A blind phacopid trilobite from the Famennian of the Holy Cross Mountains

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Trimerocephalus interruptus sp. n. from marly limestones of Famennian age in the Holy Cross Mountains is characterized by a cephalon typical for late species of *Trimerocephalus* and a pygidium typical for *Dianops*. The preservation of articulated trilobites in Salterian positions in slowly deposited marls of Kowala suggests their infaunal mode of life.

Key words: trilobites, Phacopida, Devonian, Poland, taphonomy.

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Introduction

Eye reduction and blindness are common features among Late Devonian trilobites. In the Frasnian at least two lineages of proetids developed this feature (Feist & Clarkson 1986, 1989) whilst in the Famennian the phacopid genera *Trimerocephalus* McCoy 1849 and *Dianops* Richter & Richter 1923 are represented by blind species (Chlupáč 1977). There are differences in opinion regarding interrelations between these two genera (Richter 1955; Maksimova 1955; Osmólska 1963; Chlupáč 1966, 1977). Fossils of blind phacopids from the Holy Cross Mountains seem to be crucial in elucidating the issue. Early species of both genera are represented there by numerous and excellently preserved specimens (Fig. 1). Especially interesting is the occurrence of *Trimerocephalus*(?) *trifolius* (Osmólska 1958, 1963) in the *Palmatolepis marginifera*(?) Zone at the locality of Kadzielnia. This is a species with advanced cephalic features of *Dianops*, that is anteriorly truncated glabella, while its pygidium remains primitive, lenticular, being deeply segmented as in typical representatives of *Trimerocephalus*. Paradoxically in coeval strata of Kowala another lineage of blind phacopids appears to be represented, characterized by a

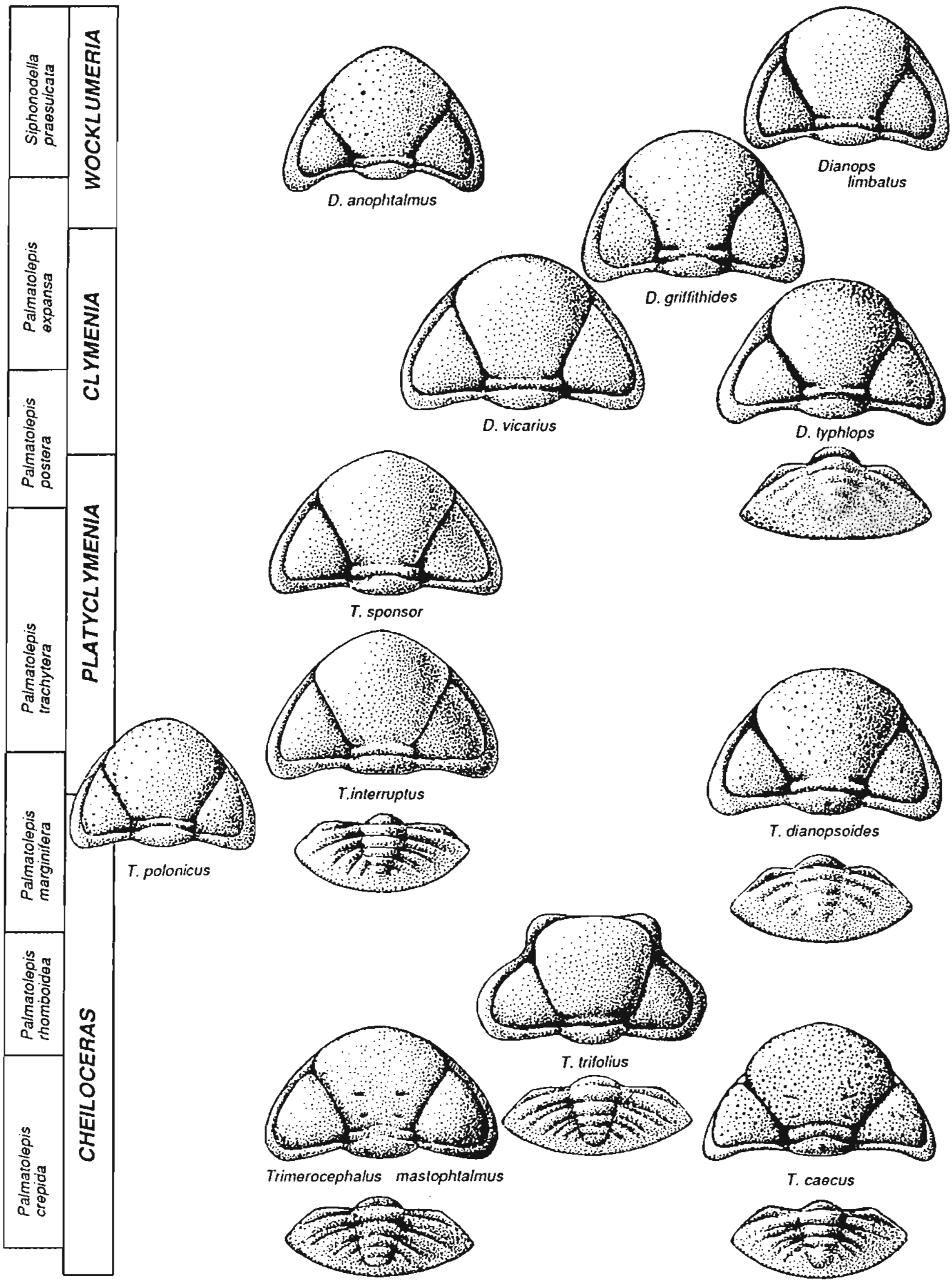

Fig. 1. Stratigraphic distribution of blind phacopids in the Famennian of Europe (based on data from Richter & Richter 1926; Osmólska 1958, 1963; Chlupáč 1966, 1977).

smooth, trapezoidal, *Dianops*-like pygidium and typical *Trimerocephalus* cephalon. In the present paper these trilobites are described and their evolutionary importance is discussed.

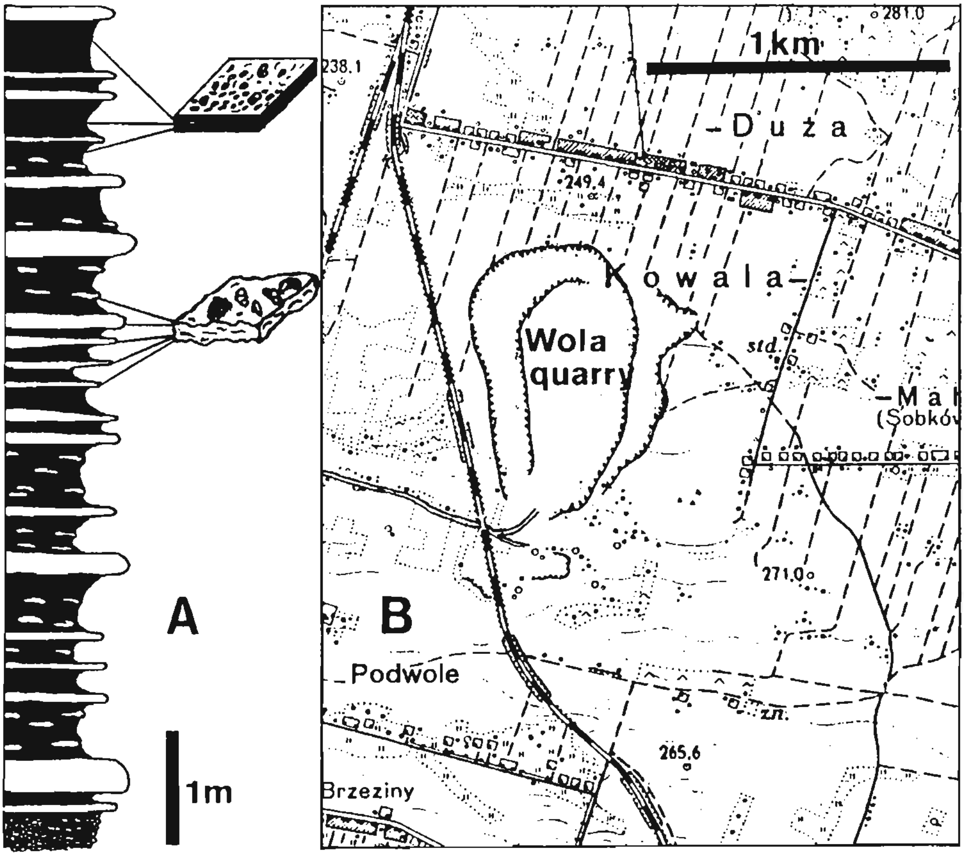

Fig. 2. ❑A. Lithologic column of the northern wall in the 'Wola' quarry at Kowala. Position of the beds of black shales with thin shelled bivalves *Guerichia* and compressed cephalopods as well as marly limestones with trilobites in Salterian positions, brachiopods and corals is indicated. ❑B. Location of the 'Wola' quarry in Kowala.

The material described from Kowala was collected during work for a MSc–thesis at the University of Warsaw and is housed at the Institute of Geology, Adam Mickiewicz University in Poznań (abbreviated UAM). The specimens from Łagów collected by Jerzy Dzik are housed at the Institute of Paleobiology of the Polish Academy of Sciences in Warsaw (ZPAL).

Geological setting

Most of the studied specimens have been found at the northern wall of the 'Wola' quarry, near the village Kowala in the Holy Cross Mountains about 8 meters below the black *Platyclymenia* shale (Fig. 2). These beds (boundary between sets 'J' and 'K' Berkowski 1990) consist of thin-bedded marly limestones or marly calcareous nodules alternating with black shales (Marly facies of Szulczewski 1971). Trilobites as well as brachiopods

(Biernat & Racki 1986) and solitary rugose corals are restricted in their occurrence to marly calcareous beds, whereas in shales numerous bivalves (mainly *Guerichia*) and rare compressed cephalopods (Berkowski 1990) occur. The age of these beds was determined as Latest *P. marginifera* or Early *P. trachytera* Zone (Biernat & Racki 1986; M. Szulczewski, personal communication).

A few specimens come from a classic locality in the ravine Dule in Łagów. They occur in the black bituminous *Platyclymenia* limestone (the *P. trachytera* Zone, J. Dzik, personal communication). Occurrence of the brachiopod *Rozmanaria magna* assemblage (*sensu* Biernat & Racki 1986) in both sites additionally supports a closely similar age for the specimens.

Descriptions

Family Phacopidae Hawle & Corda 1847
Genus *Trimerocephalus* McCoy 1849
Type species: *Phacops mastophtalmus* Richter 1856
Trimerocephalus interruptus sp. n.
Figs 3A, 4.
Holotype: Cephalon (UAM Tr. 1/1), Fig. 3A–C.
Type locality: Kowala ('Wola' Quarry), Holy Cross Mountains.
Type horizon: Famennian (Latest *P. marginifera* or Early *P. trachytera* Zone).
Derivation of the name: Latin 'interruptus': because of interrupted preoccipital furrow.

Diagnosis.– Glabella pentagonal in outline, slightly pointed anteriorly. Preoccipital furrow (S1) divided into two bent forward furrows. Pygidium trapezoidal, length to width ratio 1:2. Carapace covered by fine, dense granulation or smooth.

Material.– Kowala: 41 cephala, 12 thoracopygidia, 3 pygidia, several thoracic segments. Material includes 9 moults in Salterian position. Most of the specimens are preserved at surfaces of marly calcareous nodules (Fig. 3). Łagów–Dule: 8 cephala and 1 pygidium (collected by J. Dzik).

Description.– Cephalon (Figs 3A–E, J, K, 4). Length to width ratio is about 0.6 (Fig. 5). In dorsal view (Figs 3A, D, E, K, 4B) the margins of glabella and cheeks are gently vaulted; the frontal lobe of glabella moderately pointed anteriorly. Length to width ratio of glabella is about 0.8; lateral angles of glabella are not truncated, and dorsal furrows diverge at angles 65°–75°. Occipital ring is wide; occipital furrow bent moderately forward in its median part. Preoccipital ring is two times narrower than the occipital ring, glabellar preoccipital furrow (S1) disappears in the middle. Lateral preoccipital lobes indistinctly differentiated. Median ends of the preoccipital furrow are slightly bent forward. Lateral glabellar furrows (S2, S3), only discernible on two specimens (UAM Tr. 1/24, 35): furrows S2 are very short, near to preoccipital furrow, S3 – posterior rami are short,

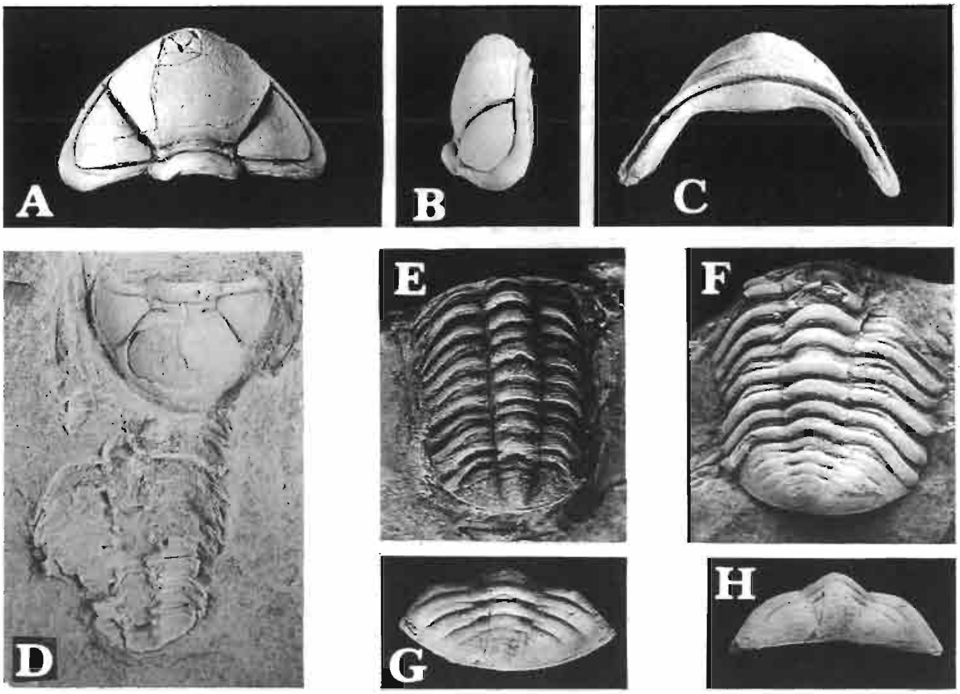

Fig. 3. Specimens of *Trimerocephalus interruptus* sp. n. from the Famennian (Latest *P. marginifera* or Early *P. trachytera* Zones) of Kowala ('Wola' Quarry), the Holy Cross Mts × 2. □A, B, C. Cephalon of the holotype UAM Tr 1/1, length (L) – 9.3 mm, width (W) – 16.3 mm. A. Dorsal view. B. Lateral view. C. Ventral view. □D. Salterian position, UAM Tr 1/23. □E. Thoracopygidium UAM Tr 1/104, dorsal view. □F. Thoracopygidium UAM Tr 1/101, dorsal view. □G, H. Pygidium UAM Tr 1/201, length (L) – 6.5 mm, width (W) – 13.6 mm, dorsal and posterior views.

parallel to occipital furrow and anterior ones are longer, near dorsal furrows and parallel to them. Cheek forms more or less equilateral triangle with posterolateral genal angle truncated, its posterior border widest at the junction with anteriorly narrowing lateral border. Border is bent strongly inside at contact with dorsal furrows, and then attains the maximum width at median part of anterior border. Border furrow is very deep. In lateral view (Figs 3B, J, 4A) the occipital ring is as high as glabella; occipital furrow is moderately deep and preoccipital ring slightly convex. Preoccipital furrow is equal to occipital furrow in depth. Glabella is gently arched, overhangs anterior border which is widest in its middle part. In ventral view (Fig. 3C) the anterior border is crescentic in shape. Vincular furrow is deep and broad. Doublure is narrow laterally and lenticular along its medial portion.

Thorax (Figs 3E, F, 4). Thoracic rings are fairly convex transversely. Pleurae posess wide, flat fulcrum, and are bent backward. Pleural furrows are distinct till the middle part of pleura.

P y g i d i u m (Figs 3G, H, 4) is trapezoidal. Length to width ratio is about 1:2. Its anterior margin is straight with markedly protruded articulating half-ring. In posterior view the margin bends at its middle part. Two anterior rings are markedly separated; two posterior (3th and 4th) rings are delimited by very shallow, narrow furrows. Four interpleural furrows become less and less distinct towards posterior end. The first and second pleural furrows are visible on the dorsal and internal surface of pygidium, 3th and 4th only on internal surface of the carapace.

S c u l p t u r e . In specimens from Kowala the carapace is usually slightly worn away and therefore seemingly smooth, only on the overlapping part of glabella and anterior border is minute granulation visible when properly lit and magnified. External surfaces of carapaces from Łagów–Dule are completely covered with fine, dense granulation.

Ontogeny.– The geometry of the cephalon (i.e. length to width ratio – CL:CW) is rather constant during ontogenetic growth (Fig. 5). However, the glabella in early stages of development seems to be more convex than in the adult specimens.

Occurrence.– Kowala ('Wola' Quarry), (Latest *P. marginifera* or Early *P. trachytera* Zone) and Łagów–Dule (*P. trachytera* Zone), Holy Cross Mountains, *Platyclymenia* Stufe of the Famennian.

Discussion

Trimerocephalus interruptus sp. n. shares several common features with *T. polonicus* Osmólska 1958 from the Holy Cross Mountains and *T. sponsor* Chlupáč 1966 from Moravia (Czechoslovakia). Both are very closely related, if not conspecific. Especially the features of the cephalon such as the pentagonal and anteriorly pointed glabella, the shape of the occipital ring and cheeks, as well as the course of the facial suture ('mastophtalmus' pattern) are common in all these three species. The main features which separate *T. interruptus* sp. n. from *T. sponsor* are the interrupted preoccipital furrow (S1) and the trapezoidal, less distinctly segmented pygidium. *T. polonicus*, known only from small specimens, differs from *T. interruptus* sp. n. in displaying continuous preoccipital furrows and a markedly ornamented cephalon. The pygidium of *T. polonicus* remains unknown. Stratigraphically *T. sponsor* occurs a little higher than *T. interruptus* sp. n. The stratigraphical position of *T. polonicus* is reported to occur in the *Clymenia* beds of Kadzielnia (Osmólska 1958) but is not sufficiently known. There is no evidence of clymeniids below and within the beds with *T. polonicus* (see Różkowska 1969). The latest conodonts which determine the age of the Kadzielnia profile (Early *P. marginifera*, Wolska 1967) occur 8 meters below the *T. polonicus* horizon. *T. polonicus* then is still inadequately known, with no data available on the stratigraphy, morphology of pygidium and ornamentation of cephala at ontogenetic stages comparable to these of *T. interruptus* sp. n. Although at present the differences in

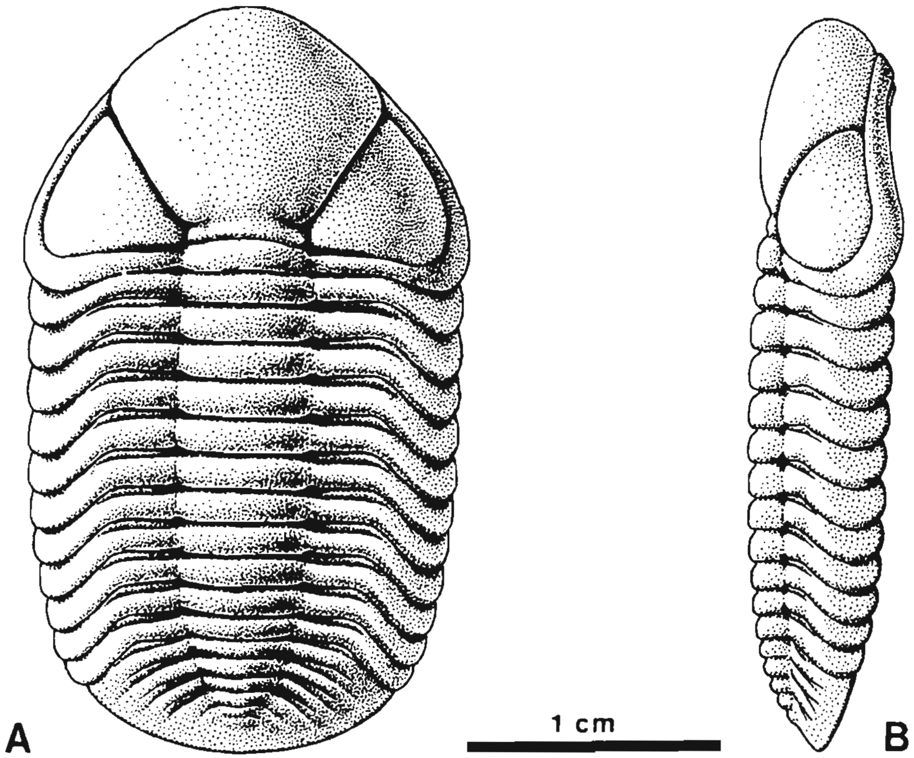

Fig. 4. Reconstruction of the carapace of *Trimerocephalus interruptus* sp. n. in dorsal (A) and lateral (B) views.

ornamentation and configuration of preoccipital furrow seem to substantiate their specific distinctness, it cannot be excluded that they actually represent different populations of the same species. According to Chlupáč (1966, 1977), *T. polonicus* and *T. sponsor* as well as *T. lentiginosus* Maksimova 1955, are known from the *Platyclymenia* Stufe and form a younger lineage of *Trimerocephalus* which is named the *T. sponsor* group. *T. interruptus* sp. n. fits well in this lineage.

The configuration of the preoccipital furrow, especially its interruption, has been introduced by Richter & Richter (1926), Maksimova (1955), Struve (1959) and Chlupáč (1966, 1977) as the typical generic character which distinguishes the closely related genera *Trimerocephalus* McCoy, 1849 and *Dianops* Richter & Richter, 1923. *T. interruptus* sp. n. has developed an interrupted preoccipital furrow (S1), which is bent forward. *D. vicarius* Chlupáč 1966, reported as the oldest representantative of *Dianops*, posesses a straight but not interrupted medially preoccipital furrow. It seems, therefore, that the course rather than interruption of the preoccipital furrow (which expresses probably a general evolutionary trend shared by both genera), is the feature which separates *Trimerocephalus* from *Dianops*.

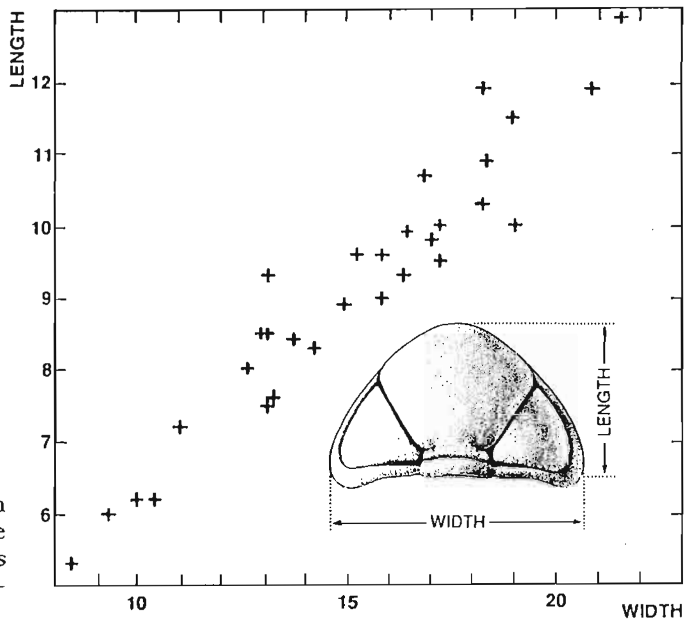

Fig. 5. Plot of cephalon length *versus* width, for the sample of *Trimerocephalus interruptus* sp. n. from Kowala, Holy Cross Mts.

Ecology and taphonomy

Apart from the species of *Trimerocephalus*, the studied fossil assemblage contains sessile benthic invertebrates, mainly the bivalves *Guerichia* (Berkowski 1990), brachiopods (Biernat & Racki 1986), and in lesser extent, solitary rugose corals. So far, the trilobites found in 'Wola' Quarry are represented mainly by moults. Nine complete specimens in classical Salterian positions (Fig. 3K) and 3 thoracopygidia without cephala (Fig. 3F, G) were collected. No outstretched body was found. The presence of articulated moult 'ensembles' (*sensu* Speyer 1985, 1987) indicates autochthonous fossil assemblages (Fortey 1975). Such moult assemblages can be created only under rapid burial conditions (see experimental data of Schäfer 1972; Plotnick 1984, 1986). Speyer (1987) even suggested, that the process of ecdysis could happen partly after rapid burial, within muddy sediment from which the burrowed trilobites could escape. However, there is no sedimentological evidences, suggesting rapid burial condition in Kowala. Paleoecologic and biostratinomic (Biernat & Racki 1986, Berkowski 1990) patterns indicate rather quiet deposition of the beds with trilobites. Therefore, one may not exclude a possibility that the occurrence of Salterian positions results from an infaunal mode of life (referred thus far only as an implication of trilobite blindness; see Maksimova 1955, Clarkson 1967, and Chlupáč 1977) rather than abrupt deposition.

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Streszczenie

Nowy gatunek ślepego trylobita z rodziny Phacopidae, *Trimerocephalus interruptus* sp. n. posiada, tak jak niektóre opisane dotąd gatunki tego rodzaju, cechy wspólne z rodzajem *Dianops*. Potwierdza to więc dodatkowo pogląd (Maksimova 1955; Osmólska 1958, 1963; Chlupáč 1966, 1977) o bliskim pokrewieństwie rodzajów *Trimerocephalus* i *Dianops*. Część cech uznawanych za indeksowe na poziomie rodzaju ma ograniczoną wartość taksonomiczną i jest jedynie generalnym trendem ewolucyjnym zaznaczającym się w obu rodzajach.

Analiza tafonomiczna jednogatunkowego zespołu trylobitowego wskazuje, że dominującym jego elementem są wylinki, które tylko w nieznacznym stopniu uległy rozpadowi. Dane te potwierdzają autochtoniczny charakter tego zespołu oraz jego przypuszczalne szybkie pogrzebanie, na co brak jest jednak przekonywujących sedymentologicznych dowodów. Wyjaśnieniem zachowania się niezaburzonych części szkieletowych mógłby być więc sugerowany infaunalny tryb życia tych organizmów, a co za tym idzie możliwość ich linienia w obrębie osadu.