



## Jurassic liverworts from Mount Flora, Hope Bay, Antarctic Peninsula

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**Abstract:** Mount Flora at Hope Bay, in northernmost part of Antarctic Peninsula, is a famous Jurassic flora locality. It has already been studied for a hundred years, but however, it is still possible to find there new taxa. Based on two species of liverworts found at Mount Flora (*Schizolepidella gracilis* and *Schizolepidella birkenmajeri* sp. nov.), the present study discusses affiliation of the genus *Schizolepidella* to liverworts. The new species *Schizolepidella birkenmajeri* is erected.

Key words: Antarctica, Jurassic, palaeobotany, liverworts, *Schizolepidella*.

### Introduction

Liverworts date back to the Devonian (Taylor and Taylor 1993). There are hypotheses that they could occur even in Ordovician strata (Kenrick 2003; Wellman *et al.* 2003), however, Palaeozoic macrofragments represent the thallophytic forms. The oldest remains of leafy liverworts belonging to the order Jungermanniales are *Schizolepidella gracilis* Halle, have been reported from the Jurassic of Antarctica (Jovet-Ast 1967; Krassilov and Schuster 1983), however affinity of this taxon to liverworts has been questioned lately (Rees and Cleal 2004).

The examined specimens come from the site Mount Flora (Hope Bay) in Antarctic Peninsula, West Antarctica (Fig. 1). This locality known for about one hundred years, has been the subject of numerous studies (Halle 1913; Gee 1989; Rees and Cleal 2004). Nevertheless new taxa may still be found there.

Among the material collected in Antarctica by Professor K. Birkenmajer there are two species of liverworts, *Schizolepidella gracilis* Halle and *S. birkenmajeri* sp. nov. Study of them confirm their taxonomical affinity.

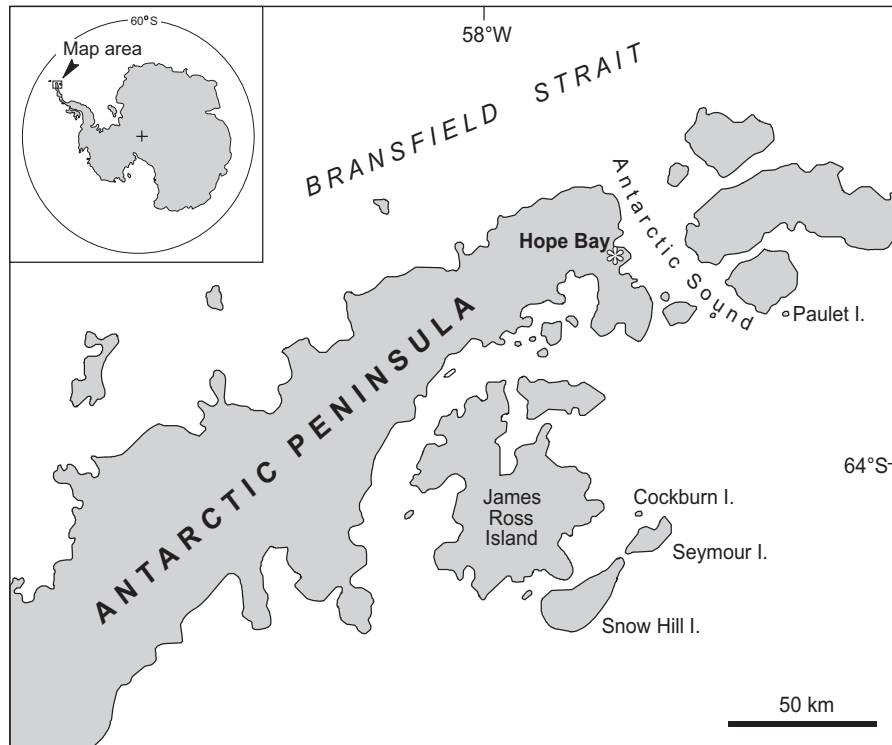


Fig. 1. Map of Antarctic Peninsula, star shows the Jurassic flora locality at Mount Flora, Hope Bay.

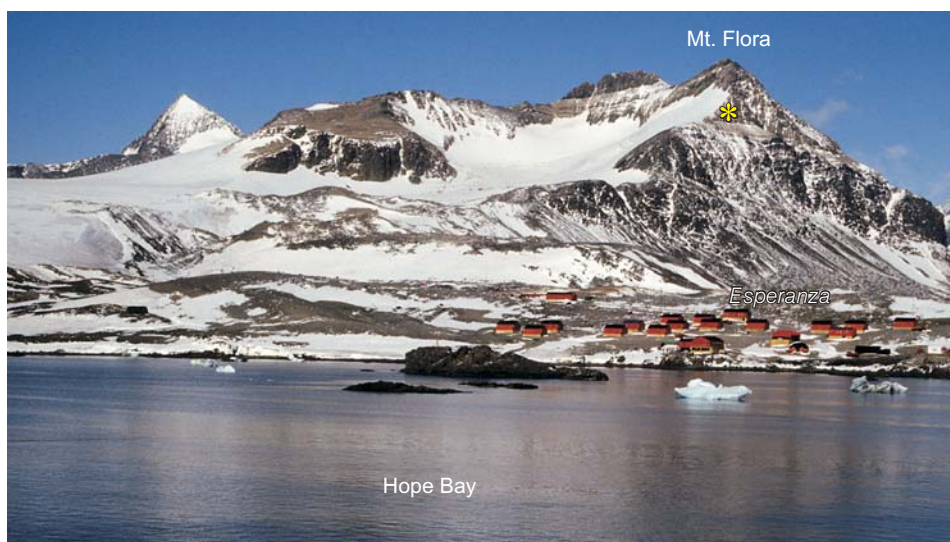


Fig. 2. Mount Flora, star shows the Jurassic liverwort flora locality *in situ*.  
Photograph by A. Gaździcki.

## Material and methods

This study is based on material of four rock fragments that contain liverwort remains, being part of collection gathered by Professor K. Birkenmajer during the 3rd Polish Geodynamic Expedition to West Antarctica (1987–88). The specimens were collected *in situ* on Mount Flora, in the Mount Flora Formation, the Flora Glacier Member (Figs 2–4).

The plant remains from this site are preserved as pyritized impressions on black shales. Their age is estimated to be Early Jurassic (Rees and Cleal 2004).

The specimens were studied using standard binocular microscopy (Nikon SMZ 1000), and pictures were taken in ethanol using Nikon Coolpix 995 camera. They are housed in the Palaeobotanical Museum of the Władysław Szafer Institute of Botany, Polish Academy of Sciences, Kraków, Poland (KRAM-P).

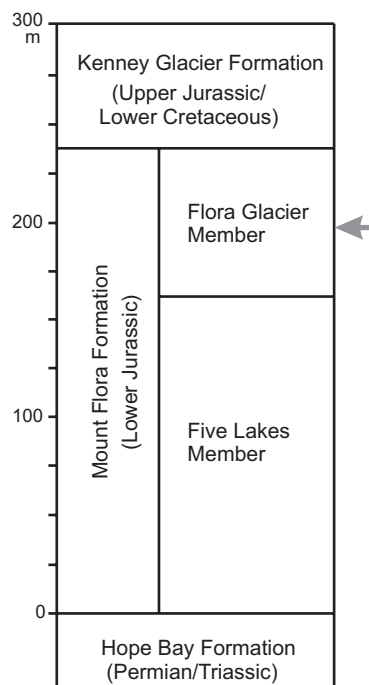


Fig. 3. Stratigraphic column of the Mount Flora Formation, arrow shows stratigraphic position of plant remains described (after Birkenmajer 1993, simplified).

## Systematic descriptions

Division Hepatophyta

Order Jungermanniales

Family unknown

Genus *Schizolepidella* Halle emend. nov.

Type species: *S. gracilis* Halle, 1913.

Emended diagnosis: Shoots long and narrow, bearing small scale-like leaves. Leaves in two ranks, in one plane, small, heart-shaped or oblong. Apex entire or oblong.

*Schizolepidella gracilis* Halle, 1913

(Fig. 4A, C–E)

1913. *Schizolepidella gracilis* Halle, pp. 90–92, text-fig. 19b–h, pl. 9: figs 19–21.

1967. *Schizolepidella gracilis* Halle, Jovet-Ast, fig. 101.

1989. *Schizolepidella gracilis* Halle, Gee, pp. 156–157, pl. 1: figs 1–2.

**Material.** — S<sub>78/50</sub> KRAM-P.

**Description.** — Shoots narrow, 3.5–17.5 mm in length and up to 1.5 mm in width. Axis about 0.5 mm in width. Leaves arranged in two ranks, on one plane.

Leaves small, up to 1.25 mm in length and 0.75 mm in width, with a bilobed apex, tapering towards leaf base.

**Discussion.** — Arrangement of leaves in two ranks, heart-shaped leaves and bilobed apex (Halle 1913; Gee 1989) testify attribution of the examined specimens to the species *Schizolepidella gracilis*.

Arrangement of leaves on one plane in two or, sometimes, in three ranks, of which one consists of smaller underleaves, is characteristic for liverworts gametophytes of the order Jungermanniales (Schuster 1984). Leaves with two to several lobes are characteristic for this order, but species with unlobed leaves do also occur. The other important feature of this order is the presence of rhizoids (Schuster 1984). Generally, the examined specimens of *Schizolepidella gracilis* show most of the above mentioned features. Underleaves cannot be seen, because only adaxial side of the shoots is visible. Rhizoids are not preserved, however lack of some morphological details should not be surprising taking into account poor condition of the specimens.

Because of morphological similarity of the genus *Schizolepidella* to shoots of certain types of conifers, Rees and Cleal (2004, p. 59) suggested, that *S. gracilis* could be an incomplete shoot of *Pagiophyllum*. However Gee (1989, pp. 156–157) gave a detailed comparison between shoots of *Schizolepidella gracilis* and those described as *Pagiophyllum* sp. A. The most important differences are: arrangement of leaves – in two ranks typical for *S. gracilis*, but helical in *Pagiophyllum* sp. A; shape of leaves – heart-shaped with bilobed apex, tapering to leaf base characterize *S. gracilis*, while spindle-shape or rhomboidal, tapering into an acute apex characterize *Pagiophyllum* sp. A.

**Occurrence.** — Antarctic Peninsula, Hope Bay, Mount Flora Fm (Flora Glacier Mbr), Jurassic (Halle 1913; Gee 1989).

*Schizolepidella birkenmajeri* sp. nov.

Holotype: S<sub>78/21</sub> KRAM-P, Fig. 4 B, F.

Repository: Palaeobotanical Museum of the Władysław Szafer Institute of Botany, Polish Academy of Sciences, Kraków, Poland (KRAM-P).

Type locality: Mount Flora (Hope Bay), Antarctic Peninsula.

Stratigraphic horizon: Mount Flora Formation, Flora Glacier Member.

Age: Early Jurassic.

Derivatio nominis: This species is named in honour of Professor Krzysztof Birkenmajer (Institute of Geological Sciences, Polish Academy of Sciences, Kraków) in recognition of his scientific achievements in Antarctica.

**Material.** — S<sub>78/6a</sub>, S<sub>78/18</sub>, S<sub>78/21</sub> (part and counterpart) KRAM-P.

**Diagnosis.** — Shoots with slender axis and small oblong leaves, about 1×0.5 mm. Leaf margins entire, apex rounded. Leaves arranged in two ranks, on one plane, alternate. Some leaves overlapping.

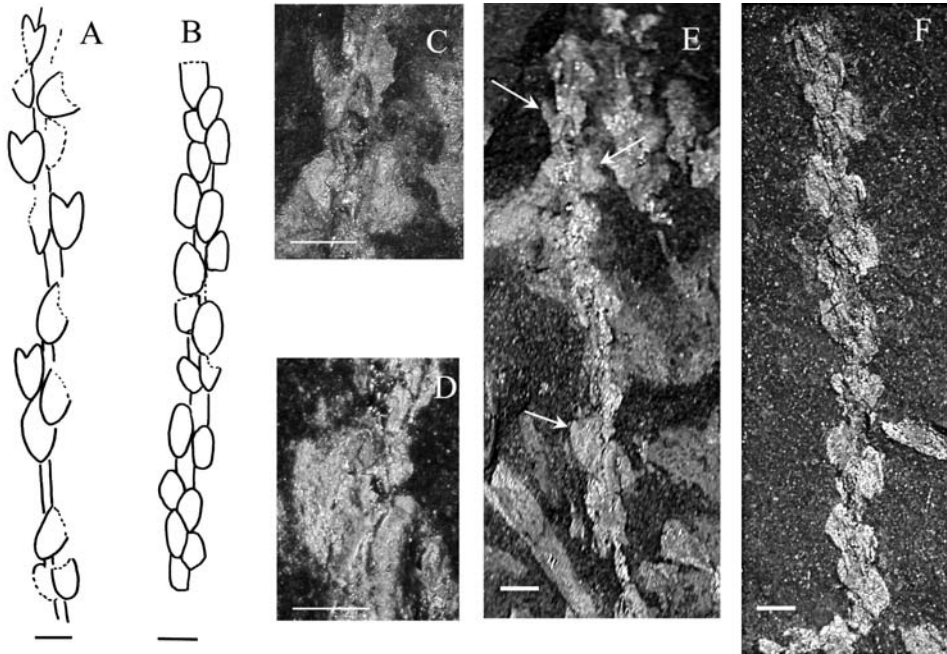


Fig. 4. A, C–E. *Schizolepidella gracilis* Halle (S<sub>78/50</sub> KRAM-P), arrows show leaves with bilobed apex. B, F. *Schizolepidella birkenmajeri* sp. nov., holotype (S<sub>78/21</sub> KRAM-P). Scale bars 1 mm. Photograph by P. Mleczko.

**Description.** — Shoots narrow, 6–14 mm in length and 1.25–1.5 mm in width. Axis visible only as small fragments. It is covered with scale-like leaves. Leaves arranged in two ranks, on one plane, alternating, oblong in shape, widest in the middle, with entire margin, with rounded apex and base. Leaves 1.2 mm in length and 0.5 mm in width. Some leaves are overlapping.

**Discussion.** — Slender and long shoots with leaves arranged in two ranks on one plane, and small, scale-like leaves are the features that indicate affinity of the examined specimens to the genus *Schizolepidella*. Until now, only one species was known in the genus *Schizolepidella* – *S. gracilis*. The examined shoots differ from *S. gracilis* in shape of leaves: they are not heart-shaped but oblong with entire, rounded, and not bilobed apex. Based on these differences, a new species is being proposed.

Shoots of *S. birkenmajeri* differ in shape and in arrangement of leaves from apparently similar shoots of conifers found in Mount Flora (compare: discussion at *Schizolepidella gracilis*). Leaves of shoots described by Gee (1989) as *Pagiophyllum* sp. A, are spindle-shaped or sometimes rhomboidal, tapering into an acute apex, while leaves of *S. birkenmajeri* are oblong, with entire rounded apex.

## Conclusions

The examined specimens of the genus *Schizolepidella* are representatives of the oldest liverworts in the world of the order Jungermaniales (Jovet-Ast 1967; Krassilov and Schuster 1983).

In Early Jurassic time, the area of Mount Flora was covered with flora composed of liverworts, horsetails, ferns, seed ferns, cycads, bennettitales and conifers (Halle 1913; Gee 1989; Rees and Cleal 2004). Nowadays, Antarctica is an inhospitable area for plants. Liverworts that occurred in Antarctica in Jurassic times are the only group of plants still present in that area (Bednarek-Ochyra *et al.* 2000).

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## References

- BEDNAREK-OCHYRA H., VÁYA J., OCHYRA R. and LEWIS SMITH R.I. 2000. *The liverwort flora of Antarctica*. Polish Academy of Sciences, Institute of Botany, Cracow: 236 pp.
- BIRKENMAJER K. 1993. Jurassic terrestrial clastics (Mount Flora Formation) at Hope Bay, Trinity Peninsula (West Antarctica). *Bulletin, Polish Academy of Sciences: Earth Sciences* 41 (1): 23–38.
- GEE C.T. 1989. Revision of the Late Jurassic/Early Cretaceous flora from Hope Bay, Antarctica. *Palaeontographica B*, 213 (4–6): 149–214.
- HALLE T.G. 1913. The Mesozoic flora of Graham Land. *Wissenschaftliche Ergebnisse der Schwedischen Südpolar-Expedition 1901–1903* 3 (14): 1–123.
- JOVET-AST S. 1967. Premier Embranchement: Bryophyta. In: E. Boureau (ed.) *Traité de paléobotanique*. Tome II *Bryophyta, Psilophyta, Lycophyta*, Masson et Cie, Éditeurs, Paris: 19–186.
- KENRICK P. 2003. Fishing for the first plants. *Nature* 425: 248–249.
- KRASSILOV V.A. and SCHUSTER R.M. 1983. Paleozoic and Mesozoic fossils. In: R.M. Schuster (ed.) *New Manual of Bryology*. 1. Hattori Bot. Lab., Nichinan, Miyazaki, Japan: 1172–1193.
- REES P.M. and CLEAL C.J. 2004. Lower Jurassic floras from Hope Bay and Botany Bay, Antarctica. *Special Papers in Palaeontology* 72: 5–89.
- SCHUSTER R.M. 1984. Evolution, phylogeny and classification of the Hepaticae. In: R.M. Schuster (ed.) *New Manual of Bryology*. 2. Hattori Bot. Lab., Nichinan, Miyazaki, Japan: 893–1070.
- TAYLOR T.N. and TAYLOR E.L. 1993. *The biology and evolution of fossil plants*. Prentice-Hall, New Jersey: 982 pp.
- WELLMAN C.H., OSTERLOFF P.L. and MOHIUDDIN U. 2003. Fragments of the earliest land plants. *Nature* 425: 282–285.

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