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The phymosomatid echinoid *Trochalosoma taeniatum* from the Maastrichtian (Upper Cretaceous) of southeast Poland

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ABSTRACT:

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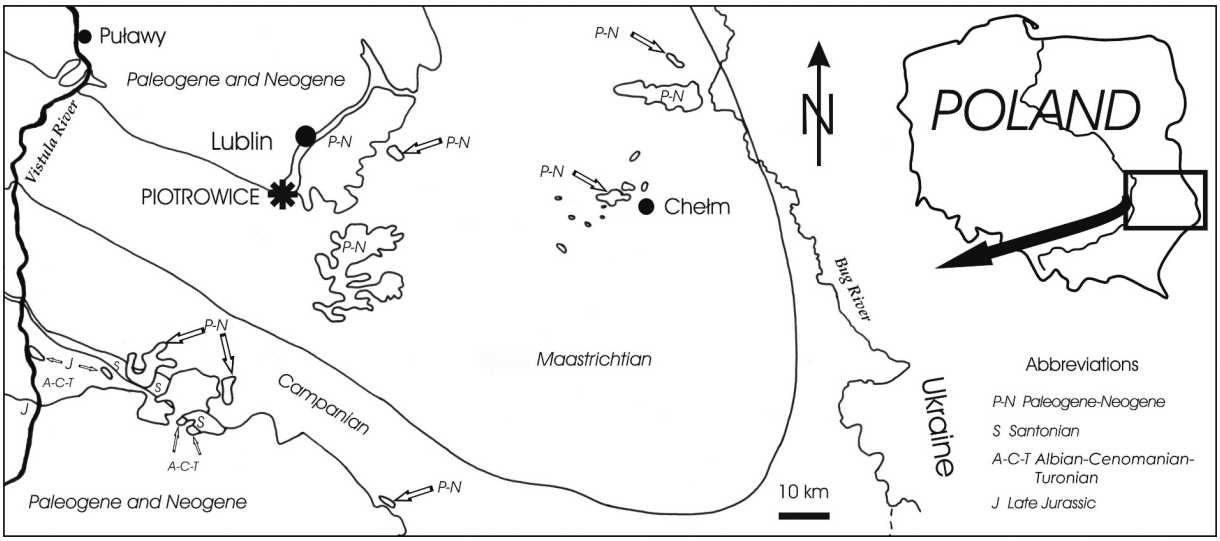
The phymosomatid *Trochalosoma taeniatum* (von Hagenow, 1840) is recorded for the first time from upper Maastrichtian strata exposed at Piotrowice, near Lublin, southeast Poland. Although fragmentary, the single, moderately preserved test is of note in representing one of the larger individuals of this species on record (estimated diameter > 60 mm), and in displaying crenulate ambulacral and interambulacral tubercles, at least adapically. Previous records of *T. taeniatum* include the lower and upper Maastrichtian of Denmark, northern Germany (Rügen), Alava (northern Spain) and Mangyshlak (Kazakhstan). *Trochalosoma corneti* (Cotteau, 1875), from the upper Maastrichtian of southern and northeast Belgium (Mons and Liege basins, respectively) and the southeast Netherlands (type area of the Maastrichtian Stage), synonymised by some authors with *T. taeniatum*, is considered to be distinct.

Key words: Echinoidea; Phymosomatidae; *Trochalosoma*; Maastrichtian; Lublin area; Poland.

INTRODUCTION

A number of authors have dealt with Late Cretaceous echinoid faunas from various parts of Poland, and referred to a range of 'regular' echinoids such as cidaroids, phymosomatoids and saleniids (see e.g. Schlüter 1892; Kongiel 1935, 1936a, b, 1939, 1950; Kongiel and Matwiejewówna 1937; Mączyńska in Malinowska 1989; Geys and Machalski 1992; Jagt *et al*. 2004; Niedźwiedzki and Godlewska 2005). Material collected recently by ourselves and colleagues from Uniwersytet Śląski (Sosnowiec) includes the cidarid *Temnocidaris* (*Stereocidaris*) gr. *serrata* (Desor, 1858), the phymosomatid *Phymosoma* gr. *granulosum* (Goldfuss, 1829) and the saleniid *Salenocidaris obnupta* (Schlüter, 1892) from the lower and upper Campanian at Wierzchowisko, Jeżówka and Rzeżuśnia (Miechów Trough, southern Poland; see Jagt *et al.* 2004), as well as cidarid test fragments and spines and typical *granulosum*-type phymosomatid spines from the upper Maastrichtian of Nasiłów, near Puławy (Lublin area).



Text-fig. 1. Simplified geological map of the Lublin area, southeast Poland (after Pożaryski 1956, with modification after Walaszczyk 2004), with indication of the provenance of NHMM 2008 103, near Piotrowice

Here we describe an interesting addition; a representative of the genus *Trochalosoma* Lambert, 1897 (see also Lambert 1898b), from the upper Maastrichtian at Piotrowice, near Lublin (Text-fig. 1), collected by Grzegorz Niedźwiedzki. Although fragmentary, the specimen is fairly well preserved and its main interest lies in the fact that it ranks amongst the largest specimens ever to have been recorded of this species, with an estimated test diameter of > 60 mm, and it is unusual in clearly showing, at least adapically, crenulate primary tubercles at this diameter (Text-figs 2, 3). Previous authors (e.g. Kutscher 1985; Smith and Jeffery 2000) relegated *T. corneti* into the synonymy of *T. taeniatum*, but we are of the opinion that differences in test ornament and spine size and structure suffice to keep these forms separate.

Abbreviations. IRScNB – Institut royal des Sciences naturelles de Belgique, Brussels (Belgium); NHMM – Natuurhistorisch Museum Maastricht, Maastricht (the Netherlands).

SYSTEMATIC PALAEONTOLOGY

Order Phymosomatoida Mortensen, 1904
Family Phymosomatidae Pomel, 1883
Genus *Trochalosoma* Lambert, 1897, p. 515

TYPE SPECIES: *Cyphosoma rugosum* Agassiz in Agassiz and Desor, 1846, by monotypy.

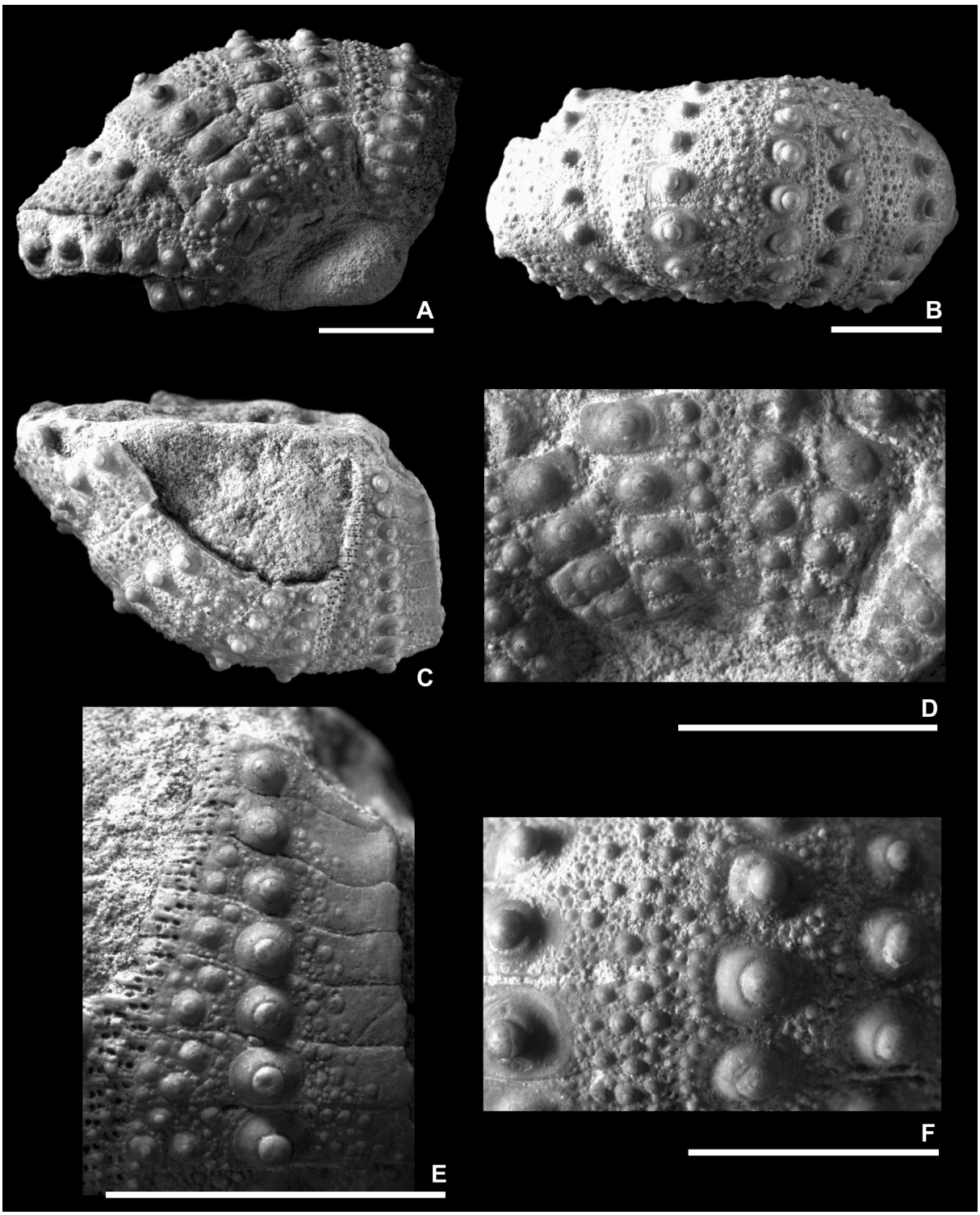
Trochalosoma taeniatum (von Hagenow, 1840)
(Text-figs 2, 3)

*1840. *Cidarites* (*Diadema*) *taeniatus* von Hagenow, p. 651.
2000. *Trochalosoma taeniatum* (von Hagenow, 1840); Smith and Jeffery, p. 107, fig. 42 (with additional synonymy).
2000. *Trochalosoma* sp. (spines); Smith and Jeffery, p. 110 (partim).
2003. *Phymosoma taeniatum* (v. Hagenow, 1840); Kutscher, p. 10, pl. 7, figs 3–8.

MATERIAL: A single fragmentary test (NHMM 2008 103) from Lubelsk Upland, near Piotrowice, 15 km south of Lublin; upper Maastrichtian.

DESCRIPTION: Test > 60 mm in diameter (estimated); clearly subpentagonal in outline (Text-fig. 2A, C); depressed in profile (Text-fig. 2B) with height c. 35 per cent of test diameter; ambitus at mid-height; apical disc opening only partially preserved (margin; Text-fig. 2C), but apparently large, plating not preserved; ambulacral pore pairs expanded into short phyllodes adorally (Text-fig. 2D), polygeminate (4, 5 or 6 elements) at ambitus and adapically (Text-fig. 2E), pore pairs arranged biserially above ambitus and in arcs ambitally; phymosomatid plate compounding; each ambulacral plate with a single large, imperforate, primary tubercle, largest at ambitus and reduced markedly in size adapically; non-crenulate, except adapically (Text-fig. 3); smaller tubercles separate poriferous zone from areoles (Text-fig. 2F); at and above ambitus, perradial area densely covered in tubercles of various sizes and miliaries, up to four or five abreast (Text-fig. 2B, F); below ambitus only few, small tubercles and miliaries (Text-fig. 2D); height of

interambulacral plates at ambitus much exceeding width, with a single large, imperforate, primary and non-crenulate tubercle, except adapically; adradial area densely covered in tubercles of various sizes and miliaries (Text-fig. 2F), as is interradial area; adapically, only one or two adradial tubercles left, and naked

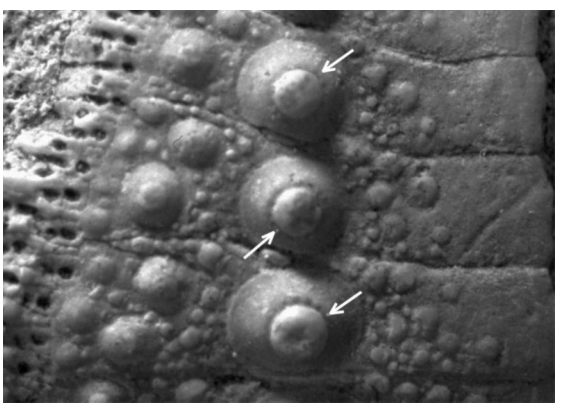


Text-fig. 2. *Trochalosoma taeniatum* (von Hagenow, 1840) (NHMM 2008 103), from the upper Maastrichtian of Piotrowice (Lublin area, south-east Poland), in oral (A, D), lateral (B, F) and apical (C, E) views. Details (D, E and F) illustrate adoral, adapical and ambital ambulacral and interambulacral plating, respectively). Scale bars equal 10 mm.

interradial zone developing, extending six to seven plates in adoral direction (Text-fig. 2E); adorally, two or three of adradial secondary tubercles on each plate larger, forming distinct adradial row (Text-fig. 2D); 18–19 ambulacral and interambulacral plates in a column, comparable in size (Text-fig. 2A, B, F); peristome apparently smaller in size than apical disc, slightly sunken, buccal notches distinct.

DISCUSSION: Although, in general, this specimen compares well with material described and illustrated by Ravn (1928), Kutscher (1985, 2003) and Smith and Jeffery (2000), some differences may be noted, and these might be size related. There are more ambulacral and interambulacral plates (18–19 vs 14–15), the adradial and interradial granulation is denser and at least eight or nine adapical tubercles are crenulated (Text-fig. 3). The last feature in particular is surprising, because Kutscher (1985, p. 523) noted that in *T. taeniatum* from Rügen there was a tendency for primary tubercles to be crenulate only in smaller-sized individuals.

Smith and Jeffery (2000, p. 106) diagnosed the genus *Trochalosoma* as follows, 'Test large, depressed in profile. Apical disc opening large, pentagonal, plating caducous, presumed monocyclic. Ambulacral plates composed of five or six elements in phymosomatid style at the ambitus. Pore-pairs biserial adapically; short phyllodes developed adorally. Primary tubercles imperforate, non-crenulate, or with rudimentary crenulation only. Interradial and adradial zones of granulation broad; naked interradial band adapically. Peristome flush to slightly invaginated. Short phyllodes developed close to the peristome.' They also noted (p. 107) that placement of this genus in the Phymosomatidae was based on the large size of the apical disc and on the phymosomatid-style plate compounding. However, the non-crenulate tubercles readily distinguish it from *Phymosoma* (see also Smith, 2010).



Text-fig. 3. Detail of adapical interambulacral plating [compare Text-fig. 2C, E], showing crenulation of tubercles (arrows)

Although the true status of the genus *Trochalosoma* cannot be established at present, for a lack of material of the type species, Smith and Jeffery (2000) referred three Late Cretaceous to Paleocene species to it. The best-known of these is *T. taeniatum*, followed by *T. mortenseni* (Checchia-Rispoli, 1932) from the Maastrichtian of Libya, which differs in having two subequal tubercles on the ambital and supra-ambital interambulacral plates (see Smith and Jeffery, 2000, fig. 43). *Trochalosoma trinitensis* (Cooke, 1961), from the Paleocene of Trinidad, has single tubercles on the interambulacral plates (differentiating it from *T. mortenseni*) and less well-developed adradial and interradial granulation than *T. taeniatum*.

PALAEOBIOGEOGRAPHIC INTEREST

To date, *Trochalosoma taeniatum* has been recorded from the lower and upper Maastrichtian of Denmark (Mon, Sjaelland and Jylland), as well as from the upper Maastrichtian of Mangyshlak (Kazakhstan), the lower Maastrichtian of Rügen (northeast Germany) and the Maastrichtian of Alava, northern Spain (see Smith and Jeffery 2000). As discussed by Jagt (2000, p. 241, pl. 13, fig. 16), *T. corneti* (Cotteau, 1875) (= *Cyphosoma rutoti* Lambert, 1898a; *Cyphosoma inops* Lambert, 1898a) is considered distinct, at least for the time being. Having been collected from the 'Poudingue de la Malogne' in the Ciply area (Mons Basin, southern Belgium), the holotype, by monotypy, of *Cyphosoma corneti* (IRScNB 9113; see Geys 1980, fig. 1/6) may originally have come from the underlying 'Craie [brune] phosphatée de Ciply', now Ciply-Malogne Phosphatic Chalk Formation (Robaszynski *et al*. 2002). On belemnitellid coleoid evidence, that would mean an early Maastrichtian, *Belemnella obtusa* Zone, age (Christensen, 1999). However, as Simon (1998, p. 192) demonstrated on brachiopod evidence, the phosphatic chalk of Ciply could be correlated with the *acutirostris-spinosa* Zone (sensu Surlyk, 1984, i.e., lower lower Maastrichtian), while brachiopod species collected from cavity fill in the overlying hardground favoured a younger (*subtilis-pulchellus* Zone) age. A third assemblage, from cavities in the median portion of that hardground, is coeval with the *stevensis-chitoniformis* Zone of Surlyk (1984), i.e. uppermost Maastrichtian. Assuming the type of *Cyphosoma corneti* to have come, alternatively, from either the upper part of the hardground or the base of the next unit (i.e., the 'Tuffeau de St Symphorien') of late Maastrichtian age, there would be a good match with occurrences in the Maastrichtian type area. The 'Tuffeau de St Sym-

	MEERSSEN Member
	NEKUM Member
MAASTRICHT Formation	EMAEL Member ---------- Lava Horizon----------
	SCHIEPERSBERG Member
	GRONSVELD Member
	VALKENBURG Member
----------	Lichtenberg Horizon----------
	LANAYE Member
GULPEN Formation	LIXHE 1-3 Members
	VIJLEN Member

Table 1. Lithostratigraphic subdivision of the upper Gulpen and Maastricht formations (upper Maastrichtian) in the type area of the Maastrichtian Stage (northeast Belgium, southeast Netherlands). *Belemnitella junior* ranges from the base of interval 4 of the Vijlen Member to the top of the Meerssen Member, while *Belemnella* (*Neobelemnella*) gr. *kazimiroviensis* is confined to the upper Meerssen Member

phorien' is easily correlatable with the upper Lanaye and lower Maastricht formations. In particular, the brachiopod species *Thecidea papillata* (von Schlottheim, 1813) and *Trigonosemus pectiniformis* (von Schlottheim, 1813) are important in this respect. The former has several acmes in the upper Lanaye Member, the basal Valkenburg Member and in the uppermost Meerssen Member, while the latter is known mainly from the upper Lanaye to the middle Emael (Lava Horizon) members, and is not recorded higher (Table 1). Thus, this matches the lower part of the range of *T. corneti* in the Maastrichtian type area.

Admittedly, the ratio test height/diameter for *Trochalosoma corneti* (0.34–0.37) corresponds to that of *T. taeniatum* (see Kutscher 1985), and primary spines are comparable. However, we favour retention of *T. corneti* as a distinct species, at least for now. The largest specimen from the Maastrichtian type area known to date (NHMM MD 3816; see Jagt 2000, pl. 10, fig. 12), from the uppermost Emael Member (see Table 1), measures 30.3 mm in diameter (peristome diameter: 11.8 mm). The adradial interambulacral granulation consists of two subequal tubercles and some miliaries only, and the interradial granulation is less dense than in *T. taeniatum* as well. Ambitally, the tubercles show more or less rudimentary crenulation. Striated, paddle-shaped spines are preserved *in situ* in at least two specimens, both from the Nekum Member (see Jagt 2000, pl. 13, fig. 16), showing the spatulate tipped-ones to be ambital and apical; the oral ones presumably were more fusiform. In comparison to spines associated with *T. taeniatum*, those of *T. corneti* appear much shorter (i.e., length not exceeding test diameter), more strongly ribbed, widest in the lower portion of the shaft, and much less thick set. Specimens with strong, divergent ribs, like the one illustrated by Jagt (2000, pl. 13, fig. 9), are rare. Of note is the fact that a number of spines from the Maastrichtian type area show colour banding, consisting of two or three pinkish-purplish bands, separated by white.

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