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Taxonomic interpretation and sexual dimorphism in the Early Cretaceous (Valanginian) ammonite *Valanginites nucleus* (ROEMER, 1841)

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ABSTRACT:

PLOCH, I. 2003. Taxonomic interpretation and sexual dimorphism in the Early Cretaceous (Valanginian) ammonite *Valanginites nucleus* (ROEMER, 1841). *Acta Geologica Polonica*, **53** (3), 201-208. Warszawa.

Sexual dimorphism in the Valanginian ammonite *Valanginites nucleus* (ROEMER, 1841), is recognised in the material from Wąwał, Central Poland. Two sexes, differing in size and number of ribs are distinguished. Intraspecific ornament variation is linked to sexual dimorphism. Three morphotypes (*nucleus*, *wilfridi* and *ventrotuberculatum*) occur along with forms intermadiate between these morphotypes. In all the morphotypes two sexes were found. *Valanginites bachelardi* is interpreted as the microconch of the *nucleus* morphotype.

Key words: Sexual dimorphism, *Valanginites nucleus*, Intraspecific variation, Central Poland, Wąwał section.

INTRODUCTION

Although some dimorphism in *Valanginites nucleus* (ROEMER, 1841) was already recognised by KEMPER (1976, 1992), his material was not sufficient for detailed studies (see KEMPER & *al*. 1981). Earlier, THIEULOY & GAZAY (1967) had reported the polymorphic nature of the species. They did not, however, encompass the whole variation of this ammonite. COMPANY (1987) considered three nominal species (*V. nucleus*, *V. wilfridi*, *V. ventrotuberculatum*) as a single biological species *Valanginites nucleus*.

In the material from Wąwał, *Valanginites nucleus* is very well preserved and is one of the most common species. In this collection it was possible to observe changes and the details of ornamentation, allowing very detailed studies of ontogenetic changes, leading consequently to a new interpretation of the species *Valanginites nucleus*, its intraspecific variation and its sexual dimorphism.

VALANGINIAN SUCCESSION IN WĄWAŁ

The present interpretation is based on the rich and well-preserved material from the Valanginian of the Wąwał clay-pit, Central Poland, located on the north-eastern limb of the Tomaszów Syncline within the Mid-Polish Anticlinorium (Text-fig. 1). The Wąwał section was extensively studied in the 20th century (LEWIŃSKI 1930, 1932, 1933; KOBYŁECKI 1948; KOKOSZYŃSKA 1956; PRUSZKOWSKI 1962; WITKOWSKI 1969; KUBIATOWICZ 1983; KUTEK & *al*. 1989; KUTEK & MARCINOWSKI 1996). The exposed succession (Text-fig. 2) is represented by monotonous clay, with sporadic ferruginous ooids, lenses of sand, glauconite, sideritic and phosphatic nodules, and a distinctive horizon of calcareous nodules. The whole succession corresponds to four Tethyan ammonite zones (Text-fig. 2): the *pertransiens*, the *campylotoxus*, the *verrucosum*, and the *trinodosum* zone. According to the traditional German subdivision the succession corresponds to the Platylenticeras-,

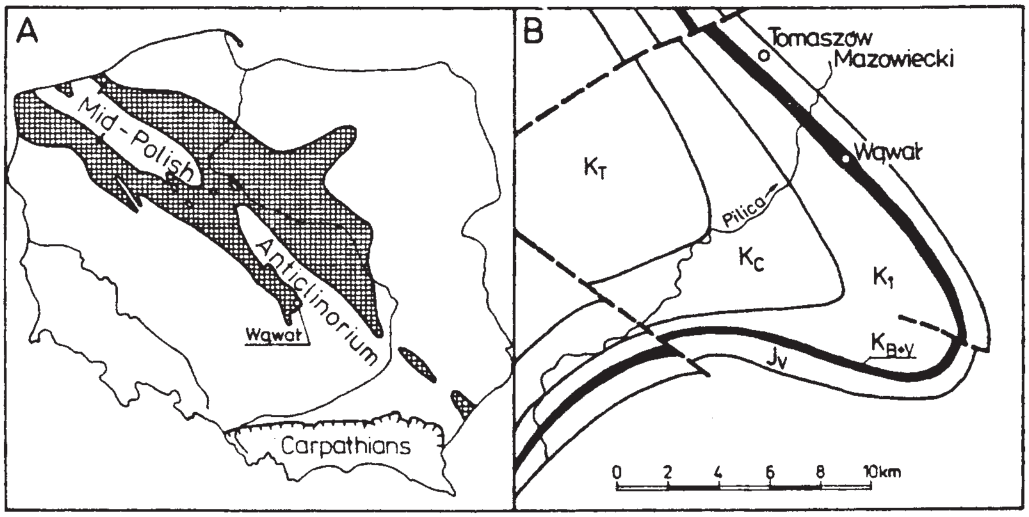

Fig. 1. A – general locality map and distribution of the Valanginian in Poland; B – geological map of the Tomaszów syncline; K_T – Turonian, K_C – Cenomanian, K_1 – higher Lower Cretaceous, K_{B+V} – Berriasian and Valanginian, J_V – Volgian (*after* KUTEK & MARCINOWSKI 1996)

Polyptychiten-, and Dichotomiten-Schichten (cf. KUTEK & *al*. 1989).

During the Valanginian, a shallow epicratonic sea covered the central part of Poland. Occasionally, this basin was connected with the Tethys to the south, and with the North Sea Basin, across North Germany. An extensive connection with the Tethys remained open in the *verrucosum* Chron (KUTEK & *al*. 1989, fig. 6). A large number of ammonite species including *Valanginites nucleus*, which originated in the Tethys, migrated during this time northward reaching the territory of Poland (KEMPER & *al*. 1981).

MATERIAL

A major part of the studied material was collected by J. DZIK (specimens with prefix Am IX) and by C. KULICKI (Institute of Paleobiology, Polish Academy of Sciences), J. KUTEK and R. MARCINOWSKI (Institute of Geology, Warsaw University) (specimens with prefix IGPKW/A/39/). Additional specimens came from the private collection of K. DEMBICZ and T. PRASZKIER. The specimens collected by the author have the prefix IGPKW/A/39/.

SYSTEMATIC PALAEONTOLOGY

The measurements used for the description of the ammonite shells are: D – shell diameter, H – whorl height, W – whorl width, U – umbilical diameter (all dimensions are given in centimetres). The suture terminology is that proposed by KULLMANN & WIEDMANN (1970).

Order Ammonoidea ZITTEL, 1884
Suborder Ammonitina HYATT, 1889
Superfamily Perisphinctaceae STEINMANN, 1890
Family Olcostephanidae HAUG, 1910
Subfamily Olcostephaninae HAUG, 1910
Genus *Valanginites* KILIAN, 1910

TYPE SPECIES: *Ammonites nucleus* ROEMER, 1841

Valanginites nucleus (ROEMER, 1841)
(Pl. 1, Figs 1-6; Pl. 2, Figs 1-8; Pl. 3, Figs 1-11)

1841 *Ammonites nucleus* PHILLIPS (?); ROEMER, p. 87, pl. 13, fig. 2.
1889. *Holcostephanus Bachelardi* nov. sp. SAYN, p. 679, pl. 17, fig. 1.
1902. *Polyptichites nucleus* ROEMER; KOENEN, p. 142, pl. 4, figs 6-7.
1902. *Holcostephanus* (*Asteria*) *Wilfridi* nov. sp.; KARAKASCH, p. 424, pl. 1, figs 1-2.
1956. *Polyptychites nucleus* ROEMER; KOKOSZYNSKA, p. 30, pl. 4, figs 12-13.
1962. *Dobrogeites ventrotuberculatus* NIKOLOV; NIKOLOV, p. 69, text-figs 1-3.
1967. *Dobrodgeiceras wilfridi ventrotuberculatum* (NIKOLOV); THIEULOY & GAZAY, p. 69, pl. 16, figs 1-5.
1967. *Dobrodgeiceras wilfridi wilfridi* (KARAKASCH); THIEULOY & GAZAY, p. 69.
1967. *Valanginites ventrotuberculatus* (NIKOLOV); DIMITROVA, p. 98, pl. 46, figs 8-9.
1969. *Polyptychites* cf. *nucleus* ROEMER; WITKOWSKI, p. 98, pl. 21, figs 7-8.
1969. *Astieria bachelardi* SAYN; WITKOWSKI, p. 94, tab. 37; pl. 20, fig. 1.

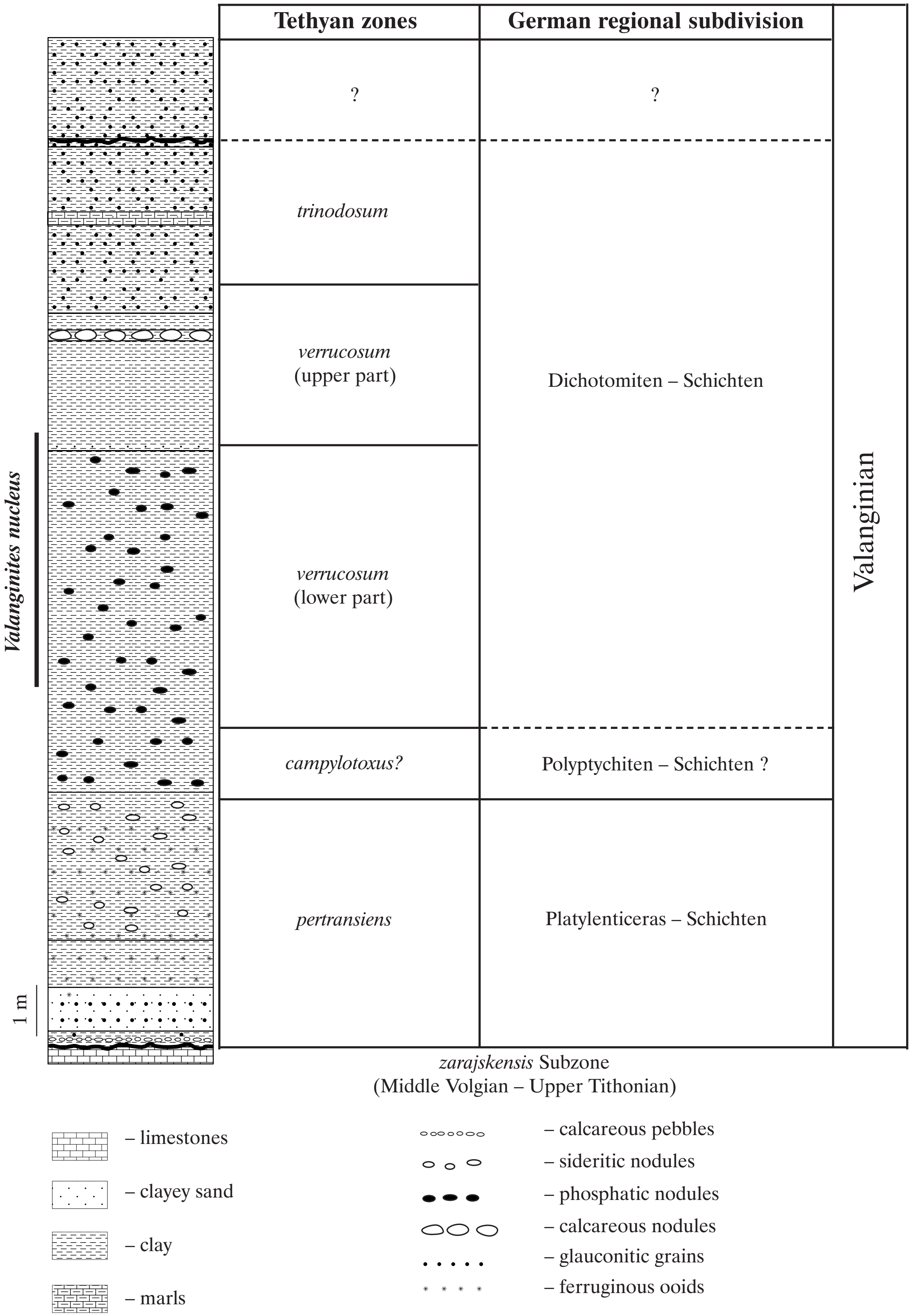

Fig. 2. Wąwał section with the Valanginian ammonite units and lithological units (see KUTEK & *al.* 1989)

1970. *Dobrodgeiceras broggianum* (LISSÓN); RICCARDI & WESTERMANN, p. 888, text-fig. 1; tab. 1; pl. 127, figs 1-5.
1977. *Valanginites nucleus* (ROEMER); THIEULOY, p. 426, pl. 8, figs 23-24.
1977. *Valanginites psaephoides psaephoides* (MAYER-EYMAR); THIEULOY, p. 430, pl. 4, figs 7-10; pl. 9, figs 12-18.
1981. *Valanginites nucleus* (ROEMER); KEMPER, RAWSON & THIEULOY, p. 274, pl. 38, figs 1-6.
1981. *Valanginites wilfridi* (KARAKASCH); KEMPER, RAWSON & THIEULOY, p. 274, pl. 38, figs 7-8.
1981. *Dobrodgeiceras wilfridi ventrotuberculatum* (NIKOLOV); KEMPER, RAWSON & THIEULOY, p. 274.
1981. *Valanginites* intermediate between *nucleus* and *wilfridi*; KEMPER, RAWSON & THIEULOY, p. 274, pl. 38, figs 11-12.
1987. *Valanginites* and *Dobrodgeiceras*; DZIK, p. 273, text-fig. 6 A-C; pl. 3, figs 9-15.
1987. *Valanginites nucleus* (ROEMER); COMPANY, p. 175, pl. 17, figs 12-17; pl. 19, figs 20-21.
1987. *Valanginites bachelardi* (SAYN); COMPANY, p. 177, text-fig. 38; pl. 17, figs 9-11.

MATERIAL: 136 macroconchs and 106 microconchs. Specimens very well preserved, most of them with shells. The microconchs are represented mostly by phragmocones. The complete body chambers are preserved mainly in macroconchs.

DIMENSIONS: Parameters of body chamber for macroconchs are:
D - 5.0-6.65, W - 3.4-4.7, H - 2.1-3.1, U - 1.1-1.2;
and for microconchs:
D - 2.15-4.3, W - 1.46-3.5, H - 0.85-1.6, U - 0.46-0.9.
The largest microconchs reach a similar size to the smallest macroconchs. Inner whorls are smooth. In macroconchs, ribs appear at an average size:
D - 1.75, W - 1.45, H - 0.95, U - 0.26;
in microconchs:
D - 1.27, W - 0.97, H - 0.65, U - 0.21.

DESCRIPTION: Sphaerocone, inflated species with narrow and deep umbilicus, elliptical on last whorl. Whorl section depressed. H/L ratio of body chamber smaller than that of phragmocone. Length of body chamber comprises approximately three-quarters of a whorl.

Ribs fine and sharp in microconchs (Pl. 2, Figs 2, 3, 8). Coarse and blunt in macroconchs (Pl. 1, Fig. 6; Pl. 2, Fig. 1). Ribs in both micro- and macroconchs bundled, bifurcated, or arise from mid-lateral tubercles, intercalated ribs rare.

Mid-lateral and mid-ventral tubercles present in some body chambers, depending on the morphotype. Mid-ventral tubercles present on whole body chamber or only on its final part (at least one or two tubercles). Distances between tubercles variable (Pl. 3, Figs 1, 2, 11). In body chamber, final part of primary ribs (connected with mid-lateral tubercles) curved occasionally towards aperture (Pl. 1, Fig. 5). Aperture collared and constricted. Suture line identical in all morphotypes (Text-fig. 3).

DISCUSSION: The three morphotypes, found in the material from Wąwał, were described originally as either separate species: *Valanginites nucleus* (KOENEN 1902; KOKOSZYŃSKA 1956; WITKOWSKI 1969; THIEULOY 1977; KEMPER & *al*. 1981), *Valanginites wilfridi* (KARAKASCH 1902; KEMPER & *al*. 1981), and *Valanginites ventrotuberculatum* (NIKOLOV 1962, 1967; DIMITROVA 1967; RICCARDI & WESTERMANN 1970; KEMPER & *al*. 1981) or as a single polymorphic species (THIEULOY & GAZAY 1967, COMPANY 1987). Following the interpretation of COMPANY (1987) all three morphotypes are considered here as a single polymorphic species, *Valanginites nucleus*.

The three morphotypes differ from each other in the development of the mid-lateral and mid-ventral tubercles. The *nucleus* morphotype has blunt mid-lateral tubercles on the last quarter whorl or no tubercles at all (Pl. 1, Fig. 1). About four secondary ribs branch from the mid-lateral swelling. Intermediate forms between *nucleus* and *wilfridi* morphotypes occur and were first described from Germany (KEMPER & *al*. 1981, pl. 38, figs 11, 12). They are characterised by coarse and elongate mid-lateral tubercles, as in the *wilfridi* morphotype, but these are limited mostly to the last quarter whorl, as in the *nucleus* morphotype (Pl. 1, Figs 3, 4, 5). The first tubercles of this form are elongate (like in the *wilfridi* morphotype) (Pl. 1, Figs 3, 4) or blunt (like in the *nucleus* morphotype) (Pl. 1, Fig. 5). The *wilfridi* morphotype possesses tubercles connected with strong primary ribs. They occur on the whole body chamber (Pl. 2, Figs 6, 7). The primary ribs are more or less curved towards the aperture, esspecialy near the end of the shell. The *ventrotuberculatum* morphotype has mid-lateral tubercles joined with strong primary ribs and mid-ventral tubercles. In contrast to the *wilfridi* morphotype its mid-lateral tubercles are more variable. The first characteristic ornament features in ontogeny are either strong primary ribs or mid-ventral tubercles (Pl. 3, Figs 1, 3, 9). One specimen has mid-lateral tubercles joined to every second strong primary rib, another one is without mid-lateral tubercles (Pl. 3, Fig. 5). Some are devoid of mid-lateral tubercles, but possess mid-ventral tubercles (see COMPANY 1987, pl. 17, fig. 17). The intraspecific variability in respect of the mid-lateral and mid-ventral tubercles is relatively large. Observed are forms where all primary ribs possess mid-lateral tubercles, through forms with tubercles on only every second rib, to forms devoid of mid-lateral tubercles. Similarly, there is also consider-

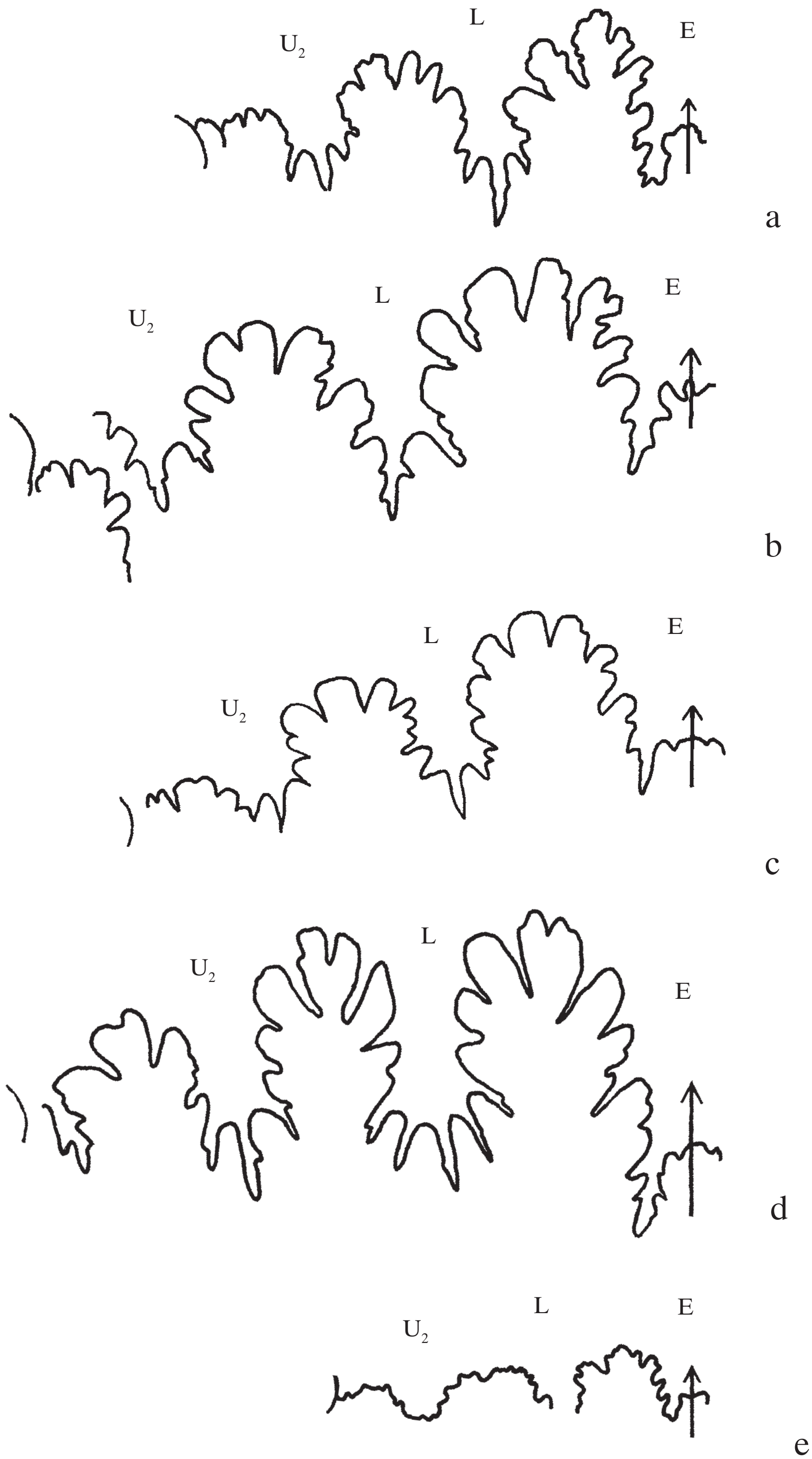

Fig. 3. Suture lines of *Valanginites nucleus* ROMER; a – morphotype *nucleus*, microconch IG PKW/A/39/298, H – 0.93 cm; b – *wilfridi* morphotype, microconch IG PKW/A/39/288, H – 1.5 cm; c – *nucleus* morphotype, microconch IG PKW/A/39/288a, H – 0.84 cm; d – *nucleus* morphotype, macroconch, unnumbered specimen (colection DEMBICZ & PRASZKIER), H – 1.6 cm; e – morphotype *ventrotuberculatum*, microconch, numberless specimen (collection DEMBICZ & PRASZKIER) H – 0.67 cm

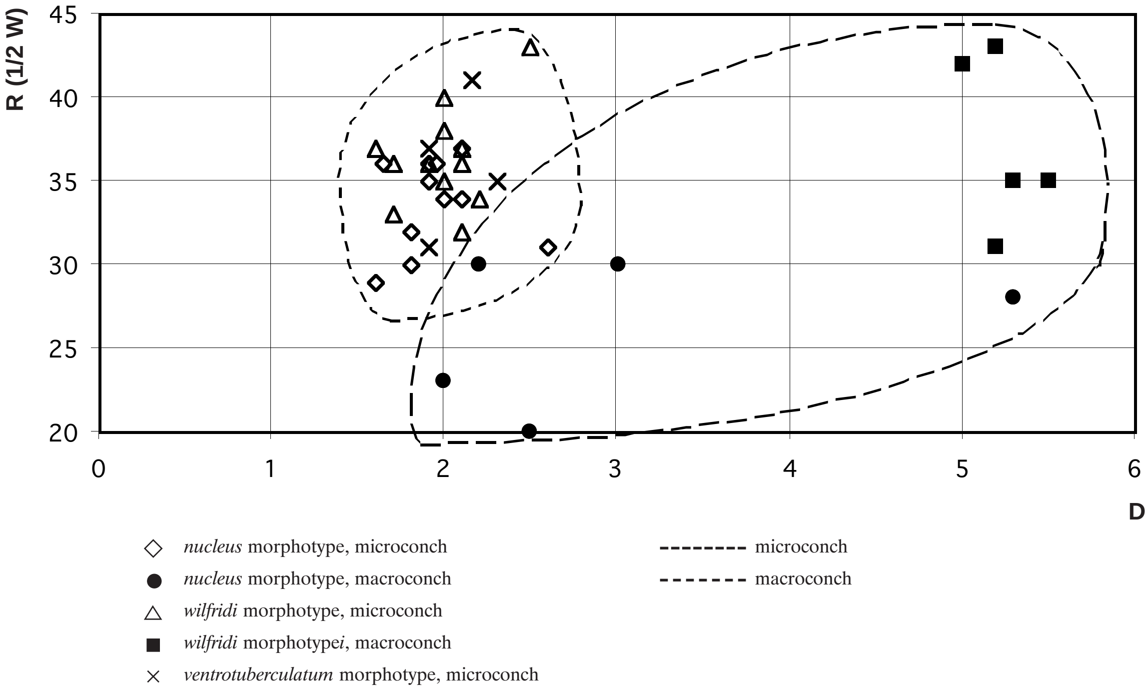

Fig. 4. Plot of ratio between shell diameter and number of ribs (R) on half of whorl (1/2 W) in *Valanginites nucleus*

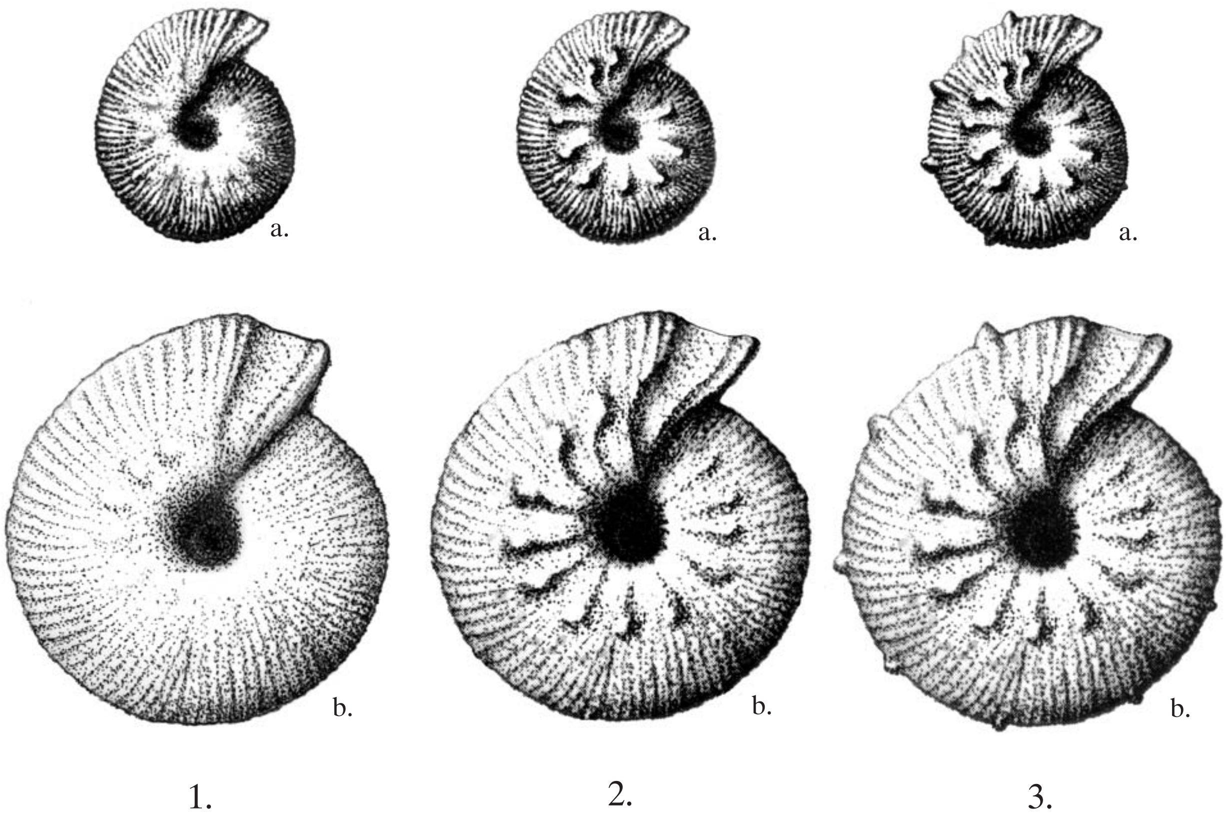

Fig. 5. Variability range of micro- and macroconch in *Valanginites nucleus*; a – microconch, b – macroconch; 1 – *nucleus* morphotype , 2 – *wilfridi* morphotype, 3 – *ventrotuberculatum* morphotype

able variation in the mid-ventral tubercles, they may occur throughout the body chamber, or their number may decrease gradually down to one or two tubercles close to the aperture. A form representing the latter case was described by THIEULOY & GAZAY (1967), and referred to as an intermediate between the subspecies *wilfridi* and *ventrotuberculatum*. Some specimens from Peru have similar ornamentation (RICCARDI & WESTERMANN 1970, pl. 127, figs 3-5). The suture lines of all three morphotypes are identical (Text-fig. 3). The aperture varies, independently of the morphotype and sex, from small, narrow, smooth and constricted (Pl. 1, Figs 1, 5) to apertures possessing a ventral, broad, horn-like flange (Pl. 1, Fig. 2; Pl. 3, Fig. 1) (see also RICCARDI & WESTERMANN 1970, pl. 127, figs 3-5; KEMPER & *al*. 1980, pl. 38, figs 2, 3, 4, 11, 12). The morphotypes shown in Text-fig. 5 represent extreme forms. All three morphotypes are known from the Tethys and the Central European Basin. Dimorphism in *Valanginites nucleus* was suggested by KEMPER (1976) as expressed by size differences. In the studied material, the microconchs and macroconchs, besides differing in size, also differ in rib number and shape. Early ontogenetic stages are smooth and identical in both dimorphs. They start to differentiate with the appearance of ornament, which in microconchs takes place earlier than in macroconchs. In microconchs the ribs are narrow and sharp, whereas in macroconchs they are coarse and blunt. This feature is clearly visible on the inner whorl (Pl. 1, Fig. 6; Pl. 2, Fig. 3). In incompletely preserved specimens the recognition of macroconchs and microconchs may be difficult. Helpful in this case can be the denser ribs spacing in microconchs than in macroconchs (Text-fig. 4), giving a bimodal distribution in this respect. Ribs on the body chamber at the same diameter are very similar in both micro- and macroconchs. Microconchs of the *nucleus* morphotype, and the early whorls of the *wilfridi* and *ventrotuberculatum* morphotypes and have the same size, construction, ornamentation, and characteristic features as *V. bachelardi* (SAYN 1889) (microconch of the *nucleus* morphotype without tubercules), and *V. psaephoides psaephoides* (MAYR-EYMAR 1887); (THIEULOY 1977) (microconch of the *nucleus* morphotype with mid-lateral tubercules). It is inferred that *V. nucleus* is conspecific with *Valanginites bachelardi* and *Valanginites psaephoides psaephoides*, both of which represent its microconch.

Moreover, there is probably some geographical variability. The largest forms (shell diameter over 7 cm), with nearly smooth shells, were found in the upper part of the range of *Valanginites nucleus* in the Rusbend Kanal section (Lower Saxony Basin) (Kurt WIEDENROTH, *pers.comm*., 2000). Nearly smooth specimens are known from the lowermost part of the stratigraphical range of the ammonite genus *Dichotomites* in the Wąwał section (Text-fig. 2). These smooth forms could have immigrated together with boreal *Dichotomites* from the Lower Saxony Basin. They were probably endemic, adapted to rather cold waters. From the neritic part of the geographical range of *Valanginites nucleus* (Peru, Morocco) are known smaller forms, whereas larger forms dominated on the platform.

One specimen showing a deviation from the plane of symmetry is present in the collection (Pl. 2, Fig. 5). This feature is similar to the paleopathology known as the "Morton's syndrome" (LANDMAN & WAAGE 1986). This kind of paleopathology is interpreted as caused by parasitosis. Before deviation the ribs are narrow and sharp (of microconch type) but after the change they are wide and gentle (of macroconch type). This change might have been caused by damage to the gonads by parasites, resulting in a change of gender.

OCCURRENCE: *Valanginites nucleus* is known from the late Valanginian of Poland, Bulgaria, Caucasus, Crimea, France, Germany, Italy, Mexico, Morocco, Peru, Spain and Switzerland.

CONCLUSION

The species *Valanginites nucleus* is a polymorphic species, which exhibits three distinct morphotypes: *nucleus*, *wilfridi* and *ventrotuberculatum*. These morphotypes were described originally as species or subspecies. They are distinguished on the basis of different types of tubercles. Intermediate forms are present. The distinct *nucleus* morphotype is characterised either by gentle mid-lateral tubercles or no tubercles at all. The *wilfridi* morphotype has tubercles joined to the primary ribs, and the *ventrotuberculatum* morphotype has tubercles joined to primary ribs, as well as mid-ventral tubercles. Two types of forms are distinguished in all morphotypes, which are interpreted as sexual dimorphism (Text-fig. 5). The dimorphism is expressed by differens in adult size, shape and number of ribs. Both in micro and macroconchs three morphotypes are recognisable (Text-fig. 5).

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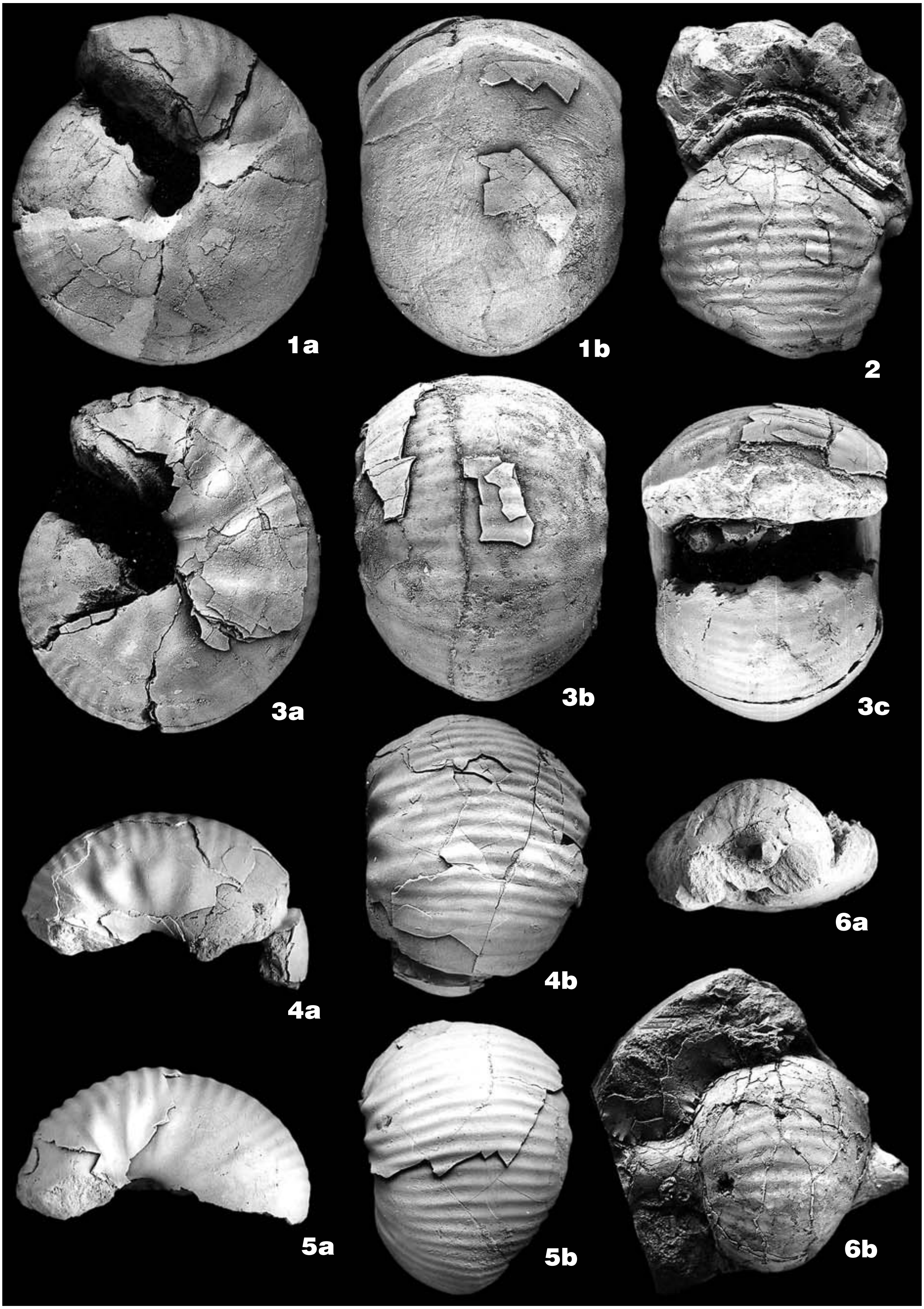
PLATES 1 – 3

PLATE 1

Valanginites nucleus (Roemer)

1-2, 6 – morphotype *nucleus*; 1 – macroconch, body chamber, Am IX 42, × 1; 2 – macroconch, body chamber, Am IX 6, × 1; 6 – macroconch, phragmocone, IGPKW/A/39/740, × 1.5.

3-5 – intermediate form between *nucleus* and *wilfridi* morphotypes; 3 – macroconch, body chamber, IGPKW/A/39/1, × 1; 4 – macroconch, body chamber, Am IX 22, × 1; 5 – macroconch, body chamber, IGPKW/A/39/557, × 1;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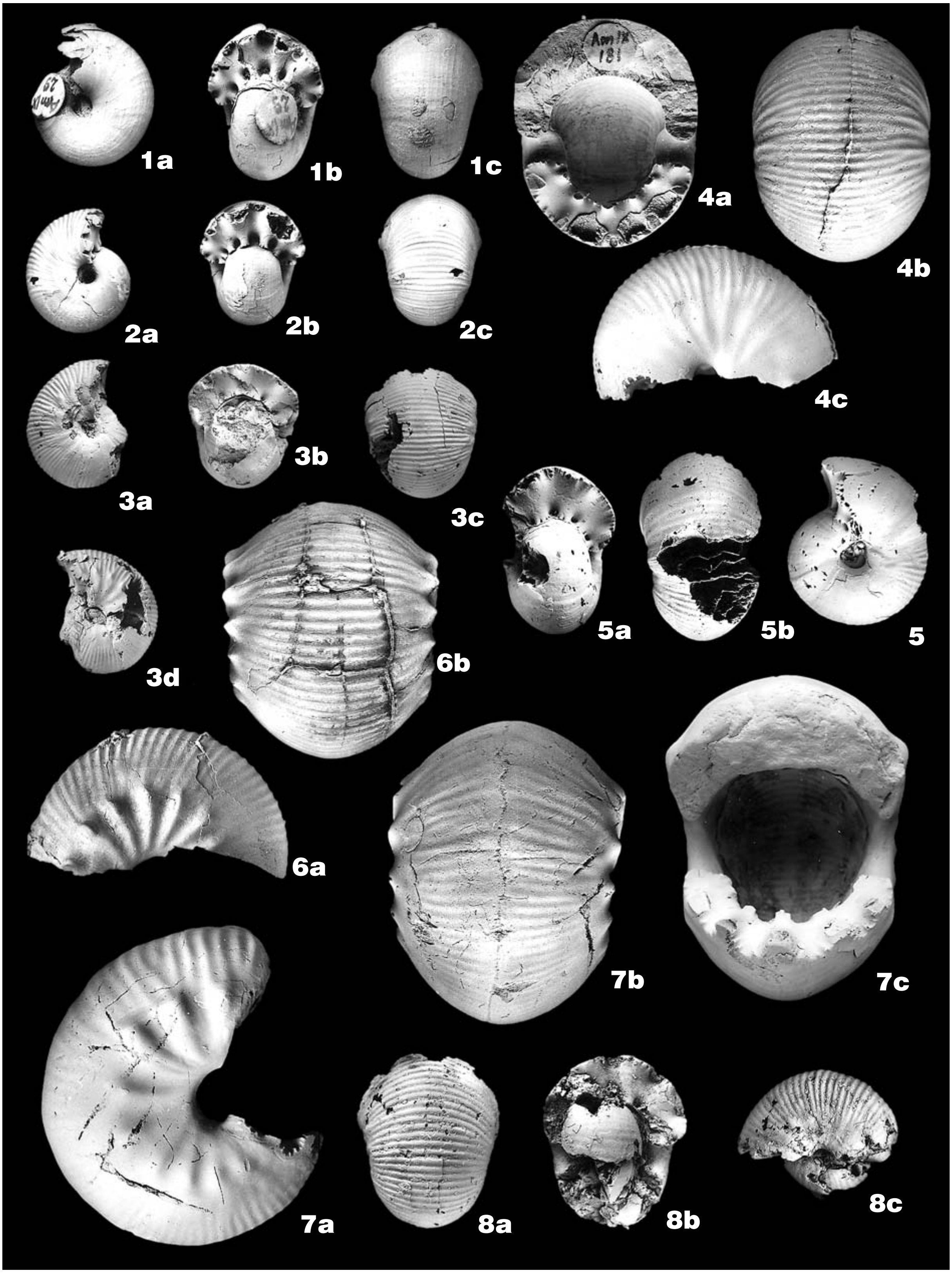
1b
2
3a
3b
3c
4a
4b
6a
5a
5b
6b

PLATE 2

Valanginites nucleus (ROEMER)

1-5, 7 – morphotype *nucleus*; 1 – macroconch, phragmocone, Am IX 29, × 1.5; 2 – microconch, phragmocone, IGPKW/A/39/299, × 1.5; 3 – microconch, phragmocone, IGPKW/A/39/II 288, × 1.5; 4 – microconch, body chamber, Am IX 181, × 1.5; 5 – microconch, phragmocone, IGPKW/A/39/288, × 1.5; 7 – microconch, body chamber, Am IX 8, × 1.

6, **8** – morphotype *wilfridi*; 6 – microconch, body chamber, IGPKW/A/39/329, × 1.5; 8 – microconch, phragmocone, IGPKW/A/39/D 9, × 1.5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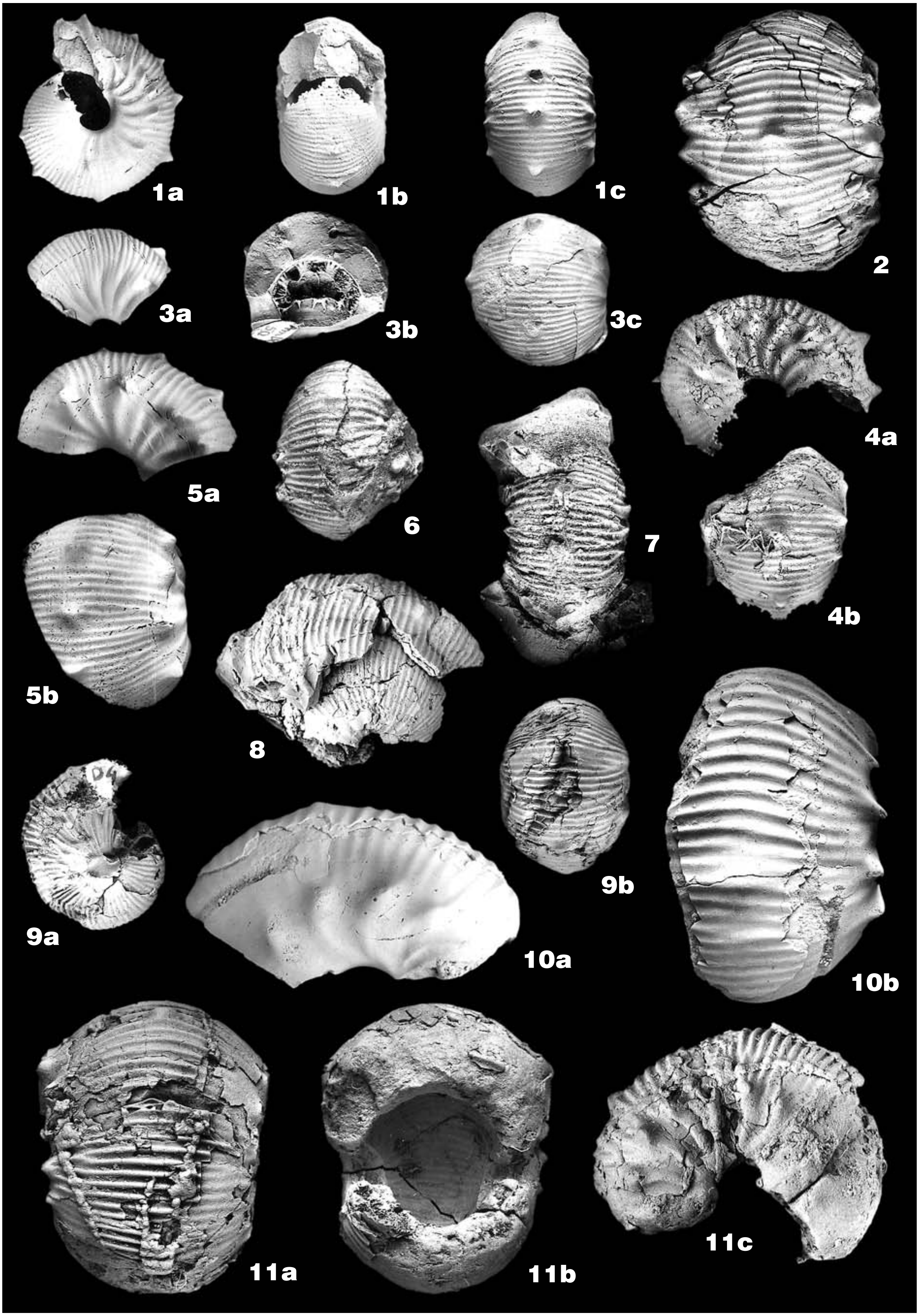
8b
8c

PLATE 3

Valanginites nucleus (ROEMER), morphotype *ventrotuberculatum*

1 – microconch, body chamber, × 1.5; 2 – microconch, body chamber, IGPKW/A/39/D 6, × 1; 3 – microconch, body chamber, Am IX 50, × 1.5; 4 – microconch, body chamber, IGPKW/A/39/D 3, × 1.5; 5 – microconch, body chamber, IGPKW/A/39/D 7, × 1.5; 6 – microconch, body chamber, IGPKW/A/39/D 5, × 1.5; 7 – microconch, body chamber, Am IX 2, × 1.5; 8 – microconch, phragmocon and body chamber, IGPKW/A/39/D 8, × 1; 9 – microconch, phragmocon, IGPKW/A/39/D 4, × 1.5; 10 – macroconch, body chamber, Am IX 22, × 1; 11 – microconch, body chamber, IGPKW/A/39/D 9a, × 1.5.


1a
1b
1c
2
3a
3b
3c
4a
5a
6
7
4b
5b
8
9b
9a
10a
10b
11a
11b
11c