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A new glyptorthid species (Brachiopoda: Orthida) from the Upper Ordovician of Estonia

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Abstract. A new glyptorthid brachiopod species *Bassettella alata* with surface pits and lamellose frills is described from the Upper Ordovician Haljala and Keila stages of northern Estonia. The new species appears in the Jõhvi Substage of the Haljala Stage (mid-Sandbian) and is somewhat younger than the type species *B. gracilis* appearing in the lower Idavere Substage of the same stage in NW Russia. In the uppermost Keila Stage (lowermost Katian), *B. alata* belongs to a mixed faunal association of the marginal facies of the Vasalemma Formation comprising the oldest Ordovician reefs in Estonia. The distribution pattern of brachiopods of the genus *Bassettella* shows a westward shift in time and changes in shell morphology from subrectangular to subtriangular with alate cardinal extremities.

Key words: Brachiopoda, taxonomy, Upper Ordovician, northern Estonia.

INTRODUCTION

Recently Zuykov & Butts (2008) discussed the taxonomy of the family Glyptorthidae Schuchert & Cooper, 1931. They also described a new genus *Bassettella*, which is characterized by enigmatic surface pits and lamellose frills. The type species of the genus, *B. gracilis*, occurs in the lower part of the Haljala Stage (Idavere Substage) in NW Russia and in the upper part of the same stage (Jõhvi Substage) in northern Estonia (Zuykov & Butts 2008).

Brachiopods with the external sculpture similar to that of *Bassettella* were identified in the collections from northern Estonia. The differences in shell morphology, however, suggest that these specimens are not conspecific with the type species and thus a new species *Bassettella alata* is erected. The new species is most common in the interlayers of argillaceous skeletal limestone in the lower part of the Vasalemma Formation (Põlma et al. 1988; Hints 1990) containing a mixed assemblage of fossils. The brachiopods characteristic of the Keila Stage, such as *Sowerbyella* (*S.*) *tenera* Rõõmusoks, *Estlandia pyron silicificata* Öpik and *Horderleyella kegelensis* (Alichova) (see Hints & Meidla 1997), co-occur in these interlayers with remains of various echinoderms (cystoids, paracrinoids and crinoids), which are the main constituents of grainstones surrounding the reefs of the Vasalemma Formation. The new species *B. alata* is, however, known only in the lowermost part of this formation.

The studied material comprises 20 specimens, most of which have been collected from shallow cores drilled in NW Estonia in the 1970s. This area is now part of a large limestone quarry in Vasalemma (Fig. 1). The specimens described are housed at the Institute of Geology at Tallinn University of Technology (institutional abbreviation for the collection is GIT). The two specimens of *Glyptorthis gracilis* mentioned in Zuykov & Butts (2008) are housed at the Geological Museum, University of Tartu (institutional abbreviation TUG).

SYSTEMATIC PALAEONTOLOGY

Order ORTHIDA Schuchert & Cooper, 1932
Suborder ORTHIDINA Schuchert & Cooper, 1932
Superfamily ORTHOIDEA Woodward, 1852
Family GLYPTORTHIDAE Schuchert & Cooper, 1931
Genus *Bassettella* Zuykov & Butts, 2008

Type species. *Bassettella gracilis* Zuykov & Butts, 2008; Gryazno and Kahula formations, Haljala Stage, Upper Ordovician, NW Russia (St Petersburg region) and northern Estonia.

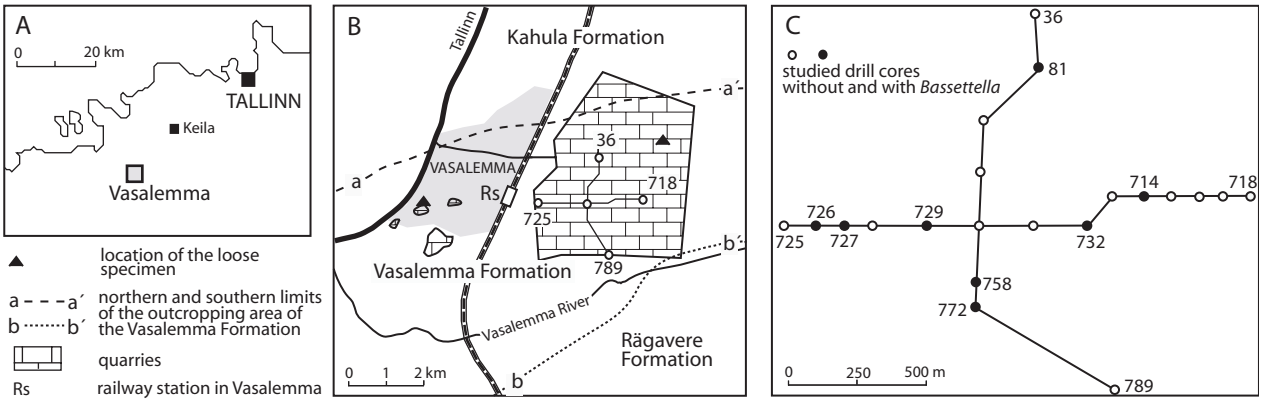


Fig. 1. Sketch map of localities in NW Estonia (A), Vasalemma settlement (in grey) and quarry (B) and sites of the studied drill cores in the Vasalemma quarry (C).

Bassettella alata sp. nov.
Figures 2, 3A–O, 4A–H

Derivation of name. Latin *ālāta* – winged, shell with alate cardinal angles.

Holotype. Complete shell GIT 595-1, Fig. 3A–E; northern part of the Vasalemma quarry, lower part of the Vasalemma Formation, Keila Stage, Upper Ordovician.

Paratypes. GIT 595-2 (Fig. 3F–L); GIT 595-3 (Fig. 4B); GIT 595-4 (Fig. 4C, D); GIT 595-6 (Fig. 3M–O); GIT 595-13 (Fig. 4G, H); GIT 595-15 (Fig. 4A); GIT 595-17 (Fig. 4F).

Diagnosis. Shell ventribiconvex with alate cardinal extremities, ramicostellate with 5–7 primary costae on the ventral valve. Lamellose frills strong, with intervals up to 0.65 mm. Superficial pits round to oval, increasing in size anteriorly and on every frill. Delthyrium narrow, up to twice as high as wide, cardinal process wedge-shaped, thickening anteriorly; ventral muscle field with elongate, anteriorly elevated adductor tracks supported by very short median septum.

Description. The subequally biconvex shell with alate cardinal extremities is about 0.6 as long as wide (Fig. 2A, B). The dorsal valve is weakly convex with a shallow sulcus between the middle primary costae, ventral valve slightly carinate (Fig. 3A–E). The anterior commissure is rectimarginate to slightly sulcate. Ornamentation is ramicostellate with 5–7 costae on the ventral and 4–6 on the dorsal valve. The first-order secondary costellae appear close to the umbo; one or two postero-lateral costellae originate on the posterior margin of the valve. The total number of costae and costellae reaches up to 29 (Fig. 2C). In the middle sector the costae are symmetrically triangular in cross section,

A

Specimen	Ventral length	Dorsal length	Width	Number of ribs
Shell GIT 595-1	6.5	6.1	11.7	20
Shell GIT 595-2	10.7	10.0	16.6	27
Ventral valve GIT 595-4	4.2	-	8.0	18
Ventral valve GIT 595-5	8.0	-	15.0	22
Dorsal valve GIT 595-6	-	7.7	~11.0	13
Ventral valve GIT 595-7	9.8	-	~16.0	29
Dorsal valve GIT 595-12	-	6.4	?	18
Dorsal valve GIT 595-13	-	4.6	8.0	18
Dorsal valve GIT 595-17	-	5.6	8.5	16
Dorsal valve TUG 72-3	-	11.6	17.5	45
Ventral valve TUG 37-15	8.2	-	14.0	31

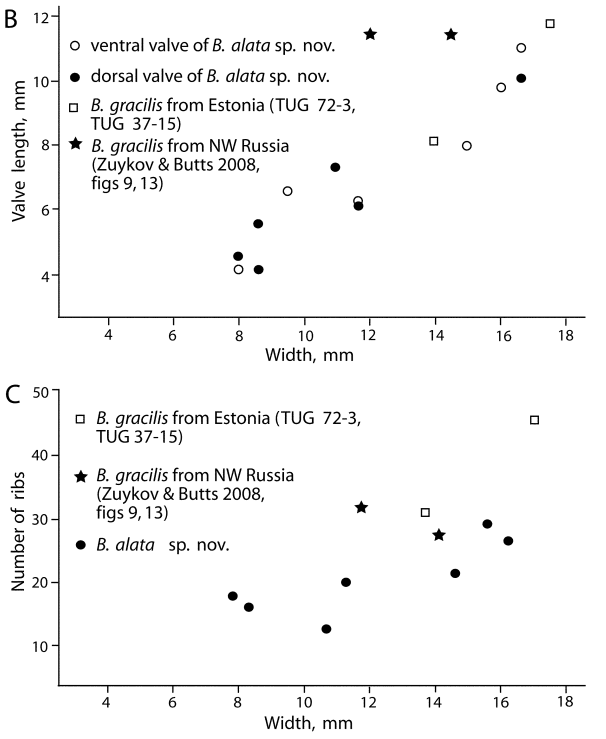


Fig. 2. Dimensions of the studied specimens in millimetres (A), valve length/width (B) and number of ribs/valve width (C) ratios.

in lateral parts become asymmetrical with a shorter flank towards the midline of the shell. The lamellose frills in the posterior part of the shell are weakly developed and occur at intervals of 0.25 mm, anteriorly the intervals between frills increase up to 0.65 mm. The superficial pits occur unevenly, most densely on the anterior parts of the lamellose frills. The size of the pits increases anteriorly from 0.06 to 0.09 mm; they are rare or missing on the posterior parts of the valves. The pits penetrate the anterior parts of the lamellose frills lifted from the valve surface. The edges of the frills can be notched (Fig. 3K, L) due to incompletely formed pits or mechanical damages.

The ventral area is apsacline, slightly concave. The delthyrium is triangular open, up to twice as high as wide or about as wide as high in smaller specimens. The dorsal area is low, almost anacline. The notothyrium is open.

The ventral interior shows small hinge teeth with weakly developed dental plates, which bend towards the delthyrial cavity and delineate laterally the muscle field. Diductor scars are elongate, about as long as the adductor field in the form of an anteriorly elevated tongue-shaped platform with subparallel lateral edges. On the older specimen the anterior part of the platform is sub-vertical in relation to the valve surface and two small cavities occur on both sides of the short septum-like continuation of the platform (Fig. 4B, E).

The dorsal interior is known by two valves (Figs 3N, 4A). The notothyrial platform is elevated, subtriangular, formed laterally and anteriorly of convergent brachiophore plates. The cardinal process is wedge-like with a sharp top; brachiophores are divergent, bounding the sockets laterally. The muscle scars are not expressed. The external ribbing pattern is developed on the interior surface of the valves as radial grooves and wide rounded-top ridges.

The peripheral rim is knee-like (Fig. 3N, O). The pitted ribbing along the anterior edge is delimited from the interior surface of the valve by tiny growth-line-like concentric filamentous sculpture on top of the knee (Fig. 3O).

For measurements of specimens see Fig. 2A.

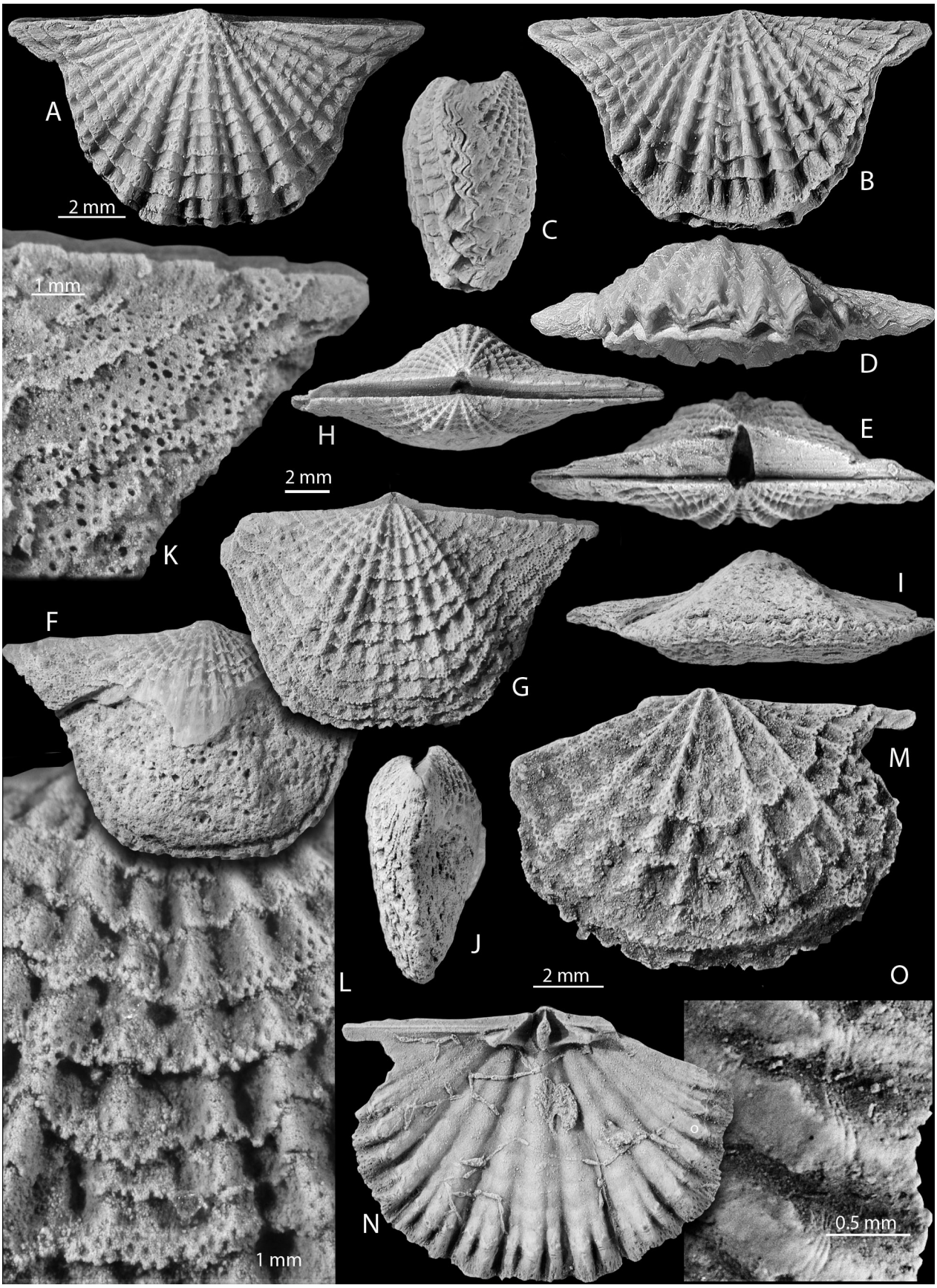
Discussion. The small surface pits of the brachiopod *Bassettella* can be regarded as exopunctae because they do not penetrate to the internal surface (Williams & Brunton 1997). However, their uneven distribution and size relation with distinct growth stages differentiates *Bassettella* from several other brachiopods with evenly distributed and densely spaced exopunctae (Jin et al. 2007). It seems possible that in case of *Bassettella* Wright's (1981) opinion about the development of surface pits is applicable. The surface pits penetrating the margin of the valve supposedly housed temporary caeca, whose development depends on the growth of the valve. The subperipheral rim on the internal margin with densely spaced fine growth lines (Fig. 3O) delimits the pitted margin of the valve which probably forms a new frill during the further growth of the shell.

The pitted external sculpture and strongly impressed ventral muscle field with anteriorly elevated adductor tracks differentiate both species of *Bassettella* from the typical species of *Glyptorthis* from North America (Cooper 1956) and Europe (Williams 1962; Hansen 2008). Another atypical Ordovician glyptorthid with minute tubercles on the shell surface has been described from the Darriwilian of China (Zhan & Jin 2005). The Chinese species *Glyptorthis sarcina* Zhan & Jin is among the oldest species of the genus *Glyptorthis*. It is similar to the Estonian species in having a relatively small number of ribs (9–11). However, the Estonian species lacks tubercles, has a shorter notothyrial platform and possibly lacks the median ridge.

The new species differs from the Russian specimens of *Bassettella gracilis* from the Gryazno Formation (Fig. 5) in its alate outline (Fig. 2B), less convex dorsal valve, more robust radial ornamentation (Fig. 2C), higher and almost flat ventral area, and more sparsely spaced lamellose frills. However, somewhat younger Estonian specimens of *B. gracilis* from the Jõhvi Substage of the Alliku and Kiikla localities (Fig. 4I–L) have acute cardinal angles as in the new species *B. alata*, but denser lamellose frills and finer surface pits. *Bassettella gracilis* and *B. alata* supposedly occur in different parts of the Jõhvi Substage (Fig. 5). At least the specimen of *B. gracilis* from Alliku (Zuykov & Butts 2008) is older than *B. alata* from the Keila locality, because in these localities, respectively, the lower and the upper part of the Jõhvi Substage are exposed (Männil 1950).

The distribution pattern of *Bassettella* displays a westward shift in time from early Haljala (mid-Sandbian) time in northwestern Russia to late Keila (early Katian) time in northern Estonia (Fig. 5). During that time interval the shell morphology changes from sub-rectangular to subtriangular with alate cardinal extremities.

Material. Keila Stage, Vasalemma Formation: Vasalemma settlement, close to the former old tavern and old quarry – 2 dorsal valves; northern part of the Vasalemma quarry – complete specimen, dorsal and ventral valve; drill cores: No. 81, depth 4.55 m – ventral valve; No. 732, depth 11.95 m – ventral valve, depth 11.35 m – dorsal valve; No. 758, depth 14.4 m – incomplete dorsal valve; No. 726, depth 12.35 m – incomplete ventral valve; No. 729, depth 11.2 m – fragments of ventral and dorsal valves; No. 727, depth 10.1 m – incomplete dorsal valve; No. 772, depth 12.7 m – small ventral valve,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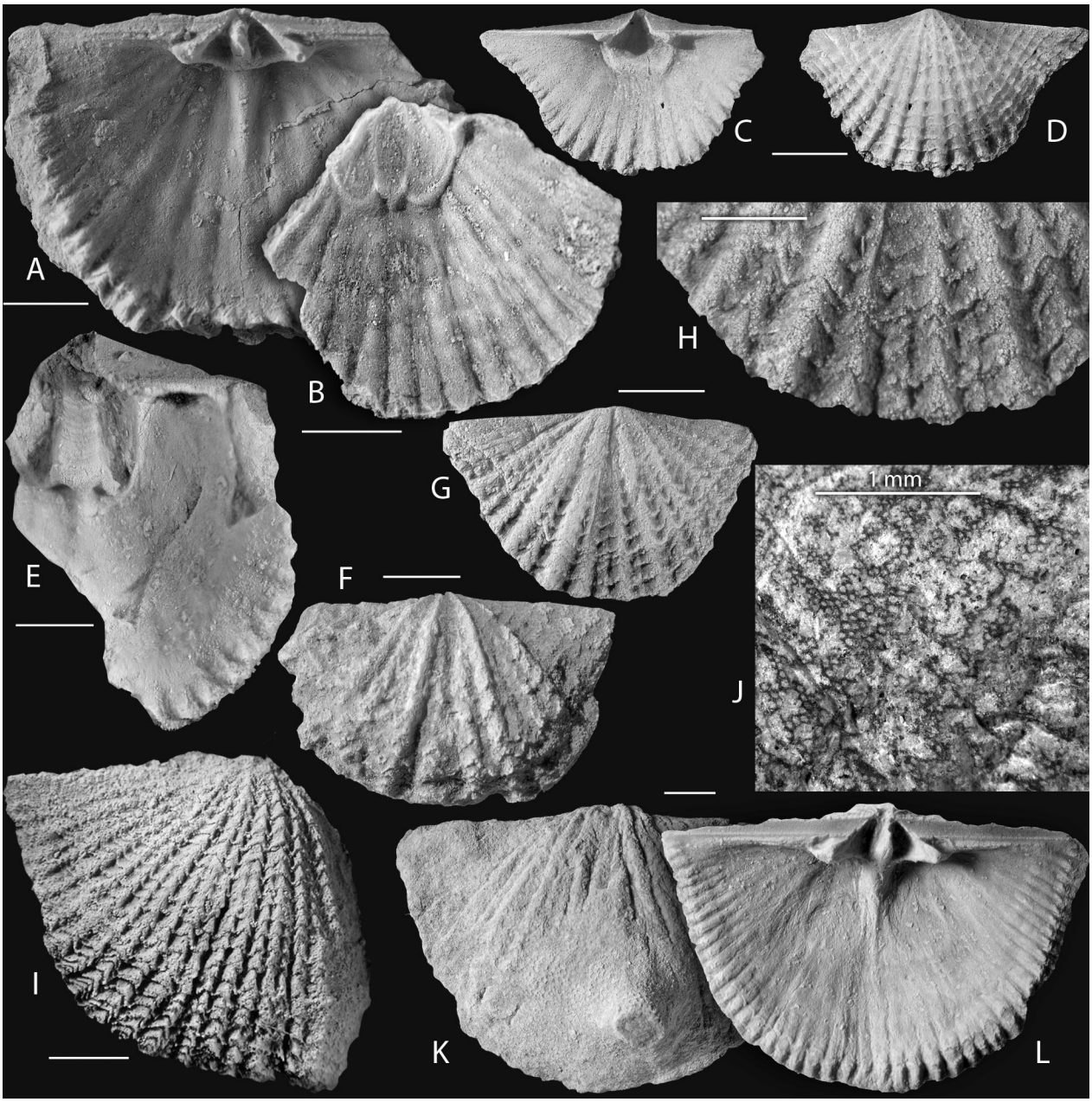

Fig. 4. A–H, *Bassettella alata* sp. nov. **A**, **E**, interior of dorsal valve GIT 595-15 and ventral valve GIT 595-16; northern part of the Vasalemma quarry, Vasalemma Formation, Keila Stage. **B–D**, interior of incomplete ventral valve GIT 595-3 and interior and exterior of ventral valve GIT 595-4; Keila, Jõhvi Substage of the Haljala Stage. **F**, exterior of dorsal valve GIT 595-17, Vasalemma settlement, close to the former tavern, Vasalemma Formation, Keila Stage. **G**, **H**, exterior and detail of the external sculpture of dorsal valve GIT 595-13; boring No. 772, depth 10.8 m; Vasalemma Formation, Keila Stage. **I–L**, *Bassettella gracilis* Zuykov & Butts. I, J, views of incomplete ventral valve and pitted sculpture TUG 37-15; Kiikla, Jõhvi Substage of the Haljala Stage. **K**, **L**, exterior and interior of dorsal valve TUG 72-3; Alliku, Jõhvi Substage of the Haljala Stage. Scale bars 2 mm, except in J.

Fig. 3. *Bassettella alata* sp. nov. **A–E**, complete shell GIT 595-1, holotype; ventral, dorsal, lateral, anterior and posterior views; northern part of the Vasalemma quarry, Keila Stage, Vasalemma Formation. **F–L**, damaged shell GIT 595-2; ventral, dorsal, posterior, anterior and lateral views, and details (K, L) showing the external sculpture on the postero-lateral edge and central part of the dorsal valve; Keila, Jõhvi Substage of the Haljala Stage. **M–O**, dorsal valve GIT 595-6, exterior and interior of the valve and view of the antero-lateral part of the valve edge; Vasalemma settlement, close to the former tavern, Vasalemma Formation, Keila Stage.

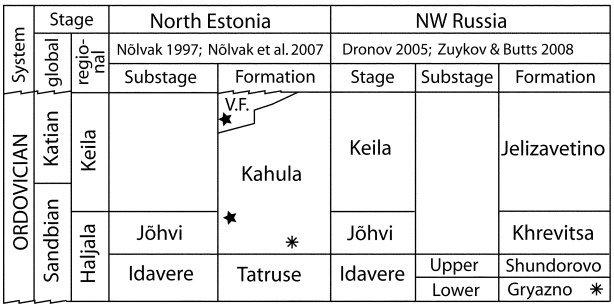

Fig. 5. Correlation of stratigraphical units and distribution of *Bassettella gracilis* Zuykov & Butts (marked by asterisks) and *B. alata* sp. nov. (marked by pentagons). V.F. – Vasalemma Formation; the indented line marks incompletely shown stratigraphical units.

depth 10.6 m – small shell, depth 10.8 m – dorsal valve; No. 714, depth 10.95 m – incomplete dorsal valve. Jõhvi Substage of the Haljala Stage: Keila – 2 ventral valves and 1 complete shell.

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REFERENCES

Cooper, G. A. 1956. Chazian and related brachiopods. *Smithsonian Miscellaneous Collections*, **127** (I–II), 1–1245, pls 1–269. Smithsonian Institution, Washington.

Dronov, A. 2005. Ordovician of St. Petersburg Region. In *6th Baltic Stratigraphical Conference. Cambrian and Ordovician of St. Petersburg Region. Guidebook of the Pre-Conference Field Trip* (Dronov, A., Tolmacheva, T., Raevskaya, E. & Nestell, M., eds), pp. 5–9. Saint Petersburg.

Hansen, J. 2008. Upper Ordovician brachiopods from the Arnestad and Frognerkilen formations in the Oslo-Asker district, Norway. *PALAEONTOS*, **13**, 1–99.

Hints, L. 1990. Vasalemma quarry. In *Field Meeting Estonia 1990. An Excursion Guidebook* (Kaljo, D. & Nestor, H., eds), pp. 128–131. Tallinn.

Hints, L. & Meidla, T. 1997. Keila Stage. In *Geology and Mineral Resources of Estonia* (Raukas, A. & Teedumäe, A., eds), pp. 74–76. Estonian Academy Publishers, Tallinn.

Jin, J., Zhan, R. Copper, P. & Caldwell, W. G. E. 2007. Epipunctae and phosphatized setae in Late Ordovician plaesiomyid brachiopods from Anticosti Island, Eastern Canada. *Journal of Paleontology*, **81**, 666–683.

Männil, R. 1950. *Materjale Viru ja Harju seeria piirilademete (D_I–E) stratigraafiast* [*Materials on the Stratigraphy of the Boundary Stages (D_I–E) between the Viru and Harju Series*]. Manuscript, Institute of Geology, Tallinn, 286 pp. [in Estonian].

Nõlvak, J. 1997. Ordovician. Introduction. In *Geology and Mineral Resources of Estonia* (Raukas, A. & Teedumäe, A., eds), pp. 52, 54–55. Estonian Academy Publishers, Tallinn.

Nõlvak, J., Hints, O., Männik, P. & Pärnaste, H. 2007. Ordovician time scale in Estonia. *Acta Palaeontologica Sinica*, **46** (Suppl.), 351–356.

Põlma, L., Sarv, L. & Hints, L. 1988. *Litologiya i fauna tipovykh razrezov Karadokskogo yarusa v Severnoj Éstonii* [*Lithology and Fauna of the Type Sections of the Caradoc Series in Northern Estonia*]. Valgus, Tallinn, 101 pp. [in Russian, with English summary].

Schuchert, C. & Cooper, G. A. 1931. Synopsis of the brachiopod genera of the suborders Orthoidea and Pentameroidea, with notes on the Telotremata. *American Journal of Science* (series 5), **22**, 241–255.

Williams, A. 1962. The Barr and Lowe Ardmillian Series (Caradoc) of the Girvan District, South-West Ayrshire, with descriptions of the Brachiopoda. *Geological Society of London. Memoir*, **3**, 1–267, Pls VI–XXY.

Williams, A. & Brunton, C. H. C. 1997. Morphological and anatomical terms applied to brachiopods. In *Treatise on Invertebrate Paleontology, Part H: Brachiopoda, Vol. 1: Revised* (Kaesler, R. L., ed.), pp. 423–440. Geological Society of America and University of Kansas Press; Boulder, Colorado, and Lawrence, Kansas.

Wright, A. D. 1981 The external surface of *Dictyonella* and other pitted brachiopods. *Palaeontology*, **24**, 443–481.

Zhan, R. & Jin, J. 2005. Brachiopods from the Middle Ordovician Shihtzupu Formation of Yunnan Province, China. *Acta Palaeontologica Polonica*, **50**, 365–393.

Zuykov, A. M. & Butts, S. H. 2008. *Glyptorthis* (Foerste, 1914) and *Bassettella* new genus (Brachiopoda: Orthida) from the Late Ordovician of the East Baltic. *Journal of Paleontology*, **82**, 197–200.

Uus glyptortiidi liik (Brachiopoda: Orthida) Eesti Ülem-Ordoviitsiumist

Linda Hints

On kirjeldatud uus liik *Bassettella alata*, mis esindab omapärase välise skulptuuriga brahhiopoodi sugukonnast Glyptorthidae. Põhja-Eestis esinev liik ilmub Haljala lademe Jõhvi vöös. Liigi noorimad esindajad on teada Vasalemma kihistu alumisest Keila vanusega osast. *B. alata* on noorem perekonna tüüpliigist *B. gracilis* Zuykov & Butts, mis ilmub Venemaa loodeosas Haljala lademe alumisse ossa kuuluvas Gryazno kihistus. Perekond *Bassettella* liikide levik näitab selle taksoni levila läänesuunalist nihet ajas.