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Some representatives of the family Pygopidae (Brachiopoda) from the Tithonian of the Pieniny Klippen Belt

ABSTRACT: Three species of brachiopods of the family Pygopidae Muir-Wood, 1965: *Antinomia sima* (Zeuschner), *Pygope diphya* (Colonna) and *Pygope janitor* (Pictet) from the Middle and Upper Tithonian limestones of the Pieniny Klippen Belt are described. The writer's studies have included the features of external and internal structure of the shell. These species, much the same as the entire faunal assemblage occurring in the deposits under study, are indicative of a deeper and calmer Tethyan basin in the Tithonian of the Pieniny Klippen Belt.

INTRODUCTION

The fauna of brachiopods, including various pygopids, from the Pieniny Klippen Belt has already more than a hundred years ago been described in two fundamental monographs by Zeuschner (1864) and Zittel (1870), whose illustrations were later reproduced many times either directly (*e.g.* Pictet 1867, Dacqué 1921) or indirectly (*e.g.* Jarre 1962, Vogel 1966). During the wars both the holotypes and entire collections were lost or completely destroyed and, therefore, it seems advisable to reconstruct and elaborate anew the brachiopods from the Pieniny Klippen Belt.

More than 3,000 specimens of brachiopods (*cf.* Barczyk 1971) was recently collected by the writer from brachiopod- and crinoid-brachiopod--bearing limestones outcropping at Czorsztyn, Falsztyn and Rogoźnik and which, on the basis of the fauna of ammonites and aptychi, had been assigned (Birkenmajer 1963) to the Middle and Upper Tithonian.

The collection includes about 150 specimens of the Pygopidae, part of which assigned to the genus *Nucleata* Quenstedt were described separately (Barczyk 1972) and 74, belonging to *Antinomia* Catullo and *Pygope* Link, are the subject of the present paper.

Despite a large number of the specimens, the state of preservation of the material is unsatisfactory. Only about 15 per cent, mostly young and rarely adult individuals, have complete shells. Thirty-five per cent are pedicle and 20 per cent brachial valves, the rest being fragmentary umbonal or lobal parts of the shells.

The material is mostly suitable for the studies on the external morphology of the shell. Serial sections could be made of few specimens only. Most of the complete specimens are filled with crystals of calcite, which destroyed a delicate structure of the brachial apparatus.

Acknowledgements. The writer's thanks are extended to the Management of the Pieniny National Park at Krościenko for allowing him to collect fauna in the reserve, to Professor K. Birkenmajer for indication the occurrence places of brachiopod fauna and to Docent A. Radwański for making available his private collection of *Pygope janitor* (Pictet) from Rogoźnik and Mt. Osobita.

DESCRIPTION OF THE MATERIAL

Superfamily **Terebratulacea** Gray, 1840
Family **Pygopidae** Muir-Wood, 1965
Genus *ANTINOMIA* Catullo, 1851
Type species: *Terebratula dilatata* Catullo, 1851

Occurrence. — Upper Jurassic through Lower Cretaceous.

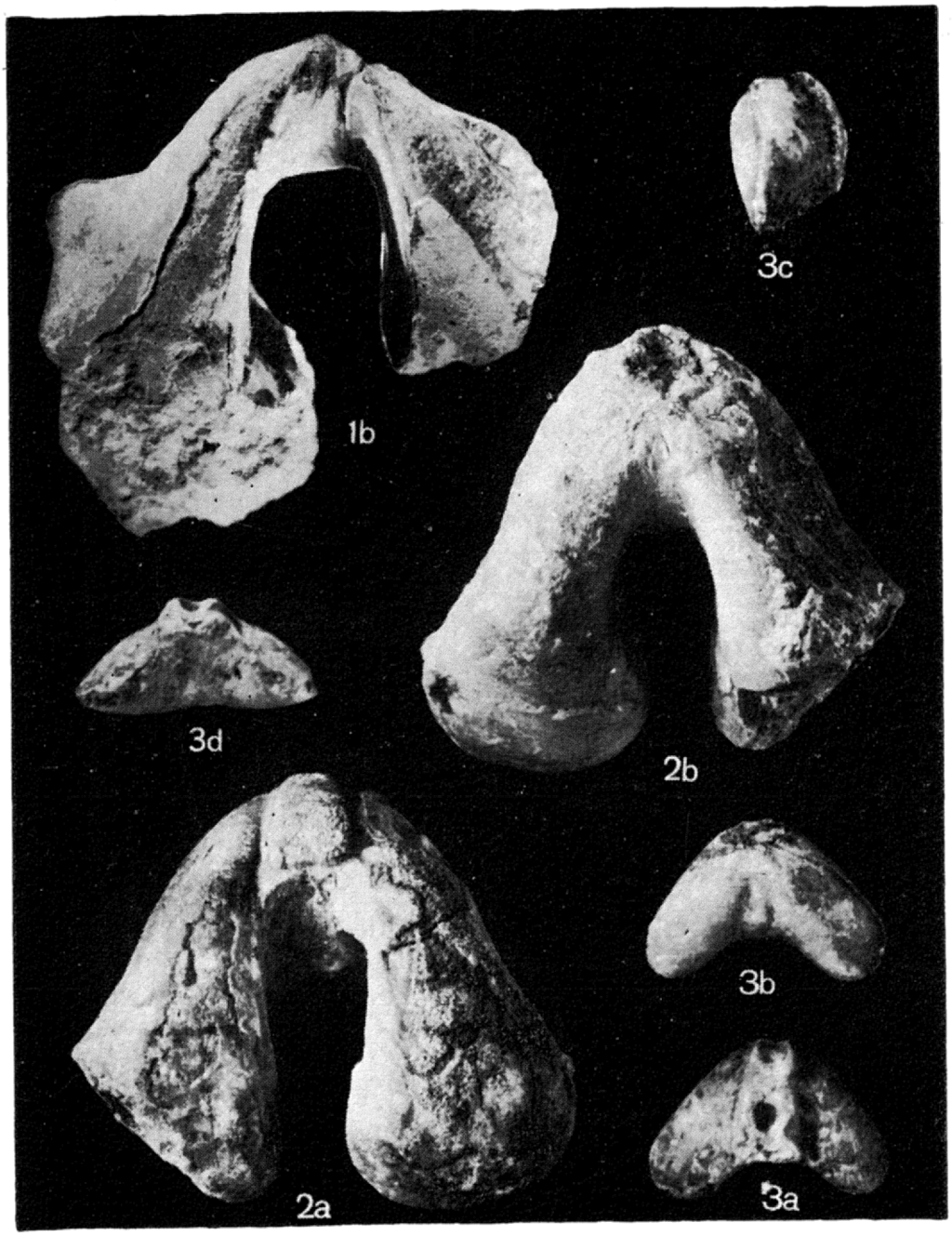
Diagnosis. — Shell large, biconvex, triangular in outline, with a deep sulcus dividing it into two lateral lobes. Lateral commissures strongly sinuous. Anterior commissure straight. Umbo short, robust, very strongly incurved perdeject. Pedicle foramen, round, tiny, situated on the beak. Loop very short, terebratulid. Pallial lines distinct, frequently branching dichotomously. Surface of both valves smooth.

Remarks. — The genus *Antinomia* is very similar to *Pygope*, except for a more triangular outline, deeper sulcus, sinuous lateral commissures and higher degree of the flattening of shell.

Antinomia sima (Zeuschner, 1846)
(Pl. 1, Fig. 1)

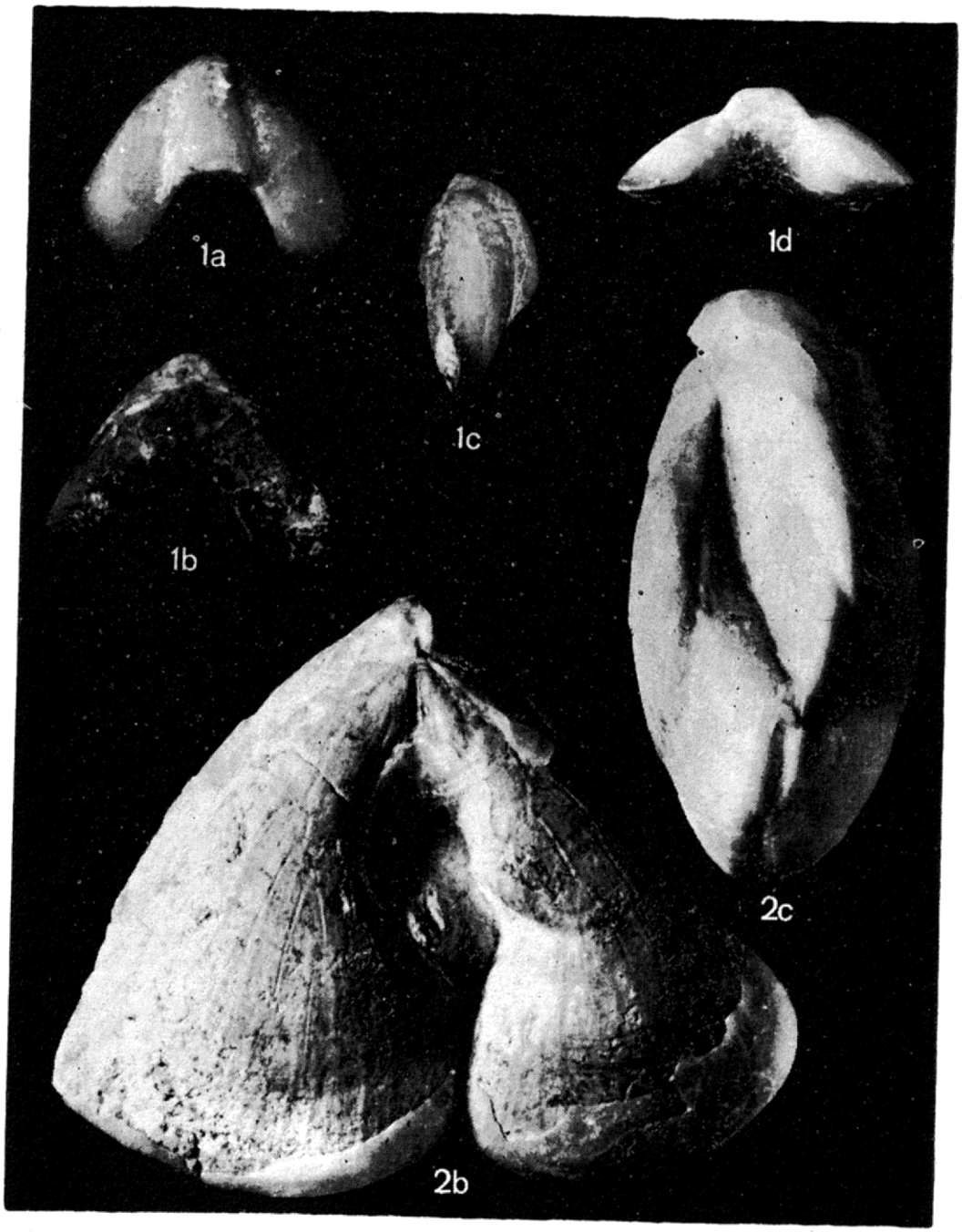
1846. *Terebratula sima* Zeuschner; L. Zeuschner, p. 20, Pl. 1, Figs 16—19; Pl. 2, Figs 1—3.
1867. *Terebratula sima* Zeuschner; F. Pictet, p. 176, Pl. 33, Figs 4—7.
1870. *Terebratula sima* Zeuschner; K. Zittel, p. 130, Pl. 13, Figs 11—14.
1906. *Antinomia sima* (Zeuschner); S. Buckman, p. 441, Pl. 41, Fig. 2.
1962. *Pygope sima* Zeuschner; P. Jarre, p. 61, Pl. D, Figs 7—8.

Material. — Nine specimens including three pedicle and one brachial valve and five determinable fragments of the shell.



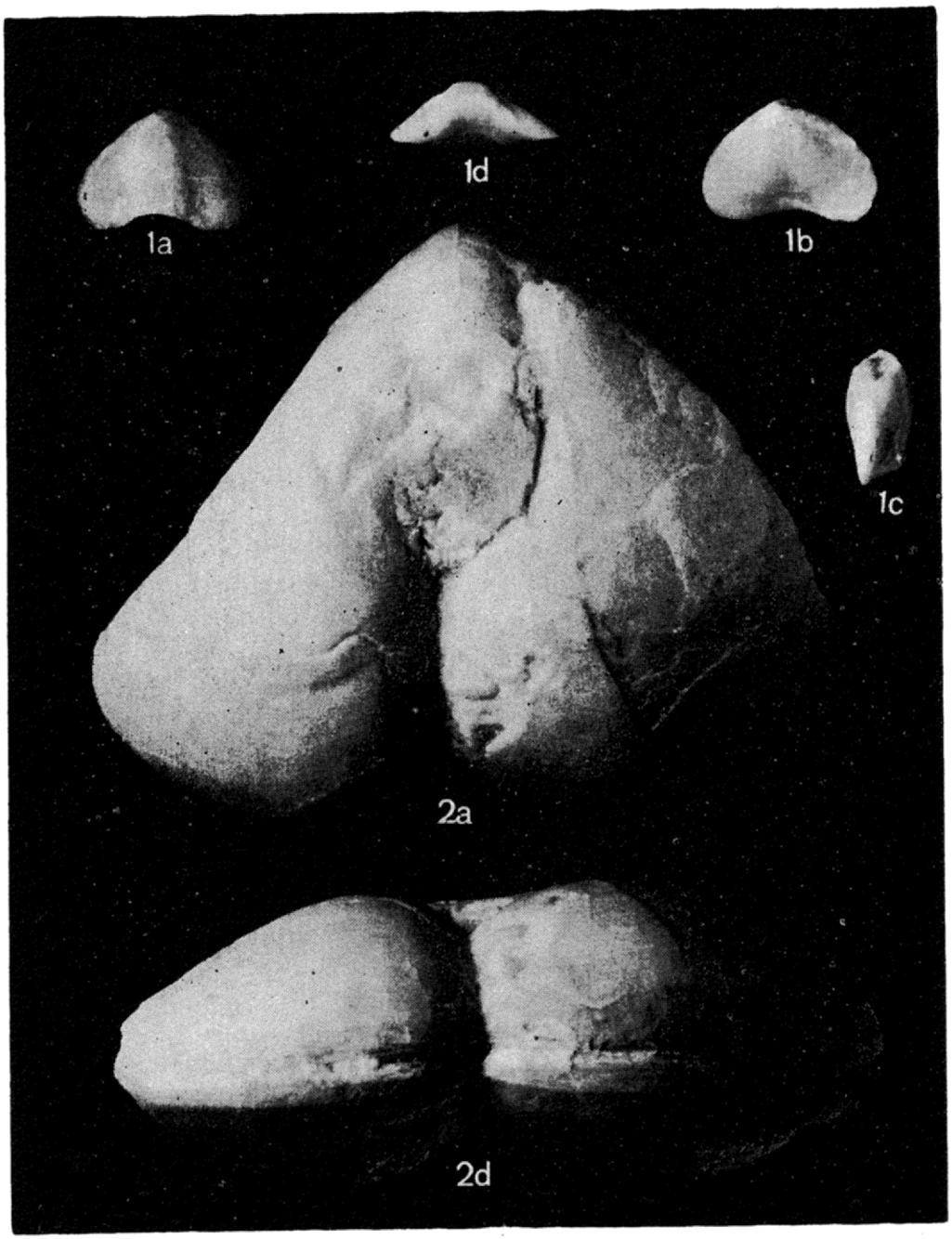
1 Antinomia sima (Zeuschner), 2—3 *Pygope diphya* (Colonna) (*2* adult specimen of triangular outline, *3* juvenile specimen). Both species from the Upper Tithonian at Czorsztyn; taken × 2

a — pedicle valve view, *b* — brachial valve view, *c* — lateral commissure view, *d* — anterior commissure view



Pygope janitor (Pictet); Upper Tithonian, × 2

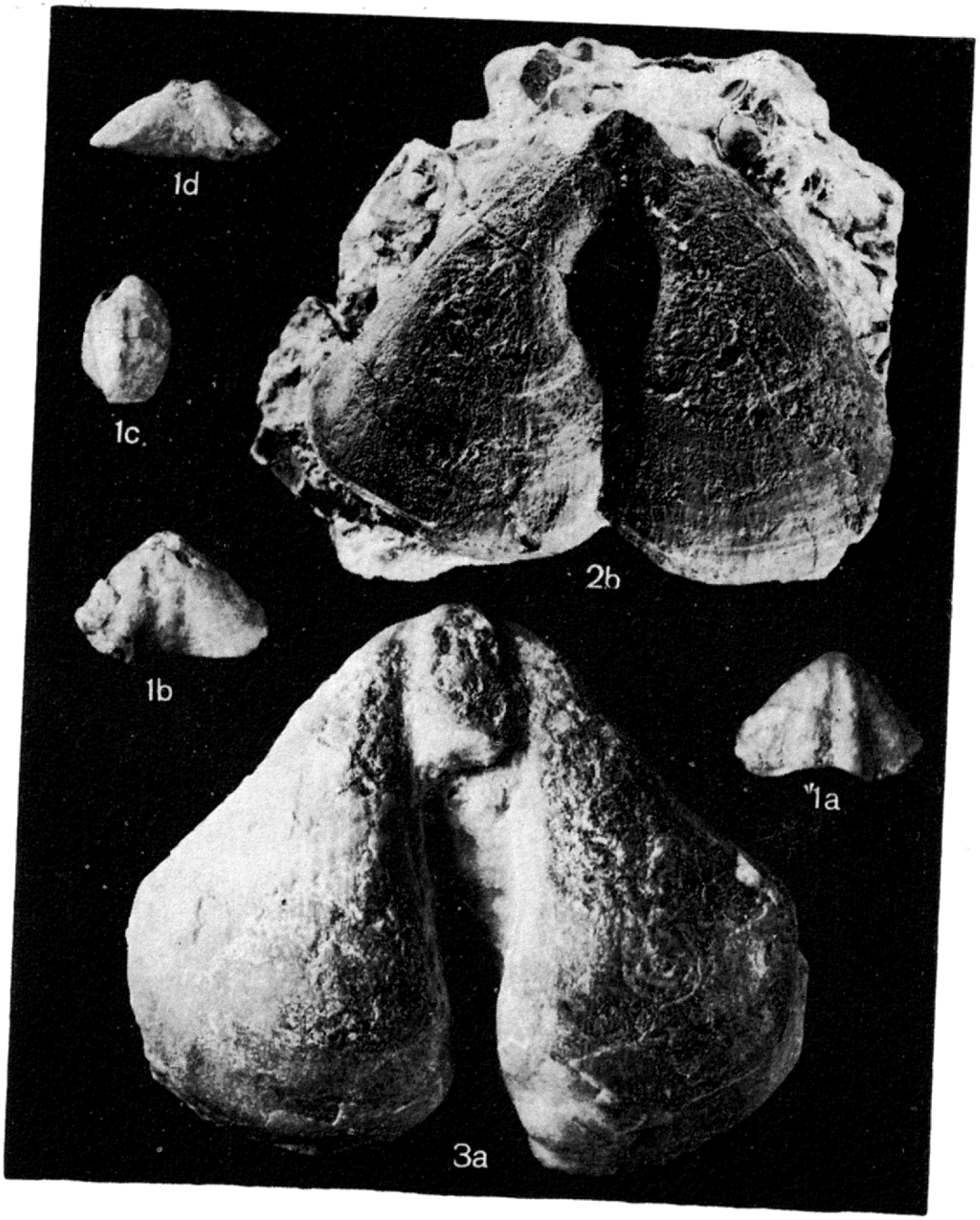
1 juvenile specimen from Czorsztyn, *2* adult specimen from Rogoźnik (*cf.* also Pl. 3, Fig. 2) *a* — pedicle valve view, *b* — brachial valve view, *c* — lateral commissure view, *d* — anterior commissure view



Pygope janitor (Pictet); Upper Tithonian, × 2

1 juvenile specimen from Czorsztyn, *2* adult specimen from Rogoźnik (the same as presented in Pl. 2, Fig. 2)

a — pedicle valve view, *b* — brachial valve view, *c* — lateral commissure view, *d* — anterior commissure view



Pygope diphya (Colonna); Upper Tithonian, Czorsztyn; × 2

1 juvenile specimen, *2—3* two adult specimens of circular outline *a* — pedicle valve view, *b* — brachial valve view, *c* — lateral commissure view, *d* — anterior commissure view

Dimensions (in *mm*):

Col. No.	Length (*L*)	Width (*W*)	W/L
MWP/P-1	32.1	39.8	125
MWP/P-3	28.4	36.6	128

Description. — Shell large, biconvex, slightly flattened near the anterior commissure, triangular in outline, with a deep sulcus dividing it as far as to three quarters of its length and forming two distinct lateral lobes. Maximum length, 32.1 mm; maximum width, always larger than length, near anterior commissure. Lateral lobes occupy only three quarters of width, a free space of the deep sulcus occurs in the middle. Width/length ratio (*W/L*) = 125. Umbo short, robust, strongly incurved over the brachial valve. Cardinal margin very short, somewhat arcuate. Lateral commissures strongly sinuous, at first bent towards the brachial and from halfway the length of the shell—towards the pedicle valve. Anterior commissure rectimarginate. Pedicle foramen tiny, almost invisible. A slightly swollen central fold is marked on the umbonal part of the pedicle valve.

Remarks. — The impossibility of tracing the internal structure prevents the writer from a revision of the species and accepting Jarre's (1962) hypothesis that Pictet's (1867) description and illustrations of *Antinomia sima* (Zeuschner) are in conformity with Jarre's description of his specimens of *Pygope catulloi* Pictet.

The fact that the specimens of *A. sima* come only from the Pieniny Mts, mostly from Czorsztyn and Rogoźnik, induces the writer to consider this species as an endemic one.

Occurrence. — The Upper Tithonian of the Pieniny Klippen Belt (Czorsztyn, Rogoźnik and Biała Woda).

Genus *PYGOPE* Link, 1830
Type species: *Terebratula antinomia* Catullo, 1827

Occurrence. — Upper Jurassic through Lower Cretaceous.

Diagnosis. — Shell large, biconvex, subround-triangular in outline, with a distinct fold on the pedicle valve and a deep central sulcus forming two separate lobes. In the adults of most species, lobes contact each other or together form the central perforation. Lateral commissures and anterior commissure rectimarginate. Umbo short, robust, strongly incurved perdeject. Pedicle foramen small, situated on the beak. Brachidium of the terebratulid type, in the form of a short loop. Pallial lines markedly dichotomous. Surface of both valves smooth.

Pygope diphya (Colonna, 1616)
(Text-fig. 1, and Pl. 1, Figs 2—3; Pl. 4, Figs 1—3)

1834. *Terebratula diphya* Buch; L. v. Buch, p. 196, Pl. 17, Fig. 9.
1837. *Terebratula diphya* Col.; B. Pusch, p. 15, Pl. 3, Fig. 13.
1846. *Terebratula deltoidea* Zeuschner; L. Zeuschner, p. 24.
1867. *Terebratula diphya* Buch; F. Pictet, p. 166, Pl. 31, Figs 1—9.
1871. *Terebratula diphoros;* F. Quenstedt, Pl. 47, Fig. 109.
1906. *Antinomia diphora* (Zeuschner); S. Buckman, p. 441, Pl. 41, Fig. 3.
1918. *Pygope diphya* Col.; L. Rollier, p. 263.
1962. *Pygope diphya* Columna; P. Jarre, p. 48, Fig. 5; Pl. *D*, Figs 1—3; Pl. *E*, Fig. 1.
1966. *Pygope diphya diphya* (Buch); J. Geyssant, p. 78, Pl. 3, Figs 1—2.

Material. — Thirty-seven specimens, including ten complete shells, eight pedicle and nine brachial valves and ten determinable fragments of the shell.

Dimensions (in *mm*):

Col. No.	Length (L)	Width (W)	Thickness (T)	W/L	T/L
MWG/P-8	38.4	45.8	23.1	122	59
MWG/P-17	30.6	32.1	16.2	104	53
MWG/P-40	10.1	14.9	6.9	146	46

Description. — *External morphology:* Shell large, biconvex, subround-triangular or triangular in outline, with a distinct fold, separated by two furrows in the umbonal part of pedicle valve, and with a deep sulcus cutting the shell into two separate lateral lobes. Maximum length, 38.4 mm; maximum width, occurring almost halfway the length of shell or near anterior commissure, is always longer than the length. Width/length (*W/L*) ratio 120 in adult and 150 in young individuals. Maximum thickness in halfway the length of shell, and *T/L* ratio always amounts to about 50. The triangular outline of shell is displayed by the specimens whose sulcus is deep and open, while more rounded are those with converging lateral lobes. Beak short, robust, strongly incurved. Pedicle foramen small. Cardinal margin short. Lateral commissures arcuate, their curvature facing the brachial valve. Anterior commissure rectimarginate.

Internal morphology: No cardinal process was observed in transverse section (Fig. 1). Dental sockets distinctly outlined by surrounding ridges, the inner one of

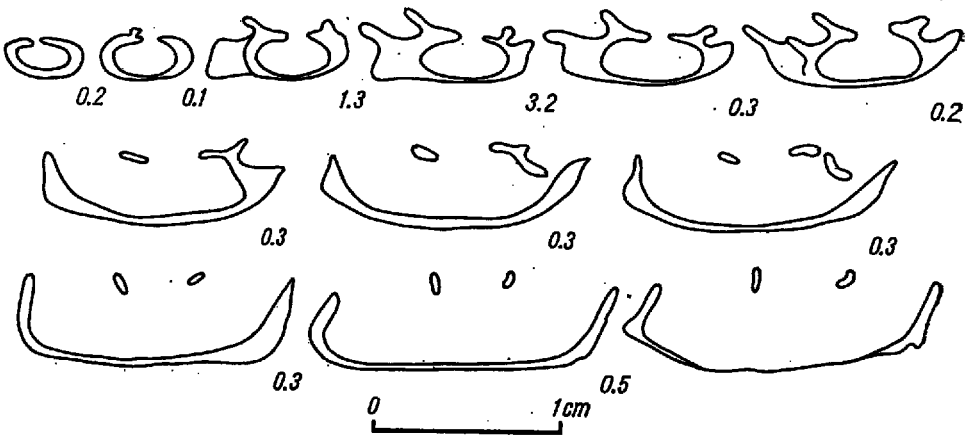


Fig. 1

Pygope diphya (Colonna), series of transverse sections

which fuses with hinge plates. These plates are slightly concave, parallel to the cardinal margin of the brachial valve. Crural processes short, straight, turning into thin, short branches of loop. The entire length of the loop reaches about one-sixth of the length of the brachial valve.

Remarks. — The species *Pygope diphya* (Colonna) displays a considerable similarity in shape to *P. janitor* (Pictet), from which it differs in a more rounded outline of the shell, arcuate lateral commissures, more distinct central sulcus and more centrally situated perforation in specimens with lateral lobes closing each other.

Occurrence. — The Tithonian of the entire Mediterranean Basin: Tunis, Algeria, Marocco, SE Spain, France, Italy, Yugoslavia and Czechoslovakia (*cf.* Geyssant 1966); in the Pieniny Klippen Belt — Upper Tithonian (Czorsztyn and Rogoźnik)

Pygope janitor (Pictet, 1867)
(Pl. 2, Figs 1—2; Pl. 3, Figs 1—2)

1867. *Terebratula janitor* Pictet; F. Pictet, p. 161, Pl. 29, Figs 4—6; Pl. 30, Figs 1—10.
1871. *Terebratula diphyoides;* F. Quenstedt, p. 365, Pl. 47, Fig. 119.
1906. *Pygope janitor* (Pictet); S. Buckman, p. 445, Pl. 41, Fig. 12.
1918. *Pygope janitor* Pictet; L. Rollier, p. 263.
1962. *Pygope janitor* Pictet sp.; P. Jarre, p. 38, Pl. *B*, Figs 3—5; Pl. *C*, Figs 1—8.
1966. *Pygope janitor* (Pictet); J. Geyssant, p. 76, Pl. 1, Fig. 8*a*—*c*.

Material. — Twenty-eight specimens, including five complete shells, six pedicle and three brachial valves, along with 14 determinable fragments of the shell.

Dimensions (in *mm*):

Col. No.	L	W	T	W/L	T/L
MWG/R-1	42.1	53.2	21.9	122	52
MWG/P-9	15.8	20.7	8.9	135	56
MWG/P-43	8.4	11.8	4.6	140	54

Description. — Shell large, triangular in outline, with a distinct fold in the umbonal part of the pedicle valve. Maximum length, 42.1 mm; maximum width, always larger than length, near the anterior commissure. Width/length ratio (*W/L*) averaging about 130. Maximum thickness recorded halfway the length, *T/L* ratio being 55. The triangular outline of the shell is emphasized by depressions in lateral margins. Lateral commissures at first are arcuately bent towards the brachial valve and subsequently, at one-quarter of the distance from the anterior commissure turn towards the pedicle valve. Anterior commissure rectimarginate. Umbo short, robust, strongly incurved over the brachial valve. Young specimens have a sulcus dividing the valve into two lateral lobes. In the adults, the lobes fuse together forming a depression in the anterior part of the shell and a more or less round perforation either in the central part of the shell or near the cardinal margin. No characteristic differences in the internal morphology of this species are observed as compared with *Pygope diphya* (Colonna).

Remarks. — The species *Pygope janitor* (Pictet) is very similar to *P. catulloi* Pictet (*cf.* Pictet 1867, p. 161, Pl 29, Fig. 4), from which it, however, differs in the position of central perforation and the outline of lateral commissure which in *P. catulloi* is similar to that observed in the genus *Antinomia*.

Occurrence. — The Tithonian of the entire Mediterranean Basin: Tunis, Algeria, Marocco, SE Spain, France, Yugoslavia, Czechoslovakia (*cf.* Geyssant 1966); in the Pieniny Klippen Belt — Upper Tithonian (Rogoźnik, Czorsztyn). In the Tatra Mts, the species occurs only in the Tithonian of Mt. Osobita.

ENVIRONMENTAL REMARKS

As follows from Birkenmajer's (1963) studies on the sedimentation of the Czorsztyn series of the Pieniny Klippen Belt, the greatest deepening of the basin occurred in the lower part of the Upper Oxfordian. Subsequently, up to a period as late as the Cretaceous, the basin became shallower and shallower. As shown by Vogel's (1966) studies on the morphology of shell and life conditions of the genus *Pygope*, as well as by the comparison with the mode of life of some of the Recent brachiopods which have a plectolophous brachial system, these animals lived, as a ben-

thos, in deeper and calmer waters. For this reason the writer believes that the Upper Tithonian deposits of the Czorsztyn series could not be formed during a considerable shallowing and that, much the same as in the areas of other klippen series, they were formed under moderately deep conditions.

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O KILKU GATUNKACH BRACHIOPODÓW Z RODZINY PYGOPIDAE MUIR-WOOD Z TYTONU PIENIŃSKIEGO PASA SKAŁKOWEGO

(Streszczenie)

Z odsłonięć w Czorsztynie, Falsztynie i Rogoźniku autor zebrał bogatą kolekcję brachiopodów z wapieni brachiopodowych i krynoidowo-brachiopodowych środkowego oraz górnego tytonu serii czorsztyńskiej (*por.* Birkenmajer 1963). W kolekcji liczącej ok. 3000 okazów (*por.* Barczyk 1971), 150 należy do rodziny Pygopidae Muir-Wood, z której rodzaje *Antinomia* Catullo i *Pygope* Link są przedmiotem niniejszego opracowania, zaś rodzaj *Nucleata* Quenstedt rozpatrzony został osobno (Barczyk 1972). Badaniami objęto cechy morfologii zewnętrznej i budowy wewnętrznej muszli trzech gatunków: *Antinomia sima* (Zeuschner), *Pygope diphya* (Colonna) oraz *Pygope janitor* (Pictet). Opisane gatunki (*por.* fig. 1 oraz pl. 1—4), podobnie jak cały zespół faunistyczny występujący w rozważanych osadach, wskazują na warunki stosunkowo głębokiego i spokojnego morza (*por.* Vogel 1966) w wyższym tytonie serii czorsztyńskiej.

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