Title: Conodont biostratigraphy of the Givetian/Frasnian boundary beds at Kostomłoty in the Holy Cross Mts

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Conodont biostratigraphy of the Givetian/Frasnian boundary beds at Kostomłoty in the Holy Cross Mts

ABSTRACT: The Upper Givetian fossiliferous limestones and marls exposed at Kostomłoty in the Holy Cross Mts, Central Poland, contain a rich conodont fauna which evidences the varcus through disparilis Zones. These zones have hitherto been unknown in the Holy Cross region, and the Givetian/Frasnian boundary runs within the overlying marl-shaly Szydłówek Beds. The Kostomłoty quarries are thought to be the key sections for the studies of this stage boundary in the Holy Cross Mts.

INTRODUCTION

The study of the Givetian/Frasnian boundary in the Holy Cross Mts is primarily linked with finding of the conodont-bearing localities (*see* RACKI 1980, SZULCZEWSKI 1981a). The present paper contains a description of the newly-discovered late Givetian conodonts, and a stratigraphic interpretation of the sequence exposed in the Laskowa Hill Quarry at Kostomłoty, NW of Kielce (*see* Text-fig. 1).

The Devonian strata of the Kostomłoty Hills have long been studied (*see* SZULCZEWSKI 1971), and the stratigraphy of their Frasnian deposits is based on conodonts (SZULCZEWSKI 1971, 1981b). More detailed characteristics of the sections and their macrofauna is given in a separate paper (RACKI & *al.* 1985).

GEOLOGIC SETTING

The Laskowa Hill Quarry is the southernmost of the three western Kostomłoty quarries situated in the southern limb of the Miedziana Góra syncline (Text-fig. 1).

In the quarry exposed are dolomites (over 100 m thick), chiefly black and cocarse-crystalline. The topmost part of the sequence is exposed in the NE-part of the quarry, where the dolomites are overlain by variably dolomitized limestones, marls and shales (Text-figs 2—3*A*). These deposits are totally dolomitized to the west (section *L-I* — *see* RACKI & *al.* 1985). The erosional contact with transgressive Permian conglomerates is well visible, particularly in the northern wall of the quarry (Text-figs 3*A*—*B*).

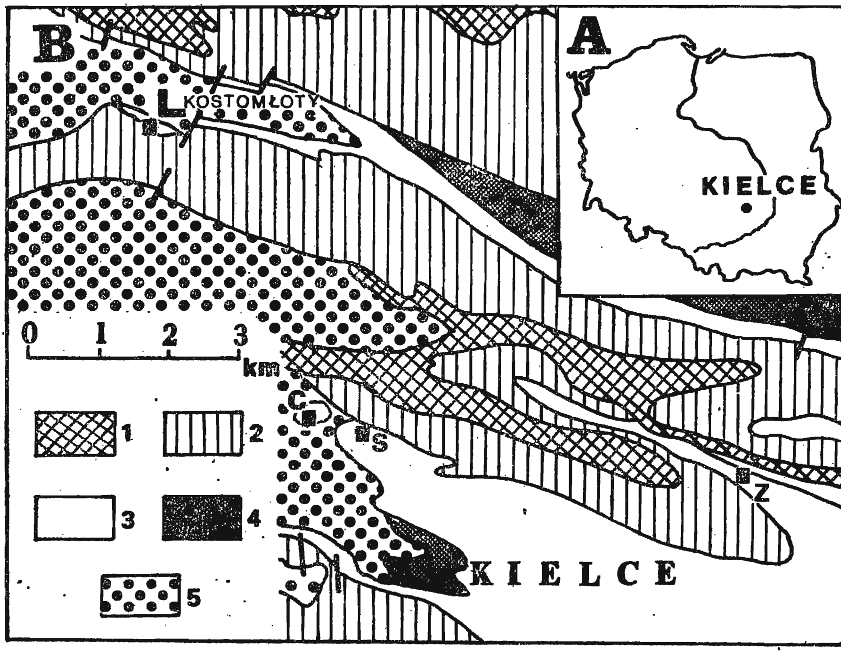


Fig. 1. Location of the discussed exposures: A — in Poland, and B — in the western part of the Holy Cross Mts (*taken from* SZULCZEWSKI 1971, Text-fig. 1; *simplified*)

1 Cambrian, Ordovician and Silurian; **2** Lower and Middle Devonian; **3** Upper Devonian; **4** Lower Carboniferous; **5** post-Variscan cover

L — Laskowa Hill and adjacent quarries, C — Czarnów (Grabinowa Hill), S — Śluchowice Quarry, Z — Szydłówek

Two distinct lithologic sets occur above dolomites in the NE-part of the quarry (*see* Text-figs 2 and 4). The set *A* is composed of dark, bedded and fossiliferous, chiefly coral and crinoid-brachiopod limestones and marls. It represents new lithostratigraphic unit, which probably is more or less dolomitized in the Kielce area (RACKI & *al.* 1985).

The set *B* is built of black to gray shales and brown-reddish marls with *Styliolina* and a few intercalations of black colored, detrital, mostly brachiopod limestones, including thick beds of intrabiorudites in the bottom part; it is considered as the lowermost member of the Szydłówek Beds (*see* SZULCZEWSKI 1981b). The higher part of this marl-shaly succession and overlying detrital Kostomłoty Beds are well exposed in the northern Kostomłoty quarries (Text-figs 2 and 3*C*), viz. Krzemucha (partly covered presently) and Kostomłoty-II (= Małe Górki).

THE INVESTIGATED MATERIAL

The sampling was made in the temporarily abandoned parts of the Laskowa Hill Quarry (chiefly section *L-II*; *see* Pl. 1, Fig. 1) during 1983; the section has been quarried in 1984. The remaining sections (*L-III*—*L-VI*; *see*

Text-figs 3*A*—*B* and 4, Pl. 1, Fig. 2) were studied in 1984 in course of active exploitation in the quarry.

Very different frequencies were stated in 35 samples and apart of the negative samples (mostly dolomites), the others contain above 100 specimens per kg of rock, *e.g.* those coming from the crinoid calcarenites of set *A*. Rich fish remains, including clododontiform shark teeth (Pl. 6, Fig. 1), and pyritized ostracodes and tentaculitids are accessory elements in several samples (*see* RACKI & *al.* 1985).

For the present study over 900 conodont specimens have been obtained from 25 samples (Table 1). The material contains many species which have so far been unknown from the Holy Cross Mts and even from Poland. Main emphasis is put on the platform elements, which are important in biostratigraphy, and the most diagnostic species of *Klapperina, Polygnathus, Schmidtognathus*(?) and *Icriodus* are described; the others are only figured (Pl. 6, Figs 2—7 and 9). Taxonomic treatment of the *Polygnathus cristatus* — *Klapperina* lineage (*cf.* Text-fig. 5) is generally in conformity with that given by ZIEGLER & KLAPPER (1982).

Table 1

Distribution and frequency of conodonts in particular sections of the Laskowa Hill Quarry
Po — *Polygnathus*, Ic — *Icriodus*, Sch — *Schmidtognathus*, Kl — *Klapperina*, Oz — *Ozarkodina*

CONODONT ZONATION	Middle-Upper varcus Subzones	hermanni-cristatus Zone - disparilis Zone		Upper hermanni-cristatus Subzone - disparilis Zone	disparilis Zone		disparilis Zone - Lowermost asymmetricus Zone		? varcus Zone	Middle-Upper varcus Subzones	?Middle-Upper varcus Subzones		?Middle varcus Subzone - disparilis Zone		disparilis Zone	disparilis Zone Lower asymmetricus Zone		Middle varcus Subzone - disparilis Zone	disparilis Zone	?	?disparilis Zone	?hermanni-cristatus Zone - disparilis Zone	disparilis Zone - Lowermost asymmetricus Zone		
Number of the sample	L - II								L - III									L-IV		L-V		L-VI			
Conodonts	a	14	19	26	37	39	44	50	4	6	8	11	18	20	29	46	47	18	41	9	16	11	25	40	45
Po. linguiformis	5								2	7	1	6	1	6				2		8					
Po. ansatus	2									4															
Po. ex gr. varcus	2								1	7															
Ic. l. latericrescens	1											2													
Ic. sp. indet.	7	5	20						5	12		4		11				6		4					
Po. dubius		20	82	21	19	60	2								7	2	2		28		2	40	16	18	3
Po. limitaris		1			1										1				2						
Po. cf. ovatinodosus			3							3												4			
Sch. cf. wittekindi			3												1				1			?1			
Po. cristatus				2	5	6									3				9				6	6	
Kl. (?) disparata					2	13									1				1				1		
Kl. disparilis					5	1		1							2								8	4	1
Sch. (?) peracutus					2	2													11				1		
Oz. semialternans																		1							
Kl. (?) aff. disparata																					1				
Po. cf. ordinatus																							1		

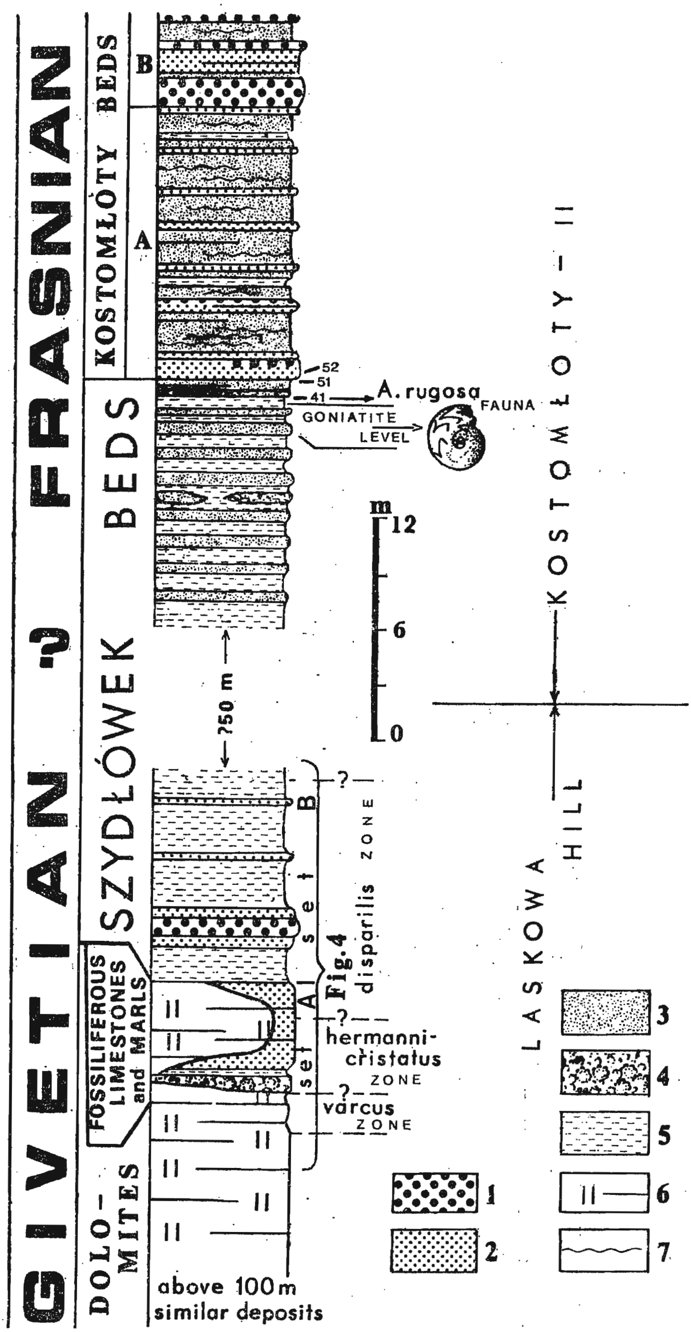
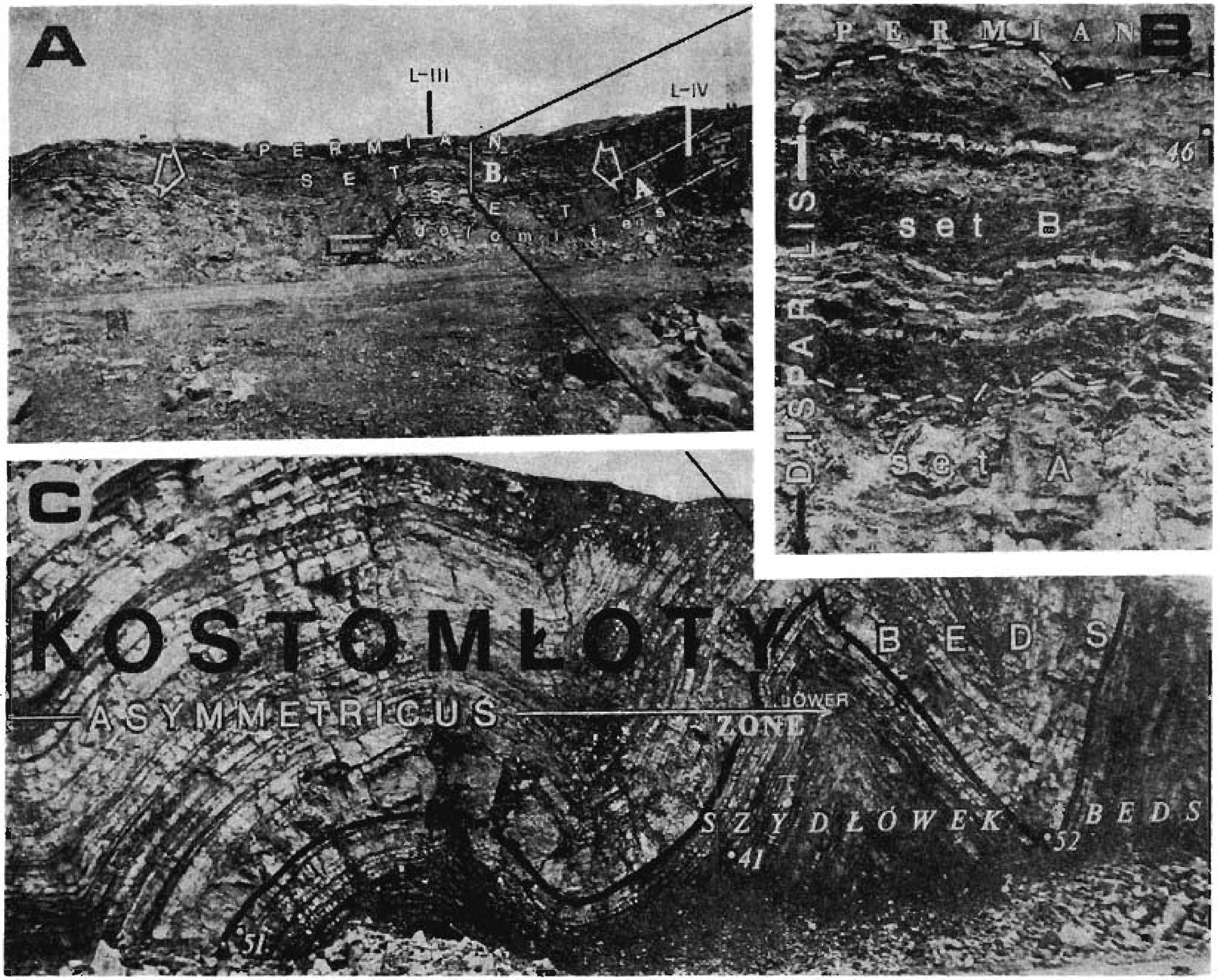


Fig. 2. Generalized section of the Kostomłoty quarries (*taken from* RACKI & *al.* 1985, Text-fig. 3)

1 calcirudites, 2 calcarenites, 3 pelitic and marly limestones, 4 biolithites, 5 marls and marly shales, 6 dolomite sand dolomitic limestones, 7 nodular structure and wavy-bedding

41, 51 and 52 — conodont samples taken at the Szydłówek/Kostomłoty Beds boundary

Szydłówek Beds at the Kostomłoty quarries

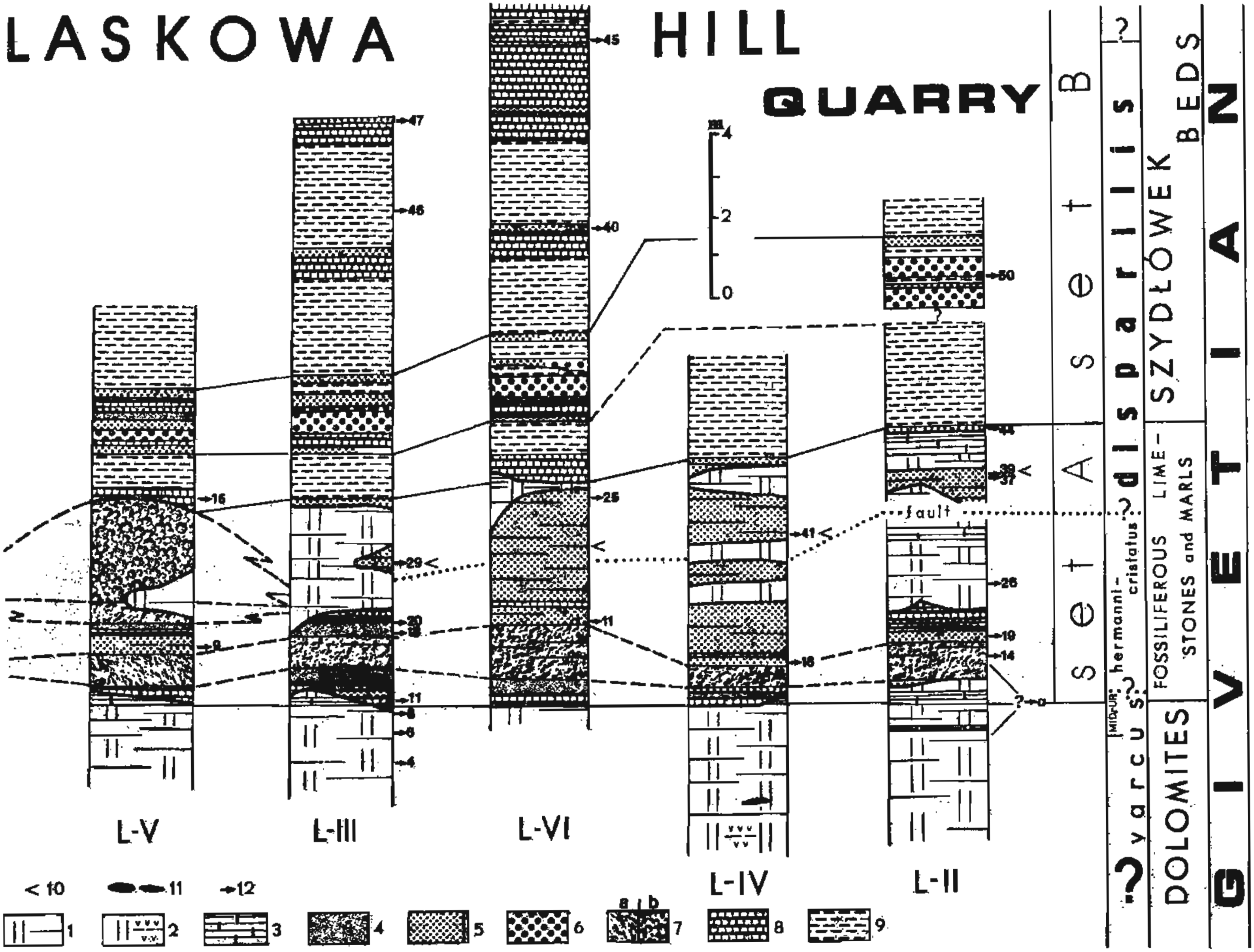


A-B — Northern wall of the Laskowa Hill Quarry (May 1984) showing lowermost part of Szydłówek Beds (= set *B*) and underlying strata; details of the bottom boundary are shown in Text-fig. 3*B*; note lateral variation of the intrabiorudite bed (*arrowed*); *L-III* and *L-IV* — studied sections (*see* Text-fig. 4); conodont sampling site (*46*) is indicated

C — Eastern wall of the Kostomłoty-II Quarry showing boundary between the Szydłówek and Kostomłoty Beds (*see* Text-fig. 2); conodont sampling sites (*41*, *51* and *52*) are indicated

Correlation of the Laskowa Hill profiles

(taken after RACKI & *al.* 1985, Text-fig. 4; *modified*)



1 — differently colored dolomites, 2 — black "*Amphipora*" dolomites, 3 — partly dolomitized marls and shales, 4 — calcilutites, 5 — calcarenites with crinoids and/or brachiopods, 6 — calcirudites, 7 — Tabulata-dominated biolithites (*a* biostromes , *b* calcilutite bioherm), 8 — marly limestones and marls, 9 — marly shales with *Styliolina*, 10 — intraclasts, 11 — cherts, 12 — conodont samples (*see* Table 1)

The most common are narrow-platformed polygnathids treated as the species *P. dubius* HINDE. A higher content (up to 30 per cent) of the wide-platformed forms has been stated only in a few samples. The conodonts are always very dark colored and frequently have a basal plate preserved. Jointly with common ferruginеous and pyrite incrustations it makes disopportunities in the recognition of some characters, especially of a basal pit. In many cases a compactional deformations occur (*cf.* Pl. 2, Fig. 5 and Pl. 6, fig. 9), causing *i. a.* the breakage of larger free blades.

SYSTEMATIC ACCOUNT

Genus *Klapperina* LANE, MÜLLER & ZIEGLER, 1979
Type species: *Klapperina disparalvea* (ORR & KLAPPER, 1968)

REMARKS: LANE & *al.* (1979) proposed *Klapperina* as a new genus, to contain the palmatolepid-like species *K. disparalvea* (ORR & KLAPPER) and *K. disparilis* (ZIEGLER & KLAPPER) displaying a large basal cavity and a weak development or absence of the central node (the most diagnostic feature of *Palmatolepis*). It is believed that *Klapperina* is derived from *Polygnathus cristatus* HINDE and the evolutionary lineage was parallel with the *Polygnathus asymmetricus* — *Palmatolepis* lineage.

KLAPPER (1980, p. 100) questioned validity of the genus, but ZIEGLER & KLAPPER (1982) suggest that *P. asymmetrious* — *Palmatolepis* lineage evolved from *Polygnathus dengleri* BISCHOFF & ZIEGLER at a substantially later time than second evolutionary line derived from *P. cristatus*.

Consequently, it seems reasonable to treat *Klapperina* as a valid genus (*cf. also* BULTYNCK & JACOBS (1981) containing the palmatolepid-like species group evolved from *P. cristatus*. As to the biostratigraphical aspect, *Klapperina* is limited to the Givetian/Frasnian boundary beds, and *Palmatolepis* remains an Upper Devonian genus, beginning undoubtly as late as the Lower asymmetricus Zone (*see* KLAPPER & JOHNSON 1980, Tables 12—13).

Klapperina disparilis (ZIEGLER & KLAPPER, 1976)
(Pl. 2; Pl. 4, Fig. 4)

1976. *Palmatolepis disparilis* sp. n.; ZIEGLER & KLAPPER, p. 119, Pl. 1, Figs 18—22, 24—31.
1981. *Klapperina disparilis* (ZIEGLER & KLAPPER); BULTYNCK & JACOBS, Pl. 7, Fig. 14.
?1981. *Schmidtognathus* aff. *pietzneri* ZIEGLER; MAŁKOWSKI, p. 225; Pl. 1, Figs 1—2, 9 and Pl. 2, Fig. 3.
1982. *Palmatolepis disparilis* ZIEGLER & KLAPPER; ZIEGLER & KLAPPER, pp. 467—468, Pl. 3, Figs 5, 7—15 [*with synonymy*].
1983. *Palmatolepis disparilis* ZIEGLER & KLAPPER; WANG & ZIEGLER, Pl. 3, Figs 4—5.

REMARKS: Apart of the typical specimens and those transitional to *Polygnathus cristatus* HINDE, there are a few others linked with *Klapperina disparalvea* (ORR & KLAPPER). Despite a well developed outer lobe and an extensive, *L*-shaped basal cavity (*see* Pl. 2, Figs 3—4), they lack any distinct constriction in the anterior-outer part of the lobe (like in *Palmatolepis proversa* ZIEGLER; *see* ZIEGLER 1973) and deep anterior adcarinal troughs as distinctly exemplified in typical material of *K. disparalvea* (ORR & KLAPPER 1968, pp. 1071—1072, Pl. 140, Figs 1—11). These and similar forms (*see* ZIEGLER & KLAPPER 1976, Pl. 1, Figs 24, 28—29; UYENO 1978, Pl. 2, Figs 8—9; BULTYNCK & JACOBS 1981, Pl. 7, Fig. 13; HUDDLE 1981, Pl. 6, Figs 3—5; ZIEGLER & KLAPPER 1982, Pl. 3, Fig. 11) may represent a separate species of *Klapperina* (*cf also* LANE & *al.* 1979, p. 217).

A juvenile specimen from Górno, east of Kielce, described by MAŁKOWSKI (1981, p. 225; Pl. 1, Figs 1—2, 9 and Pl. 2, Fig. 3) as *Schmidtognathus* aff. *pietzneri* ZIEGLER is considered as belonging to *Klapperina* and representing presumably this species; it is comparable to a juvenile specimen of *K. disparilis* figured by WANG & ZIEGLER (1983; Pl. 3, Fig. 4).

OCCURRENCE: The species *K. disparilis* is selected by ZIEGLER & KLAPPER (1982) as the guide species of the disparilis Zone; its occurrence is restricted to this very zone and to the Lowermost asymmetricus Zone (*see* ZIEGLER & KLAPPER 1976, 1982; KLAPPER & ZIEGLER 1979, Text-fig. 5; KLAPPER & JOHNSON 1980, Table 12).

Klapperina(?) *disparata* (ZIEGLER & KLAPPER, 1982) (Pl. 3, Figs 1, 3, 6)

1982. *Palmatolepis disparata* sp. n.; ZIEGLER & KLAPPER, pp. 466—467, Pl. 1, Figs 3—5 and Pl. 2, Figs 4—11.

REMARKS: The species is tentatively placed in *Klapperina*, because the basal pit (see Pl. 3, Fig. 6c), and also the central node, are weakly developed when compared to other species of the genus.

The specimens studied are chiefly transitional to *Polygnathus cristatus* HINDE.

OCCURRENCE: ZIEGLER & KLAPPER (1982, Text-fig. 1) recorded the range of *K.* (?) *disparata* as limited to the lower part of the disparilis Zone.

Klapperina(?) aff. *disparata* (ZIEGLER & KLAPPER, 1982) (Pl. 4, Fig. 5)

REMARKS: A peculiar specimen which entirely lacks the free blade despite the distinct central node. A very short free blade seems to be typical for the *K.* (?) *disparata* (ZIEGLER & KLAPPER). Consequently, the evolutionary connection with *Polygnathus alveoliposticus* ORR & KLAPPER (1968, pp. 1073—1074, Pl. 139, Figs 10—16; HUDDLE 1981, p. B25, Pl. 6, Figs 8—14 and Pl. 7, Figs 9—10), similar to that one between *P. cristatus* HINDE and *Klapperina*, seems possible.

OCCURRENCE: The specimen come from sample L-V/16 representing the disparilis Zone.

Genus *Polygnathus* HINDE, 1879
Type species: *Polygnathus dubius* HINDE, 1879

Polygnathus ansatus ZIEGLER & KLAPPER, 1976 (Pl. 3, Figs 2, 7)

1976. *Polygnathus ansatus* sp. n.; ZIEGLER & KLAPPER, pp. 119—120, Pl. 2, Figs 11—26.
1980. *Polygnathus ansatus* ZIEGLER & KLAPPER; BULTYNCK & HOLLARD, p. 42, Pl. 7, Fig. 13 and Pl. 9, Figs 1—3.
1983. *Polygnathus ansatus* ZIEGLER & KLAPPER; WANG & ZIEGLER, Pl. 5, Fig. 23.

REMARKS: In not very rich material there are mostly specimens with distinctly nodose platform (Pl. 2, Fig. 2), probably intermediate with *Polygnathus ovatinodosus* ZIEGLER & KLAPPER, as discussed by ZIEGLER & KLAPPER (1976, p. 124).

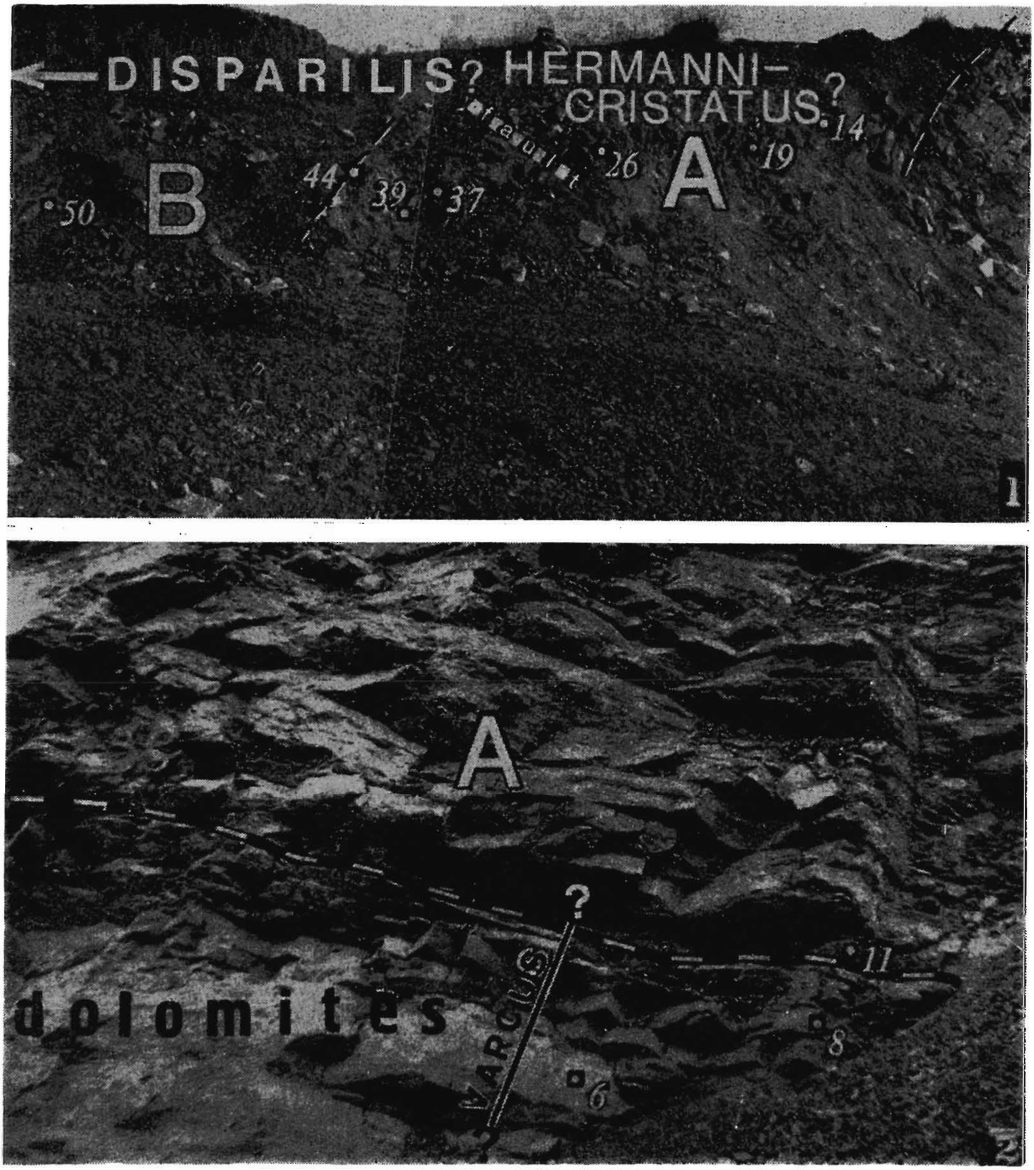
OCCURRENCE: Middle-Upper varcus Subzones (KLAPPER & ZIEGLER 1979, Text-fig. 5).

Polygnathus cristatus HINDE, 1879 (Pl. 3, Figs 4, 8; Pl. 5)

1981. *Polygnathus cristatus* HINDE; BULTYNCK & JACOBS, p. 18, Pl. 7, Figs 10—11.
1982. *Polygnathus cristatus* HINDE; MORZADEC & WEYANT, p. 33, Pl. 2, Figs 23—26.
1982. *Polygnathus cristatus* HINDE; ZIEGLER & KLAPPER, pp. 465—466, Pl. 1, Figs 1—2, Pl. 2, Fig. 3 and Pl. 3, Figs 3—4, 6 [*with synonymy*].

REMARKS: The concept of this variable species, used in the present paper, is in conformity with the most common understanding of the species, lately precised by ZIEGLER & KLAPPER (1982), although the exact character of the holotype cannot be finally resolved (HUDDLE 1981, p. B28).

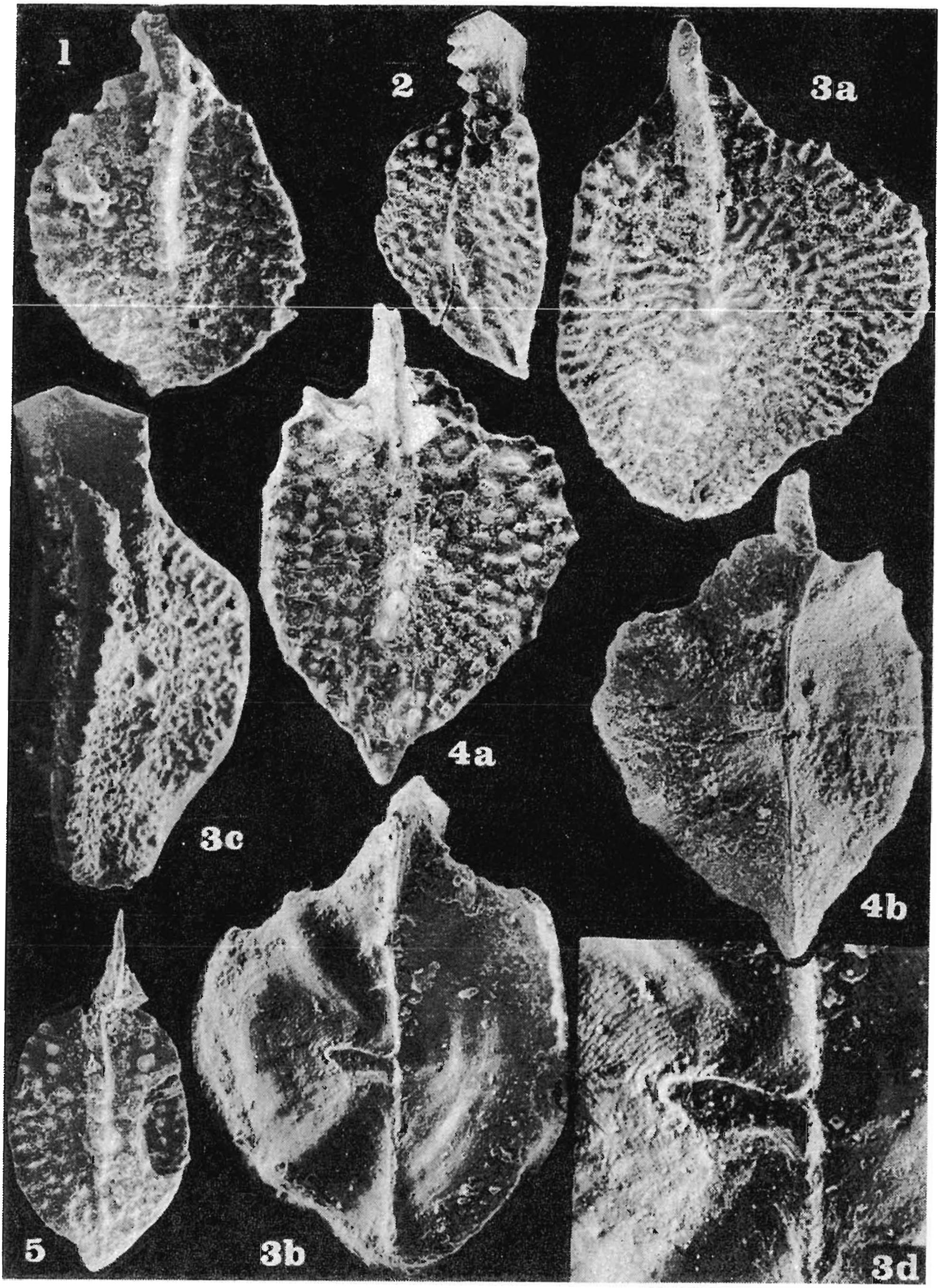
OCCURRENCE: Upper hermanni-cristatus Subzone through Middle asymmetricus Zone (KLAPPER & ZIEGLER 1979, Text-fig. 5).



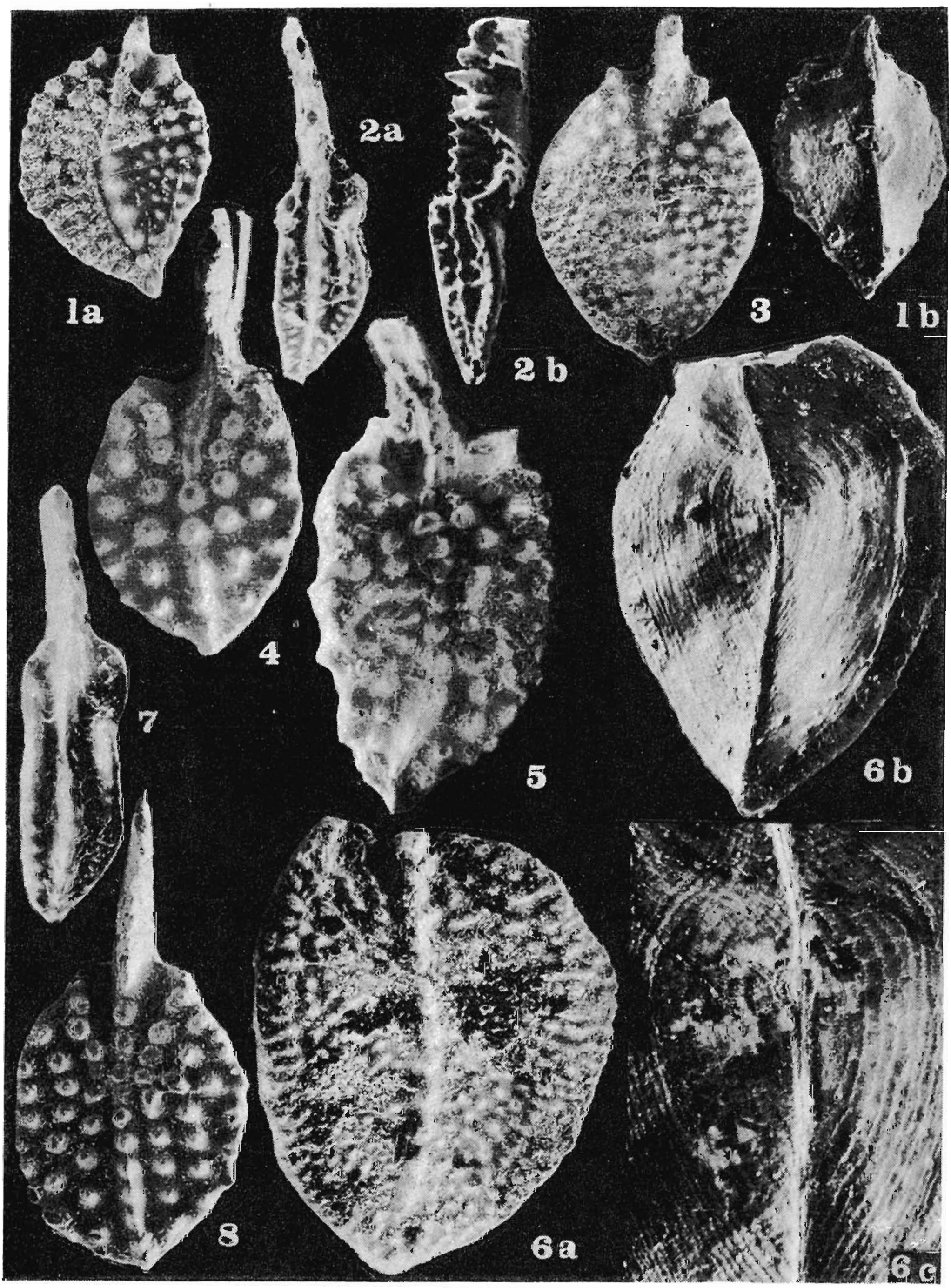
1 — NE part of Laskowa Hill Quarry (September 1983), section *L-II*

2 — Fragment of section *L-III* at northern wall of Laskowa Hill Quarry showing a contact of dolomites and fossiliferous limestones and marls (May 1984; *see also* Text-fig. 3*A*)

A-B — lithologic sets (*cf.* Text-fig. 4); numbers of conodont samples the same as in Table 1 and Text-fig. 4



1-5 — *Klapperina disparilis* (ZIEGLER & KLAPPER): *1—2, 3a, 4a, 5* upper, *3b* (magnified in *3d*), *4b* lower, *3c* lateral views; Laskowa Hill Quarry, sample L-II/37 (Figs 1—2, 5), L-II/39 (Fig. 4) and L-II/50 (Fig. 3); all X 50, except Fig. 3d taken X 130



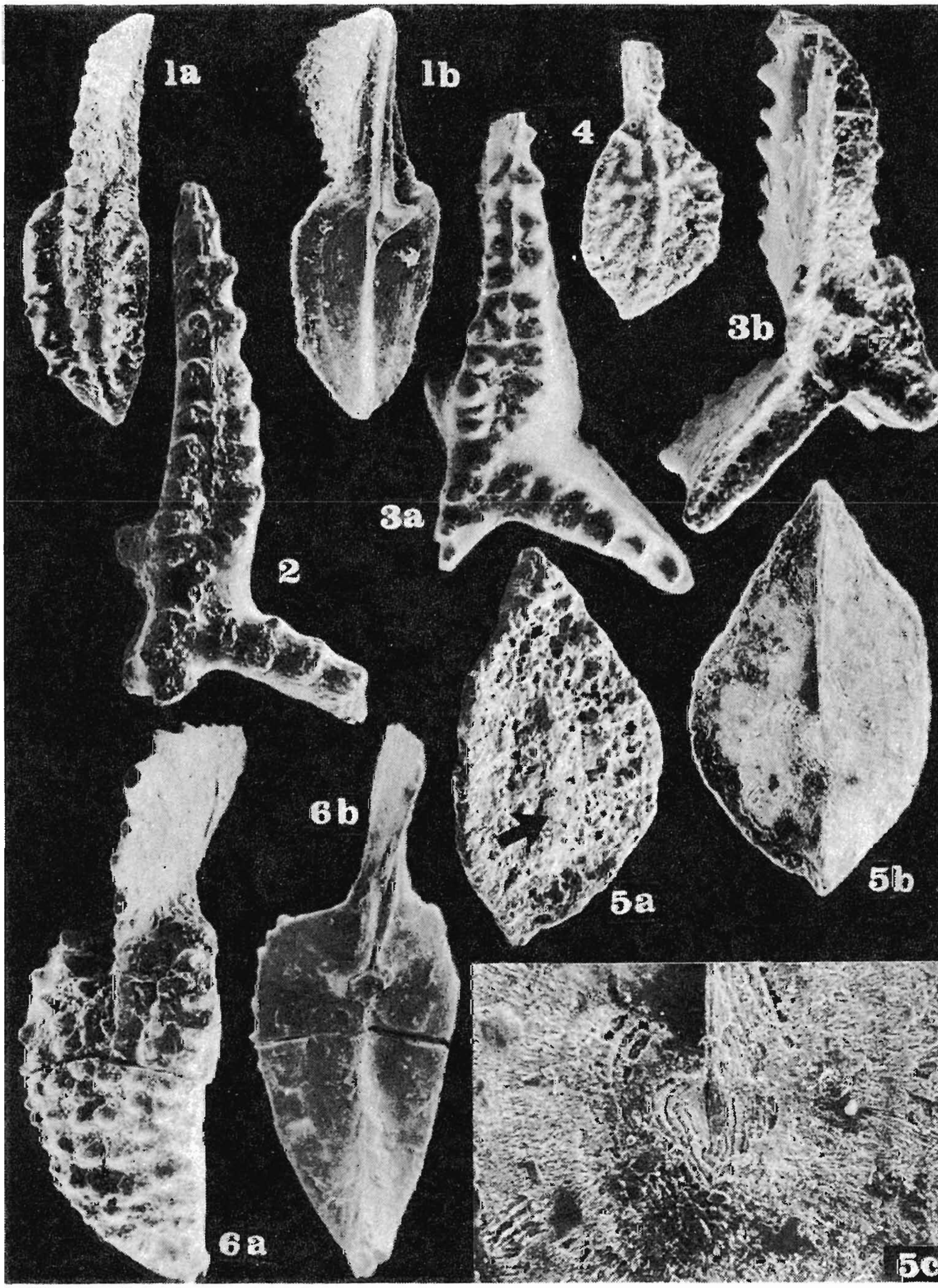
1, 3, 6 — *Klapperina* (?) *disparata* (ZIEGLER & KLAPPER); *1a, 3, 6a* upper, *1b, 6b* (magnified in *6c*) lower views; Laskowa Hill Quarry, sample L-III/39 (Fig. 3) and L-IV/41 (Figs 1, 6)

2, 7 — *Polygnathus ansatus* ZIEGLER & KLAPPER: *2a, 7* upper, *2b* lateral views, free blades partly broken; Laskowa Hill Quarry, sample L-II/a (Fig. 7) and L-III/6 (Fig. 2)

4, 8 — *Polygnathus cristatus* HINDE, upper views; Laskowa Hill Quarry, sample L-II/37

5 — *Polygnathus limitaris* ZIEGLER & KLAPPER, upper view; Laskowa Hill Quarry, sample L-II/14

All X 50, except Fig. 6c taken X 130



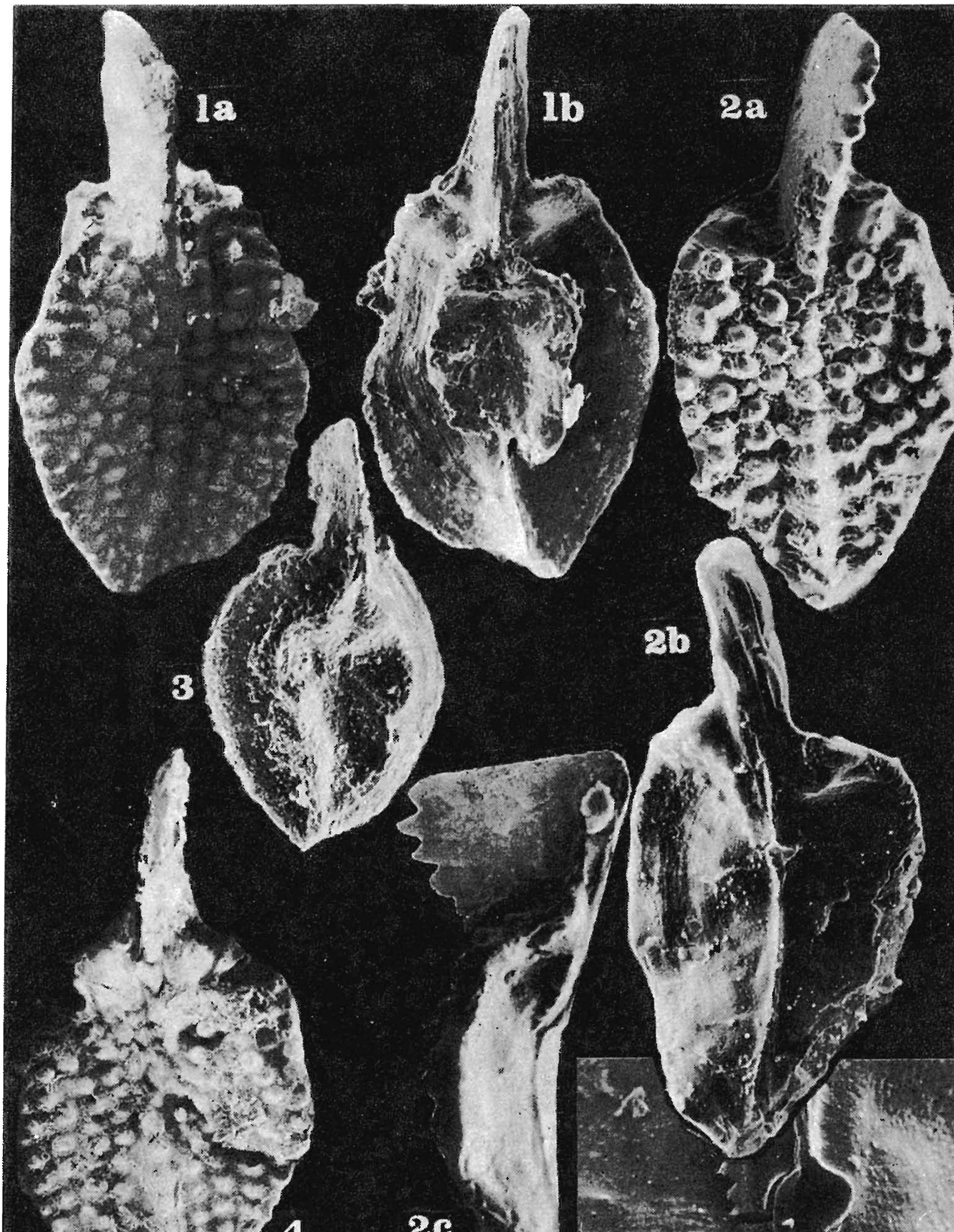
1, 6 — *Schmidtognathus* (?) *peracutus* (BRYANT): *1a, 6a* upper, *1b, 6b* lower views; Laskowa Hill Quarry, sample L-VI/25

2-3 — *Icriodus latericrescens latericrescens* BRANSON & MEHL: *2, 3a* upper, *3b* lower views; Laskowa Hill Quarry, sample L-II/a (Fig. 3) and L-III/11 (Fig. 2)

4 — *Klapperina disparilis* (ZIEGLER & KLAPPER), upper view of a juvenile specimen; Laskowa Hill Quarry, sample L-VI/40

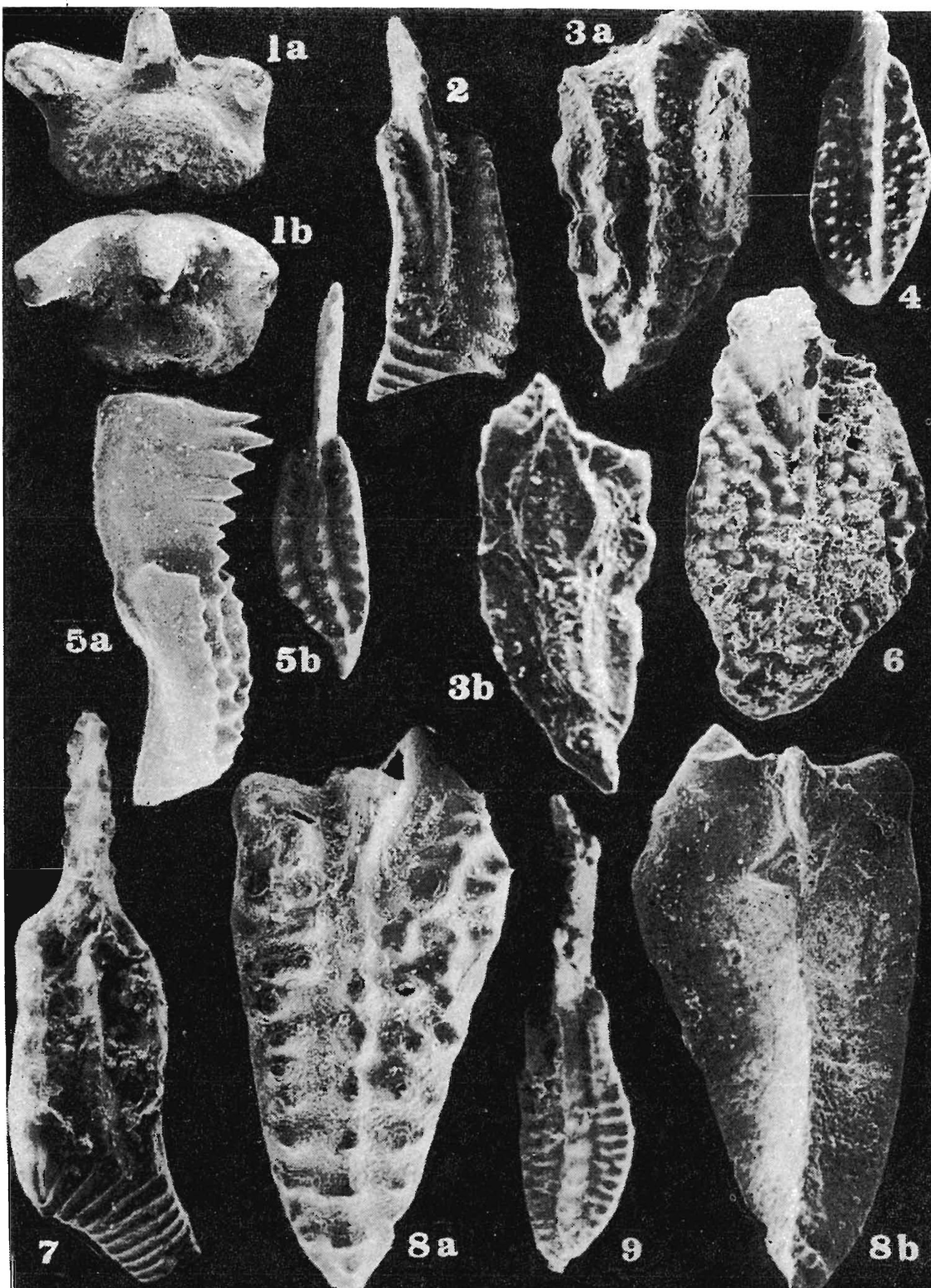
5 — *Klapperina* (?) aff. *disparata* (ZIEGLER & KLAPPER): *5a* upper, *5b* lower views, *5c* details of small basal cavity, note a central node (*arrowed*); Laskowa Hill Quarry, sample L-V/16

All X 50, except Fig. 5c taken X 130



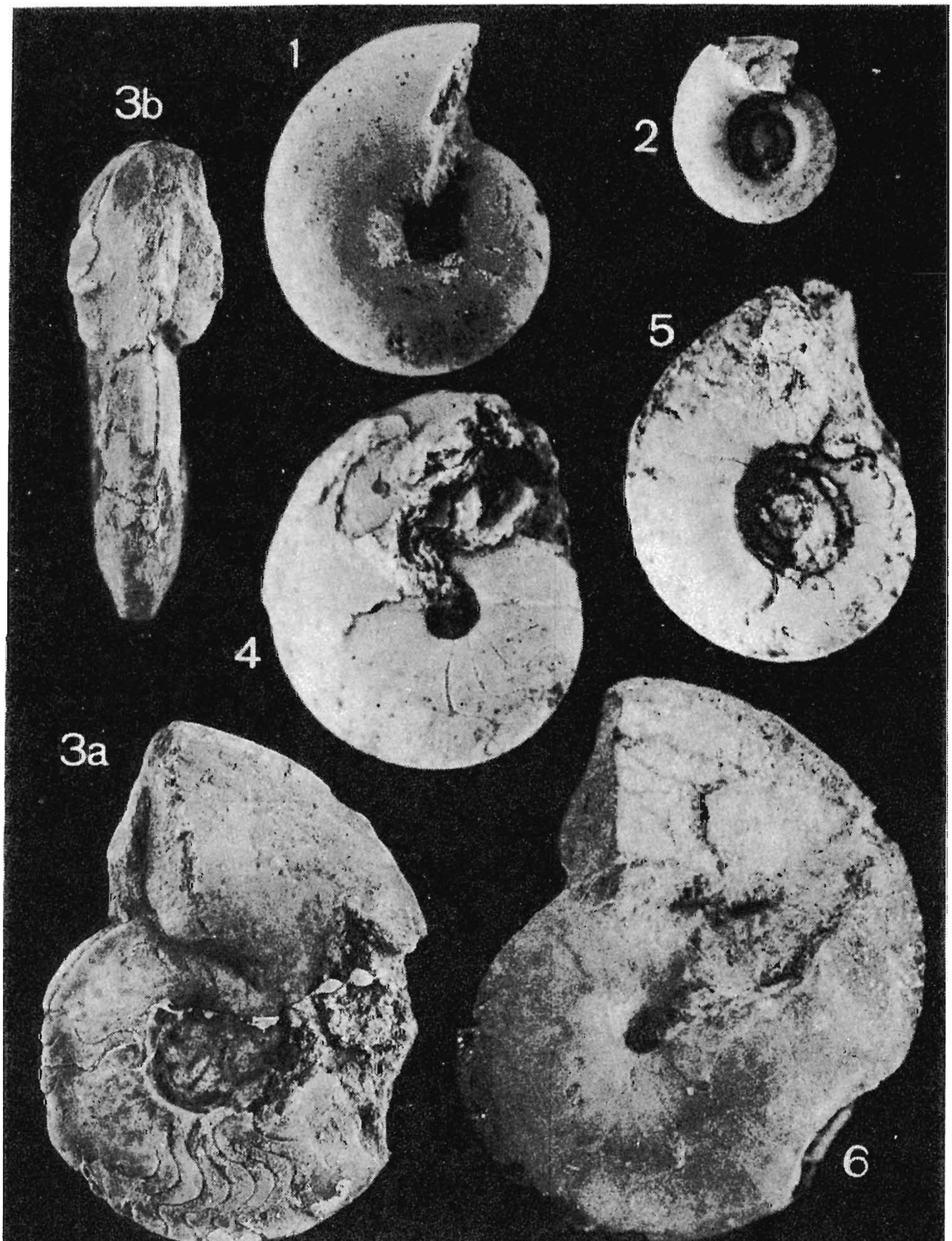
1-4 — *Polygnathus cristatus* HINDE: *1a*, *2a*, *4* upper, *1b*, *2b* (magnified in *2d* to show details of basal pit), *2c* lateral views; note variations of platform outline and transition to *Polygnathus limitaris* ZIEGLER & KLAPPER (Fig. 2), as well as preserved basal plates (Figs 1b, 3); Laskowa Hill Quarry, sample L-II/37 (Fig. 4), L-II/39 (Fig. 1), L-IV/41 (Fig. 3) and L-VI/25 (Fig. 2)

All X 50, except Fig. 2d taken X 130



1 — Cladodontiform shark tooth: *1a* anterior, *1b* upper view; Laskowa Hill Quarry, sample L-II/19
2, 7 — *Polygnathus linguiformis linguiformis* HINDE gamma morphotype BULTYNCK, upper views; Laskowa Hill Quarry, sample L-IV/18 (Fig. 2) and L-V/9 (Fig. 7)
3 — *Schmidtognathus* cf. *wittekindi* ZIEGLER: *3a* upper, *3b* lower view; Laskowa Hill Quarry, sample L-II/19
4 — *Polygnathus* cf. *ovatinodosus* ZIEGLER & KLAPPER, upper view; Laskowa Hill Quarry, sample L-VI/11
5, 9 — *Polygnathus dubius* HINDE: *5a, 9* upper, *5b* lateral views; Laskowa Hill Quarry, sample L-II/14 (Fig. 5) and L-II/37 (Fig. 9)
6 — *Polygnathus* cf. *ordinatus* BRYANT, upper view; Laskowa Hill Quarry, sample L-VI/25
8 — *Schmidtognathus*(?) *peracutus* (BRYANT): *a* upper, *b* lower view; Laskowa Hill Quarry, sample L-IV/41

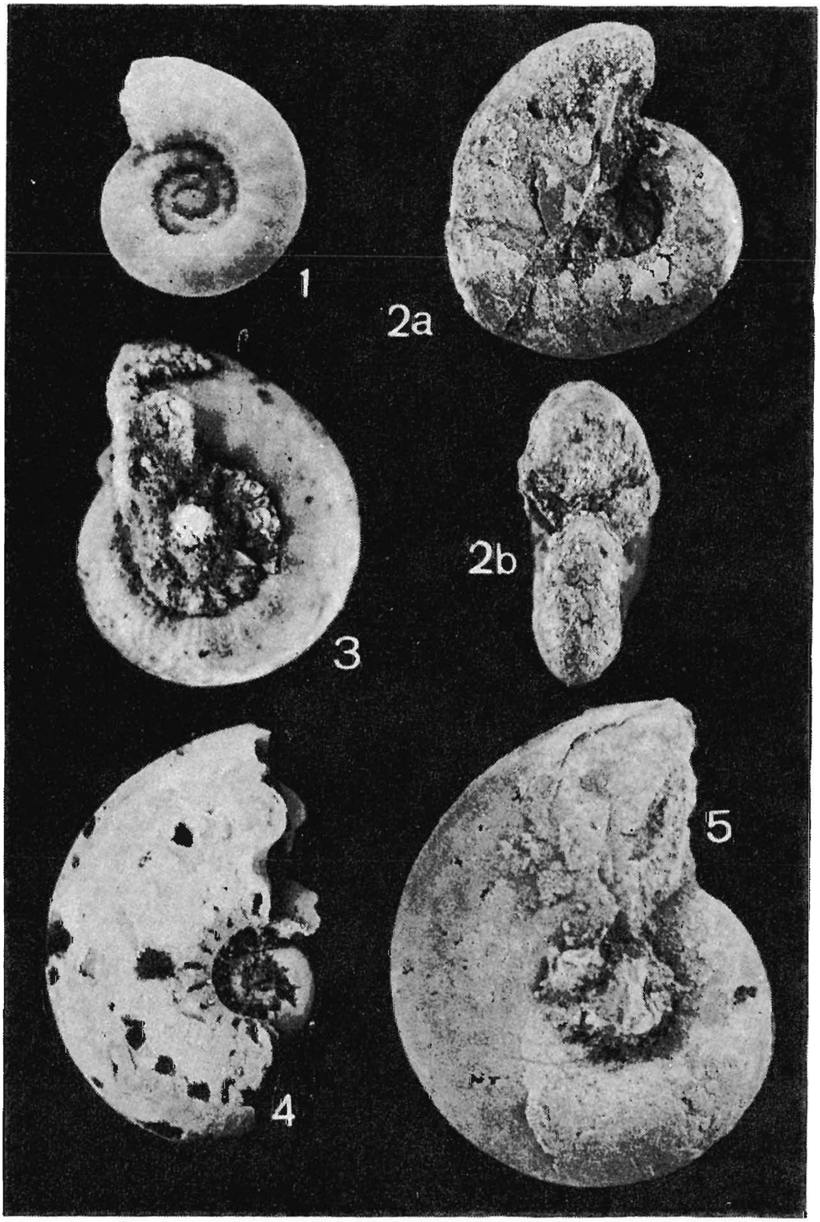
All X 50, except Fig. 1 taken X 25



Goniatites from the topmost part of the Szydłówek Beds, Kostomłoty-II Quarry; collected by J. MALEC, M. Sc., determined by Dr. J. DZIK

1, 4 — *Epitornoceras* sp. [cf. *E. mithracoides* FRECH], lateral views
2, 3, 5 — *Probeloceras* sp. [cf. *P. forcipiferum* (SANDBERGER & SANDBERGER]): *2, 3a, 5* lateral, *3b* apertural views
6 — *Tornoceras* sp. [cf. *T. simplex* (BUCH)], lateral view

All X 10, except Fig. 3 taken X 5



Goniatites *Manticoceras* sp. [cf. *M. ammon* KEYSERLING] from the topmost part of the Szydłówek Beds, Kostomłoty-II Quarry; collected by J. MALEC, M. Sc., determined by Dr. J. DZIK

1, 2a, 3—5 — lateral, *2b* — apertural views

All X 10 except Figs 2 and 4 taken X 5

Polygnathus limitaris ZIEGLER & KLAPPER, 1976
(Pl. 3, Fig. 5)

1966. *Polygnathus* sp.; ZIEGLER, Pl. 4, Figs 9—11.
1976. *Polygnathus limitaris* sp. n.; ZIEGLER & KLAPPER, pp. 121—122, Pl. 4, Figs 17, 19 [*with synonymy*].
1979. *Polygnathus limitaris* ZIEGLER & KLAPPER; LANE & *al.*, Pl. 2, Fig. 24.
1980. *Polygnathus limitaris* ZIEGLER & KLAPPER; BULTYNCK & HOLLARD, p. 43, Pl. 8, Fig. 14.
1982. *Polygnathus limitaris* ZIEGLER & KLAPPER; ZIEGLER & KLAPPER, Pl. 2, Figs 1—2 and Pl. 3, Figs 1—2.

REMARKS: The species *Polygnathus limitaris* ZIEGLER & KLAPPER is morphologically linked with *B. cristatus* HINDE; the interspecific boundary, based only on the platform outline due to great variability of node arrangement (compare the holotype figured by ZIEGLER 1966, Pl. 4, Fig. 10 with a specimen of ZIEGLER & KLAPPER 1982, Pl. 3, Fig. 1), is arbitrary. Most of the studied specimens display a relatively wide platform.

OCCURRENCE: Lower hermanni-cristatus Subzone through probably Lowermost asymmetricus Zone (*see* KLAPPER & ZIEGLER, Text-fig. 5).

Genus *Schmidtognathus* ZIEGLER, 1966
Type species: *Schmidtognathus hermanni* ZIEGLER, 1966

Schmidtognathus(?) *peracutus* (BRYANT, 1921)
(Pl. 4, Figs 1, 6; Pl. 6, Fig. 8)

1966. *Schmidtognathus peracutus* (BRYANT); ZIEGLER, p. 668, Pl. 1, Figs 1—10.
1980. *Polygnathus peracuta* BRYANT; SEDDON, pp. 61—62, Pl. 14, Figs 6—8.
1973. *Schmidtognathus peracutus* (BRYANT); ZIEGLER, pp. 429—430, Pl. 2, Figs 1—2.
1978. *Schmidtognathus peracutus* (BRYANT); UYENO, p. 249, Pl. 2, Figs 27—29.
1980. *Schmidtognathus peracutus* (BRYANT); BULTYNCK & HOLLARD, p. 46, Pl. 8, Fig. 24.
1980. *Schmidtognathus peracutus* (BRYANT); KLAPPER, Pl. 3, Figs 31—32.
1981. *Polygnathus peracutus* BRYANT; HUDDLE, pp. B31—B32, Pl. 13, Figs 7—8 and Pl. 61, Figs 1—2 [?*non* Pl. 11, Figs 5—7t.
1982. *Schmidtognathus peracutus* (BRYANT); MORZADEC & WEYANT, p. 34, Pl. 3, Figs 14—15.

REMARKS: According to SEDDON (1970, p. 61) and HUDDLE (1981, p. B31) large asymme trical basal cavity, *i.e.* the most diagnostic feature of *Schmidtognathus*, is not clearly discernible in the case of *Polygnathus peracutus* BRYANT, and HUDDLE (1980, p. B31) showed its intermediation with *Polygnathus ordinatus* BRYANT.

In the material studied there are specimens very close to some forms of *P. ordinatus* BRYANT figured by HUDDLE (1981; Pl. 16, Figs 3—7), but with one exception (*see* Pl. 6, Fig. 6), and displaying a triangular, but frequently more or less bilaterally asymmetrical platform and uniform nodose ornamentation. The asymmetrical platform is a conspicuous character of the holotype of this species (ZIEGLER 1973, Pl. 2, Fig. 2), as well as of some specimens illustrated by KLAPPER (1980, Pl. 3, Figs 31—32), HUDDLE (1981, Pl. 13, Figs 7—8 and Pl. 16, Figs 1—2) and MORZADEC & WEYANT (1982, Pl. 3, Fig. 14). The asymmetry is an additional difficulty in the species assignment.

Most of the studied specimens, due to very narrowly-outlined platform, are similar to some varieties of *S. wittekindi* ZIEGLER, particularly to those from Nevada (ZIEGLER & KLAPPER 1976, Pl. 3, Figs 36—37) and the Massif Armoricain (MORZADEC & WEYANT 1982, Pl. 3, Fig. 14). Only specimens with strongly reduced, thicker platforms and one (rarely two) rows of fused nodes parallel with carina are identified as *S.* cf. *wittekindi* ZIEGLER (*see* Pl. 6, Fig. 3).

OCCURRENCE: Upper part of the Upper hermanni-cristatus Subzone through Lowermost asymmetricus Zone (KLAPPER & ZIEGLER 1979, Text-fig. 5; KLAPER & JOHNSON 1980, Tables 11—12).

Genus *Icriodus* BRANSON & MEHL, 1938
Type species: *Icriodus expansus* BRANSON & MEHL, 1938

Icriodus latericrescens latericrescens BRANSON & MEHL, 1938
(Pl. 4, Figs 2—3)

1967. *Icriodus latericrescens latericrescens* BRANSON & MEHL: KLAPPER & ZIEGLER, pp. 74—75, Pl. 10, Figs 4—9 and Pl. 11, Figs 1—3 [*with synonymy*].

1981. *Icriodus latericrescens latericrescens* BRANSON & MEHL; HUDDLE, pp. B22—B23, Pl. 5, Figs 1—6.

OCCURRENCE: According to KLAPPER & JOHNSON (1980, Tables 10—12), the species ranges from the Lower varcus Subzone through disparilis Zone (for possible younger occurrences *see*: HUDDLE 1981); it has a limited occurrence within the varcus Zone in Europe (KLAPPER & ZIEGLER 1979, p. 217, Text-fig. 5).

STRATIGRAPHY OF THE LASKOWA HILL SECTION

In the set *A* of the Laskowa Hill section there occur diagnostic species of the hermanni-cristatus through disparilis Zones (*see* Table 1). The lower part of the disparilis, *i. e.* without *Polygnathus dengleri* (*cf.* Text-fig. 5), can firmly be recognized

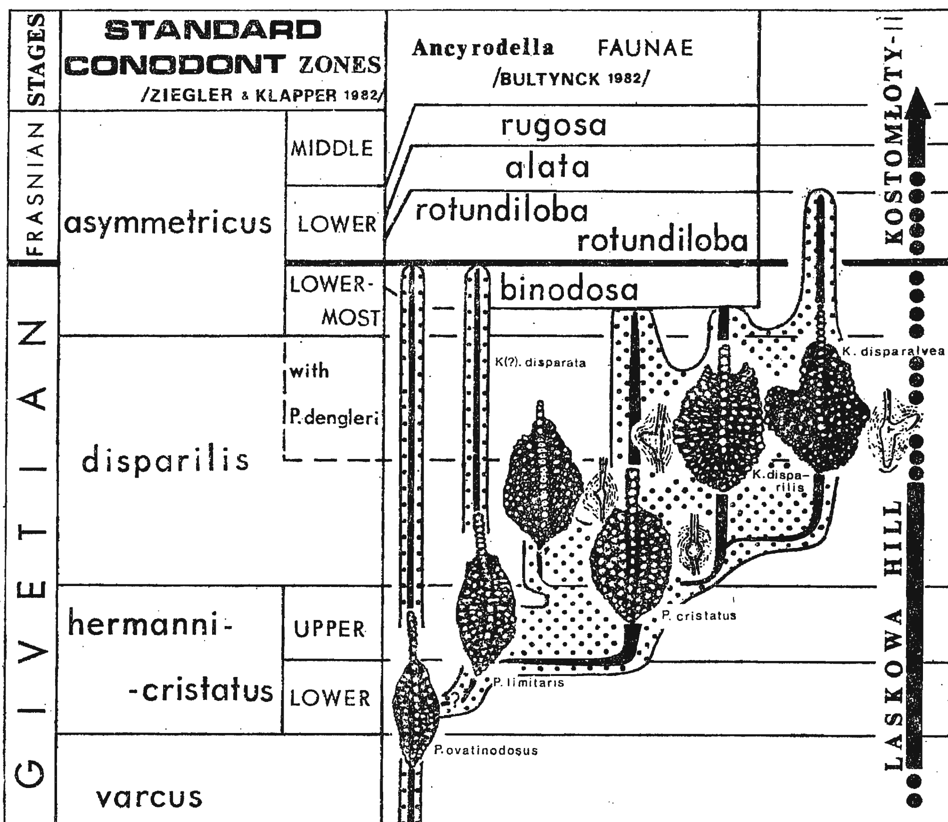


Fig. 5. Current conodont zonation of the Middle/Upper Devonian boundary and the evolutionary schema of *Polygnathus ovatinodosus—Polygnathus cristatus—Klapperina* lineage (*cf.* ZIEGLER & KLAPPER 1982, Text-fig. 1; ZIEGLER & KLAPPER 1976)

in the higher part of set *A* and in the lower part of set *B*, as indicated by the presence of *Klapperina*(?) *disparata*. It is believed that the whole set *B* is attributable to the disparilis Zone.

In the lower part of set *A* only species with wider ranges were found, but it is general methodological weakness of the hermanni-cristatus Zone. Furthermore, some biofacies control of succession is evident here, as visible by a link of presumably most shallow-water genera *Icriodus* and *Belodella* with coral biolithites. Therefore, the limits of the hermanni-cristatus Zone are established with question.

The long-ranging gamma-morphotype of *Polygnathus linguiformis linguiformis* was almost exclusively stated in the lowest samples. The occurrence of *Polygnathus ansatus* in the sample *L-III/6* indicates that the upper part of varcus Zone lies within the top part of dolomites. The boundary between the varcus and the hermanni--cristatus Zones runs near the boundary separating dolomites and overlying sets, as *P. ansatus* occurs also in the sample *L-II/a* taken from a loose block of crinoid limestones near this lithologic contact. On the other hand, the presence of *Icriodus latericrescens latericrescens* in the sample *L-III/11* suggests that the lowest bed of set *A* still belongs to the varcus Zone.

GIVETIAN/FRASNIAN BOUNDARY AT KOSTOMŁOTY

The secondary nature of the dolomite-complex top (*see* SZULCZEWSKI 1981a), as well as late Givetian age of the overlying fossiliferous limestones and marls are well documented in the Laskowa Hill Quarry. In this outcrop the lowermost part of the Szydłówek Beds, Givetian in age, is also exposed.

Concerning the Givetian/Frasnian boundary, two main proposals were introduced lately: (*i*) based on the evolution of the earliest species of *Ancyrodella* (e.g. BULTYNCK 1982), and (*ii*) derived from the *Polygnathus cristatus* — *Klapperina* lineage (ZIEGLER & KLAPPER 1982). The two versions of the conodont zonation refinement (Text-fig. 5) are partially linked with different biofacies pattern; the boundary markers of ZIEGLER & KLAPPER (1982) are absent or very rare in shallow-water carbonates which are so common in the investigated Devonian sequence of the Holy Cross Mts.

The Belgian proposition of the stage boundary is used in the present paper in accordance with a decision taken in August 1982 by the International Subcommission on Devonian Stratigraphy (*see* SANDBERG & *al.* 1983).

The Givetian zones in the Holy Cross region have been recognized first time by MAŁKOWSKI (1981) who reported from Górno the Lowermost asymmetricus Zone, *i.e.* the topmost Givetian in the present sense. This zone was distinguished by MAŁKOWSKI (1981) on the basis of a juvenile specimen attributable to the genus *Klapperina* (see above); this is interpreted herein as the undivided disparilis to Lower asymmetricus Zones.

A goniatite assemblage characterized by *Manticoceras* (*see* Pls 7—8), as determined by Dr. J. DZIK (*see* RACKI & *al.* 1985), indicates the earliest Frasnian age of the topmost part of the Szydłówek Beds. It agrees with the former conodont data (PRZYBYSZEWSKA 1974, *fide* SZULCZEWSKI 1981b). The occurrence of *Ancyrodella rugosa* BRANSON & MEHL and *Polygnathus dengleri* BISCHOFF

& ZIEGLER in the sample *Kt-41* (*see* Text-figs 2 and 3*C*) points to the upper part of the Lower asymmetricus Zone in the part of Szydłówek Beds. The lithostratigraphic boundary with overlying Kostomłoty Beds runs probably near the boundary of the Lower and Middle asymmetricus Zones, what is indicated by single occurrences of *Ancyrodella* cf. *gigas* YOUNQUIST in the slightly higher samples *Kt-51* and *Kt-52*.

Consequently, the Givetian/Frasnian boundary at Kostomłoty runs within the Szydłówek Beds, *i. e.* within the covered interval or, less probably, in the lowest, more marly part exposed in the northern quarries (*see* Text-fig. 2), where conodonts are extremely rare. This conclusion agrees with the recent conodont data obtained from the Kielce sections (*see* Text-fig. 1): late Givetian age is established for the lower part of this lithostratigraphic unit at Szydłówek (RACKI & *al.* 1985), and early Frasnian age for its top at Czarnów and the Śluchowice Quarry (*see also* SZULCZEWSKI 1971).

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KONODONTY I STRATYGRAFIA POGRANICZA ŻYWETU I FRANU W KOSTOMŁOTACH

(Streszczenie)

Przedmiotem pracy jest analiza stratygraficzna wapieni i margli leżących powyżej dolomitów odsłaniających się w Kostomłotach w Górach Świętokrzyskich. Bogata i zróżnicowana fauna konodontowa (*patrz* fig. 1—5, tab. 1 oraz pl. 1—6) dokumentuje górnożyweckie poziomy varcus, hermanni-cristatus i disparilis, które nie były dotychczas znane w Górach Świętokrzyskich. Granica żywetu z franem biegnie w obrębie wyżej leżących marglisto-łupkowych warstw szydłówieckich, co potwierdzają m.in. goniatyty (*patrz* pl. 7—8). Profile widoczne w kamieniołomach w Kostomłotach wydają się być kluczowymi w badaniu tej granicy na całym obszarze Gór Świętokrzyskich, gdyż stwarzają one okazję do studiów porównawczych sukcesji mikro- oraz makrofauny.