribution. — Chełm borehole — from the *Monograptus boučeki* zone to the *M. angustidens* zone; the Přidol and the Lochkov beds in the Barrandian basin; the Rhine Schiefergebirge (Giessen); Podolia; Morocco.

Leiopteria (*Actinopteria*) *migrans prospera* (Barr.)
(pl. IV, fig. 12; pl. V, figs. 1-2; text fig. 10)

1881. *Avicula*? *Pterinea prospera* — Barrande, Syst. silur., vol. VI, tab. 229/X,3-4, non tab. 229/X,1-2.
1881. *Avicula*? *Pterinea latiuscula* — Ibidem, tab. 224/I,1-7.
1881. *Avicula*? *Pterinea immunis* — Ibidem, tabl. 224/II,1-13.
1950. *Leiopteria* (*Actinopteria*) *migrans prospera* — Ružička, Leiopteriidae Maillieux česk. siluru a devonu, p. 223.

Material. — 13 left valves from 1219.55-1443.9 m.

Description. — Left valve from 1224.5-1224.8 m. (pl. V, fig. 1; text

fig. 10), irregular in shape, obliquely elongated towards the posterior, moderately convex. Greatest convexity occurs in the upper 1/4 of the height of valve. The axis of maximum convexity forms an angle of 60°

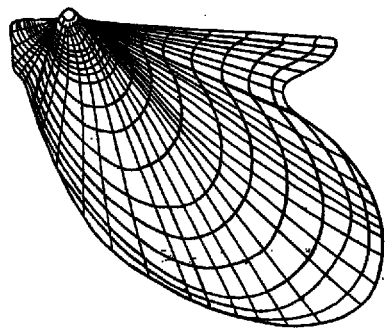

Fig. 10

Leiopteria (Actinopteria) migrans prospera (Barr.)

Left valve × 4; depth 1224.5-1224.8 m.
Skorupka lewa × 4; głębokość 1224,5-1224,8 m

with the posterior part of the hinge line. The anterior and posterior margin oblique, the lower margin arcuately curved. Umbo of valve blunt, slightly anteriorly shifted and somewhat protruding above the right hinge line; it occurs at 1/3 of the length of the hinge line. The auricle small, flat, subtriangular and separated from the body of the valve by a small depression. The wing flat, subtriangular, separated from the body of the shell by a narrow furrow which forms an angle of 20° with the posterior part of the hinge line; it terminates in a somewhat indistinct spur. Ornamentation consists of a network of intersecting radial and concentric ribs; not so regular as that in *Leiopteria (Actinopteria) migrans migrans*. Growth lines are also marked on the surface.

Dimensions: height 9.2 m., length 12.8 mm.

Comparisons. — The above described form comes nearest to that shown by Barrande in tab. 229/X,3.

Remarks. — In shape of the valve and in ornamentation the described subspecies resembles *Leiopteria (Actinopteria) migrans migrans*. From the proper species it differs in a broader and more blunt umbo, smaller and flatter auricle separated from the body of the valve not by a distinct furrow but by a slight depression, also in a shorter wing. The ornamentation of this subspecies is more irregular.

A study of Barrande's material suggests that forms belonging to *Avicula? Pterinea serviens* and which have been referred by B. Ružička (1950) to *Leiopteria (Actinopteria) migrans prospera* cannot be assigned to this subspecies because of a different ornamentation pattern (absence of radial ribs) and much smaller size of the wing and the auricle. The writers postulate to retain Barrande's species.

Stratigraphic position and distribution. — Chełm borehole — from the *Monograptus boučeki* zone to the *M. angustidens* zone; Přidol beds and Lochkov beds in the Barrandian basin.

Leiopteria (Actinopteria) innotata (Barr.)
(pl. V, figs. 3-7; text fig. 11)

1881. *Avicula innotata* — Barrande, Syst. silur., vol. VI, tab. 229/XI,1-5.

1950. *Leiopteria (Actinopteria) innotata* — Ružička, Leiopteriidae Maillieux česk. siluru a devonu, p. 224.

Material. — 49 left and 6 right valves from 1421.0-1425.1 m.

Description. — Left valve from 1421.4-1421.5 m. (pl. V, fig. 3; text fig. 11), irregular in shape, strongly obliquely elongated toward the posterior. Greatest convexity occurs in the upper 1/4 of the height of the valve; it decreases gradually in a postero-interior direction, while its descent to the anterior is very abrupt. The axis of the greatest convexity forms an angle of 30° with the posterior part of the hinge line. Anterior margin and lower margin arcuate, uniting in a broad arch. Posterior margin straight, subtending an acute angle to the lower margin. Umbo ovate, blunt, slightly protruding above the hinge line in the anterior 1/3 of the length of the hinge line. Hinge line straight, a little more than one half of the length of the valve. Auricle small, slightly convex, separated from the body of the valve by a shallow depression. Wing larger, subtriangular, flat, separated from the body of the valve by an extremely narrow keel distinctly marked along the complete length of the posterior margin. The keel forms an angle of 20° with the posterior part of the hinge line. The wing occupies two thirds of the length of the posterior margin. Ornamentation consists of fairly regular

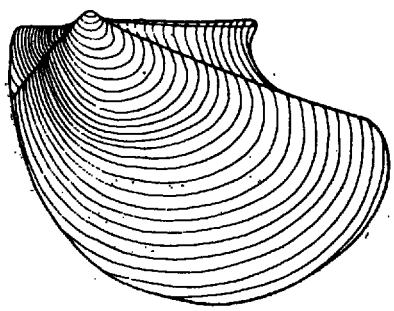

Fig. 11

Leiopteria (Actinopteria) innotata (Barr.)

Left valve × 4; depth 1421.4-1421.5 m.
Skorupka lewa × 4; głębokość 1421,4-1421,5 m

concentric ribs between which are marked the growth lines; ornamentation most distinct in the central and lower part of the valve. Extremely fine, irregular, thread-like radial striae are visible on some specimens.

Dimensions: height 10.0 mm., length 13.5 mm.

A few badly preserved right valves seem more flat and are less distinctly ornamented.

Comparisons. — The above described form comes nearest to that shown by Barrande in tab. 229/XI,4.

Stratigraphic position and distribution. — Chełm borehole — only in the *Monograptus perneri* zone; Přídol beds in the Barrandian basin.

Fam. **Pteriidae** Meek, 1865

Subfam. **Limopterinae** Maillieux, 1931

Gen. *Limoptera* Hall, 1870, emend. Frech, 1891

Subgen. *Limoptera* (*Limoptera*) Hall, 1870

Limoptera (*Limoptera*) sp.

(pl. VI, fig. 1; text fig. 12)

Material. — 1 incomplete right valve from 1370.4-1371.8 m.

Description. — Valve irregular in shape, somewhat obliquely elongated toward the posterior, slightly convex. Greatest convexity occurs just below the umbo. Umbo sharp, anteriorly shifted and slightly pro-

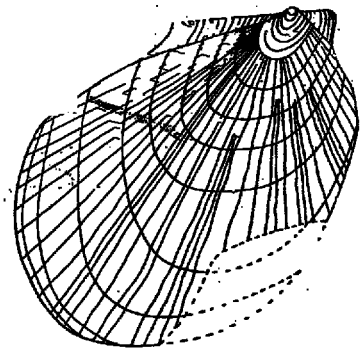

Fig. 12

Limoptera (Limoptera) sp.

Right valve × 2; depth 1370.4-1371.8 m.
Skorupka prawa × 2; głębokość 1370,4-1371,8 m

truding above the straight hinge line. Auricle small, subtriangular, separated from the body of the valve by a faintly marked depression. Wing subtriangular, flat, narrow, separated from the body of the valve by a shallow furrow. Ornamentation consists of distinct, thick, slightly sinuous radial ribs of the 1st order between which occur in pairs irregular, finer ribs of the 2nd order; these are visible only in the lower part of the valve. Irregularly arranged growth lines also mark the surface. The auricle and the wing lack radial ornamentation.

Stratigraphic position and distribution. — Chełm borehole — *Pristiograptus transgrediens* zone.

Gen. *Pterochaenia* Hall, 1842

Subgen. *Pterochaenia* (*Pterochaenia*) Hall, 1842

Pterochaenia (*Pterochaenia*) *chełmiensis* nov. sp.

(pl. VI, figs. 2-7; text fig. 13)

Name — after Chełm, a town in eastern Poland, near which the borehole was drilled.

Material. — More than 170 valves, of which 20 are right valves, from 1208.4-1249.9 m.

Holotype. — Left valve from 1248.9-1249.9 m. (pl. VI, fig. 5; text fig. 13).

Description. — Valve subrhomboidal in shape, slightly obliquely elongated towards the posterior. Length of valve equal to that of the hinge line. Valve strongly convex, the greatest convexity occurs at mid-height of the valve. The axis of the greatest convexity extends somewhat obliquely towards the lower margin and forms an angle of 60° with the posterior part of the hinge line. Anteriorly the convexity of the valve decreases abruptly while posteriorly it gradually passes into the flat part of the valve near the hinge line. Anterior margin oblique, with a faintly marked byssal slit; subparallel to the posterior margin. Lower margin rounded, arcuately united with the anterior and posterior margin. Umbo blunt, much protruding above the straight hinge line and somewhat anteriorly shifted. Posterior end of hinge line is rolled and thickened. Ornamentation consists of irregular concentric folds and growth lines. Very fine radial striae are sometimes visible on the flat posterior part of the valve.

Dimensions: height 6.9 mm., length 6.9 mm.

Right valve (pl. VI, figs. 3, 7) more flat and less distinctly ornamented.

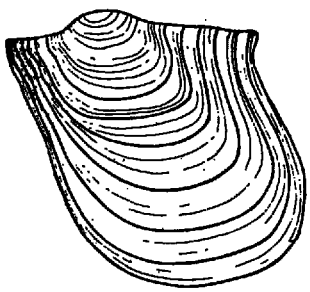

Fig. 13

Pterochaenia (Pterochaenia) chełmiensis nov. sp.

Left valve × 5; depth 1248.9-1249.9 m.
Skorupka lewa × 5; głębokość 1248,9-1249,9 m

Remarks. — It is noteworthy that within this species the shape of the valves varies, particularly in what the length and height are concerned. Moreover the left valves are considerably more convex than the right valves and have a more distinct ornamentation.

Stratigraphic position and distribution. — Chełm borehole — the *Monograptus angustidens* and *M. uniformis* zones.

Pterochaenia (*Pterochaenia*) *tenuis* nov. sp.
(pl. VI, figs. 8-12; text fig. 14)

Name — after the Latin word *tenuis* meaning slight, delicate.

Material. — 30 left valves and 4 right valves from 1219.1-1375.1 m.

Holotype. — Left valve from 1223.8-1223.9 m. (pl. VI, fig. 9; text fig. 14).

Description. — Valve subrhomboidal in shape, slightly obliquely elongated towards the posterior; anteriorly rather convex. From about

mid-height of the valve the convexity gradually decreases in the direction of the lower margin. The greatest convexity occurs in the upper 1/4 of the height of valve. The axis of the greatest convexity, extending obliquely from the apex toward the lower margin, is subparallel to the anterior and posterior margin, subtending an angle of 60° to the hinge

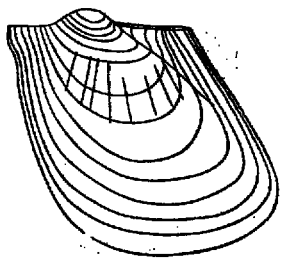

Fig. 14

Pterochaenia (Pterochaenia) tenuis nov. sp.

Left valve × 10; depth 1223.8-1223.9 m.
Skorupka lewa × 10; głębokość 1223,8-1223,9 m

line. Anterior margin parallel to the posterior margin, nearly straight, with a slight byssal slit; it passes in a gentle arch into the distinctly rounded lower margin. Posterior margin straight, gently sweeps in an arch into the lower margin at an angle of ca. 80°. Umbo blunt, turned and slightly shifted toward the anterior; it protrudes above the straight hinge line. Posterior end of hinge line somewhat longer than the anterior part, rolled and thickened. Ornamentation consists of fine, irregular concentric striae and thicker growth lines. Fine, irregularly arranged radial striae are also marked on the surface.

Dimensions: height 3.0 mm., length 3.5 mm.

The right valve (pl. VI, fig. 12) is more flat, less distinctly ornamented.

Comparisons. — The above described form differs from *Pterochaenia (Pterochaenia) chełmiensis* in somewhat different outline, notably smaller convexity and different ornamentation pattern.

Stratigraphic position and distribution. — Chełm borehole — *Pristiograptus transgrediens* and *Monograptus angustidens* zones.

Subgen. *Pterochaenia (Dvorecia)* Ružička, 1949
Pterochaenia (Dvorecia) contempta (Barr.)
(pl. VII, figs. 1-6; text fig. 15)

1881. *Avicula contempta* — Barrande, Syst. silur., vol. VI, tab. 229/VI, 1-2.

1881. *Avicula tremula* — Barrande, Ibidem, tab. 230/IV, 1-10.

1949. *Pterochaenia (Dvorecia) contempta* — Ružička, Pteriidae Thiele česk. siluru a devonu, p. 10.

Material. — 41 left and 6 right valves from 1259.0-1384.5 m.

Description. — Left valve from 1373.6-1373.7 m. (pl. VII, fig. 1a, b; text fig. 15) subovate in shape, posteriorly elongated. The greatest convexity occurs in the anterior part near the umbo, it gradually decreases posteriorly. The axis of the greatest convexity runs from the umbo, subparallel to the anterior margin and forms an angle of 50°

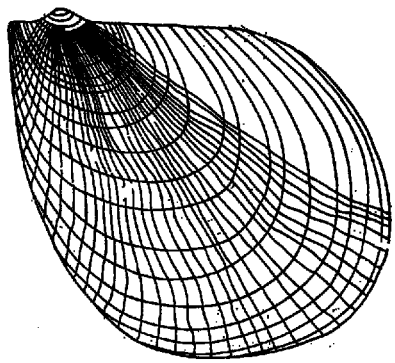

Fig. 15

Pterochaenia (Dvorecia) contempta (Barr.)

Left valve × 2,5; depth 1373.6-1373.7 m.
Skorupka lewa × 2,5; głębokość 1373,6-1373,7 m

with the posterior part of the hinge line. Anterior margin nearly straight, sweeping by a gentle arch to the lower margin which swings into the arcuate posterior margin. Umbo straight, blunt, slightly convex, somewhat protruding above the hinge line and placed very near to the anterior margin. Hinge line straight, shorter than the length of the valve (11.0 mm.). Its posterior part gently passes to the posterior margin. Auricle small, subtriangular, convex, separated by an extremely shallow furrow from the anterior margin; it is marked solely by transverse striae. The ornamentation of the valve consists of longitudinal, irregularly arranged, gently sinuous ribs descending from the umbo to the margins. They are most distinctly marked in the anterior and lower part of the valve, disappearing in the posterior part which is marked with fine radial striae. Growth lines and, occasionally, irregularly arranged transverse striae are also visible.

Dimensions: height 14.5 mm., length 18.5 mm.

Right valve from 1438.4-1438.6 m. (pl. VII, fig. 6), partly damaged, is more flat and has an ornamentation characteristic of this species.

Comparisons. — The above described form closely resembles those shown by Barrande in tab. 230/IV, 2, 6, 7 which he referred to *Avicula tremula*. After revising it B. Ružička (1949) included this species into *Pterochaenia (Dvorecia) contempta*, since he did not note any difference between the two species.

Stratigraphic position and distribution. — Chełm borehole — from the top of the *Pristiograptus admirabilis* zone to the *P. transgrediens* zone; the Přidol beds in the Barrandian basin.

Fam. **Pterineidae** Fischer, 1887

Gen. *Leptodesma* Hall, 1883
Leptodesma impar (Barr.)
(pl. VIII, fig. 1; text fig. 16)

1881. *Avicula impar* — Barrande, Syst. silur., vol. VI, tab. 229/IV, 1.

1950. *Leptodesma impar* — Ružička, Leiopteriidae Maillieux česk. siluru a devonu, p. 231.

Material. — Left and right valve of the same specimen from 1247.9–1248.4 m.

Description. — Left valve irregular in shape, moderately convex, posteriorly somewhat obliquely elongated. The greatest convexity occurs in the upper 1/3 of the height of the valve. The axis of the greatest convexity runs from the umbo subparallel to the anterior margin forming an angle of ca. 55° with the posterior part of the hinge line. The convexity gradually descends towards the margins. The anterior and posterior margin oblique, subparallel, the lower margin rounded. Umbo rather sharp, slightly convex, shifted anteriorly and somewhat protruding above the straight hinge line; it occurs in the anterior 1/3 of the length of the hinge line. Auricle small, subtriangular and not distinctly delimited from the body of the valve. The wing elongated, flat and separated from the body of the valve by an indistinct

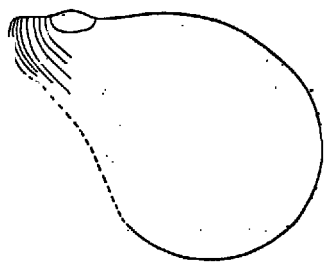

Fig. 16

Leptodesma impar (Barr.)

Left valve × 6; depth 1247.9-1248.4 m.
Skorupka lewa × 6; głębokość 1247,9-1248,4 m

depression. The ornamentation consists of hardly recognizable, irregular, concentric striae and growth lines; it is a little more distinct on the auricle. The right valve resembles the left valve.

Comparisons. — The form here considered is almost identical with that shown by Barrande in tab. 229/IV, 1.

Stratigraphic position and distribution. — Chełm borehole — *Monograptus angustidens* zone; the Přidol beds in the Barrandian basin.

Fam. **Ambonychiidae** Miller, 1877

Gen. *Mytilarca* Hall, 1869

Mytilarca lata nov. sp.
(pl. VIII, figs. 2-5; text fig. 17)

Name — after the Latin word *lata* meaning wide.

Material. — 11 left valves and 4 right valves from 1235.1-1242.6 m.

Holotype. — Left valve from 1235.7-1235.8 m. (pl. VIII, fig. 2; text fig. 17).

Description. — Valve longitudinally-ovate (mytilus-like in shape), moderately convex, greatest convexity occurs near the umbonal part while the axis of the greatest convexity runs near the anterior margin and subparallel thereto. The anterior margin nearly straight, the lower margin rounded, the posterior margin slightly arcuate and subparallel to the anterior one. Umbo moderately sharp, shifted entirely forward

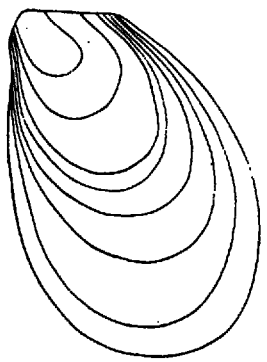

Fig. 17

Mytilarca lata nov. sp.

Left valve × 6; depth 1235.7-1235.8 m.
Skorupka lewa × 6; głębokość 1235,7-1235,8 m

and considerably protruding above the hinge line. Hinge line straight, 1/2 the length of the valve and nearly perpendicular to the posterior margin. The surface of the valve is ornamented by irregularly arranged concentric folds and growth lines.

Dimensions: height 8.8 mm., length 5.7 mm.

The right valve (pl. VIII, fig. 3) differs in no way from the left valve.

Stratigraphic position and distribution. — Chełm borehole — *Monograptus angustidens* zone.

Mytilarca procera nov. sp.
(pl. VIII, figs. 6-10; text fig. 18)

Name — after the Latin word *procera* meaning elongated.

Material. — 8 right valves and 6 left valves from 1209.7-1241.4 m.

Holotype. — Right valve from 1235.1-1235.2 m. (pl. VIII, fig. 6; text fig. 18).

Description. — Valve longitudinally-ovate (mytilus-like in shape), moderately convex. The greatest convexity occurs near the umbonal part from where it uniformly descends to the margins of the valve. The greatest convexity of the axis runs approximately through the centre

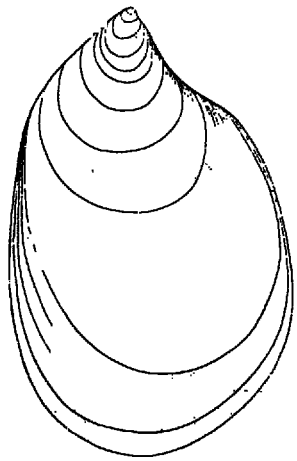

Fig. 18

Mytilarca procera nov. sp.

Right valve × 2; depth 1235.1-1235.2 m.
Skorupka prawa × 2; głębokość 1235,1-1235,2 m

of the valve. Anterior and posterior border subparallel and gently arched, the lower margin rounded. The hinge line straight, short; meeting the posterior margin at a strongly obtuse angle. Umbo completely anteriorly shifted and greatly protruding above the hinge line. Ornamentation consists of irregularly arranged and unequally thick concentric folds and growth lines.

Dimensions: height 30.4 mm., length 21.0 mm.

The left valve differs in no way from the right valve.

Comparisons. — The form here described differs from *Mytilarca lata* in a considerably more pointed umbo, shorter hinge line and different angle at which it meets the posterior margin. Moreover, the orientation of the greatest convexity axis in these two species is different.

Stratigraphic position and distribution. — Chełm borehole — *Monograptus angustidens* and *M. uniformis* zones.

Fam. **Lunulicardiidae** Fischer, 1887

Gen. *Lunulicardium* Münster, 1840

Lunulicardium evolvens Barr.

(pl. IX, figs. 1-6; pl. X, figs. 1-4; text figs. 19, 20)

1881. *Lunulicardium evolvens* — Barrande, Syst. silur., vol. VI, tab. 231/I, II, III, IV; tab. 232/I, II, III, IV.

Material. — 185 left and right valves (among these 160 are juvenile forms) from 1371.9-1435.4 m.

Description. — Left valve from 1387.9-1389.8 m. (pl. X, fig. 1; text fig. 20) subtriangular, posteriorly somewhat elongated, moderately convex, with the greatest convexity near the umbo. Umbo blunt, hooked, anteriorly shifted and protruding above the hinge line. A distinct keel, separating the bent flat part of the valve, extends from the umbo towards the lower margin. Since the writers' specimens are flattened

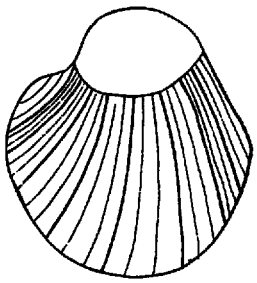

Fig. 19

Lunulicardium evolvens Barr.

Right valve × 10; depth 1387.9-1389.8 m.
Skorupka prawa × 10; głębokość 1387,9-1389,8 m

this part of the valve is not visible. The posterior part of the valve is "alar", the posterior margin straight. The lower margin rounded. Ornamentation consists of several distinctly thicker radial ribs of the first order and two, hardly recognisable ribs of the second order which

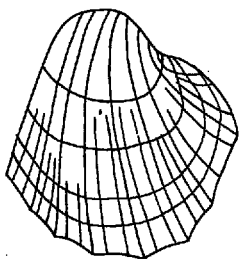

Fig. 20

Lunulicardium evolvens Barr.

Left valve × 3; depth 1387.9-1389.8 m.
Skorupka lewa × 3; głębokość 1387,9-1389,8 m

separate them. Near the keel the ribs run almost parallel to it while centrally and posteriorly they curve arcuately backwards.

Dimensions: height 11.0 mm., length 10.5 mm.

The left valve does not in any way differ from the right valve.

Numerous juvenile forms are characterised in the first place by a well preserved relatively large unornamented prodissoconch — occupying 1/3 of the height of the valve (pl. IX, figs. 1-6; text fig. 19). A semi-circular narrow groove separates the prodissoconch from the ornamented part of the valve. The ornamentation on juvenile forms is very regular. It consists of 6-7 radial ribs of the first order extending from the groove towards the margins, and curving arcuately towards the posterior. Two delicate ribs of the 2nd order invariably occur between them and follow a similar direction. As already has been mentioned ribs of the 2nd order are not always readily discernible in mature forms, particularly in the lower part of the valve. All the juvenile forms are of extremely small dimensions, not exceeding 3.5 mm.

With growth the umbonal part of the valve, together with the prodissoconch, becomes hooked, hence this part is invisible on older and flattened specimens.

Remarks. — No prodissoconchs are shown on any of the forms belonging to the genus *Lunulicardium* figured by Barrande. A study of Barrande's original specimens, however, revealed the presence of an excellently preserved prodissoconch in many species, e.g. in *L. excellens* (Barrande, vol. VI, tab. 233/IV, 6–10; in the present paper this form is shown in pl. XXVI, fig. 1) or in *L. eximium* (Ibidem, tab. 242/III, 6–10; see pl. XXVI, fig. 2).

Comparisons. — The here described form shows a very close similarity to that presented by Barrande in tab. 232/I, 11.

Stratigraphic position and distribution. — Chełm borehole — from the top of the *Monograptus boučeki* zone to the bottom of the *Pristiograptus transgrediens* zone; the Přidol beds in the Barrandian basin; the Rhine Schiefergebirge.

Lunulicardium cf. *eximium* Barr.
(pl. X, figs. 5–6; text fig. 21)

1881. *Lunulicardium eximium* — Barrande, Syst. silur., vol. VI, tab. 242/I-VIII.

1950. *Lunulicardium eximium* — Termier, Paléont. Marocaine, tab. 169, figs. 1-4.

Material. — 4 right valves and 1 left valve from 1415.2–1441.7 m.

Description. — Right valve from 1439.7-1441.1 m. (pl. X, fig. 5; text fig. 21), subtriangularly-ovate in shape, moderately convex, with the greatest convexity in the upper 1/3 of the height of the valve. Umbo blunt, hooked, much protruding above the hinge line and shifted forward. A distinct keel, extending from the umbo toward the lower

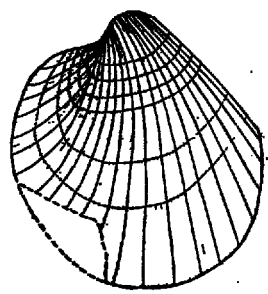

Fig. 21

Lunulicardium cf. *eximium* Barr.

Left valve × 3; depth 1439.7-1441.1 m.
Skorupka lewa × 3; głębokość 1439,7-1441,1 m

margin, separates the curved anterior part of the valve which is not visible on our specimen. The posterior of the valve near the hinge line is flat, the posterior margin is rounded and passes arcuately into the lower margin. Ornamentation consists of thicker radial ribs of the

1st order between which occur a few (2-4) more delicate ribs of the 2nd order. Only one rib of the 2nd order is distinctly marked in the umbonal part, others occur in the upper 1/3 of the height of the valve. Fine growth lines are also visible on the flattened posterior part near the hinge line.

Dimensions: height 12.7 mm., length 12.0 mm.

Comparisons: — The above described form resembles that figured by Barrande in tab. 242/I, 6-10.

Stratigraphic position and distribution. — Chełm borehole — from the *Monograptus boučeki* zone to the bottom of the *Pristiograptus admirabilis* zone; the Přidol beds in the Barrandian basin; Morocco.

Lunulicardium undulatum Barr.

(pl. XI, figs. 1-8; pl. XII, figs. 4-5; text figs. 22, 23)

1881. *Lunulicardium undulatum* — Barrande, Syst. silur., vol. VI, tab. 240/I,1-5.

Material. — 100 right and left valves (among these 60 juvenile forms) from 1429.7-1452.0 m.

Description. — Left valve from 1448.4-1448.6 m. (pl. XI, fig. 8; text fig. 23), subtriangular in shape, posteriorly somewhat elongated, moderately convex. Greatest convexity occurs in the umbonal part. Umbo blunt, hooked, and much protruding above the straight hinge line. A distinct keel extending from the umbo to the lower margin separates the curved anterior part of the valve. Both this part and the anterior margin are invisible on most of the flattened specimens. The anterior part of the valve is preserved in only one specimen from 1438.8-1439.0 m. (pl. XI, fig. 6a,b); the anterior margin in this specimen is straight and

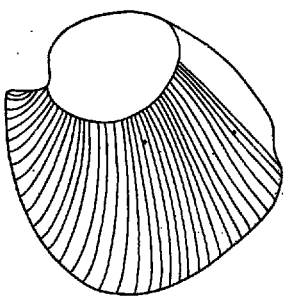

Fig. 22

Lunulicardium undulatum Barr.

Right valve × 10; depth 1444.05-1445,2 m.
Skorupka prawa × 10; głębokość 1444,05-1445,2 m

the ornamentation different than on the body of the valve. It consists of irregular concentric undulations. The posterior part of the specimen here described is "alar", the posterior margin is straight and joins arcuately with the rounded lower margin. Ornamentation consists of closely spaced delicate radial ribs. Irregularly arranged concentric undulations are also marked on the surface of the valve.

Dimensions: height 10.0 mm., length 10.0 mm.

There is no difference between the right and the left valve.

Extremely numerous juvenile forms in various stages of development are, in the first place, characterised by the presence of a visible prodissoconch; it occupies 1/3 of the height of the valve, is unornamented and separated from the body of the valve by a distinct narrow groove

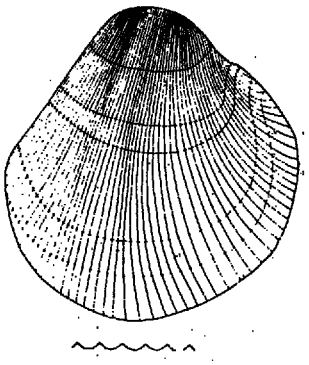

Fig. 23.

Lunulicardium undulatum Barr.

Left valve × 4; depth 1448.4-1448.6 m.
Skorupka lewa × 4; głębokość 1448,4-1448,6 m

(pl. XI, figs. 1-5; text fig. 22). In juvenile specimens the ornamentation is very distinct; it consists of closely spaced delicate radial ribs. Transverse undulations are not present in the youngest forms. They make their appearance in a later stage and are readily discernible in mature forms.

All the juvenile specimens have extremely small dimensions (2.5-3.0 mm.).

Comparisons. — The above described form resembles that figured by Barrande in tab. 240/I,1. It should be stressed that in Barrande's original specimen the umbo and the posterior margin are damaged and that his illustration differs from the original (a photo of this form is shown in the present paper in pl. XXVI, fig. 5a,b). In our forms the ornamentation is more delicate. This is probably due to the state of preservation and different ecological environment.

Remarks. — While studying Barrande's collection of lamellibranchs the writers found a form showing close similarities with specimens in their possession. That form was determined by Barrande as *Cardiola opportuna* (tab. 182/VI,1-2). In our opinion it represents a juvenile stage of the genus *Lunulicardium*. This is suggested by the following characters: conspicuous keel, curved anterior part of the valve, lack of ornamentation on the prodissoconch, and delicate radial ornamentation of the valve (a photo of this form is given in the present paper in pl. XXVI, fig. 4). The same remarks are applicable to a form figured by Barrande in tab. 178/VII,1-3, except that the latter specimen has more widely spaced radial ribs.

Stratigraphic position and distribution. — Chełm borehole — *Monograptus boučeki* zone, also 1 specimen from the bottom of the *M. perneri* zone; Přídol beds in the Barrandian basin.

Fam. **Pterinopectinidae** Newell, 1938

Gen. *Pterinopecten* Hall, 1883

Subgen. *Pterinopecten* (*Pterinopecten*) Hall, 1883

Pterinopecten (*Pterinopecten*) *cybele* (Barr.)

(pl. XII, figs. 1-3; text fig. 24)

1881. *Pterinopecten cybele* — Barrande, Syst. silur., vol. VI, tab. 228/II,1-10.

1881. *Aviculopecten simia* — Barrande, Ibidem, tab. 225/I,1-2.

1959. *Pterinopecten* (*Pterinopecten*) *cybele* — Ružička, Prantl, Přibyl, Some pectinoid Pelecypods....., pl. I-IV.

Material. — 13 left valves and 9 right valves from 1293.3-1366.95 m.

Description. — Right valve from 1295.4-1295.9 m. (pl. XII, fig. 3; text fig. 24), sub-quadrate in outline, somewhat elongated toward the posterior, slightly convex. The greatest convexity occurs between the umbo and mid-height of the valve. The greatest convexity axis forms an angle of 70° with the posterior part of the hinge line. The umbo forward-pointing, blunt, slightly protruding above the straight hinge line whose length is smaller than that of the valve. It is situated at about the anterior 1/4 of the length of the hinge line. The auricle small, subtriangular, separated by a shallow furrow from the body of the valve. The wing large, subtriangular, delimited from the body of the valve by a faintly indicated depression subtending an angle of 50° to the posterior part of the hinge line. Ornamentation consists of radial, gently

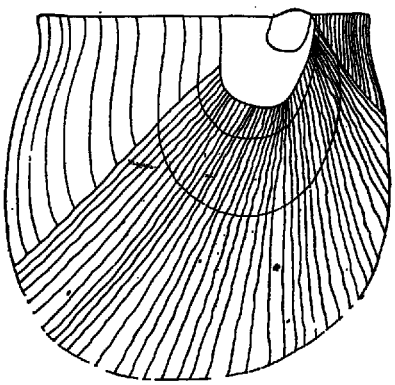

Fig. 24

Pterinopecten (Pterinopecten) cybele (Barr.)

Right valve × 3; depth 1295.4-1295.9 m.
Skorupka prawa × 3; głębokość 1295,4-1295,9 m

undulated ribs of the 1st order which run from the umbo toward the margins. Shorter, thin, delicate and sinuous ribs of the 2nd order occur between them. Extremely delicate, closely spaced concentric striae and irregularly arranged growth folds are also visible. On the auricle and wing radial ornamentation is scarcely recognisable while folds and concentric striae are readily discernible.

Dimensions: height 15.8 mm., length 17.2 mm.

In shape and ornamentation the left valve agrees with the right valve.

Comparisons. — The above form resembles that figured by Barrande in tab. 223/II,5.

Stratigraphic position and distribution. — Chełm borehole — only in the *Pristiograptus transgrediens* zone; the Přídol beds in the Barrandian basin (the same zone).

Fam. **Aviculopectinidae** Meek & Hayden, 1864

Gen. *Aviculopecten* Mac Coy, 1851

Aviculopecten sp.

(pl. XII, fig. 6; text fig. 25)

Material. — 1 right valve from 1394.5-1395.2 m.

Description. — Valve of irregular shape, posteriorly somewhat elongated, slightly convex. The greatest convexity occurs in the umbonal part. Umbo rather pointed, somewhat protruding above the straight hinge

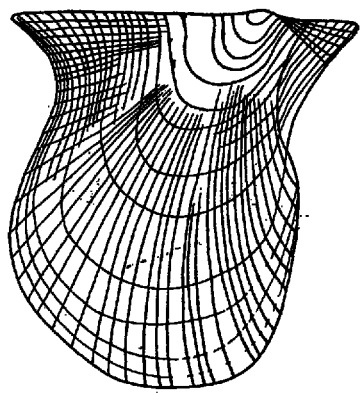

Fig. 25

Aviculopecten sp.

Right valve × 5; depth 1394.5-1395.2 m.
Skorupka prawa × 5; głębokość 1394,5-1395,2 m

line. Anterior and posterior margin oblique, lower margin rounded. The auricle large, subtriangular, slightly convex, separated from the body of the valve by a faintly indicated furrow. The wing huge, subtriangular, flat and delimited from the body of the valve by an extremely faint depression. Ornamentation consists of gently sinuous, distinct, sub-circular radial ribs and of concentric growth lines which are irregularly spaced. The ornamentation on the wing is similar except that the ribs are more closely spaced and thinner. The radial ornamentation on the auricle is not very distinct while the closely spaced concentric striae are well visible.

Dimensions: height 11.8 mm., length 11.5 mm.

Stratigraphic position and distribution. — Chełm borehole — *Pristiograptus admirabilis* zone.

Fam. **Modiolopsidae** Fischer, 1887

Gen. *Modiolopsis* Hall, 1847

Modiolopsis cf. *flexa* Barr.

(pl. XII, figs. 7-9; text fig. 26)

1881. *Modiolopsis flexa* — Barrande, Syst. silur., vol. VI, tab. 260/II,1-8.

Material. — 5 left valves and 4 right valves from 1207.9-1252.9 m.

Description. — Left valve from 1247.9-1248.4 m. (pl. XII, fig. 6; text fig. 26), subovate, posteriorly elongated, moderately convex. The greatest convexity is marked at mid-height of the valve. Its rather steep descent towards the anterior margin produces a distinct notch; towards the posterior it disappears gradually. The anterior margin oblique, the posterior margin rounded, the lower one arcuate. Umbo blunt, slightly protruding above the hinge line and somewhat shifted to the front. The hinge line straight and shorter than the overall length of the valve. Surface smooth, faint growth lines are occasionally visible.

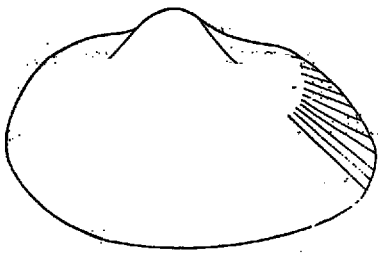

Fig. 26

Modiolopsis cf. *flexa* Barr.

Left valve × 9; depth 1247.9-1248.4 m
Skorupka lewa × 9; głębokość 1247,9-1248,4 m

Dimensions: height 3.1 mm., length 3.5 mm.

The right valve does not differ from the left one.

Comparisons. — The above form resembles that figured by Barrande in tab. 260/II,3.

Stratigraphic position and distribution. — Chełm borehole in the *Monograptus angustidens* and *M. uniformis* zones; the Přídol and the Lochkov beds in the Barrandian basin.

Fam. **Astartidae** Gray, 1840

Gen. *Astarte* Sowerby, 1818

Astarte cf. *primula* Barr.

(pl. XIII, fig. 1; text fig. 27)

1881. *Astarte primula* — Barrande, Syst. silur., vol. VI, tab. 31/VI,1-6; tab. 190/1-11; tab. 297/1-7.

Material. — 3 right and 3 left valves from 1267.6-1415.2 m.

Description. — Right valve from 1295.4-1295.9 m. (pl. XIII, fig. 1; text fig. 27), semi-circular, moderately convex. Umbo slightly shifted

to the front, blunt and considerably protruding above the straight hinge line. Ornamentation consists of concentric irregular folds; growth lines are also marked.

Dimensions: height 10.0 mm., length 10.5 mm.

Comparisons. — The above form shows a close similarity to that figured by Barrande in tab. 31/VI,1-3.

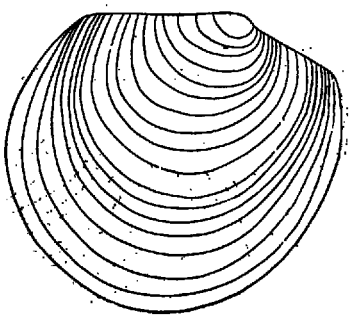

Fig. 27

Astarte cf. *primula* Barr.

Right valve × 4; depth 1295.4-1295.9 m.
Skorupka prawa × 4; głębokość 1295,4-1295,9 m

Stratigraphic position and distribution. — Chełm borehole — from the *Pristiograptus admirabilis* zone to the *P. transgrediens* zone; the Přídol beds in the Barrandian basin.

Fam. **Cypricardiniidae** Ulrich, 1897

Gen. *Cypricardinia* Hall, 1859

Cypricardinia cf. *longiuscula* Barr.
(pl. XIII. fig. 3)

1881. *Cypricardinia longiuscula* — Barrande, Syst. silur., vol. VI, tab. 285/I,14-17.

Material. — Incomplete right and left valve of the same specimen from 1208.6-1208.8 m.

Description. — The preserved fragments of this shell come nearest a form figured by Barrande in tab. 285/I, 16. Our form is strongly elongated toward the posterior. Umbones blunt and almost completely shifted to the anterior; they protrude above the straight hinge line. Ornamentation consists of closely spaced concentric folds.

Stratigraphic position and distribution. — Chełm borehole — the *Monograptus uniformis* zone; Lochkov beds in the Barrandian basin.

Cypricardinia cf. *minuscula* Barr.
(pl. XIII, figs. 4-5; text fig. 28)

1881. *Cypricardinia minuscula* — Barrande, Syst. silur., vol. VI, tab. 285/I,10-13.

Material. — 5 right valves and 7 left valves from 1222.4-1250.5 m.

Description. — Right valve from 1249.9-1250.5 m. (pl. XIII, fig. 5; text fig. 28), trapezoid in shape, elongated posteriorly, fairly convex, with the greatest convexity axis running from the umbo to the contact of the lower and the posterior margin. The convexity slopes steeply towards the posterior but gently towards the lower and the anterior margin. Umbo blunt, rather broad, anteriorly shifted and considerably protruding above the straight hinge line. Ornamentation consists of distinct, rather thick, irregular concentric folds between which are marked delicate transverse striae.

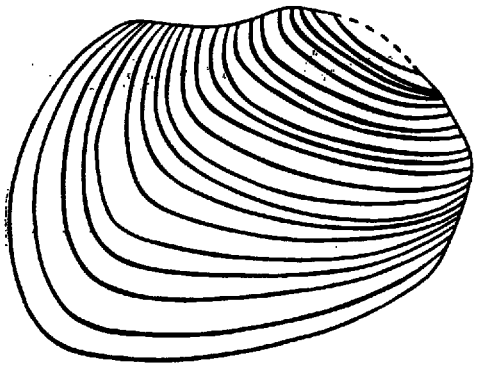

Fig. 28

Cypricardinia cf. *minuscula* Barr.

Right valve × 10; depth 1249.9-1250.5 m.
Skorupka prawa × 10; głębokość 1249,9-1250,5 m

Dimensions: height 6.0 mm., length 6.8 mm.

Comparisons. — The above form resembles that figured by Barrande in tab. 285/I,10,12.

Stratigraphic position and distribution. — Chełm borehole, — the *Monograptus angustidens* zone; Přidol beds in the Barrandian basin.

Fam. **Praecardiidae** R. Hoernes, 1884

Gen. *Praecardium* Barrande, 1881

Praecardium adolescens Barr.
(pl. XIII, fig. 2; text fig. 29)

1881. *Praecardium adolescens* — Barrande, Syst. silur., vol. VI, tab. 88/III,1-8; tab. 88/V,1-13; tab. 91/II,1-7; tab. 91/III,3-18.

Material. — 1 right valve from 1382.6-1382.7 m.

Description. — Valve subtriangular, convex; the greatest convexity occurs in the umbonal part, from there it gradually disappears towards the lower margin. Towards the anterior margin the line of convexity bends abruptly and causes the formation of a distinct arched keel. Towards the posterior, however, the bend of the line of convexity is conspicuous in the umbonal part only. Umbo in a subcentral position, strongly hooked and considerably protruding above the hinge line. Orna-

mentation of the valve consists of radial, thick rounded ribs; the distance between the ribs is nearly twice their width. In the umbonal part the ribs are narrow, they widen gradually towards the margins. Crowded, delicate concentric striae are also marked; they are well visible under strong magnification.

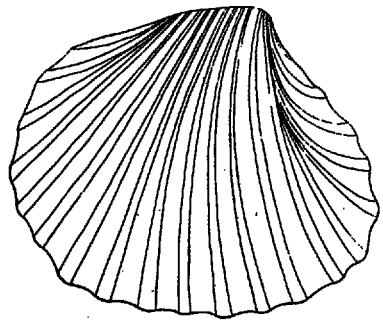

Fig. 29

Praecardium adolescens Barr.

Right valve × 3; depth 1382.6-1382.7 m.
Skorupka prawa × 3; głębokość 1382,6-1382,7 m

Dimensions: height 14.0 mm., length 17.2 mm.

Comparisons. — The above form comes closest to that figured by Barrande in tab. 91/III,16-17.

Stratigraphic position and distribution. — Chełm borehole — the *Pristiograptus perbrevis* zone; the Přidol beds in the Barrandian basin.

Praecardium cf. *numa* Barr.
(pl. XIII, fig. 6; text fig. 30)

1888. *Praecardium numa* — Barrande, Syst. silur., vol. VI, tab. 89/I,1-4.

Material. — 1 right valve from 1380.2-1380.4 m.

Description. — Valve triangular in shape, strongly convex. The greatest convexity occurs in the upper 1/3 of the height of valve. Towards the anterior margin the convexity descends steeply. Umbo blunt, slightly

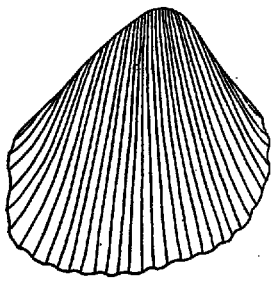

Fig. 30

Praecardium cf. *numa* Barr.

Right valve × 6; depth 1380.2-1380.4 m.
Skorupka prawa × 6; głębokość 1380,2-1380,4 m

hooked and protruding above the hinge line. Anterior and posterior margin oblique, the lower margin rounded. Ornamentation consists of radial rounded ribs, separated by fairly deep furrows. The ribs widen out downward.

Dimensions: The above form resembles that figured by Barrande in tab. 89/I,1-4.

Stratigraphic position and distribution. — Chełm borehole — the *Pristiograptus perbrevis* zone; the Přidol beds in the Barrandian basin.

Gen. *Cardiola* Broderip, 1834

Cardiola bohemica Barr.

(pl. XIV, figs. 1-5)

1881. *Cardiola bohemica* — Barrande, Syst. silur., vol. VI, tab. 164/IV, 19-22; tab. 168/I-XII; tab. 169/1-40; tab. 170/1-37.

1929. *Cardiola bohemica* — Heritsch, Faunen aus dem Silur der Ostalpen, tab. III, figs. 204-217, 220.

1930. *Cardiola bohemica* — Heritsch, Die obersilurische Fauna, tab. 34, figs. 49-51.

1953. *Cardiola bohemica* — Kegel, Das Paläozoikum der Lindener Mark bei Giessen, tab. 2, figs. 7, 8, 10.

1958. *Cardiola bohemica* — E. Tomczykowa, Fauna z łupków graptolitowych (Fauna from Silurian graptolitic shales), tab. I, fig. 3.

Material. — 37 valves from 1289.1-1571.0 m.

Description. — Valve from 1294.15-1294.25 m. (pl. XIV, fig. 1) roundish in outline, convex. Umbo blunt, strongly hooked and considerably protruding above the hinge line; placed sub-centrally, only just a little shifted toward the anterior. Hinge line straight, its length shorter than that of the valve. The ornamentation is very characteristic. It consists of radial and concentric grooves of varying depth. The distance between the concentric grooves is not constant. Beginning from the mid-height of the valve towards the umbo these grooves are closely spaced and conspicuous. In the lower part of the valve they become more shallow and widely spaced. At the point of contact of the hinge line with the anterior and posterior part, the concentric grooves grow indistinct while the longitudinal furrows are well marked producing several thicker ribs. In result of the intersection of radial furrows and concentric grooves on the remaining surface of the valve, small miniature convex rectangles are formed which are most conspicuous in the upper half of the valve. In addition to longitudinal furrows and transverse grooves, transverse sinuous striae also occur on the rectangles; in the umbonal part they are widely spaced and faintly marked but become crowded in the lower part of the valve; together with the shallowing of the transverse grooves and the disappearance of the minute convex rectangles this modifies the ornamentation pattern. Hence in the marginal parts of the valve the ornamentation seems to consist of imbricated scales.

Dimensions: height 17.8 mm., length 19.0 mm.

It is noteworthy that within the species *C. bohemica* strong variations are observable both in the shape of valves and the ornamentation pattern.

Comparisons. — The above form, as well as the other Chełm specimens show strong similarity with those described in Barrande's paper.

Remarks. — The genus *Cardiola* has been revised by J. Kříž of Prague (oral communication). The results of this revision have not so far been published but it is known that Barrande's 70 species and 3 subspecies have been reduced by that author to 13 species. J. Kříž postulates the inclusion into *C. bohemica* of the following species: *C. adaequata*, *C. adornata*, *C. bohemica irregularis* (tab. 180/VII,4-6), *C. convergens*, *C. interrupta* (tab. 170/38-41), *C. laticosta* and *C. modesta*. In view of the lack of relevant literature it is now hardly posible to make any conclusive remarks as to the correctness of the assignment of these forms to the species *C. bohemica*.

Stratigraphic position and distribution. — Chełm borehole — from the *Pristiograptus bugensius* to the *P. transgrediens* zone. This species is also recorded by H. Jaeger (1962) from the *P. transgrediens* zone of Kellerwald and the Rhine Schiefergebirge. After J. Kříž the occurrence of this form in the Barrandian basin is noted in the upper parts of the Liten beds, in the Kopanina beds and in the uppermost part of the Přidol beds. F. Heritsch (1929, 1930) quotes it from the Upper Silurian of the Harz Mts., the Carnian Alps, Sardinia and Portugal; H. Termier (1936) from Morocco and M. Chaubet (1937) from Montagne Noire in France. E. Tomczykowa (1958) reports that in the Holy Cross Mts. *C. bohemica* is encountered in the *Lobograptus scanicus* zone.

Cardiola fluctuans Barr.
(pl. XV, figs. 1-2)

1881. *Cardiola fluctuans* — Barrande, Syst. silur., vol. VI, tab. 164/IV,1-18.

1929. *Cardiola fluctuans* — Heritsch, Faunen aus dem Silur der Ostalpen, tab. III, figs. 168-181.

1953. *Cardiola fluctuans* — Kegel, Das Paläozoikum der Lindener Mark bei Giessen, p. 43.

Material. — 6 valves from 1288.7-1567.6 m.

Description. — Valve from 1567.5-1567.6 m. (pl. XV, fig. 1a,b), ovate in contour, with height greater than length; strongly convex, the maximum convexity occurs at about 1/3 of the height of valve. Umbo hooked, rather pointed, subcentrally placed and protruding above the hinge line. Ornamentation consists of regular, closely spaced, radial cylindrical ribs, growing broader towards the lower margin. The ribs are separated

by uniformly narrow furrows. Several distinct, deep, concentric grooves are also marked. Faint growth lines are visible, too.

Comparisons. — The above form comes closest to that figured by Barrande in tab. 164/IV,5-6.

Remarks. — The longitudinal cylindrical ridges in the lower part of Barrande's mature form (tab. 164/IV,15-18) are ornamented by closely spaced delicate striae which are not observable in our specimens.

Stratigraphic position and distribution. — Chełm borehole — from the *Pristiograptus bugensius* to the *P. transgrediens* zone; the Přidol beds in the Barrandian basin; the Carnian Alps and the Rhine Schiefergebirge.

Cardiola insolita Barr.
(pl. XV, figs. 3-4)

1881. *Cardiola insolita* — Barrande, Syst. silur., vol. VI, tab. 163/I,1-5.

Material. — 14 valves from 1375.1-1445.2 m.

Description. — Valve from 1433.1-1433,3 m. (pl. XV, fig. 3), roundish in contour, uniformly convex. Umbo blunt, hooked and protruding above the hinge line. Ornamentation consists of radial cylindrical ribs that thicken towards the margins. Concentric striae are also marked, resulting in a characteristic imbricated ornamentation pattern. The growth lines are most conspicuous in the marginal parts of the valve.

Dimensions: height 6.3 mm., length 6.2 mm.

Comparisons. — The above form resembles that figured by Barrande in tab. 163/I,1 (for photo of this original see pl. XXVI, fig. 3).

Stratigraphic position and distribution. — Chełm borehole — from the *Monograptus boučeki* zone to the bottom part of the *Pristiograptus transgrediens* zone; Přidol beds in the Barrandian basin.

Cardiola cf. *stellaris* Barr.
(pl. XV, fig. 5)

1881. *Cardiola stellaris* — Barrande, Syst. silur., vol. VI, tab. 161/I,1-3.

Material. — 2 valves from 1251.5-1294.45 m.

Description. — Valve from 1251.5-1251.9 m. (pl. XV, fig. 5) roundish in outline, nearly flat. Umbo blunt, considerably protruding above the hinge line. Ornamentation consists of regular, distinct, rather pointed radial ribs. These intersect concentric grooves that are irregularly spaced; they are more numerous in the umbonal part. Delicate growth lines are also marked; their number increases in the marginal areas of the valve.

Dimensions: height 5.2 mm., length 5.5 mm.

Comparisons. — The above form in appearance resembles that figured by Barrande in tab. 161/I,1-3.

Stratigraphic position and distribution. — Chełm borehole — in the *Pristiograptus transgrediens* and *Monograptus angustidens* zones; the Přidol beds in the Barrandian basin.

Cardiola pisum Barr.
(pl. XVI, figs. 1-3)

1881. *Cardiola pisum* — Barrande, Syst. silur., vol. VI, tab. 167/I,1-3.

Material. — 19 valves from 1208.6-1472.1 m.

Description. — Valve from 1438.4-1438.6 m. (pl. XVI, fig. 1), roundish in outline, moderately convex; the greatest convexity occurs at 1/3 of the height of the valve. From the umbo to the mid-height the convexity is appreciable and then gently descends to the margins. Umbo blunt, hooked, slightly protruding above the hinge line, nearly centrally placed. Ornamentation consists of closely spaced delicate radial striae, slightly arching backwards. Moreover delicate grooves mark the surface, particularly in the upper half of the valve.

Dimensions: height 3.8 mm., length 3.8 mm.

Comparisons. — The above form resembles that figured by Barrande in tab. 167/I, 1 (for photo of this original see pl. XXVI, fig. 6).

Stratigraphic position and distribution. — Chełm borehole — from the *Pristiograptus samsonowiczi* zone to the *Monograptus uniformis* zone; Přidol beds in the Barrandian basin.

Fam. **Antipleuridae** Neumayer, 1891

Gen. *Dualina* Barrande, 1881
Dualina cf. *excisa* Barr.
(pl. XVI, figs. 4-5; text fig. 31)

1881. *Dualina excisa* — Barrande, Syst. silur., vol. VI, tab. 37/25; tab. 38/1-29; tab. 39/I, 1-10; II/1-13; tab. 40/II, 1-6; tab. 284/15-21.

Material. — 2 valves from 1380.1-1382.4 m.

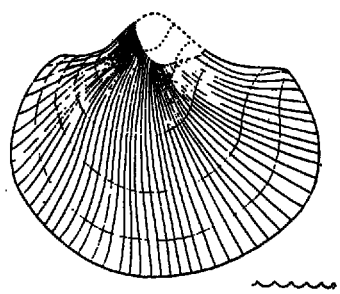

Fig. 31
Dualina cf. *excisa* Barr. × 2
Depth 1380.1-1380.4 m.
Głębokość 1380,1-1380,4 m

Description. — Valve from 1380.1-1380.4 m. (pl. XVI, fig. 5; text fig. 31), subtriangular in outline, strongly convex. Greatest convexity occurs in the umbonal region; it descends gradually toward the anterior

and the lower margin but steeply toward the posterior margin. Umbo blunt, slightly shifted to the anterior and protruding above the hinge line. Ornamentation consists of closely spaced distinct radial ribs. Growth lines are also marked.

Comparisons. — The above form resembles in appearance that figured by Barrande in tab. 38/1,14.

Stratigraphic position and distribution. — Chełm borehole — *Pristiograptus perbrevis* zone; Přídol beds in the Barrandian basin; Carnian Alps.

Dualina cf. *robusta* Barr.
(pl. XVI, fig. 6)

1881. *Dualina robusta* — Barrande, Syst. silur., vol. VI, tab. 37/1-24, 26-27; tab. 40/II, 1-7; tab. 75/VI, 1-4.

Material. — 1 valve from 1386.8-1387.6 m., strongly convex, roundish in outline. Greatest convexity occurs subcentrally and gently descends to the margins of the valve. Umbo fairly pointed, considerably protruding above the hinge line and incurved. Ornamentation consists of distinct radial ribs which thicken toward the margins. Delicate growth lines are moreover marked in the marginal parts.

Dimensions: height 23.0 mm., length 26.2 mm.

Comparisons. — The above form resembles that figured by Barrande in tab. 37/24.

Stratigraphic position and distribution. — Chełm borehole — in the *Pristograptus admirabilis* zone; the Přídol beds in the Barrandian basin, Carnian Alps.

Dualina cf. *annulosa* Barr.
(pl. XVI, figs. 7-8; text fig. 32)

1881. *Dualina annulosa* — Barrande, Syst. silur., vol. VI, tab. 23/III, 1-15.

Material. — 16 valves from 1373.9-1380.1 m.

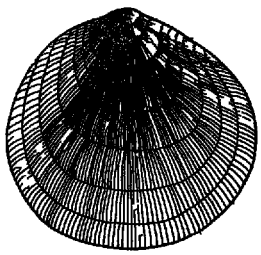

Fig. 32

Dualina cf. *annulosa* Barr. × 15

Depth 1378.7-1379.0 m.
Głębokość 1378,7-1379,0 m

Description. — Valve from 1378.7-1379.0 m. (pl. XVI, fig. 8; text fig. 32), extremely convex, ovate in outline. Umbo nearly centrally placed, rather sharp and distinctly protruding above the hinge line.

Ornamentation consists of delicate closely spaced radial striae. Regular distinctly concentric grooves are also marked. No growth lines are visible.

Dimensions: height 2.1 mm., length 1.9 mm.

Comparisons. — All our forms show similarities with those figured by Barrande in tab. 23/III, 4-5.

Stratigraphic position and distribution. — Chełm borehole — in the *Pristiograptus perbrevis* zone and in the bottom of the *P. transgrediens* zone; Přidol beds in the Barrandian basin.

Dualina cf. *consors* Barr.
(pl. XVII, figs. 1-4; text fig. 33)

1881. *Dualina consors* — Barrande, Syst. silur., vol. VI, tab. 20/1-20, 24-36; tab. 85/VIII, 7-8.

Material. — 15 valves from 1376.7-1446.6 m.

Description. — Valve from 1384.7-1384.8 m. (pl. XVII, fig. 1; text fig. 33), roundish in shape, convex; the greatest convexity occurs nearly centrally. From the umbo towards the posterior margin runs a faintly

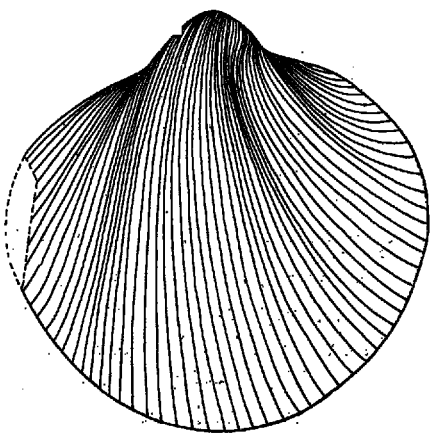

Fig. 33

Dualina cf. *consors* Barr. × 3

Depth 1384.7-1384.8 m.
Głębokość 1384,7-1384,8 m

marked keel which delimits the more flat posterior part of the valve. The anterior margin slightly oblique, the posterior and the lower margin arcuate. Umbo blunt, placed nearly centrally, it protrudes considerably above the straight hinge line. Ornamentation consists of distinct closely spaced radial ribs. Delicate growth lines are, moreover, visible in the lower part of the valve.

Dimensions: height 18.4 mm., length 19.0 mm.

Comparisons. — The above form resembles that figured by Barrande on tab. 20/35.

Stratigraphic position and distribution. — Chełm borehole — from the *Monograptus boučeki* zone to the *Pristiograptus perbrevis* zone; the Přidol beds in the Barrandian basin.

Dualina cf. *selecta* Barr.
(pl. XVII, figs. 5-7; text fig. 34)

1881. *Dualina selecta* — Barrande, Syst. silur., vol. VI, tab. 23/II, 1-12.

Material. — 4 valves from 1373.9-1380.1 m.

Description. — Valve from 1373.9-1374.0 m. (pl. XVII, fig. 6; text fig. 34), subtriangular in shape, strongly convex; the greatest convexity axis descends arcuately from the umbo towards the lower margin, approximately down the middle of the valve. This arched passage of the axis stresses the distinct curving of the valve toward the posterior. Umbo rather sharp, conspicuously hooked, anteriorly shifted and well protruding above the hinge line. The posterior and the lower margin

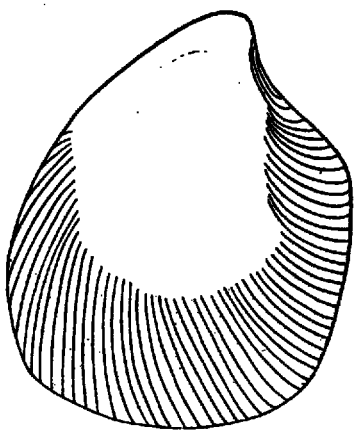

Fig. 34

Dualina cf. *selecta* Barr. × 2

Depth 1373.9-1374.0 m.
Głębokość 1373,9-1374,0 m

arcuate, they unite by a gentle passage. The anterior margin not seen. Ornamentation consists of radial closely spaced ribs, arcuately bending backwards. They are readily seen in the lower part of the valve.

Dimensions: height 6.8 mm., length 5.2 mm.

Comparisons. — The above form shows close similarity to that figured by Barrande in tab. 23/II, 4-6.

Stratigraphic position and distribution. — Chełm borehole — in the *Pristiograptus perbrevis* zone and in the bottom of the *P. transgrediens* zone; the Přidol beds in the Barrandian basin.

Dualina polonica nov. sp.
(pl. XVIII, figs. 1-4; text fig. 35)

Name — this forms has been collected at Chełm in Poland.

Material. — 17 valves from 1406.8-1416.0 m.

Holotype.—Valve from 1407.1-1408.5 m. (pl. XVIII, fig. 2; text fig. 35)

Description. — Valve semicircular-subtriangular in outline, strongly convex. The greatest convexity occurs in the central region of the valve. The greatest convexity axis runs from the umbonal region towards the lower margin, its direction agrees with that of the keel. The most

characteristic feature of the valve is the presence of a keel extending from the umbo, arcuately toward the posterior part of the lower margin. This keel sub-divides the valve into 2 parts: the anterior one is larger and more convex, with the convexity descending gradually to the anterior and the lower margin — the posterior one is smaller and it descends steeply from the keel toward the posterior margin. Umbo blunt, well protruding above the hinge line and nearly centrally placed.

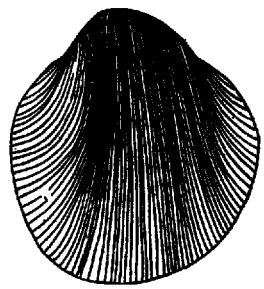

Fig. 35

Dualina polonica nov. sp. × 7

Depth 1407.1-1408.5 m.
Głębokość 1407,1-1408,5 m

Ornamentation consists of extremely delicate closely spaced radial ribs, readily discernible in the marginal regions of the valve. Growth lines are also locally marked.

Dimensions: height 5.0 mm., length 4.9 mm.

Stratigraphic position and distribution. — Chełm borehole — the *Pristiograptus admirabilis* zone.

Dualina convexa nov. sp.
(pl. XVIII, figs 5-7; text fig. 36)

Name — after the Latin word *convexa* meaning convex.

Material. — 5 valves from 1233.8-1251.9 m.

Holotype. — Valve from 1236.4-1237.4 m. (pl. XVIII, fig. 6; text fig. 36).

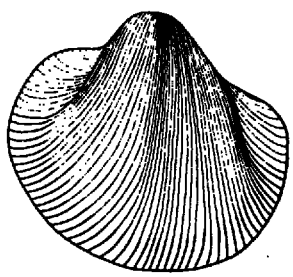

Fig. 36

Dualina convexa nov. sp. × 5

Depth 1236.4-1237.4 m.
Głębokość 1236,4-1237,4 m

Description. — Valve roundish in outline, strongly convex. The greatest convexity occurs in the upper portion of the valve. It slopes rather gradually toward the lower and the anterior margin but abruptly to the posterior margin, differentiating distinctly the convex part of the valve from its flat posterior part. Umbo subcentrally placed, rounded, hooked and much protruding above the hinge line. Arcuate transitions between the anterior, lower and posterior margins. Ornamentation

consists of extremely delicate radial ribs, most conspicuous in the marginal regions, particularly so in the posterior where they grow thicker. Growth lines are not visible.

Dimensions: height 6.6 mm., length 7.8 mm.

Stratigraphic position and distribution. — Chełm borehole — in the *Monograptus angustidens* zone.

CRUSTACEA

Fam. **Ceratiocaridae** Salter, 1865

Gen. *Ceratiocaris* Mac Coy, 1849

Ceratiocaris sp.

(pl. XVIII, fig. 8; pl. XIX, figs. 1-5; pl. XX, figs. 1-2; pl. XXI, figs. 1-2)

Material. — 1 carapace, 1 rostral plate, 4 styles and 4 stylets, also 4 toothed gnathal lobes. These remains have been collected from the following depths: 1373.9-1374.0 m.; 1437.9-1444.85 m.; 1572.1-1592.3 m.

Description

Carapace preserved as follows: flattened and consisting of two extremely thin valves (pl. XIX, fig. 1) which overlap and are shifted one to the other along the width axis and, to a small extent, also along the length axis. The right valve which overlaps the left one is partly damaged. Its only visible parts are the posterior extremity of the dorsal border, a part of the posterior border and a part of the ventral border. In the left valve the dorsal border is not seen, only the posterior border and most of the ventral border are preserved.

Dimensions of valves: length 49.0 mm., width 24.5 mm.

The dorsal border of the carapace valve straight, the anterior border oblique, the ventral border arcuate and subparallel to the dorsal, the posterior border dorsally slightly concave to halfway down the breadth of the valve, from there it grows slightly convex and arcuately joins the ventral border at a nearly right angle. The anterior border joins the ventral border in a gentle arch. A narrow (0.5 mm.) convex rim is present along the anterior, ventral and posterior border. A fusiform node, 2.5 mm. long and 1.0 mm. broad (pl. XIX, fig. 2) is present on the dorsal border of the right carapace valve at a distance of 8.7 mm. from the posterior border. Its surface is smooth, free of ornament. The ornamentation of the carapace consists of extremely thin, delicate closely spaced striae parallel to the ventral and dorsal border. Only quite near the dorsal border do these striae change their direction and meet the dorsal border at an angle of 45°. A dichotomous branching of the striae is seen at irregular intervals on the whole surface of the carapace. In the vicinity of the node the carapace striae are distorted.

Rostral plate (pl. XIX, fig. 3). It is very inadequately preserved so that only its anterior tip, terminating in a beak, is visible. The rostral plate is separated and occurs at a distance of 4.0 mm. from the anterior border of the right carapace valve. It bears an extremely delicate papillary ornamentation; a very narrow convex rim is present on the edges.

Style and stylets. One complete flattened last abdominal segment (pl. XIX, fig. 5) has been collected from a depth of 1592.15-1592.3 m. It bears a style and two stylets. The length of the style is 45.0 mm., that of the stylets 23.5 mm. The anterior part of the abdominal segment is obliterated, in another specimen, however, (pl. XX, fig. 1) collected at 1439.0-1439.5 m., it is seen to have a thickened rim and to be strongly expanded, dorsally convex, ventrally concave. Both the style and the stylets taper distally and are pointed at the end. Distinct ridges, separated by broader grooves are readily discernible on the style of the flattened specimen. No such external structure is present on the stylets; in the flattened state of preservation they are smooth.

The cross section of a fragmentary unflattened style (pl. XX, fig. 2 *a-d*) collected from 1373.9-1374.0 m. shows a distinctive polygonal structure (fig. 2 *a*). This style bears 9 ridges separating 9 broader grooves; on the dorsal side the ridges are sharp, ventrally more rounded. Taking the median dorsal ridge on the style as 1 and numbering the other ridges clockwise it will be seen that the grooves between ridges 2-3 and 8-9 carry a row of alveoli, unevenly spaced, in one line (fig. 2 *b*). These alveoli probably acted as clasps for the spinules. It is interesting to note that only 8 ridges are present in the anterior part of the style since, at ca. 10 mm. from the anterior end of the style, ridge 5 bifurcates into ridge 5 and ridge 6 (fig. 2 *c*) and thus 9 ridges are present in the middle part of the style.

Extremely delicate imbricating laminae are detectable on the style under strong magnification, producing under small magnification the semblance of very fine lamination (fig. 2 *d*).

Toothed-gnathal lobes. The mandibles in our material are all incomplete, they are represented by two left and two right toothed--gnathal lobes.

Lobe of left mandible from 1572.3-1572.4 m. (pl. XIX, fig. 4). Lenght 5.8 m., width (measured from the base of teeth) ca. 2.0 mm. distally and frontally nearly uniform. The basal distal part of this lobe terminates bluntly. The lower edge of the lobe is sinuous. The upper surface of the frontal and median part of the lobe carries 6 pairs of sharp teeth. The last pair is the longest one. Distally, the lobe is untoothed and only fine corrugations are visible. The teeth are marked by elongate striae.

Comparisons and remarks. — The above described remains of the genus *Ceriatocaris*, particularly the carapace, the last abdominal segment

and the left toothed-gnathal lobe, show a close similarity to the forms described by W. D. I. Rolfe (1962) from the upper Valentian and lower Wenlockian of Scotland as *Ceriatocaris papilio* Salter.

No complete specimen has been obtained from the Chełm borehole, the fragments here described occur at various depths of the reached Upper Silurian series. This fact has suggested to the writers the determination of these remains as *Ceriatocaris* sp., though its close similarity with the form described by W. D. I. Rolfe is indubitable. Caution in the specific identification of the fragmentary remains of gen. *Ceratiocaris* available to the writers seems particularly recommendable in view of the fact that so far *C. papilio* Salter has been recorded only from deposits older than the Ludlovian. Hence it is not excluded that the vertical extent of this species is much wider, so as to include all the Silurian stages.

The two, right and left, toothed-gnathal lobes, shown in pl. XXI, figs. 1-2, probably belong to another species as is suggested by their structure different from that of the above described left lobe. The right lobe here under consideration, collected from 1438.6-1438.8 m. (pl. XXI, fig. 2), is 7.0 mm. long, its expanded anterior portion is much constricted in the median part and expands again posteriorly, terminating in a pointed basally directed projection. Six pairs of sharp teeth are present on the upper surface of the anterior and median parts of the lobe. The distal part of the lobe is untoothed and only delicate thickenings are visible. The left lobe from 1444.45-1444.85 m. (pl. XXI, fig. 1) is very much the same as the just described right lobe.

Stratigraphic position and distribution. — Chełm borehole — in the *Pristiograptus bugensius* —, *Monograptus boučeki* — and *Pristiograptus transgrediens* zones.

TRILOBITA

Fam. **Dalmanitidae** Vogdes, 1890

Subfam. **Acastavinae** Struve, 1958

Gen. *Acastella* Reed, 1925

Acastella cf. *tiro* R. & E. Richter

(pl. XXI, fig. 3 *a-b*; pl. XXII, figs. 1-4; pl. XXIII, figs. 1-3; pl. XXIV, figs. 1-2; text fig. 37 *a-h*).

1954. *Acaste (Acastella) tiro* — R. & E. Richter, Die Trilobiten des Ebbe-Sattels, tab. 5, figs. 72-75; tab. 6, figs. 76-78; text fig. 3).

Material. — 10 incomplete cephalons, 7 glabellae, 8 pygidia, also fragments of the axial part of the trilobite body and of pleurae collected from a depth of 1208.6-1209.5 m. They are mostly moulds with fragmentary cephalons somewhat distorted.

Dimensions in *mm.*:

Cephalon

length	3.1
width	6.0
length of genal spine	1.0

Glabella

	1	2
length	3.0	6.0
frontal width	2.5	5.8
basal width	1.6	4.0

Pygidium

	1	2	3
length (without posterior spine)	3.0	2.2	3.0
width	6.0	4.5	5.2
length of axis	2.7	2.0	2.2
width of axis	1.0	1.3	1.7
length of posterior spine		0.5	0.6

Description

Cephalon. Outline semicircularly-triangular, length a little more half the width. Marginal limb distinct, very narrow, separated by a shallow border furrow from the genae (pl. XXII, figs. 1, 3; text fig. 37 *a*).

Glabella convex, axial dorsal furrows distinct, fairly deep, converging towards the base at an angle of ca. 20°. The frontal lobe broad, anteriorly triangularly rounded; tubercles, arranged in 5-6 radial bands, occur posterior to the frontal lobe (pl. XXI, fig. 3 *b*; pl. XXII, fig. 2; text fig. 37 *b*, *c*). There are 3 pairs of distinct lateral glabellar furrows. The 3rd (anterior) obliquely-arcuate shallow furrow is the longest, it reaches to the axial furrow. The frontal lobe of glabella is convex, triangular. The 2nd (median) nearly straight rather deep furrow is short and does not attain the axial furrow. The median lobe is convex, too, nearly rectangular in outline. The 1st (posterior) deep furrow is longer than the median one and subparallel to the deep occipital furrow. The posterior lobe of glabella is narrow, widening in the direction of the axial furrow. The occipital furrow is narrow, rather deep, growing more shallow in the central part. The occipital ring convex, broader than the occipital furrow.

The visual surface of the eye strongly convex, reniform, placed near the glabella; palpebral lobe smooth, visual lobe higher, with lenses arranged in rows.

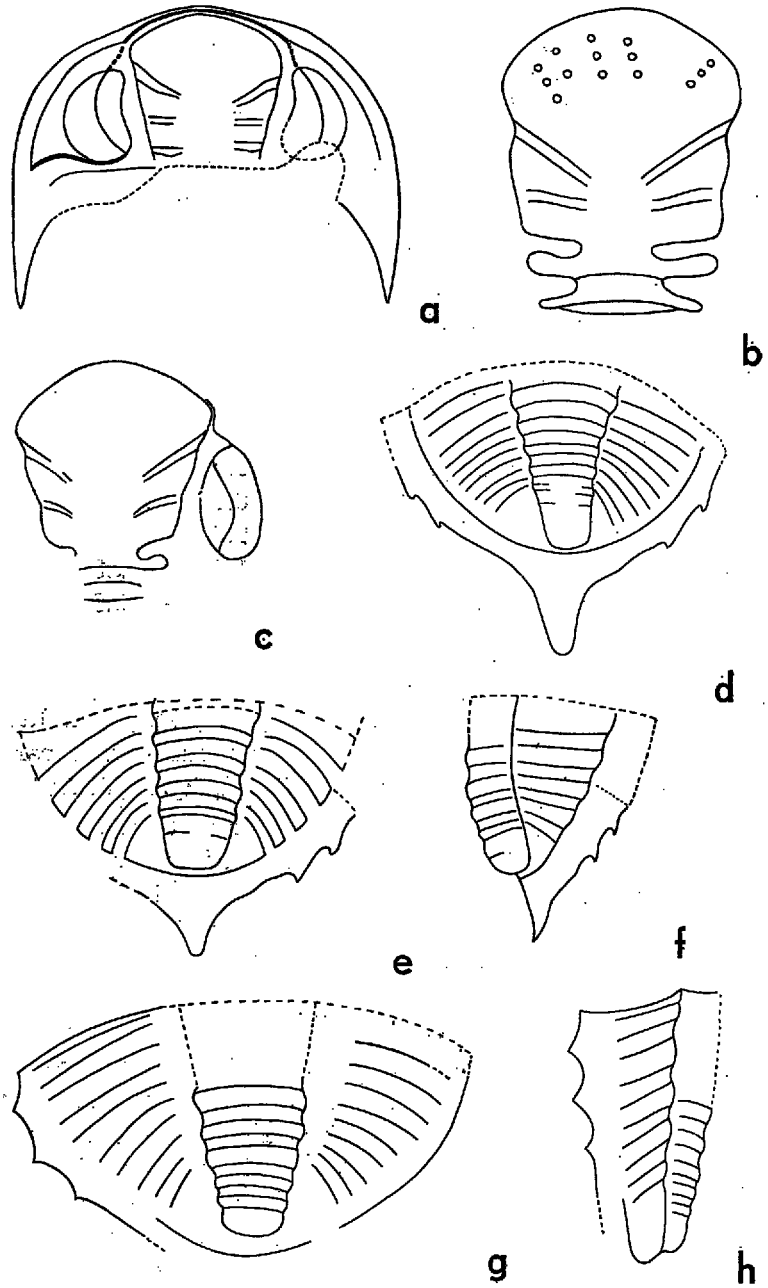

Fig. 37

Acastella cf. *tiro* R. & E. Richter

Facial suture extends from the cephalic margin to the eye, arching gently; it rims the visual lobe and then, after traversing the eye it approaches the glabella and running along the frontal lobe it joins the opposite part of the suture.

Thorax unknown. A negative of the axial part of the thorax was found at a depth of 1208.6-1209.0 m., provided with more than 10 axial rings; long, rather pointed pleural spines are visible near two of the anterior rings (pl. XXII, fig. 4).

Pygidium (pl. XXIII, figs. 1-3; pl. XXIV, figs. 1-2; text fig. 37 *d-h*). The outline is triangular, laterally slightly rounded. The width twice as great as the length. The axis of the pygidium narrows posteriorly, it ends bluntly and does not attain the border. In side-view it is seen that anteriorly the axis is high, distally it is lowered and steeply descends in the posterior part. 7-9 axial rings are present, 2-3 anterior ones are high, separated by distinct furrows. Posteriorly the furrows grow more shallow, the rings less distinct. Five paired pleura are visible on the pleural region; the 5th pair is faintly marked. The pleura do not reach the border furrow. There is a broad border round the pygidium which ends in a short blunt terminal axial spine; the tip of the spine is slightly upturned. The margin of the border is slightly sinuous and there are two (or three) pairs of rudimentary down-turned marginal spines with a fairly distinct embayment separating the two spines.

Exoskeleton. The sparse remnants of the exoskeleton preserved on the cephalon and on the pygidium are very densely and delicately granulated.

Comparisons. — Though the writers specimens are poorly preserved, it can be seen that the morphological features of the cephalon, glabella and pygidium are very nearly identical with those of the form described by R. & E. Richter (1954) as *Acaste* (*Acastella*) *tiro*. According to those authors *A.* (*Acastella*) *heberti elsana* is the ancestral form of

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Explanation of fig. 37
Objaśnienie do fig. 37

a cephalon × 8, depth 1209.0-1209.2 m.; b glabella × 6, depth 1208.8-1209.0 m.; *c* glabella × 10, depth 1209.0-1209.2 m.; *d* pygidium × 10, depth 1208.8-1209.0 m.; *e* pygidium × 10, depth 1208.6-1209.0 m.; *f* ditto — side view × 10; *g* pygidium × 8, depth 1209.0-1209.2 m.; *h* ditto — side view × 8

a cefalon × 8, głębokość 1209,0-1209,2 m; b glabella × 6, głębokość 1208,8-1209,0 m; *c* glabella × 10, głębokość 1209,0-1209,2 m; *d* pygidium × 10, głębokość 1208,8-1209,0 m; *e* pygidium × 10, głębokość 1208,6-1209,0 m; *f* to samo — widok z boku × 10; *g* pygidium × 8, głębokość 1209,0-1209,2 m; *h* to samo — widok z boku × 8

tiro. On comparing our specimens with the form just mentioned they are seen to differ in the following characters: angle of axial glabellar furrows, outline of frontal lobe and shape of cephalon. Moreover, the pygidia of our specimens are characterised by a greater number of axial rings on the pygidial axis (8-9) and of the pleura (5), the presence of more prominent marginal spines and distinct granulation of the exoskeleton. All these features suggest that the form here described belongs to *Acastella tiro*. In view, however, of its rather poor state of preservation and of a certain distortion of the specimens it is identified as *A.* cf. *tiro*.

Remarks. — During the preparation of the fossil material available to the writers three fragments of graptolite rhabdosomes were discovered in the same bedding plane, side by side with *Acastella* cf. *tiro*. The characteristic shape of thecae and their dimensions indicate that these remains belong to *Monograptus uniformis* (pl. XXI, fig. 3a-b). The side-by-side occurrence of these forms is of great significance for the Upper Silurian stratigraphy.

Stratigraphic position and distribution. — Chełm borehole — in the *Monograptus uniformis* zone; the Rhine Province — in the Hüinghäuser beds.

E. & H. Tomczyk (1962) cite this form from the Bostów beds in the Holy Cross Mts. Since, however, this species has never been described or figured by those authors it is hardly possible to make any conclusive statements on this point.

VERTICAL DISTRIBUTION OF THE FAUNA
(tabl. I)

The presence of very numerous graptolites in the Silurian series from the Chełm borehole has permitted a detailed stratigraphy of this series, and the determination of a number of Upper Silurian graptolite zones (Teller 1960, 1964a).

An abundant non-graptolite fauna, with the predominance of lamellibranchs, is also found in these deposits. The side-by-side occurrence of so different animal groups, facilitates an attempt to differentiate either index fossils of lamellibranchs or lamellibranchian assemblages, and to correlate them with graptolites which are reliable stratigraphic zone markers.

The determination of certain index fossils of the lamellibranchs is of the greatest significance, particularly for the detailed stratigraphy of the numerous Silurian sections that yield no graptolite fossils.

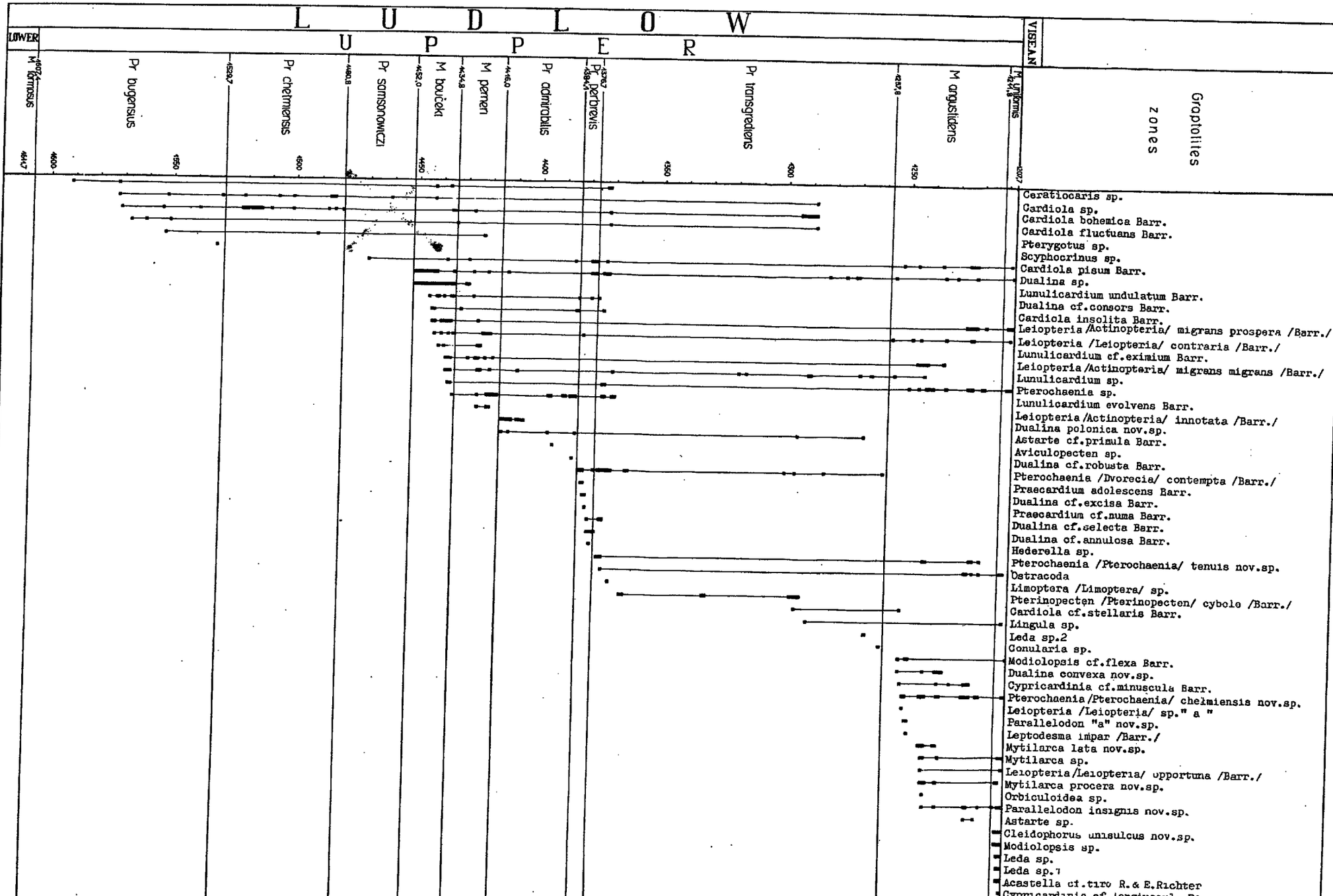
The above assumptions prompted the writers to investigate the non-graptolite fauna from Chełm and to trace its vertical range. The resulting data reveal the existence of certain lamellibranchian species which are closely associated with definite graptolite zones.

Vertical distribution of Upper Silurian non-graptolite fauna from the Chełm borehole

(depth 1207.7-1611.7 m.)

Pionowe rozmieszczenie fauny niegraptolitowej górnego syluru w wierceniu Chełm

(głębokość 1207,7-1611,7 m)



The faunal assemblages from the particular graptolite zones of the Chełm borehole are given below (from bottom to top):

Between 1607.4-1480.8 m.: *Scyphocrinus* sp., *Cardiola bohemica*, *C. fluctuans*, *Cardiola* sp., *Ceratiocaris* sp. These forms are associated with the *Pristiograptus bugensius* and *P. chełmiensis* zone (between 1529.7-1480.8 m.). It should be noted, however, that, on the whole, species of the genus *Cardiola* belong to forms with a wide vertical range and cannot, therefore, be taken into account when making a more detailed stratigraphic division.

In the series between 1480.8-1452.0 m., referred to the *Pristiograptus samsonowiczi* zone, the appearance is noted of *Cardiola pisum*, also of isolated specimens of *Cardiola* sp. and *Dualina* sp.

The deposits between 1452.0-1434.8 m. are characterised by a rich faunal assemblage and the appearance of the following new forms: *Leiopteria* (*Leiopteria*) *contraria* (in great numbers), *L.* (*Actinopteria*) *migrans migrans* (detached specimens), *L.* (*Actinopteria*) *migrans prospera* (in great numbers), *Lunulicardium evolvens*, *L. eximium*, *L. undulatum*; the last named species is nearly exclusively confined to this interval, it occurs en masse and may be regarded as an index fossil; also of *Cardiola insolita* and extremely abundant *Dualina* cf. *consors*. Other forms encountered here are *Pterochaenia* sp., *Lunulicardium* sp., *Cardiola bohemica*, *C. fluctuans*, *C. pisum*, *Cardiola* sp., *Dualina* sp. and fragments of *Ceratiocaris* sp. The whole assemblage is characteristic of deposits referred to the *Monograptus boučeki* zone.

Between 1434.8-1416.0 m. in addition to forms found in the above zone the appearance is noted of *Leiopteria* (*Actinopteria*) *innotata*; this is an index fossil solely for deposits at that depth, assigned to the *Monograptus perneri* zone.

A core segment from 1416.0-1384.1 m. reveals a quantitative impoverishment of the fauna. The new forms that make their appearance are *Pterochaenia* (*Dvorecia*) *contempta*, *Astarte* cf. *primula*, *Aviculopecten* sp. (one specimen), *Dualina* cf. *robusta* (one specimen), *Dualina polonica* (numerous). The three last named forms are restricted to this core segment. A mass occurrence of *Lunulicardium evolvens* is also observed. Some species from the foregoing zones are represented here by single specimens only; *Lunulicardium eximium* has not been found above this interval. The series of deposits containing the above assemblage has been referred to the *Pristiograptus admirabilis* zone.

The deposits occurring higher up, between 1384.1-1376.7 m. are characterised by the presence of *Praecardium adolescens*, *P.* cf. *numa* and *Dualina* cf. *excisa*, all these species are restricted to this interval. *Dualina* cf. *annulosa* and *Dualina* cf. *selecta* also make their appearance. Other lamellibranchs here encountered are *Leiopteria* (*Leiopteria*) *con-*

traria and *Pterochaenia* (*Dvorecia*) *contempta*, also *Dualina* cf. *consors*. The last named form has not been found in the younger deposits from the Chełm borehole. On the graptolite remains yielded by deposits from the above mentioned depth this series is referred to the *Pristiograptus perbrevis* zone.

A core segment from 1376.7-1257.8 m. which has been referred to the *P. transgrediens* zone on the basis of its graptolite fauna, is characterised by the following assemblage: *Pterochaenia* (*Pterochaenia*) *tenuis*, *Cardiola* cf. *stellaris* and *Pterinopecten cybele* make their appearance, the last named species is confined to this zone and may, therefore be regarded as an index fossil. The presence has also been noted in this zone of *Leda* sp. 2, *Limoptera* sp. and *Conularia* sp. It is interesting to note here the occurrence of the last representatives of *Pterochaenia* (*Dvorecia*) *contempta*, — occurring en masse at the base of the series — and of *Astarte* cf. *primula*, while *Lunulicardium evolvens*, *Cardiola insolita*, *Dualina* cf. *annulosa* and *D.* cf. *selecta* are present in the basal portion of the series. Other lamellibranchs here are: *Pterochaenia* sp., *Lunulicardium* sp., *Cardiola bohemica* (numerous), *C. fluctuans*, *C. pisum*, *Cardiola* sp., *Dualina* sp., *Ceratiocaris* sp. is encountered, too.

A very rich lamellibranchian assemblage characterises the series of deposits between 1257.8-1211.8 m., referred to the *Monograptus angustidens* zone. Forms restricted only to this zone are: *Parallelodon "a"*, *Leiopteria* (*Leiopteria*) sp. *"a"*, *Leptodesma impar*, *Mytilarca lata*, *Cypricardinia minuscula* and *Dualina convexa*. The appearance is also noted of such forms as *Parallelodon insignis*, *Leiopteria* (*Leiopteria*) *opportuna*, *Pterochaenia* (*Pterochaenia*) *chełmiensis* (mass occurrence), *Mytilarca procera*, *Modiolopsis* cf. *flexa*. Among forms known from the previous zones but not encountered above the *M. angustidens* zone may be mentioned; *Leiopteria* (*Actinopteria*) *migrans migrans*, *L.* (*Actinopteria*) *migrans prospera*, *Pterochaenia* (*Pterochaenia*) *tenuis*, *Cardiola* cf. *stellaris*. Other forms identified in this zone are: *Leiopteria* (*Leiopteria*) *contraria* (numerous), *Pterochaenia* sp. (numerous), *Mytilarca* sp. (numerous), *Lunulicardium* sp., *Astarte* sp., *Cardiola pisum* (numerous) and *Dualina* sp.

The top part of Silurian deposits reached in the Chełm borehole between 1211.8-1207.7 m., which has been referred to the *Monograptus uniformis* zone, is characterised by the presence of the trilobite *Acastella* cf. *tiro*. The appearance is also noted of *Cleidophorus unisulcus*, *Leda* sp. *1*, *Cypricardinia* cf. *longiuscula*. Other lamellibranchs present here are: *Leda* sp., *Leiopteria* (*Leiopteria*) *opportuna*, *L.* (*Leiopteria*) *contraria*, *Pterochaenia* (*Pterochaenia*) *chełmiensis*, *Pterochaenia* sp., *Parellelodon insignis*, *Mytilarca procera*, *Mytilarca* sp., *Modiolopsis* cf. *flexa*, *Modiolopsis* sp., *Cardiola pisum* and *Dualina* sp.

Crinoid segments and orthoceracones are present in great abund-

ance within the Silurian series reached in the Chełm borehole; their mass occurrence is associated with the limestone intercalation at a depth of 1257.0-1257.8 m. In the interval between 1209.5-1380.0 m. detached ostracods and fragmentary brachiopods have been encountered. Their bad state of preservation impedes any specific identification, while only 3 specimens were generically determinable: *Lingula* sp. — 2 specimens — (pl. II, figs. 2-3) and *Orbiculoidea* sp. (pl. II, fig. 4).

A fragment of a bryozoan colony with genus *Hederella* (pl. I, fig. 2) has, moreover, been encountered at a depth between 1377.1-1378.0 m.

The remains of *Pterygotus* sp. (pl. XXV, figs. 1, 3, 4) and more definitely indeterminable *Crustacea* (pl. XXV, fig. 2) have been found at various depths.

The fauna presented here has been collected from one borehole, hence the vertical range analysis of the individual lamellibranchian species is only a tentative one. Its confirmation calls for further descriptions of additional contemporaneous fauna from other boreholes or outcrops.

It may be mentioned here that the writers are in possession of a rich non-graptolite fauna collected from the Silurian of the Holy Cross Mts. Although the description of this fauna has not as yet been completed it may already be reasonably assumed that the Upper Silurian lamellibranchs contain forms which will provide reliable criteria for the differentiation of definite biostratigraphic horizons. This is all the more important in view of the fact that the Holy Cross Mts. fauna has been collected from sections without graptolites.

GENERAL CONCLUSIONS

The lamellibranchs are to-day apparently the only group from the Silurian non-graptolite fauna which does not seem attractive either to the palaeontologists or the stratigraphers. This lack of interest may be attributed to various causes but the two main ones are probably:

1) their bad state of preservation which handicaps the study of a number of important diagnostic characters,

2) their relatively great vertical extent which detracts from their value as a stratigraphic marker as compared with the graptolite or the trilobite groups.

The above reasons largely account for the small attention now paid to this group of fossils, although in some Silurian strata — including those of Poland — the lamellibranchs are well represented both in the argillaceous and the calcareous facies. Minute dimensions are a common feature of the lamellibranch fauna from the Chełm borehole. This is most likely due to the physico-chemical conditions of the environment

that prevailed in their life-time. The character of the sediments suggests a fairly deep basin.

Another non-graptolite assemblage, showing similarities with that from the Chełm borehole, is known from the Barrandian basin. The Silurian deposits there are developed predominantly in a calcareous facies and the numerous lamellibranchs associated with that facies have large dimensions and well preserved calcareous shells. This suggests the existence in the Barrandian basin of more favourable conditions for the development of the lamellibranchs as compared with those prevailing in the Silurian basin of south-eastern Poland.

Among the 39 species of lamellibranchs described in this paper only 9 are new species, the remaining ones are known from the Barrandian basin and a few from other European areas. This suggests the existence during the Upper Silurian of convenient migration routes connecting the marine basins of eastern Poland and other European regions, particularly with the Barrandian Basin. The great abundance of the graptolite fauna resembling that from those areas is a reliable confirmation of the above supposition.

Differences in the facial development of the Upper Silurian in south-eastern Poland and that of the Barrandian indicate bathymetric differences in the two basins. The marine basin of south-eastern Poland was deeper and probably occurred within the bathyal zone of the southern arm of the Caledonian geosyncline while the Barrandian basin lay within a shallow neritic zone where the prevailing conditions were exceptionally favourable to the development of fauna.

Communication between the marine basin of south-eastern Poland with eastern Europe, particularly with Podolia, was not in any way obstructed and it is only the lack of descriptions of the lamellibranchian fauna from Podolia that prevents an accurate correlation with the area.

Besides south-eastern Poland, the Upper Silurian sea also encroached on the central and northern parts of Poland. The non-graptolite Upper Silurian fauna occurs in equal abundance in the Polish Lowland and in the Holy Cross Mts. Its correlation with the Chełm borehole fauna calls for detailed investigations.

The study of the Upper Silurian lamellibranchian fauna from the Chełm borehole proved of great help in determining the boundaries between certain graptolite zones previously established by L. Teller (1960, 1964a) in that borehole. Because of the absence of graptolite remains within some intervals of the series reached by drilling at Chełm, L. Teller was unable accurately to delimit the *Pristiograptus samsonowiczi* zone from the *Monograptus boučeki* zone, the *M. perneri* zone from the *Pristiograptus admirabilis* zone, and the *P. transgrediens* from the *Monograptus angustidens* zone. On the criterion provided by the appearance of new species of lamellibranchs whose vertical distribution is restricted to

a given zone (tabl. I), it has been accepted by the present writers that the boundary between the *Pristiograptus samsonowiczi* zone and the *Monograptus boučeki* zone is to be placed at a depth of 1452.0 m. (the appearance of *Lunulicardium undulatum*), that between the *M. perneri* and the *Pristiograptus admirabilis* zones at 1416.0 m. (the appearance of *Dualina polonica*). The boundary of the *P. transgrediens* and the *Monograptus angustidens* zone has been established at 1257.8 m., i.e. at the base of a 0.8 m. thick limestone intercalation containing a great abundance of ortoceracones; this intercalation is undoubtedly the stratigraphic equivalent of the Orthoceras bank which starts the *M. angustidens* zone in the Barrandian (R. Horny 1962). In the Chełm borehole *Dualina convexa*, *Cypricardinia* cf. *minuscula*, *Parallelodon "a"*, *Pterochaenia* (*Pterochaenia*) *tenuis* and *Mytilarca lata* make their appearance directly above this limestone intercalation.

During the preparation of the lamellibranchian remains yielded by the core sample from 1209.0-1209.2 m., 3 fragmentary rhabdosomes were discovered belonging to *Monograptus uniformis*. This reliably confirms the existence of a graptolite that is still younger stratigraphically speaking and marks a separate zone. The boundary between the *M. angustidens* and *M. uniformis* zones has been accepted at 1211.8 m., where new species of lamellibranchs, such as *Cleidophorus unisulcus* and *Cypricardinia* cf. *longiuscula* make their appearance. Another characteristic feature of a zone, the last to be differentiated and at the same time the youngest zone at Chełm consists in the presence of the trilobite *Acastella* cf. *tiro*, R. & E. Richter; this is an index fossil for the Hüinghäuser beds of the Rhine Province (R. & E. Richter 1954) as well as the Bostow beds of the Holy Cross Mts. (E. & H. Tomczyk 1962).

The side-by-side occurrence of *Acastella* cf. *tiro* and *Monograptus uniformis*, first reported from Poland in the Chełm borehole, has a most important bearing on the whole Silurian stratigraphy. Beds containing *Acastella tiro* have so far been assigned to the lower Geddinian. In view, however, of the presence of *Acastella* cf. *tiro* together with *Monograptus uniformis* on the same core surface from the Chełm borehole (pl. XXI, fig. 3a-b) it seems reasonable to claim that beds with *Acastella tiro* do not yet represent the Lower Devonian but still the Silurian stage. This problem has been discussed in greater detail by L. Teller in his paper (1964b).

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SELECTED BIBLIOGRAPHY

BARRANDE J. 1872-1899. Système silurien du centre de la Bohême. Vol. I — 1872, vol. VI — 1881, vol. VII — 1899. Praha.

BOLTON TH. E. 1957. Silurian stratigraphy and palaeontology of the Niagara escarpment in Ontario. — Geol. Surv. of Canada. Mem. 289. Ottawa.

BOUČEK B. 1928. Revise českych paleozoickych konularii (Revision des Conulaires paléozoïques de la Bohême). — Palaeontogr. Bohemiae, nr XI. Praha.

— 1934. Přispevek k poznani trilobitů českého gotlandu (II). — Rozpr. II Třidy Ceske Akad., roč. XLIV, č. 34. Praha.

BOUCOT A. J. et al. 1960. A late Silurian fauna from the Southerland River formation, Devon Island, Canadian Arctic Archipelago. — Bull. Geol. Surv. Canada, 65. Ottawa.

CHAPMAN F. 1908. A monograph of the Silurian bivalved Mollusca of Victoria. — Mem. Nat. Mus. Melbourne.

CHAUBET M. CH. 1937. Contribution à l'étude géologique du Gothlandien du versant méridional de la Montagne Noire. — Trav. Lab. Géol. Fac. Sci. Montpellier. Mém., no. 1 (hors série).

CHLUPAČ J. 1953. Stratigraficka studie o hraničnich vrstvacn mezi silurem a devonem ve střednich Čechach (Stratigraphical investigation of the border strata of the Silurian and the Devonian in Central Bohemia). — Sborn. Ústř. Úst. Geol., sv. 20 — Odd. geol. Praha.

— 1960. Die Gattung Montecaris Jux (Crustacea Phyllocarida) im älteren Paläozoikum der Tschechoslowakei. — Geologie, Jahrg. 9, H. 6. Berlin.

CLARKE J. M. & RUEDEMANN R. 1912. The Eurypterida of New York. — N.Y. St. Mus., Mem. 14. Albany.

COPELAND M. J. 1962. Canadian fossil Ostracoda, Conchostraca and Phyllocarida. — Bull. Geol. Surv. Canada, 91.

CZARNOCKI J. 1957. Stratygrafia i tektonika Gór Świętokrzyskich (Stratigraphy and tectonics of the Święty Krzyż Mountains, Central Poland). — Prace I.G. Trav. Inst. Géol. Pol.) XVIII, t. II, z. 1. Warszawa.

DAHMER G. 1948. Die Fauna des Koblenzquarzits (Unterdevon, Oberkoblenz-Stufe) vom Kühkopf bei Koblenz. — Senckenbergiana, Bd. 29. No. 1/6.

EHLERS G. M. & WRIGHT E. P. 1959. Leiopteria rafinesquii Hall and a new species of the genus from the Thedford — Arkona region of southwestern Ontario. — Contr. Mus. of Paleont. Univ. Michigan, vol. XV, no. 1.

FISCHER D. W. 1957. Lithology, paleoecology and paleontology of the Vernon shale (Late Silurian) in the Type area. — N.Y. St. Mus. and Sci. Serv. Bull., no. 364. Albany.

FRECH F. 1891. Die devonischen Aviculiden Deutschlands. — Königl. Preuss. Geol. L.-A. Berlin.

GARDINER C. J. 1927. The Silurian inlier of Woolhope (Herefordshire). — Quart. J. Geol. Soc. London, vol. 83, part 3, no. 331. London.

GRABAU A. W. 1926. Silurian faunas of Eastern Yunnan. — Palaeont. Sinica, s.B, vol. 3, fasc. 2. Peking.

HALL J. 1847-1852. Palaeontology of New York. Vol. I — 1847, vol. II. — 1852. Albany.

HERITSCH F. 1929. Faunen aus dem Silur der Ostalpen. — Abh. Geol. Bundesanst.. Bd. XXIII, H. 2. Wien.

— 1930. Die obersilurische Fauna des Wiedetales im Harz. — Jb. Preuss. Geol. L.-A., Bd. 50. Berlin.

HORNY R. 1954. The Budnany beds in the western part of the Silurian of the Barrandian. — Sborn. Ústř. Úst. Geol., sv. 21 — Odd. geol., díl 2. Praha.

— 1960a. Die fazielle und biostratigraphische Entwicklung des Silurs im Barrandium. — Prager Arbeitstagung über die Stratigraphie des Silurs und des Devons (1958).

— 1960b. Die Entwicklung und Korrelation der nichtgraptolithischen Faunen des Silurs im Barrandium. — Arbeitstagung über die Silur/Devon Grenze ... Bonn 1960.

— 1962. Das mittelböhmische Silur. — Geologie, Jahrg. 11, H. 8. Berlin.

ISBERG O. 1934. Studien über Lamellibranchiaten des Laeptenakalkes in Dalarna. Lund.

JAEGER H. 1962. Das Silur (Gotlandium) im Thüringen und am Ostrand des Rheinischen Schiefergebirges (Kellerwald, Marburg, Giessen). 2. Intern. Arbeitstagung über die Silur/Devon-Grenze ... Bonn-Bruxelles 1960. Symposiums — Band. Stuttgart.

KEGEL W. 1925. Bemerkungen über die obersilurische Zweischaler-Gattung Rhombopteria und ihre Verwandten. — Centralbl. Min. Geol. Pal. Jahrg. 1925, Abt. B. Stuttgart.

— 1953. Das Paläozoikum der Lindener Mark bei Giessen. — Hess. Landesamt Bodenforschung. Wiesbaden.

KJELLESVIG-WAERING E. N. 1958. The genera, species and subspecies of the family Eurypteridae Burmeister, 1845. — J. Paleont., vol. 32, no. 6.

KOZŁOWSKI R. 1929. Les brachiopodes gothlandiens de la Podolie polonaise (Ramienionogi gotlandzkie polskiego Podola). — Palaeontologia Polonica, t. I. Warszawa.

KRASILOVA I. N. 1959. A new family Leiopectinidae from the Upper Silurian and Lower Devonian of the northeastern part of the Balkhash region. — Palaeont. J., no. 3. Moskwa.

KŘIŽ J. 1961. Pruzkum zanikle paleontologické lokality J. Barranda označovane jim jako „Butowitz". — Čas. pro miner. a geol., roč. VI, č. 2. Praha.

KŘIŽ J. & SCHMITTOVA L. 1963. Stratigrafické a paleontologické pomery „Ortoceroveho Lůmku" u Lochkova (Stratigraphische und paläontologische Verhältnisse in dem „Ortocerovy Lumek" bei Lochkov). — Čac. Nar. Muz., Odd. Přírodov., roč. CXXXII, č. 1. Praha.

LAMOUT A. PH. D. 1954-1955. New lamellibranchs from the Gulterford Burn flagstones (Gala-Tarannon) of the Pentland Hills, near Edinburgh. — Proc. Royal Soc. Edinburgh, sect. B, vol. LXV, part III. London.

LECKWIJCK W. van, SUTER G. & TERMIER H. et G. 1955. Contribution à la stratigraphie des terrains ordoviciens et gothlandiens de l'anticlinorium de Khouribga-Oulmès (Maroc central). — Notes du Service Géol. du Maroc. Notes et Mém., no. 123. Rabat.

MAILLIEUX E. 1937. Les Lamellibranches du Dévonien inférieur de l'Ardenne. — Mém. Mus. Roy. Hist. nat. Belgique, no. 81.

MOORE R. 1959. Treatise on Invertebrate Paleontology. Part O. Arthropoda 1. — Geol. Soc. Amer. and Univ. Kansas Press.

MURCHISON R. I. 1839. The Silurian system, founded on Geological Researches in ... Part II. London.

NORTHROP S. A. 1939. Palaeontology and stratigraphy of the Silurian rocks of the Port Daniel-Black Cape region, Gaspé. — Geol. Soc. Amer. Sp. Papers, no. 21.

OEHLERT M. D. 1881. Documents pour servir à l'étude des faunes dévoniennes dans l'ouest de la France. — Mém. Soc. Géol. France, III série, t. II.

Osnovy paleontologii. T. — Mšanki, brachiopody, foronidy. T. — Molljuski, pancirnye, dvustvorčatye, lopatonogie. T. — Členistonogie-trilobitoobraznye i rakoobraznye. 1960. Moskva.

PAWŁOWSKA K. 1961. W sprawie wieku warstw bostowskich w związku z problemem granicy pomiędzy sylurem i dewonem w Górach Świętokrzyskich (On the age of the Bostów beds, in connection with the boundary problem between Silurian and Devonian in the Święty Krzyż Mountains). — Kwartalnik Geol., 3. Warszawa.

PFAB L. 1934. Revision der Taxodonta des Böhmischen Silurs. — Palaeontographica, Bd. LXXX, Abt. A. Stuttgart.

PIVETEAU J. 1952. Traité de Paléontologie. Paris.

PROUTY W. F., SWARTZ C. K. et al. 1923. Systematic paleontology of Silurian deposits. — Maryland Geol. Surv. Baltimore.

REED F. R. C. 1927. Palaeontological notes on the Silurian inlier of Woolhope. — Quart. J., vol. 83, part 3, no. 331.

RICHTER R. & E. 1954. Die Trilobiten des Ebbe-Sattels und zu vergleichende Arten (Ordovizium, Gotlandium-Devon). — Abh. Senck. Nat. Ges., 488. Frankfurt.

ROLFE W. D. I. 1962a. The cuticle of some Middle Silurian ceratiocaridid Crustacea from Lanarkshire, Scotland. — Paleont., vol. 5.

— 1962b. Grosser morphology of the Scottish Silurian phyllocarid Crustacean Ceratiocaris papilio Salter *in* Murchison. — J. Paleont., vol. 36, no. 5.

RUEDEMANN R. 1934. Paleozoic plankton of North America. — Geol. Soc. Amer., Mem. 2.

RUPERT T. J. & WOODWARD H. 1892. A monograph of the British Palaeozoic Phyllopoda (Phyllocarida, Packard). Part II. London.

RUŽIČKA B. 1949a. Pteriidae Thiele českeho siluru a devonu (Lamellibranchiata). — Přirodov. Sborn. Ostr. Kraje, roč. 10, č. 3.

— 1949b. Pterineidae Dall du Silurien et du Dévonien tchèques (Lamellibranchiata). — Rozpr. II Třídy Ceske Akad., no. 13.

— 1950. Leiopteriidae Maillieux českeho siluru a devonu — Lamellibranchiata (Leiopteriidae Maillieux of the Siluro-Devonian of Bohemia — Lamellibranchiata). — Sborn. Stat. Geol. Úst. ČSR, sv. XVII — Odd. paleont. Praha.

RUŽIČKA B. & PRANTL F. 1957. O nedokonale znamych „aviculoidnich" mlžich českeho siluru a devonu (Some imperfecty known „aviculoid" Pelecypoda from the Silurian and Devonian of Bohemia). — Sborn. Nar. Mus., vol. XIII, B, no. 1-2. Praha.

— 1960. Genotypy nekterych Barrandovych rodu staroprvohornich mlžu — Pelecypoda (Types of some Barrande's Pelecypods — Barrandian). — Čas. Nar. Mus. Odd. Přirodov., č. 1.

RUŽIČKA B., PRANTL F. & PŘIBYL A. 1959. Some pectinoid Pelecypods from the Silurian and Devonian of Central Bohemia. — Sborn. Nar. Mus., vol. XV, B, no. 1. Praha.

SCHMIDT W. 1939. Die Grenzschichten Silur/Devon in Thüringen mit besonderer Berücksichtigung des Downton Problems. — Abh. Preuss. Geol. L.-A., N.F., H. 195.

SCHRIEL W. 1960. Zur Silur/Devon-Grenze im Unterharz. — Prager Arbeitstagung über die Stratigraphie des Silurs und des Devons (1958). Praha.

SIEMIRADZKI J. 1906. Monografia warstw paleozoicznych Podola (Monographie paléontologique des couches paléozoïques de la Podolie). — Spraw. Kom. Fizjogr. PAU, t. XXXIX. Kraków.

STOPPEL D. 1961. Geologie des südlichen Kellerwaldgebirges. — Abh. Hess. L.-A. Bodenforschung, H. 34. Wiesbaden.

STORMER L. 1935. Dictyocaris, Salter a large Crustacean from the Upper Silurian and Downtonian. — Norsk. Geol. Tidsskr., Bd. XV. Oslo.

STRUVE W. 1958. Beiträge zur Kenntnis der Phacopacea (Trilobita), 2: Acastavinae n. subfam. — Senckenberg. Leth., Bd. 39, H. 3/4.

TALENT J. A. & PHILIP G. M. 1956. Siluro-Devonian Mollusca from Marble Creek, Thomson River, Victoria (1955). — Proc. Roy. Soc. Victoria, vol. 68.

TELLER L. 1960. Wyniki wiercenia w Chełmie (sylur) (Results obtained in bore-hole Chełm — Lublin Upland). *W*: Z badań struktur podłoża Polski, t. VI (*In*: Investigations of the substratum structures of Poland, v. VI). — Biul. I.G. (Bull. Inst. Géol. Pol.) 165. Warszawa.

— 1964a. Graptolite fauna and stratigraphy of the Ludlovian deposits from the Chełm bore-hole (Eastern Poland). — Studia Geol. Pol., vol. XIII. Warszawa.

— 1964b. On the stratigraphy of beds younger than Ludlovian and the Silurian--Devonian boundary in Poland and Europe (Uwagi o stratygrafii warstw młodszych od ludlowu oraz o granicy między sylurem a dewonem w Polsce i w Europie). — Acta Geol. Pol., vol. XIV/2. Warszawa.

TERMIER H. 1936. Études géologiques sur le Maroc Central et le Moyen Atlas Septentrional. Notes et Mém. Nr 33. T. I, II, III. — Trav. Publ. Serv. des Mines et de la Carte Géol. Rabat.

TERMIER G. & H. 1950. Paléontologie Marocaine. II. Invertébrés de l'Ère Primaire. Fasc. III, IV. — Notes et Mém., no. 78, 79. Paris.

TOMCZYKOWA E. 1958. Fauna z łupków graptolitowych syluru niecki bardzińskiej Gór Świętokrzyskich (Fauna from Silurian graptolitic shales of the Bardo basin in the Święty Krzyż Mountains). — Kwartalnik Geol., t. 2, z. 2. Warszawa.

— 1960. Vorläufiger Entwurf der Stratigraphie des oberen und mittleren Ludlows in den Świętokrzyskie Góry. — Prager Arbeitstagung über die Stratigraphie des Silurs und des Devons (1958). Praha..

— 1962. Zespoły fauny w sylurze Polski (Faunal assemblages in the Silurian of Poland). — Biul. I.G. (Bull. Inst. Géol. Pol.) 174. Warszawa.

TOMCZYK H. & E. 1962. Das Problem der Silur/Devon-Grenze in Polen. 2. Intern. Arbeitstagung über die Silur/Devon-Grenze ... Bon-Bruxelles 1960.

UBAGHS G. 1958. Recherches sur les Crinoïdes Camerata du Silurien de Gotland (Suède). Partie III: Melocrinidae. — Arkiv för Zoologi, Bd. 11, No. 16. Stockholm.

VENJUKOV P. N. 1899. Fauna silurijskich otłoženij Podolskoj Gubernii (Die Fauna der silurischen Ablagerungen des Gouvernements Podolien). Sanktpeterburg.

WOLFART R. 1961. Stratigraphie und Fauna des älteren Paläozoikums (Silur, Devon) in Paraquay. — Geol. Jb., Bd. 78. Hannover.

WOODWARD H. 1866-1878. A monograph of British fossil Crustacea. Part I — 1866, part IV — 1872, part V — 1878.

K. KOREJWO i L. TELLER

FAUNA NIEGRAPTOLITOWA GÓRNEGO SYLURU Z WIERCENIA CHEŁM (WSCHODNIA POLSKA)

STRESZCZENIE: Wyróżniono górnosylurskie zespoły faunistyczne i podjęto próbę powiązania ich z poziomami graptolitowymi. Opisano 45 form, należących do 19 rodzin, 21 rodzajów, 5 podrodzajów, w tym 9 nowych gatunków małżów. Fauna ta wykazuje bardzo duże podobieństwo do równowiekowej fauny z Barrandienu Czech. Opracowanie fauny niegraptolitowej pozwoliło na dokładniejsze sprecyzowanie granic między niektórymi poziomami graptolitowymi, ustalonymi uprzednio w tym wierceniu.

Tematem pracy jest opracowanie górnosylurskiej fauny niegraptolitowej z wiercenia Chełm z głębokości 1207,7–1611,7 m.

W utworach syluru odwierconych w Chełmie występują bardzo liczne graptolity, które umożliwiły szczegółowe opracowanie stratygraficzne i ustalenie kilku nowych poziomów graptolitowych górnego ludlowu (Teller 1960, 1964a).

W osadach tych istnieje także liczna fauna niegraptolitowa, wśród której dominują małże. Współwystępowanie dwóch tak odmiennych grup zwierzęcych stwarza warunki do podjęcia próby wydzielenia przewodnich form małżów bądź ich zespołów i powiązania tychże z poziomami graptolitowymi. W wyniku szczegółowego opracowania opisano 45 form, należących do 19 rodzin, 21 rodzajów, 5 podrodzajów, w tym 9 nowych gatunków małżów. Z uwagi na fakt iż większość opisanych form jest analogiczna do występujących w równowiekowych osadach syluru niecki Barrandienu, porównano je, celem uniknięcia większych pomyłek, z oryginałami Barranda, znajdującymi się w Muzeum w Pradze.

Zespoły fauny charakterystyczne dla poszczególnych poziomów graptolitowych i zasięg pionowy poszczególnych gatunków w utworach górnego syluru w Chełmie przedstawione są na tablicy I.

Opisana fauna pochodzi tylko z jednego wiercenia, stąd analiza pionowego zasięgu poszczególnych gatunków małżów ma charakter tymczasowy i potwierdzona może być w wyniku opracowania dalszych równowiekowych materiałów faunistycznych z innych wierceń, bądź też z odsłonięć.

Opracowanie górnosylurskich małżów z wiercenia w Chełmie ułatwiło sprecyzowanie granicy pomiędzy niektórymi poziomami graptolitowymi, ustalonymi uprzednio przez L. Tellera (1960, 1964a) w tym wierceniu. Autor ten, z uwagi na brak graptolitów w niektórych interwałach odwierconej serii, nie mógł dokładnie ustalić granic między poziomami *Pristiograptus samsonowiczi* i *Monograptus boučeki*, *M. perneri* i *Pristiograptus admirabilis* oraz *P. transgrediens* i *Monograptus angustidens*.

Biorąc pod uwagę pojawienie się nowych gatunków małżów, których zasięg pionowy ogranicza się tylko do danego poziomu (tabl. I), autorzy niniejszej pracy przyjęli, że granicę pomiędzy poziomem *Pristiograptus samsonowiczi* a *Monograptus boučeki* należy umieścić na głębokości 1452,0 m (pojawienie się *Lunulicardium undulatum*), między poziomem *Monograptus perneri* a *Pristiograptus admirabilis* na głębokości 1416,0 m (pojawienie się *Dualina polonica*). Granicę między poziomem *Pristiograptus transgrediens* a *Monograptus angustidens* ustalono na głębokości 1257,8 m — tj. w spągu 0,8 m wkładki wapiennej z bardzo licznymi ortocerakonami; wkładka ta jest niewątpliwie stratygraficznym odpowiednikiem ławicy ortocerasowej, zaczynającej poziom *M. angustidens* w Barrandienie (Horny 1962). W wierceniu w Chełmie bezpośrednio nad tą wkładką wapienną pojawiają się: *Dualina*

convexa, *Cypricardinia* cf. *minuscula*, *Parallelodon „a"*, *Pterochaenia* (*Pterochaenia*) *tenuis* i *Mytilarca lata*.

W trakcie preparowania fauny małżów na ułamku rdzenia z głębokości 1209,0-1209,2 m znaleziono trzy fragmenty rabdozomów, należących do gatunku *Monograptus uniformis*. Tym samym więc stwierdzono istnienie jeszcze młodszego stratygraficznie graptolita, określającego samodzielny poziom.

Granicę między poziomem *M. angustidens* a *M. uniformis* ustalono na głębokości 1211,8 m, gdzie pojawiają się nowe gatunki małżów takich jak *Cleidophorus unisulcus* i *Cypricardinia* cf. *longiuscula*.

Nowo wyodrębniony i jednocześnie najmłodszy poziom stwierdzony w Chełmie charakteryzuje się ponadto obecnością trylobita *Acastella* cf. *tiro* R. & E. Richter, formy przewodniej dla warstw z Hülnghäuser z Nadrenii (R. & E. Richter 1954), jak również dla warstw bostowskich w Górach Świętokrzyskich (E. & H. Tomczyk 1962).

Występowanie *Acastella* cf. *tiro* z *Monograptus uniformis*, stwierdzone po raz pierwszy w Polsce w wierceniu w Chełmie, posiada bardzo doniosłe znaczenie dla stratygrafii syluru w ogóle. Warstwy z *Acastella tiro* zaliczane są dotychczas do dolnego żedynu. Wobec faktu stwierdzonego współwystępowania w Chełmie obu tych form (na jednej płaszczyźnie rdzenia, por. pl. XXI, fig. 3 a-c) należy przyjąć, że warstwy z *A. tiro* reprezentują jeszcze sylur, a nie dolny dewon. Szczegółowo omówione jest to zagadnienie w pracy L. Tellera (1964b).

Pracownia Stratygrafii
Zakładu Nauk Geologicznych PAN
Warszawa 22, Al. Żwirki i Wigury 6
Warszawa, w sierpniu 1963 r.

CONTENTS

DESCRIPTION OF PLATES I-XXVI

OBJAŚNIENIA DO PLANSZ I-XXVI

PL. I

Fig. 1 a, b *Conularia* sp.

1 a — positive, 1 b — negative; depth 1259.0-1259.1 m. × 3
1 a — pozytyw, 1 b — negatyw; głębokość 1259.0-1259,1 m × 3

Fig. 2 *Hederella* sp.

2 — fragment of colony; depth 1377.7-1378.0 m. × 6
fragment kolonii; głębokość 1377,7-1378,0 m × 6

PL. II

Fig. 1 *Scyphocrinus* sp.

1 — fragments of arms; depth 1533.6-1533.8 m. × 1.5
fragmenty ramion; głębokość 1533,6-1533,8 m × 1,5

Fig. 2-3 *Lingula* sp.

2 — depth 1288.9-1289.1 m. × 8
głębokość 1288,9-1289,1 m × 8
3 — depth 1209.2-1209.5 m. × 5
głębokość 1209,2-1209,5 m × 5

Fig. 4 *Orbiculoidea* sp.

4 — negative; depth 1241.2-1241.4 m. × 6
negatyw; głębokość 1241,2-1241,4 m × 6

PL. III

Fig. 1-3 *Cleidophorus unisulcus* nov. sp.

1 — right valve (holotype); depth 1208.6-1208.8 m. × 5
skorupka prawa (holotyp); głębokość 1208,6-1208,8 m × 5
2 — right valve; depth 1209.3-1209.5 m. × 5
skorupka prawa; głębokość 1209,3-1209,5 m × 5
3 — left valve; depth 1210.2-1210.4 m. × 5
skorupka lewa; głębokość 1210,2-1210,4 m × 5

Fig. 4 *Leda* sp. *1*

4 — left valve; depth 1207.9-1208.3 m. × 5
skorupka lewa, głębokość 1207,9-1208,3 m × 5

Fig. 5 *Leda* sp. *2*

5 — left valve; depth 1265.0-1266.3 m. × 5
skorupka lewa; głębokość 1265,0-1266,3 m × 5

Fig. 6-7 *Parallelodon "a"* nov. sp.

6 — right valve; depth 1247.9-1248.4 m. × 5
skorupka prawa; głębokość 1247,9-1248,4 m × 5
7 — right valve (holotype) and left valve; depth 1248.4-1248.9 m. × 4
skorupka prawa (holotyp) i lewa; głębokość 1248,4-1248,9 m × 4

Fig. 8-10 *Parallelodon insignis* nov. sp.

8 — right valve (holotype); depth 1211.8-1212.0 m. × 5
skorupka prawa (holotyp); głębokość 1211,8-1212,0 m × 5
9 — right valve; depth 1207.9-1208.3 m. × 5
skorupka prawa; głębokość 1207,9-1208,3 m × 5
10 — left valve; depth 1224.8-1225.0 m. × 5
skorupka lewa; głębokość 1224,8-1225,0 m × 5

PL. IV

Fig. 1-2 *Leiopteria (Leiopteria) opportuna* (Barr.)

1 — left and right valve; depth 1241.6-1241.7 m. × 2
skorupka lewa i prawa; głębokość 1241,6-1241,7 m × 2
2 — right valve; depth 1208.6-1208.8 m. × 3
skorupka prawa; głębokość 1208,6-1208,8 m × 3

Fig. 3-5 *Leiopteria (Leiopteria) contraria* (Barr.)

3 — right valve; depth 1248.4-1248.9 m. × 6
skorupka prawa; głębokość 1248,4-1248,9 m × 6
4 — left valve; depth 1208.4-1208.6 m. × 6
skorupka lewa; głębokość 1208,4-1208,6 m × 6
5 — right valve; depth 1441.9-1442.1 m. × 5
skorupka prawa; głębokość 1441,9-1442,1 m × 5

Fig. 6 *Leiopteria (Leiopteria)* sp. *"a"*

6 — right valve; depth 1248.9-1249.9 m. × 5
skorupka prawa; głębokość 1248,9-1249,9 m × 5

Fig. 7-11 *Leiopteria (Actinopteria) migrans migrans* (Barr.)

7 — right valve; depth 1235.8-1235.9 m. × 5
skorupka prawa; głębokość 1235,8-1235,9 m × 5
8 — left valve; depth 1245.3-1245.4 m. × 4
skorupka lewa; głębokość 1245,3-1245,4 m × 4
9 — left valve; depth 1243.9-1244.0 m. × 5
skorupka lewa; głębokość 1243,9-1244,0 m × 5
10 — left valve; depth 1245.15-1245.3 m. × 5
skorupka lewa; głębokość 1245,15-1245,3 m × 5
11 a — left valve; depth 1235.8-1235.9 m. × 5
skorupka lewa; głębokość 1235,8-1235,9 m × 5
11 b — ditto × 3
ten sam okaz × 3

Fig. 12 *Leiopteria (Actinopteria) migrans prospera* (Barr.)

12 — left valve; depth 1426.7-1426.9 m. × 3
skorupka lewa; głębokość 1426,7-1426,9 m × 3

PL. V

Fig. 1-2 *Leiopteria (Actinopteria) migrans prospera* (Barr.)

1 — left valve (latex); depth 1224.5-1224.8 m. × 3
skorupka lewa (lateks); głębokość 1224,5-1224,8 m × 3
2 — left valve; depth 1438.6-1438.8 m. × 6
skorupka lewa; głębokość 1438,6-1438,8 m × 6

Fig. 3-7 *Leiopteria (Actinopteria) innotata* (Barr.)

3 — left valve; depth 1421.4-1421.5 m. ca. × 4
skorupka lewa; głębokość 1421,4-1421,5 m ok. × 4
4 — left valve; depth 1421.7-1421.8 m. × 4
skorupka lewa; głębokość 1421,7-1421,8 m × 4
5 — left valve; depth 1421.7-1421.8 m. × 4
skorupka lewa; głębokość 1421,7-1421,8 m × 4
6 — right valve; depth 1421.4-1421.5 m. × 3
skorupka prawa; głębokość 1421,4-1421,5 m × 3
7 — mass occurrence; depth 1421.3-1421.4 m. × 2
występowanie masowe; głębokość 1421,3-1421,4 m × 2

PL. VI

Fig. 1 *Limoptera (Limoptera)* sp.

1 — right valve; depth 1370.4-1371.8 m. × 3
skorupka prawa; głębokość 1370,4-1371,8 m × 3

Fig. 2-7 *Pterochaenia (Pterochaenia) chełmiensis* nov. sp.

2 — left valve; depth 1223.6-1223.8 m. × 3
skorupka lewa; głębokość 1223,6-1223,8 m × 3
3 — right valve; depth 1224.3-1224.5 m. × 6
skorupka prawa; głębokość 1224,3-1224,5 m × 6
4 — left valve; depth 1224.5-1224.8 m. × 13
skorupka lewa; głębokość 1224,5-1224,8 m × 13
5 — left valve (holotype); depth 1248.9-1249.9 m. × 3
skorupka lewa (holotyp); głębokość 1248,9-1249,9 m × 3
6 — left valve; depth 1222.6-1222.75 m. × 8
skorupka lewa; głębokość 1222,6-1222,75 m × 8
7 — right valve; depth 1224.8-1225.0 m. × 6
skorupka prawa; głębokość 1224,8-1225,0 m × 6

Fig. 8-12 *Pterochaenia (Pterochaenia) tenuis* nov. sp.

8 — left valve; depth 1374.6-1374.7 m. × 4
skorupka lewa; głębokość 1374,6-1374,7 m × 4
9 — left valve (holotype); depth 1223.8-1223.9 m. × 5
skorupka lewa (holotyp); głębokość 1223,8-1223,9 m × 5
10 — left valve; depth 1374.8-1374.9 m. × 4
skorupka lewa; głębokość 1374,8-1374,9 m × 4
11 — left valve; depth 1374.9-1375.1 m. × 4
skorupka lewa; głębokość 1374,9-1375,1 m × 4
12 — right valve; depth 1374.6-1374.7 m. × 5
skorupka prawa; głębokość 1374,6-1374,7 m × 5

PL. VII

Fig. 1-6 *Pterochaenia (Dvorecia) contempta* (Barr.)

1 a — left valve; depth 1373.6-1373.7 m. × 3
skorupka lewa; głębokość 1373,6-1373,7 m × 3
1 b — ditto × 1.5
ta sama skorupka × 1,5
2 — left valve; depth 1371.9-1372.0 m. × 2
skorupka lewa; głębokość 1371,9-1372,0 m × 2
3 — left valve (latex); depth 1374.7-1374.8 m. × 2.5
skorupka lewa (lateks); głębokość 1374,7-1374,8 m × 2,5
4 — left valve (latex); depth 1376.3-1376.5 m. × 2
skorupka lewa (lateks); głębokość 1376,3-1376,5 m × 2
5 — left valve; depth 1374.8-1374.9 m. × 2
skorupka lewa; głębokość 1374,8-1374,9 m × 2
6 — right valve; depth 1374.8-1374.9 m. × 3
skorupka prawa; głębokość 1374,8-1374,9 m × 3

PL. VIII

Fig. 1 *Leptodesma impar* (Barr.)

1 — left and right valve; depth 1247.9-1248.4 m. × 5
skorupka lewa i prawa; głębokość 1247,9-1248,4 m × 5

Fig. 2-5 *Mytilarca lata* nov. sp.

2 — left valve (holotype); depth 1235.7-1235.8 m. × 4
skorupka lewa (holotyp); głębokość 1235,7-1235,8 m × 4
3 — right valve; depth 1241.0-1241.1 m. × 5
skorupka prawa; głębokość 1241,0-1241,1 m × 5
4 — left valve; depth 1242.3-1242.4 m. × 6
skorupka lewa; głębokość 1242,3-1242,4 m × 6
5 — left valve; depth 1240.9-1241.0 m. × 3
skorupka lewa; głębokość 1240,9-1241,0 m × 3

Fig. 6-10 *Mytilarca procera* nov. sp.

6 — right valve (holotype); depth 1235.1-1235.2 m. × 1.5
skorupka prawa (holotyp); głębokość 1235,1-1235,2 m × 1,5
7 — right valve; depth 1235.1-1235.2 m. × 2
skorupka prawa; głębokość 1235,1-1235,2 m × 2
8 — right valve; depth 1240.9-1241.0 m × 3
skorupka prawa; głębokość 1240,9-1241,0 m × 3
9 — right valve; depth 1235.1-1235.2 m. × 1.5
skorupka prawa; głębokość 1235,1-1235,2 m × 1,5
10 — right valve; depth 1241.2-1241.4 m. × 3
skorupka prawa; głębokość 1241,2-1241,4 m × 3

PL. IX

Fig. 1-6 *Lunulicardium evolvens* Barr.

1 — left valve; depth 1387.9-1389.8 m. × 6
skorupka lewa; głębokość 1387,9-1389,8 m × 6
2 — right and left valve; depth 1390.0-1390.2 m. × 9
podwójna skorupka; głębokość 1390,0-1390,2 m × 9
3 — right valve; depth 1387.9-1389.8 m. × 6
skorupka prawa; głębokość 1387,9-1389,8 m × 6
4 — right valve; depth 1387.9-1389.8 m. × 6
skorupka prawa; głębokość 1387,9-1389,8 m × 6
5 — right valve; depth 1387.9-1389.8 m. × 6
skorupka prawa; głębokość 1387,9-1389,8 m × 6
6 — mass accumulation of juvenile forms; depth 1395.5-1395.9 m. × 2.5
masowe nagromadzenie form młodocianych; głębokość 1395,5-1395,9 × 2,5

PL. X

Fig. 1-4 *Lunulicardium evolvens* Barr.

1 — left valve; depth 1387.9-1389.8 m. × 4
skorupka lewa; głębokość 1387,9-1389,8 m × 4
2 — right valve; depth 1389.8-1390.0 m. × 5
skorupka prawa; głębokość 1389,8-1390,0 m × 5

3 — left valve; depth 1395.2-1395.5 m. × 6
skorupka lewa; głębokość 1395,2-1395,5 m × 6
4 — left valve; depth 1387.9-1389.8 m. × 6
skorupka lewa; głębokość 1387,9-1389,8 m × 6

Fig. 5-6 *Lunulicardium* cf. *eximium* Barr.

5 — right valve; depth 1439.7-1441.1 m. × 3
skorupka prawa; głębokość 1439,7-1441,1 m × 3
6 — right valve; depth 1441.5-1441.7 m. × 5
skorupka prawa; głębokość 1441,5-1441,7 m × 5

PL. XI

Fig. 1-8 *Lunulicardium undulatum* Barr.

1 — right valve; depth 1445.05-1445.2 m. × 14
skorupka prawa; głębokość 1445,05-1445,2 m × 14
2 — right valve; depth 1445.05-1445.2 m. × 8
skorupka prawa; głębokość 1445,05-1445,2 m × 8
3 — right valve; depth 1445.05-1445.2 m. × 7
skorupka prawa; głębokość 1445,05-1445,2 m × 7
4 — right and left valve; depth 1446.2-1446.4 m. × 8
podwójna skorupka; głębokość 1446,2-1446,4 m × 8
5 — right valve; depth 1438.1-1439.0 m. × 8
skorupka prawa; głębokość 1438,1-1439,0 m × 8
6 a — left valve; depth 1438.8-1439.0 m. × 8
skorupka lewa; głębokość 1438,8-1439,0 m × 8
6 b — ditto, anterior part × 8
przednia część tej samej skorupki × 8
7 — right valve; depth 1445.05-1445.2 m. × 3
skorupka prawa; głębokość 1445,05-1445,2 m × 3
8 — left valve; depth 1448.4-1448.6 m. × 3
skorupka lewa; głębokość 1448,4-1448,6 m × 3

PL. XII

Fig. 1-3 *Pterinopecten (Pterinopecten) cybele* (Barr.)

1 — right valve; depth 1293.3-1293.8 m. × 2
skorupka prawa; głębokość 1293,3-1293,8 m × 2
2 — right valve; depth 1365.8-1366.95 m. × 2
skorupka prawa; głębokość 1365,8-1366,95 m × 2
3 — right valve (negative); depth 1295.4-1295.9 m. × 2
skorupka prawa (negatyw); głębokość 1295,4-1295,9 m × 2

Fig. 4-5 *Lunulicardium undulatum* Barr.

4 — right valve; depth 1439.5-1439.7 m. × 3
skorupka prawa; głębokość 1439,5-1439,7 m × 3
5 — left valve; depth 1444.85-1445.05 m. × 3
skorupka lewa; głębokość 1444,85-1445,05 m × 3

Fig. 6 *Aviculopecten* sp.

6 — right valve; depth 1394.5-1395.2 m. × 3
skorupka prawa; głębokość 1394,5-1395,2 m × 3

Fig. 7-9 *Modiolopsis* cf. *flexa* Barr.

7 — left valve; depth 1207.9-1208.3 m. × 5
skorupka lewa; głębokość 1207,9-1208,3 m × 5
8 — left valve; depth 1247.9-1248.4 m. × 7
skorupka lewa; głębokość 1247,9-1248,4 m × 7
9 — left and right valve; depth 1252.9 m. × 4
podwójna skorupka; głębokość 1252,9 m × 4

PL. XIII

Fig. 1 *Astarte* cf. *primula* Barr.

1 — right valve; depth 1295.4-1295.9 m. × 3
skorupka prawa; głębokość 1295,4-1295,9 m × 3

Fig. 2 *Praecardium adolescens* Barr.

2 — right valve; depth 1382.6-1382.7 m. × 3
skorupka prawa; głębokość 1382,6-1382,7 m × 3

Fig. 3 *Cypricardinia* cf. *longiuscula* Barr.

3 — right and left valve; depth 1208.6-1208.8 m. × 5
podwójna skorupka; głębokość 1208,6-1208,8 m × 5

Fig. 4-5 *Cypricardinia* cf. *minuscula* Barr.

4 — right and left valve; depth 1223.6-1223.8 m. × 3
podwójna skorupka; głębokość 1223,6-1223,8 m × 3
5 — right valve; depth 1249.9-1250.5 m. × 5
skorupka prawa; głębokość 1249,9-1250,5 m × 5

Fig. 6 *Praecardium* cf. *numa* Barr.

6 — right valve; depth 1380.2-1380.4 m. × 7
skorupka prawa; głębokość 1380,2-1380,4 m × 7

PL. XIV

Fig. 1-5 *Cardiola bohemica* Barr.

1 a — depth 1294.15-1294.25 m. × 2
głębokość 1294,15-1294,25 m × 2
1 b — ditto (latex)
to samo (lateks)
2 — depth 1436.5-1436.7 m. × 2
głębokość 1436,5-1436,7 m × 2
3 — depth 1514.7-1515.0 m. × 3
głębokość 1514,7-1515,0 m × 3
4 — depth 1295.9-1296.45 m. × 3
głębokość 1295,9-1296,45 m × 3
5 — depth 1294.1-1294.15 m. × 2
głębokość 1294,1-1294,15 m × 2

PL. XV

Fig. 1-2 *Cardiola fluctuans* Barr.

1 b — depth 1567.5-1567.6 m. × 5
głębokość 1567,5-1567,6 m × 5

1 a — ditto — side view × 5
to samo — widok z boku × 5
2 a — depth 1288.7-1288.9 m. × 4
głębokość 1288,7-1288,9 m × 4
2 b — ditto — side view × 4
to samo — widok z boku × 4

Fig. 3-4 *Cardiola insolita* Barr.

3 — depth 1433.1-1433.3 m. × 5
głębokość 1433,1-1433,3 m × 5
4 — right and left valve; depth 1445.05-1445.2 m. × 5
podwójna skorupka; głębokość 1445,05-1445.2 m × 5

Fig. 5 *Cardiola* cf. *stellaris* Barr.

5 — depth 1251.5-1251.9 m. × 5
głębokość 1251,5-1251,9 m × 5

PL. XVI

Fig. 1-3 *Cardiola pisum* Barr.

1 — depth 1438.4-1438.6 m. × 8
głębokość 1438,4-1438,6 m × 8
2 — depth 1223.9-1224.1 m. × 18
głębokość 1223,9-1224,1 m × 18
3 — depth 1252.9 m. × 8
głębokość 1252,9 m × 8

Fig. 4-5 *Dualina* cf. *excisa* Barr.

4 — depth 1382.1 m. × 3
głębokość 1382,1 m × 3
5 — depth 1380.1-1380.4 m. × 1.5
głębokość 1380,1-1380,4 m × 1,5

Fig. 6 *Dualina* cf. *robusta* Barr.

6 — (latex); depth 1386.8-1387.6 m. × 2
(lateks); głębokość 1386,8-1387,6 m × 2

Fig. 7-8 *Dualina* cf. *annulosa* Barr.

7 — depth 1378.7-1379.0 m. × 15
głębokość 1378,7-1379,0 m × 15
8 — depth 1378.7-1379.0 m. × 15
głębokość 1378,7-1379,0 m × 15

PL. XVII

Fig. 1-4 *Dualina* cf. *consors* Barr.

1 — depth 1384.7-1384.8 m. × 2
głębokość 1384,7-1384,8 m × 2
2 — depth 1436.7-1436.9 m. × 2
głębokość 1436,7-1436,9 m × 2
3 — depth 1376.7-1376.9 m. × 3
głębokość 1376,7-1376,9 m × 3

4 — depth 1442.1-1442.5 m. × 3
głębokość 1442,1-1442,5 m × 3

Fig. 5-7 *Dualina* cf. *selecta* Barr.

5 — depth 1375.1-1375.4 m. × 5.5
głębokość 1375,1-1375,4 m × 5,5
6 — depth 1373.9-1374.0 m. × 5
głębokość 1373,9-1374,0 m × 5
7 — depth 1379.3-1379.4 m. × 5
głębokość 1379,3-1379,4 m × 5

PL. XVIII

Fig. 1-4 *Dualina polonica* nov. sp.

1 — depth 1407.1-1408.5 m. × 5
głębokość 1407,1-1408,5 m × 5
2 — depth 1407.1-1408.5 m. (holotype) × 5
głębokość 1407,1-1408,5 (holotyp) × 5
3 — depth 1413.6-1413.8 m. × 5
głębokość 1413,6,-1413,8 m × 5
4 — depth 1406.8-1407.1 m. × 5
głębokość 1406,8-1407,1 m × 5

Fig. 5-7 *Dualina convexa* nov. sp.

5 — depth 1241.1-1241.2 m. × 4
głębokość 1241,1-1241,2 m × 4
6 — depth 1236.4-1237.4 m. (holotype) × 4
głębokość 1236,4-1237,4 m (holotyp) × 4
7 — depth 1251.5-1251.9 m. × 4
głębokość 1251,5-1251,9 m × 4

Fig. 8 *Ceratiocaris* sp.

8 — style and fragmentary stylets of abdominal segment;
depth 1439.0-1439.5 m. × 6
sztylet główny z fragmentami sztylecików bocznych segmetu
abdominalnego; głębokość 1439,0-1439,5 m × 6

PL. XIX

Fig. 1-5 *Ceratiocaris* sp.

1 — right and left valve of the carapace; depth 1572.1-1572.3 m. × 2
skorupka prawa i lewa karapaksu; głębokość 1572,1-1572,3 m × 2
2 — hinge node at dorsal margin of right carapace valve;
depth 1572.1-1572.3 m. × 11
guzek przy brzegu dorsalnym prawej skorupki karapaksu;
głębokość 1572,1-1572,3 m × 11
3 — rostral plate of carapace; depth 1572.1-1572.3 m. × 11
płytka rostralna karapaksu; głębokość 1572,1-1572,3 m × 11
4 — toothed-gnathal lobe of the left mandible; depth 1572.3-1572.4 m. × 6
płat szczękowo-zębowy mandibuli lewej; głębokość 1572,3-1572,4 m × 6
5 — style and 2 stylets of the abdominal segment; depth 1592.15-1592.3 m. × 2

sztylet główny i 2 sztyleciki boczne segmentu abdominalnego; głębokość 1592,15-1592,3 m × 2

PL. XX

Fig. 1-2 *Ceratiocaris* sp.

1 — style of abdominal segment; depth 1439.0-1439.5 m. × 4.5
sztylet główny segmentu abdominalnego; głębokość 1439,0-1439,5 m × 4,5

2 — fragment of style, not flattened; depth 1373.9-1374.0 m. × 5
a cross section; *b* dorsal side showing alveoli where grooves between ridges 2-3 and 8-9 carry a row of spinules; *c* ventral side showing the bifurcation of ridge 5; *d* lateral side.
fragment sztyletu głównego, niespłaszczonego; głębokość 1373,9-1374,0 m × 5
a przekrój poprzeczny; *b* strona dorsalna, widoczne jamki do przyczepu spinul w rowkach między drugim a trzecim oraz ósmym i dziewiątym grzbiecikiem; *c* strona wentralna, widoczny rozdwajający się piąty grzbiecik; *d* strona boczna.

PL. XXI

Fig. 1-2 *Ceratiocaris* sp.

1 — toothed-gnathal lobe of the left mandible; depth 1444,45-1444.85 m. × 6
płat szczękowo-zębowy mandibuli lewej; głębokość 1444,45-1444,85 m × 6

2 — toothed-gnathal lobe of the right mandible; depth 1438.6-1438.8 m. × 6
płat szczękowo-zębowy mandibuli prawej; głębokość 1438,6-1438,8 m × 6

Fig. 3 *Monograptus uniformis* Přibyl i *Acastella* cf. *tiro* R. & E. Richter

a — both specimens on one bedding plane at a depth of 1209.0-1209.2 m. × 3.5
oba okazy na jednej płaszczyźnie uwarstwienia z głębokości 1209,0-1209,2 m × 3,5

b — ditto under different magnification: *M. uniformis* × 10
A. cf. *tiro* × 16
te same okazy w innym powiększeniu: *M. uniformis* × 10
A. cf. *tiro* × 16

PL. XXII

Fig. 1-4 *Acastella* cf. *tiro* R. & E. Richter

1 — cephalon; depth 1209.0-1209.2 m. × 12
cefalon; głębokość 1209,0-1209,2 m × 12

2 — glabella and eye (latex); depth 1208.6-1209.0 m. × 11
glabella i oko (lateks); głębokość 1208,6-1209,0 m × 11

3 — incomplete cephalon; depth 1208.8-1209.0 m. × 10
niekompletny cefalon; głębokość 1208,8-1209,0 m × 10

4 — axial part of thorax (negative); depth 1208.6-1209.0 m. × 6.5
część osiowa toraksu (negatyw); głębokość 1208,6-1209,0 m × 6,5

PL. XXIII

Fig. 1-3 *Acastella* cf. *tiro* R. & E. Richter

1 a — pygidium with spine; depth 1208.6-1209.0 m. × 15
pygidium z widocznym kolcem; głębokość 1208,6-1209,0 m × 15

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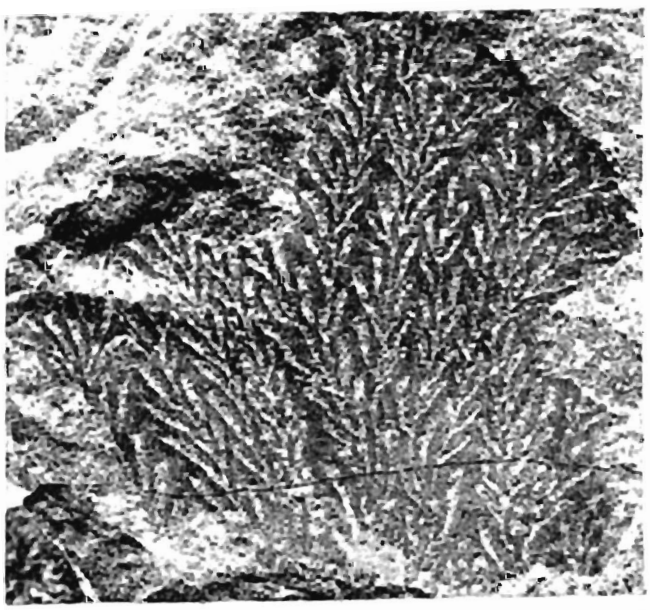

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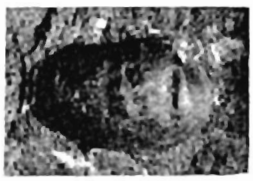

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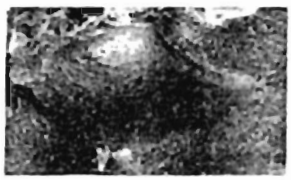

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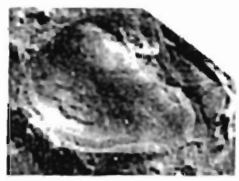

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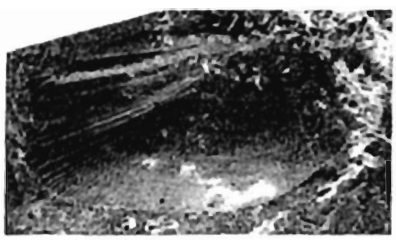

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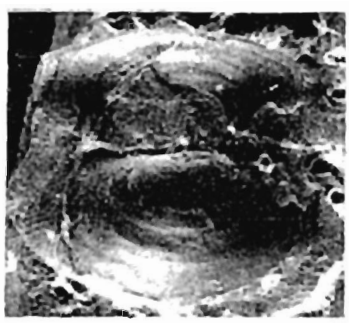

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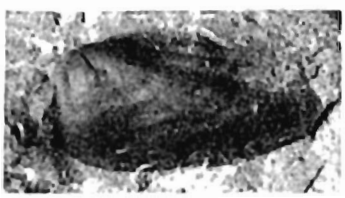

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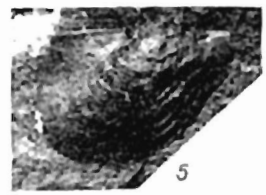
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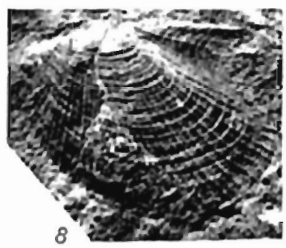
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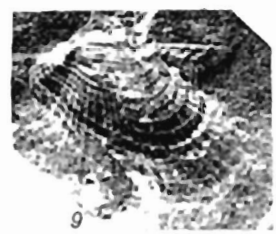
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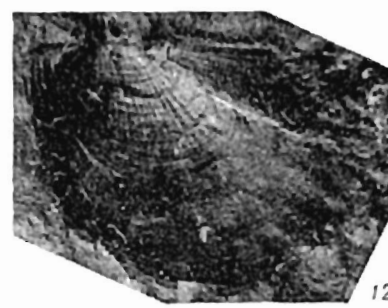
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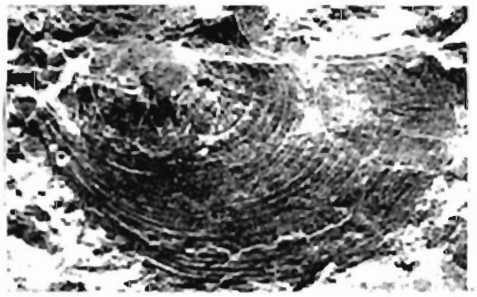

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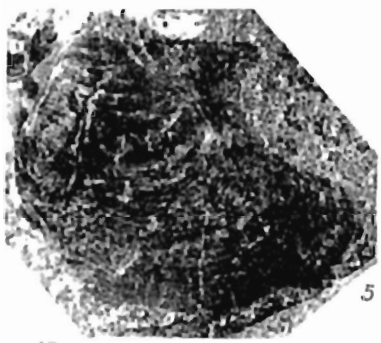

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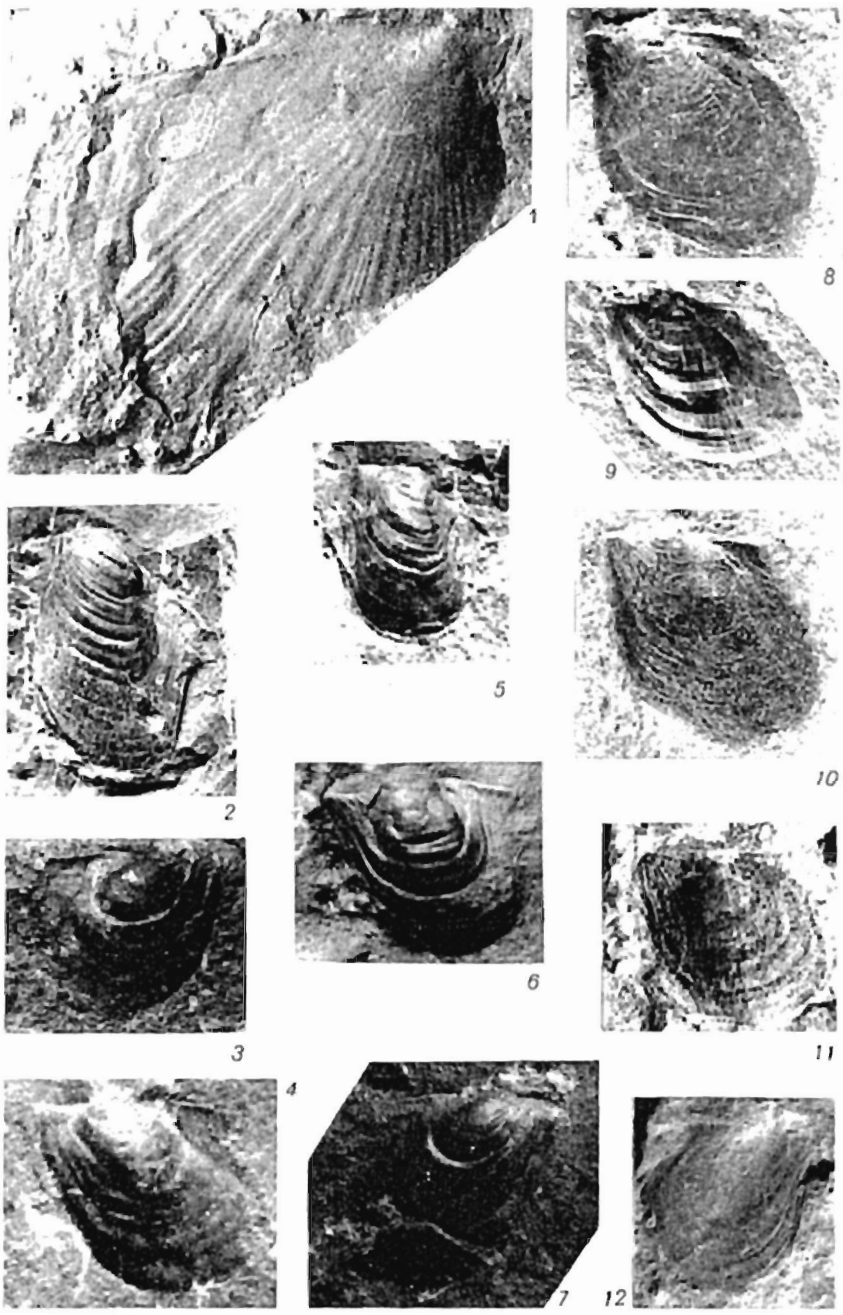
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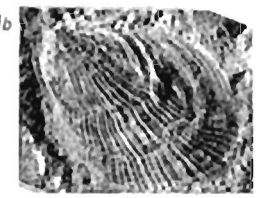

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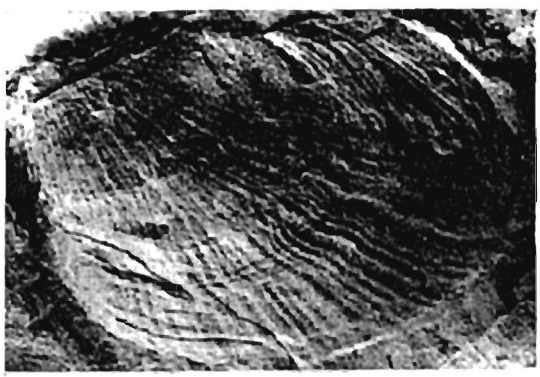

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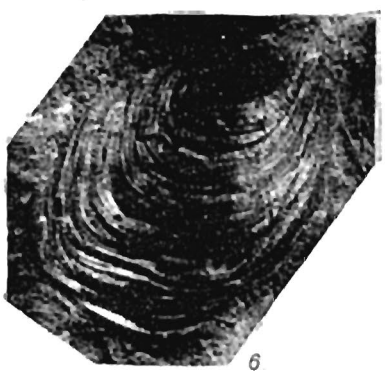

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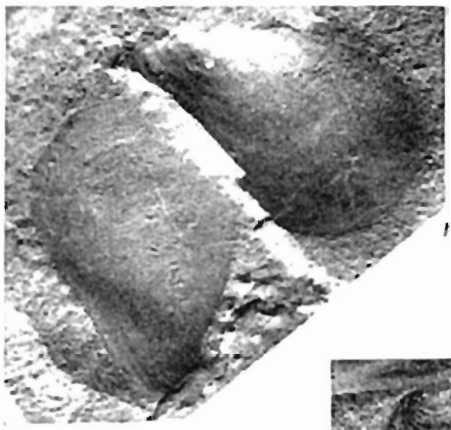
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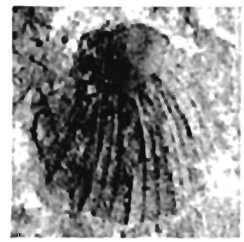

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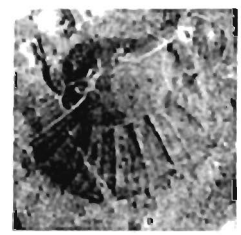

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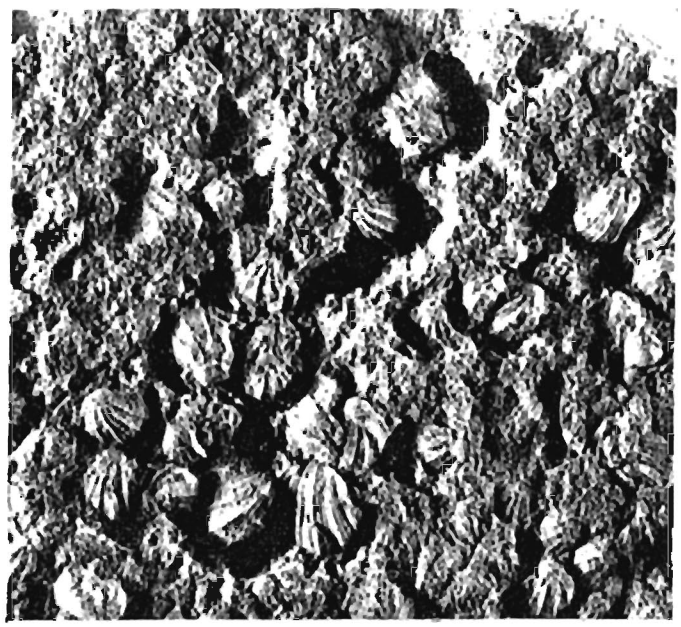

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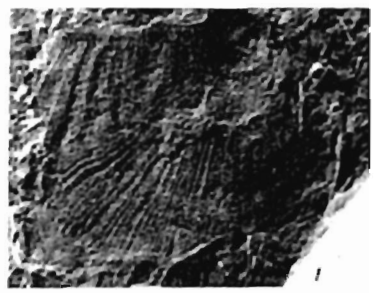
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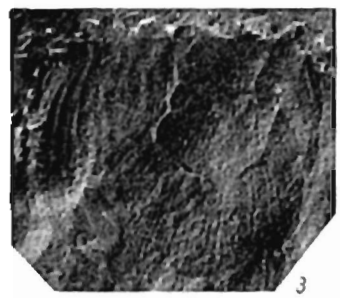
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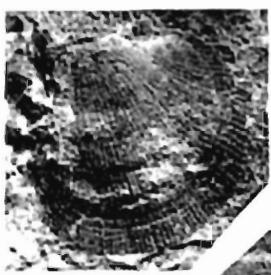
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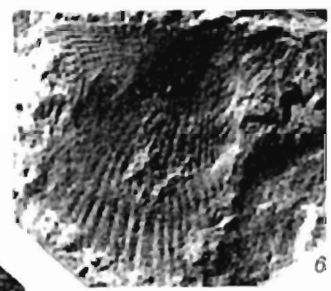
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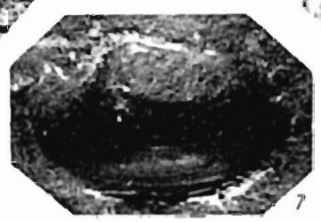
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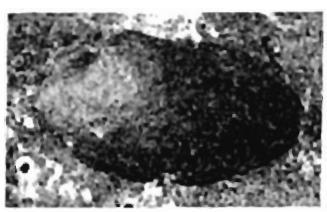
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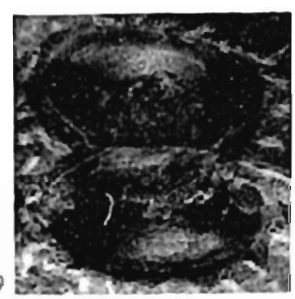
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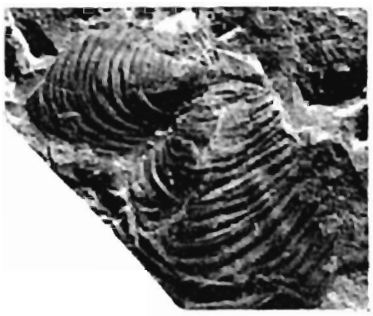

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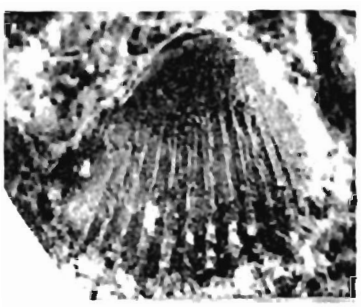

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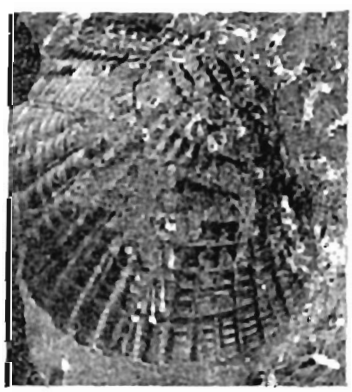

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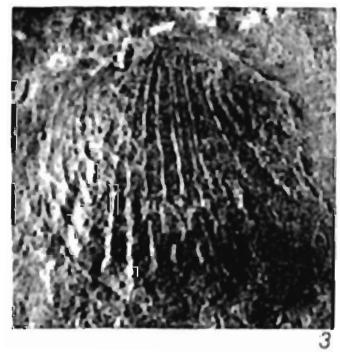

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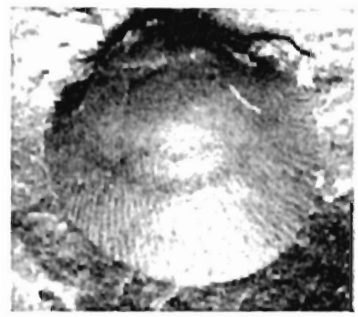
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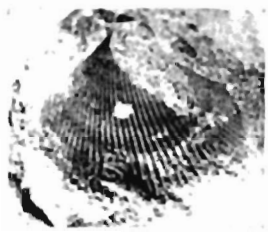
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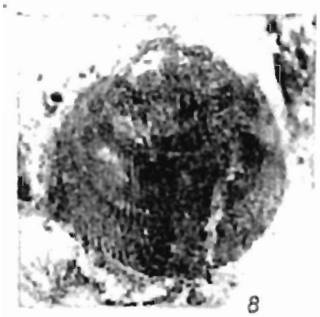
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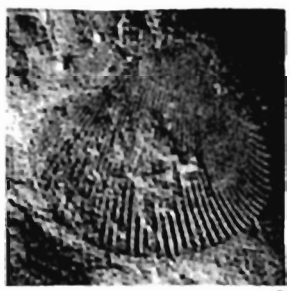

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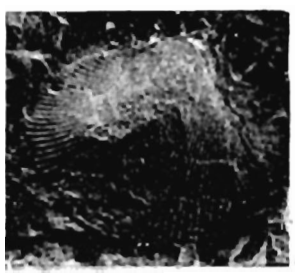

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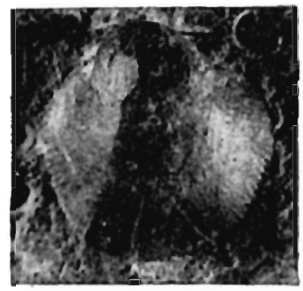

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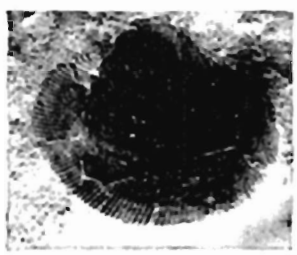

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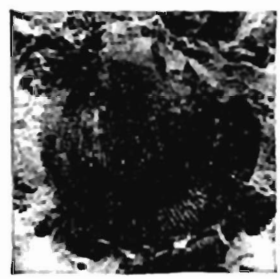

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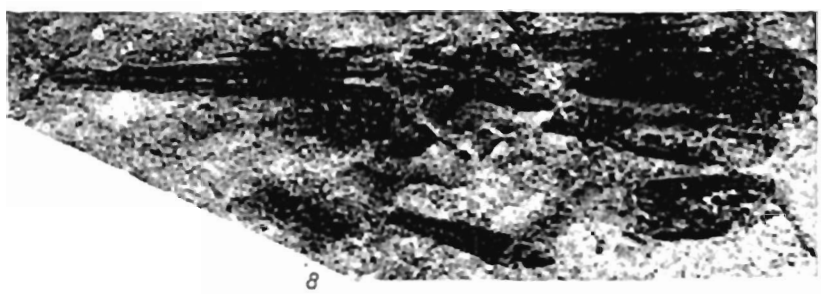

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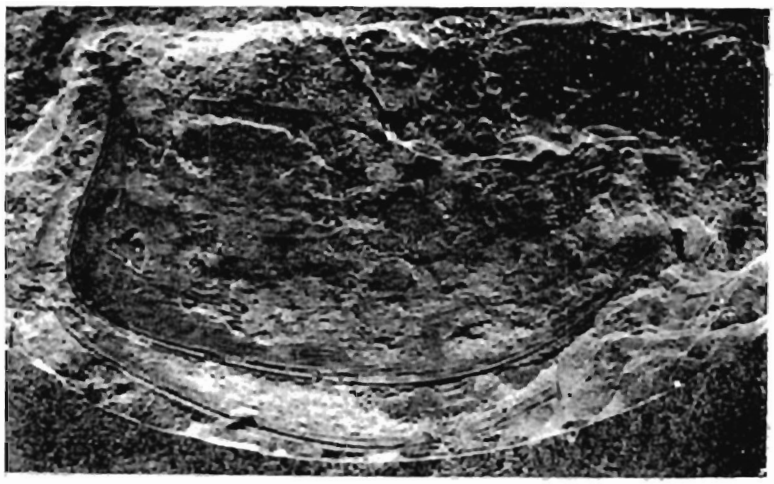

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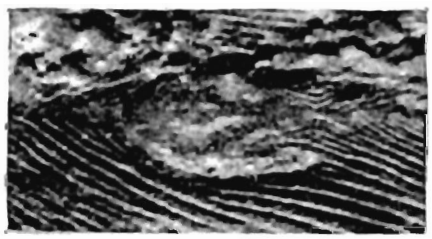

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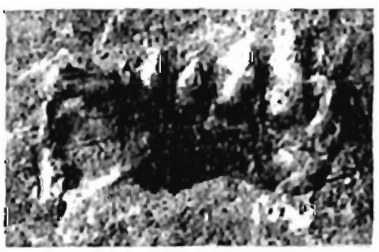

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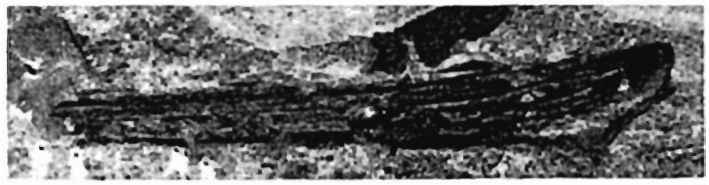

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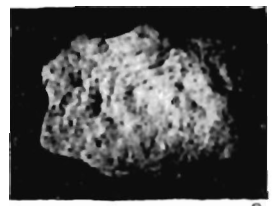

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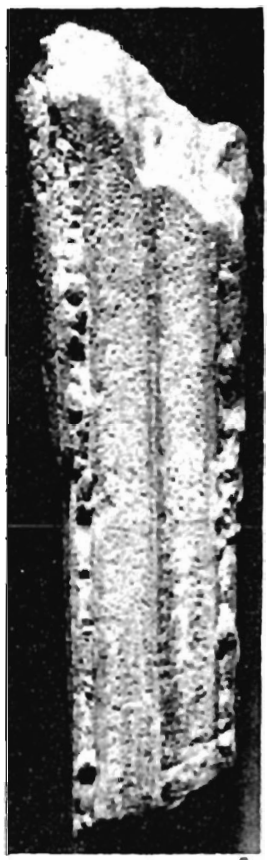
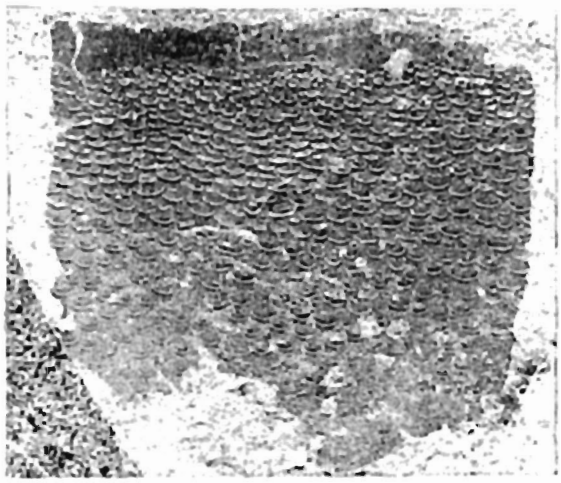


2b

2c

2d



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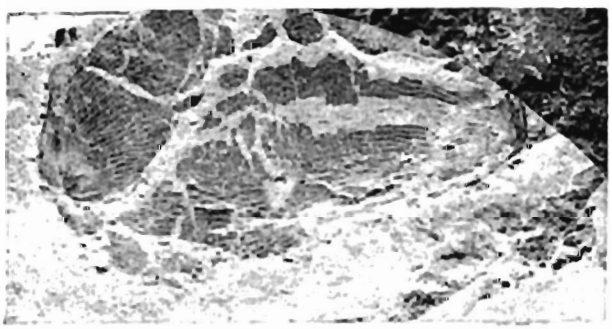

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1

3

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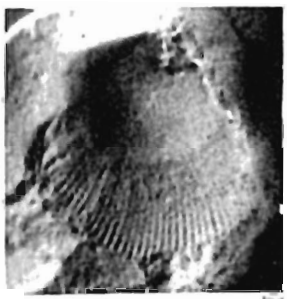

4

5a

5b

6

1 b — ditto — side view × 15
to samo — widok z boku × 15
2 — pygidium with spine; depth 1208.8-1209.0 m. × 15
pygidium z widocznym kolcem; głębokość 1208,8-1209,0 m × 15
3 — incomplete pygidium; depth 1208.8-1209.0 m. × 16
niekompletne pygidium; głębokość 1208,8-1209,0 m × 16

PL. XXIV

Fig. 1-2 *Acastella* cf. *tiro* R. & E. Richter

1 a — pygidium; depth 1209.0 m. × 10
pygidium; głębokość 1209,0 m × 10
1 b — ditto — side view × 10
to samo — widok z boku × 10
2 — pygidium; depth 1208.8-1209.0 m. × 10
pygidium; głębokość 1208,8-1209,0 m × 10

PL. XXV

Fig. 1, 3-4 *Pterygotus* sp.

1 — depth 1552.9-1553.9 m. × 3
głębokość 1552,9-1553,9 m × 3
3 — depth 1491.4-1492.6 m. × 2
głębokość 1491,4-1492,6 m × 2
4 — depth 1423.5-1423.7 m. × 5
głębokość 1423,5-1423,7 m × 5

Fig. 2 *Crustacea* gen. et sp. indet.

2 — depth 1548.3-1548.4 m. × 2
głębokość 1548,3-1548,4 m × 2

PL. XXVI

(Photographs of Barrande's specimens in the National Museum of Prague)
(Zdjęcie okazów Barranda, znajdujących się w Muzeum Narodowym w Pradze)

Fig. 1 *Lunulicardium excellens* Barr. (with prodissoconch — z widoczną prodissokonchą) × 8
Fig. 2 *Lunulicardium eximium* Barr. (with prodissoconch — z widoczną prodissokonchą) × 8
Fig. 3 *Cardiola insolita* Barr. × 5.5
Fig. 4 *Cardiola opportuna* Barr. × 10
Fig. 5a *Lunulicardium undulatum* × 6
Fig. 5b ditto — anterior margin (to samo — brzeg przedni) × 2.7
Fig. 6 *Cardiola pisum* Barr. × 6

Wszystkie fotografie wykonał R. Adamik
All photographs by R. Adamik