

A REVIEW OF ESTONIAN ORDOVICIAN RAFINESQUINIDS (BRACHIOPODA, STROPHOMENACEA)

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Abstract. In the Estonian Ordovician four genera of rafinesquinids occur. The occurrence of *Kjaerina* Bancroft, 1929 in the Oandu Stage is the first record of this genus in the Ordovician of northern East Baltic. Two species — *K. poljensis* (Alichova, 1951) and *K. orvikui* (Männil) are redescribed. Three new genera — *Rakverina*, *Harjumena*, and *Pirgumena* — are erected. The last genus is represented in the Pirgu Stage with *P. martnai* sp. n.

Key words: Strophomenida, Ordovician, Estonia.

Salmon (1942) subdivided the old, familiar genus *Rafinesquina* into *Oepikina* and *Rafinesquina* s. str. Afterwards only seven rafinesquinids have been described from the Ordovician of Estonia and Ingria, St. Petersburg District, Russia. These are *Rafinesquina poljensis* Alichova, 1951, *R. (R.) corrugatella* (Davidson), *R. (R.) expansa* (Sowerby), and *Leptaena schmidtii* (Gagel), described by Sokolskaya (Сокольская, 1954), *R. (R.) orvikui* Männil and *R. (Playfairia) ? oanduensis* Oraspõld described by Oraspõld (Ораспыльд, 1956). In none of these species interiors were known. The purpose of this paper is to briefly revise these species. In addition, three new genera, *Rakverina*, *Harjumena*, and *Pirgumena* are erected. The occurrence of *Kjaerina* in the Oandu Stage is the first record of this genus in the Ordovician of northern East Baltic. *Kjaerina* appeared in the Baltic region at the end of the Viru Epoch, approximately at the same time as it entered Britain (Hurst, 1979). This was the time of a notable exchange between faunas of several regions (Jaanusson, 1979; Jaanusson & Bergström, 1980). The new genera of the rafinesquinids described in this paper appeared at the end of the Viru Epoch and during the Harju Epoch.

The types and figured specimens are housed in the Museum of Geology at Tartu University (GMUT Br marking the catalogue numbers of the brachiopod types).

Family Rafinesquinidae Schuchert, 1893

Genus *Kjaerina* Bancroft, 1929

Kjaerina poljensis (Alichova, 1951)

Pl. I, figs. 1—4

1951 *Rafinesquina poljensis* Alichova; Алихова, p. 48; Pl. IV, figs. 76, 77.

non 1954 *Rafinesquina* (*Rafinesquina*) *poljensis* (Alichova), Sokolskaya (Сокольская, p. 37); Pl. I, figs. 1, 2 (= *Kjaerina* sp n.).

Diagnosis (emended): Large *Kjaerina* (known maximum width of the shell 35 mm) with almost flat, very thin shell, subrectangular in outline. One or two strong medial costae. Irregular posterolateral wrinkles faint or absent. Pseudodeltidium vestigial, chilidium large, medially grooved. Ventral muscle field large, with long, straight, broadly divergent bounding ridges. Dental plates short. Posterior platform weakly developed, cardinal process lobes anteriorly broadly divergent. Coarse, sparsely placed and radially arranged tubercles.

Distribution. Oandu Stage, Hirmuse Formation (U. Caradoc), North Estonia and Ingria, Russia.

Alichova (Алихова, 1951 p. 49) erroneously reported this species from the Jõhvi and Keila beds, a mistake corrected by Männil (Мяниль, 1960 p. 95). The specimens referred by Sokolskaya (Сокольская, 1954 p. 37) as *R. (R.) poljensis* belong to a new species, which occurs only in the north-western part of Estonia (Oandu Stage, Saku Member of the Vasalemma Formation).

Kjaerina orvikui (Männil), Ораспыльд, 1956

Pl. I, figs. 5—7

1956 *Rafinesquina* (*Rafinesquina*) *orvikui* Männil, Ораспыльд, p. 49;

Pl. I, fig. 21.

Diagnosis (emended): Small *Kjaerina* (known maximum width of the valve 14 mm) with moderately convex ventral valve, semicircular in outline. Dorsal valve correspondingly concave. Ornamentation weakly unequally parvicostellate. Medial accentuated costa fine. Few weak posterolateral wrinkles. Ventral muscle field small, weakly depressed. Dental plates very short. Pseudodeltidium vestigial, chilidium large, medially grooved. Cardinal process lobes long, subparallel. Posterior platform delicate. Fine tubercles, arranged radially.

Distribution. Oandu Stage, Hirmuse Formation (U. Caradoc), North Estonia and Ingria, Russia.

Genus *Rakverina* nov.

Name: After occurrence of the type species in the Rakvere Stage.

Type species. *Oepikina* (?) *inaequiclina* Alichova (Алихова, 1951; p. 58, Pl. IV, figs. 69—71) from the Rakvere Stage (U. Caradoc), North Estonia and Ingria, Russia.

Diagnosis: Medium-sized Rafinesquinidae (known maximum width of the interarea 35 mm) with convex shell, subtriangular in outline and strongly geniculated in dorsal direction. Ventral disc weakly convex or almost flat with slightly swollen umbonal part. Dorsal disc weakly concave. Trail longer than disc, mostly somewhat rounded. Ornament unequally parvicostellate with densely spaced sharp accentuated costellae. Coarse concentric wrinkles variously developed on both valves,

particularly posterolaterally. Ventral interarea long. Pseudodeltidium absent, chilidium with triangular medial groove. Ventral muscle field subcircular, weakly depressed, with low posteriorly curved lateral bounding ridges. Dental plates short. Posterior platform indistinct with short narrow posteriorly striated socket plates. Blade-like, subparallel cardinal process lobes. No true transmuscle septa. Sparse coarse tubercles.

Species assigned:

Oepikina (?) *inaequiclina* Alichova, 1951 (Алихова, p. 58) (Pl. II, figs. 6—11 in the present paper) from the Rakvere Stage.

Rafinesquina (*Playfairia*) ? *oanduensis* Oraspõld (Ораспыльд, 1956 p. 50; Pl. I, fig. 20) (Pl. II, figs. 1—5 in the present paper) from the Oandu Stage, Hirmuse Formation, North Estonia.

Comparison. *Rakverina* differs from *Kjaerina* in having a more convex ventral valve with relatively flatter disc, commonly coarse concentric wrinkles, subcircular ventral muscle field, weaker posterior platform, and no prominent medial costa.

Distribution. Oandu Stage, Hirmuse Formation and Rakvere Stage (U. Caradoc), North Estonia and Ingrida, Russia.

Genus *Harjumena* nov.

Name: After occurrence of the type species of the genus in the province of Harjumaa in Estonia.

Type species. *Strophomena schmidti* Gagel, 1890 p. 42; Pl. III, fig. 4 from erratic boulders in former East Prussia (now Kaliningrad District). Most probably derived from the Nabala Stage.

Diagnosis: Large Rafinesquinidae (known maximum width of the interarea up to 64 mm) with subtriangular shell abruptly geniculated in dorsal direction. Disc in both valves almost flat. Ornamentation strongly unequally parvicostellate with coarse, weakly irregular accentuated costellae and irregularly arranged concentric corrugations on the whole disc. Pseudodeltidium vestigial, chilidium large, medially grooved. Ventral muscle field elongate, weakly depressed. Dental plates short.

Species assigned:

Strophomena schmidti Gagel, 1890 (Pl. III, figs. 1—7 in the present paper) from the Nabala Stage, Saunja Formation (L. Ashgill), North Estonia.

Rafinesquina (?) *schmidti* Gagel in Høltedahl 1916 p. 32; Pl. III, fig. 1 (= *Harjumena* sp. n.) from the basal part of the 4d beds (Ashgill), Hadeland in the Oslo Region, Norway.

Rafinesquina (?) sp. (*R. schmidti* Gagel ?) in Høltedahl 1916 p. 32; Pl. III, fig. 2 (= *Harjumena* sp. n.) from the 4d beds (Ashgill), Ringerike in the Oslo Region, Norway.

Harjumena sp. n. (Pl. III, figs. 8 and 9 in the present paper) from the Vormsi Stage, Kõrgessaare Formation (Ashgill), North Estonia.

Discussion. *Harjumena* resembles *Rakverina*, in particular *R. oanduensis* (Oraspõld), but differs in attaining a much larger size, having fine, irregular concentric corrugations all over the disc, a narrow, elongate ventral muscle field, and a narrow dorsal medial septum. Despite the large size of the valves the shell is very thin. The type species was described and figured by Sokolskaya (Сокольская, 1954 p. 59; Pl. III, fig. 14) as

Leptaena schmidti and as *Rafinesquina* (*Rafinesquina*) *corrugatella* (Davidson) (Сокольская, 1954 p. 38; Pl. III, fig. 3), both from the Nabala Stage, Saunja Formation, from exposures at Tapa and Tõrma, North Estonia. I have examined the types of Sokolskaya in the Paleontological Museum in Moscow and I am convinced that the two specimens figured by her (Сокольская, 1954; Pl. III, figs. 15 and 16) as *Leptaena schmidti* represent actually *Bekkeromena* sp. n.

I have examined the specimens described by Høltedahl (1916) as *Rafinesquina* (?) *schmidti* and *Rafinesquina* (?) sp. (*R. schmidti* Gagel ?) from 4d beds in Norway and they obviously belong to two separate new species of *Harjumenta*, attaining a still larger size than *H. schmidti*.

Distribution. Harju Series (Ashgill) in Baltoscandia. Nabala Stage, Saunja Formation and Vormsi Stage, Kõrgessaare Formation in North Estonia; 4d beds, Hadeland and Ringerike in the Oslo Region, Norway.

Genus *Pirgumena* nov.

Name: After occurrence of the type species in the Pirgu Stage.

Type species. *Pirgumena martnai* sp. n. from the Pirgu Stage, Adila Formation including the Rõa Member (M. Ashgill), North Estonia.

Diagnosis: Large Rafinesquinidae (known maximum width at the hinge line 65 mm), shell very thin, valves semicircular to subtriangular in outline. Ventral valve flat, except the umbonal part, which is slightly but distinctly convex. Dorsal valve almost flat but slightly concave in elongated umbonal part. Ornamentation unequally parvicostellate with numerous high and rounded accentuated costellae. Pseudodeltidium small, narrow. Chilidium large, not grooved. Ventral muscle field without lateral bounding ridges. Dental plates short. Posterior platform delicate, *Kjaerina*-like with long narrow medial ridge. Socket plates thin, short. Cardinal process lobes strong, broadly diverging anteriorly. Shell substance with radially arranged coarse and sparse tubercles.

Species assigned:

Pirgumena martnai sp. n. from the Pirgu Stage of Estonia.

Rafinesquina (*Rafinesquina*) *expansa* (Sowerby) in Sokolskaya (Сокольская, 1954 p. 39; Pl. I, figs. 4—13 (= *Pirgumena* sp. n.; Pl. IV, fig. 7 in the present paper). This species was mentioned by Schmidt (1908 p. 725) as a large flat form from the Porkuni Stage with alternating coarser and finer costellae, probably identical with *Strophomena luna* Törnquist from the Leptaena Limestone (=Boda Limestone in Sweden).

Discussion. *Pirgumena* and *Aphanomena* Bergström, 1968, are among the largest and flattest rafinesquinids known. Both genera have large shells but while the valves of *Aphanomena* are almost completely flat, in *Pirgumena* the umbonal portion of the ventral valve is distinctly convex and that of the dorsal valve slightly but conspicuously concave. *Pirgumena* differs from *Aphanomena* in having a somewhat thicker shell, more prominent posterior platform, shorter dental plates, and distinctly coarser tubercles (Pl. IV, fig. 6). The available interiors of the *Pirgumena* moulds are from the dolomitic limestone of the Rõa Member. For that reason the morphology of the cardinal process and socket plates is not known in detail. Relative to the size of the shell the cardinalia of *Aphanomena* is remarkably small. In *Pirgumena* the relative size of the cardinalia is larger.

Distribution. Pirgu and Porkuni stages (Ashgill), North Estonia.

Pirgumena martnai sp. n.
Pl. IV, figs. 1—6

Name: After the Estonian geologist Dr. Jüri Martna.

1957 *Rafinesquina* ? sp., Martna p. 29 (named only).

1991 *Aphanomena* sp. n. 1, Rõõmusoks; Ры́мусокс, Pl. IV, figs. 1—4.

Holotype. Ventral valve (GMUT Br 1471) (Pl. IV, figs. 5 and 6) from the Pirgu Stage, Adila Formation (M. Ashgill), at the Atla River, Pirgu, North Estonia, coll. author, 1959.

Diagnosis: Shell large (estimated maximum width at the hinge line 65 mm), very thin, semicircular in outline. Ventral valve generally flat but weakly swollen in umbonal region up to posterior third part of the valve. Umbonal portion of the dorsal valve correspondingly concave. Ventral interarea apsacline. No foramen. Pseudodeltidium high but narrow. Chilidium unknown. Commonly 8—10 costellae per 2 mm at the anterior margin. Costellae with very fine, dense spaced concentric fila. No conspicuous posterolateral wrinkles. Ventral interior short, broadly diverging dental plates. Cardinal process lobes strong, socket plates short. Tubercles relatively coarse, radially arranged.

Distribution. Pirgu Stage, Adila Formation including the Rõa Member, North Estonia.

ACKNOWLEDGEMENTS

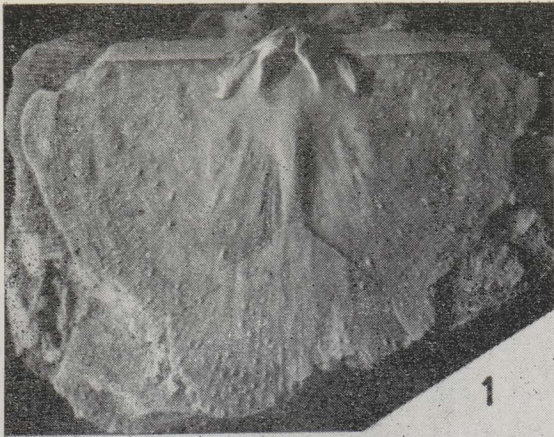
The author expresses his thanks to Prof. V. Jaanusson (Swedish Museum of Natural History) for valuable discussions, criticism, and some photographs of the Scandinavian species.

PLATE I

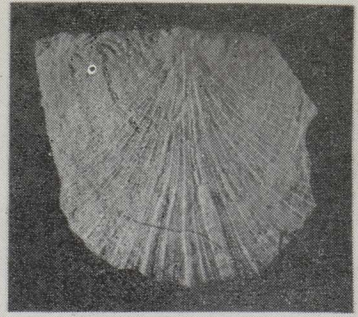
Figs. 1—4. *Kjaerina poljensis* (Alichova), all from Oandu Stage, Hirmuse Formation. 1 — dorsal interior ($\times 4.3$) (GMUT Br 1618). Rakvere, coll. A. Öpik. 2 — ventral view ($\times 1$) (GMUT Br 1635). Tõrremägi, coll. author, 1955. 3 — ventral view ($\times 2$) (GMUT Br 1620). Oandu, coll. A. Öpik. 4 — ventral interior ($\times 2$) (GMUT Br 1621). Rakvere, coll. A. Öpik. Figs. 5—7. *Kjaerina orvikui* (Männil), all from Oandu Stage, Hirmuse Formation. 5 — ventral view of holotype ($\times 2$) (TAGI Br 3058). Oandu. 6 — dorsal interior ($\times 5.5$) (GMUT Br 1623). Tõrremägi, coll. H. Palmre, 1937. 7 — ventral interior ($\times 5$) (GMUT Br 1622). Tõrremägi, coll. H. Palmre, 1937.

PLATE II

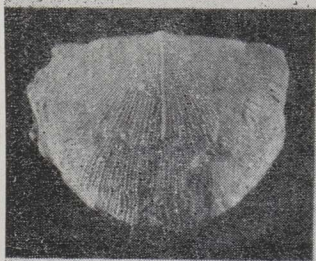
Figs. 1—5. *Rakverina oanduensis* (Oraspöld), all from Oandu Stage, Hirmuse Formation. 1—3 — ventral, lateral, and posterior views of the holotype ($\times 2$) (TAGI Br 3082). Oandu. 4 — dorsal interior ($\times 2$) (GMUT Br 1631). Tõrremägi, coll. H. Palmre, 1937. 5 — ventral interior ($\times 2$) (GMUT Br 1632). Tõrremägi, coll. H. Palmre, 1937. Figs. 6—11. *Rakverina inaequiclina* (Alichova), all from Rakvere Stage, Piilse Member of the Rägavere Formation. 6—8 — dorsal, ventral, and lateral views ($\times 2$) (GMUT Br 1560). Rägavere, coll. K. Orviku. 9 — dorsal interior ($\times 2$) (GMUT Br 1630). Rägavere, coll. Fr. Schmidt. 10 — posterior view ($\times 3.6$) (GMUT Br 1479). Rakvere, coll. G. Mechmershausen. 11 — ventral interior ($\times 3$) (GMUT Br 1482). Rägavere, coll. V. Paul.



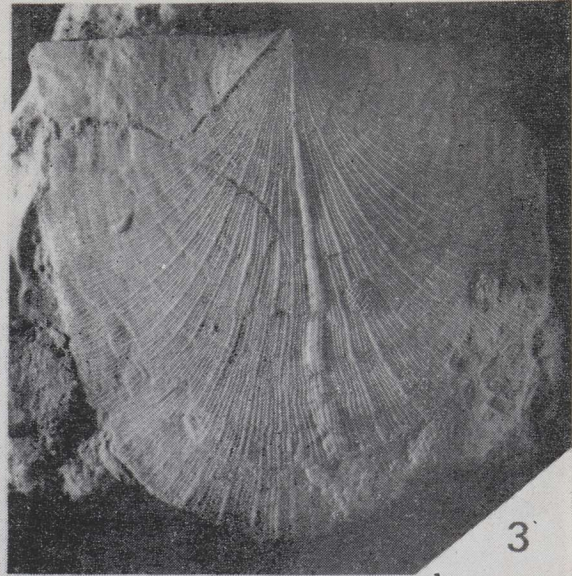
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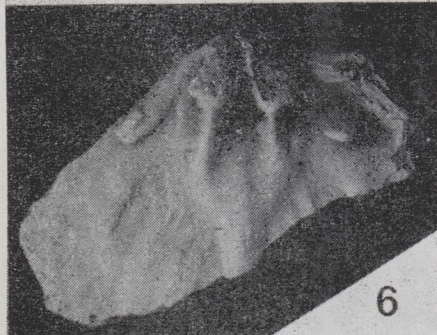
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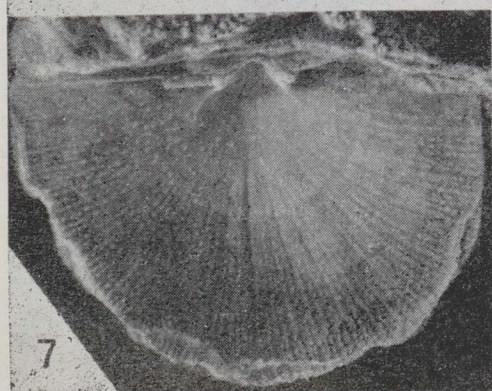
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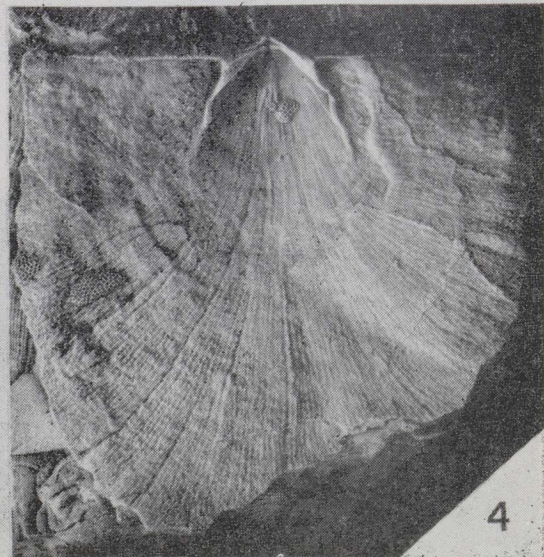
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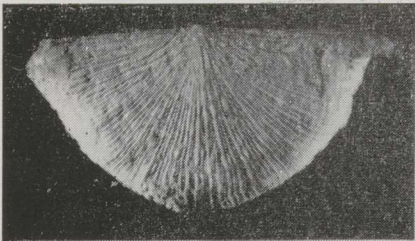
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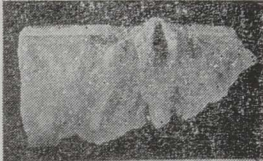
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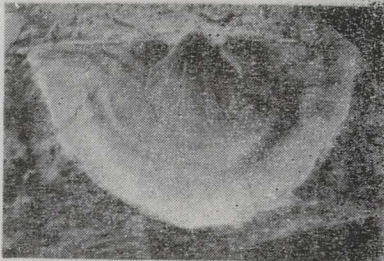
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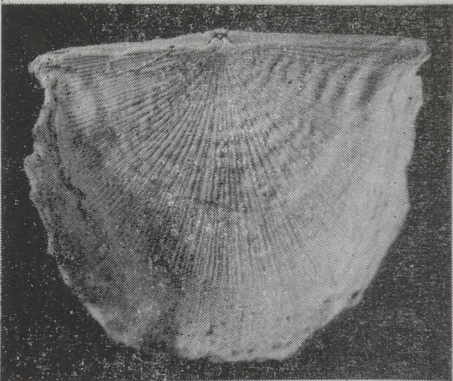
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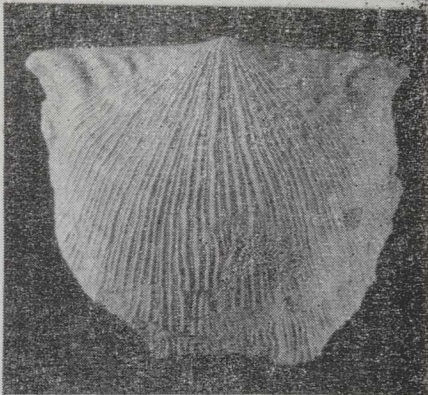
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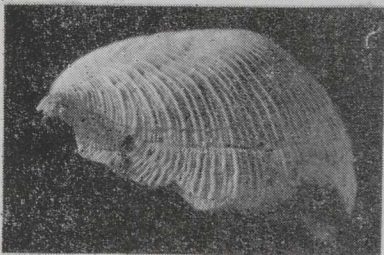
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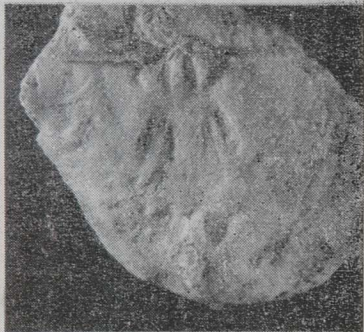
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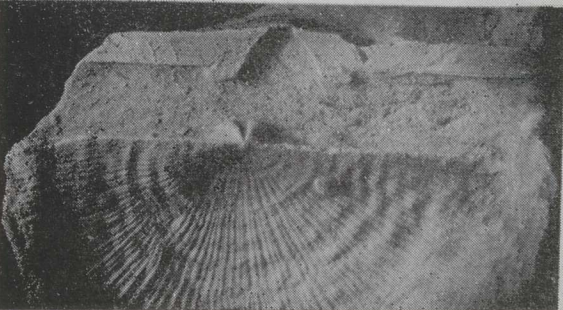
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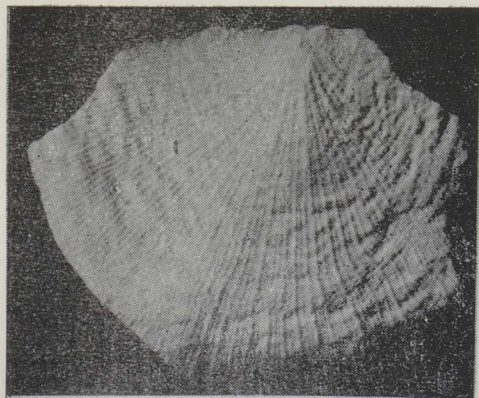
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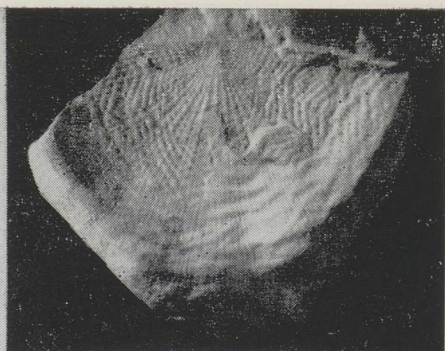
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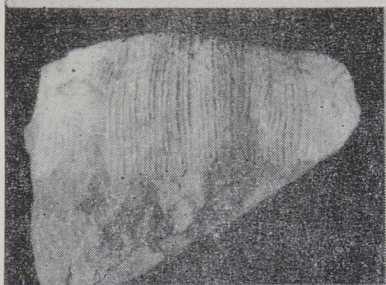
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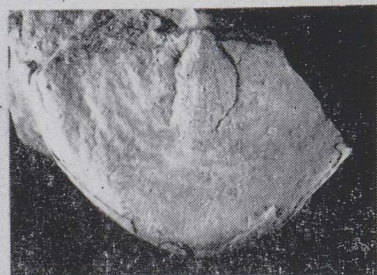
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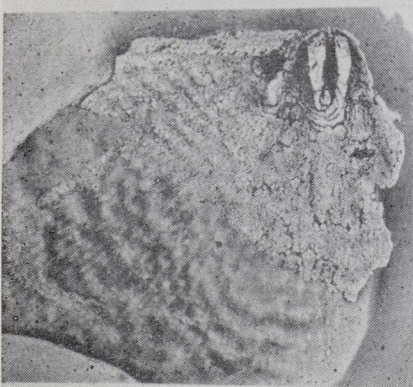
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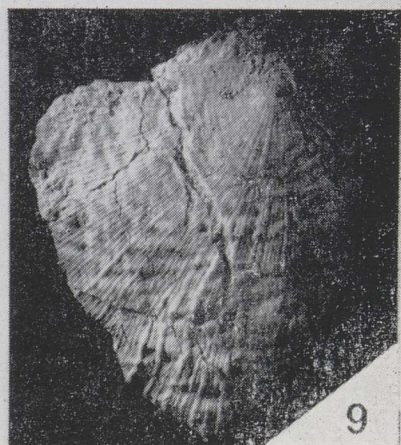
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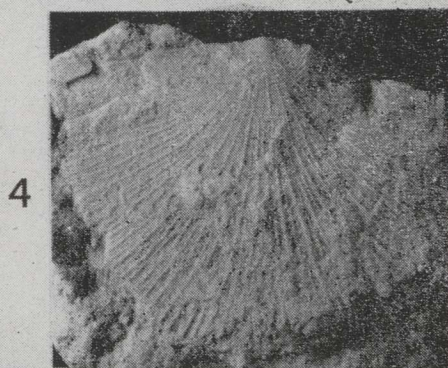
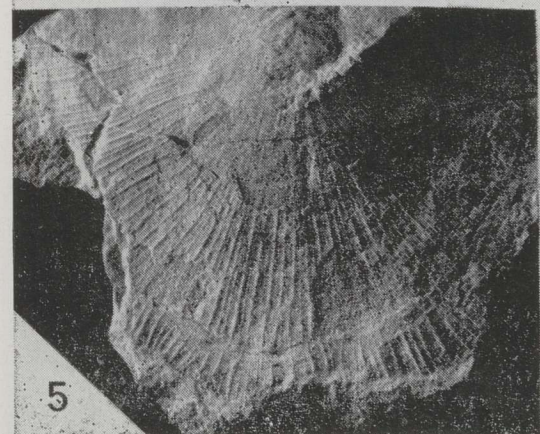
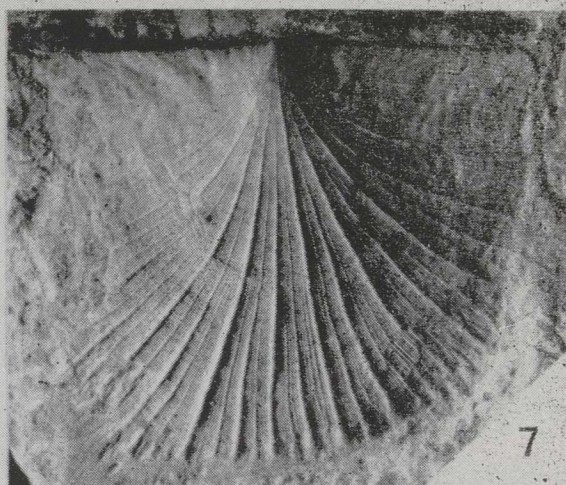
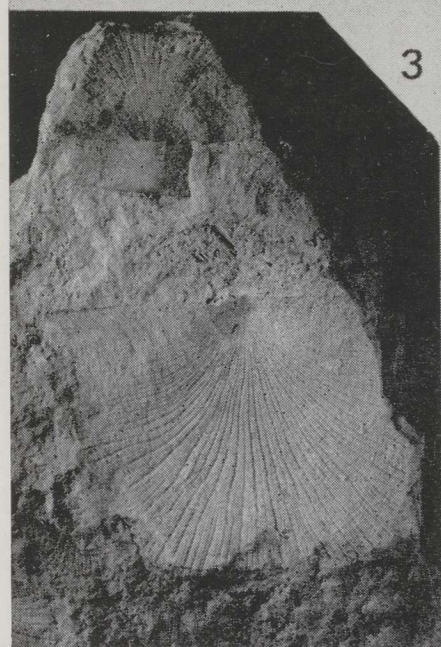
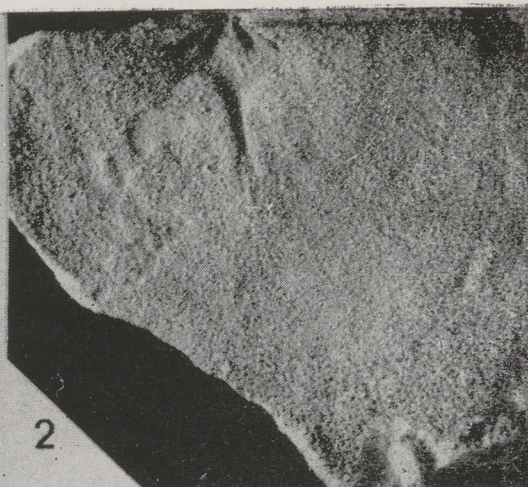
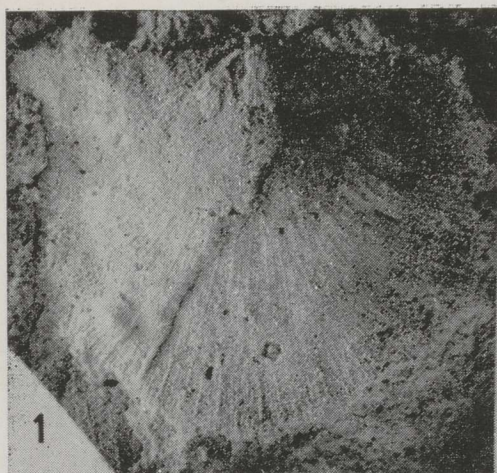
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PLATE III

- Figs. 1—7. *Harjumena schmidti* (Gagel), all from Nabala Stage, Saunja Formation. 1 — ventral view ($\times 1.6$) (GMUT Br 1594). From a boulder at Pürksi, old coll. 2 — ventral view ($\times 1$) (GMUT Br 1636). From a boulder at Käina, Hiiumaa, coll. Ignatius. 3—4 — anterior and lateral views ($\times 1.1$ and $\times 1$) (GMUT Br 1595). Kohatu, coll. A. Öpik. 5 — ventral interior ($\times 3$) (GMUT Br 1596). Odulema, coll. D. Kaljo, 1952. 6 — internal mould of the ventral interior ($\times 1$) (Naturhistoriska Riksmuseet, Stockholm, Br 13601). Mõnuste, coll. G. Holm. 7 — dorsal interior ($\times 3$) (Naturhistoriska Riksmuseet, Stockholm, Br 13609). Uuemõisa, coll. G. Holm. Figs. 8—9. *Harjumena* sp. n., all from Vormsi Stage, Kõrgessaare Formation. 8 — dorsal interior ($\times 1.4$) (GMUT Br 1546). Kohila, coll. Fr. Schmidt. 9 — ventral view ($\times 1$) (GMUT Br 1477). Kõrgessaare, coll. Fr. Schmidt.

PLATE IV

- Figs. 1—6. *Pirgumena martnai* sp. n., all from Pirgu Stage, Adila Formation. 1 — ventral interior mould ($\times 1.5$) (GMUT Br 1472). Rõa Member, Kuru, coll. Fr. Schmidt. 2 — dorsal interior mould ($\times 1.6$) (GMUT Br 1477). Rõa Member, Härkula, coll. E. Rosenstein. 3 — ventral view of the mould ($\times 1$) (GMUT Br 1492) Rõa Member, Aruküla-Kivisti, coll. D. Kaljo. 4 — ventral view ($\times 1.8$) (GMUT Br 1634). Vardi, old coll. 5—6 — ventral views of the holotype ($\times 1$ and $\times 2.6$) (GMUT Br 1471). Pirgu, coll. author, 1959. Fig. 7. *Pirgumena* sp. n., from Porkuni Stage, Siuge Member of the Arina Formation. Ventral view ($\times 2$) (GMUT Br 1467). Porkuni, coll. A. Wahl.

ÜLEVAADE EESTI ORDOVIITSIUMI RAFINESKVINIIDIDEST
(BRACHIOPODA, STROPHOMENACEA)

Arvo ROOMUSOKS

Eesti ordoviitsiumis esineb neli rafineskviinide perekonda. Oandu lademe kaks *Kjaerina* Bancroft liiki — *K. poljensis* (Alichova, 1951) ja *K. orvikui* (Männil) on selle perekonna vanimad esindajad Baltikumi ordoviitsiumis. On kirjeldatud kolm uut perekonda: *Rakverina*, *Harjumena* ja *Pirgumena*. Viimane on Pirgu lademes esindatud uue liigiga *P. martnai* sp. n.

ОБЗОР РАФИНЕСКВИНИД (BRACHIOPODA, STROPHOMENACEA)
ОРДОВИКА ЭСТОНИИ

Арво РЫМУСОКС

В ордовике Эстонии встречается четыре рода рафinesквинид. Два вида рода *Kjaerina* Bancroft — *K. poljensis* (Alichova, 1951) и *K. orvikui* (Männil) — являются старейшими представителями *Kjaerina* в ордовике Прибалтики. Описаны три новых рода: *Rakverina*, *Harjumena*, *Pirgumena*. Последний представлен в пиргуском горизонте новым видом *P. martnai* sp. n.