



A new occurrence of benthic fauna in the Niewachlów Greywackes (Upper Silurian) from Zalesie near Łagów in the Holy Cross Mountains

Wojciech KOZŁOWSKI, Ewa TOMCZYKOWA



Kozłowski W., Tomczykowa E. (1999) — A new occurrence of benthic fauna in the Niewachlów Greywackes (Upper Silurian) from Zalesie near Łagów in the Holy Cross Mountains. *Geol. Quart.*, 43 (1): 129–126. Warszawa.

In the Bardo Syncline in Zalesie near Łagów, there occur numerous assemblages of benthic fauna which correspond to a fauna from Gruchawka and Jurkowice. The predominant trilobite group occurs with graptolites of the *Bohemograptus bohemicus* Zone. The Niewachlów Greywackes, and other deposits corresponding to them in the Holy Cross Mountains containing *Buliozoma erraticum* (Schrank), are included by the authors to the Lower Siedlce unit (Upper Ludlow).

Wojciech Kozłowski, Faculty of Geology, University of Warsaw, Żwirki i Wigury 93, 02-089 Warszawa, Poland; Ewa Tomczykowa, Polish Geological Institute, Rakowiecka 4, 00-975 Warsaw, Poland (received: July 22, 1998; accepted: January 5, 1999).

Key words: Holy Cross Mts., Kielce Region, Silurian, biostratigraphy, trilobites.

INTRODUCTION

In the Bardo Syncline, in the southern part of the Holy Cross Mountains, the Silurian deposits which are developed as shales with graptolites, are well understood. They are known to comprise graptolite zones from *Akidograptus acuminatus* to *Saetograptus leintwardinensis* (H. Tomczyk, 1956, 1968). However, the Silurian deposits above the *Saetograptus leintwardinensis* Zone, known as the Niewachlów Greywackes, are developed mainly in the mudstone-greywacke facies. The deposits lying above a graptolite series in the Kielce region of the Holy Cross Mountains were ascribed to a wide stratigraphic interval (considering the rare occurrence of fauna in them) and no more importance was attached to their detailed stratigraphic position (E. Tomczykowa, 1959). However, the discovery of numerous and well-preserved fauna in the section of Gruchawka in the western part of the Kielce region (J. Malec, 1993), allowed the evaluation of its stratigraphic significance (E. Tomczykowa, 1993).

The discovery (by K. Dembicz, W. Kozłowski, T. Ochmański) of fairly abundant faunal assemblage in Zalesie near Łagów, confirms the synchronous occurrence of greywacke deposits in the entire southern part of the Holy Cross Mountains, from Gruchawka to Jurkowice (Fig. 1). As noted by the

authors, and earlier, the occurrence of *Bohemograptus bohemicus* (Barrande) specimens, and other Upper Ludlow graptolites in these deposits indicates that they correspond to the Lower Siedlce unit in the East European Platform (H. Tomczyk, 1968).

GEOLOGY

The section described is located on the bank of the stream which takes its source at the village of Sadków. This stream flows towards a ravine in a west-east direction being a continuation of the Zalesie ravine (Fig. 2). On the left-hand slope of the ravine there appear the following strata (from bottom to top):

1. Uniform series of mudstones with graptolites and greywacke shales (thickness unknown). The distance from the bottom of the greywacke series appears not to exceed 180 m (Fig. 3). There is a possibility, however, that the actual thickness may be less.

2. Series of coarse-grained, thick-bedded greywackes:
— layer of yellow, coarse-grained greywacke, in the lower part with numerous skeletal fauna, mainly cephalopods (thickness 0.13 m);

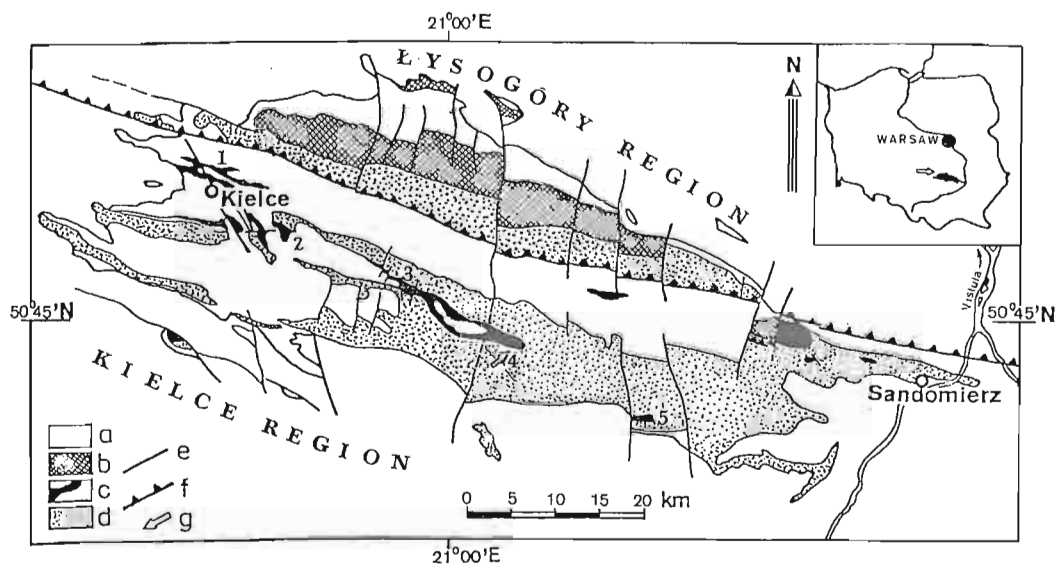


Fig. 1. Map of occurrence of the Silurian deposits against the background of the Palaeozoic core of the Holy Cross Mountains

a — Upper Palaeozoic; b — Silurian deposits in the Łysogóry (northern) region; c — Silurian deposits in the Kielce (southern) region; d — Cambrian and Ordovician deposits; e — main dislocations; f — Holy Cross Fault; g — outcrops of the Niewachłów Greywackes with benthic fauna: 1 — Gruchawka, 2 — Niestachów, 3 — Widelki, 4 — Zalesie (indicated by arrow), 5 — Jurkowice

— brown, thick-bedded, coarse-grained greywackes with lithoclasts, feldspar, and quite numerous detritus of fauna (thickness 0.25 m);

— light yellow, coarse-grained greywackes with numerous grains of feldspar (thickness 0.06 m).

3. Hard, tabular, laminated, olive-gray greywacke mudstones, interbedded with mudstones and coarse-grained greywackes (unknown thickness).

The orientation of the strata is $128^{\circ}/37^{\circ}$ N.

Within the series 1, directly below series 2 in the greywacke mudstones following graptolites were found: *Bohemograptus bohemicus* (Barrande), *B. bohemicus tenuis* (Bouček) and *Pristiograptus* sp. (determined by H. Tomczyk). Earlier (E. Tomczykowa, 1959), in addition to the above species, the following graptolites were noted from an outcrop in Zalesie: *Monograptus tomczyki* Willefert (earlier determined as *Monoclimacis ultimus* Perner) and *Linograptus posthumus* Richter.

Series 2, lithologically different, contains a significant amount of coarse-grained material (feldspar, quartz, lithoclasts). The general lithological development, together with the observed graded bedding in series 2, and also the overlying, laminated series (3) indicates the turbidite character of the sedimentation.

In series 2 there occurs a rich assemblages of benthic fauna, partly as a skeletal detritus.

However, a significant part of fauna contains the complete moulds, indicating a short transport of the skeletal material. It should be stressed that the state of preservation of the trilobite fauna allows precise and unequivocal determination (Pl. I).

From the above described series 2, in the summer 1995–1997 K. Dembiczy, W. Kozłowski and T. Ochmański collected the following fauna, as determined here by E. Tomczykowa:

Atrypa sp., *Stropheodonta* sp., *Camarotoechia nucula* (Dalman), *Izortis* sp., *Delthyris* sp., *Baliozoma erraticum* (Schrank), *Dalmanites nexilis* (Salter), *Richterarges kielcensis* Tomczykowa, *Helokybe* sp., *Harpidella* sp., *Sphaeroxochus* sp., and *Calymene* sp.

Furthermore, numerous trochites, cephalopod remains (?*Kionoceras* sp.), fragments of Tabulata, solitary corals, gastropods, bivalves, and ostracods have been found.

In the uppermost series (3) (Fig. 3) no fauna was found.

CORRELATION

Of the trilobites occurring in series 2, those with the most stratigraphic and correlative significance are as follows: *Baliozoma erraticum* (Schrank), *Dalmanites nexilis* (Salter), *Richterarges kielcensis* Tomczykowa, *Helokybe* sp., and *Harpidella* sp. (Pl. I). These trilobites were described by E. Tomczykowa (1993) from the Gruchawka sequence (J. Malec, 1993), where they are somewhat better preserved. They occur there in so-called Kielce Beds, described as an informal lithostratigraphical unit (J. Malec, 1993). The fauna under discussion occurs in the upper part of the section i.e. approximately 224 and 104 m below the Miedziana Góra Conglomerates (J. Malec, 1993, p. 514, pl. VI). From the strata lying approximately 65 m below the Miedziana Góra Conglomerates, J. Malec (1993) claims the occurrence of graptolites *Monograptus transgrediens* Perner (determined by L. Teller). Unfortunately the author did not include a photograph of the specimen.

Fragments of *Baliozoma erraticum* (Schrank), and *Dalmanites nexilis* (Salter) were also noted in the greywackes of

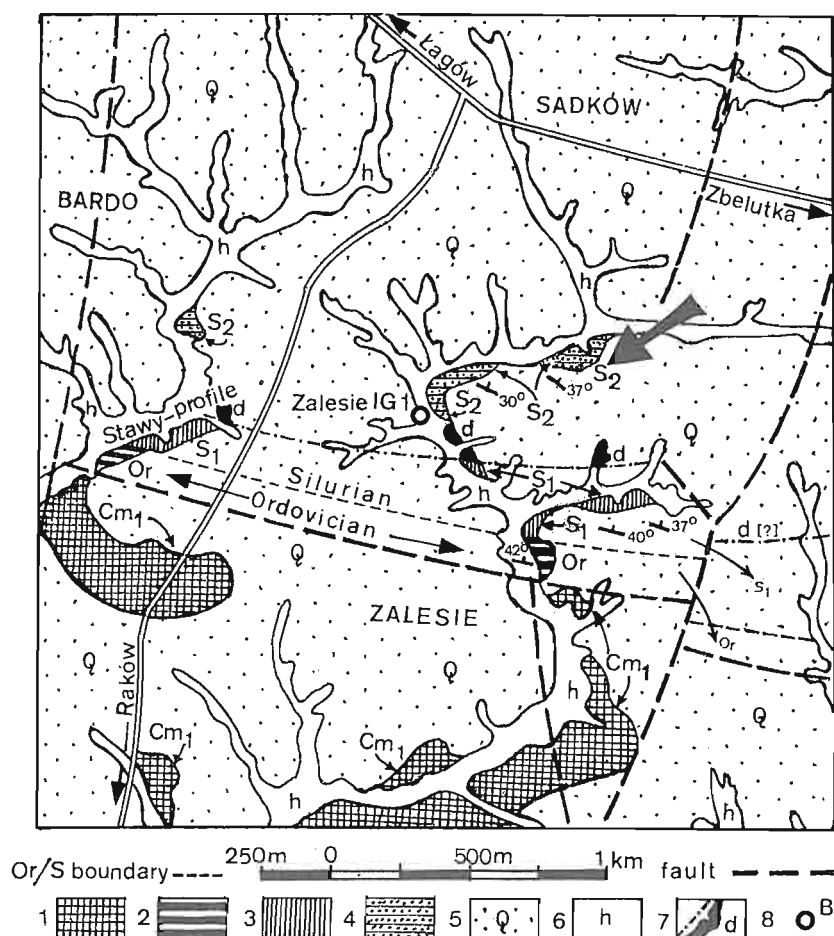


Fig. 2. Geological map of the Zalesie area, Bardo Syncline (according to H. Tomczyk, 1958)

1 — Lower Cambrian (Cm₁); 2 — Ordovician (Or); 3 — Lower Silurian (S₁), graptolite shales; 4 — Upper Silurian (S₂), Niewachlów Greywackes; 5 — Pleistocene (Q); 6 — Holocene (h); 7 — diabase (d) and its range; 8 — borehole Zalesie IG 1; the arrow indicates the layer with trilobites

Jurkowice (A. Romanek, M. Rup, 1989) in the eastern part of the southern region of the Holy Cross Mountains.

Identical trilobite fauna as in the Niewachlów Greywackes is also known from Widełki in Bardo Syncline (E. Tomczykowa, 1959). The following species of trilobites appear: *Otarion* sp. (= *Harpidella* sp.), *Proetus* sp. (probably *Helokybe* sp.), "*Trochurus* sp." (= *Richterarges* sp.) and *Calymene* sp., recorded also from Niestachów (E. Tomczykowa, 1959). From a Widełki section of a shale series lying above a greywacke series, E. Porębska noted the following graptolites: *Bohemograptus bohemicus* (Barrande), *B. bohemicus tenuis* (Bouček), *Pristiograptus dubius* s.l., *P.* sp., and *Neocucullograptus* sp. (E. Stupnicka et al., 1991). These graptolites are explicitly indicative of the Lower Siedlce unit.

The terrigenous sediments under discussion, long known (J. Czarnocki, 1919, 1936) as the Niewachlów Greywackes occur in the entire southern region of the Holy Cross Mountains. The shaly sedimentation with graptolites developed here in the zones *scanicus* to *leintwardinensis*, which have been well studied in Niestachów and Bardo-Prągowiec sec-

tions, and it marks the bottom of the greywacke series discussed here (H. Tomczyk, 1956, 1958).

Considering the poverty of fossils, the overlying sediments so far were ascribed rather generalized age. Therefore the benthic fauna discovered here, together with graptolites in Zalesie near Łągów in the entire central region of the Holy Cross Mountains, has a great stratigraphical significance.

The faunal zone under discussion is defined by graptolites, of which the most stratigraphically important are: *Bohemograptus bohemicus* (Barrande), *B. bohemicus tenuis* (Bouček) as well as by numerous trilobites. The most stratigraphically important are the trilobites represented here by: *Baliozoma erraticum* (Schrank), *Dalmanites nexilis* (Salter), *Richterarges kielcensis* Tomczykowa, *Helokybe* cf. *spio* Thomas, *Harpidella* sp., *Sphaeroxochus* sp., and *Calymene* sp.

The majority of the afore-mentioned species have been described earlier (E. Tomczykowa, 1993). Only *Sphaeroxochus* sp. — a small pygidium of which was found by T. Ochmański in Zalesie, in series 2 — does not occur in remaining outcrops. It is an interesting fact that, until now, this

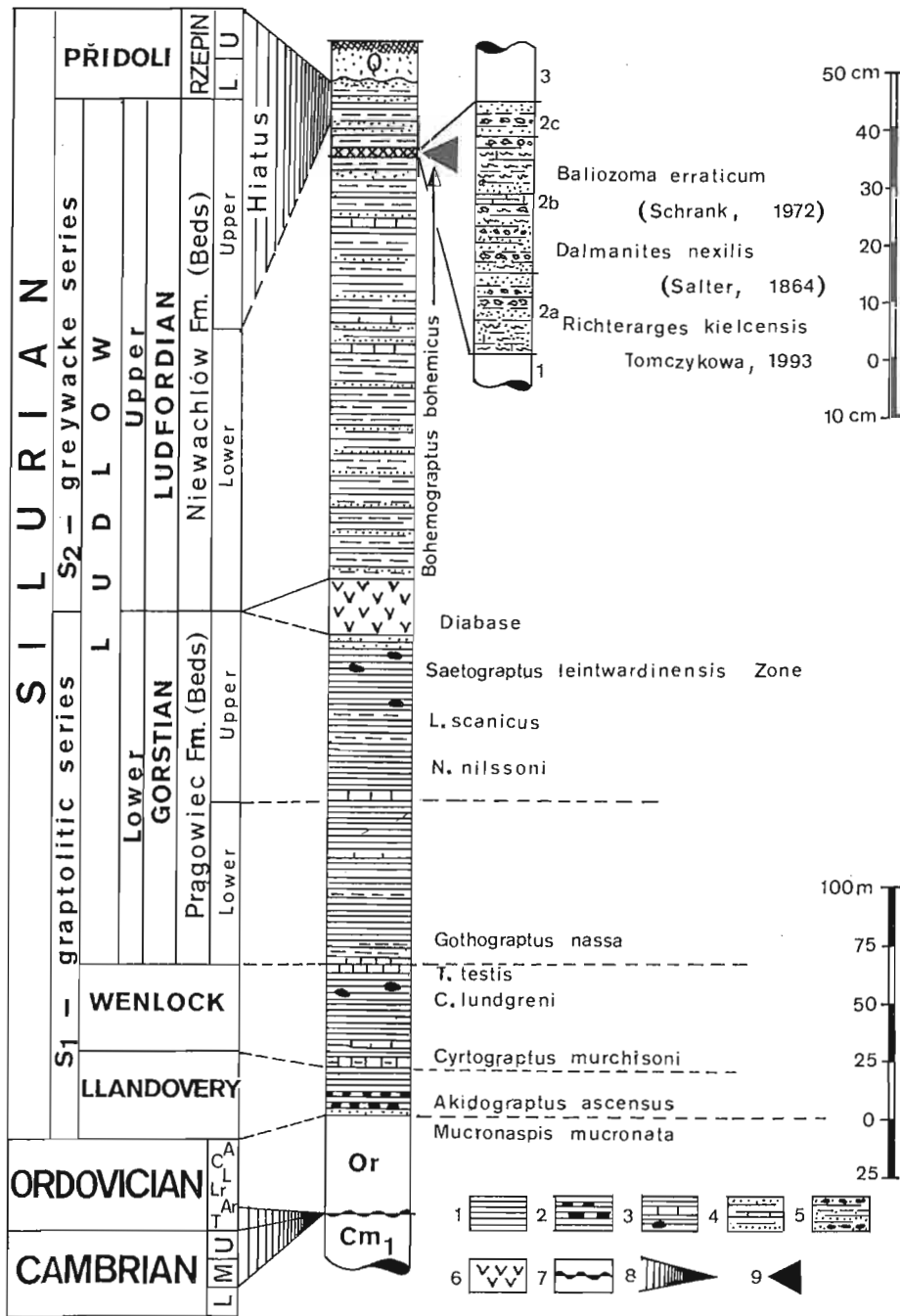


Fig. 3. Lower Palaeozoic sequence in Zalesie near Łagów, based on the outcrops and borehole Zalesie IG 1 (interpreted by H. Tomczyk 1958; H. Tomczyk, E. Tomczykowa, 1976))

1 — claystones with graptolites; 2 — black graptolite shales with siliceous shales and lydites; 3 — graptolitic shales and claystones with limestone intercalations and lenses; 4 — greywackes and mudstones; 5 — coarse-grained greywackes with feldspars and rich fragments of fauna; 6 — diabase; 7 — tectonic discordance; 8 — hiatus; 9 — stratigraphic position of described trilobites; T, Ar, Lr, L, C, A — Ordovician stages

genus has not been recorded in deposits younger than Wenlock, with the exception of *Sphaeroxochus paramirus* Šnajdr, from the lower part of the Kopanina Formation in Barrandien (M. Šnajdr, 1980). A distinctive feature is that the assemblage of trilobites similar to those from Zalesie, occurs there in mixed pyroclastic-carbonate deposits (I. Chlupač, 1987, p. 176). However, the pygidium *Sphaeroxochus* sp.

from Zalesie (Pl. I, Fig. 4) is very similar to that illustrated from the Arctic Canada as *Sphaeroxochus dimorphus* Perry et Chatterton (D. G. Perry, B. D. E. Chatterton, 1977, pl. 2, figs. 17–20; D. J. Holloway, 1980; D. L. Strusz, 1980). The entire assemblage of trilobites occurring in the Niewachłów Greywackes in the southern part of the Holy Cross Mountains is almost identical to the species occurring also in the Bohe-

mograptus bohemicus Zone in the Red Bay Formation in Arctic Canada (A. T. Thomas, G. M. Narbonne, 1979). Some of the trilobite species mentioned above occur in the upper Ludlow in Welsh Borderland (D. G. Mikulič, R. Watkins, 1981) in erratic boulders (E. Schrank, 1972) and in Gotland. This was noted earlier by E. Tomczykowa (1993).

CONCLUSIONS

1. The assemblage of trilobites occurring in the entire southern region of the Holy Cross Mountains, from Jurkowice in the east to Gruchawka in the west includes the same taxa (at least 7 species) documenting the same stratigraphical level.

2. Trilobites: *Baliozoma erraticum* (Schrank), *Dalmanites nexilis* (Salter), *Richterges kielcensis* Tomczykowa, *Helokybe* cf. *spio* Thomas, occurring in the Niewachłów Greywackes and in Kielce Beds indicate unequivocally the middle part of the Ludlow (E. Tomczykowa, 1993).

3. The co-occurring graptolites confirm the stratigraphic position of the whole assemblage, indicating the *Bohemograptus bohemicus* Zone.

4. The assemblage should be treated as a stratigraphic zone within the Niewachłów Greywackes and probably in the informal Kielce Beds.

5. At least the most part of the Kielce Beds (as defined by J. Malec, 1993) corresponds to the *Bohemograptus bohemicus* Zone. This age is documented in the Gruchawka sequence by the key trilobite assemblage 104 and 224 m below the Miedziana Góra Conglomerate (J. Malec, 1993).

6. The question of the age of the upper Silurian deposits in the Gruchawka section remains open (at least until an objective verification of the determination of graptolites is made).

7. The age of the Niewachłów Greywackes does not exceed Late Ludlow. They correspond most closely to the Wydryszów Formation in northern part of the Holy Cross Mountains, and to Lower and Middle Siedlce unit in the East European Platform (H. Tomczyk, 1968)

Acknowledgements. The authors would like to thank: Prof. Dr. Z. Kortański for his encouragement in the writing of the article, Doc. Dr. H. Tomczyk for allowing access to his stratigraphical data, M.Sc. Z. Przewłocki for his help in fieldwork and general discussion, K. Dembicz and T. Ochmański for access to their collection of fauna.

REFERENCES

- CHLUPAČ I. (1987) — Ecostratigraphy of Silurian trilobite assemblages of the Barrandien area, Czechoslovakia, *Newsl. Stratigr.*, **17** (3): 169–186.
- CZARNOCKI J. (1919) — Stratygrafia i tektonika Gór Świętokrzyskich. Stratygrafia i tektonika utworów staropaleozoicznych Gór Świętokrzyskich (kamb, sylur i dewon dolny). *Pr. Tow. Nauk. Warsz.*, **28**.
- CZARNOCKI J. (1936) — Überblick der Stratigraphie und Paläogeographie des Underdevons im Polnischen Mittelgebirge (in Polish with German summary). *Spraw. Państw. Inst. Geol.*, **8** (4): 129–162.
- HOLLOWAY D. J. (1980) — Middle Silurian trilobites from Arkansas and Oklahoma, USA. *Palaeontographica* (A), **170** (1–3).
- MALEC J. (1993) — Upper Silurian and Lower Devonian in the western Holy Cross Mts. *Geol. Quart.*, **37** (4): 501–536.
- MIKULIČ D. G., WATKINS R. (1981) — Trilobite ecology in the Ludlow Series of the Welsh Borderland. In: *Communities of the Past* (eds. J. Gray *et al.*). Hutchison Ross Pbl. Comp. Stroudsburg, Pennsylvania.
- PERRY D. G., CHATTERTON B. D. E. (1977) — Silurian (Wenlockian) trilobites from Baillie-Hamilton Island, Canadian Arctic Archipelago. *Canad. Jour. Earth Sc.*, **14** (2): 285–317.
- ROMANEK A., RUP M. (1989) — Greywackes from Jurkowice and the Upper Silurian greywacke series in the southern part of the Góry Świętokrzyskie (in Polish with English summary). *Biul. Państw. Inst. Geol.*, **362**: 41–61.
- SCHRANK E. (1972) — Proetacea, Encrinuridae und Phacopina (Trilobita) aus silurischen Geschieben. *Geologie*, **21** (76).
- ŠNAJDR M. (1980) — New Silurian trilobites from the Bohemian area. *Vest. Ustred. Ust. Geol.*, **55** (2).
- STRUSZ D. L. (1980) — The Encrinuridae and related trilobite families with a description of Silurian species from Southeastern Australia. *Palaeontographica* (A), **168** (1–4).
- STUPNICKA E., PRZYBYŁOWICZ T., ŻBIKOWSKA B. (1991) — Age of the Niewachłów greywackes and shales from Widelki near Bardo (Holy Cross Mts) (in Polish with English summary). *Prz. Geol.*, **39** (9): 389–393.
- THOMAS A. T., NARBONNE G. M. (1979) — Silurian trilobites from arctic Canada. *Geol. Mag.*, **116** (2).
- TOMCZYK H. (1956) — Wenlock and Ludlow in the Kielce syncline of the Święty Krzyż Mts. (in Polish with English summary). *Pr. Inst. Geol.*, **16**.
- TOMCZYK H. (1958) — Stratygrafia syluru synkliny bardziańskiej Gór Świętokrzyskich. *Arch. Państw. Inst. Geol. Kielce-Warszawa*.
- TOMCZYK H. (1968) — Silurian. In: *Geology of Poland*, **1**, part 1: 237–312. *Inst. Geol. Warszawa*.
- TOMCZYK H., TOMCZYKOWA E. (1976) — Development of Ashgill and Llandovery sediments in Poland. In: *The Ordovician System*: 327–347. Cardiff.
- TOMCZYKOWA E. (1959) — Preliminary study of the Middle and Upper Ludlow stratigraphy in the Święty Krzyż Mts. (in Polish with English summary). *Prz. Geol.*, **7** (2): 65–73.
- TOMCZYKOWA E. (1993) — Upper Ludlow trilobites from the southern part of the Holy Cross Mts. *Geol. Quart.*, **37** (3): 359–384.

NOWE STANOWISKO FAUNY BENTONICZNEJ W SZAROGŁAZACH NIEWACHŁOWSKICH (GÓRNY SYLUR) W ZALESIU POD ŁAGOWEM (GÓRY ŚWIĘTOKRZYSKIE)

Streszczenie

W synklinie bardziańskiej, w Zalesiu pod Łagowem (fig. 1–3), w szarogłazach niewachłowskich znaleziono liczny zespół fauny bentonicznej, odpowiadający faunie znanej z Gruchawki (E. Tomczykowa, 1993; J. Malec, 1993) i Jurkowic (A. Romanek, M. Rup, 1989), a prawdopodobnie też z Widełek i Niestachowa. Z oznaczonych tu trylobitów największe znaczenie stratygraficzne i korelacyjne mają: *Baliozoma erraticum* (Schrank), *Dalmanites nexilis* (Salter), *Richterarges kielcensis* Tomczykowa, *Helokybe* sp., *Harpidella* sp., *Sphaeroxochus* sp. (tabl. I). Wskazują one na wiek warstw odpowiadający środkowej części ludlowu (E. Tomczykowa, 1993). Bezpośrednio poniżej serii z fauną bentoniczną, która ma prawdopodobnie charakter turbidytowy, znaleziono graptolity: *Bohemograptus bohemicus* (Barrande), *B. bohemicus tenuis* (Bouček) i *Pristiograptus* sp. Z serii tej,

oprócz wymienionych powyżej, wcześniej podawane były (E. Tomczykowa, 1959): *Monograptus tomczyki* Willefert (wcześniej określony jako *Monoclimacis ultimus* Perner) oraz *Linograptus posthumus* Richter. Graptolity te potwierdzają pozycję stratygraficzną poziomu z *Baliozoma erraticum* (Schrank), wskazując na poziom *Bohemograptus bohemicus*. Szarogłazy niewachłowskie oraz większa część warstw kieleckich (*sensu* J. Malec, 1993), która zawiera przewodnie trylobity poziomu z *Baliozoma*, 104 i 224 m poniżej zlepieńca miedzianogórskiego (według J. Malca, 1993), należy zdaniem autorów do poziomu *B. bohemicus*, czyli do dolnych siedlec. Problem wieku stropowej części profilu Gruchawki pozostaje otwarty, przynajmniej do czasu paleontologicznego udokumentowania występujących tam graptolitów.

EXPLANATIONS OF PLATE

PLATE I

Fig. 1–3. *Baliozoma erraticum* (Schrank, 1972)

Fig. 1 — cranium, x 6, MUZ PIG 1640.II.1; Fig. 2 — hypostom, x 6, MUZ PIG 1640.II.2; Fig. 3 — pygidium, x 8, MUZ PIG 1640.II.3

Fig. 4. *Sphaeroxochus* sp.

Pygidium, x 5, private collection of T. Ochmański

Fig. 5. *Harpidella* sp.

Incomplete pygidium, x 7, MUZ PIG 1641.II.3

Fig. 6. *Richterarges kielcensis* Tomczykowa, 1993

Cranidium, x 7, MUZ PIG 1641.II.1

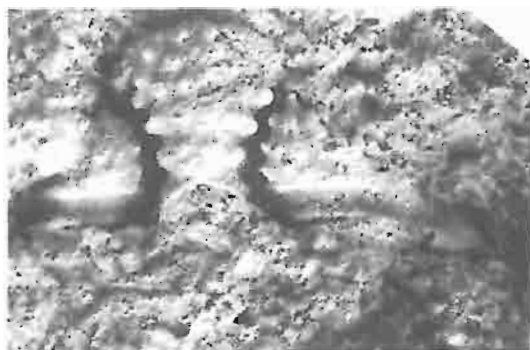
Fig. 7. *Helokybe* sp.

Pygidium, x 4,5, MUZ PIG 1640.II.5

Fig. 8. *Dalmanites nexilis* (Salter, 1864)

Incomplete pygidium, x 7, MUZ PIG 1640.II.4

All samples are internal moulds; Zalesie near Łagów, Lower Siedlec (upper Ludlow); photo Barbara Ruszkiewicz and Marek Krzyżanowski



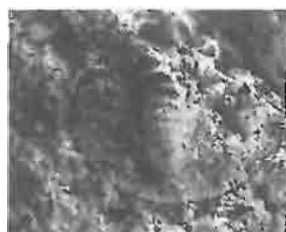
1



4



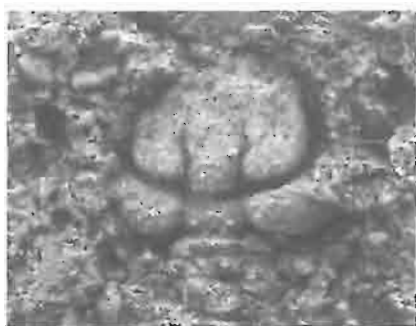
2



5



3



6



7

8

