Melanosclerites from the Öjlemyr Cherts, Gotland

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Abstract: Öjlemyr cherts from the island of Gotland, Sweden, have been known for more than a century and have been stratigraphically determined as Upper Ordovician F1c and F2. These cherts are secondarily-silicified limestone concretions that occur exclusively as glacial erratic boulders (‘geschiebes’). This chert type also contains organic microfossils, of which the so-called melanosclerites have been focussed upon in this study.

The term ‘melanosclerite’ was first introduced by EISENACK (1930) to describe problematic rod-shaped organic microfossils recovered from Ordovician and Silurian glacial erratics from the Baltic region. EISENACK (1930) differentiated two groups of melanosclerites: the first group referring to the main ‘skeleton’, the second representing appendices extending from this. An appendix consists of two main parts, a long proximal section and a rod, ball or tine-shaped distal part. In well-preserved material the wall of the melanosclerite test is smooth, opaque and dark-brown coloured, ranging in size between 60–2000 µm. Melanosclerites can be found in marine sediments from Cambrian to Devonian age. The systematic position and natural relationship of the melanosclerites is still unknown.

INTRODUCTION

More than 100 years ago Wiman (1901) described erratic limestone boulders from the island of Gotland (southeast Sweden, see Figure 1), calling them ‘Öjlemyrgeschiebe’. SCALLREUTER (1984a) introduced the term ‘Öjlemyr cherts’, after the main occurrence of these erratics in the Öjle Myr peat bog of Gotland. Secondarily-silicified concretions within the Upper Ordovician limestone occur as chert nodules within the boulders, and as isolated erratics themselves: these are the Öjlemyr cherts. The formation and diagenesis of the concretions has not been investigated as yet. The Öjlemyr cherts contain a rich and diverse assemblage of fossil groups. The preservational quality and abundance of the fossil material allows the cherts to be termed a ‘konzentrat-lagerstätte’. Fossil groups that are represented in the Öjlemyr cherts include corals, bryozoans, brachiopods, trilobites, sponges, echinoderms, ostracods, chitinozoans, graptolites, scolecodonts, acritarchs and melanosclerites.

REGIONAL AND STRATIGRAPHICAL OVERVIEW

The Öjlemyr cherts were known only from Gotland, until in 1976 they were discovered in the kaolin sand of the island of Sylt (north-west Germany) (SCHALLREUTER 1979). In 1982, another occurrence of the Öjlemyr cherts was discovered from Wielen (near Uelsen, Lower Saxony region, north-west Germany) (SCHALLREUTER 1983). The Öjlemyr cherts display different degrees of weathering, which has in turn led to increasing silicification. Three different types of the cherts are distinguished (Figure 1):
(1) ‘Gotländer-type’ (EISERHART 1992): Typical specimens are approximately fist-sized, well-rounded (like a beach pebble), compact, hard, and with splinter-like fracturing. The Gotländer-type cherts are unweathered, display a uniform light grey colour throughout, and contain abundant fossil material. The source area of this chert-type is presumed to be the region of the Hall Bank in the Baltic Sea off the north-east coast of Gotland.

(2) ‘Braderuper-type’ (SCHALLREUTER 1979, 1983, 1984): Braderuper-type cherts possess a basic tan colour with a reddish weathering crust. This type has undergone the highest degree of weathering, and is known exclusively from the island of Sylt, where they are embedded in Upper Pliocene-Pleistocene kaolin sand. The fossil fauna is very similar to that of the Gotländer-type cherts, but lacks organic microfossils. The calcareous microfossils are secondarily silicified.

(3) ‘Wielener-type’ (SCHALLREUTER 1983, 1984): This type resembles the Braderuper-type cherts, but is less strongly weathered and of a pale-reddish colour. Wielener-type cherts are restricted to the Wielen locality, Lower Saxony. This type of chert contains both organic microfossils and secondarily-silicified calcareous microfossils.

After evaluation of the fossil fauna, WIMAN (1901) dated his ‘Öjlemyrsgeschiebe’ to the Borkholmer Stage (Porkuni Stage, F2, see Figure 2). THORSLUND and WESTERGARD (1938) suggested that most Ordovician erratic boulders were from the Lyckholm Stage (equivalent to the Nabal-Pirgu stages). ORASPOLD (1975) studied cherts from Estonia, and dated them as latest Porkuni Stage. However, SCHALLREUTER (1981) dated the erratic boulders to the Pirgu Stage, and GRAHN (1982) dated them as upper Pirgu.

MARTINSSON (1958) described the Öjlemyr cherts as originating from an area of the Baltic Sea off northern Gotland, while SPIELDHAUS (1985) suggested also that the cherts may originate from an undersea area to the north of Gotland, though a subset could be descended from the Gulf of Bothnia. The precise origin of the Öjlemyr cherts, their age, and the local palaeogeography during the upper Ordovician therefore remains problematic.

MATERIALS AND METHODS

The material for the present study comes exclusively from the unweathered Gotländer-type cherts. Two 500 g samples of the chert were broken up, and treated in 40%
hydrofluoric acid for three days. The insoluble residue was washed out with water and subsequently sieved, with the organic microfossils being decanted off. Specimens were picked using a binocular microscope, and then coated with a gold/palladium alloy using a Polaron SC7640 sputter coater. The selected specimens were studied using a Zeiss DSM940A scanning electron microscope.

**HISTORICAL REVIEW**

The earliest palynomorphs now classified as melanosclerites are most likely those recorded by EISENACK (1932) from Baltic sediments of Silurian age, and described as ‘black rodlets’. EISENACK (1934) recorded additional specimens from Ordovician and Silurian deposits. The first specific work on melanosclerites was published by EISENACK (1942), for specimens recovered from Baltic limestones. It was in this publication that EISENACK introduced the term "Melanoskleritoid" for this microfossil group. The name is derived from the Greek 'mèlanos' (black) and 'skleros' (hard). EISENACK (1942) formalised the taxonomy of the group by applying binomial nomenclature, and described 16 species from 9 genera which were grouped in 2 subfamilies: together they formed the Family Melanoskleritoitidae. EISENACK (1942) also discussed the chemical composition of the melanosclerites, as well as their phylogenetic position. He reassigned many species to the melanosclerite group, and came to regard them as being derived from Octocorallia.

ELLER (1947) discussed melanosclerites indirectly, recording two species from the Ordovician Trenton series of Ontario, Quebec, as scolecodonts of the genus Orthopelta. EISENACK (1950, 1963) recorded the first complete ‘skeletons’ of melanosclerites, from the Baltic limestones. He discussed the state of preservation, stratigraphical and geographical occurrence of the melanosclerites, and their systematic classification. TAUGOURDAEU (1965) described Ordovician chitinozoans from the USA, and mentioned melanosclerites as an accompanying fauna. GORKA (1971) isolated a complete ‘skeleton’ of Melanoporella polonica from the Ordovician and Silurian deposits of Poland: she carried out quantitative analyses as well as radiographic studies and suggested an algal affinity for melanosclerites. PILCHER (1971) published a treatise on melanosclerites from the Devonian of the Eifel region, western Germany. LAUFELD (1979) produced a short
historical overview of the melanosclerites. SCHALLREUTER (1981) conducted a detailed study of melanosclerites from the Öjlemyr cherts, based partly upon the records of EISENACK (1942, 1950, 1963) and the descriptions of GORKA (1971). The first North American discovery of melanosclerites was reported by CASHMAN (1992), in which he interpreted melanosclerites to be embryonic planulae and the early polyp stage of scyphozoans, cubozoans and hydrozoans. SINHA et al. (1996) recorded melanosclerites from the Early Palaeozoic in the Himalaya. The oldest known melanosclerites were recorded by WINCHESTER-SEETO and MCIROY (2001, 2006), from the Lower Cambrian strata of Estonia.

SYSTEMATIC PALAEONTOLOGY

The terminology used within this study follows that of SCHALLREUTER (1981), EISENACK (1942) and GORKA (1971). The melanosclerite ‘skeletons’ are formed of sclerites, which are mostly 0.06 to 2 mm in length. The sclerites possess an internal construction similar to that of bone. Two layers can be distinguished: an even, thicker outside layer and a spongy inside layer. The surface of the sclerites is usually rough and dull, though they can also be smooth or striated. Formally, two groups of sclerites can be distinguished. The first group form the main structure of the ‘skeleton’, and consist of a trunk with branch-like ramifications and protrusions. The second group represents the appendices extending from the main structure, the so-called ‘pleuridien’ (singular ‘pleuridie’) of GORKA (1981). The pleuridien can be further divided into three forms: a) undifferentiated pleuridien, b) stalked pleuridien, and c) unstalked pleuridien. The most important morphological terms are indicated in Figure 3.

All type and figured specimens have the prefix IGW, and are held in the collections of the Institute for Geological and Geographical Science, University of Greifswald. All measurements are given in microns (µm).

Phylum: Coelenterata FREY & LEUCKART 1847
Subphylum: Cnidaria HATSCHEK 1888
Order: Melanoskleritoidea EISENACK 1963
Family: Melanoporellidae SCHALLREUTER 1981
Genus: Melanoporella GORKA 1971
Type species: Melanoporella polonica GORKA, 1971
Diagnosis (after GORKA 1971): Main trunk with lateral branches, bearing four vertically standing pleuridien; rhizoids present at base.

Melanoporella polonica GORKA 1971
Pl. 1 Figs. 4, 5

– 1934, black rods - EISENACK, Neue Mirkofossilien, pp. 56-57, fig. 8-11

Fig. 3 – Morphology of melanosclerite pleuridien.
1942, *Melanocladus robustus* n. sp. - Eisenack, Die Melanoscleritoidae, pp. 162, pl. 6, fig. 1-7

1971, *Melanoporella polonica* - Gorka, 38, pl. I, fig. 6-9, pl. II fig. 1-7

**Holotypus:** Gorka, 1971, pl. II, fig. 6, Species number 1-21

**Locus typicus:** Chert pebble, Zakroczym (No. 0,222)

**Stratum typicum:** Ashgill

**Dimensions:** \(l = 102-135 \text{ lm}; b = 52-79 \text{ lm}\)

**Materials:** 40 incomplete specimens

**Diagnosis:** (see diagnosis of the genus).

**Description:** The species possesses II order pleuridien from the melanosclerite ‘skeleton’. The pleuridien possess club- or pear-shaped distal ends. All are broken at different distances along their trunk and therefore detailed description of the distal ends is not possible. The surface of the pleuridien is spongy to porous.

**Comparison:** The pleuridien resemble those of *Melanoporella clava*, which possess club-shaped distal ends. The head is twice the width of the body. The pleuridien of *M. clava* are very long, and generally larger than those of the 1\textsuperscript{st}, 2\textsuperscript{nd} and 3\textsuperscript{rd} order.

**Remarks:** The species *Melanoporella polonica* as described by Gorka (1971) has a massive, spongy, irregularly formed base, and a cylindrical trunk bearing two lateral branches, which in turn bear pleuridien.

The base resembles a coral surface, on which occur thin, stalked processes that form distally into a saucer-shaped head. These basal processes were termed ‘rhizoids’ by Gorka (1971). The rhizoids stand together in a group, the heads of which are in contact with one another. Both the stalk and head of the rhizoids are of equal size. Pleuridien extend from the base, the main trunk and the branches extending from the trunk. The pleuridien on the base consist of a cylindrical stalk that develops into a club- or pear-shaped head. The main structure of the taxon comprises a cylindrical trunk, possessing a spongy surface texture. The pleuridien on the main trunk possess thicker, more massive stalks, and have a differently shaped head to those on the base, being spherical, rounded or knob-like. The main trunk divides into two lateral branches, which are cylindrical, and have a spongy surface texture. Numerous pleuridien extend from these branches. Four occur around the circumference of each branch. No clear joint can be observed at the base of the pleuridien, which extend smoothly from the branch. The four pleuridien around each branch are similar, posses-

![Fig. 4 – Illustration of *Melanoporella polonica* Gorka, 1971 showing branches, rhizoids and pleuridien (modified after Gorka 1971).](image-url)
mal part of the branches and also on the base, are termed 2\textsuperscript{nd} order, and may display a variation in length. Third order pleuridien occur on both the base and the main trunk, and possess a spherical head, and may display a variation in both length and width. Further appendices are the rhizoids, that occur only upon the base. They differ from the pleuridien in terms of their morphology, possessing saucer-shaped heads and a very thin stalk. The rhizoids are similar in length to 1\textsuperscript{st} order pleuridien.

**Occurrence:** Wyszogrod, Mochty, Poland, Ordovician, Gorka (1971)

*Melanoporella bulla* n. sp.

Pl. 1, Figs. 1, 2, 3

**Derivatio nominis:** *bulla* (lat.) = knob, button: referring to the knob-like distal ends of the pleuridien.

**Holotypus:** IGW –cTr. 38-49

**Locus typicus:** Öjlemyr Gotland

**Stratum typicum:** Ashgill

**Material:** 13 incomplete specimens

**Dimensions:** $l = 190-570 \mu m$; $b = 73-126.5 \mu m$

**Diagnosis:** Pleuridien with a knob-like distal end

**Description:** The new species possesses long straight, or occasionally curved, pleuridien that have broken off at the proximal end. The pleuridien are cylindrical in cross section. The surface of the pleuridien is smooth, or covered with small thorn-shaped points. The main body of the pleuridien forms distally into knob-shaped, distended heads. The surface of the heads is smooth. The knob-shaped heads are asymmetrical, with one side rounded, while the other may be concave or slightly sloping.

**Comparison:** This new species differs from *Melanoporella polonica* GORKA, 1971 through the nature of the pleuridien. *M. polonica* possesses several types of pleuridien (i.e., 1\textsuperscript{st} and 2\textsuperscript{nd} order), though all are symmetrical.


**Remarks:** On some specimens, a two-layered surface can be observed on the trunk of the pleuridien. The lower layer has longitudinal striations, the upper layer is smooth (pl. 1, fig. 1). The pleuridien have been broken off at different places along the trunk. It is still unclear whether this new species may represent pleuridien that occur on the trunk or branches of the overall melanosclerite ‘skeleton’, or basal rhizoids (as described for *M. polonica* by GORKA, 1971). The proximal end of the specimens cannot be described, as all are broken off.

**Occurrence:** Upper Ordovician, Öjlemyr cherts.

*Melanoporella clava* SCHALLREUTER, 1981

Pl. 1 Figs. 10, 11

- 1932 black rods. - EISENACK, p. 273, pl. 12, fig. 19-23
- 1942 *Melano cladus* or *Melanosteus* sp. - EISENACK, fig. 21
- 1955 Melanoskleriten - Reste - EISENACK, p. 185, fig. 11-12
- 1962 Knopfstäbchen - EISENACK, p. 365, fig. 7
- 1963a Knopfstäbchen - EISENACK, p. 347, fig. 34-36
- 1963b Knopfstäbchen - EISENACK, 134, Taf. 2, fig. 13
- 1981 *Melanoporella clava* - SCHALLREUTER, 115, pl. 2, fig. 1, 2

**Holotypus:** SCHALLREUTER, 1981, Taf. 2, Fig. 1, GPIMH 2456

**Locus typicus:** Öjlemyr cherts of Gotland

**Stratum typicum:** Borkholmer Stage (Porkuni, F2) of Estonia, uppermost Ordovician (though possibly Pirgu Stage, and the following F1e)

**Material:** 4 specimens

**Dimensions:** $l = 222-600 \mu m$, $b$ (head) = 96-131 \mu m

**Diagnosis:** Distally-enlarged, club-shaped pleuridien.

**Description:** The specimens consist of long, cylindrical pleuridien which have broken off at the proximal end. The pleuridien have broken off at the proximal end. The distal end is spherical to club-shaped. The head is approximately double the width of the body.

**Comparison:** In his publications on melanosclerites, EISENACK (1942, 1963, 1968) described ‘button-rods’ (‘Knopfstäbchen’) without assigning them to a genus, or describing them in detail. These so-called button-rods display a wide variation in appearance and dimensions.

SCHALLREUTER (1981) assigned the specimens to the genus *Melanoporella* GORKA, 1971. The type species of the genus displays distally club-shaped pleuridien which branch off from a main trunk. DICEVICIUS (1971) described the pleuridien of *Melanoporella longiformis* which possess a more spherical head and are generally smaller in size. The heads of certain pleuridien of *Melanoporella polonica* GORKA, 1971, are more obviously club-shaped than those of *Melanoporella clava* SCHALLREUTER (1981).

**Occurrence:** Öjlemyr cherts, Gotland, (SCHALLREUTER 1981); East Prussian, Silurian; Ordovician and Silurian of
the Baltic States; Devonian of the Eifel region; Baltic limestones; (EISENACK 1932, 1942, 1955, 1962, 1963)

**Order:** Melanoskleritoitidea EISENACK 1963
**Family:** Melanosklereitoitidae EISENACK 1942
**Subfamily:** Melanocladiinae EISENACK 1942
**Genus:** Melanorhachis EISENACK 1942

**Type species:** Melanorhachis regularis EISENACK, 1942

**Diagnosis** (from EISENACK 1942): Slightly to well-curved, bearing protrusions that are equally spaced around the circumference (‘beater-type’ arrangement).

*Melanorhachis?* sp. 1
pl. 1 fig. 13, 14, 15

– 1971 Melanosclerites indetermines - GORKA, pl. III, fig. 10-12

**Material:** 1 incomplete specimen
**Dimensions:** $l = 795 \mu m; b = 275.5 \mu m$
**Diagnosis:** Trunk bearing protrusions arranged in a beater-type fashion.
**Description:** This especially large specimen is a part of a melanosclerite ‘skeleton’. The specimen possesses a roughly cylindrical trunk, which thickens at the centre. Around this thickening occur 11 almost circular holes. Three of the openings are hollow while two are filled; the remainder are damaged. In two of the well-preserved holes, stubs can be observed from where it is thought pleuridien would extend. The stubs are arranged in a beater-type fashion around the trunk. The holes are 42 \mu m in diameter, and are oval to circular. The surface of the specimen is not uniformly smooth, but is striated in the upper and lower parts. Both ends of the specimen are broken off, so that no orientation can be determined.

**Remark:** It is uncertain to which part of the melanosclerite ‘skeleton’ the specimens belong. GORKA (1971) described a base, main trunk, branches, rhizoids and pleuridien. From the beater-type arrangement of the holes on the specimen, it could be that it represents part of the trunk, though careful analysis of the perfectly circular holes, and the stubs within, it would seem unlikely that the main branches would have broken off from the trunk thus. Therefore, it seems more likely that the specimen may represent one of the branches itself, though this cannot be determined accurately.

**Comparison:** SCHALLREUTER (1981) assigned a melanosclerite with extensions arranged in a beater-type fashion to *Melanorhachis* sp. From his Pl. 1, Fig. 1, both variations in form can be recognised, showing both a sprouting main trunk and a branch. It seems also that the main trunk is sprouting both branches and other extensions. EISENACK (1942) assigned two specimens to this genus. *Melanorhachis regularis* consists of a cylindrical main axis upon which occur short beater-shaped extensions with four or more prongs. These prongs (EISENACK 1942 also called them its ‘arms’), form a regular cross. From EISENACK’S Pl. 6 Fig. 8, it can be recognised that it is not a trunk from which these beater-shaped branches extend, as on this specimen there are no attachment points from which pleuridien might be recognised. A second specimen, illustrated in his Pl. 7 Fig. 21, is regarded by EISENACK (1942) as being a distal end, as the end of the specimen is rounded. This specimen also displays humps which are arranged in a beater-type fashion, and therefore EISENACK (1942) indicates it as being a beater-shaped branch, though this is uncertain. The second species that EISENACK (1942) assigned to the genus *Melanorhachis* was *M. brachycladus*, described as having not such a cylindrical main axis, beater-like branches, and with narrow or constricted attachment points. The beater-shaped branches are not cylindrical, but bulb-shaped, rounded or formed into small points. Another specimen on EISENACK’S Pl. 6 Figs (9-11) and Pl. 7 Figs (22-24) shows that the so-called beater-branches are arranged in a beater-type fashion. The specimen also has a main trunk with branches of even thickness that have been broken off, or are rounded. The attachment points are round in cross section, and could provide a base from which thinner branches or pleuridien could have extended. The attachment points do not occur together in a beater-type fashion.

**Occurrence:** Ordovician, Poland (GORKA 1981)

*Melanorhachis?* sp. 2
pl. 1 fig. 12

**Material:** 1 incomplete specimen
**Dimensions:** $l = 160 \mu m; b = 56 \mu m$
**Diagnosis:** Club-like, thickened branch with pleuridien arranged in a circular fashion at both the distal and proximal ends.
**Description:** This melanosclerite consists of a club-like, regular, cylindrical stalk. The proximal end is slightly extended, though it possesses no ball- or club-like protrusions. The melanosclerite appears incomplete at both ends, with the proximal end showing evidence of damage. On the club-like enlarged ends are attachment points arranged in a beater-type fashion. Three circular recesses can be observed in Pl. 1 Fig. 2, with one perfectly circular
attachment point visible at the proximal end. From these points of contact it is likely that stalked pleuridien extended, that were probably connected with a joint on the branch.

Remarks: Melanorhachis sp. 2 is assigned temporarily to the genus Melanorhachis.

Comparison: Gorka (1971) described Melanoporella polonica, the structure of which was divided into a base, main trunk, branches and pleuridien of the 1st and 2nd order. The external morphology of Melanorhachis corresponds with pleuridien of the 1st and 3rd order, however, which possess club-like distal ends. Gorka (1971) recorded the length of the pleuridien as 130-250 µm. Melanorhachis sp. 2 lies within this range, being 160 µm, and therefore there is a dimensional relationship. Gorka (1971) also described another species, Melanoscleritoites acceptiferus Eisenack, 1963, which consists of a very long trunk in which attachment points for the pleuridien are arranged in a beater-type fashion. These pleuridien are stalked, and attached via a ‘sprout’ on the trunk. The pleuridien possess a three-pronged distal end. The illustrations of Gorka (1971) reveal that the sprouts extend directly from the trunk. In the genus Melanorhachis, this not the case, as the attachment points are rounded, lenticular and indented. The attachment points of Melanorhachis sp. 2 differ further from those of Melanorhachis sp. 1, as those of the latter are rounded and hollow. Two attachment points also possess a solid branch-like attachment. The attachment points of both specimens are arranged in a beater-type fashion. The surface of Melanorhachis sp. 1 is not spongy but varies from smooth to scale-like and striated. Melanorhachis sp. sensu Schallreuter (1981) possesses branches on the trunk, and possible protrusions for the stalks of pleuridien: it cannot be determined whether Melanorhachis sp. 1 also possesses such protrusions. Eisenack (1940) described Melanorhachis regularis as a trunk from which four branches extend in a beater-type arrangement, though there are no broken parts by which direct comparison could be made with Melanorhachis sp. 1. Melanorhachis brachycladus Eisenack, 1942 does, however, show such incomplete attachment points, though these indicate the point of extension of branches rather than pleuridien.

Occurrence: Upper Ordovician, Öjlemyr cherts.

Order: Melanoscleritoitidae Eisenack, 1963
Family: Melanoscleritoitidae Eisenack, 1963

Genus: Melanorhachis Eisenack, 1931
Type species: Melanorhachis polonica Eisenack, 1931
Diagnosis (from Schallreuter 1981): Melanosclerites with stalked, isolated pleuridien

Melanorhachis polonica Eisenack, 1931

Material: 52 incomplete pleuridien
Holotypos: GPIMH 2462
Locus typicus: Gotland, Öjlemyr cherts
Stratum typicum: Porkuni stage, uppermost Ordovician
Dimensions: l = 105-185 µm, b = 107-150 µm
Diagnosis: Elongate, incomplete pleuridien with a three-pronged distal end.

Description: The pleuridien are long, rod-shaped and broken off at the slender proximal end. The distal end displays three rounded prongs, that are arranged in a beater-type fashion.

Comparison: Menola os Schallreuter, 1981 resembles the species Mirachitina? tria Schallreuter, 1981 which also possesses 3-pronged pleuridien. The pleuridien of Mirachitina? tria, however, possess short simple stalks, with which they are connected to the trunk. In addition, the pleuridien are substantially shorter and stubbier than those of Menola os. The prongs of Menola os, arranged in a beater-type fashion, are roughly twice the width than those of Mirachitina? tria. The proximal end of Menola os is also more modified, being thickened, and displaying three flanks.

Remarks: As the pleuridien recovered in the present study have broken off at different places, assignation to specific level is difficult. The specimens herein, however, display a closer affinity with Menola os than with Mirachitina tria, as the incomplete pleuridien are significantly longer than those of the latter species.

Occurrence: Gotland, Öjlemyr cherts, Porkuni Stage (Schallreuter 1981)
Order: Melanoscleritoitidae Eisenack, 1963
Family: Mirachitinidae Eisenack, 1942
Subfamily: Mirachitininae Eisenack, 1942
Genus: Mirachitina Eisenack, 1931
Type species: Mirachitina quadrupedes Eisenack, 1931
Diagnosis (Eisenack, 1942): Bipolar melanosclerite, possessing four or more thick outgrowths at one end.

Remarks: The genus Mirachitina was assigned by Eisenack (1931) to the Chitinozoa. However, in a
supplementary study of the Chitinozoa, Eisenack (1932) noted that the characteristic oral aperture, typical of the hollow chitinozoans, could not be observed in his specimens of Mirachitina quadrupedis. Investigations revealed that the specimens of Mirachitina quadrupedis consisted mostly of solid-bodied specimens, though some did indeed display a hollow structure. Therefore Mirachitina was transferred from the Chitinozoa to the melanosclerites. Eisenack (1942) retained doubts about the orientation of the Mirachitina specimens, suggesting that the aboral end (if it were a chitinozoan) with its small, rounded protrusions was very similar to the small protrusions seen at the distal head of melanosclerites of the Melanostylus form. The nature of Mirachitina sp. (Eisenack 1942, 1969) makes the reverse view likely and thus the small protrusion-bearing end is considered to be the proximal end, possessing four rounded ‘feet’, with two distal spherical thickenings.

Mirachitina hexasterides (Eisenack, 1942) comb. nov.
pl. 1 fig. 9
– 1942 Melanocyathus? hexasterides Eisenack, 1942, pp. 166, fig. 2
– 1950 Mirachitina sp. - Eisenack, pp. 375, fig. 5
– 1981 Mirachitina? sp. - Schallreuter, pp. 282-283, fig. 4
– 1990 Mirachitina? sp. - Schallreuter, pl. 3, fig. 3

Material: 3 incomplete pleuridien
Holotypus: Eisenack, 1942, pp.158, No. 5
Locus typicus: East Prussian Silurian
Stratum typicum: Upper Silurian
Dimensions: b = 140-141 μm, l = 60-140 μm
Diagnosis: incomplete pleuridien with six distal prongs, arranged in a beater-type fashion.

Description: The specimens show rod-shaped, cylindrical pleuridien that are broken off at the proximal end, with the distal ends partly preserved. The distal end forms into six prongs, arranged in a beater-type fashion. A slight bulge is apparent at the rounded tips of the prongs; some are broken off.

Comparison: Eisenack (1942) characterised Melanocyathus? hexasterides as disc-shaped, evenly curved, with six short rounded protrusions. The protrusions, as well as the disc, are hollow bodies. Assignation to the genus Melanocyathus was made by Eisenack (1942) on the basis of a certain resemblance to complete Melanocyathus-forms, suggesting that his specimen was a terminal part (as occurs in other species belonging to the genus) that had been broken off from an axis. A certain resemblance to Mirachitina? polypes, however, was also noted by Eisenack (1942), as were the problems concerning Mirachitina. Eisenack (1950) described bell-shaped terminal elements as Melanocyathus sp., while another illustrated specimen displays six spherical protrusions that are arranged in pairs, also assigned to Mirachitina sp. Eisenack (1950), however, did not characterise the proximal end of the latter specimen in more detail, and the illustration is insufficient to reveal whether the shaft of this specimen of Mirachitina sp. has broken off, or may have had stalked pleuridien. Schallreuter (1981) illustrated specimens assigned to Mirachitina? sp. These pleuridien have 6-pronged distal ends and a long cylindrical body, of which the proximal end is broken off: a rather more precise determination of the position of these elements in relation to the melanosclerite ‘skeleton’ can therefore be made. Schallreuter (1990) described another 6-pronged pleuridien, assigning it also to Mirachitina? sp. This specimen has a long shaft that is broken off at the proximal end.

Remarks: Due to the close resemblance of the specimens described and illustrated in Pl. 1 Fig. 9, and the specimens Schallreuter (1990), it is sensible to place these specimens within another genus, and integrate this with Mirachitina.

Occurrence: Upper Silurian, east Prussia (Eisenack 1942, 1950); Sylt cherts, north Germany (Schallreuter 1990).

Eichbaumia incus? Schallreuter, 1981
pl. 1 fig. 7
– 1963 Mirachitina? Eisenack, 1963 pl. 2, fig. 10
– 1981a Eichbaumia incus? - Schallreuter, 1981 pl. 5, fig. 2, 3

Material: 46 incomplete pleuridien
Holotypus: G 131
Locus typicus: Öjlemyr cherts of Gotland
Stratum typicum: Borkholmer Stage, possibly Pirgu Stage
Dimensions: l = 50-219 μm, b = 80-112.5 μm
Diagnosis: Rod-shaped pleuridien, with a four-pronged distal end; proximal end incomplete.

Description: The pleuridien are rod-shaped, and may be straight or curved. Short, stubby forms and thinner, more slender forms may occur. The four prongs form the distal end, and the apex of the prongs displays a slight bulge, in which a pore is recognised in some specimens. The distal end is broken off in most cases. The four prongs are not
always arranged symmetrically, but lie flat and form a cross. Some specimens have a hollow body, while others are solid.

**Comparison:** *Mirachitina quadrupedis* EISENACK, 1931 is substantially broader and possesses a plain stalk. *Eichbaumia incus* SCHALLREUTER, 1981 possesses an anvil-like proximal end. SCHALLREUTER (1981) is of the opinion that this anvil is not a stalk, but rather a joint-like connection. SCHALLREUTER (1981) also described specimens whose pleuridien were incomplete, and were therefore only questionably assigned to this genus. EISENACK (1963) described an entire ‘skeleton’ of *Melanostylus coronifer*, the distal end of which bears four prongs, that form a cross. The pleuridien are long and thin, while the proximal end widens and grades out into a thin skin. EISENACK (1963) suggested that the proximal end was originally hollow. EISENACK (1963) also illustrated a specimen of *Mirachitina?*, representing only the four-pronged distal end, though it appears similar to *Eichbaumia incus*. GORKA (1971) illustrated specimens that she assigned to *Cylindrochitina granata*, though this is also *Eichbaumia incus?*. Of these specimens, only the anvil-like proximal end is preserved.

**Remark:** The distal ends of *Mirachitina quadrupedis*, *Eichbaumia incus*, *Melanostylus coronifer* and *Mirachitina?* sp. appear to be very similar, and therefore no confident assignation of the specimens to a particular species can be made. CASHMAN (1992) synonymised *Eichbaumia incus* with *Melanostylus coronifer*. M. coronifer shows striking resemblances to the five day-old Cubomedusan polyp of *Carybdea alata*. The four short tentacles of the *Carybdea alata* polyps develop first from four small swellings at the distal end. Similarity is observed between the length and width of the two species. CASHMAN (1992) interprets *Eichbaumia incus* as a former ontogenetic step of *Melanostylus coronifer*, hence the suggested synonymy.

**Occurrence:** Baltic limestone deposits of South Finland, Hangö-Ekenäs area (EISENACK 1963)

- 1963 *Mirachitina?* sp. EISENACK, pl. 2, fig. 9
- 1981 *Mirachitina?* sp. - SCHALLREUTER, pl. 3, fig. 4

**Material:** 13 incomplete pleuridien

**Holotypus:** EISENACK, 134, pl. 2, fig. 9, S. G. 105 No. 9

**Locus typicus:** from a deposit of Baltic limestone at a gravel pit in Spandau, near Berlin, Germany

**Stratum typicum:** Caradocian

**Dimensions:** l = 90-263 µm, b = 104-115 µm

**Diagnosis:** Rod-shaped pleuridien with five prongs at the distal end; proximal end is incomplete.

**Description:** This species possesses rod-shaped, curved, cylindrical pleuridien. The pleuridien are hollow and broken off at the proximal end. The distal end bears five prongs, some of which are also broken off. The prongs are arranged in a beater-type fashion, and form short rounded protrusions. The prongs form into a slight bulge at their apex.

**Comparison:** Both EISENACK (1963) and SCHALLREUTER (1981) have described specimens of *Mirachitina* possessing five prongs at their distal end, though specimens bearing three, four, five, six and eight prongs were also described by both authors. Due to their damaged nature, a description of the proximal ends cannot be made.

**Occurrence:** Baltic limestone, Caradocian


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PLATES
1, 2, 3 – Melanoporella bulla sp. nov. IGW-cT/39 and IGW-cT/40 and IGW-cT/38
4, 5 – C4, 5 Melanoporella polonica Gorka, 1971 IGW-cT/16 and IGW-cT/19
6 – Menola os Schallreuter, 1981 IGW-cT/3
7 – Eichbaumia incus? Schallreuter, 1981 IGW-cT/7
8 – Mirachitina sp. Eisenack, 1963
9 – Mirachitina hexasterides IGW-cT/14
10, 11 – Melanoporella clava Schallreuter, 1981 IGW-cT/51 and IGW-cT/53
13, 14, 15 – Melanorhachis? sp. 1 IGW-cT/57
12 – Melanorhachis? sp. 2 IGW-cT/38