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SERIE C NR 744 AVHANDLINGAR OCH UPPSATSER ÅRSBOK 72 NR 6

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# CHITINOZOAN STRATIGRAPHY AND PALAEOECOLOGY AT THE ORDOVICIAN-SILURIAN BOUNDARY IN SKÅNE, SOUTHERNMOST SWEDEN

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ISBN 91-7158-141-3

A contribution to
PROJECT TORNQUIST
(IGCP Accession Number 86)

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C DAVIDSONS BOKTRYCKERI AB, VÄXJÖ 1978

*Dedicated to*

RAGNAR NILSSON

*on his 75th birthday*

## CONTENTS

## ABSTRACT

Grahn, Y.: Chitinozoan stratigraphy and palaeoecology at the Ordovician-Silurian boundary in Skåne, southernmost Sweden. Manuscript accepted for publication 1978-01-25.

The chitinozoan fauna at the Ordovician-Silurian boundary in Skåne is poor, with only four species. The two genera *Ancyrochitina* and *Conochitina* are almost mutually exclusive. This is useful when correlating the boundary in Skåne. It is concluded that *Conochitina* had a benthic and *Anchyrochitina* a planktic mode of life.

## INTRODUCTION

Skåne, the southernmost province of Sweden, is situated at the southwestern margin of the Baltic shield (Fig. 1). The Ordovician-Silurian boundary is exposed at six localities and in one boring. These are described in the Appendix. Only two sections at Östra Tommarp and the boring at Södra Sandby have continuous sedimentation across the boundary.

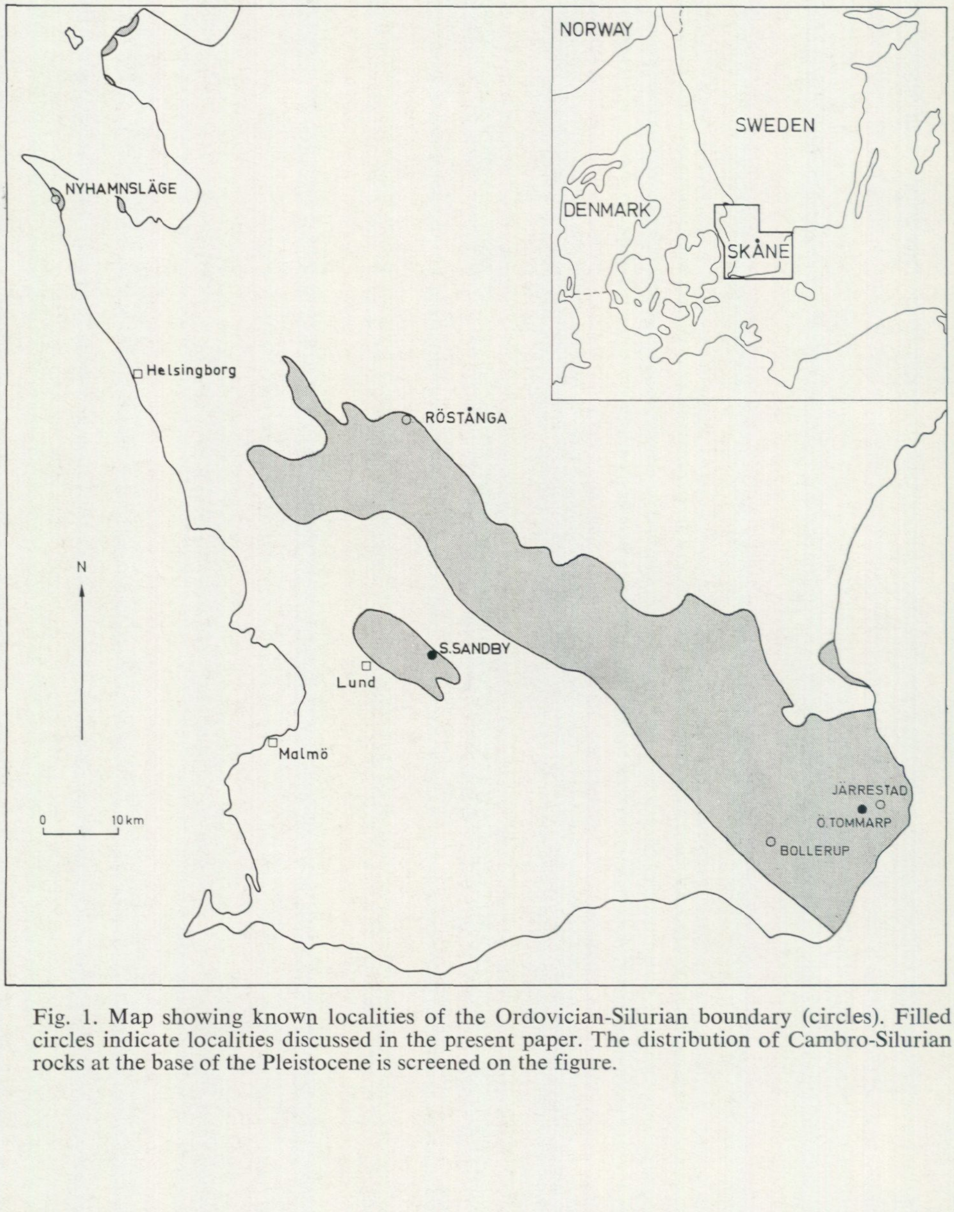

Fig. 1. Map showing known localities of the Ordovician-Silurian boundary (circles). Filled circles indicate localities discussed in the present paper. The distribution of Cambro-Silurian rocks at the base of the Pleistocene is screened on the figure.

The Ashgillian of Skåne is subdivided into three units, viz. in ascending order: Upper *Dicellograptus* Shale, *Staurocephalus* Beds and *Dalmanitina* Beds. The *Dalmanitina* Beds consist of grey and black mudstones fairly rich in pyrite, and the two lower units are mainly greenish-grey shales (Regnéll 1960, pp. 24–25). The Llandoverian of Skåne consists of the *Rastrites* Shale and the lowermost part of the *Cyrtograptus* Shale (Zone of *Monograptus crenulata).* This sequence is composed of grey to black mudstones and shales with thin beds of dark, fine-grained limestone. The Ordovician-Silurian boundary is currently placed between the *Dalmanitina* Beds and the *Rastrites* Shale (Fig. 2). Until recently, the lowermost Silurian (Zone of *Glyptograptus persculptus)* was unknown in Skåne. The presence of this zone has now been established by R. Nilsson, who will describe the graptolites in a separate paper.

## HISTORICAL REVIEW

In 1875 Linnarsson distinguished the Ordovician from the Silurian in Skåne. Tullberg (1833b, p. 259) was the first to make a comprehensive review of the Cambro-Silurian of Skåne. He placed the base of the Silurian below the level with the first monograptids (Zone of *"Diplograptus acuminatus").* Some years later, Törnquist (1889, p. 312) divided Tullberg's Ashgillian sequence into two units, viz. "Upper *Dicellograptus Shale*" and "Brachiopod Shale" *(sensu* Linnarsson 1869). Both Tullberg and Törnquist considered the "zone" yielding *Climacograptus scalaris* as the uppermost part of the Ordovician (Fig. 2). In 1910 Moberg placed the boundary at the base of the "zone" of *Climacograptus scalaris* after finds of *Monograptus* cf. *tenuis* in this "zone" at some localities (Fig. 2). Later Troedsson (1920) introduced the term *Dalmanites* Beds for the upper part of the previous Brachiopod Shale. Troedsson (1936), in agreement with Holm (1901), placed the *Dalmanites* Beds in the Silurian and considered these beds as basal in a major transgression (Fig. 2). He based his judgement on three main arguments:

1. The Zone fossil for the uppermost Ordovician, *Dicellograptus anceps,* has its last known occurrence in Sweden in the *Staurocephalus* Beds.
2. Conglomerates between the *Staurocephalus* Beds and the *Dalmanites* Beds in Skåne correspond to coarse conglomerates in the Swedish part of the Caledonian mountain chain.
3. The Dalmanites Beds show a marked faunal affinity to the Silurian.

In 1948 Waern correlated the "zone" of *Climacograptus scalaris* in Västergötland with the Zone of *Glyptograptus persculptus;* his interpretation is supported by the present study. Waern did not find the zone fossil but based his conclusion on an evolutionary series of *Climacograptus scalaris* described by Davies (1929).

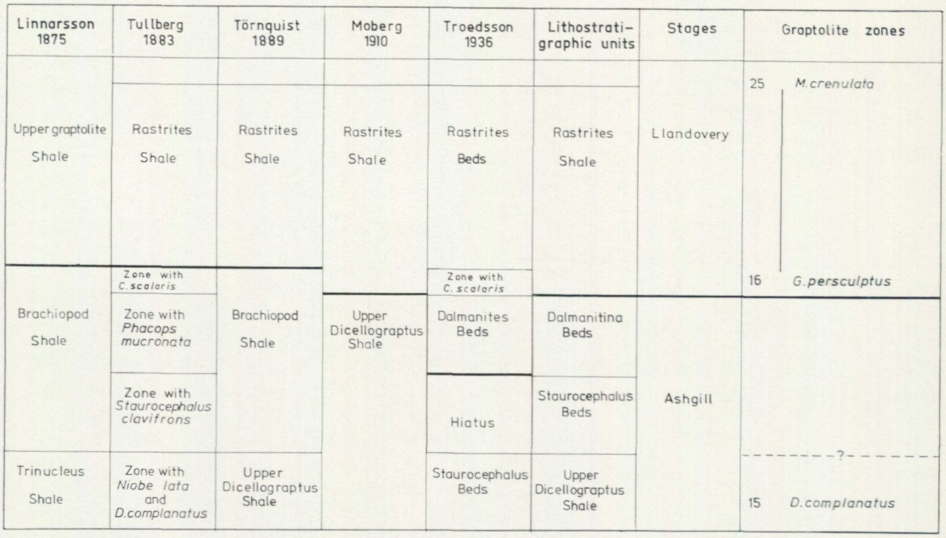

Fig. 2. Diagram showing the position of the Ordovician-Silurian boundary (marked by thick line) in Skåne as interpreted by different authors.

Davies concluded that different varieties of *Climacograptus scalaris* occur at different levels within the Zone of *Glyptograptus persculptus*. Waern considered the *Dalmanitina* Beds as an early Silurian shelly facies. Using trilobites, Temple (1952) correlated the *Dalmanitina* Beds with the upper part of the Ashgillian in Great Britain.

The thickness of the Ashgillian in Skåne is estimated at slightly less than 40 m (Lindström 1971, p. 434), and the rate of sedimentation as about 1–10 mm of compacted sediment per thousand years (Lindström 1971, p. 425). The thickness of the Llandovery in Skåne was estimated by Regnéll (1960, p. 26) to be between 40 and 120 m, and by Lindström (1971, p. 435) to be about 70 m. The rate of sedimentation was calculated as about 10–25 mm of compacted sediment per thousand years (Lindström 1971, p. 425).

## CHITINOZOANS

In the sections investigated, chitinozoans occur in greater abundance in the black mudstones than in the grey ones. The density of chitinozoans in the Silurian samples is about 10 specimens per gram of rock, but in the Ordovician ones it is at the most 2 per gram of rock. All specimens are deformed to a greater or lesser extent. There are only four species of Chitinozoa at the boundary, none of which has any major stratigraphic significance.

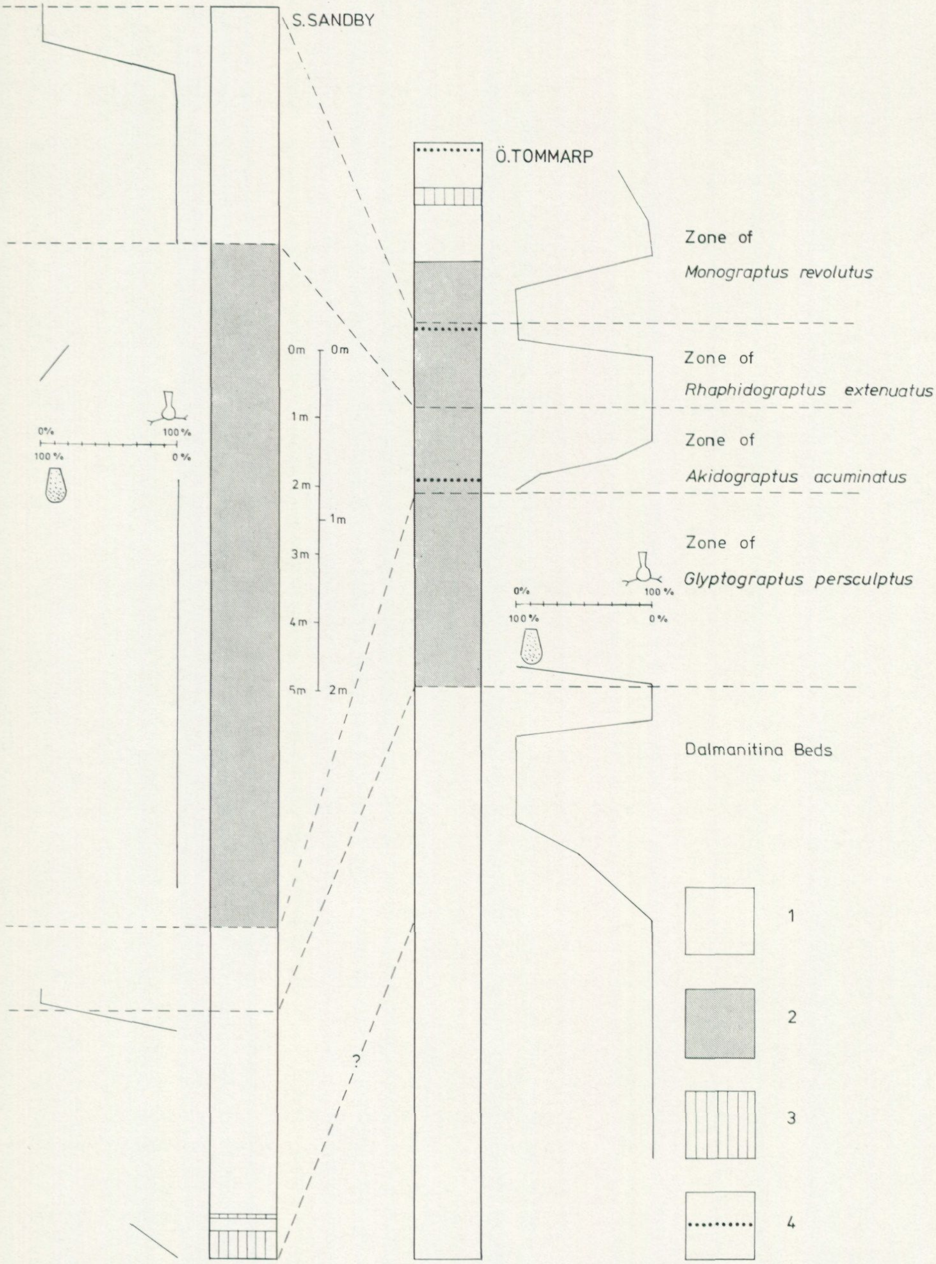

Fig. 3. Diagram showing the ratio *Conochitina robusta* (left): *Ancyrochitina ancyrea* (right) in Södra Sandby and Östra Tommarp, and the lithology of these sequences. The Östra Tommarp section is a combination of the localities Östra Tommarp 1 and Östra Tommarp 2. The upper 74 cm of the Zone of *Glyptograptus persculptus* is missing at Östra Tommarp 1, and this part was collected at Östra Tommarp 2. The localities are lithologically identical in the parts studied.

Legend: 1. Grey mudstone 2. Black mudstone 3. Grey fine-grained limestone 4. Bentonite.

*Ancyrochitina ancyrea* (Eisenack, 1931)
Fig. 5 A–B.
In the Balto-Scandian area *A. ancyrea* first appears in the latest Ashgillian (Laufeld 1971) and ranges through the entire Silurian.

*Conochitina robusta* Eisenack, 1959
Fig. 4 A–D, F–G.
*C. robusta* is known from Llanvirn-Ashgill in Estonia and from Caradoc-Llandovery in Sweden.

*Cyathochitina campanulaeformis* (Eisenack, 1931)
Fig. 4 E, 5 D.
In Estonia *C. campanulaeformis* makes its debut in the Arenig and disappears in the Llandovery. It has been reported from the Zone of *Didymograptus murchisoni* to the Zone of *Monograptus gregarius* in Sweden (Laufeld 1971). Sediments with a relatively higher content of pyrite yield a dwarf form with a length of less than 250 $\mu$m (Fig. 5 D).

*Rhabdochitina gracilis* Eisenack, 1962
Fig. 5 C, E.
In the Balto-Scandian area *R. gracilis* is restricted to the Ordovician.

## CHITINOZOAN PALAEOECOLOGY

A regression in the uppermost Ordovician is indicated in several parts of the world, due probably to a glaciation centred in northwest Africa at the end of the Ordovician (Sheehan 1975). In Skåne, the fauna in these beds is dominated by ostracodes, whereas trilobites are sparse (Regnéll 1960, p. 25). The Zone of *Glyptograptus persculptus* is here characterized by a mixture of shelly and graptolitic elements. The chitinozoans in the Södra Sandby core have been subjected to oblique deformation in relation to their longitudinal axis, and some specimens show a dislocation of the vesicle wall (Fig. 4 D, G). This is probably due to displacement along cleavage surfaces in the bedrock (cf. Laufeld 1967, pp. 290–291). Sediments rich in pyrite often contain chitinozoans whose vesicle walls are spotted with square marks resulting from the growth of pyrite crystals (Fig. 4 A–B). Several specimens, particularly of *Conochitina robusta,* have small circular holes through the vesicle wall which were probably caused by parasites (Fig. 4 A–B).

Faunal lists have been made for the Södra Sandby core and the Silurian part of the Östra Tommarp exposure (R. Nilsson, unpublished). It is striking that smooth ostracodes generally occur exclusively in beds where *Ancyrochitina* dominates over *Conochitina.* These two chitinozoan genera have a tendency to be mutually exclusive (Fig. 3). An investigation of the sedimentology of the

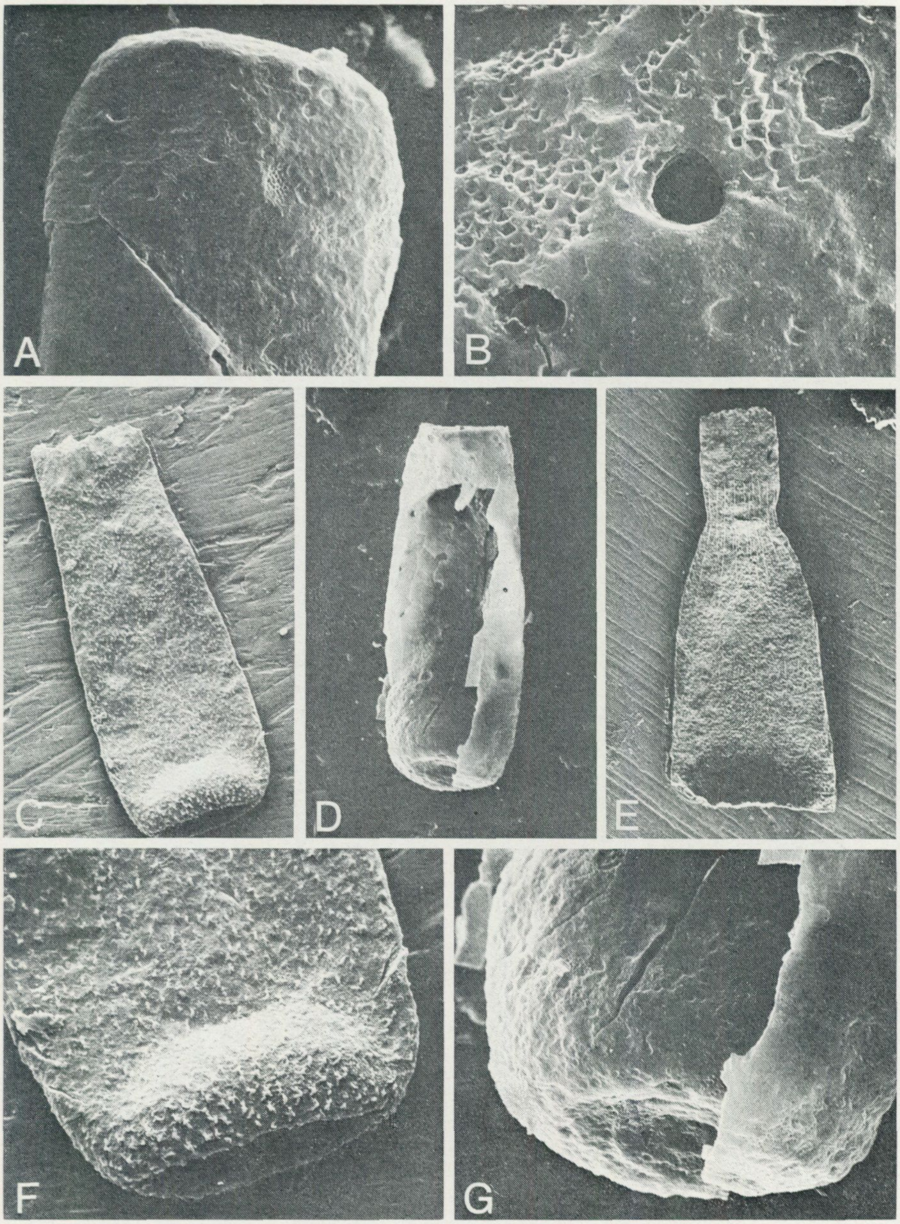

Fig. 4. *Conochitina robusta* Eisenack, 1959. A–B. LO 5271:1. D, G. LO 5271:2. Boring Södra Sandby 27, Zone of *Glyptograptus persculptus* (17.16–17.33 m). C, F. Östra Tommarp 1, Zone of *Monograptus revolutus* (JB 58). LO 5272:1. *Cyathochitina campanulaeformis* (Eisenack, 1931). E. Östra Tommarp 1, Zone of *Akidograptus acuminatus* (JB 70). LO 5273:1.

A. Aboral part of a specimen showing patches of square marks and perforations. SEM x600. B. Same specimen as A. Detail of vesicle wall. SEM x3000. C. Specimen in lateral view. SEM x155. D. Specimen with dislocated vesicle wall. SEM x180. E. Specimen in lateral view. SEM x80. F. Same specimen as C. Lateral view of the basal part. SEM x375. G. Same specimen as D. Lateral view of the basal part. SEM x600.

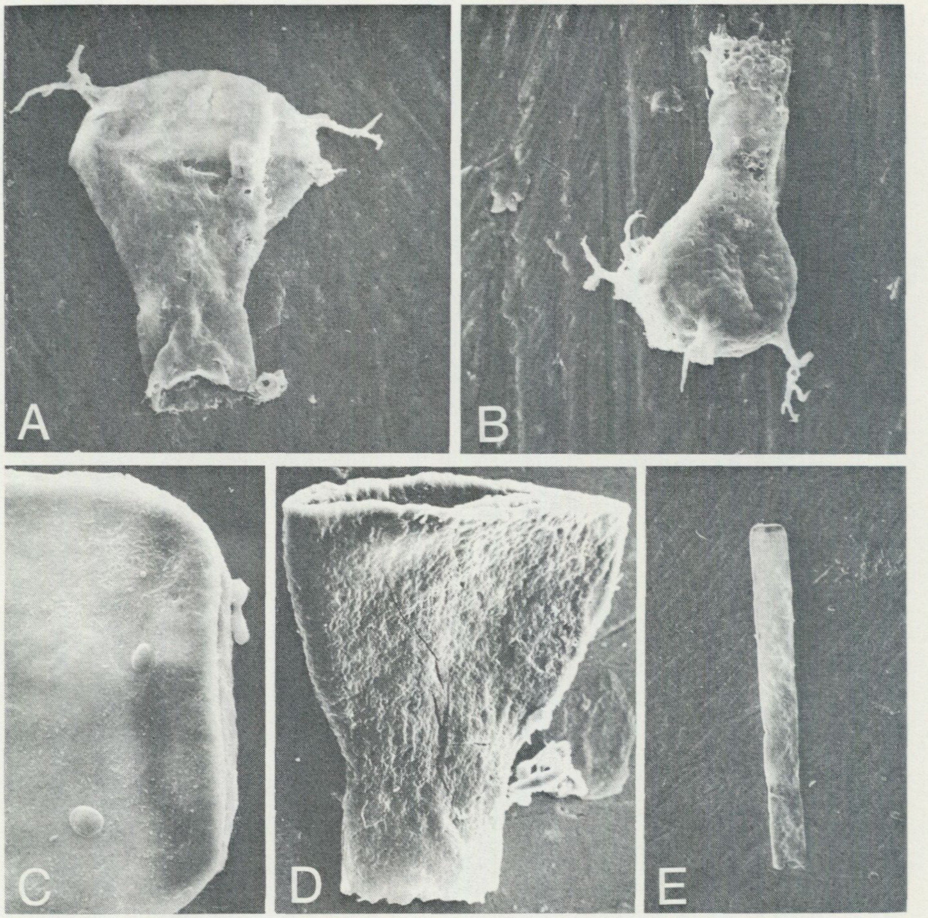

Fig. 5. *Ancyrochitina ancyrea* (Eisenack, 1931). A. LO 5274:1. B. LO 5274:2. Boring Södra Sandby 27, *Dalmanitina* Beds (20.50 – 20.55 m). *Rhabdochitina gracilis* Eisenack, 1962. C, E. Östra Tommarp 1, *Dalmanitina* Beds (JB O). LO 5274:3. *Cyathochitina campanulaeformis* (Eisenack, 1931). D. Boring Södra Sandby 27, Zone of *Akidograptus acuminatus* (15.50 – 15.55 m). LO 5271:3.

A. Specimen in lateral view. SEM x400. B. Specimen in lateral view. SEM x290. C. Same specimen as E. Lateral view of the basal part. The round bodies are probably tasmanitids. SEM x720. D. Dwarf form in lateral view. SEM x275. E. Specimen in lateral view. SEM x55.

Södra Sandby core showed that this difference is connected with the variation of grain-size. Beds where *A. ancyrea* dominates over *C. robusta* have a comparatively higher content of quartz grains. This higher content cannot be explained by temporary influxes of quartz grains from the meandering of rivers, seasonal rains etc. The few orthocone nautiloids encountered also show preference for the environment where ostracodes are common. The sea was probably deeper in beds where *C. robusta* dominates over *A. ancyrea*. The shallow intervals correspond to times of regression, and beds deposited in relatively deeper water correspond to transgressive phases. The concentration of *C. robusta* in transgressive phases can be explained by a benthic mode of life. When the sea-level rose, *C. robusta* was able to invade new areas, but when the sea-level sank the environment became unfavourable for this species. In contrast to *C. robusta, A. ancyrea* should be planktic, when its basal processes may be interpreted as having a buoyant function. The different occurrences of the two species may be explained thus.

## ACKNOWLEDGEMENTS

The present study was carried out at the Department of Geology, Lund, where Gerhard Regnéll provided working facilities. Jan Bergström and Ragnar Nilsson placed samples and unpublished notes at my disposal. The manuscript has been improved from comments by Sven Laufeld and Lennart Jeppsson. The Cementa company through Erik Högberg gave me access to the Södra Sandby core. Bertil Waern informed me about Bollerup 1. Inger Sjöö typed the manuscript, Inga Palmaer and Cristine Bron finished my line drawings, Sven Stridsberg assisted with photographic work, Birgitta Sandström and Britt-Marie Svensson did the SEM work, and Lesley Cherns corrected my manuscript linguistically.

Gyllenstiernska-Krapperupsstiftelsen paid the costs of a boring at Nyhamnsläge 1. Lunds Geologiska Fältklubb paid for the excavation of Östra Tommarp 2. The Swedish Natural Science Research Council, Stockholm (NRF G2685-009) gave financial support. My sincere thanks to all these persons and organizations.

# APPENDIX

## EXPOSURES

BOLLERUP 1, VB 3990 5015, c. 80 m S Bollerup church.
Topographical map sheet 2D Tomelilla SO. Geological map sheet Aa 109 Simrishamn.

Ditch-section, no longer accessible, north of the rivulet from the moat around Bollerup castle.

Upper Ashgill-Lower Llandovery.

JÄRRESTAD 1, VB 5437 5425, c. 1250 m SW Järrestad church.
Topographical map sheet 2E Simrishamn SV. Geological map sheet Aa 109 Simrishamn.

Exposure, no longer accessible, where a small rivulet from Backamossen falls into the Tommarpaån, c. 260 m SE of the bridge across the Tommarpaån on the main road Järrestad—Hammenhög.

Upper Ashgill-Lower Llandovery.

Reference: Moberg 1910, pp. 86, 100.

NYHAMNSLÄGE 1, UC 4685 3665, c. 3150 m WSW Brunnby church.
Topographical map sheet 3B Höganäs NO. Geological map sheet Aa 78 Höganäs.

Surface exposure on the beach c. 70 m NW of the northernmost house in Nyhamnsläge. For a detailed description, see Troedsson 1918.

Upper Ashgill-Lower Llandovery.

References: Lundgren 1874, pp. 158—159; Lindström 1880, p. 9; Törnquist 1875, p. 57; Troedsson 1918, pp. 9—10; Troedsson 1920, pp. 266, 273, 280.

ÖSTRA TOMMARP 1, VB 5180 5450, c. 370 m WSW Östra Tommarp church. Topographical map sheet 2E Simrishamn SV. Geological map sheet Aa 109 Simrishamn.

Ditch-section, no longer accessible, at an abandoned purification plant close to Tommarpaån.

Upper Ashgill-Lower Llandovery.

ÖSTRA TOMMARP 2, VB 5180 5444, c. 380 m WSW Östra Tommarp church. Topographical map sheet 2E Simrishamn SV. Geological map sheet Aa 109 Simrishamn.

Ditch-section, no longer accessible, at an abandoned purification plant close to Tommarpaån.

Upper Ashgill-Middle Llandovery.

Reference: Moberg 1910, pp. 86, 94, 100.

RÖSTÅNGAMÖLLA 1, UC 9315 0651, c. 1000 m SW Röstånga church.
Topographical map sheet 3C Helsingborg SO. Geological map sheet Aa 87 Trolleholm.

Section, no longer accessible, along the south side of a diabase close to the old road between Röstånga and Ask and about 500 m NW of Röstångamölla. The exposure is identical with Tullberg's (1880, p. 92, Pl. 4; 1883a, pp. 5—6) locality nr. 9 and Moberg's (1910, pp. 127—128) section V a—c. Parts of the Upper Ashgillian *Dalmanitina* Beds are still accessible.

Upper Ashgill-Lower Llandovery.

References: Linnarsson 1879, pp. 250—251; Lundgren 1874, pp. 157—158; Moberg 1910, pp. 108—109, 127—128, Pl. 3; Olin 1906, pp. 21—22, 26, 28; Törnquist 1875, p. 57; Troedsson 1918, pp. 10—14; Troedsson 1920, pp. 266—267, 273, 280; Tullberg 1880, p. 92, Pl. 4; Tullberg 1883a, pp. 5—6.

## BORING

SÖDRA SANDBY 27, UB 9500 7675, c. 850 m WNW Södra Sandby church. Topographical map sheet 2C Malmö NO. Geological map sheet Aa 92 Lund.

A 20 m deep boring made by the Cementa company in 1961 ca. 160 m NW of the Lindegård farm.

Upper Ashgill-Lower Llandovery.

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PRISKLASS B

Distribueras genom
LiberKartor
162 89 VÄLLINGBY

Växjö 1978 C Davidsons Boktryckeri AB
Printed in Sweden

ISBN 91-7158-141-3