A C T A P A L A E O N T O L O G I C A P O L O N I C A
Vol. 25 1980 No. 2

JAAK NÕLVAK

CHITINOZOANS IN BIOSTRATIGRAPHY OF THE NORTHERN EAST BALTIC ASHGILLIAN. A PRELIMINARY REPORT

NÕLVAK, J.: Chitinozoans in biostratigraphy of the northern East Baltic Ashgillian. A preliminary report. Acta Palaeont. Polonica, 25, 2, 253—260, July 1980.

Acid-resistant microfossils have been studied from serial bore-core samples representing different facies of Ashgillian deposits. Chitinozoans are shown to hold better promise for detailed subdivision and section correlation than other scarce representatives of macro- or microfauna. According to their vertical distribution, three types of chitinozoan species having biostratigraphic significance can be distinguished.

Key words: chitinozoans, Ashgillian, East Baltic, biostratigraphy.

Jaak Nõlvak, Institute of Geology, Estonian Academy of Sciences, Estonia pst, 7, Tallin 200101, U.S.S.R. *Received: November 1979.*

INTRODUCTION

The last ten years have seen a wide application of acid-resistant microfossils in the biostratigraphic studies of the Baltic Ordovician and Silurian. This is chiefly due to an ever increasing importance of bore-core material. The initial results of acid-resistant Ordovician and Silurian microfossil distribution (chitinozoans in particular) hold a great promise for the section subdivision and correlation (Männil 1970, 1971, 1972; Nestor 1976*a*, *b*). Made below is an attempt to show the importance of individual groups of acid-resistant microfossils for the Ashgillian biostratigraphy on the basis of studying serial samples from 12 core section, the northern East Baltic.

Acknowledgements. — The author is most grateful to Dr. R. Männil and Dr. K. Põlma (Institute of Geology, Tallinn) for stimulating discussions. Thanks are also extended to Dr. E. Klaamann and Dr. H. Nestor for critical reading the manuscript. Grateful acknowledgements are expressed to Dr. R. Wrona and Mr. W. Skarżyński (Institute of Paleobiology of Polish Academy of Sciences, Warsaw) for helping in preparation of the manuscript. SEM micrographs were made at the Institute of Geology, Tallinn, by Mr. J. Klimov.

GEOLOGICAL SETTING

The sections under study are located in the following confacies belts (see Männil 1966; Põlma 1967, Jaanusson 1976): the northern (Estonian) facies belt: the Hagudi, Orjaku, Kiriküla borings; the transition belt: the Eikla, Kingissepa, Kangatuma, Ohesaare borings; the central (Swedish-Latvian) belt: the Kolka, Ruhnu, Ikla, Viesate borings (fig. 1).

In the present report the Ashgillian is tentatively considered to embrace the Vormsi, Pirgu and Porkuni Stages. This is done due to the difficulties in defining the lower boundary of the Ashgillian, especially, after the revision of the British stratotype Ashgillian (see Ingham and Wright 1970; Williams *et al.* 1972).

Discussing the development of the Ordovician basin in the East Baltic, Männil (1966) discriminates the Ashgillian as spanning the Pirgu and Porkuni age, and points out its being fairly distinct. As compared with earlier stages in the basin development the Ashgillian is a regressive one.

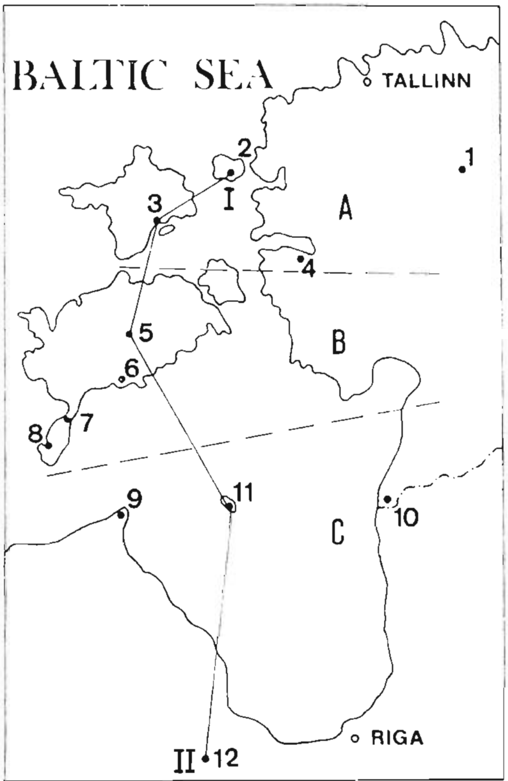


Fig. 1. Location of the sections under study. *A* — Northern (Estonian) structural-facies belt: *1* — Hagudi, *2* — Hullo, *3* — Orjaku, *4* — Kirikuküla; *B* — Transition belt: *5* — Eikla, *6* — Kingissepa, *7* — Kaugatuma, *8* — Ohesaare; *C* — Axial (Swedish-Latvian) belt: *9* — Kolka, *10* — Ruhnu, *11* — Ikla, *12* — Viesate. I—II — The line showing the location of the sections in fig. 2.

The beginning of the Ashgillian is associated with a relative stability of the basin which is accounted for by a distinct succession of lithofacies. Replacing one another towards the open sea are (fig. 2):

1) grey biodetrital carbonate deposits (Kõrgessaare Formation): the Hagudi, Orjaku borings and others;

2) grey carbonate argillaceous deposits (Tudulinna Formation): the Eikla, Kaugatuma borings and others;

3) thin grey argillaceous deposits (Fjäcka Formation): the Ruhnu, Ikla borings and others;

4) dark grey argillaceous deposits enriched with organic material (Fjäcka Formation): the Viesate boring and others.

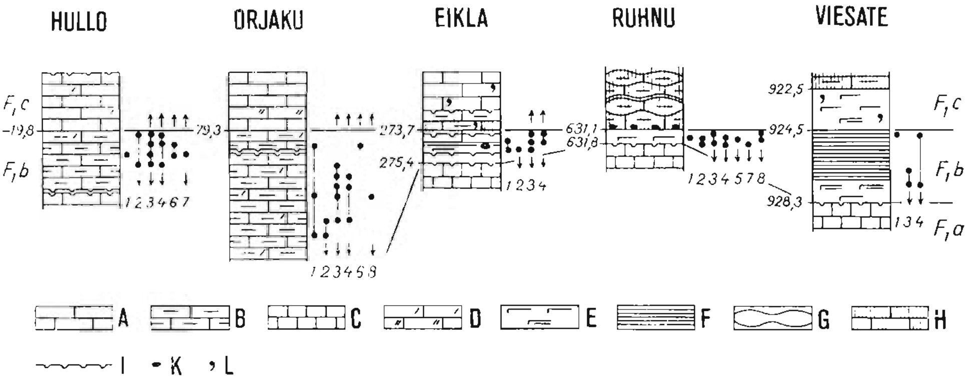


Fig. 2. Chitinozoan distribution in the upper Vormsi Stage of the sections in western North Baltic (the columns are based on the data provided by L. Põlma, E. Kala and the author). F_1a — the Nabalo Stage; F_1b — the Vormsi Stage; F_1c — the Pirgu Stage. *A* — limestone; *B* — clayey limestone; *C* — cryptocrystalline limestone; *D* — fine-biodetritic limestone (a) and coarse-biodetritic limestone (b); *E* — calcitic marl (a) and clayey marl (b), *F* — graptolitic argillite; *G* — medium-nodular limestone; *H* — completely red beds (a) spotted red beds (b); *I* — discontinuity surface; *K* — goethite oolites; *L* — glauconite. 1 — *Acanthochitina barbata*, 2 — *Cyathochitina kuckersiana*, 3 — *Lagenochitina baltica*, 4 — *Lagenochitina prussica*, 5 — *Conochitina* cf. *elegans*, 6 — *Tanuchitina bergstroemi*, 7 — *Desmochitina minor* f. *typica*, 8 — *Desmochitina* sp. The arrow marks the species having a wider range of vertical distribution.

In the northern East Baltic, the boundary between the Vormsi and Pirgu Stages displays a significant change in the nature of sedimentation. The Pirgu Stage deposits are distinguished from those lying below by their greater differentiation and fair scarcity of macrofauna. This is probably due to a higher sedimentation rate (see Põlma 1973; Oraspõld 1975).

At the boundary level of the Pirgu and Vormsi Stages there also occurs a considerable decrease in various microfossil forms. According to the data available, no zonal forms associated with the above stages have been up till now observed in the northern East Baltic as far as ostracodes (Sarv 1959, 1962, Gailite 1968; and others) and conodonts (Viira 1968, 1974) are concerned.

CHITINOZOANS AND OTHER ACID-RESISTANT MICROSSILS

Of greatest stratigraphic importance for the Ashgillian are graptoids, chitinozoans and acritarchs. Their occurrence depends, to a great extent, on the type of deposits. It appears that those deposits which have formed in fairly shallow waters, that is in lagoonal and shoaly facies belts following the Silurian basin model, contain no microplankton. Among them are:

1. Biohermal limestones of the shoaly facies belt in the Pirgu (Kaugatuma boring — Jonstorp Formation) and Porkuni (Hagudi boring — Törevere Member) Stages. The same is true for Sweden (Laufeld 1967, 1973).
2. Deposits of the Porkuni stage (Kaugatuma, Ruhnu borings — Piltene Member) containing coarse terrigenous material (quartz, carbonate oolites).

The absence of microfossils in these deposits is, probably, due to unfavourable environmental (turbulence etc.) or preservational conditions (see also Laufeld 1967, 1973).

Sections under study yield no lagoonal deposits, but some samples taken from the Porkuni stage in the sections of the central belt contain no microplankton (see also Männil 1970).

There are also significant secondary changes, such as a) dolomitization (Porkuni Stage deposits in northern Estonia) and b) marine red-beds: deposits with violet spots (Kaugatuma, Eikla borings — Toosti Formation) and reddish-brown rocks lack organic-walled acid-resistant microfossils completely (Kaugatuma boring — Ionstorp Formation).

As for their distribution in the carbonate deposits of open sea facies belts, chitinozoans show no basic distinction from representatives of other microfossil groups, for instance, graptoloids. On the basis of graptoloid distribution Männil (1976) recognizes three types of zonation which, probably, are also valid in the case of chitinozoans.

Type I. Zones characterized by the continuous presence of the zonal species; *Cyathochitina* cf. *dispar* (pl. 29: 2; at the lowermost Nabala Stage), *Acanthochitina barbata* (pl. 29: 1; at the uppermost Vormsi Stage); *Conochitina* sp. (pl. 29: 4; in the middle of the Pirgu Stage), *Conochitina taugourdeaui* (pl. 30: 6a, 6b; at the uppermost Pirgu Stage and in the Porkuni Stage). These zones can be very well applied for correlation of deposits developed in different species.

Type II. Zones which yield the zonal species only within a certain interval (zonule, according to Männil's terminology 1972); for the Ashgillian these are: *Coronochitina coronata* (pl. 30: 1a, 1b), *Cyathochitina campanulaeformis* (pl. 29: 8), *Cyathochitina kuckersiana* (pl. 29: 7) and others. They can be chiefly used for correlation of closely spaced sections and also within certain confacies belt (according to the unpublished data of Männil 1969, and Nõlvak 1972).

Type III. Species having a wide range of vertical distribution: *Conochitina minnesotensis* (pl. 30: 3), *Conochitina micracantha* (pl. 29: 6), *Rhabdochitina gracilis* and others. These species, at the present stage of our knowledge about them, cannot be used for detailed stratigraphic studies, but they are important when deposits are correlated at the stage level.

One of such chitinozoan index species (type I) for the deposits under study is *Acanthochitina barbata* whose stratigraphic significance has been pointed out by Laufeld (1967) and Männil (1971). This zone can be traced in all the known sections in the Baltic irrespective of their facies nature (fig. 2). The occurrence of *Acanthochitina barbata* in association with *Tanuchitina baergstroemi* (pl. 30: 2a, 2b), *Lagenochitina baltica* (pl. 30: 5). *Lagenochitina prussica* (pl. 29: 3) and others, is evidence, on the one hand, of contemporaneity of beds belonging to different facies, while, on the other, it allows a reliable conclusion that the occurrence of some chitinozoan forms shows little dependence on the facies conditions.

Acritarchs (which were picked up with chitinozoans) are confined chiefly to the upper half of the Pirgu Stage where, in some places, they display mass occurrence. The levels at which some of the species make their first appearance can be accepted as secondary criteria for section subdivision.

Graptoloid rhabdosomes indentifiable to the species level are fairly scarce in the Ashgillian (see Männil 1976), while the siculae, which are more common but so far underterminable reveal a sporadic distribution.

The serial samples (about 300 samples with the rock weight of 200—300 grams) yield very few coniform conodonts (*Panderodus, Acodus)* are quite scarce.

Scolecodonts, melanosclerites and foraminifera are fairly common but unevenly distributed; their occurrence is largely accounted for by the facies control.

A similar relationship in the Silurian deposits has been pointed out by Männil (1973). These groups being insufficiently studied, the evidence on their distribution is still lacking but they are of importance for section subdivision at the horizon and stage levels as well as for palaeoecological investigations.

The distribution of acid-resistant microfossils (chiefly chitinozoans) enables us to subdivide the deposits of the Vormsi Stage into two and those of the Pirgu Stage into six biostratigraphic units and to correlate them in the northern East Baltic. Strong dolomitization in the North Estonian sections limits the stratigraphic significance of the Porkuni Stage microfossils to the sections of the transition structural-facies belt (fig. 1)

REFERENCES

(GAILITE, L. K.) ГАЙЛИТЕ, Л. К. 1968. Палеонтологическая характеристика пограничных отложений ордовика и силура в Латвии. *In*: Стратиграфия нижнего палеозоя Прибалтики и корреляция с другими регионами. Вильнюс, „Минтис", 130—138.

INGHAM, J. K. and WRIGHT, A. D. 1970. A revised classification of the Ashgill Series. — *Lethaia*, **3**, 233—242.

JAANUSSON, V. 1976. Faunal dynamics in the Middle Ordovician (Viruan) of Balto-Scandia. *In*: M. G. Bassett (ed.), The Ordovician System: proceedings of a Palaeontological Association symposium, Birmingham, **1974**, 301—326. University of Wales Press and National Museum of Wales, Cardiff.

KALJO, D. L. 1978. On the bathymetric distribution of Graptolites. — *Acta Palaeont. Polonica*, **23**, 4, 523—531.

LAUFELD, S. 1967. Caradocian Chitinozoa from Dalarna, Sweden. — *Geol. Fören. Stockh. Förh.*, **89**, 275—349.

— 1973. Chitinozoa — en dålight känd microfossilgrupp. — *Fauna och Flora*, **68**, 135—141.

(MÄNNIL, R. M.) МЯННИЛЬ, Р. М. 1966. История развития Балтийского бассейна в ордовике. Таллин, „Валгус", 1—200.

— 1970. Кислотоустойчивые микрофоссилии. *In*: Д. Д. КАЛЬО (ed.) Силур Эстонии. Таллин, „Валгус", 176—179.

— 1971. Distribution of selected Ordovician Chitinozoan assemblages and species in Northern Europe and their stratigraphical evaluation. *In*: Colloque ordovicien-silurien. — *Mém. Bureau rech. géol. minières*, **73**, 309—311.

— 1972. Корреляция верхневируских отложений (средний ордовик) Швеции и Прибалтики по хитинозоям. — *Изв. АН ЭССР, химия, геол.*, **21**, 2, 137—142.

— 1976. Распределение граптолоидей в карбонатных отложениях ордовика Прибалтики. *In*: Граптолиты и стратиграфия. Таллин, АН ЭССР, 105—118.

NESTOR, V. 1976*a*. Kitinosoade jaotumus Ohesaare puurangu ulemsiluris. — *Geoloogilised märkmed*, **3**, 31—35.

(—) НЕСТОР, В. 1976. Сопоставление некоторых разрезов райккюлаского горизонта Эстонии по микропланктону. — *Изв. АН ЭССР, химия, геол.*, **25**, 4, 319—323.

(— and EINASTO, R. E.) НЕСТОР, В., ЭЙНАСТО, Р. Э. 1977. Фациально-седиментационная модель силурийского палеобатийского периконтинентального бассейна. *In*: Фации и фауна силура Прибалтики. Таллин, АН ЭССР, 89—121.

NÕLVAK, J. 1972. A characterization of the boundary beds of the Kukurse and Idavere Stages in the Lipu boring. (Esthonian with English summary) — *Loodusuurijate Seltsi Aastaraamat*, **61**, 39—59.

(ORASPOLD, A.) ОРАСПОЛЬД, А. 1975. Литологическая характеристика пиргуского горизонта в Южной Эстонии. — *Уч. зап. Тартуского гос. ун-та*, **359**, 14—32.

(PÕLMA, L.) ПЫЛМА, Л. 1967. О переходной полосе между северной и осевой фациальными зонами ордовика Прибалтики. — *Изв. АН ЭССР, химия, геол.*, **16**, 3, 272—275.

— 1973. Литологические особенности двух структурно-фациальных зон ордовика Прибалтики. — *Ibidem*, **22**, 240—247.

(SARV, L.) САРВ, Л. 1959. Остракоды ордовика Эстонской ССР. — *Тр. Ин-та геол. АН ЭССР*, **4**, 1—206.

— 1962. Остракоды поркуниского горизонта и лландовери Эстонии. — *Ibidem*, **11**, 95—141.

(VIIRA, V. J.) ВИИРА, В. Й. 1968. Распространение и корреляционное значение ордовикских конодонтов Прибалтики. *In*: Стратиграфия нижнего палеозоя Прибалтики и корреляция с другими регионами. Вильнюс, „Минтис", 111—129.
— 1974. Конодонты ордовика Прибалтики. Таллин, „Валгус", 1—142.
WILLIAMS, A., STRACHAN, I., BASSETT, D. A., DEAN, W. T., INGHAM, J. K., WRIGHT, A. D. and WHITTINGTON, H. B. 1972. Ordovician correlation. British Isles. — *Spec. Report*, **3**, 1—74.

JAAK NÕLVAK

BIOSTRATYGRAFICZNE ZNACZENIE CHITINOZOA Z ASZGILU PÓŁNOCNO-WSCHODNIEJ CZĘŚCI OBSZARU BAŁTYCKIEGO. NOTATKA WSTĘPNA

Streszczenie

Omówiono Chitinozoa z systematycznych prób skał aszgilskich różnych facji z wierceń w północno-wschodniej części obszaru bałtyckiego. Stwierdzono większą użyteczność tych mikroskamieniałości dla szczegółowych podziałów stratygraficznych i korelacji profilów, w porównaniu z innymi rzadkimi w tych utworach mikro- i makroskamieniałościami. Na podstawie rozmieszczenia Chitinozoa w profilu, można wydzielić wśród nich trzy grupy gatunków, które mają różne znaczenie biostratygraficzne.

ЯАК НЫЛВАК

ХИТИНОЗОИ В БИОСТРАТИГРАФИИ АШГИЛЛА СЕВЕРНОЙ ПРИБАЛТИКИ. ПРЕДВАРИТЕЛЬНОЕ СООБЩЕНИЕ

Резюме

Изучены кислотоустойчивые микрофоссилии из серийных проб ашгиллских разнофациальных отложений из буровых скважин западной части Северной Прибалтики. Отмечается перспективность хитинозой для дробного расчленения и кор-

реляции разрезов, по сравнению с другими редкими представителями макро- и микрофауны. Среди хитинозой, по вертикальному распределению можно выделять три типа видов, имеющие разное биостратиграфическое значение.

EXPLANATIONS OF THE PLATES 29, 30

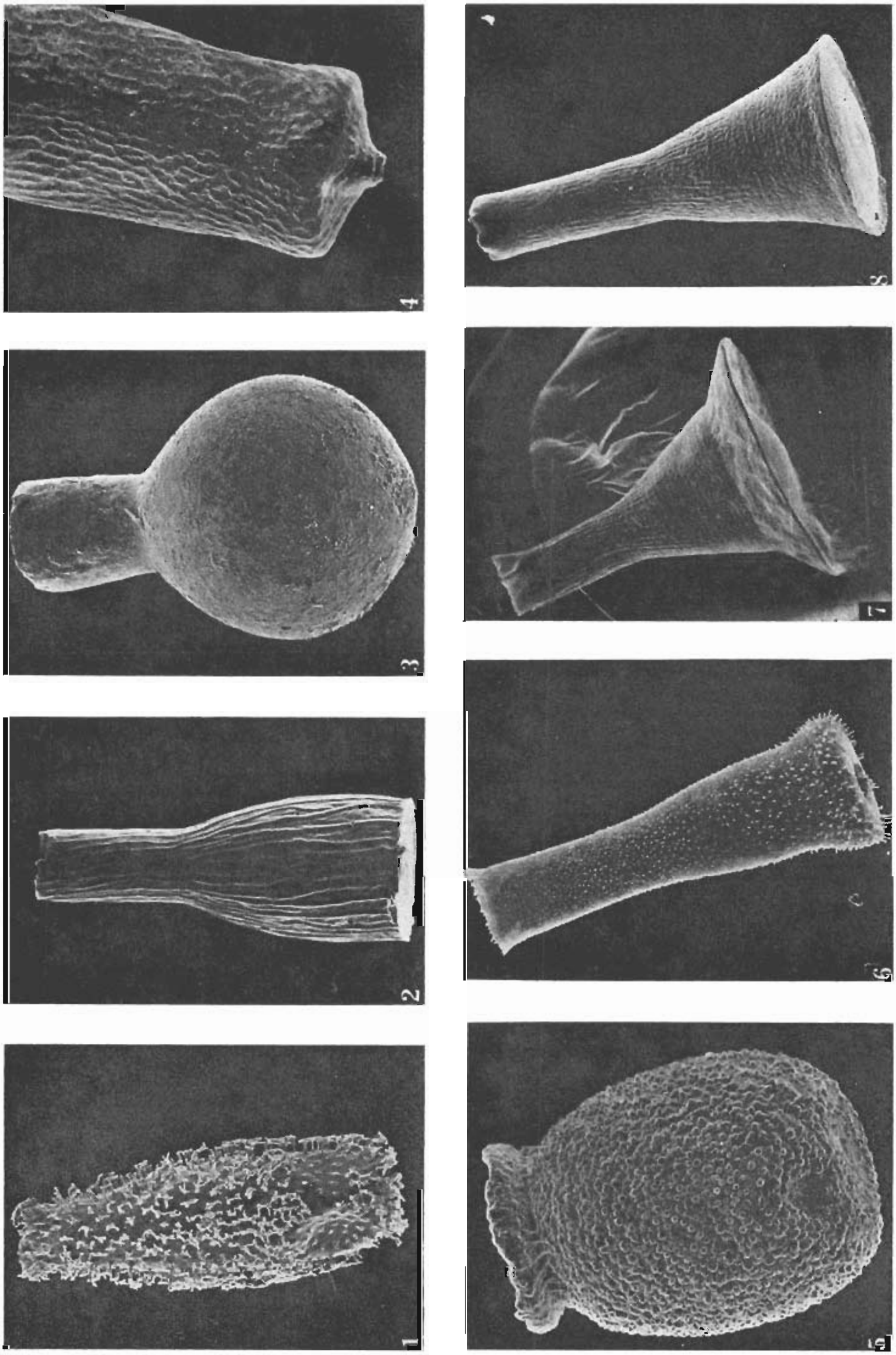
Selected chitinozoans from Upper Caradocian and Ashgillian. The well preserved specimens used for illustrations (SEM-photographs) were selected not only from boreholes and stages discussed in text.

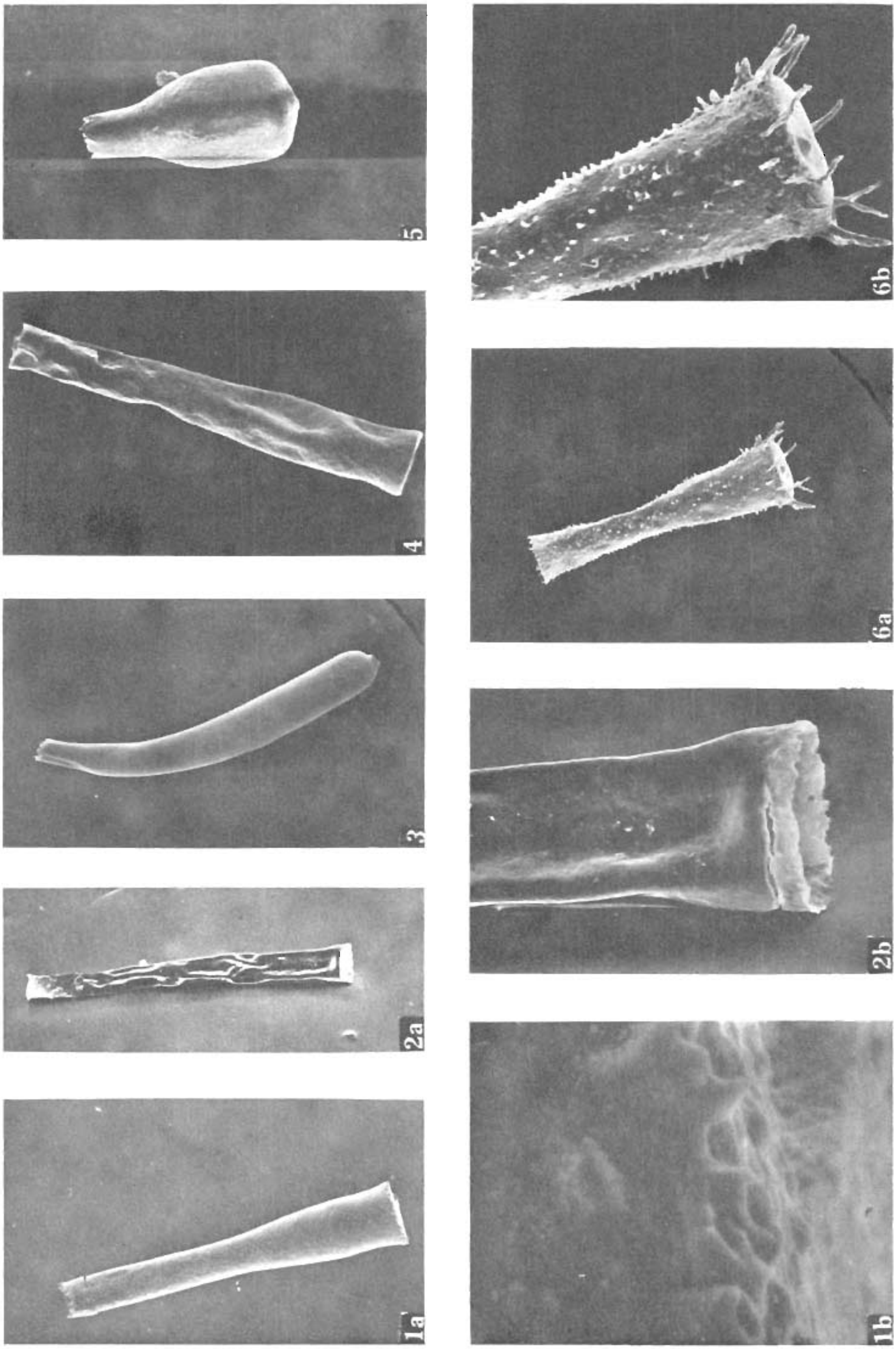
Plate 29

1. *Acanthochitina barbata* Eisenack 1931. Hullo, 21,0 m; Vormsi Stage. Ch 701/5670. Almost complete specimen in lateral view, x 125.
2. *Cyathochitina* cf. *dispar* Benoit et Taugourdeau 1961. Eikla, 289,5 m; Nabala Stage. Ch 702/5395. Complete specimen in oblique lateral view. Note the perforations caused by parasites, x 125.
3. *Lagenochitina prussica* Eisenack 1931. Ruhnu, 631,7 m; Vormsi Stage. Ch 703/5840. Specimen in oblique aboral view. x 220.
4. *Conochitina* sp. Hagudi, 24.3 m; Pirgu Stage. Ch 704/6483. Aboral part of specimen in oblique lateral view, x 310.
5. *Desmochitina minor* Eisenack 1931. Kaugatuma, 404.5 m; Nabala Stage, Ch 705/5791. Specimen in oblique aboral view, x 620.
6. *Conochitina micracantha* Eisenack 1931. Hullo, 35.5 m; Nabal Stage. Ch 706/5650. Specimen in oblique lateral view, x 220.
7. *Cyathochitina kuckersiana* (Eisenack 1934). Hullo, 21.5 m; Vormsi Stage. Ch 707/5669. Specimen in oblique lateral view, x 125.
8. *Cyathochitina campanulaeformis* (Eisenack 1931). Eikla, 275.5 m; Nabala Stage. Ch 708/5412. Specimen in oblique aboral view, x 125.

Plate 30

1. *Coronochitina coronata* (Eisenack 1931). Hagudi, 35.5 m: Pirgu Stage. Ch 709/6478: *a* almost complete specimen in oblique lateral view, x 125; *b* broken appendices at the basal edge in oblique aboral view, x 4800.
2. *Tanuchitina bergstroemi* Laufeld 1967. Hullo, 21.0 m; Vormsi Stage. Ch 710/5670: *a* somewhat flattened complete specimen in oblique lateral view, x 65; *b* aboral part, x 310.
3. *Conochitina minnesotensis* (Stauffer 1933). Hullo, 47.5 m; Rakvere Stage. Ch 711/5634. Somewhat atypical, complete specimen in lateral view. Note the curvature of the vesicle and well developed asymmetrical basal callus at the base, x 65.
4. *Conochitina* cf. *elegans* Eisenack 1931. Hullo, 25.5 m; Vormsi Stage. Ch 712/5661. Somewhat flattened specimen in lateral view, x 125.
5. *Lagenochitina baltica* Eisenack 1931. Orjaku, 96.6 m; Nabala Stage. Ch 713/3082. Specimen in oblique lateral view, x 125.
6. *Conochitina taugourdeaui* Eisenack 1968. Undva, 152.4 m; Pirgu Porkuni? Stage. Ch 714/6186: *a* specimen in oblique aboral view, x 125; *b* aboral part, x 310.




5
6b
4
6a
3
2b
2a
1a
1b