acta
geologica
polonica

Vol. 33, No. 1-4 Warszawa 1983

EWA POPIEL-BARCZYK & HANNA SENKOWICZOWA

Middle Triassic juvenile terebratulids *Angustothyris angustaeformis* (Boeckh) from the Żebrak borehole, eastern Poland

ABSTRACT: Four early stage of brachidium development are recognizable in juvenile terebratulids attributable to the species *Angustothyris angustaeformis* (Boeckh) from the Middle Triassic (Lower Muschelkalk) pierced by the Żebrak borehole, Podlasie region, *viz.*: (*1*) precentronelliform, (*2*) centronelliform, (*3*) close to quasipremagadiniform and (4) close to quasimagadiniform.

INTRODUCTION

The sedimentary sequence of the upper part of the Lower Muschelkalk in the borehole Żebrak *IG-1* near Siedlce, Podlasie region, eastern Poland (Text-fig. 1), contains numerous juvenile terebratulids, the length of which ranges from 0.25 to 4.0 mm. Their preservation state enabled the studies of the internal morphology, as such young specimens of Triassic terebratulids were found for the first time in Poland (Popiel-Barczyk & Senkowiczowa 1981). They are also rare in other countries; for instance, the smallest juvenile terebratulids of Lower and Middle Triassic age in the Soviet Union (north-western Caucasus, south-eastern Pamir) and Bulgaria, analyzed by Dagis (1972), were slightly over 1 mm long.

The juvenile terebratulids are also known from the Paleozoic formations: Upper Carboniferous Magdalena Formation of New Mexico (United States) where primitive terebratulids of the family Mutationellidae Cloud, 1941, were found (Cooper 1957), and Permian of the Causasus (Soviet Union), for which Dagis (1972) described the representatives of the family Labaiidae Likharev, 1960.

The Mesozoic formations contain also the juvenile terebratulids. The family *Zeilleridae* Rolier, 1915, is known from the Middle Jurassic deposits of England (Baker 1972), whilst within the Upper Cretaceous chalk of the Isle of Rügen, the representatives of the families *Terebratulidae* Gray, 1840, *Cancellothyridae* Thomson, 1926, *Dallinidae* Beecher, 1893, and *Terebratellidae* King, 1850, were recognized (Steinich 1965).

In the borehole Żebrak *IG-1* the Middle Triassic sediments with juvenile terebratulids occur at the depth of 976.0—1010.0 m and are represented by limestones, marls and clayey marlstones. At the depth of 1005.0 m there occurs a shelly conglomerate, composed of shell pieces of the terebratulids, spiriferids and of the pelecypods, particularly *Plagiostoma striatum* (Schlotheim), associated with such abundant microfossils as *Spirorbis valvata* Berger, holothurian sclerites, crinoid ossicles, echinoid spines, fragments of ophiuroids, spicules of calcareous sponges, and foraminifers, ostracodes, fish scales and teeth (Senkowiczowa 1958, 1972). The sedimentary area of the Podlasie region was located (Senkowiczowa & Szyperko-Śliwczyńska 1972) within a littoral zone at the eastern shores of the Middle Triassic sea that occupied Central Europe at that time (Text-fig. 1).

The analyzed collection is stored in the Museum of the Geological Survey of Poland, Warsaw, at a catalogue number *MUZ IG 1398 II*. Photos of specimens were done by D. Oleksiak and K. Ilska, Geological Survey, and by M. Małachowska-Kleiber and L. Dwornik in the Museum of the Earth, Polish Academy of Sciences.

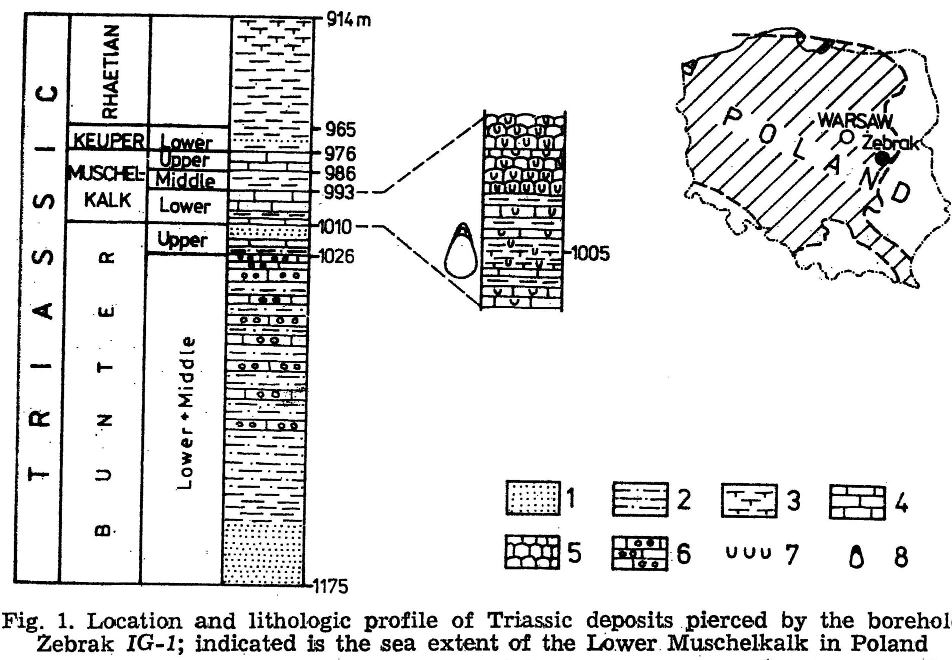


Fig. 1. Location and lithologic profile of Triassic deposits pierced by the borehole Żebrak *IG-1*; indicated is the sea extent of the Lower Muschelkalk in Poland
1 sandstones, *2* marlstones and claystones, *3* marls, *4* limestones, *5* wavy limestones, *6* oolitic limestones, *7* coquinas, *8* horizon with juvenile terebratulids

MATERIALS AND METHODS OF INVESTIGATION

After a clayey marlstone was dissolved in water, about 200 specimens of terebratulids were received. Their shell length ranges from 0.25 to 20.0 m. Among the analyzed material there are common juvenile specimens (shell length to 4.0 m), rare young specimens (shell length of 4.0—10.0 mm), and a few adult specimens.

An attribution of the specimens with their shell lengths over 10.0 mm for the mature ones is arbitrary, as some genera of Triassic terebratulids possess a mature loop already in the shells 10.0 mm long (Dagis 1972), whereas the loop development in some Jurassic specimens happens at much smaller lengths of the shells (Baker 1972).

The juvenile specimens have a diversified outer shape. Some of them display a circular or slightly transversally oval brachial valve whereas the others, have it longitudinally oval (Text-fig. 2 and Pl.1, Figs 1—5).

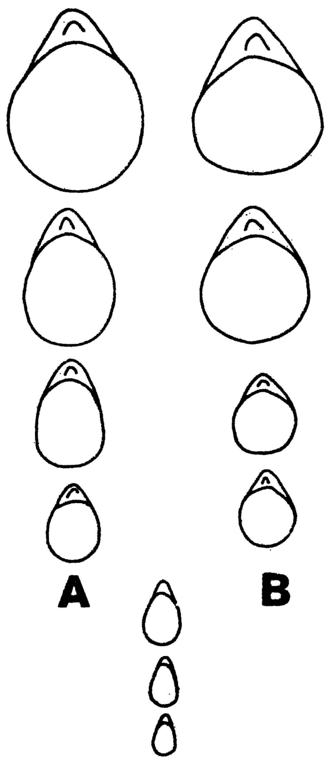


Fig. 2

Variability of shell outlines of juvenile terebratulids from Żebrak: **A** — specimens with oval brachial valves, **B** — specimens with circular brachial valves

After being boiled in balsam, the specimens filled with sediments were sectioned perpendicularly to the lateral commissure. The specimens with empty interiors were photographed in a transmitted light in immersion liquids. Among the sectioned specimens, 11 could be reconstructed: 6 represented the juvenile specimens whereas 2 were young and 3 were mature ones.

Observations of the shell interiors of the empty specimens and the reconstruction of those sectioned enable to recognize the very early development stages of the brachidium.

DEVELOPMENTAL STAGES OF BRACHIDIUM

STAGE *I*

Juvenile specimens with their shell lengths from 0.25 to 1.0 mm, with distinct triangular shapes and a sulcus on the anterior of the brachial valve, prove in a transparent light a presence of two longitudinal ribbon-like lamellae that hang freely at a hinge margin inside the valve. These elements are not connected with each other (Text-fig. 3*A* and Pl. 2, Figs 9—12). They are considered for the initial growth stage of two descending branches of the loop, still before they got jointed.

The comparable early developmental stages of the loop were noted in:

Upper Cretaceous juvenile specimens of *Chatwinothyris subcardinalis* Sahni and *Magas chitiniformis* (Schlotheim) from the Isle of Rügen (Steinich, 1965, p. 43 and 190, Text-figs 29—30 and 287—292) with their shell length to 2 mm;

Middle Jurassic terebratellids from the south-western England (Baker 1972, p. 456; Text-figs 2*A*, 3*A* and Pl. 83, Figs 13—16), *viz.* in *Zeilleria leckenbyi* (Davidson), the minimum shell length of which was about 1.0 mm;

Upper Carboniferous terebratulids from the North America, *viz.* in *Cryptacanthia prolifera* Cooper, the minimum shell length of which was equal 1.0 m (Cooper 1957, p. 8; Pl. 2*A*, Fig. 1).

In spite of an excellent documentation, such early stages of a loop development have not been named by Steinich (1965) either for terebratulids or for terebratellids. The terms of early stages of the loop development applied by Baker (1972, p. 459) for Middle Jurassic terebratellids, cannot be used for the specimens from Żebrak as the latter do not possess in these stages any element at the floor of the brachial valve Therefore, the term "precentronelliform", applied by Cooper for the terebratulid genus *Cryptacanthia* seems to be most adequate for the smallest and probably the youngest specimens from Żebrak, with their loop described as the stage *I*. Dagis (1968, 1972, 1974) when dealing with the ontogeny of Triassic terebratulids, has not analyzed the stages preceding the "centronelliform" stage.

STAGE *II*

The majority of juvenile specimens with their length from 1.0 to 4.0 mm possess triangular-shaped shells with a sulcus at the anterior of the brachial valve. The empty as well as sectioned shells contain loops at the "centronelliform" stage (Text-figs 3*B* and 4; Pl. 3, Figs 1—7). A loop, composed of two jointed descending branches, has a small echmidium-like swelling in the centre of the frontal part. It was noted in empty specimens, the length of which was up to 2 mm. Slightly larger sectioned specimens (over 2.0 mm) bear a well developed vertical plate (Text-figs 3*B* and 4). A loop length of smaller as well as of larger specimens is close to or greater than a half length of the brachial valve The sectioned specimens present also other elements of the internal morphology: high inner socket ridges and early developed septalium in the brachial valve, as well as a distinct pedicle collar and hinge teeth without dental plates in the pedicle valve (Text-fig. 4).

The centronelliform stages of the loop development are noted for many genera of fossil terebratulids (Cloud 1942); Cooper 1957; Dagis 1968, 1972, 1974; Usnarska

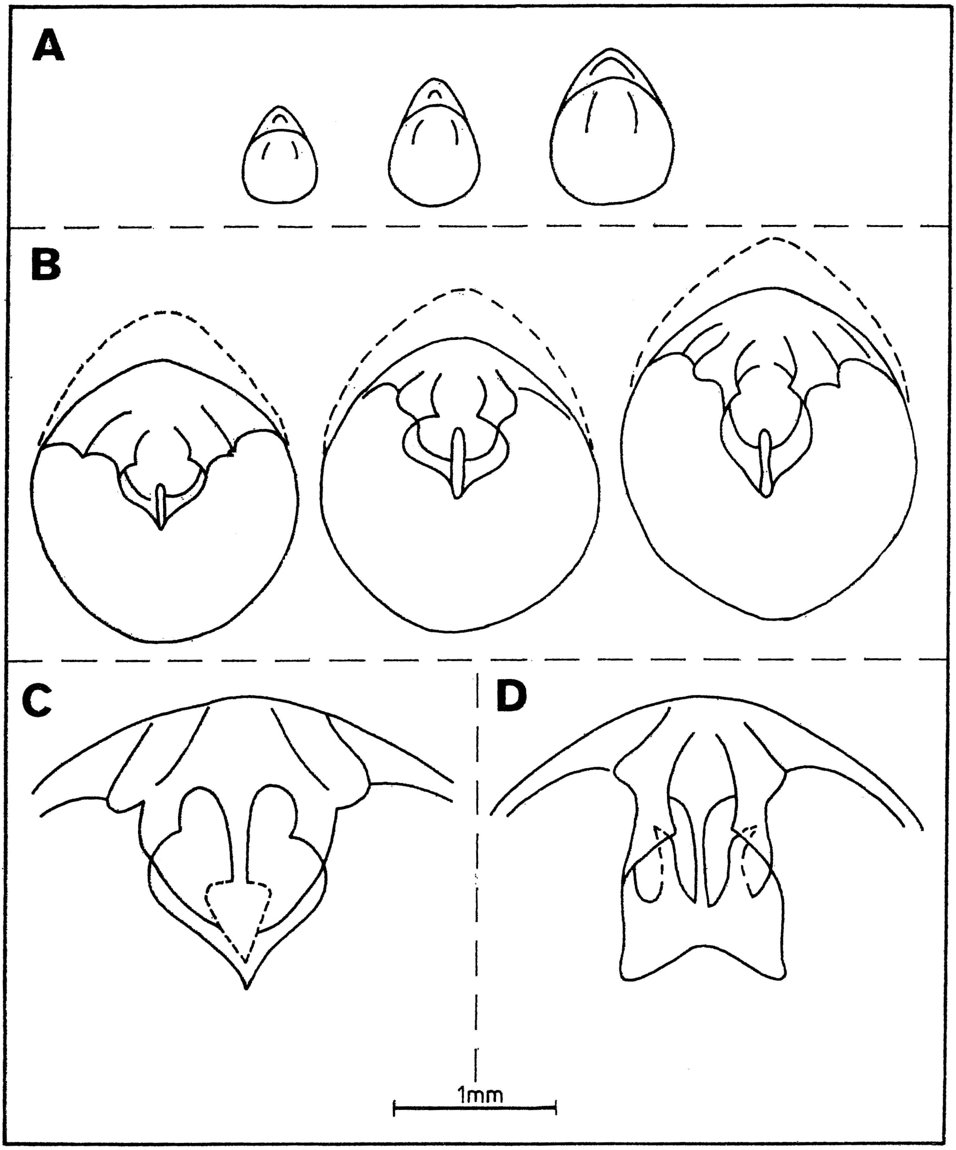


Fig. 3. Development stages of brachidium of juvenile *Angustothyris angustaeformis* (Boeckh) from Żebrak; **A** — drawings from empty specimens with the loop at the "precentronelliform" stage, **B** — reconstructions from sectioned specimens with the loop at the "centronelliform" stage, **C** — reconstruction from a sectioned specimen with the loop at the stage close to the "quasipremagadiniform" stage, **D** — reconstruction from a sectioned specimen with the loop at the stage close to the "quasimagadiniform" stage

-Talerzak 1981). Among the Triassic forms, the material from Żebrak can be compared, there are the following genera: *Angustothyris* Dagis, *Coenothyris* Douvillé, *Fletcherithyris* Campbell, and *Plectoconcha* Cooper.

Basing on internal shell characters of the sectioned specimens from Zebrak, the greatest similarities were found to occur with young specimens of *Angustothyris angustaeformis* (Boeckh) from the Anisian deposits of the north-western Caucasus (Dagis 1972, p. 34, Text-figs. 11—14). Among the above mentioned genera, *Coenothyris* displays also a great conformity of the loop appearance in the centronelliform stage with the one of the specimens from Żebrak. In the genus *Coenothyris*, however, this stage was noted for the specimens considerably larger, 4.9 mm in shell lenght (Usnarska-Talerzak 1981). Besides, the presence of dental plates in this genus has not yet been clarified. The two other genera display the centronelliform stages at slightly smaller dimensions

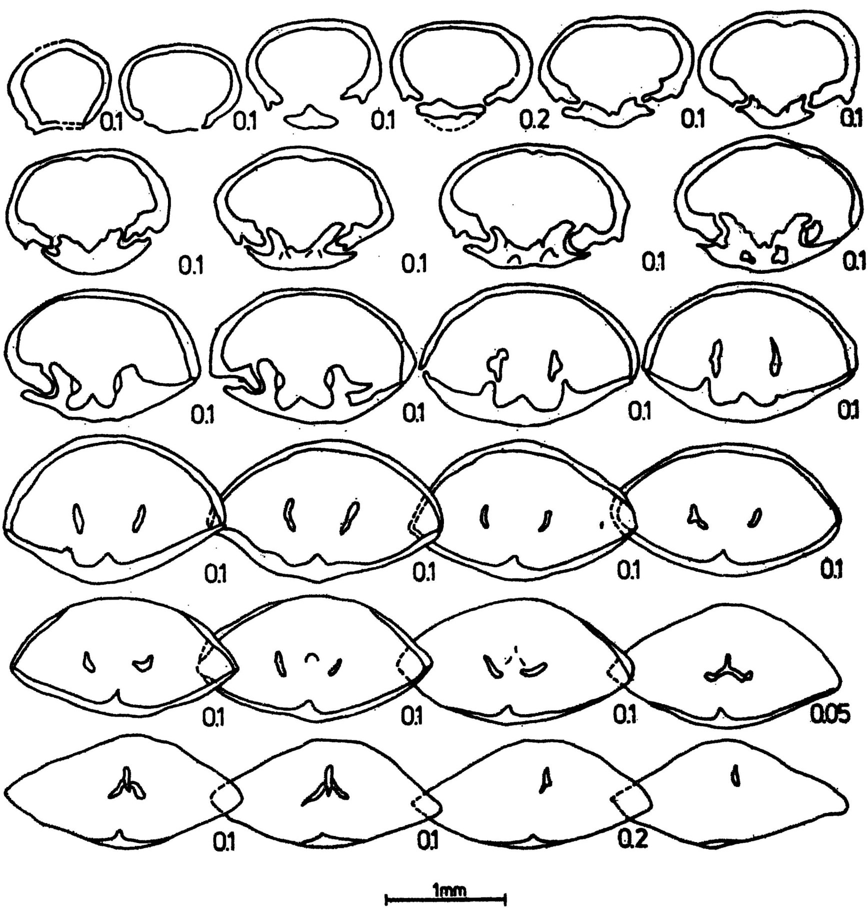


Fig. 4. Serial transverse sections of juvenile specimen *A. angustaeformis* (Boeckh) with the loop at the "centronelliform" stage; shell is 2.2 mm long and 2.0 mm wide

of the shell. In *Fletcherithyris,* the specimens with their shell lengths of 2.5 mm have dental plates (Dagis 1972, p. 32, Fig. 9*a*), whilst *Plectoconcha* has no septalium but is well ribboned (Dagis 1972, p. 28, Figs 5—6).

A more advanced stage of the loop development was noted in one of the empty specimens, with its lenght below 2.0 mm (Pl. 4, Fig. 4). This stage is comparable with those described below and typical of the specimens over 4.0 mm long. The specimen is triangular, with a transversally oval-shaped brachial valve.

STAGE *III* and following

The specimens with shell length close to 4.0 mm or slightly larger, possess accessory elements on the vertical plate: swellings visible in loops of empty specimens (Pl. 4, Figs 1—3) and appendices in the sectioned specimens (Text-fig. 3*C*). The frontal part of the loop in specimens with their shells over 5.0 mm long is also distinctly divided into the left and right side (Text-fig. 3*D* and Pl. 4, Figs 4—5). The other

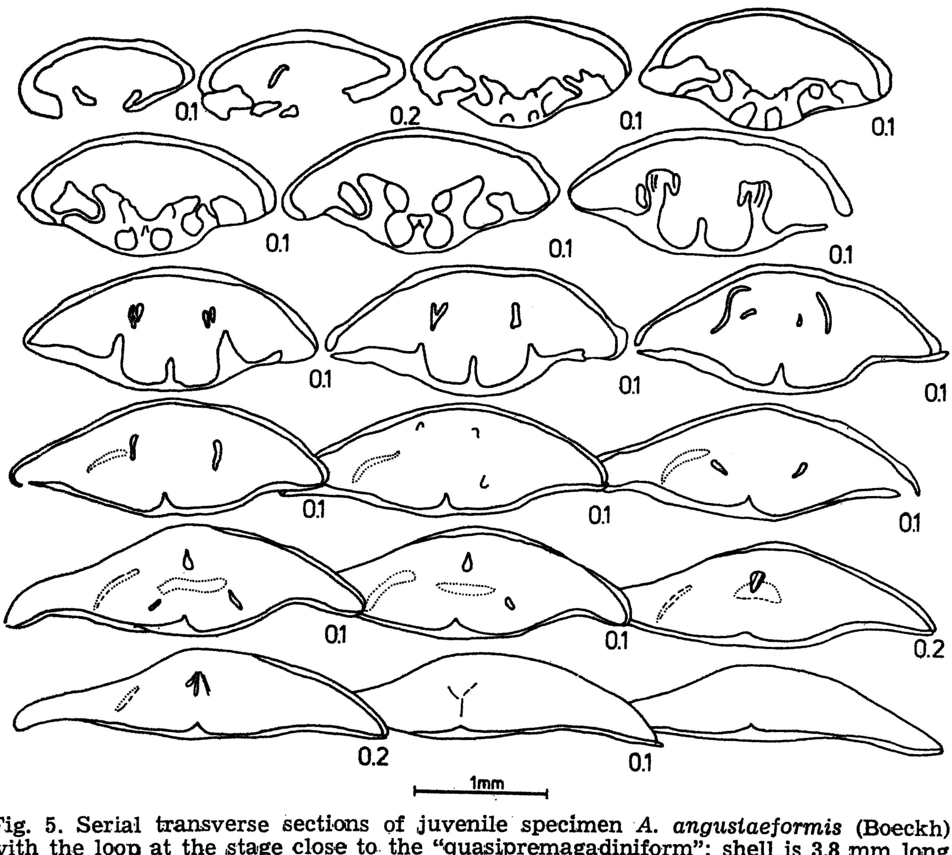


Fig. 5. Serial transverse sections of juvenile specimen *A. angustaeformis* (Boeckh) with the loop at the stage close to the "quasipremagadiniform"; shell is 3.8 mm long and 3.0 mm wide

elements of the internal morphology, *i.e.* high inner socket ridges, septum and teeth devoid of dental plates, remain without any change.

The internal characters of the investigated shells are similar to those of *Angustothyris angustaeformis* (Boeckh), described by Dagis (1972, p. 45) as the stages following the "centronelliform" stage. For the latter,

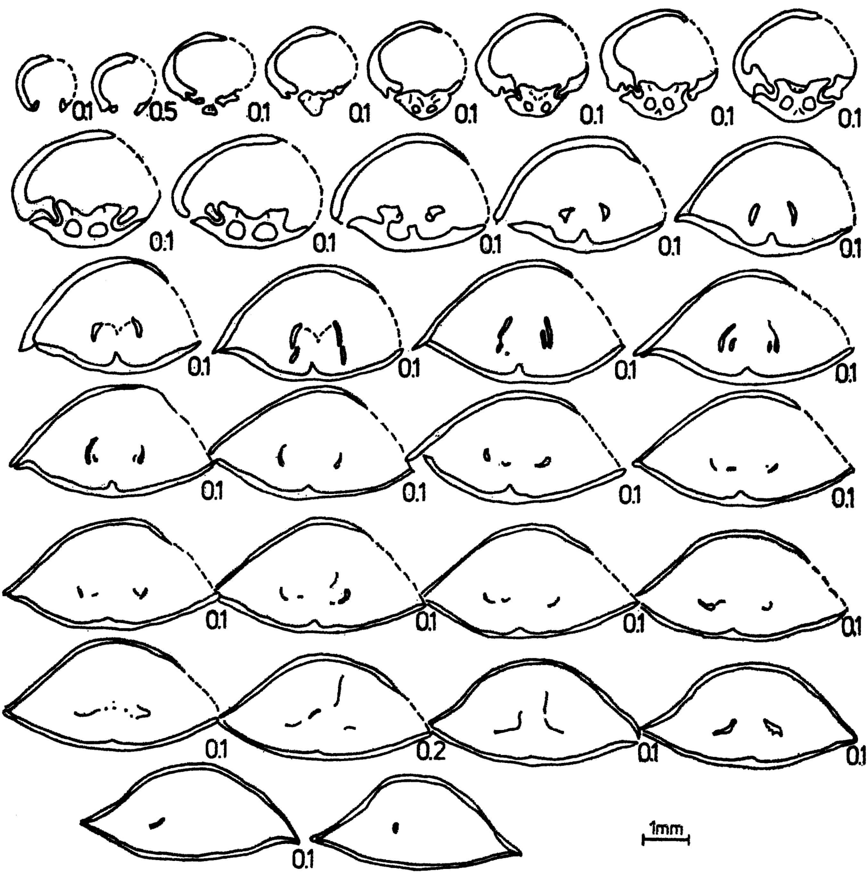


Fig. 6. Serial transverse sections of young specimen *A. angustaeformis* (Boeckh) with the loop at the stage close to the "quasimagadiniform"; shell is 6.8 mm long and 4.8 mm wide

Dagis introduced the terms that suggest similarities to typical developmental stages of the loop in the dallinids and terebratellids. Thus, the loops of the empty specimens (Pl. 4, Figs 1—3) and of a sectioned one (Text-figs 3*C* and 5) are considered as close to the "quasipremagadiniform" stage at which the accessory hood-like elements start growing. They are comparable with loops labelled as *4b* by Dagis (1974, p. 45, Fig. 163). The loops with a marked initial division into right and left sides (Text-figs 3*D*, 6 and Pl. 4, Figs 4—5) are considered as close to the "quasimagadiniform" stage, comparable with loops *4g* in the Dagis's scheme.

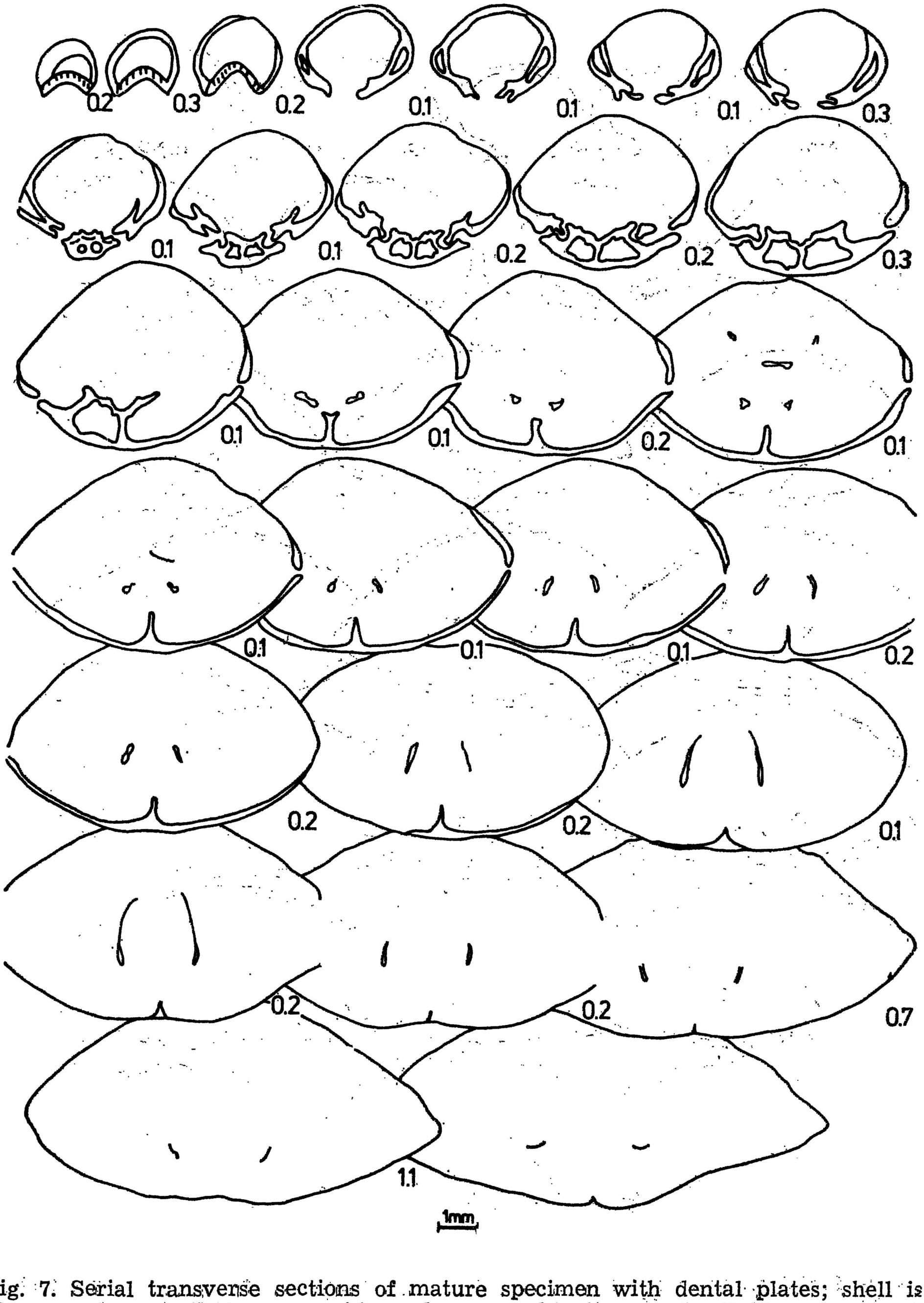


Fig. 7. Serial transverse sections of mature specimen with dental plates; shell is 13.7 mm long and 12.5 mm wide and presumably belongs to *Zeilleria edlingeri* (Assmann)

The mature forms of *Angustothyris angustaeformis* (Boeckh) have a short loop, without a distinct division of its branches into descending and ascending ones, developed according to the scheme considered by Dagis (1974) as the "angustothyrid" type of the loop.

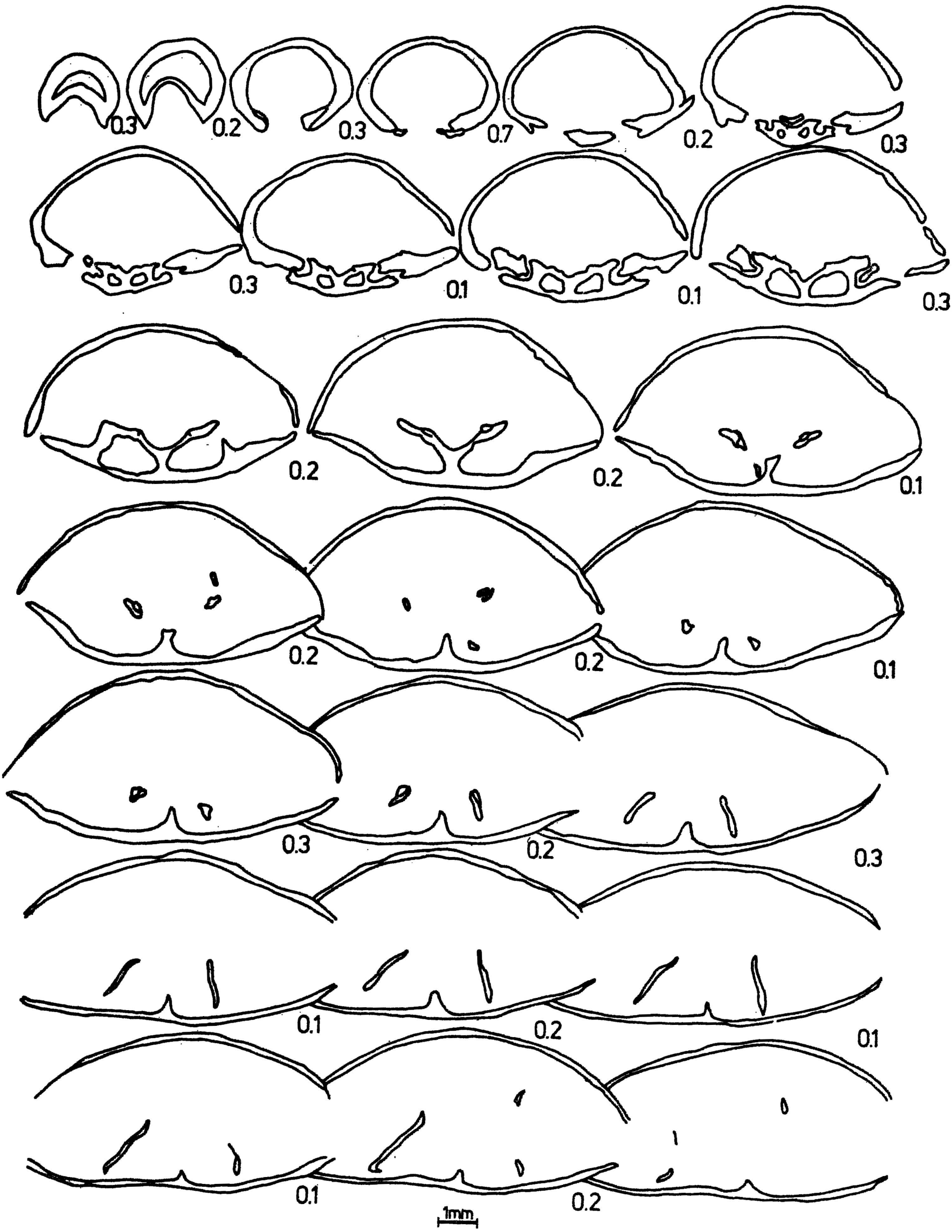


Fig. 8. Serial transverse sections of mature specimen without dental plates; shell is 13.0 mm long and 13.1 mm wide and presumably belongs to *Angustothyris angustaeformis* (Boeckh)

FINAL REMARKS

The primarily juvenile forms of the species *Angustothyris angustaeformis* (Boeckh) occur among the investigated terebratulids. Although the internal shell morphology of three specimens, considered for mature ones, has not been reconstructed fully, these forms (Pl. 1, Figs 6—7), were found to represent even two genera as the dental plates were either present or absent. Two specimens, provided for the dental plates (Text-fig. 7), may belong to the species *Zeilleria edlingeri* (Assmann). The third specimen, without dental plates (Text-fig. 8), belongs presumably to *Angustothyris angustaeformis* (Boeckh), the same as the juveniles do.

An attribution of this specimen to *A. angustaeformis* is partly supported by a similarity of its shell width and thickness indices to these of *Waldheimia angustaeformis* described by Boeckh (1873, p. 173) from the Middle Triassic (Recoarokalk) at Köveskala, Tihany Peninsula in Hungary. These indices show a greater similarity than those of the specimen *Angustothyris angustaeformis* (Boeckh) from the Anisian of the Caucasus, reported by Dagis (1974, Pl. 48, Fig. 1) and of the specimen

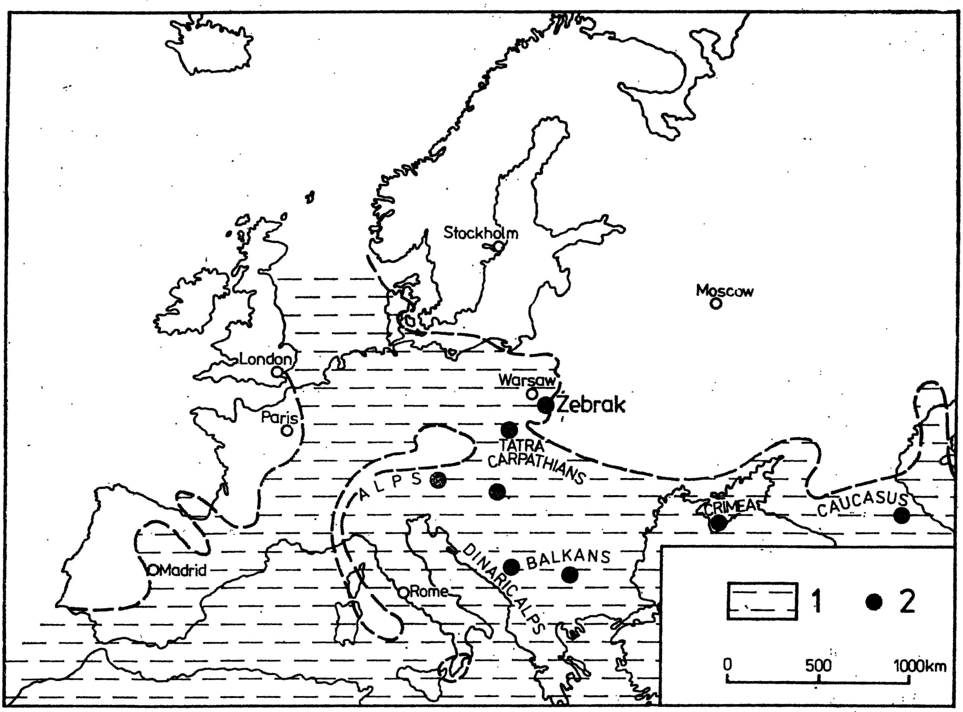


Fig. 9. Occurrence of representatives of the family *Angustothyrididae* in Europe (*after* Dagis, 1974; *modified*)

1 — extent of the marine sediments of Middle Triassic age; 2 — localities with representatives of the family *Angustothyrididae*

Aulacothyris angustaeformis (Boeckh) from the turn of the Anisian and Ladinian of the Tatra Mts (Kotański 1973, Pl. 2, Fig. 8).

Amidst these three mature forms from Żebrak there is no *Coenothyris vulgaris* (Schlotheim), commonly cited for Middle Triassic. This species, which has not yet been revised, probably collects the specimens of various species or even genera of similar shell shapes. Some authors (Koschinsky 1878, Bittner 1890, Kirchner 1934) mention for instance a presence of dental plates as diagnostic features of *C. vulgaris*, whereas the others note their absence (Muir-Wood 1965). There is also an opinion (Nowakowski 1972, Dagis 1974) on a varying development of dental plates in *C. vulgaris*.

A preservation of juvenile specimens of *Angustothyris angustaeformis* (Boeckh) proves them to have been buried in the same place they had lived. Destructed and crumbled mature specimens that form, together with other faunistic remains, a shelly conglomerate, have been most probably transported from distant areas.

The recognition of juvenile specimens of *Angustothyris angustaeformis* (Boeckh) extends the geographic distribution of this species in Poland from the Tatra Mts (Kotański 1973) and Upper Silesia (Usnarska-Talerzak 1981) to the Podlasie region. It also extends the distribution of the whole family *Angustothyrididae* sensu Dagis (1974, Fig. 167) from the Tethyan realm further to the north (Text-fig. 9).

Museum of the Earth,
Polish Academy of Sciences,
Al. Na Skarpie 20/26,
00-488 Warszawa, Poland
(E. Popiel-Barczyk)

Geological Survey of Poland,
ul. Rakowiecka 4
00-975 Warszawa, Poland
(H. Senkowiczowa)

REFERENCES

BAKER P. G. 1972. The development of the loop in the Jurassic brachiopod Zeilleria leckenbyi. *Palaeontology,* **15** (3), 450—572. London.

BITTNER A. 1890. Brachiopoden der alpinen Trias. *Abh. K. K. Geol. Reichsanst.,* **14** (1), 1—325. Wien.

BOECKH J. 1873. Die geologischen Verhältnisse des Südlichen Theiles des Bakony. Theil I. *Mittheil. Jb. K. Ungar. Geol. Anstalt,* II B, I Lief., **2**—156. Budapest.

CLOUD P. E. 1942. Terebratuloid Brachiopoda of the Silurian and Devonian. *Geol. Soc. Amer. Spec. Papers.* **38**, 43—80. New York.

COOPER G. A. 1957. Loop development of the Pennsylvanian terebratulid Cryptacanthia. *Smiths. Misc. Coll.,* **134** (3), 1—18. Washington.

DAGIS A. S. 1968. Jurassic and Lower Cretaceous brachiopods of North Siberia [*in Russian*]. *Trans. Inst. Geol. Geoph. Acad. Sc. USSR,* **41**, 1—29. Moskva.

— 1972. Postembrionalnoye razvitye brakhidya pozdnepaleozoiskih i rannemezozoiskih Terebratulida. *Trans. Inst. Geol. Geoph. Acad. Sc. USSR,* **112**, 22—58. Moskva.

— 1974. Triassic Brachiopods (Morphology, Classification, Phylogeny, Stratigraphical significance and Biogeography) [*in Russian*]. *Trans. Inst. Geol. Geoph. Acad. Sc. USSR,* **214**, 5—309. Moskva.

KIRCHNER H. 1934. Die Fossilien der Würzburg Trias. Brachiopoda. *Neues Jb. Mineral. Geol. Paläont., Abt. B,* **71**, 88—136. Stuttgart.

KOSCHINSKY C. 1878. Beiträge zur Kenntniss von *Terebratura vulgaris* Schloth. *Z. Deutsch. Geol. Ges.,* **30** (3), 376—386. Berlin.

KOTAŃSKI Z. 1973. Upper and middle subtatric nappes in the Tatra Mts. *Bull. Acad. Polon. Sci., Sér. Sci. Terre,* **22** (1), 75—83. Varsovie.

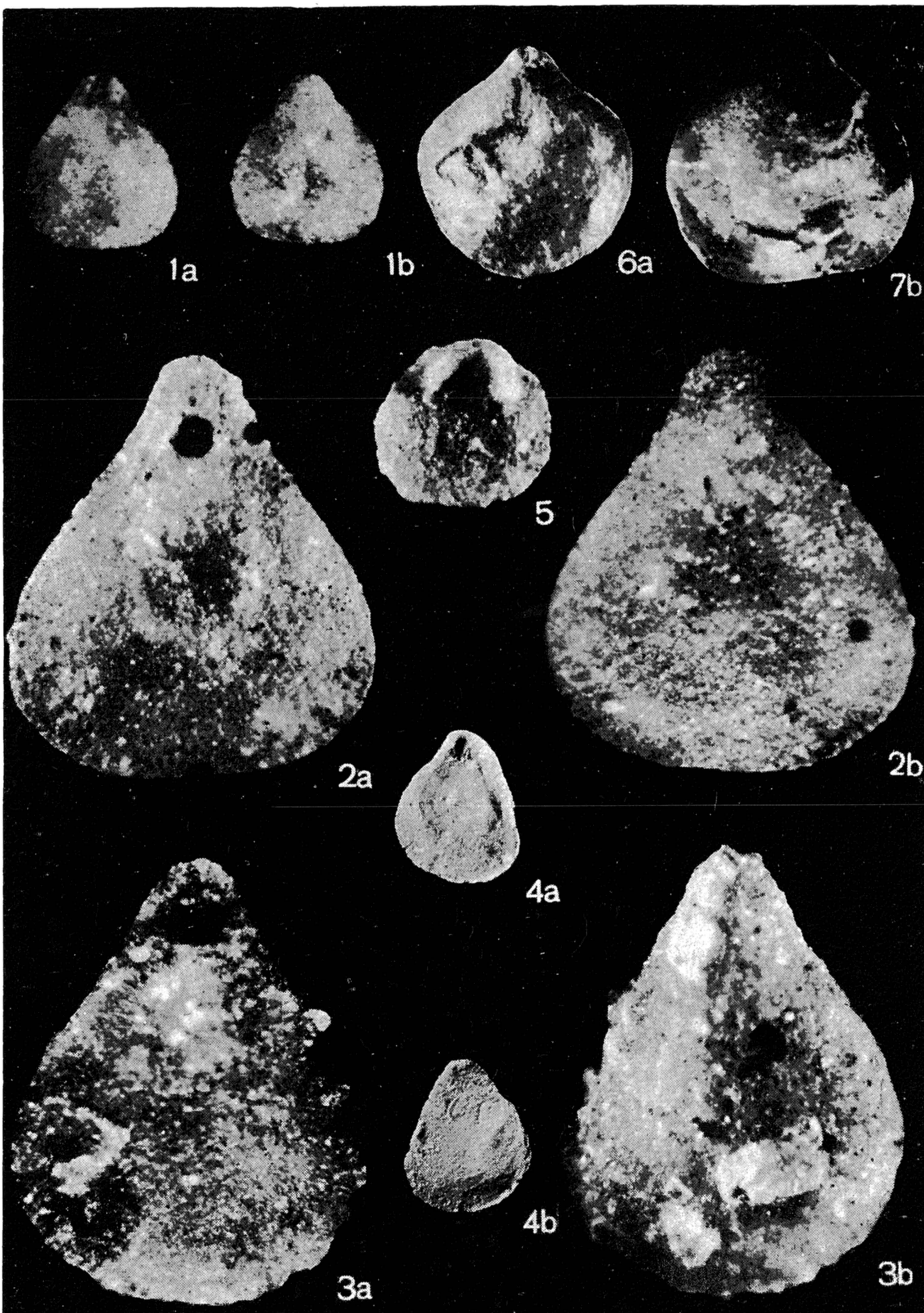
MUIR-WOOD H. M. 1965. Hesozoic and Cenozoic Terebratulidina. *In*: MOORE R. C. *(Ed.)*, Treatise on Invertebrate Paleontology, Part *H2*, *H762—H816*. Lawrence.
NOWAKOWSKI E. 1972. *Coenothyris vulgaris* (Schlotheim) z warstw terebratulowych dolnego wapienia muszlowego Strzelc Opolskich. [*Unpublished M. Sc. thesis*; Faculty of Biology, University of Warsaw.]
POPIEL-BARCZYK E. & SENKOWICZOWA H. 1981. Juwenilne terebratulidy środkowego triasu z otworu wiertniczego Żebrak *IG 1* (Podlasie). *In:* Materiały V Krajowej Konferencji Paleontologów, pp. 35—41. Warszawa.
SENKOWICZOWA H. 1958. New data on the Middle Triassic upon the area of northeastern Polan. *Kwart. Geol.*, 2 (4), 722—739. Warszawa.
— 1972. Holothurioidea and Ophiuroidea in the Lower Maschelkalk from borehole Żebrak. *Kwart. Geol.* 16 (4), 887—896. Warszawa.
— & SZYPERKO-ŚLIWCZYŃSKA A. 1972. Stratygrafia i paleogeografia triasu. *Biul. Inst. Geol.*, 252, 135—151. Warszawa.
STEINICH G. 1965. Die articulaten Brachiopoden der Rügener Schreibkreide (Unter--Maastricht). *Paläont. Abh. A.*, II (1), 1—200. Berlin.
USNARSKA-TALERZAK K. 1981. Uwagi o *Coenothyris vulgaris* (Schlotheim) z zespołu brachiopodowego warstw terebratulowych Wyżyny Śląsko-Krakowskiej: *In*: Materiały V Krajowej Konferencji Paleontologów, pp. 30—34. Warszawa.

E. POPIEL-BARCZYK i H. SENKOWICZOWA

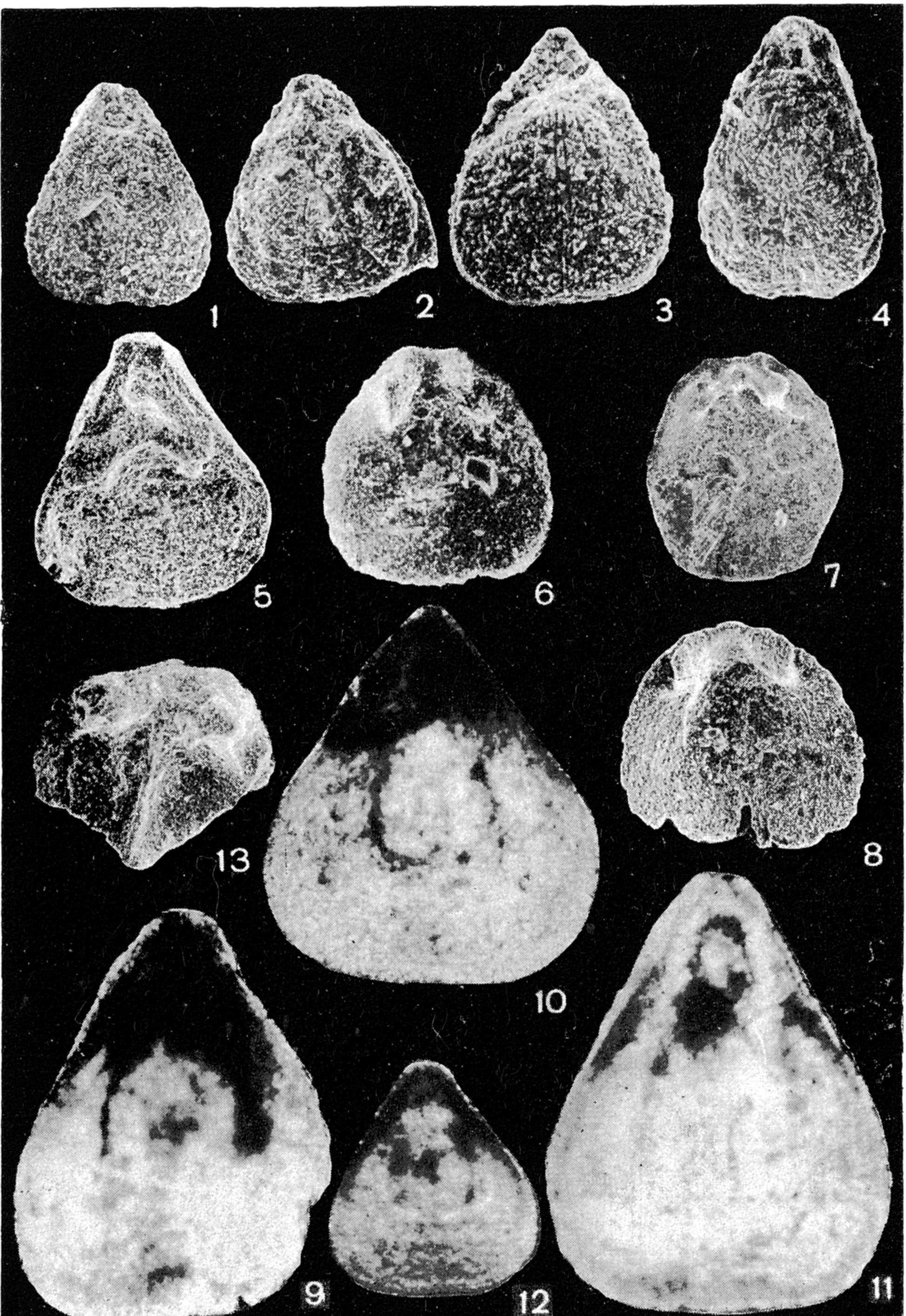
JUWENILNE TEREBRATULIDY ŚRODKOWEGO TRIASU Z OTWORU WIERTNICZEGO ŻEBRAK NA PODLASIU

(Streszczenie)

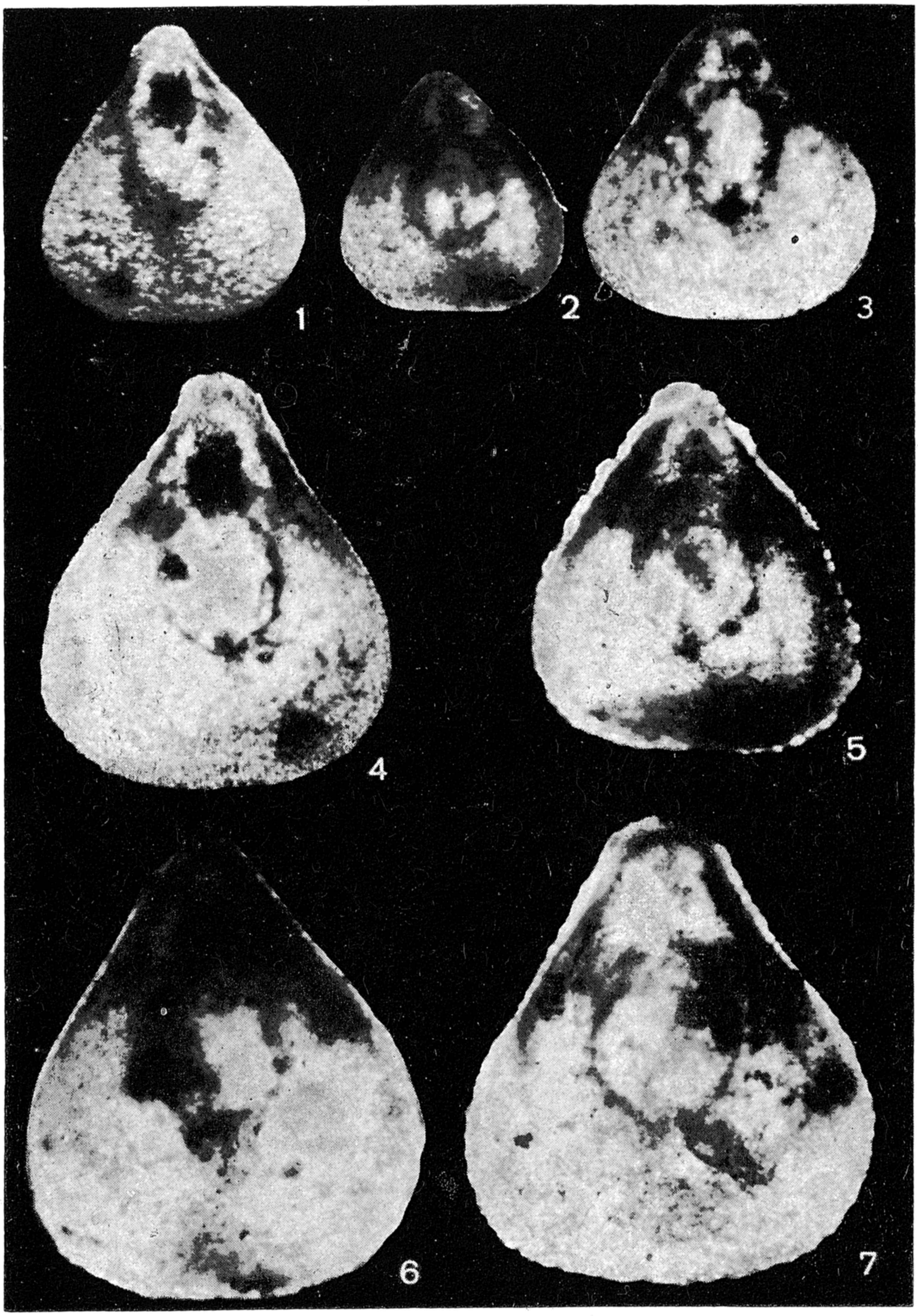
Przedmiotem pracy jest analiza juwenilnych terebratulidów z osadów dolnego wapienia muszlowego napotkanych w wierceniu Żebrak *IG-1* na Podlasiu (fig. 1—2). Stan zachowania okazów pozwolił na zbadanie wnętrza muszli najmniejszych form o długości od 0,25 do 4,00 mm metodą szlifów seryjnych (fig. 3—8) oraz prześwietlania w cieczach imersyjnych okazów pustych (pl. 2—4). Poznano w ten sposób bardzo wczesne stadia rozwoju aparatu ramieniowego, identyfikując wśród nich następujące: *1* stadium „precentronelliform", *2* stadium „centronelliform", *3* stadium zbliżone do „quasipremagadiniform", oraz *4* stadium zbliżone do „quasimagadiniform". Analiza budowy aparatu ramieniowego w stadiach *2, 3* i *4* pozwoliła stwierdzić, że badane juwenilne terebratulidy należą do gatunku *Angustothyris angustaeformis* (Boeckh). Znalezienie *A. angustaeformis* (Boeckh) na obszarze Podlasia przesuwa dotychczas znaną granicę występowania tego gatunku w Polsce oraz rozszerza zasięg rozprzestrzenienia rodziny Angustothyrididae w Europie (fig. 9).



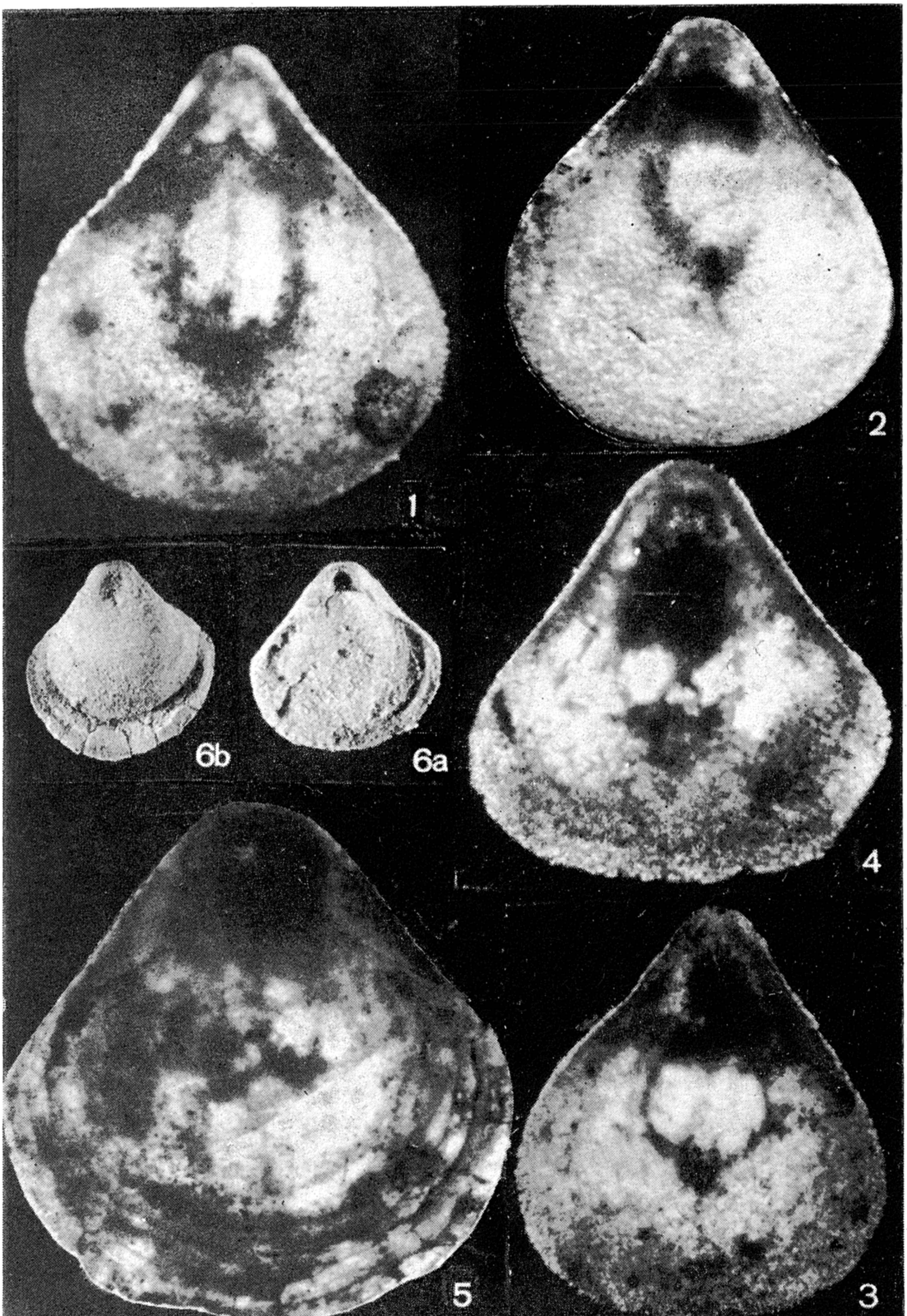
1—5 — Angustothyris angustaeformis (Boeckh), juvenile specimens with circular (*1, 2, 5*) and oval (*3, 4*) brachial valves; 5 — interior, visible are crural bases and high inner socket ridges; 1 and 5 — ×10, 2 and 3 — ×40, 4 — ×5; **6a** — mature specimen presumably of *Zeilleria edlingeri* (Assmann), ×2.5; **7b** — mature specimen presumably of *Angustothyris angustaeformis* (Boeckh), ×2.5
a — brachial and **b** — pedicle valve views



1—12 — *Angustothyris angustaeformis* (Boeckh), 1—5 — smallest juvenile specimens, 6—8 — interiors of brachial valves (*SEM*); 1 — ×78, 2 and 4 — ×90, 3 — ×120, 5 — ×47, 6 — ×21, 7 — ×60, 8 — ×51; 9—12 — specimens with their loop at the "precentronelliform" stage (transmitted light), 9—11 — ×70, 12 — ×40; **13** — interior of juvenile brachial valve, presumably of *Zeilleria edlingeri* (Assmann), ×32 (*SEM*)



1—7 — *Angustothyris angustaeformis* (Boeckh), juvenile specimens with their loop at the "centronelliform" stage (transmitted light), 1 and 3 — ×47, 2 — ×40, 4 and 5 — ×50, 6 and 7 — ×60



1—6 — *Angustothyris angustaeformis* (Boeckh), 1—3 — juvenile specimens with their loop at a stage close to the "quasipremagadiniform", 1 — ×50, 2 and 3 — ×40; 4 and 5 — juvenile specimens with their loop at a stage close to the "quasimagadiniform", 4 — ×55, 5 — ×17 (transmitted light); 6 — specimen from Fig. 5 (reflected light), ×6