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Taxonomy of the Sandbian (Upper Ordovician) brachiopod *Dalmanella kegelensis* Alichova, 1953 and the new genus *Alichovella*

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ABSTRACT

The brachiopod species *Dalmanella kegelensis* Alichova, 1953 is reported in the geological literature of the Baltic region as a species characteristic of the Keila Regional Stage at the Sandbian–Katian transition, and a nominal taxon of a regional biozone. The spatial distribution of *D. kegelensis* forms a belt around the deeper parts of the palaeobasin. The easternmost occurrences of *D. kegelensis* have been recorded at the westernmost periphery of the Moscow Basin. The selection of the holotype of the species *D. kegelensis* from a locality in western Estonia caused some confusion in understanding Alichova's species, since the description of the species is mainly based on brachiopods collected from northwestern Russia. The earlier attempt to revise the taxonomy of *D. kegelensis* group brachiopods was unsustainable, while assigning these brachiopods to the genus *Horderleyella* is no longer feasible. However, two subspecies were identified, which are discussed here as two separate species, *kegelensis* and *oanduensis*, belonging to two different genera: one species belongs to the new genus *Alichovella* in the family Draboviidae, and the second one, following Alichova's classification, to the genus *Dalmanella* in the family Dalmanellidae. These species possibly represent somewhat different ages prior to the beginning of the Guttenberg carbon isotope excursion and supposedly differ in their positions on the onshore-offshore transect.

Introduction

The brachiopod species *Dalmanella kegelensis* Alichova, 1953 has attracted attention due to its potential for biostratigraphy at the Sandbian–Katian transition in the shallow shelf environments of the Baltic Basin. Alichova's species co-occurs with species common in the older strata (*Clinambon anomalus* Schlotheim, *Estlandia pyron silicificata* Öpik, *Leptaena rugosoides* Oraspõld and some other species) and with several short-living species occurring only in the Keila Regional Stage (RS). Examples include, besides *Dalmanella kegelensis* (*sensu* Alichova), two strophomenide species *Strophomena* (*Keilamena*) *occidens* (Oraspõld) and *Longvilia asmusi* (Verneuil) (Alichova 1953; Rõõmusoks 2004, 2010). Alichova (1953, 1960) used the species *D. kegelensis* as an index taxon of the regional biozone in the Keila RS, occurring below the ostracode '*Leperditia*' zone (Lutkevich 1939; Fig. 1). In an earlier study, Alichova (1953) did not accept the Oandu Stage as a chronostratigraphic unit and correlated corresponding strata with the '*Leperditia*' zone (Fig. 1). However, later this zone was not used in the stratigraphic charts (Alichova 1960).

The similarity of the Late Sandbian brachiopod fauna, which includes *D. kegelensis*, across northern Estonia and northwestern (NW) Russia is evident from Alichova's monographic studies as well as from overviews on Baltic Ordovician faunas in general (Alichova 1953, 1969; Männil 1958; Rõõmusoks 1970). *D. kegelensis* (*sensu lato*) is reported from the westernmost transitional part of the Moscow Basin (see the Pestovo section in Dmitrovskaya 1991).

The taxonomic revision of Alichova's species *Dalmanella kegelensis* pointed out two groups of brachiopod shells, differing in shell size, convexity, and interior of valves. These two varieties were identified as two subspecies and included unsuccessfully in the genus *Horderleyella*, family Harknessellidae (Hints 1975). The large size and evenly convex ventral valve of the studied brachiopods distinguish them from harknessellids, which have smaller shells with a clearly carinate ventral valve. The only large harknessellid brachiopods in the East Baltic (Estonia, Latvia and

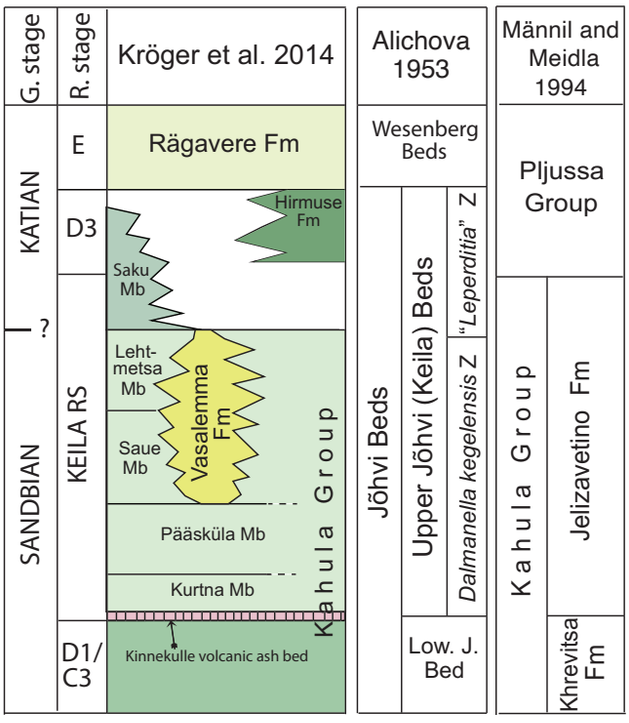

Fig. 1. Stratigraphic units at the Sandbian–Katian transition in Estonia and correlation with the units identified by Alichova in 1953 and 1960. Abbreviations: G. stage – global stage, R. stage – regional stage (RS), E – Rakvere RS, D3 – Oandu RS, D1/C3 – Haljala RS, Fm – formation, Mb – member, Low. J. Bed – Lower Jõhvi Bed, Z – zone.

Lithuania) belong to the genus *Reuschella* in the lowermost Katian Oandu and Hirnantian Porkuni RSs (Hints 1975, 2012; Paškevičius 1997).

New materials from different parts of the East Baltic and NW Russia provide an opportunity to review the earlier affiliation of genera and species level taxa of the *Dalmanella kegelensis* group brachiopods. Alichova's description of the species *Dalmanella kegelensis* was mainly based on data from St. Petersburg and neighbouring districts in NW Russia (Alichova 1953). Taxonomic confusion arose in the choice of the holotype of *D. kegelensis* from the Saue locality (Friedrichshof, the original German name of the locality) in western Estonia. The holotype and conspecific specimens with large subquadrate to suboval shells from western Estonia constitute a group, which was identified as the subspecies *Horderleyella kegelensis kegelensis* (Hints 1975). The subcircular dalmanellide-type shells from the easternmost parts of the studied region were included (ibid.) in the subspecies *H. kegelensis oanduensis*. In the present study, the subspecies are defined as separate species, designated according to the name-bearing types (ICZN 2000, art. 72) as *kegelensis* and *oanduensis*. The first species belongs to a new genus *Alichovella*, erected here and assigned to the family Draboviidae (superfamily Enteletoidea Waagen, 1884). The dalmanellide-type shells were, following Alichova, included in the genus *Dalmanella.* Both species occur in strata that were formed before the facies and faunal turnover in the Late Sandbian, marked also by changes in the carbon isotope composition (Ainsaar and Meidla 2001; Ainsaar et al. 1999; see p. 53).

Material

The present study is based on collections comprising about 360 specimens obtained from the outcrops and drill cores in the East Baltic and NW Russia, including around 100 specimens which are part of the collection (GIT 207) described by Hints in 1975. The brachiopods were collected from about 30 localities (Fig. 2), complemented by previously published data (Ropot and Pushkin 1987; Dmitrovskaya 1991; Paškevičius 1997). The original specimens, described by Alichova, were studied at the TsNIGRI museum in St. Petersburg.

The studied brachiopods are housed at several institutions: the Department of Geology, Tallinn University of Technology, Estonia (collections GIT 207, 877 and 716; institutional abbreviation GIT), the Natural History Museum, University of Tartu, Estonia (institutional abbreviation TUG), and the F. N. Chernyshev Central Geological Scientific Research and Exploration Museum (TsNIGRI) in St. Petersburg (collection 7135 studied by Alichova in 1953). The specimens from Latvia belong to the Latvian Museum of Natural History, Riga (collection LDM G 328), and Lithuanian specimens are housed at Vilnius University.

Systematic palaeontology

Class RHYNCHONELLATA Williams, Carlson, Brunton, Holmer & Popov, 1996
Order ORTHIDA Schuchert & Cooper, 1932
Suborder DALMANELLIDINA Moore, 1952
Superfamily ENTELETOIDEA Waagen, 1884
Family DRABOVIIDAE Havlíček, 1950
Subfamily DRABOVIINAE Havlíček, 1950
Genus *Alichovella* gen. nov.

1953 *Dalmanella* (pars); Alichova, pp. 57–60.

1975 *Horderleyella* (pars); Hints, pp. 71–73.

Derivation of name. After the distinguished palaeontologist Tatyana Alichova (1912–2007), who investigated the Ordovician brachiopods and stratigraphy of the East Baltic and NW Russia.

Type species. Alichovella kegelensis (Alichova 1953), Keila RS, Upper Sandbian, East Baltic and NW Russia.

Species assigned. *Alichovella kegelensis* (Alichova 1953).

Diagnosis. Large biconvex shell, with equally convex valves in adults. Outline subquadrate to semioval, anterior commissure parasulcate to undulating, ornament fascicostellate to ramicostellate, with posterior costa parallel to posterior edge of valves. Interspaces on dorsal valve, capillae common, hollow costae rare. Ventral muscle field trapezoidal or heart-shaped. Diductor scars elongate, bounded by dental plates extending anteriorly. Dorsal muscle field with triangular posterior scars extending laterally of brachiophore bases, anterior adductor scars subquadrate. Notothyrial platform narrow, rhomboidal, cardinal process bilobate, myophore finely crenulated. Shaft merges with septa on notothyrial platform, joining with myophragm. Brachiophore plates

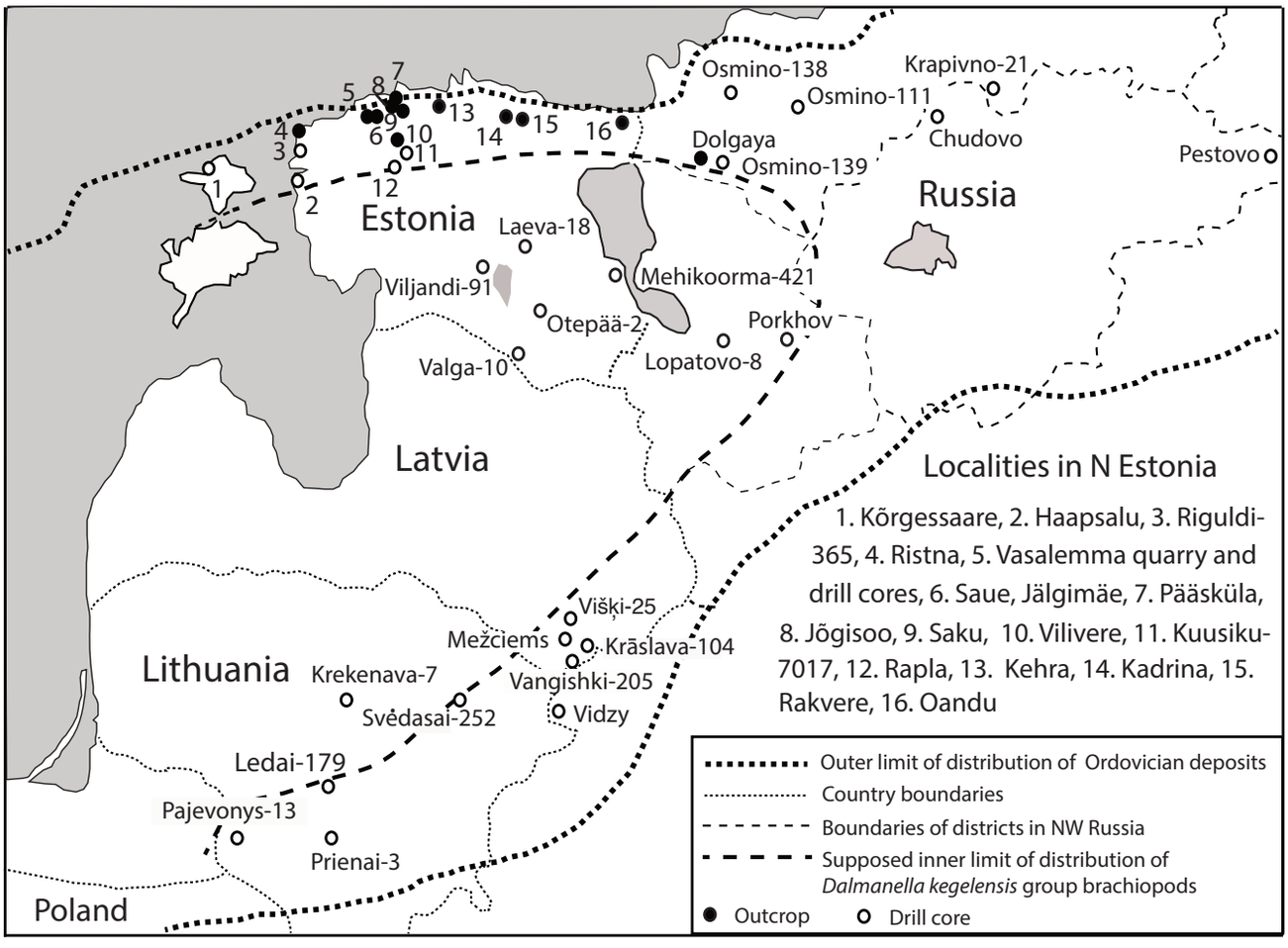

Fig. 2. Localities of the distribution of *Dalmanella kegelensis* group brachiopods in the East Baltic and NW Russia.

convergent. Endopores very fine, occurring on rib crests and interspaces (Fig. 6U).

Species included. Alichovella kegelensis (Alichova 1953), uppermost Sandbian, Keila RS, East Baltic and NW Russia.

Comparison. The new genus differs from both *Dalmanella* and *Horderleyella* by its larger shell size, approximately equal convexity of valves, and the absence of a markedly carinate middle part on the ventral valve. *Alichovella* has convergent brachiophore plates, whereas divergent plates are common in most of the Dalmanellinae. The new genus has the closest similarity with the brachiopods of the subfamily Draboviinae (superfamily Enteletoidea), especially with the genus *Pionodema*, represented by several species in northern America (*P. minnesotensis*, *P. subaequata*, *P. circularis*; Schuchert and Cooper 1956). A few species are also known from Europe (*P. girvanensis*, *P.* cf. *subaequata*, *P. retusa*; Williams 1962; Mitchell 1977; Harper 1984; Cocks 2008; Candela 2003). The brachiopods of the genus *Pionodema* are similar to the new genus by their valve convexity and interior features of the dorsal valve (Cooper 1956). The new genus differs from the genus *Pionodema* in having a wider hinge-line, a shorter ventral muscle field, and a smaller number of radial ribs. In Estonia, the younger early Sandbian (Oandu RS) Draboviinae brachiopod species of *Oanduporella* and *Pionodema* (Hints 1975) share similarities with *Alichovella* in terms of shell shape, ornamentation and dorsal interior structures. However, they differ in their smaller size and the presence of a mesh-like microsculpture between the costae.

Distribution. Uppermost Sandbian Keila RS, East Baltic and NW Russia.

***Alichovella kegelensis* (Alichova, 1953)**

Fig. 3; Fig. 4A–I; Fig. 5A–J, O; Fig. 6A–E, J, P, R, U

?1890 *Dalmanella testudinaria*; Gagel, p. 32, pl. 2, figs 9, 10.

1953 *Dalmanella kegelensis* sp. nov. (pars); Alichova, pp. 57–60, pl. 6, figs 1–3.

1975 *Horderleyella kegelensis kegelensis* (Alichova); Hints, pp. 71–73, pl. 18, figs 1–18, text-figs 38, 39.

Holotype. Shell 7135/78, TsNIGRI, Alichova, 1953, pl. 6, figs 1a–e, Saue (Friedrichshof), Keila RS, NW Estonia.

Diagnosis (emended). Large, semioval to subquadrate biconvex shell, with equally convex valves in adults. Anterior commissure weakly parasulcate to undulating. Ornament fascicostellate to ramicostellate, with up to 90 costae and costellae; 6–9 costae and costellae intercalate with 2–5 capillae on 5 mm along anterior edge, 12–16 fine equal-sized costellae on 5 mm of postero-lateral edges. Posterior costae subparallel to posterior edges of valve, interspaces on dorsal valve.

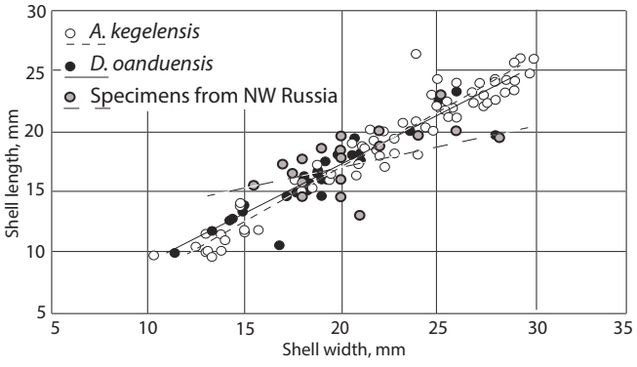

Fig. 3. Measurements and trend lines of changes of the *D. kegelensis* group brachiopods.

Ventral valve: delthyrial chamber trapezoidal or heart-shaped, ventral muscle field bilobate, occupying about 0.3 of valve width and 0.4 of valve length, with narrow adductor between diductors. Dorsal valve: notothyrial platform narrow, anteriorly elongate trapezoidal, brachiophore plates converge anteriorly, joining with myophragm. Cardinal process relatively small, bilobate. Myophore finely granulated. Shaft stout, continues anteriorly as septum, which joins with short myophragm. Dorsal adductor scars reach up to mid-length of valve length and about 1/3 of valve width, triangular posterior scars delimited posteriorly by dental plates. Microstructure finely punctate (Fig. 6U).

Description. **Shell** large, with maximum width of about 30 mm at midline, 0.8 as long as wide (variation 0.71–0.97), 0.5 as thick as wide, thickness of shell about 0.6 of shell length. Valves of equal convexity or ventral valve slightly more convex, dorsal valve with anteriorly flattened middle part. Hinge line straight, attaining 0.6–1 of valve width. Cardinal angles quadrate or rounded, anterior commissure rectimarginate to slightly paraculcate or undulating (Hints 1975, fig. 38A).

Ornamentation ramicostellate, with 16–18 costae around umbo, fascicostellate on anterior half of valve. New costellae appear by bifurcation, 6–9 costae and costellae with 2–6 capillae on 5 mm of anterior margin, 12–16 fine equal-sized costellae on 5 mm of postero-lateral edges. Primary posterior costae located subparallel to posterior edge of valve throughout or more than half of length of hinge line. Dorsal valve with interspaces. Costellae appear in three to four generations, with some asymmetry in arrangement. Up to 90 ribs occur along shell edges.

Ventral valve moderately convex with flattened postero-lateral parts, middle part undulates radially. Length of valve forms 0.8 of shell width. Umbo curved posteriorly, beak small, interarea concave up to 3 mm wide, apsacline; delthyrium triangular, open. Teeth triangular, with dorsally turning tops, crural plates variably developed; dental plates extend anteriorly as bounding ridges, which delimit the trapezoidal or heart-shaped delthyrial chamber. Elongate bilobed muscle field attains about 0.4 of valve length and less than 0.3 of shell width. Diductors narrow, elongate, adductor field narrow, shorter of diductors. Exterior ribbing expressed on interior surface around valve edge or up to middle part of valve.

Dorsal valve of adult specimens equally convex with ventral valve, low depression in posterior part flattens anteriorly. Interarea anacline to orthocline, almost flat to weakly concave. Notothyrial platform narrow, trapezoidal, delineated by brachiophores and triangular brachiophore plates, which merge with myophragm on anterior part of platform. Cardinal process triangular bilobed, myophore of tiny granulation. Shaft attains about 1/3 of length of notothyrium, widens anteriorly as septum, which merges with short myophragm. Fulcral plates undercut, forming bases of sockets below interarea. Dorsal posterior scars triangular, separated by transverse septa from oval anterior scars. Shell microstructure finely punctate, pores with pyritic fillings visible in crests and interspaces of ribs (Fig. 6). Some hollow ribs apparent on few growth lines.

Comparison

The species *A. kegelensis* comprises the largest share of specimens within Alichova's *Dalmanella kegelensis* group. The specimens from NW Russia display higher variation in the length/width ratio (Fig. 3), with the measured specimens representing a composite *Dalmanella kegelensis* group, where exact species level identification is complicated due to poor preservation. Nevertheless, among specimens from certain drill core sections (Osmino-139 and Osmino-111), fragments of ventral valves are present, characterised by narrow, bilobed and relatively long diductor scars. These specimens could be attributed to the species *A. kegelensis* (Fig. 5D, F, H). However, insufficient detailed data on the distribution of *A. kegelensis* and *D. oanduensis* in NW Russia prevent the assessment of potential differences in their ages, as is the case with specimens from Estonia (Hints and Nõlvak 2023).

The species *Horderleyella alichovae* from the Goraevka Formation (Oandu–Rakvere RS; Männil and Meidla 1994), located in Podolia in the southern part of the East European Platform, is with its shorter hinge line and finer ornament (Tsegelnyuk 1976) more similar to *D. oanduensis* than to *A. kegelensis*, with which it was compared by Tsegelnyuk.

Outside the East Baltic, the species *Alichovella kegelensis* exhibits similarities with Sandbian species *Pionodema girvanensis* (Davidson) from the Girvan District, southwestern Scotland (Williams 1962). However, it differs from *P. girvanensis* in its larger size, subquadrate outline and longer hinge line. *A. kegelensis* is most similar to *Pionodema subaequata* (Conrad) from the Decorah Formation (Cooper 1956). Both species have large shells, with *A. kegelensis* reaching a maximum width of up to 30 mm and *P. subaequata* up to 25 mm.

The rather similar interiors of both valves of *A. kegelensis* and *P. subaequata* can be distinguished by the trapezoidal and narrow notothyrial cavity, less divergent brachiophore bases and trapezoidal or heart-shaped ventral muscle field of the Baltic species, instead of the subtrigonal, anteriorly widening

Fig. 4. A–I – ***Alichovella kegelensis*** **Alichova, 1953**, Keila RS, N Estonia: A, B – shell, GIT 207-237, ventral and dorsal views, ditch in Jõgisoo, N Estonia; C–G – shell, GIT 207-95, exterior views and view of ribbing pattern on postero-lateral margin (D1), ditch in Saue, NW Estonia; H – ventral valve, GIT 207-428, Kõrgessaare drill core, depth 49.57–49.62 m, NW Estonia; I – ventral valve, GIT 207-193, Jälgimäe, N Estonia. **J–U** – ***Dalmanella oanduensis*** **Hints, 1975**, Keila RS, Estonia, NW Russia: J–M – shell, GIT 207-101, holotype, exterior views, Oandu, NE Estonia; N–Q – shell, GIT 207-460, exterior views and view of ribbing pattern on postero-lateral margin of dorsal valve (O1); R – posterior view of shell, TUG 76-122, Kehra, N Estonia; S–T – ventral valves, GIT 207-391 and GIT-398, with view of ribbing pattern on postero-lateral margin of valve (T1), localities on the River Dolgaya, NW Russia; U – dorsal valve, GIT 207-409, localities on the River Dolgaya, NW Russia. The scale for A–U is 5 mm; for D1, O1 and T1, the scale is shown separately for a better overview.

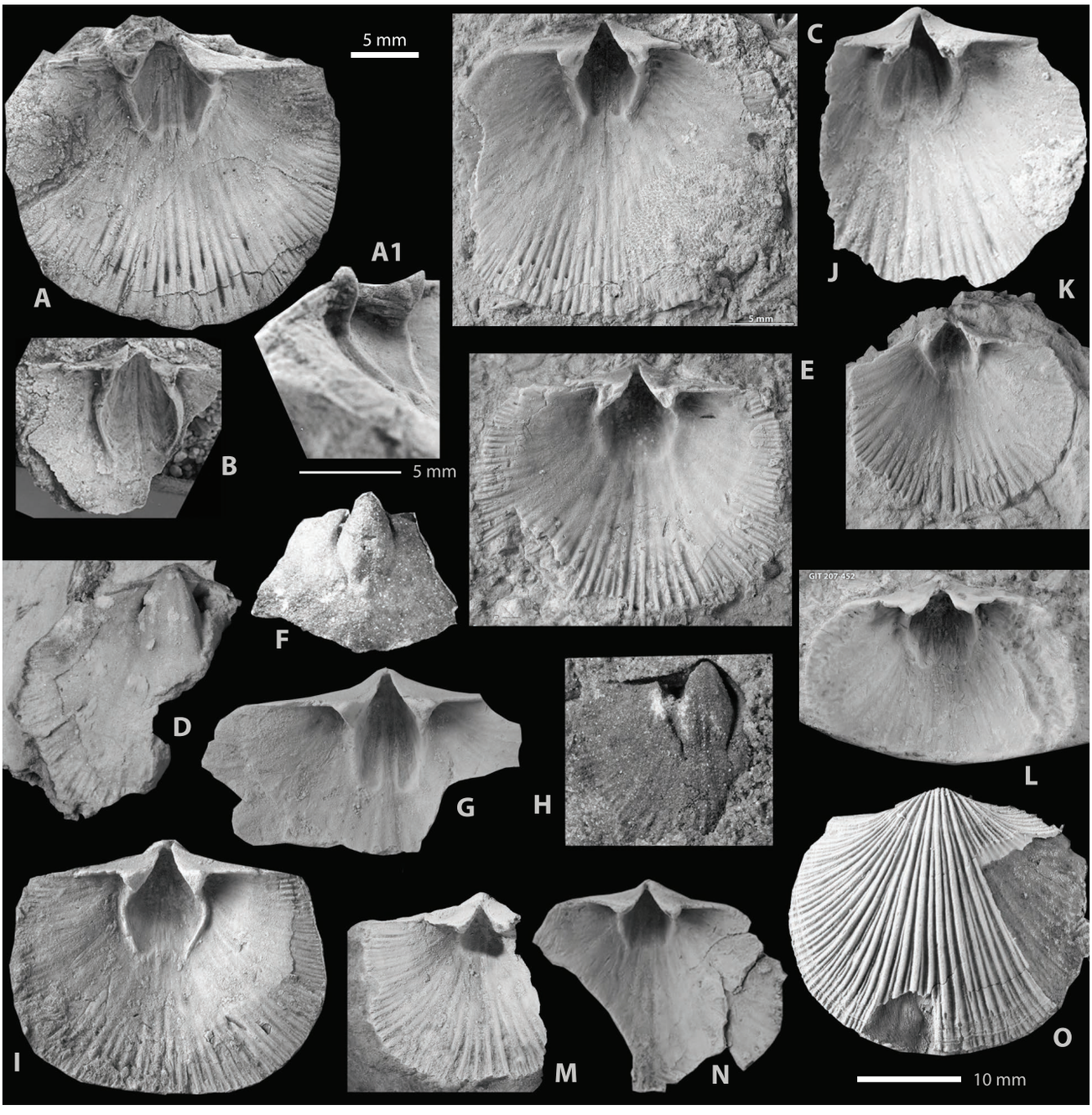

Fig. 5. A–D, F–J – ***Alichovella kegelensis* Alichova, 1953**, Keila RS, N Estonia: A, A1 – ventral interior and view of delthyrial chamber, GIT 207-96, ditch in Saue, NW Estonia; B – fragment of ventral valve, view of delthyrial chamber, GIT 207-97, ditch in Saue; C – interior of ventral valve, GIT 207-1950, ditch in Saue; D – mould of ventral valve, GIT 877-32, Osmino-111 drill core, depth 36.1 m, NW Russia; F – mould of fragment of ventral valve, GIT 877-12, Osmino-139 drill core, depth 46.3–46.5 m, NW Russia; G – fragment of ventral valve, GIT 207-472, Vasalemma (Partek) quarry, W Estonia; H – mould of ventral valve, GIT877-27, Osmino-139 drill core, depth 46.3–46.5 m, NW Russia; I – interior of ventral valve, GIT 207-2006, Vasalemma (Partek) quarry, W Estonia; J – interior of ventral valve, TUG 39-699, Jälgimäe, N Estonia. **E, K–O** – ***Dalmanella oanduensis* Hints, 1975**, Keila RS, East Baltic: E – ventral valve, GIT 207-2065, Kuusiku-7017 drill core, depth 16.18 m, N Estonia; K – interior of ventral valve, GIT 207-2065, Oandu, NE Estonia; L – interior of ventral valve, GIT 207-452, Višķi-25 drill core, depth 544.3 m, E Latvia; M – interior of ventral valve, GIT 877-16, Osmino-111 drill core, depth 48.1–48.2 m, NW Russia; N – interior of ventral valve, GIT 716-458, Pajevonys-13 drill core, depth 1202 m, SW Lithuania; O – ventral valve, LDM G382-170, Krāslava-104 drill core, depth 414 m, E Latvia. The scale for A–N is 5 mm, shown separately for A1 for a better overview; the scale for O is 10 mm.

notothyrial cavity, divergent brachiophore bases and relatively long bilobed ventral diductor scars characteristic of the American species. The latter species has more numerous and finer ribbing than the Baltic *A. kegelensis*. Cooper (1956) has noted that *P. subaequata* could be a composite species, as it is represented by two types of shells, some with rectangular and others with subcircular outlines. This is reminiscent of Alichova's species *Dalmanella kegelensis*, which is divided here into two separate species.

The new species differs from the American species *P. circularis* Winchell, 1895 and *P. minnesotensis* Cooper, 1930 in its larger size, less convex valves, the trapezoidal shape of the notothyrial platform, and the radial ornament with a smaller number of costae and costellae arranged in

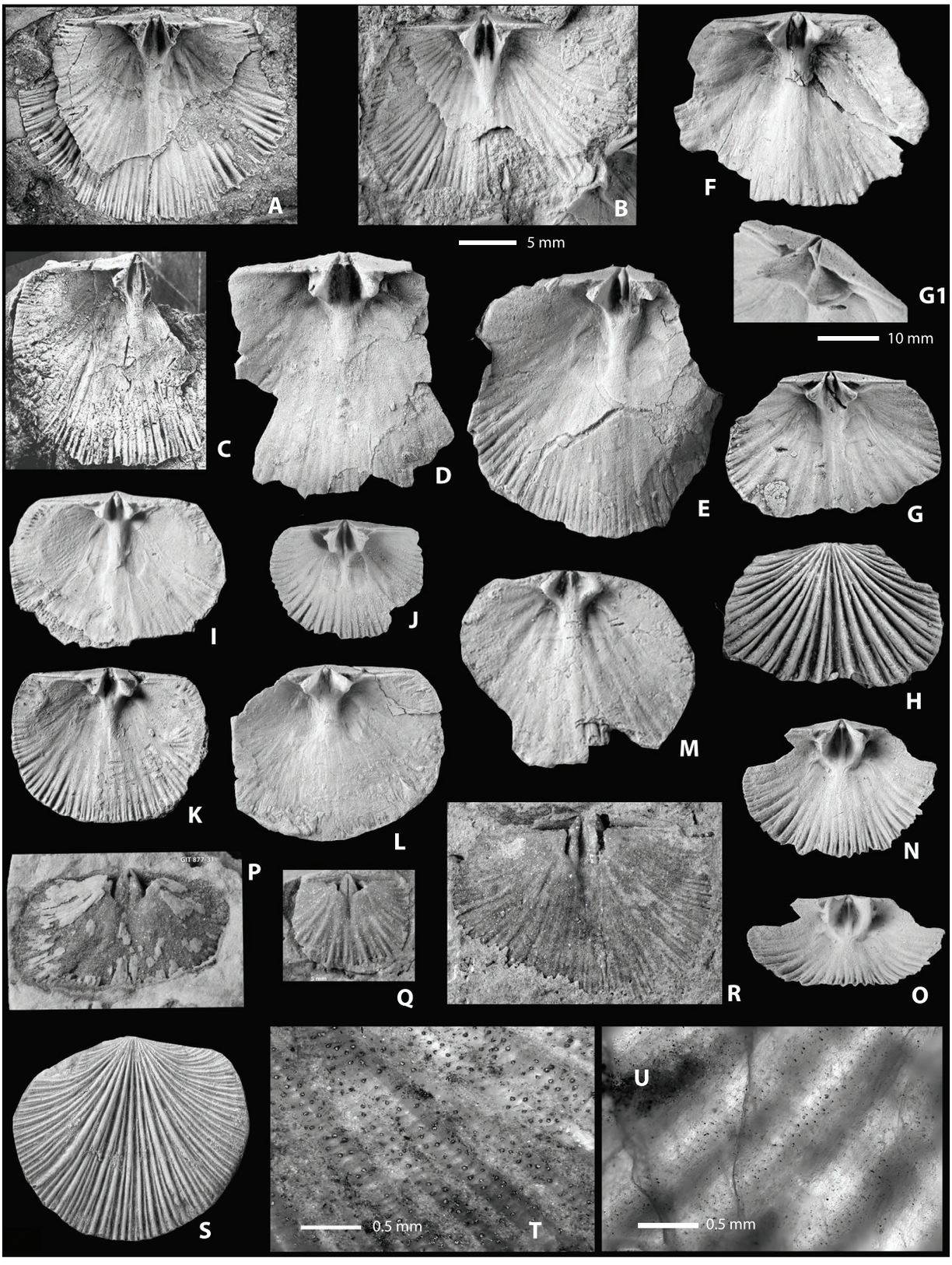

Fig. 6. A–E, J, P, R, U – ***Alichovella kegelensis*** **Alichova, 1953**, Keila RS, N Estonia: A, C – interiors of dorsal valves, GIT 207-99 and GIT 207-98, Saue, NW Estonia; B – interior of dorsal valve, GIT 207-1951, Kanama, N Estonia; D, E – interiors of dorsal valves, GIT 207-472 and GIT 207-556, Vasalemma, NW Estonia; J – interior of dorsal valve, TUG 74-340, Jälgimäe, N Estonia; P – mould of dorsal valve, GIT 877-6, Osmino-111, depth 42.4 m, NW Russia; R – mould of dorsal interior, GIT 877-3, Osmino-139, depth 47.1 m; U – microstructure of valve, GIT 207-457, Jälgimäe outcrop, N Estonia. **F–I, K–O, Q, S, T** – ***Dalmanella oanduensis*** **Hints, 1975**, Keila RS, N Estonia: F – interior of dorsal valve, TUG 74-343, Oandu, NE Estonia; G, G1, H – interior of dorsal valve, lateral and exterior views, GIT 207-103, Oandu, NE Estonia; I, K – interior of dorsal valve, GIT 207-412 and GIT 207-411, River Dolgaya, NW Russia; L – interior of dorsal valve, GIT 207-527, Haapsalu drill core, W Estonia; M – interior of dorsal valve, B016, Ledai-179 drill core, depth 879.9 m, Lithuania; N, O – ventral and anterior views of dorsal interior, GIT 207-463, Oandu, NE Estonia; Q – mould of dorsal interior, GIT 877-36, Osmino-111, depth 36.1 m, NW Russia; S, T – exterior of dorsal valve, GIT 207-604, shell structure with pyritic pores, Kuusiku-7017 drill core, depth 16.13–16.18 m, N Estonia. The scale for A–S is 5 mm, the scale for G1 is 10 mm, and the scale for T and U is 0.5 mm.

bundles. The hollow costae observed in the American species are rare in the Baltic species. For comparison with *D. oanduensis*, see below.

Occurrence and localities. The species *Alichovella kegelensis* occurs in the Late Sandbian Keila RS in the Estonian and Lithuanian shelves (Harris et al. 2004) and in shallow shelf environments towards the Moscow Basin (Fig. 2).

Occurrences in northern Estonia: 1. Ditch in Jõgisoo Village (on the 21st km of the Tallinn–Pärnu Road), 2. Vasalemma (Partek) quarry, 3. Rummu quarry, 4. Pääsküla outcrop, 5. Jälgimäe old quarry, 6. Saue (Friedrichshof) old quarry (type locality) and Kanama, 7. Saue-Kirsimäe quarry, 8. Saku old quarry, 9. Kehra old quarry, 10. Vilivere old outcrop, 11. ?Kadrina, 12. ?Rakvere temporary outcrops. Drill cores in Estonia: 13. Ardu, 14. Kõrgessaare, 15. Riguldi-365. Drill cores in Latvia: 16. Krāslava-104, 17. Mežciems. Drill cores in Lithuania: 18. ?Prienai-3, 19. Krekenava-7, 20. Svėdasai-252 (Paškevičius 1997), 21. Pajevonys-13 (Hints et al. 2016). Drill cores in NW Russia: 22. Osmino-139, 23. Osmino-111, 24. Krapivno-21, 25. Pestovo (Dmitrovskaya 1991).

Order ORTHIDA Schuchert & Cooper, 1932
Suborder DALMANELLIDINA Moore, 1952
Family DALMANELLIDAE Schuchert, 1913
Subfamily DALMANELLIDINA Schuchert, 1913
Genus *Dalmanella* Hall & Clarke, 1892

***Dalmanella oanduensis* Hints, 1975**
Fig. 3; Fig. 4J–U; Fig. 5E, K–N; Fig. 6F–I, L–T

?1951 *Dalmanella* aff. *testudinaria* (Dalman); Alichova, pp. 40, 41, pl. 3, figs 44–46.

?1953 *Dalmanella kegelensis* sp. nov.; Alichova, pp. 57–61, pl. 6, figs 6, 7.

1975 *Horderleyella kegelensis oanduensis* subsp. nov.; Hints, pp. 73, 74, pl. 19, figs 1–13, text-figs 38, 39 (the name *oaduensis* on p. 73 is an erratum, the name *oanduensis* should be used instead, based on the name of the River Oandu).

Holotype. Shell, GIT 702-101 (old number Br 4259), northeastern Estonia, locality in Oandu Village; Fig. 4J–M (Hints 1975, pl. 19, figs 1–5, not pl. 22).

Diagnosis. Relatively large for Dalmanellidae, subcircular shell, ventri-biconvex to nearly planoconvex. Hinge line attains on average about 0.7 of valve width. Ornament fascicostellate to ramicostellate, 12–16 ribs appear around umbo, 3–8 posterior ribs recurve posteriorly. Dorsal valve with interspaces in rib arrangement. Notothyrial platform triangular, brachiophore plates anteriorly U-shaped. Bilobed cardinal process small, finely crenulated. Shaft short on elevated notothyrial platform.

Description. **Shell** subcircular, maximum length 22.5 mm and width 25.1 mm, average length/width ratio 0.84, ventri-biconvex to nearly planoconvex, with shallow sinus on middle of dorsal valve, about half as thick as shell length. Hinge line attains on average 0.67 (variation 0.46–0.81) of shell width, cardinal angles rounded, anterior commissure sulcate.

Ornamentation fascicostellate to ramicostellate, with median costae on ventral and interspace on dorsal valve. 14–16 costae appear around umbo, 3–8 posterior ribs recurved backward. About 80 costae and costellae occur along margins. Costae increase in number by bifurcation at three orders. First-order costellae appear at 1/3 of valve length, second-order bifurcation occurs at middle and third-order bifurcation in anterior part of valve. Sector median costae on ventral valve comprises up to 8 lower-order costellae. Exterior ornamentation expressed on inner valve surface.

Ventral valve with greatest convexity in posterior half, uniformly round in posterior view. Umbo weakly incurved, beak small, interarea concave apsacline, up to 2 mm wide. Delthyrium open, teeth small, short dental plates almost vertical. Muscle field oval, about 1/3 as long as valve length, and about 1/4 as wide as valve width, with adductor and diductor scars of same length.

Dorsal valve weakly convex, with anteriorly widening sinus on posterior part. Cardinal process on notothyrial platform with bilobed, faintly crenulated myophore with swollen anterior parts, wedged shaft short. Fulcral plates raised from valve floor, forming the bottom of socket pits. Brachiophore plates merge with notothyrial platform, appearing U-shaped in anterior view. Diductor muscle scars on both sides of myophragm reaching anteriorly up to middle of valve. Anterior adductors scars suboval, equal to or slightly longer than subtriangular posterior scars. Shell microstructure punctate, with relatively large pores having pyritized filling (Fig. 6T).

Comparison. The described species exhibits a subcircular outline, with an interspace on the dorsal valve. Anteriorly subparallel dental plates, bounding a small cordatae muscle field, and a delicate cardinal process with a bilobed myophore are characteristic of the genus *Dalmanella* (Jin and Bergström 2010). The species *Dalmanella oanduensis* is similar to taxa within the family Dalmanellidae, especially to the species of genera *Onniella*, *Paucicrura* and *Cincinnetina*, based on the shell outline and strongly recurved posterior ribs. However, species of the genus *Onniella* differ from the new species in having widely divergent brachiophores and subquadrate shells, with some species, such as *O. depressa* and *O. broeggeri* (Hurst 1979), possessing costae along the posterior margin. On the other hand, species of the genus *Paucicrura* feature a trilobed cardinal process instead of a bilobed one as seen in the described species. The genus *Cincinnetina* is distinguished by the interspace in ribbing on the dorsal valve, which is considered as a genus level diagnostic feature (Jin 2012).

Most of the specimens classified as *Dalmanella oanduensis* from the outcrops along the River Dolgaya differ from *Alichovella kegelensis* by smaller size, shorter anteriorly widening notothyrial cavity, almost equal sizes of anterior and posterior adductor scars on the dorsal valve, flat to weakly convex dorsal valve, and posterior ribs inclined towards the posterior edge (Fig. 4S–U). In Belarus, *Horderleyella kegelensis oanduensis* has been reported in the

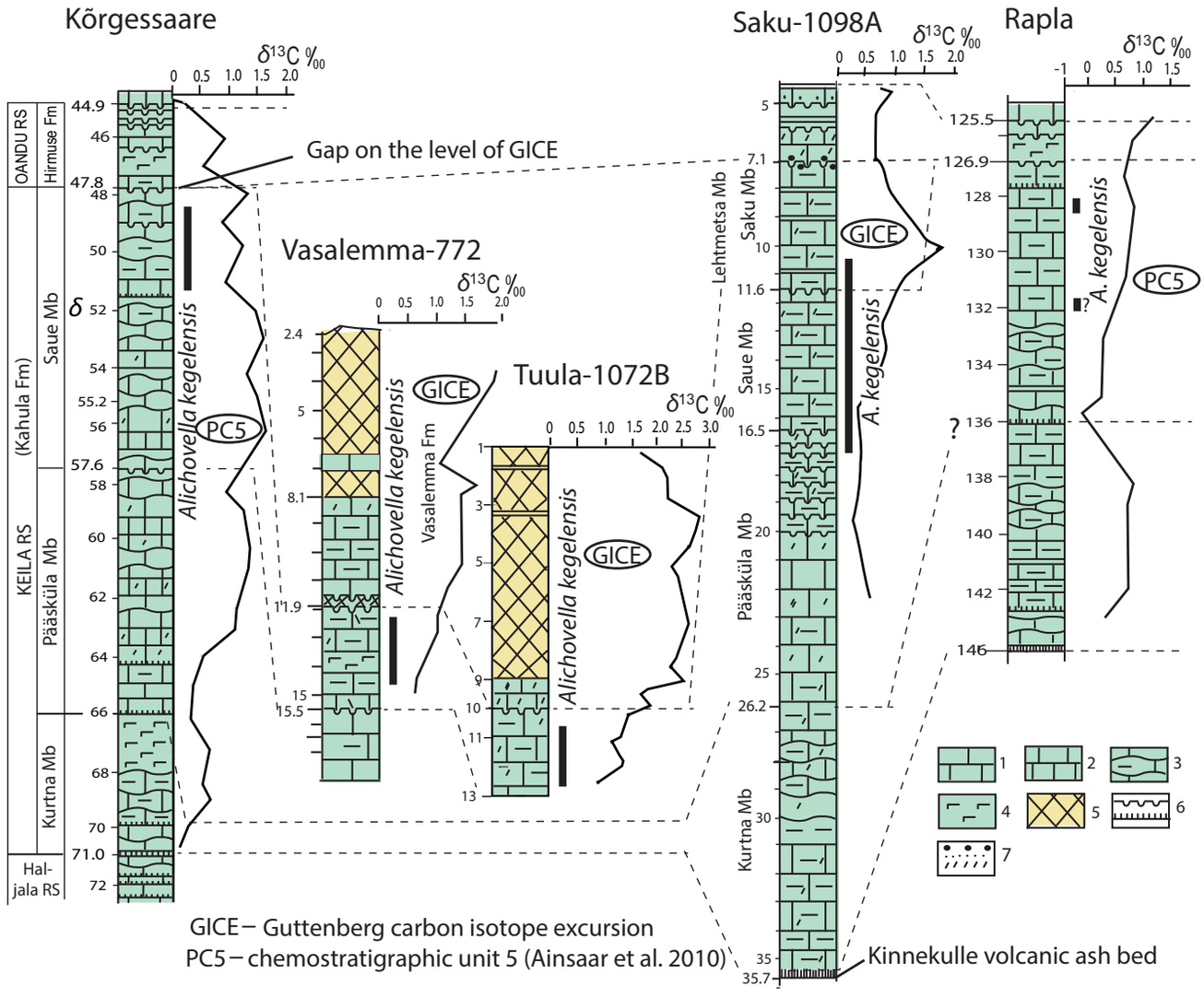

Fig. 7. Distribution of *Alichovella kegelensis* (Alichova) in the drill cores of NW Estonia and carbon isotope curves (Kaljo et al. 2004; Kröger et al. 2004). Legend for logs: 1 – limestone, 2 – micritic to peloidal limestone, 3 – nodular argillaceous limestone, 4 – marl, 5 – (top down) discontinuity surface, volcanic ash bed, 6 – biodetrital, 7 – (top down) pebbles, admixture of sand.

Keila RS (Vidzy and Vangishki-205 core sections; Ropot and Pushkin 1987) but no figures have been published. In Lithuania, this species is associated with the Oandu and Rakvere RSs (Paškevičius 1997), which is uncommon for the rest of the region. At least some specimens (B022 and B023, Taučionys-49 drill core, depth 425.95 m), labelled as *Horderleyella kegelensis oanduensis* from the Oandu RS, belong to the species *Howellites? wesenbergensis vilniusensis* (Alichova in Alichova et al. 1954), rather than to *D. oanduensis*.

Occurrence. Later Sandbian, Keila RS. In Estonia: outcrops in the Oandu Village and Kehra, Haapsalu (Hints 1975) and Kuusiku drill cores; in Latvia: Višķi-25 and Krāslava-104 drill cores; in Lithuania: Pajevonys-13 (Hints et al. 2016), Krekenava-7 and Svėdasai-252 drill cores; in NW Russia: outcrops along the left bank of the River Dolgaya, Osmino-139 and Osmino-111 drill cores. Additional localities are mentioned by Alichova (1953).

Distribution range of the brachiopod *Alichovella kegelensis* relative to the GICE curve

The stratigraphic position of *Alichovella kegelensis* is aligned with changes in the composition of chitinozoans in two sections located in western Estonia (Hints and Nõlvak 2023). The species *Alichovella kegelensis* (Fig. 4H) and *Dalmanella oanduensis* (Fig. 6L) are associated with chitinozoans of different species compositions, which may be attributed to age differences or differences in environments. On the background of isotopic curves in the Kõrgessaare drill core and neighbouring sections in western Estonia, *Alichovella kegelensis* is positioned in the isotope zone BC6 (Ainsaar et al. 2010) below the Guttenberg carbon isotope excursion (GICE; Bergström et al. 2011). The species disappears before the turnover of facies and faunas at the Sandbian–Katian transition (Meidla et al. 1999). Comparable data on the isotopes and distribution of *D. oanduensis* are missing yet.

Based on Estonian data, *A. kegelensis* occurs in more carbonate-rich sediments than *D. oanduensis*, which probably indicates their dependence on facies and/or differences in their position within the facies succession.

The distribution of a similar draboviid brachiopod in the latest Sandbian of the East Baltic and in the Decorah Formation, comprising the Guttenberg Member with GICE (Ludvigson et al. 1996) in Laurentia, indicates faunal relationships between these two palaeocontinents.

Conclusions

1. The species *Dalmanella kegelensis* Alichova, 1953 was revised first by Hints in 1975. The affiliation of *kegelensis* group brachiopods together with two subspecies *kegelensis kegelensis* and *kegelensis oanduensis* to the genus *Horderleyella* was not sustainable.
2. A new genus *Alichovella* is established here, with the type species originally described by Alichova as *Dalmanella kegelensis*. The holotype of this species was identified by Alichova from the section in the Saue Member of the Keila RS in western Estonia. The second subspecies, *kegelensis oanduensis*, is identified here as a separate species of the genus *Dalmanella*, following Alichova's interpretation of the *kegelensis* group brachiopods.
3. *Alichovella kegelensis* and possibly *Dalmanella oanduensis* occur in the upper half of the Keila RS, below the GICE.
4. The Baltic enteletoidean species *A. kegelensis* is similar to the Laurentian species *Pionodema subaequata*, which also occurs below GICE. Cooper (1956) noted that among specimens of *P. subaequata*, some exhibit a more rounded outline. However, the occurrence of transitional morphologies in some areas suggests that this difference represents intraspecific variability. In the Baltic region, specimens with a circular outline are classified here as *Dalmanella oanduensis*.
5. Poor preservation of palaeontological material due to dolomitization has complicated the species level taxonomic identification of *kegelensis* group brachiopods in the sections of NW Russia. To enhance the integration of Russian data with Estonian data in the future, detailed sampling of sections and studies of carbon isotopic composition will be crucial. Such investigations could provide more precise insights into the occurrences of species and relations with environmental changes.

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Sandby (Ülem-Ordoviitsiumi) brahhiopoodi *Dalmanella kegelensis* Alichova, 1953 taksonoomia ja uus perekond *Alichovella*

Linda Hints

Alichova kirjeldatud brahhiopoodi liik *Dalmanella kegelensis* on tuntud kui Ülem-Ordoviitsiumi Keila lademele iseloomulik liik Baltikumis ja Loode-Venemaal. Liigiga seotud taksonoomilised probleemid ilmnesid esmalt kahe alamliigi eritlemisel ja nende ebaõnnestunud lisamisel perekond *Horderleyella* koosseisu. Käesolevas revisjonis lähtuti liigi identifitseerimisel selle holotüübist (tüüpeksemplar), mis liigi autori järgi pärineb Lääne-Eestist Sauelt ja erineb oluliselt idapoolsetest eksemplaridest. Tüübiga sarnaste eksemplaride kogum eristub suure koja ja siseehituse tunnuste poolest. Revisjon võimaldas varem alamliikidena eritletud taksonid tõsta liigi staatusesse ning eritleda uut perekonda *Alichovella*, tüüpliigiga *Alichovella kegelensis* Alichova, 1953. Viimase holotüübiks on eksemplar, mille valis Alichova liigile *Dalmanella kegelensis*. Teine osa esialgsest liigist lisati Alichova eeskujul perekonda *Dalmanella* ja vastava liigi (*Dalmanella oanduensis*) tüüpeksemplariks on valitud eksemplar Kirde-Eestist Oandu piirkonnast.

Andmed kirjeldatud liikide leviku kohta viitavad võimalusele, et need liigid on kas mõnevõrra eriaegsed või kuuluvad fatsiaalselt erinevatesse vööndidesse. *Alichovella kegelensis*'e leviku andmete ja Keila lademe kivimite isotoopkoostise võrdlemisel ilmnes, et see liik eksisteeris enne suuri ökoloogilisi muutusi paleobasseinis, mistõttu suri välja suurem osa basseini elustikust, mis Keila eale järgneval Oandu eal asendus uute kooslustega. Seda markeerib ka isotoopkoostise muutus, mis on tuvastatud nii Balti paleobasseinis kui ka erinevatel paleokontinentidel.