Acta Palaeontologica Polonica
Vol. 29, No. 3—4 pp. 157—160; pls. 15—16 Warszawa, 1984

PIOTR MIERZEJEWSKI

CEPHALODISCUS-TYPE FIBRILS IN THE GRAPTOBLAST FUSELLAR TISSUE

MIERZEJEWSKI, P.: *Cephalodiscus*-type fibrils in the graptoblast fusellar tissue. Acta Palaeont. Polonica, 29, 3—4, 157—160, 1985 (1984).

The fusellar tissue of an Ordovician graptoblast has been studied with TEM. It was found that it is solely composed of *Cephalodiscus*-type fibrils, unknown hitherto in graptolites. The fusellar tissue of the studied specimen has more in common with recent pterobranchs than with graptolites.

Key words: graptolites, pterobranchs, ultrastructure, Ordovician.

Piotr Mierzejewski, Zakład Paleobiologii, Polska Akademia Nauk, Pracownia Graptolitów, ul. Newelska 6, 01-447 Warszawa, Poland. *Received: February 1984.*

INTRODUCTION

The main features of the graptolite periderm ultrastructure were recognized by Towe and Urbanek (1972) and Urbanek and Towe (1974, 1975). As they indicated, the fusellar fabric of graptolites is composed of coarse, wavy, branched or anastomosing fibrils producing a characteristic spongy pattern (Urbanek and Towe 1974). In contradistinction to the graptolites, the fusellar fabric of rhabdopleurid and cephalodiscid pterobranchs consists of narrow, straight fibrils never forming an interconnected meshwork (Dilly 1971, Urbanek 1976). The phylogenetic significance of this and other differences, at the submicroscopic level, between the periderm tissues of graptolites and pterobranchs has been discussed in detail by Urbanek (1976), Andres (1980) and Crowther (1981).

The aim of this paper is to present the first finding of a graptolite fusellar tissue composed of fibrils very similar to the pterobranch fibrils. This tissue has been found in the wall of a Llanvirnian graptoblast classed as "*Graptoblastoides*" sp., which was etched from a glacial boulder of the Baltic origin. The fine structure of the graptoblasts from this boulder have also been examined by Urbanek, Mierzejewski and Rickards (in prep.).

The specimen studied was embedded in Epon 812 and sectioned with a L.K.B. III ultramicrotome provided with a diamond knife. Sections were mounted on carbon coated grids and examined in a Tesla BS 500 electron microscope. Sixty kV were used for viewing and taking micrographs. The studies were conducted at the Institute of Zoology (University of Warszawa).

Acknowledgements. — I am greatly obliged to Professor Adam Urbanek (Warszawa) for a helpful discussion.

RESULTS AND DISCUSSION

The material of the fusellar fabric of the graptoblast under study is excusively composed of straight, unbranched and indistinctly banded fibrils (pl. 15). Each fibril is provided with a large, distinct, lucent central core (pl. 15 : 1—2). The diameter of fibrils fluctuates within the limits of 90 to 129 nm. The fibrils are irregularly displaced within the fuselli. In some parts they are loosely packed, forming locally irregular aggregations (pl. 15: 2). Some extremely tightly and parallely packed fibrils were observed in the trunks of the fuselli. In the graptoblast studied the fibrils do not form outer lamellae in the fuselli. No traces of an interfibrillar matrix have been found.

The fusellar tissue described above differs distinctly from the same tissue of graptoblasts examined by Urbanek and Rickards (1974). To the same degree it also differs from the fusellar tissue in different orders of the graptolites. Urbanek and Towe (1974, 1975) have reported the presence of tightly packed unbranched fibrils, lying parallel to one another in the outer lamella of some graptolites. But these fibrils were always intimately associated with wavy, loosely anastomosing fibrils. Moreover, straight, unbranched and indistinctly banded fibrils with large lucent cores have not been found so far either in the fusellar tissue or in the cortical tissue of graptolites.

The ultrastructure of the graptoblast fusellar tissue here described reveals a fabric and pattern very similar to those recognized in living cephalodiscid pterobranchs. As it has been observed by Urbanek, Dilly and Mierzejewski (in prep.) the fusellar tissue of *Cephalodiscus solidus* Andersson is also built of nothing but straight unbranched fibrils provided with a large, lucent central core (pl. 16). However, cephalodiscid fibrils are much thinner. Their diameter varies from 19 to 22 nm.

The graptolite and pterobranch fusellar tissues display distinct ultrastructural differences. In the opinion of Urbanek (1976) the differences in the fabric, pattern and the assumed mode of secretion of the fusellar tissues in both groups form essential obstacles for recognizing homology between them. Recently this opinion has been disputed by Crowther

(1981) and Armstrong, Dilly and Urbanek (1984). Up to now it was very difficult and hazardous to discuss the phylogenetic significance of the above mentioned ultrastructural differences, because the biochemical composition of the pterobranch fibrils was obscure. Two types of fibrils embedded in an electron-lucent matrix in the living *Rhabdopleura compacta* Hincks were tentatively described by Dilly (1971) as keratin-like. This opinion was criticized by several authors (see Urbanek 1976). The latest biochemical studies on the periderm of *Rhabdopleura compacta* Hincks and *Cephalodiscus hodgsoni* Ridewood, conducted by Armstrong, Dilly and Urbanek (1984) show that it contains considerable quantaties of a collagenous material. On the other hand, it is almost certain that the graptolite fusellar fibrils are of a collagen-like nature (Urbanek and Towe 1974). Now, one can say that the graptoblast fusellar fibrils discussed above fill the structural gap between the pterobranch and the graptolite fusellar tissues. These fibrils are of a cephalodiscid ultrastructure and of graptolite dimensions. My observations support the opinion of Armstrong, Dilly and Urbanek (1984) that the ultrastructural differences between the skeletal tissues of the Pterobranchia and the Graptolithina are probably of less importance for phylogenetic considerations than it was suggested earlier.

REFERENCES

ANDRES, D. 1980. Feinstrukturen und Verwandschaftsbeziehungen der Graptolithen. — *Paläont. Z.*, **54**, 1—2, 129—170.

ARMSTRONG, W. G., DILLY, P. N. and URBANEK, A. 1984. Collagen in the pterobranch skeleton and the problem of graptolite affinities. — *Lethaia*, **17**, 2, 145—152.

CROWTHER, P. R. 1981. The fine structure of graptolite periderm. — *Spec. Pap. Palaeont.*, **26**, 8—119.

DILLY, P. N. 1971. Keratin-like fibres in the hemichordate *Rhabdopleura compacta*. — *Z. Zellforsch.*, **117**, 502—515.

TOWE, K. M. and URBANEK, A. 1972. Collagen-like structures in Ordovician graptolite periderm. — *Nature*, **237**, 443—445.

URBANEK, A. 1976. The problem of graptolite affinities in the light of ultrastructural studies on peridermal derivatives in pterobranchs. — *Acta Palaeont. Polonica*, **21**, 1, 3—36.

— and RICKARDS, R. B. 1974. The ultrastructure of some retiolitids and graptoblasts. — *Spec. Pap. Palaeont.* **13**, 177—186.

— and TOWE, K. M. 1974. Ultrastructural studies on graptolites, I: The periderm and its derivatives in the Dendroidea and in *Mastigograptus*. — *Smith. Contr. Paleobiol.*, **20**, 1—48.

— and — 1975. Ultrastructural studies on graptolites, II: The periderm and its derivatives in the Graptoloidea. — *Ibidem*, **22**, 1—25.

PIOTR MIERZEJEWSKI

WŁÓKNA TYPU *CEPHALODISCUS* W TKANCE FUZELARNEJ GRAPTOBLASTA

Streszczenie

Metodami transmisyjnej mikroskopii elektronowej zbadano tkankę fuzelarną ordowickiego graptoblasta. Wykazano, iż jest ona zbudowana z długich, prostych włókien. Włókna te charakteryzują się zmienną średnicą (90—129 nm) oraz obecnością szerokiego rdzenia o małej gęstości elektronowej. Do złudzenia przypominają włókna rozpoznane w coenecium współczesnego *Cephalodiscus* (Pterobranchia, Cephalodiscida), różnią się natomiast zasadniczo od włókien fuzelarnych dotychczas opisanych u graptolitów, a mających postać włókien krótkich, krętych, rozgałęzionych, o jednorodnej gęstości elektronowej.

EXPLANATIONS OF PLATES 15—16

All figures are TEM micrographs

Abbreviations: *b* — bunch of fibrils, *t* — transverse section of fibril.

Plate 15

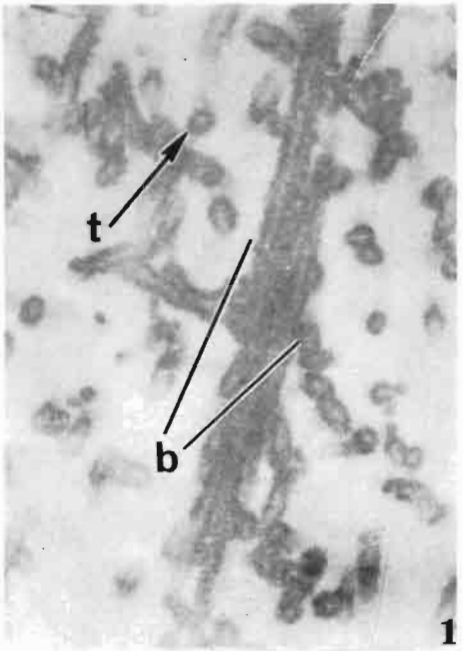
"Graptoblastoides" sp., Llanvirnian glacial boulder no. MZ/42 from Orzechowo, Baltic coast

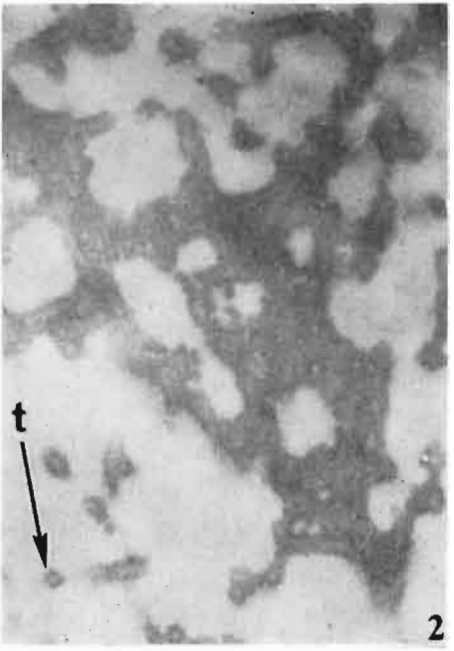
1. Bunch of fibrils, ca 33500.
2. Irregular aggregations of fibrils, ca ×33500.
3. General view of fusellar tissue in low magnification, ca ×5600.

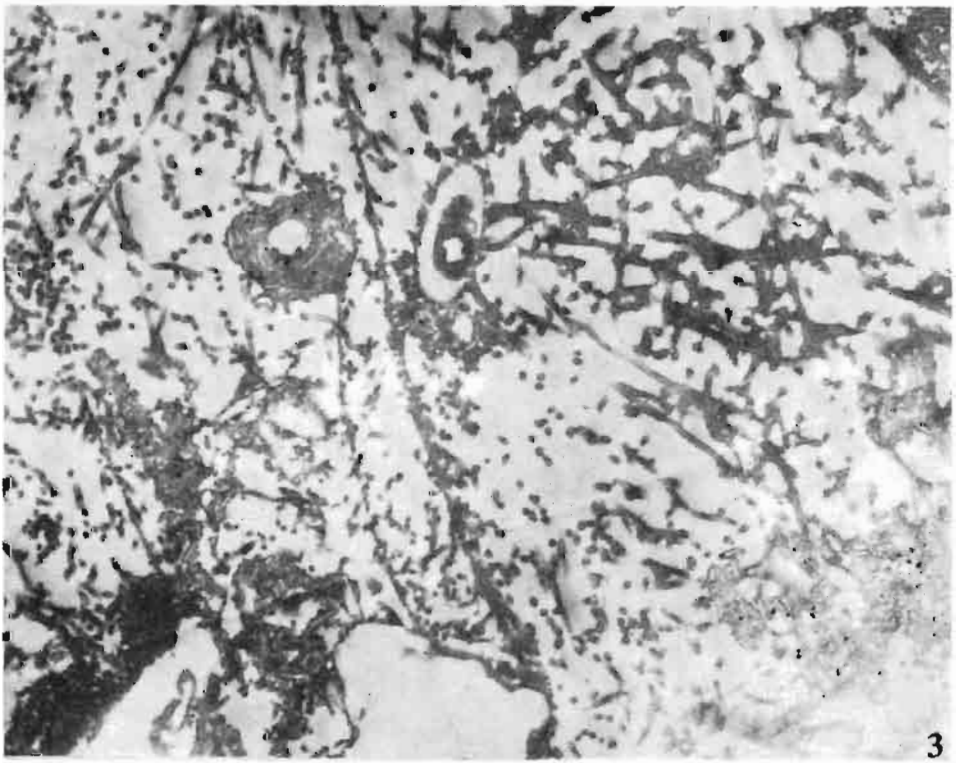
Plate 16

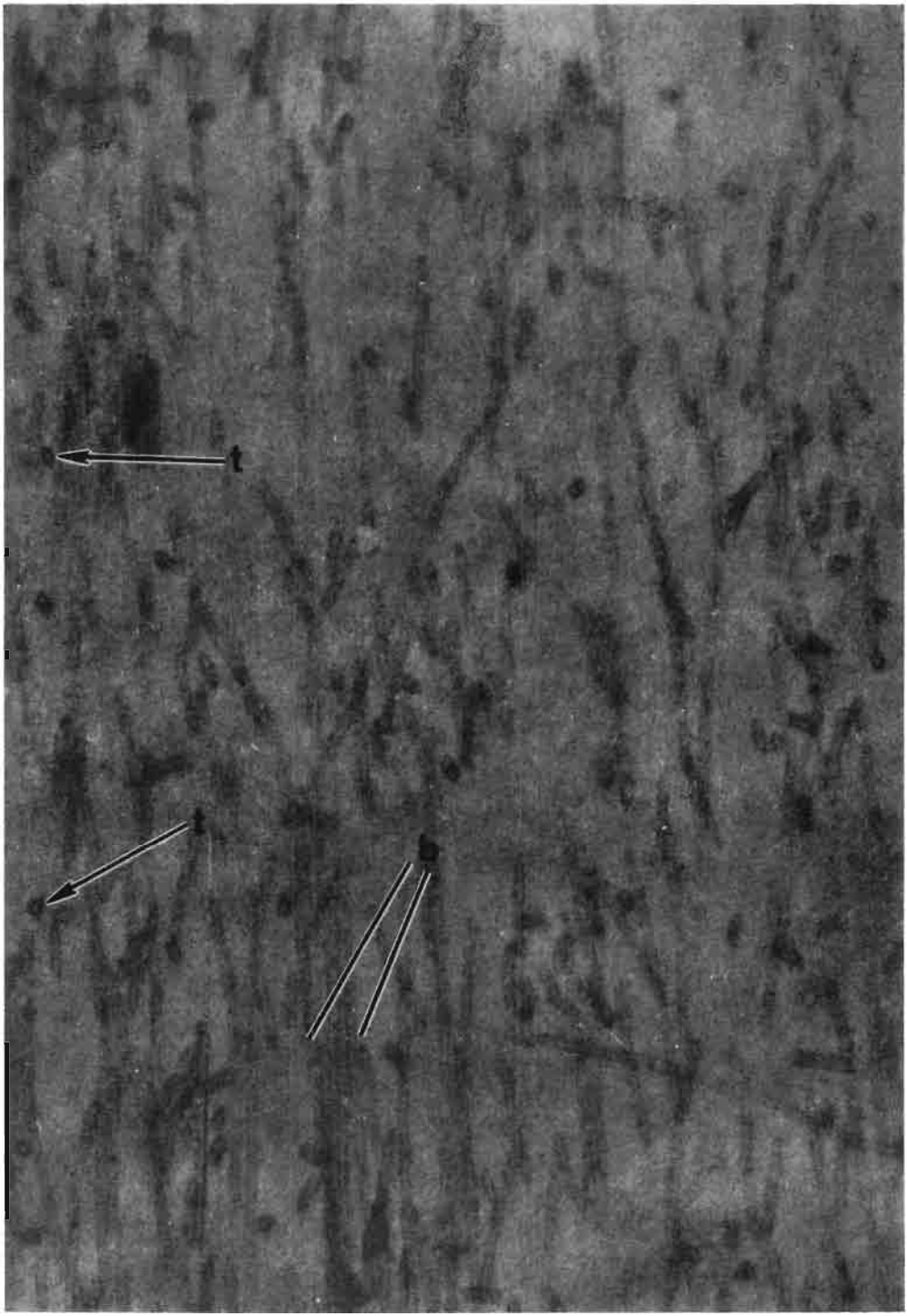
Cepholodiscus solidus Andersson, Recent, Souths Shetlands, King George Island, Admiralty Bay

Fusellar tissue in large magnification showing the shape and structure of fibrils, ca ×100 000.


t
b
1


t
2


3


t