acta
geologica
polonica

Vol. 25, No. 3 Warszawa 1975

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The systematic position and ontogeny of the Lower Cambrian trilobite species *Ellipsocephalus sanctacrucensis* (Samsonowicz, 1959)

ABSTRACT: The systematic position of the most common trilobite species *Ellipsocephalus sanctacrucensis* (Samsonowicz, 1959) in the Lower Cambrian Protolenus Zone of the Holy Cross Mts is discussed, and its ontogeny is reconstructed.

INTRODUCTION

Diverse trilobites, brachiopods and jellyfish were described from the Lower Cambrian Protolenus Zone of the Holy Cross Mts, Central Poland (Czarnocki 1927; Samsonowicz 1959, 1962; Bednarczyk 1970), but the most common fossil in this zone is the trilobite *Ellipsocephalus sanctacrucensis* (Samsonowicz, 1959), a rich material of which has been collected over several decades from the sandy deposits exposed at Zamczysko Hill near the village Widełki, 25 km ESE of Kielce.

The collection under study mostly includes cranidia, while librigenae, pygidia and thoracic segments are less frequent; completely preserved exoskeletons are very rare. The specimens, on which the present paper is based come mostly from the collections of Professor J. Samsonowicz, Docent W. Bednarczyk, Dr. M. Piwocki and the present writer. They are mostly housed at the Institute of Geology of the Warsaw University.

Acknowledgements. The writer is greatly indebted to Docent W. Bednarczyk for making the fossil collection available and to W. R. Kowalski, M. Sc. for his assistance in technical work.

THE LITHOTOPE

Few outcrops of fine- and median-grained standstone, grey in colour, with intercalations of hard, compact, quartzitic sandstones are situated on the north slope (called Łapigrosz) of Zamczysko Hill at the village Widełki. The layers of sandstone reach 15 cm in thickness. They yield very common *Ellipsocephalus sanctacrucensis* (Samsonowicz, 1959) brachiopods (*cf.* Pl. 4, Fig. 1) and diverse trace fossils produced by various worm-shaped burrowers. There also occur trilobite trackways, *Cruziana* sp., considerably large in size (*cf.* Pl. 2, Fig. 11 and Pl. 4, Fig. 2) but usually badly preserved. The specimens of *Cruziana* sp., attributable to this very ellipsocephalid species were previously reported from this locality by Orłowski, Radwański & Roniewicz (1970, p. 346 and 354 — locality called as Widełki and the trilobites as *Germaropyge*).

DESCRIPTION OF THE SPECIES

Family **Ellipsocephalidae** Matthew, 1887
Genus *ELLIPSOCEPHALUS* Zenker, 1833

Type species: *Trilobites hoffi* Schlotheim, 1823

The type species of the genus *Ellipsocephalus* is marked by glabella which is narrower in the middle, by rounded librigenae and twelve thoracic segments.

The diagnosis of the genus was established by Kiaer (1916), who pointed out its considerable similarity to the genus *Strenuella*. Species with genal spine were included by Kobayashi (1935, vide Westergård 1950) in *Ellipsocephalus*. A new version of diagnosis was presented by Lake (1940) who emphasized the rounded librigenae as a diagnostic character.

Since the species *Ellipsocephalus germari* is marked by librigenae having long and solid genal spines, smaller eyes and more divergent branches of facial suture, Lake (1940) excludes it from the genus *Ellipsocephalus*.

Westergård (1950) maintains that most features which, according to Lake (1940), exclude *E. germari* from *Ellipsocephalus*, may be found in *E. lejostracus*, an unquestionable *Ellipsocephalus*, with the genal spine being an only distinct dissimilarity. The genal spine is not a generic criterion of this genus, and the species *E. germari* should therefore be retained in *Ellipsocephalus*.

Šnajdr (1957) separated the genus *Germaropyge* and selected *Ellipsocephalus germari* as a type species. The diagnosis of this new established genus (Šnajdr 1958) was based on six characters, the most important being: small eyes, librigenae with a genal spine, and different course of the facial suture.

Librigenae with long rudimentary genal spines or without are included by Henningsmoen (1959) in the diagnosis of the genus *Ellipsocephalus*.

Samsonowicz (1959) includes the new created species *Ellipsocephalus sanctacrucensis* Samsonowicz in the genus *Germaropyge* but only on the basis of its librigenae having genal spines.

In the present writer's opinion, the diagnosis of *Ellipsocephalus* is more correct in Westergård's (1950) and Henningsmoen's (1959) interpretations. The features of the species *E. sanctacrucensis* match well to the diagnosis of the genus *Ellipsocephalus*.

Ellipsocephalus sanctacrucensis (Samsonowicz, 1959)
(Pl. 1, Figs 1—7; Pl. 2, Figs 1—10; Pl. 3, Figs 1—8)

1927. *Ellipsocephalus S-ta Cruzensis* sp. n.; Czarnocki (nomen nudum), pp. 193—194.
1959. *Germaropyge sancta-crucensis* (Czarnocki); Samsonowicz, pp. 527, 529, Pl. II, Figs 4—12.
(non) 1972. *Germaropyge* aff. *sancta-crucensis* Samsonowicz; Lendzion, p. 131, Pl. IV, Figs 1—2.
1973. *Germaropyge* cf. *sanctacrucensis* Samsonowicz; Orłowski, pp. 370—371, Pl. 1, Fig. 3.

Lectotype: — Dorsal exoskeleton (specimen No. 10), presented in Pl. 1, Fig. 1a, b.

Material. — Two almost completely preserved specimens, one cephalon, sixty cranidia, several more or less complete thoraces and thoracic segments, librigenae and pygidia.

Description. — Dorsal exoskeleton elongate. Cephalon convex, slightly broader across palpebral lobes than long, librigenae with genal spines. Glabella broad (*tr.*), parallel-sided, narrower in the middle, angulate enteriorly; a pair of shallow glabellar furrows is visible in some specimens. Occipital lobe rounded posteriorly; occipital furrow straight, long (*sag.*), shallow. The length of glabella equals about 3/4 to 5/6 that of cranidium. Eye middle-sized, situated nearer the posterior margin furrow, eye ridge short, faintly marked. Anterior branch of facial suture longer than posterior, both slightly divergent. Preglabellar field evenly arcuate and separated from glabella and fixigenae by a long (*sag.*) and shallow furrow.

Librigenae with genal spines, sharp, longer in young than adult individuals, directed back-outwardly, reaching the third or second thoracic segment. An ornamentation is visible on some librigenae, composed of small points covering the exoskeleton.

Thorax with 13 segments in the meraspis stage; holaspis stage with 14 thoracic segments. Axial part as broad (*tr.*) as the pleural part. Pleurae flat with pleural furrows, outer part bent downward; terminal ends of young individuals with spines, those of the adults triangular.

Pygidium small, triangular, with the margin visible in the lateral part. Axial part well marked in the anterior part of pygidium, triangular posteriorly and not reaching the posterior margin. Pleural parts flat, smooth; a pleural furrow is visible in front of pleural part of some specimens.

The species is marked by a capability of enrollment (Pl. 2, Figs 7a-d). Thoracic segments enroll under the cephalon, upturning over a relatively short distance. Thorax gently arcuate, closely adhering, together with terminal ends of pleurae, to the margin of cephalon. In this specimen, a few posterior thoracic segments and pygidium are lacking but the cast of pygidium is visible. Dorsal side of pygidium contacting only the cephalic doublure. The bend of pygidium towards thorax probably represent a hinge.

According to Barrand's classification (1852; accepted in *Treatise on Invertebrate Paleontology,* Part *O,* Arthropoda 1, p. 102, 1959), this species belongs to trilobites with a double enrollment as in many other micropygous Cambrian trilobites, e.g. other species of the genus *Ellipsocephalus.* However, in relation to a classical double enrollment two differences are observed in *E. sanctacrucensis,* that is, only pygidium is enrolled under cephalon without the posterior thoracic segments and the bend of thorax is also of the nature of hinge. According to Bergström (1973), this enrollment is of the spiral type.

Remarks. — Czarnocki (1927) mentioned a new species *Ellipsocephalus sanctacrucensis* from the Protolenus Zone of the Lower Cambrian from the Holy Cross Mts, but he left this species without any description (*nomen nudum*). He only noted that the specimens were long, thorax had fourteen segments and librigenae bore genal spines as in *E. germari.*

The species mentioned by Czarnocki was first decribed by Samsonowicz (1959), who assigned it to the genus *Germaropyge* Šnajdr. He did not examine critically the features of this species in which the presence of genal spine was the most important feature. He noticed differences between this species and the genotype of *Germaropyge*, i.e. the species *germari* and admitted the possibility of an introducing of a new genus.

The species *Ellipsocephalus sanctacrucensis* differs from *E. hoffi* in a shorter glabella, longer (*sag.*) and posteriorly rounded occipital lobe, smaller eyes and the presence of genal spine. The similarity of thoraces and pygidia of the two species is remarkable (*cf.* Horný & Bastl 1970).

Chernysheva (*in:* Korkutis 1971) described a new species, *Germaropyge? mendosa* partly by comparing it with the Samsonowicz's species. Dr. A. Korkutis, Geological Survey of Lithuanian SSR, was so kind as to send the writer a photograph of the holotype; in the writer's opinion, the cranidium belongs rather to *Strenuaeva* or *Strenuella*.

The specimens determined as *Germaropyge* aff. *sancta-crucensis* were described by Lendzion (1972), from the Lower Cambrian of Eastern Poland, but her specimens should be excluded from *E. sanctacrucensis* since they considerably differ in a much longer genal spine, reaching the seventh thoracic segment, different ornamentation on the genal spine and less visible furrows on the thoracic segments.

Horizon and locality. — The species *Ellipsocephalus sanctacrucensis*, very common in the Lower Cambrian Protolenus Zone, seems to come to the lowermost Middle Cambrian of the Holy Cross Mts (*cf.* Orłowski 1964).

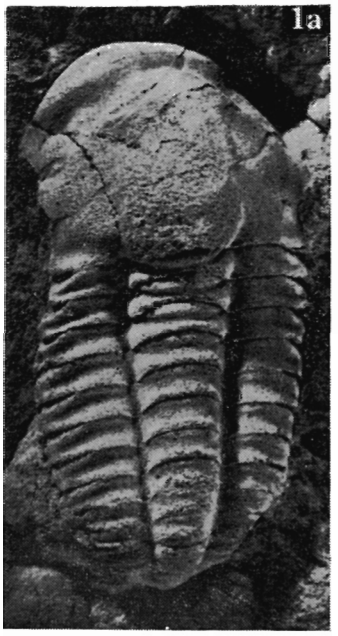
ONTOGENY

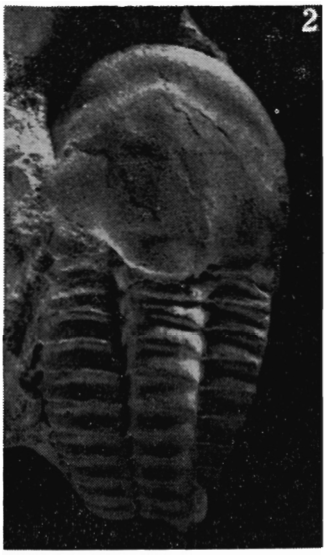
Complete specimens of trilobites are most suitable for the ontogenetic discussions, in particular for establishing the boundaries between protaspis, meraspis and holaspis stages. In drawning the boundary between the meraspis and holaspis stages, thorax is indispensable, since this boundary is traced between individuals with an increasing, variable number of thoracic segments (meraspis stage) and those displaying a constant number of such segments (holaspis stage).

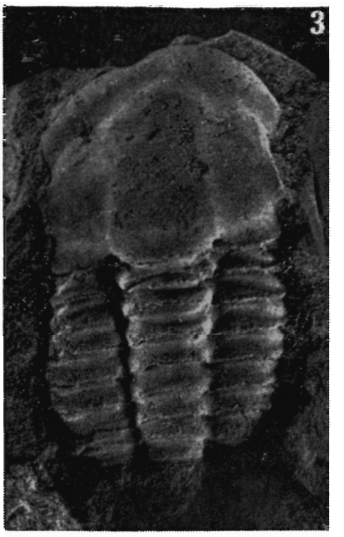
In the material under study, the species *Ellipsocephalus sancta-crucensis* (Samsonowicz, 1959) is represented by a single complete individual and several specimens with a variable number of thoracic segments, but the number of segments is determined by the state of preservation of specimens and not by their ontogenetic development, the largest group of fossils being cranidia. For this reason, the ontogenetic observations and the resulting conclusions are based on the studies of cranidia.

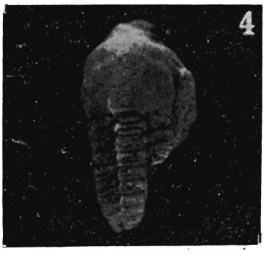
Of interest is the lack of specimens typical of the protaspis stage. This was probably caused by the environmental conditions characterized by a turbulent, shallow-water sedimentation.

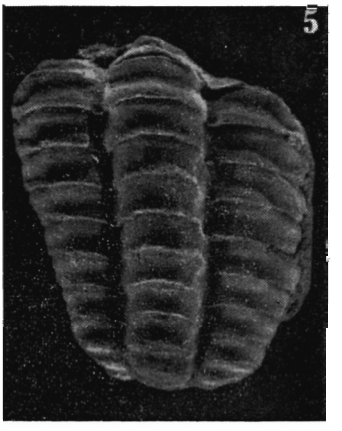
The smallest cranidia are about 5 mm long. Others, increasing up to 45 mm in length may be observed in succession (Pl. 2, Figs 1—4, Pl. 3, Figs 1—8). The smallest specimen, preserved as a cranidium with nine thoracic segments, is about 7 mm long, but the number of segments is incomplete (Pl. 1, Fig. 4).

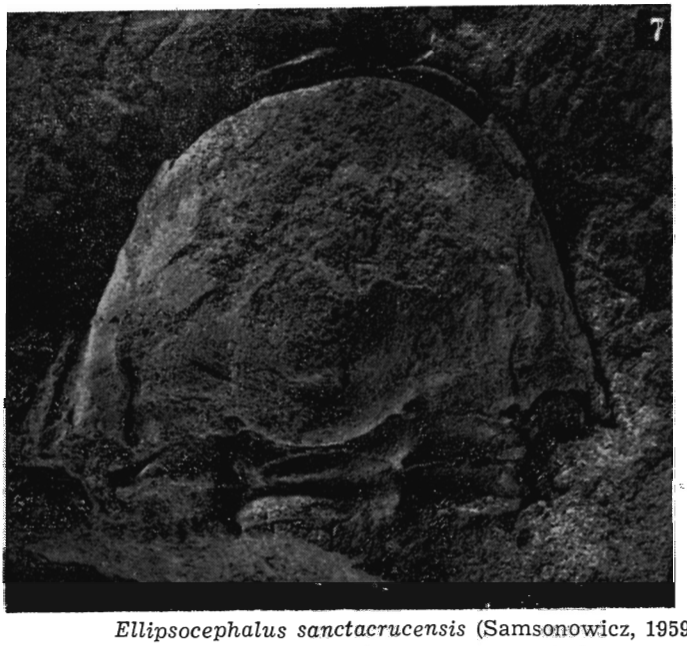








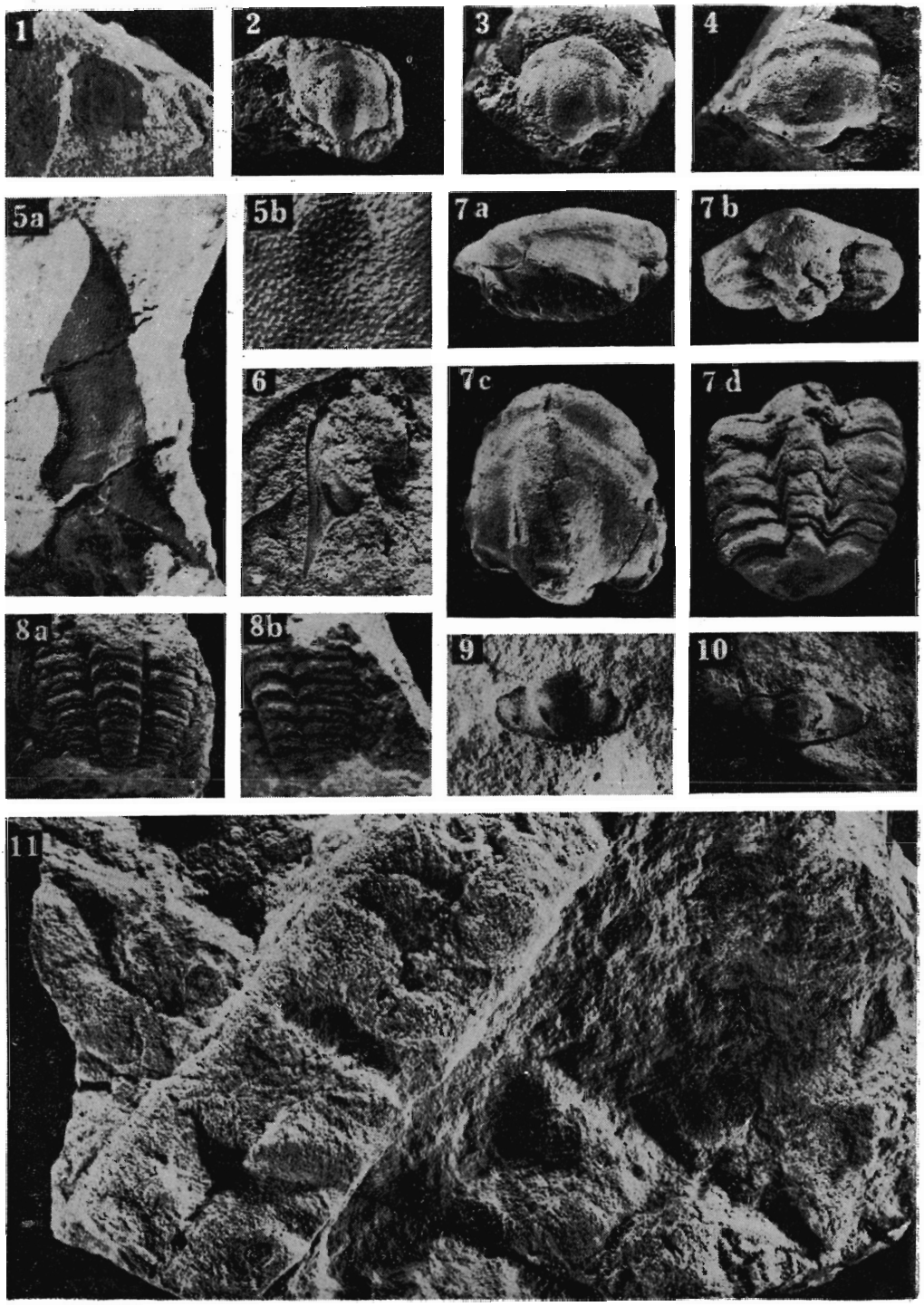




Ellipsocephalus sanctacrucensis (Samsonowicz, 1959) from Zamczysko

1 Lectotype (specimen with 13 thoracic segments but without librigenae): *a* general view, *b* detailed view of the posterior part of thorax and pygidium; 2—4 Partly preserved specimens (2 with 11, 3 with 8, 4 juvenile, with 9 thoracic segments); 5—6 Parts of thorax with 11 segments; 7 Cephalon

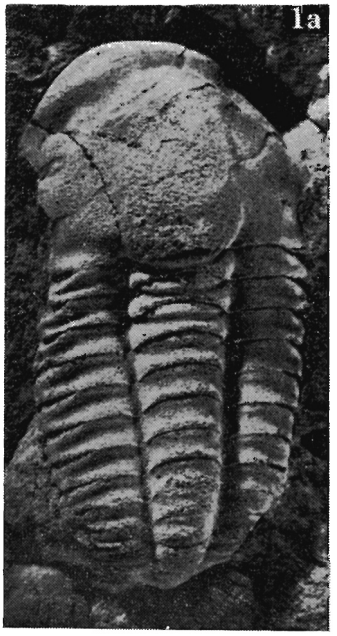
All photos × 1.5; taken by B. Drozd, M. Sc.

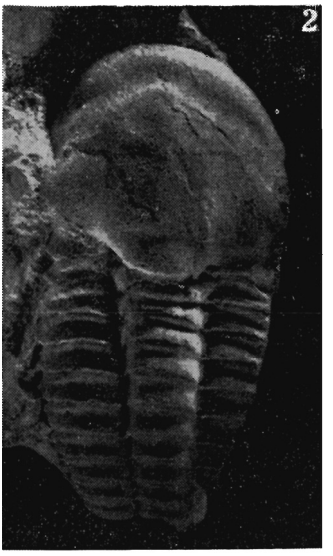


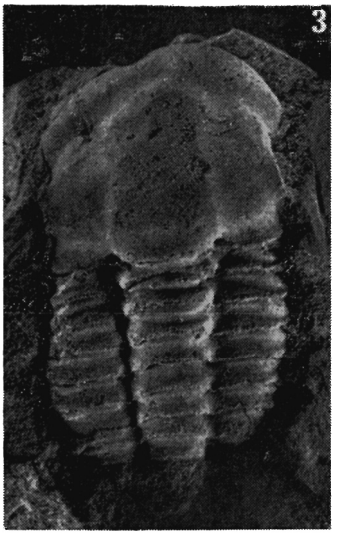
Ellipsocephalus sanctacrucensis (Samsonowicz, 1959) from Zamczysko

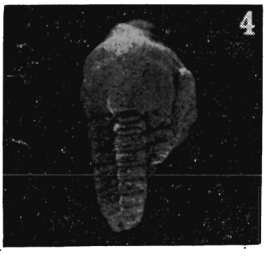
1—4 Cranidia of successive "degrees" 1—4; 5 Librigena with genal spine: *a* general view, *b* detailed (× 10) view of microornamentation; 6 Librigena; 7 Enrolled specimen (*a* lateral, *b* posterior, *c* top, *d* bottom view); 8 Part of thorax of a juvenile specimen (*a* general view, *b* oblique view to show pleural spines); 9—10 Pygidia; 11 Trackway, *Cruziana* sp., attributable to the discussed trilobite species (nat. size)

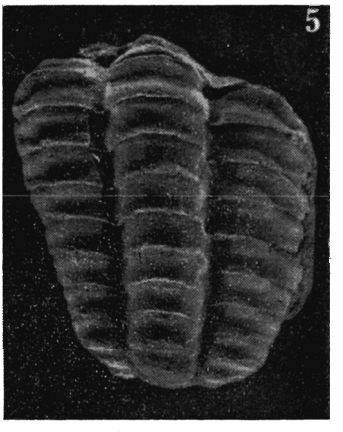
All photos × 1.5, except for Fig. 5b and 11; taken by B. Drozd, M. Sc.

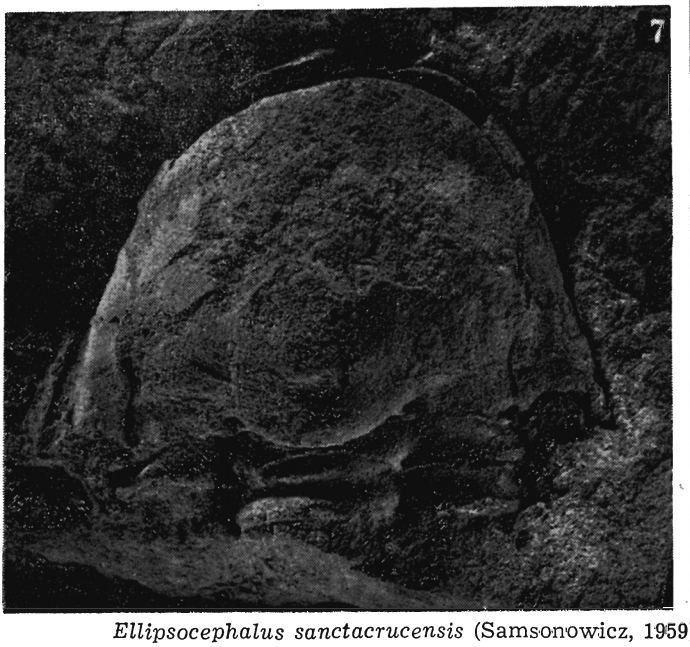












Ellipsocephalus sanctacrucensis (Samsonowicz, 1959) from Zamczysko

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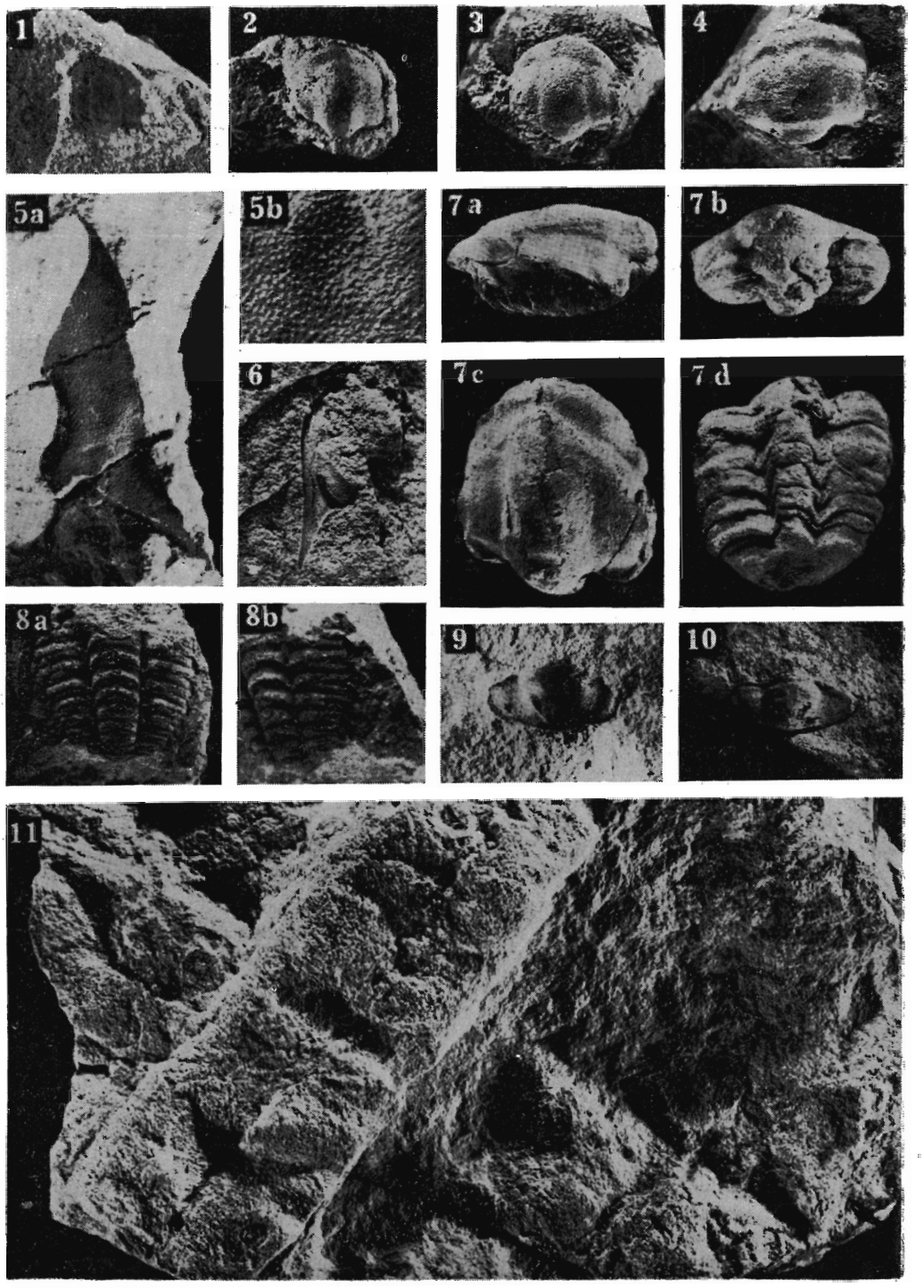
All photos × 1.5; taken by B. Drozd, M. Sc.



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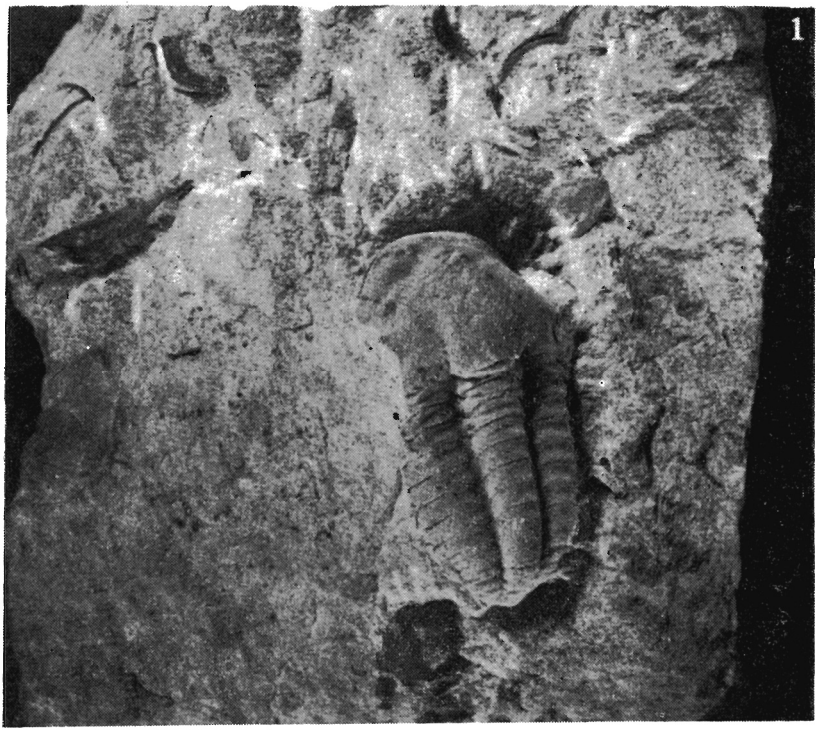
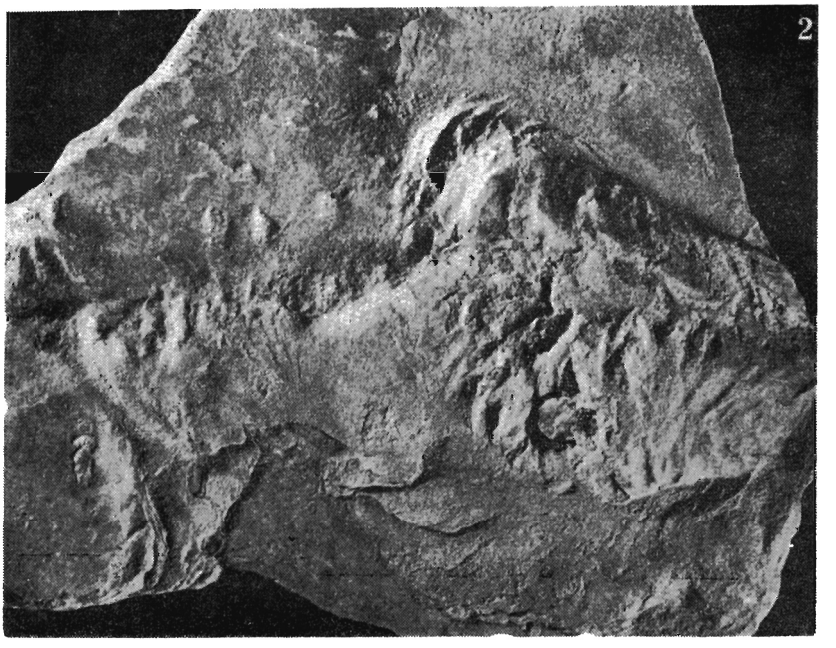
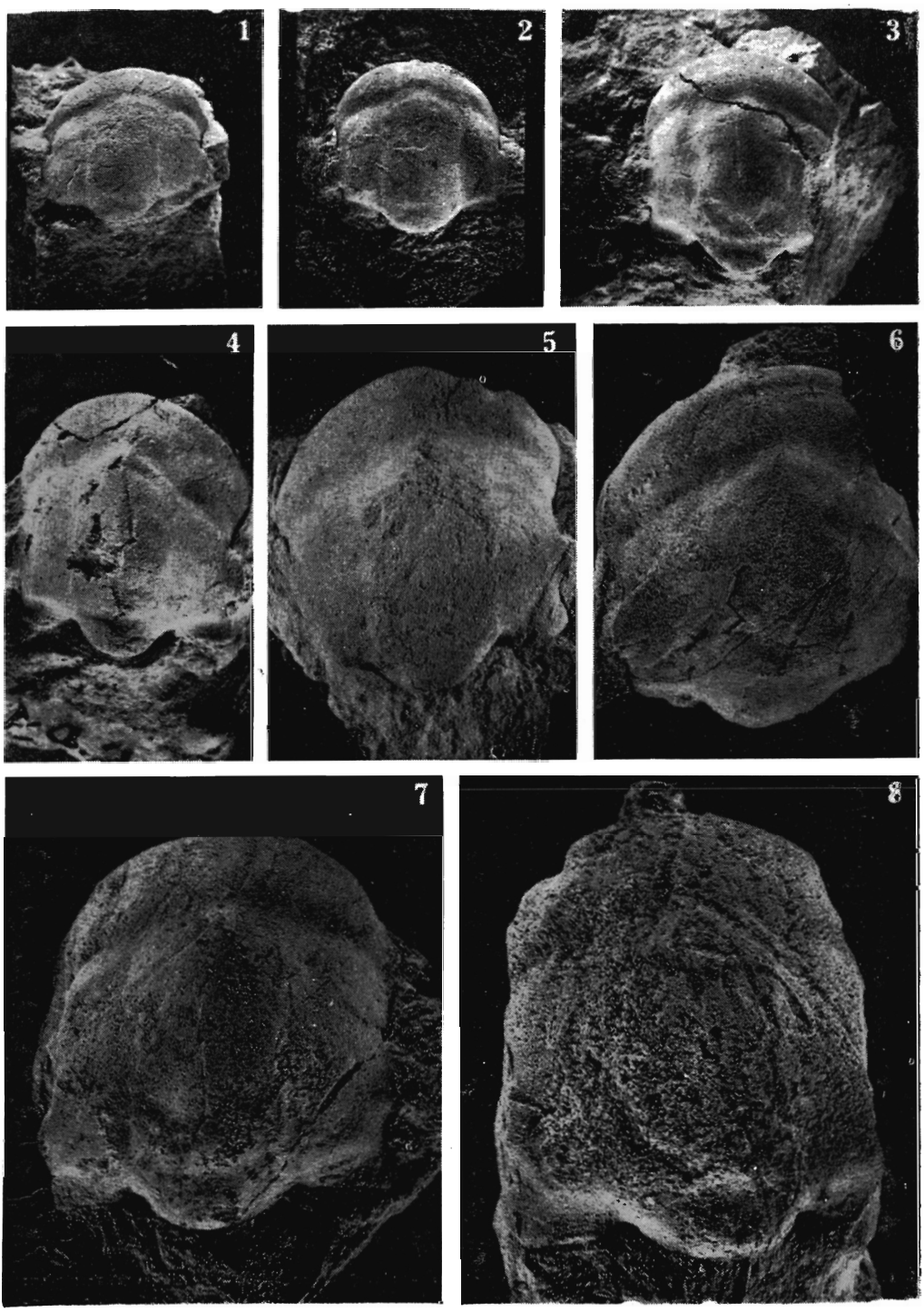




1 Typical lithotope with *Ellipsocephalus sanctacrucensis* (Samsonowicz, 1959) from Zamczysko: on the upper surface of a sandstone layer the lectotype, diverse fragments of the exoskeletons, and associated brachiopods are visible.

2 Trackway, *Cruziana* sp., attributable to *Ellipsocephalus sanctacrucensis* (Samsonowicz, 1959), on the sole of another sandstone layer from Zamczysko.

Both photos of natural size; taken by B. Drozd, M. Sc.



Cranidia of *Ellipsocephalus sanctacrucensis* (Samsonowicz, 1959) from Zamczysko
1—8 Successive "degrees" from 5 to 12
All photos × 1.5; taken by B. Drozd, M. Sc.

The ontogenetic changes in *Ellipsocephalus sanctacrucensis* occur in the parts of dorsal exoskeleton in the following way.

In young individuals (Pl. 2, Fig. 8a, b), thorax is marked by pleurae with short, sharp pleural spines directed posteriorly; pleural spines are longer in posterior thoracic segments. The pleurae of older individuals (Pl. 1, Figs 1a, 2—3, 5) are triangular and directed downward. Transitional stages from pleurae with pleural spines to those with triangular terminal parts are observed.

Pygidia, triangular in young individuals, become broader (*tr.*) in older ones. Axial part of pygidium, broader (*tr.*) in young individuals, is proportionally narrower in older ones. Axial part nearly reaches the posterior margin of pygidium in younger and it is shorter (*sag.*) in older individuals. In bigger specimens anterior pleural furrows are distinctly visible, but other furrows are less so.

Librigenae with genal spines are more slender in young individuals (Pl. 2, Fig. 6). In older individuals, genal spine is shorter and more massive (Pl. 1, Fig. 7 and Pl. 2, Fig. 5a).

Cranidia display slight changes in the length-width proportion and in the length and width of glabella, but it is difficult to estimate the regularity of these changes. Glabella is more convex and better marked in young individuals, while cranidium and glabella are less convex in older ones.

The largest changes occur in the size of cranidia. An attempt was undertaken by Shaw (1956) to systematize cranidia according to their size by measuring the length of cranidium, the width of cranidium (across palpebral lobes, across anterior corners of facial suture, and along the posterior margin), as well as the length and width of glabella.

The cranidia measured in such a way as recommended by Shaw (1956) are grouped in assemblages of similar dimensions. Presumably, these assemblages correspond to particular molts of the carapace of a trilobite. Particular growth stages, which correspond to successive molts, are regarded here as "degrees" of the meraspis and holaspis stages and numbered *1—4* (Pl. 2, Figs 1—4) and *5—12* (Pl. 3, Figs 1—8) respectively. The "degree" *1* denotes only the smallest cranidia in the collection under study. As follows from the above considerations, the species *Ellipsocephalus sanctacrucensis* passed through not less than twelve molts of the exoskeleton.

A protaspis stage is unknown in *Ellipsocephalus sanctacrucensis;* the boundary between the meraspis and holaspis stage remains an open question. This boundary should be established between specimens with a varying amount of thoracic segments and those with a constant amount (*cf.* Whittington 1959). The completely preserved specimen has thirteen thoracic segments (Pl. 1, Figs 1a, b) and is about 50 mm long, its cranidium belonging to "degree" 7. Very large specimens with fourteen thoracic

segments were mentioned by Czarnocki (1927), unfortunately, they got lost. It seems that specimens with fourteen thoracic segments belong to the holaspis stage, while those with a smaller number of such segments belong to the meraspis stage. The young specimen (Pl. 1, Fig. 4) belongs to "degree" *2* of the meraspis stage and has nine thoracic segments, but the total number of its segments is unknown.

Cranidia of "degrees" *11* and *12* (Pl. 3, Figs 7–8), e.g., the biggest ones and with an evenly convex cranidium and glabella seem to belong to the holaspis stage.

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REWIZJA DOLNOKAMBRYJSKIEGO GATUNKU TRYLOBITÓW *ELLIPSOCEPHALUS SANCTACRUCENSIS* (SAMSONOWICZ, 1959) I UWAGI O JEGO ROZWOJU ONTOGENETYCZNYM

(Streszczenie)

Przedmiotem pracy jest krytyczna analiza dolnokambryjskiego gatunku trylobitów *Ellipsocephalus sanctacrucensis* (Samsonowicz, 1959) ze stanowiska Zamczysko koło Widełek w Górach Świętokrzyskich. W bogatej kolekcji szczątków należących do tego gatunku (pl. 1—4) wyróżniono szereg kranidiów odpowiadających poszczególnym wylinkom pancerza. Na tej podstawie prześledzono zmiany w budowie pancerza w stadiach meraspis i holaspis, oraz rozpatrzono całość zagadnień dotyczących rozwoju ontogenetycznego badanego gatunku.