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A monograph of the Polish Oxfordian echinoids; Part 1, Subclass Cidaroidea CLAUS, 1880

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ABSTRACT:

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Cidaroid echinoids (subclass Cidaroidea CLAUS, 1880) from the Oxfordian part of a more than 1 km thick Upper Jurassic carbonate sequence developed over epicontinental areas of Poland (Polish Jura, Holy Cross Mountains, Mid-Polish Anticlinorium) are assigned to 13 taxa of the genera *Rhabdocidaris* DESOR, 1855, *Polycidaris* QUENSTEDT, 1858, *Plegiocidaris* POMEL, 1883, and *Paracidaris* POMEL, 1883. Their taxonomy is revised and discussed with a special emphasis on establishing the relationships between species based on bare tests and isolated spines. As former attempts to combine these elements, and to accommodate them into particular genera, have resulted in a very confused taxonomy of almost all of the species studied, the synonymies of the Polish species are revised. This offers a new insight into content of the genus *Paracidaris* POMEL, 1883, to which the species *Paracidaris blumenbachi* (MÜNSTER *in* GOLDFUSS, 1826), *P. elegans* (MÜNSTER *in* GOLDFUSS, 1826), *P. florigemma* (PHILLIPS, 1829), *P. laeviscula* (L. AGASSIZ, 1840), *P. propinqua* (MÜNSTER *in* GOLDFUSS, 1826) are assigned, and whose relation to the often-confused species *Paracidaris parandieri* (L. AGASSIZ, 1840) and *P. filograna* (L. AGASSIZ, 1840) is discussed.

The distinction is clarified between the species *Plegiocidaris monilifera* (GOLDFUSS, 1826) and *Plegiocidaris coronata* (GOLDFUSS, 1826) whose topotypic material from Staffelstein in Franconia (Germany) is analyzed.

Key words: Echinoidea, Cidaroidea, Taxonomy, Upper Jurassic, Poland.

INTRODUCTION

This paper is a sequel to the monographic description of the echinoids of Lower Kimmeridgian age in Poland (RADWAŃSKA 1999). It deals with part of the echinoid fauna of Oxfordian age, specifically the cidaroids, which hold a basal position in the systematics of regular echinoids, and indeed of all echinoids (FELL 1966, HESS 1975, SMITH 1984, SMITH & WRIGHT 1988).

The Oxfordian sequences in Poland represent rather unfavourable living conditions for echinoids (RADWAŃSKA 1999, p. 291). Being generally deeper marine than those of the Lower Kimmeridgian carbonate platform, these sequences are dominated by biohermal sponge-cyanobacterial buildups ("The Sponge Megafacies"; see MATYJA & WIERZBOWSKI 1995) associated with interbiohermal ("basinal") limy deposits, more or less distinctly bedded (MATYJA 1977; MATYJA & TARKOWSKI 1981; TRAMMER 1982, 1989).

Echinoids from these sequences are poorly known. Only a few have been illustrated previously (ROEMER 1870, BARCZYK 1961, WIŚNIEWSKA-ŻELICHOWSKA 1971), although numerous species have been reported. The echinoid fauna listed from these beds by PUSCH (1837), ZEUSCHNER (1847a,b, 1864), SIEMIRADZKI (1893), GALLINEK (1896), WÓJCIK (1910, 1913-14), LEWIŃSKI (1912), ŚWIDZIŃSKI (1931), and SAMSONOWICZ (1934), consists primarily of the com-

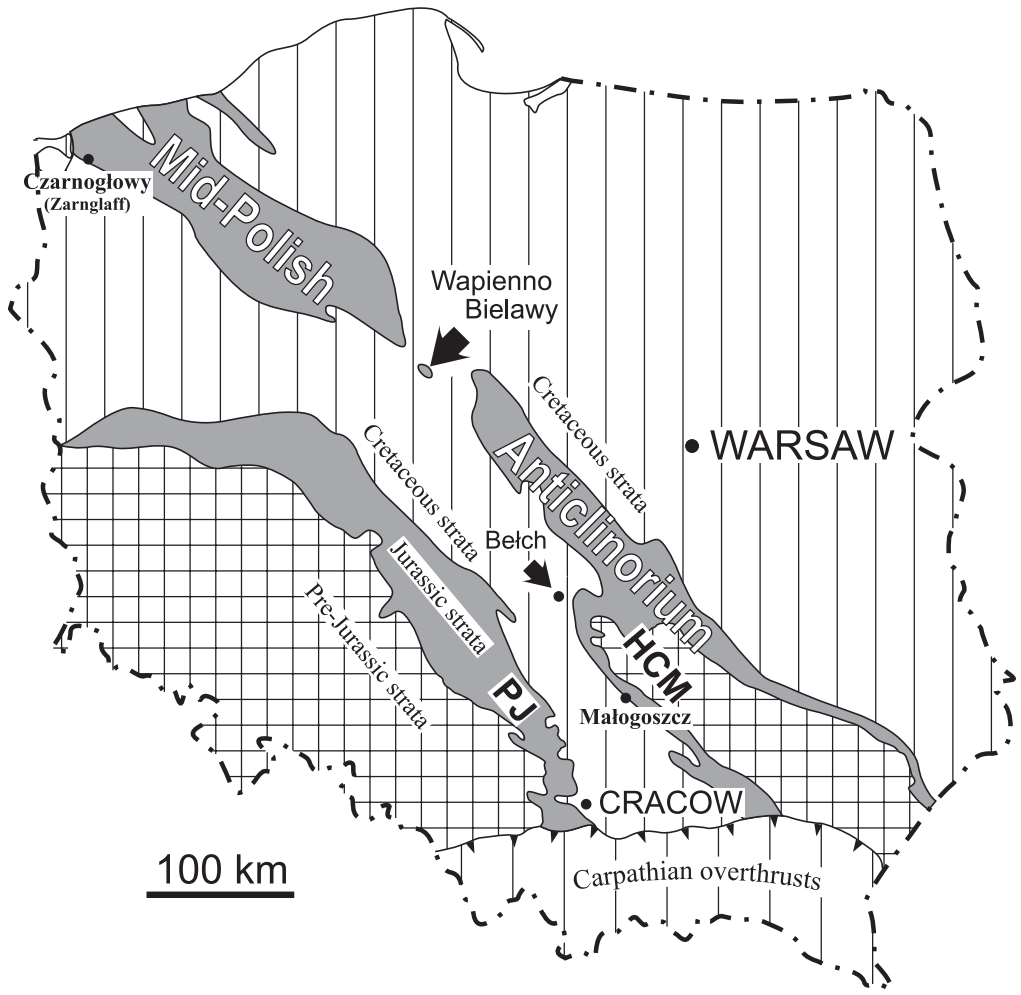

Fig. 1. Geological map of Poland, without Cenozoic cover, to show the main locations of the Oxfordian cidaroid-bearing localities. PJ – Polish Jura (see Text-fig. 2), HCM – Holy Cross Mountains (see Text-fig. 3); also indicated are Wapienno and Bielawy quarries in the Zalesie anticline (the Couiavia region), and the Bełchatów open-mine (abbreviated as *Bełch*), as well as the referenced localities Małogoszcz and Czarnogłowy (Zarnglaff), bearing Lower Kimmeridgian echinoids (see RADWAŃSKA 1999); adopted from MATYJA & WIERZBOWSKI (2000, fig. 1)

mon European species of cidaroids, such as *blumenbachi*, *coronata*, *filograna*, *florigemma*, usually with no accompanying information on how they are preserved (i.e. whether as tests or isolated spines). Since almost all collections (except that of SIEMIRADZKI 1893) were lost during the Second World War, there is no possibility of now verifying any of these identifications. In the systematic account given below such former reports are therefore indicated only when a given species, under the same name or its synonym, has been verified as occurring at the locality studied.

Cidaroids dominate in these previous reports of the echinoid fauna from the Oxfordian sequences of Poland, while other regulars are rare, and the irregulars are almost entirely missing. The same faunal domination by cidaroids is also apparent from the own research performed since the eighties at the exposures now accessible, as well as in private collections. Of the scientific collections, Oxfordian echinoids are held solely in Cracow in the two Institutions of the Polish Academy of Sciences, that is The Natural History Museum and The Geological Museum in whose care SIEMIRADZKI's collection is kept.

Regardless of their rarity, the cidaroid echinoids are characteristic element of the Oxfordian sequences in Poland. Their more or less fragmented tests, usually consisting of isolated interambulacral plates and isolated spines or their fragments, are readily found at many localities. They are scattered throughout the thick limestone succession, especially along the flanks of the bioherms, as at Niegowonice in the Polish Jura, and the huge quarries Wapienno and Bielawy in the Couiavia

Subzone of the Plicatilis Zone) is found (MATYJA & TARKOWSKI 1981; for former echinoid reports see ROEMER 1870, SIEMIRADZKI 1893, WÓJCIK 1910). Of a similar age is the sequence exposed at Ogrodzieniec and the cidaroid-yielding part of the sequence at Wysoka (TRAMMER 1982, fig. 3). The sequence of Niegowonice and the cidaroid-yielding part of Trzebinia represent the Middle Oxfordian Transversarium Zone (SIEMIRADZKI 1893, pp. 142-143; TRAMMER 1989, fig. 3). Deposits of the Upper Oxfordian Bimammatum Zone (WIERZBOWSKI 1978, p. 322) were formerly exposed at Podgórze (also called Krzemionki, now in the city of Cracow) and yielded well preserved cidaroids (ZEUSCHNER 1864, p. 577) including some collected by SIEMIRADZKI (1893, pp. 142-143) and others.

The youngest Oxfordian sequences in the Polish Jura crop out in the vicinity of Maszków and have recently been studied by ZIÓŁKOWSKI (2002, p. 22: exposure Sk 26 of Iwanowice Dworskie). ZIÓŁKOWSKI classified these as belonging to the Upper Oxfordian Bimammatum and/or Planula Zone. Also belonging to the Planula Zone are the cidaroid-bearing deposits of Rudniki, monographed by WIŚNIEWSKA-ŻELICHOWSKA (1971).

Holy Cross Mountains

In the northeastern margin of the Holy Cross Mountains (Text-fig. 3) diverse Oxfordian limestone lithologies (SAMSONOWICZ 1934; GUTOWSKI 1992, 1998) are very poorly exposed, and locally yield fragmentary cidaroid remains (SAMSONOWICZ 1934). Material described in this study comes from two localities: Ostrowiec (called also Ostrowiec-Koszary), from a bioherm sequence which probably represents the Middle, or the upper part of the Lower Oxfordian (cf. position of bioherms in the region: GUTOWSKI 1998, fig. 3), and Bałtów (called also Bałtów-Zarzecze) where cidaroids occur in thick-bedded chalky grainstones along with the ubiquitous and well-known pink-

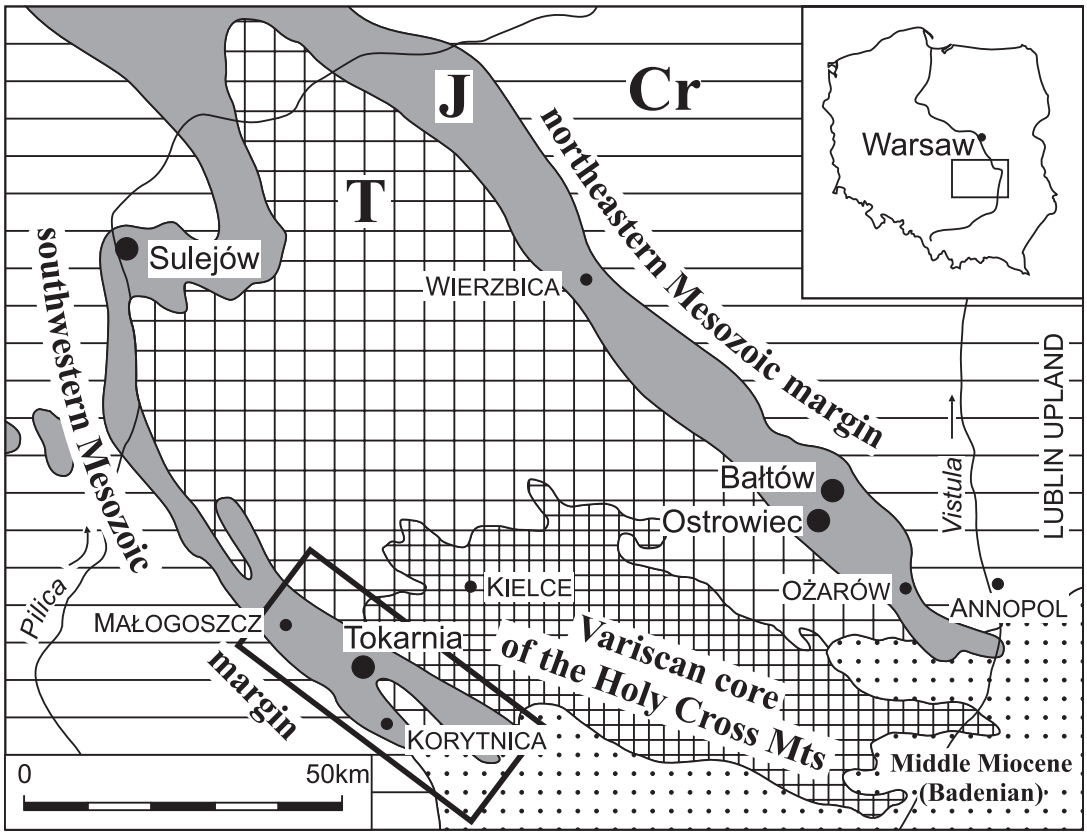

Fig. 3. Location of the Oxfordian cidaroid-bearing exposures along the Mesozoic margins of the Holy Cross Mountains (inset shows position in Poland, see Text-fig. 1): T – Triassic, J – Jurassic, C – Cretaceous; rectangled is the area of well-exposed Oxfordian-Kimmeridgian sections, the Oxfordian cidaroid content of which was reported by previous authors (PUSCH 1837, LEWIŃSKI 1912, ŚWIDZIŃSKI 1931), and Kimmeridgian one was studied by the present author (RADWAŃSKA 1999); indicated is also locality Sulejów of Oxfordian echinoids reported by BARCZYK (1961); adopted from KUTEK, MATYJA & WIERZBOWSKI (1992, fig. 1) and RADWAŃSKA (1999, fig. 2)

Repositories

Most of the echinoid material described hereafter is housed in the Department of Palaeontology, Faculty of Geology, University of Warsaw. It is kept under the collection numbers preceded by the character E (echinoids), followed by a lettered symbol Ox indicative of Oxfordian age. Comparative material from Staffelstein is labelled EStaff.

Other specimens are labelled by the collection numbers of their mother institutions, or by the name of private collectors as follows:

ZNG PAN – Geological Museum, Institute of Geological Sciences, Polish Academy of Sciences, Cracow Research Centre (Muzeum Geologiczne Instytutu Nauk Geologicznych Polskiej Akademii Nauk w Krakowie),
ZNG PAN A-I-3 – SIEMIRADZKI's (1893) Collection kept at the Geological Museum,
MP – Natural History Museum, Institute of Systematics and Evolution of Animals, Polish Academy of Sciences (Muzeum Przyrodnicze Instytutu Systematyki i Ewolucji Zwierząt Polskiej Akademii Nauk w Krakowie),
Coll. MM – private collection of Dr. Marcin MACHALSKI, Warsaw,
Coll. EN – private collection of Edward NONIEWICZ, Wałcz.

Abbreviations

Throughout the systematic description of the species, in *Tables of dimensions*, the following abbreviations are used:

hd – horizontal diameter of the test,
vd – vertical diameter of the test,
∅Ad – diameter of the apical disc (apical system + periproct),
∅Pm – diameter of the peristome.

Class Echinoidea LESKE, 1778
Subclass Cidaroidea CLAUS, 1880
Order Cidaroida CLAUS, 1880
Family Rhabdocidaridae LAMBERT, 1900
Subfamily Rhabdocidarinae LAMBERT, 1900
Genus *Rhabdocidaris* DESOR, 1855

TYPE SPECIES: *Cidaris orbignyana* L. AGASSIZ, 1840; *SD* LAMBERT & THIÉRY (1910, p. 136).

DIAGNOSIS: Rhabdocidarids with strongly conjugate ambulacral pores arranged uniserially in each column.

Rhabdocidaris nobilis (MÜNSTER *in* GOLDFUSS, 1826)
(Pl. 1, Figs 1-3; Pl. 2, Figs 1-2; Pl. 3, Figs 5-6 and ?Pl. 3, Figs 1-4)

1826. *Cidarites nobilis* MÜNSTER; G. MÜNSTER, p. 117, pl. 39, figs 4a-4b.
?1840b. *Cidaris nobilis* MSTR.; L. AGASSIZ, p. 65, pl. 21a, fig. 21.
1847. *Cidaris nobilis* MÜNST. *in* GOLDF.; L. AGASSIZ & E. DESOR, p. 28.
1855. *Rhabdocidaris nobilis* MÜNSTER *in* GOLDFUSS; E. DESOR, p. 40, pl. 8, fig. 10.
1869. *Rhabdocidaris nobilis* (MÜNSTER), DESOR; E. DESOR & P. DE LORIOL, p. 68, pl. 10, figs 1, 1a-1c; *non* pl. 13, fig. 2.
1880. *Rhabdocidaris nobilis* (MÜNSTER), DESOR, 1856; G. COTTEAU, pp. 442-448, pl. 259, figs 5-8; pl. 260, figs 1-4.
1929. *Rhabdocidaris Desori* nov.spec.; A. JEANNET, pp. 26-28, text-figs 13-14.
1929. *Rhabdocidaris* cfr. *Desori* nov.spec.; A. JEANNET, p. 28, text-fig. 4, pl. 3, fig. 10.
1929. *Rhabdocidaris nobilis* MÜNSTER (*Cidarites*); A. JEANNET, pp. 30-35, pl. 2, figs 8-10; pl. 4, figs 3-4 and 13; pl. 5, figs 19-24.
1929. *Rhabdocidaris Orbignyiformis* nov.spec.; A. JEANNET, pp. 35-37, pl. 4, figs 5-6; pl. 5, figs 28-30 and 37-39.
1929. *Rhabdocidaris Cotteaui* nov.spec.; A. JEANNET, pp. 37-39, text-fig. 17 and pl. 4, figs 7-9; pl. 5, figs 31-33 and 41-43.
1929. *Rhabdocidaris rauraca* nov.spec.; A. JEANNET, pp. 39-40, pl. 4, figs 10-12; pl. 5, figs 16-18.
1929. *Rhabdocidaris Stingelini* nov.spec.; A. JEANNET, p. 41, pl. 2, fig. 11; pl. 5, figs 34-36.
1933. *Rhabdocidaris Tobleri* nov. sp.; A. JEANNET, pp. 2-4, pl. 1, figs 1-3, 6-7, 11.
1971. *Rhabdocidaris nobilis* (MÜNSTER); M. WIŚNIEWSKA-ŻELICHOWSKA, p. 57, pl. 33, figs 10-13 and pl. 34, figs 1a-1b.
1975. *Rhabdocidaris nobilis* (MÜNSTER); H. HESS, p. 88, pl. 30, fig. 4.
?1988. *Rhabdocidaris nobilis* (MÜNSTER, 1826); A. VADET, pp. 134-136, pl. 22, figs 1-3.
1999. *Rhabdocidaris nobilis* (MÜNSTER, 1826); U. RADWAŃSKA, pp. 301-302, pl. 1, figs 1a-1b.
1999. *Rhabdocidaris nobilis* (MÜNSTER, 1826); J.G. BAUMEISTER, pp. 321-322, text-figs 6-8.
2000. *Rhabdocidaris nobilis* (MÜNSTER, 1826); U. RADWAŃSKA, p. 22.

MATERIAL: 15 tests from Bielawy (EOx/177-EOx/180, EOx/182, EOx/ 242-EOx/251) , 4 tests from Podgórze (ZNG PAN D-I-24/181, ZNG PAN A-I-3/234a, ZNG PAN A-I-3/234b, ZNG PAN A-I-3/238), one test fragment from Maszków (EOx/252); several fragments of primary spines from Bielawy and Wapienno (EOx/183-EOx/185, EOx/253).

al outline, and the characteristic ornamentation of the shaft. Some of the specimens (Pl. 3, Figs 3-4) probably represent adoral spines.

The species *Rhabdocidaris nobilis* (MÜNSTER *in* GOLDFUSS, 1826) was first recorded from Poland by SIEMIRADZKI (1893, p. 143), who noted is as being common at Podgórze near/at Cracow. However, his collection contains only three fragmented tests (see below) and one primary spine. This species was also reported by WIŚNIEWSKA-ŻELICHOWSKA (1971) from the Oxfordian of Rudniki near Częstochowa (Polish Jura), as well as by the present author (RADWAŃSKA 1999) from the Lower Kimmeridgian of Małogoszcz, and in a preliminary report (RADWAŃSKA 2000) from the sequence at Bielawy.

It is noteworthy that the specimen from Podgórze (Pl. 3, Fig. 6; Coll. Number ZNG PAN D-I-24/181) has only its adoral (peristomial) side preserved. The same is also true of two specimens of the three specimens of this species in SIEMIRADZKI's Collection (ZNG PAN A-I-3/234a and ZNG PAN A-I-3/234b). The third of SIEMIRADZKI's specimens (ZNG PAN A-I-3/238) has only its aboral (periproctal) side. All these are broken ambitally ("half-truncated") by synsedimentary erosion, as demonstrated by the matrix rock adhering to, and healing, the broken tests.

Rhabdocidaris maxima (MÜNSTER *in* GOLDFUSS, 1826)
(Pl. 9, Figs 5-6)

1826. *Cidarites maximus* MÜNSTER; G. MÜNSTER, p. 116, pl. 39, figs 1a-1b.
1855. *Rhabdocidaris maxima*; E. DESOR, p. 39, pl. 8, fig. 17.
1855. *Rhabdocidaris princeps* DESOR nov.sp.; E. DESOR, p. 40, pl. 8, fig. 1.
1869. *Rhabdocidaris maxima* MÜNSTER; E. DESOR & P. DE LORIOL, pp. 71-73, pl. 11, figs 1a-1d; pl. 12, fig. 1.
non 1870. *Rhabdocidaris maxima* DESOR; F. ROEMER, p. 227, pl. 17, figs 12 and 14-15.
? 1870. *Rhabdocidaris maxima* DESOR; F. ROEMER, p. 227, pl. 17, fig. 16.
1926. *Rhabdocidaris Schneideri*; J. LAMBERT, p. 759, pl. 29, fig. 2.
1929. *Rhabdocidaris princeps* DESOR; A. JEANNET, pp. 9-13, text-figs 5-8, pl. 1, figs 1-2; pl. 2, fig. 1; pl. 5, figs 46-47 [*non* figs 48 and 50].
1929. *Rhabdocidaris schneideri* LAMBERT; A. JEANNET, pp. 14-16, text-fig. 9, pl. 2, figs 4-7; pl. 5, fig. 49.
1975. *Rhabdocidaris princeps* DESOR; H. HESS, p. 88, text-fig. 38, pl. 30, fig. 3.
1988. *Dickesicidaris maxima* (MÜNSTER, 1826); A. VADET, pp. 137-139, pl. 24, fig. 1; pl. 25, figs 1-2.

MATERIAL: One test with attached primary spine from Podgórze (MP 431/267/01), another one from Wysoka (EOx/193), one fragment of a primary spine from Wapienno (EOx/224).

DIMENSIONS (*in* mm):

Coll. Number	*hd*	*vd*	*∅Ad*	*∅Pm*	Figured in:
MP431/267/01	98.0	~84.0	—	40.0	Pl. 9, Fig. 5

DIAGNOSIS: A species of *Rhabdocidaris* with numerous (8-9) interambulacral plates per column and straight ambulacra. Adoral interambulacral plates have almost confluent, transverse-oval scrobicules. Each ambulacral plate with one marginal tubercle lacking an incision at the boss. Spines long, spatulate or spindle-shaped with their shaft covered by distinct granules or thorns.

DESCRIPTION: The tests are circular, moderately high and flattened above and below. The tests of adult specimens are very large and reach 10 cm in diameter (Pl. 9, Fig. 5).

The ambulacra (Pl. 9, Fig. 5) are straight. The interporiferous zone is distinctly wider than the pore zone. Marginal series of tubercles are uniform and contiguous; the bosses of the tubercles are flattened and without an incision. In addition, each plate carries three or four smaller tubercles. The pores are conjugate, connected by a narrow, distinct interporal furrow. The pores are large and equal in size; both are oval in outline.

The interambulacra are wide, and are composed of 9-10 plates per column. The areoles are large and shallow, transverse-oval in outline and almost confluent adorally (Pl. 9, Fig. 5). The perforate tubercles are moderately large with the bosses distinctly crenulate. The scrobicular tubercles (Pl. 9, Fig. 5) are not very prominent. Adapical and adoral miliary zones are reduced whereas the adradial and admedian zones are wide and closely covered by very fine miliary tubercles decreasing in size towards the sutures.

The apical disc is not preserved.

The peristome (Pl. 9, Fig. 5) is subpentagonal in outline and reaches 40% of the test diameter.

The primary spines (Pl. 9, Figs 5-6) are long, spatulate or spindle-shaped with the shaft covered by distinct granules or thorns.

REMARKS: This specimen is consistent in morphology with the neotype of the species indicated by VADET (1988, pl. 25, figs 1-2). The species *maxima* was ascribed by VADET (1988, p. 136) to his new genus *Dickesicidaris* which he differrentiated from *Rhabdocidaris* merely by its ambulacral marginal tubercles lacking an incision at the boss. However, this character is of such a trivial nature that it seems an inappropriate basis for a generic distinction.

Polycidaris sp. 2
(Pl. 4, Figs 5-7)

MATERIAL: Several fragments of primary spines from Zalas (EOx/191, EOx/192, MP313/267/01).

The primary spines (Pl. 4, Figs 5-7) belong to a single morphological type. They are long and cylindrical, with their shaft ornamented by a short, almost perpendicular set of loosely spaced thorns, associated with longitudinal crests Pl. 4, Figs 5, 7). The crests are better developed towards the distal end of the shaft. The collar is short and smooth (Pl. 4, Fig. 6). The milled ring is well developed, and the base is relatively short.

REMARKS: These spines match those described by AGASSIZ (1840) as "*Cidaris spinosa*", a species established on the grounds of spines alone. Some authors (e.g. COTTEAU 1877, VADET 1988) have assigned naked (spineless) tests to this species, and VADET (1988) included to the synonymy of *spinosa* QUENSTEDT's (1858) species *multiceps* a species established on test morphology. Unfortunately, such spines may also characterise the closely related species *suevica* DESOR, 1855. Consequently, as spines are not distinguishable at the species level [see remarks for the species *Polycidaris*? *suevica* (DESOR, 1855)], they are classified only as belonging to the genus *Polycidaris* QUENSTEDT, 1858. Furthermore, so long as the status of *spinosa* remains doubtful, the species *multiceps* should be treated as a valid species.

Polycidaris? *suevica* (DESOR, 1855)
(Pl. 4, Figs 1-3)

1855. *Polycidaris suevica* DESOR, nov.sp.; E. DESOR, p. 7, pl. 1, figs 2-2a.
1858. *Cidarites suevicus*; F.A. QUENSTEDT, p. 642, pl. 73, fig. 51.
1869. *Cidaris suevica*, DESOR; E. DESOR & P. DE LORIOL, pp. 56-57, pl. 8, figs 6, 6a-6d.
1988. *Polycidaris suevica* (DESOR, 1856); A. VADET, pp. 106-107.
1910. *Plegiocidaris* (*Paracidaris*) *suevica* DESOR; J. LAMBERT & P. THIÉRY, p. 135.
1995. *Polycidaris spinosa* (AGASSIZ, 1840); P. NICOLLEAU & A. VADET, pp. 65-66, text-fig. on p. 65; pl. 31, figs 2a-2c, ?fig.2d.

MATERIAL: Two fragments of tests from Zalas (EOx/187, EOx/188), one from Ogrodzieniec (EOx/189).

DIAGNOSIS: A species of *Polycidaris* with a relatively low number of interambulacral plates in an interambulacral column and with interambulacral plates high and short. 11-13 ambulacral plates correspond to one interambulacral plate at the ambitus. Adapical and ambital areoles contiguous and almost circular. Pore pairs surrounded by a relatively wide attachment area.

DESCRIPTION: The tests are moderately large and reach a diameter of 6 cm.

The ambulacra (Pl. 4, Figs 3a-3c) are straight. The interporiferous zone is somewhat wider than the pore zone (Pl. 4, Fig. 3a); the pores are large, circular in outline, nonconjugate and separated by a narrow, conspicuous interporal rim that is distinctly narrower than the diameter of the pore (Pl. 4, Figs 3a-3b). The pore pair is surrounded by relatively wide attachment area (Pl. 4, Fig. 3b). Every third pore pair is associated with a large tubercle while the intervening two pore pairs are adorned with two small tubercles, giving a characteristic, regular ornamentation to the interporiferous zone (Pl. 4, Figs 3a, 3c). A relatively large number (13) of ambulacral plates correspond to an interambulacral plate at the ambitus.

The interambulacra as in all *Polycidaris* species, are constructed of relatively few plates, some 7-8 in a series and the interambulacral plates are relatively high and short. The areoles (Pl. 4, Figs 1-2, 3d) are large, moderately deep; adapical and ambital ones are contiguous and almost circular in outline (Pl. 4, Fig. 2) whereas adoral ones (3-4 proximal) become confluent, and oval in outline. The primary tubercles are small, perforate and distinctly crenulate (Pl. 4, Fig. 3d). The scrobicular ring of tubercles is very narrow and inconspicuous (Pl. 4, Figs 1, 3d). Secondary tubercles are circular, and decreasing in size towards the sutures. The miliaries are developed only on the interradial and adradial parts of the plates, and they are wedged between the scrobicular and secondary tubercles.

The apical disc and the peristome are not preserved.

The primary spines have not hitherto been described.

REMARKS: DESOR's species *suevica* is here only tentatively assigned to the genus *Polycidaris* QUENSTEDT, 1858, because of the structure of its interambulacral plates, whose adapical and ambital areoles are contiguous and almost circular in outline. This is not typical for *Polycidaris* species, whose areoles are usually confluent and oval in outline, and whose interambulacral plates are typically distinctly wider than high. In these characters *suevica* resembles species of the genus *Histocidaris* MORTENSEN, 1903. However, *Histocidaris* has not been recorded from beds older than the Oligocene. Although LAMBERT & THIÉRY (1910, p. 135) assigned the species *suevica* to the subgenus *Paracidaris* POMEL,

sp. 1 by having a smaller number of interambulacral plates in a series, and by its contiguous areoles. However, the fragmentary nature of the material does not suffice for unequivocal diagnosis at species level.

Tribe Poriocidarini MORTENSEN, 1909
Genus *Plegiocidaris* POMEL, 1883

TYPE SPECIES: *Echinus coronatus* V. SCHLOTHEIM 1820; *SD* LAMBERT & THIÉRY (1910, p. 135).

DIAGNOSIS: Histocidarids with short, club-like primary spines bearing a well developed collar occupying 10-40% of their length.

Plegiocidaris crucifera (L. AGASSIZ, 1840)
(Pl. 5, Figs 1-10)

1840a. (nomen nudum) *Cidaris crucifera* AG.; L. AGASSIZ, p. 10.
1840b. *Cidaris crucifera* AG.; L. AGASSIZ, p. 61, pl. 21, figs 1-4.
partim 1840b. *Cidaris propinqua* MUNST.; L. AGASSIZ, pp. 62-63, pl. 21, fig. 8 [*non* pl. 21, figs 5-7, 9,10].
1840b. *Cidaris cervicalis* AG.; L. AGASSIZ, p. 77, pl. 21a, fig. 10.
partim 1847. *Cidaris Blumenbachii* MÜNST. var. minor: *Cidaris crucifera* AGASS.; L. AGASSIZ & E. DESOR, p. 27.
1847. *Cidaris cervicalis* AGASS.; L. AGASSIZ & E. DESOR, p. 31.
1855. *Cidaris cervicalis* AGASS.; E. DESOR, p. 8, pl. 3, figs 20-22.
1868. *Cidaris monasteriensis*, THURMANN; E. DESOR & P. DE LORIOL, p. 29, pl. 4, figs 1-14.
1869. *Cidaris cervicalis*, AGASSIZ; E. DESOR & P. DE LORIOL, pp. 44-46, pl. 6, figs 6, 6a-6b, 7, 7a-7b and pl. 7, figs 1-6.
1869. *Cidaris ducreti* P. DE LORIOL, 1869; E. DESOR & P. DE LORIOL, p. 52, pl. 8, figs 1-3.
partim 1876. *Cidaris coronata* (SCHLOTHEIM), GOLDFUSS, 1825; G. COTTEAU, pp. 132-140, pl. 176, figs 3-16 [non pl. 176, figs 1-2].
partim 1876. *Cidaris cervicalis*, AGASSIZ, 1840; G. COTTEAU, pp. 140-149, pl. 178, figs 1-6; pl. 179, figs 1-7; pl. 180, figs 1-2, 5-11 and pl. 193, figs 1-8 [*non* pl. 180, figs 3-4: internal moulds, indeterminable].
1877. *Cidaris Ducreti*, DE LORIOL, 1869; G. COTTEAU, pp. 210-211, pl. 198, figs 18-19.
1877. *Cidaris kimmeridgensis*, COTTEAU, 1877; G. COTTEAU, pp. 218-220, pl. 201, figs 1-4.
1883. *Plegiocidaris cervicalis*; M.A. POMEL, p. 109.
1910. *Plegiocidaris monasteriensis* THURMANN; J. LAMBERT & P. THIÉRY, p. 132.
1910. *Plegiocidaris cervicalis* AGASSIZ; J. LAMBERT & P. THIÉRY, p. 132.
1910. *Plegiocidaris Ducreti* DE LORIOL; J. LAMBERT & P. THIÉRY, p. 133.
1910. *Plegiocidaris kimmeridgensis* COTTEAU; J. LAMBERT & P. THIÉRY, p. 133.
1975. *Plegiocidaris cervicalis* (AGASSIZ); H. HESS, p. 86, pl. 27, figs 4-6.
1975. *Plegiocidaris* cf. *coronata* (SCHLOTHEIM); H. HESS, pl. 27, fig. 3.
partim 1988. *Plegiocidaris crucifera* (AGASSIZ, 1840); A. VADET, pp. 122-128, pl. 15-17, and pl. 18, figs 1-3 [*non* pl. 16, fig. 7].
1995. *Plegiocidaris crucifera* (AGASSIZ 1840); P. NICOLLEAU & A. VADET, p. 68, text-figs on p. 68, pl. 33, figs 1a-1g.
1996. *Plegiocidaris crucifera* (AGASSIZ 1840); A. VADET, P. NICOLLEAU & J.P. PINEAU, p. 26, pl. 5, text-figs 33-34 and pl. 5, figs 1a-1c, 2.
partim 1997. *Plegiocidaris crucifera* (AGAS.); J. THIERRY, B. CLAVEL, P. HANTZPERGUE, D. NERAUDEAU, L. RIGOLLET & A. VADET, pp. 258, 260 and 271, pl. 35, fig. 9 [*non* pl. 36, fig. 6] .
1997. *Nenoticidaris parandieri* (AGAS.); J. THIERRY, B. CLAVEL, P. HANTZPERGUE, D. NERAUDEAU, L. RIGOLLET & A. VADET, p. 271, pl. 36, fig. 5.
1999. *Plegiocidaris crucifera* (L. AGASSIZ, 1840); U. RADWAŃSKA, pp. 306-307, pl. 6, figs 1-4 and pl. 7, figs 1-3.

MATERIAL: One test from Trzebinia (EOx/195), several primary spines from Ostrowiec (Coll. EN), Zalas (EOx/196-EOx/199) and the vicinity of Częstochowa (MP357/26701-MP361/267/01).

DIAGNOSIS: A species of *Plegiocidaris* with four rows of tubercles on the interporiferous zone, the marginal tubercles being distinctly larger than the inner ones. Ambulacral pores (*P1* isopores) large and separated by a moderately large interporal rim. Primary spines club-shaped with their shaft covered by large tubercles, arranged in longitudinal, not densely spaced rows, and with a relatively long, smooth collar.

DESCRIPTION: The test is circular in ambital section and moderately high (Pl. 5, Fig. 1).

The ambulacra (Pl. 5, Figs 1, 2a) are slightly sinuate. The interporiferous zone is twice as wide as the pore zone. The large marginal tubercles form a regular series; the bosses of these tubercles are large and swollen and the mamelons are flat and positioned eccentrically on

MATERIAL: 6 tests from Bielawy (EOx/207, EOx/208, EOx/253-EOx/256), 10 fragments of primary spines from Bielawy and Wapienno (EOx/209, EOx/210, EOx/257).

DIMENSIONS (*in* mm):

Coll. Number	*hd*	*vd*	*∅Ad*	*∅Pm*	Figured in:
EOx/207	~46.0	27.0	~19.0	~18.0	Pl. 6, Figs 1a-1c
EOx/208	38.0	~20.0	16.0	16.0	Pl. 6, Figs 2a-2b

DIAGNOSIS: A species of *Plegiocidaris* with rows of 6-8 almost uniform and contiguous tubercles filling the interporiferous zone of ambulacral plates, the marginal tubercles being a bit larger than inner ones. Ambulacral pores (*P2* isopores) very small and separated by a wide interporal rim. Primary spines with a long, shaft shaped like a maize cob and covered by small tubercles arranged in longitudinal, densely spaced rows.

DESCRIPTION: The tests are circular in ambital section and relatively high (Pl. 6, Fig. 1a).

The ambulacra (Pl. 6, Figs 5a-5c) are sinuate. The interporiferous zone is twice as wide as the pore zone. The contiguous marginal tubercles form a regular series and are a bit larger than the inner ones (Pl. 6, Fig. 5b). Each ambulacral plate carries two or three approximately equal-sized, secondary tubercles arranged in regular horizontal series (Pl. 6, Figs 5a-5b). The pore pairs are nonconjugate and separated by a wide interporal rim. The pores are very small (Pl. 6, Fig. 5c) and the pore pair is a *P2*- type isopore, as distinguished by SMITH (1978b, p. 764). The relatively numerous miliaries are wedged between the secondary tubercles (Pl. 6, Figs 5b-5c). Twenty-six ambulacral plates correspond to one interambulacral plate at the ambitus.

The interambulacra are wide, composed of 4-5 relatively high interambulacral plates in a series (Pl. 6, Figs 1a, 2a). The areoles are circular in outline, and nonconfluent throughout. The primary tubercles are prominent, perforate and finely crenulate (Pl. 6, Fig. 5d). The scrobicular ring is conspicuous; scrobicular tubercles are large, bearing prominent mamelons. The secondary tubercles are almost uniform in size, characteristically pearl-shaped, and particularly well developed on the adapical and interradial part of the plates (Pl. 6, Figs 1a, 2a, 5d). Miliaries are dispersed between the secondary tubercles. The interradial sutures are incised. The apical disc is large and reaches 46% of the test diameter (Pl. 6, Fig. 1b). The peristome is large, subpentagonal in outline, and reaches 46% of the test diameter (Pl. 6, Fig. 1c, 2b).

The primary spines (Pl. 6, Figs 3-4) are relatively long and somewhat asymmetrical, with the shaft shaped like a cob of maize, and a long, smooth collar that reaches 27-30% of the spine's length. The shaft is relatively slender and covered by small tubercles arranged in longitudinal, densely spaced rows. The transition between the collar and the shaft is gentle but accented by a narrow, but distinct hoop. The milled ring is well developed, and the base is short.

REMARKS: These specimens compare closely with the holotype of the species, described by GOLDFUSS (1826, p. 118) as "*Cidarites moniliferus*" and re-illustrated by PHILIP (1962, pl. 115, figs 1-3 and 6) and VADET (1988, pl. 13, fig. 3). The tests of *Plegiocidaris monilifera* (GOLDFUSS, 1826) are relatively easy to distinguish from other *Plegiocidaris* species because their ambulacra have a wide interporiferous zone composed of rows of 6-8 uniform, densely spaced tubercles as well as very small pores separated by a wide rim (Pl. 6, Figs 5a-5c). However, some authors (L. AGASSIZ & DESOR 1847, VADET 1988) have also included in the synonymy of this species the specimens classified by GOLDFUSS (1826, p. 119 and pl. 39, figs 8a-8m) as "*Cidarites coronatus*". As a result, these two species have previously been either united (e.g. L. AGASSIZ & DESOR 1847, VADET 1988), or kept separate (e.g. DESOR 1855, DESOR & DE LORIOL 1869, COTTEAU 1876, THIERRY & *al*. 1997).

VADET (1988) re-illustrated both specimens figured by GOLDFUSS (1826, pl. 39, fig. 6a-6b and fig. 8a-8b) as "*Cidarites moniliferus*" and "*Cidarites coronatus*", respectively. When analysing the structure of ambulacra (primarily of ambulacral pores), he stated that these two species do not differ in their type of ambulacral pores (*P2* isopores) at the ambitus, and thus concluded that they should be joined under the older name of *monilifera*. This conclusion is not valid, however, because the other features of ambulacra, particularly of the interporiferous zone and the scrobicular ornamen-

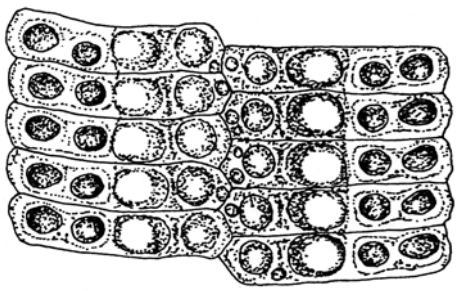

Fig. 6. Detail view of the ambital part of the test of *Plegicidaris coronata* (GOLDFUSS, 1826) from the GOLDFUSS' topotype Staffelstein in Franconia (Germany), to show details (interporal ornamentation and *P1* isopores) of ambulacral plates, differing from those of the studied species *Plegiocidaris monilifera* (GOLDFUSS, 1826); × 15

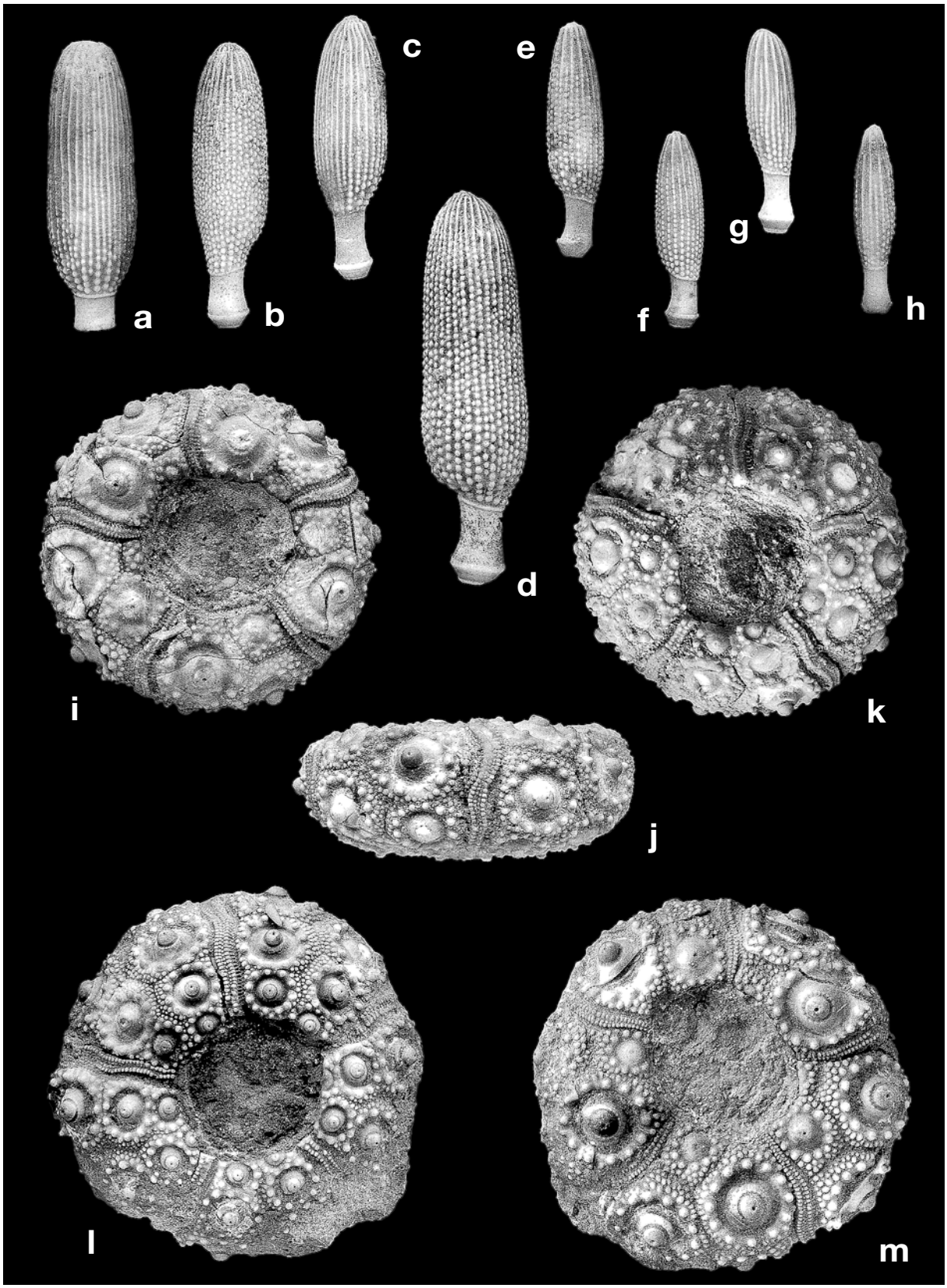

Fig. 7. Topotypic specimens of *Plegiocidaris coronata* (GOLDFUSS, 1826) from Staffelstein in Franconia (Germany), to elucidate its difference to the studied species *Plegiocidaris monilifera* (GOLDFUSS, 1826) with which it has often been confused (*see* the text) a - h – Primary spines; Specimens No. EStaff./01 successively to No. EStaff./08; i – Aboral view of the test, j – Lateral view of the test, to show ambulacrum, k – Oral view of the test, Specimen No. EStaff./09; l – Oral view of the test, m – Aboral view of the test, Specimen No. EStaff./10; all specimens × 2

1910. *Plegiocidaris Blumenbachi* GOLDFUSS; J. LAMBERT & P. THIÉRY, p. 132.
1927. *Paracidaris Nunlisti* sp.nov.; A. JEANNET, pp. 393-396, pl. figs 1-6.
1975. *Paracidaris blumenbachii* (MÜNSTER); H. HESS, p. 87, text-fig. 36, pl. 28, figs 6-7.
1988. *Nenoticidaris parandieri* (AGASSIZ, 1840); A. VADET, pp. 108-109, pl. 2, figs 3-4; pl. 3, Figs 1-4; pl. 4, figs 1-2; pl. 5, figs 1-2 and pl. 8, figs 1-2.
1988. *Nenoticidaris blumenbachii* (MÜNSTER *in* GOLDFUSS, 1826); A. VADET, pp. 109-110, pl. 5, figs 3-4.
1995. *Nenoticidaris blumenbachii* (MÜNSTER *in* GOLDFUSS, 1826); P. NICOLLEAU & A. VADET, p. 66, text-figs on p. 66, pl. 31, figs 3a-3c.
non 1997. *Nenoticidaris parandieri* (AGAS.); J. THIERRY, B. CLAVEL, P. HANTZPERGUE, D. NERAUDEAU, L. RIGOLLET & A. VADET, pl. 36, fig. 5.
1997. *Plegiocidaris crucifera* (AGAS.); J. THIERRY, B. CLAVEL, P. HANTZPERGUE, D. NERAUDEAU, L. RIGOLLET & A. VADET, pl. 36, fig. 6.
2001. *Nenoticidaris parandieri* (AGASSIZ, 1840); A. VADET, N. REMY & E. WILLE, p. 14, pl. 5.

MATERIAL: One test from Tokarnia (Coll. MM), one from Włodowice (EOx/258), one from Wysoka (EOx/212), two fragmentary tests from Wrzosowa (EOx/216, EOx/259), several test fragments from Zalas (EOx/215, EOx/217, EOx/220-EOx/223).

DIMENSIONS (*in* mm):

Coll. number	*hd*	*vd*	*∅Ad*	*∅Pm*	Figured in:
EOx/212	50.0	27.0	—	21.0	Pl. 7, Figs1a-1b

DIAGNOSIS: A species of *Paracidaris* whose ambulacral zones have a characteristic tuberculation pattern, whereby every third pore pair is associated with a large tubercle and the intervening two pore pairs are adorned with two smaller tubercles. Primary spines with a long, smooth shaft covered by small thorns arranged in longitudinal rows and with a short collar.

DESCRIPTION: The tests are moderately large and reach a diameter of 6 cm.

The ambulacra (Pl. 7, Figs 5a-5c; Pl. 8, Figs 2a-2b) are slightly sinuous. The interporiferous zone is a little wider than the pore zone; pores are moderately large, oval in outline, nonconjugate and separated by a wide, conspicuous interporal rim that is distinctly wider than the diameter of the pore (Pl. 7, Figs 5b-5c; Pl. 8, Figs 2a-2b). The pore pairs are surrounded by a narrow attachment area (Pl. 7, Fig. 5c) and represent *P1* isopores. Every third pore pair is associated with a large tubercle whereas the two pore pairs in between are adorned with two smaller tubercles giving a characteristic, regular ornamentation to the interporiferous zone (Pl. 7, Figs 5a-5b; Pl. 8, Figs 2a-2b). Relatively numerous (14) ambulacral plates correspond to one interambulacral plate at the ambitus.

The interambulacra are wide, composed of 7-8 relatively low plates in a series (Pl. 7, Figs 1a, 2). The areoles are circular in outline adapically but become oval ambitally and adorally, and are deep and nonconfluent throughout. The primary tubercles are small, perforate and crenulate (Pl. 7, Figs 1a-1b). The scrobicular ring is composed of relatively small tubercles (Pl. 7, Figs 1a-1b, 2; Pl. 8, Fig. 1). Secondary tubercles are developed on adradial and interradial parts of the plates (Pl. 8, Figs 1, 2a) and decrease in size towards the sutures. Miliaries are well developed and are wedged between the scrobicular and secondary tubercles (Pl. 7, Fig. 5a; Pl. 8, Fig. 2a). The apical disc is moderately large and reaches 38-41% of the test diameter. The peristome is moderately large, subpentagonal in outline, and reaches 40% of the test diameter (Pl. 7, Figs 1b, 2).

The primary spines (Pl. 7, Figs 3-4; Pl. 9, Figs 1-4) are relatively long (all specimens studied are damaged), with a narrow shaft, and a short, striated collar that reaches approximately 13-15% of the spine's length. The shaft is slender and covered by thorns that are more or less inclined to the shaft and arranged in longitudinal, densely spaced rows (Pl. 7, Fig. 4; Pl. 9, Figs 1-4). The tips of the thorns are sharply pointed or distinctly rounded (Pl. 9, Figs 3, 4b). The transition between the collar and the shaft is gradual. The milled ring is well developed and the base is short.

REMARKS: This common European species has a perplexing synonymy. One of the most contentious problems is its relation to the species *parandieri* AGASSIZ, 1840, which has either been synonymized (e.g. L. AGASSIZ & DESOR 1847, DESOR & DE LORIOL 1869, COTTEAU 1876, HESS 1975) or treated as separate (DESOR 1855, VADET 1988).

According to VADET (1988, p. 110), these two species do not differ in test morphology but do have different spine morphologies. However, the spines of *parandieri* were never illustrated by the creator of the species, AGASSIZ (1840a, b), nor by any subsequent authors, except VADET (1988) who arbitrarily classified as *parandieri* one test with adherent spines.

Amongst the Polish specimens studied are found spines corresponding to those classified by VADET as *blumenbachi* (Pl. 7, Figs 3-4), those as *parandieri* (Pl. 9, Figs 2-4), as well as to intermediate forms (Pl. 9, Fig. 1). The differences in spine morphology separating *blumenbachi* and *parandieri* that were indicated by VADET

to *propinquus*. No tests of *elegans* with spines have ever been reported, and thus the primary spines of *Paracidaris elegans* (MÜNSTER *in* GOLDFUSS, 1826) remain unknown.

The Polish tests conform closely in morphology to the lectotype. The species *P. elegans* differs from other *Paracidaris* species by its very scarce secondary and miliary tuberculation, which makes the ambulacra and interambulacra appear naked.

Paracidaris florigemma (PHILLIPS, 1829) (Pl. 5, Figs 11-12)

partim 1826. *Cidarites Blumenbachii* MÜNSTER; G. MÜNSTER, p. 117, pl. 39, figs 3c-3e.
partim 1840b. *Cidaris blumenbachii* MÜNST.; L. AGASSIZ, pp. 56-58, pl. 20, figs 5-6 [*non* figs 2-4, 7].
1840b. *Cidaris oculata* AG.; L. AGASSIZ, p. 63, pl. 21a, figs 15-17.
1847. *Cidaris occulata* AGASS.; L. AGASSIZ & E. DESOR, p. 28.
partim 1855. *Cidaris Blumenbachii* MÜNST. *in* GOLDF.; E. DESOR, p. 5, pl. 3, fig. 14 (only spine).
1857. *Cidaris florigemma*, PHILLIPS; T. WRIGHT, pp. 44-50, pl. 2, figs 2a-2g and pl. 8, figs 4a-4d.
1869. *Cidaris florigemma*, PHILLIPS; E. DESOR & P. DE LORIOL, pp. 36-40, pl. 5, figs 3-13.
1870. *Cidaris Blumenbachii* GOLDF.; F. ROEMER, p. 267, pl. 25, fig. 20.
partim 1876. *Cidaris Blumenbachi*, MÜNSTER, 1826; G. COTTEAU, pp. 89-101, pl. 167, figs 1-6 [statement of VADET (1988, p. 117), accepted].
1876. *Cidaris florigemma*, PHILLIPS, 1829; G. COTTEAU, pp. 149-163, pl. 181, figs 1-2; pl. 182, figs 1-5; pl. 183, figs 1-11 and pl. 184, figs 1-9.
1883. *Paracidaris florigemma*; M.A. POMEL, p. 109.
1884. *Cidaris florigemma*, PHILLIPS, 1829; G. COTTEAU, pp. 804-805, pl. 491, fig. 5.
1884. *Cidaris houllefortensis* COTTEAU, 1884; G. COTTEAU, pp. 809-811, pl. 491, figs 1-4.
1910. *Plegiocidaris houllefortensis* COTTEAU; J. LAMBERT & P. THI&RY, p. 132.
1975. *Paracidaris florigemma* (PHILLIPS); H. HESS, p. 87, text-fig. 35, pl. 28, figs 2-3.
1988. *Paracidaris florigemma* (PHILLIPS, 1835); A. VADET, pp. 115-119, pl. 8, fig. 3; pl. 9, figs 1-5; pl. 10, figs 1- 6; pl. 11, figs 1-4 and pl. 12, figs 1-4.
1997. *Paracidaris florigemma* (PHILIPS); J. THIERRY, B. CLAVEL, P. HANTZPERGUE, D. NERAUDEAU, L. RIGOLLET & A. VADET, p. 260, pl. 36, fig. 8.
2001. *Paracidaris florigemma* (PHILLIPS, 1835); A. VADET, N. REMY & E. WILLE, pp.14-16, pls 4-5.

MATERIAL: 8 fragments of primary spines from Bałtów (EOx/205, EOx/206, EOx/261).

DIAGNOSIS: Primary spines long, with a somewhat asymmetrical, fusiform shaft covered by relatively large tubercles arranged in longitudinal rows; the tubercles in juxtaposed rows alternate and the surface between rows is covered by densely spaced granules.

DESCRIPTION: The primary spines (Pl. 5, Figs 11-12) are long and somewhat asymmetrical, with a fusiform shaft and a short, smooth collar that reaches 10% of the spine's length. The shaft is slender and covered by relatively large tubercles arranged in longitudinal rows. The surface between rows is covered by densely spaced granules (Pl. 5, Figs 12a-12b). The distal end of the spine is often flattened (Pl. 5, Fig. 11). The transition between the collar and the shaft is gradual. The milled ring is well developed and the base is short.

REMARKS: This common and widely distributed European species is well known and is represented by some tests with spines adhering (e.g., COTTEAU 1876, pl. 181, fig. 1; refigured by FELL 1966, fig. 251/1a). The spines studied here match those ascribed to *Paracidaris florigemma* (PHILLIPS, 1829) by previous authors (see synonymy). The general outline and ornamentation of the shaft is so distinctive that specific assignation of the spines is fully warranted. These spines are close to those of *Paracidaris filograna* (AGASSIZ, 1840) [=*P. laeviscula*, see below], but differ in their shaft ornamentation which consists of relatively large tubercles arranged in longitudinal rows, and small tubercles densely dispersed between these rows.

Included in the synonymy are the spines which MÜNSTER (*in* GOLDFUSS 1826), followed by AGASSIZ (1840b) and DESOR (1855), ascribed to *blumenbachi*. Moreover, the statement by VADET (1988, p. 117) that one of the specimens illustrated by COTTEAU (1876, pl. 167, figs 1-6) as *Cidaris blumenbachi* in fact represent the species *florigemma* is also accepted.

Paracidaris laeviscula (L. AGASSIZ, 1840) (Pl. 10, Figs 1-4; Pl. 11, Figs 1-3 and Pl. 12, Figs 1-5, 5a-5c)

1840a. (nomen nudum) *Cidaris filograna* AG.; L. AGASSIZ, p. 10.
1840b. *Cidaris laeviscula* AG.; L. AGASSIZ, p. 64, pl. 21a, figs 18-20.
1840b. *Cidaris filograna* AG.; L. AGASSIZ, pp. 77-78, pl. 21a, figs 11a-11b.
1847. *Cidaris elegans* var. *laeviscula* MÜNST. *in* GOLDF.; L. AGASSIZ & E. DESOR, p. 28.

viously suggested by HESS (1975, p. 87). The spines of this species have hitherto been unrecognized. However, at Zalas numerous tests of the species *laeviscula* co-occur with spines of *filograna* AGASSIZ (1840b) in the same beds of early Middle Oxfordian age. AGASSIZ (1840a) based his species *filograna* on spines alone. Furthermore, there is one test of an evident *laeviscula* from this locality (Pl. 11, Fig. 2) that has a spine of the *filograna*-type in close association. Although the spine is not directly attached to a tubercle, this association does not seem to be accidental. HESS (1975, p. 87) has already suggested that *laeviscula* tests and *filograna* spines should be combined and this assumption is confirmed by this specimen from Zalas. Of these two species established by AGASSIZ, priority is here ascribed to *laeviscula*, introduced by AGASSIZ (1840b, p. 64) prior to *filograna* AGASSIZ (1840b, p. 77).

A brief comment is needed about the treatment of the species *laeviscula* AGASSIZ, 1840, by NICOLLEAU & VADET (1995) who assigned it to the genus *Romanocidaris* of VADET 1991 (*non* 1988, as given by NICOLLEAU & VADET 1995, p. 68). They presented a variety of cidaroid material, of which only a part is herein classified as *laeviscula* (the tests, see NICOLLEAU & VADET 1995, pl. 33, figs 2a-2h). The only specimen labelled as *laeviscula* by NICOLLEAU & VADET (1995, pl. 32, fig. 1) is, in the present author's opinion, of quite different systematic provenance. This is an imperfectly preserved test with spines in position. These spines correspond neither to the genus *Romanocidaris,* as diagnosed by VADET (1988), nor to the genus *Paracidaris*. There is no reason to ascribe such spines to the species *laeviscula*/*filograna*, and their only possible affinities lie with the genus *Polycidaris* QUENSTEDT, 1858, or with the subfamily Histocidarinae MORTENSEN, 1928.

Paracidaris propinqua (MÜNSTER *in* GOLDFUSS, 1826) (Pl. 13, Figs 1-7)

1826. *Cidarites propinquus* MÜNSTER; G. MÜNSTER, p. 119, pl. 40, figs 1a-1d.

partim 1826. *Cidarites elegans* MÜNSTER; G. MÜNSTER, p. 118, pl. 39, fig. 5c-5f (spines), [*non* figs 5a-5b (test)].

partim 1840b. *Cidaris propinqua* MUNST.; L. AGASSIZ, pp. 62-63, pl. 21, figs 5-7, 9-10 [*non* fig. 8 (*Plegiocidaris cervicalis*)].

1855. *Cidaris propinqua* MÜNS. *in* GOLDF.; E. DESOR, p. 7, pl. 3, figs 25-26.

1855. *Cidaris elegans* MÜNS. *in* GOLDF.; E. DESOR, p. 8, pl. 3, figs 23-24.

1858. *Cidarites propinquus*; F.A. QUENSTEDT, p. 646, pl. 79, figs 70-72.

partim 1858. *Cidarites elegans*; F.A. QUENSTEDT, p. 728, pl. 88, figs 75-76 (spines only), [*non* figs 77-78 (test)].

1868. *Cidaris propinqua*, MÜNSTER; E. DESOR & P. DE LORIOL, pp. 22-24, pl. 3, figs 4-7.

1876. *Cidaris propinqua*, MÜNSTER, 1826; G. COTTEAU, pp. 169-174, pl. 188, figs 1-12.

1883. *Eucidaris propinqua*; M.A. POMEL, p. 109.

1885. *Cidaris propinqua*, MÜNSTER, 1826; G. COTTEAU, pp. 898-899, pl. 515, figs 3-7.

1910. *Plegiocidaris propinqua* MÜNSTER; J. LAMBERT & P. THIÉRY, p. 132.

1975. *Plegiocidaris propinqua* (MÜNSTER); H. HESS, p. 86, pl. 27, fig. 7.

MATERIAL: Two fragments of tests from Bielawy (EOx/237, EOx/238), one test from Ostrowiec (Coll. EN), 20 primary spines from Bielawy and Wapienno (EOx/239-EOx/241, EOx/269), one primary spine from the vicinity of Częstochowa (MP 362/267/01).

DIMENSIONS (*in* mm):

Coll. number	*hd*	*vd*	*∅Ad*	*∅Pm*	Figured in:
Coll. EN	25.0	12.5	12.0	12.0	Pl. 13, Figs 1a-1b

DIAGNOSIS: A species of *Paracidaris* with two columns of relatively large ambulacral tubercles more or less filling the interporiferous zone; ambulacral pores small, surrounded by a wide attachment area (*P2*-type isopores) at the ambitus. Primary spines short, club-shaped and asymmetrical with their shaft covered on one side by tubercles arranged in longitudinal rows and on the opposite side by tubercles irregularly dispersed; these tubercles cross the transition between the shaft and the collar and they cover one side of the collar.

DESCRIPTION: The tests are small, circular in ambital section and moderately high (Pl. 13, Figs 1a, 1b).

The ambulacra (see Pl. 13, Fig. 1a) are sinuate. The interporiferous zone is a little wider than the pore zone. The large marginal tubercles form regular series (Pl. 13, Figs 1a, 3a, 3b). The ambulacral plates at the ambitus may carry one secondary tubercle. The pores are non-conjugate, separated by a moderately large interporal rim. The pores are small and rounded with a well developed attachment area (Pl. 13, Figs 2c, 3a, 3b). The adradial pore bears the anchor-shaped neural canal (Pl. 13, Fig 2c). Pore pair represent *P2*-type isopores, as distinguished by SMITH (1978, pp. 764 and 766). Fifteen ambulacral plates correspond to one interambulacral plate at the ambitus.

The interambulacra are wide and composed of 4-5 plates in a series; interambulacral plates (Pl. 13, Figs 1a,

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PLATE 1

Rhabdocidaris nobilis (MÜNSTER *in* GOLDFUSS, 1826)

1a - Lateral view of the test, to show ambulacrum, **1b** - Aboral view of the test, **1c** - Oral view of the test; nat. size; Specimen from Bielawy, No. EOx/177; **2** - Lateral view of the test, to show ambulacrum; nat size; Specimen from Bielawy, No. EOx/178; **3a** - Lateral view of the test, to show ambulacrum, **3b** - Lateral view of the test, to show interambulacrum, **3c** - Aboral view of the test; nat. size; Specimen from Bielawy, No. EOx/179

1a-1c, 2, 3a-3b taken by B. MALINOWSKA, 3c by ST. KOLANOWSKI

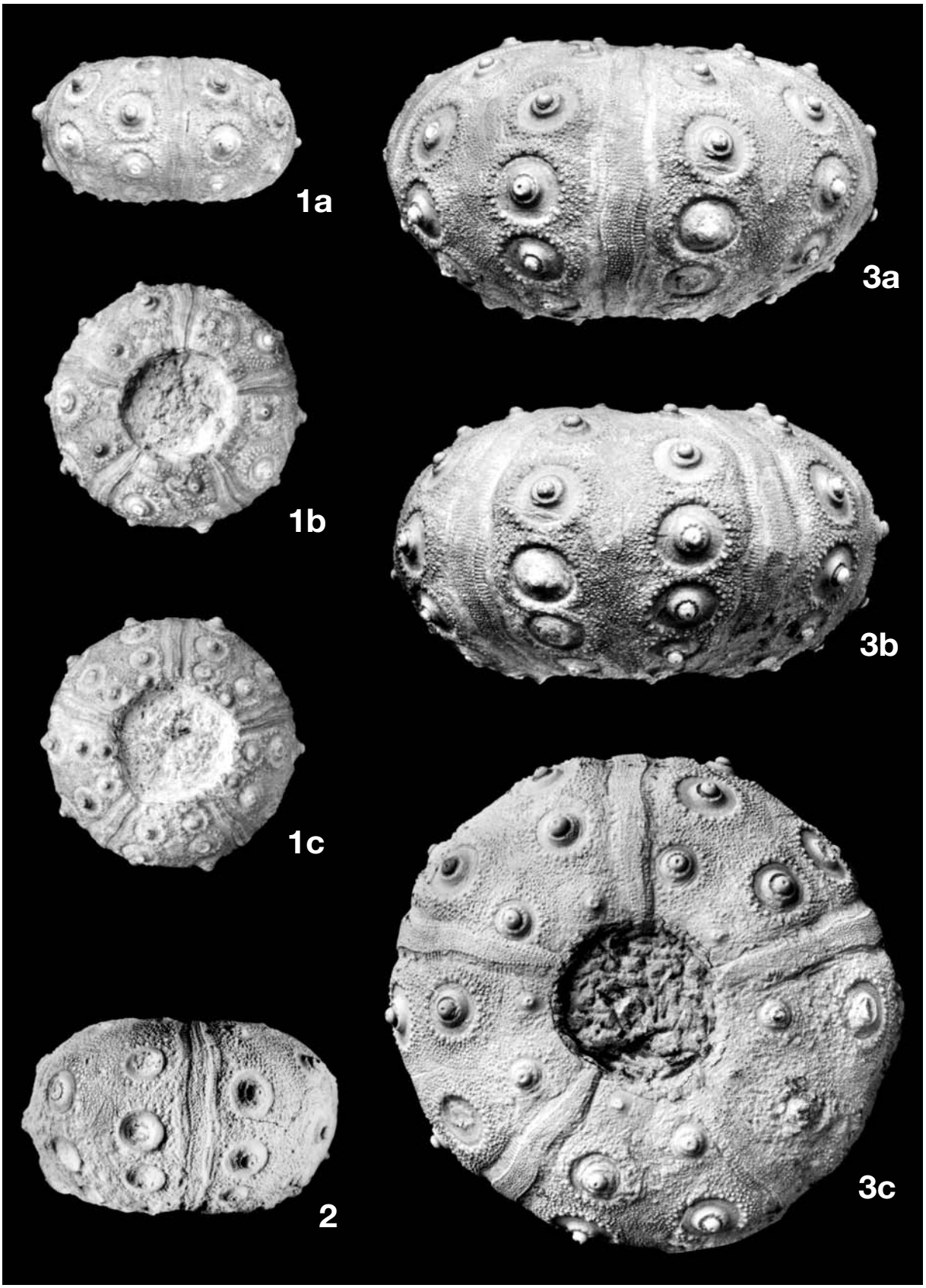

1a
1b
1c
2
3a
3b
3c

PLATE 2

Rhabdocidaris nobilis (MÜNSTER *in* GOLDFUSS, 1826)

1a - Lateral view of the test, to show interambulacrum, **1b** - Aboral view of the test, **1c** - Oral view of the test, **1d** - Lateral view of the test, to show ambulacrum; nat size; **2** - Specimen from Bielawy, No.EOx/180; **2a** - Close-up view of the ambulacrum, to show ambital *C1* isopores and interporal ornamentation; **2b** - Fragment of the interambulacral plate, to show primary and scrobicular tubercles; Specimen from Bielawy, No. EOx/181

1a, 1b, 1d taken by B. MALINOWSKA, 1c by ST. ULATOWSKI

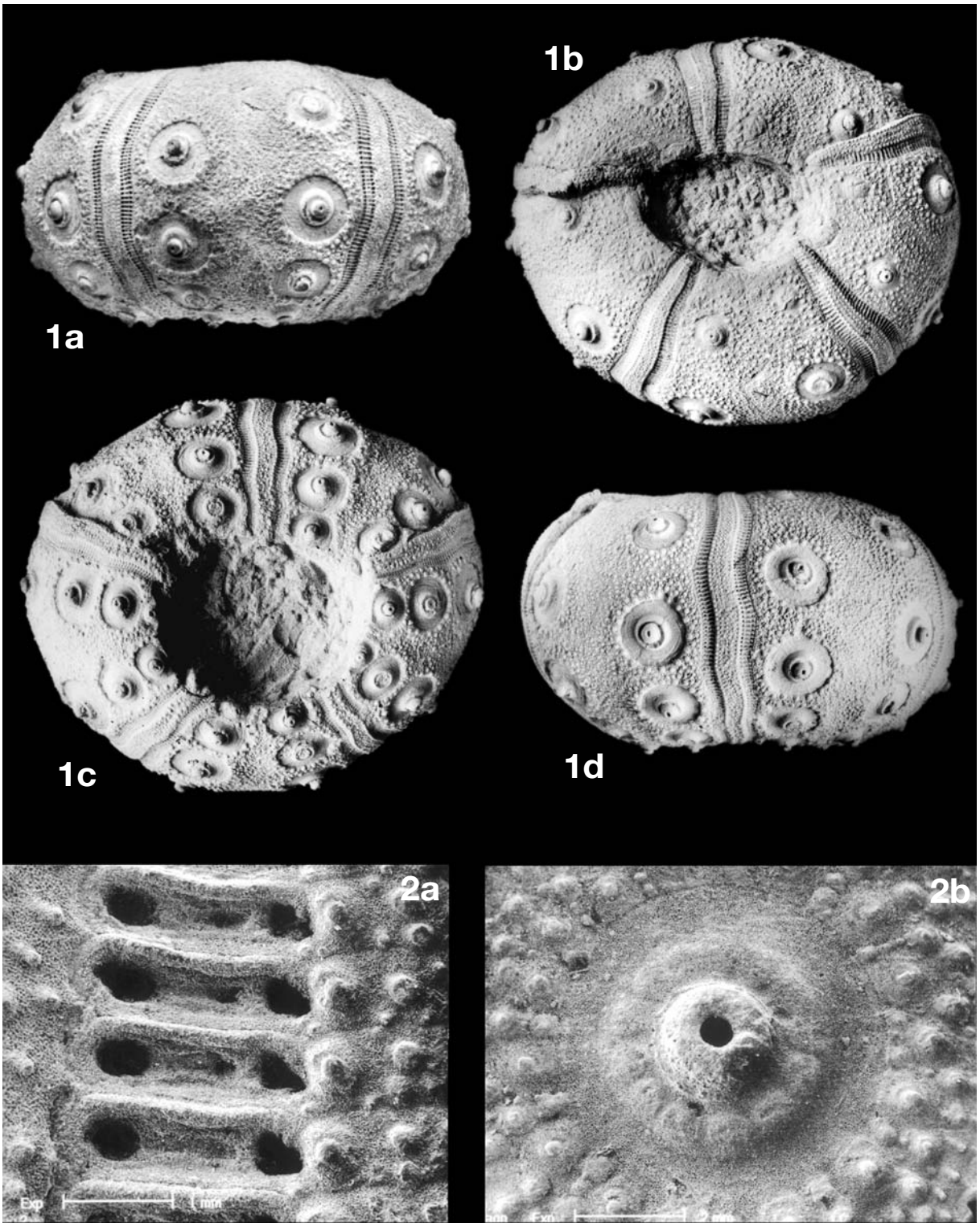

1a
1b
1c
1d
2a
2b

PLATE 3

Rhabdocidaris nobilis (MÜNSTER *in* GOLDFUSS, 1826)

1 - Fragment of the distal part of the aboral primary spine; nat. size; Specimen from Wapienno, No. EOx/183; **2** - Aboral spatulate primary spine; Specimen from Bielawy, No. EOx/184; **3-4** - Adoral primary spines; × 2; 3 - Specimen from Bielawy, No. EOx/185; 4 - Specimen from Bielawy, No. EOx/186; **5** - Adoral view of the test; nat. size; Specimen from Bielawy, No. EOx/182; **6** - Adoral view of the test; nat. size; Specimen from Podgórze, No. ZNG PAN D-I-24/181

All photos taken by B. MALINOWSKA

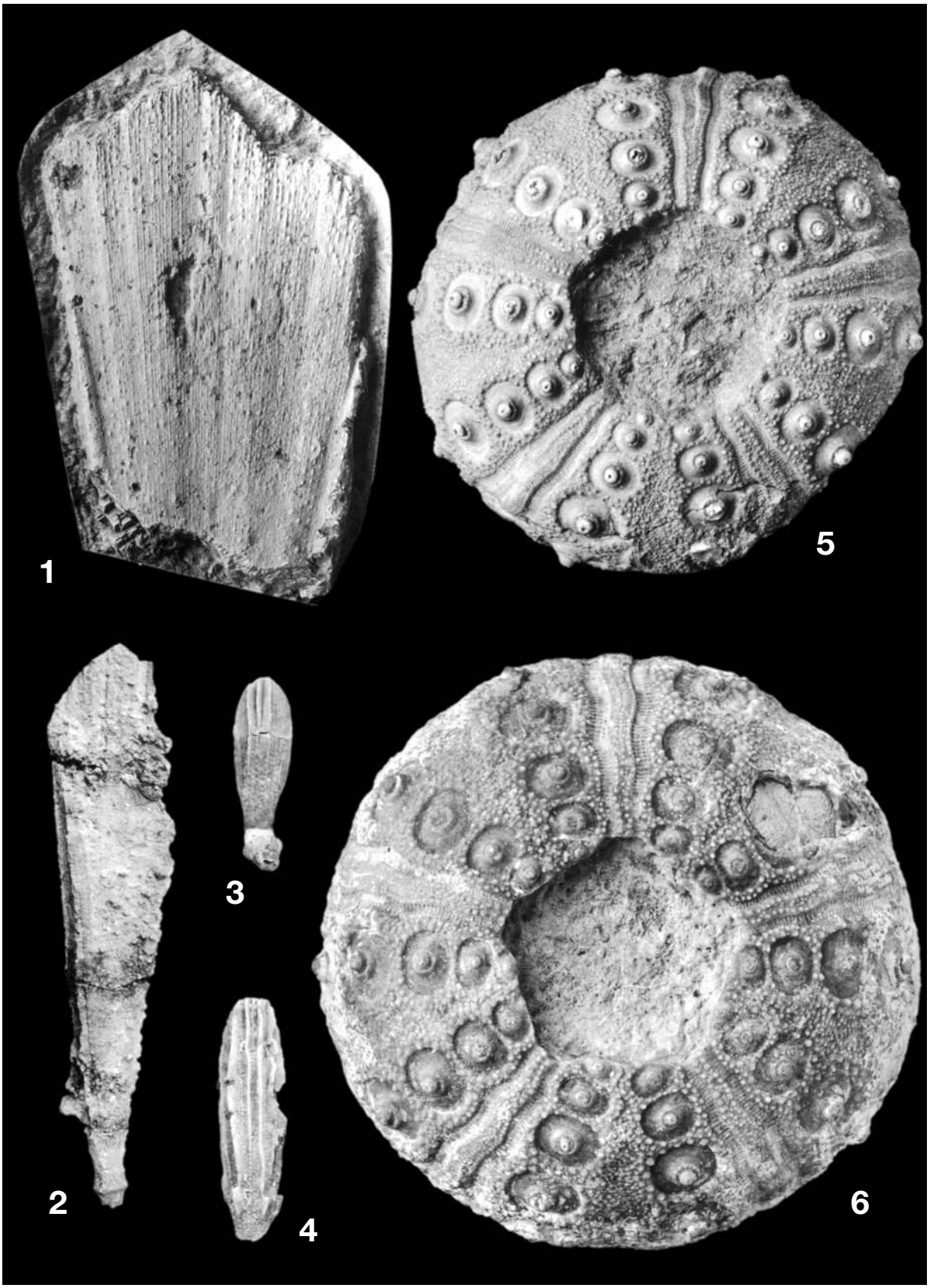

1
2
3
4
5
6

PLATE 4

1-3 – *Polycidaris*? *suevica* (DESOR, 1855); 1 - Adoral interambulacral plate; × 2; Specimen from Zalas, No. EOx/187; 2 - Fragment of the test, interambulacral with associated ambulacral plates; × 2; Specimen from Zalas, No. EOx/188; 3a - Close-up of the ambital fragment of ambulacrum, to show interporal ornamentation; 3b - Close-up of the ambital *P1* isopores; 3c - Fragment of the ambital part of ambulacrum; 3d - Fragment of the interambulacral plate, to show primary and scrobicular tubercles; Specimen from Ogrodzieniec, No. EOx/189

4 – *Polycidaris* sp. 1; Fragment of the test; × 2; Specimen from Niegowonice, No. EOx/190

5-7 – *Polycidaris* sp. 2; 5-7 - Fragments of primary spines; × 2; 5 - Specimen from Zalas, No. EOx/191; 6 - Specimen from Zalas, No. EOx/192; 7 - Specimen from Zalas, No. MP 313/267/01

8 – *Polycidaris*? sp. 3; Fragment of the test; × 2; Specimen from Niegowonice, No. EOx/194

1, 2, 5, 6 taken by B. MALINOWSKA, 7 by ST. KOLANOWSKI

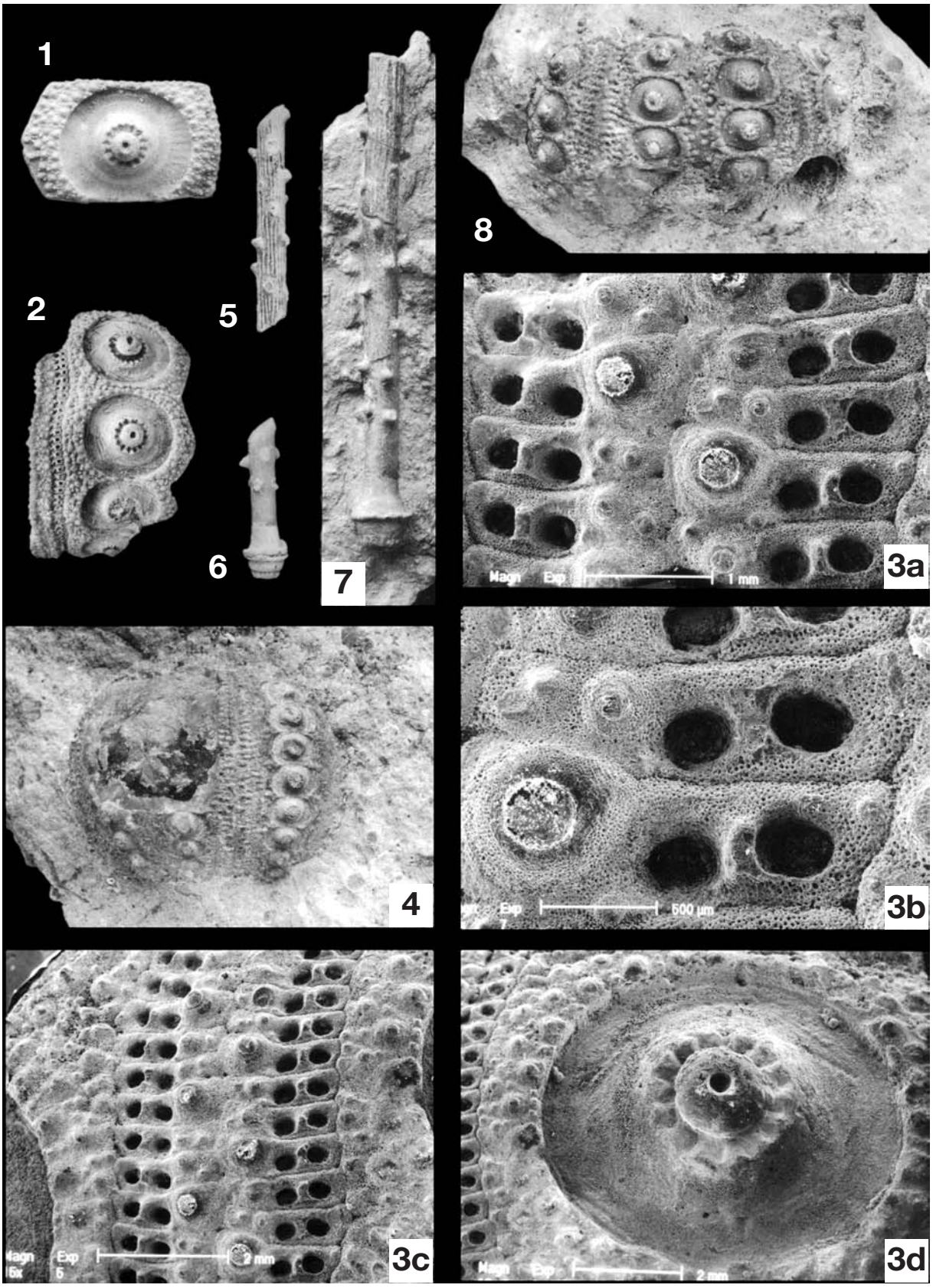

1
2
5
6
7
8
3a
Magn Exp 1 mm
4
3b
Exp 500 µm
3c
Exp 2 mm
3d
Magn Exp 2 mm

PLATE 5

1-10 – *Plegiocidaris crucifera* (L. AGASSIZ, 1840); 1 - Lateral view of the test; × 2; Specimen from Trzebinia, No. EOx/195; 2a - Close-up of the ambital part of ambulacrum, to show intrerporal ornamentation; 2b - Fragment of the interambulacral plate, to show primary and scrobicular tubercles; Specimen from Zalas, No. EOx/196; 3-10 - Morphologically variable primary spines; × 2; 3,5,8 - Specimens from Zalas, No. EOx/197, EOx/198, EOx/199; 4,6,7,9,10 - Specimens from the vicinity of Częstochowa, No. MP 357/267/01 successively to MP 361/267/01

11-12 – *Paracidaris florigemma* (PHILLIPS, 1829); 11 - Shaft of the primary spine; nat. size; Specimen from Bałtów, No. EOx/205; 12a - Close-up of the distal part of the shaft; 12b - Close-up of the shaft, to show details of ornamentation; Specimen from Bałtów, No. EOx/206

1, 3-11 taken by B. MALINOWSKA

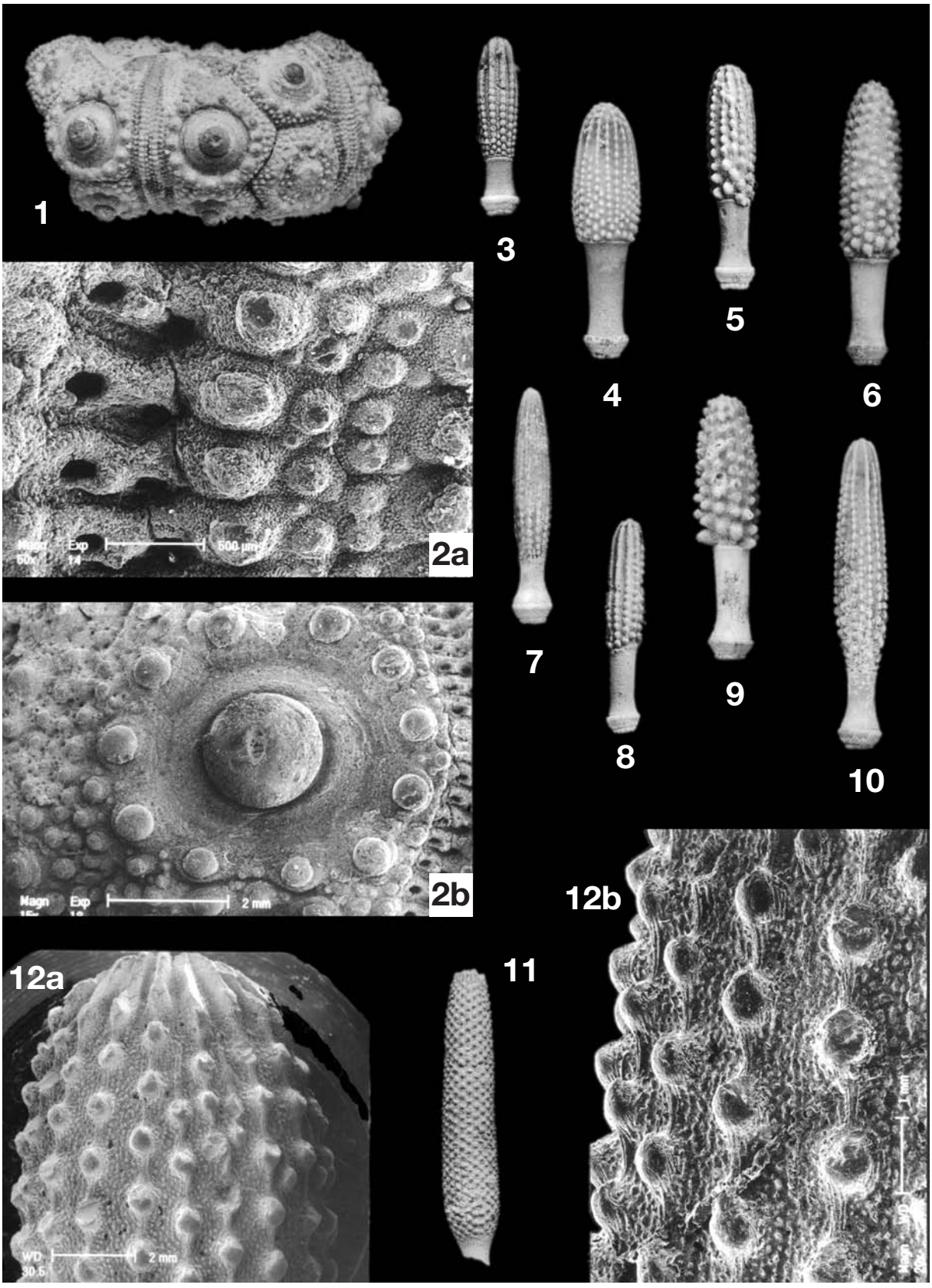

1
3
4
5
6
2a
Magn Exp 500 µm
7
8
9
10
2b
Magn Exp 2 mm
12a
11
12b
WD 30.5 2 mm

PLATE 6

Plegiocidaris monilifera (GOLDFUSS, 1826)

1a - Lateral view of the test, to show interambulacrum; **1b** - Aboral view of the test; **1c** - Oral view of the test; nat size; Specimen from Bielawy, No. EOx/207; **2a** - Lateral view of the test, to show ambulacrum; **2b** - Oral view of the test; nat size; Specimen from Bielawy, No. EOx/208; **3-4** - Primary spines; × 2; 3 - Specimen from Wapienno, No. EOx/209; 4 - Specimen from Wapienno, No. EOx/210; **5a** - Close-up view of the test, to show ambulacrum; **5b** - Close-up view of the ambulacrum, to show interporal ornamentation; **5c** - Close-up view of the ambulacrum, to show ambital isopores; **5d** - Fragment of the interambulacral plate, to show primary and scrobicular tubercles; Specimen from Bielawy, No. EOx/211

1a-1c taken by B. MALINOWSKA, 2a-2b, 3, 4 by ST. ULATOWSKI

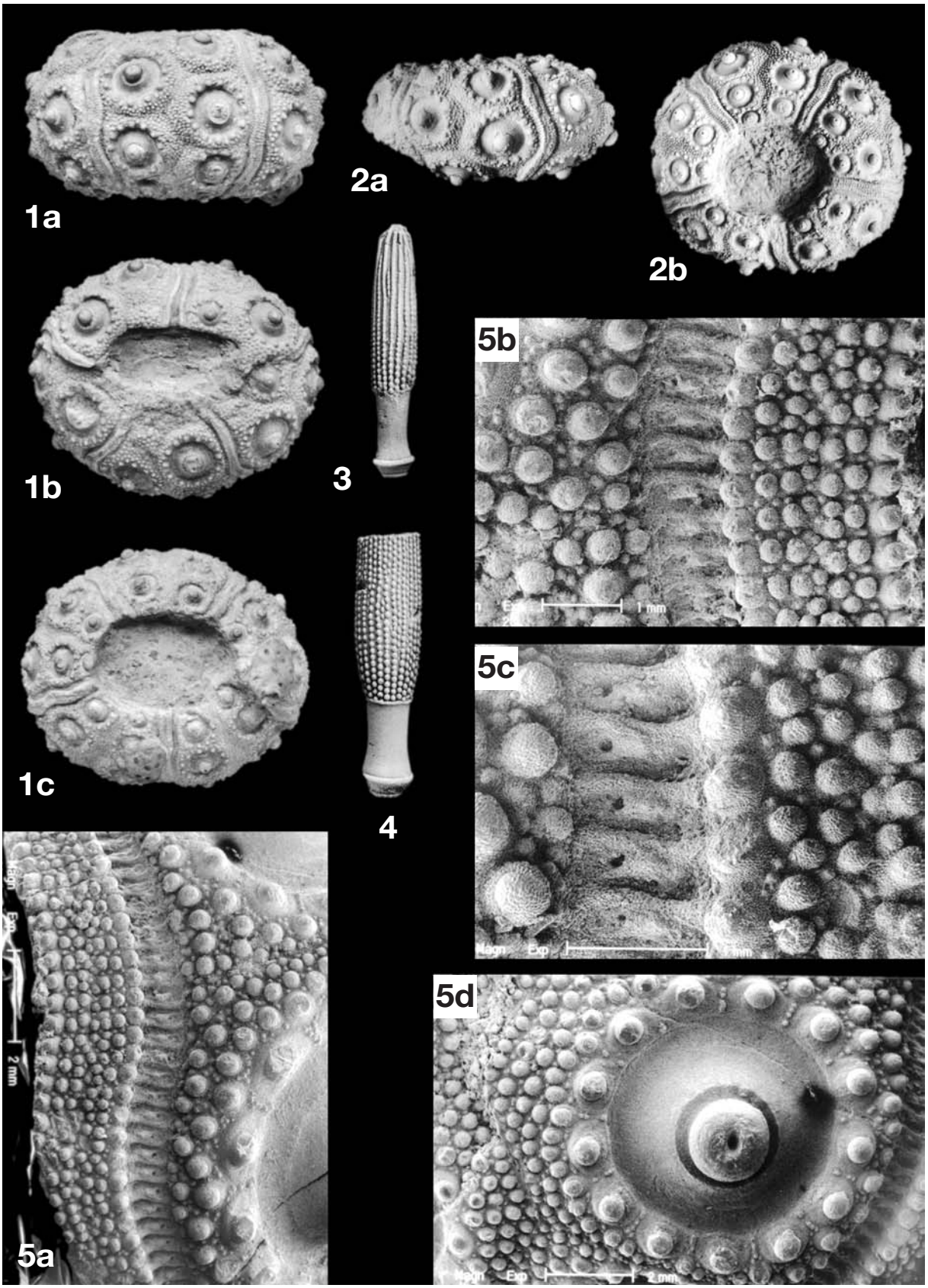

1a
2a
2b
1b
3
5b
1c
4
5c
5a
5d

PLATE 7

Paracidaris blumenbachi (MÜNSTER *in* GOLDFUSS, 1826)

1a - Lateral view of the test, to show interambulacrum; **1b** - Oral view of the test; nat. size; Specimen from Wysoka, No. EOx/212; **2** - Oral view of the test; nat. size; Specimen from Tokarnia, Coll. MM; **3** - Fragment of the primary spine; × 2; Specimen from Zalas, No. EOx/213; **4** - Close-up view of the shaft, to show ornamentation; Specimen from Bielawy, No. EOx/214; **5a** - Close-up view of the ambulacrum; **5b** - Close-up view of the ambital part of ambulacrum, to show interporal ornamentation; **5c** - Close-up view of ambital *P1* isopores; Specimen from Zalas, No. EOx/215

1a-1b, 2, 3 taken by ST. ULATOWSKI

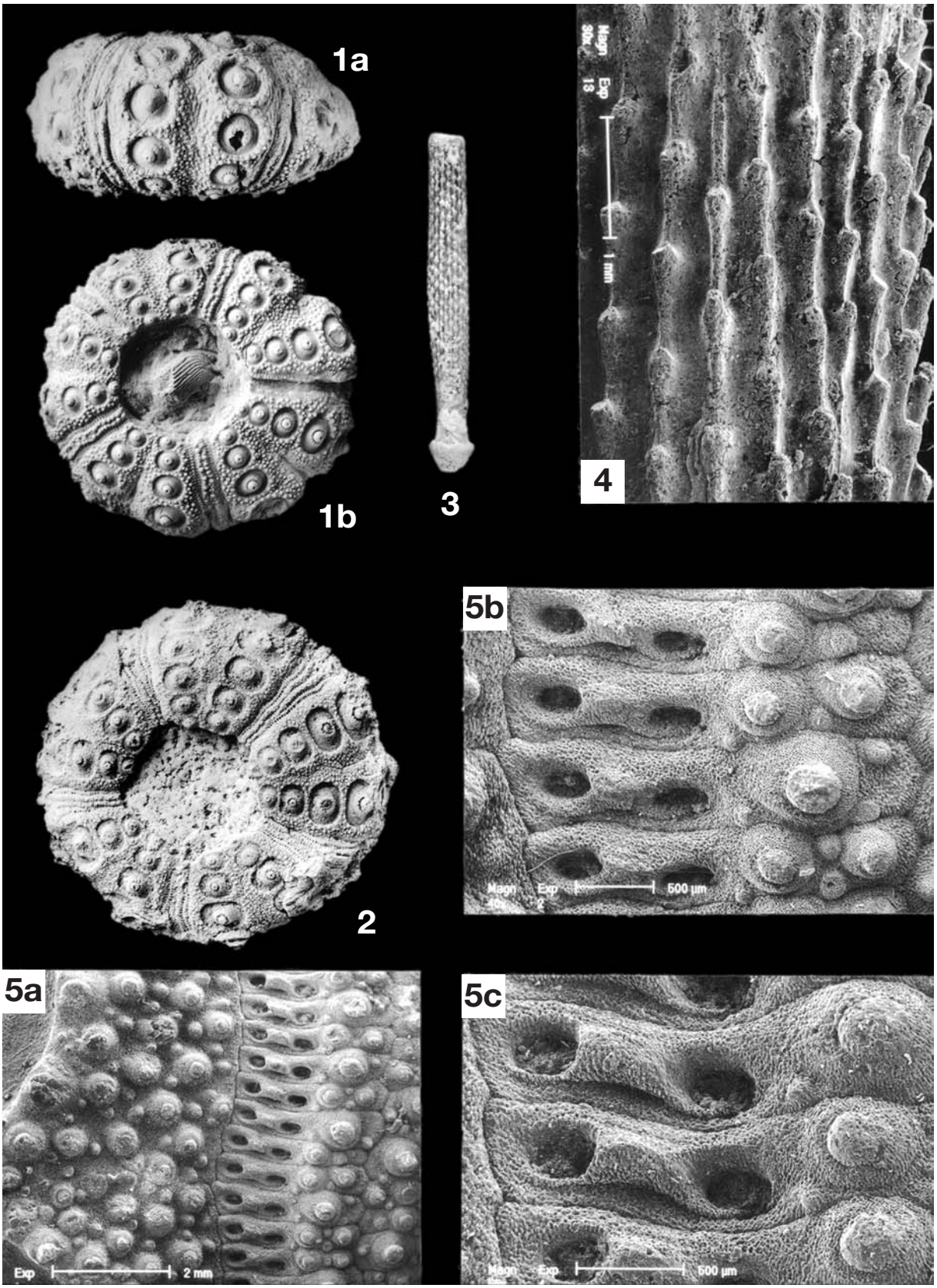

1a
1b
2
3
4
Magn 38x
Exp 13
1 mm
5a
Exp
2 mm
5b
Magn
Exp
500 µm
5c
Magn
Exp
500 µm

PLATE 8

1-2 – *Paracidaris blumenbachi* (MÜNSTER *in* GOLDFUSS, 1826); 1 - Lateral view of the test, to show ambulacrum; × 2; Specimen from Wrzosowa, No. EOx/216; 2a - Close-up view of ambulacrum; 2b - Close-up view of adapical *P1* isopores; Specimen from Zalas, No. EOx/217

3-5 – *Paracidaris elegans* (MÜNSTER *in* GOLDFUSS, 1826); 3a - Lateral view of the test, to show ambulacrum; 3b - Oral view of the test; × 2; Specimen from Ostrowiec, Coll. EN; 4a - Close-up view of ambital *P2* isopores and interporal ornamentation; 4b - Fragment of the interambulacral plate, to show ornamentation; Specimen from Zalas, No. EOx/218; **5** - Fragment of the interambulacral plate, to show primary and scrobicular tubercles; Specimen from Zalas, No. EOx/219

1 taken by B. MALINOWSKA, 3a-3b by ST. ULATOWSKI

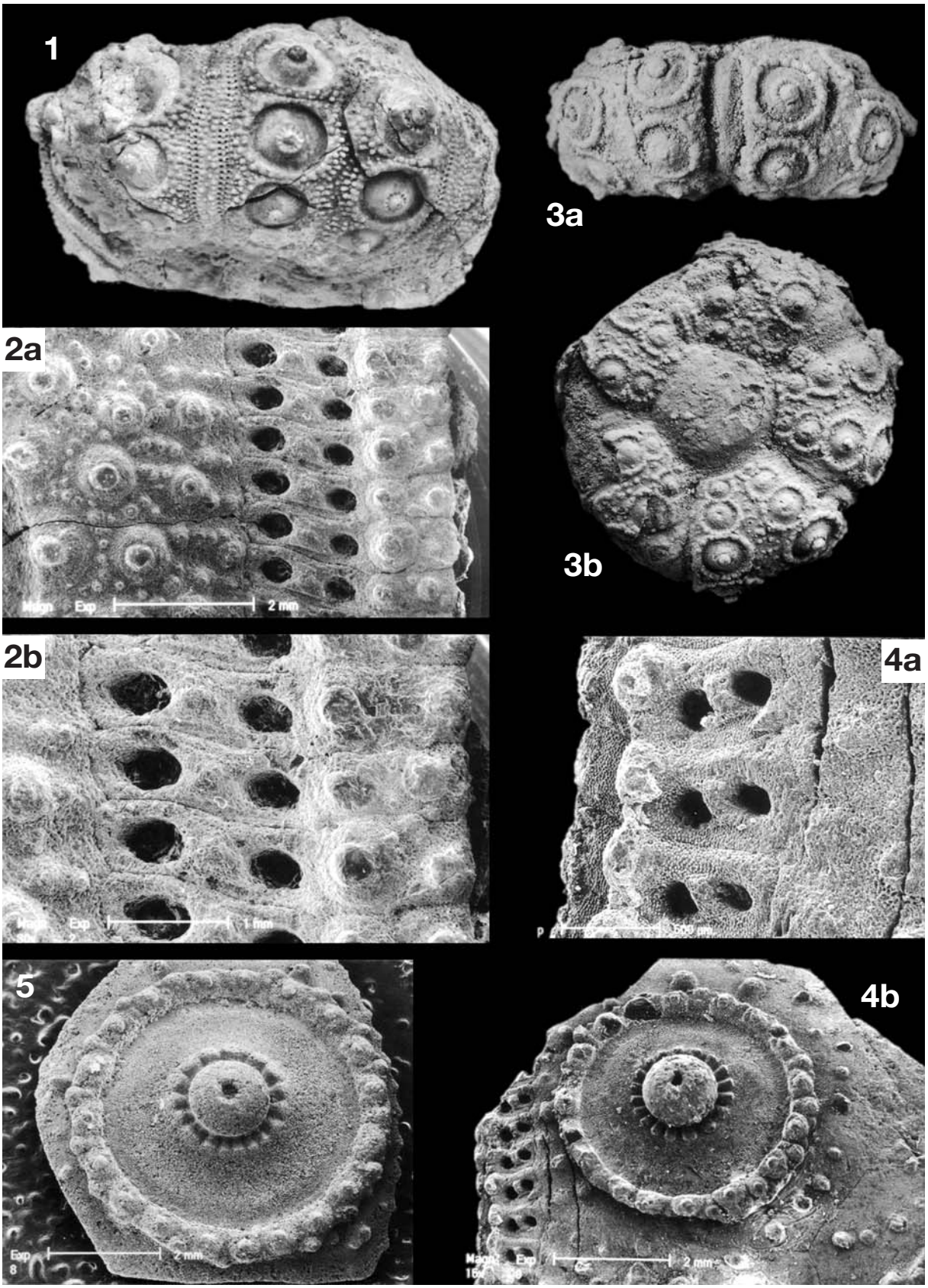

1
3a
3b
2a
2 mm
2b
1 mm
4a
5
2 mm
4b
2 mm

PLATE 9

1-4 – *Paracidaris blumenbachi* (MÜNSTER *in* GOLDFUSS, 1826); 1-3 - Close-up views of primary spines, to show details of the shaft and the variable array of ornamentation; 1 - Specimen from Zalas, No. EOx/220; 2 - Specimen from Zalas, No. EOx/221; 3 - Specimen from Zalas, No. EOx/222; 4a - Fragment of the primary spine; 4b - Close-up view of the primary spine, to show details of the shaft; Specimen from Zalas, No. EOx/223

5-6 – *Rhabdocidaris maxima* (MÜNSTER *in* GOLDFUSS, 1826); 5 - Oral view of the test, with the fragmented spine; nat. size; Specimen from Podgórze, No. MP 431/267/01; 6 - Fragment of the primary spine; × 2; Specimen from Wapienno, No. EOx/224

5 taken by ST. ULATOWSKI, 6, 4a by B. MALINOWSKA

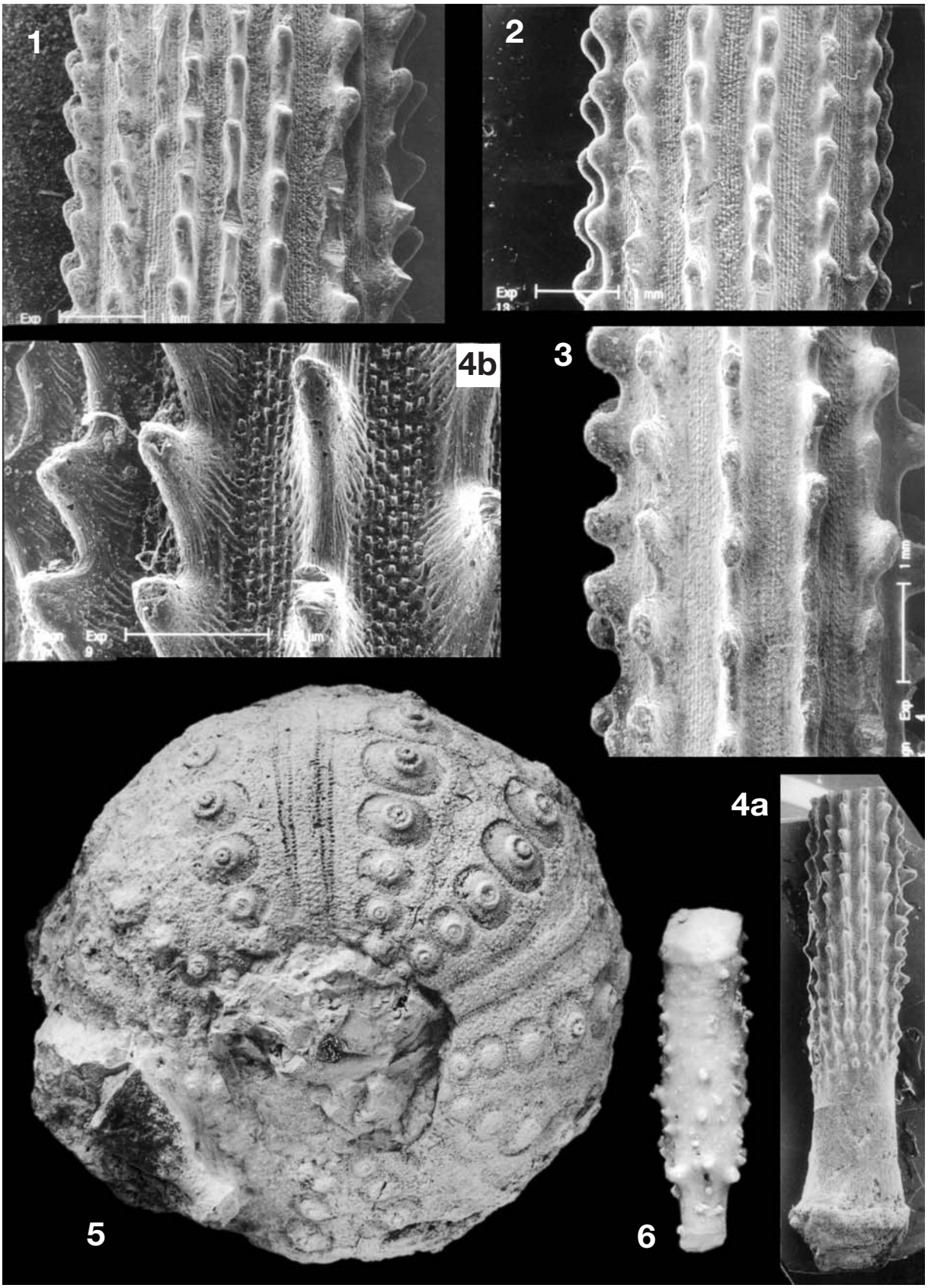

1
2
3
4b
4a
5
6

PLATE 10

Paracidaris laeviscula (L. AGASSIZ, 1840)

1a - Aboral view of the test; **1b** - Lateral view of the test, to show interambulacrum; × 2; Specimen from Ogrodzieniec, No. EOx/225; **2a** - Aboral view of the test; **2b** - Lateral view of the test, to show interambulacrum; **2c** - Lateral view of the test, to show ambulacrum; **2d** - Oral view of the test; × 2; Specimen from Zalas, No. EOx/226; **3a** - Fragment of the adapical interambulacral plate, to show primary and scrobicular tubercles; **3b** - Close-up view of ambulacrum, to show adapical *P1* isopores; Specimen from Zalas, No. EOx/227; **4a** - Fragment of the ambital interambulacral plate, to show primary and scrobicular tubercles; **4b** - Close-up view of ambulacrum, to show ambital *P1* isopores; Specimen from Zalas, No. EOx/228

1a-1b, 2a-2d taken by B. MALINOWSKA

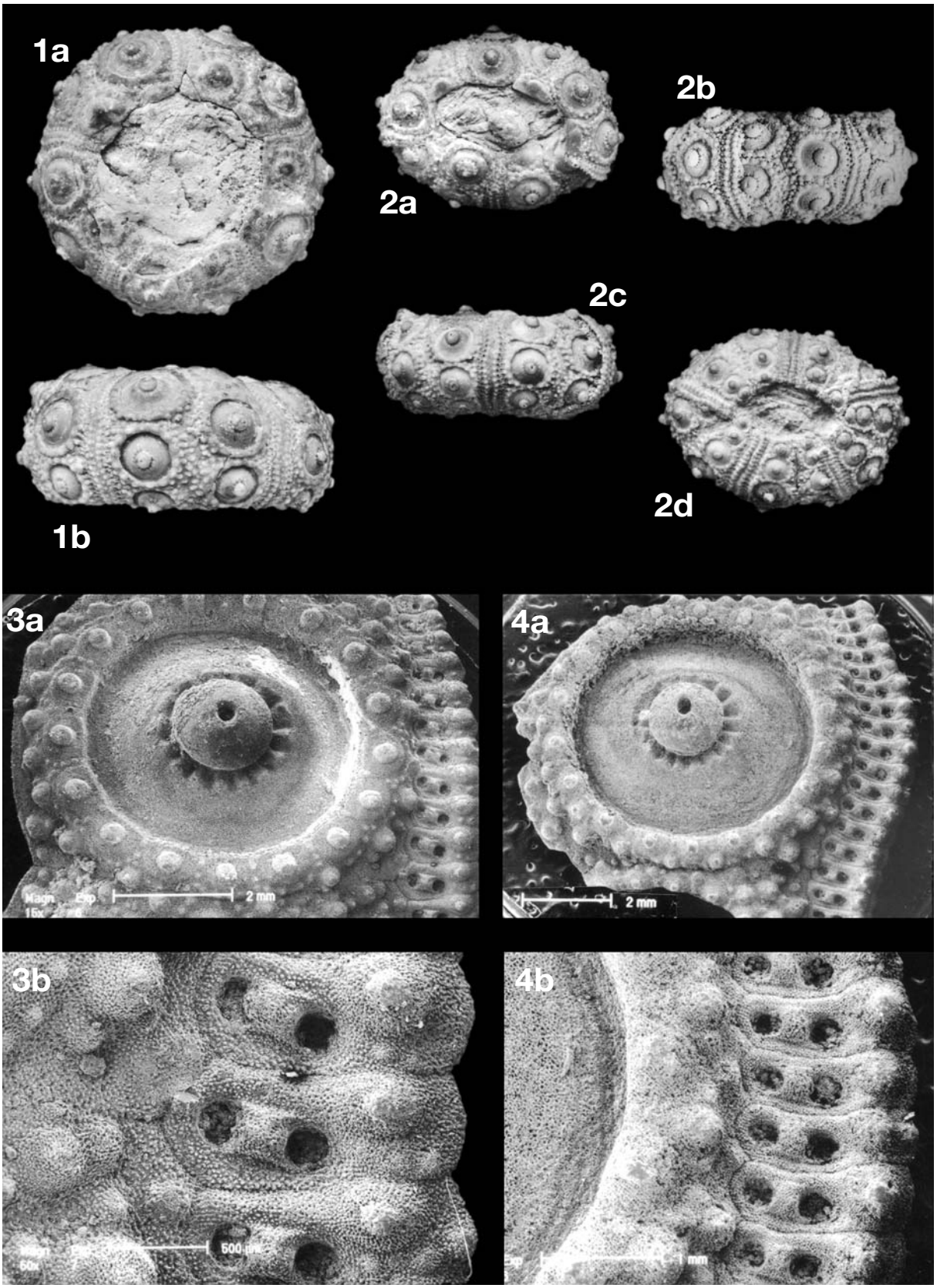

1a
2a
2b
2c
2d
1b
3a
2 mm
4a
2 mm
3b
500 µm
4b
1 mm

PLATE 11

Paracidaris laeviscula (L. AGASSIZ, 1840)

1a - Aboral view of the test; **1b** - Lateral view of the test, to show ambulacrum; **1c** - Oral view of the test; × 2; Specimen from Zalas, No. EOx/229; **2** - Fragment of the test with the primary spine attached; nat. size; Specimen from Zalas, No. EOx/230; **3a** - Close-up view of ambulacrum, to show interporal ornamentation; **3b** - Close-up view of ambulacrum, to show ambital *P1* isopores; **3c** - Close-up view, to show interambulacral ornamentation; **3d** - Fragment of the ambital interambulacral plate, to show primary and scrobicular tubercles; Specimen from Zalas, No. EOx/231

1a, 1c, 2 taken by B. MALINOWSKA

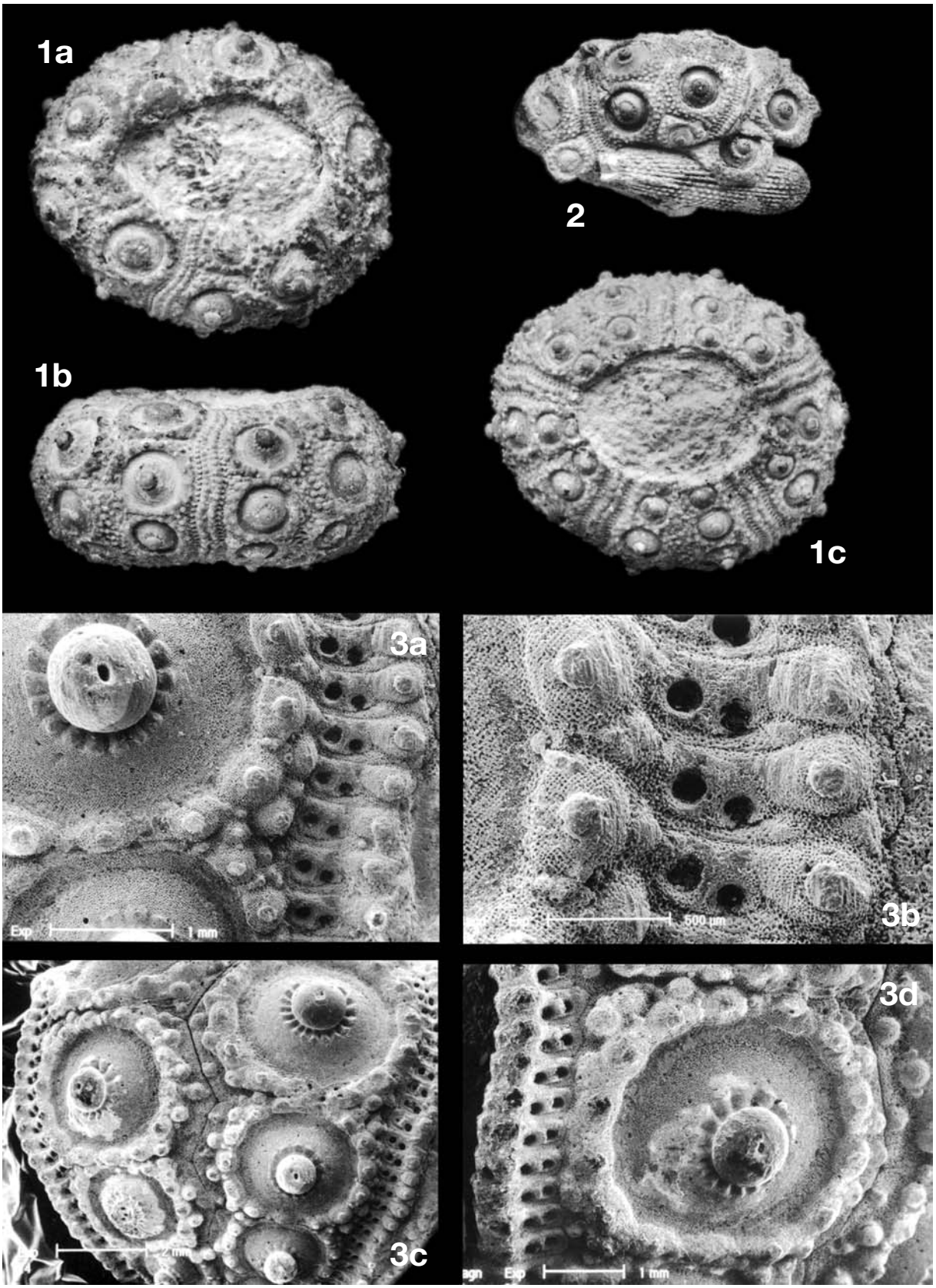

1a
1b
2
1c
3a
Exp
1 mm
500 µm
3b
3c
3d
1 mm

PLATE 12

Paracidaris laeviscula (L. AGASSIZ, 1840)

1-4 – Primary spines; × 2; Specimens from Zalas, No. EOx/232 successively to EOx/235;
5 – Close-up view of the basal part of the primary spine; **5a-5c** - Close-up view of the primary spine, to show details of ornamentation; Specimen from Zalas, No. EOx/236

1-4 taken by ST. ULATOWSKI

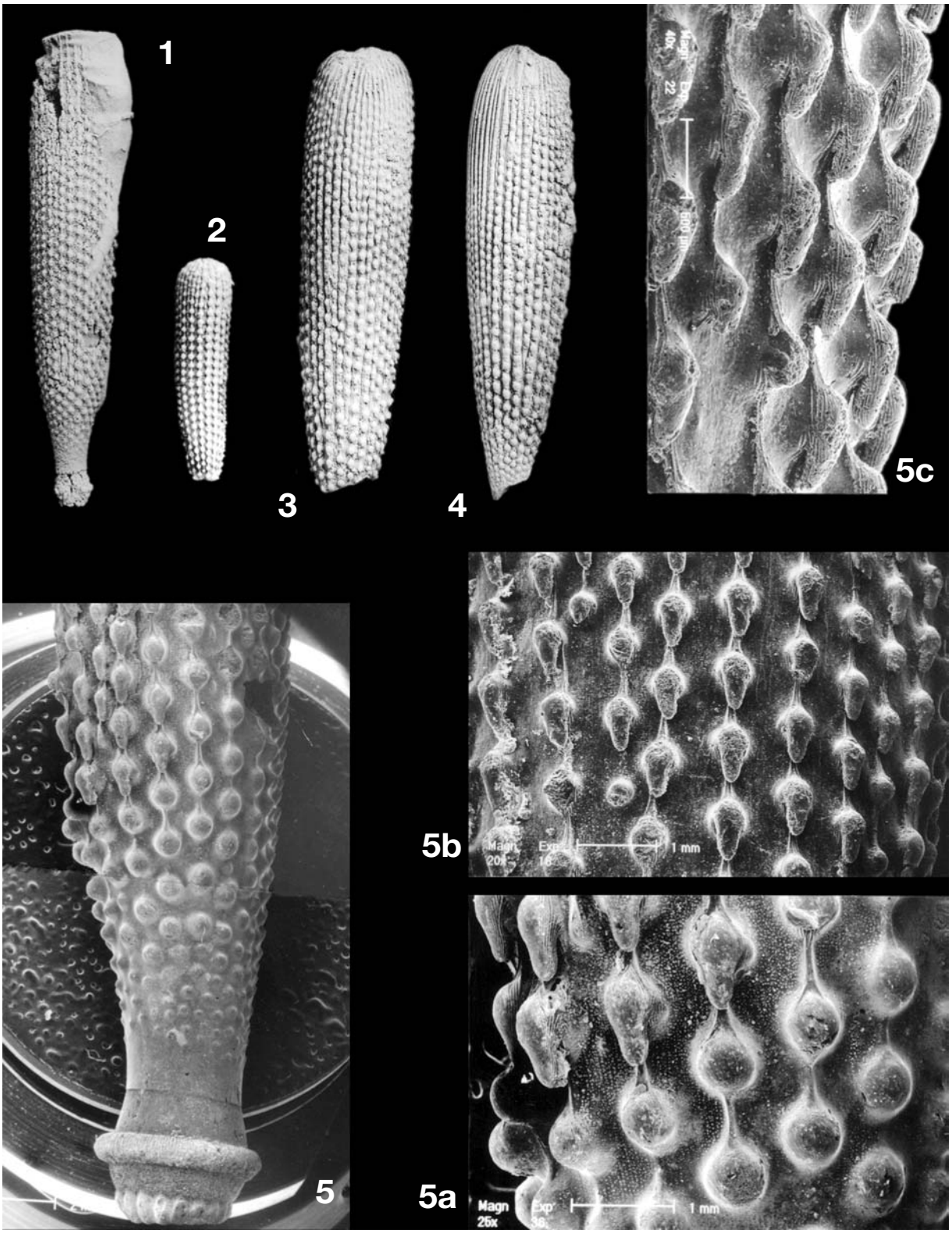

1
2
3
4
5c
5
5b
5a
1 mm
1 mm

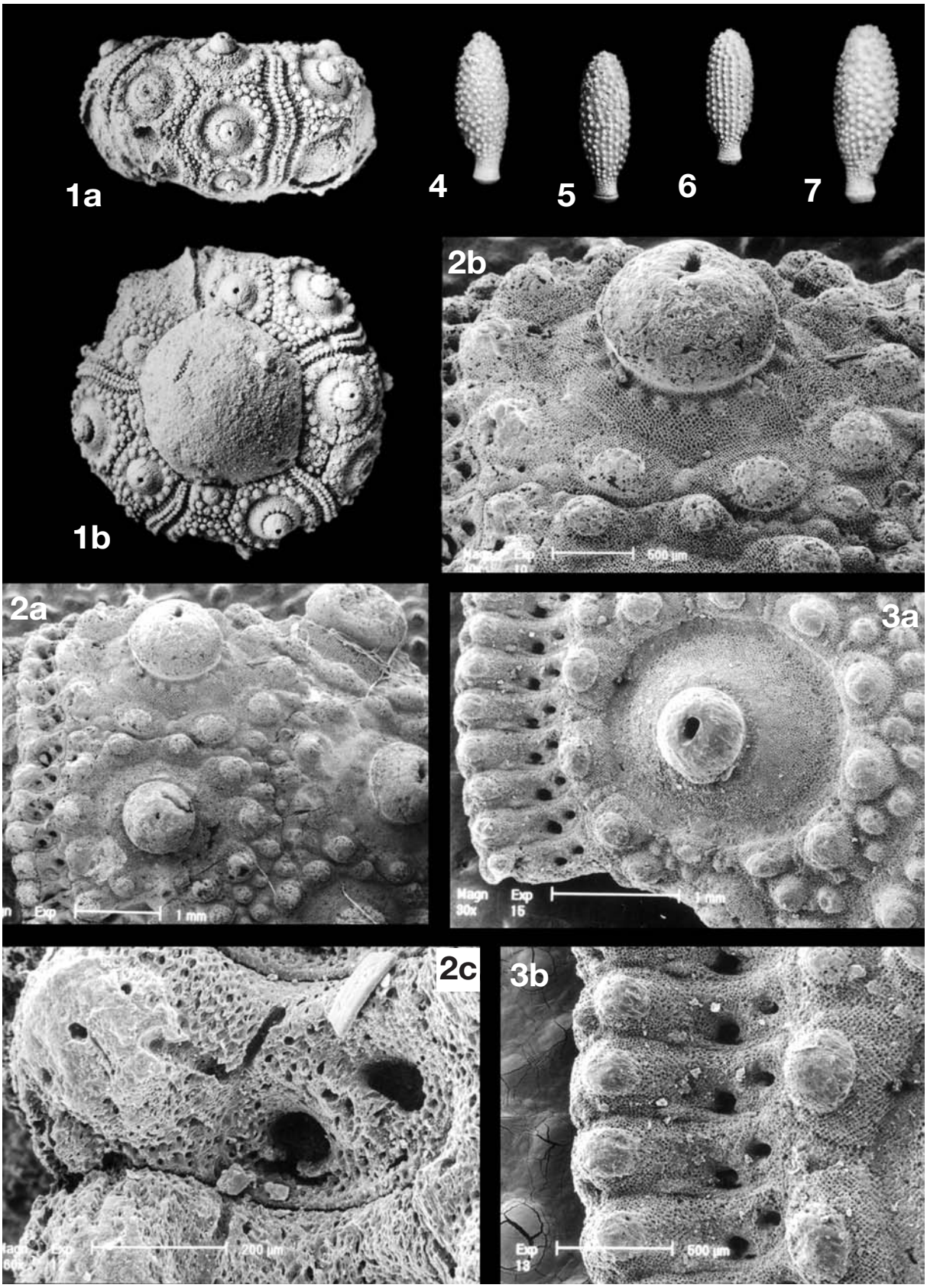
PLATE 13

Paracidaris propinqua (MÜNSTER *in* GOLDFUSS, 1826)

1-3 – 1a - Lateral view of the test, to show ambulacrum, **1b** - Aboral view of the test; × 2; Specimen from Ostrowiec, Coll. EN; **2a** - Close-up view of interambulacrum, to show ornamentation; **2b** - Fragment of the ambital interambulacral plate, to show primary and scrobicular tubercles; **2c** - Close-up view of the ambulacrum, to show the ambital *P2* isopore; Specimen from Bielawy, No. EOx/237; **3a** - Close-up view of the adapical part of test; **3b** - Close-up view of the adapical fragment of the ambulacrum, to show interporal ornamentation; Specimen from Bielawy, No. EOx/238;

4-7 – Primary spines; × 2; 4,5,6 - Specimens from Wapienno, No. EOx/239 successively to EOx/241; 7 - Specimen from the vicinity of Częstochowa, No. MP 362/267/01

1a-1b, 4-7 taken by ST. ULATOWSKI


1a
4
5
6
7
1b
2b
500 µm
2a
1 mm
3a
Magn
30x
Exp
15
1 mm
2c
200 µm
3b
Exp
13
500 µm