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New data on Middle Triassic echinoderms from the Sudetes Mountains

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This paper describes the Triassic ophiuroid genus *Aspiduriella* and outlines the stratigraphic ranges of crinoids and echinoids in the Lower Muschelkalk strata of the North-Sudetic Basin. It is shown that, contrary to previous opinion, echinoderm taxa occurred in the North-Sudetic Basin at the same time as in other areas of the eastern part of the Germanic Basin.

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INTRODUCTION

Marine Triassic deposits (Röt, Lower and Middle Muschelkalk) occur in the Sudetes Mountains only in the North-Sudetic Basin (Fig. 1). Detailed lithological investigations of these sediments have been made by Leśniak (1978), Szulc (1991) and Chrząstek (2002). Lithostratigraphic subdivision of the Lower Muschelkalk (Units A–E) by Chrząstek (2002), used in this article (Table 1), shows its great similarity to the classic division of the Muschelkalk from Upper Silesia proposed by Assmann (1944) and partly formalised by Bodzioch (1997) and Niedźwiedzki (2000). Dolomitic limestones with no fossils are dominant in unit A (Chrząstek, 2002). Unit B is built of crinoidal limestones, common mainly in the lower part of these beds, and by marls and pelitic limestones. Wavy limestones (Wellenkalk) with intercalations of organodetrital limestones (bivalve and gastropod coquinas) occur in unit C and oncolitic limestones in unit D. Nodular limestones with intercalations of terebratulid coquinas occur in the lower part of unit E and nodular limestones intercalated with bivalve coquinas occur in the higher part of unit E. This paper describes new echinoderm findings in the North-Sudetic Basin, including ophiuroids (Fig. 2) which are extremely rare in this area, and compares the group of echinoderms investigated with records of Triassic echinoderms from Upper Silesia and the Holy Cross Mountains. There have been very few Triassic echinoderms found in the North-Sudetic Basin so far and the data presented by different authors have often been contradictory. Noetling (1880) noted *Encrinus gracilis* = *Dadocrinus gracilis* (Buch, 1845) in units B–E, *Entrochus dubius* = *Holocrinus dubius* (Goldfuss, 1831) and *Encrinus liliiformis* Lamarck, 1801 in units B–E. The latter species was also found by Leśniak (1978) in the upper part of unit C and in unit E. According to Senkowiczowa (1979, table 9) the only crinoid that occurred in the North-Sudetic Basin was *E. liliiformis*, *D. gracilis* being absent there. Chrząstek (2002) described columnals of *Dadocrinus* sp. from unit B, *Holocrinus acutangulus* (Meyer, 1847) from units B and C, and *H. dubius* from units D and E. She also recorded unidentified encrinids in units C–E. Noetling (1880) found fragments of *Triadotiaris grandaeva* (Alberti, 1834) only in the Schaumkalk (section "h" of his stratigraphical overview), currently described as unit E, while Senkowiczowa (1979, table 9) stated, that the species occurred in the North-Sudetic Basin from the Górażdże Formation to the Karchowice Formation. Chrząstek (2002) also noted echinoid spines in units C and D. Investigations of ophiuroids of the eastern part of the Germanic Basin began with Eck (1865), who described *Aspidura similis* Eck, 1865 from Upper Silesia. Ophiuroids were also discussed by Assmann (1913, 1937), Schöndorf (1913), Klinghardt (1930), Piotrowski and Liszkowski (1981), Boczarowski and Salamon (2000), and Salamon and Boczarowski (2002). These authors recorded the following species in the Polish part of the epicontinental basin: *Acroura* sp., *Aspidura similis*, *A. scutellata* (Blumenbach, 1804), *Ophioderma squamosum* (Picard, 1883) and *O. hauchecorni*

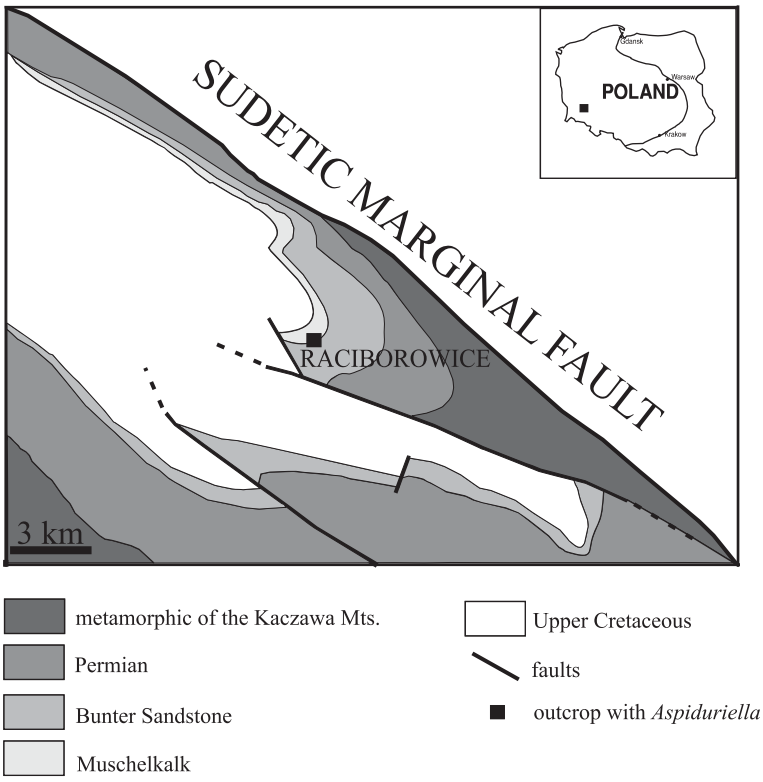


Fig. 1. Geological map of North-Sudetic Basin (after Chrząstek, 1995; modified)

Eck, 1872. Holdefleiβ (1915) described *Aspidura ludeni* Hagenow, 1846 probably from uppermost part of unit C in the North-Sudetic Basin.

MATERIAL

All crinoid remains (Fig. 2 d–g) are completely disarticulated, occurring as individual columnals or arm plates, usually unabraded. The echinoid *Triadotiaris grandaeva* (Fig. 2a) was represented by a few separate plates of the arm, or broken spines. Three specimens of *Aspiduriella* sp. (Fig. 2 b–c) had broken ends of the arms. Ophiuroids have been found in the middle part of unit C, about 1 m below the *Punctospirella fragilis* horizon that is an important correlation level in the North-Sudetic Basin (Chrząstek, 2002). Dadocrinid skeletal elements are numerous, especially in the lower part of unit B in crinoid limestones; other crinoids are represented by rare elements.

SYSTEMATIC PALAEONTOLOGY

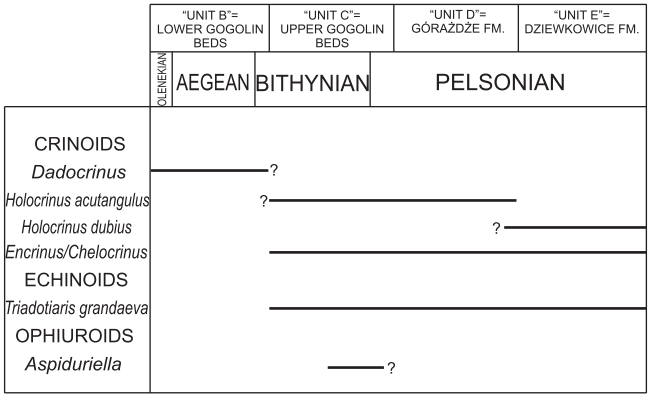
Class **Stelleroidea** Lamarck, 1816
Order **Ophiurida** Müller and Troschel, 1840
Family **Ophiuridae** Lyman, 1865
Genus *Aspiduriella* Bolette, 1998
Aspidura Agassiz, 1835
Aspiduriella sp.
(Fig. 2b–c)

M a t e r i a l . Three incomplete specimens (MGUWr-5328-29s); four isolated ventral shields (distal/medial; MGUWr-5328s) and two lateral shields (MGUWr-5328s); four basal plates (MGUWr-5328s).

D e s c r i p t i o n . Poorly preserved discs and arms; morphological borders not very distinct. The flat and low rounded disc with slightly convex interradial margins, of which both the oral and aboral surface are exposed. Disc diameter varies between 0.86–1.38 mm. Five incomplete arms of length that must have been at least twice the disc diameter.

T a b l e 1

Stratigraphic ranges of Triassic echinoderms from the North-Sudetic Basin (chronostratigraphy according to Nawrocki and Szulc, 2000; lithostratigraphy of the Lower Muschelkalk of the North-Sudetic Basin after Chrząstek, 2002)



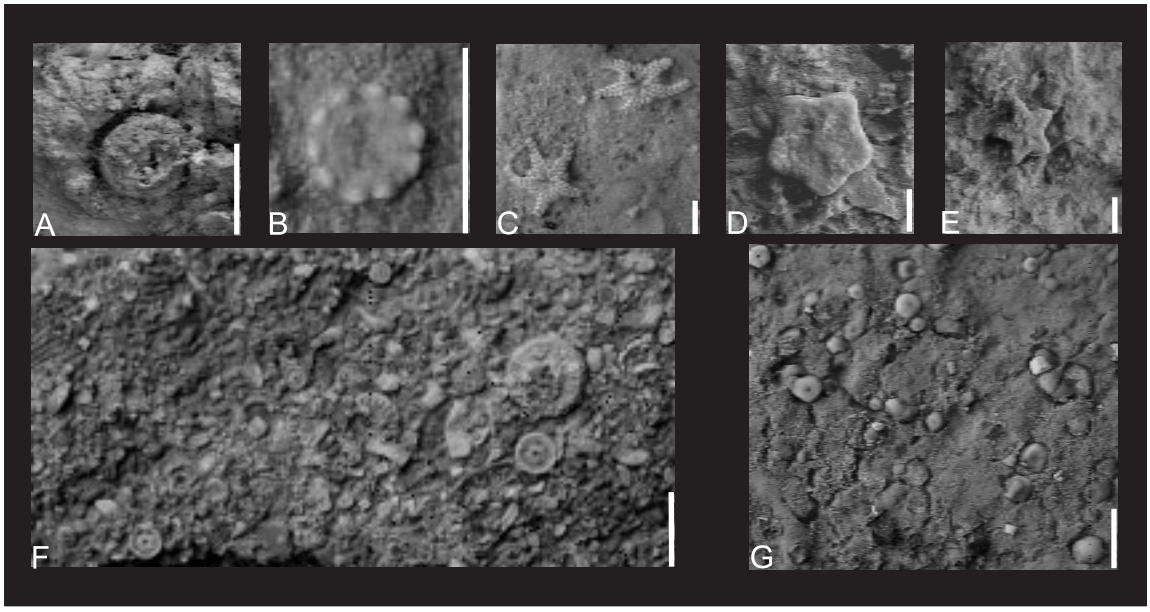


Fig. 2. Echinoderms from Raciborowice quarry

A — interambulacral plate of *Triadotiaris grandaeva* (unit C), scale bar 1 mm, MGUWr-5332s; **B** — dorsal view of *Aspiduriella* sp. disc, scale bar 1 mm, MGUWr-5329s; **C** — ventral view of *Aspiduriella* sp. discs and proximal/medial arms portions, scale bar 1 mm, MGUWr-5328s; **D** — medial columnal of *Holocrinus acutangulus* (unit C), scale bar 1 mm, MGUWr-5331s; **E** — proximal columnal of *Holocrinus dubius* (unit E), scale bar 1 mm, MGUWr-5330s; **F** — columnals of Encrinidae gen. et sp. indet. (unit C), scale bar 1 cm, MGUWr-5333s; **G** — columnals of *Dadocrinus* sp. (unit B), scale bar 1 cm, MGUWr-5334s

The aboral surface covered with one tumid, pentagonal central plate. Five pentagonal basal plates are distinctly smaller than the tumid central plate; ten smallest pentagonal radial plates. Distal margin of dorsal shield side straight and its width decreasing to a pointed proximal end and indented sides. The oral surface of disc is partly concealed by matrix. Oral plates of disc longish with rounded distal margins. Proximal ventral shields triangular in outline with almost straight dorsal margin rounding into lateral margins. Dorsal shields much larger than ventral, rectangular in outline, of width approximately twice the height. Lateral arm shields narrow and strongly curved, widest ventrally.

D i s c u s s i o n . The incompleteness of the specimens investigated did not allow classification to species level. They are similar to specimens from the Holy Cross Mountains and Upper Silesian specimens described by Boczarowski and Salamon (2000), and Salamon and Boczarowski (2002). However, there are some differences. Disc elements and arms are reminiscent of *Aspiduriella similis*, from which it differs in having more strongly curved lateral arm shields. There are slightly smaller and more fragile dorsal arm shields in specimens from the North-Sudetic Basin, and ventral arm shields are more robust. Additionally, some plates from the North-Sudetic Basin specimens, including of distal ones, have a large, locally tentacle pore indentation, but in our opinion this is not morphological feature but an artefact of preservation.

R e m a r k s . The ophiuroid generic name *Aspidura* Agassiz, 1835 is a junior homonym of the reptile genus *Aspidura* Wagler, 1830. Therefore, Bolette (1998) proposed the new name *Aspiduriella* for the ophiuroid genus.

Occurrence. Poland: Upper Silesia (Lower and Upper Gogolin Beds): Dąbie, Jaworzno (Ciężkowice, Stara Huta, Szczakowa), Maciejkowice, Rogoźnik, Strzemieszyce Małe, Warpie, Wielka Góra, Wojkowice; Lower Silesia (Lower and Upper Gogolin Beds): Gogolin, Ligota Dolna, Zakrzów; the Holy Cross Mountains (Łukowa Beds): Starochęciny and Zajączków.

DISCUSSION

Previous data (see: Introduction) concerning crinoids from the North-Sudetic Basin were in pronounced disagreement with the stratigraphic range of crinoids occurring in Upper Silesia and the Holy Cross Mountains. *Dadocrinus gracilis* was to occur up to unit E, which corresponds to the Dziewkowice Formation of Upper Silesia and the *Plagiostoma striatum* beds of the Holy Cross Mountains. In Upper Silesia, the Holy Cross Mountains and East Germany the species disappeared in the lower part of the Upper Gogolin Beds (e.g. Hagdorn and Głuchowski, 1993) or their chronostratigraphic equivalents. Also *Holocrinus dubius*, which according to Noetling (1880), occurred in the North-Sudetic Basin in units B–E (Lower Gogolin Beds — Dziewkowice Formation) ranged to the Dziewkowice Formation, the lowermost part of the Karchowice Beds in Upper Silesia (Hagdorn and Głuchowski, 1993). Our investigations have shown that *Dadocrinus* occurs in the area investigated in unit B strata, and did not occur in units D–E (Table 1), as also indicated by Chrząstek (2002).

Due to the lack of any records concerning dadocrinids found by Noetling (1880) in the upper part of the Lower Muschelkalk, it can be assumed that the range of the genus should be limited to the equivalent of the Lower Gogolin Beds or eventually also the lower part of the Upper Gogolin Beds, as in Upper Silesia and the Holy Cross Mountains. The data given by Senkowiczowa (1979, table 9) suggest the lack of *D. gracilis* in the deposits of the North-Sudetic Basin though Noetling (1880) described this species. No complete dadocrinid cup found at the present investigations making specific identification impossible. We found *Holocrinus acutangulus* in units C and D and *H. dubius* in the uppermost part of units D and in E (Table 1). This is consistent with the data of Hagdorn and Głuchowski (1993) from Upper Silesia and the Holy Cross Mountains. *Encrinus liliiformis* does not occur in Poland below the Upper Muschelkalk (Salamon, 2002). Records of *E. liliiformis* in the North-Sudetic Basin (e.g. Noetling, 1880; Leśniak, 1978; Senkowiczowa, 1979) have no graphic documentation or palaeonotological descriptions and the specimens reported were not placed in any museum; therefore the reliability of their descriptions cannot be verified. This also concerns descriptions of other species of crinoids, excluding the data of Chrząstek (2002). Leśniak (1978) identified the columnals he had found as *E. liliiformis*, probably based on their large diameter (up to 2 cm), but other encrinids (e. g. *Encrinus aculeatus* or *Chelocrinus carnalli*), which are quite common in units D and E equivalents in Upper Silesia and in the Holy Cross Mountains, may reach a similar size. On the other hand, investigations carried out by Chrząstek (2002) as well as our last investigations have not confirmed the existence of *E. liliiformis* in the Lower Muschelkalk from the North-Sudetic Basin, which is in agreement with the opinions of Hagdorn and Głuchowski (1993) and Niedźwiedzki (2002). New crinoid localities, described in this paper and by Chrząstek (2002) indicates that at corresponding stratigraphic levels in Upper Silesia (Hagdorn and Głuchowski, 1993), the Holy Cross Mountains (Salamon, in prep.) and the North-Sudetic Basin, comparable crinoid zones can be distinguished. Spines of *T. grandaeva* are known from Upper Silesia from the lowermost part of the Upper Gogolin Beds (Niedźwiedzki, 2002), and from the Wellenkalk Beds of the Holy Cross Mountains (Salamon, in prep.). In both cases the first occurrence is Bithynian. Previous data (Noetling, 1880; Senkowiczowa, 1979, table 9) suggested the species appeared in the North-Sudetic Basin much later (in the Pelsonian; units D or E). However, the remains of *T. grandaeva* we found in unit C, the equivalent of the Upper Gogolin Beds, show that the species appeared more or less simultaneously in the whole SE part of the Germanic Basin. The oldest ophiuroids we found in Upper Silesia come from the lowermost part of the Lower Gogolin Beds (the limestones with *Entolium* and *Dadocrinus* at Gogolin). However, their mass occurrence can be observed in the Conglomeratic Horizon of the Upper Gogolin Beds (Bithynian) (Boczarowski and Salamon, 2000). In the Holy Cross Mountains they occur in large number in the lowermost part of the Łukowa Beds (Bithynian) (Salamon, in prep.). The currently found ophiuroids from the North-Sudetic Basin come from the middle part of the unit C, the stratigraphic position of which corresponds to the levels with ophiuroids known from other regions of southern Poland. The ophiuroids from the North-Sudetic Basin recorded by the authors were accompanied by crinoids of the genera *Encrinus* and/or *Chelocrinus*. The co-occurrence of crinoids with ophiuroids in Upper Silesia led Assmann (1937) to the conclusion that they lived in symbiosis. However, most of the scientists assume their occasional coexistence, which is typical also of contemporary biocoenoses (Hendler *et al*., 1999).

CONCLUSION

During the last investigations at the Raciborowice quarry, the taxon *Aspiduriella* sp., very rare in the area, was discovered, and extended stratigraphic ranges of some species were determined. Newly found locations of echinoderms in the Lower Muschelkalk of the North-Sudetic Basin indicate that echinoderm faunas were taxonomically similar over the whole of southern Poland, with corresponding echinoderm zones being distinguished and many echinoderm taxa appearing almost isochronally over the whole southwestern part of the Germanic Basin.

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REFERENCES

ASSMANN P. (1913) — Beitrag zur Kenntnis der Stratigraphie des oberschlesischen Muschelkalks. Jb. Preuss. Geol. L. A., **34**: 268–340.

ASSMANN P. (1937) — Revision der Fauna der Wirbellosen der oberschlesischen Trias. Abh. Preuss. Geol. Landesanst., N. F., **170**.

ASSMANN P. (1944) — Die Stratigraphie der oberschlesischen Trias. Teil II — Der Muschelkalk. Abh. Reichsamts Bodenforsch., **208**.

BOCZAROWSKI A. and SALAMON M. (2000) — Kompletne wężowidła jako wskaźnik warunków sedymentacji warstw gogolińskich Górnego Śląska. In: Historia basenów sedymentacyjnych a zapis paleontologiczny. XVII Konferencja Paleontologów: 20–21. Kraków.

BODZIOCH A. (1997) — The Karchowice Formation: definition and stratigraphy (in Polish with English summary). Geologos, **2**: 165–199.

BOLETTE D. P. (1998) — *Aspiduriella* nom. n. for the genus *Aspidura* Agassiz, 1835 (Echinodermata: Ophiuroidea: Ophiuridae); preoccupied by *Aspidura* Wagler, 1830 (Reptilia: Serpentes: Colubridae). J. Paleont., **72** (2): 401–402.

CHRZĄSTEK A. (1995) — Roetian deposits in Czaple (North-Sudetic Basin) (in Polish with English summary). Acta Univ. Wratisl., Pr. Geol.-Miner., **48**: 43–56.

CHRZĄSTEK A. (2002) — Stratigraphy and sedimentation condition of Roet and Lower Muschelkalk of the North-Sudetic Basin. Acta Univ. Wratisl., Pr. Geol.-Miner., **73**: (in press).

ECK H. (1865) — Über die Formationen des bunten Sandsteins und des Muschelkalks in Oberschlesien und ihre Versteinerungen. Friedländer u. Sohn. Berlin.

HAGDORN H. and GŁUCHOWSKI E. (1993) — Palaeobiogeography and stratigraphy of Muschelkalk Echinoderms (Crinoidea, Echinoidea) in Upper Silesia. In: Muschelkalk. Schöntaler Symposium 1991 (eds. H. Hagdorn and A. Seilacher): 165–176. Goldschneck. Stuttgart.

HENDLER G., GRYGIER M. J., MALDONADO E. and DENTON J. (1999) — Babysitting brittle stars: heterospecific symbiosis between ophiuroids (Echinodermata). Invertebrate Biology, **118**: 190–201.

HOLDEFLEIβ G. (1915) — Das Triasvorkommen von Gross-Hartmannsdorf in Niederschlesien. Jahresbericht der Schlesischen Gesellschaft für vaterländische Cultur, **93**: 1–23.

KLINGHARDT F. (1930) — Über fossile und lebende Schlangensterne nebst Bemerkungen über eine Schlangenstern — und Seelilien — Brekzie. Z. Deutsch. Geol. Ges., **82**: 711–718.

LEŚNIAK T. (1978) — Lithostratigraphical profile of Bunter Sandstone and Muschelkalk deposits in the North-Sudetic Depression (in Polish with English summary). Geologia, **4** (1): 6–26.

NAWROCKI J. and SZULC J. (2000) — Magnetic polarity scale for the Roetian and Muschelkalk deposits from Silesia and northern part of the Holy Cross Mts. (Poland) (in Polish with English summary). Prz. Geol., **48** (3): 236–238.

NIEDŹWIEDZKI R. (2000) — Lithostratigraphy of the Górażdże and the Dziewkowice Formations in Opole Silesia (in Polish with English summary). Acta Univ. Wratisl., Pr. Geol.-Miner., **71**.

NIEDŹWIEDZKI R. (2002) — Revision of stratigraphic ranges of selected invertebrate taxa from the Muschelkalk in Silesia. Geol. Quart., **46** (2): 219–225.

NOETLING F. (1880) — Die Entwicklung der Trias in Niederschlesien. Z. Deutsch. Geol. Ges., **32**: 300–349.

PIOTROWSKI A. and LISZKOWSKI J. (1981) — Występowanie wężowideł w wapieniu muszlowym Wyżyny Śląsko-Krakowskiej. In: Materiay V Konferencji Paleontologów: 58–60. Kielce-Sosnowiec.

SALAMON M. (2002) — *Encrinus liliiformis* Lamarck, 1801 z górnego wapienia muszlowego Polski. In: XXII Terenowa Szkoła Geologów Uniwersytetu Śląskiego: 82–84. Sosnowiec.

SALAMON M. (in prep.) — Środkowotriasowe liliowce (*Crinoidea*) obszaru Świętokrzyskiego. Unpub. Ph. D. Thesis. Department of Paleontology and Biostratigraphy University of Silesia.

SALAMON M. and BOCZAROWSKI A. (2002) — *Aspidura similis* Eck, 1865 z utworów dolnego anizyku (bitynu) Polski. In: XVII Konferencja Naukowa Paleontologów, PTG, Poznań: **31**.

SCHÖNDORF F. (1913) — Über einige Ophiuren aus der Trias von Oberschlesien und Thüringen. Jb. Preuss. Geol. L. A., **33**: 215–231.

SENKOWICZOWA H. (1979) — Gromada Branchiopoda Latreille, 1817. In: Atlas skamieniałości przewodnich i charakterystycznych. Mezozoik. Trias. (ed. L. Malinowska): 103–105. Inst. Geol. Warszawa.

SZULC J. (1991) — Stop B 11. Raciborowice. In: Muschelkalk. A Field Guide (ed. H. Hagdorn): 58–61. Korb (Goldschneck).