

SVERIGES GEOLOGISKA UNDERSÖKNING

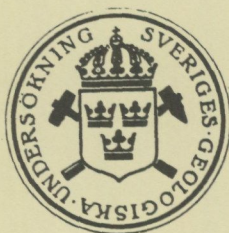
SERIE C NR 784

AVHANDLINGAR OCH UPPSATSER

ÅRSBOK 75 NR 5

YNGVE GRAHN

MIDDLE
ORDOVICIAN CHITINOZOA
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ABSTRACT

Grahn, Yngve, 1980-11-04: Middle Ordovician Chitinozoa from Öland. Sveriges geologiska undersökning, Ser. C, No. 784, pp. 1-51, Uppsala 1981.

The chitinozoans from twenty-five localities through the Viruan (Middle Ordovician) sequence and erratic boulders of late Caradocian to early Ashgillian age from Öland, southeast Sweden, have been investigated. Thirty-five species of the genera *Angochitina*, *Conochitina*, *Cyathochitina*, *Desmochitina*, *Eisenackitina*, *Hercochitina*, *Rhabdochitina*, and *Tanuchitina* are described. *Cyathochitina reticulifera* and *Cyathochitina sebyensis* are described as new species. The genus *Hercochitina* is reported for the first time from the Baltoscandian area. Local range zones of the chitinozoans in the Viruan of Öland are established.

INTRODUCTION

This paper is the second of three dealing with Ordovician Chitinozoa from Öland. The first paper (Grahn 1980) described the Ontikan (Early Ordovician) chitinozoans, and the present paper the Viruan (Middle Ordovician) Chitinozoa. It is based on three borings and twenty-one exposures in the Viruan beds (Fig. 1). Chitinozoans from erratic boulders of late Caradocian to early Ashgillian age, found on the southeast coast of Öland at Gräsgård, are also included in this study. The Viruan bedrock on Öland has a maximum thickness of about 24 m in the north and about 10 m less in the south. Viruan beds include strata from the base of the Zone of *Didymograptus purchisoni* up to the *Dicranograptus clingani*-*Pleurograptus linearis* zonal boundary (Fig. 2). The definition of the Viruan Series has been discussed by Jaanusson (1960a:212-219; 1960b:292-302). For a historical review prior to 1960 reference is made to Jaanusson (1960a, 1960b). During the last twenty years, literature about the Viruan on Öland has been very scanty. Papers dealing with general aspects on the Viruan sequence after 1960 are those by Jaanusson (1973, 1976). The stratigraphic succession in erratic boulders at Gräsgård have been described by Andersson (1893) and Martna (1955).

Eisenack (1955, 1962a, 1968b) described Viruan Chitinozoa from two localities, not treated in this paper, on Öland. From a locality with "Chasmops Limestone" (Dalby Limestone of Kukrusean age) situated at the old harbour of Böda, he reported eleven chitinozoan species, all of them described from the Böda Hamn boring. The second locality yielded "Schroeteri Limestone" (approximately equivalent with the Lasnamägi Stage) and is situated northeast of Källaberg, probably one of the abandoned quarries of Källa Limestone within 1 km northwest of Källa church. From this locality Eisenack reported the following chitinozoans: *Conochitina clavaherculi*, *Conochitina pelliifera*, *Cono-*

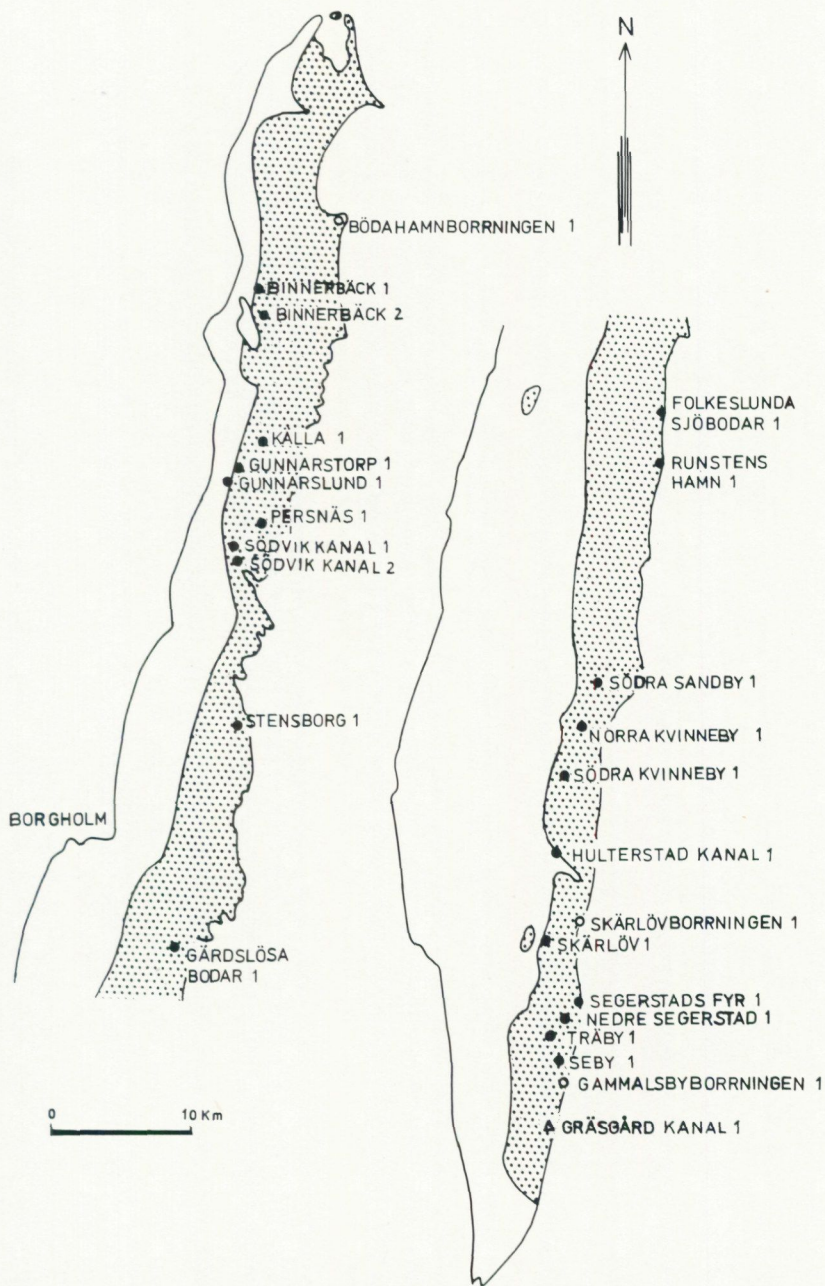


Fig. 1. Map showing Viruan (Middle Ordovician) localities. Filled circles indicate outcrops, open circles borings and triangle erratic boulders. The distribution of Viruan rocks at the base of the Pleistocene is screened on the figure. Pre-Viruan beds crop out towards west.

BRITISH SERIES	BALTOSCANDIAN STAGES	FORMATIONAL UNITS ON ÖLAND		SCANIAN GRAPTOLITE ZONES	CONODONT ZONES	LITHOLOGY
		N	S			
CARADOC ?	KUKRUSE	DALBY	ERODED	NEMAGRAPTUS	PYGODUS ANSERINUS	GREY CALCARENITES
LLANDEILO				UHAKU		
	KALLA	GLYPTOGRAPTUS	PYGODUS SERRA			
	LLANVIRN	LASNAMAGI		FOLKESLUNDA		TERETIUSCULUS
SEBY			SKÄRLÖV	DIDYMOGRAPTUS MURCHISONI	VARIEGATED REDDISH-BROWN AND GREY-MOTTLED CALCARENITES	
ASERI		SEGERSTAD			Not yet defined	REDDISH BROWN FINELY NODULAR CALCILUTITES AND MARLS
				REDDISH-BROWN CALCARENITES		

Fig. 2. Diagram showing correlation and lithology of Viruan rocks on Öland. Based on Bergström (1971, 1973, written comm. 1980) and Jaanusson (1960a, 1973, pers. comm. 1980).

chitina primitiva, and *Cyathochitina calix*. The chitinozoan fauna confirms an early Uhakuan age.

Fig. 2. summarizes the Viruan stratigraphy of Öland.

SAMPLES AND LOCALITIES

In all, 168 samples from twenty-five localities have been examined. Altogether about 31 000 specimens of Chitinozoa were recovered. Only about half of the number of localities and about 52 % of the samples yielded chitinozoans. The field work and laboratory methods used has been described earlier (Grahm 1980). The localities studied (Fig. 1) are described in alphabetical order, and their positions are given in UTM co-ordinates.

BINNERBÄCK 1, XD 1875 4305, c. 6 450 m SW of Böda church.

Topographical map sheet 5H Borgholm NV/NO. Geological map sheet Ac 5 Oskarshamn.

Abandoned quarry on either side of the main road between Högby and Byerum and about 1 075 m SSE of point 6.16 at Byerums Sandvik.

Segerstad Limestone.

References: Jaanusson 1960a, p. 225.

A sample was taken in a reddish-brown calcarenite. No chitinozoans were recorded.

BINNERBÄCK 2, XD 1860 4175, c. 5 125 m NW of Högby church.

Topographical map sheet 5H Borgholm NV/NO. Geological map sheet Ac 8 Mönsterås med Högby.

Abandoned quarry immediately W of the road between Vedby and Bäcka-lund and about 550 m E of lake Hornsviken.

Folkeslunda Limestone.

References: Jaanusson 1960a, p. 226.

About a metre of grey calcarenite from the lower part of Folkeslunda Limestone is exposed here. Two samples were collected.

0–0.05 m YG 14. *Conochitina* aff. *elegans*, *Conochitina micracantha*, *Conochitina primitiva*, *Cyathochitina campanulaeformis*, *Cyathochitina striata*, *Desmochitina amphorea*, *Desmochitina cocca*, *Desmochitina minor*, *Desmochitina ovulum*, *Desmochitina rugosa*, and *Rhabdochitina gracilis*.

0.80–0.85 m YG 15. *Conochitina* aff. *claviformis*, *Conochitina* cf. *comma*, *Conochitina* aff. *elegans*, *Conochitina micracantha*, *Conochitina pellifera*, *Conochitina primitiva*, *Conochitina wesenbergensis*, *Cyathochitina campanulaeformis*, *Cyathochitina striata*, *Desmochitina complanata*, and *Desmochitina minor*.

BÖDAHAMNBORRNINGEN 1 (For details, see Grahn 1980)

Fifty-seven samples were processed from the Aserian-Kukrusean section of the Viruan part of the core, which is shown in Fig. 3.

FOLKESLUNDA SJÖBODAR 1, XC 0703 8800, c. 2 550 m SE of Långlöt church.

Topographical map sheet 4G/4H Kalmar NO/Runsten NV. Geological map sheet Ac 6 Kalmar.

Exposure at the beach N of where the road from Folkeslunda ends.

Seby Limestone.

References: Jaanusson 1960a, p. 250.

A sample taken in a grey calcarenite yielded the following chitinozoans: *Conochitina* aff. *claviformis*, *Conochitina* aff. *elegans*, *Conochitina micracantha*, and *Desmochitina minor*.

GAMMALSBYBORRNINGEN 1 (For details, see Grahn 1980)

Fifty-five samples were collected from the Aserian–Uhakuan section of the Viruan part of the core, which is shown in Fig. 4.

BÖDAHAMBORRNINGEN 1

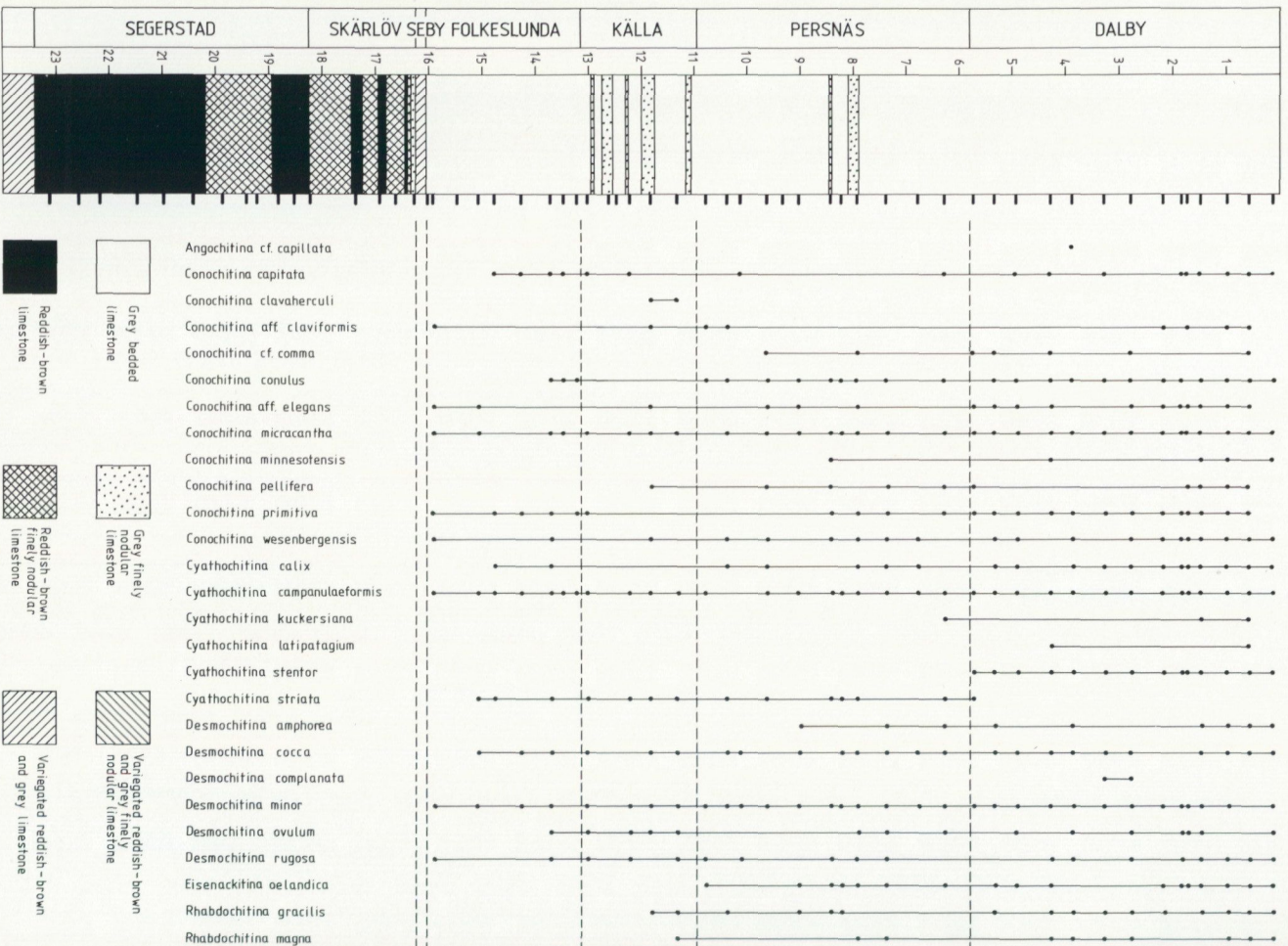


Fig. 3. Böhåmmborringen 1, lithology and sample levels in the Viruan part of the core. Based on Jaansson (1960a).

GAMMALSBYBORNINGEN 1

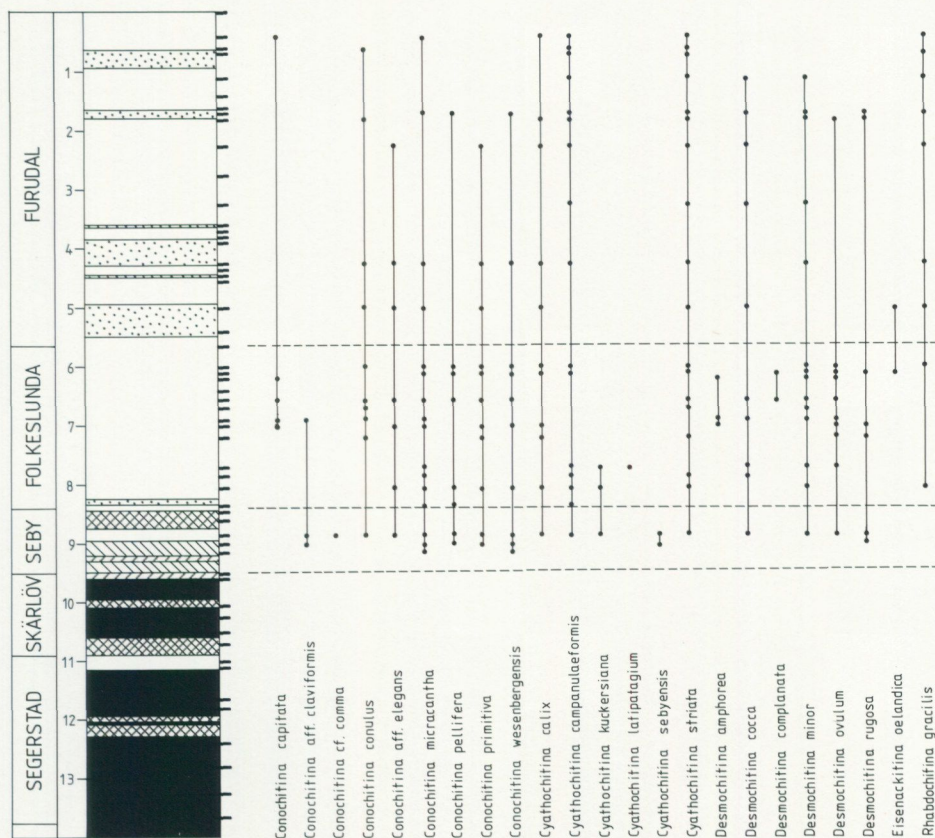


Fig. 4. Gammalsbyborringen 1, lithology and sample levels in the Viruan part of the core. Based on Jaanusson (1960a). For legend, see Fig. 3.

GÄRDSLÖSA BODAR 1, XC 0712 9460, c. 1 700 m SE of Gärdslösa church.

Topographical map sheet 4G/4H Kalmar NO/Runsten NV. Geological map sheet Ac 6 Kalmar.

Water hole immediately S of the road between Södra Gärdslösa and Gärdslösa bodar at the coast.

Folkeslunda Limestone.

A 0.93 m thick section of grey calcarenite was measured by Laufeld (unpublished material) in 1966. From top to bottom the following chitinozoans were recorded.

0.05–0.12 m Öl 66-6. *Conochitina capitata*, *Conochitina aff. claviformis*, *Conochitina micracantha*, *Conochitina primitiva*, *Cyathochitina striata*, and *Desmochitina minor*.

- 0.20–0.25 m Öl 66-5. *Conochitina conulus*, *Conochitina micracantha*, *Conochitina primitiva*, *Cyathochitina striata*, *Desmochitina cocca*, *Desmochitina minor*, and *Eisenackitina oelandica*.
- 0.35–0.37 m Öl 66-4. *Conochitina micracantha*, *Conochitina primitiva*, *Conochitina wesenbergensis*, *Cyathochitina calix*, *Cyathochitina campanulaeformis*, *Cyathochitina striata*, *Desmochitina cocca*, *Desmochitina minor*, *Desmochitina ovulum*, and *Desmochitina rugosa*.
- 0.59–0.61 m Öl 66-3. *Conochitina* aff. *claviformis*, *Conochitina conulus*, *Conochitina* aff. *elegans*, *Conochitina micracantha*, *Conochitina pelliifera*, *Conochitina primitiva*, *Conochitina wesenbergensis*, *Cyathochitina calix*, *Cyathochitina campanulaeformis*, *Desmochitina minor*, *Desmochitina rugosa*, and *Rhabdochitina gracilis*.
- 0.88–0.91 m Öl 66-2. *Conochitina capitata*, *Conochitina* aff. *elegans*, *Conochitina primitiva*, *Cyathochitina campanulaeformis*, *Desmochitina cocca*, *Desmochitina minor*, *Desmochitina ovulum*, *Desmochitina rugosa*, and *Rhabdochitina gracilis*.
- 0.91–0.93 m Öl 66-1. *Conochitina* aff. *claviformis*, *Conochitina conulus*, *Conochitina micracantha*, *Conochitina primitiva*, *Cyathochitina campanulaeformis*, *Cyathochitina striata*, *Desmochitina cocca*, and *Desmochitina minor*.

GRÄSGÅRD KANAL 1, WC 9288 4020, c. 1 600 m SSW of Gräsgård church. Topographical map sheet 3G Kristianopel NO. Geological map sheet Ac 7 Ottenby.

Erratic boulders in a ditch E of the main road between Össby and Gräsgård and towards the coast. The locality is also known as Össby Bäck.

Keila? (Middle Caradoc)–Pirgu (Lower Ashgill).

References: Andersson 1893, pp. 521–540; Jaanusson 1953, pp. 98–99; Martna 1955, pp. 238–240, 247–249, 251–254.

Samples of a yellowish-grey calcareous siltstone equivalent to the lower part of the *Macrourus* Siltstone yielded the following chitinozoans: *Conochitina cactacea*, *Conochitina capitata*, *Conochitina conulus*, *Conochitina micracantha*, *Conochitina minnesotensis*, *Conochitina robusta*, *Conochitina suecica*, *Conochitina wesenbergensis*, *Cyathochitina campanulaeformis*, *Cyathochitina kuckersiana*, *Cyathochitina latipatagium*, *Desmochitina cocca*, *Desmochitina minor*, *Desmochitina rugosa*, and *Hercochitina* cf. *crickmayi*.

Erratics of undifferentiated late Caradocian age yielded four different chitinozoan faunas.

Boulder 1. *Cyathochitina campanulaeformis*, *Rhabdochitina gracilis*, *Rhabdochitina magna*, and *Tanuchitina bergstroemi*.

Boulder 2. *Conochitina capitata*, *Conochitina* aff. *claviformis*, *Conochitina* aff. *elegans*, *Conochitina micracantha*, *Conochitina primitiva*, *Conochitina robusta*, *Cyathochitina calix*, *Cyathochitina campanulaeformis*, *Desmochitina cocca*, *Desmochitina minor*, *Desmochitina nodosa*, *Desmochitina rugosa*, and *Rhabdochitina gracilis*.

Boulder 3. *Conochitina micracantha*, *Cyathochitina campanulaeformis*, and *Cyathochitina reticulifera*.

Boulder 4. *Conochitina* aff. *elegans*, *Conochitina robusta*, *Cyathochitina campanulaeformis*, *Cyathochitina reticulifera*, and *Desmochitina minor*.

Samples of a grey, fine-grained limestone rich in calcareous algae yielded no chitinozoans. The age is probably early Ashgill.

GUNNARSLUND 1 (For details, see Grahn 1980)

A sample was taken 10 cm above a discontinuity surface in reddish-brown, calcarenitic Segerstad Limestone. No chitinozoans were recorded.

GUNNARSTORP 1, XD 1660 3020, c. 3 250 m NNW of Persnäs church.

Topographical map sheet 5H Borgholm NV/NO. Geological map sheet Ac 8 Mönsterås med Högby.

Ditch-section immediately N of the main road between Källa and Södvik and about 400 m E of the farm of Gunnarstorp. The Folkeslunda Limestone crops out S of the road.

Skärlöv-Seby Limestones.

References: Jaanusson 1960a, pp. 225–226.

A sample was collected in a grey and reddish-brown mottled limestone from the Seby limestone and another sample in a reddish-brown marl from the Skärlöv Limestone. None of the samples yielded chitinozoans.

HULTERSTAD KANAL 1, WC 9685 5655, c. 600 m S of Hulterstad church.

Topographical map sheet 4G/4H Kalmar SO/Runsten SV. Geological map sheet Ac 6 Kalmar.

Ditch-section in Penåsabäcken immediately E of the main road between Skärlöv and Hulterstad.

Segerstad Limestone.

A sample of reddish-brown calcarenite yielded no chitinozoans.

KÄLLA 1, XD 1855 3250, c. 700 m W of Källa church.

Topographical map sheet 5H Borgholm NV/NO. Geological map sheet Ac 8 Mönsterås med Högby.

Abandoned quarry immediately S of the road between Källa and Hagelstad.
Källa Limestone.

References: Jaanusson 1960a, p. 227.

A calcilutite sample from the upper 0.3 m of the section yielded specimens of *Cyathochitina striata*.

NEDRE SEGERSTAD 1, WC 9495 4650, c. 850 m S of Segerstad church.

Topographical map sheet 3G Kristianopel NO. Geological map sheet Ac 7 Ottenby.

Water hole immediately E of the main road between Seby and Segerstad.
Skärlov-Segerstad Limestones.

A sample collected in a reddish-brown calcarenite yielded no chitinozoans.

NORRA KVINNEBY 1, WC 9890 6668, c. 1 850 m NNE of Stenåsa church.

Topographical map sheet 4G/4H Kalmar SO/Runsten SV. Geological map sheet Ac 6 Kalmar.

Drainage-ditch immediately E of the main road between Stenåsa and Gårdby and S of the village of Norra Kvinneby.

Seby Limestone.

References: Jaanusson 1960a, p. 250 lines 38–41.

A 1.5 m thick section of grey calcarenite was sampled at three levels. The following chitinozoans were recorded:

- 0.10–0.15 m YG 16. *Conochitina micracantha*, *Conochitina pelifera*, *Cyathochitina calix*, *Cyathochitina campanulaeformis*, *Cyathochitina striata*, *Desmochitina minor*, and *Desmochitina rugosa*.
- 0.60–0.65 m YG 17. *Conochitina capitata*, *Conochitina* aff. *claviformis*, *Conochitina* aff. *elegans*, *Conochitina pelifera*, *Cyathochitina campanulaeformis*, *Cyathochitina striata*, *Desmochitina minor*, and *Rhabdochitina gracilis*.
- 1.20–1.25 m YG 18. *Conochitina capitata*, *Conochitina primitiva*, *Cyathochitina calix*, *Cyathochitina campanulaeformis*, *Cyathochitina striata*, and *Rhabdochitina gracilis*.

PERSNÄS 1, XD 1680 2693, c. 600 m W of Persnäs church.

Topographical map sheet 5H Borgholm NV/NO. Geological map sheet Ac 8 Mönsterås med Högby.

Abandoned quarry S of and close to the main road between Persnäs and Södvik.

Persnäs Limestone.

References: Jaanusson 1960a, p. 228.

A 1.3 m thick section in a grey calcarenite was measured by Jaanusson at this locality. Three levels were sampled and yielded the following chitinozoans:

- 0–0.05 m YG 19. *Conochitina* aff. *claviformis*, *Conochitina conulus*, *Conochitina micracantha*, *Conochitina pelifera*, *Conochitina primitiva*, *Conochitina wesenbergensis*, *Cyathochitina calix*, *Cyathochitina campanulaeformis*, *Desmochitina cocca*, *Desmochitina minor*, *Desmochitina ovulum*, *Desmochitina rugosa*, and *Eisenackitina oelandica*.
- 0.50–0.55 m YG 20. *Conochitina conulus*, *Conochitina micracantha*, *Conochitina wesenbergensis*, *Cyathochitina campanulaeformis*, *Desmochitina cocca*, *Desmochitina minor*, *Desmochitina rugosa*, *Eisenackitina oelandica*, and *Rhabdochitina gracilis*.
- 0.75–0.80 m Öl 66-101. *Conochitina* aff. *claviformis*, *Conochitina conulus*, *Conochitina micracantha*, *Conochitina primitiva*, *Conochitina wesenbergensis*, *Cyathochitina calix*, *Cyathochitina striata*, *Desmochitina cocca*, *Desmochitina minor*, *Eisenackitina oelandica*, and *Rhabdochitina gracilis*.

RUNSTENS HAMN 1, XC 0655 8475, c. 2 400 m ESE of Runsten church.

Topographical map sheet 4G/4H Kalmar NO/Runsten NV. Geological map sheet Ac 6 Kalmar.

Exposure at the beach N of where the road from Runsten ends at the harbour.
Källa Limestone.

References: Jaanusson 1960a, p. 251.

A sample taken in a grey chamositiferous limestone yielded the following chitinozoans: *Conochitina capitata*, *Conochitina* aff. *elegans*, *Conochitina micracantha*, *Conochitina primitiva*, *Cyathochitina calix*, *Cyathochitina campanulaeformis*, *Cyathochitina striata*, *Desmochitina cocca*, *Desmochitina minor*, and *Desmochitina ovulum*.

SEBY 1, WC 9253 4578, c. 1 850 m SSE of Segerstad church.

Topographical map sheet 3G Kristianopel NO. Geological map sheet Ac 7 Ottenby.

Water hole about 500 m E of the northernmost house of the village of Seby.
Skärlöv-Seby Limestones.

References: Jaanusson 1960a, pp. 257–258.

A 0.76 m thick section was measured by Bohlin at this locality in 1941. For details, see Jaanusson 1960a: 257. Two samples from the Seby Limestone yielded the following chitinozoans:

0.05–0.10 m YG 21. *Conochitina capitata*, *Conochitina* aff. *claviformis*, *Conochitina conulus*, *Conochitina* aff. *elegans*, *Conochitina micracantha*, *Conochitina pellifera*, *Conochitina primitiva*, *Conochitina wesenbergensis*, *Cyathochitina calix*, *Cyathochitina campanulaeformis*, *Cyathochitina kuckersiana*, *Cyathochitina sebyensis*, *Cyathochitina striata*, *Desmochitina cocca*, *Desmochitina minor*, *Desmochitina ovulum*, *Desmochitina rugosa*, and *Rhabdochitina gracilis*.

0.21–0.26 m YG 22. *Desmochitina minor* and *Desmochitina rugosa*.

SEGERSTADS FYR 1, WC 9690 4845, c. 2 150 m NE of Segerstad church.

Topographical map sheet 3G Kristianopel NO. Geological map sheet Ac 7 Ottenby.

Exposure at the beach about 100 m N of the lighthouse.

Segerstad Limestone.

References: Jaanusson 1960a, p. 254.

A sample of reddish-brown calcarenite yielded no chitinozoans.

SKÄRLÖVBORRNINGEN 1 (For details, see Grahn 1980)

Ten samples from the Viruan part of the core (Fig. 5) yielded no chitinozoans.

SKÄRLÖV 1 (For details, see Grahn 1980)

A sample was collected in the top layer of the quarry in a reddish-brown calcarenite. No chitinozoans were recorded.

SÖDRA KVINNEBY 1, WC 9708 6243, c. 2 820 m SW of Stenåsa church.

Topographical map sheet 4G/4H Kalmar SO/Runsten SV. Geological map sheet Ac 6 Kalmar.

Ditch-section W of the main road between Hulterstad and Stenåsa. Close to and N of the sample point is Tannes Hög, a grave, probably from Germanic Iron Age (c. 400–800 A.D.).

Seby Limestone.

A sample was taken in a grey, reddish-brown mottled calcarenite.

No chitinozoans were recorded.

SKÄRLÖVBORRNINGEN 1

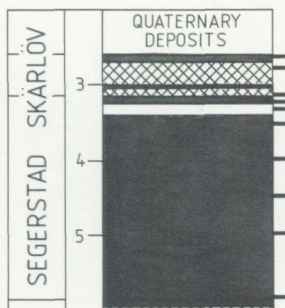


Fig. 5. Skärlovborrningen 1, lithology and sample levels in the Viruan part of the core. Based on Jaanusson (1960a). For legend, see Fig. 3.

SÖDRA SANDBY 1, WC 9928 7093, c. 1 900 m SW of Sandby church.

Topographical map sheet 4G/4H Kalmar SO/Runsten SV. Geological map sheet Ac 6 Kalmar.

Quarry about 100 m W of the main road between Stenåsa och Gårdby and c. 500 m NNW of the village of Södra Sandby.

Seby Limestone.

References: Jaanusson 1960a, pp. 249–250.

A sample collected in a grey, reddish-brown mottled calcarenite yielded no chitinozoans.

SÖDVIK KANAL 1, XD 1470 2525, c. 3 000 m SW of Persnäs church.

Topographical map sheet 5H Borgholm NV/NO. Geological map sheet Ac 8 Mönsterås med Högby.

Three exposures along the drainage-ditch from Södvik to the bay of Södviken on the east coast. They are situated immediately S of the road from Södvik to Viksgård and c. 300 m further downstream.

Segerstad Limestone.

References: Jaanusson 1960a, p. 225.

A sample was collected from a reddish-brown calcarenite. No chitinozoans were recorded.

SÖDVIK KANAL 2, XD 1505 2445, c. 4 100 m NNW of Föra church.

Topographical map sheet 5H Borgholm NV/NO. Geological map sheet Ac 8 Mönsterås med Högby.

Exposure in a drainage-ditch from Södvik to the bay of Södviken, about 500 m NNE of the farm of Enetorp.

Segerstad Limestone.

References: Jaanusson 1960a, p. 225.

A sample was taken in a reddish-brown calcarenite. No chitinozoans were recorded.

STENSBORG 1, XD 1400 1320, c. 3 775 m NE of Löt church.

Topographical map sheet 5H Borgholm SV. Geological map sheet Ac 8 Mönsterås med Högby.

Quarry about 50 m NW of the main road between Arbelunda and Kårehamn, and about 1 450 m SW of Kårehamn harbour.

Persnäs Limestone.

References: Jaanusson 1960a, pp. 228–229.

A section of grey calcarenites about 0.5 m thick is exposed here. Two samples yielded the following chitinozoans:

0–0.05 m YG 23. *Conochitina* aff. *claviformis*, *Conochitina micracantha*, *Desmochitina minor*, and *Desmochitina rugosa*.

0.45–0.50 m YG 24. *Conochitina* aff. *claviformis*, *Conochitina conulus*, *Conochitina micracantha*, *Conochitina primitiva*, *Conochitina wesenbergensis*, *Cyathochitina calix*, *Cyathochitina striata*, *Desmochitina amphorea*, *Desmochitina cocca*, *Desmochitina minor*, *Desmochitina ovulum*, *Desmochitina rugosa*, and *Eisenackitina oelandica*.

TRÄBY 1, XC 9370 4570, c. 2 275 m SW of Segerstad church.

Topographical map sheet 3G Kristianopel NO. Geological map sheet Ac 7 Ottenby.

Water hole near the abandoned railway track and about 600 m ESE of the village of Träby.

Folkeslunda Limestone.

References: Jaanusson 1960a, p. 258.

A sample of grey calcarenite yielded the following chitinozoans:

Angochitina cf. *capillata*, *Conochitina* aff. *claviformis*, *Conochitina conulus*, *Conochitina micracantha*, *Conochitina primitiva*, and *Conochitina wesenbergensis*.

SYSTEMATICS

The taxonomic principles, terminology, methods of measurements and of photography are the same as those described by Grahn (1980). The dimensions given in the descriptions are in microns.

Genus *Angochitina* Eisenack, 1931, emend. 1968*Angochitina* cf. *capillata* Eisenack, 1937

Fig. 6 A, E

- 1937 *Angochitina capillata* n.sp. – Eisenack, p. 225; Pl. 15:12–13.
 1962a *Angochitina capillata* – Eisenack, p. 300; Pl. 15:9–10.
 1965 *Angochitina capillata* – Eisenack, p. 122; Pl. 11:3.
 1969 *Angochitina capillata* – Jenkins, p. 10; Pl. 1:7–11.

DESCRIPTION – *Angochitina* species with an ellipsoidal body and a subcylindrical neck that widens at the aperture. The width of the neck is about half the body, and the length about 1/3 of the total length. The base is ovoid. The vesicle wall is covered with simple spines that taper towards the distal tip.

DIMENSIONS – The few specimens encountered have the same dimensions as those described by Eisenack 1937.

REMARKS – *Angochitina* cf. *capillata* differs from *Angochitina capillata* Eisenack, 1937 in having much shorter spines and a more ovoid base.

OCCURRENCE – Öland: Folkeslunda and Dalby Limestones.

Nabala to Pirgu (Upper Caradoc to Lower Ashgill), Estonia (Eisenack 1962a, 1965). Viola Limestone (Upper Caradoc to Lower Ashgill), Oklahoma, U.S.A. (Jenkins 1969).

Genus *Conochitina* Eisenack, 1931, restricted 1955*Conochitina cactacea* Eisenack, 1937

Fig. 6B–D, F

- 1937 *Conochitina cactacea* n.sp. – Eisenack, pp. 222–223; Pl. 15:14–15.
 1959 *Conochitina cactacea* – Eisenack, pp. 10–11; Figs. 2A–B; Pl. 1:12–13.
 1962b *Conochitina cactacea* – Eisenack, Pl. 44:14–15.
 1965 *Conochitina cactacea* – Eisenack, p. 125; Pl. 9:18–19.
 1967 *Conochitina cactacea* – Laufeld, pp. 299–300; Figs. 9 A–F.
 1970 *Conochitina cactacea* – Jenkins, pp. 272–273; Pl. 49:18–25.
 1975 *Conochitina cactacea* – Tynni, p. 44; Pl. 43 A.

DESCRIPTION – *Conochitina* species with a conical body and a cylindrical neck that slightly widens at the straight aperture. The neck is short, around 1/4 of the total length. The base is flat or convex and the basal edge rounded. The body is covered by long simple spines.

DIMENSIONS – Total length 140–165, max. width 78–91, width of aperture 22–46, max. height of ornamentation 10.

OCCURRENCE – Öland: Erratics of Lower *Macrourus* Siltstone (Middle Caradoc).

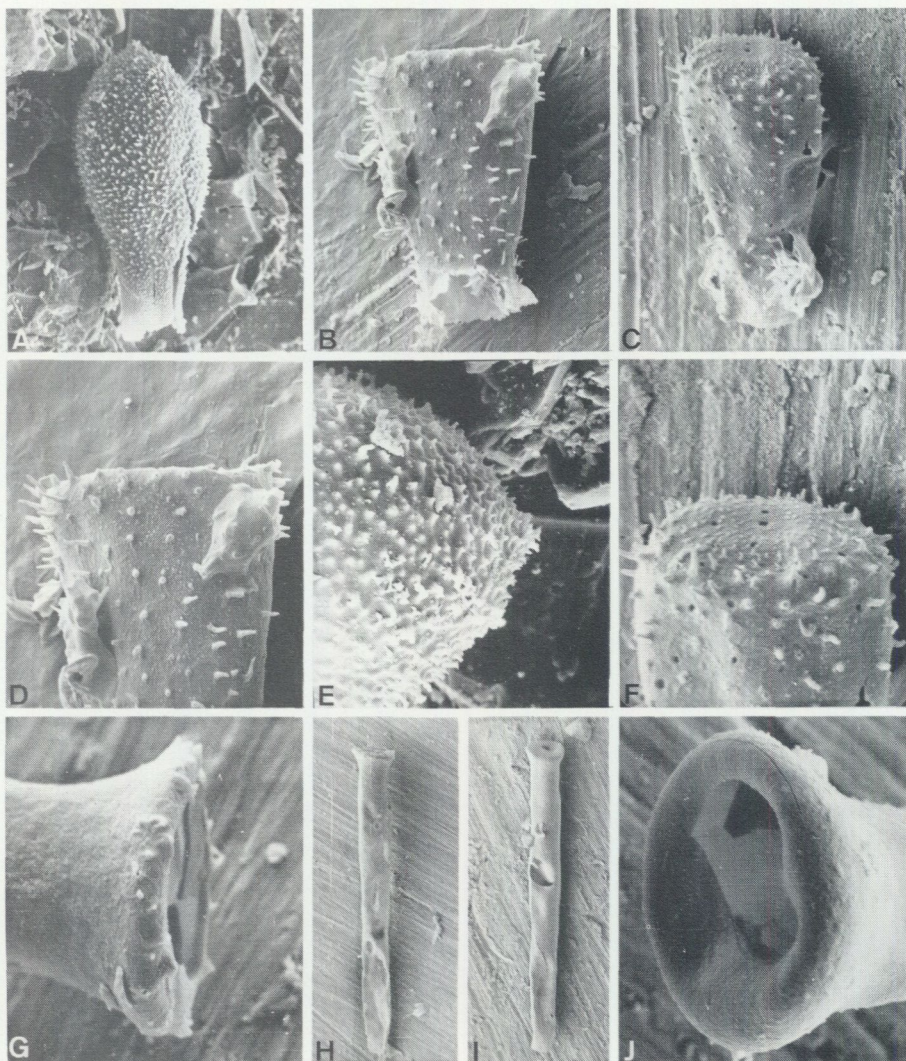


Fig. 6. A, E. *Angochitina* cf. *capillata* Eisenack, 1937. A, E. Bödahamnborrningen 1, Dalby Limestone (3.85–3.90 m). B–D, F. *Conochitina cactacea* Eisenack, 1937. B–D, F. Gräsgård kanal 1, *Macrourus* Siltstone. G–J. *Conochitina capitata* Eisenack, 1962. G–H. Bödahamnborrningen 1, Persnäs Limestone (10.10–10.15 m). I. Gammalsbybörningen 1, Folkeslunda Limestone (6.98–7.01 m). J. Gärslösa bodar 1, Folkeslunda Limestone (Öl 66-6).

A, E. SGU Type 725. A. Lateral view, SEM x170; E. Aboral view, SEM x430. B, D. SGU Type 730. B. Lateral view, SEM x240; D. Aboral view, SEM x330. C, F. SGU Type 731. C. Lateral view, SEM x220; F. Aboral view, SEM x440. G–H. SGU Type 735. G. Aboral view. Note the simple spines along the basal edge, SEM x360; H. Lateral view, SEM x50. I. SGU Type 732. Lateral view, SEM x60. J. SGU Type 736. Aboral view, SEM x470.

Rakvere (Upper Caradoc), Estonia (Eisenack 1962b, 1965). Dalby and Slandrom Limestone (Caradoc), Dalarna, Sweden (Laufeld 1967). Sylvan Shale (Lower Ashgill), Oklahoma, U.S.A. (Jenkins 1970).

Conochitina capitata Eisenack, 1962

Fig. 6 G–J

1962a *Conochitina micracantha* subsp. *capitata* n. subsp. – Eisenack, pp. 310–311; Pl. 15:6–8.

1967 *Conochitina capitata* – Laufeld, pp. 300–302; Figs. 10 A–E.

1972 *Conochitina micracantha* subsp. *capitata* – Eisenack, pp. 125–126; Pl. 37:1.

DESCRIPTION – *Conochitina* species with a subcylindrical body and a conically widened basal part. The base is convex to concave. The rounded basal edge is smooth or provided with simple spines. The neck widens slightly at the aperture which is straight. Orally of the basal edge the vesicle is always smooth.

DIMENSIONS – Total length 240–680, max. width 50–102, width of aperture 27–56.

REMARKS – Laufeld (1967:301) remarked that *Conochitina capitata* from the Dalby Limestone in Dalarna has simple spines on the basal edge. The Öland specimens often have a smooth basal edge. Some of the specimens from Dalarna were also covered by minute, spinose thickenings. Such an ornamentation has not been observed in the specimens from Öland.

OCCURRENCE – Öland: Seby to Dalby Limestones. Erratics of Lower *Macrourus* Siltstone (Middle Caradoc) and undifferentiated late Caradocian age.

Aseri to Uhaku (Upper Llanvirn to Llandeilo) through Jöhvi (Caradoc), Estonia (Eisenack 1962a). Dalby Limestone (Lower Caradoc), Dalarna, Sweden (Laufeld 1967).

Conochitina clavaherculi Eisenack, 1959

Fig. 7 A–D

1959 *Conochitina clavaherculi* n. sp. – Eisenack, pp. 4–5; Pl. 3:3.

DESCRIPTION – *Conochitina* species with a subcylindrical body and a cylindrical neck that comprises about 1/3 of the total length. The base is slightly convex and provided with a flat and broad basal process. After the rounded basal edge, the body is somewhat convex towards the straight aperture. The vesicle wall is smooth.

DIMENSIONS – Total length 537–976, max. width 74–122, width of aperture 37–74.

OCCURRENCE – Öland: Källa Limestone

Aseri to Uhaku (Upper Llanvirn to Llandeilo), Estonia (Eisenack 1959).

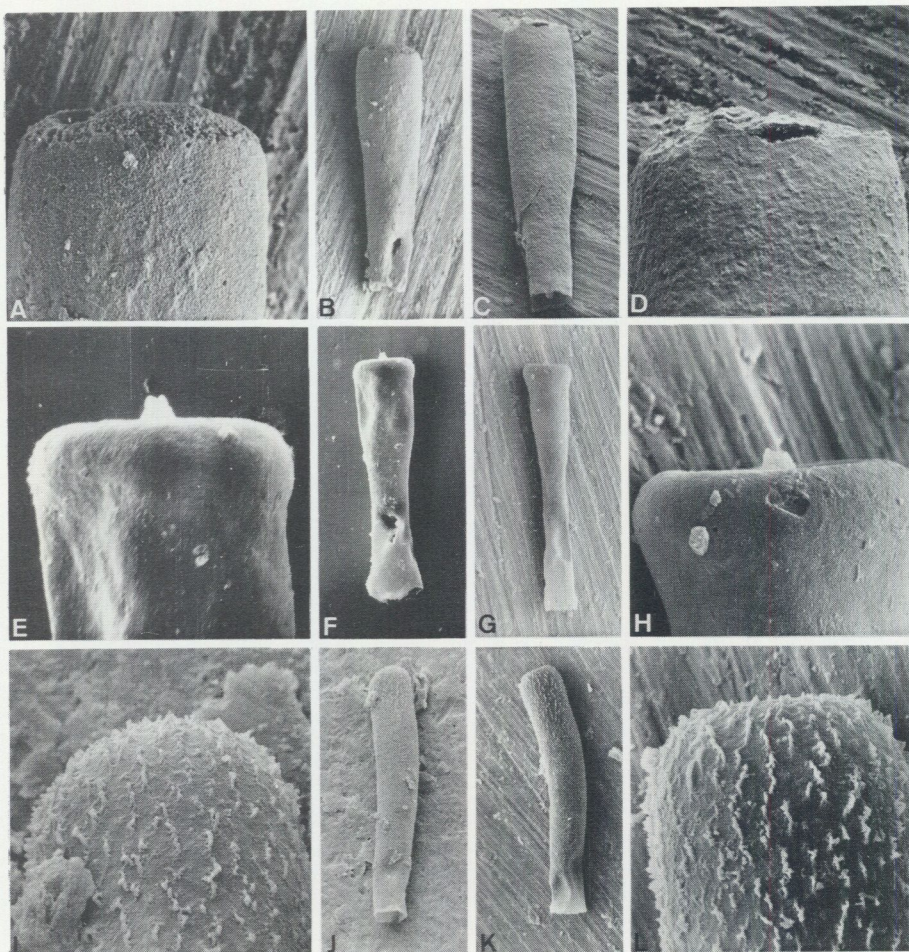


Fig. 7. A–D. *Conochitina clavaherculi* Eisenack, 1959. A–D. Bödahamnborrningen 1, Källa Limestone (11.30–11.33 m). E–H. *Conochitina* aff. *claviformis* Eisenack, 1931. E–F. Bödahamnborrningen 1, Dalby Limestone (0.96–1.00 m). G–H. Träby 1, Folkeslunda Limestone. I–L. *Conochitina* cf. *comma* Eisenack, 1959. I–J. Gammalsbyborrningen 1, Seby Limestone (8.85 m). K–L. Bödahamnborrningen 1, Persnäs Limestone (7.90–7.94 m).

A–B. SGU Type 733. A. Aboral view, SEM x190; B. Lateral view, SEM x50. C–D. SGU Type 734. C. Lateral view, SEM x60; D. Aboral view, SEM x220. E–F. SGU Type 737. E. Aboral view. Note the tapering basal process, SEM x500; F. Lateral view, SEM x130. G–H. SGU Type 735. G. Lateral view, SEM x70; H. Aboral view, SEM x380. I–J. SGU Type 738. I. Aboral view. Note the coalescent spines, SEM x490; J. Lateral view, SEM x80. K–L. SGU Type 741. K. Lateral view, SEM x160; L. Aboral view, SEM x470.

Conochitina aff. *claviformis* Eisenack, 1931

Fig. 7 E–H

DESCRIPTION – *Conochitina* species with a conical body and a subcylindrical neck that widens at the straight aperture. The base is flat and has a tapering basal process. The basal edge is rounded. Orally of the basal edge there is a

constriction beyond which the vesicle is slightly convex. The vesicle wall is smooth.

DIMENSIONS – Total length 171–483, max. width 53–98, width of aperture 37–54.

REMARKS – The Öland specimens are similar to those illustrated by Eisenack 1931; Pl. 1:17 and 1968 b; Pl. 25:6. However, Eisenack reported *Conochitina claviformis* from erratics of Silurian age. Laufeld (1974:72) found specimens similar to *Conochitina claviformis* from Wenlockian beds on Gotland. These were assigned as *Conochitina* aff. *proboscifera*. *Conochitina* aff. *claviformis* and *Conochitina claviformis* Eisenack, 1931 probably constitute two different taxa.

OCCURRENCE – Öland: Seby to Dalby Limestones except Furudal Limestone. Erratics of undifferentiated late Caradocian age.

Conochitina cf. *comma* Eisenack, 1959

Fig. 7 I–L

1959 *Conochitina micracantha* subsp. *comma* n. subsp. – Eisenack, pp. 7–8; Pl. 1:4.

1965 *Conochitina micracantha* subsp. *comma* – Eisenack, p. 125; Pl. 10:1–2.

1968b *Conochitina micracantha* subsp. *comma* – Eisenack, p. 163; Pl. 26:33.

DESCRIPTION – *Conochitina* species with a gently curved, subcylindrical vesicle that gently tapers towards a slightly widened and straight aperture. The base is provided with a central depression and the basal edge is rounded. The vesicle wall is covered by coalescent spines that are best developed at the aboral part.

DIMENSIONS – The few specimens encountered have the same dimensions as those described by Eisenack 1959.

REMARKS – *Conochitina* cf. *comma* differs from *Conochitina comma* in having an ornamentation that covers the entire vesicle. *Conochitina comma* has a faintly developed ornamentation at the basal part. Eisenack (1965) remarked that some specimens may lack an ornamentation.

OCCURRENCE – Öland: Seby to Folkeslunda and Persnäs to Dalby Limestones.

Rakvere (Upper Caradoc), Estonia (Eisenack 1959, 1965).

Conochitina conulus Eisenack, 1955

Fig. 8 A–D

1955 *Conochitina conulus* n. sp. – Eisenack, p. 312; Pl. 1:1–3.

1967a *Euconochitina conulus* – Rauscher & Doubinger, p. 478; Pl. 3:3.

1967b *Euconochitina conulus* – Rauscher & Doubinger, p. 313; Pl. 4:1.

1968b *Conochitina conulus* – Eisenack, p. 161; Pl. 26:34.

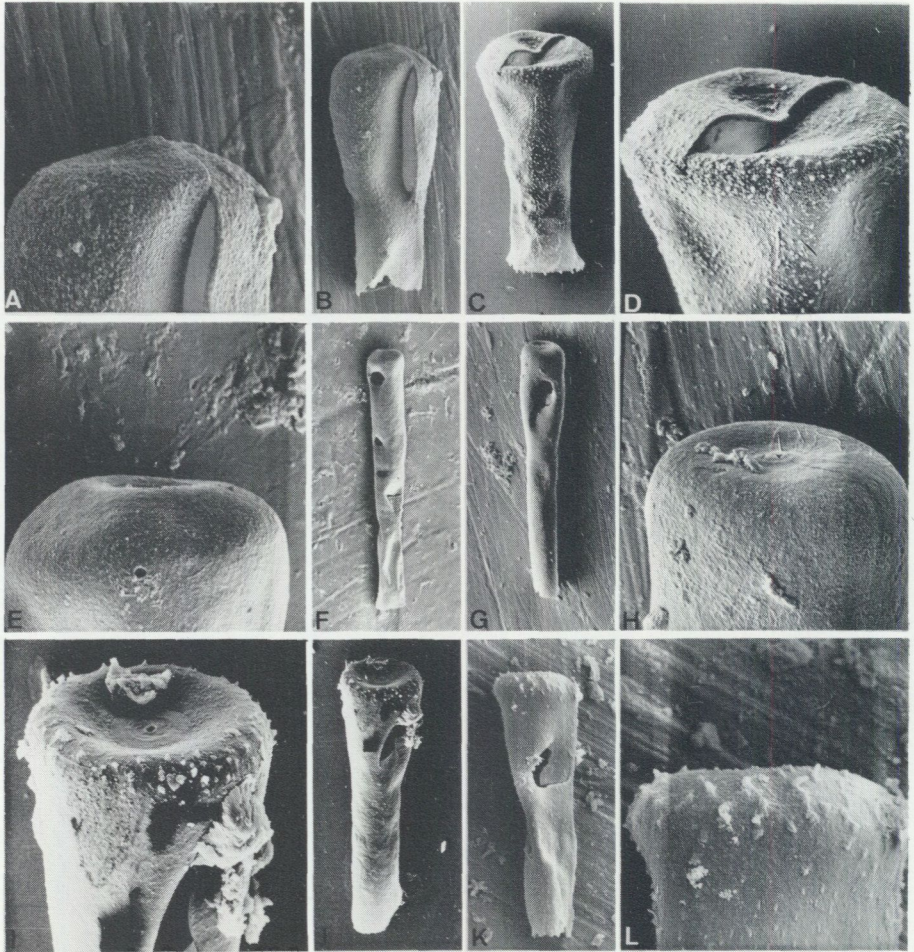


Fig. 8. A–D. *Conochitina conulus* Eisenack, 1955. A–B. Bödahamnborrningen 1, Dalby Limestone (5.30–5.36 m). C–D. Gärdslösa bodar 1, Folkeslunda Limestone (Öl 66-5). E–H. *Conochitina* aff. *elegans* Eisenack, 1931. E–F. Seby 1, Seby Limestone (YG 21). G–H. Gärdslösa bodar 1, Folkeslunda Limestone (Öl. 66-3). I–L. *Conochitina micracantha* Eisenack, 1931. I–J. Bödahamnborrningen 1, Persnäs Limestone (9.00–9.03 m). K–L. Gammalsbyborrningen 1, Furudal Limestone (5.01–5.04 m).

A–B. SGU Type 743. A. Aboral view, SEM x550; B. Lateral view, SEM x240. C–D. SGU Type 746. C. Lateral view. Note the fringed aperture, SEM x150; D. Aboral view. Note the minute, simple spines, SEM x370. E–F. SGU Type 747. E. Aboral view, SEM x430; F. Lateral view, SEM x60. G–H. SGU Type 748. G. Lateral view, SEM x70; H. Aboral view, SEM x390. I–J. SGU Type 750. I. Aboral view, SEM x420; J. Lateral view, SEM x130. K–L. SGU Type 742. K. Lateral view, SEM x160; L. Aboral view, SEM x480.

DESCRIPTION – *Conochitina* species with a conical body and a cylindrical neck that widens at the fringed aperture. The base is convex and the basal edge rounded. The vesicle is covered by minute, simple spines.

DIMENSIONS – Total length 120–200, max. width 48–102, width of aperture 29–61.

REMARKS – In his original description Eisenack (1955:312) remarked that *Conochitina conulus* has a smooth vesicle.

OCCURRENCE – Öland: Seby to Dalby Limestones except Källa Limestone. Erratics of Lower *Macrourus* Siltstone (Middle Caradoc).

Aseri to Uhaku (Upper Llanvirn to Llandeilo), Estonia (Eisenack 1955). *Calymene* Shale (Llanvirn), Normandie, France (Rauscher & Doubinger 1967a, 1967b).

Conochitina aff. *elegans* Eisenack, 1931

Fig. 8 E–H

1976b *Conochitina elegans* – Eisenack, p. 188; Pl. 2:6–7.

1980 *Conochitina* aff. *elegans* – Grahn, p. 18; Figs. 10 A–D.

DESCRIPTION – See Grahn 1980.

DIMENSIONS – Total length 293–805, max. width 48–95, width of aperture 29–68.

REMARKS – The Viruan specimens have the same dimensions and morphology as those from the Ontikan. As pointed out by Grahn (1980), they are not conspecific with *Conochitina elegans* Eisenack, 1931.

OCCURRENCE – Öland: The Hunderum and Lower Valaste (Uppermost Arenig to Lower Llanvirn). Seby to Dalby Limestones. Erratics of undifferentiated late Caradocian age.

Conochitina micracantha Eisenack, 1931

Fig. 8 I–L

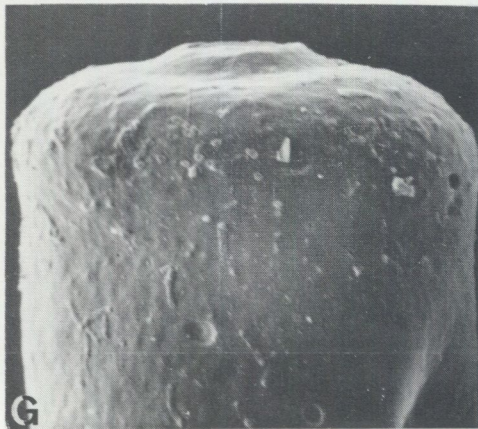
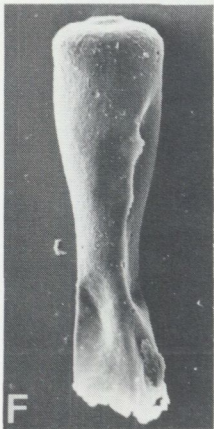
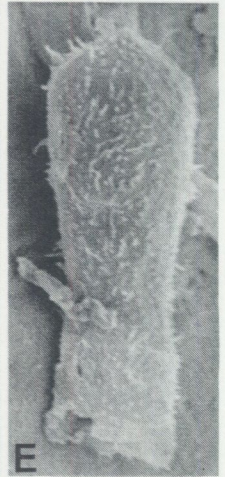
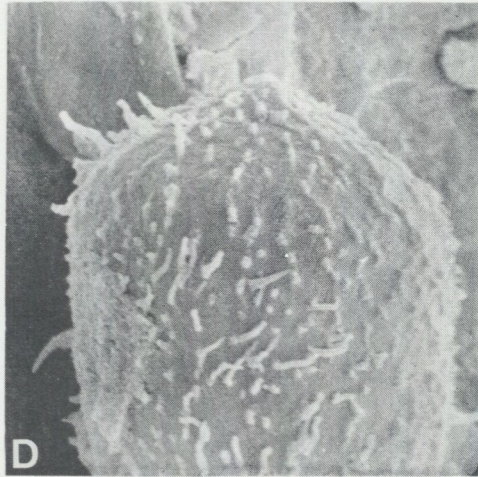
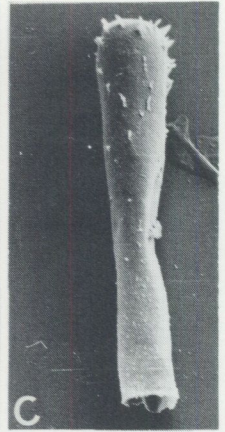
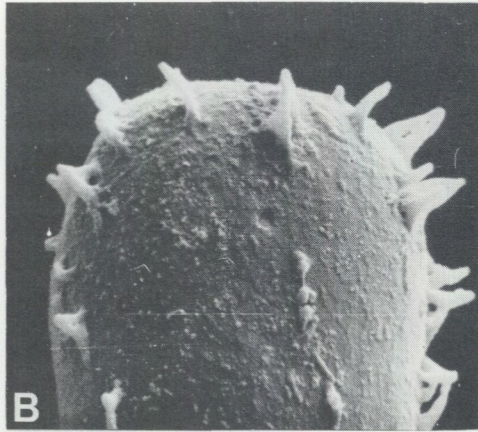
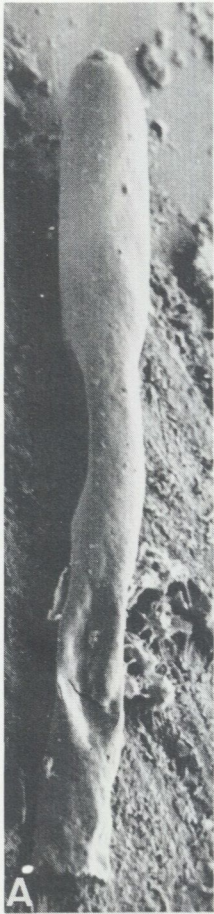
1980 *Conochitina micracantha* – Grahn, pp. 18–20; Figs. 10 E–H (further references).

DESCRIPTION – See Grahn 1980.

DIMENSIONS – Total length 146–439, max. width 51–98, width of aperture 27–73.

REMARKS – The spinose ornamentation is concentrated to the basal part of the Viruan specimens. This supports the idea (Grahn 1980) that the degree of ornamentation varies stratigraphically, from an ornamentation that covers the entire vesicle, towards an ornamentation concentrated in the basal part.

OCCURRENCE – Öland: Upper Langevoja (Eisenack 1976b) to the Hunderum (Uppermost Arenig to Lower Llanvirn) and Upper Aluoja (Lower



Llanvirn). Seby to Dalby Limestones. Erratics of Lower *Macrourus* Siltstone (Middle Caradoc) and of undifferentiated late Caradocian age.

Aseri (Upper Llanvirn) to Nabala (Upper Caradoc), Estonia (Eisenack 1959, 1965, 1968b). Louredo Formation (Caradoc), Serra de Buçaco, Portugal (Paris 1979). Upper Viola Limestone (Upper Caradoc to Lower Ashgill), Oklahoma, U.S.A. (Jenkins 1969). Molodova Beds (Upper Caradoc to Lower Ashgill), Podolia, U.S.S.R. (Laufeld 1971).

Conochitina minnesotensis (Stauffer, 1933)

Fig. 9 A

1980 *Conochitina minnesotensis* – Grahn, pp. 20–22; Figs. 12 A–D (further references).

DESCRIPTION – See Grahn 1980.

DIMENSIONS – Length up to 1610, max. width 98–146.

OCCURRENCE – Öland: Upper Langevoja (Upper Arenig) to Lower Valaste (Lower Llanvirn). Persnäs to Dalby Limestones. Erratics of Lower *Macrourus* Siltstone (Middle Caradoc).

Volkhov (Upper Arenig) to Porkuni (Upper Ashgill), Estonia (Eisenack 1962b, 1965). Decorah Formation (Lower Caradoc), Minnesota, U.S.A. (Stauffer 1933). Dalby and Skagen Limestone (Lower Caradoc), Dalarna, Sweden (Laufeld 1967). Herscheider Shale (Caradoc?), Westphalia, West Germany (Eisenack 1939). Upper Viola Limestone (Upper Caradoc to Lower Ashgill), Oklahoma, U.S.A. (Jenkins 1969).

Conochitina pellifera Eisenack, 1959

Fig. 9 B–E

1959 *Conochitina micracantha* subsp. *pellifera* n. subsp. – Eisenack, pp. 8–9; Pl. 1:7–9.

1968b *Conochitina micracantha* subsp. *pellifera* – Eisenack, p. 162; Pl. 24:7; Pl. 26:15.

1972 *Conochitina pellifera* – Eisenack, p. 124; Pl. 34:22.

1976a *Conochitina micracantha* subsp. *pellifera* – Eisenack, p. 642; Fig. 9.

DESCRIPTION – *Conochitina* species with a conical body and a subcylindrical neck that widens towards a straight aperture. The base is flat or provided with a tapering basal process, and the basal edge is broadly rounded. The vesicle is covered by coalescent spines that are best developed in the aboral part.

Fig. 9. A. *Conochitina minnesotensis* (Stauffer, 1933). A. Bödahamnbörningen 1, Persnäs Limestone (8.43–8.47 m). B–E. *Conochitina pellifera* Eisenack, 1959. B–C. Bödahamnbörningen 1, Dalby Limestone (0.96–1.00 m). D–E. Gammalsbyörningen 1, Seby Limestone (8.85 m). F–H. *Conochitina primitiva* Eisenack, 1939. F–G. Gammalsbyörningen 1, Folkeslunda Limestone (7.22–7.25 m). H. Binnerbäck 2, Folkeslunda Limestone (YG 15).

A. SGU Type 751. Lateral view, SEM x110. B–C. SGU Type 752. B. Aboral view. Note the coalescent spines, SEM x660; C. Lateral view, SEM x130. D–E. SGU Type 739. D. Aboral view, SEM x730; E. Lateral view, SEM x290. F–G. SGU Type 753. F. Lateral view, SEM x200; G. Aboral view. Note the basal process, SEM x800. H. SGU Type 754. Lateral view, SEM x240.

DIMENSIONS – Total length 146–439, max. width 48–73, width of aperture 32–48.

REMARKS – The Öland specimens in general have a less conspicuous ornamentation than the specimens described by Eisenack 1959.

OCCURRENCE – Öland: Seby to Dalby Limestones.

Aseri to Uhaku (Upper Llanvirn to Llandeilo), Estonia (Eisenack 1959, 1976a).

Conochitina primitiva Eisenack, 1939

Fig. 9 F–H

1980 *Conochitina primitiva* – Grahn, pp. 22–23; Figs. 12 E–H (further references).

DESCRIPTION – See Grahn 1980.

DIMENSIONS – Total length 98–232, max. width 43–73, width of aperture 24–48.

REMARKS – The morphological variation in the Viruan population is less than that in the Ontikan.

OCCURRENCE – Öland: Upper Langevoja (Upper Arenig) to Lower Valaste (Lower Llanvirn), and Upper Aluoja (Lower Llanvirn). Seby to Dalby Limestones. Erratics of undifferentiated late Caradocian age.

Volkhov (Upper Arenig) to Jöhvi (Upper Caradoc), Estonia (Eisenack 1934, 1962a). The Hunderum (Uppermost Arenig to Lower Llanvirn), Dalarna, Sweden (Eisenack 1962a). Kunda (Upper Arenig to Lower Llanvirn), Moscow Syncline, U.S.S.R. (Umnova 1969). *Calymene* Shale (Llanvirn), Normandie (Rauscher & Doubinger 1967a, 1967b) and *Calvados* (Rauscher 1970), France. Louredo Formation (Caradoc), Serra de Buçaco, Portugal (Henry *et al.* 1974). Herscheider Shale (Caradoc?), Westphalia, West Germany (Eisenack 1939).

Conochitina robusta Eisenack, 1959

Fig. 10 A–B

1959 *Conochitina micracantha* subsp. *robusta* n. sp. – Eisenack, pp. 9–10; Pl. 1:6; Pl. 3:4–5.

1964 *Belenochitina robusta* – Jansonius, pp. 906–907; Pl. 2:24–25.

1967 *Conochitina robusta* – Laufeld, pp. 307–309; Figs. 14 A–E.

1968b *Conochitina micracantha* subsp. *robusta* – Eisenack, p. 162; Pl. 26:16–23.

1969 *Conochitina robusta* – Jenkins, pp. 15–16; Pl. 3:4–5, 10; Text fig. 6.

1972 *Conochitina robusta* – Eisenack, p. 125; Pl. 35:1–2; Pl. 36:1–2.

1973 *Conochitina robusta* – Martin, p. 34; Pl. 6:206–207; Pl. 8:265.

1975 *Conochitina robusta* – Martin, p. 1011; Pl. 1:1, 8; Pl. 3:7.

1978 *Conochitina robusta* – Grahn, p. 10; Figs. 4 A–D, F–G.

1979 *Conochitina robusta* – Paris, pp. 32–33; Pl. 3:1, 2 A–B, 3, 6–7.

DESCRIPTION – *Conochitina* species with an elongated conical vesicle and a wide and straight aperture. The base is convex and the basal edge broadly rounded. The vesicle wall is covered by coalescent spines.

DIMENSIONS – The few specimens encountered have the same dimensions as those described by Eisenack 1959.

REMARKS – There is a gradual transition between specimens that have their spines restricted to the basal part to specimens with spines covering the entire vesicle (Eisenack 1959:9–10; Laufeld 1967:308). Eisenack (1968b) remarked that some specimens may have a smooth vesicle.

OCCURRENCE – Öland: Erratics of Lower *Macrourus* Siltstone and of undifferentiated late Caradocian age.

Dalby to Slandrom Limestone (Caradoc), Dalarna, Sweden (Laufeld 1967). Jõhvi and Oandu (Middle Caradoc) to Pirgu (Lower Ashgill), Estonia (Eisenack 1959, 1972). Lower Viola Limestone (Upper Caradoc), Oklahoma, U.S.A. (Jenkins 1969). Laggan Burn Limestone (Caradoc), Scotland (Jansonius 1964). Trenton Group to Utica Formation (Caradoc), Canada (Martin 1975). Louredo Formation (Caradoc), Portugal (Paris 1979). Upper Caradoc to Lower Llandovery, Belgium (Martin 1973). *Dalmanitina* Beds (Upper Ashgill) to the Zone of *Monograptus convolutus* (Middle Llandovery), Skåne, Sweden (Grahn 1978, unpubl. mat.).

Conochitina suecica Laufeld, 1967

Fig. 10 C–F

1967 *Conochitina suecica* n. sp. – Laufeld, pp. 309–311; Fig. 15 A–E.

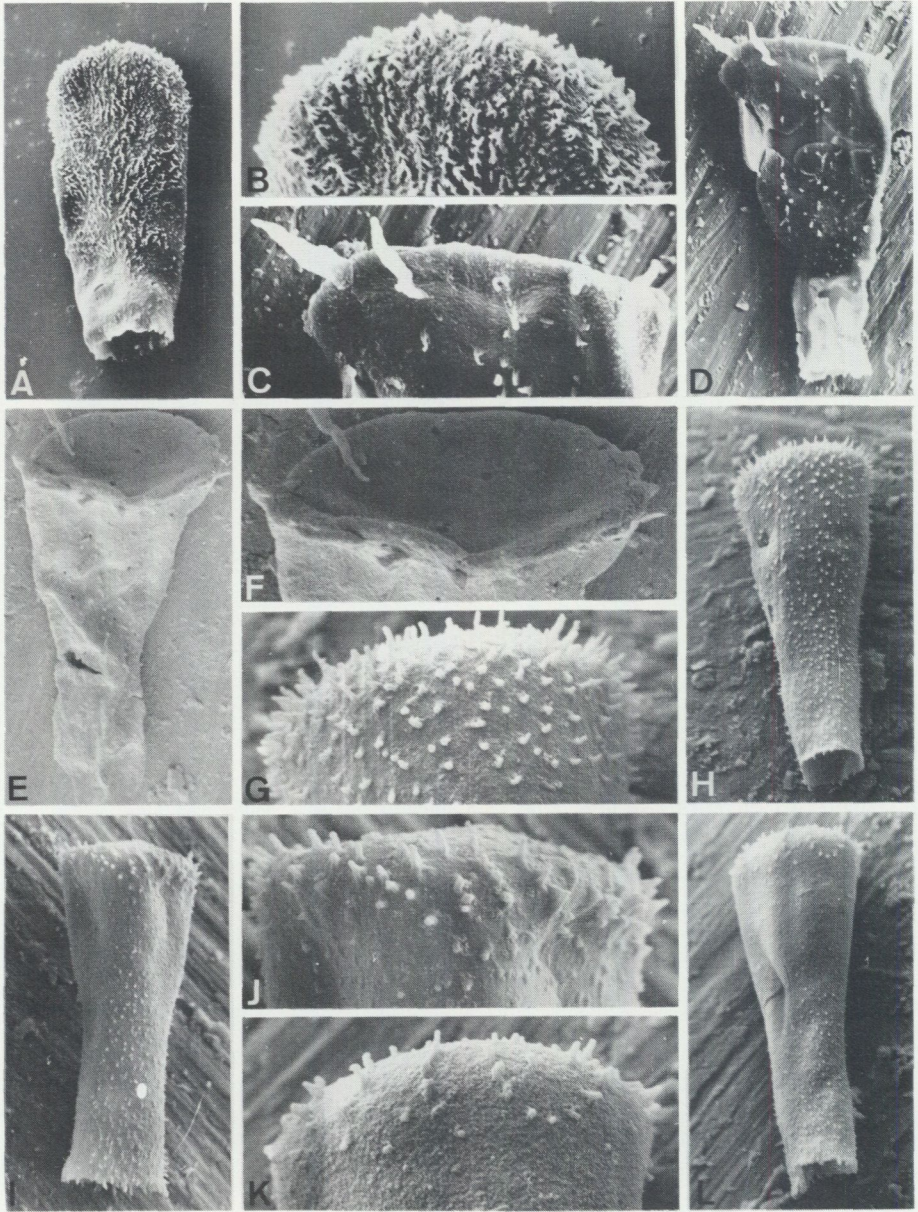
DESCRIPTION – *Conochitina* species with a conical body and a subcylindrical neck that slightly widens towards the fringed aperture. The basal edge is rounded and provided with long simple spines that taper towards the distal tip. Orally from the basal edge there is a constriction, whereafter the body is smooth or covered by small simple spines.

DIMENSIONS – Total length 93–183, max. width 73–98, width of aperture 37–48, max. length of ornamentation 30.

REMARKS – Several specimens from Dalarna, Sweden, have a slight constriction of the neck where the operculum is attached (Laufeld 1967:310). This structure has not been observed in the Öland specimens.

OCCURRENCE – Öland: Erratics of Lower *Macrourus* Siltstone (Middle Caradoc).

Dalby Limestone (Lower Caradoc), Dalarna, Sweden (Laufeld 1967).



Conochitina wesenbergensis Eisenack, 1959

Fig. 10 G–L

- 1931 *Conochitina micracantha* n. sp. (pars) – Eisenack, pp. 84–85; Pl. 2:21–22.
 1959 *Conochitina micracantha* subsp. *wesenbergense* n. subsp. – Eisenack, p. 10; Pl. 1:11; Pl. 3:8.
 1962b *Conochitina micracantha* subsp. *wesenbergensis* – Eisenack, p. 357; Pl. 44:13.
 1965 *Conochitina micracantha* subsp. *wesenbergensis* – Eisenack, pp. 123–124; Pl. 9:10–15; Pl. 10:3.
 1968b *Conochitina micracantha* subsp. *wesenbergensis* – Eisenack, p. 162; Pl. 26:28–30.
 1969 *Conochitina wesenbergensis* – Jenkins, p. 12; Pl. 1:15–16; Pl. 2:1–2, 4.
 1971 *Conochitina wesenbergensis* – Laufeld, p. 294; Pl. 2 J.
 1972 *Conochitina wesenbergensis* subsp. *brevis* – Eisenack, p. 125; Pl. 34:25–28; Pl. 37:2–3.
 1978 *Conochitina wesenbergensis* subsp. *brevis* – Paris, p. 197; Pl. 1:1 A–B, 4 A–B.

DESCRIPTION – *Conochitina* species with a conical body and a cylindrical neck that may widen at the aperture, which is mostly fringed. The base is flat to convex and the basal edge rounded. The vesicle is covered by simple spines that are best developed at the basal edge.

DIMENSIONS – Total length 146–342, max. width 48–93, width of aperture 29–73.

REMARKS – *Conochitina wesenbergensis* differs from *Conochitina micracantha* in not having a constriction orally of the basal edge and in having a less convex body. Furthermore, in contrast to *Conochitina micracantha* it has a fringed aperture. On the basis of difference in length and width Eisenack (1965) divided *Conochitina wesenbergensis* into two forms (*Conochitina micracantha wesenbergensis* f. *elongata* and *Conochitina micracantha wesenbergensis* f. *brevis*). Except for their dimensions, these two forms have the same ornamentation and general morphology and they are therefore included in *Conochitina wesenbergensis*.

OCCURRENCE – Öland: Seby to Dalby Limestones. Erratics of Lower *Macrourus* Siltstone (Middle Caradoc).

Rakvere to Pirgu (Upper Caradoc to Lower Ashgill), Estonia (Eisenack 1959, 1968b). Lower Viola Limestone (Upper Caradoc), Oklahoma, U.S.A. (Jenkins 1969). Molodova Beds (Upper Caradoc to Lower Ashgill), Podolia, U.S.S.R. (Laufeld 1971).

Fig. 10. A–B. *Conochitina robusta* Eisenack, 1959. A–B. Gräsgård kanal 1, *Macrourus* Siltstone. C–F. *Conochitina suecica* Laufeld, 1967. C–F. Gräsgård kanal 1, *Macrourus* Siltstone. G–L. *Conochitina wesenbergensis* Eisenack, 1959. G–H. Bödahamnborrningen 1, Persnäs Limestone (7.39–7.40 m). I–J. Stensborg 1, Persnäs Limestone (YG 24). K–L. Bödahamnborrningen 1, Dalby Limestone (5.30–5.36 m).

A–B. SGU Type 755. A. Lateral view. Note the wide aperture, SEM x170; B. Aboral view. Note the coalescent spines, SEM x460. C–D. SGU Type 756. C. Aboral view. Note the long simple spines, SEM x480; D. Lateral view, SEM x250. E–F. SGU Type 759. E. Lateral view, SEM x260; F. Aboral view, SEM x490. G–H. SGU Type 761. G. Aboral view, SEM x590; H. Lateral view, SEM x260. I–J. SGU Type 762. I. Lateral view. Note the fringed aperture, SEM x280; J. Aboral view, SEM x700. K–L. SGU Type 763. K. Aboral view, SEM x560; L. Lateral view, SEM x230.

Genus *Cyathochitina* Eisenack, 1955*Cyathochitina calix* (Eisenack, 1931)

Fig. 11 A, D

1980 *Cyathochitina calix* – Grahn, pp. 23–25; Figs. 14 A–G (further referenses).

DESCRIPTION – See Grahn 1980.

DIMENSIONS – Total length 122–464, max. width 48–146, width of aperture 24–73.

REMARKS – The morphological variation is the same as that among the Ontikan specimens.

OCCURRENCE – Öland: Upper Langevoja (Upper Arenig) to Lower Valaste (Lower Llanvirn) and Upper Aluoja (Lower Llanvirn). Seby to Dalby Limestones. Erratics of undifferentiated late Caradocian age.

Volkhov (Upper Arenig) to Aseri (Upper Llanvirn), Estonia (Eisenack 1958, 1962a, 1968b). The Hunderum (Uppermost Arenig to Lower Llanvirn), Dalarna, Sweden (Eisenack 1962a). Hope Shales (Lower Llanvirn), Welsh Borderland (Jenkins 1967). Herscheider Shale (Caradoc?), Westphalia, West Germany (Eisenack, 1939).

Cyathochitina campanulaeformis (Eisenack, 1931)

Fig. 11 B–C, E

1980 *Cyathochitina* cf. *campanulaeformis* – Grahn, pp. 25–27; Figs. 15 A–D (further referenses).

DESCRIPTION – See Grahn 1980.

DIMENSIONS – Total length 122–512, max. width 48–232, width of aperture 24–73.

REMARKS – As noted by Laufeld (1967) and Grahn (1980) the longitudinal thickenings form a characteristic structure at the flexure of *Cyathochitina campanulaeformis*. Specimens with this structure are known from Caradoc and younger strata in the Baltoscandian area. The Öland specimens from the erratics of Caradocian age show longitudinal thickenings at the flexure, while those from Upper Arenig to Upper Llandeilo do not have this structure. There is, however, no difference in size and general morphology between the pre-Caradocian and Caradocian specimens. Probably the longitudinal thickenings at the flexure do not constitute a good character for the species. Furthermore, longitudinal thickenings on different parts of the vesicle are also known from *Cyathochitina kuckersiana* (Jenkins 1969). Hence, the specimens from the Ontikan of Öland described as *Cyathochitina* cf. *campanulaeformis* by Grahn (1980) and those in this study are included in *Cyathochitina campanulaeformis*.

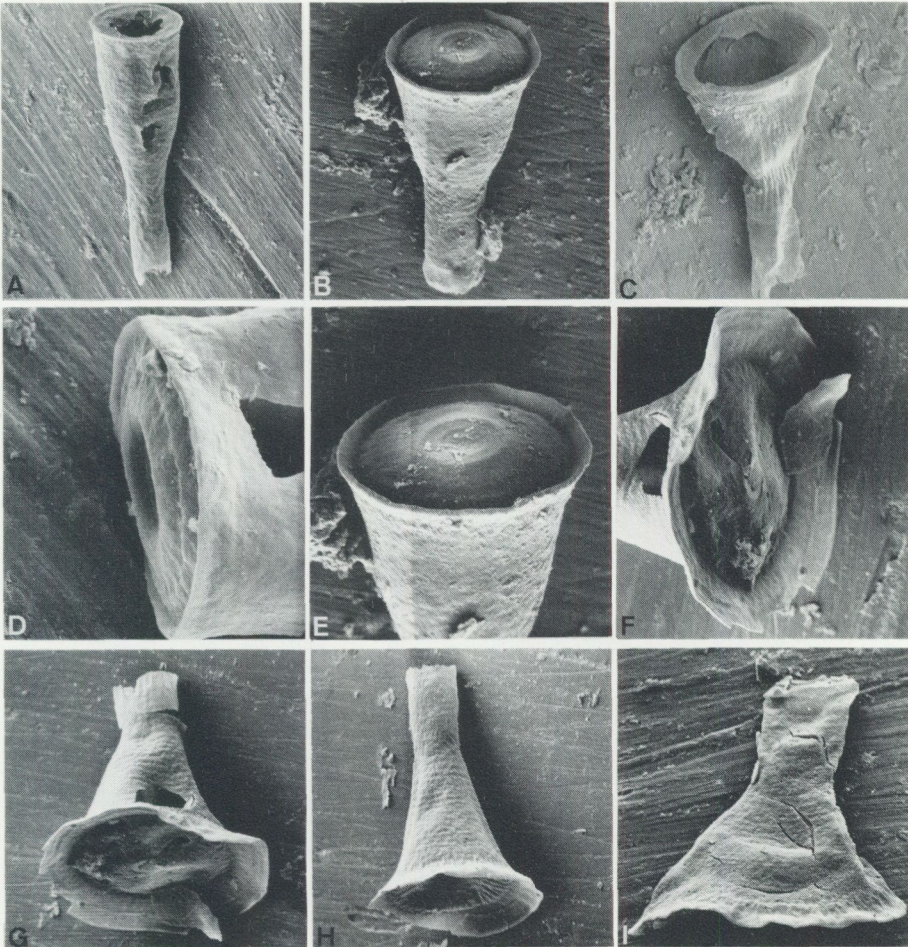


Fig. 11. A, D. *Cyathochitina calix* (Eisenack, 1931). A. Bödahamnborrningen 1, Persnäs Limestone (7.39–7.40 m). D. Bödahamnborrningen 1, Persnäs Limestone (6.75–6.81 m). B–C, E. *Cyathochitina campanulaeformis* (Eisenack, 1931). B, E. Bödahamnborrningen 1, Dalby Limestone (0.55–0.60 m). C. Gräsgård kanal 1, *Macrourus* Siltstone. F–H. *Cyathochitina kuckersiana* (Eisenack, 1934). F–H. Bödahamnborrningen 1, Dalby Limestone (0.55–0.60 m). I. *Cyathochitina latipatagium* (Jenkins, 1969). I. Bödahamnborrningen 1, Dalby Limestone (0.55–0.60 m).

A. SGU Type 764. Lateral view, SEM x70. D. SGU Type 765. Aboral view, SEM x350. B, E. SGU Type 749. B. Lateral view, SEM x150; E. Aboral view, SEM x220. C. SGU Type 768. Lateral view. Note the longitudinal thickenings at the flexure, SEM x140. F–G. SGU Type 773. F. Aboral view, SEM x200; G. Lateral view, SEM x180. H. SGU Type 774. Lateral view, SEM x130. I. SGU Type 766. Lateral view, SEM x150.

OCCURRENCE – Öland: Upper Langevoja (Upper Arenig) to Lower Valaste (Lower Llanvirn). Seby to Dalby Limestones. Erratics of Lower *Macrourus* Siltstone (Middle Caradoc) and of undifferentiated late Caradocian age.

Kunda (Upper Arenig) to Porkuni (Upper Ashgill), Estonia (Eisenack 1962a,

1968a, 1968b). Hope Shales (Lower Llanvirn) to Meadowtown Beds (Lower Llandeilo), Welsh Borderland (Jenkins 1967). Base of *murchisoni* Zone (Upper Llanvirn) to *triangulatus* Subzone (Middle Llandovery), Sweden (Laufeld 1971). Dalby to Slandrom Limestone (Caradoc), Dalarna, Sweden (Laufeld 1967). Herscheider Shale (Caradoc?), Westphalia, West Germany (Eisenack 1939). Middle Ordovician in Bohemia (Eisenack 1948). Middle Ordovician erratics from Poland (Kozłowski 1963). Molodova Beds (Upper Caradoc to Lower Ashgill), Podolia, U.S.S.R. (Laufeld 1971). *Dalmanitina* Beds (Upper Ashgill) to the Zone of *Monograptus revolutus* (Lower Llandovery), Skåne, Sweden (Grahm 1978).

Cyathochitina kuckersiana (Eisenack, 1934)

Fig. 11 F-H

- 1934 *Conochitina kuckersiana* n. sp. - Eisenack, pp. 62-63; Figs. 30-31; Pl. 4:14.
 1962a *Cyathochitina kuckersiana* - Eisenack, pp. 298-300; Fig. 4; Pl. 14:8.
 1967 *Cyathochitina kuckersiana* - Laufeld, pp. 315-317; Fig. 18 A-C.
 1967a *Cyathochitina kuckersiana* - Rauscher & Doubinger, p. 477; Pl. 2:6.
 1967b *Cyathochitina kuckersiana* - Rauscher & Doubinger, p. 312; Pl. 3:2.
 1971 *Cyathochitina kuckersiana* - Laufeld, p. 294; Pl. 2 Q.

DESCRIPTION - *Cyathochitina* species with a conical body and a subcylindrical neck that slightly widens at the straight aperture. The neck comprises 1/3-1/2 of the total length. The flexure is distinct and the flanks are bent in a gentle concave curve. The basal edge is provided with a membranous flange supported by longitudinal thickenings. The base is flat and shows concentric structures. The vesicle wall has faintly transverse striations.

DIMENSIONS - Total length 171-271, max. width (excluding carina) 98-135, width of aperture 48-54, max. width of carina 31.

REMARKS - In the chitinozoan faunas from Öland three distinct species can be distinguished within the "*Cyathochitina kuckersiana*" group. They are clearly separated by length, width and general morphology.

OCCURRENCE - Öland: Seby to Folkeslunda and Persnäs to Dalby Limestones. Erratics of Lower *Macrourus* Siltstone (Middle Caradoc).

Calymene Shale (Llanvirn), Normandie, France (Rauscher & Doubinger 1967a, 1967b). Dalby (Lower Caradoc), Dalarna, Sweden (Laufeld 1967). Kukruse to Oandu (Caradoc), Estonia (Eisenack 1962a). Molodova Beds (Upper Caradoc to Lower Ashgill), Podolia, U.S.S.R. (Laufeld 1971).

Cyathochitina latipatagium (Jenkins, 1969)

Fig. 11 I

- 1962a *Cyathochitina kuckersiana* f. *brevis* - Eisenack, pp. 298-300; Fig. 5; Pl. 14:9.
 1967 *Cyathochitina kuckersiana* - Jenkins, pp. 458-459; Pl. 72:3-7.

- 1967a *Cyathochitina kuckersiana* – Rauscher & Doubinger, p. 477; Pl. 2:7.
 1967b *Cyathochitina kuckersiana* – Rauscher & Doubinger, p. 312; Pl. 3:3.
 1969 *Cyathochitina kuckersiana latipatagium* n. subsp. – Jenkins, pp. 19–20; Pl. 4:6–8, 10.
 1975 *Cyathochitina kuckersiana brevis* – Martin, p. 1015; Pl. 2:21.
 1977b *Cyathochitina kuckersiana* – Achab, p. 2200; Pl. 6:5, 8–9.
 1978 *Cyathochitina kuckersiana latipatagium* – Achab, pp. 303–305; Pl. 2:3–4, 9.
 1979 *Cyathochitina kuckersiana* – Achab, Pl. 2:1; Pl. 3:8.
 1979 *Cyathochitina kuckersiana latipatagium* – Paris, p. 35; Pl. 2:7.

DESCRIPTION – *Cyathochitina* species with a conical body and a cylindrical neck that comprises about 1/3 of the total length. The aperture is straight. The flexure is distinct and the flanks are convex. The basal edge is provided with a wide membranous flange supported with longitudinal thickenings. The vesicle wall has faint transverse striations.

DIMENSIONS – Total length 98–142, max. width (excluding carina) 68–85, width of aperture 37–48, max. width of carina 40.

REMARKS – *Cyathochitina latipatagium* differs from *Cyathochitina kuckersiana* in having a length:width ratio close to 1:1 and a comparatively shorter cylindrical neck. In contrast to the concave flanks of *Cyathochitina kuckersiana* the flanks of *Cyathochitina latipatagium* are convex.

OCCURRENCE – Öland: Folkeslunda and Dalby Limestones. Erratics of Lower *Macrourus* Siltstone (Middle Caradoc).

Calymene Shale (Llanvirn), Nor.nandie, France (Rauscher & Doubinger 1967a, 1967b). Jõhvi to Oandu (Caradoc), Estonia (Eisenack 1962a). Coston Beds to *Onnia* Beds (Caradoc), Welsh Borderland (Jenkins, 1967). Louredo Formation (Caradoc), Serra de Buçaco, Portugal (Paris 1979). Viola Limestone (Caradoc), Oklahoma, U.S.A. (Jenkins 1969). Trenton Group to Utica Formation (Caradoc), Canada (Martin 1975). Macasty Formation (Upper Caradoc) to Ellis Bay Formation (Upper Ashgill), Anticosti Island, Canada (Achab 1977b, 1978, 1979).

Cyathochitina reticulifera n. sp.

Fig. 12 A–C

ETYMOLOGY – Latin, *reticulum*, reticulated or a little net, referring to the characteristic arrangement of the ornamentation.

HOLOTYPE – SGU Type 727.

TYPE STRATUM – Erratics of undifferentiated late Caradocian age.

TYPE LOCALITY – Gräsgård kanal 1, Öland.

DESCRIPTION – *Cyathochitina* species with a subconical body and a cylindrical or conical neck tapering towards the straight aperture. The flexure is rounded and the flanks are convex. The basal edge is provided with a short

carina. The base is flat with concentric ridges and the body has an irregular ornamentation of ridges. The neck comprises 1/3–1/4 of the total length and shows a transverse striation. The operculum is a simple disc with a central protrusion.

DIMENSIONS – Total length 171–390, max. width 105–208, width of aperture 44–98.

OCCURRENCE – Öland: Erratics of undifferentiated late Caradocian age.

Cyathochitina sebyensis n. sp.

Fig. 12 D–G

ETYMOLOGY – Latin, *sebyensis*, from Seby, the type locality for the Seby Limestone.

HOLOTYPE – SGU Type 775.

TYPE STRATUM – Seby Limestone.

TYPE LOCALITY – Gammalsbyborrningen 1 (8.85 m), Öland.

DESCRIPTION – *Cyathochitina* species with a conical body and a cylindrical neck that comprises about 2/3 of the total length. The aperture is straight. The flanks are gently concave. The basal edge is provided with a short membranous flange supported by short distinct longitudinal thickenings, orally of which the vesicle wall is smooth.

DIMENSIONS – Total length 293–537, max. width 146–195, width of aperture 36–68.

REMARKS – *Cyathochitina sebyensis* differs from *Cyathochitina kuckersiana* in having a longer vesicle, and a more slender cylindrical neck. Furthermore, *Cyathochitina sebyensis* has a smooth vesicle orally of the longitudinal thickenings.

OCCURRENCE – Öland: Seby Limestone.

Cyathochitina stentor (Eisenack, 1937)

Fig. 12 H–J

1937 *Conochitina stentor* n. sp. – Eisenack, pp. 221–222; Pl. 15:1–3.

1939 *Conochitina stentor* – Eisenack, pp. 137–138; Pl. A:1.

1962a *Cyathochitina stentor* – Eisenack, p. 300; Pl. 14:10.

1967 *Cyathochitina stentor* – Laufeld, pp. 317–319; Figs. 19 A–D.

1968b *Cyathochitina stentor* – Eisenack, p. 168; Pl. 24:26–28; Pl. 31:5–6.

DESCRIPTION – *Cyathochitina* species with a subcylindrical body that is constricted in its basal part. Aborally of the constriction a large conical carina is

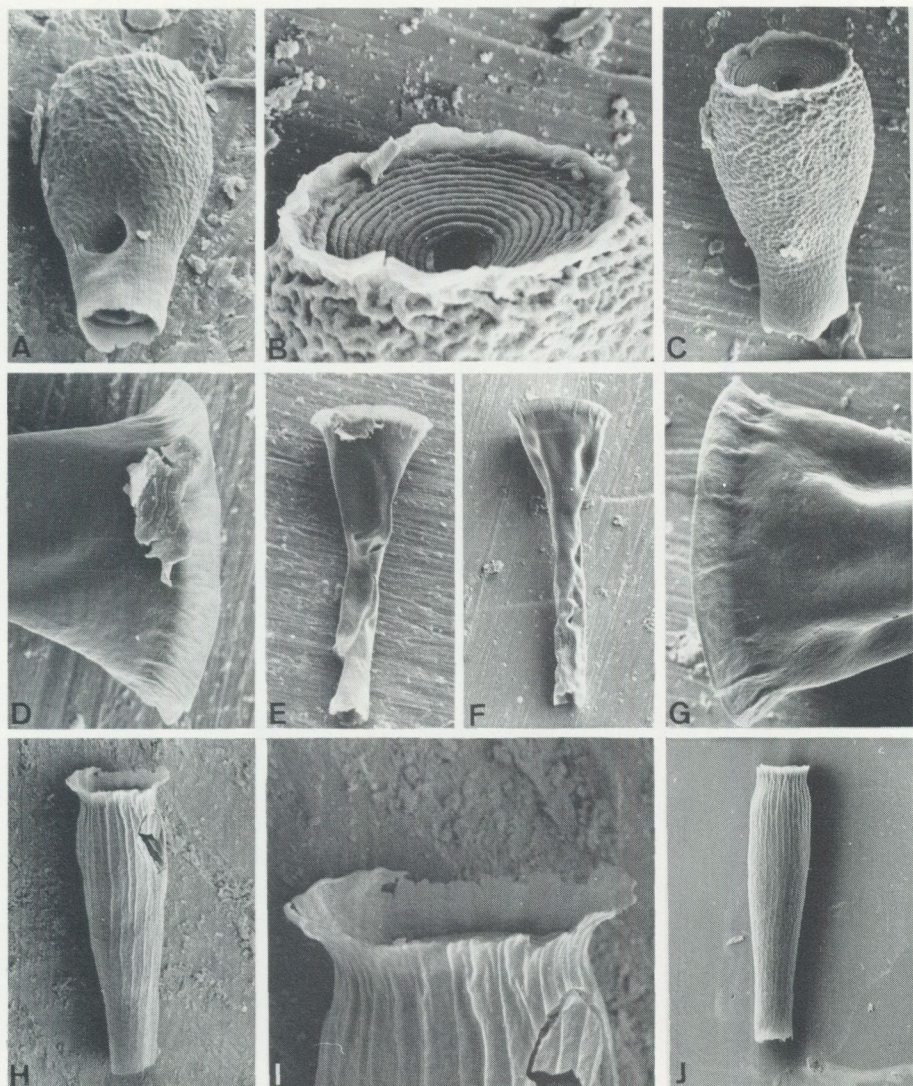


Fig. 12. A–C. *Cyathochitina reticulifera* n. sp. A–C. Gräsgård kanal 1, Erratics of undifferentiated late Caradocian age. D–G. *Cyathochitina sebyensis* n. sp. D–E. Seby 1, Seby Limestone (YG 21). F–G. Gammalsbyborrningen 1, Seby Limestone (8.85 m). H–J. *Cyathochitina stentor* (Eisenack, 1937). H–I. Bödahamnborrningen 1, Dalby Limestone (2.18–2.23 m). J. Bödahamnborrningen 1, Dalby Limestone (0.55–0.60 m).

A. SGU Type 726. Lateral view, SEM x160. B–C. SGU Holotype 727. B. Aboral view. Note the concentric ridges in the base, SEM x310; C. Lateral view. Note the irregular ornamentation of ridges, SEM x140. D–E. SGU Type 770. D. Aboral view, SEM x180; E. Lateral view, SEM x70. F–G. SGU Holotype 775. F. Lateral view, SEM x120; G. Aboral view. Note the longitudinal thickenings at the basal edge, SEM x230. H–I. SGU Type 769. H. Lateral view. Note the longitudinal ribs, SEM x80; I. Aboral view, SEM x260. J. SGU Type 778. Lateral view, SEM x50.

developed. Towards the cylindrical neck the body is convex. The vesicle is supported by longitudinal ribs.

DIMENSIONS – Total length 318–1196, max. width 96–220, width of aperture 48–98.

REMARKS – Laufeld (1967:318) remarked that the specimens from Dalarna have transverse bands on the carina. This structure has not been observed in the Öland specimens.

OCCURRENCE – Öland: Dalby Limestone.

Kukruse (Upper Llandeilo to Lower Caradoc), Estonia (Eisenack 1962a). Dalby Limestone (Lower Caradoc), Dalarna, Sweden (Laufeld 1967).

Cyathochitina striata (Eisenack, 1937)

Fig. 13 A–D

1937 *Conochitina striata* n. sp. – Eisenack, p. 222; Fig. 2.
1968b *Cyathochitina striata* – Eisenack, p. 169; Pl. 31:7.

DESCRIPTION – *Cyathochitina* species with a subcylindrical body and a cylindrical neck. The basal part is developed as a circular disc with a basal callus and a short conical carina. The vesicle is wrinkled with deep furrows.

DIMENSIONS – Total length 244–1538, max. width 72–122, width of aperture 48–96.

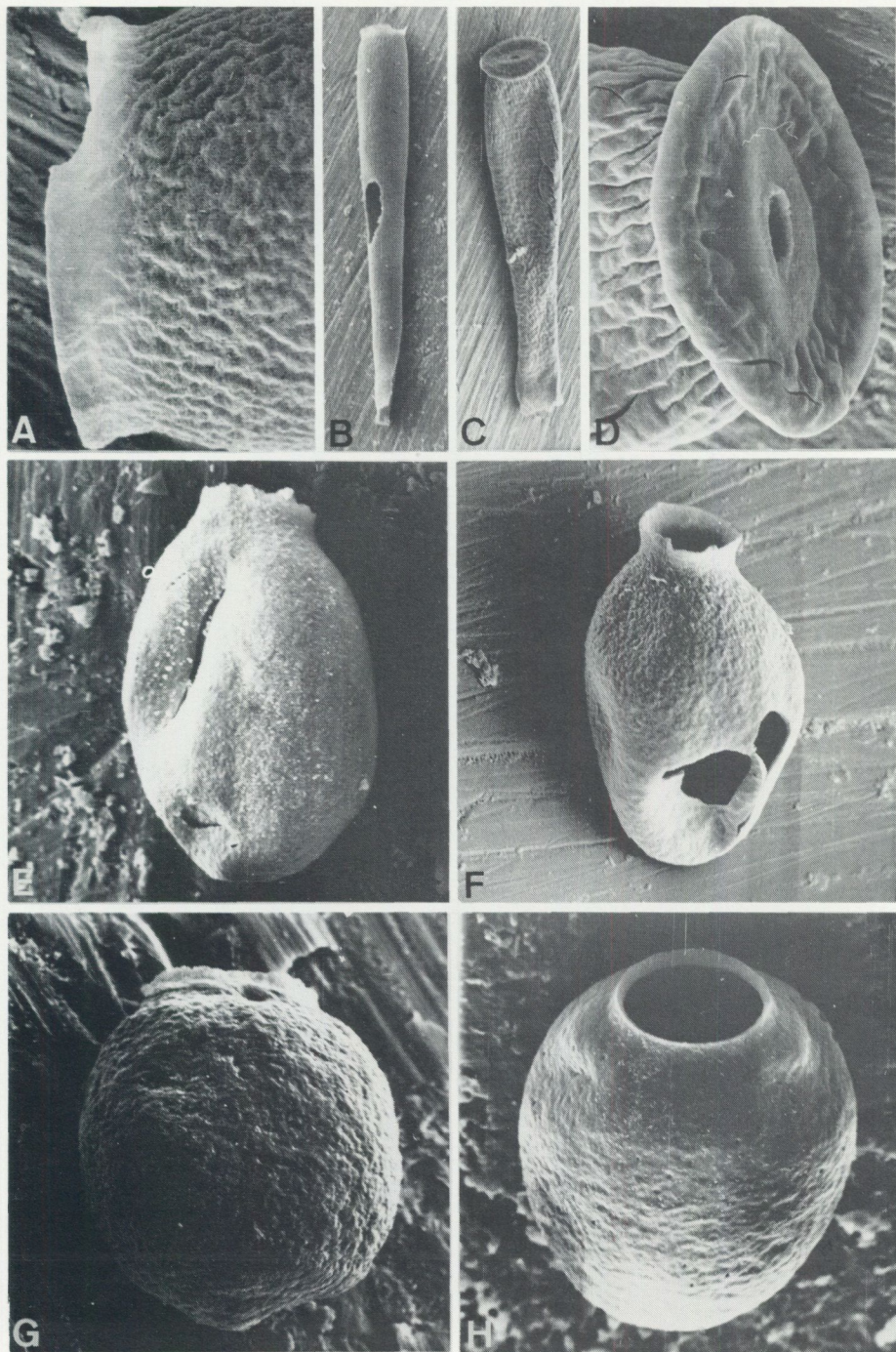
REMARKS – Eisenack (1937) found transverse striations in a *Cyathochitina striata* specimen. The striations were concentrated in the middle part of the vesicle. Such a structure has not been observed in the Öland specimens. As pointed out by Eisenack this phenomenon may be due to shrinkage.

OCCURRENCE – Öland: Seby to Lowermost Dalby Limestones.

Aseri to Uhaku (Upper Llanvirn to Llandeilo), Estonia (Eisenack 1968b).

Fig. 13. A–D. *Cyathochitina striata* (Eisenack, 1937). A–B. Bödahamnborrningen 1, Dalby Limestone (5.70–5.77 m). C–D. Persnäs 1, Persnäs Limestone (Öl 66-101). E–F. *Desmochitina amphorea* Eisenack, 1931. E. Binnerbäck 2, Folkeslunda Limestone (YG 14). F. Gammalsbyborrningen 1, Folkeslunda Limestone (6.98–7.01 m). G–H. *Desmochitina cocca* Eisenack, 1931. G. Gärdslösa bodar 1, Folkeslunda Limestone (Öl 66-2). H. Bödahamnborrningen 1, Dalby Limestone (3.27–3.32 m).

A–B. SGU Type 767. A. Aboral view. Note the wrinkled ornamentation, SEM x510; B. Lateral view, SEM x60. C–D. SGU Type 771. C. Lateral view, SEM x50; D. Aboral view, SEM x290. E. SGU Type 779. Lateral view. Note that the collar is attached to the body in a gentle curve, SEM x410. F. SGU Type 776. Lateral view, SEM x370. G. SGU Type 782. Lateral view, SEM x480. H. SGU Type 785. Lateral view, SEM x690.



Genus *Desmochitina* Eisenack, 1931

Desmochitina amphorea Eisenack, 1931

Fig. 13 E-F

- 1931 *Desmochitina amphorea* n. sp. – Eisenack, p. 93; Pl. 3:12.
 1962a *Desmochitina minor* f. *amphorea* – Eisenack, p. 304; Pl. 17:5-7.
 1965 *Desmochitina minor* f. *amphorea* – Eisenack, p. 130; Pl. 10:15.
 1967 *Desmochitina amphorea* – Laufeld, pp. 320-322; Figs. 20 A-B.
 1974 *Desmochitina minor* f. *amphorea* – Henry, Nion, Paris & Thadeu, pp. 315-316; Pl. 3:3, 5, 11.
 1975 *Desmochitina* sp. cf. f. *amphorea* – Tynni, p. 49; Fig. 47 D.

DESCRIPTION – *Desmochitina* species with a subspherical to ellipsoidal vesicle. The longitudinal axis is often gently curved, and the collar is attached in an oblique angle or in a gentle curve to the body. The vesicle is covered with somewhat spongy thickening.

DIMENSIONS – Total length 85-134, max. width 61-85, width of aperture 24-48.

OCCURRENCE – Öland: Seby to Folkeslunda and Persnäs to Dalby Limestones.

Aseri to Uhaku (Upper Llanvirn to Llandeilo) and Jöhvi through Oandu (Caradoc), Estonia (Eisenack 1962a, 1965). Dalby Limestone (Lower Caradoc), Dalarna, Sweden (Laufeld 1967). Louredo Formation (Caradoc), Serra de Buçaco, Portugal (Henry *et al.* 1974).

Desmochitina cocca Eisenack, 1931

Fig. 13 G-H

- 1980 *Desmochitina cocca* – Grahn, p. 29; Figs. 16 A-C (further references).

DESCRIPTION – See Grahn 1980.

DIMENSIONS – Total length 73-122, max. width 61-98, width of aperture 24-48.

OCCURRENCE – Öland: Upper Langevoja (Upper Arenig) to Lower Valaste (Lower Llanvirn) and Upper Aluoja (Lower Llanvirn). Seby to Dalby Limestones. Erratics of Lower *Macrourus* Siltstone (Middle Caradoc) and undifferentiated late Caradocian age.

Aseri (Upper Llanvirn) to Kukruse (Upper Llandeilo to Lower Caradoc), Estonia (Eisenack 1962a). Glenburrell Beds (Lower Caradoc), Welsh Borderland (Jenkins 1967). Louredo Formation (Caradoc), Serra de Buçaco, Portugal (Henry *et al.* 1974).

Desmochitina complanata Eisenack, 1932

Fig. 14 A-D

- 1932 *Desmochitina? complanata* n. sp. – Eisenack, p. 272; Pl. 12:24-25.
 1959 *Desmochitina? complanata* – Eisenack, p. 16; Pl. 3:13.

1965 *Desmochitina complanata* – Eisenack, p. 131; Pl. 10:19–20.

1967 *Hoegisphaera complanata* – Jenkins, p. 462; Pl. 73:4–5.

DESCRIPTION – *Desmochitina* species with a discoidal vesicle and a large collar attached to the body in an acute angle. The operculum is a simple disc. The vesicle wall is smooth. Length:width ratio about 0.5:1.

DIMENSIONS – Length (excluding collar) 37–61, max. width 73–102, width of aperture 48–73, length of collar 12–24.

REMARKS – Laufeld (1967:325) reported that *Desmochitina complanata* shows ornamentation. This is lacking in the Öland specimens.

OCCURRENCE – Öland: Folkeslunda and Dalby Limestones.

Acton Scott Beds (Caradoc), Welsh Borderland (Jenkins 1967). Baltic erratics of undifferentiated late Llanvirnian to Llandeilian age (Eisenack 1959).

Desmochitina minor Eisenack, 1931

Fig. 14 E–F

1980 *Desmochitina minor* – Grahn, p. 30; Figs. 18 A–D (further references).

DESCRIPTION – See Grahn 1980.

DIMENSIONS – Total length 68–134, max. width 61–98, width of aperture 24–78.

OCCURRENCE – Öland: Upper Langevoja (Upper Arenig) to Lower Valaste (Lower Llanvirn) and Upper Aluoja (Lower Llanvirn). Seby to Dalby Limestones. Erratics of Lower *Macrourus* Siltstone (Middle Caradoc) and undifferentiated late Caradocian age.

Volkhov (Upper Arenig) to Porkuni (Upper Ashgill), Estonia (Eisenack 1958, 1962a, 1965, 1968b). The Hunderum (Uppermost Arenig to Lower Llanvirn) (Eisenack 1962a) and Dalby to Slandrom Limestone (Caradoc), Dalarna, Sweden (Laufeld 1967). Louredo Formation (Caradoc), Serra de Buçaco, Portugal (Paris 1979). Molodova Beds (Upper Caradoc to Lower Ashgill), Podolia, U.S.S.R. (Laufeld 1971). Viola Limestone (Upper Caradoc to Lower Ashgill), Oklahoma, U.S.A. (Jenkins 1969).

Desmochitina nodosa Eisenack, 1931

Fig. 14 G

1931 *Desmochitina nodosa* n. sp. – Eisenack, p. 92; Pl. 3:1–4; Pl. 4:7–10.

1932 *Desmochitina amphorea* (pars) – Eisenack; Pl. 12:6.

1939 *Desmochitina minor* (pars) – Eisenack; Pl. A:2.

1962a *Desmochitina nodosa* – Eisenack, pp. 302–303; Pl. 17:15.

1962a *Desmochitina minor* f. *typica* (pars) – Eisenack; Pl. 16:1–2.

1963 *Desmochitina nodosa* – Kozłowski, pp. 433–434; Fig. 6.

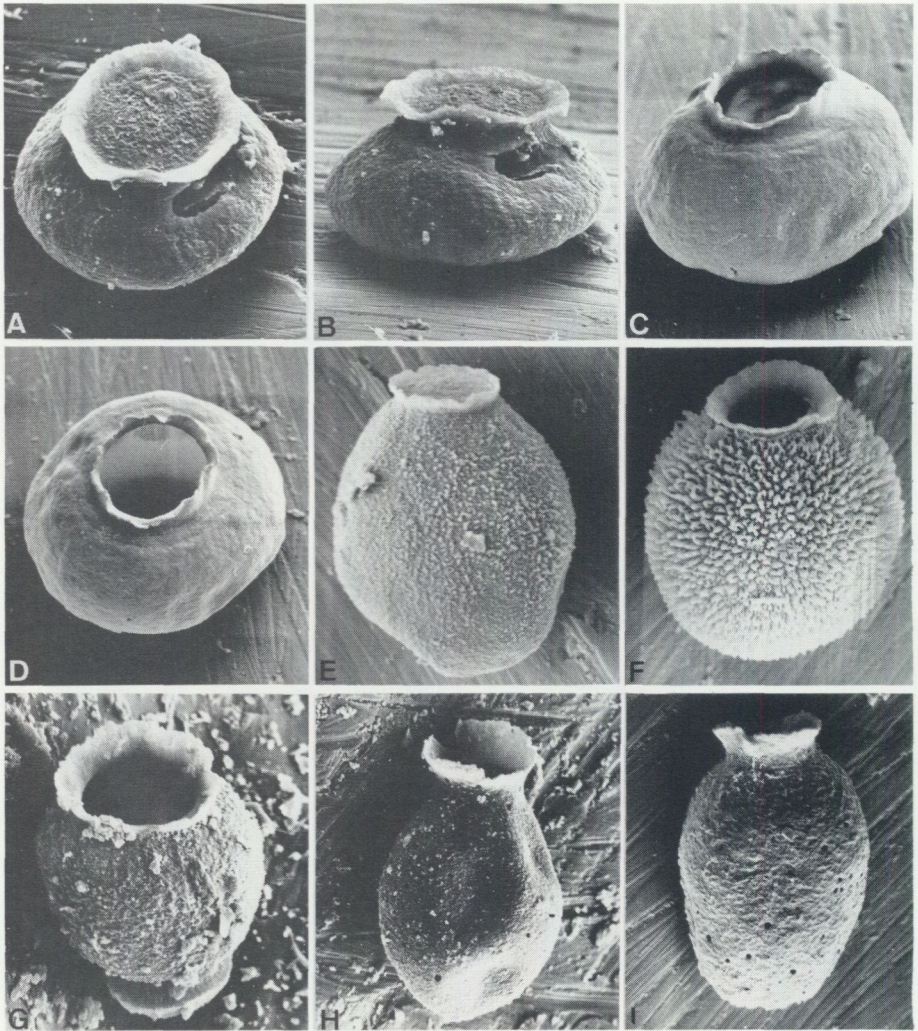


Fig. 14. A–D. *Desmochitina complanata* Eisenack, 1932. A–B. Bödahamnbörningen 1, Dalby Limestone (2.76–2.80 m). C–D. Gammalsbybörningen 1, Folkeslunda Limestone (6.10–6.12 m). E–F. *Desmochitina minor* Eisenack, 1931. E. Bödahamnbörningen 1, Dalby Limestone (0.96–1.00 m). F. Runstens Hamn 1, Källa Limestone. G. *Desmochitina nodosa* Eisenack, 1931. G. Gräsgård kanal 1, Erratics of undifferentiated late Caradocian age. H–I. *Desmochitina ovulum* Eisenack, 1962. H. Bödahamnbörningen 1, Dalby Limestone (1.47–1.53 m). I. Persnäs 1, Persnäs Limestone (YG 19).

A–B. SGU Type 783. A. Oblique oral view. Note the operculum, SEM x330; B. Lateral view, SEM x350. C–D. SGU Type 777. C. Lateral view, SEM x350; D. Oblique oral view, SEM x340. E. SGU Type 744. Lateral view, SEM x390. F. SGU Type 745. Lateral view. Note the coalescent spines, SEM x330. G. SGU Type 784. Oblique lateral view, SEM x360. H. SGU Type 780. Lateral view, SEM x270. I. SGU Type 781. Lateral view, SEM x280.

- 1963 *Desmochitina dornbuschi* n. sp. – Schallreuter, pp. 399–401; Pl. 2:1–10.
 1965 *Desmochitina nodosa* – Eisenack, p. 131; Pl. 10:18.
 1967 *Desmochitina nodosa* – Laufeld, pp. 330–332; Figs. 26 A–E.
 1967 *Desmochitina nodosa* – Bergström, Bergström & Laufeld, p. 462; Pl. 3 A–C.
 1976a *Desmochitina minor* f. *typica*? – Eisenack, p. 642; Figs. 1–2.

DESCRIPTION – *Desmochitina* species with a spherical body and a large conical collar attached in an acute angle to the body. The vesicles usually have the operculum of the next vesicle attached to their bases by a rim. The operculum is disc-like. The vesicle wall is covered by verrucate thickenings.

DIMENSIONS – Total length 73–93, max. width 61–76, width of aperture 29–48, length of operculum up to 19.

OCCURRENCE – Öland: Erratics of undifferentiated late Caradocian age.

Keila (Middle Caradoc), Estonia (Eisenack 1962a). Skagen Limestone (Middle Caradoc), Dalarna, Sweden (Laufeld 1967). Zone of *Diplograptus multidentis* (Upper Caradoc), Skåne, Sweden (Bergström *et al.* 1967). Baltic erratics of late Caradocian age (Schallreuter 1963). Middle Ordovician erratics from Poland (Kozłowski 1963).

Desmochitina ovulum Eisenack, 1962

Fig. 14 H–I

- 1980 *Desmochitina* cf. *ovulum* – Grahn, p. 32; Figs. 18 E–F (further references).

DESCRIPTION – See Grahn 1980.

DIMENSIONS – Total length 105–207, max. width 68–98, width of aperture 24–68.

OCCURRENCE – Öland: Upper Langevoja (Upper Arenig) (Eisenack 1976b) to Lower Valaste (Lower Llanvirn). Seby to Dalby Limestones.

Volkhov (Upper Arenig), Moscow Syncline, U.S.S.R. (Umnova 1969). Aseri (Upper Llanvirn) to Kukruse (Upper Llandeilo to Lower Caradoc), Estonia (Eisenack 1962a). Louredo Formation (Caradoc), Serra de Buçaco, Portugal (Henry *et al.* 1974).

Desmochitina rugosa Eisenack, 1962

Fig. 15 A–C

- 1962a *Desmochitina minor* f. *rugosa* n. f. – Eisenack, p. 305; Pl. 16:16–18.
 1967 *Desmochitina rugosa* – Laufeld, pp. 333–334; Figs. 28 A–B.
 1968b *Desmochitina minor* f. *rugosa* – Eisenack, p. 181; Pl. 24:19–20; Pl. 31:26.

DESCRIPTION – *Desmochitina* species with an ellipsoidal vesicle and a well developed collar, often attached in an acute angle to the body. The base is convex. The operculum is a simple disc. The vesicle wall is thickly rugged.

DIMENSIONS – Total length 85–171, max. width 71–98, width of aperture 29–61.

REMARKS – The collar does not show spinose thickenings or any fenestration as pointed out by Laufeld (1967:334) for specimens from Dalarna.

OCCURRENCE – Öland: Seby to Dalby Limestones. Erratics of Lower *Macrourus* Siltstone (Middle Caradoc) and undifferentiated late Caradocian age.

Aseri (Upper Llanvirn) to Kukruse (Lower Caradoc), Estonia (Eisenack 1962a, 1968b). Dalby Limestone (Lower Caradoc), Dalarna, Sweden (Laufeld 1967).

Genus *Eisenackitina* Jansonius, 1964

Eisenackitina oelandica (Eisenack, 1955)

Fig. 15 D

1955 *Conochitina oelandica* n. sp. – Eisenack, p. 312; Pl. 1:4–6.

1967b *Bursachitina oelandica* – Rauscher & Doubinger, p. 310; Pl. 1:11.

1970 *Bursachitina oelandica* – Rauscher, p. 119; Pl. 1:1–3.

1972 *Eisenackitina oelandica* – Eisenack, p. 123; Pl. 33:22–29.

DESCRIPTION – *Eisenackitina* species with a short, subcylindrical body that tapers into a short cylindrical neck. The aperture is wide and straight. The base is convex and the basal edge rounded. The vesicle is perfectly smooth.

DIMENSIONS – Total length 93–122, max. width 48–95, width of aperture 24–61.

OCCURRENCE – Öland: Uppermost Folkeslunda to Furudal and Persnäs to Dalby Limestones.

Calymene Shale to *Marrolithus* Shale (Llanvirn to Llandeilo), Normandie (Rauscher & Doubinger 1967b) and Calvados (Rauscher 1970), France.

Genus *Hercochitina* Jansonius, 1964, emend. Jenkins 1969

Hercochitina cf. *crickmayi* Jansonius, 1964

Fig. 15 E–F

1964 *Hercochitina crickmayi* n. sp. – Jansonius, pp. 908–909; Pl. 1:9–11.

1964 *Hercochitina* sp. A – Jansonius; Pl. 1:13.

1969 *Hercochitina crickmayi* – Jenkins, pp. 26–28; Pl. 8:1–11.

1977b *Hercochitina crickmayi* – Achab, pp. 2202, 2208; Pl. 3:1–3; Pl. 7:1–3.

1979 *Hercochitina crickmayi* – Achab, Pl. 2:2–4; Pl. 3:1–5.

DESCRIPTION – *Hercochitina* species with a conical body and a cylindrical neck with a fringed aperture. The basal edge is rounded and the base is flat to

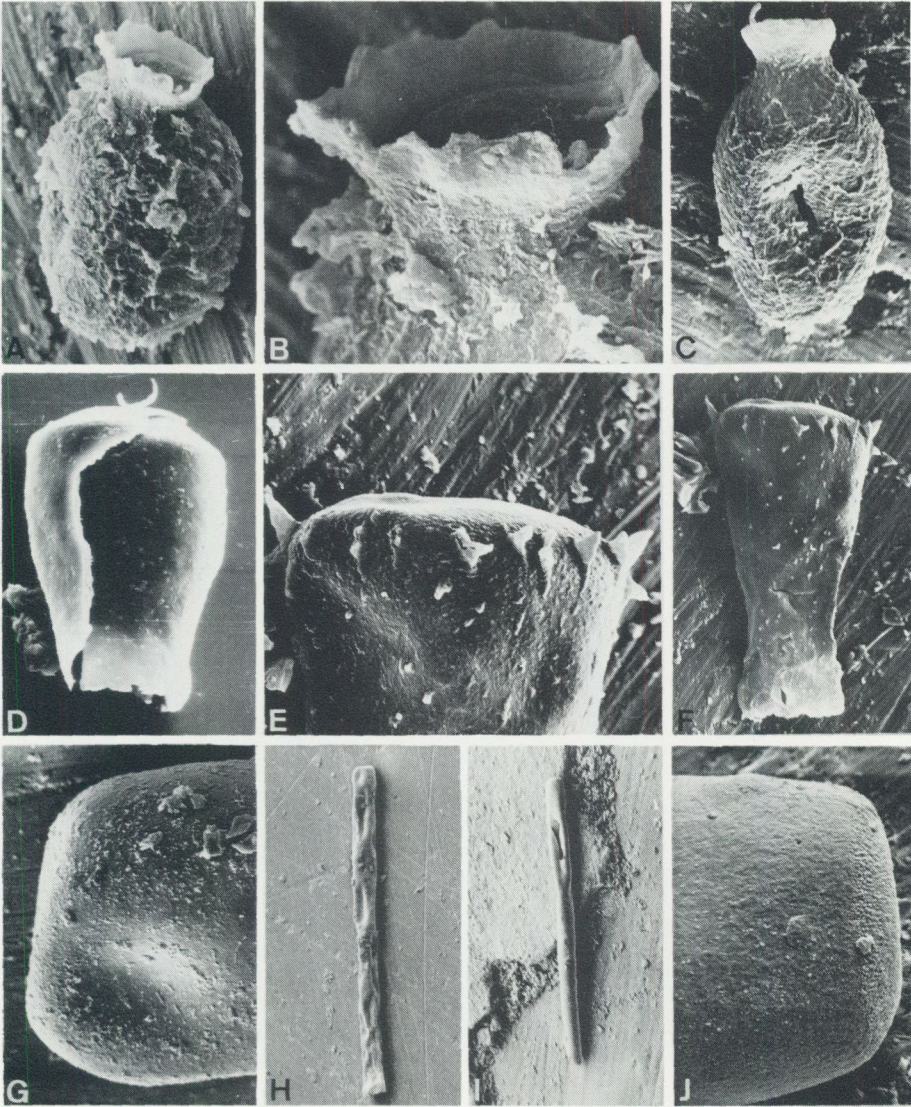


Fig. 15. A-C. *Desmochitina rugosa* Eisenack, 1962. A-B. Bödahamnborrningen 1, Folkeslunda Limestone (15.90-15.95 m). C. Gammalsbyborrningen 1, Seby Limestone (8.85 m). D. *Eisenackitina oelandica* (Eisenack, 1955). D. Bödahamnborrningen 1, Dalby Limestone (0.55-0.60 m). E-F. *Hercochitina* cf. *crickmayi* Jansonius, 1964. E-F. Gräsgård kanal 1, *Macrourus* Siltstone. G-J. *Rhabdochitina gracilis* Eisenack, 1962. G-H. Bödahamnborrningen 1, Källa Limestone (11.30-11.33 m). I-J. Bödahamnborrningen 1, Dalby Limestone (3.27-3.32 m).

A-B. SGU Type 772. A. Lateral view, SEM x250; B. Oral view. Note the operculum, SEM x750. C. SGU Type 786. Lateral view, SEM x340. D. SGU Type 787. Lateral view, SEM x290. E-F. SGU Type 757. E. Aboral part, SEM x480; F. Lateral view, SEM x220. G-H. SGU Type 788. G. Aboral view, SEM x460; H. Lateral view, SEM x40. I-J. SGU Type 789. I. Lateral view, SEM x30; J. Aboral view, SEM x470.

slightly convex. The flanks are convex. All specimens observed have an incomplete ornamentation arranged in longitudinal rows.

DIMENSIONS – Total length 146–200, max. width 73–97, width of aperture 37–61, max. width of ornamentation 15.

REMARKS – The Öland specimens are smaller than those reported from Canada and the U.S.A. Jenkins (1969, Pl. 8:1) described a tapering basal process in some specimens. This structure has not been observed in the Öland specimens. *Hercochitina crickmayi* has an ornamentation that forms membranous longitudinal ridges, attached to the vesicle wall by short, pillar-like spines. In younger populations the ridges are more homogeneous (Jenkins 1969). *Hercochitina* cf. *crickmayi* has a wider ornamentation than *Hercochitina crickmayi*. *Hercochitina* cf. *crickmayi* is also the first described species of the genus from Baltoscandia.

OCCURRENCE – Öland: Erratics of Lower *Macrourus* Siltstone (Middle Caradoc).

Viola Limestone (Upper Caradoc), Oklahoma, U.S.A. (Jenkins 1969). Vauréal Formation (Ashgill), Anticosti Island, Canada (Achab 1977b, 1979; Jansonius 1964).

Genus *Rhabdochitina* Eisenack, 1931

Rhabdochitina gracilis Eisenack, 1962

Fig. 15 G–J

1980 *Rhabdochitina gracilis* – Grahn, pp. 35–36; Figs. 20 A–B, D (further references).

DESCRIPTION – See Grahn 1980.

DIMENSIONS – Max. length 1000, width 48–73.

REMARKS – The Ontikan specimens of *Rhabdochitina gracilis*, and those described by Grahn (1978, Fig. 5 C, E) from Skåne, display a central depression in the base. The depression is provided with an inner circular rim (Grahn 1980, Fig. 20 D). One possible explanation of this structure is that *Rhabdochitina gracilis* originally occurred in chains, and the rim represents the remains of the attachment to the prosome in next specimen.

OCCURRENCE – Öland: Upper Langevoja (Upper Arenig) to Lower Valaste (Lower Llanvirn). Seby to Dalby Limestones. Erratics of undifferentiated late Caradocian age.

The Hunderum (Uppermost Arenig to Lowermost Llanvirn), Dalarna, Sweden (Eisenack 1962a). Aluoja (Lower Llanvirn) to Kukruse (Lower Caradoc), Estonia (Eisenack 1962a). *Dalmanitina* Beds (Upper Ashgill),

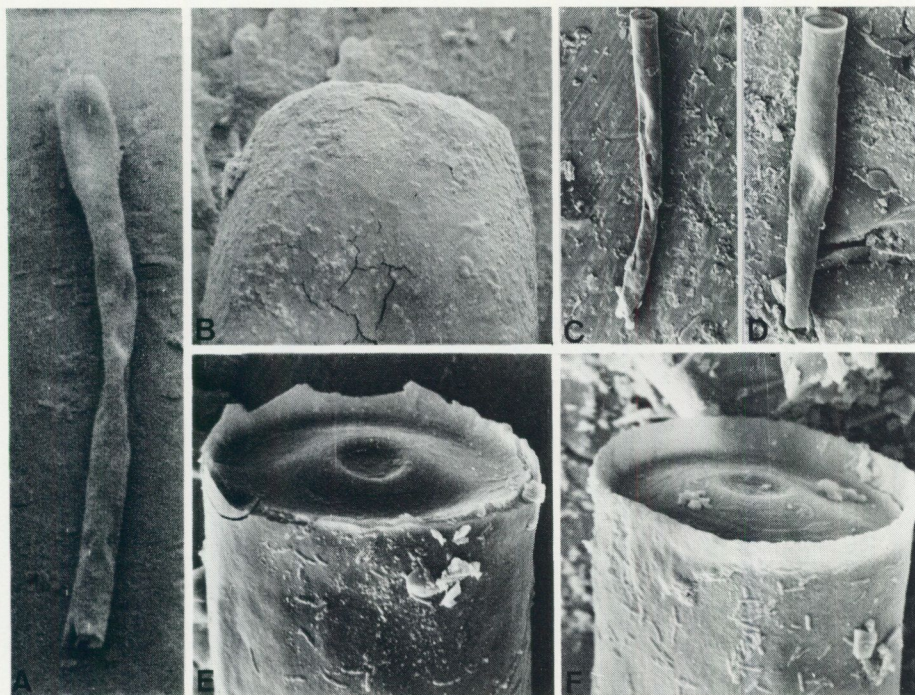


Fig. 16. A–B. *Rhabdochitina magna* Eisenack, 1931. A–B. Gräsgård kanal 1, Erratics of undifferentiated late Caradocian age. C–F. *Tanuchitina bergstroemi* Laufeld, 1967. C–F. Gräsgård kanal 1, Erratics of undifferentiated late Caradocian age.

A–B. SGU Type 740. A. Lateral view, SEM x50; B. Aboral view, SEM x360. C, E. SGU Type 728. C. Lateral view, SEM x40; E. Aboral view. Note the central depression, SEM x480. D, F. SGU Type 729. D. Lateral view, SEM x70; F. Aboral part, SEM x460.

Skåne, Sweden (Grahn 1978) and Baltic erratics of the same age (Eisenack 1968a).

Rhabdochitina magna Eisenack, 1931

Fig. 16 A–B

1980 *Rhabdochitina magna* – Grahn, p. 36; Figs. 20 C, E (further references).

DESCRIPTION – See Grahn 1980.

DIMENSIONS – Max. length 1366, width 98–134.

REMARKS – The base of *Rhabdochitina magna* is sometimes provided with an inner circular rim (Grahn 1980; Fig. 20 E). This structure probably had the same function as that in *Rhabdochitina gracilis*. Hence the rim is the remains of the joint between specimens in a chain.

OCCURRENCE – Öland: Upper Langevoja (Upper Arenig) to Lower Valaste (Lower Llanvirn) and Upper Aluoja (Lower Llanvirn). Källa to Dalby Limestones. Erratics of undifferentiated late Caradocian age.

Aluoja (Lower Llanvirn) to Aseri (Upper Llanvirn) and Nabala (Upper Caradoc) to Porkuni (Upper Ashgill), Estonia (Eisenack 1962a, 1965, 1968a, 1968b). Meadowtown Beds (Lower Llandeilo), Welsh Borderland (Jenkins 1967). Vauréal Formation (Ashgill), Anticosti Island, Canada (Achab 1977a, 1978).

Genus *Tanuchitina* Jansonius, 1964

Tanuchitina bergstroemi Laufeld, 1967

Fig. 16 C-F

1967 *Tanuchitina bergstroemi* n. sp. – Laufeld, pp. 343–345; Figs. 34 A-F.

1968b *Tanuchitina bergstroemi* – Eisenack, p. 169; Pl. 29:23–24.

DESCRIPTION – *Tanuchitina* species with a long subcylindrical vesicle that tapers towards the aperture. The base is convex with a central depression. The basal edge is provided with a membranous flange. The vesicle wall is perfectly smooth.

DIMENSIONS – Total length 683–1 098, max. width 61–73, width of aperture 37–73, max. length of basal membranous flange 12.

REMARKS – Laufeld (1967:344) remarked that *Tanuchitina bergstroemi* also tapers toward the base. This has not been observed in the specimens from Öland. Furthermore, the Öland specimens lack ornamentation, in contrast to those from Dalarna.

OCCURRENCE – Öland: Erratics of undifferentiated late Caradocian age.

Fjåcka Shale (Uppermost Caradoc), Dalarna, Sweden (Laufeld 1967).

STRATIGRAPHY

The chitinozoan distribution on Öland is characterized by a small number of short-ranging species. In the Ontikan (Lower Ordovician) only one species, *Lagenochitina tumida*, is restricted to one unit (Grahn 1980). In the Viruan there are three species, viz. *Conochitina clavaherculi* (Källa Limestone), *Cyathochitina sebyensis* (Seby Limestone) and *Cyathochitina stentor* (Dalby Limestone). In addition to those species, one species, viz. *Eisenackitina oelandica* is restricted to Llandeilian beds and seven species, viz. *Conochitina cactacea*, *Conochitina robusta*, *Conochitina suecica*, *Cyathochitina reticulifera*, *Desmochitina nodosa*, *Hercochitina* cf. *crickmayi*, and *Tanuchitina bergstroemi* are restricted to erratics of Caradocian age. Altogether sixteen species are confined to the Viruan. The biostratigraphy is summarized in Fig. 17. On Öland the first Viruan chitinozoans appear in the Seby Limestone. This may be due to

the more oxidizing conditions during Segerstad and Skärlov time. The palaeoecology of the Viruan chitinozoans will be treated in more detail in a later publication.

SEBY LIMESTONE

Jaanusson (1960:274) subdivided the Seby Limestone into seven subunits (a-g). Four of them have yielded chitinozoans (a-d). From the base of Seby (a) the abundance of chitinozoans increases to a maximum in c, whereafter the abundance suddenly decreases in d. Eleven species appear for the first time in the Ordovician sequence of Öland (Fig. 17). One species, *Cyathochitina sebyensis*, is an excellent index fossil for the lower part of the Seby Limestone. In general the abundance of chitinozoans is below 1.7 specimens per gram of rock, with a maximum of 44.6 specimens.

FOLKESLUNDA LIMESTONE

No chitinozoans are restricted to this unit. There occur, however, five new species for the Ordovician sequence, viz. *Angochitina* cf. *capillata*, *Cyathochitina latipatagium*, *Desmochitina amphorea*, *Desmochitina complanata*, and *Eisenackitina oelandica*. The latter species first appears in the upper part of the unit and indicates an early Llandeilo age. The abundance of chitinozoans is in general below 2 specimens per gram of rock, with a maximum of about 22.5 specimens. It is worthy of note that the chitinozoan abundance always reaches a pronounced maximum at the supposed Llanvirn - Llandeilo boundary, about $\frac{1}{3}$ of the thickness down in the unit.

FURUDAL LIMESTONE

The Furudal Limestone is restricted to the south of Öland and is roughly synchronous with the Källa and Persnäs Limestones in the north. There are no significant chitinozoan species for the unit. In general the abundance of chitinozoans is 1-3 specimens per gram of rock, with a maximum of 12.9 specimens.

KÄLLA LIMESTONE

The Källa Limestone is a tongue of the Furudal Limestone in the north of Öland. One species, *Conochitina clavaherculi*, is restricted to the upper part of the unit, and *Rhabdochitina magna* occurs for the first time in the Viruan sequence. In general the abundance of chitinozoans is 3-4 specimens per gram of rock, with a maximum of 17.3 specimens.

LLANVIRN					LLANDEILO			CARADOC		
ASERI		LASNAMÄGI			UHAKU		KUKRUSE		OANDU	?
SEGERSTAD	SKÄRLÖV	SEBY			FOLKESLUNDA	KÄLLA	PERSNÄS	DALBY	"MACROURUS"	UNDIFFERENTIATED UPPER CARADOC
		a	b	c		d	FURUDAL			
<i>Angochitina cf. capitata</i>					*			*		
<i>Conochitina cactacea</i>									*	
<i>Conochitina capitata</i>		*	*	*	*	+	+	*	*	*
<i>Conochitina clavaheruli</i>						*				
<i>Conochitina aff. claviformis</i>		*	*	*	*	*	*	*		*
<i>Conochitina cf. comma</i>		*			*			*	*	
<i>Conochitina conulus</i>		*			*		+	*	*	*
<i>Conochitina aff. elegans</i>		*	*	*	*	+	+	*		*
<i>Conochitina micrantha</i>		*	*	*	*	+	+	*	*	*
<i>Conochitina minnesotensis</i>							*	*	*	*
<i>Conochitina pellifera</i>		*	*	*	*	+	+	*		*
<i>Conochitina primitiva</i>		*	*	*	*	+	+	*		*
<i>Conochitina robusta</i>								*	*	*
<i>Conochitina suecica</i>								*		*
<i>Conochitina wesenbergensis</i>		*	*	*	*	+	+	*	*	*
<i>Cyathochitina calix</i>		*	*	*	*	+	+	*		*
<i>Cyathochitina campanulaeformis</i>		*	*	*	*	+	+	*	*	*
<i>Cyathochitina kuckersiana</i>		*			*		*	*	*	*
<i>Cyathochitina latipatagium</i>					*			*	*	*
<i>Cyathochitina reticulifera</i>										*
<i>Cyathochitina sebyensis</i>		*	*							*
<i>Cyathochitina stentor</i>								*		*
<i>Cyathochitina striata</i>		*	*	*	*	+	+	*		*
<i>Desmochitina amphorea</i>					*	*		*	*	*
<i>Desmochitina cocca</i>		*	*	*	*	+	+	*	*	*
<i>Desmochitina complanata</i>					*	*		*		*
<i>Desmochitina minor</i>		*	*	*	*	+	+	*	*	*
<i>Desmochitina nodosa</i>										*
<i>Desmochitina ovulum</i>		*	*	*	*	+	+	*		*
<i>Desmochitina rugosa</i>		*	*	*	*	+	+	*	*	*
<i>Eisenackitina oelandica</i>					*		+	*		*
<i>Herachitina cf. crickmayi</i>								*		*
<i>Rhabdochitina gracilis</i>		*	*	*	*	+	+	*		*
<i>Rhabdochitina magna</i>						*	*	*		*
<i>Tanuchitina bergstroemi</i>										*

Fig. 17. Occurrence of chitinozoans of the different stratigraphical units on Öland. Crosses represent co-occurrences of species in the Furudal Limestone and Källa or Persnäs Limestones, respectively.

PERSNÄS LIMESTONE

Conochitina minnesotensis appears for the first time in the Viruan sequence within the Persnäs Limestone, otherwise there are no significant chitinozoan species. The abundance of chitinozoans is in general below 4 specimens per gram of rock, with a maximum of 21.6 specimens.

DALBY LIMESTONE

The Dalby Limestone is the youngest unit found *in situ* on Öland. One species, *Cyathochitina stentor*, is restricted to the unit and comprises an excellent index fossil. The upper part of the Dalby Limestone has the greatest abundance of Chitinozoa in the Ordovician of Öland. In general the abundance of chitinozoans is 1–4 specimens per gram of rock, with a maximum of 47.5 specimens.

"MACROURUS" SILTSTONE

Four chitinozoan species, viz. *Conochitina cactacea*, *Conochitina robusta*, *Conochitina suecica*, and *Hercochitina* cf. *crickmayi* differentiate the fauna in the erratics of the Lower *Macrourus* Siltstone from that in the bedrock on Öland. One sample had an abundance of chitinozoans around 6.4 specimens per gram of rock.

ERRATICS OF UNDIFFERENTIATED LATE CARADOCIAN AGE

Four chitinozoan faunas have been found in the investigated erratics. Fauna 1 is characterized by *Tanuchitina bergstroemi*. This species has been previously reported from the Fjäckå Shale (Uppermost Caradoc) in Dalarna, Sweden (Laufeld 1967). The other species in the fauna are all long-ranging. Erratics of the same age as the Fjäckå Shale are known from Öland. The abundance of chitinozoans is around 2.8 specimens per gram of rock. In fauna 2 only one species, *Desmochitina nodosa*, has a restricted range. This species occurs in the Skagen Limestone (Middle Caradoc) and equivalent beds. Erratics of Skagen Limestone are probably present on Öland. However, chitinozoan faunas of this age in Sweden are much less diverse than in the erratics. The abundance of chitinozoans is around 13 specimens per gram of rock. Faunas 3 and 4 are characterized by *Cyathochitina reticulifera*, otherwise there are no diagnostic species. The abundance of chitinozoans is about 4.1 and 4 specimens per gram of rock, respectively.

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