ACTA PALAEONTOLOGICA POLONICA
Vol. 22 1977 Nr. 3

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TROCHILISCUS (*EUTROCHILISCUS*) CF. *BULBIFORMIS* KARPINSKY (CHAROPHYTA) IN THE DEVONIAN LIMESTONE OF TRAUNKAMMEN, SPITSBERGEN

Abstract.— The fossil Charophyta from the Devonian sediments of Spitsbergen are here described for the first time and classified to the species rank on the basis of thin sections.

INTRODUCTION

The material which is the basis for the present paper was collected during the summer season of 1975 in Spitsbergen during the Paleontological Expedition of the Institute of Paleobiology, Polish Academy of Sciences. The samples were taken from thick bedded limestones that crop out on the northern slope of Traunkammen along the southern coast of Hornsund (fig. 1). The rocks are greenish-grey to dark green or pinkish limestones, and attain a thickeness of several hundred meters. They rest on reddish-brown sandstones and are classified to the middle part of the Marietoppen Formation (Birkenmajer 1964, fig. 7; Friend, Heintz & Moody-Stuart 1966). Bone fragments, possibly fish, are found in these limestones, especially at their lower portions. In the opinion of Birkenmajer (*op. cit.*) the fish remains *Monaspis hornsundi* Heintz and *Monaspis* sp. and abundant ostracods found in the Hornsundt massif during the years 1917 — 1919 come from an outcrop of the middle part of the Marietoppen Formation. In thin sections gyrogonites of *Trochiliscus* and ostracod shells are visible. The gyrogonites are most frequent in the lower beds (50 — 120 sections of gyrogonites in a thin section) less frequent in the upper beds (one section in a thin section). Some intermediate beds did not contain any sections of gyrogonites.

The Middle Part of the Marietoppen Formation is classified as the

Emsian on the basis of fish remains, ostracods, lithology and general geological position (Birkenmajer 1964, Table 1).

Limestone samples from Traunkammen and thin sections made of them are stored in the Institute of Paleobiology, Polish Academy of Sciences in Warszawa (abbreviated as ZPAL).

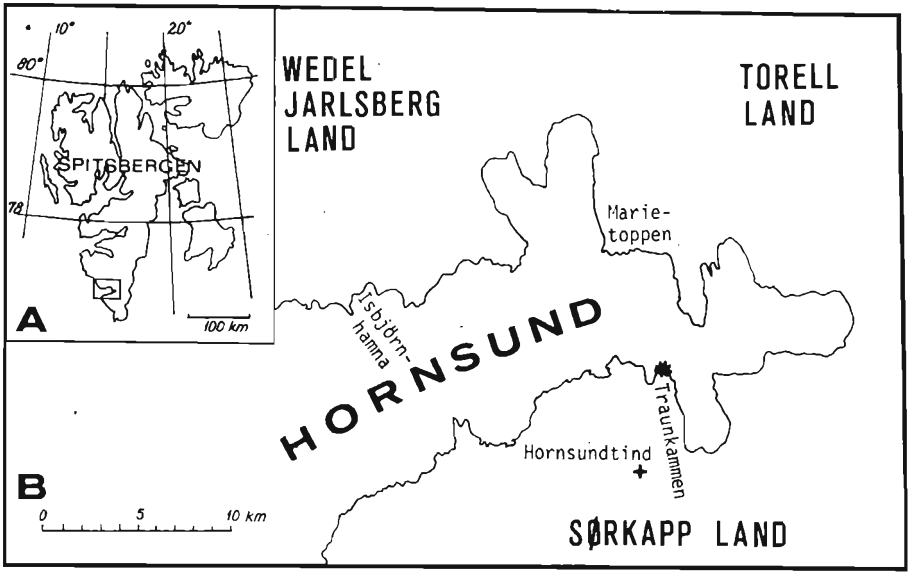

Fig. 1. Location of fossil Charophyta (asterisk) at Traunkammen, Hornsud (B) in Spitsbergen (A).

Acknowledgements. — Thanks are due to Prof. Gertruda Biernat, scientific leader of the Paleontological Expeditions to Spitsbergen, who encouraged the present investigation and to Drs. Jadwiga Karczewska and Maria Ziembińska-Tworzydło for introducing me to new problems, lending literature, and making useful remarks during my work. I wish to thank my Expedition colleagues for help in collecting material in the field. Thanks are also due to Mr. Scott Moody (Museum of Zoology, University of Michigan) who kindly corrected English of the typescript.

DISCUSSION

Trochiliscaceae belong to the oldest known Charophyta. The oldest species *Trochiliscus* (*Eutrochiliscus*) *podolicus* Croft is known from the Lower Devonian of Podolia (Croft 1952). Trochiliscaceae are also known from the Middle and Upper Devonian of the Russian Platform (Samoilova & Prinada 1966) and from the Tien-Shan (Pojarkov 1966). The gyrogonites

of Trochiliscaceae have been also found in many localities in North America in Middle and Upper Devonian sediments and in the Lower Mississippian (Peck & Morales 1966).

Recent Charophyta constitute a small group of green algae and are most frequent in fresh or brackish waters at depths of a few centimeters down to 5 meters. The environment of the oldest fossil Charophyta has not been explicitly defined. Undoubtedly they lived as they do to day in shallow basins of weak hydrodynamics; salinity and communication of the basins with the open sea is difficult to define (Karpinsky 1906; Croft *op. cit.*; Maslov 1963; Peck & Morales *op. cit.*: Samoilova & Prinada *op. cit.* and others).

In the area of Spitsbergen the Trochiliscaceae occur in limestones that are a part of a continuous sedimentation cycle that starts with sediments of inland lakes, rivers and streams through calcareous sediments of a steadily deepening basin. This cycle ends with sediments containing marine pelecypods that may prove a connection with the open sea (Birkenmajer 1964: 62-65). Thus this is a new example of occurrence of Palaeozoic Charophyta in fresh or brackish waters. This is an important factor in the discussion about the character of the environment of Charophyta older than the Jurassic (Peck & Morales *op. cit.*) which supports Croft's (*op. cit.*) ideas.

Presence of well preserved gyrogonites of Charophyta in the lower limestone beds at Traunkammen (pl. 21: 2) suggests an autochtonous or almost autochtonous position of those gyrogonites and confirms the opinion of Birkenmajer (1964) about shallow water conditions of deposition of those rocks. The depth of the basin was probably between ten to several tens meters. Many observations suggest a deepening of the basin during the deposition of the Marietoppen Formation (Birkenmajer *op. cit.*) that probably caused a shifting of the ecozone of Charophyta beyond the depocenter of the limestones of Traunkammen. The decrease in number of gyrogonites in the upper beds and their increasing degree of corrosion may be possibly explained by the above factors (pl. 21: 7,9).

Trochiliscaceae are known to occur from the Lower Devonian up to the Lower Carboniferous but their usefullness in stratigraphy of the Devonian system has not yet been established.

The Devonian sediments in Spitsbergen are divided on the basis of their Ostracoderm content and lithology and correlated with similar sediments of Europe (Podolia, Estonia, Anglo-Welsh region) and of North America (see Friend, Heintz & Moody-Stuart 1966; Halstead & Turner 1973; Dineley & Loeffler 1976). Similar distribution of Trochiliscaceae and of some ostracoderm genera in the Devonian sediments of Europe, North America and Spitsbergen prove once more the paleofaunistic unity of these regions during the Devonian.

DESCRIPTION

Family **Trochiliscaceae**
Genus *Trochiliscus* Karpinsky, 1906
Subgenus *Eutrochiliscus* Croft, 1952
Trochiliscus (*Eutrochiliscus*) cf. *bulbiormis* Karpinsky, 1906
(pls 21 and 22)

Material. — Several hundred various sections of gyrogonites in thin sections of limestones. The maximal abundance — about 2 sections per 10 mm² of rock surface. In the lower limestone beds they are well preserved, in the upper ones they are highly corroded.

Dimensions in μm:

	longitudinal	transversal
width of gyrogonite	280	220 — 300 usually 250
height of gyrogonite together with neck	300	
width of oospore	152 — 206 usually 169	145 — 189 usually 169
height of oospore	145 — 169 usually 152	

thickness of gyrogonite wall (depending on the degree of calcification) 34 — 51, diameter of the spiral at equator is similar to the wall thickness of the gyrogonite
diameter of basal opening 34 — 51, average 51
diameter of apical opening 34
length of apical channel 34 — 85, average 51
number of spiral cells 8

Description. — Gyrogonite onion-shaped, consisting of 8 dextrally coiled spiral cells. At the apex these cells form a neck with an apical pore. The cellular spirals are separated by distinct sutures that are particularly well visible in transverse sections. Large distance between the calcitic infilling of the oospore and the cellular spirals sugests that a primary thick organic membrane must have once existed (about 8 μm). Spiral cells are most calcified on the oospore side thus making broad calcitic half-moons protecting the oospore. The relief of gyrogonites depends on the calcification degree of cellular spirals: completely calcified ones give gyrogonite with cellular ridges and intercellualr furrows (pl. 21: 4), whereas the weakly calcified — gyrogonite with cellular furrows and intercellular ridges (pl. 21: 8).

Remarks. — Lack of complete specimens and of possibility to observe their external morphology allows only a tentative assignment of gyrogonites here described to *Trochiliscus* (*Eutrochiliscus*) *bulbiformis* Karpinsky. Basic taxonomic characters such as shape of gyrogonites, sizes and number of spiral cells agree with the species diagnosis (Karpinsky 1906). Of all known genera of Charophyta only *Trochiliscus* has gyrogonites with dextrally coiled spiral cells. The direction of convolutions may be established in thicker sections by observing sections close to the apex or to the base of the gyrogonites. By changing the microscope focus it was possible also to determine whether a section was being viewed from the internal or exter-

nal side of the gyrogonite. Following Grambast (1974) I retain the name *Trochiliscus* although it is an younger synonym of *Moellerina* Ulrich, 1886.

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March, 1977

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TROCHILISCUS (*EUTROCHILISCUS*) CF. *BULBIFORMIS* KARPINSKY (CHAROPHYTA) Z DEWOŃSKICH WAPIENI Z TRAUNKAMMEN, SPITSBERGEN

Streszczenie

Po raz pierwszy opisano w niniejszej pracy lęgnie Charophyta z dewońskich osadów Spitsbergenu i oznaczono je gatunkowo na podstawie przekrojów w płytkach cienkich. Próby pobrano z wapieni zaliczanych do Emsu, stanowiących środ-

kową część Formacji Marietoppen (Birkenmajer 1964, Friend, Heintz & Moody-Stuart 1966). Zawarte w nich Trochiliscaceae należą do najstarszych znanych Charophyta. Występują one w osadach stanowiących część ciągłego cyklu sedymentacyjnego. Zaczyna się on osadami śródlądowych jezior i rzek, następnie stopniowo przeważają osady węglanowe stale pogłębiającego się zbiornika. Cykl ten kończą osady ilaste, zawierające małże morskie, które wskazują na powstanie połączenia z otwartym morzem (Birkenmajer *op. cit.*). Znalezienie Trochiliscaceae w słodkowodnych lub brakicznych osadach dewońskich Spitsbergenu potwierdza słuszność koncepcji podobieństwa środowisk kopalnych i dzisiejszych Charophyta (Croft 1952). Obecność bardzo dobrze zachowanych lęgni Charophyta w dolnych warstwach wapieni wskazuje na autochtoniczną lub prawie autochtoniczną pozycję tych lęgni i potwierdza słuszność poglądu Birkenmajera (*op. cit.*) o płytkowodnych warunkach sedymentacji wapieni. Głębokość zbiornika w strefie sedymentacji wapieni z Traunkammen wynosiła około kilkunastu lub może kilkudziesięciu metrów. Szereg obserwacji wskazuje na pogłębianie się zbiornika w trakcie sedymentacji Formacji Marietoppen, które spowodowało odsuwanie się strefy życia Charophyta poza rejon sedymentacji wapieni z Traunkammen. Być może tym można objaśnić zmniejszenie się ilości lęgni w wyższych warstwach profilu i ich wzrastające skorodowanie. Dewońskie osady Spitsbergenu korelowane są na podstawie ostrakodermów i wykształcenia litologicznego z podobnymi osadami Europy i Ameryki Północnej (Friend, Heintz & Moody-Stuart *op. cit.*, Halstead & Turner 1973, Dineley & Loeffler 1976). Podobne rozmieszczenie Trochiliscaceae jak i niektórych rodzajów ostrakodermów w osadach dewońskich Europy, Ameryki Północnej i Spitsbergenu jest jeszcze jednym potwierdzeniem jedności świata organicznego tych obszarów w dewonie.

РЫШАРД М. ВРОНА

TROCHILISCUS (*EUTROCHILISCUS*) CF. *BULBIFORMIS* KARPINSKY (ХАРОФИТЫ) ДЕВОНСКИХ ИЗВЕСТНЯКОВ ТРАУНКАММЕНА, ШПИЦБЕРГЕН

Резюме

В настоящей статье впервые описаны оогонии Charophyta девонских отложений Шпицбергена, а также был определён их вид на основе разреза в шлифе. Проба была отобрана в известняках, которые относятся к эмсу и являются центральной частью Формации Мариетоппен (Birkenmajer 1964; Friend, Heintz

& Moody-Stuart 1966). Содержащиеся в них трохилиски принадлежат к самым древним харофитам. Они выступают в отложениях, которые являются частью постоянного седиментационного цикла. Он начинается отложениями озёр и рек центральной части материка, а затем начинают постепенно преобладать известняковые отложения постонно опускающегося дна бассейна. Этот цикл коньчается глинистыми отложениями, которые содержат морские пластинчатожаберные, указывающие на наличие связи с открытым морем (Birkenmayer см. выше). Обнаружение трохилисков в пресноводных и солоноватоводных отложениях девона Шпитцборгена подтверждают правильность концепции сходства сред ископаемых и современных харофитов (Croft 1952). Присутствие хорошо сохранившихся оогоний харофитов в нижних слоях известняка указывает на автохтонный или же почти автохтонный характер этих оогоний и подтверждает правильность точки зрения Биркенмаера (см. выше) о мелководных условиях седиментации этих известняков. Глубина бассейна в зоне седиментации известняков Траункаммена составляла несколько сотен или же может быть несколько десятков метров. Ряд наблюдений указывает, что во время седиментации Формации Мариетоппен происходило опускание дна бассейна, которое привело к расширению зоны существования харофитов за район седиментации известняков Траункаммена. Может быть, этим можно объяснить уменьшение количества оогоний в верхних слоях профиля и их увеличивающуюся коррозию. Девонские отложения Шпицбергена скоррелированы на основе остракодермов и литологии подобных отложений Европы и Северной Америки (Friend, Heintz & Moody-Stuart 1966; Halstead & Turner 1973; Dineley & Loeffler 1976). Подобное распределение трохилисков, а также некоторых родов остракодермов в отложениях девона Европы, Северной Америки и Шпицбергена ещё раз является подтверждением единства органического мира этих территорий в девоне.

EXPLANATION OF THE PLATES

All specimens are from the Lower Devonian limestones of the Middle Part of the Marietoppen Formation at Traunkammen along southern coast of Hornsund fjord, Spitsbergen

Plate 21

Trochiliscus (*Eutrochiliscus*) cf. *bulbiformis* Karpinsky, 1906

1 — 2. Longitudinal sections of gyrogonites. ZPAL AL. IV/2,2,1 Tk.

4 — 9. Transversal sections of gyrogonites close to equatorial section. Different degree of calcification and corrosion is to be seen. ZPAL Al. IV/2,2,3,9,1,9, Tk.

× 140

Plate 22

Trochiliscus (*Eutrochiliscus*) cf. *bulbiformis* Karpinsky, 1906

1 — 2. Transversal sections of the neck near the apex of gyrogonites. ZPAL Al. IV/1,2, Tk.

3 — 4. Transversal sections at the base of gyrogonites. ZPAL Al. IV/3,3, Tk.

6 — 9. Various sections to tangent to the surface of the gurogonites. ZPAL Al. IV/2,3,2,2, Tk.

× 140


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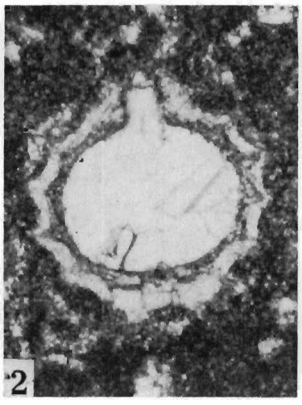
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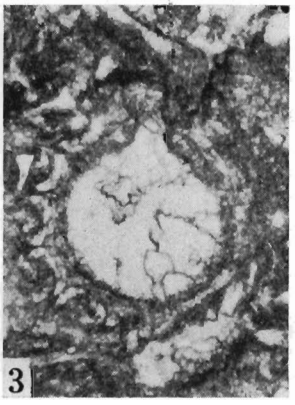
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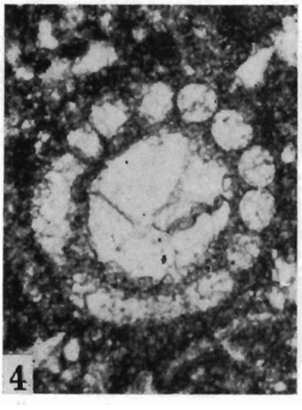
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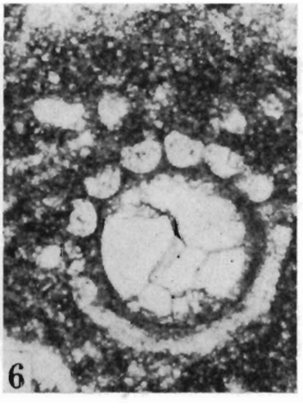
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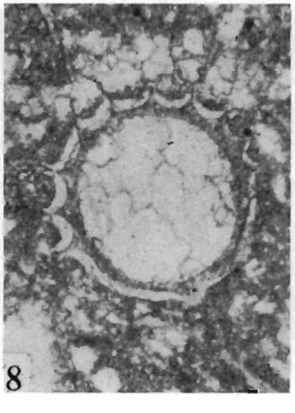
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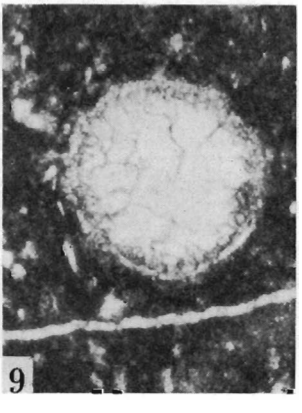
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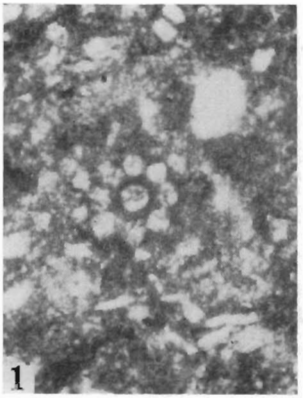
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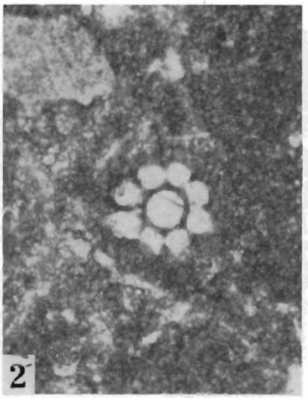
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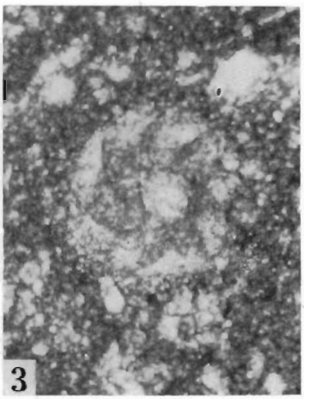
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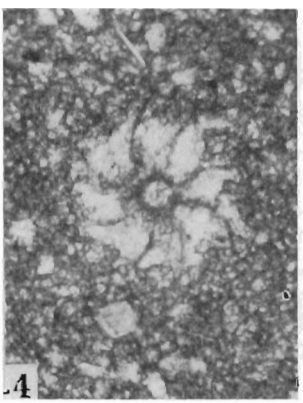
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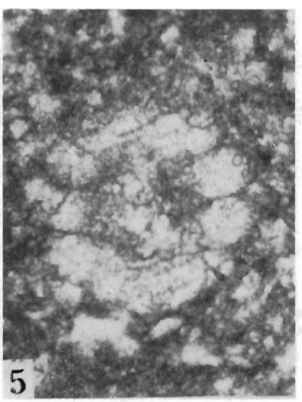
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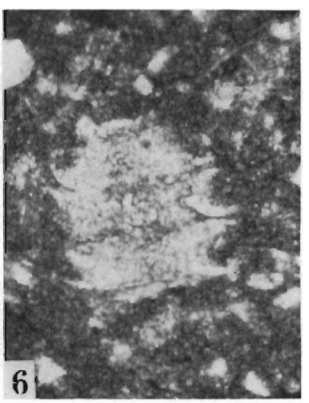
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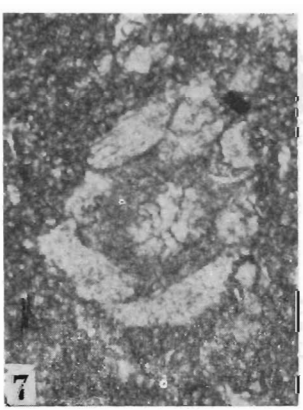
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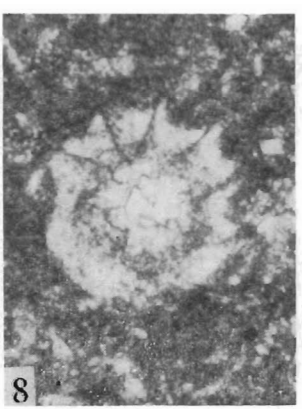
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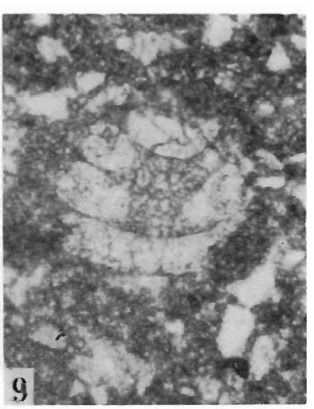
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