

## SOME BRACHIOPOD GENERA OF THE SUBFAMILY STROPHOMENINAE FROM THE ORDOVICIAN OF ESTONIA

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**Abstract.** Emended diagnosis is proposed for the genus *Actinomena* (Öpik, 1930). *Actinomena asmusi* (Verneuil, 1845) is included to the genus *Longvillia* Bancroft, 1933. Two new genera are erected: *Keilamena*, type species *Actinomena occidentis* Männil in Oraspõld (Ораспыльд, 1956), and *Rugomena*, type species *Rugomena adiensis* sp. n. For the genera *Microtrypa* Wilson, 1945, *Trigrammaria* Wilson, 1945, and *Luhaia* Rõõmusoks, 1956, new data of distribution are presented.

**Key words:** Strophomenida, Ordovician, Estonia.

In the Ordovician sequence of Estonia four genera of the subfamily Strophomeninae, *Actinomena*, *Microtrypa*, *Trigrammaria*, and *Luhaia*, have hitherto been recorded. The subgenus *Strophomena* (*Actinomena*) Öpik was raised to generic rank already by Sokolskaya (Сокольская, 1954). Besides the type species *S.(A.) orta*, Öpik included in *Strophomena* (*Actinomena*) four subspecies from the Kukruse Stage, *Orthis asmusi* Verneuil from the Keila Stage, and some Upper Ordovician species (Öpik, 1930, p. 166). According to Sokolskaya (Сокольская, 1954) *O. asmusi* was a *Strophomena*, whereas Oraspõld (Ораспыльд, 1956) regarded the species together with a new species *occidens* as representatives of *Actinomena*. Spjeldnaes (1957) was mistaken treating *Actinomena* as a synonym to *Kjerulfina*; he included also *A. asmusi* in this genus. In this paper *A. asmusi* and *A. occidentis* are not considered as congeneric with *A. orta*. The former species is very similar to *Strophomena grandis* Sow, the type species of *Longvillia* Bancroft, 1933. The latter species, *A. occidentis* Männil in Oraspõld (Ораспыльд, 1956), is here selected as the type species for the new genus *Keilamena*.

Spjeldnaes (1957) described three new species of *Strophomena* (*S. norvegica*, *S. hirsuta*, *S. steinari*) from the Upper Caradoc of Norway. He mentioned that *Strophomena* includes both species with a comparatively coarse undifferentiated sculpture, and those with fine, well differentiated sculpture. The latter species might perhaps be included in *Longvillia* (Spjeldnaes, 1957, p. 140). Subsequently Williams (1963, p. 452) redescribed and figured *S. grandis*, which distinctly differs from the other species of *Strophomena* in shape and sculpture. In spite of this Williams (1965) regarded *Longvillia* as a junior synonym of *Strophomena*. Cocks (1990) has now asked the International Commission on Zoological Nomenclature to designate the well-known species *Leptaena planumbona* Hall as the type species of *Strophomena*. Proceeding from



this, all species of Baltoscandian *Strophomena* should probably be assigned to other genera. During a visit to Oslo in 1991 I examined the types of Høltedahl (1916) and Spjeldnaes (1957) in Paleontologisk Museum. As a result it could be asserted that a true *Strophomena* does not occur in the Viruan of Baltoscandia. *Strophomena norvegica* Spjeldnaes might be included in *Longvillia*, *S. steinari* Spjeldnaes, and perhaps *S. hirsuta* Spjeldnaes, in *Keilamena* gen. n.

The types of the species described by Öpik are housed in the Institute of Geology, Estonian Academy of Sciences, Tallinn. The types of the new species are housed in the Museum of Geology of Tartu University (Br. marking the brachiopod types catalogue numbers).

### Genus *Actinomena* Öpik, 1930

**Type species** (by original designation). *Strophomena (Actinomena) orta* Öpik, 1930, p. 166; pl. X, figs. 131, 132, 135 (see Pl. I, figs. 1—9 in the present paper) from the Kukruse Stage, Kiviõli Member of Viivikonna Formation (U. Llandeilu), North Estonia.

**Diagnosis** (emended): Medium-sized thin-shelled resupinate Strophomeninae with almost flat, semielliptical ventral disc, and long ventrally deflected trail. Geniculum rounded. Ornament strongly unequally parvicostellate with widely spaced accentuated costellae. Short weak oblique wrinkles along hinge line laterally at umbo. Ventral muscle field small, elongately subquadrate in outline and with short, low subparallel bounding ridges. Adductor scar broad, weakly raised. Cardinalia small. Two pairs of weakly developed transmuscle septa. Extra-muscular area densely and finely, irregularly pseudopunctate.

**Discussion.** *Actinomena* differs from *Strophomena* in having stronger resupination and a long trail (mostly broken off), weakly oblique wrinkles, strongly unequally parvicostellate ornament, and by the character of the ventral muscle field.

**Distribution.** The type species is known only from the Kukruse Stage. A still undescribed new species occurs in the underlying Uhaku Stage (L. Llandeilu). Another undescribed species of *Actinomena* occurs in Dalby Limestone (mostly equivalent of the Kukruse Stage) on Öland and in the Siljan district, Sweden (Jaanusson, 1960, 1963). *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 perhaps belongs to a new genus, related to *Rugomena* gen. n.

Thus *Actinomena* seems to be a genus endemic for Baltoscandia occurring in beds equivalent to the *Pygodus anserinus* Conodont Zone of Bergström (1971).

### Genus *Microtrypa* Wilson, 1945

The first representative ascribed to *Microtrypa* from the Ordovician of Europe is *M. cassata* Williams from the Scottish Craighead Limestone (U. Caradoc) (Williams, 1962). Three other species of this genus were recently described from Baltoscandia by the author (Rõõmusoks, 1985). They are *M. estonica* from the Oandu and Rakvere stages, *M. minima* from the Rakvere Stage (U. Caradoc till L. Ashgill), Estonia, and *M. oelandica* from the Gräsgård Siltstone boulders (topmost Caradoc), Öland, Sweden.



Now the author has examined the types of *Strophomena keilhau* Høltedahl (1916, p. 53; pl. VII, fig. 8) and Spjeldnaes (1957, p. 146) in Paleontologisk Museum, Oslo. These specimens, plus two interiors of the ventral valve on the reverse side of the sample collected from the top of Mjøsa Formation (roughly equivalent to the Rakvere Stage of Estonia; Spjeldnaes, 1982; Owen et al., 1990), seem to be related to *M. estonica* Rõõmusoks. The European forms probably represent invading elements of the fauna from North American Midcontinent, where this genus occurs in much older strata (Wilson, 1945; Cooper, 1956), equivalents to *N. gracilis* to *D. multident* zones (Bergström, 1971).

#### Genus *Trigrammaria* Wilson, 1945

Occurrence of this originally North American Midcontinent stock (known mainly from the Ottawa Formation) in the Ordovician of Baltoscandia was first mentioned by Jaanusson (1982, p. 28, 33, 39), who referred to an undescribed *Trigrammaria* sp. n. A. from the Molda and Skålberg limestones (= equivalents of the Oandu Stage in Estonia) in the Siljan district, Sweden. This species was later described by the author as *T. valdari* (Rõõmusoks, 1985, p. 135). Another Upper Caradoc form is *Trigrammaria* sp. from the Gräsgård Limestone boulders on Öland, and from a probably contemporaneous limestone glacial boulder at Boltenhagen, North Germany (Rõõmusoks, 1985, p. 136). It is interesting to note that from the latter boulder the author has identified some species which are characteristic of the upper part of the Keila Stage in Estonia together with *Toxochasmops* cf. *extensus* (Boeck). Thus, *Trigrammaria* sp. mentioned above may be the oldest representative of the genus in Baltoscandia. The youngest known species of the genus — *T. virve* — occurs in the Nabala Stage, Paekna Formation (L. Ashgill) in North Estonia (Rõõmusoks, 1985, p. 134). Thus, in Baltoscandia the occurrence of both *Trigrammaria* and *Microtrypa* is within the *Amorphognathus superbus* Conodont Zone as defined by Bergström (1971).

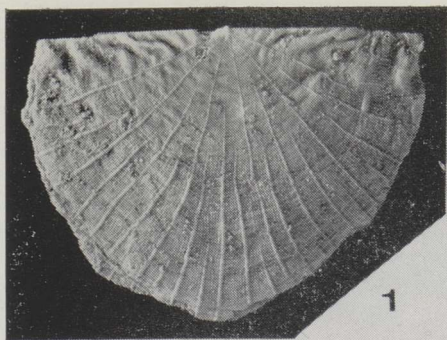
#### PLATE I

Figs. 1—9. *Actinomena orta* (Öpik), all from Kukruse Stage, Viivikonna Formation. 1 — dorsal exterior 201 (133) (×2). Kohtla. Figured by Öpik (1930, pl. X, fig. 133). 2—4 — ventral, lateral, and posterior views (Br 1502) (×2). Kohtla, coll. A. Öpik. 5—6 — dorsal interior (×2 and ×5). Kohtla. Figured by Öpik (1930, pl. X, fig. 135). 7 — ventral interior (×2) (Br 1504). Kohtla, coll. A. Öpik. 8 — ventral interior (×4.4) (Br 1515). Küttejõu, coll. author, 1964. 9 — dorsal interior (×3) (Br 2401), Kohtla. Figured by Oraspõld (Ораспыльд, 1956, pl. III, fig. 6).

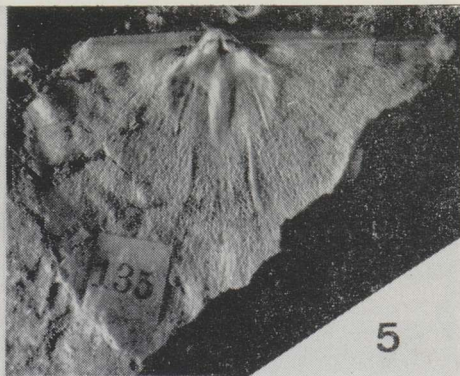
#### PLATE II

Figs. 1—5. *Luhaia vardi* Rõõmusoks, all from Pirgu Stage, Adila Formation. 1 — dorsal mould. Holotype (×1) (Br 4004). Hosholm, Vormsi Island, coll. V. Jaanusson, S. Kiin, and R. Männil in 1939. 2 — posterior view (×2) (Br 1611). Haapsalu, coll. V. Reimer. 3—4 — posterior and lateral views (×2) (Br 4003). Uuemõisa, coll. B. Stein. 5 — ventral view (×2) (Br 1607). Hosholm, Vormsi Island, coll. V. Jaanusson, S. Kiin, and R. Männil in 1939. Figs. 6—7. *Luhaia* sp. n., ventral and dorsal interior (×3) (G 1010, Paleontologiska Museet, Uppsala). Öjle Myr Limestone (block 17), Gotland, coll. O. W. Wennersten in 1897; photo L. Ramsköld.

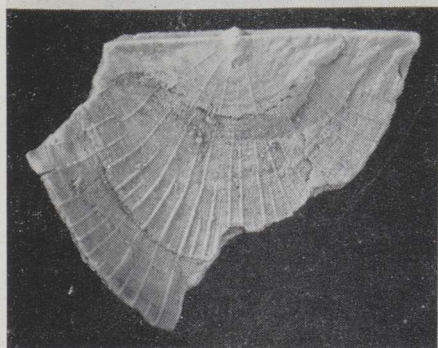




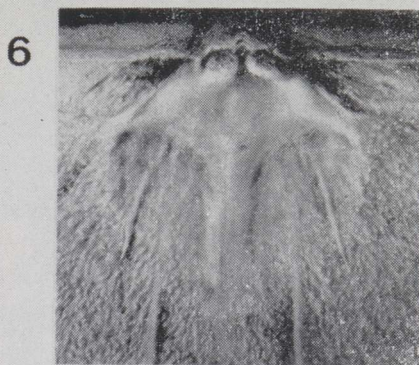
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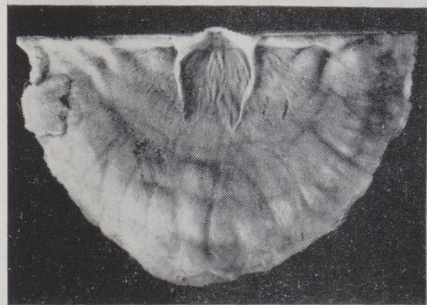
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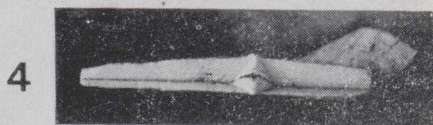
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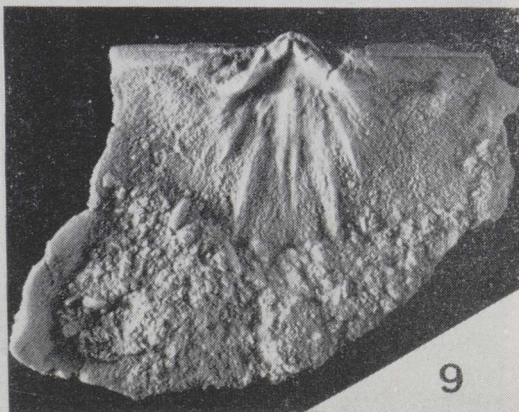
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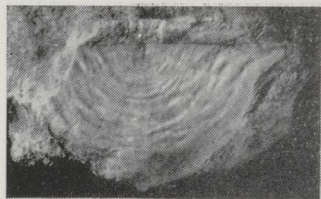


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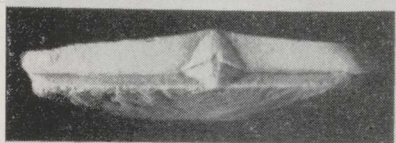


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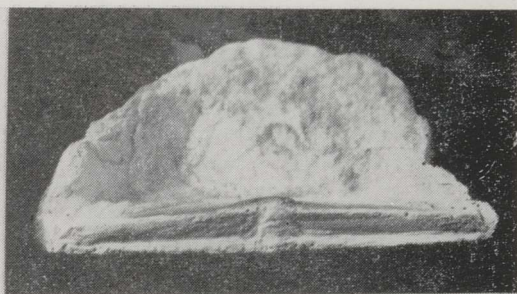




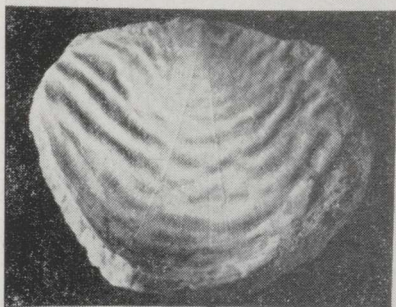
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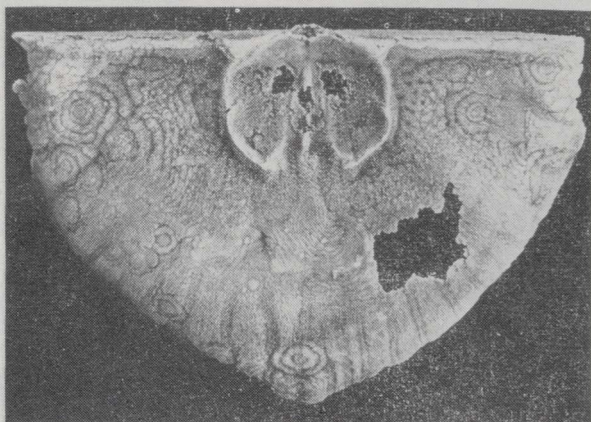
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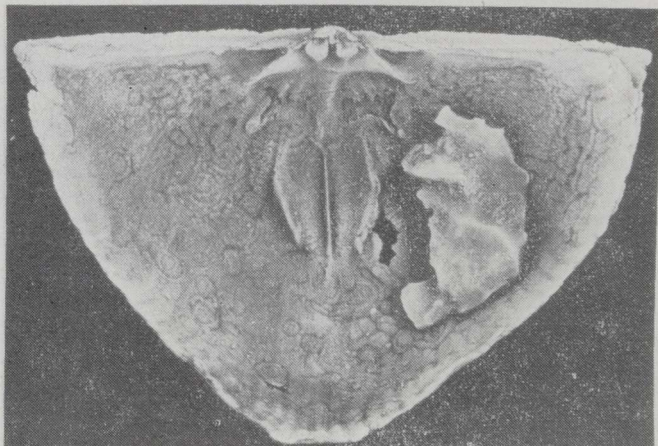
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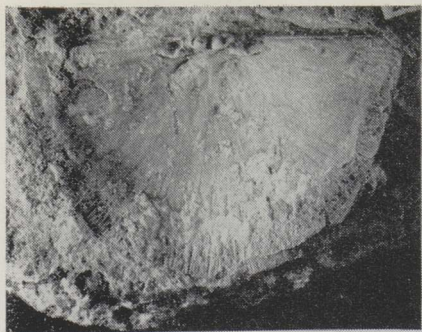


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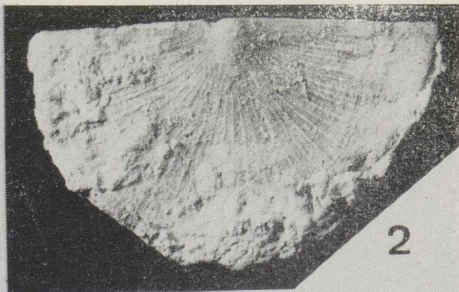


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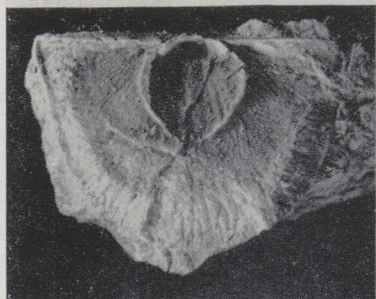




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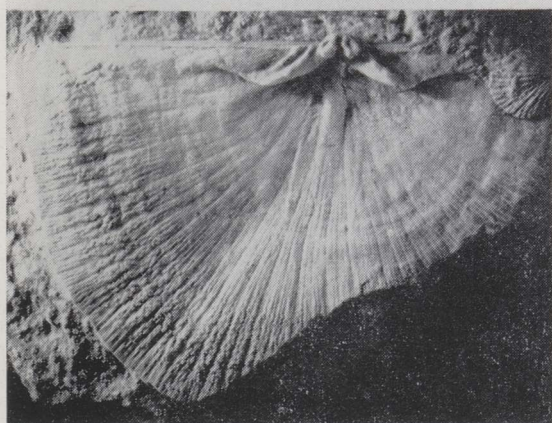
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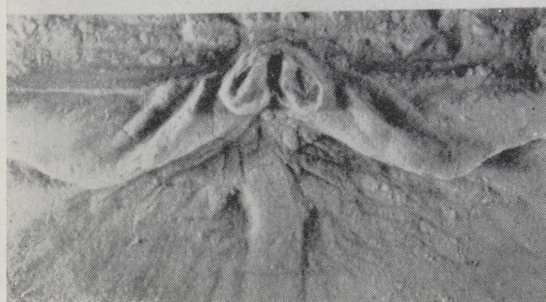
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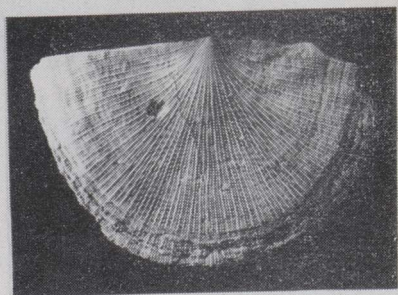
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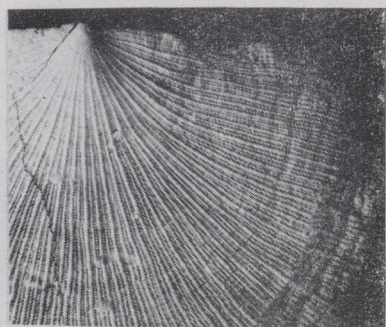
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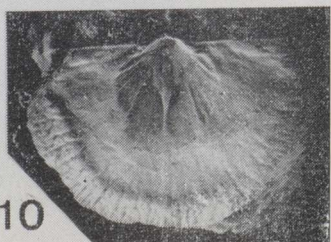
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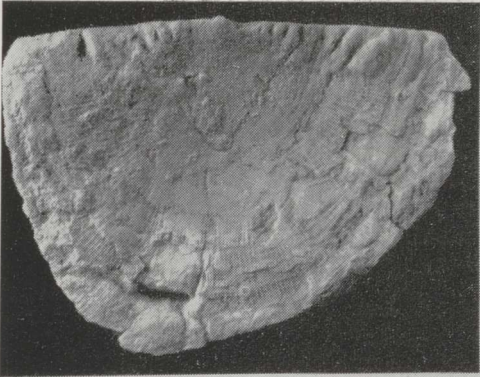


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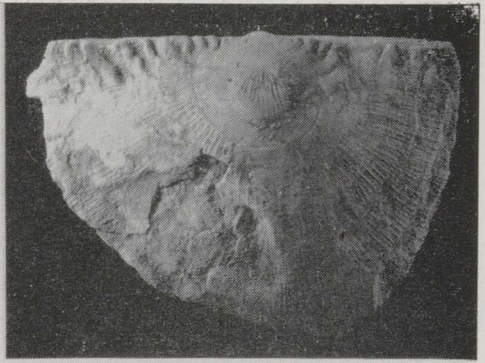


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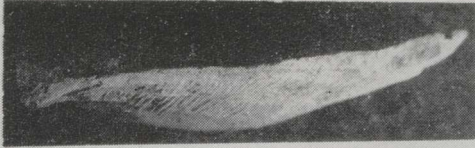


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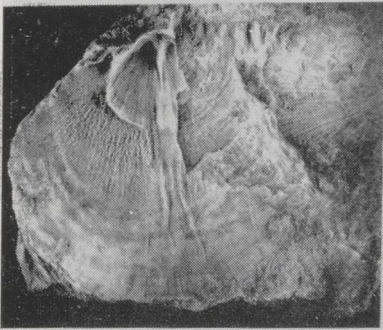
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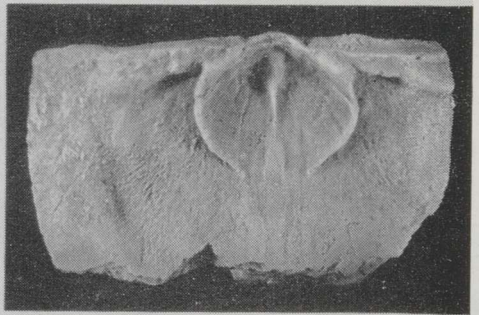
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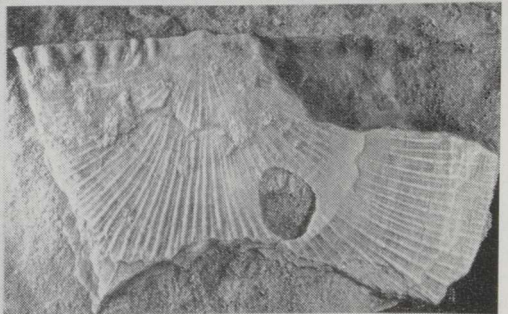
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**Type species.** *Luhaia vardi* Rõõmusoks (Рыымусокс, 1956, p. 1091); text-figs. 1—4; from the Pirgu Stage, Adila Formation with Rõa Member (U. Ashgill), North Estonia.

**Diagnosis** (emended): Medium-sized Strophomeninae. Shell with sharp ventral geniculation, rounded triangular in outline. Trail longer than disc, medially weakly folded. Disc concentrically rugate, in particular postero-laterally. Ornament unequally parvicostellate with wide spaces between few accentuated costellae. Ventral interarea high, pseudodeltidium large. Ventral muscle field subquadrate, flabellate, with raised bounding ridges and a long medial ridge. Posterior platform small, socket plates short. Cardinal process lobes erect. Short posterior and long anterior trans-muscle septa. Brevisseptum thin, long. Very fine and dense pseudopunctae.

**Species assigned.** *Luhaia vardi* Rõõmusoks (Рыымусокс, 1956, p. 1091; text-figs. 1—4); from the Pirgu Stage, Adila Formation with Rõa Member (U. Ashgill), North Estonia (see Pl. II, figs. 1—5 in the present paper).

*Luhaia vardi* rõõmusoksi Sheehan, 1987, p. 40; pl. 13, figs. 3—11; from the Fosse Formation (Ashgill), Belgium.

*Luhaia* ? sp., in Mitchell, 1977, p. 99; pl. 21, figs. 1—6; from Killey Bridge Formation (Ashgill), Ireland.

*Luhaia* sp. n., mentioned by Wiman (1901, p. 179) as *Strophomena* aff. *euglypha* Dalman (Jaanusson, pers. comm.), from the erratic blocks of the Öje Myr Limestone (U. Ashgill), Gotland, Sweden (see Pl. II, figs. 6—7 in the present paper).

*Luhaia* sp. n. from the Boda Limestone (Ashgill), Kallholn, Siljan district, Sweden.

*Luhaia* sp. n., described by Høltedahl (1916, p. 47; pl. VI, figs. 2, 3 as *Strophomena pseudodeltoidea* Stolley, 1895) from the 5a beds (= Bønsnes Formation, U. Ashgill), Ringerike, Norway.

### PLATE III

Figs. 1—5. *Keilamena occidens* (Männil), all from Keila Stage (upper part). 1 — dorsal interior ( $\times 1$ ) (Br 2380). Kulna. 2 — ventral view ( $\times 1$ ) (Br 2387). Jälgimägi, coll. A. Oraspõld, 1951. 3—4 — cardinalia, ventral and posterior views ( $\times 2$  and  $\times 4.2$ ) (Br 2390). Jälgimägi, coll. A. Oraspõld. 5 — ventral interior ( $\times 1$ ). Holotype (Br 3091). Keila, coll. R. Männil. Figured by Oraspõld (Ораспыльд, 1956, pl. III, fig. 7). Figs. 6—10. *Longvillia asmusi* (Verneuil), all from Keila Stage (upper part). 6—7 — ventral view and sculpture ( $\times 1$  and  $\times 2$ ) (Br 2356). Lilli near Kehra, coll. A. Wahl. 8—9 — dorsal interior ( $\times 1.8$  and  $\times 4.7$ ) (Br 1518). Lilli near Kehra, coll. A. Wahl. 10 — ventral interior ( $\times 1$ ) (Br 3093). Rakvere, coll. A. Öpik.

### PLATE IV

Figs. 1—8. *Rugomena adilensis* sp. n., all from Pirgu Stage, Adila Formation. 1—2 — ventral and dorsal views ( $\times 1$ ); Holotype (Br 1529). Vardi, coll. G. Pahnsch. 3 — lateral view ( $\times 1.4$ ). Holotype (Br 1529). 4 — posterior view ( $\times 2.2$ ) (Br 1533). Haapsalu, coll. V. Reimer. 5 — ventral interior ( $\times 1$ ) (Br 1530). Vardi, coll. G. Pahnsch. 6 — ventral interior ( $\times 2$ ) (Br 1531). Vardi, coll. G. Pahnsch. 7 — dorsal mould ( $\times 2$ ) (Br 1535). Rõa, Rõa Member, coll. author, 1975. 8 — dorsal view ( $\times 2$ ) (Br 1532). Haapsalu, coll. K. Orviku, 1937.



**Remarks.** Prof. V. Jaanusson has kindly sent me photos of both interiors of a *Luhaia* from the Öjle Myr Limestone (erratic block No 17) from Gotland, presumably of Pirgu age. Now for the first time we have the interior of the ventral valve of a *Luhaia* from the Ordovician of Baltoscandia. The muscle field is like that of *Strophomena* but subquadrate, somewhat flabellate, with raised bounding ridges and a broad anterior gap. There is a long medial ridge. Prof. V. Jaanusson has sent me for comparison also several specimens of another undescribed *Luhaia* from the Boda Limestone. Unfortunately, there were no interiors but the external character of the shell appears to be similar to those of the Norwegian species, described by Holtedahl (1916). Examination of the specimens of the latter species in the Paleontologisk Museum, Oslo, convinced me that it was a new *Luhaia* species, similar to *L. vardi*.

**Distribution.** Ashgill of Baltoscandia, Ireland, and Belgium.

### Genus *Keilamena* nov.

**Name.** After occurrence of the type species in the Keila Stage, particularly in the environs of the town of Keila, north-eastern Estonia.

**Type species.** *Actinomena occidentens* Männil in Oraspõld (Ораспыльд, 1956, p. 59; pl. III, figs. 7—9; pl. IV, fig. 1), from the upper part of the Keila Stage (U. Caradoc), north-western Estonia.

**Diagnosis:** Very large Strophomeninae with moderately convexo-concave, gently resupinate, transversely semi-oval or subquadrate shell. Ornament strongly unequally parvicostellate with narrow spaces between numerous accentuated costellae. The latter are more conspicuous on the ventral valve. High ventral interarea, pseudodeltidium and chilidium broad. Ventral muscle field elongately subcircular with raised lateral bounding ridges and striated surface. Long teeth. Cardinal process lobes triangular, stout, erect. Posterior platform small with a short low medial ridge and very short socket plates. No transmuscle septa. Internal surface of the valves smooth but finely and densely pseudopunctate near the valve margins. Straight, long subperipheral ciliar grooves.

**Species assigned.** *Actinomena occidentens* Männil in Ораспыльд, 1956, p. 59 (see Pl. III, figs. 1—5 in the present paper).

*Strophomena steinari* Spjeldnaes, 1957, p. 147; pl. 11, figs. 11, 12; text-figs. 6D, 6H, 6L, 33C from the Coelosphaeridium beds (= Furuberget Formation) (U. Caradoc), Norway.

**Discussion.** The interiors of *Keilamena*, particularly the ventral one, are quite similar to those of *Tetraphalerella* but its size, shape, and radial ornament of the shell are different. Moreover, the latter genus occurs in the considerably younger, Richmondian strata of North America. Our new genus differs from the contemporaneous *Longvillia* in having larger shell with slightly concave ventral valve, more densely placed accentuated costellae, smaller, elongated ventral muscle field with raised lateral bounding ridges, and short dental plates. Cardinalia of *Keilamena* is larger than in *Longvillia* and medial ridge shorter. For comparison with *Keilamena* photos are given of *Longvillia asmusi* (Verneuil) from the upper part of the Keila Stage of north-eastern Estonia (see Pl. III, figs. 6—10). To the genus *Longvillia* should be included also the contemporaneous *Strophomena norvegica* Spjeldnaes, 1957, from the 4ba- $\beta$  beds (= Arnestad and Furuberget Formations) (U. Caradoc) in Norway.

*Keilamena steinari* (Spjeldnaes) differs from *K. occidentens* in having flat, not resupinate ventral valve. Spjeldnaes (1957) did not figure the shell exterior but the internal characters, which suggest *Keilamena*.



**Distribution.** Viru Series of Baltoscandia, Keila Stage in Estonia, and its equivalents in Norway (U. Caradoc).

Genus *Rugomena* nov.

**Name.** From Latin, *ruga*; referring to the coarse rugae along the hinge line.

**Type species.** *Rugomena adilensis* sp. n. from the Pirgu Stage, Adila Formation with the Rõa Member (U. Ashgill) of North Estonia.

**Diagnosis:** Large *Strophomeninae* with moderately convexo-concave, anteriorly slightly rounded subrectangular shell. Radial ornament strongly unequally parvicostellate with many densely placed accentuated costellae. 4—9 strong short postero-lateral rugae approximately perpendicular to the hinge line. Pseudodeltidium high and wide, chilidium small, not medially grooved. Ventral muscle field subcircular, with sharply raised lateral bounding ridges and broad antero-medial gap. Short posterior medial ridge. Socket plates short. Four long parallel adventitious dorsal septa. Extra-muscular area with densely and irregularly placed small elongated pseudopunctae.

**Species assigned.** *Rugomena adilensis* sp. n. (Pl. IV, figs. 1—8). **Derivation of name.** After Adila Formation, referring to the type horizon.

**Holotype.** Complete but partly broken shell (Br 1529) from the Pirgu Stage, Adila Formation from the glacial boulders at Vardi, West Estonia, coll. G. Pahnsch. **Diagnosis.** Largest *Rugomena* known (maximum width of the shell 60 mm). Shell gently resupinate. Radial ornament with many densely placed accentuated costellae. 8—9 short strong posterior rugae.

**Distribution.** Harju Series, Pirgu Stage, Adila Formation with Rõa Member. Haapsalu (2 specimens), Piirsalu (1 specimen), Vardi (14 specimens), Rõa (2 specimens).

*Strophomena vetusta* (James), 1874 (see Foerste, 1912, p. 98) from the Richmondian of Ohio, Indiana, Kentucky, U.S.A.

*Strophomena kiaeri* Høltedahl, 1916, p. 54; pl. IX, figs. 4—6 from 5a beds (= Bønsnes Formation) in Norway.

*Strophomena planocorrugata* Twenhöfel, 1928, p. 194; pl. XVII, figs. 4—5 from the Richmondian of Anticosti; U. Bighorn Formation, Wyoming, U.S.A.

**Discussion.** This *Strophomena*-like new genus includes more or less contemporaneous and closely related species. Generically *Rugomena* can be distinguished from *Strophomena* by the character of the dorsal interior, and particularly by the prominent short posterior rugae and strongly unequally parvicostellate radial ornament. Nevertheless, its ventral muscle field is very similar to *Strophomena*.

*Rugomena* is apparently of North American Midcontinent origin since the earliest known member of the genus is *R. vetusta* from the Maysvillian or even late Edenian of Wyoming (Macomber, 1970). In Baltoscandia this genus appears as an immigrant in the late Pirgu time associated with some other elements of the American origin new for the region (for example *Hebertella*, *Hysiptycha*, and *Maclurites*; Рыбмусокс, 1964, p. 27).

**Distribution.** Upper part of the Harju Series of Baltoscandia; U. Bighorn Formation of Wyoming, U.S.A.; Richmondian of North American Midcontinent and Anticosti Island.



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## MÕNED BRAHHIOPOODI PEREKONNAD ALAMSUGUKONNAST STROPHOMENINAE EESTI ORDOVIITSIUMIST

Arvo RÕOMUSOKS

On esitatud perekonna *Actinomena* (Öpik, 1930) täpsustatud diagnoos. *Actinomena asmusi* (Verneuil, 1845) on viidud perekonda *Longvillia* Bancroft, 1933. On kirjeldatud kaks uut perekonda: *Keilamena* (tüüpliik *Actinomena occidens* Männil; Ораспыльд, 1956) ja *Rugomena* (tüüpliik *Rugomena adilensis* sp. n.). On toodud uusi andmeid perekonnade *Microtrypa* Wilson (1945), *Trigrammaria* Wilson (1945) ja *Luhaia* Rõõmusoks (1956) levikust Baltoskandias.

## НЕКОТОРЫЕ РОДЫ БРАХИПОД ИЗ ПОДСЕМЕЙСТВА STROPHOMENINAE ИЗ ОРДОВИКА ЭСТОНИИ

Арво РЫЙМУСОКС

Представлен уточненный диагноз рода *Actinomena* (Öpik, 1930). *Actinomena asmusi* (Verneuil, 1845) переведен в род *Longvillia* Bancroft, 1933. Описаны два новых рода: *Keilamena*, с типовым видом *Actinomena occidens* Männil (Ораспыльд, 1956), и *Rugomena*, с типовым видом *Rugomena adilensis* sp. n. Приведены новые данные о распространении родов *Microtrypa* Wilson, 1945, *Trigrammaria* Wilson, 1945 и *Luhaia* Rõõmusoks, 1956 в Балтоскандии.