Ordovician strophomenoid brachiopods of northern Estonia

Arvo Rõõmusoks

Fossilia Baltica 3

Institute of Geology, University of Tartu

Institute of Geology, University of Tartu

Ordovician strophomenoid brachiopods of northern Estonia

Arvo Rõõmusoks

Tartu 2004

Fossilia Baltica is a monograph series established in 1986 by the Academy of Sciences of the Estonian SSR. Its further volumes have been supported by the Institute of Geology, University of Tartu, Institute of Geology, Tallinn (present Institute of Geology, Tallinn University of Technology) and Estonian Academy of Sciences.

This publication can be ordered from: Institute of Geology, University of Tartu, Vanemuise 46, Tartu 51014 Estonia (by e-mail: Ivar.Puura@ut.ee, Tonu.Meidla@ut.ee).

ISSN 1406-0728
ISBN 9985-4-0412-2

Previous publications in the *Fossilia Baltica* series:

Fossilia Baltica 1 - Märss, Tiiu, 1986. Silurian Vertebrates of Estonia and West Latvia, Academy of Sciences of the Estonian SSR. Institute of Geology, Tallinn, Valgus, 104 pp., 36 plates (in Russian). (Requests to: Marss@gi.ee).

Fossilia Baltica 2 - Meidla, Tõnu, 1996. Late Ordovician Ostracodes of Estonia, Institute of geology, University of Tartu, Tartu, 222 pp., 32 plates. (Requests to: Tonu.Meidla@ut.ee).

Recommended reference to this publication:

Rõõmusoks, Arvo, 2004. Ordovician strophomenoid brachiopods of northern Estonia. *Fossilia Baltica* 3, Institute of Geology, University of Tartu, Tartu, 151 pp., 34 plates.

ABSTRACT

Brachiopods of the superfamily Strophomenoidea from the Viru and Harju Series of the Ordovician of northern Estonia are described, including 31 genera (7 new) with 65 species (22 new) and. In the family Strophomenidae, Subfamily Strophomeninae is represented by 8 genera (Table 3), of which *Leigerina* and *Saxbyonia* are new. Subfamily Furcitellinae is represented by 10 genera (Table 4), of which *Kukrusena*, *Haljalanites*, *Sakunites* and *Crassoseptaria* are new. In the family Rafinesquinidae, subfamily Rafinesquininae is represented by 4 genera (Table 5), of which *Virunites* is new, and subfamily Leptaninae by 9 genera (Table 6).

This publication has been supported by grants from the Estonian Science Foundation (No. 4574) and Estonian Academy of Sciences (to the author).

Edited by Ivar Puura

CONTENTS

INTRODUCTION

The Ordovician brachiopod fauna of northern Estonia is dominated by representatives of two orders: Orthida and Strophomenida. The taxonomy of the orthids is rather well known, whilst the strophomenid genera and species have been less studied. This work is dedicated to the brachiopod superfamily Strophomenoidea. The aim of this study is to describe new taxa and to present a systematic revision of strophomenoids from the Ordovician of northern Estonia. The studied collection is deposited at the Museum of Geology, University of Tartu and has new catalogue numbers (TUG). New and previous catalogue numbers (GMUT) are referred to in the systematic part, where relevant. Other figured and discussed comparative material is in the Estonian Museum of Natural History, Tallinn (Eesti Loodusmuuseum, ELM), the Palaeontological Museum in Oslo (Paleontologisk Museum, Oslo, PMO), the Swedish Museum of Natural History, Stockholm (Naturhistoriska Riksmuseet, RM), and Palaeontological Institute of the Russian Academy of Sciences, Moscow (PIN). In the systematic part of this monograph, only a brief reference is given to localities by their names. Brief descriptions and co-ordinates of the type localities of the new species and references to the author's previous stratigraphic work, where most of the studied sections have been described are given in the appendix. Most of the photographic work was carried out by the author.

The first description and drawings of a strophomenoid brachiopod species from Estonia was published by the French palaeontologist Edouard de Verneuil (1845). This species – *Orthis asmusi*, revised here as *Longvillia asmusi* (Verneuil) – occurs in the limestones of the Keila Stage. Friedrich Schmidt (1858, 1881, 1908) mentioned some strophomenoids in his works, but did not include any species descriptions. Further new species were described by Bekker (1921, 1924), Öpik (1930a,b, 1937), Alichova (1951), Sokolskaya (1954) and Oraspõld (1956). Oraspõld (1956) published some descriptions by Ralf Männil in a manuscript version (referred to as [Männil MS] in Oraspõld, 1956 in the synonymies here). The most recent list of strophomenoid genera was given by Rõõmusoks (in Hints & Rõõmusoks, 1997).

The author of the present monograph started the study and revision of strophomenoids back in 1949. Some results of this work have been published in a series of papers (Rõõmusoks, 1956, 1963, 1985, 1989, 1991, 1993a,b,c). This monograph includes a revision of previous and description of new taxa, altogether 31 genera (Table 1) and 65 species, of which 7 genera and 22 species are new.

The systematics of the superfamily Strophomenoidea follows the Treatise on Invertebrate Paleontology (Cocks & Rong, 2000). The described genera are assigned to two families and four subfamilies. In the family Strophomenidae King, the subfamilies Strophomeninae and Furcitellinae are represented by 8 and 11 genera respectively. In the family Rafinesquinidae Schuchert, the subfamilies Rafinesquininae and Leptaeninae are represented by 4 and 9 genera respectively. In the descriptions of the genera, the description of the type species of the genus is followed by the description of other species according to their stratigraphic position from the oldest to the youngest.

The origin and phylogeny of the Ordovician strophomenoids from northern Estonia remains unsolved, because the related taxa from relevant neighbouring regions, especially Scandinavia, are rather poorly known. Some strophomenoid taxa from Norway have been described by Holtedahl (1916) and Spjeldnaes (1957), and some Swedish taxa by Bergström (1968). According to present knowledge, it can be suggested that most of the Ordovician strophomenoid taxa of northern Estonia are likely to have been endemic.

Some North Estonian species (e.g. *Panderites imbrex* Pander) are known to occur in Ingria, NW Russia. Some other species from Ingria, e.g. *Oepikina? inaequalis* and *O. subaequalis* described by Alichova (1951) are likely related to Estonian species and genera. However, as the current state of knowledge about them (poor illustrations, no interiors known) is not sufficient for making any definite comparisons at species and generic level, these questions are left outside the scope of the present work, which is focused on the collections from North Estonia.

Table 1. Strophomenoid genera in the Viru and Harju Series of northern Estonia.

Series	Viru								Harju			
Regional stages and their indices	C_1a	C_1b	C_1c	C_{II}	C_{III}-D_I	D_{II}	D_{III}	E	F_1a	F_1b	F_1c	F_{II}
	Aseri	Lasnamägi	Uhaku	Kukruse	Haljala	Keila	Oandu	Rakvere	Nabala	Vormsi	Pirgu	Porkuni
Strophomeninae												
Actinomena Öpik				+					?			
Keilamena Rõõmusoks						+						
Longvillia Bancroft						+						
Holtedahlina Foerste							+	+	+		+	
Pseudostrophomena Rõõmusoks								+	+			
Leigerina gen. nov.										+		
Saxbyonia gen.nov.										+	+	
Rugomena Rõõmusoks											+	
Genus and species undet.												+
Furcitellinae												
Panderites Rõõmusoks	+											
Tallinnites Rõõmusoks			+									
Bekkerina Rõõmusoks			+	+								
Kukrusena gen. nov.				+								
Haljalanites gen. nov.					+							
Sakunites gen. nov.							+					
Trigrammaria Wilson							+	+				
Geniculina Rõõmusoks								+	+	+	+	
Crassoseptaria gen. nov.									+			
Luhaia Rõõmusoks											+	
Rafinesquininae												
Kjaerina Bancroft							+					
Virunites gen. nov.							+					
Rakverina Rõõmusoks							+	+				
Pirgumena Rõõmusoks										?	+	
Leptaeninae												
Septomena Rõõmusoks		+	+	+	+	+						
Estonomena Rõõmusoks		+	+	+								
Kurnamena Rõõmusoks				+	+	+	+					
Astamena Rõõmusoks					+							
Oandumena Rõõmusoks							+					
Similoleptaena Rõõmusoks							+	+	+	+	+	
Harjumena Rõõmusoks									+			
Bekkeromena Rõõmusoks									+	+	+	
Schmidtomena Rõõmusoks												+

Geological setting

Estonia is situated in the north-western part of the East European Craton. Structurally, it includes the northern part of the southern slope of the present Fennoscandian Shield, which extends to the northern flanks of the Baltic Syneclise and the Latvian Saddle, and is bordered by the Valmiera-Lokno uplift in the south. The Proterozoic crystalline basement is covered by Neoproterozoic (Vendian) to Devonian sedimentary rocks, cropping out as successively younger sublatitudinal belts (Fig. 1), owing to a very gentle dip (0.1-0.3°) to the south (Sildvee & Vaher, 1995; Puura & Vaher, 1997). The Quaternary cover is of variable thickness, usually not exceeding 10 m in northern Estonia, where the Ordovician rocks crop out.

Ordovician facies maps of the Palaeobaltic basin were first drawn by Männil (1966). Based on the relatively stable facies configuration of the basin throughout the post-Tremadocian Ordovician, Jaanusson (1976) developed the concept of confacies belts. According to this, the northern part of the distribution area of the Ordovician rocks belongs to the North Estonian Confacies Belt (Jaanusson, 1976, 1995), which is represented mostly by carbonate rocks: limestone, marl and dolomite (Fig. 2). All the material of this study originates from these carbonate rocks in northern Estonia (see the appendix, Fig. 3, p. 76).

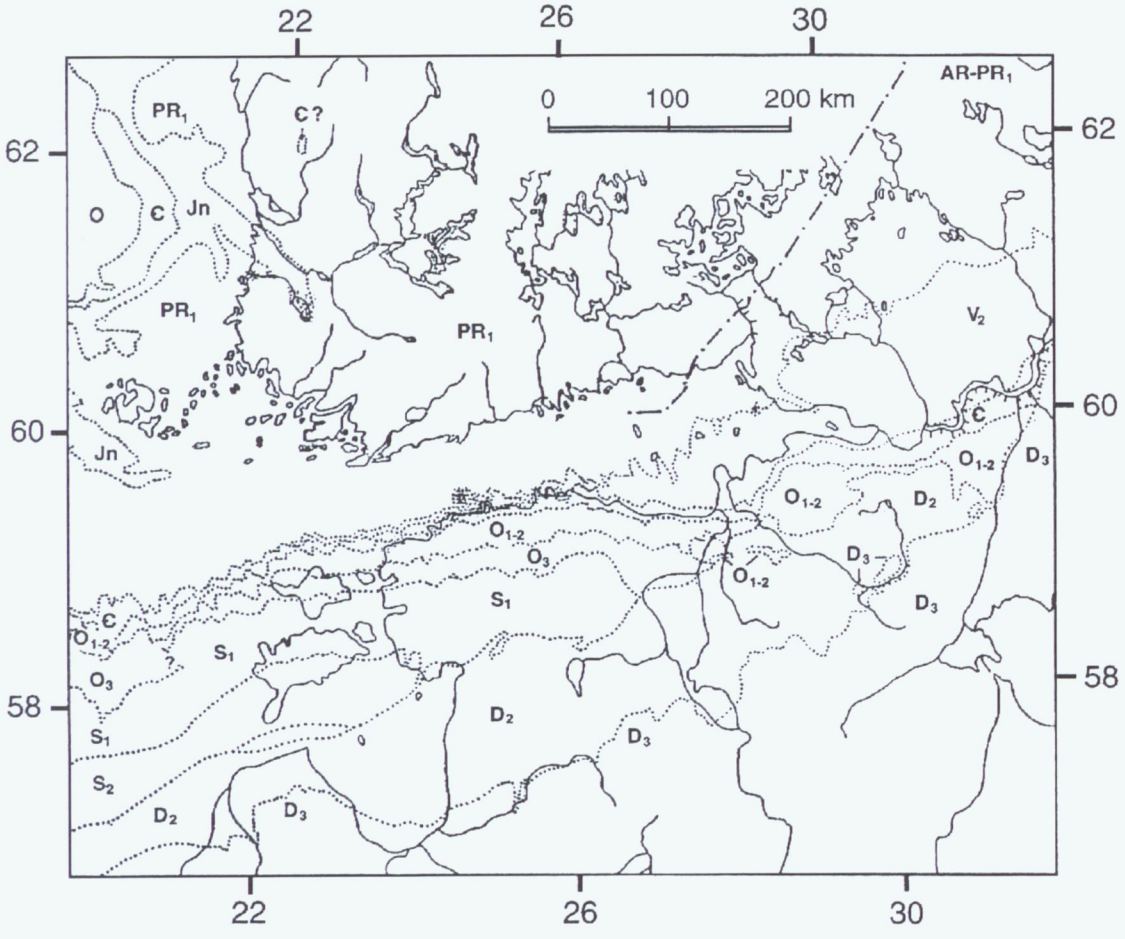


Figure 1. Generalized bedrock map of Estonia and adjacent areas (modified after Vaher et al., 1992). Legend: PR_1 – Proterozoic crystalline basement, V_2 – Upper Vendian, C – Cambrian, O_1-O_2 – Öland and Viru Series and O_3 – Harju Series of the Ordovician, S_1-S_2 – Silurian, D_1-D_3 – Devonian.

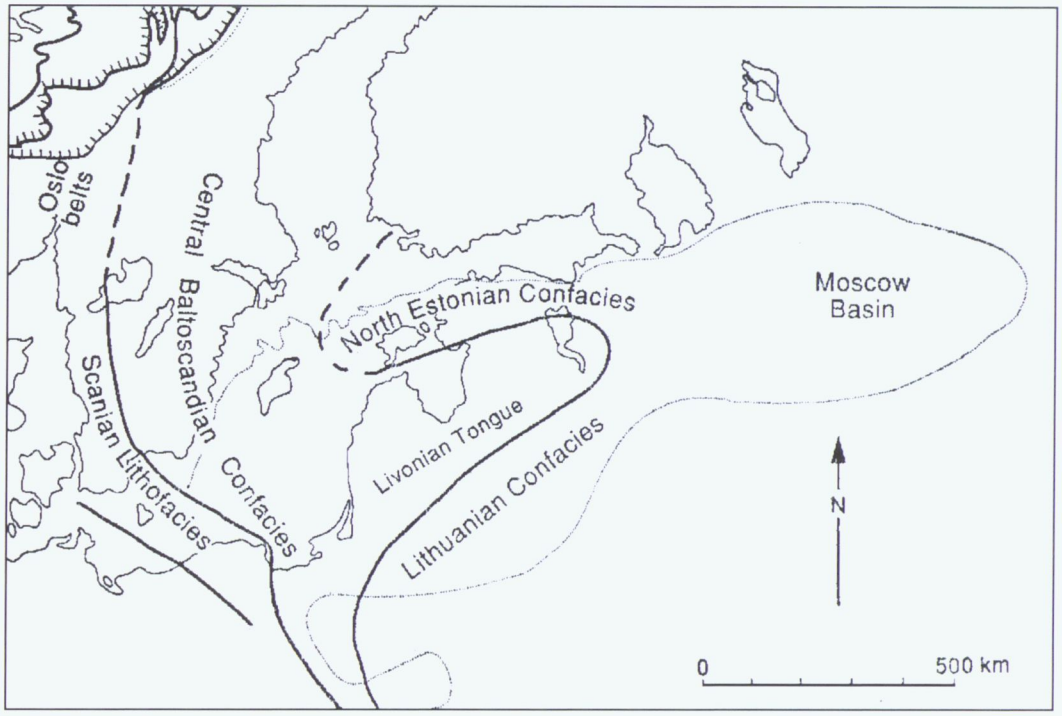


Figure 2. Distribution of Ordovician post-Tremadocian confacies belts in the Baltoscandian palaeobasin (after Jaanusson, 1995).

Stratigraphy

The Ordovician stratigraphy of Estonia established by Friedrich Schmidt (1858, 1881) was based on observations of outcrops in northern Estonia. The names of Schmidt's stratigraphical units were derived from place names in Estonia in the German language. Schmidt's units were lithologically characterized, but had a biostratigraphic basis, and were further (e.g., Männil, 1990; Männil & Meidla, 1994) used as a framework for developing the stratigraphic subdivision based on regional chronostratigraphic units termed regional stages (Table 2A). Examples include, from the oldest to the youngest, the interval from the Aseri to the Uhaku Stage (Echinosphaerites limestone, Schmidt, 1881, p. 23), the Kukruse Stage (Kukersche Schicht or Brandschiefer of Schmidt, 1881, p. 10), the interval from the Haljala to the Keila Stage (Jewe'sche Schicht of Schmidt, 1858, p. 49), the interval from the the Rakvere to the Nabala Stage (Wesenberg'sche Schicht. Schmidt, 1858, p. 49), the interval from the Vormsi to the Pirgu Stage (Lyckholm'sche Schicht, Schmidt, 1858, p. 50; Jaanusson, 1956), and the Porkuni Stage (Borkholm'sche Schicht, Schmidt, 1858, p. 51). Bekker (1921) was the first to use the Estonian versions of these place names for these stratigraphic units, although he defined the units somewhat differently.

Lithostratigraphic studies began with the work of Orviku (1940), and several formations and members were established later. A tripartite subdivision of the Ordovician into Öland, Viru and Harju Series (Jaanusson, 1945; Kaljo, Rõõmusoks, Männil, 1958) represented the original concept of "lower", "middle" and "upper" Ordovician in Baltoscandia. Remane (2003), based on Webby (1998 and further work), has presented the most recent correlation of these units with global Early, Middle and Upper Ordovician subsystems.

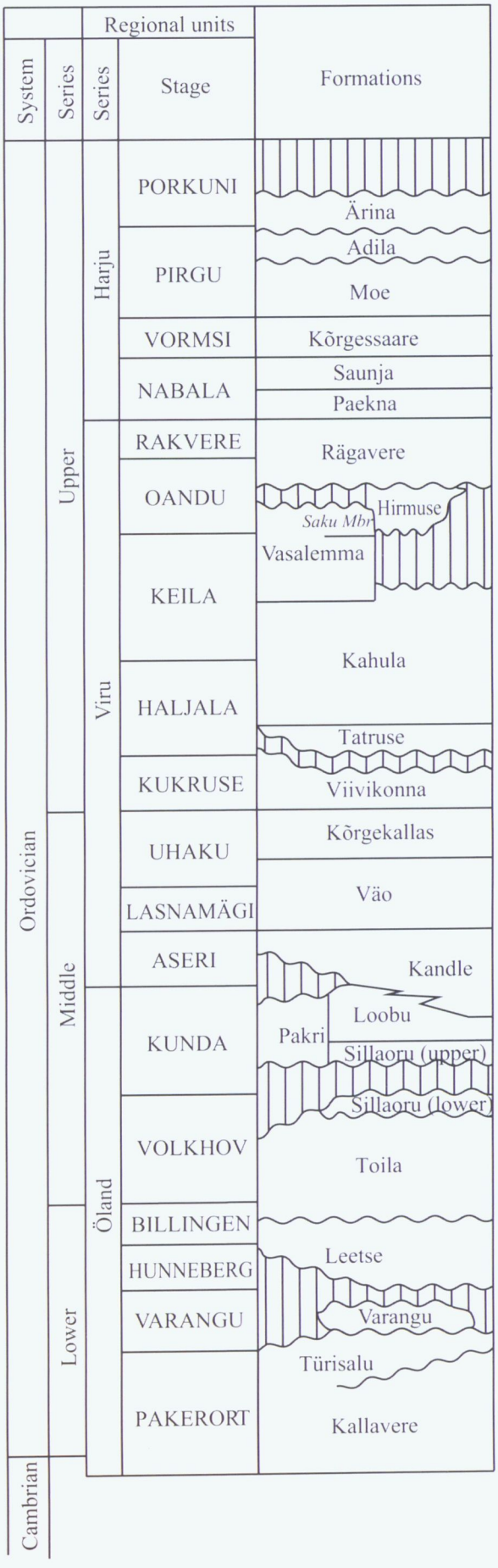
The most recent account of the stratigraphy of the Viru and Harju series in Estonia (Table 2B) was published in a series of articles by Meidla and Hints (in Raukas & Teedumäe,

1997) and the most recent correlation chart for the Ordovician of Estonia by Meidla and Ainsaar (2004). Other relevant sources include an account of the stratigraphy of the Viru Series, with descriptions of stratotypes and faunal lists (Rõõmusoks, 1970) and an Ordovician correlation chart for the East European Platform (Männil & Meidla, 1994). Very significant for the stratigraphy of this interval was the definition of the Haljala Stage, with former Idavere and Jõhvi stages as substages (Jaanusson, 1995).

Table 2A. Regional stages of the Viru and Harju Series and the stratigraphic units of Friedrich Schmidt (1881).

UPPER ORDOVICIAN	HARJU SERIES	PORKUNI STAGE (F_{II})	Borkholmsche Schicht
		PIRGU STAGE (F_1c)	Lyckholmsche Schicht
		VORMSI STAGE (F_1b)	
		NABALA STAGE (F_1a)	Wesenbergsche Schicht
	VIRU SERIES	RAKVERE STAGE (E)	
		OANDU STAGE (D_{III})	Jewesche Schicht
		KEILA STAGE (D_{II})	
		HALJALA STAGE (C_{III} - D_I)	
		KUKRUSE STAGE (C_{II})	Itfersche Schicht Kukersche Schicht (Brandschiefer)
MIDDLE RDOVICIAN		UHAKU STAGE (C_1c)	Echinosphaeritenkalk
		LASNAMÄGI STAGE (C_1b)	
		ASERI STAGE (C_1a)	

TABLE 2B. Ordovician stratigraphy of Estonia (after Meidla & Ainsaar, 2004).



Acknowledgements

This study could not possibly have been undertaken without the active encouragement of the late Valdar Jaanusson (Uppsala University) in the early years of my work. I am thankful to Anthony D. Wright (Belfast), and especially Ivar Puura (Tartu) and L. Robin M. Cocks (London) who helped to correct the English and to edit the text. Art Boucot (Oregon) and Niels Spjeldnaes (Oslo) provided the comparative material relevant for this study. Jan Bergström (Uppsala, now Stockholm) and the late Hermann Jäger (Berlin) made the study of the collections in their institutions very comfortable. I gratefully acknowledge the help of my colleagues Tõnu Meidla, Oive Tinn and secretary Kaja Lanno (Institute of Geology, University of Tartu).

This study was supported by grants No. 3011, 4574 from the Estonian Science Foundation and a grant from the Estonian Academy of Sciences for the preparation of the monograph.

SYSTEMATIC PALAEONTOLOGY

Class STROPHOMENATA Williams, Carlson, Brunton, Holmer & Popov, 1996
Order STROPHOMENIDA Öpik, 1934
Superfamily STROPHOMENOIDEA King, 1846
Family STROPHOMENIDEA King, 1846
Subfamily STROPHOMENINAE King, 1846

Genus *ACTINOMENA* Öpik, 1930a

Type species. *Strophomena* (*Actinomena*) *orta* Öpik, 1930a, p. 166, by original designation (OD). From the Kukruse Stage, Viivikonna Formation, northern Estonia.

Diagnosis (emended). Shell thin, medium-sized, semielliptical in outline. Profile convexo-concave. Ventral valve gently resupinate. Geniculation flatly convex, trail short. Ornament unequally parvicostellate, with widely spaced accentuated ribs. Short oblique rugae postero-laterally. Pseudodeltidium short and narrow, chilidium without median groove. Ventral muscle field short subquadrate, with low subparallel bounding ridges. Transmuscle ridges and side septa narrow, poorly defined.

Discussion. Öpik (1930a, p. 166) erected the new subgenus *Strophomena* (*Actinomena*) with three species – *S.* (*A.*) *orta* sp. nov., *S.* (*A.*) *quintana* sp. nov., *S.* (*A.*) *vanadis* sp. nov. and two unnamed subspecies – all from the Kukruse Stage. At the same time he numbered a series of species from other regions and younger deposits, assigning them also to *Strophomena* (*Actinomena*).

Sokolskaya (1954) considered *Actinomena* to be an independent genus. This view was followed by Oraspõld (1956), Muir-Wood & Williams (1965), Havlíček (1967), Pope (1976), Mitchell (1977), Rõõmusoks (1993b) and Cocks & Rong (2000). Spjeldnaes (1957), on the other hand, synonymized *Actinomena* with *Kjerulfina* – a statement not accepted here, because the species of the latter genus possess abrupt geniculation, coarse, irregular concentric rugae, triangular shell and no transmuscle ridges.

Actinomena sp. from the Killey Bridge Formation (Middle Ashgill) of Ireland, described by Mitchell (1977), has flatly convex valve profiles, the shell is not resupinate, and the ventral interior is unknown. This species may belong to a new genus, related to *Rugomena*.

One so far undescribed *Actinomena*-like species occurring in the Kõrgekallas Formation of the Uhaku Stage in northern Estonia cannot be assigned to this genus with confidence because no interiors are known. Thus, the earliest known genus of the subfamily *Strophomeninae* in northern Estonia is *Actinomena*.

Distribution. *Actinomena* seems to be an endemic genus for Baltoscandia, occurring in the Kukruse Stage in northern Estonia (Rõõmusoks, 1993b, p. 111) and in the Dalby Limestone (according to Jaanusson 1960, p. 230, 234; Jaanusson, 1963, p. 28 an equivalent of the Kukruse Stage in Sweden). In addition, a new, rare, poorly known species, with no interiors known, occurring in the Saunja Formation of the Nabala Stage in northern Estonia, is perhaps an *Actinomena* (pl. I, fig. 7 here).

Actinomena orta (Öpik, 1930a)
Plate I, figs 1-6.

1921	*Strophomena* cf. *corrugatella* Davidson; Bekker, p. 76; pl. IV, fig. 14.
1921	*Strophomena* sp.; Bekker, pl. III, fig. 19.
1930a	*Strophomena* (*Actinomena*) *orta* Öpik; p. 166; pl. X, figs 131, 132, 135.
1930a	*Strophomena* (*Actinomena*) *orta* subsp. a Öpik; p. 168; pl. X, fig. 133.
1930a	*Strophomena* (*Actinomena*) *orta* subsp. b Öpik; p. 169; pl. X, fig. 134.
1930a	*Strophomena* (*Actinomena*) *quintana* Öpik; p. 169; pl. XI, figs 136, 137.
1930a	*Strophomena* (*Actinomena*) sp. Öpik; p. 171, pl. XI, fig. 139.

1954 *Actinomena orta* Öpik; Sokolskaya, p. 78, pl. VI, figs 2, 3.
1956 *Actinomena orta* Öpik; Oraspõld, pl. III, fig. 6.
1957 *Kjerulfina orta* (Öpik); Spjeldnaes, pl. 9, fig. 6.
1993b *Actinomena orta* (Öpik); Rõõmusoks, p. 111, pl. I, figs 1-9.
2000 *Actinomena orta* (Öpik); Cocks & Rong, p. 222; fig. 136, 1a-1d.

Lectotype. Ventral valve TUG 72-104, figured by Öpik (1930a, pl. X, fig. 131) from the Kukruse Stage, Viivikonna Formation, Kiviõli Member, Käva quarry, coll. by A. Öpik.

Description. Shell convexo-concave, thin, with gently resupinate profile, medium-sized (maximum width at hinge line 27 mm) and transversely semielliptical in outline. Ornament strongly unequally parvicostellate, with widely spaced accentuated ribs. Some weak, short oblique rugae along hinge line laterally at umbo. Cardinal extremites almost right-angled. Ventral disc posteriorly flat, anteriorly weakly concave. 12 ribs per 2 mm at disc anterior margin.

Pseudodeltidium small, chilidium medially not sulcate. Oblique rugae along hinge line variably defined, posterolaterally nearly parallel to hinge line.

Ventral muscle field short, up to one third of valve length, weakly depressed and with subparallel bounding ridges, which are conspicuously high and become gradually lower anteriorly. Adductor scars broad, complicatedly developed, with some narrow, elongate irregular fine ridges. Hinge teeth triangular, high.

Notothyrial platform low, very short. Cardinal process lobes knob-like, low, triangular, with deep posterior myophore. Socket plates short, blunt, anteriorly broadly divergent. Myophragm well developed, bifurcating anteriorly. Transmuscle ridges narrow slender, well defined; side septa fine and long. Subperipheral rim broad, weakly developed. Extramuscular surface of valve with densely spaced fine tubercles.

Measurements (in mm), maximum preserved length and width:

Ventral interior (TUG 72-104), lectotype	17	26
Complete shell (TUG 72-124)	19	-
Ventral muscle field (TUG 1003-93)	7	6
Ventral valve (TUG 1054-133)	18	25
Dorsal interior (TUG 47-307)	15	23

Occurrence and material (number of specimens in brackets). Kukruse Stage, Viivikonna Formation, Kiviõli Member. Exposures: Harku (6); Lasnamägi in town of Tallinn (7); Ubja quarry (6); Uuemõisa ditch (3); Küttejõu quarry (3); Kohtla-Järve quarry (67); Käva quarry (6); Kukruse excavations (1).

Viivikonna Formation, Peetri Member. Exposures: Peetri quarry (1); Harku (1); Lasnamägi (2); Savala, Hirmuse river-bank (2); Tatruse (2).

Genus *KEILAMENA* Rõõmusoks, 1993b

Type species. *Actinomena occidens* Oraspõld, 1956 p. 59, OD. From the Keila Stage, upper Kahula Formation, north-western Estonia.

Diagnosis (emended). Shell profile convexo-concave, outline transversely semi-oval. Ventral valve centrally gently concave. Dorsal valve in both lateral and longitudinal profile evenly gently convex. Ornament strongly unequally parvicostellate, with narrow spaces between accentuated ribs. Ventral muscle field elevate, longitudinally oval, forming up to a half of the valve length, with high bounding ridges which are anteriorly converging, but do not join centrally. Notothyrial platform faintly developed, myophragm short. No transmuscle ridges and side septa. Cardinal process lobes stout, erect, with deep long myophore.

Discussion. A conspicuously large shell with relatively flat valves from the Keila Stage was described and figured by Verneuil (1845, p. 191, pl. X, figs 17a, b, c) as *Orthis asmusi*.

Further authors placed these species in different genera, until Oraspõld (1956), based on Männil's manuscript, separated *Actinomena occidens* sp. n. from *asmusi*. *A. occidens* was later assigned to *Keilamena* (Rõõmusoks, 1993b) and Verneuil's *Orthis asmusi* is assigned here to *Longvillia* (see below). Spjeldnaes (1957) described *Strophomena steinari*, which occurs in the Norderhov Formation *Coelosphaeridium* beds (equivalent of the Keila to Oandu Stages of Estonia) in Ringsaker district, Norway. That species is very similar to *Keilamena occidens* and is assigned here to *Keilamena*.

Recently Cocks & Rong (2000, p. 220) considered *Keilamena* as a subgenus of *Strophomena*. However, the photos of dorsal and ventral interiors of the type species of *Strophomena – S. planumbona* (pl. I, figs 13, 14 pl. II, fig. 9) show notable differences from the type species *Keilamena occidens*. *Keilamena* differs from *Strophomena* s. str. above all in its flatter shell and in lacking transmuscle ridges, side septa and muscle bounding ridges. In addition, the lobes of the cardinal process are stronger. The same features distinguish *Keilamena* from *Actinomena*. In addition, *Actinomena* has well-differentiated ornament and a smaller and weaker ventral muscle field.

Distribution. Keila Stage, upper Kahula Formation, north-western Estonia and also equivalent beds of Keila to Oandu Stage (Norderhov Formation) in Ringsaker district, Norway.

Keilamena occidens (Oraspõld, 1956)
Plate I, figs 8-12.

1845	*Orthis asmusi* Verneuil, vol. II, p. 191 (*pars*); pl. X, fig. 17.
1956	*Actinomena occidens* [Männil MS] Oraspõld, p. 59; pl. III, figs 7-9, pl. IV, fig. 1.
1993b	*Keilamena occidens* (Männil); Rõõmusoks, p. 114; pl. III, figs 1-5.
2000	*Strophomena* (*Keilamena*) *occidens* (Männil); Cocks & Rong, p. 220, figs 135, 3a-3c.

Holotype. Ventral valve interior TUG 43-147 (= GMUT Br 3091, figured by Oraspõld, 1956, pl. III, fig. 7; refigured here, pl. I, fig. 8) from the Keila Stage, upper Kahula Formation, Pääsküla Member, Keila quarry, coll. by R. Männil.

Description. Shell large (maximum estimated width at hinge line 62 mm; maximum length 40 mm), transversely semioval, moderately thick. Umbonal area considerably elevated. Ornament of numerous accentuated ribs usually separated by 3-6 finer ribs at the valve margins. Ribs more conspicuous on the ventral valve. 5 ribs per 2 mm at disc margin. Ventral valve very gently resupinate peripherally. Dorsal valve in both lateral and longitudinal profile evenly gently convex. Ventral interarea long, pseudodeltidium broad, oval in outline, occupying up to half valve length, narrowly open anteriorly. Diductor muscle scars radially striated, adductor scars narrow and low. Teeth high.

Ventral muscle field with high bounding ridges.

Notothyrial platform delicate, myophragm short and low. Cardinal process lobes triangular, stout, erect, with deep, broad myophore. Socket plates very short; sockets triangular, low. Internal surface of valve almost smooth. Subperipheral rim comparatively flat.

Measurements (in mm), maximum preserved length and width:

Ventral valve interior (TUG 43-147), holotype	30	43
Fragmentary dorsal valve interior (TUG 74-40)	-	31
Ventral valve (TUG 665-129)	31	42

Occurrence and material. Keila Stage, upper Kahula Formation in north-western Estonia. Exposures: new Vasalemma quarry (1), Kulna (1), Keila quarry (2), Jälgimägi (5), Pääsküla (1), Lehmja (1).

Genus *LONGVILLIA* Bancroft, 1933

Type species. *Orthis grandis* Sowerby, 1839, p. 638, OD.
Diagnosis. See Cocks & Rong, 2000, p. 224.
Occurrence. Ordovician (Llandeilo-Ashgill) of Europe and Asia (Cocks & Rong, 2000).

Longvillia asmusi (Verneuil, 1845).
Plate II, figs 1-8.

1845	*Orthis asmusi* Verneuil, p. 191, pl. X, figs 17a, b, c.
1890	*Strophomena asmusi* Verneuil; Gagel, p. 46, pl. III, fig.13.
1934	*Strophomena* (*Actinomena*) *assmusi* (Verneuil); Öpik, p.158, pl. XXX, fig. 4.
1956	*Actinomena asmusi* (Verneuil); Oraspõld, p. 57, pl. III, figs 3-5.
1993b	*Longvillia asmusi* (Verneuil); Rõõmusoks, p. 114, pl. III, figs 6-10.

Neotype. Designated here, TUG 665-131 (= GMUT Br 2356 in Rõõmusoks, 1993b; conjoined valves, x 2 pl. III, figs 6,7; refigured here pl. II, fig. 5), from the Keila Stage, upper Kahula Formation, Kehra exposure, coll. by A. Wahl. The location of Verneuil's originals is not known. According to Verneuil, the specimens of *Orthis asmusi* were found in environs of Tallinn. His description and figures leave no doubt that it is the species that occurs fairly commonly in the upper Kahula Formation only in north-eastern Estonia.

Description. Shell conspicuously thin, large (maximum estimated width at hinge line 50 mm). Outline almost rectangular with broadly curved anterior border. Ventral valve almost flat or medially gently concave, dorsal valve evenly weakly convex. Pseudodeltidium up to the three times longer than chilidium. Chilidium not grooved medially. Ornament gently unequally parvicostellate, with very densely placed accentuate ribs. About 1-4 ribs per 2 mm at disc anterior margin.

Ventral muscle field large, elongately subcircular, occupying half valve length, weakly impressed, with laterally raised bounding ridges. Adductor and diductor muscle scars with equal broadness, median ridge narrow and short. Teeth high, long, sharp.

Cardinal process lobes low, erect and posteriorly converging. Myophores deep. Socket plates firstly broadly diverging, laterally curving and then running almost subparallel to hinge line. Notothyrial platform faintly developed, myophragm short, no transmuscle ridges and side septa. Subperipheral rim relatively flat and broad, with many densely placed long vascular canals.

Measurements (in mm), maximum preserved length and width:

Ventral valve (TUG 665-129)	31	41
Ventral interior (TUG 72-136)	27	38
Dorsal interior (TUG 665-127)	28	49
Complete shell (TUG 665-131), neotype	30	44
Complete shell (TUG 47-428)	31	43
Dorsal interior (TUG 1068-3)	26	40

Remarks. Oraspõld (1956, p. 59) realised that two externally similar but internally quite different species occur in the Keila Stage in northern Estonia. They are *Actinomena asmusi* (Verneuil) and *A. occidens* (Oraspõld, 1956). *A. asmusi* has been assigned to the genus *Longvillia* (Rõõmusoks, 1993b) and *A. occidens* to *Keilamena* here. Now we know that *Longvillia asmusi* occurs mainly in the uppermost beds of the Kahula Formation, *Keilamena occidens*, also occurs in the lower Kahula Formation, but only in north-western Estonia.

Occurrence and material. Keila Stage, upper Kahula Formation. Exposures: Kehra (Lilli) (5), town of Rakvere (3), Oandu river-side (1).

Genus *HOLTEDAHLINA* Foerste, 1924

Type species. *Leptaena sulcata* Verneuil, 1848, p. 350, OD.
Diagnosis. See Cocks & Rong, 2000, p. 224.
Occurrence. Ordovician (Llandeilo-Ashgill) of Europe and Asia (Cocks & Rong, 2000).

Holtedahlina sakuensis Oraspõld, 1956
Plate III, figs 1-3.

1956 *Holtedahlina sakuensis* Oraspõld; p. 60, pl. IV, figs 3-5.

Holotype. Complete shell TUG 74-9 (= GMUT Br 2372, figured by Oraspõld, 1956, pl. IV, fig. 3; refigured here, pl. III, fig. 1) from the Oandu Stage, Vasalemma Formation, Saku Member, Saku exposure, coll. by A. Oraspõld, 1951.

Description. Shell relatively flat, small, (maximum width in mid-shell 21 mm), profile unequally biconvex. Dorsal valve weakly convex, with very low broad fold, ventral valve anteriorly gently sulcate. Ornament almost multicostellate with closely spaced ribs with almost equal coarseness, about 8 ribs per 2 mm antero-medianly. Some faint growth lines anteriorly. Pseudodeltidium short, narrow.

Ventral muscle field narrowly oval, to half of valve length, with sharply-defined bounding ridges and median ridge.

Notothyrial platform short, transmuscle ridges and side septa long, convergent anteriorly to centre, myophragm very narrow and short. Cardinal process lobes small, knob-like. Socket plates short.

Measurements (in mm); maximum preserved length and width:

Complete shell (TUG 74-9), holotype	14	20
Complete shell (TUG 74-7)	11	16
Dorsal interior (TUG 47-322)	15	21

Remarks. This species is one of the earliest representatives of the genus. It differs from other species of the genus by very fine equal ribs and having very low, broad, dorsal anterior fold.

Occurrence and material. Oandu Stage, Vasalemma Formation, Saku Member north-western Estonia. Exposures: Saku (4), Üksnurme (1) and Kopelmaa ditch at Voore road (1).

Holtedahlina rakverensis Oraspõld, 1956
Plate III, figs 4-6.

1956 *Holtedahlina rakverensis* "Männil in coll."; Oraspõld, p. 61, pl. IV, figs 6-7.

Holotype. Complete shell TUG 72-133 (= GMUT Br 3069, Oraspõld, 1956, pl. IX, figs 6, 6a; refigured here, pl. III, figs 4, 5) from the Rakvere Stage, Rägavere Formation, Piilse Member, Rägavere exposure in town of Rakvere, coll. by A. Öpik.

Description. Shell small (estimated maximum width at hinge line 22 mm), posteriorly biconvex. Ventral valve with gently defined anterior sulcus, with corresponding flat fold in dorsal valve. Pseudodeltidium relatively long and broad; chilidium very short, medially gently grooved. Ornament multicostellate with differentially thickened ribs, about 6 ribs per 2 mm antero-medianly. Disc with strong, but impersistent concentric growth lines. Ventral muscle field suboval in outline, to half valve length, with myophragm and relatively high strongly developed bounding ridges, gently converging anteriorly.

Measurements (in mm); maximum preserved length and width:

Almost complete shell (TUG 72-133), holotype	20	15
Ventral interior (TUG 242-6)	9	16

Remarks. This species has, unlike the other species of the genus, relatively coarse ribs, faintly developed concentric growth lines and a faintly-defined anterior fold and sulcus.

Occurrence and material. Rakvere Stage, Rägavere Formation, Piilse Member, exposures in town of Rakvere (3) and Rägavere (6). Nabala Stage, Paekna Formation. Permisküla exposure at the Narva river (6).

Holtedahlina subtilis sp. nov.
Plate III, figs 7-11.

Derivation of name. Latin *subtilis*, thin, alluding to the very thin shell, as compared with other species of the genus occurring in the Ordovician of northern Estonia.

Holotype. Complete shell TUG 72-130 (pl. III, figs 7-9) from the Nabala Stage, Saunja Formation, Tõrma exposure, coll. by A. Öpik.

Description. Shell very thin, small (estimated maximum width at hinge line 16 mm). Middle sector of ventral valve strongly convex, but turning anteriorly into a low broad sulcus. Dorsal valve almost completely flat, with a low fold arising medially near anterior border. Pseudodeltidium and chilidium broad. Ornament multicostellate, ribs rectilinear. Spaces between ribs grow narrower than ribs, 5 ribs per 2 mm antero-medially. Concentric growth lines usually not observed.

Ventral muscle field broadly subelongate, with low but broad myophragm and a pair of shorter side septa. Muscle bounding ridges prominent, anteriorly broadly divergent.

Dorsal interior (only a fragmentary specimen available, see pl. III, fig. 11) shows thin long transmuscle ridge and socket plate.

Measurements (in mm), maximum preserved length and width:

Complete shell (TUG 72-130), holotype	9	14
Ventral interior (TUG 72-132)	11	13
Fragmentary dorsal interior (TUG 72-131)	8	9

Remarks. The shell of this species is extraordinarily thin, with coarse ribs and weakly defined concentric growth lines.

Occurrence and material. Nabala Stage, Saunja Formation. Exposures: Odulema (2) Tõrma (3), Voore (Virumaa district) (1).

? *Holtedahlina moensis* sp. nov.
Plate III, figs 12-15.

Derivation of name. After the Moe Formation where this species occurs.

Holotype. Complete shell TUG 3-547 (pl. 3, figs 12-14) from the Pirgu Stage, Moe Formation, Moe exposure, coll. by A. Wahl.

Description. Shell small (maximum width at hinge line 17 mm), thicker than in any other species of the genus described here. Dorsal valve flat, faintly convex only along lateral borders. Antero-median dorsal fold low, narrow, short. Ventral valve evenly gently convex, with broad low antero-median sulcus. Pseudodeltidium short and low. Chilidium short, with poorly defined median groove. Ornament multicostellate, ribs coarse, of almost equal thickness, faintly sinuous, 3 ribs per 2 mm antero-medianly. Some weakly-defined concentric growth lines near umbonal region.

Ventral muscle field subcircular, with elevated bounding ridges and thick myophragm. Teeth high, sharp.

Dorsal interior unknown.

Measurements (in mm); maximum preserved length and width:

Complete shell (TUG 3-547), holotype	10	14
Fragmentary ventral interior (TUG 72-129)	7	7

Remarks. This species differs from any other representatives of the genus in its coarser ribs and particularly in its pronounced anterior sulcus and fold. As the dorsal interior is unknown, this species is tentatively assigned to *Holtedahlina* on the basis of its external shape and ornament.

Occurrence and material. Pirgu Stage, Moe Formation, Moe exposure (4).

Genus *PSEUDOSTROPHOMENA* Rõõmusoks, 1963

Type species. *Pseudostrophomena reclinis* Rõõmusoks, 1963, OD. From the Rakvere Stage, Rägavere Formation, Piilse Member, northern Estonia.

Other species. The genus is monotypic.

Diagnosis (emended). Shell small, subtriangular in outline. Profile convexoconcave, gently resupinate. Lateral and anterior border of shell with strong resupinate convexity. Pseudodeltidium very short, narrow. Perideltidium weakly defined, narrow. Ventral muscle field gently impressed, with very short posterolateral bounding ridges. Notothyrial platform short, no transmuscle ridges and side septa. Ornament unequally costellate, reflected also on interior surface of valves.

Discussion. This genus is most similar to *Strophomena,* from which it is distinguished externally in its longer, strongly ventralwards rising border of shell, by its subtriangular outline and in having a perideltidium. Simple gently-impressed ventral muscle field almost without muscle bounding ridges, very small notothyrial platform and missing transmuscle ridges. *Pseudostrophomena* lacks the more complicated muscle fields of *Strophomena*. For comparison, photos of *S. planumbona* are given here (pl. I, figs 13, 14; pl. II, fig. 9).

The existence of a perideltidium was an argument for including this new genus in the Orthotedidae (Rõõmusoks, 1963). Recently Cocks & Rong (2000) placed *Pseudostrophomena* in the Strophomeninae.

Occurrence. Rakvere and Nabala Stages of northern Estonia.

In the Oandu Stage, Hirmuse Formation there occurs a small species, with semicircular shell but otherwise externally very similar to *Pseudostrophomena reclinis*, figured here (see pl. IV, fig. 8). Unfortunately no dorsal interiors are available.

Pseudostrophomena reclinis Rõõmusoks, 1963
Plate IV, figs 1-7.

1954	*Strophomena pseudodeltoidea* Stolley; Sokolskaya, p. 85, pl. V, figs 6-9.
1963	*Pseudostrophomena reclinis* Rõõmusoks, p. 237, pl. II, figs 1-7, textfigs 4,5.
2000	*Pseudostrophomena reclinis* Rõõmusoks; Cocks & Rong, p. 224, figs 4a-4d; p. 674, figs 488, 1a-1f.

Holotype. Complete shell TUG 74-118 (= GMUT Br 1252; Rõõmusoks, 1963, pl. II, figs 1-4; refigured here pl. IV, figs 1-5) from the Rakvere Stage, Rägavere Formation, Piilse Member, Kaarli exposure, coll. by A. Oraspõld and I. Elvre.

Description. Shell small. Umbonal part of ventral valve gently convex, medio-anteriorly concave, rising laterally and anteriorly up to form a high border. Middle sector of ventral

valve near anterior border narrowly depressed. Umbo small, hardly noticeable. Pseudodeltidium small, narrow, chilidium robustly developed, usually without median groove. Dorsal valve posteriorly almost flat, anteriorly and laterally more convex. Ornament of comparatively uniform fine regular ribs, 5-11 per 2 mm at valve margin. Growth lines unnoticeable. Teeth relatively high, triangular. Dental plates small. Ventral muscle field weakly impressed, semicircular in outline. Diductor muscle scars broad, anteriorly poorly defined. Two short parallel ridges in centre of muscle field. Cardinal process lobes posteriorly inclined, low, with short myophore. Socket ridges broad, sockets low, triangular. Notothyrial platform low and short. Adductor scars low, poorly defined.

Measurements (in mm); maximum preserved length and width:

Complete shell (TUG 74-118), holotype	26	31
Dorsal interior (TUG 102-46)	12	16

Occurrence and material. Rakvere Stage, Rägavere Formation, Piilse Member. Exposures: Paeküla (2), Määra-Saueaugu (1), Voore, NW Estonia (numerous), Jõgisoo (12), Vaidu (9), Rakvere (numerous), Kullaaru (4), Kaarli (8), Piilse (1), Pikaveski (1).

Nabala Stage, Paekna Formation. Exposure Nõmmeküla (2).

Genus *LEIGERINA* gen. nov.

Type species. *Leigerina hiiuensis* sp. nov.; from the Vormsi Stage, Kõrgessaare Formation, north-western Estonia.

Derivation of name. After Leiger, a man's name in West Estonian mythology.

Other species. The genus is monotypic.

Diagnosis. Shell with relatively plain valves, very thin, biconvex and resupinate, subrectangular in outline, with broadly rounded anterior margin. Ornament unequally multicostellate, with accentuated ribs broadly separated from each other. Ventral muscle field elevated, short, obliquely suboval. Notothyrial platform poorly defined. No transmuscle and side septa. Cardinal process lobes long, placed posteriorly, erect, with deep myophore. Socket ridges return laterally abruptly to hinge line.

Comparison. *Leigerina* is externally most similar to the much earlier genera *Keilamena* and *Longvillia* from the Keila Stage in possession of a thinner shell with relatively flat valves and similar radial ornament. The ornament is closely similar to that of *Actinomena*. Neverthless the internal features of all the named genera are different.

Occurrence. Vormsi Stage, Kõrgessaare Formation, predominantly in north-western Estonia, particularly in Hiiumaa Island.

Leigerina hiiuensis sp. nov.
Plate IV, figs 9-14.

Derivation of name. After Hiiumaa Island, where most specimens have been found, including the holotype.

Holotype. Complete shell TUG 1003-109 (pl. IV, fig. 9) from the Vormsi Stage, Kõrgessaare Formation, Kõrgessaare exposure, Hiiumaa Island, north-western Estonia, coll. by A. Rõõmusoks, 1975.

Diagnosis. As for genus.

Description. Ventral valve nearly flat, gently convex in umbonal part and very faintly concave near antero-median border. Dorsal valve weakly convex, with noticeable concave narrow median sector. Pseudodeltidium relatively long and broad, chilidium small, medially not grooved. Ornament notably regular with prominent accentuated ribs, in particular on

dorsal valve, 5 ribs per 2 mm medially at shell margin. Few slightly defined growth lines visible in centre or anterior of valves.

Ventral muscle field broader than length, elevated, and with high narrow bounding ridges. Myophragm very short and narrow, poorly defined.

Cardinal process lobes prominent, high, diverging, inclined forward and with deep broad myophore. Notothyrial platform little pronounced. No transmuscle ridges and side septa. Socket ridges high, but short. Sockets deep, of triangular outline, defined laterally by thin lamellae curving back to hinge line. Fine, short, dense vascular canals along valve border, no subperipheral rim.

Measurements (in mm); maximum preserved length and width:

Complete shell (TUG 1003-109), holotype	23	32
Complete shell (TUG 42-65)	19	25
Ventral interior (TUG 42-61)	22	29
Complete shell (TUG 50-30)	-	28
Dorsal interior (TUG 106-20)	-	49

Occurrence and material. Vormsi Stage, Kõrgessaare Formation, north-western Estonia. Hiiumaa Island, exposures: Kõrgessaare (5), town of Kärdla (1). Mainland of Estonia, Kohila exposure (1).

Genus *SAXBYONIA* gen. nov.

Type species. *Saxbyonia fluctuosa* sp. nov.; from the Vormsi Stage, Kõrgessaare Formation, north-western Estonia.

Derivation of name. After Saxby village on the western coast of the Vormsi Island near the type locality.

Other species. The genus is monotypic.

Diagnosis. Shell comparatively large, nearly rectangular in outline, with broadly rounded anterior margins. Profile convexo-concave, gently resupinate. Low, broad ventral anterior sulcus and corresponding flattened dorsal fold. Ornament unequally costellate, ribs relatively coarse. Very irregular, narrow, prominent, undulating concentric rugae increasing in thickness anteriorly. Cardinal process lobes relatively long, parallel. No transmuscle ridges and side septa.

Comparison. *Saxbyonia* differs from all known strophomenids in its distinctive rugation, its often irregular fold and sulcus, and in its relatively coarser ribs which are developed also in interior surface of valves.

Occurrence. Rare in the Vormsi Stage of north-western Estonia.

Saxbyonia fluctuosa sp. nov.
Plate V, figs 1-6.

1993c *Harjumena* sp. nov. Rõõmusoks, pl. III, figs 8, 9

Derivation of name. Latin *fluctuosus*, wave; referring to the narrow, very irregular undulate concentric rugae.

Holotype. Complete shell TUG 80-132 (pl. V, figs 1-3) from the Vormsi Stage, Kõrgessaare Formation, from the west coast of Vormsi Island, coll. by V. Jaanusson, 1939.

Diagnosis. As for the genus.

Description. Umbonal part of ventral valve gently convex, flattening laterally. Anterior border forming a broad low median sulcus. Ventral interarea relatively short, pseudodeltidium small. Dorsal valve unequally convex – medially higher, laterally lower. Flat broad anterior

median fold. Chilidium very short. Ornament of somewhat roundish ribs of irregular coarseness (3 to 4 per 2 mm at anterior margin). Rugae relatively narrow, distinctively undulate, interrupted.

Ventral muscle field subrhomboidal in outline, with moderately elevated bounding ridges, almost completely surrounding diductor muscle scars. Adductor muscle scars and myophragm very narrow. Well-defined reflections of irregular rugae on interior surface of valve.

Notothyrial platform low, weakly developed. Cardinal process lobes long, prominent, well-separated from each other, lying well behind posterior margin of shell. Sockets small, with thin socket ridges, delimiting the socket laterally and turning to hinge line. Central median septum low and short.

Measurements (in mm); maximum preserved length and width:

Complete shell (TUG 80-132),	holotype	38	52
Dorsal interior (TUG 42-100)		32	52
Ventral interior (TUG 50-24)		24	54
Ventral valve (TUG 42-103)		44	40

Occurrence and material. Vormsi Stage, Kõrgessaare Formation, north-western Estonia. Exposures: Kõrgessaare in Hiiumaa Island (4), Saxby coast in Vormsi Island (2) and Kohila in mainland (1).

Genus *RUGOMENA* Rõõmusoks, 1993b

Type species. *Rugomena adilensis* Rõõmusoks, 1993b, OD. From the Pirgu Stage, Adila Formation, western Estonia.

Diagnosis (emended). Shell thick, medium-sized to large. Ventral valve widely evenly moderately concave, dorsal valve correspondingly convex. Radial ornament strongly parvicostellate, with many densely placed accentuated ribs. Four to nine strong, short postero-lateral rugae meet approximately perpendicular to the hinge line. Ventral muscle field subcircular, with sharply raised bounding ridges and myophragm. Four long thin parallel ridges anteriorly.

Species assigned. *Strophomena kiaeri* Holtedahl, 1916, p. 54, figs 4-6, from the 5a beds (= Bønsnes Formation; probably an equivalent of the Pirgu Stage in Estonia), Vestre Svartø, Ringerike, Norway. I have examined the Holtedahl's originals in Oslo Museum and concluded that the Norwegian species is very similar to *R. adilensis*.

Discussion. *Rugomena* is, according to Cocks & Rong (2000, p. 220), a subjective junior synonym of *Strophomena*, but *Rugomena* differs from *Strophomena* (pl. I, figs 13, 14 and pl. II, fig. 9) in the character of dorsal interior, and particularly in its prominent short posterior rugae and strongly unequally parvicostellate radial ornament. The ventral muscle fields of these two genera are similar, but the dorsal muscle field of *Rugomena* differs from that of *Strophomena* in having four parallel anterior septa.

Distribution. Upper part of the Harju Series of Baltoscandia.

Rugomena adilensis Rõõmusoks, 1993b
Plate V, figs 7-12

1993b *Rugomena adilensis* Rõõmusoks; p. 115, pl. IV, figs 1-8.

Holotype. Complete shell TUG 950-8 (= GMUT Br 1529; Rõõmusoks, 1993b, p. 115; pl. IV, figs 1-3; refigured here, pl. V, figs 7, 8) from the Pirgu Stage, Adila Formation, erratic at Vardi, coll. by G. Pahnsch.

Diagnosis (emended). Shell comparatively thick. Ventral valve gently concave, dorsal valve correspondingly convex. Ornament with many densely placed accentuated ribs. 8-9 strong posterior rugae.

Description. Shell large (maximum width at hinge line 60 mm), subrectangular, anteriorly slightly rounded, moderately convexo-concave. Pseudodeltidium long and wide, chilidium small, not medially grooved. Radial ornament strongly unequally parvicostellate. 4-5 ribs per 2 mm at disc margin.

Ventral muscle field subcircular, with sharply raised lateral bounding ridges and narrow antero-median gap. Myophragm short, diductor muscle scars narrow, elongated. Socket plates short.

Dorsal interior known only from one poorly preserved mould. There are four long parallel adventitious septa (pl. V, fig. 12). Socket ridges short. Notothyrial platform very low.

Measurements (in mm); maximum preserved length and width:

Complete shell (TUG 950-8), holotype	42	59
Fragmentary dorsal exterior (TUG 46-28)	18	29
Posterior view (TUG 107-18)	29	35
Ventral interior (TUG 950-9)	17	30
Dorsal interior mould (TUG 1003-148)	28	33

Occurrence and material. Pirgu Stage, Adila Formation, and Ärina Formation, Röa Member; Haapsalu Holm, erratics (2), Piirsalu exposure (1), Vardi, erratics (14), Röa exposure (2).

Genus and species undetermined
Plate XXXIV, Fig. 6

Remarks. The biggest known strophomenid from the Ordovician of northern Estonia is represented by two poorly preserved ventral exteriors. The estimated width of the shell at hinge linge is 143 mm. The broad and poorly-defined anterior sulcus resembles to that of *Holtedahlina.* Although interiors are not known, the general shell shape is more like *Holtedahlina* than any other genus. Externally, the shell has weakly shaped broad concentric rugae on disc. Ornament multicostellate, with differentially thickened ribs, about 1 per 2 mm anteromedially.

Figured specimen: TUG 47-657, estimated width at hinge line 143 mm.

Ocurrence and material. Porkuni Stage, Ärina Formation, Siuge Member, Tikkaru exposure (2).

Table 3. The subfamily *Strophomeninae* in the Ordovician of northern Estonia.

Series	Species	Stage	Formation	Member
Harju	Genus and species undetermined	Porkuni	Ärina	Siuge
	Rugomena adilensis Rõõmusoks	Pirgu	Adila	
	? *Holtedahlina moensis* sp. nov.	Pirgu	Moe	
	Saxbyonia fluctuosa sp. nov.	Vormsi	Kõrgessaare	
	Leigerina hiiuensis sp. nov	Vormsi	Kõrgessaare	
	? *Actinomena* sp.	Nabala	Saunja	
	Holtedahlina subtilis sp. nov.	Nabala	Saunja	
	Holtedahlina rakverensis Oraspõld	Nabala	Paekna	
Viru	*Holtedahlina rakverensis* Oraspõld	Rakvere	Rägavere	Piilse
	Pseudostrophomena reclinis Rõõmusoks	Rakvere	Rägavere	Piilse
	? *Pseudostrophomena reclinis* Rõõmusoks	Oandu	Hirmuse	
	Holtedahlina sakuensis Oraspõld	Oandu	Vasalemma	Saku
	Longvillia asmusi (Verneuil)	Keila	Kahula	
	Keilamena occidens (Oraspõld)	Keila	Kahula	
	Actinomena orta (Öpik)	Kukruse	Viivikonna	Kiviõli
	? *Actinomena* sp.	Uhaku	Kõrgekallas	

Subfamily FURCITELLINAE Williams, 1965
Genus *PANDERITES* Rõõmusoks, 1993a

Type species. *Plectambonites imbrex* Pander, 1830, p. 91, OD. From the Aseri Stage, Kandle Formation, North Estonia and Ingria (environs of St. Petersburg), north-western Russia.

Diagnosis (emended). Shell concavo-convex, elongate, sharply dorsally geniculated. Trail more than twice longer than disc. Ornament unequally parvicostellate, with broad interspaces between accentuated ribs. Ventral muscle field subcircular, faintly impressed, muscle bounding ridges weak, anteriorly convergent. Notothyrial platform broad. Short, narrow transmuscle ridges and side septa.

Discussion. *Panderites* differs from other genera of the subfamily in having a unique shell shape, with a strongly geniculated trail at right angle. The dorsal interior is most similar to *Bekkerina*.

Distribution. Kunda Stage(?) to Aseri Stage. The oldest definite specimens of *Panderites* from Estonia have been found in the Aseri Stage. However, in Ingria, NW Russia, *P. imbrex* has been recorded from the lowermost Kunda Stage (Lamansky, 1905, pp. 57, 59, 76).

Panderites imbrex (Pander, 1830).
Plate VI, figs 1-6.

1830	*Plectambonites imbrex* Pander, p. 91, pl. XIX, fig. 12.
1830	*Plectambonites triangularis* Pander, p. 91, pl. XIX, fig. 11.
1954	*Oepikina imbrex* (Pander); Sokolskaya, p. 48, pl. II, figs 5-8, [non fig. 9 = *Haljalanites assatkini* (Alichova)].
1993a	*Panderites imbrex* (Pander); Rõõmusoks, p. 49, pl. I, figs 1-5.
2000	*Panderites imbrex* (Pander); Cocks & Rong, p. 233, fig. 143, 4a, 4c.

Neotype. Complete shell TUG 2-288 (pl. VI, 5-6) selected by Rõõmusoks, 1993a, from the Aseri Stage at Pavlovsk, Ingria.

Description. Shell medium-size (known maximum width at hinge line 22 mm). Disc in both valves almost flat, trail very long. Ornament unequally parvicostellate, strongly filate, ten to twelve relatively narrow accentuated ribs with very broad interspaces. 8-10 ribs per 2 mm at disc margin. Pseudodeltidium small, apical. Chilidium large.

Ventral muscle field subcircular, faintly depressed, with very weak bounding ridges converging anteriorly.

Notothyrial platform and myophragm broad, low, continuing anteriorly as a very narrow median septum. Transmuscle ridges and side septa well defined, long. Cardinal process lobes small, inclined towards hinge line. Interior surface very fine and densely tuberculate outside muscle field.

No subperipheral rim.

Measurements (in mm); maximum preserved length and width:

Complete shell (RM Br 74561)	29	25
Ventral interior mould (TUG 2-289)	-	20
Dorsal interior (RM Br 131660)	21	25.5
Ventral valve of complete shell (TUG 2-288), neotype	32	-

Occurrence and material. Aseri Stage, Kandle Formation. Exposures: Lasnamägi quarry, in Tallinn (2); Ojaküla quarry (1); Lüganuse (2); Purtse, riverbank (3); Voka cliff (1); Valaste cliff (1); Aluoja riverside (2); Mustajõe riverside (2); Türsamäe (3); Pavlovsk, Ingria (7).

Genus *TALLINNITES* Rõõmusoks, 1993a

Type species. *Oepikina? imbrexoidea* Sokolskaya, 1954, OD.
Diagnosis. See Cocks & Rong, 2000, p. 236.
Species assigned. The genus is monotypic.
Occurrence. Uhaku Stage, Estonia.

Tallinnites imbrexoidea (Sokolskaya, 1954)
Plate VI, figs 7-13.

1930a	*Rafinesquina* aff. *imbrex* (Pander); Öpik, p. 196, pl. XXI, fig.272.
1954	*Oepikina* (?) *imbrexoidea* Sokolskaya, p. 51, pl. II, figs 10-13.
1993a	*Tallinnites imbrexoidea* (Sokolskaya); Rõõmusoks, p. 50, pl. II, figs 1-4.
2000	*Tallinnites imbrexoidea* (Sokolskaya); Cocks & Rong, p. 236, fig. 144; 3a -3c.

Holotype. Ventral valve exterior (PIN 435/1733, figured by Sokolskaya, 1954, pl. II, figs 10a, b) from the Uhaku Stage, Väo Formation, Lasnamägi old quarry in Tallinn.

Description. Shell subrectangular to rounded in outline, medium-sized (maximum width of ventral valve 34 mm), usually wider at mid-shell than at hinge line (pl. VI, fig. 10). Ventral valve convex, dorsal valve concave. Unequally parvicostellate ornament with relatively broad interspaces between accentuated ribs with four to six ribs between them near anterior margin. 10 ribs per 2 mm at disc margin. Some weak short rugae postero-laterally. Pseudodeltidium small, chilidium large and broad.

Ventral muscle field long, weakly elliptical, with strongly-defined, almost parallel bounding ridges converging anteriorly.

Notothyrial platform narrow, myophragm long and thick, with long very narrow breviseptum extending almost to the anterior margin. Cardinal process lobes thick, knob-like, oblique to the hinge line. Socket ridges feebly defined. Transmuscle ridges long, narrow; side septa high, long, anteriorly curved. Short narrow anterior septum on both sides of breviseptum (pl. VI, figs 9, 11). No subperipheral rim.

Measurements (in mm); maximum preserved length and width:

Complete shell (TUG 1003-236)	25	24
Complete shell (TUG 1003-239)	-	35
Dorsal interior (TUG 1003-240)	26	26
Dorsal interior (TUG 1003-237)	23	20
Ventral valve interior mould (TUG 97-2)	19	25
Ventral valve (TUG 46-144)	25	23

Discussion. The narrow, long notothyrial platform and the strong evenly convex and not abruptly geniculate ventral valve profile are the most characteristic distinguishing features of *Tallinnites*.

Occurrence and material. Uhaku Stage, Väo and Kõrgekallas Formations, particularly in the Erra Member. The cliff of Osmussaar and Väike-Pakri Islands (2; 5) and in following exposures in mainland: Paldiski (1), Vahiküla (1), Harku (1), Lasnamägi, in Tallinn (4), Väo (2), Kostivere (2), Loo (1), ditch at Kohtla-Järve (1), ditch between Kiviõli and Erra (1), Kõrgekallas at the Purtse River (1).

Genus *BEKKERINA* Rõõmusoks, 1993a

Type species. *Rafinesquina dorsata* Bekker, 1921, p. 73, OD. From the Kukruse Stage, northern Estonia.

Other species. *Bekkerina raricostellata* Rõõmusoks, 1993a, p. 51.

Discussion. Öpik (1930a, p. 183 and 198) treated some species and subspecies, mostly from the Kukruse Stage, as the *dorsata*-group, including *Rafinesquina dorsata* Bekker, *R. dorsata media* Öpik, *R. bekkeri* Öpik, *R. jaervensis* Bekker, *R. angusta* (*nomen nudum*), *R. troedssoni* Öpik, *R.* aff. *imbrex* (Pander), *R. anijana* Öpik and R. aff. *deltoidea* (Conrad). A re-examination of Bekker's (1921) and Öpik's (1930a) types and subsequently collected new material suggest that the shell profile, outline and ornament, together with the main interior characteristics of *R. dorsata media*, *R. bekkeri*, *R. jaervensis* and *R. troedssoni* indicate infraspecific variation range within only one species - *Bekkerina dorsata* (photos on plate VII). Of the remaining species, *R.* aff. *imbrex* belongs to the genus *Tallinnites*, *R. anijana* to *Haljalanites* gen. nov. and *R.* aff. *deltoidea* to the new genus *Kukrusena* (described below).

Bekkerina is one of the smallest furcitellines known. *Bekkerina* resembles *Oepikina* Salmon (1942), but differs in having a smaller shell, with noticeably stronger convexity, broader ventral muscle field, more highly defined transmuscle ridges and side septa. The long socket plates are fused with postero-lateral ends of subperipheral rim.

Distribution. Uhaku and Kukruse stages, northern Estonia, Ingria (environs of St. Petersburg, NW Russia), Lithuania and Sweden.

Bekkerina dorsata (Bekker, 1921)
Plate VII, figs 6-12.

1921	*Rafinesquina dorsata* Bekker, p. 73, pl. III, figs 9-13; pl. V, figs 4-8.
1921	*Rafinesquina jaervensis* Bekker, p. 75, pl. I, fig. 23, pl. III, figs 5-8.
1930a	*Rafinesquina dorsata* Bekker; Öpik, p. 183, pl. XIV, figs 154-160, 165; pl. XXI, fig. 261; textfig. 22.
1930a	*Rafinesquina dorsata media* Öpik, p. 189, pl. XIV, figs 161-164.
1930a	*Rafinesquina bekkeri* Öpik, p. 190, pl. XIV, fig 166; pl. XV, figs 167-169.
1930a	*Rafinesquina jaervensis* Bekker; Öpik, p. 192, pl. XV, figs 170-174.
1930a	*Rafinesquina troedssoni* Öpik, p. 195, pl. XV, figs 175, 176.
1942	*Oepikina dorsata* (Bekker); Salmon, p. 92, pl. 86, figs 39-44.
1951	*Oepikina dorsata* (Bekker); Alichova, p. 50, pl. IV, figs 1-4.
1954	*Oepikina dorsata* (Bekker); Sokolskaya, p. 49, pl. II, figs 1-4.
1954	*Oepikina dorsata dorsata* (Bekker); Alichova, p. 20, pl. X, figs 5-8.
1993a	*Bekkerina dorsata* (Bekker); Rõõmusoks, p. 50, pl. I, fig. 10; pl. II, figs 5-10.
2000	*Bekkerina dorsata* (Bekker); Cocks & Rong, p. 277, fig. 138, 3a-d.

Neotype (selected here). TUG 1054-160, conjoined valves. Pl. VII, figs 6-9 (Öpik, 1930a, pl. XIV, fig. 160; Rõõmusoks, 1993a, pl. II, figs 5-8; Cocks & Rong, 2000; textfig. 138, 3b) from the Kukruse Stage, Viivikonna Formation, Kiviõli Member, Kohtla quarry, coll. by A. Öpik.

When describing the new species *Rafinesquina dorsata*, Bekker selected no holotype. Later Öpik (1930a, p. 184) nominated a specimen, collected by himself, as holotype, a designation, which is not valid according to ICZN rules. Therefore, a neotype is selected here.

Description. Shell suboval to rounded-trapezoidal, small (known maximum width at hinge line 18 mm). 9 ribs per 2 mm at disc margin. Ventral valve profile strongly convex, nearly rectangular from trail to disc. Dorsal valve deeply concave. Unequally parvicostellate ornament with densely placed accentuated ribs. Pseudodeltidium vestigial, chilidium small, usually medially not grooved.

Ventral muscle field very broad, impressed, occupying more than half valve length and densely striated radially. Adductor muscle scars small, median ridge narrow, long.

Notothyrial platform with thick myophragm and short narrow breviseptum. Cardinal process lobes high, stout, posteriorly inclined. Myophores deep. Socket plates long. Adductor muscle scars laterally indented. Transmuscle ridges high, narrow. Side septa directed inward but then anteriorly outward. Subperipheral rim narrow, irregularly interrupted by short vascular markings. The interior surface finely and densely tuberculate.

Measurements (in mm); maximum preserved length and width:

Complete shell with ventral valve exterior (TUG 1054-160), neotype	12	8
right lateral view	12	-
posterior view	-	18
Dorsal valve interior (TUG 1054-276)	11	13
Ventral valve interior (TUG 1054-168)	9	13
Dorsal valve interior (TUG 1003-32)	11	12
Dorsal valve interior (TUG 1054-167)	11	15
Dorsal valve interior (TUG 1003-32)	12	13

Occurrence and material. Kukruse Stage, Viivikonna Formation, exposures: Paldiski, Pakri peninsula (7), Humala (15), Peetri (2), Alliku (2), Harku (67), Lasnamägi in Tallinn (74), Pirita-Ülemiste ditch (2), Ubja quarry (81), Uuemõisa river-side (2), Kiviõli ditch (3), Küttejõu quarry (18), Purtse river-side at Savala (19), Kohtla-Järve quarry (416), Käva quarry (1), Kukruse (1), Tatruse (4).

Bekkerina raricostellata Rõõmusoks, 1993a
Plate VII, figs 1-5.

1993a *Bekkerina raricostellata* Rõõmusoks, p. 51, pl. I, figs 6-9.

Holotype. Complete shell TUG 1003-24 (= GMUT Br 1579; Rõõmusoks, 1993a, pl. I, figs 7, 8, refigured here pl. VII, figs 1, 2) from the Uhaku Stage, Kõrgekallas Formation, Koljala Member, Kiviõli-Erra ditch north of the road, collected by A. Rõõmusoks, 1964.

Description. Shell suboval in outline with rounded anterior border, small for the genus (maximum known width at hinge line 15 mm). Cardinal extermities obtuse, lateral margins broadly curved. Ventral valve moderately convex, geniculate almost at right angle or a little more. Disc subcircular, weakly convex, in umbonal part gently swollen. Sides weakly depressed towards the cardinal extremities. 8 ribs per 2 mm at disc margin. Trail longer than disc, with rare sharp growth-lines anteriorly. Dorsal valve deeply concave. Ornament on ventral disc with five to six accentuated ribs in broad interspaces.

Ventral muscle field very broad, deeply impressed with narrow medium septum. Adductor muscle scars very small, of equal width and length, half valve length. Diductor muscle scars thin, striated.

Cardinalia relatively narrow. Transmuscle ridges, side septa and myophragm short. Subperipheral rim rounded, not sharp. Cardinal process lobes low, posteriorly inclined.

Measurements (in mm); maximum preserved length and width:

Conjoined valves (TUG 1003-24), holotype	12	13
Ventral valve interior (TUG 2-282)	12	13
Dorsal valve interior (TUG 2-281)	9	10
Ventral valve (TUG 1003-29)	11	13

Occurrence and material. Uhaku Stage, upper Väo Formation. Exposures: Paldiski (2), Kallaste (5), Harku (2), Kadaka (6), Väo (1), Rebala (3), Uhaku (3). Kõrgekallas Formation.

Exposures: Osmussaar Island (2), Lasnamägi in Tallinn (6), Kiviõli-Erra ditch (34), Purtse riverside at Kõrgekallas (7), Uhaku riverside (13), Erra (2), Varja ditch (10).

Remarks. Öpik (1930a, pp. 189, 238) reported the occurrence of *Rafinesquina dorsata* from throughout the Uhaku Stage. However, that form is *Bekkerina raricostellata*, the smallest furcitelline species in the Ordovician of northern Estonia, which differs from *B. dorsata* in its ventral valve ornament and smaller size.

Genus *KUKRUSENA* gen. nov.

Type species. *Kukrusena peetriensis* sp. nov. from the Kukruse Stage, Viivikonna Formation, Peetri Member, north-western Estonia.

Derivation of name. After the Kukruse Stage, where the type species occurs.

Diagnosis. Shell subtriangular in outline. Ventral valve evenly convex, with vestigial disc. Weakly-defined concentric undulations over ventral valve. Ventral muscle field oval, narrow, reaching 1/3 of valve length. Notothyrial platform narrow, myophragm low, short. Weakly-defined side septa.

Discussion. This new genus is related to and resembles *Bekkerina*, but differs in its weaker notothyrial platform, smaller oval ventral muscle field and in the absence of a subperipheral rim.

Occurrence. Rare in the upper part of the Kukruse Stage, Viivikonna Formation, Peetri Member.

Kukrusena peetriensis sp. nov.
Plate VII, figs 13-16.

1930a *Rafinesquina* aff. *deltoidea* (Conrad); Öpik, p. 198; pl. XV, fig. 151; pl. XVI, figs 181, 183.

Holotype. Ventral valve TUG 1054-181 (pl. VII, figs 15-16) from the Kukruse Stage, Viivikonna Formation, Peetri Member, Peetri exposure, coll. by A. Öpik.

Derivation of name. After the Peetri exposure, where the holotype was found.

Description. Shell small to medium-size (known maximum width at mid-shell 26 mm). Ventral valve in longitudinal profile weakly convex centrally, but flatter at the sides. Dorsal valve with low central concavity. Ornament unequally parvicostellate, more prominent ribs in middle sector. 3-5 ribs between coarser ribs on anterior margin of ventral valve. 15-16 ribs per 2 mm at disc margin. Pseudodeltidium apical.

Ventral muscle field oval, very short and narrow. Muscle bounding ridges weakly developed, anteriorly converging.

Notothyrial platform relatively narrow. Socket plates short but high. Myophragm short, low. Median ridge and side septa fine. Transmuscle ridges thick, very short. Cardinal process lobes small, posteriorly inclined. Subperipheral rim very weak.

Measurements (in mm); maximum preserved length and width:

Ventral valve (TUG 1054-181), holotype	19	20
Ventral interior (TUG 72-201)	17	18
Dorsal interior (TUG 1003-245)	18	23

Occurrence and material. Kukruse Stage, Viivikonna Formation, Peetri Member; exposures: Peetri (2); Humala (15).

Genus *HALJALANITES* gen. nov.

Type species. *Rafinesquina anijana* Öpik, 1930a, p. 197, pl. XV, fig. 180, OD. From the Haljala Stage, Anija exposure.

Derivation of name. After the Haljala Stage, where two species of the genus occur.

Other species. *Oepikina dorsata assatkini* Alichova, 1951, p. 51; *Oepikina anijana grandis* Alichova, 1953, p. 115.

Diagnosis. Shell rectangular to subpentagonal in outline, wider medially than at hinge line, with broad rounded anterior margin. Ventral valve almost uniformly hemispherical in both profiles. Dorsal valve evenly and deeply concave, with abruptly deflected sides and anterior margin.

Ventral interarea short, pseudodeltidium small. Dorsal interarea half as long as ventral. Chilidium protrusive, medially not grooved. Radial ornament of numerous accentuated ribs. Dorsal valve evenly and deeply concave. Ventral muscle field small, weakly depressed. Notothyrial platform with short low myophragm and very narrow long median septum. Transmuscle ridges coarse, short, side septa medially sigmoidally sinuously curved towards lateral margins. Socket ridges gently defined. Adductor muscle scars weakly elevated, narrow and laterally bounded by coarse short pustules. Cardinal process lobes stout, posteriorly directed, with fine myophore. Subperipheral rim narrow, conspicuously sharp and high, with sparse vascular canals.

Discussion. This new genus is very similar to the earlier *Bekkerina,* but differs from it in its larger and more convex shell with dorsally strongly returned ventral disc, shorter ventral muscle field and higher and narrower subperipheral rim. The dorsal interior differs in its weaker and shorter myophragm, long side septa and in its more elevated muscle scars.

Occurrence. Haljala Stage to Keila Stage, northern Estonia and north-western Russia.

Haljalanites anijana (Öpik, 1930a)
Plate VIII, figs 7-10.

1930a	*Rafinesquina anijana* Öpik, p. 197, pl. XV, fig. 180.
1951	*Oepikina anijana* (Öpik); Alichova, p. 56, pl. IV, figs 67, 68.
1953	*Oepikina anijana anijana* (Öpik); Alichova, p. 115, pl. XVII, figs 15, 16.

Holotype. Complete shell TUG 665-168 (pl. VIII, figs 8-10) from the Haljala Stage, Jõhvi Substage, lower Kahula Formation, Anija exposure, coll. by A. Wahl.

Description. Lateral sides nearly subparallel, anterior margin somewhat rounded. Ventral valve strongly convex; maximum convexity in posterior third of valve. Umbonal area in longitudinal profile more abruptly geniculate than the trail. Trail long, moderately convex. Steep lateral slopes. Pseudodeltidium small, apical; chilidium massive, not medially grooved. Few accentuated ribs with broad interspaces on umbonal area, getting coarser anteriorly (pl. VIII, figs 7, 8). About 12-14 ribs per 2 mm at the shell margin.

Ventral interior unknown.

Notothyrial platform broad, short. Myophragm broad and high. Transmuscle ridges short, well defined; side septa long, weak, extending to short and high subperipheral rim. Median dorsal ridge very long, anteriorly branching. Parallel cardinal process lobes thick, low, curved towards hinge line. Adductor muscle scars small, narrow.

Measurements (in mm); maximum preserved length and width:

Complete shell (TUG 665-168), holotype	19	13
Dorsal interior (TUG 665-169)	12	12

Occurrence and material. Haljala Stage, Idavere Substage, Tatruse Formation. Exposures: Idavere (3), Kavastu (3). Vasavere Formation, Aluvere quarry (2). Jõhvi Substage,

lower Kahula Formation. Exposures: Männiku (Pakri peninsula) (1), Adraküla (1), Alliku (1), Harku (2), Pääsküla (1), Sõjamägi (10), Anija (7), Aluvere quarry (8), Kahula (2).

Haljalanites assatkini (Alichova, 1951)
Plate VIII, figs 1-6.

1951 *Oepikina dorsata* var. *assatkini* Alichova, p. 51; pl. IV, fig. 64.
1953 *Oepikina dorsata assatkini* Alichova, p. 114, pl. XVII, figs 13, 14.
1993a *Bekkerina assatkini* (Alichova); Rõõmusoks, p. 51, 53, pl. III, figs 1-4.

Holotype. Ventral interior (without number), figured by Alichova (1951, pl. IV, fig. 64), from the Haljala Stage, near the town of Slantsy, Ingria, north-western Russia, coll. by B. P. Assatkin.

Description. Shell small (maximum preserved length 22 mm). Cardinal extremities obtuse, lateral sides oblique, anterior margin broadly rounded. Ventral valve strongly convex in both profiles. Weak umbo (pl. VIII, fig. 5). Trail long, evenly convex, with postero-lateral slopes gently descending towards cardinal extremities. Dorsal valve deeply concave, with sides and anterior margin abruptly deflected. Ventral interarea short, pseudodeltidium small. Dorsal interarea half as long as ventral. Chilidium not well preserved in specimens available, but apparently small and thin. Radial ornament of numerous accentuated ribs, with four to six finer ribs between them near anterior margin. 15 ribs per 2 mm at disc margin.

Ventral muscle field rhomboidal, gently depressed, occupying less than half valve length. Long narrow median ridge extending to the deflection of anterior margin. Diductor muscle scars weakly radially striated; adductor scars broad, elongate. Teeth small, dental plates short. Internal surface finely and densely tuberculate outside the muscle field.

Dorsal valve interior gently elevated centrally. Notothyrial platform with short low myophragm and very narrow median septum. Transmuscle ridges coarse, short. Side septa high, long, sinuously curved towards lateral margins. Socket ridges gently defined. Adductor muscle scars weakly elevated, narrow, and laterally bounded by coarse short pustules. Cardinal process lobes stout, posteriorly-directed, with fine myophore. Subperipheral rim narrow, conspicuously sharp and high, with sparse vascular canals. Internal latero-median area with large sparse tubercles, peripheral area with fine and dense tubercles.

Measurements (in mm), maximum preserved length and width:

Complete shell (TUG 77-16)	15	16
Ventral valve (TUG 72-74)	22	21
Dorsal valve interior (TUG 72-73)	13	18
Ventral valve interior (TUG 1003-41)	11	15

Occurrence and material. Haljala Stage, Idavere Substage, Vasavere Formation. North-eastern Estonia; exposures: Aluvere quarry (50), Ojamaa river-bank (1). North-western Russia, Ingria and environs of Slantsy (Alichova, 1951, 1953).

Haljalanites grandis (Alichova, 1953)
Plate VIII, figs 11-14.

1953 *Oepikina anijana grandis* Alichova, p. 115, pl. XVII, figs 17-19.

Holotype. Complete shell (without number) figured by Alichova; pl. XVII, figs 17a-d from the Keila Stage, upper Kahula Formation, Porkhov borehole (depth 392.15 m), north-western Russia.

Description. Shell quadrangular in outline, slightly wider than long, posterolaterally gently winged, medium-sized (maximum width at hinge line 26 mm). Ventral valve high, almost uniformly convex in both profiles. Disc strongly-defined only in short umbonal part. Ventral interarea long. Pseudodeltidium very small, apical. Chilidium massive, not grooved. Dorsal valve evenly deeply concave, with maximum concavity in the middle. Radial ornament unequally parvicostellate, numerous accentuated costellae faintly defined. 9 ribs per 2 mm at disc margin.

Ventral interior unknown.

Notothyrial platform short, broad, weakly elevated. Myophragm very short. Median ridge strongly developed, short. Cardinal process lobes thick, strongly inclined backwards. Socket plates narrow, almost parallel with hinge line. Adductor muscle scars broad, laterally elevated. Transmuscle ridges short, side septa weakly defined, short. Subperipheral rim low, broad, with fine long vascular canals.

Measurements (in mm); maximum preserved length and width:

Dorsal interior (TUG 1007-5)	22	17
Complete shell (TUG 1007-30)	21	22
Complete shell (TUG 72-14)	20	21

Comparison. This species differs from the older species *H. anijana* in having markedly larger, broader shell with a more convex ventral valve, more strongly defined cardinalia and with the longer sloped subperipheral rim having deeply formed, long vascular canals.

Occurrence and material. Keila Stage, upper Kahula Formation. Exposures: in town of Rakvere (2), Sõmeru (6), Oandu river side (19), north-eastern Estonia.

Genus *SAKUNITES* gen. nov.

Type species. *Leptaena luhi* Sokolskaya, 1954, p. 57, OD. From the Oandu Stage, Vasalemma Formation, Saku Member, north-western Estonia.

Derivation of name. After the Saku Member, where this species occurs.

Diagnosis. Ventral valve gently convex, with occasional concentric but irregular corrugations. Dorsal valve almost flat, with narrow elevated antero-dorsal margin and very fine widely-spaced variably regular concentric rugae.

Comparison. *Sakunites* differs from other genera of the *Furcitellinae* in the flatter convexity of the ventral valve in longitudinal profile, the more elevated ventral muscle bounding ridges and in the coarser, more elevated indented edges of the notothyrial platform.

Occurrence. Oandu Stage, Vasalemma formation, Saku Member.

Sakunites luhi (Sokolskaya, 1954)
Plate XXXIV, figs 1-5.

1954 *Leptaena luhi* Sokolskaya, p. 57, pl. III, figs 10-13.
1956 *Leptaena luhi* Sokolskaya; Oraspõld, p. 55, pl. III, figs 1, 2.

Holotype. Complete shell, PIN 543/238 (at the Palaeontological Institute of the Russian Academy of Sciences, Moscow) from the Oandu Stage, Vasalemma Formation, Saku Member, Jõgisoo exposure, north-western Estonia, coll. by A. Sokolskaya.

Description. Ventral muscle field broad, reaching one third of valve length, with well-defined elevated bounding ridges converging anteriorly.

Notothyrial platform narrowly elongate, and broadening weakly antero-laterally. Transmuscle ridges and side septa coarse, high. Myophragm short. Central median ridge

short, narrow. Subperipheral rim sharp, narrow and high. Cardinal process lobes small, plate-like, parallel, posteriorly directed.

Ornament unequally parvicostellate, with some accentuated ribs. 10 ribs per 2 mm at disc margin.

Measurements (in mm); maximum preserved length and width:

Ventral valve exterior (TUG 72-237)	15	19
Dorsal valve interior (TUG 72-234)	13	26
Ventral valve interior (TUG 72-175)	23	24
Dorsal valve interior (TUG 72-173)	19	18

Remarks. The interiors were unknown to Sokolskaya; and the first description was given by Oraspõld (1956). Although the name of this species should have been *luhai*, after Prof. Artur Luha, the original misspelling must stand.

Occurrence and material. Oandu Stage, Vasalemma Formation, Saku Member. Exposures: Saku (9), Üksnurme (6), Jõgisoo (2), Tuula (5).

Genus *TRIGRAMMARIA* Wilson, 1945

Type species. *Trigrammaria trigonalis* Wilson, 1945, p. 140, OD.

Diagnosis. See Cocks & Rong (2000, p. 237).

Remarks. According to Cocks & Rong (2000), *Microtrypa* (Wilson, 1945) is a subjective junior synonym of *Trigrammaria*. Thus the two Upper Ordovician species from northern Estonia, previously described by Rõõmusoks (1985) as *Microtrypa estonica* and ?*M. minima* are here assigned to *Trigrammaria*. However, it is now known that the species *Trigrammaria virve* Rõõmusoks, 1985 has features different from *Trigrammaria* and therefore that species is assigned here to the new genus *Crassoseptaria*.

Occurrence. Llandeilo and Llanvirn of North America (Cocks & Rong, 2000), Rakvere and Oandu stages of Estonia.

Trigrammaria estonica (Rõõmusoks, 1985)
Plate IX, figs 1-3.

1985 *Microtrypa estonica* Rõõmusoks, p. 137, pl. III, figs 1-8 (non fig. 9 = ? *Trigrammaria minima*; pl. IV, fig. 5).

Holotype. Dorsal valve interior TUG 666-183a (= GMUT Br 1302; figured by Rõõmusoks, 1985, pl. III, fig. 5; refigured here, pl. IX; fig. 1) from the Rakvere Stage, Rägavere Formation, Piilse Member, Munalaskme exposure, north-western Estonia. Coll. during expedition in 1946.

Description. Shell convexo-concave, medium-sized (maximum estimated width at hinge line 30 mm), with rounded triangular outline and broad dorsal anterior fold. Ventral valve gently concave medianly. Chilidium narrowly grooved medially. Radial ornament parvicostellate; every 2nd or 3rd rib thicker than others near anterior margin. Well-developed growth lines. Weakly-defined short oblique rugae variably developed near posterior margin on both sides of umbo. 6-7 ribs per 2 mm at disc margin.

Ventral muscle field almost circular, with high elevated margins occupying 1/3 of the valve length. Median ridge very faintly developed.

Dorsal muscle field gently concave. Notothyrial platform broad, low. Myophragm broad. Narrow transmuscle ridges broadly divergent, side septa strongly defined.

Measurements (in mm), maximum preserved length and width:

Dorsal interior (TUG 666-183a), holotype	17	23
Ventral valve exterior (TUG 666-183b)	20	23
Ventral valve interior (TUG 666-182)	16	21

Occurrence and material. Rakvere Stage, Rägavere Formation, basal beds of the Piilse Member. Exposures: Paeküla (8), Määra (2), Munalaskme (6), Voore (SW of Saku) (16), Vaida (3).

? *Trigrammaria minima* (Rõõmusoks, 1985)
Plate IX, figs 4-6.

1985 *Microtrypa* ? *minima* Rõõmusoks, p. 138, pl. IV, figs 1-4; pl. III, fig. 9.

Holotype. Complete shell TUG 102-47 (= GMUT Br 1290; figured by Rõõmusoks, 1985, pl. IV, figs 1-4) from the Oandu Stage, Hirmuse Formation, Tõrremägi exposure, coll. by H. Palmre, 1937 (not from the Rakvere Stage, Piilse Member, from locality Moonaküla as erroneously printed in Rõõmusoks, 1985, p. 138).

Description. Shell small (maximum estimated width at hinge line 20 mm) flat, with rounded triangular outline. Ventral valve gently concave along antero-lateral margin, dorsal valve longitudinally slightly evenly convex, with faintly elevated median fold. Ventral interarea relatively low; chilidium medially grooved. Ornament parvicostellate. Ribs weakly irregular, every second rib near anterior margin gently thickened. Five to seven strong ribs per 2 mm near anterior margin. Weakly-defined rugae posterolaterally on both valves. Strongly developed concentric growth lines, particularly on ventral valve.

Ventral muscle field subtrapezoidal, with coarse bounding ridges converging anteriorly. Median septum strong, with a pair of weak parallel septa along sides. Low subperipheral rim with long fine vascular canals.

The interior of dorsal valve unknown.

Measurements (in mm), maximum preserved length and width:

Ventral interior (TUG 72-233)	17	20
Complete shell (TUG 72-232)	13	15

Comparison. As compared with *Trigrammaria estonica*, ? *T. minima* has a smaller size, less convex dorsal valve with less sulcate anterior margin, coarser ribs and the ventral muscle field has coarser, more elevated bounding ridges and a median ridge.

Occurrence and material. Oandu Stage, Hirmuse Formation, north-eastern Estonia, exposures in the town of Rakvere (4) and Tõrremägi (1). The previously reported occurrence in the Rakvere Stage (Rõõmusoks, 1985, p. 139) is an unfortunate typing error.

Genus *GENICULINA* Rõõmusoks, 1993a

Type species. *Strophomena pseudoalternata* Schmidt, 1858, p. 214, OD. From the Pirgu Stage, Adila and Ärina Formations, northern Estonia.

Other species. In contrast to a previous paper (Rõõmusoks, 1993a, p. 53), only the Baltoscandian species are here assigned to the genus *Geniculina.* These are *G. helgoeyensis* (Spjeldnaes) (see Rõõmusoks, 1993a, p. 54), *G. voorensis* sp. nov, *G. vironiensis* sp. nov. and *G. ralfi* sp. nov.

Diagnosis (emended). Profile concavo-convex, outline subtrapezoidal. Disc of both valves almost flat, with short irregular oblique rugae postero-laterally. Ventral valve evenly rounded, dorsally geniculated. Ventral muscle field almost subcircular, reaching one third disc length, with strongly-developed bounding ridges. Socket plates widely divergent, becoming almost parallel to hinge line, with small denticles posteriorly. Transmuscle ridges usually weakly developed, side septa long. Cardinal process lobes robust, ventro-posteriorly directed, with deeply grooved myophores. Subperipheral rim present. Ornament unequally parvicostellate.

Discussion. The ventral interior and geniculation of *Geniculina* resemble those of *Mjoesina* Spjeldnaes (1957). However, the systematic status of the latter genus is still somewhat uncertain because the dorsal interior of the type species *Rafinesquina mjoesenis* Holtedahl (1916) is not known (Cocks & Rong, 2000, p. 252).

Distribution. Rakvere and Pirgu stages, northern Estonia; Bønsnes Formation, Norway. Whether *Oepikina* (?) *subaequiclina* Alichova (1951, p. 57) from the Oandu or Rakvere Stage in Ingria, NW Russia, belongs to *Geniculina* remains uncertain because the interiors of this species are unknown.

Geniculina pseudoalternata (Schmidt, 1858)
Plate XI, figs 1-15.

1858	*Strophomena pseudoalternata* Schmidt, p. 214.
1956	*Rafinesquina pseudoalternata* (Schmidt); Jaanusson, p. 375, 377, 379, 383.
1991	*"Rafinesquina" pseudoalternata* (Schmidt); Rõõmusoks, p. 30, 31, 33; pl. II, fig. 1; pl. III, figs 1-4.
1993a	*Geniculina pseudoalternata* (Schmidt); Rõõmusoks, p. 54; pl. IV, figs 1-6.
2000	*Geniculina pseudoalternata* (Schmidt); Cocks & Rong, p. 229, 230, figs 1a, b, c.

Lectotype. Dorsal valve interior TUG 42-36 (pl. XI, figs 11-12; = GMUT Br 1460, selected by Rõõmusoks, 1993a, p. 54), from the Pirgu Stage, Adila Formation. This specimen, together with four other ventral interiors, was collected by F. Schmidt from erratic boulders at Vardi (= Schwarzen, Schmidt, 1908, p. 729) in north-western Estonia.

Description. Shell large (maximum recorded width at hinge line 44 mm). Ventral disc almost flat, subtrapezoidal in outline. Trail longer than disc, with relatively abrupt sides, evenly convex anteriorly. Ventral interarea long, projecting beyond hinge line. Pseudodeltidium large, chilidium not grooved medially. Seven to eight short irregular rugae across hinge line along posterior margin, becoming longer and coarser towards cardinal extremities. Radial ornament unequally parvicostellate, with numerous accentuated ribs and five to ten finer ribs between them at anterior margin of disc. Ten to thirteen fine ribs per 2 mm at disc margin.

Ventral muscle field circular, with prominent long median ridge and high bounding ridges.

Notothyrial platform well defined. Socket plates long, flaring, high, parallel to hinge line. Four small denticles at posterior side (pl. XI, fig. 12). Sockets low, triangular in outline. Muscle fields weakly depressed. Transmuscle ridges weakly-defined or absent. Side septa straight and long. Myophragm narrow, dorsal median septum very narrow, extending to anterior end of side septa. Subperipheral rim weakly developed.

Measurements (in mm); maximum preserved length and width:

Dorsal valve interior (TUG 42-36), lectotype	26	41
Posterior view of conjoined valves (TUG 42-36)	-	30
Ventral valve exterior (TUG 42-37)	23	28
Ventral valve interior mould (TUG 1003-235)	31	37

Discussion. The first illustrations of *Geniculina pseudoalternata* were published by Rõõmusoks (1991). The original short diagnosis of this species by Schmidt (1858, p. 215) is as follows: "The shell distinctly geniculated. Ornament regular, always 7-8 fine ribs between the coarser. The ventral interarea higher, the beak with foramen projected posteriorly from hinge line".

Holtedahl (1916, p. 21; pl. III, figs 9-11) identified material from the 5a beds (now termed Bønsnes Formation) in Norway as *Rafinesquina pseudoalternata* Schmidt. After examination of the Holtedahl's collection at the Paleontologisk Museum, Oslo, I suggested that these specimens should be assigned to a new species of *Geniculina* (Rõõmusoks, 1993a, p. 54). Unfortunately no interiors are known.

Occurrence and material. Pirgu Stage, Moe Formation. Exposures: Nyby (5), Salutaguse (8), Moe and Imastu (4). Adila Formation. Exposures: Vohilaid Island (1), Hosholm, Vormsi Island (20), Haapsalu (from erratics, 12), Uuemõisa (from erratics, 2), Rannaküla (4), Piirsalu (4), Vardi (from erratics, 13), Rabivere (1), Pirgu (4), Umeru (1), Habaja (1), Käravete (1). Ärina Formation, Röa Member. Exposures: Vardi (from erratics, 1), Röa (6), Kuru (1).

Geniculina voorensis sp. nov.
Plate X, figs 1-8.

Derivation of name. After Voore exposures in north-western Estonia from where all the specimens were collected.

Holotype. Ventral valve TUG 74-19 (pl. X, 1-2) from the Rakvere Stage, Rägavere Formation, basal beds of the Piilse Member, Voore exposure, coll. by A. Oraspõld, 1955.

Description. Shell subrhomboidal in outline, medium-sized (maximum recorded width at hinge line 28 mm). Ventral valve gently convex, with steep lateral slopes. Small pseudodeltidium, chilidium medially weakly grooved. Ventral disc posteriorly weakly convex. Very narrow, short rugae oblique to hinge line postero-laterally. Ventral interarea short. Ornament on disc multicostellate becoming unequally parvicostellate on geniculum and trail, with two to three fine ribs between accentuated ribs. Ten to twelve ribs per 2 mm at shell margin. Dorsal valve slightly concave.

Ventral muscle field almost circular (known only in one poorly preserved specimen; pl. X, fig 8). Bounding ridges converge anteriorly, medial ridge short.

Interior surface of dorsal valve gently convex, with weakly depressed adductor muscle scars. Subperipheral rim moderately high, with rare short vascular canals. Narrow marginal furrow surrounding the rim. Notothyrial platform broad, but short and low. Socket ridges broadly divergent, bearing four minute denticles on posterior side. Myophragm wide, better-defined anteriorly. Central median ridge short and narrow. Transmuscle ridges relatively long, side septa poorly defined, but long and gently sinuous anteriorly. Cardinal process lobes small, erect, posteriorly grooved. Sockets transversely elongately triangular and deep.

Measurements (in mm); maximum preserved length and width:

Ventral valve (TUG 74-19), holotype	17	22
Ventral valve (TUG 74-20)	17	25
Dorsal valve interior (TUG 1003-136)	16	24
Complete shell (TUG 1003-122)	20	22
Ventral valve interior (TUG 1003-116)	20	23

Occurrence and material. Rakvere Stage, Rägavere Formation, basal beds of the Piilse Member north-western Estonia. Voore exposure (8), Voore road-side ditch (1).

Geniculina vironiensis sp. nov.
Plate IX, figs 7-13.

1954 *Rafinesquina* (*Playfairia*) *deltoidea* (Conrad) (*pars*); Sokolskaya, p. 43, textfigs 8, 9; pl. II, figs 14-20.
1993a *Geniculina subaequiclina* (Alichova); Rõõmusoks, pl. III, figs 5-10.

Derivation of name. After Virumaa district, north-eastern Estonia, in Latin Vironia, where available specimens of this species were collected.

Holotype. Complete shell TUG 102-18 (= GMUT Br 1543, Rõõmusoks, 1993a, pl. III, figs 5-7, refigured here pl. IX, figs 7-8) from the Rakvere Stage, Rägavere Formation, Piilse Member, exposure in the town of Rakvere, coll. by H. Palmre, 1937.

Description. Shell subtrapezoidal, with somewhat rounded sides, medium-sized (maximum recorded width at hinge line 32 mm). Ventral valve strongly convex in both profiles; ventral disc smoothly rounded into trail. Dorsal disc almost flat, anteriorly and laterally abruptly geniculate. Pseudodeltidium relatively short, chilidium prominent and medially gently grooved. Faintly-developed sinuous short oblique rugae posterolaterally near hinge line become thicker near cardinal extremities. Ornament unequally parvicostellate, in particular anteriorly on trail. There are numerous accentuated ribs, eight to nine per 2 mm at disc margin.

Ventral muscle field subrhomboidal, extending to one third of disc length, with relatively high anteriorly-converging lateral bounding ridges. Adductor muscle scars narrow, with short conspicuous median ridge. Diductor muscle scars broad, triangular. Hinge teeth finely crenulate posteriorly.

Dorsal valve interior almost flat. Notothyrial platform low, broad, with weakly developed short myophragm. Socket plates widely divergent, turning towards hinge line and bearing well-defined small denticles on posterior sides. Transmuscle ridges very weakly defined, short. Side septa long, anteriorly sinuous. Cardinal process lobes small, directed backwards, myophores weak. Subperipheral rim weakly developed, convex, with numerous vascular canals.

Measurements (in mm); maximum preserved length and width:

Complete shell (TUG 102-18), holotype	17	24
Complete shell (TUG 1003-118)	21	26
Dorsal valve interior (TUG 242-11)	19	25
Ventral valve interior (TUG 242-12)	19	29

Discussion. This new species differs from *Geniculina voorensis* in its more strongly-developed oblique posterolateral rugae, in having stronger accentuated ribs, weak dorsal transmuscle ridges, longer side septa, a more strongly-defined ventral muscle field and denticles on the socket plates.

Occurrence and material. Rakvere Stage, Rägavere Formation, Piilse Member. Exposures: in the town of Rakvere (in particular, Rägavere) (65), Kullaaru (3), Oandu river-bank at Piilse (3).

Geniculina ralfi sp. nov.
Plate X, figs 9-17.

Derivation of name. After Estonian geologist and palaeontologist, the late Ralf Männil.

Holotype. Ventral valve exterior TUG 1003-121 (pl. X, figs 9-11) from the Nabala Stage, Paekna Formation, Nõmmeküla exposure, coll. by A. Rõõmusoks, 1968.

Description. Shell subtrapezoidal in outline, with small sharp cardinal extremities, medium-sized (maximum recorded width at hinge line 26 mm). Ventral disc almost flat, trail

moderately convex. Ventral interarea short, pseudodeltidium smaller than chilidium which is medially grooved. Dorsal disc flat or gently concave anteriorly. Ornament with conspicuous dense accentuated ribs. There are three to six finer ribs between the coarser. About nine ribs per 2 mm at disc margin. Occasional weak, broadly-interspaced concentric rugae on both discs changing to weak oblique rugae postero-laterally near hinge line.

Ventral valve interior known from one specimen only (pl. X, fig. 12) Muscle field reaching half valve length, subcircular with high bounding ridges converging anteriorly. Diductor muscle scars longitudially striated. Teeth small, crenulated.

Dorsal valve interior surface weakly depressed. Notothyrial platform delicate. Myophragm very narrow and short. Socket ridges widely divergent, with four to seven denticles on posterior side. Sockets transversely triangular. Transmuscle ridges subdued, side septa relatively long, widely-diverging and gently sinuous anteriorly. Cardinal process lobes small, inclined backwards. Narrow marginal furrow surround subperipheral rim inside.

Measurements (in mm). Maximum preserved length and width:

Ventral valve (TUG 1003-121), holotype	22	22
Ventral valve interior (TUG 43-145)	17	27
Conjoined valves (TUG 1003-119)	15	26
Dorsal valve interior (TUG 1008-2)	17	24
Dorsal valve interior (TUG 54-31)	16	21
Ventral valve exterior (TUG 1003-120)	12	19
Dorsal valve exterior (TUG 54-34)	18	20

Comparison. This species differs from other congeneric forms in its prolate shape, coarser latero-posterior rugae, and gently developed notothyrial platform.

Occurrence and material. Nabala Stage, Paekna Formation. Exposures: Kärdla, Hiiumaa Island (3); in mainland: Laitse (1), Nõmmeküla (36).

Genus *CRASSOSEPTARIA* gen. nov.

Type species. *Trigrammaria virve* Rõõmusoks, 1985 OD. From the Nabala Stage, Paekna Formation, north-western Estonia.

Derivation of name. Latin *crassus*, coarse and *septum*.

Diagnosis. Shell convexo-concave, trigonal in outline, strongly geniculate, with broad low dorsal median fold. No concentric rugae on disc. Short, small notothyrial platform. Myophragm coarse, particularly posteriorly, short. Socket plates thick and short. Thick, prominent side septa.

Discussion. Shell externally comparatively similar to *Luhaia*, but with broad dorsal fold. The notothyrial platform of the new genus is relatively small, with coarsely-developed side septa.

Occurrence. Nabala Stage, Paekna Formation, north-western Estonia and western Ingria.

Crassoseptaria virve (Rõõmusoks, 1985)
Plate XII, figs 1-6

1985 *Trigrammaria virve* Rõõmusoks, p. 134, pl. I, figs 1-9.

Holotype. Conjoined valves TUG 42-126 (= GMUT Br 1190; figured by Rõõmusoks, 1985, pl. I, figs 1-3, refigured here pl. XII, figs 1-3) from the Nabala Stage, Paekna Formation, Laitse exposure, coll. by F. Schmidt.

Description. Shell of medium size (maximum recorded estimated width at hinge line 33 mm), ventrally strongly geniculated, subtriangular in outline. Broad low dorsal median fold

with very gently sloping sides and ventral valve antero-medianly correspondingly concave. Ventral interarea relatively high, pseudodeltidium narrow. Chilidium without median groove. Ornament unequally parvicostellate. Every fourth to fifth rib near anterior margin thicker than the others. 6 ribs per 2 mm at disc margin.

Ventral muscle field occupying one third of the interior length, almost circular, bounding ridges highly elevated. Coarse median septum, becoming finer anteriorly. Teeth posteriorly trigonal.

Notothyrial platform with short, broad, thick myophragm. Cardinal process lobes triangular anteriorly, broad and high. Socket plates short, diverging at about 90 degrees. Sockets triangular. Transmuscle ridges narrow, very short; side septa coarse, gently sinuous anteriorly. Internal surface of valves with very fine, relatively sparse, tubercles.

Measurements (in mm); maximum preserved length and width:

Complete shell (TUG 42-126), holotype	21.4	26.9
Ventral valve interior (TUG 1003-242)	27	33
Dorsal valve interior (TUG 1003-241)	23.5	23

Occurrence and material. Nabala Stage, Paekna Formation. Exposures: Laitse (1), Nõmmeküla (25), Oru (2); Slantsy, Plyussa river-bank, Ingria (2).

Genus *LUHAIA* Rõõmusoks, 1956

Type species. *Luhaia vardi* Rõõmusoks, 1956, p. 1091, OD.
Diagnosis. See Cocks & Rong (2000, p. 231).
Occurrence. Pirgu Stage, Upper Ordovician, Estonia.

Luhaia vardi Rõõmusoks, 1956
Plate XII, figs 7-13.

1956	*Luhaia vardi* Rõõmusoks, p. 1091, textfigs 1-4.
1965	*Luhaia vardi* Rõõmusoks; Muir-Wood & Williams, p. 384, figs 6a-6b.
1993b	*Luhaia vardi* Rõõmusoks; Rõõmusoks, p. 113, pl. II, figs 1-5.
2000	*Luhaia vardi* Rõõmusoks; Cocks & Rong, p. 231, fig. 142, 3a.

Holotype. Ventral valve exterior mould TUG 80-199 (= GMUT Br 4004; figured by Rõõmusoks, 1956, fig. 3; refigured here, pl. XII, fig 7) from the Pirgu Stage, Adila Formation, Hosholm coast in Vormsi Island, north-western Estonia, coll. by V. Jaanusson, S. Kiin and R. Männil, 1939.

Description. Shell large (maximum recorded estimated width at hinge line 30 mm); outline rounded, triangular. Cardinal extremites angular. Shell abruptly geniculate ventrally, almost rectangular in profile. Rugae narrow, irregular, particularly laterally. Ornament unequally parvicostellate, with wide spaces between the few accentuated ribs. 14 ribs per 2 mm at disc margin. Pseudodeltidium large, long; chilidium broad, medially weakly grooved.

Ventral muscle field narrow, elongate; median septum narrow, long.

Notothyrial platform small. Cardinal process lobes stout, erect. Myophragm very short. Transmuscle ridges gently defined; side septa high, long, anteriorly converging. Socket ridges short.

Measurements (in mm), maximum preserved length and width:

Ventral valve exterior mould (TUG 80-199), holotype	20	33
Complete shell (TUG 36-36)	-	33

Complete shell (TUG 107-19)	-	24
Ventral valve exterior (TUG 80-201)	17	21
Ventral valve interior mould (TUG 38-79)	20	25
Dorsal valve interior mould (TUG 950-20)	17	21

Occurrence and material. Pirgu Stage, Adila Formation. Exposures: Vohilaid Island (1); Hosholm coast in Vormsi Island (2); exposures in mainland: Holm in the town of Haapsalu, erratics (3), Uuemõisa, erratics (4), Piirsalu (4), Vardi, erratics (6), Pirgu (1); Oru (1). Ärina Formation, Röa Member Muuga (2).

Table 4. The subfamily Furcitellinae in the Ordovician of northern Estonia

Series	Species	Stage	Formation	Member
Harju	*Luhaia vardi* Rõõmusoks	Pirgu	Adila + Ärina	Röa
	Geniculina pseudoalternata (Schmidt)	Pirgu + Vormsi	Adila + Moe + Kõrgessaare	
	Crassoseptaria virve (Rõõmusoks)	Nabala	Paekna	
	Geniculina ralfi sp. nov.	Nabala	Paekna	
Viru	*Geniculina vironiensis* sp. nov.	Rakvere	Rägavere	Piilse
	Geniculina voorensis sp. nov.	Rakvere	Rägavere	Piilse
	Trigrammaria estonica (Rõõmusoks)	Rakvere	Rägavere	Piilse
	? *Trigrammaria minima* (Rõõmusoks)	Oandu	Hirmuse	
	Sakunites luhi (Sokolskaya)	Oandu	Vasalemma	Saku
	Haljalanites grandis (Alichova)	Keila	Upper Kahula	
	Haljalanites anijana (Öpik)	Haljala	Tatruse + Vasavere	
	Haljalanites assatkini (Alichova)	Haljala	Vasavere	
	Kukrusena peetriensis sp. nov.	Kukruse	Viivikonna	Peetri
	Bekkerina dorsata (Bekker)	Kukruse	Viivikonna	
	Tallinnites imbrexoidea (Sokolskaya)	Uhaku	Väo + Kõrgekallas	Erra
	Bekkerina raricostellata Rõõmusoks	Uhaku	Kõrgekallas	Erra, Koljala
	Bekkerina raricostellata Rõõmusoks	Uhaku	Upper Väo	
	Panderites imbrex (Pander)	Aseri	Kandle	

Family RAFINESQUINIDAE Schuchert, 1893
Subfamily RAFINESQUININAE Schuchert, 1898
Genus *KJAERINA* Bancroft, 1929

Type species. *Kjaerina typa* Bancroft; OD. From the upper Longvillian, Cheney Longville Flags, Onny section, Shropshire, England (pl. XIII, fig. 10, here).

Distribution. Oandu Stage, Hirmuse Formation, northern Estonia; Ingria, NW Russia, and equivalent beds of Cheney Longville Formation, Shropshire, England.

Kjaerina poljensis (Alichova, 1951)
Plate XIII, figs 1-4.

1951 *Rafinesquina poljensis* Alichova, p. 48; pl. IV, figs 76, 77.
1993c *Kjaerina poljensis* (Alichova); Rõõmusoks, p. 161, pl. I, figs 1-4.

Holotype (without number). Ventral valve exterior, figured by Alichova (1951, pl. IV, fig. 76) from the Oandu Stage, Hirmuse Formation, left bank of the Plyussa River at Bol′shiye Pol′ya village near Slantsy, Ingria, NW Russia.

Description. Shell extraordinarily thin, subrectangular in outline, medium-sized (maximum estimated width 35 mm). Ventral valve almost flat, faintly convex only postero-medially. One strong median rib on ventral valve. Ornament parvicostellate. Fine irregular oblique rugae postero-laterally. 8 ribs per 2 mm at disc margin. Vestigial pseudodeltidium, large medially-grooved chilidium. Ventral muscle field low, elongate, almost half as long as valve length, with thin straight, anteriorly broadly divergent bounding ridges. Dental plates short. Notothyrial platform with short narrow myophragm. Cardinal process lobes thin, anteriorly a little divergent. Transmuscle ridges short, weakly developed. Socket ridges short and narrow. Ornament of dorsal valve with uniformly-developed ribs (pl. XIII, fig. 3).

Measurements (in mm); maximum preserved length and width:

Ventral valve exterior (TUG 72-103)	35	34
Ventral valve interior (TUG 72-100)	32	32
Dorsal valve exterior (TUG 1003-66)	18	20
Dorsal valve interior (TUG 102-15)	10	12

Discussion. *K. poljensis* differs from the contemporary British species *K. typa* Bancroft and *K. bipartita* (Salter) (see Hurst, 1979, p. 282) mainly in its broader, longer ventral muscle field (compare figs 2 and 10 in plate XIII here), more strongly-developed notothyrial platform and thinner shell with subrectangular outline.

Alichova (1951, p. 49) erroneously reported *Rafinesquina poljensis* from the Jõhvi (= Haljala) and Keila Stages – a mistake corrected by Männil (1960, p. 95).

Sokolskaya (1954, p. 37) referred the *Kjaerina*-like specimens from the Oandu Stage, Vasalemma Formation, Saku Member, to *Rafinesquina* (*Rafinesquina*) *poljensis*. These specimens might belong to a new species of *Kjaerina*, occurring only in the north-western part of Estonia, but it is not described here since the interior is not known.

Occurrence and material. Oandu Stage, Hirmuse Formation. Exposures: in the town of Rakvere (8), Tõrremägi (3), Oandu river-side (1) and left bank of the Plyussa River at the Bol′shiye Pol′ya village near Slantsy, Ingria, NW Russia (1).

Genus *VIRUNITES* gen. nov.

Derivation of name. After occurrence in the Viru district of north-eastern Estonia.

Type species. *Rafinesquina* (*Rafinesquina*) *orvikui* (Oraspõld, 1956), from the Oandu Stage, Hirmuse Formation.

Diagnosis. Shell small (maximum recorded width at hinge line 18 mm) subcircular in outline, moderately concavo-convex. Ornament nearly multicostellate, with one stronger median rib on ventral valve. Pseudodeltidium very small, apical. Cardinal process lobes exceptionally long, with broad myophores: transmuscle ridges absent. Ventral muscle field not defined laterally.

Discussion. *Virunites* is the smallest of the three rafinesquinine genera in Estonia in Oandu time. This genus differs from *Kjaerina* and *Rakverina* in the cardinal process lobes, low notothyrial platform as well as in the very simple ventral muscle field.

Occurrence. Oandu Stage, Hirmuse Formation.

Virunites orvikui (Oraspõld, 1956)
Plate XIII, figs 5-9.

1956 *Rafinesquina* (*Rafinesquina*) orvikui [Männil MS] Oraspõld, p. 49, pl. I, fig. 21.
1993c *Kjaerina orvikui* (Männil); Rõõmusoks, p. 161, pl. I, figs 5-7.

Holotype. Complete shell TUG 1009-1 (= GMUT Br 3058, Oraspõld, 1956, pl. I, fig. 21; refigured here, pl. XIII, figs 5-7) from the Oandu Stage, Hirmuse Formation, Oandu river-side, coll. by a students' expedition in 1955.

Description. Shell very thin, without rugae. Very fine ribs. 9 ribs per 2 mm at valve margin. Chilidium large, medially grooved. Notothyrial platform low, with short myophragm. Cardinal process lobes narrow in basal part, long, extending anteriorly as far as the end of myophragm and weakly divergent. Myophores broad, elongately, triangular in shape. Socket ridges diverging at less than 90°. Muscle field narrow, triangular. Deep elongate hollow between the bases of cardinal process lobes becoming broader anteriorly (pl. XIII, fig. 8).

Ventral muscle field circular, one-third valve length, not defined laterally. Dental plates short. Ventral interior with radially arranged fine tubercles.

Measurements (in mm); maximum preserved length and width:

Complete shell (TUG 1009-1), holotype	14	18
Fragmentary dorsal interior (TUG 102-13)	7	11
Ventral interior (TUG 102-14)	11	13

Occurrence and material. Oandu Stage, Hirmuse Formation. Town of Rakvere, several exposures (24), Tõrremägi ditch (19), Oandu, river-side (2).

Genus *RAKVERINA* Rõõmusoks, 1993

Type species. *Oepikina* (?) *inaequiclina* Alichova (1951), from the Rakvere Stage in Ingria, NW Russia.

Derivation of name. After the Rakvere Stage.

Other species. *Rakverina oanduensis* (Oraspõld).

Diagnosis. Shell rounded, subtriangular in outline and strongly geniculate in dorsal direction, medium-sized (known maximum width at hinge line 35 mm), with concavo-convex profile. Ornament unequally parvicostellate. Obscure concentric rugae coarser postero-laterally near the hinge line. Pseudodeltidium very small, apical or absent. Chilidium large, medially deeply grooved. Ventral muscle field subcircular, with weak lateral bounding ridges.

Cardinal process lobes plate-like, almost parallel. Poorly defined or absent transmuscle ridges. Dental plates short.

Discussion. Rõõmusoks (1993c) assigned ? *Oepikina inaequiclina* Alichova (1951) and *Rafinesquina* (*Playfairia*) (?) *oanduensis* Oraspõld, 1956 to a new genus *Rakverina*. Cocks and Rong (2000, p. 238) considered *Rakverina* as a subjective junior synonym of *Hedstroemina* Bancroft, 1929. Nevertheless, *Rakverina* differs from the related *Hedstroemina* in having a more geniculate shell anteriorly, regularly parvicostellate ornament, coarse ribs, weaker concentric wrinkles, a larger chilidium which is not grooved, a moderately impressed ventral muscle field with weak bounding ridges, and poorly-defined dorsal transmuscle ridges lacking prominent median rib.

Occurrence. Oandu and Rakvere stages of northern Estonia and Ingria, NW Russia.

Rakverina inaequiclina (Alichova, 1951)
Plate XIV, figs 1-8, plate XV, figs 1-5.

1951	*Oepikina* (?) *inaequiclina* Alichova, p. 58, pl. IV, figs 69-71.
1993c	*Rakverina inaequiclina* (Alichova)(pars); Rõõmusoks, p. 161, pl. II, figs 6-11.
2000	*Hedstroemina inaequiclina* (Alichova); Cocks & Rong, p. 238, figs 148, 2d, e.

Description. Shell small (recorded maximum estimated width at hinge line 30 mm), rounded triangular, longer as far as width. Dorsal disc generally flat, weakly elevated in median sector. Ventral disc gently concave medially. Trail longer than disc, geniculum broadly round. Obscure irregular concentric rugae over whole disc, strongly reflecting in interiors. 5-8 ribs per 2 mm at anterior margin. Ornament with numerous accentuated ribs with 1-2 finer costellae between them.

Notothyrial platform short and narrow. Cardinal process lobes thin, parallel. Socket ridges very narrow, diverging anteriorly at right angle. Transmuscle ridges obscure, relatively short.

Ventral muscle field with weakly-defined lateral bounding ridges.

Measurements (in mm), maximum preserved length and width:

Complete shell (TUG 691-15)	23	26
Posterior view of ventral valve (TUG 242-58)	-	16
Ventral interior (TUG 75-45)	-	19
Dorsal valve exterior (TUG 1003-117)	17	25
Dorsal valve interior (TUG 42-71)	17	19
Dorsal valve interior (TUG 2-305)	23	29

Discussion. In the lower part of the Rakvere Stage at Rägavere the population of *Rakverina* includes some specimens slightly different from *R. inaequiclina* in having a more triangular shell outline, gently flatter ventral valve profile, and coarser concentric rugae in the dorsal interior. These specimens (pl. XV, figs 1-5) are still assigned to *R.*cf. *inaequiclina*.

Occurrence and material. Rakvere Stage, Rägavere Formation, Piilse Member, exposures in north-western Estonia, Voore (6), Määra-Saueaugu (1). Exposures in the town of Rakvere and environs: Rägavere (129), Rakvere (25), Moonaküla (7), Piilse (1), Kaarli (1).

Rakverina oanduensis (Oraspõld, 1956)
Plate XIV, figs 9-13.

1956 *Rafinesquina* (*Playfairia*) (?) *oanduensis* Oraspõld, p. 50, pl. I, fig. 20.
1993c *Rakverina oanduensis* (Oraspõld); Rõõmusoks, p. 164, pl. II, figs 1-5.

Holotype. Ventral valve TUG 1009-13 (= GMUT Br 3082; Oraspõld, 1956, pl. I, fig. 20; refigured here, pl. XIV, fig. 9) from the Oandu Stage, Hirmuse Formation, Oandu river-bank, coll. by students' expedition in 1955.

Description. Shell transverse, subtriangular in outline, small-sized (recorded maximum width at hinge line 24 mm). Ventral disc flat, with very fine ribs (8 per 2 mm at valve margin) and weakly defined short irregular concentric rugae. Trail relatively abruptly dorsally geniculate. Weak unequally parvicostellate ornament. Apical pseudodeltidium very small or closed. Chilidium large, deeply grooved medially.

Ventral muscle field broad, subcircular, with weakly defined bounding ridges converging anteriorly. Teeth very small, dental plates short, broadly divergent. Notothyrial platform low. Cardinal process lobes narrow, subparallel, gently diverging anteriorly. Myophores narrow and elongate. Myophragm low, posterior adductor scars faintly impressed. Socket ridges low and short. Transmuscle ridges weakly defined (pl. XIV, fig. 12).

Measurements (in mm), maximum preserved length and width:

Ventral valve (TUG 1009-13), holotype	14	18
Dorsal interior (TUG 102-29)	8	15
Ventral interior (TUG 102-28)	15	23

Discussion. *R. oanduensis* differs from *R. inaequiclina* in having a smaller and subtriangular shell, a more abruptly geniculate trail, almost uniformly coarse ribs and weakly-defined postero-lateral rugae. Its notothyrial platform resembles to that of *R. inaequiclina*.

Occurrence and material. Oandu Stage, Hirmuse Formation. Exposures: town of Rakvere (6), Oandu river-bank (3), Tõrremägi ditch (4).

Genus *PIRGUMENA* Rõõmusoks, 1993c.

Type species. *Pirgumena martnai* Rõõmusoks, 1993c, OD, p. 163. From the Pirgu Stage, Adila Formation and the Röa Member of the Ärina Formation, northern Estonia.

Diagnosis (emended). Shell large (maximum width at hinge line 65 mm), elongate triangular to semicircular, mostly longer than shell width. Parvicostellate, dense and accentuated ribs. Ventral muscle field short, without lateral bounding ridges. Side septa fine, no transmuscle ridges.

Other species. ? *Pirgumena* cf. *martnai* (pl. XV, figs 6, 7) from the Vormsi Stage, Kõrgessaare Formation and ? *Pirgumena* sp. nov. (pl. XVI, figs 6, 7) from the Porkuni Stage, Ärina Formation, Siuge Member are tentatively assigned to the genus *Pirgumena* and are only illustrated, but not separately described here since their interiors are unknown.

Discussion. Some interiors of *Pirgumena*-specimens are available as moulds from the dolomitic limestone of the Röa Member, and thus the morphology of cardinal process and socket plates of these specimens is not known in great detail.

Cocks & Rong (2000, p. 282) regarded *Pirgumena* Rõõmusoks, 1993, and also *Aphanomena* Bergström (1968) as subjective junior synonyms of *Eostropheodonta* Bancroft (1949). However, *Eostropheodonta* differs from *Pirgumena* in having very small cardinalia, in particular the myophragm, and a weakly developed ventral valve muscle field. This is considered sufficient for generic difference and thus *Pirgumena* is regarded here as a separate genus. *Pirgumena* resembles *Aphanomena*, but differs in its somewhat thicker shell, more

prominent notothyrial platform and broader ventral muscle field. The shell size and cardinalia of *Aphanomena* are smaller than in *Pirgumena*.

Distribution. Vormsi Stage (?), Pirgu and Porkuni stages in northern Estonia.

Pirgumena martnai Rõõmusoks, 1993c.
Plate XV, figs 8-10; pl. XVI, figs 1-5.

1991	*Aphanomena* sp. n. 1, Rõõmusoks; pl. 1, fig 1; pl. IV, figs 1-4.
1993c	*Pirgumena martnai* Rõõmusoks, p. 164, pl. IV, figs 1-6.
2000	*Eostropheodonta martnai* (Rõõmusoks); Cocks & Rong, p. 282, fig. 181, h, i.

Holotype. Ventral valve exterior TUG 1003-5 (= GMUT Br 1471, Rõõmusoks, 1993c, pl. IV, figs 5, 6; refigured here, pl. XVI, figs 1-2) from the Pirgu Stage, Adila Formation, Atla river-dredge, at Pirgu village, northern Estonia, coll. by A. Rõõmusoks, 1959.

Description. Shell very thin. Ventral valve generally flat, but weakly swollen in umbonal region up to posterior third of valve length; umbonal portion of dorsal valve correspondingly concave. Pseudodeltidium narrow. Chilidium not preserved. 8-10 ribs per 2 mm at the anterior margin. Poorly defined oblique rugae postero-laterally.

Ventral muscle field broad, without anterior bounding ridges. Dental plates broadly diverging.

Notothyrial platform with narrow, long myophragm. Cardinal process lobes strong, anteriorly gently divergent. Socket plates short. Very fine long side septa, transmuscle ridges absent.

Measurements (in mm), maximum preserved length and width:

Ventral valve (TUG 1003-4)	27	19
Ventral valve (TUG 2-189)	33	35
Dorsal valve interior (TUG 1015-1)	29	29
Ventral valve exterior mould (TUG 1003-1)	46	42
Ventral valve interior mould (TUG 36-33)	25	27
Ventral valve exterior (TUG 1003-5), holotype	48	63
Dorsal valve exterior (TUG 46-90)	45	44
Dorsal valve interior (TUG 1001-2)	37	43
Ventral valve interior (TUG 42-34)	33	33
Ventral valve exterior (TUG 2-33)	27	36
Ventral valve exterior (TUG 665-110)	28	31

Remarks. After publication of Rõõmusoks (1993c), new study of the collection revealed two specimens from the Vormsi Stage, Kõrgessaare Formation (pl. XV, figs 6, 7 here) which closely resemble *Pirgumena martnai* in ornament. These specimens may belong to an earlier new species of the genus, *Pirgumena* cf. *martnai*. Another species, characterized by peculiar radial ornament (conspicuously broad spaces between coarse accentuated ribs; see pl. XVI, figs 6, 7 here), from the Porkuni Stage, Ärina Formation, Siuge Member, is also tentatively assigned to this genus as ? *Pirgumena* sp. nov.

Occurrence and material. Vormsi Stage, Kõrgessaare Formation. Exposures Lyckholm (1) and Kohila (1). Pirgu Stage, Moe Formation. Exposures: Kärrslätt, Vormsi Island (1), carbonate mounds in mainland Nyby (1) and Ruunavere (1); Pirgu Stage, Adila Formation, erratics from Holm in the town of Haapsalu (2), exposures Piirsalu (1), Vardi (5), Atla river-dredge at Pirgu (1), Umbru (1). Pirgu Stage, Ärina Formation, Röa Member, exposures at Röa (1) and Härgla (Härküla) (2). Porkuni Stage, Ärina Formation, Vohilaid Member, exposures: Vohilaid Island (29), Kasari river-dredge (1), Aruküla-Kivisti (2), Röa-Jaagupi (7), Härgla (1), Rünga (2), Seli-Russalu (4), Kuru (2), Porkuni (4). Siuge Member, exposures: Härgla (2), Seli (3), Porkuni (7). Tõrevere Member, exposure Porkuni (7).

Table 5. The subfamily Rafinesquininae in the Ordovician of northern Estonia.

Series	Species	Stage	Formation	Member
Harju	? *Pirgumena* sp. nov.	Porkuni	Ärina	Siuge
	Pirgumena martnai Rõõmusoks	Pirgu + Porkuni	Moe + Adila + Ärina	Röa, Vohilaid, Siuge, Tõravere
	? *Pirgumena* cf. *martnai* Rõõmusoks	Vormsi	Kõrgessaare	
Viru	*Rakverina inaequiclina* (Alichova)	Rakvere	Rägavere	Piilse
	Rakverina oanduensis (Oraspõld)	Oandu	Hirmuse	
	Virunites orvikui (Oraspõld)	Oandu	Hirmuse	
	Kjaerina poljensis (Alichova)	Oandu	Hirmuse	

Subfamily LEPTAENINAE Hall & Clarke, 1894

Remarks. Numerous species have been assigned to the genus *Leptaena* Dalman, 1828. The lectotype of the genus, *Leptaena rugosa* Dalman was chosen by Spjeldnaes (1957, p. 173) who published first photos of ventral valve interior. First drawings of the dorsal valve interior were published by Bergström (1968). Spjeldnaes justly noted that the genus *Leptaena* has been misinterpreted by most previous authors and revised this genus in redescribing Dalman's type material from the Upper Ordovician Dalmanitina-beds in Västergötland, Sweden (illustrated here on pl. XXXIII, figs 11-14). He stressed that *Leptaena rugosa* differs from most Silurian leptaenines and is known only from the uppermost Ordovician of Scandinavia. He suggested further that it may be advisable to use genus *Leptagonia* McCoy (1844) as a subgeneric term for the Silurian and younger species. In this case, the stratigraphic range of *Leptaena* would be restricted to the Upper Ordovician and possibly to the basal Silurian.

Among the Leptaeninae in the Ordovician of northern Estonia, the present author has distinguished two groups of genera (Rõõmusoks, 1989, p. 113), one with more or less sharply geniculate shell (the new genera *Estonomena, Astamena, Kurnamena, Similoleptaena, Schmidtomena*) and the second group with evenly convex shell (*Septomena* Rõõmusoks, 1989, *Bekkeromena* Rõõmusoks, 1963 and *Oandumena* gen. nov.). A photo of dorsal interior of "*Leptaena*" from the Silurian of Estonia is added here for the comparison (pl. XXXIII, fig. 15).

Genus *SEPTOMENA* Rõõmusoks, 1989

Type species. *Leptaena juvenilis* Öpik, 1930a, p. 173 OD. From the Kukruse Stage, northern Estonia.

Other species. ? *Septomena senecta* sp. nov.; ? *Septomena* aff. *juvenilis* (Öpik), 1930a; *Septomena crypta* (Öpik), 1930a; *Septomena alliku* (Oraspõld, 1956); ? *Septomena* cf. *alliku* (Oraspõld, 1956); *Septomena cryptoides* (Oraspõld, 1956).

Diagnosis (emended). Shell medium-sized to large (maximum width at hinge line 45 mm), subcircular or transversely semioval in outline and with small alae. Geniculation gently rounded, profile occasionally strongly convex, without high geniculated ridge around the disc. Coarse, continuous, predominantly sinuous rugae over whole disc, usually reflected on the valve interiors. Pseudodeltidium broad and high. Notothyrial platform broad, short. Cardinal process lobes knob-like, thick, low, curved backwards, with coarse furrowed myophores. Transmuscle ridges and side septa usually well developed. Ventral muscle field circular, reaching half or third of disc length.

Discussion. *Septomena* and *Estonomena* (see above) are the earliest known leptaenines in the Ordovician of northern Estonia, appearing in Lasnamägi time.

Spjeldnaes (1957, p. 183, pl. 7, fig. 17) assigned *Leptaena juvenilis* from Estonia to *Kiaeromena*. However, the general morphology of *juvenilis* does not correspond to the diagnosis of *Kiaeromena*, except for the similar myophores. The main features distinguishing *Septomena* from *Kiaeromena* are (1) less coarse and weakly sinuous rugae; (2) circular, relatively narrower and not flabellate ventral muscle field; (3) the mostly well-developed transmuscle ridges and side septa. In addition, *Kiaeromena* has strong muscle bounding ridges, but no transmuscle ridges and weak side septa (see Cocks & Rong, 2000, fig. 152, 1c).

Septomena is, according to Rong & Cocks (1994, p. 682) and Cocks & Rong (2000, p. 243), a subgenus of *Leptaena*. However, the species of *Septomena* are essentially different from the much younger *Leptaena rugosa* Dalman, the type species of *Leptaena* (pl. XXXIII, figs 11-14 here) from the middle Ashgill of Sweden. The main characteristic features of *Septomena* which are different from *Leptaena* are: (1) the notothyrial platform, which is absent in *Leptaena*; (2) the cardinal process lobes which are knob-like, not plate-like and anteriorly diverging (Bergström, 1968, p. 14, text-fig. 7); (3) the transmuscle ridges and side septa present in most species; (4) the coarse, continuous and gently sinuous rugae; (5) the lack

of a sharply-elevated ridge around the ventral disc margin, which is an important feature for *Leptaena* (see Spjeldnaes, 1957, p. 173 and textfig. 38G). Thus, *Leptaena rugosa* may be even the only representative of the genus *Leptaena* (compare dorsal interiors of *L. rugosa* and a specimen from the Jaani Stage, Wenlock of Estonia; pl. XXXIII, figs 13,14 and fig. 15, respectively). *Septomena* includes an evolutionary lineage of rather similar species (pl. XX, figs 5-8) known at least from the North Estonian Confacies Belt during Middle and early Late Ordovician.

Occurrence. The Lasnamägi, Uhaku, Kukruse, Haljala and Keila stages of northern Estonia.

Septomena juvenilis (Öpik, 1930a)
Plate XVII, figs 1-9; pl. XX, fig. 5.

1921	*Leptaena rhomboidalis* Wilckens; Bekker, p. 70, pl. IV, fig. 9.
1930a	*Leptaena juvenilis* Öpik; p. 173, pl. XI, figs 140, 141; pl. XII, figs 142-145.
1957	*Kiaeromena juvenilis* (Öpik); Spjeldnaes, pl. 7, fig. 17.
1989	*Septomena juvenilis* (Öpik); Rõõmusoks, p. 115, pl. II, figs 1-3.

Holotype. Ventral valve TUG 72-200 (Öpik, 1930a, p. 174, pl. XI, fig. 140, refigured here, pl. XVII, figs 1-2) from the Kukruse Stage, Kiviõli Member of the Viivikonna Formation, at Käva quarry (bed XII), coll. by A. Öpik.

Description. Shell transversely semioval, with obtuse cardinal extremities, medium-sized (recorded maximum width at hinge line 26 mm). Ventral disc flat, gently convex near the umbo; dorsal disc almost flat, trail weakly convex. Ventral interarea relatively long, pseudodeltidium broad and high. Dorsal interarea short, chilidium broad, usually medially grooved. Four to six prominent, weak, irregularly-rounded rugae over the whole disc, well-reflected in valve interiors. Radial ornament well differentiated, 7-9 ribs between coarser ones; 12-16 ribs per 2 mm at the disc margin.

Ventral muscle field relatively large, reaching half disc length, nearly circular and with raised lateral bounding ridges. Adductor muscle scars broad, extending up to anterior margin of the muscle field. Median ridge narrow, long. Dental plates short. Extra-muscular area finely and densely tuberculate.

Cardinal process lobes knob-like, strong, parallel, inclined backwards. Myophores becoming broader upwards and deeply striated. Notothyrial platform low and short. Socket ridges high, short, very narrow and almost parallel to the hinge line. Myophragm narrow and very short. Mesocardinal ridge very short. Sockets narrow, triangular. Transmuscle ridges straight, narrow and high; side septa narrow, long. Extra-muscular area finely and densely tuberculate. High subperipheral rim with many vascular canals.

Measurements (in mm); maximum preserved length and width:

Ventral valve (TUG 72-200), holotype	11	18
Ventral interior (TUG 1054-145)	17	25
Ventral valve (TUG 1054-142)	16	23
Dorsal interior (TUG 1054-144)	13	21
Dorsal interior (TUG 1003-171)	15	22
Dorsal interior (TUG 1003-225)	14	16

Occurrence and material. Kukruse Stage, Viivikonna Formation, Kiviõli Member; exposures: Küttejõu quarry (15), Kukruse (8), Kohtla-Järve quarry (4).

? *Septomena senecta* sp. nov.
Plate XVII, figs 10-11.

Derivation of name. Latin, *senectus*, meaning old.

Holotype. Incomplete ventral valve TUG 42-114 (pl. XVII, fig. 10) from the Lasnamägi Stage, Väo Formation (lowermost beds), cliff at the town of Paldiski, coll. by F. Schmidt.

Description. Shell small (maximum width 22 mm), subcircular. Disc almost flat, longer than width at hinge line. Rounded geniculation. Rugae strong, almost regular, less well-developed at centre of disc, separated by broad interspaces, particularly anteriorly. Number of rugae varies from five to eight; umbonal part of ventral valve with no rugae. Ornament sharply unequally parvicostellate. Ribs medially better defined than laterally. An average 15 ribs per 2 mm antero-medially at disc margin.

Valve interiors unknown.

Measurements (in mm); maximum preserved length and width:

Ventral valve (TUG 42-114), holotype	9	11
Ventral valve exterior mould (TUG 692-9)	12	22

Comparison. This species is distinguished from other species in its relatively longer and flatter disc, strong unequally parvicostellate ornament and more regular rugae, in particular postero-laterally.

Remarks. ? *S. senecta* is evidently the oldest known leptaenine in the Ordovician of Baltoscandia. In our collection it is represented only by five incomplete specimens. Unfortunately, there are no interiors, and therefore the generic status of this rare species is still uncertain, although its exteriors suggest *Septomena*.

Occurrence and material. Lasnamägi Stage, Väo Formation (lowermost beds). Exposures: town of Paldiski (1); Vääna quarry (1); dredged river-bed of Vääna river at Vahiküla (2); Lüganuse quarry (1).

? *Septomena* aff. *juvenilis* (Öpik, 1930a)
Plate XVII, figs 12-13.

Description. Shell small, transversely semioval, with short alae. Ventral disc relatively short, almost flat. Trail gently convex, longer than disc, weakly rounded. Ventral interarea long, pseudodeltidium large, chilidium wide. Eight narrow, densely-spaced relatively regular rugae which meet to the hinge line at an acute angle. Ornament with 4-6 fine ribs in wide interspaces between coarser. About two ribs per 2 mm at the disc margin.

Interiors of valves unknown.

Measurements (in mm), maximum preserved length and width:

Incomplete shell (TUG 1003-215)	13	32
Dorsal valve exterior (TUG 1003-226)	14	23

Remarks. As the interiors are unknown, this rare form is tentatively assigned to *Septomena* on the basis of its shape, rugation and ornament. It closely resembles *S. juvenilis*, but is distinguished by its transverse, alate, shorter and wider shell and finer rugae.

Occurrence and material. Uhaku Stage, Väo and Kõrgekallas formations. Exposures: Harku (1), Lasnamägi in town of Tallinn (4) and Uhaku riverbank (1).

Septomena crypta (Öpik, 1930a).
Plate XVIII, figs 1-10; pl. XX, fig. 6.

1930a *Leptaena crypta* Öpik, p. 181, pl. XVI, fig. 182.
1989 *Septomena crypta* (Öpik); Rõõmusoks, p. 115, pl. II, figs 4, 5.

Holotype. Ventral valve exterior TUG 72-199 (= GMUT Br 182, Öpik, 1930a, pl. XVI, fig. 182; refigured here, pl. XVIII, figs 1-5) from the Kukruse Stage, Viivikonna Formation, Peetri Member, Adra exposure, coll. by A. Öpik.

Description. Shell medium-sized, maximum estimated width at hinge line 40 mm, transversely subelliptical in outline and with weakly acute and concave cardinal extremities. Ventral valve both transversely and longitudinally moderately convex, not sharply geniculate. Ventral interarea quite long (maximum 6 mm) in the middle, pseudodeltidium long, convex and broad. Chilidium prominent, medially grooved. Ten fairly regular, relatively coarse rugae, poorly developed on umbonal area only, not reflected on interior surface. Radial ornament of very fine ribs, each eighth to tenth being coarser. About 12 ribs per 2 mm anterolaterally on valve.

According to Öpik (1930a, p. 181), relatively large ventral muscle field (about one third valve width), with high bounding ridges. Unfortunately, the specimens described by Öpik are lost.

Cardinal process lobes low, expanded distally, with broad striated myophores, situated on the posterior part of prominent notothyrial platform. A short septum between lobes corresponds to the deep median groove of the chilidium. Notothyrial platform high and broad. Socket plates and transmuscle septa short, but thick. Posterior part of adductor muscle scars narrow, anterior part relatively broad. Myophragm short, delicate, with short fine central median ridge. Sockets deep, triangular. Well-developed wide subperipheral rim, highest anteriorly and interrupted by many distinct vascular markings. Valve interior coarsely tuberculate outside muscle fields.

Measurements (in mm); maximum preserved length and width:

Ventral valve (TUG 72-199), holotype	31	40
Dorsal valve interior (TUG 1003-227)	31	40
Dorsal valve interior (TUG 1003-213)	22	30
Dorsal valve interior (TUG 1003-209)	28	30

Comparison. *Septomena crypta* differs from the somewhat older *S. juvenilis* in its larger, longer and flatter shell, in having more regular rugae, more strongly developed transmuscle ridges and lacking side septa. In addition, *S. crypta* has a longer subperipheral rim, sloping less steeply towards the shell margin than *S. juvenilis*. Besides, in *S. crypta* the rugae are not reflected on the interior surface of dorsal valve like *S. juvenilis*.

Occurrence and material. Kukruse Stage, Viivikonna Formation, Peetri Member. Exposures: Adra (1) and Humala (5).

Septomena alliku (Oraspõld, 1956)

Plate XIX, figs 1-9; pl. XX, fig. 7.

1956 *Leptaena alliku* [Männil MS] Oraspõld, p. 50, pl. II, figs 1-3.

Holotype. Incomplete shell TUG 43-156 (= GMUT Br 3055; Oraspõld, 1956, p. 50; pl. II, fig. 1; refigured here, pl. XIX, figs 1-4) from the Haljala Stage, Jõhvi Substage, Alliku exposure, coll. by R. Männil.

Description. Shell subcircular in outline, with small pointed cardinal extremities, medium-sized (maximum estimated interarea width 40 mm). Anterior and lateral margins evenly curved. Ventral disc gently convex, dorsal valve almost flat, but weakly concave in umbonal region. Trail not complete in any specimen available, but its observed length does not exceed disc length. Geniculation gently sloping. Pseudodeltidium long and broad; chilidium short, medially weakly grooved. Eight to nine strong, rounded, continuous, densely spaced and mostly regular rugae, absent on trail, but which are deflected slightly near the hinge line towards cardinal extremities and are strongly reflected on valve interiors, including the muscle fields. Radial ornament multicostellate. Ribs very fine, weakly differentiated and densely spaced over the disc and trail. 11-13 ribs per 2 mm at disc margin, commonly 2-4 finer ribs between two accentuated ones. Very fine concentric fila on and between ribs.

Small subcircular ventral muscle field known only in two juvenile specimens (pl. XIX, figs 7, 9), lacking lateral bounding ridges. Dental plates short. Teeth not preserved.

Notothyrial platform high, relatively narrow and short, with short myophragm. Transmuscle ridges and side septa short, weak. Socket ridges short and narrow. Sockets minute, low. Cardinal process lobes small, knob-like, erect and with coarsely grooved myophore. Muscle field without bounding ridges. Extra-muscular area finely and densely tuberculate.

Measurements (in mm); maximum preserved length and width:

Incomplete shell (TUG 43-156), holotype	19	26
Incomplete dorsal interior (TUG 43-154)	22	27
Ventral valve exterior (TUG 993-1709)	12	18
Incomplete ventral interior (TUG 1003-181)	6	9
Incomplete ventral interior (TUG 72-165)	9	15
Incomplete dorsal interior (TUG 72-179)	12	21

Comparison. The dorsal interior of *Septomena alliku* is quite similar to that of *S. juvenilis*, except for the less well-developed transmuscle ridges and in the absence of side septa (see pl. XIX, fig. 5 and pl. XVII, fig 3). The interior of the ventral valve, at least in juvenile specimens of *S. alliku*, is also similar to that of *S. juvenilis* (see pl. XIX, fig. 7 and pl. XVII, fig. 2), but the rugation, ribs and shell shape of the two species are noticeably different.

S. alliku differs from the somewhat similar *Kiaeromena kjerulfi* (Holtedahl, 1916), the type species of the genus *Kiaeromena* Spjeldnaes, 1957 (some specimens of which I have examined in Paleontologisk Museum, Oslo in 1991) in having (1) a much smaller shell; (2) finer rugae; (3) flatter geniculation; (4) more closely-spaced ribs; (5) a relatively smaller and more poorly defined ventral muscle field without lateral bounding ridges; and (6) more delicate cardinalia. Therefore *Kiaeromena* does not occur in the Ordovician deposits of the North Estonian Confacies belt as I suggested earlier (Rõõmusoks, 1989, p. 115). However, a poorly preserved specimen figured here (pl. XIX, fig. 12) as ? *Septomena* sp. from the Keila Stage, Ristiküla core in south-western Estonia (Central Baltoscandian Confacies belt, see Fig. 2), resembles *Kiaeromena* and further collecting may reveal the presence of the latter in Estonia.

Occurrence and material. Haljala Stage, Idavere Substage, Vasavere Formation. Exposures: Männiku (Pakri Peninsula) (1), Aluvere quarry (10). Haljala Stage, Jõhvi Substage; exposures: Põõsaspea (Spitham) coast (11), Alliku (20), Pääsküla (1), Anija (1), Aluvere quarry (3), Kahula (3), Soonurme (2), Jõhvi (3).

Septomena cf. *alliku* (Oraspõld, 1956)
Plate XIX, figs 10, 11.

Remarks. Four specimens only showing the exterior are available, all from the Keila Stage, upper Kahula Formation from north-eastern Estonia, Tammiku quarry (3) and town of

Rakvere (1). This form closely resembles the stratigraphically somewhat older *Septomena alliku* in outline and ornament, but the large anterior rugae are mostly coarser and more broadly spaced than those in the former species. The number of rugae is 8-10.

Septomena cryptoides (Oraspõld, 1956)
Plate XXI, figs 1-13; pl. XX, fig. 8.

1956 *Leptaena cryptoides* Oraspõld, p. 54, pl. II, figs 12-14.

Holotype. Complete shell TUG 43-158 (= GMUT Br 3052; Oraspõld; 1956, pl. II, fig. 12; refigured here pl. XXI, figs 1-4) from the Keila Stage, Kahula Formation, Kurtna Member, Ristna beds; Pääsküla exposure, coll. by R. Männil.

Description. Shell medium-sized (recorded maximum width at hinge line 40 mm), roundedly trapezoidal in outline. Ventral valve in both profiles strongly, almost evenly convex, but somewhat flatter on the very short disc. Dorsal valve flat, weakly concave in the umbonal part. Trail twice as long as disc. Ventral interarea long. Pseudodeltidium broad, equilaterally triangular. Dorsal interarea narrow, chilidium wide, medially distinctly grooved. Coarse, somewhat irregular rugae with relatively broad interspaces over the whole disc, somewhat more weakly reflected on valve interior. Radial ornament usually multicostellate, with about 8 ribs per 2 mm on anterior part of disc.

Ventral muscle field small, circular, with weakly curved and raised bounding ridges.

Notothyrial platform broad, very low. Cardinal process lobes minute, knob-like. Myophragm relatively long, central median ridge narrow, weakly developed. Socket plates very short. Prominent, short transmuscle ridges. Side septa commonly short, high and long. Subperipheral rim weakly developed, slope relatively abrupt down. Extra-muscular surface of valves finely and densely tuberculate, especially on dorsal interior.

Measurements (in mm); maximum preserved length and width:

Complete shell (TUG 43-158), holotype	30	36
Incomplete dorsal interior (TUG 1003-217)	24	30
Incomplete dorsal interior (TUG 43-164)	14	16
Incomplete ventral interior (TUG 1003-216)	13	15
Incomplete ventral interior (TUG 42-111)	28	27
Incomplete ventral exterior (TUG 43-161)	27	34

Comparison. Oraspõld (1956, p. 54) suggested that *Leptaena cryptoides* is closest to *Leptaena crypta* Öpik. Hower, she had no interiors of either species available. As revealed by studies of the dorsal and ventral interiors, *Septomena cryptoides* is most similar to *S. juvenilis* from the Kukruse Stage, but differing in its more transverse shell with finer and more irregular rugae.

Occurrence and material. Keila Stage, Kahula Formation, lower part of the Kurtna Member (Ristna beds). Exposures: Kulna (railwayside excavation near the town of Keila (3), Keila-Ohtu roadside ditch (2), Keila (1), Pääsküla (14), Põlula (1); town of Rakvere (1), Sõmeru (5), Kahula (3), Madise? (2).

Genus *ESTONOMENA* Rõõmusoks, 1989

Type species. *Leptaena estonensis* Bekker, 1921, p. 71, OD. From the Kukruse Stage of northern Estonia.

Other species. *Estonomena kalevi* sp. nov.; ? *Estonomena lindae* sp. nov.

Diagnosis (emended). Shell medium-sized to large (maximum recorded width at hinge line 60 mm). Shell subtriangular in outline with obtuse angle of geniculation. Trail weakly

curved and longer than disc. Coarse, irregular rugae over whole disc except umbonal area, reflected in valve interiors. Ornament distinctly unequally parvicostellate. Notothyrial platform delicate. Cardinal process lobes low, knob-like, erect, slightly broader upwards and inclined weakly backwards. No distinct dorsal transmuscular ridges. Ventral muscle field large, reaching half disc length, suboval, with lateral elevated boundaries.

Discussion. *Estonomena* and *Septomena* are the earliest leptaenine genera known from the Ordovician of Estonia, which appeared during Lasnamägi time. *Estonomena* differs from almost all other leptanines, in particular from the partly contemporaneous *Septomena* (type species *Leptaena juvenilis* Öpik) in its relatively larger shell, mostly triangular outline and higher, pyramidal ventral valve. The most distinctive features of *Septomena* are (1) few, relative coarse and continuous weakly sinuous rugae, (2) a pair of usually well developed transmuscle ridges, and side septa. The dorsal interior of *Estonomena* resembles to some extent the species of *Kiaeromena* to which *Leptaena estonensis* was ascribed by Spjeldnaes (1957, p. 183). However, the ventral muscle field of *Kiaeromena* is rather different - broader, somewhat flabellate and relatively larger. Moreover, *Kiaeromena* lacks distinct geniculation and has stronger, generally regular and finer, almost equal, ribs (Spjeldnaes, 1957, p. 175, texfig. 38G). Rong & Cocks (1994, p. 682) and Cocks & Rong (2000, p. 246) have considered *Estonomena* to be a subjective junior synonym of *Kiaeromena*. However, *Kiaeromena* has well developed, warped dorsal muscle bounding ridges which are absent in *Estonomena* and a weaker notothyrial platform (Cocks & Rong, 2000, fig. 152). In addition, *Estonomena* has usually subtriangular, pyramidal ventral valve and an elongate, relatively narrow muscle field. These differences are regarded here as sufficient for considering *Estonomena* to be a separate genus. It belongs to the evolutionary lineage *Estonomena* – *Kurnamena* – *Septomena* (pl. XX) known from the Middle and Upper Ordovician of the Baltoscandian paleobasin (Fig. 2).

Occurrence. Lasnamägi to Kukruse Stages (Upper Llanvirn – Upper Llandeilo) of northern Estonia.

Estonomena estonensis (Bekker, 1921)
Plate XXIII, figs 1-9; pl. XX, fig. 1.

1908	*Leptagonia trigonalis* Schmidt p. 726 (*nomen nudum*; *pars*).
1921	*Leptaena estonensis* Bekker p. 71; pl. I, figs 7, 8; pl. III, fig. 17; pl. IV, figs 8, 10.
1924	*Leptaena estonensis* Bekker; pl. I, fig. 10.
1930a	*Leptaena trigonalis* Schmidt; Öpik p. 176 (*pars*), pl. XII, figs 146-148; pl. XIII, figs 150, 152, 153 [non fig. 151 = *? Kurnamena spumifera* (Öpik)].
1930b	*Leptaena trigonalis* Schmidt var.; Öpik, pl. II., fig. 15.
1954	*Leptaena trigonalis* Schmidt; Sokolskaya, p. 54 (*pars*), pl. III, fig. 1 (non fig. 2 = *Estonomena lindae* sp. nov.).
1989	*Estonomena estonensis* (Bekker); Rõõmusoks, p. 113; pl. I, figs 1-6.
2000	*Kiaeromena* (*Kiaeromena*) *estonensis* (Bekker); Cocks & Rong, p. 246-247, fig. 152, 1e, 1f.

Lectotype. Selected by Öpik (1930a p. 177), a dorsal valve interior (TUG 73-150), figured already by Bekker (1921, pl. III, fig. 17; refigured here, pl. XXIII, fig. 1) from the Kukruse Stage, Kiviõli Member of Viivikonna Formation at Kohtla-Järve quarry, coll. by H. Bekker.

Description. Shell large (maximum estimated width at hinge line 60 mm), with relatively high, pyramidal ventral valve. Ventral disc forms a regular triangle, sometimes well defined by a low narrow confining posterior median marginal fold, 1-3 mm broad. Umbonal region of disc weakly convex, peripherally changing to concave. Geniculation evenly rounded at about 110° laterally and 90° - 120° anteriorly. Trail equally long or longer than disc. Narrow short ventral median sulcus with corresponding projection sometimes on trail, particularly in young specimens (see pl. XXIII, fig 5). Coarse, mostly irregular rugae over nearly whole disc, but

stronger laterally and well-reflected on the internal surface of valves. Pseudodeltidium broad, high and flatly convex. Chilidium medially grooved. Radial ornament distinctly parvicostellate, in particular on middle of disc. 7-10 ribs per 2 mm at disc margin. Disc surface with fine concentric fila.

Ventral muscle field elongate, with anteriorly-convergent bounding ridges and extending to anterior third of disc length. Adductor muscle scars relatively narrow. Dental plates short. Extra-muscular area coarsely tuberculate with elongate tubercles arranged radially, which are finer and sparser on trail.

Notothyrial platform narrow, short and low. Cardinal process lobes discrete, somewhat divergent anteriorly, separated by relatively broad hollow. Myophores prominent. Myophragm short. Socket ridges straight, short and diverge at 90°. Sockets triangular, low. Adductor scars small, not well defined. No prominent transmuscle ridges.

Measurements (in mm); maximum preserved length and width:

Dorsal interior (TUG 73-150), lectotype	34	37
Dorsal interior (TUG 1054-153)	37	45
Ventral exterior (TUG 1003-228)	47	57
Ventral interior (TUG 1003-170)	25	36
Ventral exterior (TUG 1054-148)	32	36
Ventral exterior (TUG 1054-150)	41	51

Discussion. Schmidt (1908, p. 726) was aware of the specimens with a triangular pyramidal shell shape from the topmost Echinosphaerites beds (equivalent to the topmost Uhaku Stage) as well as from the Kukruse Stage. He referred them to *Leptagonia trigonalis*. Four specimens from the topmost Uhaku Stage exposure Lasnamägi in the town of Tallinn, labelled by Schmidt, are now at our disposal (TUG 42-113; see pl. XXII, fig. 9, 10). Öpik was probably not aware of these specimens and mentioned therefore that the occurrence of *L. trigonalis* in C_1 (the Echinosphaerites beds) is questionable (Öpik, 1930a p. 180) It is also now apparent that Schmidt designated at least two species under the name "*trigonalis*". The name "*Leptagonia trigonalis*" is in any case a *nomen nudum,* because it was not accompanied by a figure or a formal description. The species from the Kukruse Stage was described later by Bekker (1921 p. 71) as *Leptaena estonensis*. This species is closely related to the somewhat older ? *Estonomena lindae* sp. nov. (see below), but differs in possessing a larger and broader shell with better developed, relatively coarse rugae and a weakly concave ventral disc.

Occurrence and material. Kukruse Stage, Kiviõli, Maidla and Peetri Members of the Viivikonna Formation. Many specimens from many localities, particularly from the Kiviõli Member (see Rõõmusoks 1970, p. 176).

Estonomena kalevi sp. nov.
Plate XXII, figs 1-7.

Derivation of name. From Kalev, a man's name from Estonian mythology.

Holotype. Incomplete shell (TUG 43-163, pl. XXII, figs 1, 2) from the Uhaku Stage, Koljala Member of the Kõrgekallas Formation, coastal cliff in the Osmussaar Island, north-western Estonia, coll. by A. Rõõmusoks, 1966.

Description. Shell medium-sized (recorded maximum width at interarea 37 mm), subtrapezoidal to subtriangular in outline. Ventral disc weakly concave antero-medially, with correspondingly convex dorsal disc. Geniculation relatively abrupt, 50° - 60° between disc and trail. Trail shorter than disc. Ventral interarea short, pseudodeltidium wide and high. Rugae low, weakly irregular, stronger laterally. About 12 very fine ribs per 2 mm at disc margin. Ventral interior unknown. Notothyrial platform very low, socket ridges and

myophragm short. No transmuscle ridges. Sparse, small, elongated tubercles outside the muscle field.

Measurements (in mm); maximum preserved length and width:

Incomplete shell (TUG 43-163), holotype	25	31
Incomplete shell (TUG 993-759) estimated width	-	34
Ventral valve (TUG 1003-166)	21	35
Dorsal interior mould (TUG 42-115)	21	31
Ventral valve (TUG 692-10)	17	23

Discussion. *Estonomena kalevi* is one of the oldest leptaenine in the Ordovician of North Estonia. This species differs from the younger species of the genus in having a weakly-rounded subtriangular shell and weakly-developed rugae.

Occurrence and material. Lasnamägi Stage, lower part of the Väo Formation. Vääna exposure (1). Uhaku Stage, upper part of the Väo Formation. Exposures: Vääna riverside at Vahiküla (3), Kadaka quarry (1). Kõrgekallas Formation. Coastal cliff of the Osmussaar Island (12), Paldiski (1).

? *Estonomena lindae* Rõõmusoks, 1989
Plate XXII, figs 8-11.

1908	*Leptagonia trigonalis* Schmidt p. 726 (*nomen nudum, pars*).
1954	*Leptaena trigonalis* Schmidt; Sokolskaya p. 54 (*pars*); pl. III, fig. 2 (non fig. 1 = *E. estonensis*).
1989	*Estonomena lindae* Rõõmusoks pl. I, fig. 7.

Derivation of name. After Linda, a woman's name from Estonian mythology.

Holotype. Incomplete shell (TUG 1003-189); Rõõmusoks 1989, pl. I, fig. 7 (refigured here pl. XXII, fig. 8) from the Uhaku Stage, Kõrgekallas Formation, Erra Member, Lasnamägi exposure in town of Tallinn, coll. A. Rõõmusoks, 1943.

Description. Shell of pyramidal profile and triangular outline, medium-sized (recorded maximum width at interarea 37 mm). Relatively broad sharp-crested ridge at disc margin: ventral disc weakly concave. Short wide anteromedian sulcus on ventral disc, with corresponding fold-like projection on trail. Trail longer than disc. Geniculation relatively abrupt, about 70° - 80° between disc and weakly convex trail. Ventral interarea low, pseudodeltidium small, chilidium wide and low. Rugae low, irregular, covering almost whole disc and reflected on valve interiors. Accentuated ribs on centre of disc. About 10-12 ribs per 2 mm at disc margin.

Ventral muscle field wide, nearly circular; adductor scar narrow. Extra-muscular area with sparse small tubercles.

Dorsal interior not known.

Measurements (in mm); maximum preserved length and width:

Incomplete shell (TUG 1003-189), holotype	25	29
Incomplete shell (TUG 1003-190)	29	37
Incomplete shell (TUG 42-113)	33	37

Discussion. Ventral interior is known from a single specimen figured by Sokolskaya (1954, pl. III, fig. 2). This specimen was collected by Sokolskaya from the Kõrgekallas Formation in an exposure of the Uhaku Stage at Harku near the town of Tallinn (not from the Kukruse Stage as erroneously mentioned by Sokolskaya, 1954; see Rõõmusoks, 1970 p. 87). ? *E. lindae* differs from other species of the genus by the sharp-crested ridge around the

ventral disc and by the few low, weakly irregular rugae. It is more similar to *E. estonensis* from the overlying Kukruse Stage than to *E. kalevi* sp. nov. As dorsal interior is not known, this species can be only tentatively assigned to *Estonomena.*

Occurrence and material. Uhaku Stage, Väo Formation. Exposures: Vääna riverside at Vahiküla (2), Kostivere (1), Uhaku Stage, Kõrgekallas Formation. Exposures: Harku near the town of Tallinn (1) and Lasnamägi (12).

Genus *KURNAMENA* Rõõmusoks, 1989

Type species. *Leptaena taxilla* Oraspõld, 1956, p. 51, OD. From the Haljala Stage, Jõhvi Substage, northern Estonia.

Other species. *Kurnamena spumifera* (Öpik, 1930a); *K. acuta* sp. nov.; *K. laterorugata* Rõõmusoks, 1989; *K. rugosoides* (Oraspõld, 1956); *K. palmrei* sp. nov.

Diagnosis (emended). Shell outline subtriangular to transversely semioval, large (maximum recorded width at hinge line 58 mm). Sharp cardinal extremities. Angle of geniculation obtusely convex, about 90°. Trail longer than disc, moderately curved longitudinally. Pseudodeltidium very short or lacking; chilidium high and grooved medially. Ventral disc without ventrally projecting marginal ridge. Rugae coarse, partly sinuous and irregular, well developed in particular postero-laterally. Radial ornament unequally parvicostellate with accentuated ribs on middle sector of ventral disc. Notothyrial platform high, with short myophragm. Cardinal process lobes prominent, thick, crooked conspicuously backwards and with broad, mostly elongate myophores. Transmuscle ridges and side septa poorly developed. Ventral muscle field nearly circular in outline, extremely large (up to two thirds of the valve length) and with short elongate antero-median gap.

Discussion. Rong & Cocks (1994) and Cocks & Rong (2000) regarded *Kurnamena* as a subjective junior synonym of the subgenus *Leptaena* (*Leptaena*) Dalman. Here, *Kurnamena* is considered as a separate genus. *Kurnamena* is distinguished from other contemporaneous leptaenines, such as *Septomena* and *Astamena*, by a set of distinctive characters, chiefly in its cardinalia. *Septomena* differs from *Kurnamena* in its thick, knob-like cardinal process lobes, well developed transmuscle ridges and side septa and by possessing a gently convex weakly geniculated shell and large pseudodeltidium. *Astamena* differs from *Kurnamena* in having narrow plate-like elongated cardinal process lobes, which are parallel to one another, and weakly-developed muscle bounding ridges and no transmuscle ridges and side septa. In addition, in *Kurnamena*, the posterolateral rugae on disc are irregular, the pseudodeltidium is very small and there is a relatively narrow long anteromedian fold on trail.

Occurrence. Kukruse to Oandu Stage. *Kurnamena* belongs to the *Estonomena – Kurnamena – Septomena* lineage from the Middle and Upper Ordovician.

Kurnamena taxilla (Oraspõld, 1956)

Plate XVIII, fig 12; pl. XXVI, figs 1-4, 13; pl. XXVII, figs 1-3.

1956 *Leptaena taxilla* [Männil MS] Oraspõld, p. 51, pl. II, figs 4-6.
1989 *Kurnamena taxilla* (Oraspõld); Rõõmusoks, p. 114, pl. III, figs 1, 2, 4 [non fig. 3 = *Septomena alliku* (Oraspõld, 1956)].
2000 *Leptaena* (*Leptaena*) *taxilla* Oraspõld; Cocks & Rong, p. 243; fig. 150, 1g.

Holotype. Complete shell TUG 72-195 (= GMUT Br 3102; Oraspõld, 1956, pl. II, fig. 4; refigured here, pl. XXVI, figs 1, 2) from the Haljala Stage, Jõhvi Substage, Alliku exposure, coll. by A. Öpik.

Description. Shell medium-sized (recorded maximum width at hinge line 43 mm), transversely suboval in outline, with moderately slender cardinal extremities. Disc almost flat, except for short weakly convex umbonal part.

Geniculation abrupt, about 90° relative to disc. Trail twice as long as disc, anteriorly weakly rounded and postero-laterally weakly depressed at cardinal extremities. Anterior central part of trail commonly weakly and irregularly folded. Ventral interarea relatively high; pseudodeltidium very small. Chilidium large, pronounced, not grooved medially. 5-7 coarse, low, rounded rugae, more or less regular with relatively wide wavelength, more prominent postero-laterally and poorly reflected on dorsal interior. Radial ornament generally parvicostellate but with some accentuated ribs on median sector of disc. 10-11 ribs per 2 mm at disc margin.

Only a single fragmentary ventral interior is available (pl. XXVII, fig. 2), showing the anterior part of a large, weakly subcircular striated muscle field with high bounding ridges and short anteromedian gap. Adductor muscle scars narrow, weakly raised. Internal surface of valve outside muscle field with densely-spaced small tubercles.

Notothyrial platform short, with low, broad socket ridges which bear four small denticles and a short narrow myophragm. Sockets very narrow, shallow. Cardinal process lobes slender, low, parallel to one another, with small, oval myophores. Adductor scars subcircular to elongate, striated. Subperipheral rim narrow. Sparse coarse tubercles outside muscle field.

Measurements (in mm), maximum preserved length and width:

Complete shell (TUG 72-195), holotype	14	24
Complete shell (TUG 72-177)	17	27
Complete shell (TUG 72-109)	23	43
Dorsal interior (TUG 72-191)	11	15
Dorsal interior (TUG 72-192)	17	21
Ventral interior (TUG 1003-179)	18	25

Comparison. *K. taxilla* differs from the other species of the genus in having a relatively smaller shell, usually with more regular and coarser rugae, more delicate cardinalia, and stronger rugae on the dorsal valve interior. The exterior of *K. taxilla* resembles to that of *K. rugosoides*, which has larger, longer, more transverse shell, more distinctly defined cardinalia, and a much larger ventral muscle field.

Remarks. Unfortunately the holotype of *K. taxilla* is a small and young specimen, and thus not showing all the characteristic features of the species. Therefore, for better comparison with other species, a larger specimen (pl. XXVI, fig 4) is also illustrated here.

Occurrence and material. Haljala Stage, Idavere Substage, Tatruse Formation, Idavere exposure (1); Vasavere Formation, exposures: Sõjamägi in town of Tallinn (1), Aluvere quarry (1), Kavastu (1), Haljala Stage, Jõhvi Substage. Exposures Põõsaspea (Spitham) coast (3), Humala (2), Pääsküla (2), Alliku (13), Raasiku (1), Anija (2), Aluvere (4), Edise (1).

Kurnamena spumifera (Öpik, 1930a).
Plate XX, fig. 2; pl. XXIII, fig 10; pl. XXIV, figs 1-5.

1930a *Leptaena spumifera* Öpik, p. 180, pl. XII, fig. 149.
1930a *Leptaena trigonalis* Schmidt; Öpik (*pars*), pl. XIII, fig. 151.

Holotype. Incomplete shell (TUG 1054-149); figured by Öpik (1930a, pl. XII, fig. 149; refigured here, pl. XXIV, figs 1-3), from the Kukruse Stage, Viivikonna Formation, Kiviõli Member, at Kohtla quarry, coll. by A. Öpik.

Description. Shell semioval in outline, broad (50 mm), but relatively short. Coarse, weakly irregular concentric rugae over whole disc turning postero-laterally abruptly towards lateral extremities, well reflected on valve interiors. Pseudodeltidium long for *Kurnamena*. Cardinal process lobes strongly developed, fused together at the bases before merging with notothyrial platform. Ventral muscle field relatively short, semi-circular in outline, with

elevated bounding ridges. Ventral disc almost flat, broad, but relatively short. Trail without any anteromedian sulcus. Geniculation abrupt, at about 100° between disc and trail. 10-12 ribs per 2 mm at disc margin. Very fine concentric fila on external surface of ventral valve. 6-7 accentuated ribs at centre of ventral valve.

Ventral muscle field relatively short, rounded and with raised bounding ridges. Adductor muscle scar relatively broad, somewhat elevated. Dental plates short. Extra-muscular area sparsely and coarsely tuberculate.

Notothyrial platform broad and high, socket ridges thin and short. Muscle-bounding ridges relatively broad and long, diverging at 85°. Cardinal process lobes stout, fused together at the bases and with elongate, posteriorly converging striated myophores (see pl. XX, fig. 2). Sockets triangular. Adductor scars large, subcircular, separated by thin, short myophragm.

Measurements (in mm); maximum preserved length and width:

Ventral valve (TUG 1054-149), holotype	29	50
Interior of ventral valve (TUG 72-205)	37	40
Interior of dorsal valve (TUG 1054-151)	21	42

Discussion. Öpik's description of *Leptaena spumifera* was only based on the holotype. Another specimen assigned here to this species is a dorsal interior (TUG 1054-151) figured by Öpik (1930a, pl. XIII, fig. 151; refigured here pl. XXIV, fig. 4 and pl. XX, fig. 2), which has cardinalia quite different from *Estonomena estonensis* (see pl. XXIII, fig. 2). The outline of that shell resembles the holotype of *Kurnamena spumifera*. Besides, I have found an additional specimen (ventral interior, TUG 72-205; pl. XXIV, fig. 5) in Öpik's collection from Kohtla, collected perhaps after 1930, in which the muscle field differs also from that of *E. estonensis*; it apparently belongs to *K. spumifera.*

K. spumifera differs from other species of the genus in its relatively broader and shorter shell, in the morphology of the cardinalia and ventral interior, and in the number of rugae.

Occurrence and material. Kukruse Stage, Viivikonna Formation, very rare in the Kiviõli Member of northeastern Estonia. Kohtla quarry (3).

Kurnamena acuta sp.nov.
Plate. XXIV, figs 6-12.

Derivation of name. Latin *acuta*, pointed, alluding to very sharp and long cardinal extremities of shell.

Holotype. Incomplete shell TUG 1003-150 from the Haljala Stage, Idavere Substage, Vasavere Formation, Soonurme ditch, coll. by A. Rõõmusoks, 1966; figured here pl. XXIV, fig. 6.

Description. Shell large (maximum estimated width at hinge line 58 mm), transversely semioval, relatively broad, but short, with long and sharp cardinal extremities. Rugae irregular, turning posterolaterally abruptly to cardinal extremities. Geniculation abrupt, the angle between disc and trail nearly 90°. Shell very thin, with almost flat ventral disc without elevated anterior margin. Rugae on median sector of disc poorly developed. Ornament faintly unequally multicostellate. 6 ribs per 2 mm at disc margin. No information on the pseudodeltidium. Chilidium large, medially grooved. Trail longer than disc.

Notothyrial platform weakly developed, low, without distinct transmuscle ridges and side septa. Myophragm long. Cardinal process lobes relatively thick, posteriorly inclined and with elongate myophores. Socket ridges very low and broad. Extra-muscular area with densely spaced small tubercles.

Oval striated ventral muscle field with weakly elevated lateral bounding ridges (see pl. XXIV, fig.11).

Measurements (in mm) maximum preserved length and width:

Complete shell (TUG 1003-150), holotype	21	58
Ventral valve (TUG 1003-188A)	25	54
Dorsal interior (TUG 1003-188B)	22	38
Ventral interior (TUG 72-187)	21	22
Dorsal valve (TUG 665-133)	22	41

Discussion. Only one poorly preserved specimen shows the dorsal interior and there is only one fragmentary specimen of the ventral interior. This species is more transverse in shell outline and angular cardinal extremities than any other of the genus. Besides, it differs in having peculiar postero-lateral rugae of disc that return abruptly to the cardinal extremities. The cardinalia, although poorly preserved (see pl. XXIV, figs 9, 10), are characteristic of *Kurnamena*.

Occurence and material. Haljala Stage, Idavere Substage, Tatruse Formation, Tatruse exposure (1). Vasavere Formation, Aluvere quarry (7); Soonurme ditch (1).

Kurnamena laterorugata Rõõmusoks, 1989
Plate XX, fig. 3; pl. XXVI, figs 5-8; pl. XXVII, fig. 7.

1989 *Kurnamena laterorugata* Rõõmusoks, p. 114; pl. III, figs 5, 6.

Holotype. Ventral valve TUG 1003-192 (= GMUT Br 1331, Rõõmusoks, 1989, pl. III, fig. 5), refigured here (pl. XXVI, fig. 5) from the Keila Stage, Kahula Formation, Ristna beds, exposure Sõmeru, coll. A. Rõõmusoks, 1964.

Description. Shell large (maximum width at hinge line 58 mm), rounded, trapezoidal in outline, with long sharp cardinal extremities. Ventral disc almost flat, but weakly convex on umbonal part. Coarse, somewhat irregular rugae, well developed posterolaterally and inclined sharply towards cardinal extremities. They are weakly reflected on dorsal interior. Broad middle sector of ventral disc with bundle of accentuated ribs. Geniculation abrupt, approximately 90° between disc and trail. Somewhat convex trail longer than disc. Pseudodeltidium very short, chilidium broad and protruding. Radial ornament on median ventral valve strongly unequally parvicostellate, but almost undifferentiated laterally. 7-10 ribs per 2 mm at disc margin and 5-10 finer between accentuated ribs.

Ventral muscle field relatively large, up to two-third disc length, almost circular, with strong elevated bounding ridges and a narrow gap antero-medially. No information on teeth and dental plates.

Notothyrial platform narrow, short, socket ridges diverging at right angles and bearing four small denticles posterolaterally. Myophragm short and broad. Cardinal process lobes weakly developed short, parallel. Adductor muscle scars small, narrow and elongated, usually with pair of low transmuscle ridges. Extra-muscular area finely and densely tuberculated. Low subperipheral rim.

Measurements (in mm); maximum preserved length and width:

Ventral valve (TUG 1003-192), holotype	22	30
Incomplete shell (ELM g 149:519)	9	43
Ventral valve interior mould (TUG 72-176)	24	38
Dorsal valve interior (TUG 72-174)	17	29

Comparison. *K. laterorugata* differs from *K. taxilla* (from the underlying Jõhvi Substage) in having a longer and more transverse, sharply alate shell, with more irregular and coarser rugae mostly posterolaterally. On the broad middle sector of the ventral valve rugae

more weakly developed than in *K. taxilla*. The notothyrial platform of *K. laterorugata* is narrower and shorter; myophragm broader and shorter than in *K. taxilla*.

Occurrence and material. Keila Stage, Kahula Formation, Ristna beds (see Jaanusson, 1945, p. 213). Exposures: Ristna coast (1), Keila-Ohtu roadside ditch (2), Keila-Haapsalu railway-side ditch near the town of Keila (1), Kurna (1), Sõmeru (4), Oandu (3), Kahula (1), Sompa (1).

Kurnamena rugosoides (Oraspõld, 1956)

Plate XVIII, fig. 11; pl. XX, fig. 4; pl. XXVI, figs 9-12; pl. XXVII, figs 4-6.

1954 *Leptaena rugosa* (Hisinger), Sokolskaya, p. 56, pl. III, fig. 8.
1956 *Leptaena rugosoides* [Männil MS] Oraspõld, p. 52 (*pars*), pl. II, figs 7, 9-11 [*non* fig. 8 = *Kurnamena taxilla* (Oraspõld)].

Holotype. Complete shell TUG 242-37 (= GMUT Br 3105, Oraspõld, 1956; pl. II, fig. 7, refigured here pl. XXVI, figs. 9-11), from the upper part of the Keila Stage, Kahula Formation, Kurtna Member, exposure in town of Rakvere, coll. by G. Mechmershausen.

Description. Shell large (maximum recorded width at hinge line 48 mm), relatively short, transversely semioval and sharply alate. Ventral disc completely flat. Angle of geniculation 90°. Trail twice as long as disc, faintly curved and bent back towards the hinge line. Antero-median fold low, narrow, weakly defined. Ventral interarea long. Pseudodeltidium short; chilidium large, protruding and weakly-grooved medially. Four to six coarse, partly sinuous rugae with broad wavelength, somewhat more weakly defined centrally than laterally. Radial ornament unequally parvicostellate. Accentuated ribs mainly on middle sector of ventral disc. Eight ribs per 2 mm at disc margin.

Ventral interior with small teeth, very short dental plates and almost circular muscle field occupying up to four-fifths of valve length. Muscle bounding ridges elevated, with a long middle gap between their anterior ends. Diductor muscle scars semioval in outline and radially striated. Medially-disposed adductor scars elongate and very narrow, with narrow, long myophragm (pl. XXVII, fig. 6).

Notothyrial platform strongly developed, with broad socket ridges and short median ridge. Socket ridges with four small denticles posterolaterally. Cardinal process lobes relatively thick, high and recumbent. Myophores broad, oval. Adductor scars broad, with broad coarse transmuscle ridges. Short side septa located anteriorly of adductor scars, often obscured by secondary tissue. High subperipheral rim with sparse vascular grooves around ventral valve. Extramuscular area with fine to coarse dense tubercles.

Measurements (in mm); maximum preserved length and width:

Complete shell (TUG 242-37), holotype	18	47
Ventral valve interior (TUG 47-438)	20	34
Dorsal interior (TUG 72-194)	20	30
Ventral interior (TUG 43-162)	16	25
Complete shell (TUG 2-315)	21	44

Comparison. This species differs from *K. laterorugata* in having a wider, more transverse shell, with rugae over the whole disc, more strongly-defined cardinalia, and a larger ventral muscle field. A closer form is *K. taxilla* from the underlying Jõhvi Substage (see p. 55).

Occurrence and material. Keila Stage, Kahula Formation, Kurtna Member. Exposures: town of Rakvere (10), Sõmeru (5), Oandu river-bank (11), Tammiku (2), Kurtna (2).

? *Kurnamena palmrei* sp. nov.
Plate XXVIII, figs 1-5.

Derivation of name. After the Estonian geologist, late mag. Hendrik Palmre, who collected most of the fossils from the Oandu Stage.

Holotype. Incomplete shell, TUG 102-35 (pl. XXVIII, figs 1-3) from the Oandu Stage, Hirmuse Member, from a former exposure in the town of Rakvere, coll. by H. Palmre, 1937.

Description. Shell small (recorded maximum width at hinge line 31 mm), semicircular in outline. Coarse rugae on sides of the ventral valve. No pseudodeltidium. Notothyrial platform narrow, with short but strongly developed myophragm and weakly defined transmuscle ridges.

Ventral valve anteriorly evenly gently convex; disc almost flat, but with faintly convex umbo. 6-8 coarse regular rugae on side of ventral valve with relatively broad wavelengths. Rugae becoming posteriorly stronger and reach hinge line roughly at right angles. Radial ornament unequally parvicostellate. Ribs relatively coarse, 4-5 per 2 mm at anterior margin of disc. Delthyrium almost completely sealed by broad and high medially grooved chilidium.

Ventral interior unknown.

Only one dorsal interior is available (pl. XXVIII, fig. 4). Notothyrial platform strongly developed. Muscle field deeply impressed and transmuscle ridges low, short. Myophragm broad. Cardinal process lobes short, relatively thick and inclined backwards. Socket ridges thin and short.

Measurements (in mm); maximum preserved length and width:

Ventral valve (TUG 102-35), holotype	17	31
Ventral valve exterior (TUG 1010-3)	18	24
Dorsal valve interior (TUG 1003-182)	8	12

Occurrence and material. Oandu Stage, Hirmuse Formation. A temporary exposure in town of Rakvere (1), Tõrremägi ditch (1), borehole 57-g, depth 27.2 m, NE Estonia.

Remarks. This rare species is the youngest known of the genus in northern Estonia. It differs from the older species in its smaller size and semicircular outline of the shell, less rugae on the disc and in the more distinctively developed cardinalia.

Genus *ASTAMENA* Rõõmusoks, 1989

Type species. *Astamena inaequalis* Rõõmusoks, 1989, from the Haljala Stage, northern Estonia.

Other species. The genus is monotypic.

Diagnosis (emended). Medium-sized to large leptaenine (maximum recorded shell width 56 mm). Shell rounded subtrapezoidal in outline. Trail considerably longer than disc, with long narrow fold anteromedially. Pseudodeltidium very small. Chilidium prominent, broad and high, medially grooved. Rugae irregular, developed predominantly posterolaterally and usually poorly defined. Radial ornament sharply unequally parvicostellate. Two to three prominent median ribs.

Ventral muscle field oval with curved bounding ridges.

Notothyrial platform relatively narrow, cardinal process lobes long plate-like, elongate, parallel to one another. No transmuscle ridges and side septa.

Comparison. This genus differs from other contemporary genera above all in the morphology of the cardinalia (no transmuscle ridges and side septa). The posterolateral rugae on disc are irregular.

Occurrence. Haljala Stage, northern Estonia.

Astamena inaequalis Rõõmusoks, 1989
Plate XX, fig. 9, pl. XXV, figs 1-12.

1954 *Leptaena rugosa* (Hisinger); Sokolskaya, p. 56 (*pars*), pl. III, figs 3a, 3b.
1956 *Leptaena rugosoides* [Männil MS] Oraspõld, p. 52 (*pars*).
1989 *Astamena inaequalis* sp. nov.; Rõõmusoks, p. 114, pl. II, figs 6, 8, 9 [non fig. 7 = *Kurnamena taxilla* (Oraspõld)].
1989 *Astamena flexuosa* sp. nov. Rõõmusoks, 1989, p. 114; pl. II, fig. 9 (*nomen nudum*).
2000 *Leptaena* (*Leptaena*) *inaequalis* (Rõõmusoks, 1989); Cocks & Rong, p. 243, fig. 150, 1f.

Holotype. Incomplete shell TUG 3-278 [= GMUT Br 1346; Rõõmusoks, 1989, pl. II, fig. 6; refigured here, pl. XXV, figs 1-3] from the Haljala Stage, Jõhvi Substage, Anija exposure, coll. by A. Wahl.

Description. Shell very thin, subquadrate to transversely semi-oval in outline, with broadly rounded anterior margin. Disc of ventral valve flat, very weakly convex near umbo. Trail longer than disc, weakly convex. Fold on anteromedial part of trail wide, slightly asymmetrical. Geniculation abrupt, about 90° relative to trail. Interarea of ventral valve high, pseudodeltidium very narrow, apical. Chilidium large, broad, convex and medially grooved. Rugae low, irregular and discontinuous, developed only postero-laterally. Ribs relatively fine. Middle sector of disc and trail with two or three widely spaced prominent ribs. About 10 ribs per 2 mm at disc margin.

Muscle field of ventral valve oval, at half of valve length, with low bounding ridges. Adductor scars low and narrow. Extra-muscular area with radially arranged, elongate tubercles. Dorsal interior known from a young specimen only (pl. XXV, figs 8, 9). Notothyrial platform very low. Cardinal process lobes long, low, parallel to each other. Muscle-bounding ridges poorly defined, myophragm short and narrow. Strong dense rounded tubercles outside muscle field, not arranged radially.

Measurements (in mm); maximum preserved length and width:

Incomplete shell (TUG 3-278), holotype	22	31
Incomplete shell (TUG 72-185)	22	32
Incomplete ventral valve (TUG 1003-153)	11	21
Incomplete shell (TUG 72-143)	26	40
Incomplete ventral interior (TUG 72-190)	21	27
Incomplete shell (TUG 72-147)	25	38
Incomplete ventral interior mould (TUG 1003-194)	25	33
Incomplete ventral interior mould (TUG 1014-1)	21	39

Occurrence and material. Haljala Stage, Idavere Substage, Kahula Formation, Vasavere Member. Aluvere quarry (32). Haljala Stage, Jõhvi Substage, Kahula Formation. Exposures: Madise (2); Põõsaspea (Spitham) (5); exposure NE of the town of Keila (1); Alliku (2); Pääsküla (1); Sõjamägi in town of Tallinn (5); Anija (2); Sämi (1); Aru (3); Aluvere (4).

Remarks. Oraspõld (1956, p. 54) reported that *Leptaena rugosoides* ranges from the Idavere to the Keila Stage and this was also accepted by Rõõmusoks (1970, pp. 219, 244, 294). After systematic study, I consider that *L. rugosoides* is a composite species in its original definition, part of which belongs to the genus *Kurnamena*. The true *Kurnamena rugosoides* occurs only in the Keila Stage (see above).

Astamena flexuosa was mentioned and figured in my previous paper as a new species (Rõõmusoks, 1989, p. 114; pl. II, fig. 9) but proved to be conspecific with *A. inaequalis*. Very thin shells of *Astamena inaequalis* are poorly preserved, so that the long trail is commonly totally broken off. Thus, specimens with a preserved fold on the trail are rare. The shells of *Astamena* are intraspecifically much more variable than is usual in other genera of leptaenines, and only few specimens with preserved interiors are available.

Genus *OANDUMENA* Rõõmusoks, 1989

Type species. *Leptaena fluviatilis* [Männil MS] Oraspõld, 1956 p. 54 pl. I, figs 18, 19 from the Oandu Stage, Hirmuse Formation of North Estonia.

Diagnosis. Shell medium-sized, transversely subcircular (recorded maximum width at hinge line 27 mm). Geniculation broadly evenly rounded. Ornament almost equally multicostellate, ribs mostly very fine. Disc with weakly concentric rugae. Ventral muscle field with short weak almost straight lateral bounding ridges and faintly developed median ridge. Subdued dorsal transmuscle ridges and side septa. Short, high notothyrial platform. Cardinal process lobes erect knob-like, myophragm short and narrow.

Remarks. *Oandumena* is distinguished from all other leptaenines in its weak rugae and fine, equally multicostellate radial ornament. The dorsal interior resembles that of *Kurnamena* (see p. 55).

Oandumena is a member of the rich brachiopod assemblage of the Oandu Stage but this genus does not belong to any Baltoscandian stock. During Oandu time many new northern Estonian elements from different groups appeared, including the strophomenaceans *Sakunites*, *Kjaerina*, *Rakverina*, *Virunites*, *Trigrammaria*, *Holtedahlina*, and also *Zygospira*, *Rostricellula*, *Camerella* and the first stromatoporoids (*Stromatocerium*) and tabulate corals (*Lyopora*, *Saffordophyllum*). Thus, at that time a considerable late Viruan immigration to the Baltoscandian basin took place (Rõõmusoks, 1970, p. 327, 328; 1985; 1993c). Nevertheless, *Oandumena*-like forms have not been recorded elsewhere.

Occurrence. Oandu Stage, Hirmuse Formation, North Estonia.

Oandumena fluviatilis (Oraspõld, 1956)
Plate XXVIII, figs 6-11.

1956 *Leptaena fluviatilis* [Männil MS] Oraspõld p. 54; pl. I, figs 18,19.
1989 *Oandumena fluviatilis* (Oraspõld); Rõõmusoks p. 116; pl. III figs 7,8.

Holotype. Ventral valve TUG 72-169 (= GMUT Br 3078; Oraspõld 1956, pl. I, fig. 18, refigured here pl. XXVIII, figs 6-8) from the Oandu Stage, Hirmuse Formation, at town of Rakvere.

Description. Ventral disc generally flat, but gently convex in umbonal part, dorsal disc flat. Trail shorter than disc, weakly curved. Ventral interarea relatively long, pseudodeltidium large; chilidium deeply grooved medially. Ribs very fine, four to five per 2 mm at disc margin, but every fourth or fifth rib slightly thicker anteriorly. Four to five very low rounded rugae with subequal wavelength occur on ventral disc in front of relatively long umbonal area with weak rugae. Rugae weakly reflected on shell interior.

Ventral muscle field broad, with almost straight bounding ridges, roughly half valve length. Dental plates very short, basally fused with low and narrow muscle bounding ridges. Long narrow myophragm. Extra-muscular area with rare coarse tubercles.

Notothyrial platform high, extending anteriorly as broad but short myophragm. Socket ridges narrow and short, commonly with four small denticles on the posterior side. Long narrow central median ridge. Cardinal process lobes knob-like, stout, low and erect. Broad short transmuscle ridges and side septa developed only in adults. Coarse and dense tubercles outside muscle field.

Measurements (in mm); maximum preserved length and width:

Ventral valve (TUG 72-169), holotype	17	24
Ventral valve (TUG 72-168)	15	21
Dorsal valve (TUG 695-5)	15	20
Conjoined valves (TUG 102-32)	18	25

Occurrence and material. Oandu Stage, Hirmuse Formation, North Estonia. Exposures in town of Rakvere (15), Tõrremägi (14), Oandu (40).

Genus *SIMILOLEPTAENA* Rõõmusoks, 1989

Type species. *Similoleptaena paucirugata* Rõõmusoks, 1989, p. 114; pl. IV, figs 4, 5 (refigured here, pl. XXIX, figs 1-7), from the Vormsi Stage, Kõrgessaare Formation.

Other species. ? *Similoleptaena ingrica* sp. nov., ? *Similoleptaena tarwanpensis* sp. nov., ? *Similoleptaena undosa* sp. nov., ? *Similoleptaena crassorugata* sp. nov.; *Similoleptaena pertenuis* sp. nov., *Similoleptaena planitia* sp. nov., ? *Similoleptaena friedrichi* sp. nov.

Diagnosis (emended). Shell small-sized to large (maximum recorded width at hinge line 50 mm), thin, usually transverse, broad, but relatively short. Ventral disc flat, rounded, subtrapezoidal to suboval in outline, with weakly-elevated convex marginal ridge. Coarse, mostly regular rugae with narrow wavelength cover the whole disc, weakly reflected on valve interiors. Ornament usually multicostellate, rarely parvicostellate. Trail with broad flat fold anteromedially.

Notothyrial platform delicate, with small low cardinal process lobes and with broad shallow median hollow extending forwards from cardinal process. No transmuscle ridges and side septa.

Discussion. Rong & Cocks (1994, p. 682) and Cocks & Rong (2000, p. 241) regarded *Similoleptaena* as a subjective junior synonym of *Leptaena* Dalman, 1828. However, *Leptaena* belongs to a younger stock which differs from *Similoleptaena* in a more simply developed notothyrial platform with central hollow and in possessing a high sharp marginal ridge around ventral disc, as in the lectotype of *Leptaena rugosa* Dalman (see Spjeldnaes, 1957, textfig. 38G; Bergström, 1968, p. 14, textfig. 7 and photos of dorsal and ventral interiors in Cocks and Rong, 2000, p. 244, fig. 150, 1a-1d).

Similoleptaena is an important genus from a stratigraphical point of view. In most stages, formations or members of the Harju Series a different species occurs. Unfortunately, the interiors of most of the species described here are not well known and they are only tentatively included to *Similoleptaena*. *Similoleptaena* appears to be a new *Leptaena*-like stock which differs from the older *Astamena* and *Kurnamena* in its thinner shell, more regular, coarser and denser developed rugae and in some features of notothyrial platform.

Occurrence. Oandu Stage in Ingria, north-western Russia; Rakvere, Nabala, Vormsi, Pirgu and Porkuni Stages in northern Estonia. Representatives of *Similoleptaena* occur also in the Kullsberg and Boda Limestones (equivalents of Keila and Pirgu Stages) in Siljan District, Dalarna, Sweden, as determined from the material in the Naturhistoriska Riksmuseet (Swedish Museum of Natural History), Stockholm.

Similoleptaena paucirugata Rõõmusoks, 1989
Plate XXIX, figs 1-7.

1989 *Similoleptaena paucirugata* Rõõmusoks, p. 114, pl. IV, figs 4-6.

Holotype. Ventral valve TUG 1003-193 (= Br 1349, Rõõmusoks, 1989, pl. IV, figs 4, 5; refigured here pl. XXIX, figs 1, 2) from the Vormsi Stage, Kõrgessaare Formation, Hiiumaa Island, Kõrgessaare quarry, coll. by A. Rõõmusoks, 1955.

Description. Shell large (maximum recorded width at hinge line 50 mm), transversely trapezoidal to semioval in outline, with depressed broad concave edges near cardinal extremities. Trail usually as long as disc, anteromedially distinctly trilobed, with gently convex broad fold-like median area. Coarse regular rugae over whole disc. Notothyrial platform high, well developed.

Ventral disc rounded trapezoidal, moderately convex in umbonal part, but gently concave around lateral and anterior margins. There is a weak elevated convex marginal edge.

Postero-lateral parts of shell broadly depressed. Sharply geniculate, angle of geniculation about 90°, but geniculation itself weakly rounded. Interareas low. Pseudodeltidium small, chilidium medially narrowly grooved. Rugae coarse, regular, with somewhat narrower interspaces and weakly reflected on valve interiors. Ornament generally parvicostellate, with some accentuated ribs in the median sector of disc. Narrow, almost uniform ribs on trail. Six to seven ribs per 2 mm at disc margin.

Notothyrial platform comparatively high with shallow elongate central hollow (see pl. XXIX, fig. 7). Myophragm short. Short, low, poorly-developed muscle bounding ridges, muscle scars small. Central median ridge narrow but long. Coarse irregularly spaced tubercles outside muscle field.

Ventral interior unknown.

Measurements (in mm), maximum preserved length and width:

Incomplete ventral valve (TUG 1003-193), holotype	16	35
Incomplete ventral valve (TUG 134-972)	21	50
Complete shell (TUG 42-89)	15	36
Incomplete dorsal valve interior (TUG 54-43)	20	22
Incomplete dorsal valve interior mould (TUG 80-213)	21	30

Comparison. The rugae and shape of the ventral disc in *S. paucirugata* are quite similar to those of the older species ? *S. ingrica,* although it differs from the latter in its more transverse shell and regular rugae. The differences from the other species are outlined below.

Occurrence. Vormsi Stage, Kõrgessaare Formation. Hiiumaa Island, exposures: Kõrgessaare (24), Paopa (1), Paluküla (1). Vormsi Island, exposures: Saxby coast (3) and Borrby (2). Exposures in mainland: Lyckholm (2), Aulepa (3), Sutlepa (1), Küti (1).

? *Similoleptaena ingrica* sp. nov.
Plate XXIX, figs 8-10.

Derivation of name. After Ingria district (north-western Russia), where the specimens of this species were collected.

Holotype. Ventral valve (TUG 1002-1); pl. XXIX, fig. 8; from the Oandu Stage, Hirmuse Formation, left bank of the Plyussa River at the Bol′shiye Pol′ya village near Slantsy, Ingria (Leningrad Region), NW Russia, coll. by A. Rõõmusoks, 1955.

Description Shell transverse, gently rounded, subtrapezoidal in outline, medium-sized (maximum width at hinge line 31 mm). Ventral disc generally flat, weakly convex on umbonal region only, becoming marginally gently concave antero-medially. Geniculation abrupt, almost 90° relative to flat, almost not curved trail (the latter not completely preserved). No information about ventral interarea. Five to six coarse low gently irregular developed rugae mainly posterolaterally. Radial ornament multicostellate. There are a few accentuated ribs in the median sector of the disc; about six to seven ribs per 2 mm at the disc margin.

Interior of the valves unknown.

Measurements (in mm), maximum preserved length and width:

Ventral valve (TUG 1002-1), holotype	15	25
Ventral valve (TUG 1003-54)	15	31

Remarks. This new species is the oldest representative of the genus known from the northern East Baltic. Only two specimens are available. Although the interiors are not known, the ornament and rugation are so similar to younger congeneric species that this rare species belongs with little doubt to *Similoleptaena.* No specimens of this species from

contemporaneous beds in North Estonia have been found, although from those beds we have abundant collections of other fossils.

Comparison. *S. ingrica* differs from the other species described here in having low, not well-developed coarse rugae, mainly posterolaterally and in its abrupt angle of geniculation.

Occurrence and material. Oandu Stage, Hirmuse Formation, at the Bol′shiye Pol′ya village near Slantsy, Plyussa river-bank, Ingria (2).

? *Similoleptaena tarwanpensis* sp. nov.
Plate XXX, fig 1.

Derivation of name. After Tarwanpe – a historical name of an Estonian stronghold at the Rakvere town, close to the exposures of the Rakvere Stage.

Holotype. Conjoined valves TUG 74-42 (pl. XXX, fig. 1). Rakvere Stage, Piilse Member of Rägavere Formation, Piilse river-bank, coll. by A. Oraspõld, 1956.

Description. Disc rounded, trapezoidal in outline, medium sized (maximum width at hinge line 39 mm). Shell relatively short, transverse, with sharp cardinal extremities. Seven to nine generally regular coarse rugae strongly developed in posterolateral part of the disc.

Ventral valve almost flat, but with wide low peripheral trough just posterior to the rugae at the geniculation, geniculated abruptly at about 90° relative to trail. Ventral interarea low; pseudodeltidium very small, apical. Chilidium large, medially deeply grooved. Relatively narrow, almost regular rugae with equal wavelength occur mostly posterolaterally. Radial ornament multicostellate, with some prominent median ribs. About seven to eight ribs per 2 mm at the disc margin.

Interiors not known.

Measurements (in mm); maximum preserved length and width:

Ventral valve, holotype, complete shell (TUG 74-42) in rock	16	29

Remarks. This species differs from all other species of the genus in its short shell with sharp cardinal extremities. Unfortunately, no interiors are available; however, the characteristic external features leave no doubt of its relationship with the type species of the genus. The closest species to ? *S. tarwanpensis* is *S. ingrica* from the underlying Oandu Stage, with a similar type of rugation. Unfortunately, no interiors are available.

Occurrence and material. Rakvere Stage, Rägavere Formation, Piilse Member, exposures: Munalaskme (2), Voore (2), Rakvere (2), Rägavere (1), Piilse river-bank (1). Tudu Member, Paekna quarry (9).

? *Similoleptaena undosa* sp. nov.
Plate XXX, figs 2-6.

Derivation of name. From the Latin, *undosus*, meaning strongly undulated; alluding to the mostly sinuously curved weakly developed rugae.

Holotype. Incomplete shell (TUG 80-224), pl. XXX, fig. 2 from the Nabala Stage, Paekna Formation, Paekna-Põldmäe exposure, coll. by V. Jaanusson, J. Martna and H. Neuhaus, 1942.

Description. Shell large (maximum estimated width at hinge line about 50 mm) with rounded trapezoidal transverse outline. Eight to ten irregularly undulating low rugae over whole disc.

Ventral disc flat, but very slightly convex on umbo, without elevated marginal ridge on the geniculation. Cardinal extremities obtuse. Angle of geniculation about 110°. Ventral interarea low; pseudodeltidium very small, chilidium large, medially grooved. Relatively narrow, irregularly undulating rugae of narrower wavelength. Ornament multicostellate, with

ribs increasing slightly in size anteriorly. There are five to six ribs per 2 mm at the disc margin. Anterior region of the trail unevenly folded in the middle.

Dorsal interior not known.

Measurements (in mm); maximum preserved length and width:

Incomplete ventral valve (TUG 38-74)	26	38
Incomplete ventral valve (TUG 80-224), holotype	17	28
Ventral valve internal mould (TUG 1003-231)	23	14
Ventral valve (TUG 1001-1)	18	32

Comparison. *S. undosa* is the largest species of the genus and distinguished from all other species described here in its large angle of geniculation, and in the higher number of mostly irregular rugae.

Occurrence and material. Nabala Stage, Paekna Formation. Exposures: Paekna quarry (1), Nõmmeküla exposure (5), Permisküla at Narva river (3).

? *Similoleptaena crassorugata* sp. nov.
Plate XXX, figs 7, 8.

Derivation of name. From the Latin, *crassa*, meaning coarse and *ruga*, wrinkle.

Holotype. Ventral valve TUG 1003-242 (pl. XXX, figs 7, 8) from the Nabala Stage, Saunja Formation, Tõrma exposure, coll. by A. Rõõmusoks, 1954.

Description. Shell small (maximum recorded width at hinge line 20 mm), outline suboval. Cardinal extremities of ventral valve posterolaterally weakly depressed. Ventral disc flat. Angle of geniculation 90°, trail upright. Six fully regular strong rugae with narrower spaced wavelength. Ornament well-defined, multicostellate; ribs relative coarse, five to six per 2 mm at disc margin. There are some accentuated ribs on middle sector of valve.

No information on valve interiors.

Measurements (in mm); maximum preserved length and width:

Ventral valve, TUG 1003-242, holotype	10	20

Remarks. The nearest probable descendant of this species may be ? *Similoleptaena ingrica* from the Oandu Stage.

Occurrence and material. Nabala Stage, Saunja Formation; exposures: Odulema (1), Mäemetsa (3),Tõrma (1), Illuka (1).

Similoleptaena pertenuis sp. nov.
Plate XXX, figs 9-12.

Derivation of name. From the Latin, *pertenuis*, meaning very thin, alluding to very thin shell.

Holotype. Incomplete shell (TUG 50-33; pl. XXX, figs 9, 10) from the Pirgu Stage, Moe Formation, Vormsi Island, exposure Kärrslätt, coll. by E. Möls, 1951.

Description. Shell extremely thin (thickness at the umbo no more than 2-3 mm), transversely subtrapezoidal in outline, becoming more acute posterolaterally. Ventral valve laterally and anteriorly gently concave, with weakly elevated marginal edge on geniculation, medium-sized (maximum estimated width at hinge line 38 mm). Ventral disc almost flat, gently concave along lateral and anterior margin and bounded by a low rim. Umbonal region faintly convex. Geniculation about 90°. Trail very weakly convex, as long as disc. Interareas comparatively low. No information on pseudodeltidium; chilidium high and broad, medially

broadly grooved. Well-developed regular rugae over whole disc, narrow spaced and faintly reflected also on dorsal interior. Radial ornament finely and equally parvicostellate, with seven to eleven ribs per 2 mm at the anterior margin of disc. Some accentuated ribs on the middle sector of disc.

No information on ventral interior. Notothyrial platform very low, short and with short median ridge.

Measurements (in mm); maximum preserved length and width:

Incomplete shell (TUG 50-33), holotype	15	32
Incomplete ventral valve (TUG 1003-229)	13	25
Dorsal interior (TUG 1003-169)	17	23

Comparison. The general morphology of shell, rugation and notothyrial platform of *S. pertenuis* suggest that it is probably an immediate descendant of *S. paucirugata* from the underlaying Vormsi Stage. It differs from the latter in having more numerous and finer rugae, a flatter disc with elevated lateral and anterior margin, thinner shell, in the lack of a ventral anteromedian fold on trail and some minute differences in the notothyrial platform.

Occurrence and material. Pirgu Stage, Moe Formation. Exposures in Vormsi Island: Saxby village (5), Kärrslätt village (5), Hoitberg mound (9). Exposures in mainland: Nyby moundstone erratics (18), Nyby quarry (6), Aulepa (1), Kohila (1), Pahkla (1), Ruunavere mound (4). Adila Formation. Exposures: coast of Vohilaid Island (3); Vormsi Island, coast at Hosholm (3); exposures in mainland: Uuemõisa, erratics (3), Vardi erratics (15), Atla river at Pirgu (5). Ärina Formation, Röa Member, Porkuni quarry (2).

Similoleptaena planitia sp. nov.
Plate XXXI, figs 1-5.

Derivation of name. From the Latin, *planitia*, meaning plane, alluding to the conspicuosly flat ventral disc.

Holotype. Incomplete ventral valve TUG 107-26 (pl. XXXI, fig. 2) from the Pirgu Stage, erratic boulder from the Adila Formation, town of Haapsalu (at Holm) coll. by V. Reimer.

Description. Shell relatively long, almost subcircular in outline, with obtuse cardinal extremities, medium-sized (maximum width at hinge line 36 mm). Ventral disc flat, but gently convex near umbo, with weakly elevated marginal rugae. Interareas low. Ten to thirteen narrow rugae over whole disc, reflected also on valve interiors. Radial ornament multicostellate, with four to five ribs per 2 mm at disc margin. All ribs are of equal width intervals. Geniculation abrupt, about 90°. Anterior face of trail is gently irregulary folded.

Ventral muscle field relatively large, about one third valve length, with almost parallel bounding ridges. No information on teeth and dental plates.

Notothyrial platform broad, short. There is a broad low and rounded central hollow below the cardinalia. Myophragm short, with narrow central median ridge. Muscle-bounding ridges poorly developed, muscle fields elongate. No transmuscle ridges. No information on cardinal process and socket ridges.

Measurements (in mm); maximum preserved length and width:

Ventral valve (TUG 107-26), holotype	19	35
Ventral valve (TUG 107-27)	21	36
Dorsal valve interior (TUG 43-167)	15	26
Ventral valve interior mould (TUG 42-119)	21	34

Comparison. This new species differs from all other species of the genus, in particular, from the partly contemporaneous *S. pertenuis* in possessing a relatively longer, subcircular, flatter ventral disc and finer gently irregular rugae of equal width.

Occurrence and material. Pirgu Stage, Adila Formation; Exposures: Paluküla in the Hiiumaa Island (2); Vohilaid Island (2); Hosholm coast in the Vormsi Island (5). Exposures in mainland: erratics at coast in town of Haapsalu, Holm (3), Sutlepa (2). Ärina Formation, Röa Member. Exposures: Röa railway-side ditch (3) and Porkuni quarry (1).

? *Similoleptaena friedrichi* sp. nov.
Plate XXX, fig. 13.

Derivation of name. After Academician Friedrich Schmidt, the collector of the type specimen.

Holotype. Ventral valve TUG 42-121 (pl. XXX, fig. 13) from the Porkuni Stage, Ärina Formation, Siuge Member. Porkuni quarry, coll. F. Schmidt.

Description. This is the smallest leptaenine known from the Ordovician of northern Estonia (maximum recorded estimated width at hinge line 14 mm). Shell almost semicircular in outline with very short sharp cardinal extremities. Ventral disc gently concave around anterior and lateral margin. Geniculation abrupt at about 90°. Rugae regular, low and exceptionally fine, numbering five to six. Ornament multicostellate, with few accentuated ribs on short middle sector of ventral disc. 10 ribs per 2 mm at disc margin.

No information on interiors.

Measurements (in mm), maximum preserved length and width:

Ventral valve (TUG 42-121), holotype	16	12

Discussion. The general morphology of shell is very similar to the older ? *S. crassorugata*. This species, together with ? *S. crassorugata* may perhaps be representatives of a new genus.

Occurrence. Porkuni Stage, Siuge Member. Exposure: Porkuni quarry (5); Tõrevere Member, Porkuni quarry (1).

Genus *HARJUMENA* Rõõmusoks, 1993c

Type species. *Strophomena schmidti* Gagel, 1890, p. 42, pl. III, figs 4a, 4b.

Diagnosis (emended). Shell large (maximum estimated width 52 mm), subtriangular to elongately subtriangular in outline, abruptly geniculate dorsally. Trail gently convex and as long as disc. Ornament strongly parvicostellate. Fine, fragmentary, irregularly arranged concentric corrugations over whole disc; no regular rugae. Vestigial pseudodeltidium, large chilidium. Cardinal process lobes long, low, blade-like and parallel to one another. Transmuscle ridges and muscle bounding ridges absent. Ventral muscle field elongate, open anteriorly.

Discussion. The type species was briefly described and figured by Gagel (1890). His specimens were collected from erratics in the environs of Königsberg, East Prussia (the present Kaliningrad region) and were apparently derived from the bottom of the Baltic Sea west of Estonia. Specimens of this species from the bedrock of northern Estonia were first described by Sokolskaya (1954, p. 59; pl. III, fig. 14) and assigned erroneously to *Leptaena schmidti* (Gagel) and to *Rafinesquina* (*Rafinesquina*) *corrugatella* (Davidson) (Sokolskaya, 1954, p. 38; pl. I, fig. 3.). These specimens were collected from the Nabala Stage, Saunja Formation, from exposures at the town of Tapa and in Tõrma (near Tapa).

Besides, Sokolskaya (1954, pl. III, figs 15, 16) included in *Leptaena schmidti* two small specimens which actually belong to *Bekkeromena ilmari* sp. nov. (see below; I examined them in the Palaeontological Museum of the Russian Academy of Sciences in Moscow in 1990).

The specimens described and figured by Holtedahl (1916, p. 32; pl. III, figs 1, 2) as *Rafinesquina* (?) *schmidti* and *Rafinesquina* (?) sp. from 4d beds, Ashgill, Hadeland and Ringerike districts, Norway, may represent a new species of *Harjumena*.

Recent reinvestigation of material from the Vormsi Stage indicates that *Harjumena* does not occur there. The two specimens figured in my previous paper (Rõõmusoks, 1993c, pl. III, figs 8, 9) as *Harjumena* sp. nov. belong to the new genus *Saxbyonia* (see above).

Harjumena differs from other leptaenine genera above all in having peculiar fine, dense corrugations on the disc of both valves and in the lack of distinctly developed regular concentric rugae.

Occurence. Nabala Stage, Saunja Formation, North Estonia. Gerdauen; former East Prussia, now Kaliningrad district (from erratic boulders of former Lyckholm Stage, lower part; these boulders are most likely derived from the Saunja Formation).

Harjumena schmidti (Gagel, 1890)
Plate XXXI, figs 6-12

1890	*Strophomena schmidti* Gagel; p. 42, pl. III, figs 4a, 4b.
1908	*Leptagonia schmidti* Gagel; Schmidt, p. 726.
1954	*Rafinesquina* (*Rafinesquina*) *corrugatella* (Davidson); Sokolskaya, pl. I, fig. 3.
1954	*Leptaena schmidti* (Gagel); Sokolskaya, p. 59 (*pars*), pl. III, figs 14a, 14b (non figs 15, 16 = *Bekkeromena ilmari* sp. nov.).
1993c	*Harjumena schmidti* (Gagel); Rõõmusoks, p. 162, pl. III, figs 1-7 (non figs 8, 9 = *Saxbyonia fluctuosa* sp. nov.).
2000	*Harjumena schmidti* (Gagel); Cocks & Rong, p. 243, fig. 151, 2a-c.

Description. Shell very thin, roundly triangular in outline, relatively abruptly geniculated in dorsal direction. Ventral valve trail laterally about twice as wide as disc. Ventral disc in centre weakly concave, except for slightly convex umbonal region. Dorsal valve flat. Geniculation gently rounded. Trail longer than disc.

Radial ornament strongly developed, weakly irregular, with accentuated ribs anteriorly in particular. Distinct irregularly-arranged narrow concentric corrugations over whole disc, weakly developed in interiors. 3-4 ribs per 2 mm at disc margin.

Pseudodeltidium small, vestigial; chilidium large.

Ventral muscle field narrow, elongate, almost twice as long as valve length and open anteriorly. Lateral bounding ridges almost parallel. Dental plates short.

Notothyrial platform faintly developed, with short, parallel cardinal process lobes posteriorly. Socket ridges very short. Muscle fields gently depressed. Median ridge short and low. Muscle bounding ridges lacking.

Measurements (in mm); maximum preserved length and width:

Ventral exterior (partially mould) (TUG 861-5)	32	45
Ventral exterior (TUG 2-318)	29	35
Right lateral view (TUG 72-183)	30	-
Ventral interior (TUG 106-22)	11	35

Occurrence and material. Nabala Stage, Saunja Formation. Hiiumaa Island; erratics from Käina (1) and Kõrgessaare (1). Vormsi Island; erratics from Saxby (2). Mainland of Estonia; erratics from Pürksi (1) and Lyckholm (1); exposures Odulema (3), Mõnuste (1), Kohatu (2), Lehtse (1), Tõrma (1), Küti (1).

Genus *BEKKEROMENA* Rõõmusoks, 1963

Type species. *Strophomena semipartita* Roemer, 1861, p. 43; pl. V, figs 9a, b, c, from the limestone erratics of the Pirgu Stage, Silesia, south-western Poland.

Other species. ? *Bekkeromena ilmari* sp. nov., *Bekkeromena vormsina* sp. nov., *Bekkeromena infirma* sp. nov. and *Bekkeromena* aff. *semipartita* (Roemer).

Diagnosis (emended). Medium-sized to large leptaenines (recorded maximum shell width 50 mm) usually with moderately rounded geniculation, weakly unequally parvicostellate (with some accentuated ribs in the middle sector of shell). Rugae mostly coarse, slightly irregular, in particular postero-laterally. No pseudodeltidium; chilidium large, convex, medially faintly grooved. Ventral muscle field elongate, with high and long subparallel bounding ridges. Notothyrial platform low, broad, posteriorly weakly depressed, wide and smooth. Cardinal process lobes low, thick, with long elongated myophores and inclined backwards. Socket ridges faintly defined, muscle field small. No prominent transmuscle ridges and side septa.

Discussion. The genus *Bekkeromena* forms a fairly homogeneous group of species with a characteristic leptaenine morphology. The main distinctive features between the species are the shape, size and convexity of the shell and features of rugation. The general development of the genus proceeded by increasing the shell size and the formation of finer, irregular rugae. Almost all the available specimens of *Bekkeromena* are incomplete, but exception is a specimen which has a fairly long convex trail with a wide and low fold antero-medially (TUG 2-326, figured here pl. XXXII, fig. 6).

The most similar genera to *Bekkeromena* are *Septomena* Rõõmusoks, 1989, *Oandumena* Rõõmusoks, 1989 and *Kiaeromena* Spjeldnaes, 1957. *Bekkeromena* differs from *Septomena* by its larger size, stronger convexity, in having a longer trail, and by the lack of pseudodeltidium and prominent transmuscle ridges. However, the general morphology of the notothyrial platform of these two genera is quite similar. *Oandumena* can be distinguished from *Bekkeromena* by its smaller shell, weakly-developed rugae, finer ribs, lower notothyrial platform and by the presence of transmuscle ridges. *Kiaeromena* differs in the possession of less even geniculation, very coarse broad rugae, a larger flat disc, a different morphology of the notothyrial platform, and a smaller flabellate ventral muscle field. Considering these differences, *Bekkeromena* is regarded here as an independent genus, not as a subgenus of *Kiaeromena* Spjeldnaes, as recommended by Rong & Cocks (2000, p. 246).

Occurrence. The Harju Series of Baltoscandia; Nabala, Vormsi and Pirgu Stages of North Estonia.

Some specimens of leptaenines from the flank facies of the Boda Limestone (Middle Ashgill) in Siljan district examined in the Naturhistoriska Riksmuseet, Stockholm (in 1966) seem to belong to a new species of *Bekkeromena.* A specimen from the Bønsnes Formation (5a, Middle Ashgill of Norway) in the Palaeontologisk Museum, Oslo, figured by Holtedahl (1916; pl. III, fig. 4), may represent another new species of *Bekkeromena*. Unfortunately there are no specimens with preserved interiors.

? *Bekkeromena ilmari* sp. nov.
Plate XXXII, figs 1-4.

Derivation of name. After the late Ilmari Mitnits, who collected the holotype.

Holotype. Incomplete shell TUG 81-5 (pl. XXXII, fig. 1) from the Nabala Stage, Saunja Formation at Taaldevälja exposure. Coll. by Ilmari Mitnits, 1948.

Description. Shell medium-sized (recorded maximum width at interarea 38 mm), relatively thin. Shell outline subtriangular, alate. Nine to thirteen fine, almost regular rugae distinct also medially, directed posterolaterally abruptly towards cardinal extremities. 4 ribs per 2 mm at disc margins.

Shell strongly convex in lateral profile. Disc of ventral valve moderately convex and short. Trail about twice as long as disc. Ventral interarea low, no pseudodeltidium; chilidium large, medially grooved. Ribs fine, but some of these are coarser in median sector of disc.

Ventral interior unknown.

Notothyrial platform broad, but smooth, weakly depressed. Socket plates faintly developed. Cardinal process lobes small, stout. Valve surface outside muscle field with coarse, dense tuberculation. Rugae weakly reflected on valve interiors.

Measurements (in mm); maximum preserved length and width:

Ventral valve (TUG 81-5), holotype	18	21
Incomplete shell (TUG 72-202)	19	22
Incomplete shell (TUG 2-327)	22	-
Dorsal interior (TUG 106-21)	10	26

Comparison. This species resembles to *B. vormsina* sp. nov., but differs in having a smaller, less subtriangular but more convex shell, finer and more numerous rugae and an evenly rounded geniculation.

Occurrence and material. Nabala Stage, Saunja Formation. Hiiumaa Island, exposures near Paluküla chapel (7), Hausma (1) and Kõrgessaare coast (2). Exposures in mainland: Turvaste (1) (directly below of the upper boundary of the Saunja Formation), Odulema (4), Mõnuste (9), Taaldevälja (1), Uuemõisa (1), Tõrma (7).

Bekkeromena vormsina sp. nov.
Plate XXXII, figs 5-8.

1963	*Bekkeromena semipartita* (Roemer), *pars*; Rõõmusoks, p. 235, pl. I, figs 5-9; textfigs 2, 3.
1965	*Bekkeromena semipartita* (Roemer); Muir-Wood and Williams, p. H393, figs 253-2a-d.
2000	*Kiaeromena (Bekkeromena)* sp. aff. *K. (B.) semipartita* (Roemer); Rong & Cocks, p. 246, figs 152-2c, 2d.

Derivation of name. After the Vormsi Stage.

Holotype. Conjoined valves TUG 2-325 (pl. XXXII, fig. 5) from the Vormsi Stage, Kõrgessaare Formation, Küti exposure, coll. by F. Schmidt.

Description. Shell large (maximum recorded width at hinge line 50 mm), almost evenly convex in lateral profile. Outline subtriangular, cardinal angles not obtuse. 10-12 strong, commonly regular coarse rugae over whole disc inclined lateroposteriorly. 5-6 ribs per 2 mm at disc margin.

Trail in adult specimens at least twice as long as disc. Ventral interarea long. Middle sector of disc with few prominent ribs. Chilidium large, medially faintly grooved.

Ventral muscle field elongate, relatively large, with high subparallel bounding ridges which curve inwards anteriorly. Short but high teeth joined with bounding ridges of muscle field. Median ridge small and short. There is a pair of unusually short oblique ridges anteriorly. Antero-central part of muscle field gently elevated. Valve floor outside muscle field sparsely but coarsely tuberculate.

Notothyrial platform broad, low and smooth, weakly concave in the centre only, with faintly-defined narrow short socket plates. No transmuscle ridges and side septa. Cardinal process lobes high, erect, stout. Valve floor densely and coarsely tuberculate.

Measurements (in mm); maximum preserved length and width:

Conjoined valves (TUG 2-325), holotype	34	45
Ventral interior (TUG 42-93)	15	28
Dorsal interior (TUG 1003-178)	30	36
Conjoined valves (TUG 2-326)	40	35

Comparison. The subtriangular outline of *B. vormsina* resembles that of *B. ilmari* sp. nov. which also possesses coarse continuous rugae. However, the shell of the latter species is smaller, with less numerous rugae. *B. infirma* sp. nov. differs in having a subquadrate shell outline and medially weakly developed irregular rugae.

Occurrence and material. Vormsi Stage, Kõrgessaare Formation. Hiiumaa Island: exposures: Paopa (11), Kõrgessaare (28), Kärdla (4), Paluküla (4). Vormsi Island: exposures: Kärslätt (4), Saxby north coast (8), Borrby (1). Exposures in mainland: Lyckholm (3), Aulepa (4), Nõmmküla (1), Turvaste (1) (directly above at the boundary between the Nabala and Vormsi Stages), Seljaküla (1), Mõnuste (4), Kohila (7), Kata (1), Lehtse (2), Imastu (near the town of Tapa) (2), Saksi (2), Küti (3).

? *Bekkeromena infirma* sp. nov.
Plate XXXII, fig. 9, 10.

1956	*"Rafinesquina" semipartita* (Roemer); Jaanusson, p. 383 (*pars*).
1963	*Bekkeromena semipartita* (Roemer); Rõõmusoks, p. 235 (*pars*), pl. I, figs 7-9 (non figs 5, 6 and textfigs 2, 3 = B. *vormsina* sp. nov.).
2000	*Kiaeromena (Bekkeromena)* Rõõmusoks; Cocks & Rong, p. 246, figs 152, 2c, 2d.

Derivation of name. Latin, *infirma*, weakish, alluding to weakly developed rugation.

Holotype. Conjoined valves (TUG 72-170), pl. XXXII, fig. 9 from the Pirgu Stage, Moe Formation, Moe exposure, coll. by A. Öpik.

Description. Shell large (maximum recorded width at interarea 42 mm), rounded subquadrate in outline, with obtuse cardinal angles. 9-14 comparatively low somewhat irregular rugae, weakly developed medially. Ventral valve almost evenly weakly convex, dorsal valve correspondingly concave. Trail three times as long as disc. Geniculation on lateral parts of ventral valve abrupt. Ventral interarea relatively long, chilidium large, convex and medially grooved. Rugae mostly weak, irregular and comparatively narrow, medially poorly defined to obsolete. Median sector of disc commonly with some accentuated ribs. 5-6 ribs per 2 mm at disc margin.

Ventral muscle field elongate with high nearly subparallel, medially straight muscle-bounding ridges, with anterior ends inclined abruptly forwards one another.

Dorsal interior unknown.

Measurements (in mm); maximum preserved length and width:

Conjoined valves (TUG 72-170), holotype	30	40
Interal mould of ventral valve (TUG 112-13)	32	43

Comparison. This species seems to be closely related to *B. vormsina* sp. nov. but the latter species has a distinctly subtriangular outline, better medially defined rugae, and a different shape of the ventral muscle field bounding ridges, whose anterior ends are slightly inclined towards one another.

Occurrence. Pirgu Stage, Moe Formation. Hiiumaa Island, exposure Paluküla (1). Vormsi Island, Saxby old quarry (6). Exposures in mainland: Salu (6), Moe (6), Enniksaare (2).

Bekkeromena aff. *semipartita* (Roemer, 1861).
Plate XXXIII, figs 1-3.

1956 *"Rafinesquina" semipartita* (Roemer); Jaanusson, p. 382, 383.
1963 *Bekkeromena semipartita* (Roemer); Rõõmusoks, p. 235.
2000 *Kiaeromena (Bekkeromena) semipartita* (Roemer); Cocks & Rong, p. 246, fig. 152, 2a.

Description. Medium-sized shell (maximum recorded width of hinge line 42 mm) with rounded subrectangular almost flat disc. Geniculation relatively abrupt. Trail slightly longer than disc. Ventral interarea long; no pseudodeltidium. Chilidium large, convex, weakly grooved medially. Cardinal extremities obtuse. Trail longitudinally weakly convex but abrupt on shell flanks. Rugae exceedingly irregular, particularly posterolaterally, fine in umbonal area, subdued medially and almost absent anteromedially. Ornament unequally multicostellate, particularly in middle sector. 6 ribs per mm at anterior margin.

Dorsal interior not known.

Measurements (in mm); maximum preserved length and width:

Conjoined valves (TUG 42-90)	38	42
Conjoined valves (TUG 80-214)	34	36
Ventral valve (TUG 472-15)	37	39

Comparison. This species can be distinguished from all other species of the genus in its almost flat disc and irregular rugation, which is best developed posterolaterally. Although the dorsal valve interior is unknown, the external shell morphology, ventral interior, and especially the lack of a pseudodeltidium, show that this species belongs to *Bekkeromena*.

Remarks. Until recently I was not sure if true *B. semipartita* occurs in the Pirgu Stage of northern Estonia. However, recently two specimens collected in the 19th century from the glacial boulders at Sadewitz near Wroclaw in Poland were found in the old collection of our Museum of Geology at the University of Tartu. One specimen (TUG 472-15; see pl. XXXIII fig. 4) is labelled as "*Leptaena semipartita* F. R., Sadewitz" and the second in F. Schmidt's handwriting, as "*Strophomena semipartita* Roemer, Sadewitz, Breslauer Museum". F. Roemer (1861, p. IV) mentioned that F. Schmidt visited Wroclaw (Breslau) in 1858, and it may have been on that occasion that he received these specimens for comparison with Estonian forms. These two specimens correspond exactly to Roemer's description and figures of *Strophomena semipartita* and also somewhat to our form, described below from the Pirgu Stage, Adila Formation of northern Estonia. In addition, there are three new species from the Harju Series which are described above, each of which has a limited stratigraphical range and they all appear belong to one phylogenetic lineage.

Roemer's material of *semipartita* was housed in the Museum of Breslau (now Wroclaw, in Poland) and was destroyed in World War II. Both the composition of the fauna and also the lithology indicates that the erratic boulders at Sadewitz were derived from the Pirgu Stage, either from north-western Estonia or from the submarine outcrop area westward from the coast of Estonia.

Unfortunately, no interiors of true *B. semipartita* are known. For that reason the Estonian form is here tentatively described as *B.* aff. *semipartita*. The interiors figured by Rõõmusoks (1963, pl. I, figs 5,6; textfigs 2,3) and Williams (1965, fig. 253, 2c, 2d) do not belong to *B. semipartita*, but to *B. vormsina* described above.

Occurrence and material. Pirgu Stage, Adila Formation, north-western Estonia. Vormsi Island: Hosholm coast (1). Exposures in mainland: Rannaküla (1), Piirsalu (4), and erratics in town of Haapsalu (4) and at Vardi (2).

Genus *SCHMIDTOMENA* Rõõmusoks, 1989

Type species. *Leptagonia acuteplicata* Schmidt, 1908, p. 726, OD, from the Porkuni Stage, Ärina Formation, North Estonia.

Diagnosis. Shell trapezoidal with wide flat thin frill surrounding trail anteriorly and marginally. Ventral disc margins weakly narrowly steeply elevated. Two accentuated ribs medially. Fine regular concentric rugae which are stronger laterally. Ventral muscle field subcircular, with raised bounding ridges. Notothyrial platform lacking, adductor muscle fields strongly concave. No transmuscle ridges and side septa. Central median septum very narrow, developed only anteriorly.

Discussion. *Schmidtomena* is externally distinguished from other genera of leptaenines (except *Limbimurina* Cooper, 1956) in its wide frill and correlated twofold geniculation on the shell. The ventral muscle field of *Schmidtomena* is like that of *Similoleptaena*.

Occurrence. Porkuni Stage, Ärina Formation, northern Estonia.

Schmidtomena acuteplicata (Schmidt, 1908)
Plate XXXIII, figs 5-10.

1908	*Leptagonia acuteplicata* Schmidt p. 726.
1937	*Leptaena acuteplicata* Schmidt; Öpik, p. 51, fig. 31.
1954	*Leptaena acuteplicata* (Schmidt); Sokolskaya, p. 60; pl. IV, figs 1-4, textfig. 20.
1989	*Schmidtomena acuteplicata* (Schmidt); Rõõmusoks, p. 115, figs 7-10.

Lectotype. Ventral valve, TUG 72-164 (= GMUT Br 1334 selected by Rõõmusoks, 1989; pl. IV, figs 7-9; figured at first by A. Öpik (1937, p. 151, fig. 31), refigured here pl. XXXIII, figs 5-7) from the Porkuni Stage, Ärina Formation, Tõrevere Member, Porkuni quarry, coll. by A. Öpik.

Description. Shell medium-sized (recorded maximum width in an incomplete specimen 40 mm), with wide flat frill surrounding ventral disc of trail. Ventral disc, subtrapezoidal in outline, generally flat but with narrow fold-like edge laterally and anteriorly. Low, regular concentric rugae on disc and frill. Ribs fine, except for two accentuated ones medially, coarser on trail. 10 ribs per 2 mm at disc margin. Trail geniculate.

Ventral muscle field small, circular, reaching one third of the disc length, circular, with gently raised bounding ridges converging anteriorly. Muscle scars densely striated.

Notothyrial platform lacking, adductor scars laterally strongly concave. Muscle bounding ridges weak. No transmuscle ridges and side septa. Central medium septum thin and weak. Cardinal process lobes short, striated. On the muscle field strongly reflected concentric rugae.

Measurements (in mm); maximum preserved length and width:

Dorsal valve (TUG 72-164), lectotype	13	28
Ventral interior (TUG 1001-3)	12	18
Ventral interior (TUG 54-52)	12	12
Dorsal interior (TUG 2-399)	13	19

Discussion. Cocks & Rong (2000, p. 243) regarded *Schmidtomena acuteplicata* as a species of the subgenus *Leptaena* (*Leptaena*). However, no other species of this subgenus lacks notothyrial platform or has a twofold geniculation of the shell. Therefore, this species is regarded here as the single representative of the independent genus, *Schmidtomena*.

Occurrence and material. Porkuni Stage, northern Estonia. Ärina Formation, Vohilaid Member. Exposures: Vohilaid Island, northern coast (4), Röa-Jaagupi (2), Aruküla (1). Siuge Member. Exposures: Tikkaru (1), Siuge (4), Porkuni quarry (25). Tõrevere Member. Localities: erratics at Heltermaa harbour, Hiiumaa Island (4); exposures in mainland: Tõrevere (5), Koigi (1), Ärina (5), Soonurme ditch (1).

Table. 6. The subfamily Leptaeninae in the Ordovician of northern Estonia

Series	Species	Stage	Formation	Member
Harju	*Schmidtomena acuteplicata* (Schmidt)	Porkuni	Ärina	Siuge, Tõrevere
	? *Similoleptaena friedrichi* sp. nov.	Porkuni	Ärina	Siuge
	Similoleptaena planitia sp. nov.	Pirgu	Adila; Ärina	Röa
	Bekkeromena aff. *semipartita* (Roemer)	Pirgu	Adila	
	Similoleptaena pertenuis sp. nov.	Pirgu	Moe; Adila	
	? *Bekkeromena infirma* sp. nov.	Pirgu	Moe	
	Bekkeromena vormsina sp. nov.	Vormsi	Kõrgessaare	
	Similoleptaena paucirugata Rõõmusoks	Vormsi	Kõrgessaare	
	? Bekkeromena ilmari sp. nov.	Nabala	Saunja	
	Harjumena schmidti (Gagel)	Nabala	Saunja	
	? *Similoleptaena crassorugata* sp. nov.	Nabala	Saunja	
	? *Similoleptaena undosa* sp. nov.	Nabala	Paekna	
Viru	? *Similoleptaena tarwanpensis* sp. nov.	Rakvere	Rägavere	Piilse
	? Similoleptaena ingrica sp. nov.	Oandu	Hirmuse	
	Kurnamena palmrei sp. nov.	Oandu	Hirmuse	
	Oandumena fluviatilis (Oraspõld)	Oandu	Hirmuse	
	Kurnamena rugosoides (Oraspõld)	Keila	Kahula	Kurtna
	Kurnamena laterorugata Rõõmusoks	Keila	Kahula	
	Septomena cryptoides (Oraspõld)	Keila	Kahula	
	Septomena cf. *alliku* (Oraspõld)	Keila	Kahula	
	Astamena inaequalis Rõõmusoks	Haljala	Kahula	Vasavere
	Kurnamena acuta sp. nov.	Haljala	Tatruse; Kahula	Vasavere
	Kurnamena taxilla (Oraspõld)	Haljala	Tatruse; Kahula	
	Septomena alliku (Oraspõld)	Haljala	Kahula	Vasavere
	Septomena crypta (Öpik)	Kukruse	Viivikonna	Peetri
	Kurnamena spumifera (Öpik)	Kukruse	Viivikonna	Kiviõli
	Estonomena estonensis (Bekker)	Kukruse	Viivikonna	Kiviõli - Peetri
	Septomena juvenilis (Öpik)	Kukruse	Viivikonna	Kiviõli
	? *Estonomena lindae* Rõõmusoks	Uhaku	Väo; Kõrgekallas	
	? *Septomena* aff. *juvenilis* (Öpik)	Uhaku	Väo; Kõrgekallas	
	Estonomena kalevi sp. nov.	Lasnamägi	Väo	
	? *Septomena senecta* sp. nov.	Lasnamägi	Väo	

APPENDIX

Type localities of the new species

Brief notes on the 19 type localities of the new species described in this monograph, followed by approximate latitude and longitude, stratigraphic position and references to the previous works where these localities are described are given below. The localities are numbered in ascending order according to their location, from the West to the East (Fig. 3). Most of these and other localities of the described species are included in the author's Dr. Sci. thesis in four volumes (Rõõmusoks, 1966), part of which is published (Rõõmusoks, 1970). A copy of the thesis is accessible at the Institute of Geology, University of Tartu. As the above studies are in Russian, more recent English descriptions of the sections are referred to, where available. Useful accounts on the Ordovician stratigraphy and on selected localities of Estonia and adjacent areas can be found in Rõõmusoks (1983), Männil and Meidla (1994), Kaljo and Nestor (1990), Raukas and Teedumäe (1997) and Hints and Ainsaar (2004).

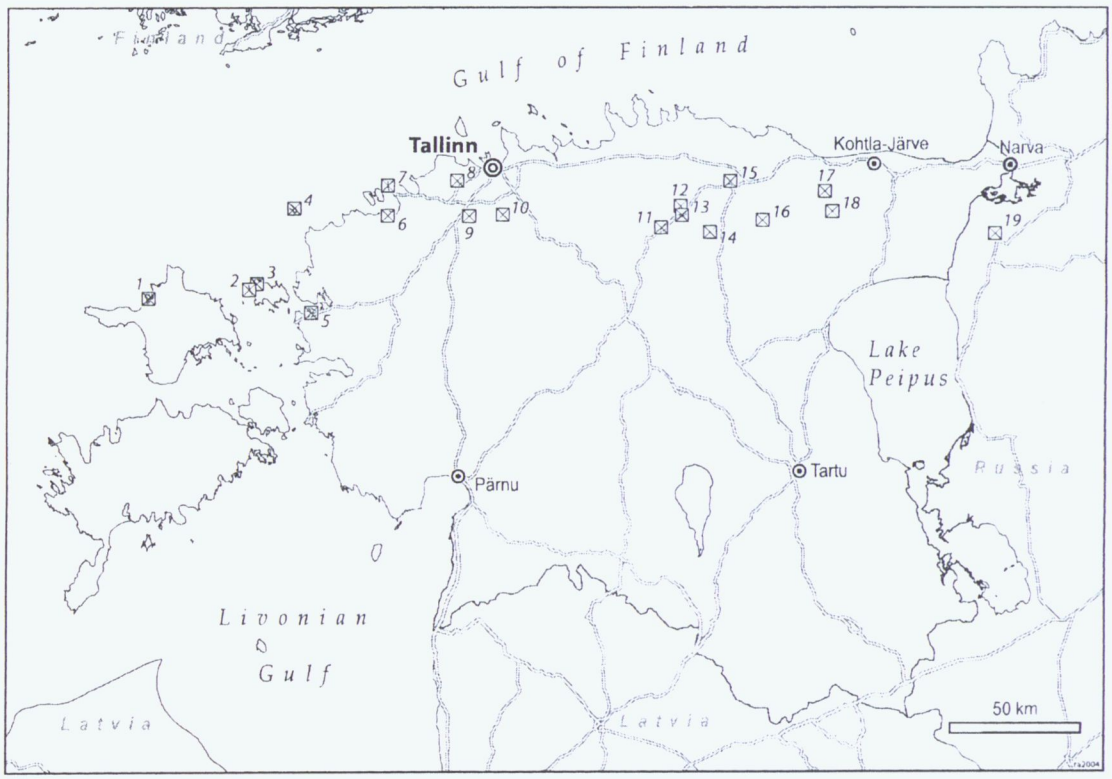


Figure 3. Map of type localities of new species. 1 – Kõrgessaare, Hiiumaa Island; 2 – Saxby, Vormsi Island; 3 – Kärrslätt, Vormsi Island; 4 – Osmussaar coast; 5 – Haapsalu Holm, erratics; 6 – Paekna-Põldmäe; 7 – Paldiski; 8 – Peetri hillock; 9 – Voore; 10 – Nõmmeküla; 11 – Taaldevälja; 12 – Tõrma; 13 – Moe; 14 – Porkuni quarry; 15 – Rakvere town; 16 – Küti; 17 – Soonurme ditch; 18 – Piilse river-bank; 19 – Bol´shiye Pol´ya (near Slantsy, Russia).

Brief descriptions of the localities

The localities on are numbered according to their location, from the West to the East.

1. Kõrgessaare, Hiiumaa Island (58°58′30″ N, 22°27′31″ E). The old, mostly overgrown Kõrgessaare Quarry is known as the stratotype of the Kõrgessaare Formation (Vormsi Stage). The moderately argillaceous bioclastic limestones exposed today to a thickness of 60 cm (Rõõmusoks, 1983, p. 132) yield *Leigerina hiiuensis* sp. nov.

2. Saxby, Vormsi Island (coastal outcrop between 59°00′36″ N, 23°07′13″ E and 59°01′35″ N, 23°07′07″ E). The outcrop extends over a distance of more than 1 km along the western coast of the Vormsi Island. The bioclastic limestones of the Kõrgessaare and Moe formations are exposed both below and above the sea level (Meidla, 1983; Meidla et al., 2001). The accessibility of strata is very much dependent on the water level. Usually some parts of the outcrop are buried under the pebbles and loose blocks due to wave action. The outcrops right at the lighthouse are referred to as the stratotype section of the Vormsi Stage. The boundary with the overlying Pirgu Stage is most likely present in the section as well, but this part of the succession is poorly exposed above the sea level. Type locality of *Saxbyonia fluctuosa* sp. nov.

3. Kärrslätt (Kersleti), Vormsi Island (59°01′48″ N, 23°10′16″ E). The old, completely overgrown quarry near the Kärrslätt village. Moderately argillaceous bioclastic limestones of the Kõrgessaare Formation (Vormsi Stage) were previously exposed. Type locality of *Similoleptaena pertenuis* sp. nov.

4. Osmussaar coast (coastal cliff between 59°17′15″ N, 23°24′53″ E and 59°17′37″ N, 23°24′09″ E). One of the coastal outcrops in the southern part of the island has yielded *Estonomena kalevi* sp. nov. from the limestone of the Kõrgekallas Formation (Uhaku Stage).

5. Haapsalu Holm, erratic boulders (approximate coordinates 58°56′ N, 23°32′ E). An old locality of erratic boulders in the northern part of the Haapsalu town. The boulders of bioclastic limestone have yielded *Similoleptaena planitia* sp. nov. Based on characteristic lithology, it is assumed that the limestone boulders originate from the Pirgu Stage.

6. Paekna-Põldmäe (59°15′48″ N, 24°02′27″ E). An old, small, currently abandoned quarry 300 m SW of the Nõmmeküla quarry, where the argillaceous limestones of the Paekna Formation (Nabala Stage) cropped out. Type locality of ?*Similoleptaena undosa* sp. nov.

7. Paldiski (59°22′00″ N, 24°02′27″ E). The coastal cliff north of the Paldiski town has been referred to by many authors. The southern part of the escarpment exposes the stratigraphical interval from the Hunneberg Stage to the Lasnamägi Stage. ?*Septomena senecta* sp. nov. was collected from the limestone of the lowermost Väo Formation (Lasnamägi Stage).

8. Peetri Hillock (59°22′05″ N, 24°30′11″ E). The bedrock elevation west of Tallinn with WW1 military installations (trenches and tunnels) where the limestones of the Kukruse and Haljala stages are well exposed. *Kukrusena peetriensis* sp. nov. was collected from the limestone of the Peetri Member of the Viivikonna Formation (Kukruse Stage).

9. Voore (59°15′36″ N, 24°34′55″ E). An old quarry in the northern part of the old manor park near Koppelmaa, about 6 km S of the Saue town. Micritic (cryptocrystalline) limestones of the Piilse Member of the Rägavere Formation (Rakvere Stage) were exposed in 1950s. Type locality of *Geniculina voorensis* sp. nov.

10. Nõmmeküla (59°15′50″ N, 24°48′23″ E). An old quarry east of Nabala, not far from the Paekna Quarry which is often referred to in literature. The quarry is formally regarded as the stratotype sections of the Nabala Stage. The quarry walls were formed of slightly argillaceous bioclastic limestone but are totally overgrown today, only the limestone floor is occasionally exposed. Type locality of *Geniculina ralfi* sp. nov.

11. Taaldevälja (59°12′30″ N, 25°51′40″ E). An old quarry in the Metsküla village, near the Taaldevälja country-house, 6 km S of the Nabala village. It exposes the limestone of the Nabala Stage. Type locality of ?*Bekkeromena ilmari* sp. nov., collected in late 1940s from the Saunja Formation of this locality.

12. Tõrma (59°16′50′′ N, 25°59′39′′ E). A small quarry east of Tapa, near the railway. Originally rather deep (up to 4 m) quarry of micritic (cryptocrystalline) limestone of the Saunja Formation (Nabala Stage) is today largely filled and exposure is rather poor. Type locality of *Holtedahlina subtilis* and ?*Similoleptaena crassorugata* sp. nov.

13. Moe (59°14′54′′ N, 26°00′08′′ E). An old quarry near a farm-house, in the field, close to the Moe village, SE of Tapa. Thick-bedded micritic limestone is exposed. This locality is known as the stratotype section of the Moe Formation (Pirgu Stage) (Rõõmusoks, 1983). Type locality of *Holtedahlina moensis* sp. nov. and ?*Bekkeromena infirma* sp. nov.

14. Porkuni quarry (59°11′15′′ N, 26°11′13′′ E). An old quarry near the Porkuni village is the most extensively studied outcrop of the Porkuni Stage. It exposes most of the Ärina Formation (except for the lowermost and uppermost parts of the unit) in a total thickness of 5.8 m (Hints & Oraspõld, 2004). The quarry was mentioned already by Schmidt (1897) and has repeatedly been referred to in the literature (for the most recent overview and former references see Hints et al., 2004). The old quarry was recently cleaned and is under nature protection. Type locality of ?*Similoleptaena friedrichi* sp. nov.

15. Rakvere town (the tentative coordinates of NE and SW corners of the area are (59°21′39′′ N, 26°19′56′′ E and 59°20′16′′ N, 26°23′14′′ E, respectively). Temporary excavations are occasionally dug in the Rakvere town for various reasons. *Geniculina vironiensis* sp. nov. was collected from one such excavation in the southern part of the town. The exact locality is unknown but the excavation reached the micritic (cryptocrystalline) limestone of the lower part of the Rägavere Formation (Rakvere Stage). Another new species from a temporary excavation in the Rakvere town, ?*Kurnamena palmrei*, has been found from a different level – from the Hirmuse Formation of the Oandu Stage.

16. Küti (59°13′20′′ N, 26°32′23′′ E). An old quarry, mostly overgrown today. It is one of the localities where the lower boundary of the Vormsi Stage was formerly exposed. Today, only the micritic (cryptocristalline) limestone of the topmost Saunja Formation (Nabala Stage) is exposed here. Type locality of *Bekkeromena vormsina* sp. nov.

17. Soonurme ditch (approximately 59°18′51′′ N, 26°57′32′′ E). A temporary exposure at the Soonurme village, where the limestone of the Vasavere Formation (Idavere Substage, Haljala Stage) was exposed in 1960s. Abandoned and not accessible today. Type locality of *Kurnamena acuta* sp. nov.

18. Piilse river-bank (59°14′35′′ N, 27°00′11′′ E). The right river bank next to the bridge in the Piilse village (Purtse River) is referred to as the type sections of the Piilse Member of the Rägavere Formation (Rakvere Stage). The section exposes rather monotonous micritic (cryptocrystalline) limestones of the lower part of the Rägavere Formation. Type locality of *?Similoleptaena tarwanpensis* sp. nov.

19. Bol′shiye Pol′ya, Plyussa River (59°08′14′′ N, 28°04′03′′ E). In the outcrop on the left bank of the Plyussa River, near the Bol′shiye Pol′ya village in Ingria (Leningrad Region, NW Russia), near the northern border of the Slantsy town, the limestone of the Hirmuse Formation (Oandu Stage) is exposed. Type locality of ?*Similoleptaena ingrica* sp. nov.

For further information, please contact the author and the editor at the Institute of Geology, University of Tartu, Estonia (Prof. Arvo Rõõmusoks, c/o Ivar Puura@ut.ee).

REFERENCES

Alichova, T.N. 1951. *Brachiopods from the middle and upper part of the Lower Silurian from the Leningrad Region and their stratigraphic significance*: 71 pp., 4 pl. Moscow, VSEGEI, Gosgeolizdat (in Russian).

Alichova, T.N. 1953. *Index brachiopod fauna of the Ordovician deposits of the northwestern part of the Russian Platform*: 164 pp., 2 pl. Moscow, VSEGEI, Gosgeolizdat (in Russian).

Bancroft, B.B. 1929. Some New Genera and Species of Strophomenacea from the Upper Ordovician of Shropshire. *Manchester Literary and Philosophical Society, Memoirs and Proceedings* 73(4): 33-65, 2 Pls.

Bekker, H. 1921. The Kuckers stage of the Ordovician rocks of NE Estonia. *Acta et Commentationes Univ. Dorpatensis* A 2(1): 1-92, 12 tab. Tartu.

Bekker, H. 1924. Mõned uued andmed Kukruse lademe stratigraafiast ja faunast. [Some new data on the stratigaphy and fauna of the Kukruse Stage.] *Acta et Commentationes Univ. Dorpatensis* A 6(1) 1: 1-20. Tartu. (in Estonian).

Bergström, J. 1968. Upper Ordovician brachiopods from Västergötland, Sweden. *Geologica et Palaeontologica* 2: 1-35, 7 pl.

Cocks, L.R.M & Rong, Yia-Yu, 2000. Strophomenida. In: *Kaesler, R. L. (ed.). Treatise on Invertebrate Paleontology. Part H (Brachiopoda, revised). Volume 2. Linguliformea, Craniiformea and Rhynchonelliformea (part)* 216-348. The Geological Society of America, Inc. and The University of Kansas.

Gagel, C. 1890. Die Brachiopoden der cambrischen und silurischen Geschiebe im Diluvium der Provinzen Ost- und Westpreussen. *Beitr. Naturk. Preuss.* 6, 1-79, 5 Taf. Königsberg, Koch.

Havlíček, V. 1967. Brachiopoda of the Suborder Strophomenidina in Czechoslovakia. *Rozpravy Ústředního Ústavu Geologického* 33: 1-235, 52 pl.

Hints, L. & Oraspõld, A. 2004. Porkuni quarry. In: Hints, O. and Ainsaar, L. 2004. *WOGOGOB-2004 Conference Materials. Tartu University Press*, Tartu: 127-128.

Hints, L. & Rõõmusoks, A. 1997. Ordovician articulate brachiopods. In: *Raukas, A., Teedumäe, A. (eds). Geology and Mineral Resources of Estonia*: 226-228. Tallinn, Estonian Academy Publishers.

Hints, O. and Ainsaar, L. 2004. *WOGOGOB-2004. 8th Meeting on the Ordovician Geology of Baltoscandia. Conference Materials.* Tartu University Press, Tartu, 141 pp.

Holtedahl, O. 1916. The Strophomenidae of the Kristiania Region. *Videnskapsselskapts Skrifter I, Mat.-Naturv. Klasse 1915* 12: 117 pp., 16 pl. Kristiania.

Hurst, J.M. 1979. The stratigraphy and brachiopods of the upper part of the type Caradoc of south Salop. *Bulletin of the British Museum (Natural History). Geology Series* 32(4): 183-304.

Jaanusson, V. 1945. Über die Stratigraphie der Viru – resp. Chasmops-Serie in Estland. *Geologiska Föreningens i Stockholm Förhandlingar* 67: 212-224.

Jaanusson, V. 1956. Untersuchungen über den oberordovizischen Lyckholm-Stufenkomplex in Estland. *Bull. Geol. Inst. Univ. Upsala* 36: 369-400.

Jaanusson, V. 1960. The Viruan (Middle Ordovician) of Öland. *Bulletin of the Geological Institutions of the University of Uppsala* 38: 207-288.

Jaanusson, V. 1963. Classification of the Harjuan (Upper Ordovician) rocks of the mainland of Sweden. *Geologiska Föreningens i Stockholm Förhandlingar* 85: 110-144.

Jaanusson, V. 1976. Faunal dynamics in the Middle Ordovician (Viruan) of Baltoscandia. In: *Bassett, M.G. (ed.). The Ordovician System. Proceedings of a Palaeontological Association Symposium*: 301-326. Cardiff, University of Wales Press and the National Museum of Wales.

Jaanusson, V. 1995. Confacies differentiation and upper Middle Ordovician correlation in the Baltoscandian basin. *Proceedings of the Estonian Academy of Sciences. Geology* 44: 73-86.

Kaljo D. and Nestor, H. (eds). 1990. *Field Meeting Estionia 1990. An Excursion Guidebook.* Tallinn, 209 pp.

Kaljo, D., Rõõmusoks, A. & Männil, R. 1958. On the series of the Baltic Ordovician and their significance. *Eesti NSV Teaduste Akadeemia toimetised. Tehniliste ja füüsikalis-matemaatiliste teaduste seeria* 1: 71-74. (in Russian).

Lamansky, W. 1905. The oldest strata of the Silurian deposits of Russia. *Trudy Geologicheskogo Komiteta. Novaya Seriya* 20: 203 pp. St. Petersburg (in Russian).

Macomber, R.W. 1970. Articulate brachiopods from the upper Bighorn Formation (Late Ordovician) of Wyoming. *Journal of Paleontology* 44(3): 416-450, pls. 75-80.

Meidla, T. 1983. Die Ostrakoden aus den Grenzschichten der Vormsi- und Pirgu-Stufen Westestlands. (in Russian, German summary). *Eesti NSV Teaduste Akadeemia toimetised. Geoloogia* 32: 53-59.

Meidla, T., Isakar, M. & Rõõmusoks, A. 2001. Vormsi saare aluspõhja geoloogia. [Bedrock geology of the Vormsi Island]. *Estonia Maritima* 5: 17-27. (in Estonian).

Männil, R. 1960. The stratigraphy of the Oandu ("Vasalemma") Stage. *Trudy instituta geologii AN ESSR* 5: 89-122 (in Russian).

Männil, R. 1966. *Evolution of the Baltic basin during the Ordovician*: 248 pp. Tallinn, Eesti Teaduste Akadeemia Geoloogia Instituut, Valgus (in Russian).

Männil, R. 1990. The Ordovician of Estonia. In: *Kaljo, D. & Nestor, H. (eds). Field Meeting Estonia 1990. An Excursion Guidebook*: 11-20. Tallinn, Estonian Academy of Sciences.

Männil, R. & Meidla, T. 1994. The Ordovician System of the East European Platform (Estonia, Lithuania, Byelorussia, Parts of Russia, the Ukraine and Moldova). *IUGS Publications* 28: 1-52.

Meidla, T. & Ainsaar, L. 2004. On the Ordovician System in Estonia. In: *Hints, O. & Ainsaar, L. WOGOGOB-2004. 8th Meeting of the Working Group of the Ordovician Geology of Baltoscandia. May 13-18, 2004, Tallinn and Tartu, Estonia.* Tartu University Press, Tartu: 107-111.

Mitchell, W.I. 1977. The Ordovician Brachiopoda from Pomeroy, Co. Tyrone. *Palaeontographical Society Monographs*: 138 pp., 28 pls. London.

Muir-Wood, H. & Williams, A. 1965. Strophomenida. In: *Moore, R.C. (ed.). Treatise on Invertebrate Paleontology* 1: H361-H521. The Geological Society of America, Inc. and The University of Kansas Press.

Murchison, R.I., Verneuil, E. & Keyserling, A. 1845. *Géologie de la Russie d'Europe et des montagnes l'Oural. Vol. II. Paléontologie*: 511 p., Pl. 1-43, Pl. A-G. Londres, Paris.

Oraspõld, A. 1956. New brachiopods from the Jõhvi, Keila and Vasalemma stages. *Trudy instituta geologii AN ESSR* 1: 41-67, 2 plates (in Russian).

Orviku, K. 1940. Lithologie der Tallinna-Serie (Ordovizium, Estland). *Acta et Commentationes Univ. Dorpatensis* A 36(1): 216 S., 33 tab. Tartu.

Öpik, A. 1930a. Brachiopoda Protremata der estländischen ordovizischen Kukruse-Stufe. *Acta et Commentationes Univ. Dorpatensis* A 17 (1): 238 S., 22 tab. Tartu.

Öpik, A. 1930b. Beiträge zur Kenntnis der Kukruse- (C_2- C_3) Stufe in Eesti. *Acta et Commentationes Universitatis Dorpatensis.* A 19 (2): 34 S., 6 tab. Tartu.

Öpik, A. 1937. The geology of the environs of Porkuni-Tamsalu. *Eesti Loodus* 2: p. 52, Fig. 31 (in Estonian).

Pander, C. 1830. *Beiträge zur Geognosie des Russischen Reiches*: 165 S., 31 Taf. St. Petersb.

Pope, J.K. 1976. Comparative morphology and shell histology of the Ordovician Strophomenacea (Brachiopoda). *Palaeontographica Americana* 8(49): 125-213.

Puura, V. & Vaher, R. 1997. Cover structure. In: *Raukas, A., Teedumäe, A. (eds). Geology and Mineral Resources of Estonia*: 167-177. Tallinn, Estonian Academy Publishers.

Raukas, A., Teedumäe, A. (eds). 1997. *Geology and Mineral Resources of Estonia*. Tallinn, Estonian Academy Publishers: 436 pp.

Remane, J. 2003. Chronostratigraphic correlations: their importance for the definition of geochronologic units. *Palaeogeography, Palaeoclimatology, Palaeoecology* 196: 7-18.

Roemer, F. 1861. Bericht über eine geologische Reise nach Russland im Sommer 1861. [Durch Livland, Estland und Ingermannland.] *Z. Dtsch. Geol. Ges.* 34:178-233.

Rong, Yia-Yu & Cocks, L.R.M. 1994. True *Strophomena* and a revision of the classification and evolution of the strophomenoid and 'strophodontoid' brachiopods. *Palaeontology* 37(3): 651-694.

Rõõmusoks, A., 1956. *Luhaia*, a new strophomenid genus from the Upper Ordovician of Estonia. *Doklady Akademii Nauk SSSR* 106(6): 1091-1092 (in Russian).

Rõõmusoks, A. 1963. Strophomenoidea of the Ordovician and Silurian of Estonia II. New genera and species from the Harju Series. *Proceedings of the Academy of Sciences of the Estonian SSR. Biology* 12(3): 231-241 (in Russian).

Rõõmusoks, 1966. Stratigraphy of the Viru and Harju series (Ordovician) in northern Estonia. Doctoral dissertation. University of Tartu, Tartu, Parts I-IV, 953 pp. (MS in Russian).

Rõõmusoks, A. 1970. *Stratigraphy of the Viruan Series (Middle Ordovician) in northern Estonia*: 346 pp. (in Russian). Tallinn, Valgus.

Rõõmusoks, A. 1983. *Eesti aluspõhja geoloogia.* Tallinn, Valgus, 1983, 224 pp. (in Estonian).

Rõõmusoks, A. 1985. The genera *Trigrammaria* and *Microtrypa* (Strophomenidae) in the Ordovician of Baltoscandia. *Proceedings of the Academy of Sciences of the Estonian SSR. Geology* 34(4): 133-140. (in Russian).

Rõõmusoks, A. 1989. Über die Divergenz der *Leptaenidae* (Brachiopoda) in der Viru- und Harju-Zeit in Baltoskandia. *Proceedings of the Academy of Sciences of the Estonian SSR. Geology* 38(3): 112-117.

Rõõmusoks, A. 1991. On the stratigraphy and fauna of the boundary beds between the Pirgu and Porkuni stages of North Estonia. *Acta et Commentationes Univ. Tartuensis* 934: 23-42 (in Russian).

Rõõmusoks, A. 1993a. Four new brachiopod genera of the superfamily Oepikinae (Strophomenacea) from the Ordovician of Estonia. *Proceedings of the Academy of Sciences of the Estonian SSR. Geology* 42(2): 48-57.

Rõõmusoks, A. 1993b. Some brachiopod genera of the superfamily Strophomeninae from the Ordovician of Estonia. *Proceedings of the Academy of Sciences of the Estonian SSR. Geology* 42(3): 110-117.

Rõõmusoks, A. 1993c. A review of Estonian Ordovician Rafinesquinids (Brachiopoda, Strophomenacea). *Proceedings of the Academy of Sciences of the Estonian SSR. Geology* 42(4): 160-166.

Salmon, E.S. 1942. Mohawkian Rafinesquinae. *Journal of Paleontology* 16: 564-603.

Schmidt, F. 1858. Untersuchungen über die silurische Formation von Ehstland, Nord-Livland und Oesel. *Archiv für Naturkunde Liv-, Ehst- und Kurlands. Erste Serie. Mineralogische Wissenschaften, nebst Chemie, Physik und Erdbeschreibung. Zweiter Band*: 1-248. Druck von Heinrich Laakmann, Dorpat.

Schmidt, F. 1881. Revision der ostbaltischen silurischen Trilobiten nebst geognostischer Übersicht des ostbaltischen Silurgebiets. Abteilung I. Phacopiden, cheiruriden und Encrinuriden. *Mémoires de l'Académie Impériale des Sciences de St.-Pétersbourg, 7e Série* 30(1): 1-237. St. Pétersbourg.

Schmidt, F. 1897. *Excursion durch Estland.* St.-Petersburg: 1-21.

Schmidt, F. 1908. Beitrag zur Kenntnis der ostbaltischen, vorzüglich untersilurischen, Brachiopoden der Gattungen *Plectambonites* Pand., *Leptaena* Dalm. und *Strophomena* Blainv. *Bull. Acad. Sci. St.-Pétersb., sér. 6,* 2: 717-726.

Sildvee, H. & Vaher, R. 1995. Geological structure and seismicity of Estonia. *Proceedings of the Estonian Academy of Sciences* 44(1): 15-25.

Sokolskaya, A.N. 1954. Strophomenids of the Russian Platform. *Trudy paleontol. Instituta AN SSSR* 51: 192 pp. (in Russian).

Spjeldnæs, N. 1957. The Middle Ordovician of the Oslo Region. Norway. 8. Brachiopods of the Suborder Strophomenida. *Norsk Geologisk Tidsskrift* 37: 1-214, 14 pl.

Vaher, R., Winterhalter, B., Mägi, S. and Põlma, L. 1992. Sedimentary cover. In: Raukas, A. and Hyvärinen, H. (eds). *Geology of the Gulf of Finland.* Tallinn: 30-37. (in Russian).

Verneuil, E. de. 1845. – see Murchison, Verneuil & Keyserling, 1845.

Webby, B. 1998. Steps toward a global standard for Ordovician stratigraphy. *Newsletters on Stratigraphy* 36(1): 1-34.

Williams, A. 1965. – see Muir-Wood & Williams, 1965.

PLATES

Figures 1–6. *Actinomena orta* (Öpik); p. 12
Kukruse Stage, Viivikonna Formation, Kiviõli Member.
1 – Lectotype, TUG 72-104 [= GMUT Br 1504; Rõõmusoks, 1993 b, pl. I, fig. 7; Cocks & Rong, 2000; textfig. 136,1c]. Ventral valve interior, x 2. Kohtla quarry, collected by A. Öpik.
2–3 – TUG 72-124 [= GMUT Br 1502; Rõõmusoks, 1993 b, pl. I, fig. 3-4]. Ventral valve lateral and posterior views, x 2. Kohtla quarry, collected by A. Öpik.
4 – TUG 1003-93 [= GMUT Br 1515; Rõõmusoks, 1993 b, pl. I, fig. 8]. Ventral valve interior, x 4.4. Küttejõu quarry, collected by A. Rõõmusoks, 1964.
5 – TUG 1054-133 [= GMUT 201 (133); Öpik, 1930, pl. X, fig. 133; Rõõmusoks, 1993 b, pl. I, fig. 1; Cocks & Rong, 2000; textfig. 136,1a]. Dorsal valve exterior, x 2. Kohtla quarry, collected by A. Öpik.
6 – TUG 47-307 [= GMUT Br 2401; Oraspõld, 1956, pl. III, fig. 6; Rõõmusoks, 1993 b, pl. I, fig. 9]. Dorsal valve interior, x 3. Kohtla quarry, collected by A. Öpik.

Figure 7. ? *Actinomena* sp.; p. 12
Nabala Stage, Saunja Formation.
TUG 54-27. Ventral valve exterior, x 2.7 Tõrma exposure, collected by A. Rõõmusoks and D. Kaljo, 1954.

Figures 8–12. *Keilamena occidens* (Oraspõld); p. 14
Keila Stage, Kahula Formation.
8 – Holotype, TUG 43-147 [= GMUT Br 3091; Oraspõld, 1956, pl. III, fig. 7; Rõõmusoks, 1993 b, pl. III, fig. 5; Cocks & Rong, 2000; textfig. 155,3b]. Ventral valve interior, x 1. Keila quarry, collected by R. Männil.
9 – TUG 47-425 [= GMUT Br 2380; Oraspõld, 1956, pl. III, fig. 9; Rõõmusoks, 1993 b, pl. III, fig. 1]. Dorsal valve interior, x 1. Kulna exposure.
10–11 – TUG 74-40 [= GMUT Br 2390; Rõõmusoks, 1993 b, pl. III, figs 3-4]. Dorsal valve interior, x 2 and posterior view, x 4.2. Jälgimägi exposure, collected by A. Oraspõld, 1951.
12 – TUG 665-129. Ventral valve exterior, x 2. Kehra (Lilli) exposure, collected by A. Wahl.

Figures 13–14. *Strophomena planumbona* (Hall); p. 14, 18
Richmond. Ohio, North America, collected by A. Boucot, 1961.
13 – TUG 1012-3. Dorsal valve interior, x 2;
14 – TUG 1012-2. Ventral valve interior, x 2.

PLATE I

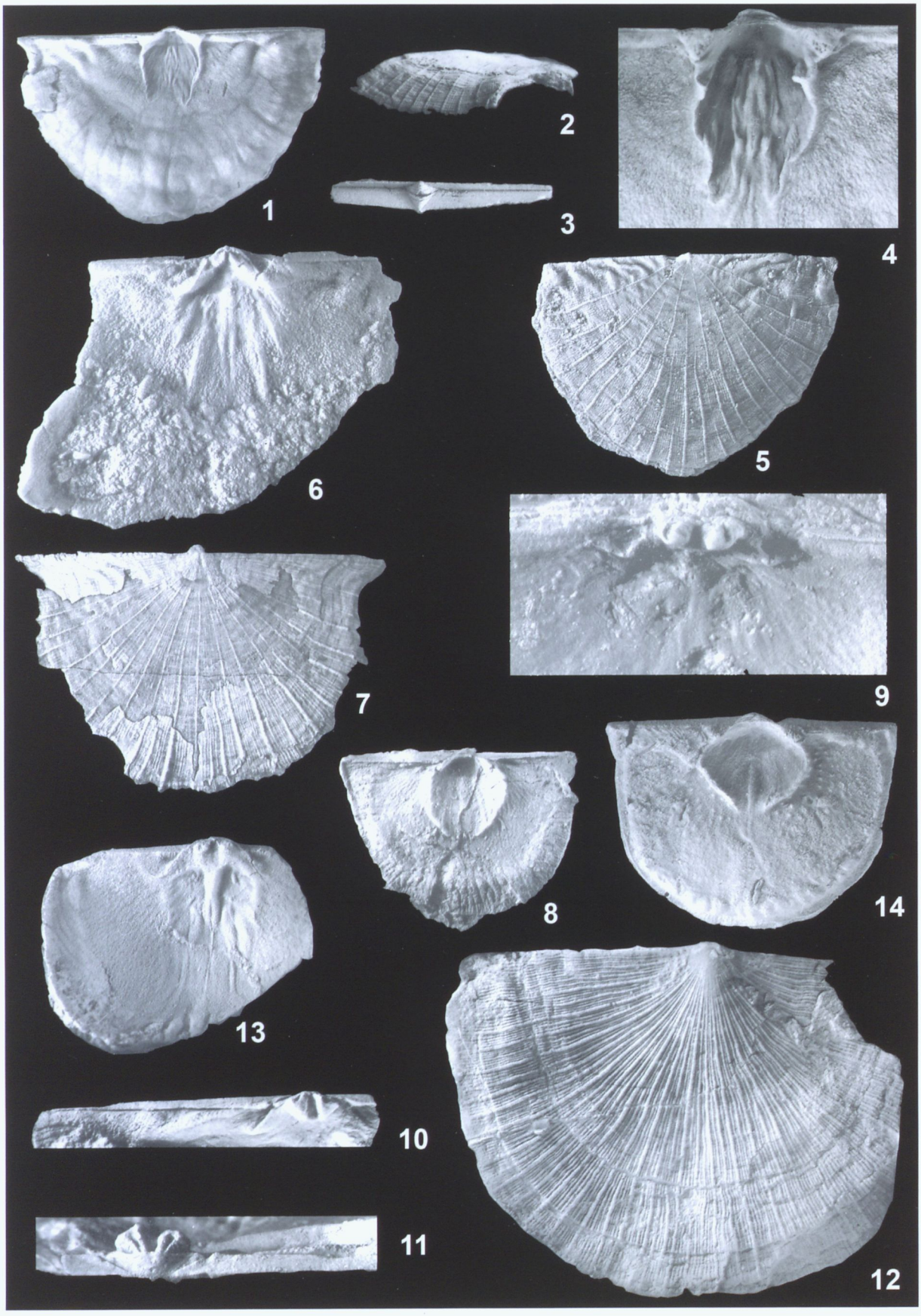
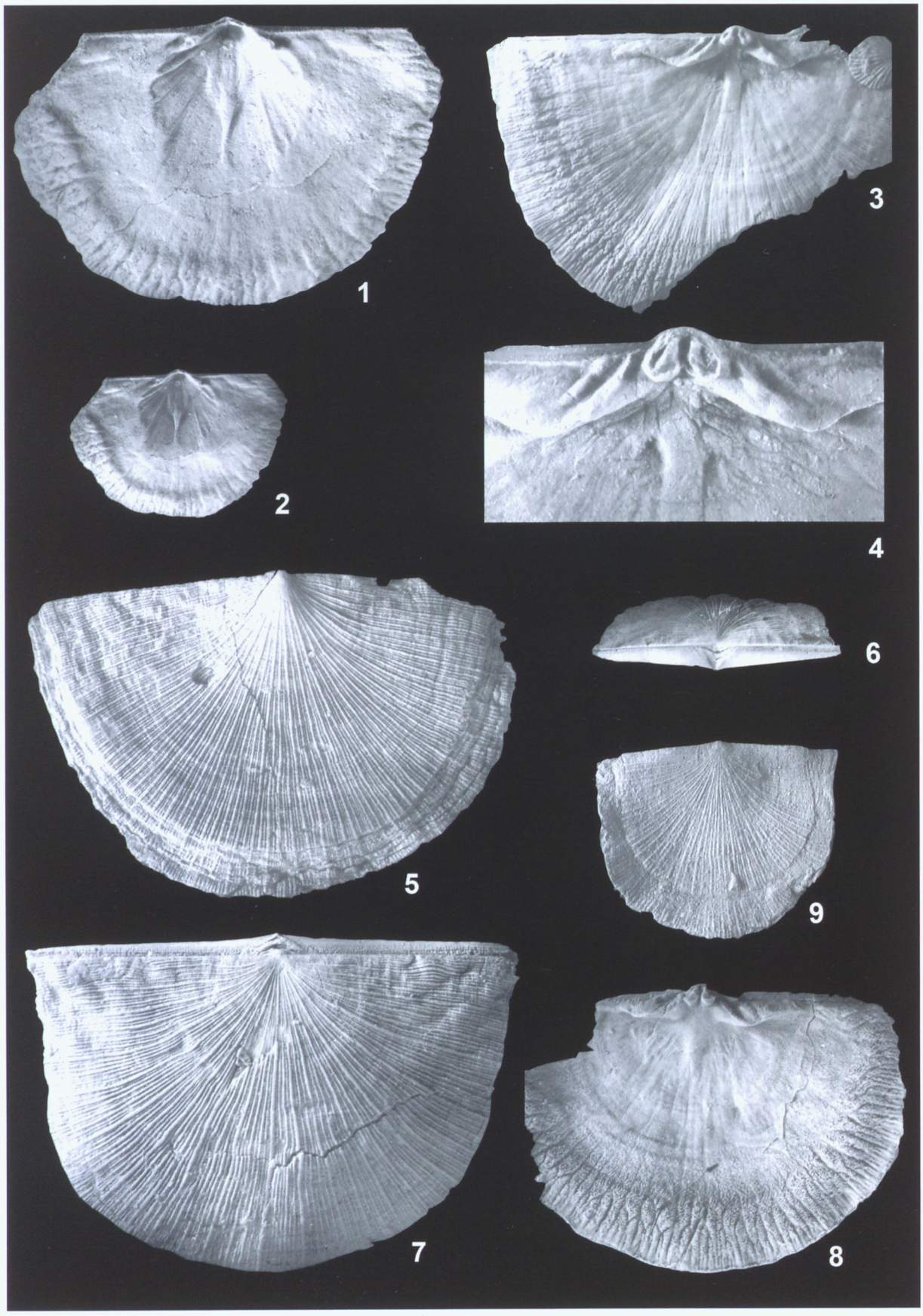


Plate II

Figures 1–8. *Longvillia asmusi* (Verneuil); p. 15
Keila Stage, upper Kahula Formation.
1–2 – TUG 72-136 [= GMUT Br 3093; Oraspõld, 1956, pl. III, fig. 4]. Ventral valve interior, x 2 and x 1. Town of Rakvere, collected by A. Öpik.
3–4 – TUG 665-127. Dorsal valve interior, x 1.8 and x 5. Kehra (Lilli) exposure, collected by A. Wahl.
5 – Neotype, TUG 665-131. Ventral valve exterior, x 2. Kehra (Lilli) exposure, collected by A. Wahl.
6–7 – TUG 47-428. Posterior view, x 1 and dorsal valve exterior, x 2. Town of Rakvere. Old collection.
8 – TUG 1068-3 [= Öpik, 1934, pl. XXX, fig. 4; = GMUT Br 2393 Oraspõld, 1956, pl. III, fig. 5]. Dorsal valve interior, x 2. Town of Rakvere, collected by A. Öpik.

Figure 9. *Strophomena planumbona* (Hall); p. 14, 18
Richmond.
TUG 1012-4. Ventral valve exterior, x 2. Ohio, 4.6 miles south of Camden, collected by A. Boucot.

PLATE II



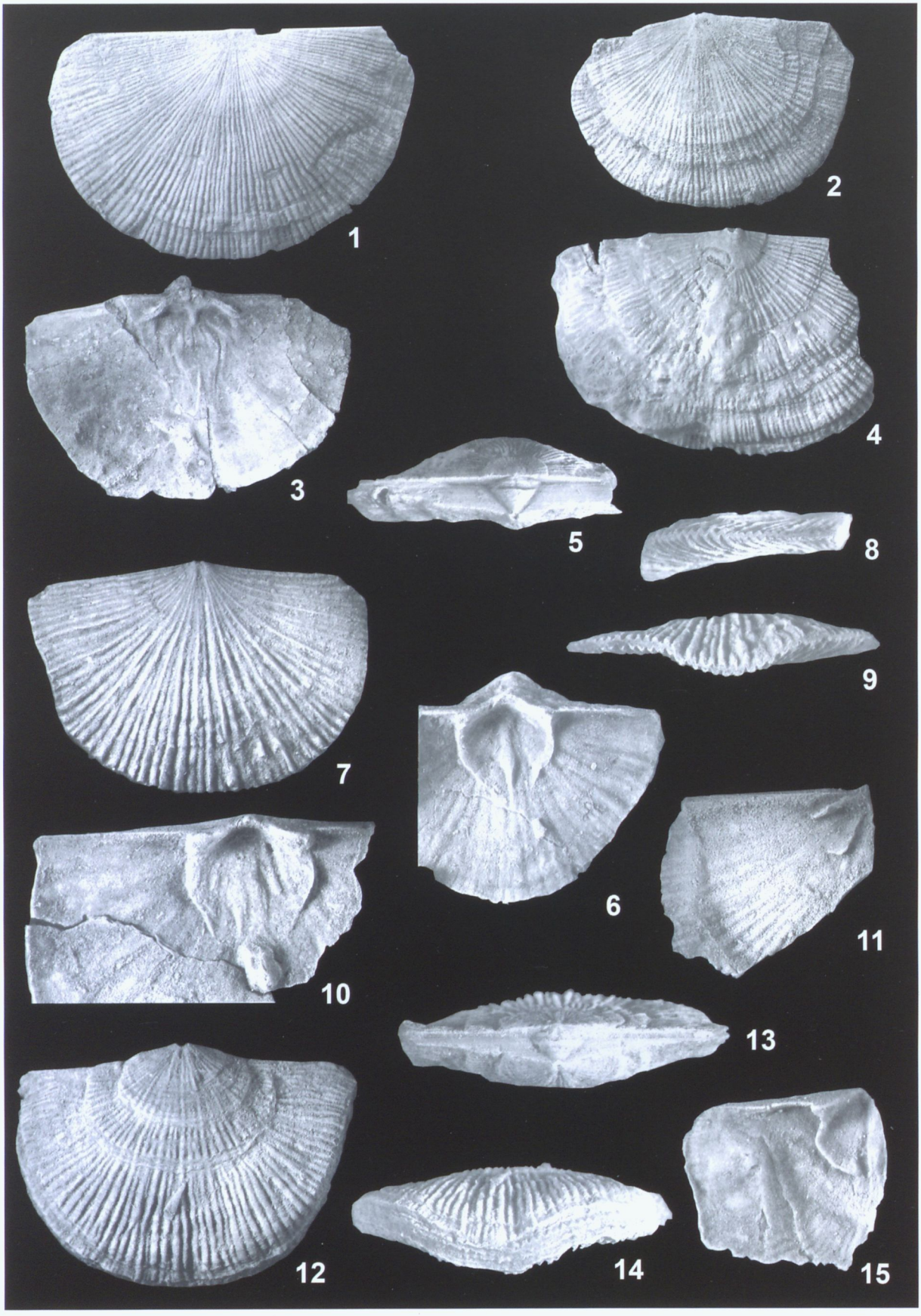
Figures 1–3. *Holtedahlina sakuensis* Oraspõld; p. 16
Oandu Stage, Hirmuse Formation, Saku Member.
1 – Holotype, TUG 74-9 [= GMUT Br 2372; Oraspõld, 1956, pl. IV, figs 3-5]. Dorsal valve exterior, x 3. Saku exposure, collected A. Oraspõld, 1951.
2 – TUG 74-7. Ventral valve exterior, x 2.6. Saku exposure (upper beds), collected by A. Oraspõld, 1951.
3 – TUG 47-322. Dorsal valve interior, x 2.7. Voore ditch at Kopelmaa (uppermost beds), collected by an expedition in 1961.

Figures 4–6. *Holtedahlina rakverensis* Oraspõld; p. 16
Rakvere Stage, Rägavere Formation, Piilse Member.
4–5 – Holotype, TUG 72-133 [= GMUT Br 3069; Oraspõld, 1956, pl. IV, figs 6-6a]. Ventral valve exterior, x 4.4 and ventral valve posterior view, x 2.1. Rägavere, town of Rakvere, collected by A. Öpik.
6 – TUG 242-6. Ventral valve interior, x 4.3. Rägavere exposure, collected by G. Mechmershausen.

Figures 7–11. *Holtedahlina subtilis* sp. nov.; p. 17
Nabala Stage, Saunja Formation.
7–9 – Holotype, TUG 72-130. Ventral valve exterior, x 7.3, right lateral view, x 3.9 and anterior view, x 5. Tõrma exposure, collected by A. Öpik.
10 – TUG 72-132. Ventral valve interior, x 4.6. Tõrma exposure, collected by A. Öpik.
11 – TUG 72-131. Fragmentary dorsal valve interior, x 4.6. Tõrma exposure, collected by A. Öpik.

Figures 12–15. ? *Holtedahlina moensis* sp. nov.; p. 17
Pirgu Stage, Moe Formation.
12–14 – Holotype, TUG 3-547. Ventral valve exterior, x 4.2, posterior view, x 4.1 and anterior view, x 4. Moe exposure, collected by A. Wahl.
15 – TUG 72-129. Fragmentary ventral interior, x 6. Moe exposure, collected by A. Öpik.

PLATE III

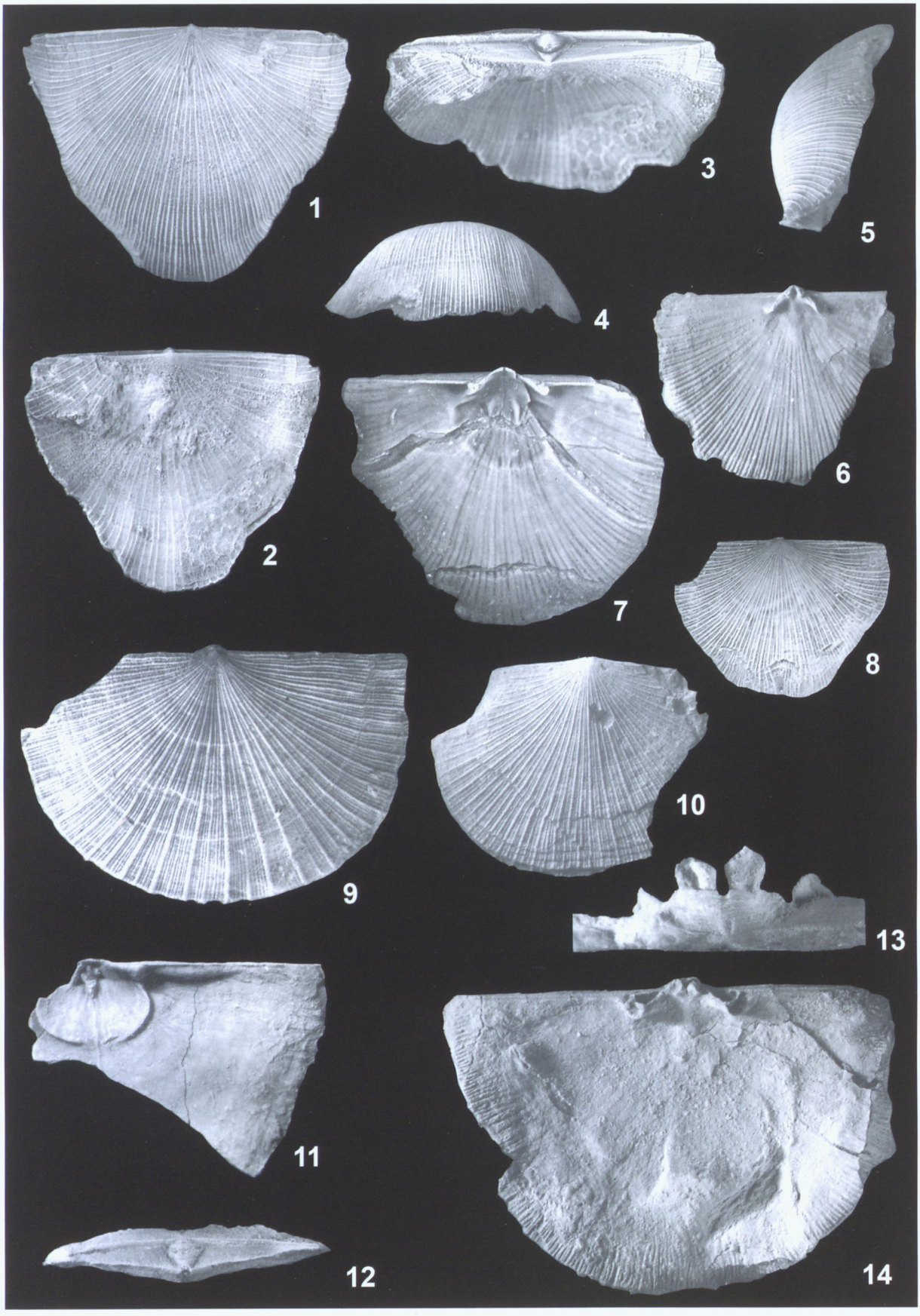


Figures 1–7. *Pseudostrophomena reclinis* Rõõmusoks; p. 18
Rakvere Stage, Rägavere Formation, Piilse Member.
1–5 – Holotype, TUG 74-118 [= GMUT Br 1252; Rõõmusoks, 1963, pl. II, figs 1–4; Williams & Brunton, 2000, p. 676, fig. 488, 1a–1d]. Dorsal valve exterior, x 1.8, ventral valve exterior, x 1.7, posterior view, x 1.9, anterior view, x 1.5 and left lateral view, x 1.4. Kaarli exposure, collected by A. Oraspõld and I. Elvre, 1948.
6 – TUG 102-46 [= GMUT Br 1251; Rõõmusoks, 1963; pl. II, fig. 6]. Dorsal valve interior, x 3.6. Town of Rakvere, collected by H. Palmre.
7 – TUG 74-119 [= GMUT Br 1254; Rõõmusoks, 1963; pl. II, fig. 7]. Ventral valve interior, x 1.8. Rägavere exposure, collected by A. Oraspõld.

Figure 8. ? *Pseudostrophomena* sp.; p. 18
Oandu Stage, Hirmuse Formation
TUG 72-236. Dorsal valve exterior, x 1.5. Exposure at Oandu river, collected by A. Öpik.

Figures 9–14. *Leigerina hiiuensis* sp. nov.; p. 19
Vormsi Stage, Kõrgessaare Formation.
9 – Holotype, TUG 1003-109. Dorsal valve exterior, x 2.1. Hiiumaa Island, Kõrgessaare exposure, collected by A. Rõõmusoks, 1975.
10 – TUG 42-65. Ventral valve exterior, x 1.9. Hiiumaa Island, Kõrgessaare exposure, collected by F. Schmidt and A. Harder.
11 – TUG 42-61. Ventral valve interior, x 1.8. Hiiumaa Island, Kärdla exposure, collected by F. Schmidt.
12 – TUG 50-30. Conjoined valves, posterior view, x 2. Hiiumaa Island, Kõrgessaare exposure, collected by E. Möls, 1946.
13 – TUG 50-28. Dorsal valve interior, posterior view, x 3.6. Hiiumaa Island, Kõrgessaare exposure, collected by E. Möls, 1946.
14 – TUG 106-20. Dorsal valve interior, x 1.6. Kohila exposure, collected by D. Kaljo, 1952.

PLATE IV



Figures 1–6. *Saxbyonia fluctuosa* sp. nov.; p. 20
Vormsi Stage, Kõrgessaare Formation.

1–3 – Holotype, TUG 80-132. Dorsal valve exterior, x 1.2; posterior view, x 1.7 and anterior view, x 1.3. Vormsi Island, Saxby coast, collected by V. Jaanusson, 1939.

4 – TUG 42-100 [= GMUT Br 1546, Rõõmusoks, 1993c, pl. III, fig. 8]. Dorsal valve interior, x 1.7. Kohila exposure, collected by F. Schmidt.

5 – TUG 50-24. Ventral valve interior, x 1.7. Hiiumaa Island, Kõrgessaare, collected by E. Möls, 1946.

6 – TUG 42-103 [= GMUT Br 1477, Rõõmusoks, 1993c, pl. III, fig. 9]. Ventral valve exterior, x 1.1. Hiiumaa Island, Kõrgessaare, collected by F. Schmidt.

Figures 7–12. *Rugomena adilensis* Rõõmusoks; p. 22
Pirgu Stage, Ärina Formation.

7–8 – Holotype, TUG 950-8 [= GMUT Br 1529, Rõõmusoks, 1993b, pl. IV, fig. 2]. Dorsal valve exterior and anterior view x 1. Vardi (erratic), collected by G. Pahnsch.

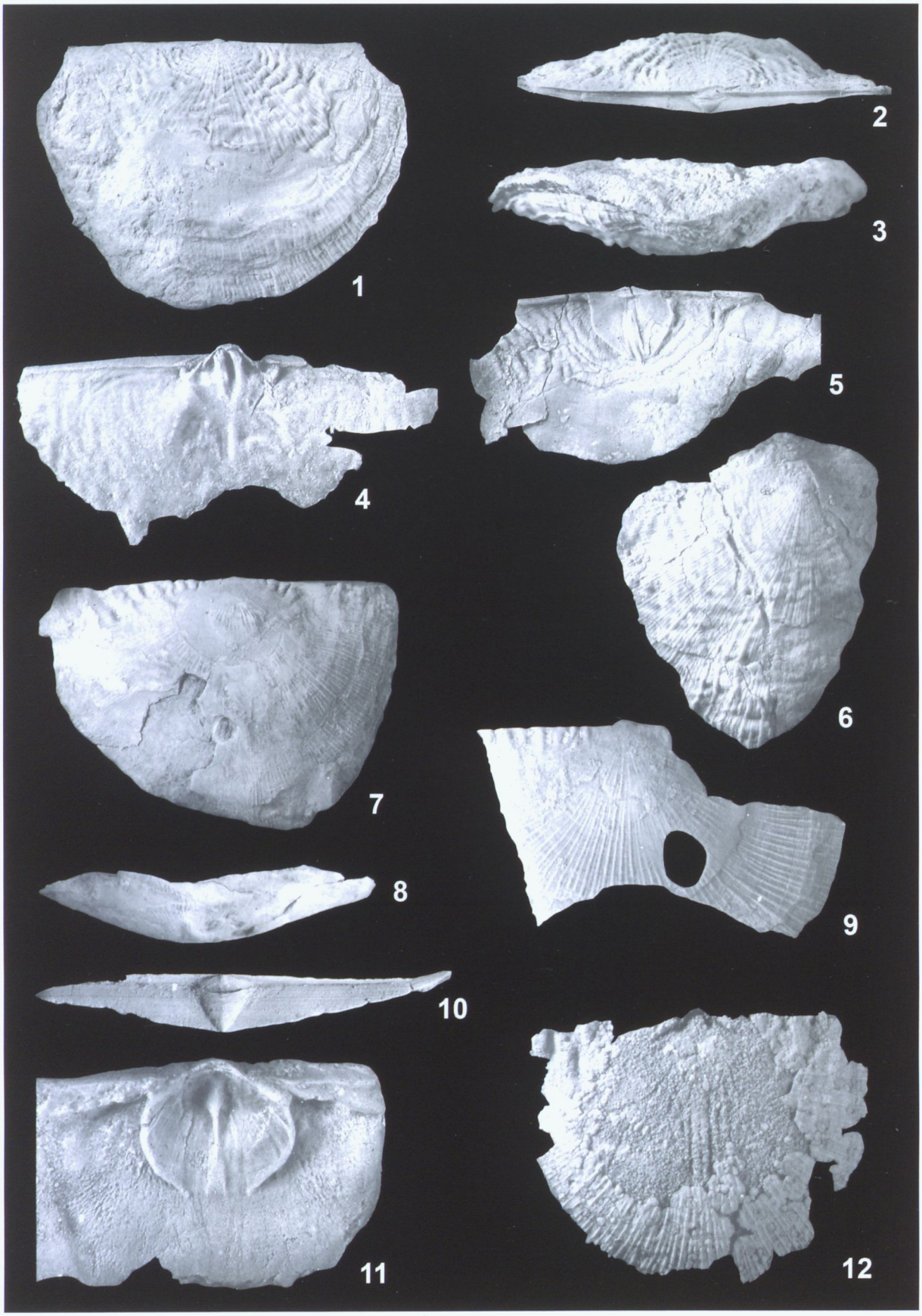
9 – TUG 46-28 [= GMUT Br 1532; Rõõmusoks, 1993b, pl. IV, fig. 8]. Ventral valve exterior, x 2. Town of Haapsalu, Holm (erratic), collected by K. Orviku, 1937.

10 – TUG 107-18 [= GMUT Br 1533, Rõõmusoks, 1993b, pl. IV, fig. 4]. Posterior view, x 2.2. Town of Haapsalu, Holm (erratic) collected by V. Reimer.

11 – TUG 950-9 [= GMUT Br 1531; Rõõmusoks, 1993b, pl. IV, fig. 6]. Ventral valve interior, x 2.5. Vardi (erratic), collected by G. Pahnsch.
Pirgu Stage, Adila Formation, Röa Member.

12 – TUG 1003-148 [= GMUT Br 1535; Rõõmusoks, 1993b, pl. IV, fig.7]. Dorsal valve interior mould, x 2.1, Röa railway-side excavation, collected by A. Rõõmusoks, 1975.

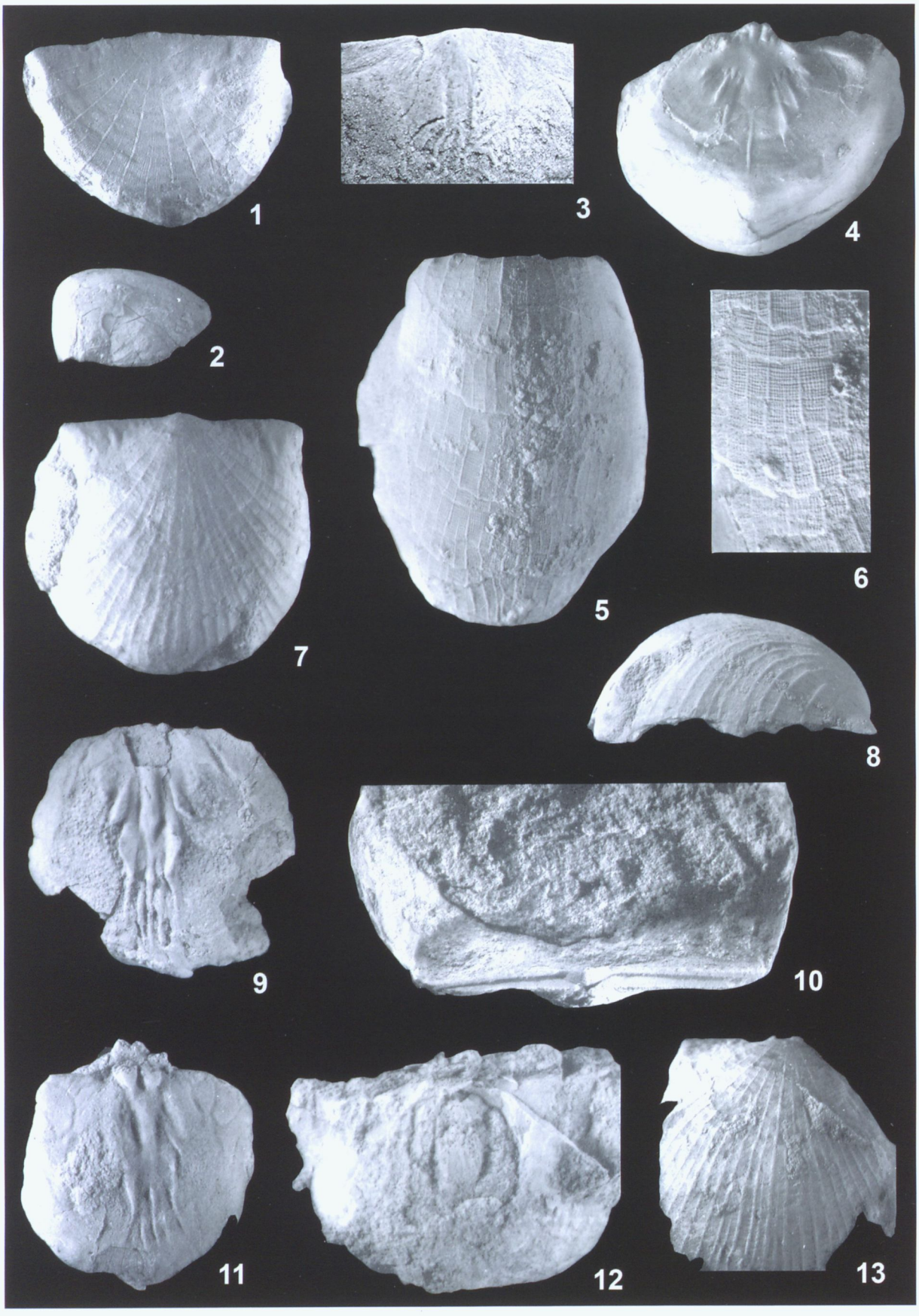
PLATE V



Figures 1–6. *Panderites imbrex* (Pander); p. 24
Aseri Stage, Kandle Formation.
1 – RM Br 74561 [= Cocks & Rong, 2000; textfig. 143,4a]. Disk of ventral valve, x 2. Pulkovo, Ingria (Leningrad District), NW Russia, old collection.
2 – RM Br 74531. Left lateral view, x, 1. Pulkovo, Ingria (Leningrad District), NW Russia, old collection.
3 – TUG 2-289. Ventral valve internal mould, x 4. Pavlovsk, St. Petersburg area, Russia, old collection.
4 – RM Br 131660 [= Rõõmusoks, 1993a; pl. I, fig 4; Cocks & Rong, 2000; textfig. 143, 4c]. Dorsal valve interior, x 2. Popovka, Ingria, NW Russia, old collection.
5–6 – Neotype, TUG 2-288 [= GMUT Br 1583; Rõõmusoks, 1993a; pl. I, fig. 2]. Ventral valve exterior, x 2 and ornament, x 3. Pavlovsk, Ingria, NW Russia, old collection.

Figures 7–13. *Tallinnites imbrexoidea* (Sokolskaya); p. 25
Uhaku Stage Kõrgekallas Formation.
7–8 – TUG 1003-236 [= GMUT Br 1572; Rõõmusoks, 1993a; pl. II, figs 1.2; Cocks & Rong, 2000; textfig. 144, 3a] ventral valve exterior, x 2; and right lateral view, x 2.3. Ditch at Kohtla-Järve. Erra Member, collected by A. Rõõmusoks, 1966.
9 – TUG 1003-240. Dorsal valve interior, x 1.6. Ditch at Kõrgekallas, Purtse river-bank, Koljala Member, collected by A. Rõõmusoks, 1960.
10 – TUG 1003-239. Posterior view of conjoined valves, x 2.2. Ditch between Kohtla-Järve and Erra. Koljala Member, collected by A. Rõõmusoks, 1964.
11 – TUG 1003-237. Dorsal valve interior, x 2. Lasnamägi quarry in the town of Tallinn. Erra Member, collected by A. Rõõmusoks and V. Nurm, 1949.
12 – TUG 97-2 [= GMUT Br 1617; Rõõmusoks, 1993a; pl. II, fig. 3]. Ventral valve internal mould, x 2.2. Loo exposure, collected R. Usar, 1953.
Uhaku Stage, upper Väo Formation.
13 – TUG 46-144. Ventral valve exterior, x 2. Osmussaar Island, northern bank, collected K. Orviku, 1927.

PLATE VI

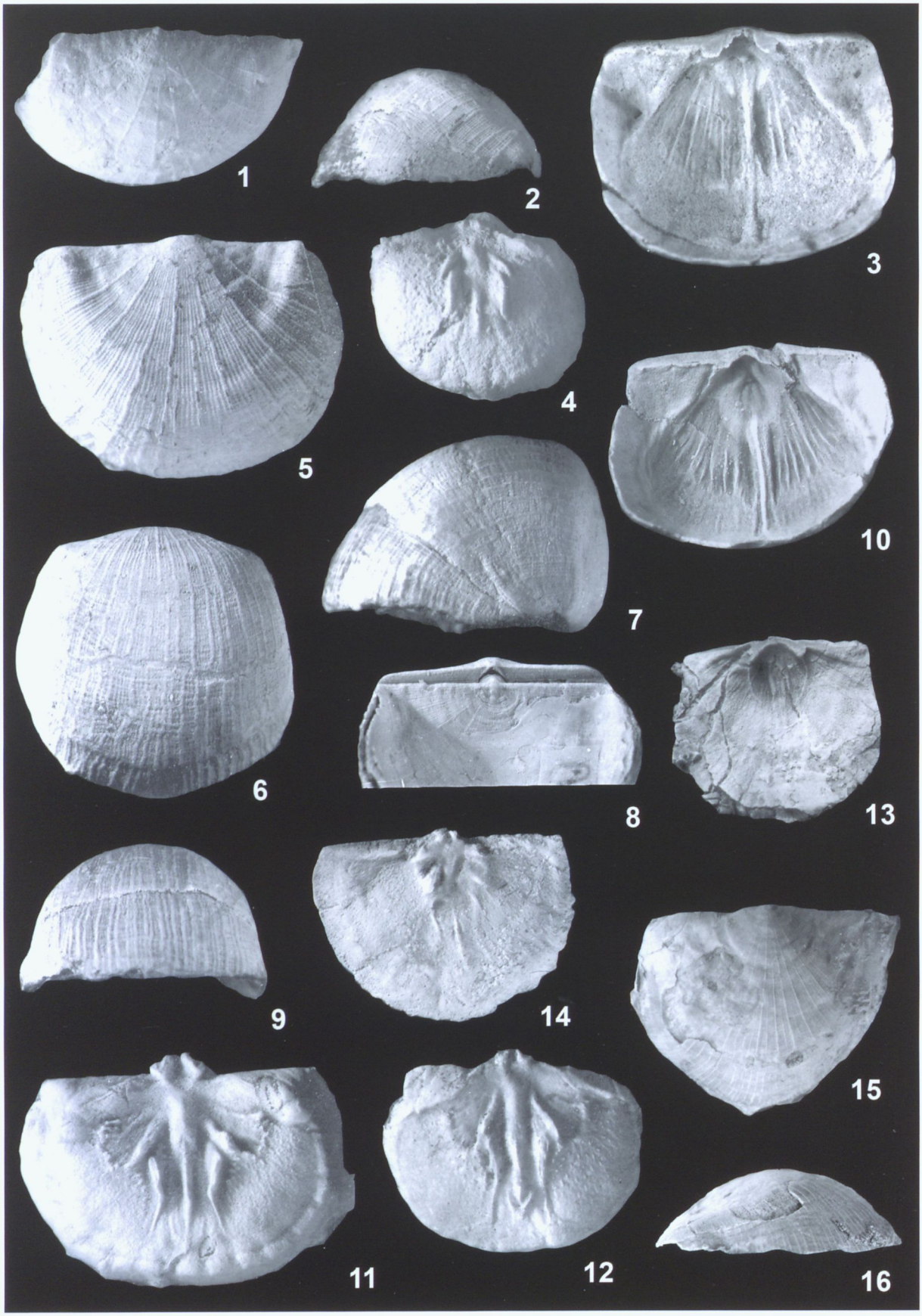


Figures 1–5. *Bekkerina raricostellata* Rõõmusoks; p. 27
Uhaku Stage, Väo and Kõrgekallas formations.
1–2 – Holotype, TUG 1003-24 [= GMUT Br 1579; Rõõmusoks 1993a, pl. I, figs 7, 8]. Ventral valve exterior, x 4; right lateral view, x 4. Kiviõli-Erra ditch, Koljala Member; collected by A. Rõõmusoks, 1964.
3 – TUG 2-282. Ventral valve interior, x 4.3. Erra river. Koljala Member; old collection.
4 – TUG 2-281. Dorsal valve interior, x 4. Lasnamägi quarry, town of Tallinn. Kõrgekallas Formation; old collection.
5 – TUG 1003-29. Ventral valve exterior, x 4. Küttejõu quarry, Kõrgekallas Formation, Erra Member; collected by A. Rõõmusoks, 1964.

Figures 6–12. *Bekkerina dorsata* (Bekker); p. 26
Kukruse Stage, Viivikonna Formation, Kiviõli Member.
6–9 – Neotype, TUG 1054-160 [= GMUT Br 227 (160); Öpik 1930a, pl. XIV, fig. 160; Rõõmusoks, 1993a, pl. II, figs 5–8; Cocks & Rong, 2000; textfig. 138, 3b]. Ventral valve exterior, x 4, right lateral view, x 4.2, posterior view, x 3.6 and anterior view, x 4. Kohtla quarry, collected by A. Öpik.
10 – TUG 1054-168 [= GMUT Br 168; Öpik 1930a, pl. XV, fig. 168]. Ventral valve interior, x 3. Kohtla quarry, collected by A. Öpik.
11 – TUG 1054-167 [= GMUT Br 167; Öpik 1930a, pl. XV, fig. 167]. Dorsal valve interior, x 3.5. Kohtla quarry, collected by A. Öpik.
12 – TUG 1003-32 [= GMUT Br 1578]. Dorsal valve interior, x 3.7. Küttejõu quarry, collected by A. Rõõmusoks, 1964.

Figures 13–16. *Kukrusena peetriensis* sp. nov.; p. 28
Kukruse Stage, Viivikonna Formation, Peetri Member.
13 – TUG 72-201 [= Br 183; Öpik 1930a, pl. XVI, fig. 183]. Ventral valve interior, x 1.8. Peetri exposure, collected by A. Öpik.
14 – TUG 1003-245. Dorsal valve interior, x 2. Humala exposure, collected by A. Rõõmusoks, 1964.
15, 16 – Holotype, TUG 1054-181 [= Br 181; Öpik 1930a; pl. XVI, fig. 181]. Peetri exposure, collected by A. Öpik, TUG 1054-181. 15 – Ventral valve exterior, x 2.1. 16 – Right lateral view, x 2.

PLATE VII

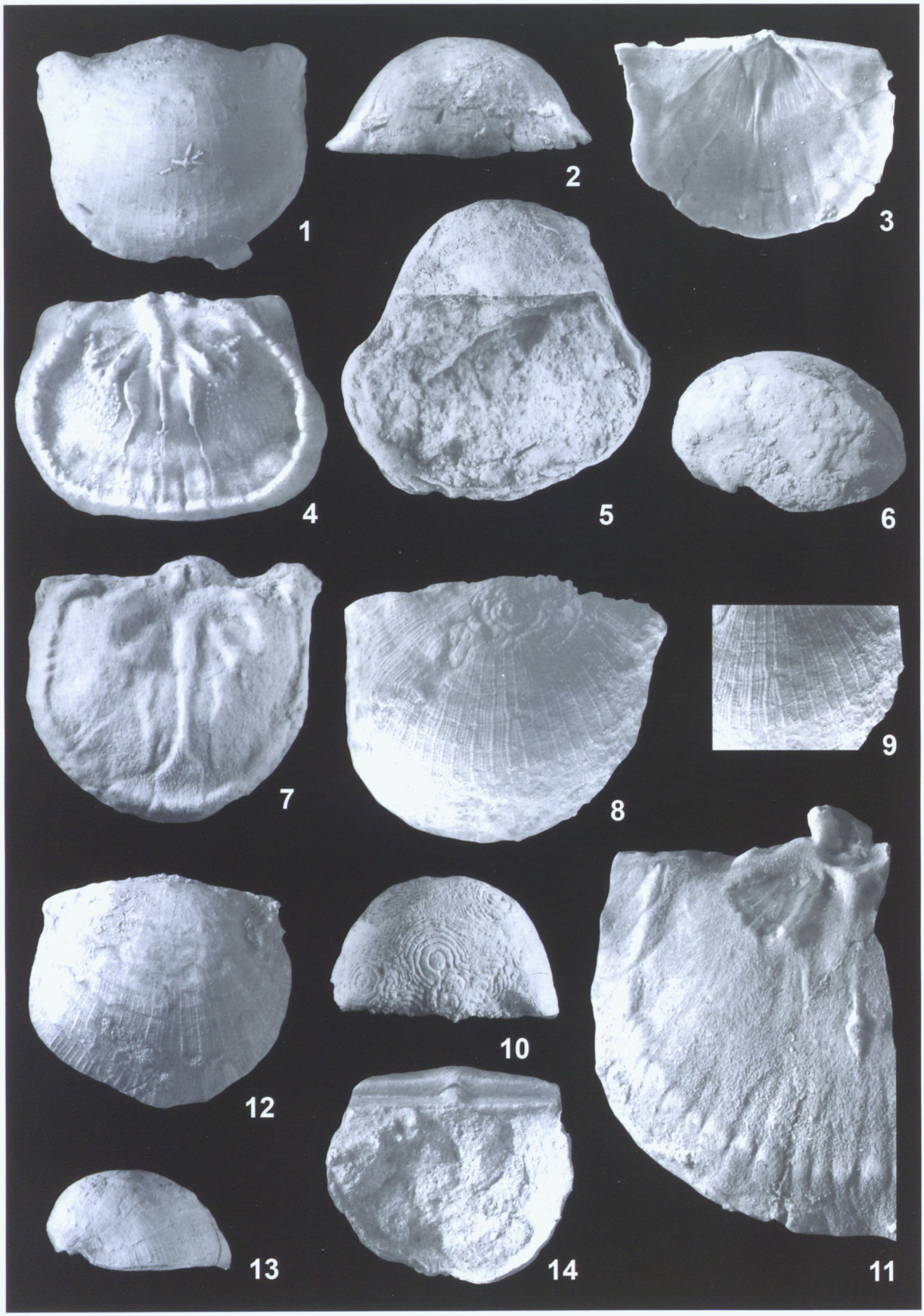


Figures 1–6. *Haljalanites assatkini* (Alichova); p. 30
Haljala Stage, Idavere Substage, Kahula Formation, Vasavere Member.
1–2 – TUG 77-161 [= GMUT Br 1584; Rõõmusoks 1993a pl. III, figs 1–2]. Ventral valve exterior and posterior view, x 3. Aluvere quarry, collected by I. Elvre.
3 – TUG 1003-41 [= GMUT Br 1586; Rõõmusoks 1993a, pl. III, fig. 4]. Ventral valve interior, x 3.1. Aluvere quarry, collected by A. Rõõmusoks, 1962.
4 - TUG 72-73 [= GMUT Br 1585; Rõõmusoks 1993a, pl. III, fig. 3]. Dorsal valve interior, x 3. Aluvere quarry, collected by A. Öpik.
5–6 – TUG 72-72 [= GMUT Br 1714]. Ventral view, x 3 and left lateral view, x 4. Aluvere quarry, collected by A. Öpik.

Figures 7–10. *Haljalanites anijana* (Öpik); p. 29
Haljala Stage, Jõhvi Substage, lower Kahula Formation.
7 – TUG 665-169. Dorsal valve interior, x 4. Anija exposure, collected by A. Wahl.
8–10 – Holotype, TUG 665-168. Dorsal view of conjoined valves, a fragment of it, x 4 and posterior view, x 3.1. Anija exposure, collected by A. Wahl.

Figures 11–14. *Haljalanites grandis* (Alichova); p. 30
Keila Stage, upper Kahula Formation.
11 – TUG 1007-5. Dorsal valve interior, x 3.8. Oandu river-bank, collected by an expedition in 1947.
12–13 – TUG 1007-30. Ventral valve exterior, x 2 and left lateral view, x 1.6. Oandu river-side, collected by an expedition in 1947.
14 – TUG 72-14. Dorsal view of conjoined valves, x 2. Oandu river-side, collected by A. Öpik, 1933.

PLATE VIII



Figures 1–3. *Trigrammaria estonica* (Rõõmusoks); p. 32
Rakvere Stage, Rägavere Formation, Piilse Member.
1 – Holotype, TUG 666-183a [= GMUT Br 1302; Rõõmusoks, 1985, pl. III, fig. 5]. Dorsal valve interior, x 2.4. Munalaskme exposure, collected by an expedition in 1946.
2 – TUG 666-183b [= GMUT Br 1303; Rõõmusoks, 1985, pl. III, fig. 4]. Ventral valve exterior, x 3.2. Munalaskme exposure, collected by an expedition in 1946.
3 – TUG 666-182 [= GMUT Br 1307]. Ventral valve interior, x 2.7. Määra-Saueaugu exposure, collected by an expedition in 1946.

Figures 4–6. ? *Trigrammaria minima* (Rõõmusoks); p. 33
Oandu Stage, Hirmuse Formation.
4 – TUG 72-233 [= GMUT Br 1314; Rõõmusoks, 1985, pl. III, fig. 9]. Ventral valve interior, x 1.7. Town of Rakvere, collected by A. Öpik.
5–6 – TUG 72-232. Ventral valve exterior, x 3 and anterior view, x 2.7. Town of Rakvere, collected by A. Öpik.

Figures 7–13. *Geniculina vironiensis* sp. nov.; p. 36
Rakvere Stage, Rägavere Formation, Piilse Member.
7–8 – Holotype, TUG 102-18. Ventral valve exteriorand posterior view, x 2. Town of Rakvere (exposure in Näituse street), collected by H. Palmre, 1937.
9–10 – TUG 1003-118. Right lateral view and dorsal valve exterior x 2. Rägavere exposure, collected by A. Rõõmusoks, 1942.
11–12 – TUG 242-11. Dorsal valve interior, x 2 and x 5. Town of Rakvere, temporary exposure at teachers' institute, collected by G. Mechmershausen, 1920.
13 – TUG 242-12. Ventral valve interior, x 2.4. Town of Rakvere, temporary exposure at teachers' institute, collected by G. Mechmershausen, 1920.

PLATE IX

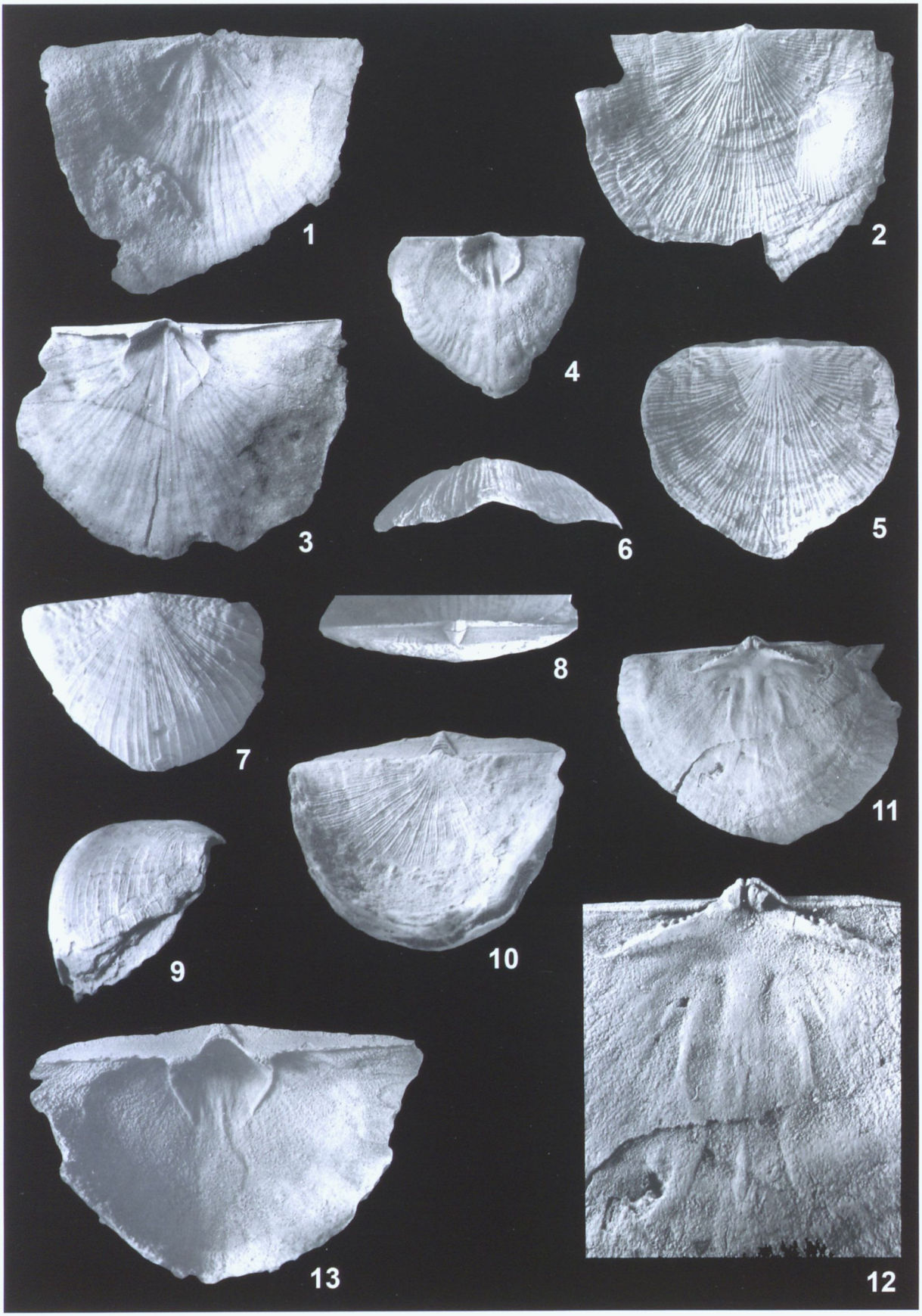


Plate X

Figures 1–8. *Geniculina voorensis* sp. nov.; p. 35

Rakvere Stage, Rägavere Formation, Piilse Member.

1–2 – Holotype, TUG 74-19. Ventral valve exterior and posterior view, x 2. Voore exposure, collected by A. Oraspõld, 1955.

3–4 – TUG 74-20. Ventral valve exterior and right lateral view, x 2. Voore exposure, collected by A. Oraspõld, 1955.

5–6 – TUG 1003-136. Dorsal valve interior, x 2 and x 4. Voore exposure, collected by A. Rõõmusoks, 1960.

7 – TUG 1003-122. Posterior view, x 2. Voore exposure, collected by A. Rõõmusoks, 1960.

8 – TUG 1003-116. Ventral valve interior, x 2. Ditch at Voore, basal beds of the Piilse Member, collected by A. Rõõmusoks, 1961.

Figures 9–17. *Geniculina ralfi* sp. nov.; p. 36

Nabala Stage, Paekna Formation; Nõmmeküla exposure.

9–11 – Holotype, TUG 1003-121. Ventral valve exterior, anterior and right lateral views x 2, collected by A. Rõõmusoks, 1968.

12 – TUG 43-145. Ventral valve interior, x 2, collected by R. Männil, 1956.

13 – TUG1003-119. Posterior view, x 2, collected by A. Rõõmusoks, 1954.

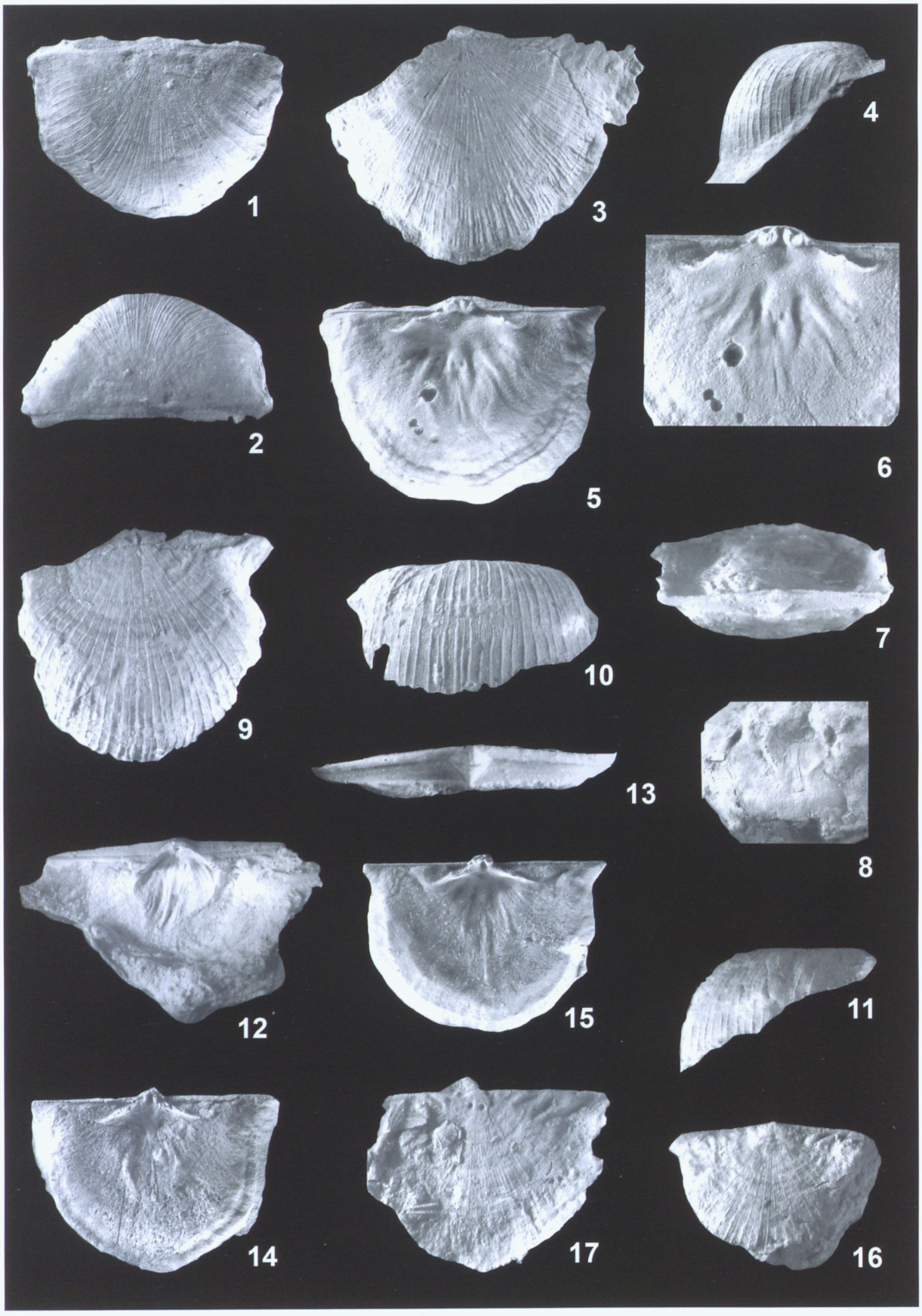
14 – TUG 1008-2. Dorsal valve interior, x 2, collected by R. Männil and A. Rõõmusoks, 1956.

15 – TUG 54-31. Dorsal valve interior, x 2, collected by A. Rõõmusoks and D. Kaljo, 1954.

16 – TUG 1003-120. Ventral valve exterior, x 2, collected by A. Rõõmusoks, 1961.

17 – TUG 54-34. Dorsal valve exterior, x 2, collected by A. Rõõmusoks and D. Kaljo, 1954.

PLATE X



Figures 1–15. *Geniculina pseudoalternata* (Schmidt); p. 34

Pirgu Stage, Moe Formation.

1–5 – TUG 665-117. Dorsal and ventral valve exterior; anterior, posterior and left lateral views, x 2. Moe exposure, collected by A. Wahl.

6 – TUG 1003-73. Fragmentary ventral interior, x 2. Nyby exposure, collected by A. Rõõmusoks, 1966.

Vormsi Stage, Kõrgessaare Formation.

7 – TUG 42-54. Left lateral view of complete shell, x 1.8. Kohila exposure, collected by F. Schmidt.

8–9 – TUG 42-76. Fragmentary dorsal valve interior, x 2.2 and right lateral view, x 2.3. Imastu exposure, collected F. Schmidt.

10 – TUG 1003-71. Fragmentary ventral valve interior, x 2. Mõnuste quarry, collected by A. Rõõmusoks, 1954.

Pirgu Stage, Adila Formation.

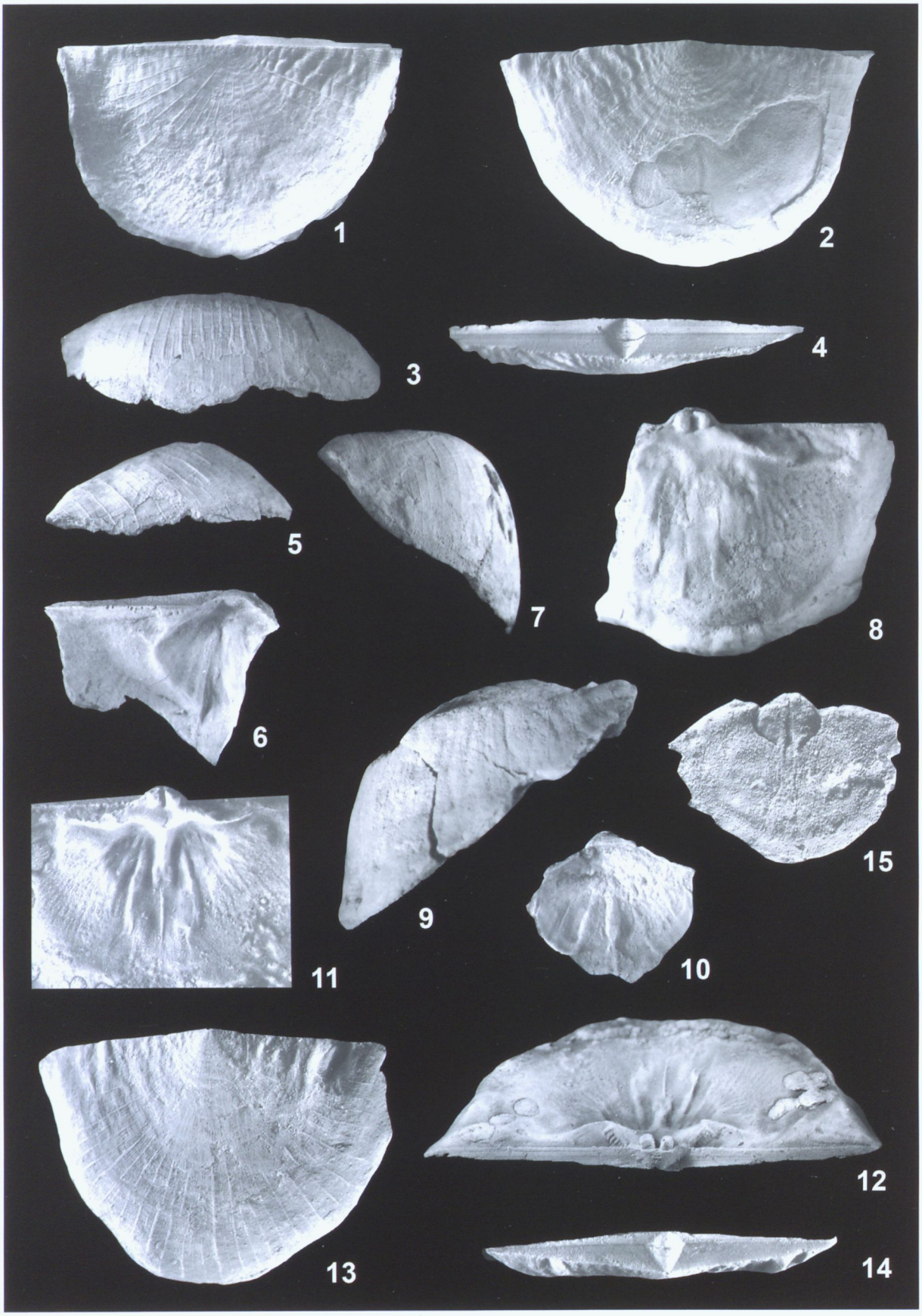
11–12 – Lectotype, TUG 42-36 [= GMUT Br 1460; Rõõmusoks, 1993a, pl. IV, figs 1-3; Cocks & Rong, 2000; textfig. 140, 1c]. Dorsal valve exterior, x 2.3 and posterior view, x 2. Vardi erratics, collected by F. Schmidt.

13–14 – TUG 42-37 [= GMUT Br 1463; Rõõmusoks, 1993a, pl. IV, figs 4, 5; Cocks & Rong, 2000; textfig. 140, 1a]. Ventral valve exterior and posterior view, x 2. Piirsalu exposure, collected by F. Schmidt.

Pirgu Stage, Ärina Formation, Röa Member.

15 – TUG 1003-235 [= GMUT Br 1539; Rõõmusoks, 1993a, pl. IV, fig. 6; Cocks & Rong, 2000; textfig. 140, 1b]. Ventral valve internal mould, x 1. Röa railway-side ditch, collected by A. Rõõmusoks, 1975.

PLATE XI



Figures 1–6. *Crassoseptaria virve* (Rõõmusoks); p. 37
Nabala Stage, Paekna Formation.

1–3 – Holotype, TUG 42-126 [= GMUT Br 1190; Rõõmusoks, 1985; pl. I, figs 1-3]. Conjoined valves – ventral valve exterior, x 1.6, left lateral view, x 1.5 and posterior view, x 1. Laitse exposure, collected by F. Schmidt.

4–5 – TUG 1003-241 [= GMUT Br 1193; Rõõmusoks, 1985; pl. I, figs 7,8]. Dorsal valve interior, x 4.6 and x 2. Nõmmeküla exposure, collected by A. Rõõmusoks, 1961.

6 – TUG 1003-242 [= GMUT Br 1194; Rõõmusoks, 1985; pl. I, fig. 4]. Ventral valve interior, x 1.4. Nõmmeküla exposure, collected by A. Rõõmusoks, 1961.

Figures 7–13. *Luhaia vardi* Rõõmusoks; p. 38
Pirgu Stage, Adila Formation.

7 – Holotype, TUG 80-199 [= GMUT Br 4004; Rõõmusoks, 1956; p. 1091, fig. 3]. Ventral valve exterior mould, x 2. Vormsi Island, Hosholm coast, collected by V. Jaanusson, S. Kiin and R. Männil, 1939.

8–9 – TUG 36-36 [= GMUT Br 4003; Rõõmusoks, 1993b, pl. II, fig. 3]. Posterior view of conjoined valves, x 1.8 and right lateral view, x 1.3. Uuemõisa, erratics, collected by B. Stein, 1938.

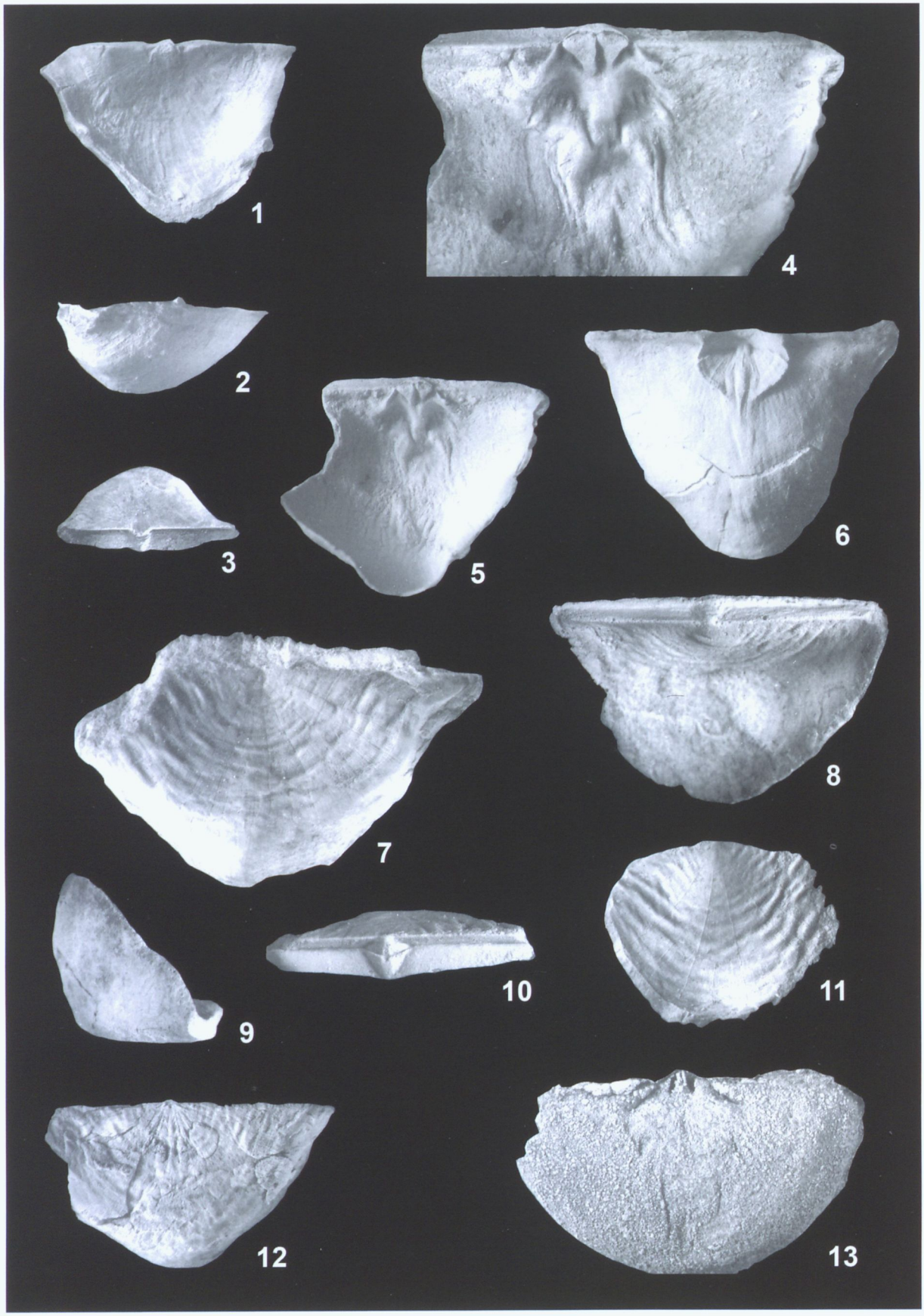
10 – TUG 107-19 [= GMUT Br 1611; Rõõmusoks, 1993b, pl. II, fig. 2]. Posterior view of conjoined valves, x 2. Town of Haapsalu, Holm, erratic, collected by V. Reimer.

11 – TUG 80-201 [= GMUT Br 1607; Rõõmusoks, 1993b, pl. II, fig. 5; Cocks & Rong, 2000; textfig. 142, 3a]. Ventral valve exterior, x 1.8. Vormsi Island, Hosholm coast, collected by V. Jaanusson, S. Kiin and R. Männil, 1939.

12 – TUG 38-79 [= GMUT Br 1615]. Partly exfoliated ventral valve internal mould, x 1.8. Piirsalu exposure, collected by L. Sarv and V. Karise, 1953.

13 – TUG 950-20 [= GMUT Br 1610]. Dorsal valve internal mould, x 2.5. Vardi, erratic, collected by L. Pahnsch.

PLATE XII

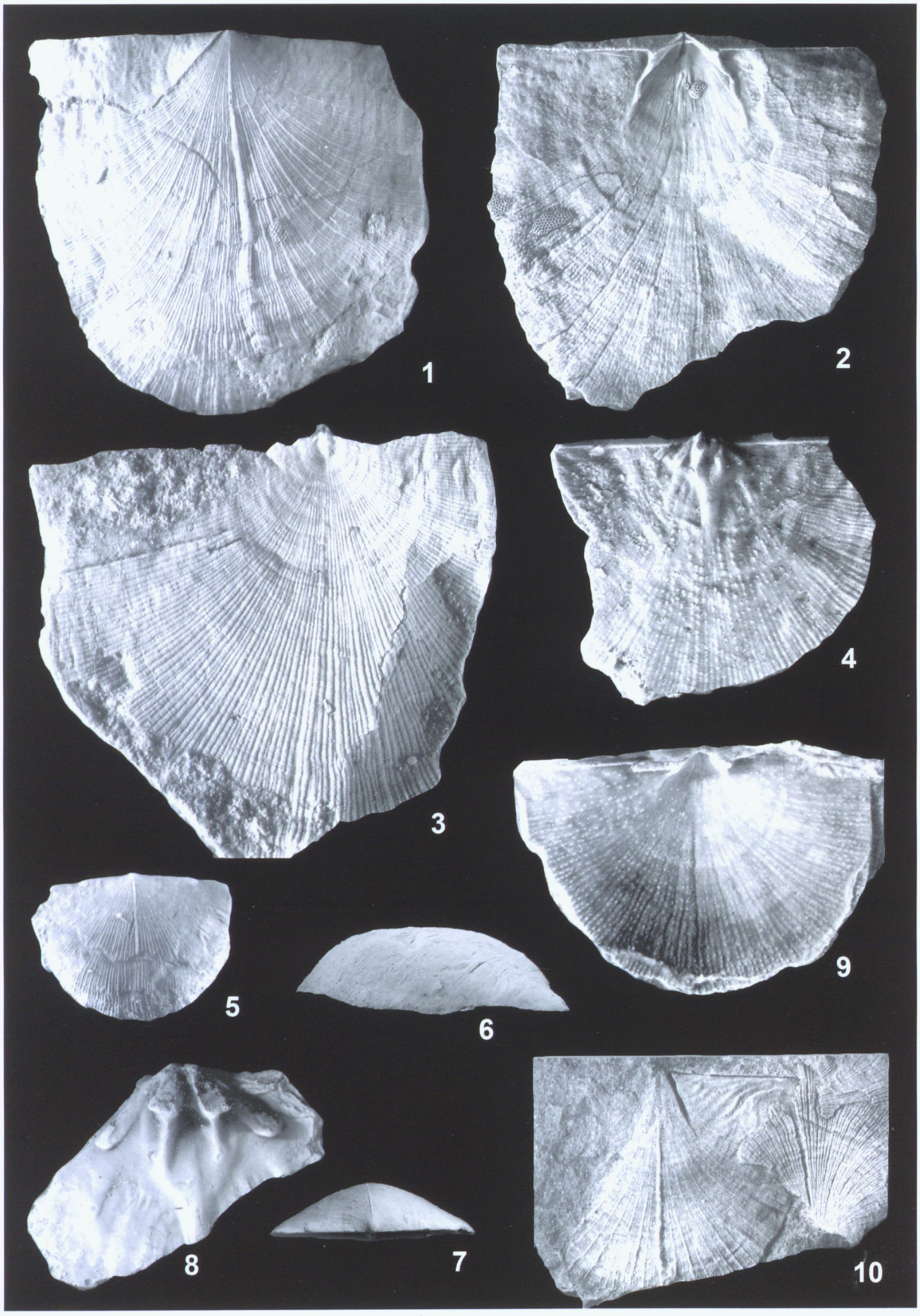


Figures 1–4. *Kjaerina poljensis* (Alichova); p. 40
Oandu Stage, Hirmuse Formation.
1 – TUG 72-103 [= GMUT Br 1620, Rõõmusoks, 1993c, pl. I, fig. 3]. Ventral valve exterior, x 2. Oandu river bed, collected by A. Öpik.
2 – TUG 72-100 [=GMUT Br 1621, Rõõmusoks, 1993c, pl. I, fig. 4]. Ventral valve interior, x 2. Rakvere exposure, collected by A. Öpik.
3 – TUG 1003-66. Dorsal valve exterior, x 4.3. Tõrremägi exposure, collected by A. Rõõmusoks, 1946.
4 – TUG 102-15. Dorsal valve interior, x 5. Tõrremägi exposure, collected by H. Palmre, 1937.

Figures 5–9. *Virunites orvikui* (Oraspõld); p. 41
Oandu Stage, Hirmuse Formation.
5–7 – Holotype, TUG 1009-1 [= GMUT Br 3058, Oraspõld, 1956, pl. I. fig. 21]. Ventral valve exterior; left lateral view; posterior view, x 2. Oandu river bed, collected by an expedition in 1955.
8 – TUG 102-13 [= GMUT Br 1623, Rõõmusoks, 1993c, pl. I, fig. 6]. Fragmentary dorsal valve interior, x 5.5. Tõrremägi exposure, collected by H. Palmre, 1937.
9 – TUG 102-14 [= GMUT Br 1622, Rõõmusoks, 1993c, pl. I, fig. 7]. Ventral valve interior, x 4.8. Tõrremägi exposure, collected by H. Palmre, 1937.

Figure 10. *Kjaerina typa* Bancroft; p. 40
Upper Longvillian.
TUG 1016-3A. Fragmentary ventral valve internal mould, x 1.7. Onny section, Shropshire, England, collection at the Department of Geology, University of Bristol.

PLATE XIII



Figures 1–8. *Rakverina inaequiclina* (Alichova); p. 42
Rakvere Stage, Rägavere Formation, Piilse Member.

1–3 – TUG 691-15 [= GMUT Br 1560, Rõõmusoks, 1993c, pl. II, figs 6–8]. Conjoined valves. Ventral valve exterior, x 2.4, left lateral view x 2.1 and dorsal valve exterior, x 2.3. Rägavere quarry, collected by K. Orviku.

4 – TUG 242-58 [= GMUT Br 1479, Rõõmusoks, 1993c, pl. II, fig. 10]. Posterior view, x 3.6. Town of Rakvere, collected by G. Mechmershausen.

5 – TUG 75-45 [= GMUT Br 1482, Rõõmusoks, 1993c, pl. II, fig. 11]. Ventral valve interior, x 3. Rägavere quarry, collected by V. Paul.

6 – TUG 1003-117. Dorsal valve exterior, x 2. Rägavere quarry, collected by A. Rõõmusoks, 1942.

7 – TUG 2-305. Dorsal valve interior, x 5. Aru exposure. Old collection.

8 – TUG 42-71 [= GMUT Br 1630, Rõõmusoks, 1993c, pl. II, fig. 9]. Dorsal valve interior, x 3.8. Rägavere quarry, collected by F. Schmidt.

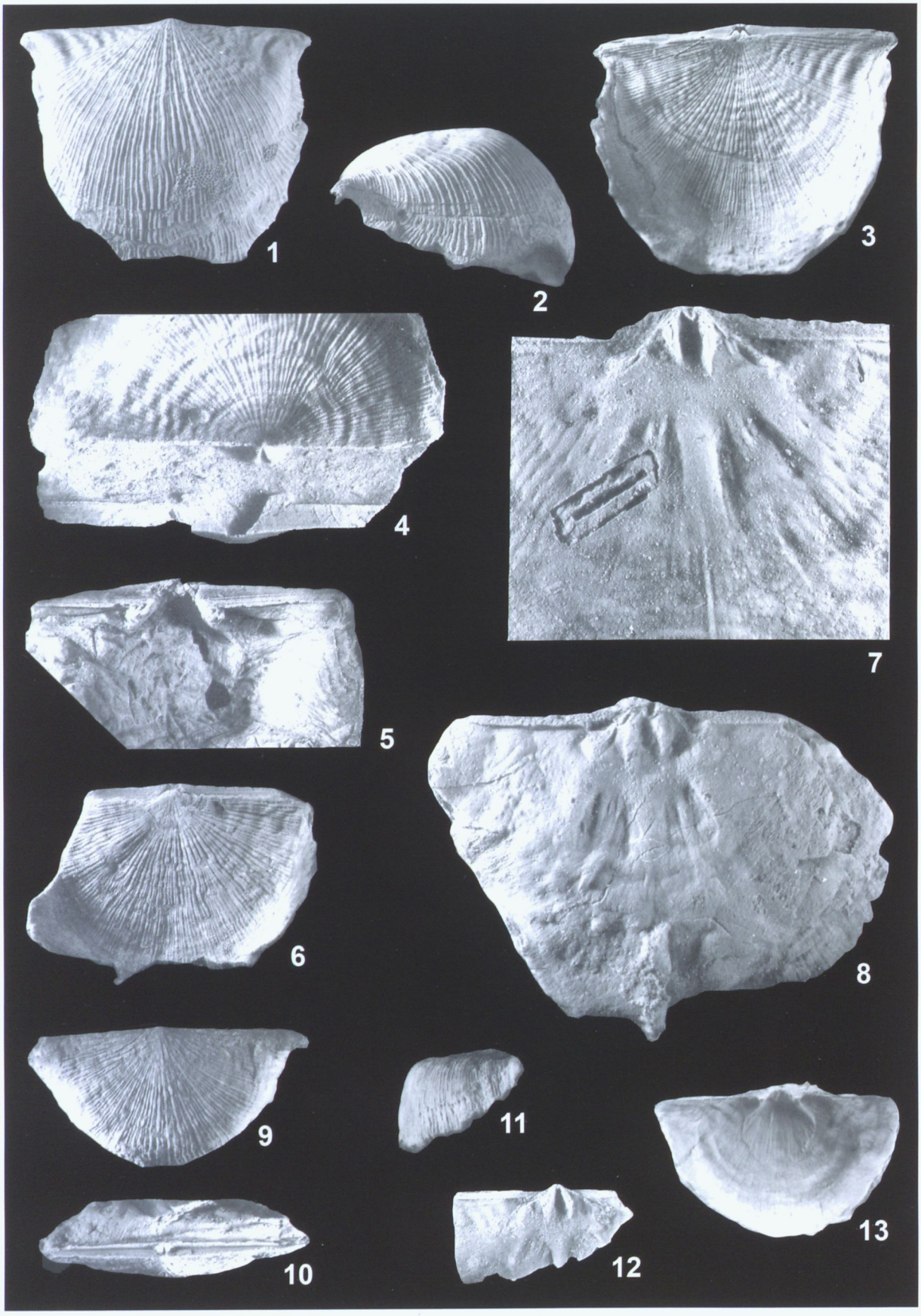
Figures 9–13. *Rakverina oanduensis* (Oraspõld); p. 43
Oandu Stage, Hirmuse Formation.

9–11 – Holotype, TUG 1009-13 [= GMUT Br 3082, Oraspõld, 1956, pl. I, fig. 20]. Ventral valve exterior, posterior view and right lateral view, x 2. Oandu river-bank, collected by an expedition in 1955.

12 – TUG 102-29 [= GMUT Br 1631, Rõõmusoks, 1993c, pl. II, fig. 4]. Dorsal valve interior, x 2. Tõrremägi exposure, collected by H. Palmre, 1937.

13 – TUG 102-28 [= GMUT Br 1632, Rõõmusoks, 1993c, pl. II, fig. 5]. Ventral valve int., x 2.1. Tõrremägi exposure, collected by H. Palmre, 1937.

PLATE XIV

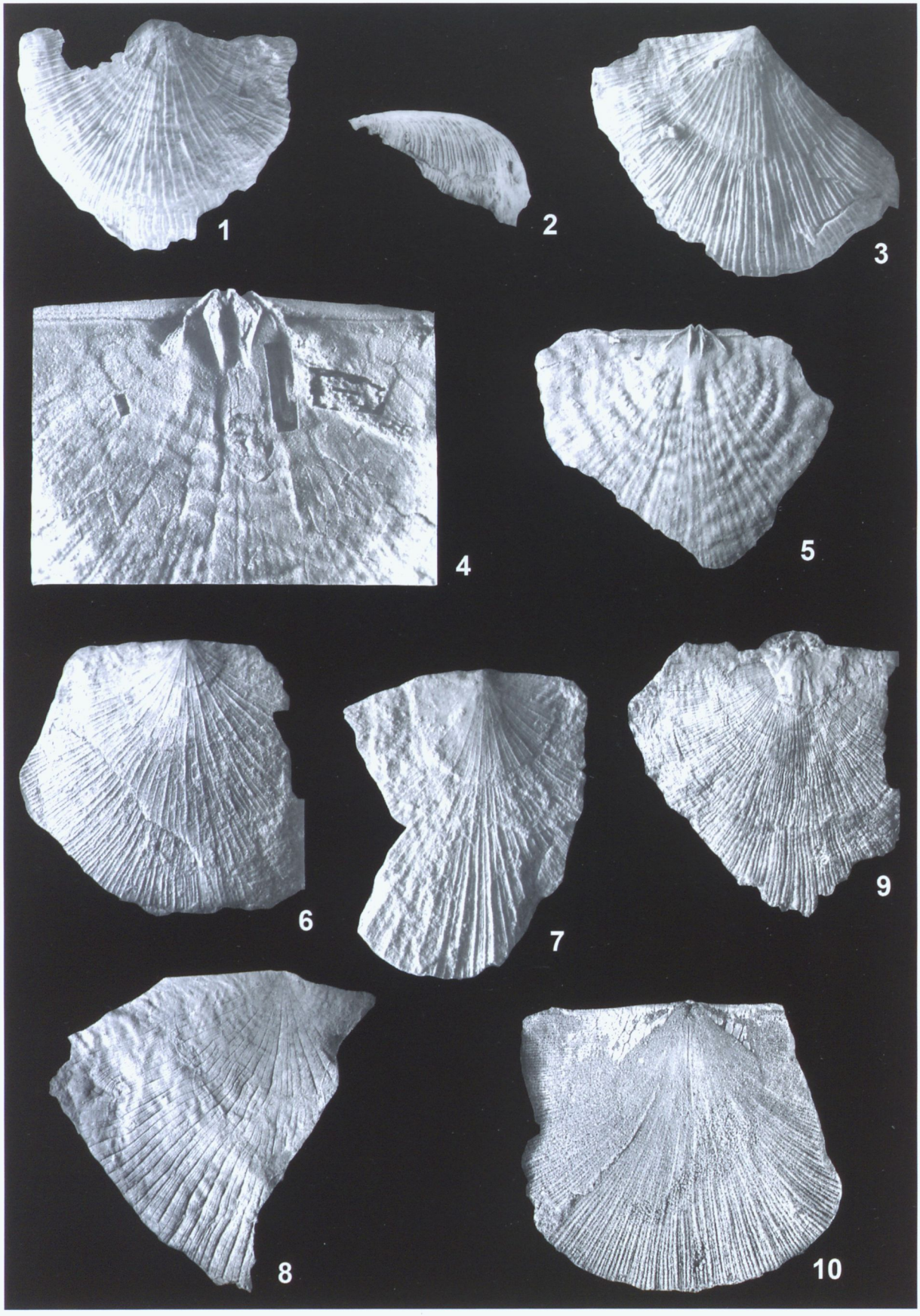


Figures 1–5. *Rakverina inaequiclina* (Alichova); p. 42
Rakvere Stage, Rägavere Formation, Piilse Member.
1–2 – TUG 75-43. Ventr. v. ext., x 1.8 and left side view, x 1.3. Rägavere exposure, collected by V. Paul, 1931.
3 – TUG 1003-113. Ventral valve exterior, x 2.1. Rägavere exposure, collected by A. Rõõmusoks, 1942.
4 – TUG 75-42. Dorsal valve interior, x 5. Rägavere exposure, collected by V. Paul, 1931.
5 – TUG 691-14. Dorsal valve interior, x 3. Rägavere exposure, collected by K. Orviku.

Figures 6–7. ? *Pirgumena* cf. *martnai* Rõõmusoks p. 44
Vormsi Stage, Kõrgessaare Formation?
6 – TUG 2-189. Ventral valve exterior, x 1.5. Lyckholm exposure, coll by F. Schmidt.
7 – TUG 1003-4. Ventral valve exterior, x 2. Kohila exposure, coll by A. Rõõmusoks, 1953.

Figure 8–10 *Pirgumena martnai* Rõõmusoks; p. 44
Pirgu Stage, Moe Formation.
8 – TUG 1003-1. Dorsal valve external mould. Temporary exposure at Kärrslätt village, Vormsi Island, collected by A. Rõõmusoks, 1964.
Porkuni Stage, Ärina Formation, Vohilaid Member.
9 – TUG 1015-1. Dorsal valve interior, x 2. Kasari river-bed, erratic, collected by S. Säga.
10 – TUG 36-33. Ventral valve internal mould, x 2. Vohilaid Island, collected by B. Stein, 1937.

PLATE XV



Figures 1–5. *Pirgumena martnai* Rõõmusoks; p. 44

Pirgu Stage, Adila Formation.

1–2 – Holotype, TUG 1003-5 [= GMUT Br 1471; Rõõmusoks, 1993c, pl. IV, figs 5, 6]. Ventral valve exterior, x 1 and a fragment x 2.6. From the Atla river dredge at the Pirgu village, collected by A. Rõõmusoks, 1959.

3 – TUG 46-90. Dorsal valve exterior, x 1.9. Town of Haapsalu, Holm, erratic, collected by K. Orviku, 1937.

Pirgu Stage, Ärina Formation, Röa Member.

4 – TUG 1001-2 [= GMUT Br 1477A; Rõõmusoks, 1993c, pl. IV, fig. 2]. Dorsal valve interior mould, x 1.6. Härküla exposure, collected by E. Rosenstein.

5 – TUG 42-34 [= GMUT Br 1472; Rõõmusoks, 1993c pl. IV, fig. 1]. Ventral valve internal mould, x 1.5. Kuru exposure, collected by F. Schmidt.

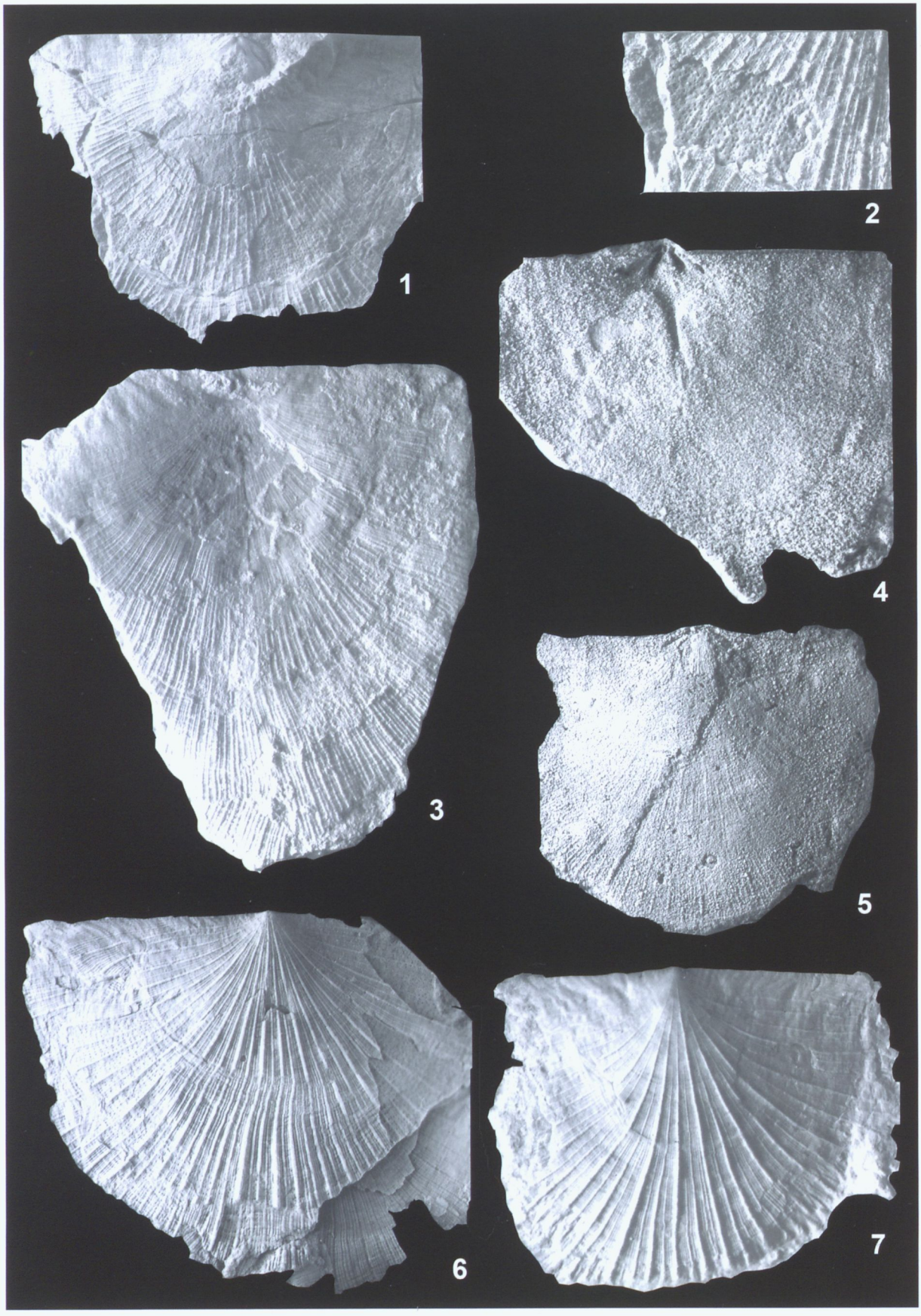
Figures 6–7. ? *Pirgumena* sp. nov.; p. 44

Porkuni Stage, Ärina Formation, Siuge Member.

6 – TUG 2-33. Ventral valve exterior, x 2.3. Porkuni quarry, old collection.

7 – TUG 665-110. [GMUT Br 1467; Rõõmusoks, 1993c, pl. IV, fig. 7]. Ventral valve exterior, x 2. Porkuni quarry, collected by A. Wahl.

PLATE XVI



Figures 1–9. *Septomena juvenilis* (Öpik); p. 47

Kukruse Stage, Viivikonna Formation, Kiviõli Member.

1–2 – Holotype, TUG 72-200 [Öpik, 1930a, pl. XI, fig. 140 = GMUT Br 207, Rõõmusoks, 1989, pl. II, fig.1]. Ventral valve exterior, x 4 and ventral valve interior, x 2.1. Käva quarry, collected by A. Öpik.

3 – TUG 1054-144 [Öpik, 1930, pl. XII, fig. 144]. Dorsal valve interior, x 4, Kohtla quarry, collected by A. Öpik.

4 – TUG 1003-171. Dorsal valve interior, x 3. Küttejõu quarry, collected by A. Rõõmusoks, 1966.

5 – TUG 1003-225. Fragmentary dorsal valve interior, x 3. Küttejõu quarry, collected by A. Rõõmusoks, 1966.

6 – TUG 1054-145 [Öpik, 1930a, pl. XII, fig. 145 = GMUT Br 212, Rõõmusoks, 1989, pl. II, fig. 3]. Ventral valve interior, x 2.8. Kohtla quarry, collected by A. Öpik.

7–9 – TUG 1054-142 [Öpik, 1930a, pl. XII, fig. 142]. Ventral valve exterior, left lateral view, x 2 and posterior view, x 2. Kohtla quarry, collected by A. Öpik.

Figures 10–11. ? *Septomena senecta* sp. nov.; p. 48

Lasnamägi Stage, lower Väo Formation.

10 – Holotype, TUG 42-114. Incomplete ventral valve exterior, x 2.6. Cliff at town of Paldiski, collected by F. Schmidt.

11 – TUG 692-9. Dorsal valve external mould, x 2.2. Vahiküla, Vääna riverbank, collected by K. Orviku, 1928.

Figures 12–13. ? *Septomena* aff. *juvenilis* (Öpik); p. 48

Uhaku Stage, Kõrgekallas Formation.

12 – TUG 1003-215. Almost complete ventral valve exterior, x 2.2. Lasnamägi quarry, collected by A. Rõõmusoks, 1943.

Uhaku Stage, upper Väo Formation.

13 – TUG 1003-226. Dorsal valve exterior, x 2.3. Canyon of the Uhaku river, collected by A. Rõõmusoks, 1966.

PLATE XVII

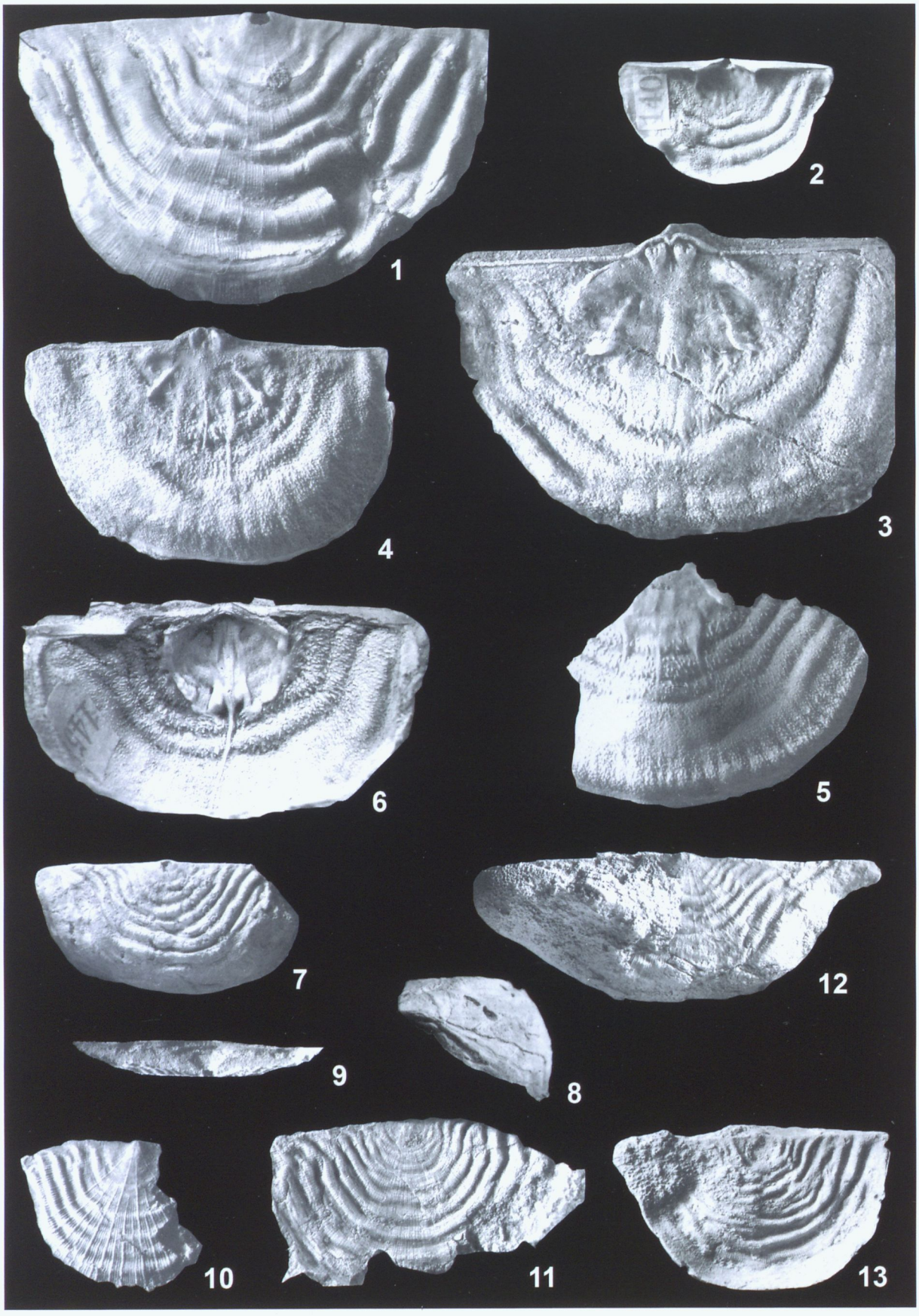


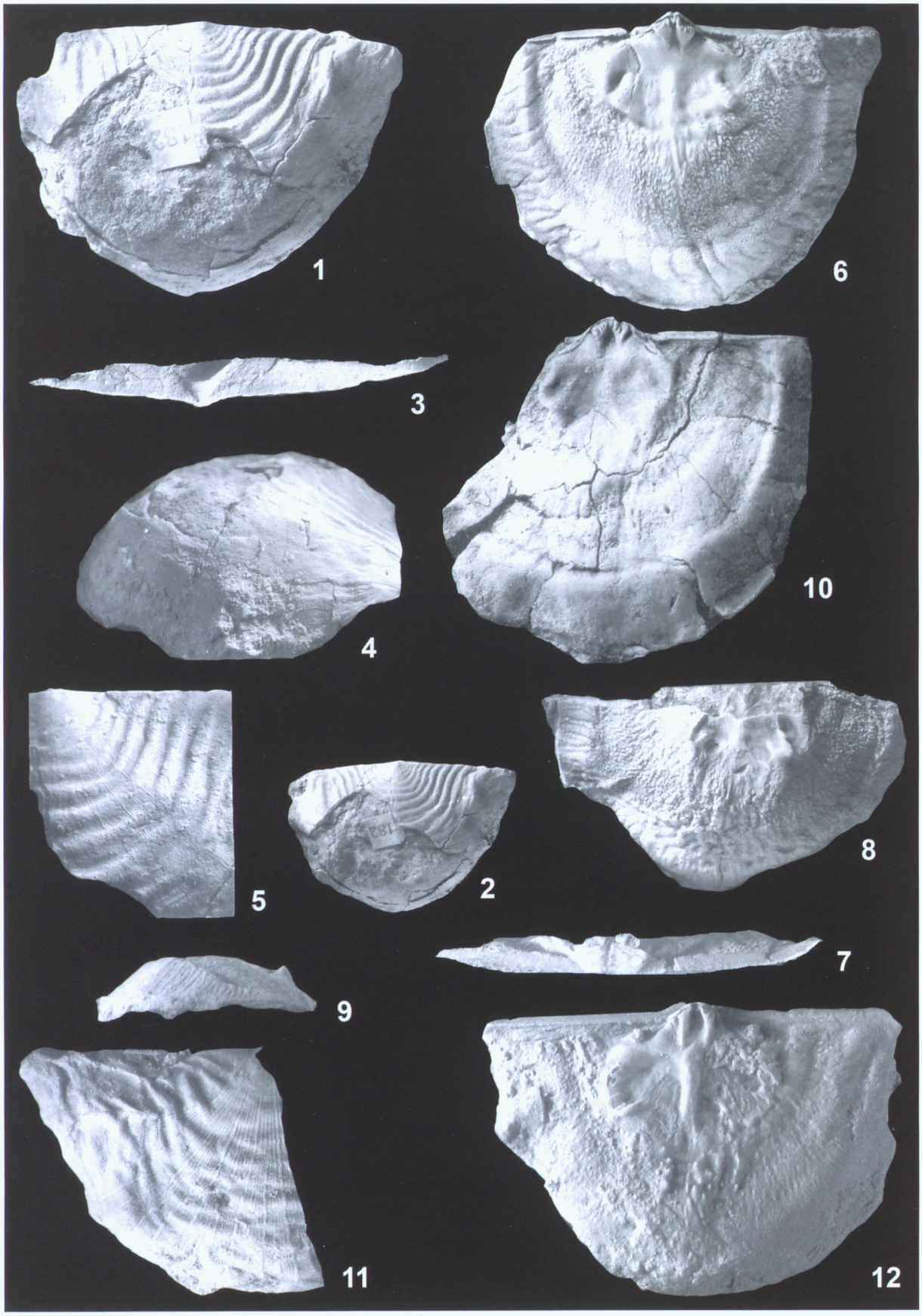
Plate XVIII

Figures 1–10. *Septomena crypta* (Öpik); p. 49
Kukruse Stage, Viivikonna Formation, Peetri Member.
1–5 – Holotype, TUG 72-199 [Öpik, 1930a, pl. XVI, fig. 182; = GMUT Br 221, Rõõmusoks, 1989, pl. II, fig. 4].
1–2 Ventral valve exterior, x 1.7 and x 1
3 – posterior view, x 3;
4 – right lateral view, x 1.7;
5 – right part of ventral valve exterior, x 2.3. Adra exposure, collected by A. Öpik.
6–7 – TUG 1003-227 [= GMUT Br 1322, Rõõmusoks, 1989, pl. II, fig. 5]. Dorsal valve interior, x 1.8; posterior view, x 2. Humala exposure, collected by A. Rõõmusoks, 1942.
8–9 – TUG 1003-213. Fragmentary dorsal valve interior, x 2 and right lateral view, x 2. Humala exposure, collected by A. Rõõmusoks, 1961.
10 – TUG 1003-209. Dorsal valve interior, x 2.1. Humala exposure, collected by A. Rõõmusoks, 1961.

Figure 11. *Kurnamena rugosoides* (Oraspõld, 1956); p. 59
Keila Stage, upper Kahula Formation.
TUG 80-196. Ventral valve exteriorshowing the ornament and rugae, x 2. Oandu riverbank, collected by an expedition in 1947.

Figure 12. *Kurnamena taxilla* (Oraspõld, 1956); p. 55
Haljala Stage, Jõhvi Substage.
TUG 72-192. Dorsal valve interior, x 2.8. Alliku exposure, collected by A. Öpik.

PLATE XVIII



Figures 1–9. *Septomena alliku* (Oraspõld); p. 49

Haljala Stage, Jõhvi Substage.

1–4 – Holotype, TUG 43-156 [= GMUT Br 3055, Oraspõld, 1956; pl. II, fig. 1]. Ventral valve exterior, x 2.3, ventral valve exterior showing ornament, x 4; posterior view, x 2 and right lateral view, x 1.8. Alliku exposure, collected by R. Männil.

5 – TUG 43-154 [= GMUT Br 2395, Oraspõld, 1956; pl. II, fig. 3]. Dorsal valve interior, x 5. Alliku exposure, collected by R. Männil.

6 – TUG 993-1709. Ventral valve exterior, x 3.6. Alliku exposure, collected by R. Männil.

7 – TUG 1003-181. Ventral valve interior, x 3.8. Kahula ditch, collected by A. Rõõmusoks, 1963.

Haljala Stage, Idavere Substage, Vasavere Formation.

8 – TUG 72-179. Dorsal valve interior, x 2.6. Aluvere quarry, collected by A. Öpik.

9 – TUG 72-165. Ventral valve interior, x 2.5. Aluvere quarry, collected by A. Öpik.

Figures 10–11. *Septomena* cf. *alliku* (Oraspõld); p. 50

Keila Stage, upper Kahula Formation.

10 – TUG 1003-177. Ventral valve exterior, x 2.2. Tammiku quarry, collected by A. Rõõmusoks, 1963.

11 – TUG 853-54. Ventral valve exterior, x 1.8. Exposure in town of Rakvere, old collection.

Figure 12. ? *Septomena* sp.; p. 50

Keila Stage, Variku Formation.

TUG 1003-1. Ventral valve external mould, x 1.6. Ristiküla borehole, 411.0 m. South-Western Estonia.

PLATE XIX

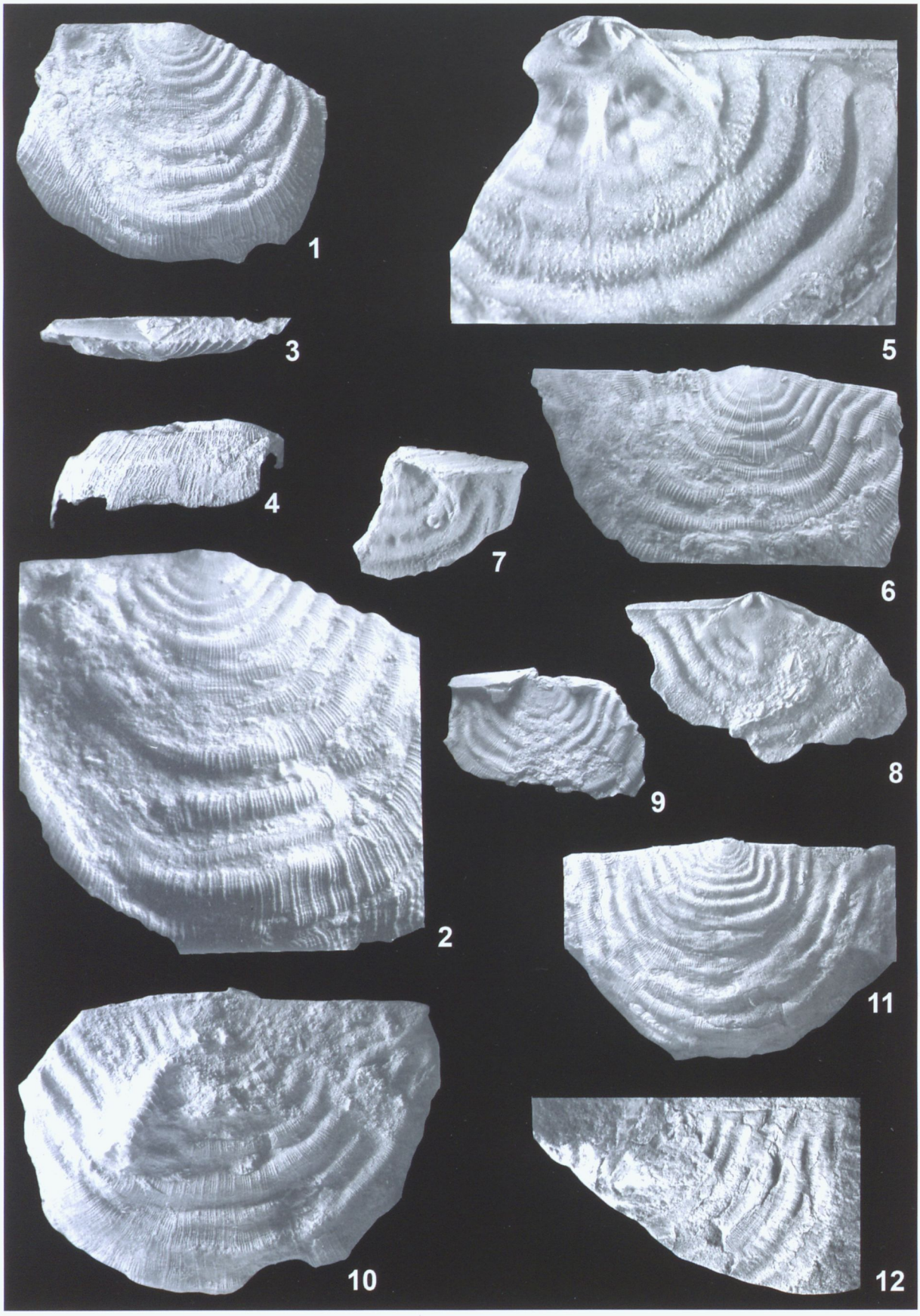


Plate XX

Figure 1. *Estonomena estonensis* (Bekker); p. 52
Kukruse Stage, Viivikonna Formation, Kiviõli Member.
TUG 1054-153. Dorsal valve interior, x 3. Kohtla quarry, collected by A. Öpik.

Figure 2. *Kurnamena spumifera* (Öpik); p. 56
Kukruse Stage, Viivikonna Formation, Kiviõli Member.
TUG 1054-151. Dorsal valve interior, x 5. Kohtla quarry, collected by A. Öpik.

Figure 3. *Kurnamena laterorugata* Rõõmusoks; p. 58
Keila Stage, Ristna beds of Kahula Formation.
TUG 72-174. Dorsal valve interior, x 4. Keila-Ohtu road-side ditch, collected by A. Öpik.

Figure 4. *Kurnamena rugosoides* (Oraspõld); p. 59
Keila Stage, upper Kahula Formation.
TUG 72-194. Dorsal valve interior, x 2.2. Exposure in town of Rakvere, collected by A. Öpik.

Figure 5. *Septomena juvenilis* (Öpik); p. 47
Kukruse Stage, Viivikonna Formation, Kiviõli Member.
TUG 1054-144. Dorsal valve interior, x 3. Kohtla quarry, collected by A. Öpik.

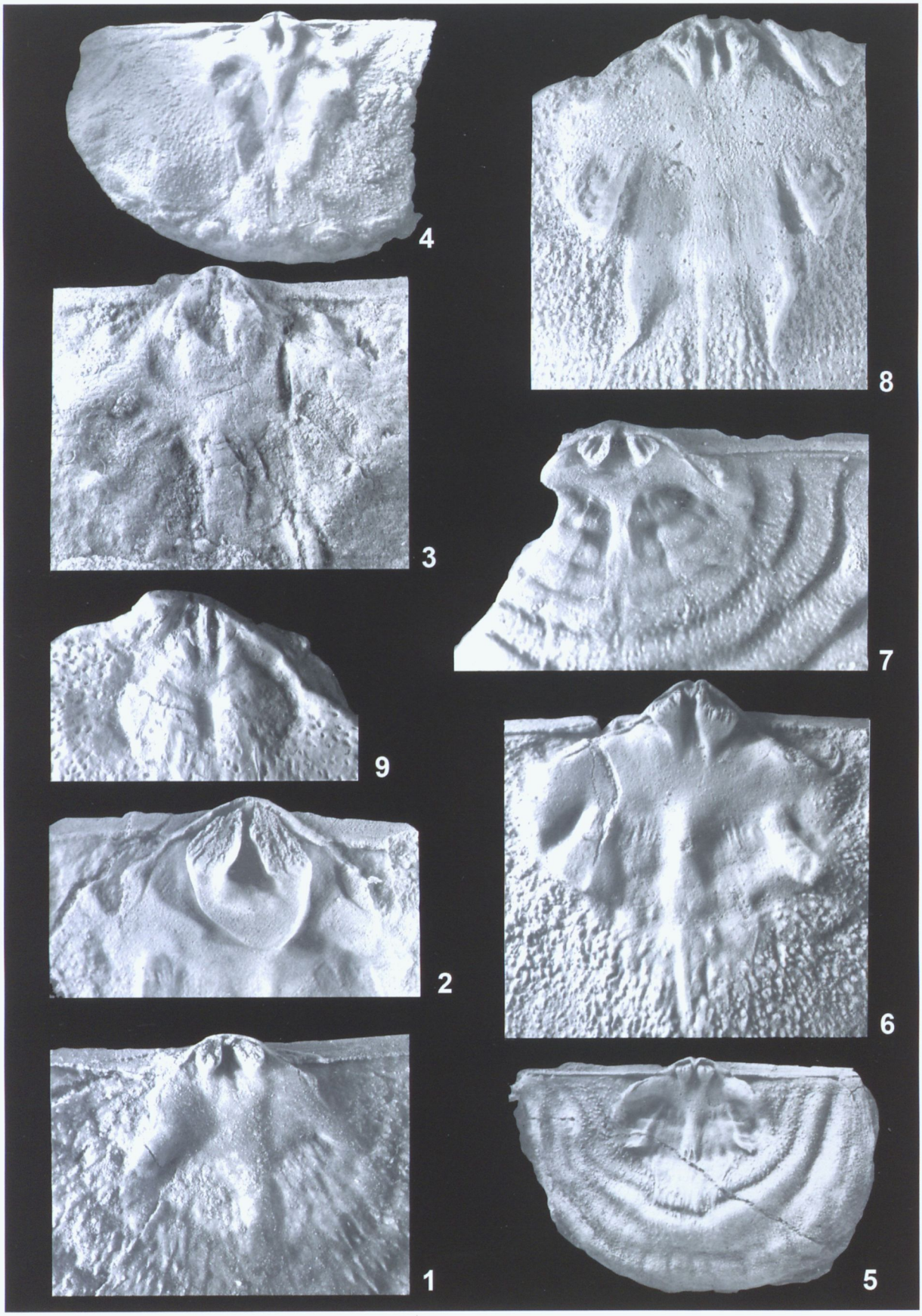
Figure 6. *Septomena crypta* (Öpik); p. 49
Kukruse Stage, Viivikonna Formation, Peetri Member.
TUG 1003-227. Dorsal valve interior, x 4. Humala exposure, collected by A. Rõõmusoks 1942.

Figure 7. *Septomena alliku* (Oraspõld); p. 49
Haljala Stage, Jõhvi Substage.
TUG 43-154. Dorsal valve interior, x 5. Alliku exposure, collected by R. Männil.

Figure 8. *Septomena cryptoides* (Oraspõld); p. 51
Keila Stage, basal part (Ristna beds) of Kahula Formation.
TUG 1003-217. Dorsal valve interior, x 5. Kahula ditch, collected by A. Rõõmusoks, 1946.

Figure 9. *Astamena inaequalis* Rõõmusoks; p. 61
Haljala Stage, Jõhvi Substage.
TUG 72-190. Dorsal valve internal mould, x 4. Põõsaspea (Spitham) coastbank, collected by A. Öpik.

PLATE XX



Figures 1–13. *Septomena cryptoides* (Oraspõld); p. 51

Keila Stage, basal part (Ristna beds) of Kahula Formation.

1–4 – Holotype, TUG 43-158 [= GMUT Br 3052, Oraspõld, 1956, pl. II, fig.12]. Ventral valve exterior, posterior view, x 1.8, left lateral view, x 2.4 and detail of ventral valve showing ornament, x 3.9. Pääsküla exposure, collected by R. Männil.

5–7 – TUG 1003-217. Dorsal valve interior, x 2 and x 3.3; right lateral view, x 2. Kahula ditch, north-eastern Estonia, collected by A. Rõõmusoks, 1946.

8 – TUG 1003-216. Fragmentary ventral valve interior, x 2.2. Pääsküla exposure, collected by A. Rõõmusoks, 1964.

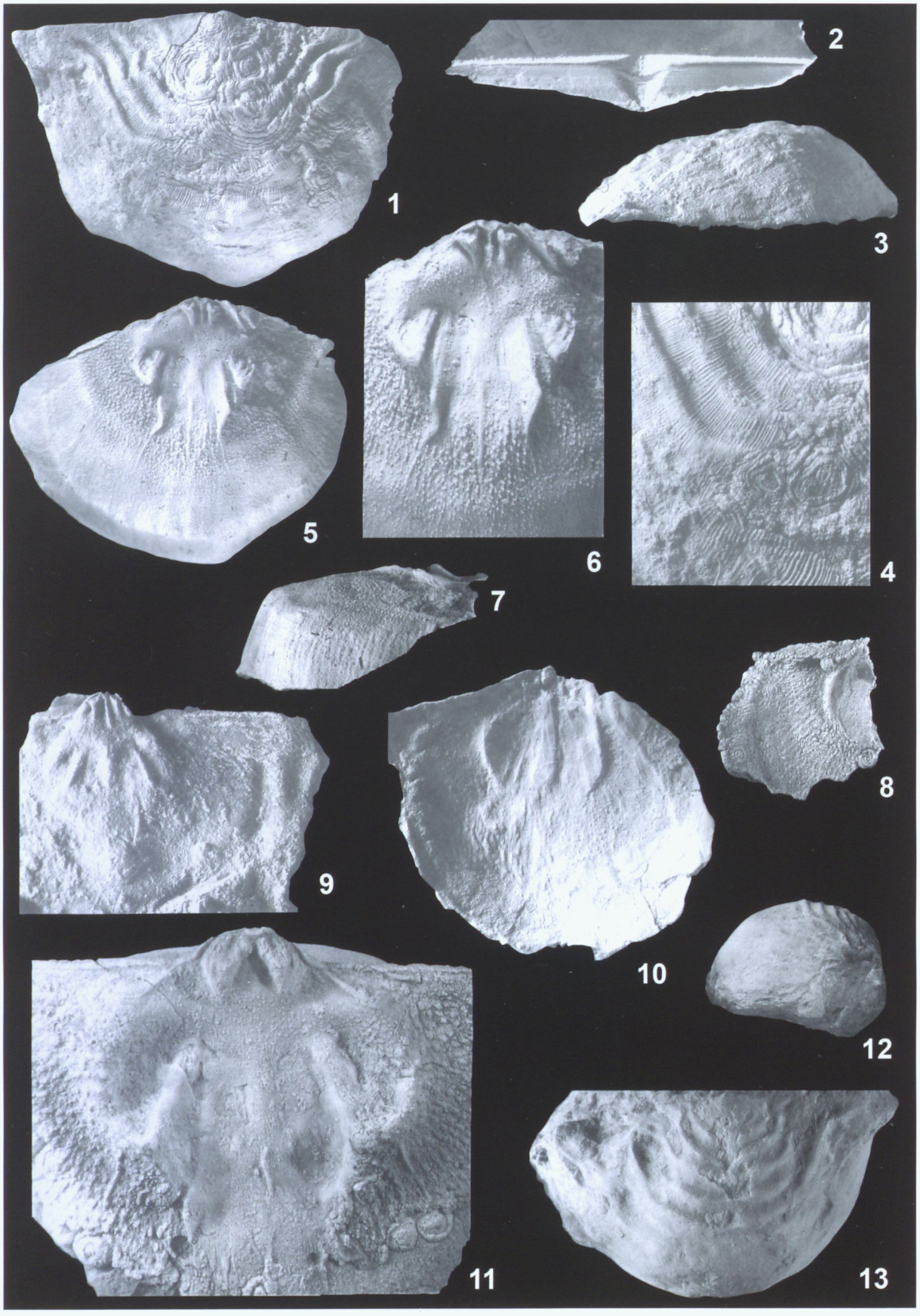
9 – TUG 43-164. Dorsal valve interior, x 3.3. Pääsküla exposure, collected by R. Männil, 1939.

10 – TUG 42-111. Ventral valve interior, x 2. Madise (?) exposure, collected by F. Schmidt.

11 – TUG 1002-4. Dorsal valve interior, x 5. Keila-Kulna railway ditch, north-western Estonia, collected by A. Mickwitz, 1896.

12–13 – TUG 43-161. Right lateral and ventral views, x 1.8. Pääsküla exposure, collected by R. Männil.

PLATE XXI



Figures 1–7. *Estonomena kalevi* sp. nov.; p. 53
Lasnamägi and Uhaku Stages, Väo Formation.

1–2 – Holotype, TUG 43-163. Ventral valve exterior, x 1.7 and right lateral view, x 2. Kadaka quarry, collected by R. Männil.

3 – TUG 993-759. Posterior view, x 2. Kadaka quarry, collected by R. Männil

4–5 – TUG 1003-166. Ventral and dorsal valve moulds, x 2. Osmussaar Island, collected by A. Rõõmusoks, 1960.

6 – TUG 42-115. Dorsal valve internal mould, x 3.3. Coastal outcrop near the town of Paldiski, collected by F. Schmidt.

7 – TUG 692-10. Ventral valve exterior, x 2.3. Vahiküla exposure, Vääna river bank, collected by K. Orviku.

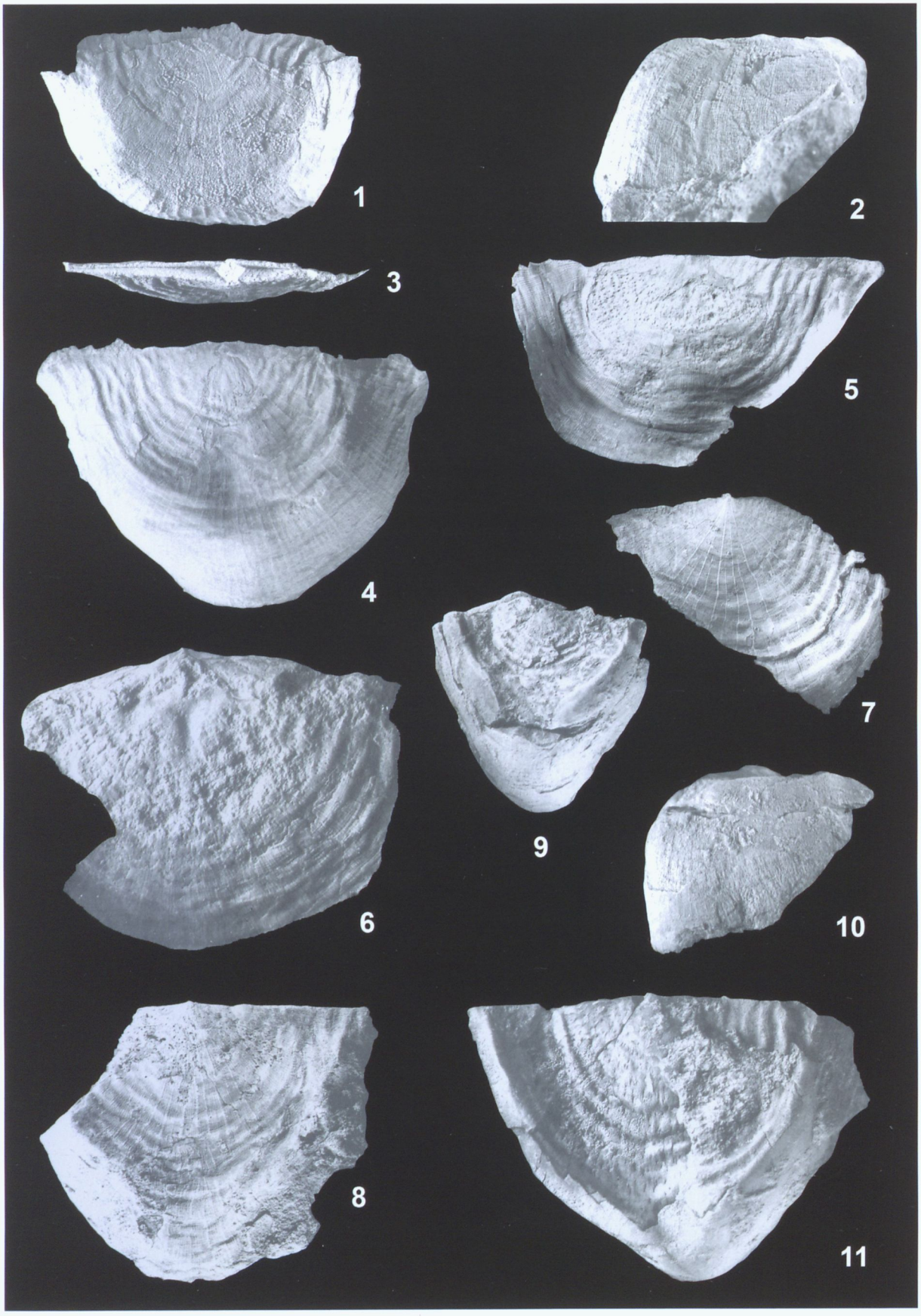
Figures 8–11. ? *Estonomena lindae* sp. nov.; p. 54
Uhaku Stage, Väo and Kõrgekallas Formations.

8 – Holotype, TUG 1003-189. Ventral valve exterior, x 3.7. An exposure at Lasnamägi, town of Tallinn, collected by A. Rõõmusoks, 1943.

9–10 – TUG 42-113. Ventral valve exterior, x 1 and right lateral view, x 1.2. An exposure at Lasnamägi, town of Tallinn, collected by F. Schmidt.

11 – TUG 1003-190. Ventral valve exterior (partly mould), x 2. An exposure at Lasnamägi, town of Tallinn, collected by A. Rõõmusoks, 1943.

PLATE XXII



Figures 1–9. *Estonomena estonensis* (Bekker); p. 52
Kukruse Stage, Viivikonna Formation, Kiviõli Member.

1 – Lectotype, TUG 73-150 [Bekker, 1921, pl. III, fig. 17]. Dorsal valve interior, x 1.3. Kohtla quarry, collected by H. Bekker.

2 – TUG 1054-153 [Öpik, 1930a, pl. XIII, fig. 153; = GMUT Br 219, Rõõmusoks, 1989, pl. I, fig. 6]. Dorsal valve interior, x 3.6. Vanamõisa quarry, collected by H. Bekker.

3–4 – TUG 1003-228 [= GMUT Br 1315, Rõõmusoks, 1989, pl. I, fig 1]. Ventral valve ext., x 1 and ventral left lateral view, x 1.2. Küttejõu quarry, collected by A. Rõõmusoks, 1956.

5 – TUG 1054-148 [Öpik, 1930a, pl. XII, fig. 148]. Ventral valve exterior, x 1.8. Käva quarry, collected by A. Öpik.

6 – TUG 1054-150 [= GMUT Br 216, Rõõmusoks, 1989, pl. I, fig. 5]. Posterior view, x 1. Kohtla quarry, collected by A. Öpik.

7 – TUG 1003-233 [= GMUT Br 1316, Rõõmusoks, 1989, pl. I, fig. 3]. Ventral valve ornament, x 3. Küttejõu quarry, collected by A. Rõõmusoks, 1962.

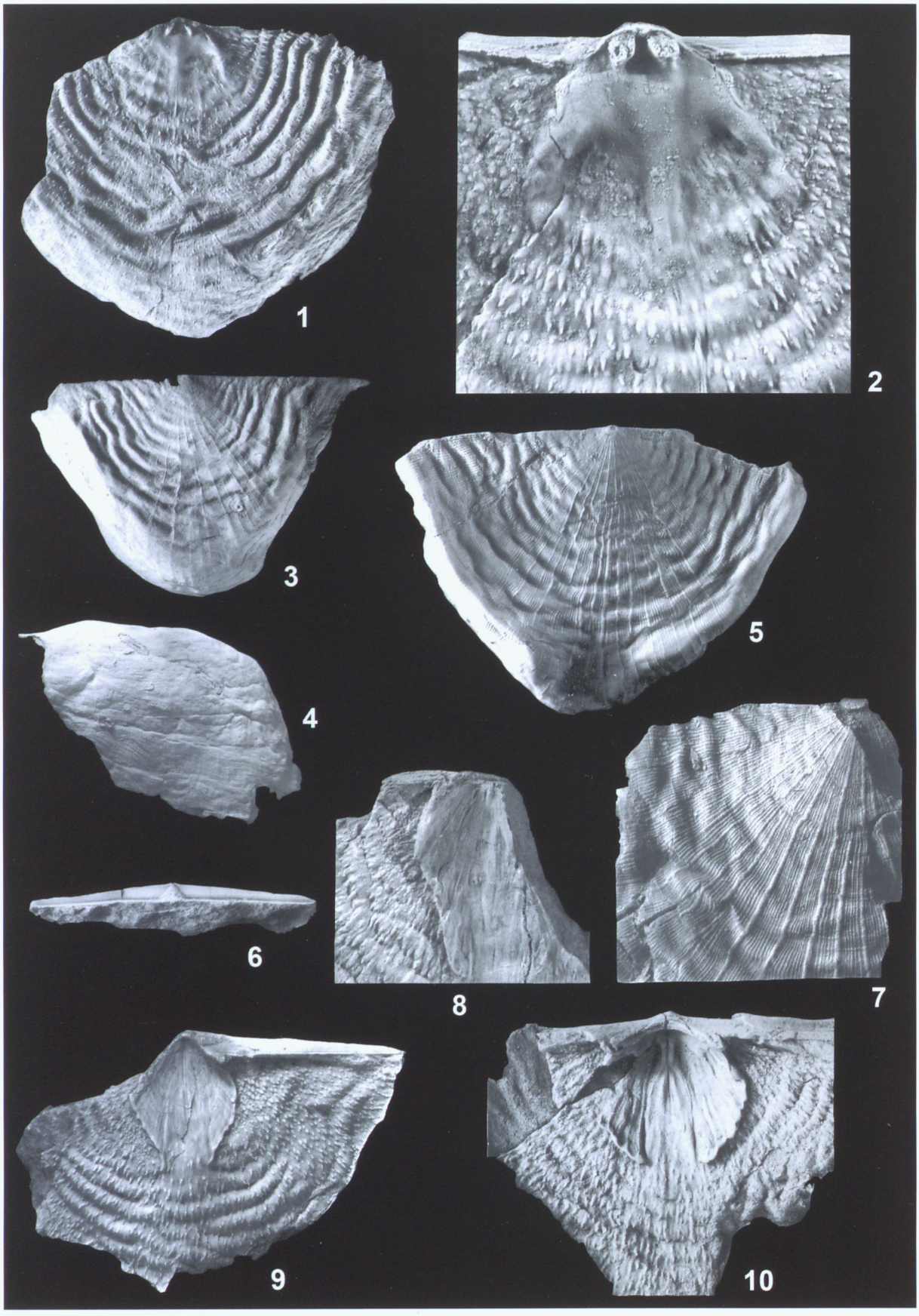
8 – TUG 73-151. Fragmentary ventral valve interior, x 2. Lasnamägi, town of Tallinn, exposure at South Lighthouse, collected by H. Bekker.

9 – TUG 1003-170. Ventral valve interior, x 2. Küttejõu quarry, collected by A. Rõõmusoks, 1963.

Figure 10. *Kurnamena spumifera* (Öpik); p. 56
Kukruse Stage, Viivikonna Formation, Kiviõli Member.

TUG 1054-152 [Öpik, 1930a, pl. XIII, fig. 152; = GMUT Br 218, Rõõmusoks, 1989, pl. I, fig. 4]. Ventral valve interior, x 2. Käva quarry, collected by A. Öpik.

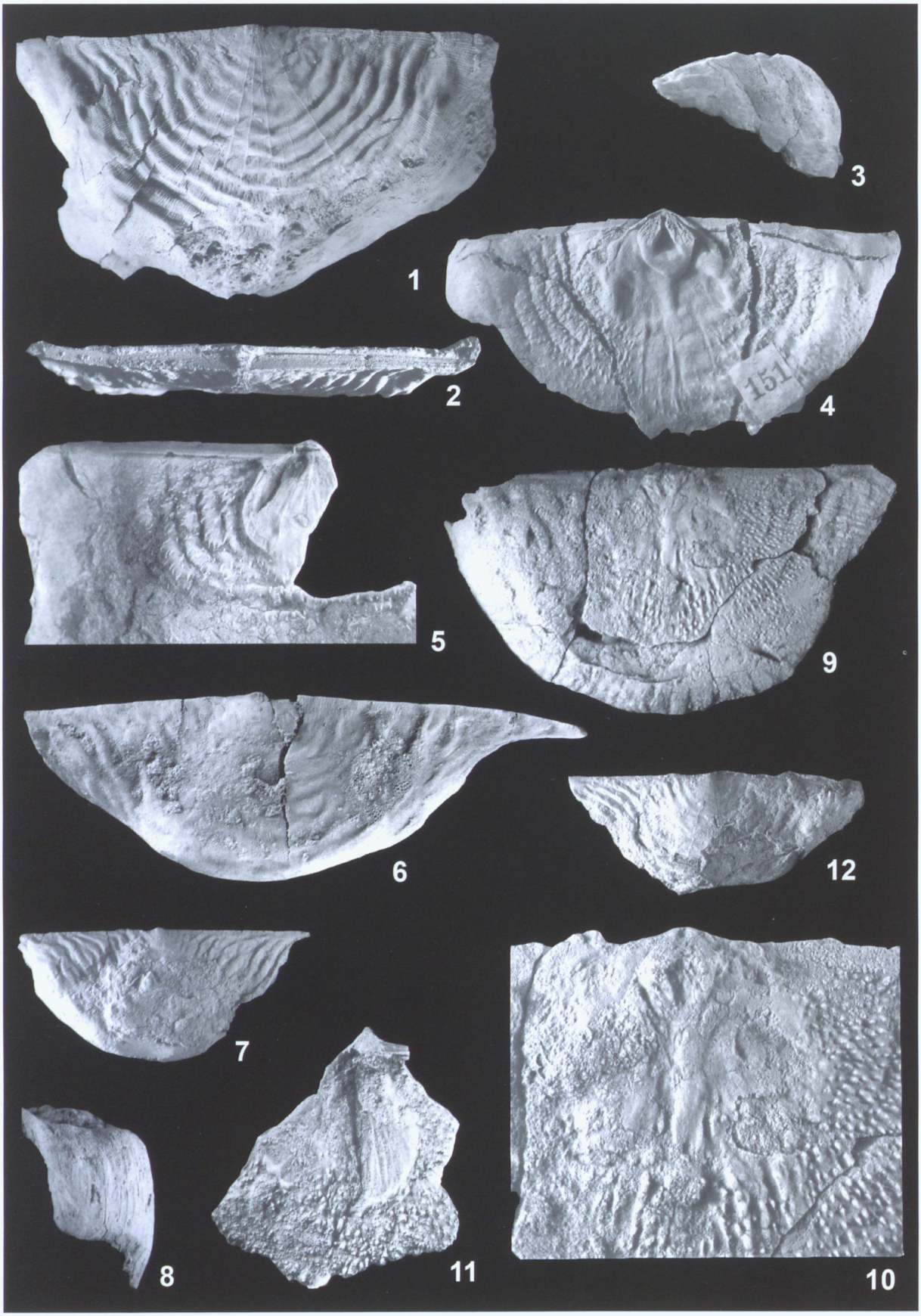
PLATE XXIII



Figures 1–5. *Kurnamena spumifera* (Öpik); p. 56
Kukruse Stage, Viivikonna Formation, Kiviõli Member.
1–3 – Holotype, TUG 1054-149 [Öpik, 1930a, pl. XII, fig. 149]. Ventral valve exterior, x 1.7, posterior view, x 1.6 and left lateral view, x 1.5. Kohtla quarry, collected by A. Öpik.
4 – TUG 1054-151 [Öpik, 1930a., pl. XIII, fig. 151]. Dorsal valve interior, x 4.4. Kohtla quarry, collected by A. Öpik.
5 – TUG 72-205. Ventral valve interior, x 2.1. Kohtla quarry, collected by A. Öpik.

Figures 6–12. *Kurnamena acuta* sp. nov.; p. 57
Haljala Stage, Idavere Substage, Vasavere Formation.
6 – Holotype, TUG 1003-150. Ventral valve exterior, x 1.8. Soonurme ditch, collected by A. Rõõmusoks, 1966.
7–8 – TUG 1003-188A. Ventral valve exterior and left lateral view x 1. Aluvere quarry, collected by A. Rõõmusoks, 1961.
9–10 – TUG 1003-188B. Dorsal valve interior, x 1.6 and x 5.3. Aluvere quarry, collected by A. Rõõmusoks, 1961.
11 – TUG 72-187. Fragmentary ventral valve interior, x 2.2. Aluvere quarry, collected by A. Öpik.
Haljala Stage, Idavere Substage, Tatruse Formation.
12 – TUG 665-133. Dorsal valve exterior, x 1.3. Tatruse exposure, collected by A. Wahl.

PLATE XXIV



Figures 1–12. *Astamena inaequalis* Rõõmusoks; p. 61
Haljala Stage, Jõhvi Substage.

1–3 – Holotype, TUG 3-278 [= GMUT Br 1346, Rõõmusoks, 1989; pl. II, fig. 6]. Ventral valve exterior, x 2.3, anterior view, x 1.8 and right lateral view, x 2. Anija exposure, collected by A. Wahl.

4–5 – TUG 72-185 [= GMUT Br 1330, Rõõmusoks, 1989; pl. II, fig.9]. Anterior view, x 2 and oblique anterior view, x 1. Oandu riverbank at Aru, collected by A. Öpik.

6 – TUG 1003-153. Ventral valve exterior, x 2.3. Sämi exposure at Kunda river, collected by A. Rõõmusoks, 1964.

7 – TUG 72-143. Posterior view of conjoined valves, x 3.3. Alliku exposure, collected by A. Öpik.

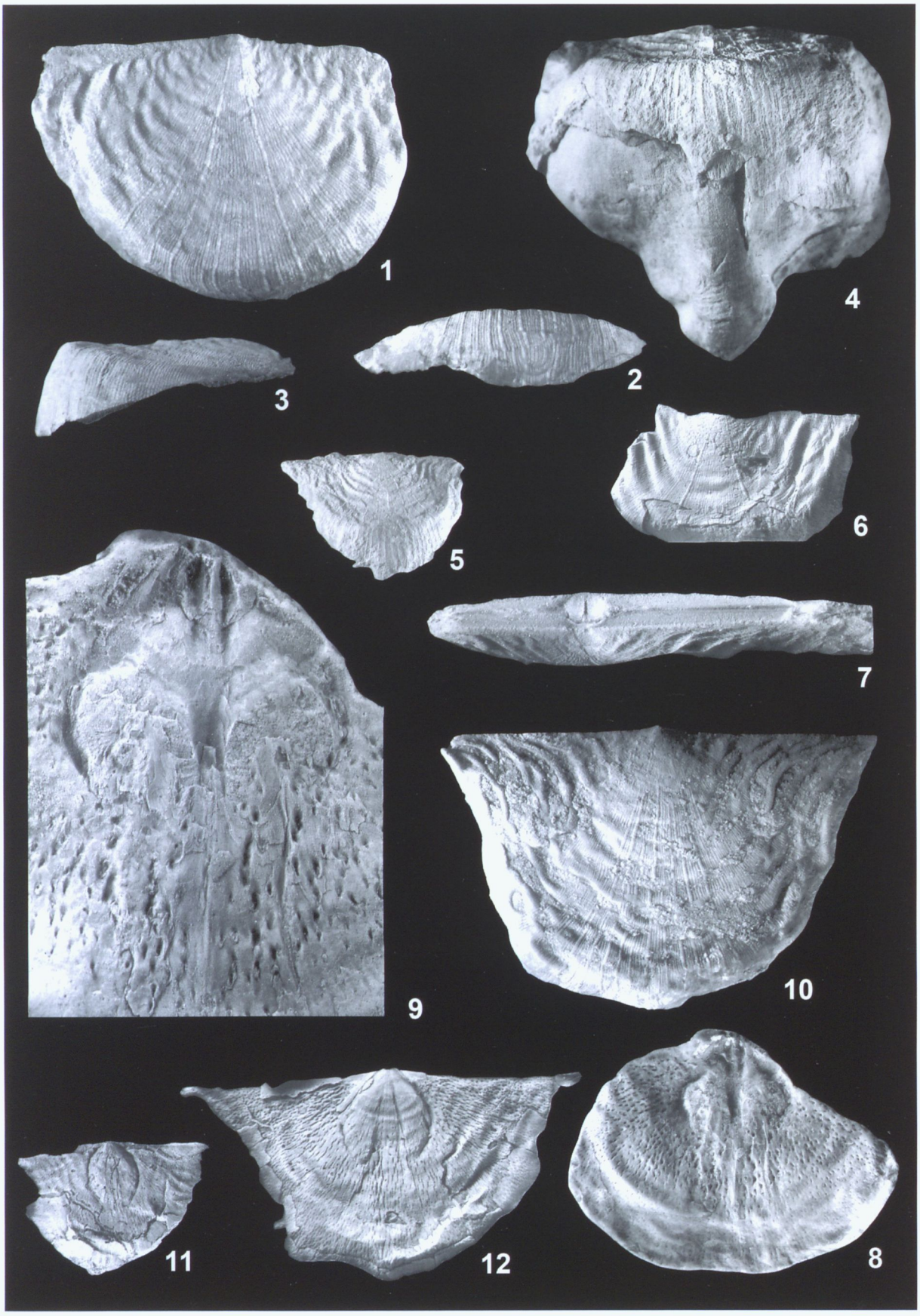
8–9 – TUG 72-190. Dorsal valve interior mould, x 2.1 and x 5. Põõsaspea (Spitham) coastbank, collected by A. Öpik.

10 – TUG 72-147. Ventral valve exterior, x 2.1. Aru exposure at Oandu river, collected by A. Öpik, 1933 or 1934.

11 – TUG 1003-194. Ventr. v. int. mould, x1. Sõjamägi exposure in town of Tallinn; from the boundary bentonite bed between Idavere and Jõhvi substages, collected by A. Rõõmusoks 1950.

12 – TUG 1014-1 [= GMUT Br 1345, Rõõmusoks, 1989, pl. II, fig. 8]. Ventral valve internal mould, x 1.8. Sõjamägi exposure in town of Tallinn; from the boundary bentonite bed between Idavere and Jõhvi substages, collected by an expedition in 1940.

PLATE XXV



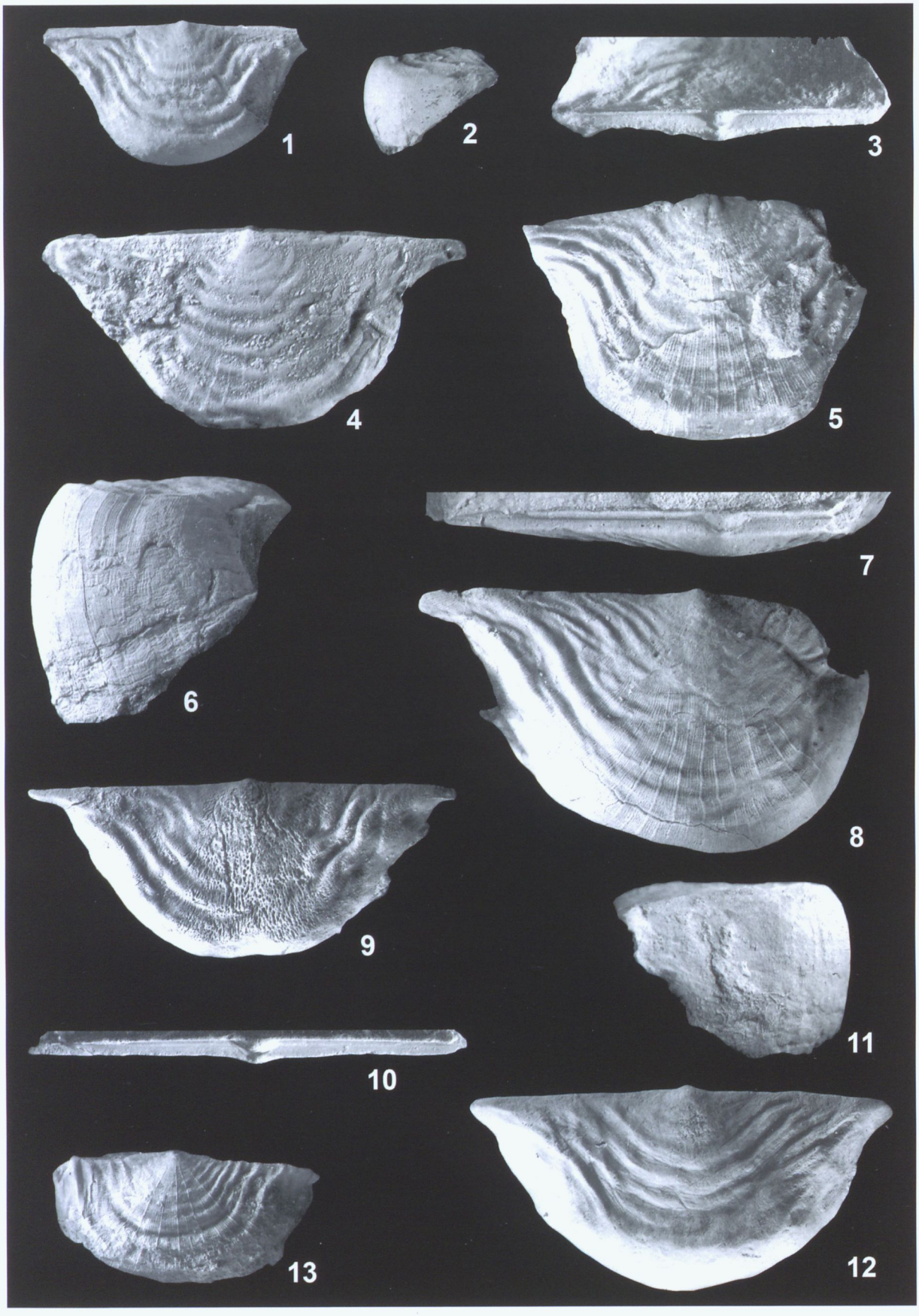
Figures 1–4. *Kurnamena taxilla* (Oraspõld); p. 55
Haljala Stage, Jõhvi Substage, lower Kahula Formation.
1–2 – Holotype, TUG 72-195 [= GMUT Br 3102, Oraspõld, 1956, pl. II, fig. 4]. Ventral valve exterior, x 2 and right lateral view, x 1.6. Alliku exposure, collected by A. Öpik.
3 – TUG 72-177. Posterior view, x 2.1. Alliku exposure, collected by A. Öpik.
4 – TUG 72-109 [= GMUT Br 3106, Oraspõld, 1956, pl. II, fig. 8]. Ventral valve exterior, x 1.7. Põõsaspea (Spitham) coast, collected by F. Schmidt.

Figures 5–8. *Kurnamena laterorugata* Rõõmusoks; p. 58
Keila Stage, upper Kahula Formation.
5 – Holotype, TUG 1003-192 [= GMUT Br 1331, Rõõmusoks, 1989, pl. III, fig. 5]. Ventral valve exterior, x 2.4. Sõmeru exposure, collected A. Rõõmusoks, 1964.
6–8 – ELM g 149:519. Right lateral view, x 1.7, posterior view, x 2 and ventral view, x 2. Keila-Kulna railway-side ditch, collected by A. Mickwitz, 1907.

Figures 9–12. *Kurnamena rugosoides* (Oraspõld); p. 59
Keila Stage, upper Kahula Formation.
9–11– Holotype, TUG 242-37 [= GMUT Br 3105, Oraspõld, 1956, pl. II, fig. 7]. Ventral valve exterior, x 1.6, posterior view, x 1.6 and left lateral view, x 2.3. Exposure in the town of Rakvere, collected by G. Mechmershausen.
12 – TUG 2-315. Ventral valve exterior, x 1.5. Town of Rakvere, old collection.

Figure 13. *Kurnamena taxilla* (Oraspõld); p. 55
Haljala Stage, Idavere substage, Tatruse Formation.
TUG 42-125. Ventral valve exterior, x 2. Idavere exposure, collected by F. Schmidt.

PLATE XXVI

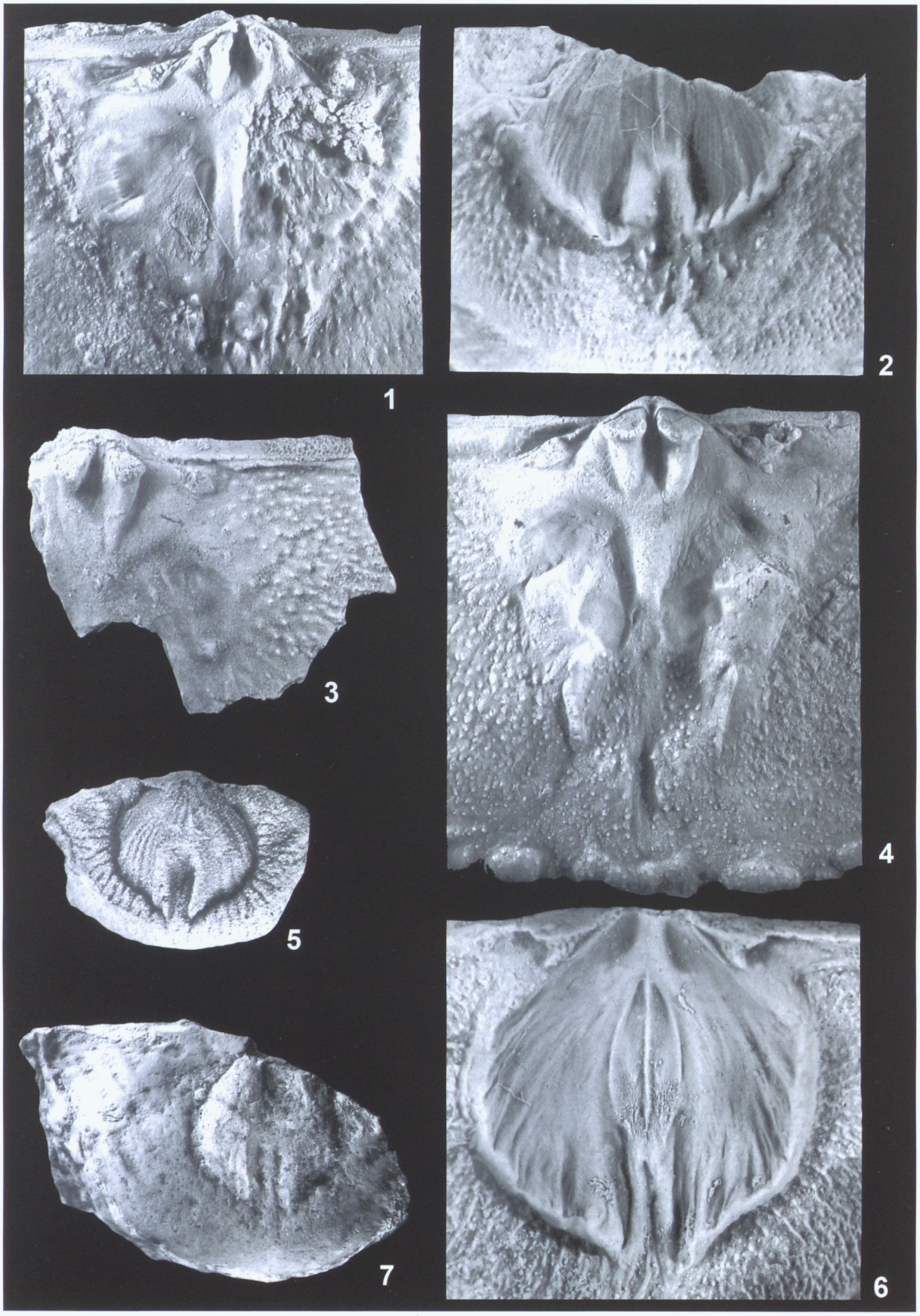


Figures 1–3. *Kurnamena taxilla* (Oraspõld); p. 55
Haljala Stage, Jõhvi Substage.
1 – TUG 72-192 [= GMUT Br 3103, Oraspõld, 1956, pl. II, fig. 6]. Dorsal valve interior, x 5. Alliku exposure, collected by A. Öpik.
2 – TUG 1003-179 [= GMUT Br 1329, Rõõmusoks, 1989, pl. III, fig. 4]. Fragmentary ventral valve interior, x 5. Alliku exposure, collected by A. Rõõmusoks, 1965.
Haljala Stage, Idavere Substage, Vasavere Member.
3 – TUG 72-191 [= GMUT Br 1344, Rõõmusoks, 1989, pl. II, fig. 7]. Fragmentary dorsal valve interior, x 4.3. Aluvere quarry, collected by A. Öpik.

Figures 4–6. *Kurnamena rugosoides* (Oraspõld); p. 59
Keila Stage, upper Kahula Formation.
4 – TUG 72-194 [= GMUT Br 3107, Oraspõld, 1956, pl. II, fig. 9]. Dorsal valve interior, x 5. Exposure in market place, town of Rakvere, collected by A. Öpik.
5 – TUG 43-162. Ventr. v. int. mould, x 2. Oandu riverbank, collected by R. Männil, 1947.
6 – TUG 47-438 [= GMUT Br 2400, Oraspõld, 1956, pl. II, fig. 10]. Ventral valve interior, x 5. An exposure in the town of Rakvere.

Figure 7. *Kurnamena laterorugata* Rõõmusoks; p. 58
Keila Stage, upper Kahula Formation, Ristna beds.
TUG 72-176. Ventral valve internal mould, x 2. Ristna cape, collected by A. Öpik.

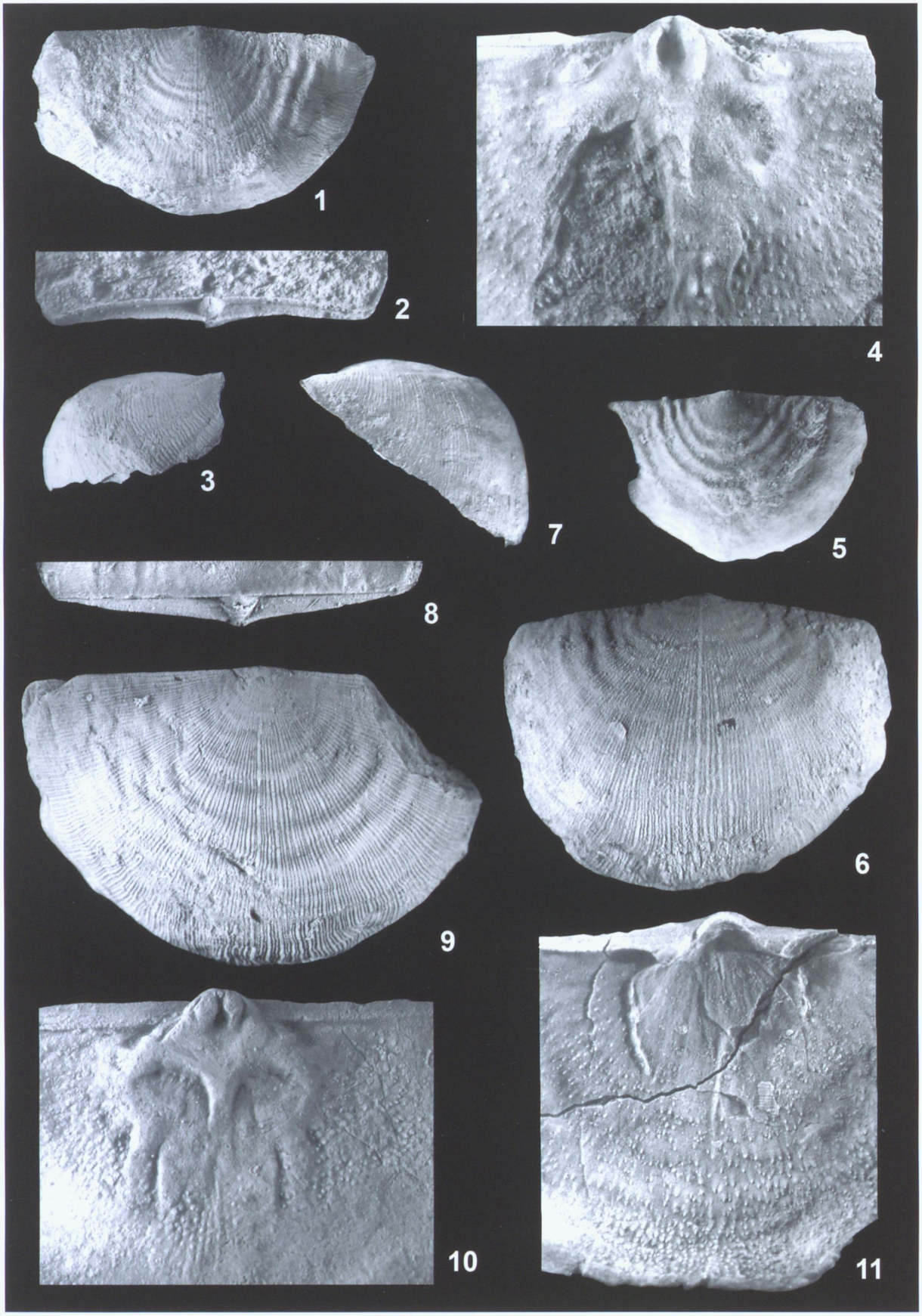
PLATE XXVII



Figures 1–5. ? *Kurnamena palmrei* sp. nov.; p. 60
Oandu Stage, Hirmuse Formation.
1–3 – Holotype, TUG 102-35. Ventral valve exterior, x 2, posterior view, x 2 and right lateral view, x 1.8. A temporary exposure in the town of Rakvere, collected by H. Palmre, 1937.
4 – TUG 1003-182. Dorsal valve interior, x 6.5. Town of Rakvere, exposure at a secondary school, collected by A. Rõõmusoks, 1960.
5 – TUG 1010-3. Ventral valve exterior, x 1.5. Bore-hole 57-g, depth 27.2 m. North-eastern Estonia.

Figures 6–11. *Oandumena fluviatilis* (Oraspõld); p. 62
Oandu Stage, Hirmuse Formation.
6–8 – Holotype, TUG 72-169 [= GMUT Br 3078, Oraspõld, 1956, pl. I, fig. 18]. Ventral valve exterior, x 3; left lateral view, x 2.8 and posterior view, x 3. Oandu river bank, collected by A. Öpik.
9 – TUG 102-32 [= GMUT Br 1347, Rõõmusoks, 1989, pl. III, fig. 7]. Ventral valve exterior, x 3.3. A temporary exposure in the town of Rakvere, collected by H. Palmre, 1937.
10 – TUG 695-5. Dorsal valve interior, x 5.8. Oandu river bank, collected by K. Orviku, 1933.
11 – TUG 72-168. Ventral valve interior, x 6.2. Oandu river bank, collected by A. Öpik.

PLATE XXVIII



Figures 1–7. *Similoleptaena paucirugata* Rõõmusoks; p. 63

Vormsi Stage, Kõrgessaare Formation.

1–2 – Holotype, TUG 1003-193 [= GMUT Br 1349, Rõõmusoks, 1989, pl. IV, figs. 4,5]. Ventral valve exterior, x 1.8 and left lateral view, x 2.3. Kõrgessaare quarry, Hiiumaa Island, collected by A. Rõõmusoks, 1955.

3–4 – TUG 42-89. Anterior view, x 1.9 and left lateral view, x 2. Kõrgessaare quarry, Hiiumaa Island collected by F. Schmidt.

5 – TUG 134-972. Ventral valve exterior, x 1.7. Sutlepa exposure, old collection.

6 – TUG 80-213. Dorsal valve internal mould, x 2.2. Saxby coast, Vormsi Island, collected by V. Jaanusson, H. Neuhaus and R. Männil (GALR), 1939.

7 – TUG 54-43. Dorsal valve interior, x 4. Paopa exposure, Hiiumaa Island, collected by A. Rõõmusoks and D. Kaljo, 1955.

Figures 8–10. ? *Similoleptaena ingrica* sp. nov.; p. 64

Oandu Stage, Hirmuse Formation. Left bank of the Plyussa River at Bol'shiye Pol'ya village in Ingria (Leningrad District), NW Russia, collected by A. Rõõmusoks, 1955.

8 – Holotype, TUG 1002-1. Ventral valve exterior, x 2.1.

9–10 – TUG 1003-54. Ventral valve exterior, x 2; left lateral view, x 2.1.

PLATE XXIX

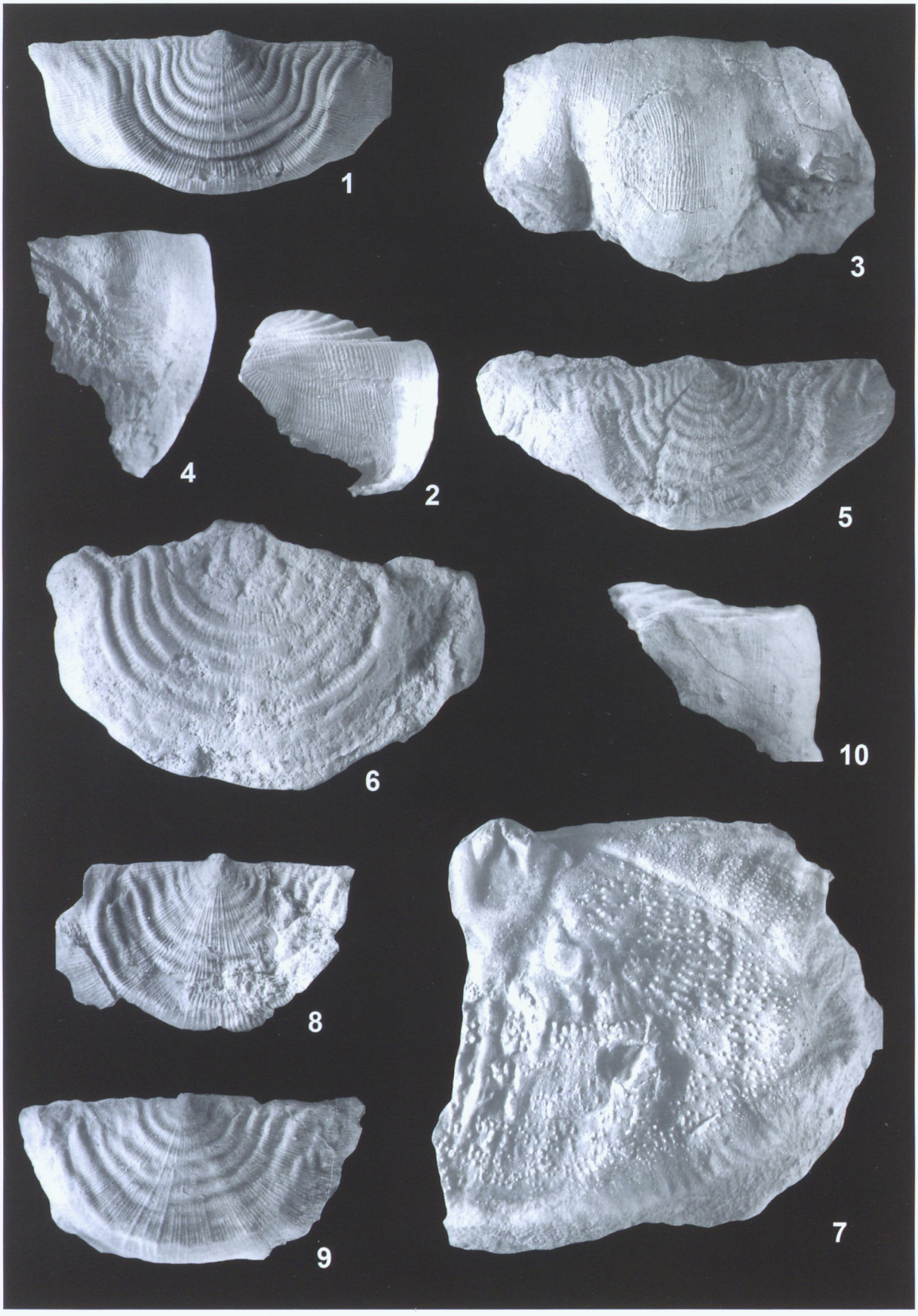


Plate XXX

Figure 1. ? *Similoleptaena tarwanpensis* sp. nov.; p. 65
Rakvere Stage, Rägavere Formation, Piilse Member.
Holotype, TUG 74-42. Ventral valve exterior, x 2.1. Piilse river bank, collected by A. Oraspõld, 1956.

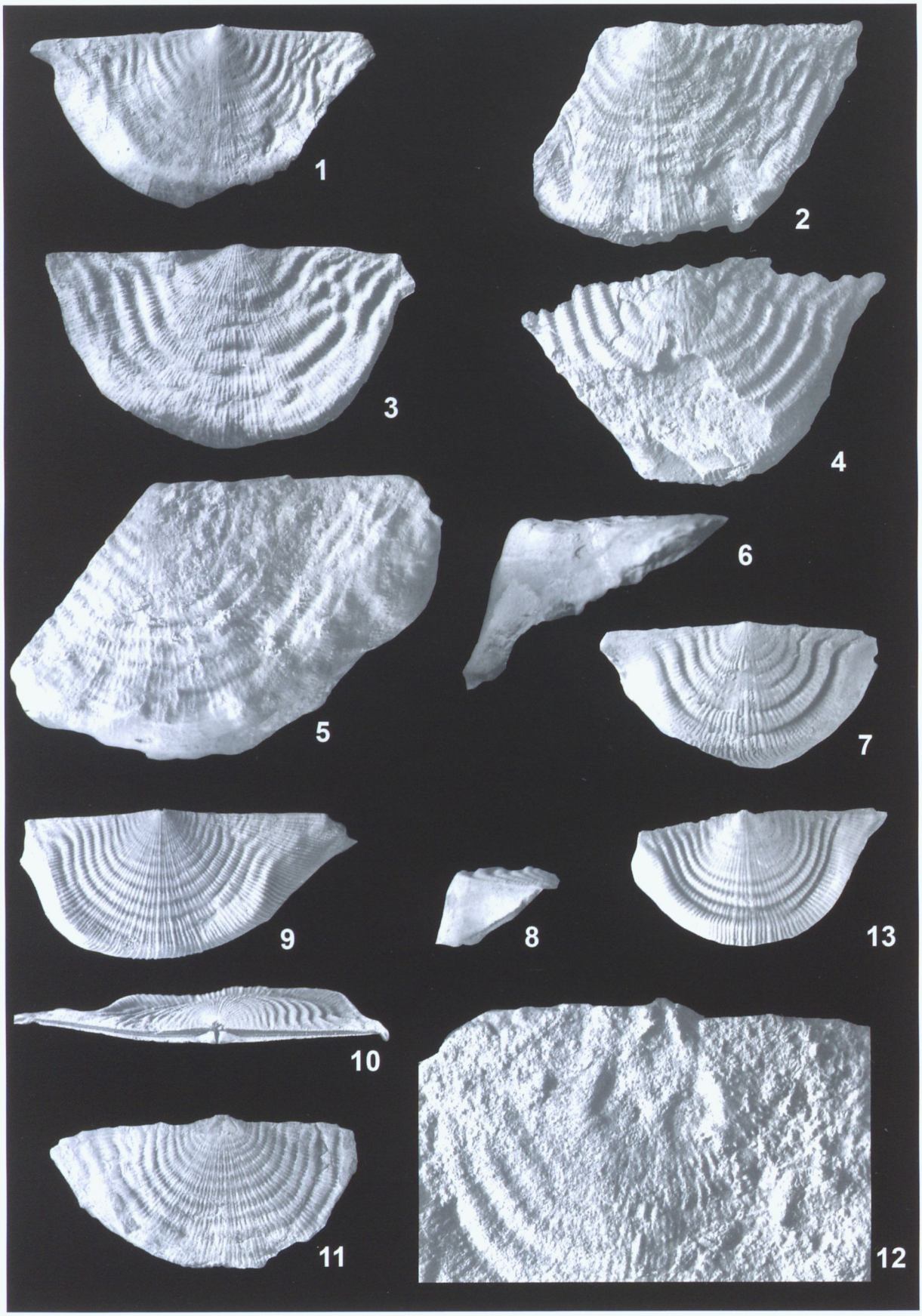
Figures 2–6. ? *Similoleptaena undosa* sp. nov; p. 65
Rakvere Stage, Rägavere Formation, Tudu Member.
2 – Holotype, TUG 80-224. Ventral valve exterior, x 2.1. Paekna exposure, collected by V. Jaanusson, J. Martna, H. Neuhaus, 1942.
3 – TUG 1001-1. Ventral valve exterior, x 2. Paekna exposure, collected by R. Männil and A. Rõõmusoks, 1956.
4 – TUG 1003-231. Ventral valve interior, x 2.8. Paekna exposure, collected by A. Rõõmusoks, 1961.
Nabala Stage, Paekna Formation.
5–6 – TUG 38-74. Ventral valve exterior, x 2 and right lateral view, x 1.6. Nõmmeküla exposure, collected by L. Sarv and V. Karise, 1953.

Figures 7–8. ? *Similoleptaena crassorugata* sp. nov.; p. 66
Nabala Stage, Saunja Formation.
Holotype, TUG 1003-242. Ventral valve exterior, x 2.7 and right lateral view, x 1.8. Tõrma exposure, collected by A. Rõõmusoks, 1954.

Figures 9–12. *Similoleptaena pertenuis* sp. nov.; p. 66
Pirgu Stage, Moe Formation.
9–10 – Holotype, TUG 50-33. Ventral valve exterior, x 1.8 and posterior view, x 2.1. Vormsi Island, Kärrslätt exposure, collected E. Möls, 1956.
11 – TUG 1003-229. Ventral valve exterior, x 1.6. Nyby (erratic), collected by A. Rõõmusoks, 1959.
12 – TUG 1003-169. Dorsal valve interior, x 4. Aulepa exposure, collected by A. Rõõmusoks, 1959.

Figure 13. ? *Similoleptaena friedrichi* sp. nov.; p. 68
Porkuni Stage, Ärina Formation, Siuge Member.
Holotype, TUG 42-121. Ventral valve exterior, x 3.4. Porkuni quarry, collected by F. Schmidt.

PLATE XXX



Figures 1–5. *Similoleptaena planitia* sp. nov.; p. 67

Pirgu Stage, Adila Formation.

1 – TUG 107-27. Ventral valve exterior, x 1.8. Erratic at sea-shore in the town of Haapsalu, Holm, collected by V. Reimer.

2 – Holotype, TUG 107-26. Ventral valve exterior; x 1.8. Erratic at sea-shore in the town of Haapsalu, Holm, collected by V. Reimer.

3 – TUG 46-43. Dorsal valve interior, x 2.2. Erratic at sea-shore, in the town of Haapsalu, Holm, collected by K. Orviku, 1937.

Pirgu Stage, Ärina Formation, Röa Member.

4 – TUG 42-119. Ventral valve internal mould, x 2. Porkuni quarry, collected by F. Schmidt.

5 – TUG 43-167. Dorsal valve interior, x 2. Kuru exposure, collected by R. Männil, 1961.

Figures 6–12. *Harjumena schmidti* (Gagel); p. 69

Nabala Stage, Saunja Formation.

6–7 – TUG 78-183 [= GMUT Br 1595, Rõõmusoks, 1993c, pl. III, figs 3, 4]. Ventral valve anterior and right lateral views, x 1. Kohatu exposure, collected by A. Öpik.

8 – TUG 72-183. Ventral valve exterior, x 0.9. Kohatu exposure, collected by A. Öpik.

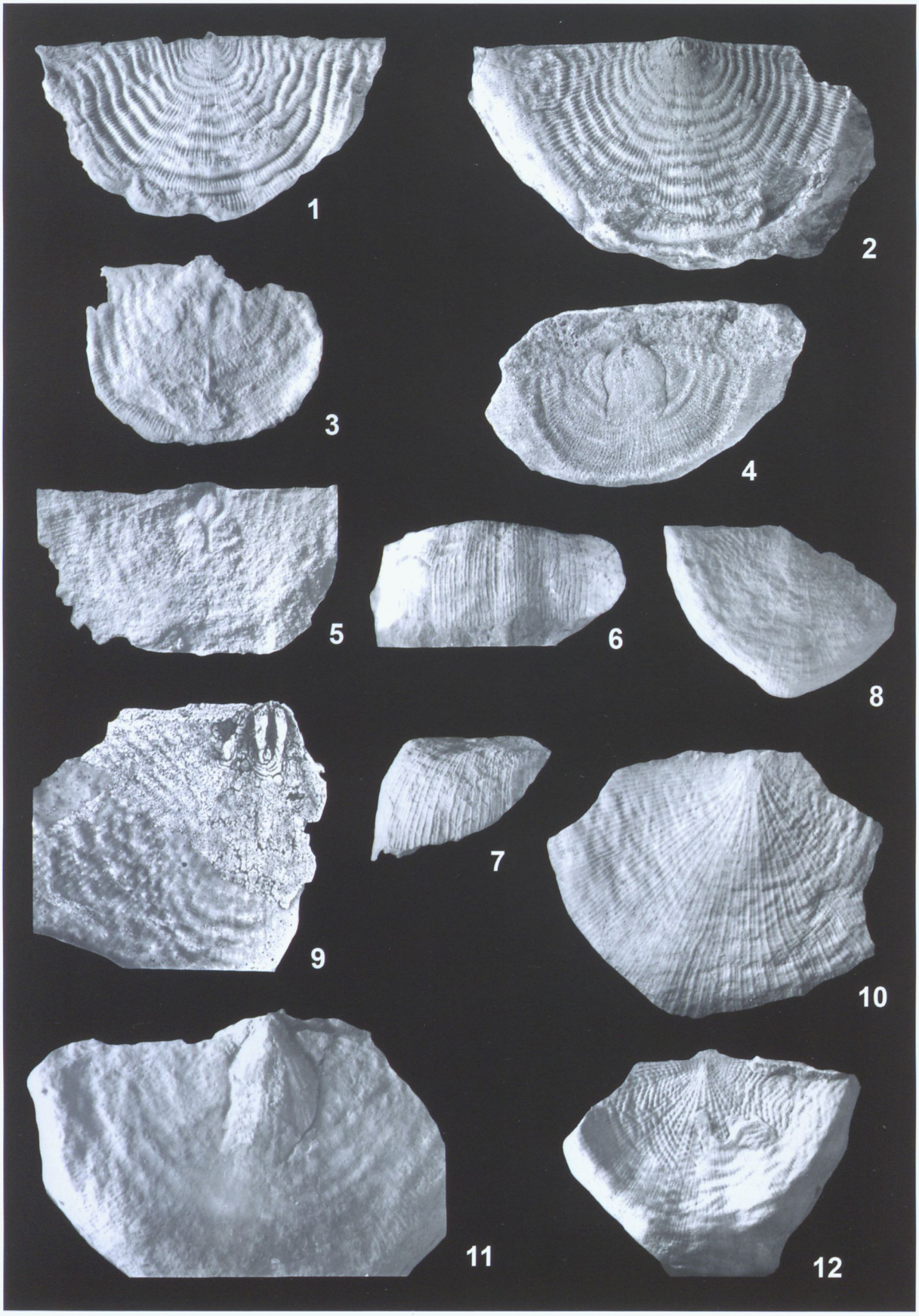
9 – RM Br 13609 [Rõõmusoks, 1993c, pl. III, fig. 7; Cocks & Rong, 2000 fig. 151, 2c]. Dorsal valve interior, x 3. Uuemõisa exposure, collected by G. Holm.

10 – TUG 2-318 [= GMUT Br 1594; Rõõmusoks, 1993c. pl. III, fig. 1]. Ventral valve exterior, x 1.6. Pürksi, erratic. Old collection.

11 – RM Br 13601 [= Rõõmusoks, 1993c, pl. III, fig. 6; Cocks & Rong, 2000; fig. 151, 2b]. Ventral valve internal mould, x 2. Mõnuste quarry, collected by G. Holm.

12 – TUG 861-5 [= GMUT Br 1636; Rõõmusoks, 1993c, pl. III, fig. 2; Cocks & Rong, 2000, fig. 151, 2a]. Ventral valve exterior, x 1. Hiiumaa Island, Käina, erratic, collected by H. Ignatius.

PLATE XXXI



Figures 1–4. ? *Bekkeromena ilmari* sp. nov.; p. 70

Nabala Stage, Saunja Formation.

1 – Holotype, TUG 81-5. Ventral valve exterior, x 1.9. Taaldevälja exposure, collected by I. Mitnits, 1948.

2 – TUG 106-21. Dorsal valve interior, x 5. Odulema exposure, collected by D. Kaljo, 1952.

3 – TUG 72-202. Posterior view, x 2. Tõrma exposure, collected by A. Öpik.

4 – TUG 2-327. Left lateral view, x 1.7. Mõnuste quarry, old collection.

Figures 5–8. *Bekkeromena vormsina* sp. nov.; p. 71

Vormsi Stage, Kõrgessaare Formation.

5 – Holotype, TUG 2-325. Ventral valve exterior, x 1.6. Küti exposure, collected F. Schmidt.

6 – TUG 2-326. Right lateral view of ventral valve, x 1.9. Saksi exposure, old collection.

7 – TUG 1003-178 [= GMUT Br 1296; Rõõmusoks, 1963, pl. I, fig. 5; Cocks & Rong, 2000, fig. 152,2d]. Dorsal valve interior, x 6. Paopa quarry, Hiiumaa Island, collected by A. Rõõmusoks, 1955.

8 – TUG 42-93 [= GMUT Br 1297; Rõõmusoks, 1963, pl. I, fig. 5; Cocks & Rong, 2000, fig. 152,2c]. Ventral valve int., x 2.4. Küti exposure, collected by F. Schmidt.

Figure 9–10. ? *Bekkeromena infirma* sp. nov.; p. 72

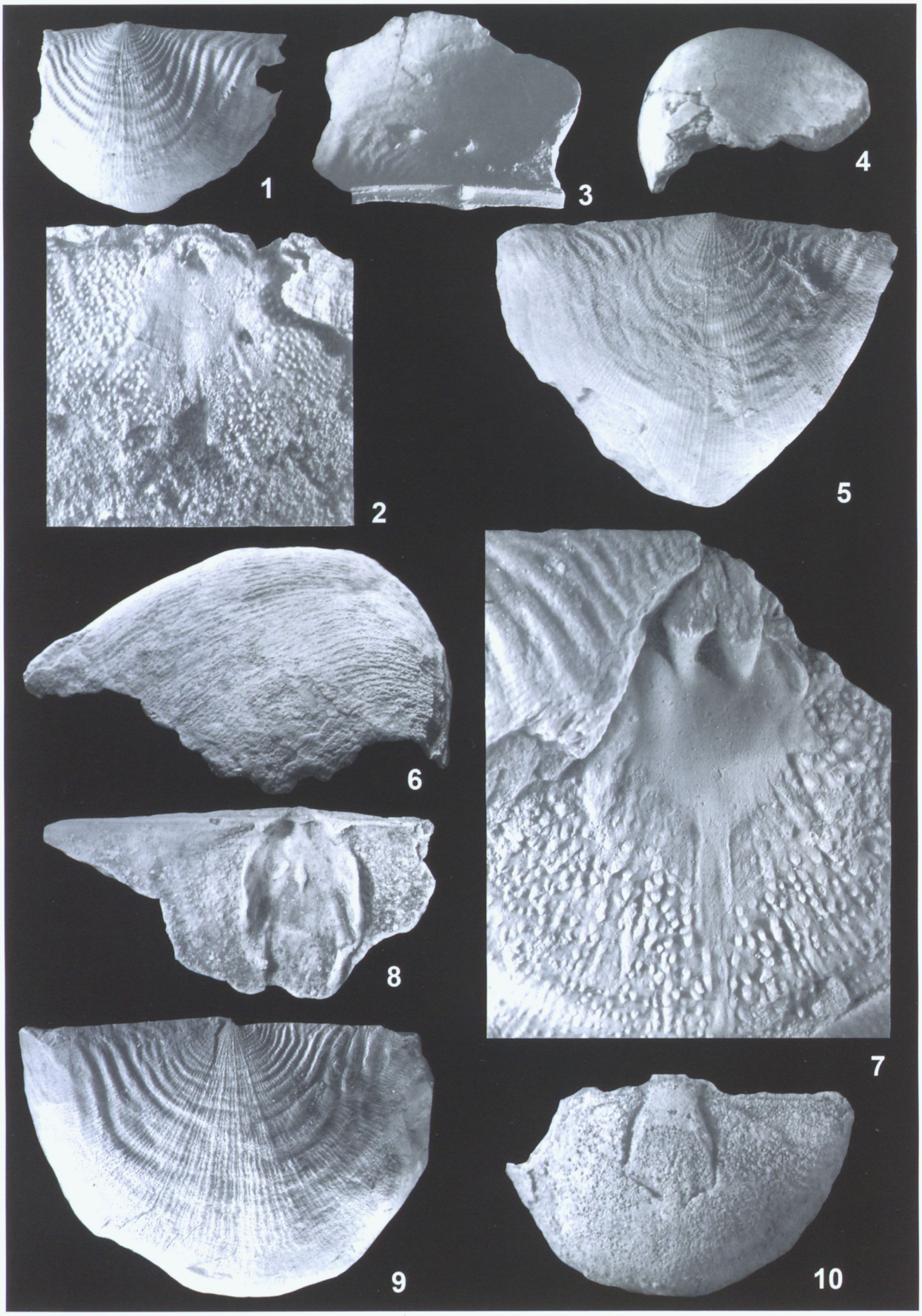
Pirgu Stage, Moe Formation.

9 – Holotype, TUG 72-170 [= GMUT Br 1310; Rõõmusoks, 1963, pl. I, fig. 8]. Ventral valve exterior, x 1.8. Moe exposure, collected A. Öpik.

Pirgu Stage, Ärina Formation, Röa Member.

10 – TUG 112-13. Ventral valve internal mould, x 1.6. Enniksaare ditch, collected by H. Teder.

PLATE XXXII



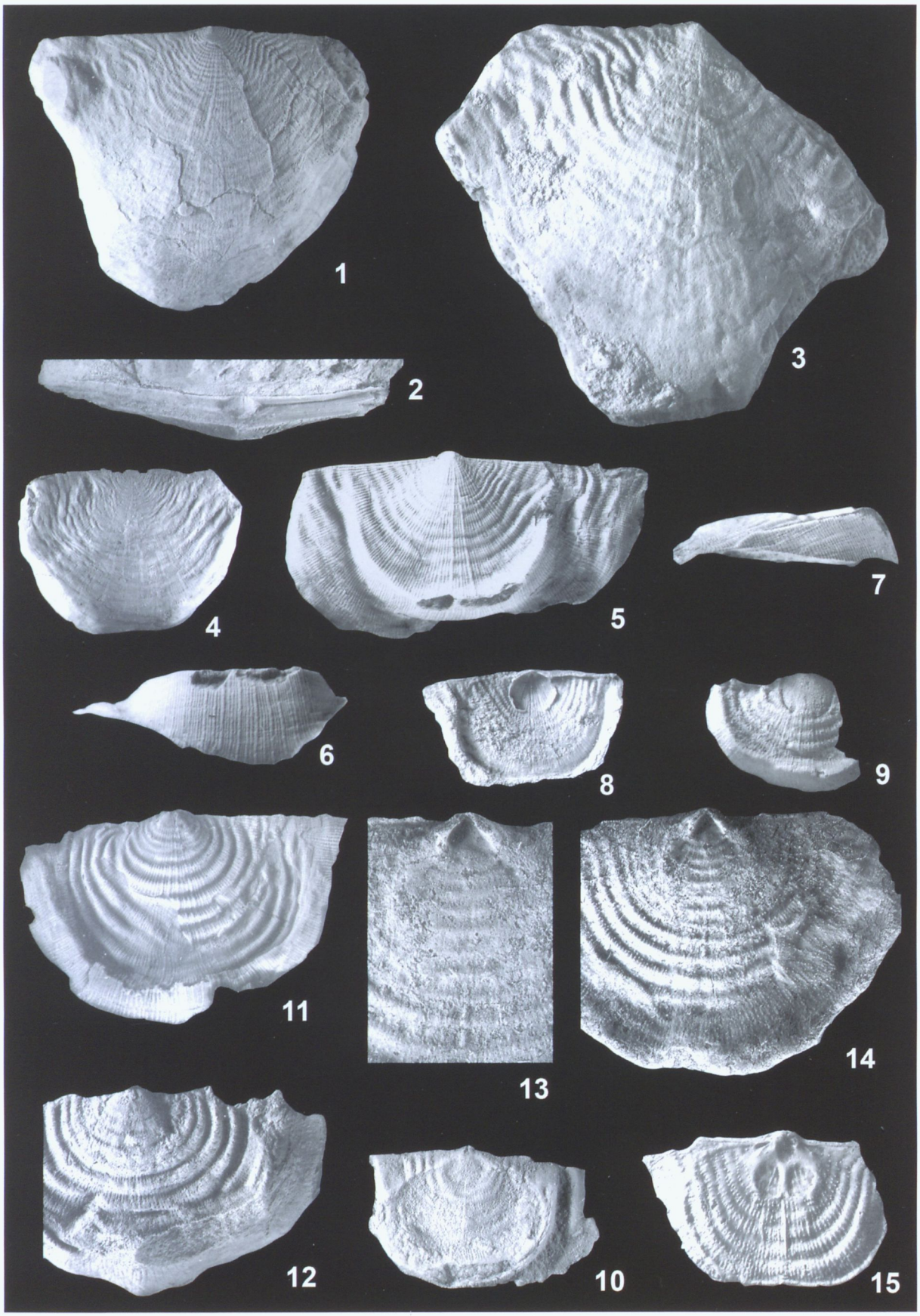
Figures 1–4. *Bekkeromena* aff. *semipartita* (Roemer); p. 73
Pirgu Stage, Adila Formation.
1–2 – TUG 42-90. Ventral valve exterior, x 1.4 and posterior view, x 1.5. Piirsalu exposure, collected by F. Schmidt.
3 – TUG 80-214. Ventral valve exterior, x 2. Vormsi Island, Hosholm coast, collected by V. Jaanusson, S. Kiin and R. Männil, 1939.
4 – TUG 472-15. Ventral valve exterior, x 1. Upper Ordovician limestone erratics, Sadewitz, Silesia, Poland, collected by F. Roemer.

Figures 5–10. *Schmidtomena acuteplicata* (Öpik); p. 74
Porkuni Stage, Ärina Formation.
5–7 – Lectotype, TUG 72-164. Ventral valve exterior, x 2; anterior view x 2 and left lateral view, x 1.6. Porkuni quarry, Tõrevere Member, collected by A. Öpik.
8 – TUG 1001-3. Ventral valve interior, x 2. Soonurme exposure, Siuge Member, collected by E. Rosenstein.
9 – TUG 54-52. Ventral valve internal mould, x 2. Aruküla-Kivisti exposure, Vohilaid Member, collected by A. Rõõmusoks and D. Kaljo, 1954.
10 – TUG 2-399, dorsal valve interior, x 2. Porkuni quarry, Vohilaid Member.

Figures 11–14. *Leptaena rugosa* Dalman; p. 46
Dalmanitina beds, Sweden. Ålleberg, Västergötland, Sweden (photos by L. Ramsköld, Stockholm).
11 – RM Br 10422, latex cast of ventral valve exterior, x 2.
12 – RM Br 10438, latex cast of ventral valve interior, x 2.
13–14 – RM Br 10425, latex cast of dorsal valve interior, x 3.3 and x 2.

Figure 15. "*Leptaena*" sp.; p. 46
TUG 42-117. Dorsal valve interior, x 2.3.
Silurian, Wenlock Series, Jaani Stage, Jaani Formation, Paramaja Member, Paramaja cliff, Saaremaa Island, collected by F. Schmidt.

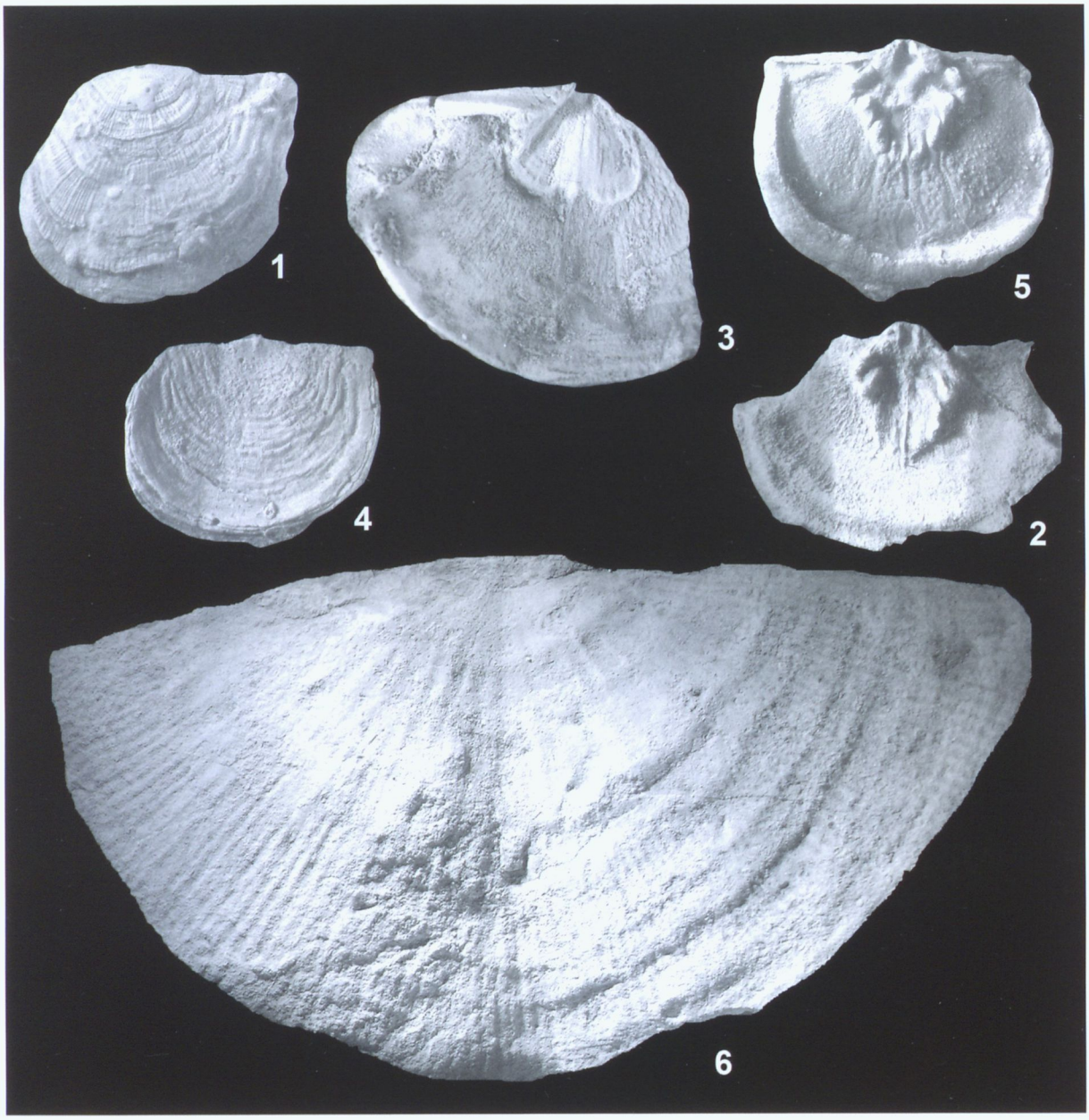
PLATE XXXIII



Figures 1–5. *Sakunites luhi* (Sokolskaya); p. 31
Oandu Stage, Vasalemma Formation, Saku Member.
1 – TUG 72-237. Ventral valve exterior, x 2. Tuula exposure; collected by A. Öpik.
2 – TUG 72-234. Dorsal valve interior, x 2. Üksnurme; collected by A. Öpik.
3 – TUG 72-175. Ventral valve interior, x 2. Jõgisoo; collected by A. Öpik.
4–5 – TUG 72-173 [= GMUT Br 3085. Oraspõld, 1956, pl. III, figs 1,1a]. Dorsal valve exterior, x 2; dorsal valve interior, x 2.7. Saku; collected by A. Öpik.

Figure 6. *Strophomeninae* genus and species undetermined, p. 22
Porkuni Stage, Ärina Formation, Siuge Member.
6 – TUG 47-657. Ventral valve exterior, x 1.4. Tikkaru exposure.

PLATE XXXIV



ISSN 1406-0728
ISBN 9985-4-0412-2

ISSN 1406-0728
ISBN 9985-4-0412-2

Ordovician strophomenoid brachiopods of northern Estonia

Arvo Rõõmusoks

Fossilia Baltica 3

Institute of Geology, University of Tartu