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Tube-dwelling polychaetes from some Upper Cretaceous sequences of Poland

ABSTRACT: The tube-dwelling polychaetes are recognized to have been the relatively very rare elements in some, otherwise much fossiliferous, intervals of the Upper Cretaceous sequences in Poland. Their occurrence was confined to shallow, or extremely shallow-water biotopes that developed either at the mid-Cretaceous transgressive onlap, some further transgressive pulses including, or at the Late Cretaceous (latest Maastrichtian) regression. A systematic account presents 17 taxa belonging to 12 genera: *Cycloserpula* PARSCH, 1956; *Protula* RISSO, 1826; *Proliserpula* REGENHARDT, 1961; *Rotularia* DEFRANCE, 1827; *Ditrupa* BERKELEY, 1835; *Pentaditrupa* REGENHARDT, 1961; *Filogranula* LANGERHANS, 1884; *Vepreculina* REGENHARDT, 1961; *Sclerostyla* MÖRCH, 1863; *Hamulus* MORTON, 1834; *Placostegus* PHILIPPI, 1844; and *Orthoconorca* JÄGER, 1983; whose only few representatives have formerly been reported in Poland. Of such the latter forms, one species, formerly referred to as *Serpula proteus* (J. DE C. SOWERBY), is herein established as new, *Rotularia* (*Praerotularia*) *marcinowskii* sp.n. Moreover, indicated is the presence of the hydroids *Protulophila gestroi* ROVERETO, 1901, living as a symbiont to some specimens of *Proliserpula ampullacea* (J. DE C. SOWERBY, 1829), *Pentaditrupa subtorquata* (MÜNSTER *in* GOLDFUSS, 1831), and *Sclerostyla macropus* (J. DE C. SOWERBY, 1829).

INTRODUCTION

The subject of the present paper is a result of successive investigations of the fossil tube-dwelling polychaetes from Poland, to continue a study of the Middle Miocene (Badenian) assemblage from the Korytnica Basin (RADWAŃSKA 1994a, b). The polychaetes of the older formations in Poland have hitherto been very poorly known, and only a few were illustrated, with one exception of those coming from the Danian deposits of the Boryszew borehole, west of Warsaw, studied by PUGACZEWSKA (1967).

In the present paper described are tube-dwelling polychaetes collected in some fossiliferous intervals of the Upper Cretaceous sequences that subjected to systematic studies undertaken in the last decades by the staff members and students of the Institute of Geology, University of Warsaw.

A greater part of the studied material was thus kindly offered to be investigated by the Author, and a relatively smaller one was collected in the field by herself.

The polychaete-bearing localities that supplied the studied material from the Upper Cretaceous sequences in Poland are briefly characterized hereafter, starting with these of the Polish Jura, the Cracow Upland including (localities Mokrzesz and Mydlniki), to be followed by those situated along the Middle Vistula Valley where an almost complete sequence of the mid-Cretaceous (locality Annopol-on-Vistula) to the topmost Cretaceous strata (locality Kazimierz-on-Vistula and its vicinity) is exposed. Finally, announced are two localities (Mielnik-on-Bug and Kornica) of chalk deposits in eastern Poland which are regarded to be erratic masses within glacial deposits of the Pleistocene Scandinavian icesheet.

THE POLYCHAETE-BEARING LOCALITIES

Mokrzesz

The section of the mid-Cretaceous transgressive sandy deposits, overstepping the Upper Jurassic substrate (massive limestones), and exposed along the roadsides at **Mokrzesz** in the Polish Jura, has been discovered, and long explored for ubiquitous fossils, by MARCINOWSKI (1970, 1974; *see also* MARCINOWSKI & RADWAŃSKI 1983, Fig. 2, *and* 1989, Fig. 7). The lithology herein is a marly greensand, over 1m thick, with a very diversified, condensed faunal content whose specimens are more or less phosphatized, and all aragonitic shells having been dissolved. The stratigraphic age is referred to as Lower – Middle to Upper Cenomanian (*see* MARCINOWSKI & RADWAŃSKI 1983, Fig. 2).

A rather poor polychaete material comprising only two species (but, one of them new) is characterized by well preserved tubes that are filled with phosphates. All the studied specimens were collected by Professor R. MARCINOWSKI, and one of them was shown formerly (MARCINOWSKI 1974, Pl. 17, Fig. 4; *re-illustrated by* MARCINOWSKI & RADWAŃSKI 1989, Pl. 3, Fig. 2).

Mydlniki

The section of the Upper Cretaceous (Senonian) marls at **Mydlniki**, near the western outskirts of the city of Cracow, has once been exposed in a huge quarry of Upper Jurassic massive limestones, now abandoned (location: quarry at the railway station Mydlniki-Limekiln). The Upper

Cretaceous transgressive sequence begins herein with the condensed Turonian limestones, truncated by an abrasion surface (*see* ALEXANDROWICZ 1954, pp. 373-374), and overlain by the Lower Campanian marls, locally with the Santonian greensand at their base (stratigraphy interpreted on data from the neighboring sections of the Cracow Upland; *see* PANOW 1934, BARCZYK 1956, WALASZCZYK 1992, pp. 90-95).

A very scanty polychaete material, comprising only one species comes from an undescribed yet, a few meters thick, sequence of white marls containing both *Actinocamax verus* MILLER and *Gonioteuthis quadrata* (BLAINVILLE), associated with the echinoid *Offaster pillula* (LAMARCK), thus indicative of the age straddling the Santonian/Campanian boundary (*see* regional interpretation *by* WALASZCZYK 1992, Fig. 29).

The studied specimens of *Placostegus* sp. were found attached to an undetermined corallite of the scleractinian coral.

Annopol-on-Vistula

The famous section of the mid-Cretaceous transgressive deposits exposed at **Annopol-on-Vistula**, overlying the Upper Jurassic substrate, and containing phosphatic lag deposits of a bygone commercial value, has long been known to contain a very rich and much diversified faunal content, both of invertebrates and vertebrates (*see* SAMSONOWICZ 1925; *and* summarizing reviews *by* MARCINOWSKI & RADWAŃSKI 1983; MARCINOWSKI & WIEDMANN 1985, 1990). The detailed paleontologic and stratigraphic studies promoted by Professor R. MARCINOWSKI have recently realized in a series of the very comprehensive faunistic reports and monographs, primarily of ammonites and inoceramids (MARCINOWSKI 1980; MARCINOWSKI & RADWAŃSKI 1983, 1989; MARCINOWSKI & WALASZCZYK 1985; WALASZCZYK 1987; MARCINOWSKI & WIEDMANN 1985, 1990).

The studied polychaete material comes from the phosphorite beds representing the Middle and lower Upper Albian (sandy phosphorites) and uppermost Albian (marly phosphorites), the detailed stratigraphic position of which is well presented in the referenced papers (*see* WALASZCZYK 1987, Fig. 2; MARCINOWSKI & RADWAŃSKI 1989, Figs 3-4).

The specifically determinable polychaetes from this section were reported only by SAMSONOWICZ (1925), who listed "*Serpula cincta* GOLDF." from the Albian, and "*Serpula gordialis* SCHL." from the Cenomanian part of the sequence, accessible at that time both in the underground mine, as well as in numerous exploring trenches and shafts.

Kazimierz-on-Vistula and its vicinity (**Bochotnica, Nasiłów**)

The sections of the topmost Cretaceous and lowest Tertiary deposits exposed in the vicinity of Kazimierz-on-Vistula in Central Poland have long been known to yield ubiquitous fossils, especially common in the beds ageing around the K/T boundary (*see* POŻARYSKI 1938; PUTZER 1942; POŻARYSKA & POŻARYSKI 1951; RADWAŃSKI 1985, 1996; ABDEL-GAWAD 1986; WIEDMANN 1988, p. 118; HANSEN & *al.* 1989; FRAAYE 1994; RADWAŃSKA & RADWAŃSKI 1994).

The locality **Kazimierz-on-Vistula** itself, as labelled in some collections, usually refers to the presently abandoned Town Quarry, situated south of the town, and exposing siliceous chalk deposits ("Opoka" facies) of low-uppermost Maastrichtian age (*see* ABDEL-GAWAD 1986, Fig. 5).

The locality **Bochotnica**, north of Kazimierz-on-Vistula, comprises a series of exposures along the Vistula escarpment in which the K/T boundary sequence is still quite well accessible (*see* PUTZER 1942; POŻARYSKA & POŻARYSKI 1951; ABDEL-GAWAD 1986, Fig. 10*A-B*).

The locality **Nasiłów**, facing locality Bochotnica just across the Vistula, exposes the same sequence in the huge Nasiłów Quarry, now abandoned (*see* ABDEL-GAWAD 1986, Fig. 6; HANSEN & *al.* 1989, Fig. 1; RADWAŃSKA & RADWAŃSKI 1994).

The studied polychaete material comes, in a part, from the Town Quarry at Kazimierz-on-Vistula and, in the majority, from the Nasiłów Quarry, from the lower part of the greensand (about 30 cm thick) overlying the hardground that truncates the uppermost Maastrichtian siliceous chalk ("Opoka" facies) and which is topped by a phosphatic residual lag just pointing to the K/T boundary (*see* HANSEN & *al.* 1989, Fig. 1; RADWAŃSKA & RADWAŃSKI 1994; RADWAŃSKI 1996, Plate 1). The polychaete-bearing greensand is thus of topmost Maastrichtian age (*see* HANSEN & *al.* 1989, RADWAŃSKI 1996), and the studied polychaetes were collected at Nasiłów either as lying loose in the sediment, or as encrusting variable shell material, especially the common belemnite guards of the species *Belemnella kazimiroviensis* (SKOŁOZDRÓWNA, 1932). Small polychaete specimens of the species *Rotularia* (*Rotularia*) *hisingeri* (LUNDGREN, 1891) were found, at Nasiłów, as accumulated in local depressions of the hardground surface. The largest specimen of *Sclerostyla macropus* (J. DE C. SOWERBY, 1829) comes (*see* Pl. 10, Fig. 9) from the bottom part of the gaizes ("Siwak" facies) overlying the residual lag, and recognized as of Lower Danian age (HANSEN & *al.* 1989, p. 11).

The polychaetes from the topmost Maastrichtian greensand of Nasiłów and Bochotnica have first been recorded by MATWIEJEWÓWNA (*in* KONGIEL & MATWIEJEWÓWNA 1937) who noted the presence of: "*Ditrupula*

cf. *cicatrica* Brünn.Niels., *Proterula* sp., *Serpentula fluctuata* Sow., *Serpentula* cf. *macropus* Sow., *Spirorbula Hisingeri* Lundgr." This list was repeated by PUTZER (1942, p. 374) who enriched it with the species "*Serpula heptagona* Hag." Of all these taxa, only two were illustrated by MATWIEJEWÓWNA (1937, Pl. 2, Figs 6-7 and 8, determined as "*Proterula* sp.", and "*Serpentula* cf. *macropus* Sow.", respectively), but very inadequate photos do not allow these forms to be revised.

Mielnik-on-Bug

The section exposed at **Mielnik-on-Bug** in eastern Poland, situated within a huge erratic mass (*see* ALEXANDROWICZ 1965), comprises a sequence typical of the white chalk with flint bands, capped by a hardground, and overlain by the grayish chalk. The age has recently been determined by OLSZEWSKA (1990) as the Lower Campanian through the lowest part of the Upper Campanian for the white chalk, and the Lower Maastrichtian for the grayish chalk, thus indicative of a remarkable gap at the hardground horizon.

The exposure in a large chalk-pit at Mielnik-on-Bug has long been famous to yield a very diversified faunal content, the most common of which are belemnites, in places quite ubiquitous. Their taxonomy has been studied detaily by OLSZEWSKA (1987, 1990), whereas their taphonomy and the biology of numerous endo- and epibionts, the polychaetes including, have subjected to separate papers by PUGACZEWSKA (1965) and RADWAŃSKI (1972). Within the whole faunal content from Mielnik-on-Bug, of particular interest were also the much variable, primarily paedomorphic, brachiopods (BITNER & PISERA 1979) and scalpellid cirripedes (COLLINS & RADWAŃSKI 1982).

The studied polychaete material comes from the white chalk, the faunal content of which is much richer than that of the grayish chalk. It was either collected in the exposure, or obtained after sieving the bulk samples of chalk. A part of the material has kindly been donated by Dr. M.A. BITNER, as coming from the sieving residues.

Kornica

The white chalk exposure at **Kornica**, some 20 km SSW of Mielnik-on-Bug, is recognized as situated within another erratic mass (*see* ALEXANDROWICZ & ŚLUSARCZYK 1963, ALEXANDROWICZ 1965, LANGNER 1990). The exposed chalk sequence, more or less coeval in age to that of Mielnik-on-Bug, characterizes by a very low frequency of fossils which have not as yet been systematically studied (*cf.* LANGNER 1990).

SYSTEMATIC ACCOUNT

The investigated polychaete material is housed at the collection of the Department of Paleontology, Faculty of Geology, University of Warsaw.

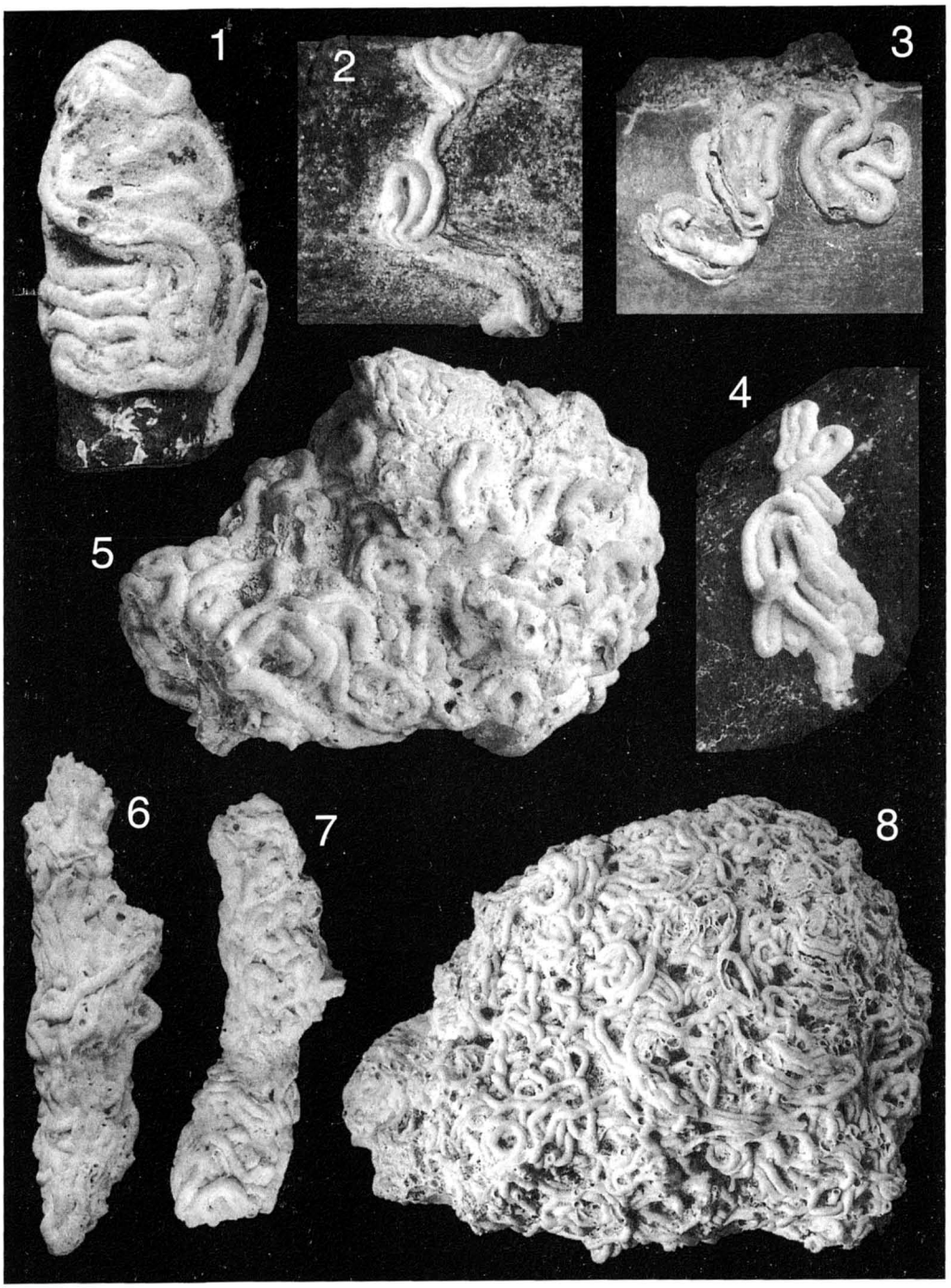
The illustrated specimens (*see* Pls 1-12) are labelled with their collection numbers, the lettered part of which contains abbreviations of the Polychaeta (P) and the Cretaceous (C), followed by the name of the localities: **A** – Annopol-on-Vistula, **B** – Bochotnica, **K** – Kazimierz-on-Vistula, **M** – Mielnik-on-Bug, **Ms** – Mokrzesz, **My** – Mydlniki, **N** – Nasiłów. The specimens numbered *560* belong to the Collection of the Natural Science Museum at Kazimierz-on-Vistula.

Class **Polychaeta** GRUBE, 1850
Order **Sedentarida** LAMARCK, 1818
Family **Serpulidae** RAFINESQUE, 1815
Subfamily **Filograninae** RIOJA, 1923

Genus *Cycloserpula* PARSCH, 1956

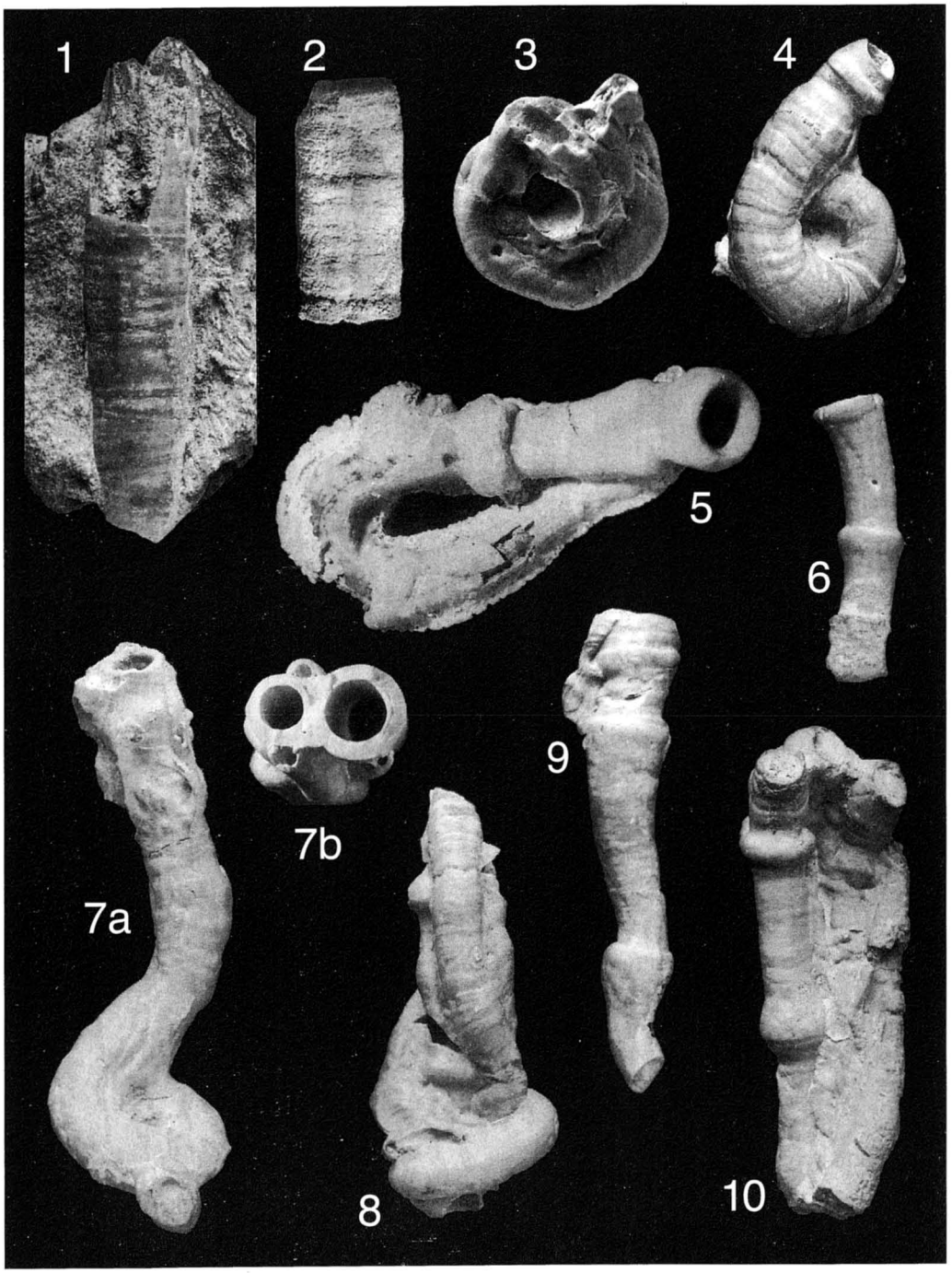
Cycloserpula gordialis (SCHLOTHEIM, 1820)
(Pl. 1, Figs 1-4)

1831. *Serpula gordialis* SCHLOTH.; A. GOLDFUSS, p. 234, Pl. 69, Fig. 8a-c.
1831. *Serpula Ilium* nobis.; A. GOLDFUSS, p. 234, Pl. 69, Fig. 10a-d.
1831. *Serpula gordialis* SCHLOTH. *Varietas serpentina*.; A. GOLDFUSS, p. 240, Pl. 71, Fig. 4.
1931. *Glomerula gordialis* v. SCHLOTH. sp.; K. BRÜNNICH NIELSEN, p. 88, Pl. 1, Figs 9-11.
1956. *Serpula* (*Cycloserpula*) *gordialis* (SCHLOTHEIM) 1820; K.O.A. PARSCH, p. 214, Pl. 20, Figs 15-16.
1961. *Glomerula gordialis* (SCHLOTHEIM, 1820); H. REGENHARDT, p. 26, Pl. 1, Fig. 2.
1961. *Glomerula scitula* n.sp.; H. REGENHARDT, p. 27, Pl. 1, Fig. 1.
1961. *Glomerula solitaria* n.sp.; H. REGENHARDT, p. 28, Pl. 9, Fig. 11.
1961. *Glomerula saucia* n.sp.; H. REGENHARDT, p. 28, Pl. 1, Fig. 3.
1961. *Protula rasilis* n.sp.; H. REGENHARDT, p. 33, Pl. 1, Fig. 7.
1961. *Omasaria funiculis* (WOLLEMANN); H. REGENHARDT, p. 45, Pl. 3, Fig. 1.
1961. *Omasaria omnivaga* n.sp.; H. REGENHARDT, p. 45, Pl. 5, Fig. 1.
1962. *Glomerula gordialis* (VON SCHLOTHEIM); B.F. HOWELL, p. *W*157, Text-fig. 97/3.
1963b. *Glomerula gordialis* v. SCHLOTH.; A.H. MÜLLER, Text-fig. 517.
1964b. *Glomerula gordialis* (v. SCHLOTHEIM); A.H. MÜLLER, p. 621, Text-figs 5-6.
1965. *Glomerula gordialis* (SCHLOTHEIM); H. NESTLER, p. 74, Pl. 4, Figs 6, 8-10.
1965. *Glomerula saucia* REGENHARDT; H. NESTLER, p. 74, Pl. 4, Fig. 11.
1965. *Glomerula solitaria* REGENHARDT; H. NESTLER, Pl. 4, Fig. 7.
1965. *Serpula* (*Cycloserpula*) *gordialis* (SCHLOTHEIM, 1820); H. PUGACZEWSKA, p. 82, Pl. 6, Fig.1a-b.
1966. *Glomerula gordialis* (v. SCHLOTHEIM); A.H. MÜLLER, p. 1060, Text-fig. 13.
1967. *Glomerula gordialis* (SCHLOTHEIM, 1820); H. PUGACZEWSKA, p. 180, Pl. 1, Figs 5-10, Pl. 2, Fig. 4 and Pl. 3, Fig. 1.
1973. *Glomerula gordialis* (SCHLOTHEIM), 1820; S. PASTERNAK, p. 9, Text-fig. 1, Pl. 1, Figs 3-5.
1973. *Glomerula solitaria* REGENHARDT, 1961; S. PASTERNAK, p. 10, Pl. 1, Figs 6-7.
?1973. *Protula rasilis* REGENHARDT, 1961; S. PASTERNAK, p. 12, Pl. 1, Fig. 9.
1975. *Glomerula gordialis* (SCHLOTHEIM, 1820); H. NESTLER, p. 64, Text-fig. 98.
1975. *Glomerula saucia* REGENHARDT, 1961; H. NESTLER, Text-fig. 99.
1979. *Glomerula gordialis* (SCHLOTHEIM, 1820); A. LOMMERZHEIM, p. 130.
1983. *Glomerula gordialis* (SCHLOTHEIM, 1820); M. JÄGER, p. 26, Pl. 2, Figs 1-18.
1987. *Glomerula gordialis* (SCHLOTHEIM, 1820); M. JÄGER, p. 40, Pl. 1, Figs 17-20.



1-4 — *Cycloserpula gordialis* (SCHLOTHEIM, 1820); **1** – Specimen No. PCA-001, **2** – No. PCN-002, **3** – No. PCA-003, **4** – No. PCM-004; all × 3

5-8 — *Cycloserpula plexus* (J. DE C. SOWERBY, 1829); **5** – Specimen No. PCM-005, **6** – No. PCM-006, **7** – No. PCM-007; all × 1.5; **8** – No. PCM-008, nat. size



1-2 — *Protula* sp.; **1** – Specimen No. PCN-009, **2** – No. PCN-10; both × 2

3-10 — *Proliserpula ampullacea* (J. DE C. SOWERBY, 1829); **3** – Specimen No. PCM-011, **4** – No. PCM-012; both nat. size; **5** – No. PCM-013, × 3; **6** – No. PCM-14, × 1.5; **7** – No. PCM-015, **8** – No. PCM-016; both nat. size; **9** – No. PCM-017, × 1.5; **10** – No. PCM-018, nat. size

MATERIAL: 6 specimens from Mielnik, 2 specimens from Annopol, 1 specimen from Nasiłów.

DESCRIPTION: Tubes gregarious, coiled very variably, spirally, meander-like, or straight with a plot; attached to the substrate or free; cross-section of the tube circular or oval; thickness of the tube wall variable; tube dimensions from 0.5 to 1mm; outer surface smooth; peristome absent.

REMARKS: The studied specimens are fully concordant with those given in the synonymy. Tubes of this species have already been reported from Poland by PUGACZEWSKA (1965, 1967) as "*Serpula* (*Cycloserpula*) *gordialis* (SCHLOTHEIM, 1820)" and "*Glomerula gordialis* (SCHLOTHEIM, 1820)". More recently, JÄGER (1993, p. 74) recognized that the genus *Glomerula* REGENHARDT, 1961, is a junior synonym of *Cycloserpula* PARSCH, 1956, and the studied species having been ascribed, so commonly, to the genus *Glomerula* REGENHARDT, 1961 (*sensu* BRÜNNICH NIELSEN 1931), should be included into the genus *Cycloserpula* PARSCH, 1956.

Cycloserpula plexus (J. DE C. SOWERBY, 1829)
(Pl. 1, Figs 5-8)

1831. *Serpula vibicata* MÜNSTER; A. GOLDFUSS, p. 240, Pl. 71, Fig. 3a-b.
1961. *Filograna congestica* n.sp.; H. REGENHARDT, p. 23, Pl. 2, Fig. 3.
1973. *Filograna* cf. *congestica* REGENHARDT, 1961; S. PASTERNAK, p. 8, Pl. 1, Fig. 2.
1983. *Glomerula plexus* (SOWERBY, 1829); M. JÄGER, p. 31, Pl. 3, Figs 1-3.

MATERIAL: 19 specimens from Mielnik.

DESCRIPTION: Gregarious, aggregated tubes, building both spherical and longitudinal tangles (*see* Pl. 1, Figs 5-8); single tubes are massive, irregularly coiled, circular in transverse section, of the diameter about 1-2mm.

REMARKS: The studied specimens are concordant with those given in the synonymy. This species has not hitherto been reported from Poland.

Genus *Protula* RISSO, 1826
Protula sp.
(Pl. 2, Figs 1-2)

MATERIAL: 2 specimens from Nasiłów.

DESCRIPTION: Tubes moderately massive (thickness of the tube wall about 0.4mm), slightly curved; transverse section circular; dimension of the tube 7.5mm; outer surface covered with delicate, transverse corrugations; peristomes absent.

REMARKS: The studied specimens, due to their dimensions, thickness of the wall and character of the outer surface, fit well into the features of the genus *Protula* RISSO, 1826. An inferior material collected justifies its recognition to the genus level only.

Subfamily **Serpulinae** MACLEAY, 1840

Genus *Proliserpula* REGENHARDT, 1961
Proliserpula ampullacea (J. DE C. SOWERBY, 1829)
(Pl. 2, Figs 3-10 and Pl. 12, Fig. 4)

1829. *Serpula ampullacea*; J. DE C. SOWERBY, p. 199, Pl. 597, Figs 1-5.
1831. *Serpula Nöggerathii* MÜNSTER; A. GOLDFUSS, p. 238, Pl. 70, Fig. 14a-c.
1931. *Serpula ampullacea* SOW. sp.; K. BRÜNNICH NIELSEN, p. 90, Pl. 1, Figs 13-16.
1961. *Parsimonia squalida* n.sp.; H. REGENHARDT, p. 40, Pl. 2, Fig. 2.
1961. *Parsimonia spoliata* n.sp.; H. REGENHARDT, p. 40, Pl. 5, Fig. 6.
1961. *Parsimonia (Proliserpula) dithyrambica* n.sp.; H. REGENHARDT, p. 51, Pl. 3, Fig. 5.
1961. *Proliserpula (Proliserpula) praepilata* n.sp.; H. REGENHARDT, p. 52, Pl. 4, Fig. 7.
1961. *Proliserpula (Proliserpula) ampullacea* (SOWERBY, 1829); H. REGENHARDT, p. 54.
1961. *Proliserpula (Parricidula) parricidula* n.sp.; H. REGENHARDT, p. 56, Pl. 4, Figs 8-9.
1961. *Proliserpula (Parricidula) ulcerosa* n.sp.; H. REGENHARDT, p. 56, Pl. 8, Fig. 8.
1961. *Cycloserpula cycloserpula* n.sp.; H. REGENHARDT, p. 60, Pl. 6, Fig. 1.
1970. *Genicularites articularis* n.g. n.sp.; A.H. MÜLLER, p. 54, Text-fig. 1a-c.
1973. *Parsimonia squalida* REGENHARDT, 1961; S. PASTERNAK, p. 15, Pl. 2, Figs 1-2.
1973. *Parsimonia spoliata* REGENHARDT, 1961; S. PASTERNAK, p. 16, Pl. 2, Fig. 3.
1973. *Proliserpula ampullacea* (SOWERBY), 1829; S. PASTERNAK, p. 25, Pl. 4, Figs 1-2.
1973. *Proliserpula nöggerathii* (MÜNSTER), 1833; S. PASTERNAK, p. 26, Pl. 4, Fig. 3.
1973. *Proliserpula dithyrambica* REGENHARDT, 1961; S. PASTERNAK, p. 26, Pl. 4, Fig. 4.
1973. *Proliserpula parricidula* REGENHARDT, 1961; S. PASTERNAK, p. 28, Pl. 4, Figs 6-7.
1973. *Cycloserpula cycloserpula* REGENHARDT, 1961; S. PASTERNAK, p. 32, Pl. 5, Fig. 1.
1983. *Proliserpula ampullacea* (SOWERBY, 1829); M. JÄGER, p. 41, Pl. 5, Figs 1-8.
1991. *Proliserpula ampullacea* (SOWERBY, 1829); M. JÄGER, p. 143, Pl. 1, Figs 2-5 and Pl. 2, Fig. 10.

MATERIAL: 70 specimens from Mielnik.

DESCRIPTION: Tubes massive, large-sized (the diameter of the tubes about 6-7mm); coiling of the tubes very variable, in the posterior part loop-like or spiral (*see* Pl. 2, Figs 3-5 and Figs 7-8), and in the anterior part straight or curved; outer surface with distinct transverse corrugations and well developed, characteristic, ring-like peristomes (*see* Pl. 2, Figs 5, 9-10).

REMARKS: The studied specimens are fully concordant with those given in the synonymy. This species has not hitherto been recorded from Poland.

Genus *Rotularia* DEFRANCE, 1827
Subgenus *Rotularia* DEFRANCE, 1827
Rotularia (Rotularia) hisingeri (LUNDGREN, 1891)
(Pl. 3, Figs 1-3 and Pl. 4, Figs 1-4)

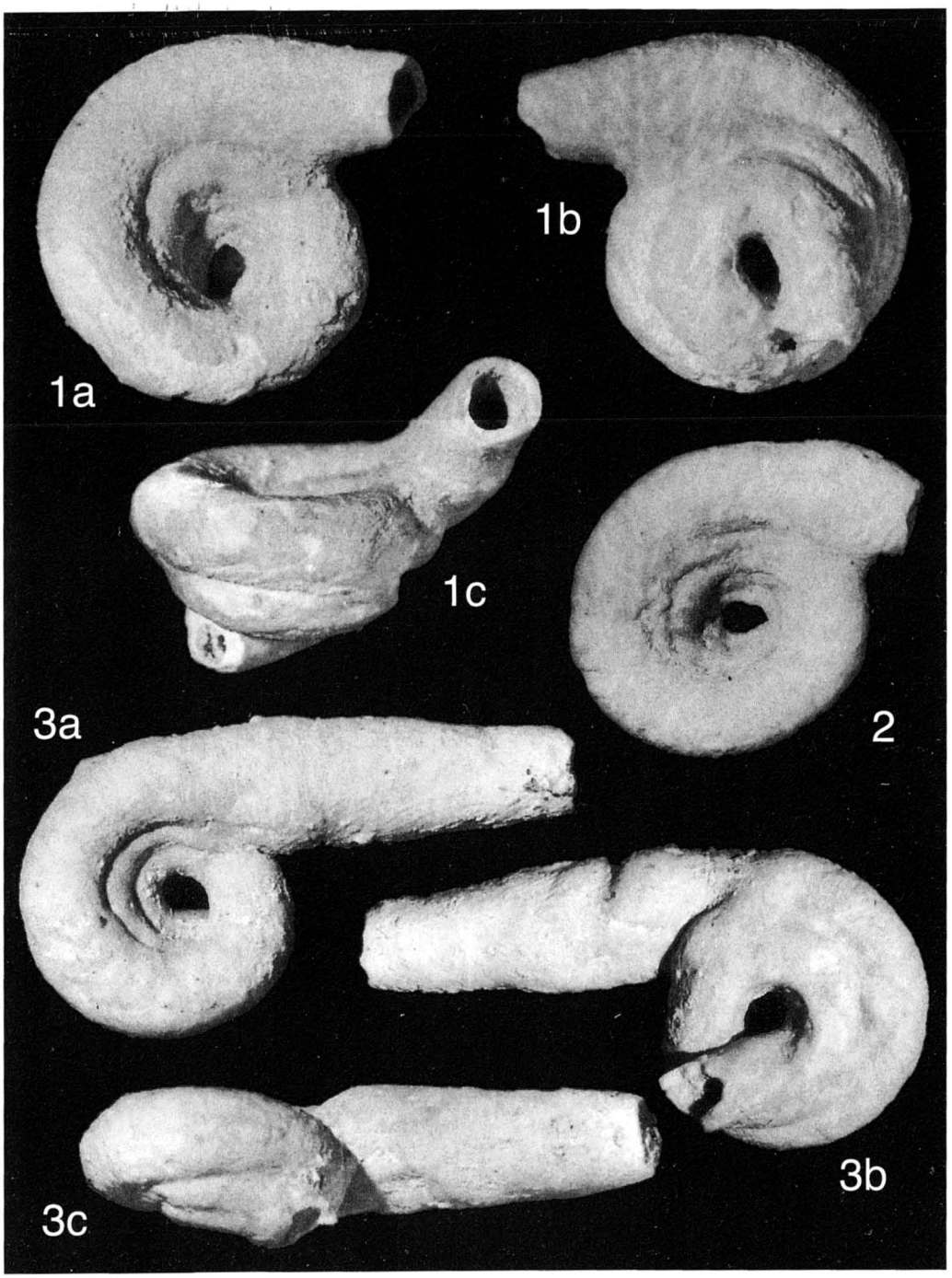
1931. *Serpula Hisingeri* LUNDGR. sp.; K. BRÜNNICH NIELSEN, p. 103, Pl. 3, Figs 1-4.
1993. *Rotularia (Rotularia) hisingeri* (LUNDGREN, 1891); M. JÄGER, p. 88, Pl. 4, Figs 14-19.

MATERIAL: 40 specimens from Nasiłów.

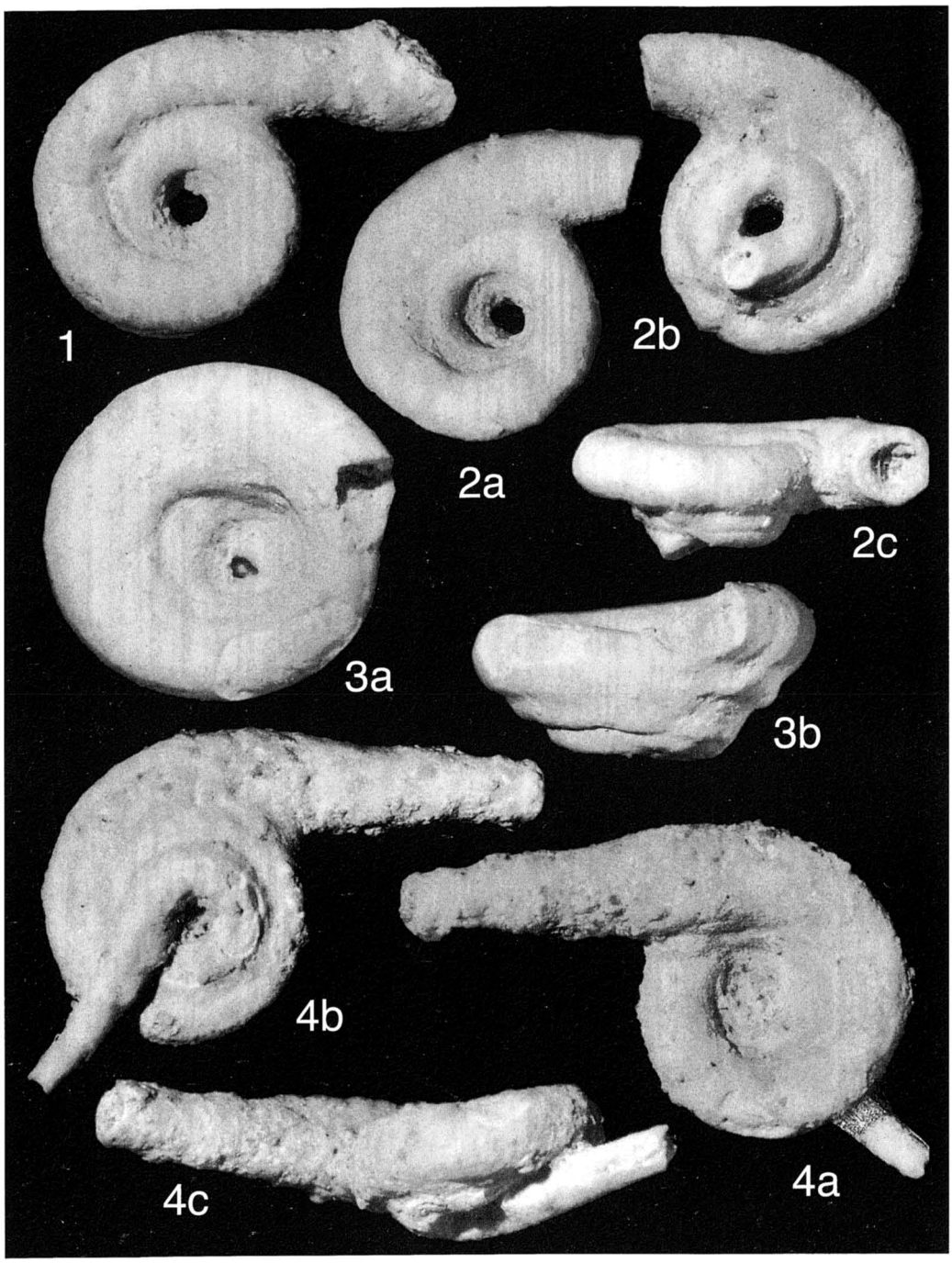
DESCRIPTION: Tubes small, coiled inverse-trochospirally, sinistral or dextral (*see* Pl. 4, Figs 2c, 3b, 4c); the spiral low and regular, the initial part of the tube straight (*see* Pl. 3, Fig. 3b and Pl. 4, Fig. 4b); the diameter of the whole spiral 3-5mm; the umbilicus wide; the turns of the spiral cemented together; the tube increasing gradually in the diameter during the growth of the spiral, where the spiral following by the straight part the tube is swollen (*see* Pl. 3, Fig. 3a-3b); the straight anterior part 3-4mm long and gradually decreasing in the diameter; outer surface without ornamentation.

REMARKS: The studied specimens are fully concordant with those given in the synonymy. This species has not hitherto been reported from Poland.

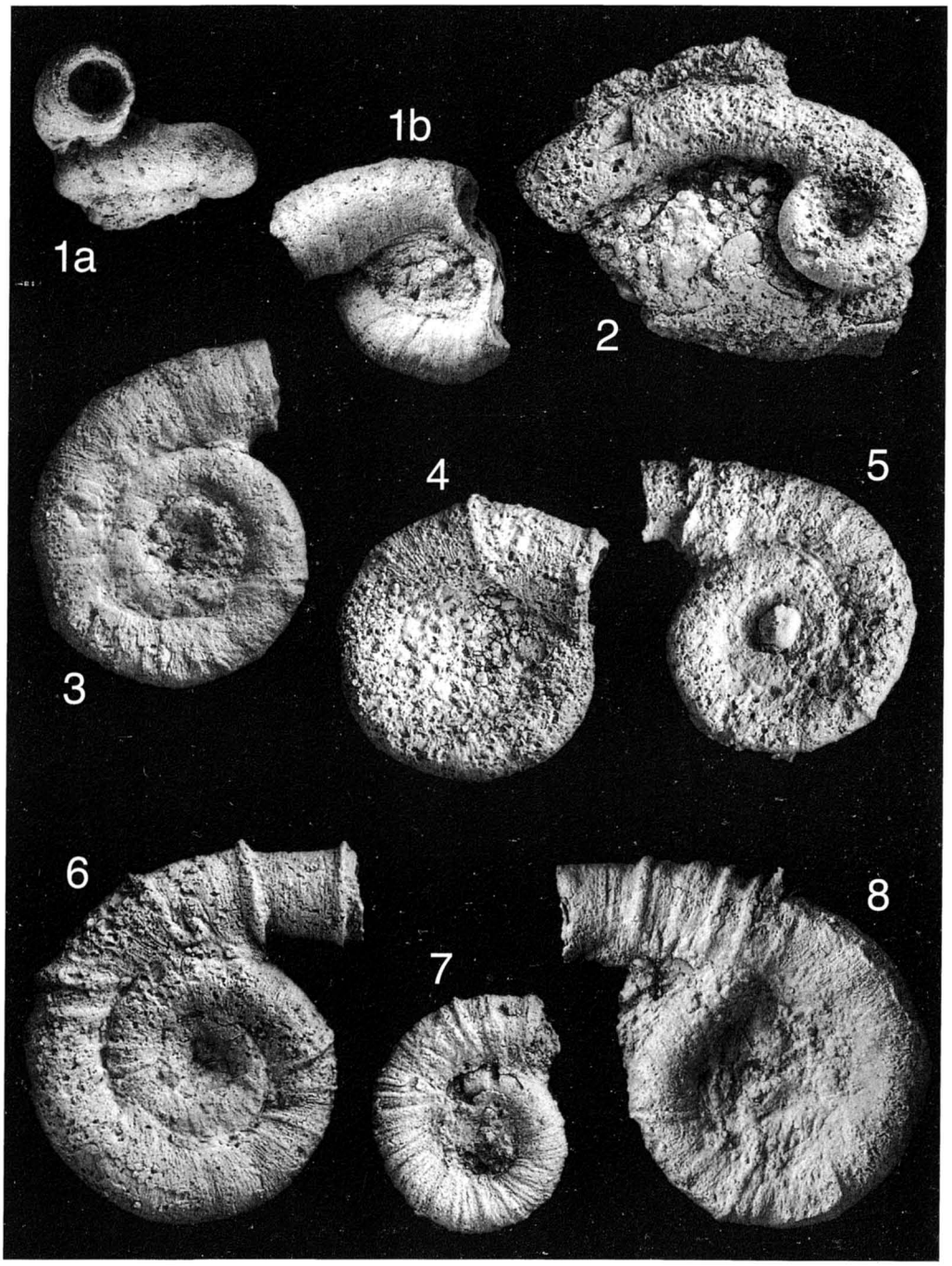
Subgenus *Praerotularia* LOMMERZHEIM, 1979
Rotularia (Praerotularia) marcinowskii sp.n.
(Pl. 5, Figs 3-8 and Pl. 6, Figs 1-2)



1-3 — *Rotularia* (*Rotularia*) *hisingeri* (LUNDGREN, 1891); **1a**, **2**, **3a** – top views of the tube; **1b**, **3b** – bottom views of the tube; **1c**, **3c** – lateral views of the tube; **1** – Specimen No. PCN-019, **2** – No. PCN-020, **3** – No. PCN-021; all × 10

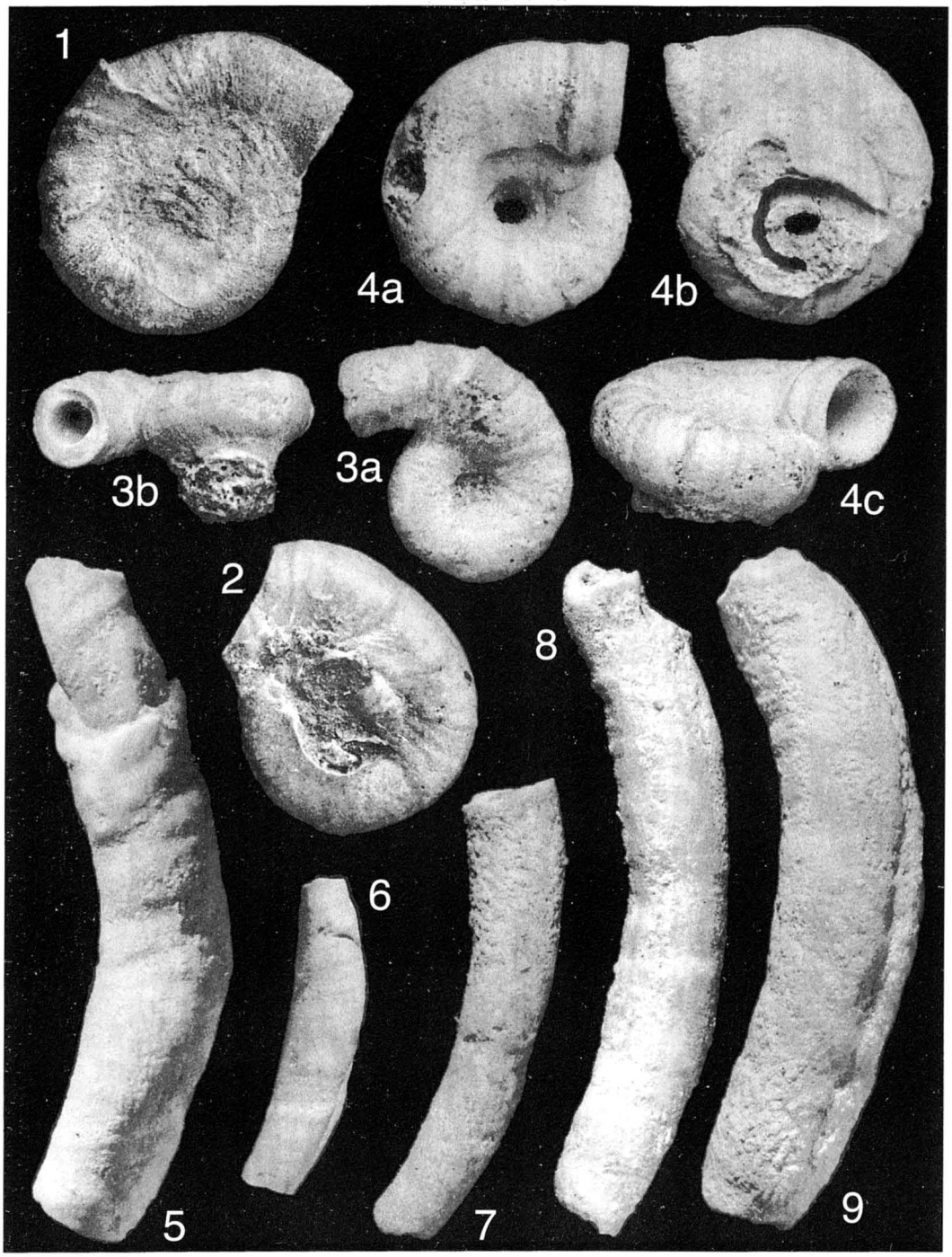


1-4 — *Rotularia* (*Rotularia*) *hisingeri* (LUNDGREN, 1891); **1**, **2a-4a** – top views of the tube; **2b**, **4b** – bottom views of the tube; **2c**, **3b**, **4c** – lateral views of the tube; **1** – Specimen No. PCN-022, **2** – No. PCN-023, **3** – No. PCN-024, **4** – No. PCN-025; all × 10



1-2 — *Rotularia* (*Praerotularia*) *saxonica* MÜLLER, 1966; **1a** – lateral view of the tube; **1b**, **2** – top views of the tube; **1** – Specimen No. PCMs-026, **2** – No. PCMs-027; both × 3

3-8 — *Rotularia* (*Praerotularia*) *marcinowskii* sp.n.; **6** – **holotype**, **3-5** and **7-8** – **paratypes**; **3** – Specimen No. PCMs-028, **4** – No. PCMs-029, **5** – No. PCMs-030, **6** – No. PCMs-031 (the same specimen as *in* MARCINOWSKI 1974, Pl. 17, Fig. 4 *and* MARCINOWSKI & RADWAŃSKI 1983, Pl. 3, Fig. 2), **7** – No. PCMs-032, **8** – No. PCMs-033; all × 3



1-2 — *Rotularia* (*Praerotularia*) *marcinowskii* sp.n.; **paratypes**: **1** – top view of the tube, **2** – bottom view of the tube; **1** – Specimen No. PCA-034, **2** – No. PCA-035; both × 3

3-4 — *Rotularia* (*Praerotularia*) *saxonica* MÜLLER, 1966; **3a**, **4a** – top views of the tube, **3b**, **4c** – lateral views of the tube, **4b** – bottom view of the tube; **3** – Specimen No. PCA-036, **4** – No. PCA-037; both × 3

5-9 — *Ditrupa schlotheimi* ROSENKRANTZ, 1920; **5** – Specimen No. PCN-038, **6** – No. PCN-039; both × 6; **7** – No. PCN-040, **8** – No. PCN-041, **9** – PCN-042; all × 10

1974. *Serpula proteus* J. DE C. SOWERBY; R. MARCINOWSKI, p. 159, Pl. 17, Fig. 4.
1983. *Serpula proteus* (SOWERBY); R. MARCINOWSKI & A. RADWAŃSKI, Pl. 3, Fig. 2.

HOLOTYPE: The specimen presented in Pl. 5, Fig. 6.
TYPE LOCALITY: Mokrzesz, east of Częstochowa, Polish Jura.
TYPE HORIZON: Condensed Cenomanian.
DERIVATION OF THE NAME: To honor Professor R. MARCINOWSKI (University of Warsaw), who first reported on this polychaete species.
MATERIAL: 16 specimens from Mokrzesz, 2 specimens from Annopol.

DIAGNOSIS: Tubes planispirally coiled; tube wall moderately massive with the circular cross-section; anterior part of the tube straight with numerous, characteristic trumpet-like peristomes; outer surface covered by densely spaced transverse corrugations.

DESCRIPTION: Tubes moderately large-sized, planispirally coiled, sinistral or dextral; the initial part of the tubes straight (*see* Pl. 6, Fig. 2); the maximum diameter of the whole spiral 15mm; the cross-section of the tube circular; the tube wall moderately massive; the diameter of the tube 4mm; the anterior part of the tube straight with numerous, trumpet-like peristomes (*see* Pl. 5, Figs 6, 8); outer surface of the tube covered by densely spaced, transverse corrugations; in some specimens there appears a delicate, longitudinal crest developed on the upper part of the tube (*see* Pl. 5, Fig. 8).

REMARKS: This species has hitherto been reported in Poland to occur only at Mokrzesz, wherefrom it was referred to (*see* synonymy) as *Serpula proteus* J. DE C. SOWERBY, 1844. The latter taxon has recently been indicated, by JÄGER (1983), to be a younger synonym of *Proliserpula ampullacea* (J. DE C. SOWERBY, 1829).

The studied specimens differ from those of the latter species, *Proliserpula ampullacea* (J. DE C. SOWERBY, 1829), by their mode of coiling, thickness of the tube wall, and by their size. The mode of coiling of the studied specimens is typical of the genus *Rotularia* DEFRANCE, 1827. Of the other species of that genus, the studied specimens differ by the presence of numerous trumpet-like peristomes, and by the more planispiral coiling.

It worths to be noted, that of other species of the genus *Rotularia* DEFRANCE, 1827, close to the newly established species *Rotularia* (*Praerotularia*) *marcinowskii* sp.n. is *R. damesi* (NOETLING, 1885) whose tubes are distinctly thicker, and coiled slightly more trochospirally, without trumpet-like peristomes (*see* NOETLING 1885, Pl. 1, Figs 8-10).

The species *Rotularia damesi* was established by NOETLING (1885) upon specimens coming from the erratic material, primarily pebbles of glauconitic sandstones (presumably of Cenomanian age) scattered by the Late Pleistocene Scandinavian icesheet in northern Poland (Pomerania, Baltic shore, Mazury Lakeland). Such pebbles, findable also in the present time, are characterized by a mass occurrence of specimens (*see* NOETLING 1885, Pl. 1, Fig. 7; KONGIEL 1950, photo in p. 18) distinctly contrasting, due to their brown-yellowish to whitish color of tubes, against the freshly green-colored background of the greensand.

Rotularia (*Praerotularia*) *saxonica* MÜLLER, 1966 (Pl. 5, Figs 1-2 and Pl. 6, Figs 3-4)

1966. *Rotularia*? *saxonica* n.sp.; A.H. MÜLLER, p. 1066, Pl. 2, Figs 1-5 and Pl. 3, Figs 1-5.
1973. *Rotularia* (*Rotularia*) *saxonica* A.H. MÜLLER, 1966; S. PASTERNAK, p. 51, Pl. 8, Figs 6-7.
1979. *Rotularia* (*Praerotularia*) *saxonica* A.H. MÜLLER, 1966; A. LOMMERZHEIM, p. 174, Pl. 16, Figs 1-4.
1991. *Rotularia* (*Praerotularia*) *saxonica* MÜLLER, 1966; M. JÄGER, p. 143, Pl. 2, Figs 1-6.

MATERIAL: 6 specimens from Annopol, 2 specimens from Mokrzesz.

DESCRIPTION: Tubes inverse-trochospirally coiled, dextral or sinistral; dimension of the whole spiral from 8 to 15mm; umbilicus wide and deep; the long, anterior part of the tube not coiled, but curved; tube wall massive, 1.2-1.4mm thick; cross-section of the tube circular; dimension of the tube varies from 3 to 5mm; outer surface of the tube sculptured by transverse rugae; trumpet-like peristomes.

REMARKS: The studied specimens are concordant with those given in the synonymy. The collected material comprises one specimen (*see* Pl. 6, Fig. 4) with its apertural part, but with a very short free part of the tube, and one specimen with very long, curved anterior part of the tube (*see* Pl. 5, Fig. 2); the rest of the specimens have that (anterior) part of the tube damaged. According to the present author's opinion, all these tubes, due to their size and character of coiling, fit well into diagnostic features of the indicated species. This species has not hitherto been reported from Poland.

Genus *Ditrupa* BERKELEY, 1835
Ditrupa schlotheimi ROSENKRANTZ, 1920
(Pl. 6, Figs 5-9)

1920. *Ditrupa Schlotheimi* n.sp.; A. ROSENKRANTZ, p. 25, Pl. 2, Figs 8-9.
1931. *Ditrupula schlotheimi* RZK. sp.; K. BRÜNNICH NIELSEN, p. 95.
1961. *Ditrupa schlotheimi* ROSENKRANTZ; H. REGENHARDT, p. 72.
1967. *Ditrupa* (*Ditrupa*) *schlotheimi* ROSENKRANTZ, 1961; H. PUGACZEWSKA, p. 184, Pl. 1, Figs 1-4 and Pl. 2, Figs 1-3.
1993. *Ditrupa schlotheimi* ROSENKRANTZ, 1920; M. JÄGER, p. 93, Pl. 4, Figs 1-13.

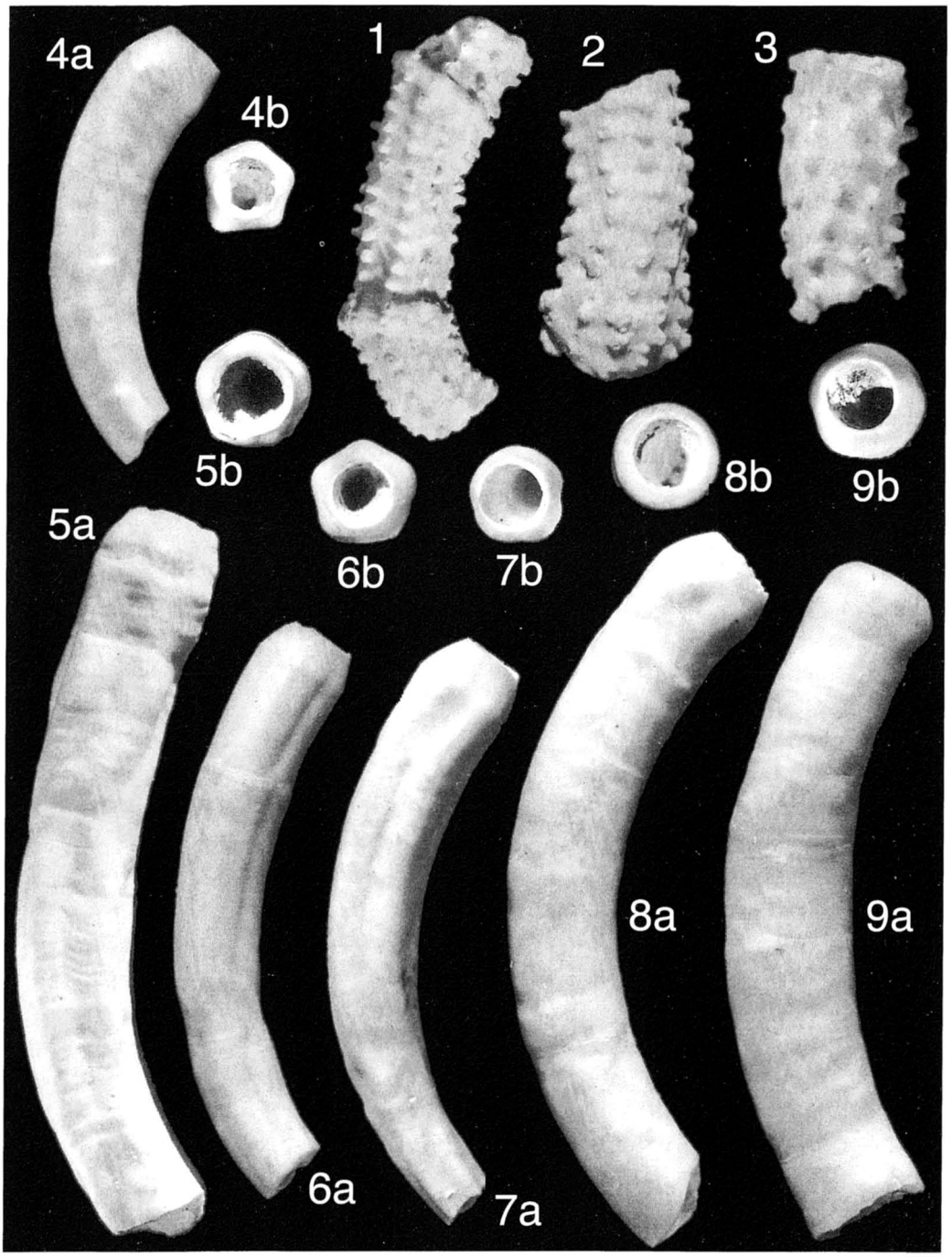
MATERIAL: 30 specimens from Nasiłów.

DESCRIPTION: Tubes free, slightly arched or almost straight, clavately swollen at the peristome ("*Ditrupa*-like"); outer surface smooth or with a longitudinal, relatively deep furrow.

REMARKS: The collected specimens are fully concordant with those given in the synonymy. This species has already been reported from Poland by PUGACZEWSKA (1967) from the Danian strata of the borehole at Boryszew near Sochaczew, 50 km west of Warsaw.

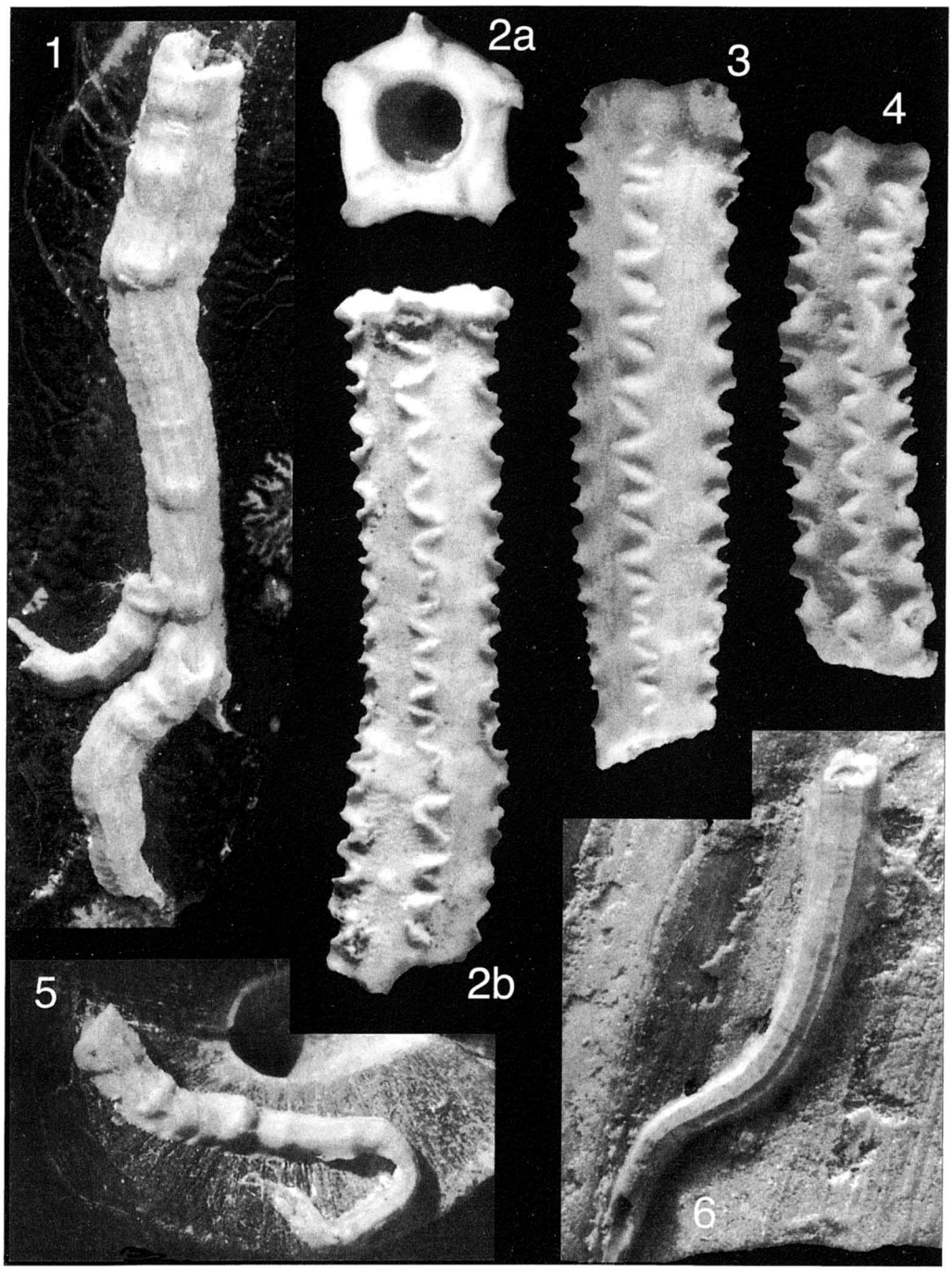
Genus *Pentaditrupa* REGENHARDT, 1961
Pentaditrupa subtorquata (MÜNSTER *in* GOLDFUSS, 1831)
(Pl. 7, Figs 4-9 and Pl. 12, Figs 5-8)

1831. *Serpula subtorquata* MÜNSTER; A. GOLDFUSS, p. 238, Pl. 70, Fig. 11b-d; *non* Fig. 11a.
1931. *Ditrupula Triminghamiensis* n.sp.; K. BRÜNNICH NIELSEN, p. 88, Pl. 1, Figs 7-8.
1931. *Ditrupula subtorquata* MÜNSTER.; K. BRÜNNICH NIELSEN, p. 96.
1961. *Ditrupa pruinosa* n.sp.; H. REGENHARDT, p. 32, Pl. 1, Fig. 8.
1961. *Ditrupa* (*Pentaditrupa*) *intracursa* n.sp.; H. REGENHARDT, p. 75, Pl. 9, Fig. 9.
1961. *Ditrupa* (*Pentaditrupa*) *subtorquata* (MÜNSTER, 1831); H. REGENHARDT, p. 76, Pl. 7, Fig. 11.
non 1963a. *Ditrupa* (*Pentaditrupa*) *subtorquata* (v. MÜNST.); A.H. MÜLLER, p. 1194, Pl. 1, Figs 1-7.
1963b. *Ditrupa subtorquata* (MÜNSTER); A.H. MÜLLER, p. 400, Text-fig. 513e-g.
non 1966. *Ditrupa* (*Pentaditrupa*) cf. *subtorquata* (v. MÜNST.); A.H. MÜLLER, p. 1066, Text-fig. 21.
1973. *Ditrupa* (*Ditrupa*) cf. *schlotheimi* ROSENKRANTZ, 1920; S. PASTERNAK, p. 33, Pl. 5, Figs 9-11.
1973. *Ditrupa* (*Pentaditrupa*) *subtorquata* (MÜNSTER), 1833; S. PASTERNAK, p. 37, Text-fig. 2/12; Text-fig. 3/4 and Pl. 5, Figs 4-5.
1973. *Ditrupa* (*Pentaditrupa*) *subtorquata versiformis* (PASTERNAK), 1955; S. PASTERNAK, p. 38, Pl. 5, Fig. 6.



1-3 — *Vepreculina tuberculifera* (BRÜNNICH NIELSEN, 1931); **1** – Specimen No. PCM-043, × 10; **2** – No. PCM-044, **3** – No. PCM-045; both × 15

4-9 — *Pentaditrupa subtorquata* (MÜNSTER *in* GOLDFUSS, 1831); a – lateral views of the tube, b – apertural views of the tube; **4** – Specimen No. PCM-046, **5** – No. PCM-047, **6** – No. PCM-048, **7** – No. PCM-049, **8** – No. PCM-050, **9** – No. PCM-051; all × 6



1-6 — *Filogranula cincta* (GOLDFUSS, 1831); **1** – Specimen No. PCM-052, × 4; **2** – No. PCM-053, **3** – No. PCM-054, **4** – No. PCM-055; all × 10; **5** – No. PCM-056, × 4; **6** – No. PCM-057, × 6

1983. *Pentaditrupa subtorquata* (MÜNSTER *in* GOLDFUSS, 1831); M. JÄGER, p. 56, Pl. 7, Figs 1-8.
1987. *Pentaditrupa subtorquata* (MÜNSTER *in* GOLDFUSS, 1831); M. JÄGER, p. 39, Pl. 1, Figs 2-3.
1991. *Pentaditrupa subtorquata* (MÜNSTER *in* GOLDFUSS, 1831); M. JÄGER, p. 146, Pl. 1, Fig. 7.

MATERIAL: 95 specimens from Mielnik.

DESCRIPTION: Tubes massive, curved, but with their posterior part broken; tubes increasing very slowly in the diameter during the growth, and clavately swollen at the peristomal part ("*Ditrupa*-like"); tubes with five, more or less rounded, longitudinal rims (*see* Pl. 7, Figs 4-6) or almost smooth (*see* Pl. 7, Figs 8-9); transverse section varies from pentagonal to almost circular (*see* Pl. 7, Figs 4b-9b); outer surface furnished with delicate transverse corrugations.

REMARKS: The studied specimens are concordant with those given in the synonymy. This species has not hitherto been reported from Poland.

Genus *Filogranula* LANGERHANS, 1884
Filogranula cincta (GOLDFUSS, 1831)
(Pl. 8, Figs 1-6)

1831. *Serpula cincta* nobis.; A. GOLDFUSS, p. 237, Pl. 70, Fig. 9a-c.
1931. *Serpentula cincta* GOLDF. sp.; K. BRÜNNICH NIELSEN, p. 90, Pl. 1, Figs 17-18, *non* Fig. 19.
1961. *Flucticularia flucticularia* n.sp.; H. REGENHARDT, p. 57, Pl. 9, Fig. 2.
1961. *Flucticularia undulata* (HAGENOW, 1840); H. REGENHARDT, p. 57, Pl. 6, Fig. 6.
1961. *Flucticularia trilix* n.sp.; H. REGENHARDT, p. 58, Pl. 5, Fig. 5.
1961. *Flucticularia calamistrata* n.sp.; H. REGENHARDT, p. 59, Pl. 6, Fig. 5.
1961. *Vepreculina plumosa* n.sp.; H. REGENHARDT, p. 68, Pl. 6, Fig. 4.
1963b. *Serpula (Flucticularia) undulata* v. HAG.; A.H. MÜLLER, Text-fig. 515a-d.
1964. *Flucticularia* cf. *undulata* (v. HAGENOW); A.H. MÜLLER, p. 623, Pl. 1, Figs 1-2.
1964. *Flucticularia undulata* (v. HAGENOW); A.H. MÜLLER, p. 624, Pl. 1, Fig. 4.
1966. *Flucticularia flucticularia* REGENHARDT; A.H. MÜLLER, p. 1065, Text-fig. 18a-b.
?1966. *Flucticularia* cf. *undulata* (v. HAGENOW); A.H. MÜLLER, p. 1065, Text-fig. 20a-b.
1966. *Ditrupinae*?; A.H. MÜLLER, p. 1063, Pl. 1, Figs 4-5, *non* Figs 1-3 and Figs 6-11.
1973. *Mucroserpula frustulenta* (REGENHARDT), 1961; S. PASTERNAK, p. 19, Text-fig. 2/4 and Pl. 3, Fig. 13.
1973. *Mucroserpula* cf. *trilineata* (ROEMER), 1841; S. PASTERNAK, p. 20, Text-fig. 2/6 and Pl. 3, Fig. 8.
1973. *Mucroserpula juliformis* (NIELSEN), 1931; S. PASTERNAK, p. 20, Pl. 3, Fig. 7.
1973. *Flucticularia flucticularia* REGENHARDT, 1961; S. PASTERNAK, p. 30, Pl. 6, Fig. 1.
1973. *Flucticularia* cf. *trilix* REGENHARDT, 1961; S. PASTERNAK, p. 30, Pl. 6, Fig. 2.
1973. *Flucticularia fluctuata* (SOWERBY), 1929; S. PASTERNAK, p. 30, Pl. 6, Fig. 4.
1973. *Flucticularia undulata* (HAGENOW), 1840; S. PASTERNAK, p. 31, Pl. 6, Fig. 3.
1975. *Flucticularia undulata* (v. HAGENOW, 1840); H. NESTLER, Text-fig. 94a-b.
1979. *Filograna fluctuata* (SOWERBY, 1829); A. LOMMERZHEIM, p. 155.
1983. *Filogranula cincta* (GOLDFUSS, 1831); M. JÄGER, p. 68, Pl. 8, Figs 8-13.
1987. *Filogranula cincta* (GOLDFUSS, 1831); M. JÄGER, p. 39, Pl. 1, Figs 11-16.
1991. *Filogranula cincta* (GOLDFUSS, 1831); M. JÄGER, p. 148, Pl. 5, Figs 1-5.

MATERIAL: 50 specimens from Mielnik, 3 specimens from Kornica.

DESCRIPTION: Posterior part of the tube attached to the substrate, anterior part erected freely; the attached part with three longitudinal, more or less undulated crests (*see* Pl. 8, Figs 1 and 5-6); the free part with five pronounced, undulated crests (*see* Pl. 8, Figs 2-4); ring-like peristomes irregularly spaced (*see* Pl. 8, Figs 1 and 5) or absent (*see* Pl. 8, Fig. 6).

REMARKS: The studied specimens are fully concordant with those given in the synonymy. Due to the great variability of the tube ornamentation, observable also within the collected material, numerous species described by PASTERNAK (1973), regardless their identity with the taxa labelled by him, are included into the synonymy of the studied species. This species has not hitherto been reported from Poland.

Genus *Vepreculina* REGENHARDT, 1961
Vepreculina tuberculifera (BRÜNNICH NIELSEN, 1931)
(Pl. 7, Figs 1-3)

1931. *Serpentula tuberculifera* n.sp.; K. BRÜNNICH NIELSEN, p. 92, Pl. 1, Figs 22-23.
1961. *Paraserpula paupercula* n.sp.; H. REGENHARDT, p. 66, Pl. 5, Fig. 8.
1961. *Vepreculina acuta* n.sp.; H. REGENHARDT, p. 68, Pl. 9, Fig. 3.
1964. *Vepreculina* cf. *acuta* REGENHARDT; A.H. MÜLLER, p. 624, Pl. 1, Fig. 3.
1983. *Vepreculina tuberculifera* (NIELSEN, 1931); M. JÄGER, p. 77, Pl. 9, Figs 11-12.

MATERIAL: 3 specimens from Mielnik, 1 specimen from Kornica.

DESCRIPTION: Tubes small, attached to the substrate; diameter of the tube 1mm; outer surface sculptured by seven crests furnished with relatively pronounced nodes, in majority densely spaced; transverse section of the tube heptagonal; ring-like peristomes well developed.

REMARKS: The collected material comprises only fragmented tubes, what does not allow to estimate an overall shape of the tubes. Nevertheless, the preserved tube fragments are fully concordant with those given in the synonymy. This species has not hitherto been reported from Poland.

Genus *Sclerostyla* MÖRCH, 1863
Sclerostyla basisculpta JÄGER, 1983
(Pl. 9, Figs 3-5)

1965. *Serpula* (*Dorsoserpula*) *lumbricalis* (SCHLOTHEIM, 1820); H. PUGACZEWSKA, p. 83, Pl.7, Fig. 2; *non* Pl. 6, Fig. 3, *non* Pl. 7, Figs 3-4.
1983. *Sclerostyla*? *basisculpta* n.sp.; M. JÄGER, p. 92, Pl. 11, Fig. 2.

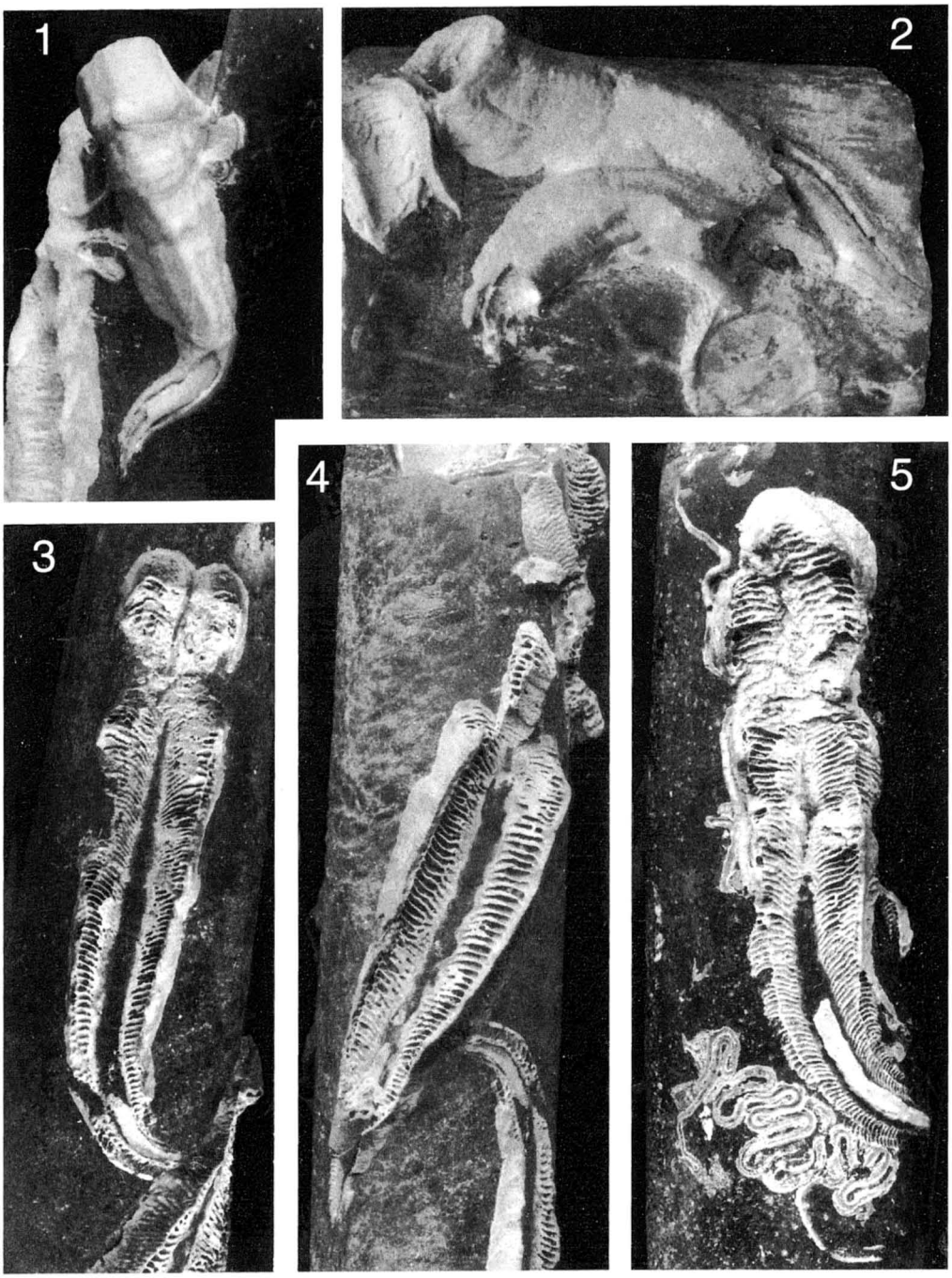
MATERIAL: 4 specimens from Nasiłów.

DESCRIPTION: Tubes large-sized (30mm long); the posterior part of the tube attached to the substrate; the basal part of the tube with characteristic, regular "septa"; the outer surface (preserved only in the basal part of the tube) covered by delicate, transverse corrugations (*see* Pl. 9, Fig. 4).

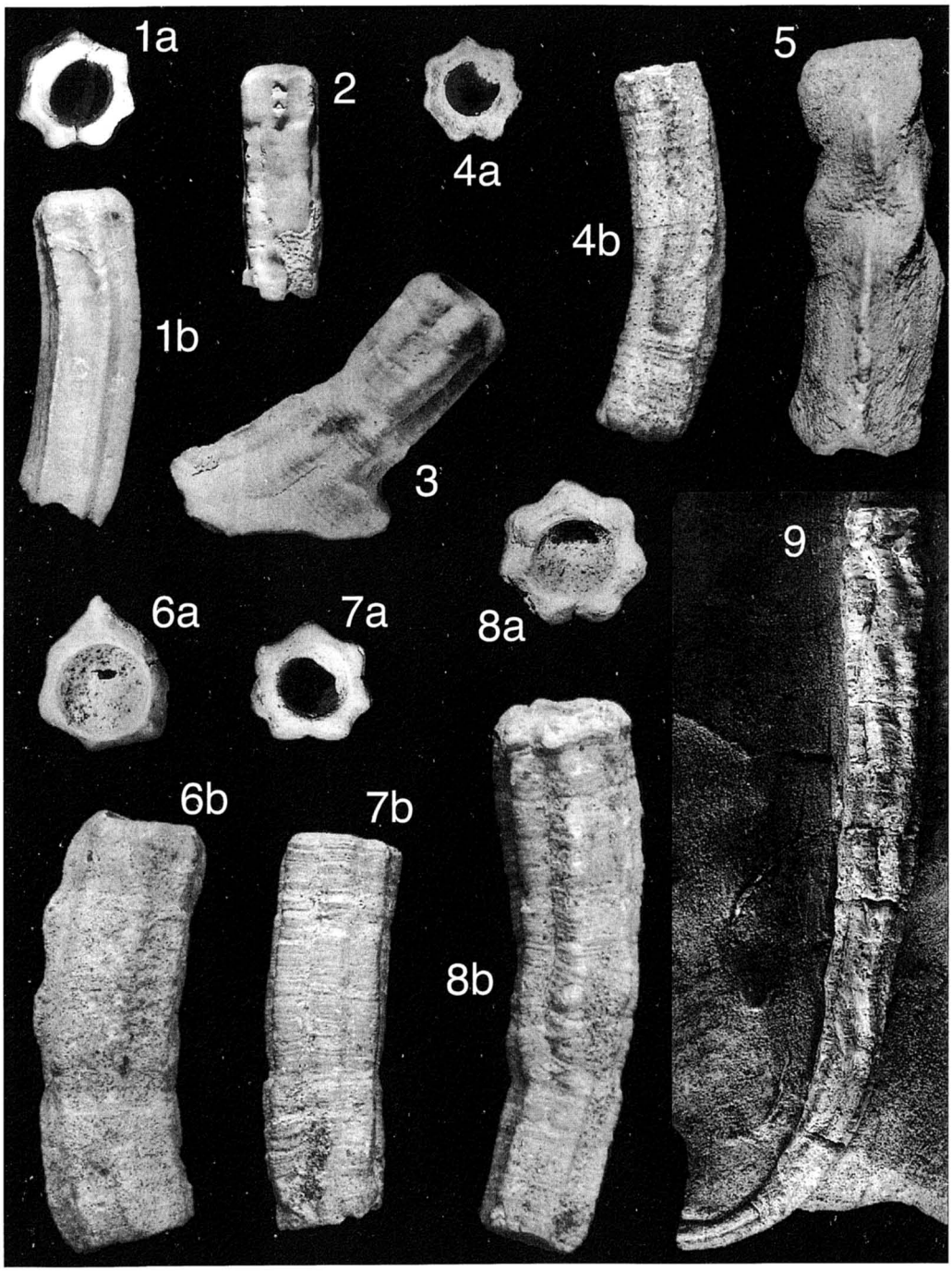
REMARKS: The studied specimens are concordant with the holotype of the species (*see* JÄGER 1983, Pl. 11, Fig. 2). The collected material comprises only basal parts of the tubes with characteristic "septa". The state of preservation of the tubes is the same as in JÄGER's type collection. According to the present author's opinion, the studied specimens, due to their size, shape of the tubes, and character of the basal part of the tube, fit well into the diagnostic features of the genus *Sclerostyla* MÖRCH, 1863. The hesitation of JÄGER (1983), concerning the generic assessment of the species does not seem thus to be unjustified. The discussed features of the studied specimens correspond well to those displayed by the present-day representatives of that genus, as shown *e.g.* by its species from the Caribbean, reported by TEN HOVE (1973).

This species has already been reported from Poland by PUGACZEWSKA (1965) as "*Serpula* (*Dorsoserpula*) *lumbricalis* (SCHLOTHEIM, 1820)", the species typical of the Middle to Upper Jurassic strata (*see* GOLDFUSS 1831, MAKOWSKI 1952, PARSCH 1956).

Sclerostyla ignota JÄGER, 1983
(Pl. 9, Figs 1-2)



1-2 — *Sclerostyla ignota* JÄGER, 1983; **1** – Specimen No. PCM-058, × 2; **2** – No. PCK-059, × 3
3-5 — *Sclerostyla basisculpta* JÄGER, 1983; **3** – Specimen No. PCN-060, **4** – No. PCN-061, **5** – No. PCN-062; all × 3



1-9 — *Sclerostyla macropus* (J. DE C. SOWERBY, 1829); **a** – apertural views of the tube, **b** – lateral views of the tube; **1** – Specimen No. PCK-063, **2** – No. PCM-064; both × 2; **3** – No. PCK-065, × 3; **4** – No. PCB-066, **7** – No. PCB-067; both × 2; **9** – No. PCN-068, × 1.5; **5**, **6**, **8** – No. 560 (Collection of the Natural Science Museum at Kazimierz-on-Vistula), all × 3

1965. *Serpula (Dorsoserpula) lumbricalis* (SCHLOTHEIM, 1820); H. PUGACZEWSKA, p. 83, Pl. 6, Fig. 3, *non* Pl. 7, Figs 2-4.
1983. *Sclerostyla? ignota* n.sp.; M. JÄGER, p. 91. Pl. 11, Fig. 3.
1980. *Sclerostyla mosae* (BRONN); F. CUPEDO, Text-fig. 28a-28d, *non* Text-figs 22- 27.

MATERIAL: 11 specimens from Mielnik, 1 specimen from Kazimierz-on-Vistula.

DESCRIPTION: Tubes massive, attached to the substrate almost alongwith its whole length; short anterior part erected; dimensions of the tubes 5mm; transverse section *U*-shaped or triangular; outer surface sculptured by the rounded median crest and shallow furrows, both crossed by transverse corrugations; alate peristomes rare.

REMARKS: The studied specimens are concordant with the holotype of the species (*see* JÄGER 1983, Pl. 11, Fig. 3). The collected material is much richer than JÄGER's type collection, and comprises a specimen with an erected (anterior) part of the tube (*see* Pl. 9, Fig. 1). The studied specimens share also their features with those of the present-day representatives of the genus *Sclerostyla* MÖRCH, 1863, from the Caribbean, reported by TEN HOVE (1973).

This species has already been reported from Poland by PUGACZEWSKA as "*Serpula (Dorsoserpula) lumbricalis* (SCHLOTHEIM, 1820)".

Sclerostyla macropus (J. DE C. SOWERBY, 1829) (Pl. 10, Figs 1-9 and Pl. 12, Figs 1-3)

1829. *Serpula (Vermilia ?) macropus*; J. DE C. SOWERBY, p. 200, Pl. 597, Fig. 6.
1931. *Serpula heptagona* HAG.; K. BRÜNNICH NIELSEN, p. 79.
1931. *Ditrupula Hagenowii* n.sp.; K. BRÜNNICH NIELSEN, p. 88, Pl. 1, Figs 5-6.
1961. *Sclerostyla* sp.; H. REGENHARDT, p. 14, Text-fig. 4.
1961. *Hepteris grandiscapia* n.sp.; H. REGENHARDT, p. 83, Pl. 7, Fig. 5.
1961. "*Serpula*" *heptagona* HAGENOW, 1840; H. REGENHARDT, p. 85.
1963a. *Ditrupa (Pentaditrupa) subtorquata* (V. MÜNST); A.H. MÜLLER, p. 1194, Pl. 1, Figs 3, 5, 7 and Pl. 3, Figs 3-7, ? Pl. 1, Figs 1-2, 4, 6 and ?Pl. 3, Fig. 1.
1963b. *Serpula heptagona* V. HAG.; A.H. MÜLLER, Text-fig. 510.
1963. *Sclerostyla (Septenaria) septenaria* REGENHARDT, 1961; H. NESTLER, p. 597, Text-figs 3-7 and Pl. 1, Figs 1-5.
1966. *Ditrupa (Pentaditrupa)* cf. *subtorquata* (V. MÜNSTER); A.H. MÜLLER, p. 1066, Text-fig. 21a-c.
1966. "*Serpula*" *heptagona* (V. HAGENOW); A.H. MÜLLER, p. 1066, Text-fig. 22a-b.
1970. *Sclerostyla septenaria* REGENHARDT; A.H. MÜLLER, p. 55, Text-figs 2 and 4, and Pl. 1, Figs 1-7.
1973. *Sclerostyla heptagona* (HAGENOW), 1840; S. PASTERNAK, p. 42, Text-fig. 2/16; Text-fig. 3/1; Text-fig. 4 and Pl. 7, Figs 1-5.
1973. *Sclerostyla meridionalis* n.sp; S. PASTERNAK, p. 44, Text-fig. 2/17-18; Text-fig. 3/2-3 and Pl. 7, Figs 6-8.
1973. *Sclerostyla* cf. *septenaria* REGENHARDT, 1961; S. PASTERNAK, p. 45, Pl. 9, Figs 12-13.
1975. *Sclerostyla (Septenaria) septenaria* REGENHARDT, 1961; H. NESTLER, p. 66, Text-fig. 95a-b.
1983. *Sclerostyla macropus* (SOWERBY, 1829); M. JÄGER, p. 84, Pl. 10, Figs 6-9.
1991. *Sclerostyla macropus* (SOWERBY, 1829); M. JÄGER, p. 150, Pl. 4, Fig. 12.

MATERIAL: 30 specimens from Kazimierz-on-Vistula, 15 specimens from Bochotnica, 6 specimens from Mielnik, 4 specimens from Nasiłów.

DESCRIPTION: Tubes massive, large-sized (the largest specimen is 75mm long); posterior part of the tube attached to the substrate, the cross-section of this part being triangular, and the outer surface having been furnished with a median keel; anterior part of the tube erected with seven, rounded keels, crossed by closely spaced transverse corrugations; peristomes absent.

REMARKS: The studied specimens are concordant with those given in the synonymy. This species has not hitherto been reported from Poland.

Genus *Hamulus* MORTON, 1834
Hamulus sexangularis (MÜNSTER *in* GOLDFUSS, 1831)
(Pl. 11, Figs 5-8)

1831. *Serpula sexangularis* MÜNSTER; A. GOLDFUSS, p. 238, Pl. 70, Fig. 12a-b.
1961. *Hamulus (Senarius) sexangularis* (MÜNSTER *in* GOLDFUSS, 1831); H. REGENHARDT, p. 81.
1983. *Hamulus sexangularis* (MÜNSTER *in* GOLDFUSS, 1831); M. JÄGER, p. 94, Pl. 11, Figs 10-11.

MATERIAL: 4 specimens from Mielnik, 1 specimen from Kornica.

DESCRIPTION: Tubes average-sized; posterior part of the tube attached to the substrate, with *U*-shaped transverse section; anterior part erected; outer surface of the tube covered by six longitudinal crests, crossed by transverse, undulate corrugations (*see* Pl. 11, Fig. 8b); peristomes absent.

REMARKS: The studied specimens are fully concordant with those given in the synonymy. This species has not hitherto been reported from Poland.

Genus *Placostegus* PHILIPPI, 1844
Placostegus sp.
(Pl. 11, Figs 9-10)

MATERIAL: 2 specimens from Mydlniki.

DESCRIPTION: Tubes relatively small with a massive wall; trochospiral, coiled sinistrally; diameter of the coil 3mm; short anterior part of the tube freely erected; outer surface of the tube covered by very delicate, transverse corrugations.

REMARKS: The studied specimens are close to those of the species *Placostegus pusillus* (J. DE C. SOWERBY, 1844), from which they differ by their smaller size and relatively more delicate ornamentation of the tube. The very limited number of specimens justifies its recognition to the indicated genus only. Such forms have not hitherto been reported from Poland.

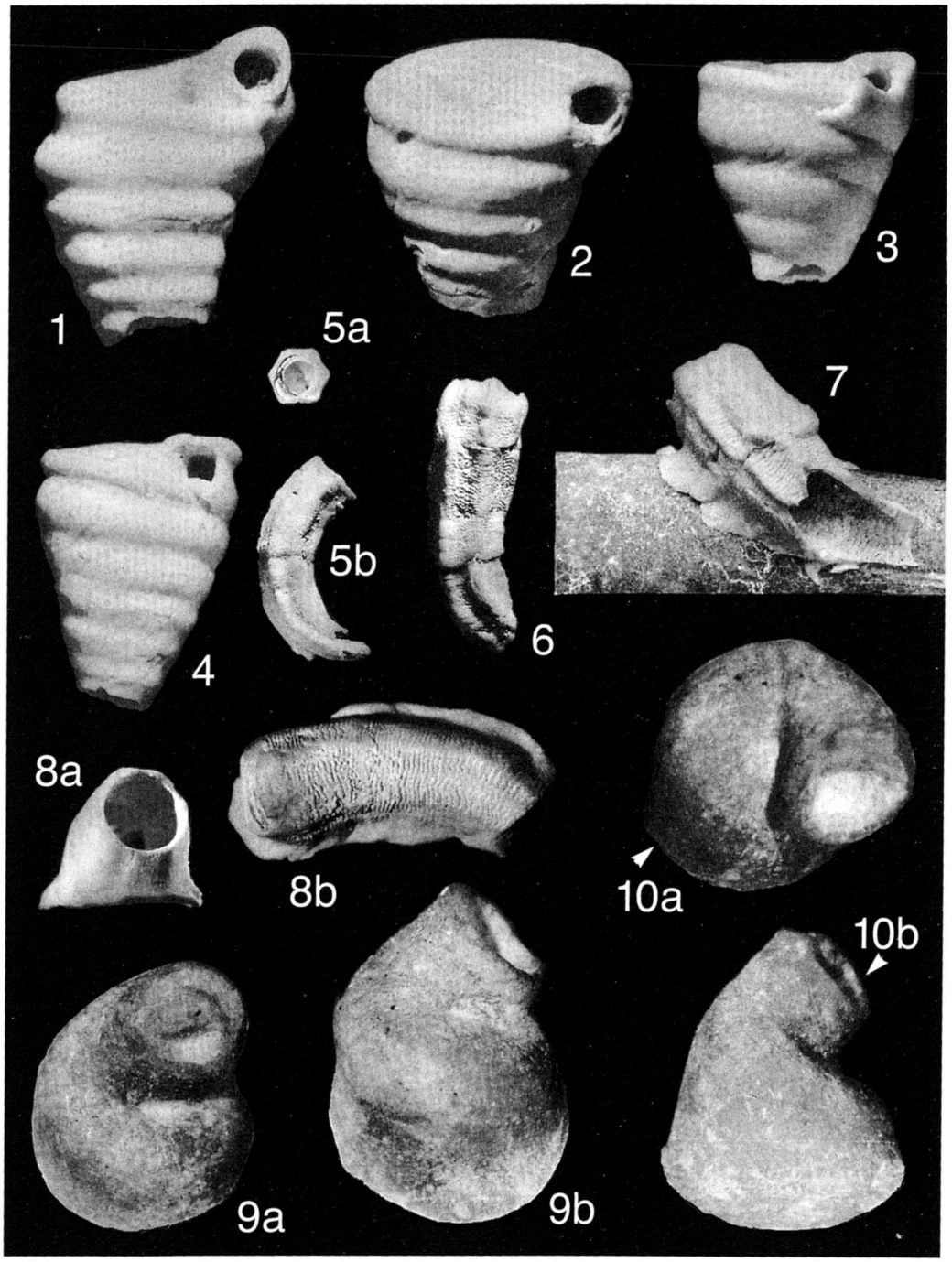
Genus *Orthoconorca* JÄGER, 1983
Orthoconorca conica (HAGENOW, 1840)
(Pl. 11, Figs 1-4)

1931. *Serpula conica* v. HAG.; K. BRÜNNICH NIELSEN, p. 92, Pl. 1, Figs 26-28.
1961. *Serpula conica* (HAGENOW, 1840); H. REGENHARDT, p. 96.
1965. *Conorca conica* (v. HAGENOW); H. NESTLER, Pl. 4, Fig. 18; Pl. 5, Figs 2-3.
1973. *Conorca conica* (HAGENOW, 1840); S. PASTERNAK, p. 54, Pl. 9, Figs 7-9.
non 1975. *Conorca conica* (v. HAGENOW); H. NESTLER, p. 64, Text-fig. 97.
1983. *Orthoconorca conica* (HAGENOW, 1840); M. JÄGER, p. 113, Pl. 14, Figs 1-4.

MATERIAL: 15 specimens from Mielnik.

DESCRIPTION: Tubes relatively massive, inversely high-trochospirally coiled; outer surface of the coil convex, on the top flattened, what involves a subquadrangular cross-section; outer surface of the tube without ornamentation; peristomes absent.

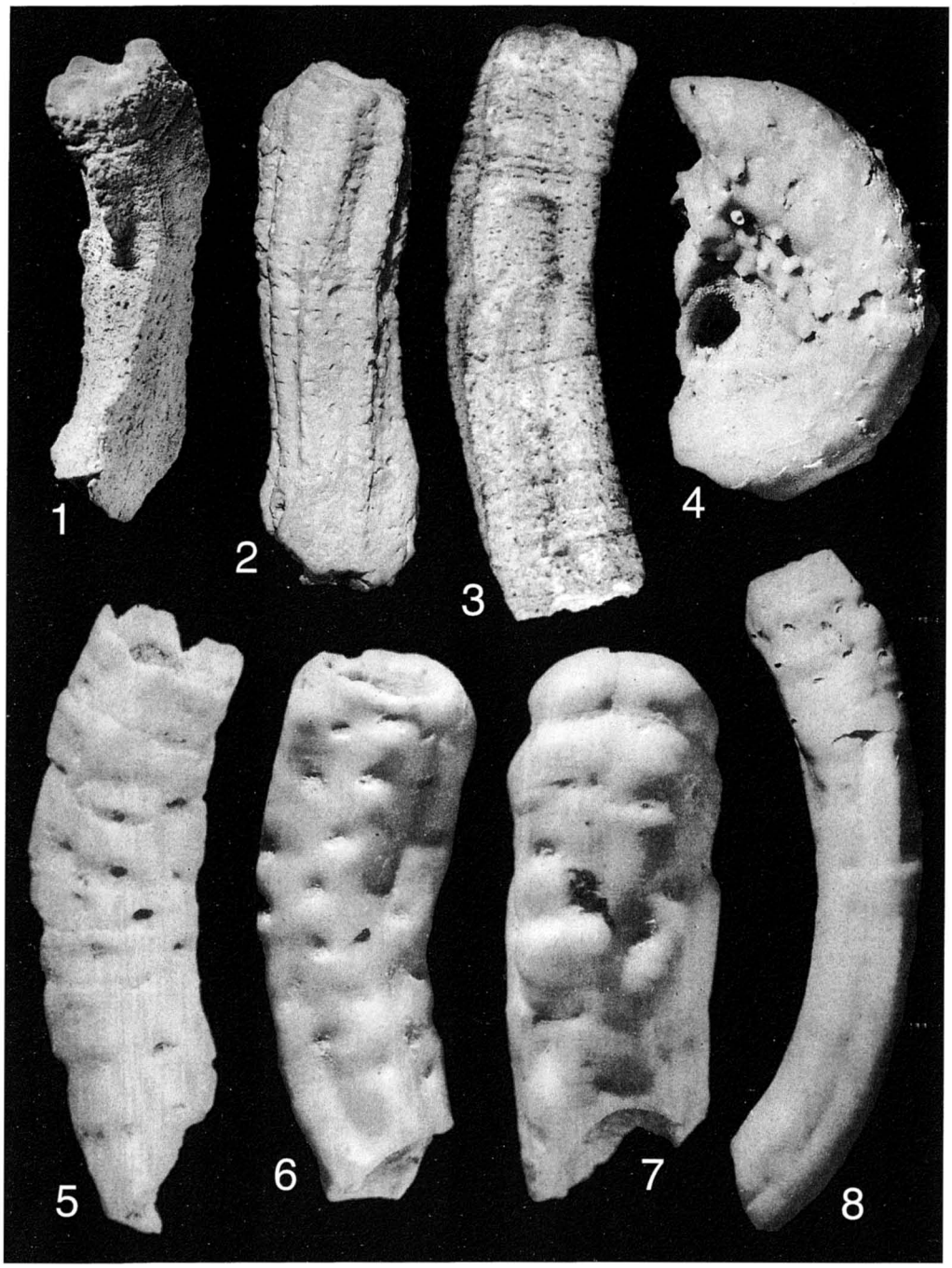
REMARKS: The studied specimens are fully concordant with those given in the synonymy. The collected material comprises exclusively tubes with their juvenile parts broken. This species has not hitherto been reported from Poland.



1-4 — *Orthoconorca conica* (HAGENOW, 1840); **1** – Specimen No. PCM-069, **2** – No. PCM-070, **3** – No. PCM-071, **4** – No. PCM-072; all ×10

5-8 — *Hamulus sexangularis* (MÜNSTER *in* GOLDFUSS, 1831); **5a**, **8a** – apertural views of the tube; **5b**, **6-7** – lateral views of the tube; **8b** – top view of the tube; **5** – Specimen No. PCM-073, × 2; **6** – No. PCM-074, **7** – PCM-075, **8** – PCM-076; all × 3

9-10 — *Placostegus* sp.; **a** – top view of the tube, **b** – lateral view of the tube; **9** – Specimen No. PCMy-077, **10** – No. PCMy-078; both × 10



Tubes of the polychaete species infested by the commensal hydroid *Protulophila gestroi* ROVERETO, 1901

1-3 — *Sclerostyla macropus* (J. DE C. SOWERBY, 1829); **1** – Specimen - No. 560 (Collection Natural Science Museum at Kazimierz-on-Vistula), × 3; **2** – No. PCM-079, × 4; **3** – No. PCB-066 (the same as presented in Pl. 10, Fig. 4), × 3

4 — *Proliserpula ampullacea* (J. DE C. SOWERBY, 1829); Specimen No. PCM-080, × 4

5-8 — *Pentaditrupa subtorquata* (MÜNSTER *in* GOLDFUSS, 1831); **5** – Specimen No. PCM-081, **6** – No. PCM-082, **7** – No. PCM-083; all × 10; **8** – No. PCM-084, × 6

THE POLYCHAETE SYMBIONT — HYDROID *Protulophila gestroi* ROVERETO, 1901

A number of the studied polychaete tubes bear very peculiar features outerly (*see* Pl. 12), that are identical to those referred to as produced by the hydroid *Protulophila gestroi* ROVERETO, 1901, the taxon being revised and comprehensively studied by SCRUTTON (1973, 1975).

These peculiar features appear either as the narrow holes elongated parallelly to the polychaete-tube growth lamellae (*see* Pl. 12, Figs 1-3 and 5-8), or as hollow, chimney-like bosses, circular in outline, and projecting more or less pronouncedly from the tube wall (*see* Pl. 12, Fig. 4). As evidenced by SCRUTTON (1975), they are the apertures, either naked or collared, of the polyp chambers distributed very regularly throughout a reticulate stolonal network embedded within the polychaete tube; the naked apertures are often adorned with a kind of a hood adapically (*see* Pl. 12, Figs 6-8).

A study of the present-day analogues allowed SCRUTTON (1975) to recognize the hydroid nature of the discussed structures, and to identify the presence of the stolonal network in the fossil material when tubes were exfoliated either by weathering (*compare* ROVERETO 1901, WALTER 1965), or by a lab procedure. The nature of the hydroid/polychaete relationship should be classified as commensal, or even mutualistic (*see* SCRUTTON 1975, pp. 269 and 271; POHOWSKY 1978, p. 42).

The discussed structures in the polychaete tubes have first been described by ROVERETO (1901) from the Pliocene of Liguria, Italy, and the name used by him, *Protulophila gestroi*, has remained fully useful up to date. It denotes, obviously, a pattern of traces (molds) which corresponds exactly to the structure of the hydroid colony. The precise image of the body, reproduced by the traces (molds), is thus well comparable to those known in the ctenostome boring bryozoans (*see* POHOWSKY 1978, BAŁUK & RADWAŃSKI 1979) and in the acrothoracican cirripedes (*see* BAŁUK & RADWAŃSKI 1991).

When reporting on these structures, ROVERETO (1901, pp. 223-224 and Pl. 28, Fig. 7a-7c) ascribed them to the ctenostome bryozoans. Such an attribution of the Upper Jurassic forms from France was also used by WALTER (1965) whose interpretation became objected by SCRUTTON (1973, 1975) and POHOWSKY (1978, pp. 120 and 139).

A review of older reports on *Protulophila gestroi* ROVERETO, 1901, as given by SCRUTTON (1975), comprises only two papers more: an older one, by J. DE C. SOWERBY (1829, p. 226 and Pl. 608, Fig. 3), and that one of WRIGLEY (1951, pp. 187-188 and Figs 41-45) who distinguished the infested tubes of *Sclerostyla heptagona* (J. DE C. SOWERBY) from the Eocene of England as a separate species, *Sclerostyla perforata* WRIGLEY.

It is to note that the full list of the recognized fossil occurrences of *Protulophila gestroi* ROVERETO, 1901, given by SCRUTTON (1975), comprises primarily Jurassic and Cretaceous polychaetes (*cf. also* JÄGER 1983), and very few Tertiary ones. The Middle Miocene (Badenian) polychaete material from the Korytnica Basin in Poland has formerly been stated by the Author (RADWAŃSKA 1994a, p. 75) to be lacking the discussed symbionts.

The list of the Cretaceous occurrences (*see* SCRUTTON 1975, p. 274 *and* JÄGER 1983, pp. 160-161) of *Protulophila gestroi* ROVERETO, 1901 becomes supplemented by the present study as follows:

Lower through low-Upper Campanian (*see* Pl. 12, Figs 2 and 4-8)
Proliserpula ampullacea (J. DE C. SOWERBY, 1829), *Pentaditrupa subtorquata* (MÜNSTER *in* GOLDFUSS, 1831), *Sclerostyla macropus* (J. DE C. SOWERBY, 1829);

topmost Maastrichtian (*see* Pl. 12, Figs 1-3)
solely *Sclerostyla macropus* (J. DE C. SOWERBY, 1829).

SUMMARIZING REMARKS

The studied tube-dwelling polychaetes are recognized as relatively very rare fossils within the mid- to Upper Cretaceous sequences of Poland. The polychaete-bearing intervals of these sequences are apparently confined either to the transgressive onlaps (localities Mokrzesz and Annopol-on-Vistula), the further transgressive pulses including (locality Mydlniki), or to the regressive phase of the Late Cretaceous sea (locality Kazimierz-on-Vistula and its vicinity). All these events have evidently been involving the shallowest marine regime over a larger area. The greatest number of the polychaetes appears particularly around the hardground horizons, either beneath (locality Mielnik-on-Bug) or just above the hardground surface (locality Nasiłów), what therefore indicates, generally, very shallow or even extremely shallow-water conditions of their formation (*cf.* other data presented *by* MARCINOWSKI 1970, 1974; WALASZCZYK 1987, 1992; RADWAŃSKI 1985, 1996). A conclusion on the very shallow-water conditions featuring the Late Cretaceous polychaete-inhabited biotopes in Poland is well compatible with that one resulting from the study of the Middle Miocene (Badenian) polychaete assemblage of the Korytnica Basin, as well as with the data on environmental requirements of most of the present-day polychaetes (*see* RADWAŃSKA 1994a, p. 74).

The studied polychaetes are recognized to have constituted the better individualized assemblages in the very selected intervals of the mid- to Upper Cretaceous sequences in Poland, precisely in those connected with the development of the hardground horizons. The species diversity of these assemblages is, however, much lower than of those recorded in other parts

of the Late Cretaceous Central European Basin, the chalk interval and the Ukrainian region including (*cf.* REGENHARDT 1961; PASTERNAK 1973; LOMMERZHEIM 1979; JÄGER 1983, 1991, 1993). A further progress in the recognition of the mid- to Late Cretaceous polychaete fauna in Poland is thus still needed and any, even supplementary, account does remain much welcomed.

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