TWO NEW BRACHIOPODS FROM THE DANISH WHITE CHALK (MAASTRICHTIAN)

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The Danish white chalk can be divided into 10 zones by means of brachiopods.

Two new brachiopods, *Rugia tegulata* n. sp. and *Rugia spinosa* n. sp. belonging to the family Cancellothyrididae Thomson, 1926, are described. Both species are very small. *Rugia spinosa* n. sp. is found in the lower Lower Maastrichtian and *Rugia tegulata* n. sp. is found in the lower Upper Maastrichtian. Recrystallised spicular skeletons in *Rugia tegulata* n. sp. are described.

The brachiopods from the Danish white chalk have been described by Posselt (1894), Nielsen (1909, 1914, 1921, 1928), Rosenkrantz (1944) and Steinich (1965, 1967, 1968).

In the present paper two new species are described. Both species have been found by examination of a great number of samples collected at the most important Danish chalk localities.

Rugia tegulata n. sp. is shown on scanning electron micrographs. This has not been attempted with *Rugia spinosa* n. sp., as the ultrasonic cleaning was considered to be too great a risk for the very scarce and fragile material.

Dr Ole Berthelsen, director of the Geological Survey of Denmark, is cordially thanked for the loan of material from boring no. 1 at Rørdal. The field work was made possible through a grant from the Carlsberg Foundation. Mrs Annelise Nørgaard-Jensen has most kindly made the photographic work, and Henrik Egelund is thanked for making the drawings. Dr Richard Bromley kindly improved the English manuscript.

Systematic description

Both *Rugia tegulata* n. sp. and *Rugia spinosa* n. sp. belong to the family Cancellothyrididae Thomson, 1926 in the superfamily Terebratulacea Gray, 1840. In order to ease comparison with the closely related species *R. acutirostris* Steinich, 1965 and *R. tenuicostata* Steinich, 1963, the measurements are presented in the same kind of scatter diagrams as used by Steinich (1965).

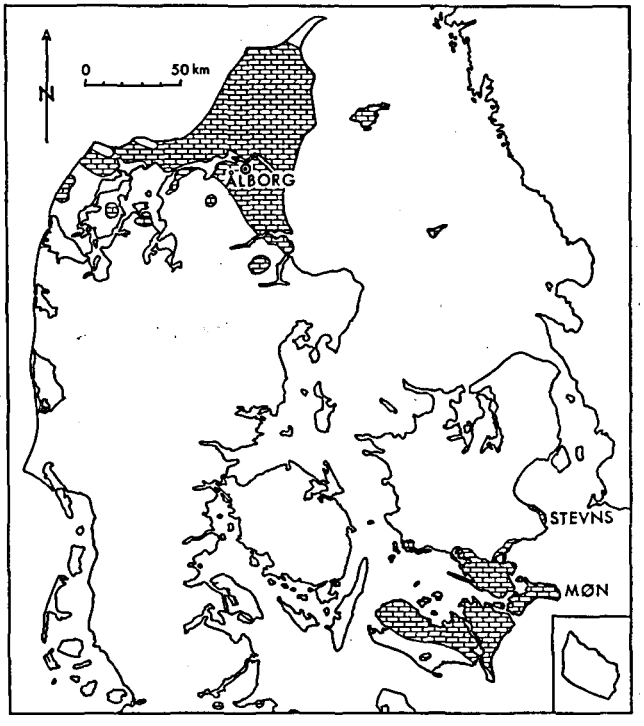


Fig. 1. The signature shows the distribution of the Upper Cretaceous in the pre-Quaternary surface of Denmark.

Rugia tegulata n. sp.

Plate 1, figs. a-e. Fig. 4a-d.

Derivatio nominis: lat. tegula = tile, after the platy scales of the ribs.

Holotypus: MMH no. 11017 (plate 1, fig. c):

Locus typicus: Lindholm chalk pit, north of Aalborg, sample: Lindholm 8.

Stratum typicum: Lower Upper Maastrichtian.

Measurements: Length: 1.78 mm. Length of brachial valve: 1.52 mm. Width: 1.34 mm. Width of the hinge line: 0.58 mm, diameter of the foramen: 0.10 mm. Number of ribs: 29. The median angle of the hinge line (α by Steinich, 1965): 160°. The angle between the lateral edges of the rostrum (β by Steinich, 1965): 83°. The angle between the lateral commisure and the hinge line (δ by Steinich, 1965): 131°. Thickness: 0.54 mm.

Diagnosis

A *Rugia* (see Steinich, 1965 p. 115) with up to 30 ribs which bear a characteristic sculpture of platy scales that are as wide as the ribs. The scales lie

transversely across the ribs, forming an angle of 50° with the surface of the shell. New ribs are formed by intercalation.

Description

The outline in dorsal view is subtriangular to pointed oval. The maximum width lies anterior to the midline of the shell. The ratio of length to width varies between 1.28 and 1.63, decreasing rapidly with growth (fig. 2 a). The ratio of length to width of the brachial valve varies between 1.04 and 1.37 and likewise decreases rapidly (fig. 2 b). Blunt ears are present. The angle (δ) between the lateral commisure and the hinge line varies between 112° and 138°, increasing rapidly with growth (fig. 3c).

The shell is sligthly biconvex. The brachial valve is a little less convex than

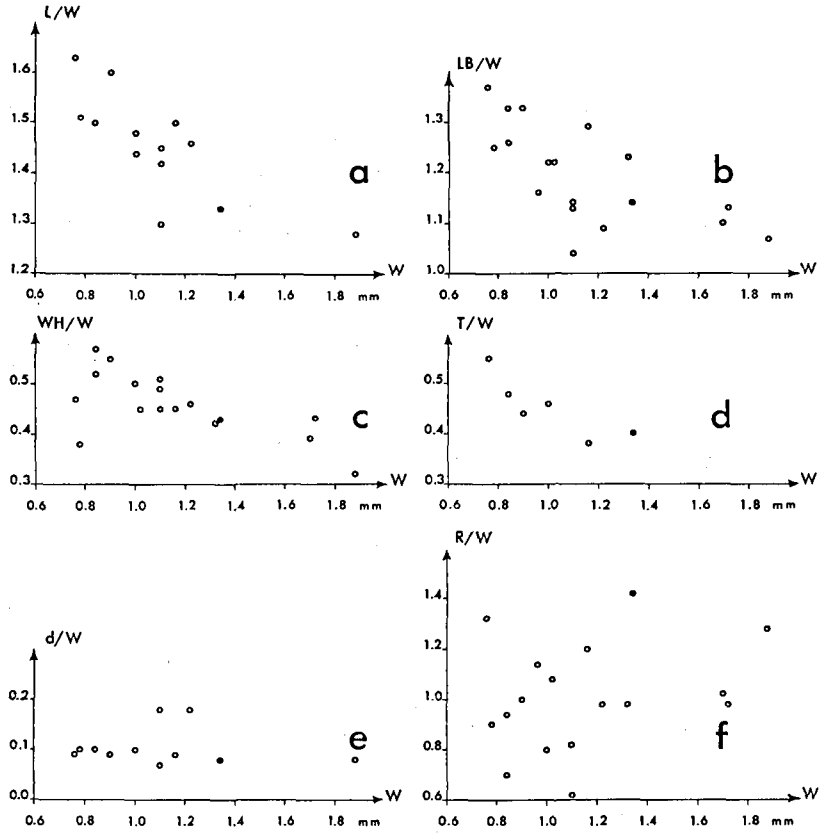


Fig. 2. *Rugia tegulata* n. sp. L = length of pedicle valve. LB = length of brachial valve. W = width. WH = width of the hingeline. T = thickness. d = diameter of the foramen. R = number of ribs. α = the median angle of the hingeline. δ = the angle between the lateral commisure and the hingeline. Black dots = Holotypus.

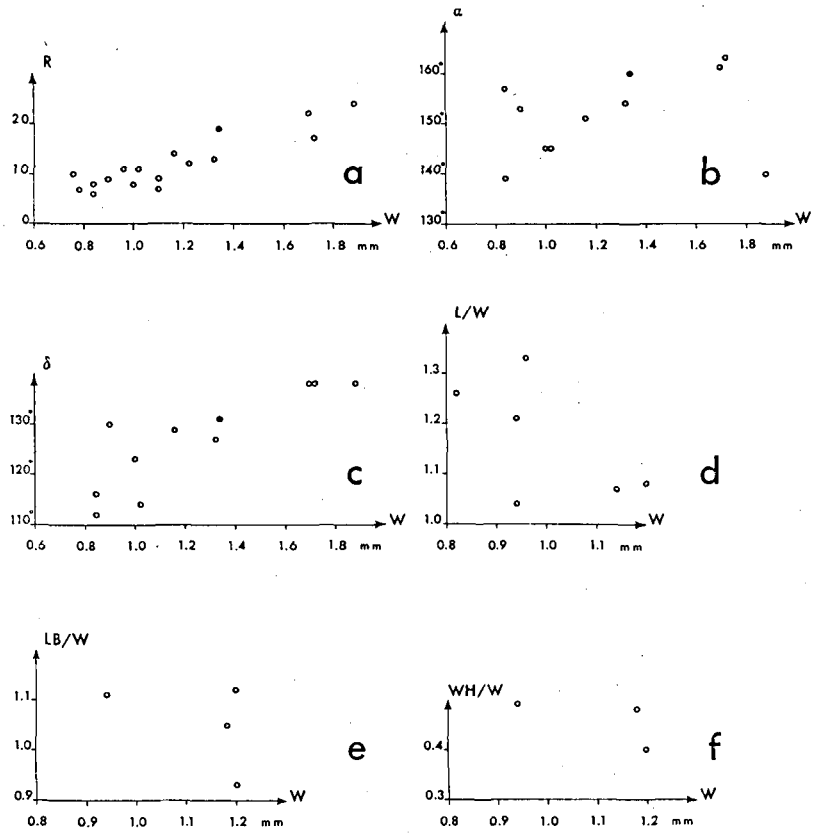


Fig. 3. a–c: *Rugia tegulata* n. sp. d–f: *Rugia spinosa n.* sp. For explanation of the symbols see fig. 2.

the pedicle valve. The ratio of thickness to width varies between 0.38 and 0.55 decreasing rapidly during the early stages of growth (fig. 2d).

At the width of about 0.5 mm some 5 ribs are formed. The number of ribs increases very rapidly by intercalation of new ribs (fig. 3a). In comparison with the growth of the shell this takes place very irregularly so that the relation between the number of ribs and the width varies considerably (fig. 2f). The ribs are very strongly sculptured (pl. 1, fig. e) with plate-like scales lying across them. The scales are arranged like roof tiles. They are as wide as the rib and make an angle of about 50° with the shell surface. There are 3–4 growth lines. The rostrum is suberect and the area is small. The foramen is triangular and hypothyridid; it is bordered by two deltidial plates which often take the form of two irregular ridges. There is, in addition, a constriction at the middle of each deltidial plate (pl. 1, fig. d). The ratio of diameter of foramen to shell width varies between 0.07 and 0.18 (fig. 2e).

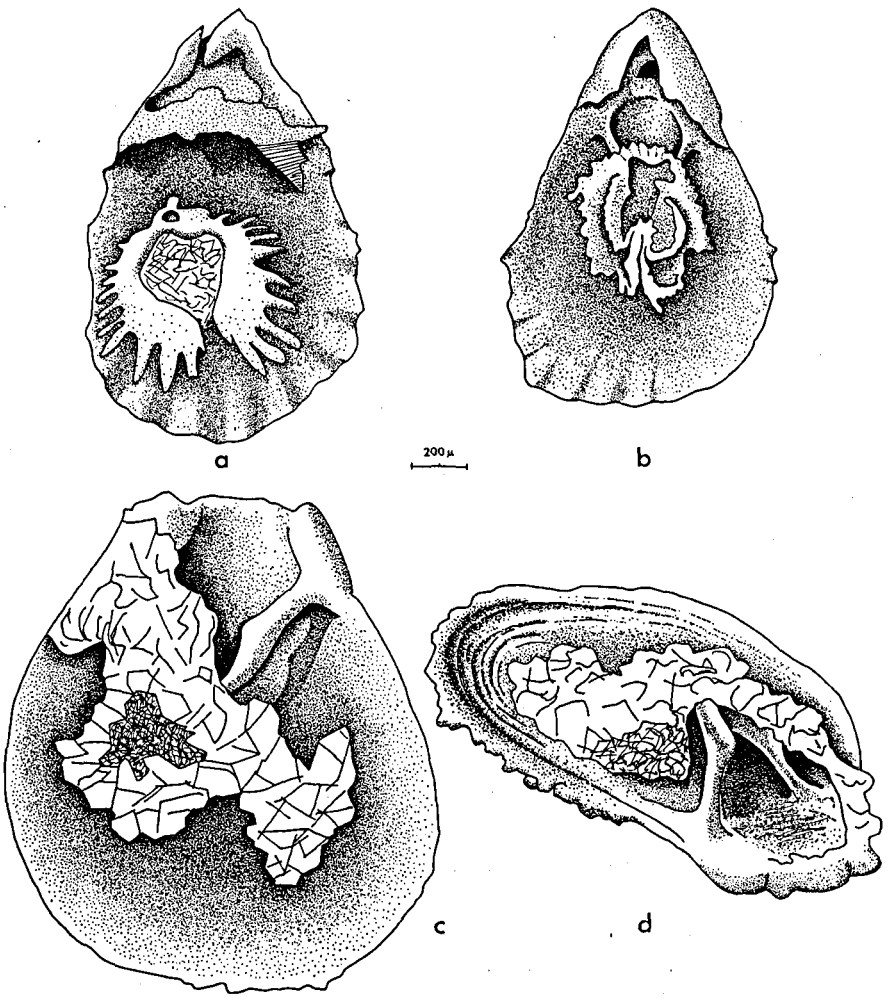
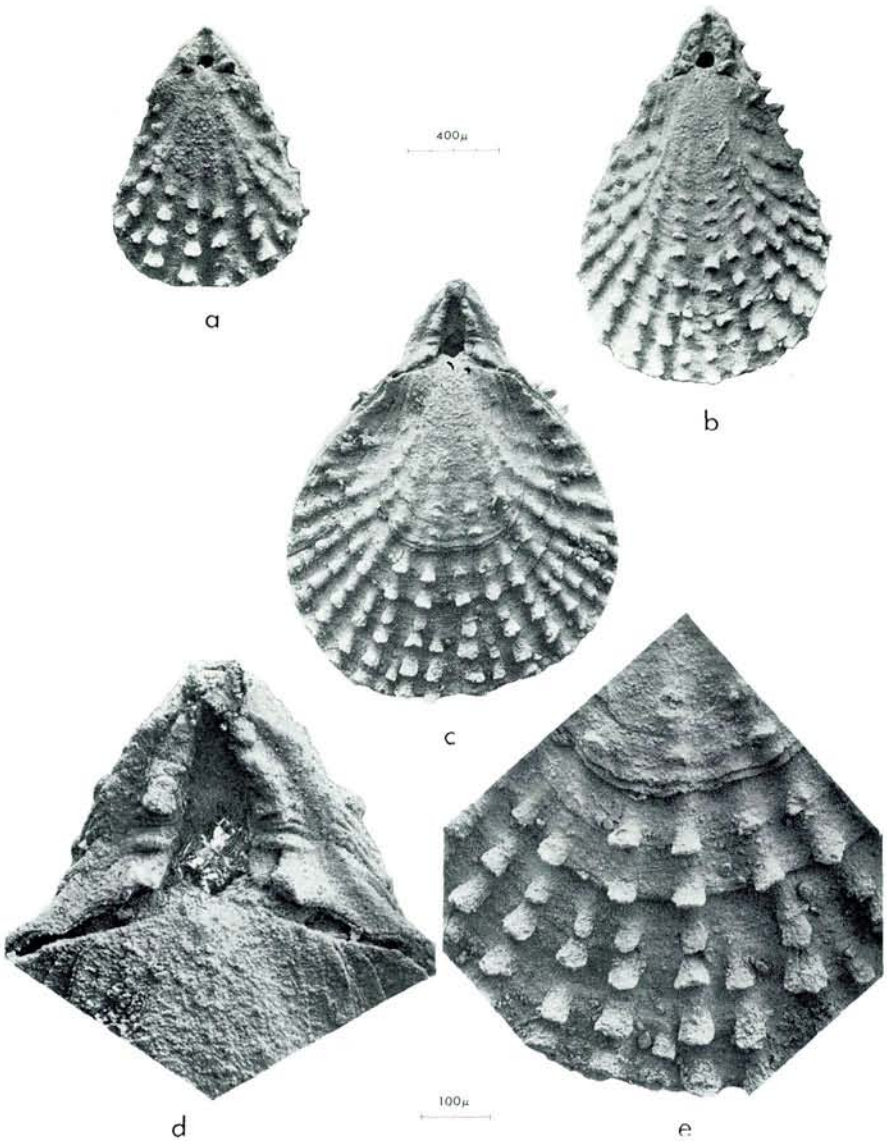


Fig. 4. *Rugia tegulata* n. sp. All specimens from Lindholm. *a:* Specimen showing recrystallised spicular skeleton. Dorsal view. *b:* Specimen showing recrystallised spicular skeleton. Ventral view. *c:* Specimen showing brachidium partly hidden by strongly recrystallised spicular skeleton. Ventral view. *d:* Same specimen as *c*. Seen in oblique posterior-lateral view.

The inner socket ridges are short but strong. Crura are long and thin like those of the other *Rugia* species, arising from the anterior edge of the ridges.

It has not been possible to investigate the development of the brachidium on account of the shortage of material. A fully developed brachidium has been found in two specimens. The better preserved specimen can be seen in figs 4c-d, where the brachidium is partly hidden by the strongly recry-

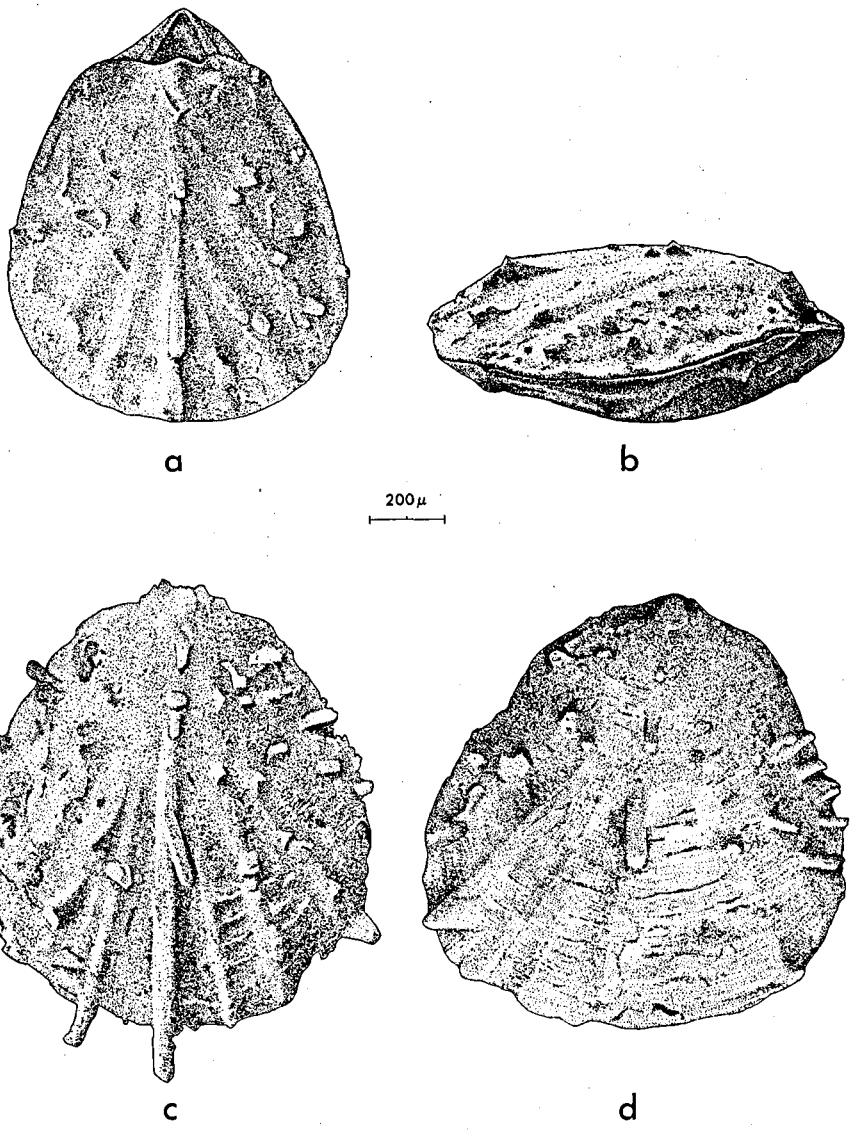


Rugia tegulata n. sp. Scanning electron micrographs.

a-b: Specimens from Lindholm chalk pit.

c: Holotype. Lindholm chalk pit. Upper Lower Maastrichtian, zone 8 (Surlyk, 1969).

d–e: Holotype. Foramen (d). Detail of shell surface (e).



Rugia spinosa n. sp.

a–b: Holotype, dorsal view (a) and oblique lateral view (b). Cliff at the lighthouse of Gedser. Lower Lower Maastrichtian, zone 2 (Surlyk, 1969).

c–d: Brachial valves in dorsal view. Cliff at the lighthouse of Gedser.

stallised spicular skeleton. The descending branches converge rapidly, fusing in a strong bridge. The ascending branches are very short and blunt.

Rugia tegulata n. sp. is provided with a very strong spicular skeleton (figs 4a-b). Fig. 4b shows a lophophore at a stage of development between a schizolophe and a zygolophe. The adult lophophore seems to be a plectolophe, but the present material does not allow any definite statement. The spicular skeletons of the filaments are long (fig. 4a) and the brachial lip is strongly developed. Gentle undulations of the inner surface of the shell correspond to the ribs of the outher surface.

The shell of *Rugia tegulata* n. sp. is rather thick.

Remarks

Rugia tegulata n. sp. can be referred with certainty to the genus *Rugia* Steinich, 1963 on account of the irregular deltidial plates, the long crura and the semicircle of the brachidium.

Material

Lindholm chalk pit: 60 specimens; »Danmark« chalk pit: 6; Sættepileklinten (Møns klint): 3.

Stratigraphical distribution
Lower Upper Maastrichtian. Zones 7 and 8 of the present writer (fig. 5).

Rugia spinosa n. sp.

Plate 2, figs a-d.
Derivatio nominis: lat. spina = spine, after the sculpture of the shell surface.

Holotypus: MMH no. 11018 (plate 2, figs a-b).

Locus typicus: Glacial mass in the cliff by the lighthouse of Gedser.

Stratum typicum: Probably lower Lower Maastrichtian.

Measurements: Length: 1.14 mm. Length of the brachial valve: 1.04 mm. Width: 0.94 mm. Width of the hinge line: 0.46 mm. Thickness: 0.50 mm. The angle between the edges of the rostrum (β by Steinich, 1965): 98°. The angle between the lateral commisure and the hinge line (δ by Steinich, 1965): 135°.

Diagnosis

A *Rugia* (Steinich, 1965 p. 115) with a very characteristic surface sculpture consisting of long, pointed spines which are directed forward. The spines in many cases extend from irregular radial ribs.

Description

The outline in dorsal view is pointed oval. The ratio of length to width varies between 1.04 and 1.33 (fig. 3d) while that of length to width of the brachial valve varies between 0.93 and 1.12 (fig. 3e). The greatest width lies anterior to the midline of the shell. The ratio of length of the hinge line to width varies between 0.40 and 0.49 (fig. 3f). Stumpy, blunt ears are present. The angle (δ) between the lateral commissure and the hingeline in two specimens 0.94 and 1.20 mm wide is 135° and 136° respectively. The shell is strongly biconvex. The ratio of thickness to width in two specimens 0.94 and 1.26 mm wide is 0.53 and 0.45 respectively.

The commissure is straight. Long, cylindrical pointed, solid spines comprise the sculpture. The spines are irregularly distributed over the surface of the shell and have variable form and size. They are present all over the shell surface. On the posterior part of the shell the spines have a tendency to be at right angles to the shell surface, while they are directed forwards and are larger on the anterior part of the shell. In many cases the large spines begin as an irregular, plain rib, which later breaks away abruptly and extends as a spine.

The spines may be arranged in rows as extended granules on an indistinct rib. These ribs are very few in number (ca. 1–8), are irregularly distributed and may often be seen on the inside of the shell as strong, plain ribs.

The rostrum is very short and suberect. The area is narrow and indistinctly formed. The angle (β) between the lateral edges of the rostrum measures 98° and 72° in two specimens which are 0.94 and 0.96 mm wide respectively.

The deltidial plates are narrow and triangular. The foramen is very small and submesothyrid. In two specimens 0.94 and 0.96 mm wide the foramen has a diameter of 0.06 and 0.08 mm respectively.

The structure of the hinge is reminiscent of those of *Rugia tenuicostata* and *Rugia acutirostris*. The inner socket ridges lie close together. They are very short with an anterio-lateral bend. A cardinal process is present only in the largest specimens. It is small and rounded and does not extend as far as the posterior part of the inner socket ridges. The posterior part of the socket ridges and the cardinal process together protrude beyond the edge of the shell. The teeth are short and pointed. Three adult specimens were opened to investigate the brachidium, but they were found to be filled with secondary calcite. A single, partly destroyed specimen shows that the brachidium

has a similar form to that of *Rugia tenuicostata*. Crura are long, thin and cylindrical originating from a position anterior to the inner socket ridges. They are directed forward and medially and make an angle of ca. 45° to the median plane of the shell.

No spicules have been found. The inner surface of the shell is plain in a few specimens, but commonly a few smooth ribs are found.

The shell of *Rugia spinosa* n. sp. is thin.

Material

Glacial mass in the cliff by the spit of Gedser: 7 specimens. Mass in the cliff by the light-house of Gedser: 17. Rørdal, boring no. 1, 85–96 m depth: 6. The eastern part of Hvide klint: 3.

Stratigraphical distribution

Lower Lower Maastrichtien. Guidefossil of zone 2 of the present writer (table 1).

Stratigraphy

On the basis of the vertical distribution of the brachiopods in the chalk of Rügen, Steinich (1965) succeeded in dividing it into 5 zones. In order to see if this distribution has any validity in the Danish chalk, samples from more than 40 localities have been examined. On the basis of the brachiopods it is possible to divide the Danish chalk into 10 zones (table 1). Further the boundary between Lower and Upper Maastrichtian is placed between zone 7 and 8 (Surlyk, in press).

Rugia spinosa n. sp. is the index fossil for the second zone from the bottom. It has not yet proved possible to date the chalk masses of Gedser by means of other fossils. The boring of Rørdal, which is 100 m deep, descends from the bottom of a locality placed in u. L. Maastrichtian (Birkelund 1957). The eastern part of Hvide Klint is placed in l. L. Maastrichtian (Birkelund, 1957). *Rugia spinosa* n. sp. is not known from the oldest Danish Maastrichtian, which is exposed in a chalk mass at Kongsted.

Rugia tegulata n. sp. is characteristic for that part of the l. U. Maastrichtian, which is exposed at several places near Aalborg and for the younger part of the chalk exposed at Møns Klint.

Dansk sammendrag

Det danske skrivekridt (Maastrichtien) kan på grundlag af de articulate brachiopoder inddeles i 10 zoner.

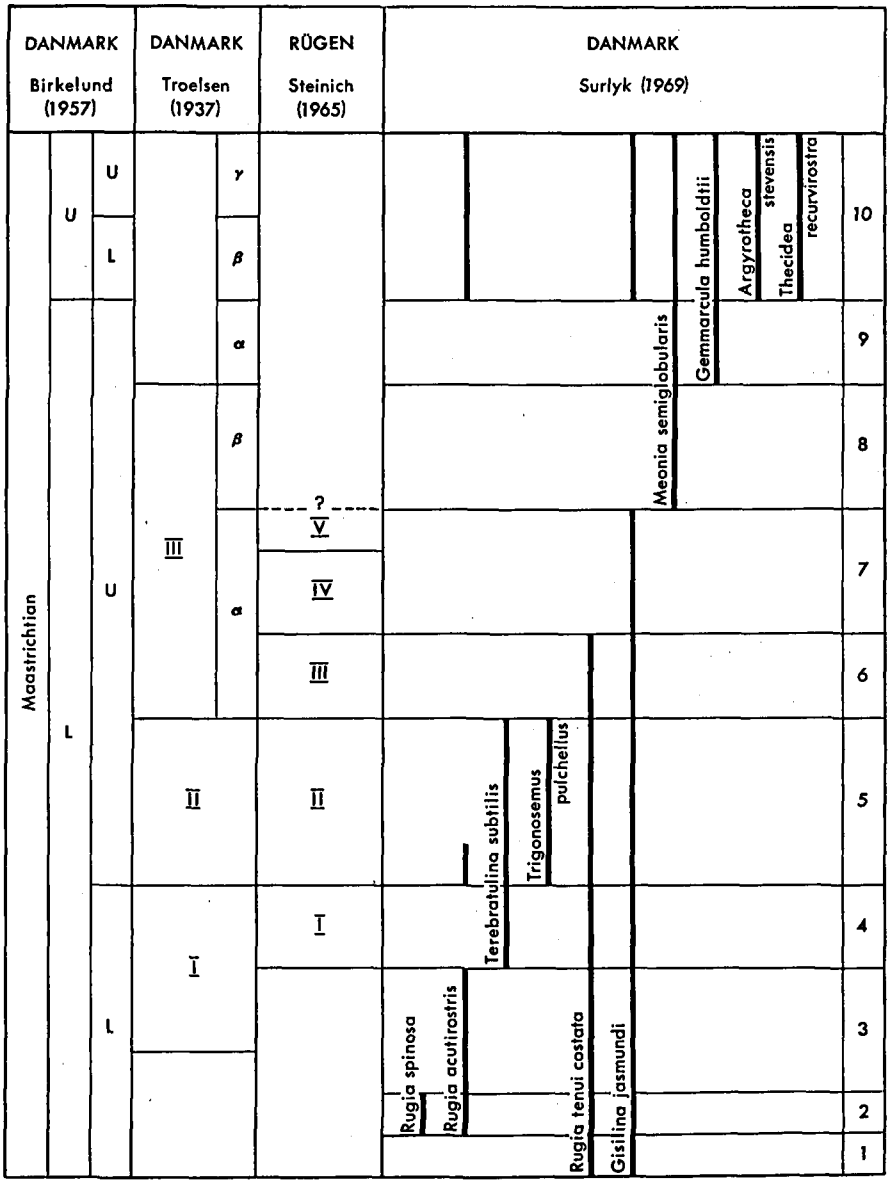


Table 1. Stratigraphy of the Danish white chalk compared with that of Rügen. Compiled from Troelsen (1937), Birkelund (1957), Steinich (1965) and Surlyk (1969).

Der gives en beskrivelse af to nye brachiopoder *Rugia tegulata* n. sp. og *Rugia spinosa* n. sp., der er fundet i skrivekridtet. Begge arter er meget små. De tilhører familien Cancellothyrididae Thomson, 1926.

Rugia spinosa n. sp. findes i det ældste danske Maastrichtien. *Rugia tegulata* n. sp. findes i den nedre del af øvre Maastrichtien. Hos denne art findes ofte et veludviklet rekrystalliseret spikelskelet.

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March 6th, 1970

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