Trilobites from the Givetian and Frasnian of the Holy Cross Mountains

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Three species of Givetian and Frasnian trilobites have been recognized in the stromatoporoid-coral platform and Dyminy reef complex (Kowala Formation) of the southern part of the Holy Cross Mts, and two more in deeper facies of the Kostomłoty area. Representatives of the genus *Scutellum*, common in the shallow-water (related to carbonate buildups) associations of the Variscan Europe, are most widespread and diversified. *Cyrtodechenella*(?) *declinans* sp. n., *Phacops (Chotecops) zofiae* sp. n., and *Scutellum mariae* sp. n. are proposed.

Key words: trilobites, taxonomy, Devonian, Poland.

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Introduction

Although the first Devonian trilobites were collected in the Holy Cross Mountains in the early 19th century (Pusch 1833), their systematic description began only in the 1950's; since then the Eifelian and Famennian faunas have been relatively well documented. In the present paper some little known trilobites from the Givetian and Frasnian strata are described.

New collections from recent field studies in the Holy Cross Mountains, as well as material from the State Geological Institute in Warsaw, yielded 47 specimens from 10 localities, mostly from the southern part of the area. The Givetian and Frasnian strata are poor-in-trilobites stromatoporoid-coral facies Kowala Formation (localities Jurkowice-Budy, Sowie Górki, Kadzielnia, Góra Łgawa) and reef-related, detrital facies (Grabina, Karwów, Tudorów, Szczukowskie Górki) characteristic of the shallow-water Kielce Region. There are only a few records of trilobites (Gürich 1896; Samsonowicz 1917; Baliński 1973) from the strata. The two sites studied, at

Laskowa Góra and Szydłówek, represent more open-shelf, chiefly marly facies of the Kostomłoty ('western Łysogóry') Zone. A rich older Middle Devonian trilobite fauna was described by Kielan (1954) from similar strata in the Łysogóry area. More details on the localities, lithologic units and their stratigraphic setting are presented in Racki (1993) and Racki & Bultynck (in preparation).

Most reference material has been deposited at the Department of Earth Sciences of the Silesian University in Sosnowiec (GIUS); the collection of Andrzej Baliński is housed at the Institute of Paleobiology of the Polish Academy of Sciences in Warsaw (ZPAL); and specimens collected by Jan Samsonowicz are at the Museum of the State Geological Institute in Warsaw (IG).

Descriptions

Family Proetidae Salter 1864

Subfamily Dechenellinae Přibyl 1946

Genus *Cyrtodechenella* Richter & Richter 1950

Cyrtodechenella(?) *declinans* sp. n.

Fig. 1.

Holotype: Cranidium ZPAL Tr IV/3, Fig. 1C, D.

Type locality: Jurkowice-Budy quarry, set E, Holy Cross Mountains, Poland.

Type horizon: *Stringocephalus* Beds of the Kowala Formation, Middle Givetian.

Derivation of the name: From Latin declinans – deflecting, referring to its intermediate systematic position between genera *Cyrtodechenella* and *Dechenella*.

Diagnosis.– Glabella coniform, glabellar furrows S_2 and S_3 weak, anterior border narrow, preglabellar field concave. Occipital lobes distinctly separated. Genal field of librigena with a slightly convex circumocular ridge. Pygidium with 15 axial rings and 7-8 flat ribs; pleural furrows narrow and sharp, with interpleural furrow indicated on first anterior rib.

Material.– One cephalon with librigenae, 6 cranidia, 5 librigenae, 10 pygidia. All extracted from light-grey weathered limestones by Andrzej Baliński.

Description.– The glabella is moderately vaulted, subconical in outline, only very slightly constricted opposite γ. Dorsal furrows are narrow and sharp, converging anteriorly from basal lobes. There are three pairs of glabellar furrows: S_1 shallow and sharp, delimiting the gently convex basal lobe; S_2 and S_3 marked as dark lines at the surface of the exoskeleton, slightly indicated. The occipital furrow is deep and sharp, bent anteriorly in abaxial parts, transverse medially. Occipital ring has a small occipital tubercle and small distinctly separated and gently convex occipital lobes. The anterior border is narrow and upraised, with 5-6 longitudinal parallel ridges at the anterior margin. The anterior border furrow is shallow and blunt, with gently concave preglabellar field. Palpebral lobes are rather

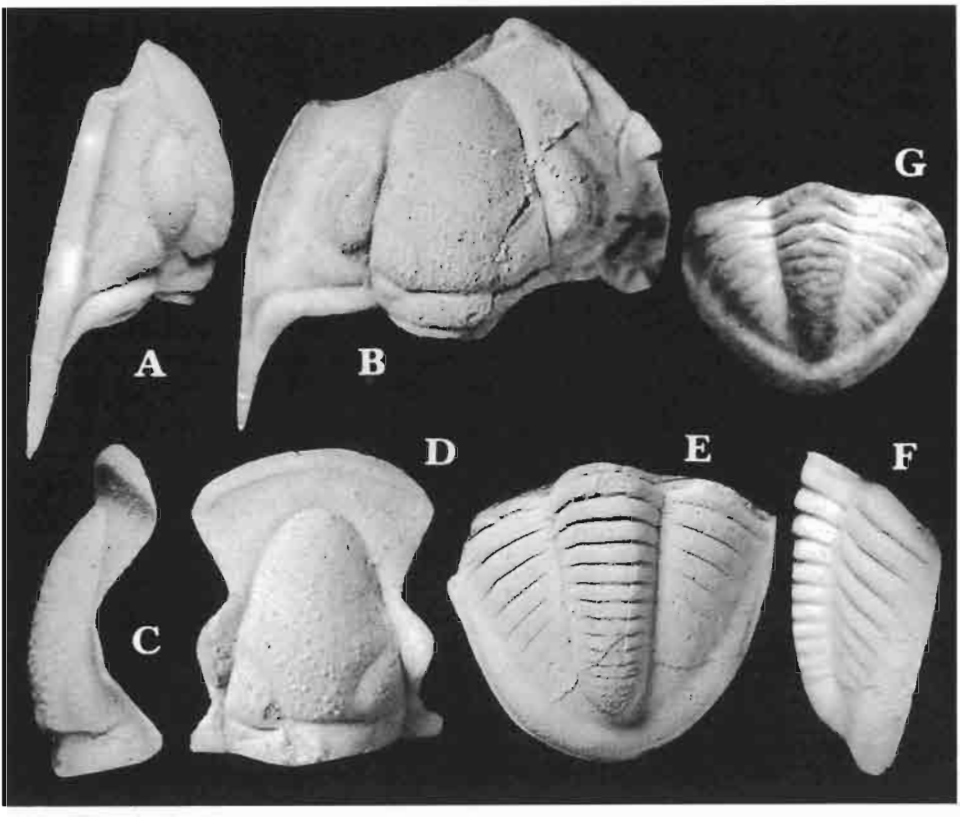

Fig. 1. *Cyrtodechenella*(?) *declinans* sp. n. from the Middle Givetian *Stringocephalus* Beds of Jurkowice-Budy. ❑A, B. Incomplete cephalon ZPAL Tr IV/1 with exoskeleton in lateral (A) and top (B) views, width 8.9 mm; × 6. ❑C, D. Cranidium ZPAL Tr IV/3 (holotype) in top (D) and lateral (C) views, length 6.9 mm; × 6. ❑E, F. Pygidium ZPAL Tr IV/2 with exoskeleton in top (E) and lateral (F) views, length 7.0 mm; × 5. ❑G. Pygidium of a juvenile specimen ZPAL Tr IV/4 with exoskeleton; × 11.

small, gently curved abaxially, sloping towards dorsal furrows; their length equals to about 1/3 of the length of glabella. Palpebral furrows are absent.

Facial sutures. The anterior section between β and γ is moderately divergent at about 25° to sagittal axis, almost rectilinear; γ is rounded and approaching dorsal furrow at the ε angle, slightly arcuate; the posterior section of the facial suture is subparallel, with dorsal furrow extending up to the preoccipital lobes, then turning abruptly abaxially.

Librigenae. A strongly convex visual surface, distant from posterior border furrow, bordered by a shallow, rather broad depression. The genal field is gently vaulted, and possesses a slightly convex circumocular ridge. The lateral border furrow is represented by a broad and concave, gently delimited depression. The lateral border is narrow and upraised, with parallel ridges (5-7) on the vertical lateral margin. Genal spine is equal to about 1/2 of the sagittal length of the cephalon. The posterior border furrow is sharp, posterior border convex and slightly broadened abaxially.

Pygidium. Long and richly segmented, with a length-to-width ratio of 0.9 (specimen ZPAL Tr IV/2, slight deformation not excluded). A strongly convex axis tapers very gradually up to the 11th ring, abruptly narrowing in the terminal posterior part; 15 axial rings are separated by narrow ring furrows (weak between posterior 4 rings). The lateral lobes are moderately convex and falling laterally, with 7-8 flat ribs delimited by narrow and sharp pleural furrows. The interpleural furrow is a slight line only on the first anterior rib, and almost indistinct on the second rib. The border is convex and rather broad, gradually broadening posteriorly, differentiated by a shallow border furrow.

One smaller pygidium (ZPAL Tr IV/4) is only 2 mm long and shows typical larval features seen in a deeper border furrow, deeper pleural furrows, and interpleural furrows distinctly incised on the anterior two ribs, and marked in abaxial parts of further ribs up to the fourth rib.

Sculpture. Unequal and rather distant granulae are present on the frontal lobe of glabella pass anteriorly in small scaly ridges; slight pitting on genal field. Pygidial axis and lobes are smooth; borders carry very fine and dense granulation.

Remarks.– The species was listed by Baliński (1973: p. 273) as *Dechenella (Dechenella)* sp. It shows an intermediate position between *Cyrtodechenella* and *Dechenella*. The coniform outline of glabella, weak impression of glabellar furrows S_2 and S_3, narrow anterior border and concave preglabellar field – all agree with *Cyrtodechenella*, whilst the presence of occipital lobes and the long and richly segmented pygidium point to *Dechenella*. Following Hupé (1953), Ormiston (1967) and Thomas & Narbonne (1979), *Cyrtodechenella* is herein placed in Dechenellinae Přibyl 1946.

Among dechenellids from the Holy Cross Mountains, *Dechenella* (*?Basidechenella) dombrowiensis* (Sobolev 1909) seems to show some resemblance to the new species. This species, however, needs to be revised on the basis of the type material from Eifelian Dąbrowa Limestone at the type locality at Dąbrowa, near Kielce. The lectotype (pygidium figured by Richter 1912: Pl. 18, Fig. 13a-c; see also Richter & Richter 1950: p. 178) shows markedly broader pleural furrows, well defined interpleural furrows, more convex ribs and marked granulae on ribs and axial rings. According to Yolkin (1968: p. 53) cranidia assigned to this species by Richter (1912: Pl. 18, Figs 9, 10) may not be conspecific with the lectotype. The assignment of *D.* (*?B.*) *dombrowiensis* to *Ganinella* and the conspecificity of Asian specimens with those from Poland (Yolkin 1968, 1983) has not been convincingly demonstrated, as already indicated by Maksimova (*in* Yolkin 1968: p. 53).

Distribution.– Middle Givetian (*Stringocephalus* Beds of the Kowala Formation) of the Holy Cross Mountains; only(?) set E at the type site.

Family Phacopidae Hawle & Corda 1847

Genus *Phacops* Emmrich 1839

Subgenus *Phacops (Chotecops)* Chlupáč 1971

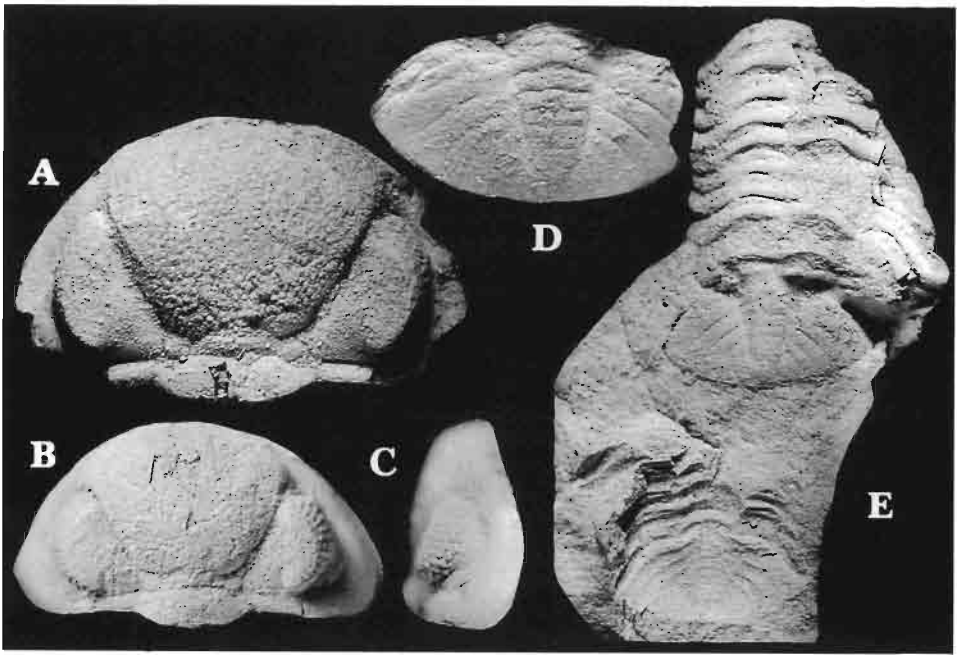

Fig. 2. *Phacops (Chotecops) zofiae* sp. n. from Szydłówek, Givetian to Frasnian boundary beds. ❑A. Cephalon, holotype GIUS-4-287/t-1 with exoskeleton; × 5. ❑B, C. Cephalon GIUS-4-287/t-2 with partly preserved exoskeleton; × 5.5. ❑D. Pygidium GIUS-4-287/t-5 with exoskeleton; × 5. ❑E. Two specimens with incomplete thorax and pygidium (GIUS-4-287/t-7), × 4.

Phacops (Chotecops) zofiae sp. n.

Fig. 2.

Holotype: Cephalon GIUS-4-287/t-1, Fig. 2A.

Type locality: In a ditch, eastern Bocianek suburb, Kielce, Holy Cross Mountains, Poland.

Type horizon: Szydłówek Beds, lower fossiliferous part (et A); Givetian/Frasnian boundary.

Derivation of the name: In honour of Professor Zofia Kielan-Jaworowska who studied Devonian trilobites of the Holy Cross Mountains.

Diagnosis.– Moderately inflated cephalon with S_1 furrow strongly shallowed medially. Eyes long, closely approaching posterior border furrow; visual surface low; 15 to 16 vertical rows of lenses, with no more than 4 to 5 lenses in one row. Postocular area very narrow, equal in length to about one ocular lens. Sculpture on glabella of rather dense granulation; other parts of exoskeleton smooth or very finely granulated as on lateral border. Pygidium with weakly furrowed 8 (+1) flat ribs; pleural furrows on lateral lobes narrow and shallow, dying out far from outer margin of pygidium (broader and shallow on internal moulds).

Material.– Three cephala, three thoraces with pygidia, and two isolated pygidia preserved in soft marly shale and slightly deformed; collected by Grzegorz Racki and Tomasz Wrzołek.

Remarks.– The Holy Cross Mountains species is placed in the subgenus *Phacops (Chotecops)* as defined by Chlupáč (1971, 1977). Later regarded

it as some authors (Flick & Struve (1984) a separate genus because of moderately vaulted cephalon steeply falling to the anterior border furrow, weak and not impressed S_2 and S_3 furrows, shallow S_1 furrow, flat and laterally not reduced preoccipital ring, flat preoccipital lobes and palpebral area, rather fine sculpture, and weakly furrowed pygidium. Among described species, *P. (Ch.) hoseri* (Hawle & Corda 1847) from the Eifelian of the Barrandian area shows some similarity, but differs particularly in eye structure detail (18 vertical rows of lenses, 5-6 lenses in one row), longer postocular area and richer segmented pygidium (see Chlupáč 1977: pp. 53-54, Pl. 20, Fig. 1-23). Other Middle Devonian representatives of *P. (Chotecops)*, namely *P. (Ch.) despujolsi* Richter & Richter 1943, *P. (Ch.) hassiacus* Herman 1911, *P. (Ch.) koeneni* Holzapfel 1895, *P. (Ch.) latissimus* Holzapfel 1895, *P. (Ch.) spectabilis* Meischner 1965, *P. (Ch.) occidomaurus* Alberti 1981, and *P. (Ch.) zizensis* Alberti 1983 differ especially in eye detail (see Holzapfel 1895; Richter & Richter 1943; Meischner 1965; Alberti 1981, 1983).

Distribution.– Givetian/Frasnian boundary beds (lower Szydłówek Beds) of the Holy Cross Mountains; type locality only.

Family Scutelluidae Richter & Richter 1955

Genus *Scutellum* Pusch 1833

Scutellum flabelliferum (Goldfuss 1839)

Discussion.– A damaged moderately vaulted pygidium (GIUS-4-170/t-1, collected by Tomasz Wrzołek) with sharply delimited costae, rather broad intercostal furrows with flat bottoms, and sculpture consisting of distant granulae of subequal size, corresponds to *S. flabelliferum* as interpreted by Richter & Richter (1926) and Kielan (1954). The size of the specimen examined (length exceeding 39 mm, width extrapolated to 45 mm) falls within the range of larger representatives known from other parts of Europe.

The species is widely distributed especially in the Middle Devonian of the European Variscan Belt (Kielan 1954; Richter & Richter 1956; Selwood 1966), particularly southern England, Ardennes, Rhenish Slate Mountains, Moravia, and Łysogóry region of the Holy Cross Mountains. Related specimens are known from the Early Frasnian. The specimen studied derives from the Late Givetian of the Sowie Górki Quarry (set C; Coral-Crinoid Level of the Kowala Formation) thus extending the known geographical range of this significant species.

One incomplete pygidium was collected by Grzegorz Racki in the Early Frasnian Kadzielnia Member of the Kowala Formation at Góra Łgawa (set J) (Fig. 3C). Its length is 8.3 mm and extrapolated width 11 mm. The rather small pygidium agrees with that of *S. flabelliferum* in gentle vaulting, flat border region, sharply deliminated ribs, broad intercostal furrows with flattened bottoms, and in the configuration of the median rib. It differs in sculpture, which consists of distant granulae unequal in size and more prominent than in the typical specimens of this species.

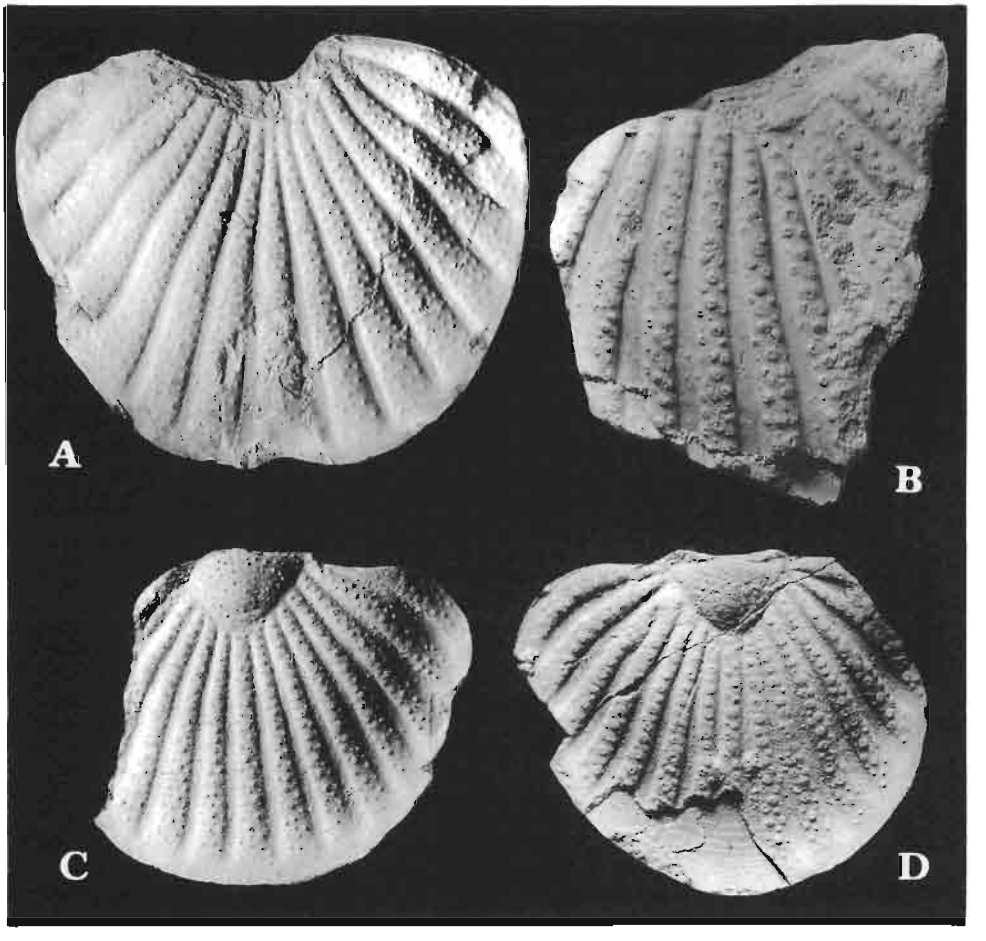

Fig. 3. ❑A. *Scutellum* sp. [aff. *S. flabelliferum* (Goldfuss 1839)], pygidium GIUS-4-296/t-1b with exoskeleton; Laskowa, Middle Givetian; × 1. ❑B. *Scutellum mariae* sp. n., fragmentary pygidium GIUS-4-258/t-2; Kadzielnia, Early Frasnian; × 3.5. ❑C. *Scutellum* aff. *flabelliferum* (Goldfuss 1839), incomplete pygidium GIUS-4-256/t-1b with exoskeleton; Góra Łgawa, Early Frasnian; × 5. ❑D. *Scutellum mariae* sp. n., pygidium of a small specimen, holotype GIUS-4-258/t-1 with exoskeleton, length 9.8 mm; Kadzielnia, Early Frasnian; × 5.5.

Two incomplete pygidia of *Scutellum* preserved on the same slab of dark fine-grained limestone were collected by Tomasz Wrzołek in the Middle Givetian Laskowa Góra Beds at type section (Fig. 3A). The specimen length is about 34 mm with axis broken off; its width is 42.5 mm.

The moderately vaulted pygidium shows a flattened median platform gently sloping to the flat border. The axis is not preserved. Postaxial part of the median platform is slightly depressed. The median rib is strongly narrowed adaxially, and markedly widened in the border region. Lateral ribs are moderately convex, broad, continuing up to near the outer margin. Intercostal furrows are of moderate width, deep, and with flattened bottoms equal in width to about 1/3 to 1/4 of the adjacent lateral rib.

Sculpture consists of distant granulae of subequal size regularly distibuted on ribs (3-4 granulae per the width of a rib in abaxial part).

The specimens from Laskowa Góra exhibit features intermediate between *S. flabelliferum* and *S. costatum* Pusch 1833. Whilst the flattened bottoms of intercostal furrows and the sculpture agree with *S. flabelliferum*, the adaxially strongly narrowed median rib and narrow intercostal furrows point to *S. costatum*. As both *S. flabelliferum* and *S. costatum* are closely allied and evidently belong to the same lineage, the existence of transitional forms is not surprising (Richter & Richter 1926; Selwood 1966).

The configuration of the intercostal furrows much resembles the specimens of *S. flabelliferum* figured by Richter & Richter (1956: Pl. 7, Fig. 42) and by Kowalski (1979: Fig. 6) which also shows narrow intercostal furrows. Its median rib is, however, markedly less narrowed adaxially than in the specimen studied.

Scutellum mariae sp. n.

Fig. 3B, D.

Holotype: Pygidium (GIUS-4-258/t-1), illustrated in Fig. 3D.

Type locality: Kadzielnia quarry, Kielce, Holy Cross Mountains, Poland.

Type horizon: Kadzielnia Massive Limestone Member of the Kowala Formation; Early Frasnian.

Derivation of the name: In honour of Dr. Maria Pajchlowa in recognition of her contribution to the Devonian stratigraphy of the Holy Cross Mountains.

Diagnosis.– Pygidium of prolonged semi-elliptical outline, gently vaulted. Subtriangular axis without expressive tr'obation, delimited by narrow axial furrows only slightly shallowed me ially. Median rib narrow and maintaining same width for long distan e behind axis (this distance exceeds one half of total lenght of media rib). Lateral ribs narrow and convex, only slightly broadening abaxially Intercostal furrows wide, almost corresponding in width to ribs, botto is of furrows flat. Sculpture on ribs of coarse granules of markedly uneq al size, 1 granule per width of rib in adaxial part, 1 to 2 in abaxial part o ribs. Axis with markedly finer granulae.

Material.– One smaller and one incomplete larger pygidium, both obtained from lightgrey 'reef' limestone by Grzegorz Racki.

Dimensions: Pygidium in the holotype measures 9.8 mm in length, extrapolated to 11.2 mm when complete.

Remarks.– *S. mariae* sp. n. differs from *S. flabelliferum* in more convex and narrower ribs, with median rib maintaining the same width for a long distance, broader intercostal furrows, and much coarser and unequal granulation of ribs. The general outline seems to be more elongated. *S. costatum* shows markedly flatter ribs strongly narrowing adaxially, and narrower intercostal furrows. The same applies to *'Bronteus kielcensis'* Gürich 1896 present at the same locality as *S. mariae* sp. n., which was correctly placed in synonymy with *S. costatum* by Richter & Richter (1926). The more complete of the two specimens is slightly malformed. The median

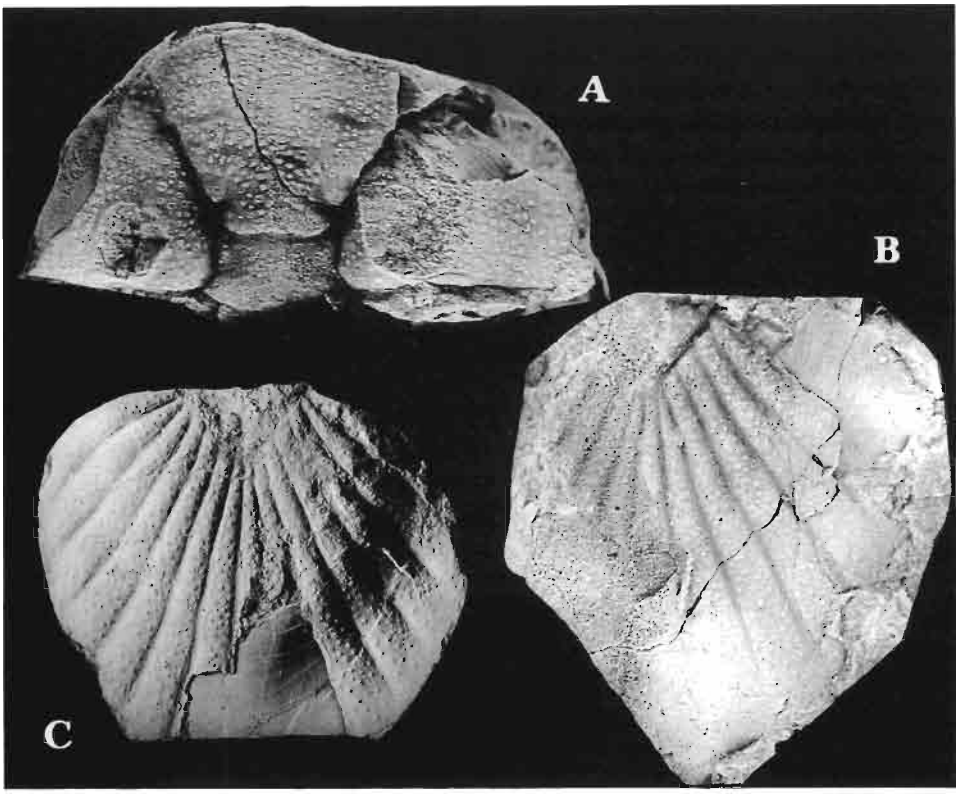

Fig. 4. *Scutellum costatum costatum* Pusch 1833. ❑A, B. Specimens from Tudorów, Late(?) Frasnian, coll. J. Samsonowicz, natural size. A. Cephalon IG II. 720 in top view; × 1.5. B. Fragmentary pygidium IG 8. II. 719a; × 1.3. ❑C. Incomplete pygidium (GIUS-4-262/t-1, exoskeleton partly preserved; Karwów, Frasnian; × 1.3.

rib is for a short distance connected with the seventh left lateral rib, and the third and fourth left lateral ribs are joined together in adaxial parts. This specimen, despite its small size, is devoid of larval features. A specimen from the Frasnian of Ferques identified by Morzadec (1988) as *Scutellum (Scutellum)* cf. *flabelliferum* and figured in his Pl. 57: 1a, b shows some similarity in development of ribs, intercostal furrows and sculpture, but differs in a more elongate outline of the pygidium.

Distribution.– Early (?to Middle) Frasnian of the Holy Cross Mountains, Kadzielnia Member of the Kowala Formation; type section only.

Scutellum costatum costatum Pusch 1833

Fig. 4.

Material.– One cephalon (IG 8.II.720) and 8 pygidia from light 'reef' limestones collected by Jan Samsonowicz (IG 8.II.719-721), Grzegorz Racki (GIUS-4-277/t-1, 3; GIUS-4-264/t-1) and Helena Ozonkowa (GIUS-4-262/t-1). Five specimens from Tudorów near Opatów (reported as *Bronteus granulatus* Goldfuss by Samsonowicz 1917: p. 45) as well as pygidia

from the new collections of the Silesian University, show some characteristic features of *Scutellum costatum costatum*.

Remarks.– The structure of the single cephalon (Fig. 7A) agrees with the description by Richter & Richter (1926). Pygidia exhibit diagnostic characters such as flattened to slightly concave median platform, markedly sloping towards flat border regions, median rib strongly narrowed adaxially, not united with axis, intercostal furrows narrow and deep, sculpture consisting of conspicuous granules with pointed tops characterized by variable size and irregular distribution (3 to 5 per the width of rib), and distant terrace lines on the doublure.

The specimen from Karwów is distinguished by markedly flattened median platform and adaxially depressed median and seventh paired lateral ribs, i.e. features observable also to a lesser degree in other larger specimens and evidently accentuated in later ontogenetic stages.

Distribution.– The material studied derives from the Frasnian limestones of Grabina, sets B-?C, Szczukowskie Górki in the western, and Tudorów, Karwów, eastern part of the Holy Cross Mountains. The type locality is the Kadzielnia hill in Kielce (Pusch 1833; Richter & Richter 1926). The stratigraphic position of Pusch's type specimens (early Frasnian bioherm *versus* later Frasnian detrital limestones) is unclear in the context of present trilobite data.

S. costatum is widely distributed in the Givetian and Frasnian strata in England, Ardennian-Rhenish area, Harz, Moravia, Thuringia, Holy Cross Mountains, and Asia (Urals, Kuzbass); closely allied forms occur in North America (Richter & Richter 1926; Selwood 1966).

Conclusions

The trilobite assemblages from the Kielce Region represent shallow-water facies. *Scutellum costatum*, *S. mariae* sp. n., and *S.* aff. *flabelliferum* were recovered from the Frasnian Dyminy reef complex, which are various light and massive limestones, including the biohermal Kadzielnia Member of the Kowala Formation (Szulczewski & Racki 1981: p. 159). *Cyrtodechenella*(?) *declinans* and *S. flabelliferum* were found also in the shallow-water, chiefly biostromal facies of the Givetian age (Baliński 1973). The scutelluids and dechenellids in the reef and allied habitats in the Holy Cross Mountains material as well as elsewhere support earlier interpretations of the trilobite distributional patterns (Mikulic 1981; Chlupáč 1983).

Trilobites from the Kostomłoty area are linked to rocks with markedly greater clayey influx. *S.* sp. (aff. *S. flabelliferum*) occurs in dark micrite with calcareous shale interbeds rich in crinoids and corals of the Givetian Laskowa Góra Beds, and *Phacops (Chotecops) zofiae* in dark calcareous mudstone layers of the slightly stratigraphically younger Szydłówek Beds. Whilst the scutelluid evidently comes from shallower-water deposits, partially biolithites (Racki *et al.* 1985), *P. (Ch.) zofiae* sp. n. derives from a

low energy and probably deeper, basinal environment. Also these data correspond well to patterns known from other areas. *S. flabelliferum* tends to be concentrated in rather shallow-water sediments with different clayey influx, as can be seen also in the Skały Beds (Kielan 1954). Representatives of *Phacops (Chotecops)* evidently inhabited a wide range of environments from shallow-water biotopes with an intensive carbonate sedimentation up to low-energy areas with clayey deposition.

Generally, the trilobites from the Holy Cross Mountains give evidence of both the close faunal relationships with the Central and Western Europe Variscan faunas, and an uninterrupted evolution of trilobite lineages between the Givetian and Frasnian.

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Streszczenie

W oparciu o nowe kolekcje, pochodzące ze stanowisk głównie w obrębie platformy stromatoporoidowo-koralowcowej i dymińskiego kompleksu rafowego (Formacja z Kowali) południowej części Gór Świętokrzyskich oraz z głębszych facji obszaru kostomłockiego, opisano faunę trylobitową żywetu i franu oraz przedyskutowano różne aspekty jej występowania. Wyróżniono 5 taksonów, w tym 3 nowe gatunki: *Cyrtodechenella*(?) *declinans* sp. n., *Phacops (Chotecops) zofiae* sp. n. i *Scutellum mariae* sp. n.

Przedstawiciele rodzaju *Scutellum* są najbardziej szeroko rozpowszechnieni i zróżnicowani. Wykazują oni ścisłe pokrewieństwa z płytkowodnymi asocjacjami środkowej i zachodniej (waryscyjskiej) Europy, związanymi z różnorodnymi budowlami węglanowymi.