

Systematic Studies on the Conducting Tissue of the Gametophyte in Musci : (18) On the Relationships between the Stem and the Rhizome

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Systematic Studies on the Conducting Tissue of the Gametophyte in Musci

(18) On the Relationships between the Stem and the Rhizome

Eugenia RON* and Isawa KAWAI**

ABSTRACT : Terrestrial and subterranean gametophytes of *Polytrichum commune* HEDW. are taken into consideration, and differences are found, that is, terrestrial gametophyte is differentiated into an epidermis, cortex, leptom, hydrom sheath, stereome and a hydrom, and is found true leaf traces. The upper portion of subterranean gametophyte (the rhizome-like organization) is differentiated into an epidermis, cortex, hypodermal- and radial- strands, leptom, hydrom sheath, and a hydrom, and is absent leaf traces and stereome. The under portion of subterranean gametophyte (the rhizome-like organization) is differentiated into a parenchyma, leptom, hypodermal- and radial- strands, and a hydrom. Hypodermal strands bear several rhizoids.

Key words : Hydrom—Hydrom sheath—Hypodermal strand—Leptom—Radial strand

Introduction

In some species of Polytrichales, several earlier authors have defined that the erect gametophytes spring from an underground so-called rhizome, and this organ bears abundant rhizoids which tend to be massed together. And RUHLAND (1924) had described that the gametophyte of *Polytrichum formosum* and *P. commune* have the rhizome but *Atrichum undulatum* has not.

In *Polytrichum commune*, each tissue of the rhizome is compared with that of the stem through staining with different colors.

Materials and Methods

Fresh materials of *Polytrichum commune* HEDW. are collected from the Botanical Garden, Kanazawa University.

Methods : Stem of *Polytrichum commune* HEDW. is cut 5 μ m in thickness, and one drop of methyl green solution (0.01g/100cc) let fall on the cross-sections of the stem. After 30 seconds, three drops of eosin solution (0.3g/100cc) let fall on the methyl green solution and

* : Department of Botany, Faculty of Biology, Complutense University 28040 Madrid Spain

** : Department of Biology, Faculty of Science, Kanazawa University Marunouchi 1-1 Kanazawa 920 Japan

are mixed. After 2 hours, the sections are washed with water, and are observed.

In upper portion of the rhizome, two drops of methyl green solution (0.01g/100cc) let fall on the cross sections. After 40 seconds, two drops of eosin solution (0.3g/100cc) let fall on the methyl green solution, and are mixed. After 2 hours, the sections are washed with water, and are observed.

In central- and the lowest- portions of the rhizome, two drops of methyl green solution (0.01g/100cc) let fall on the cross sections. After 40 seconds, three drops of eosin solution (0.3g/100cc) let fall on the methyl green solution, and are mixed. After two hours, the sections are washed with water, and are observed.

Results and Discussion

In the stem, cell walls of the epidermis and cytoplasm of the leptom are stained red, and cell walls of the cortex are stained blue-green. Cell walls of the hydrom sheath and of the hydrom are stained dark green. And leaf traces have several hydroids of which cell walls are stained dark green. The stereome is no staining. That is, the stem of *Polytrichum commune* HEDW. is differentiated into an epidermis, cortex, leptom, hydrom sheath, stereome and a hydrom. And true leaf traces are present. (False leaf traces do not come into contact with the central strand, and true leaf traces joint it.) **Plate I -Photo. 1.**

The so-called rhizome of Polytrichales is gametophyte, and the rhizome of Tracheophytes is sporophyte. Therefore the so-called rhizome of Polytrichales is not homologous to the rhizome of Tracheophytes. And many differences exist between conducting elements of mosses and Tracheophytes. And TRACHTENBERG and ZAMSKI suggested that by definition, the term "endodermis" implied in existence of stele in vascular plants. In all polytrichaceous mosses, the central strand is surrounded by living parenchyma cells, cells of the hydrom sheath. That is, the tissue which consists of one layer, surrounds the hydrom. In the figure of the rhizome after RUHLAND (1924), the amylo and the endodermis surround the hydrom. Therefore the amylo and the endodermis may be self-same to the hydrom sheath. We suggest that by definition, the term "rhizome" implied in the sporophyte of Tracheophyte, and we use temporarily the term "rhizome-like organization" instead of the rhizome and of the so-called rhizome.

In the rhizome-like organization, inner structures of the upper-, middle- and the lowest- portions are different respectively. In the upper- portion of the rhizome-like organization, cell walls of the epidermis are stained red, and cell walls of the cortex are stained blue-green. Cytoplasm of the leptom (three masses of small round shape), three radial- and three hypodermal- strands are stained red. Cell walls of the hydrom sheath and of the

hydrom are stained dark green. That is, the upper portion of the rhizome-like organization is differentiated into an epidermis, cortex, leptom, hypodermal- and radial-strands, hydrom sheath and a hydrom. **Plate I -Photo. 4 and 5.**

In the middle-portion of the rhizome-like organization, cytoplasm of the hypodermal- and the radial-strands and of the leptom are stained red. Cell walls of the hydrom are stained dark green, and cell walls of the rhizoids are stained violet-brown. Parenchyma cells are no staining, that is, the middle-portion of the rhizome-like organization is differentiated into a hypodermal- and radial-strands, hydrom, leptom and a parenchyma. Abundant rhizoids spring from the three hypodermal strands. **Plate I -Photo. 6.**

In the lowest-portion of the rhizome-like organization, cell walls of the hydrom are stained dark green, and cytoplasm of the hypodermal strand is stained red. Cell walls of the rhizoids are stained violet-brown. The lowest-portion of the rhizome-like organization is differentiated into a parenchyma and a hydrom. Small hypodermal strands are present, and the rhizoids produce at various points on the surface of it. **Plate II. -Photo. 1-4.**

Diagrams of these cross-sections in different portions are shown in **Plate III.** And the stem, the upper-, middle-and the lowest-portions of the rhizome-like organization are compared each other (**Table I**).

Table I Relationships among the inner structures of the stem, upper-middle-and the lowest-portions of the rhizome-like organization

Tissues	Organs		Rhizome-like organization		
	Stem	Upper-portion	Middle-portion	Lowest-portion	
Leaf traces	+	-	-	-	
Stereome	+	-	-	-	
Epidermis	+	+	-	-	
Cortex	+	+	-	-	
Hydrom sheath	+	+	-	-	
Leptom	+	+	+	-	
Hypodermal strand	-	+	+	-	
Radial strand	-	+	+	-	
Parenchyma	-	-	+	+	
Rhizoids	-	-	+	+	
Hydrom	+	+	+	+	

+ : Present, - : Absent.

In the Table I, the stem is differentiated into an epidermis, cortex, leptom, hydrom sheath, stereome and a hydrom, and the true leaf traces are found. The upper-portion of the rhizome-like organization consists of an epidermis, cortex, leptom, hydrom sheath,

hypodermal- and radial-strands and a hydrom, and is absent the true leaf traces and the stereome. The middle-portion of the rhizome-like organization consists of a parenchyma, hypodermal- and radial-strands, leptom and a hydrom. The hypodermal strands bear rhizoids. The lowest-portion of the rhizome-like organization is differentiated into a parenchyma, hypodermal -strands and a hydrom, and is absent an epidermis, radial -strand, cortex, leptom, hydrom sheath.

In some species of Polytrichales, the subterranean axes were found to possess an organization similar in appearance to that of a phanerogamous root. And in *Polytrichum commune*, the middle-portion of the rhizome-like organization is found to possess similar characteristics in appearance to the triarch of the phanerogamous root. The absorbing organization requires further examination on anatomical and physiological observation.

Summary

In the gametophyte of *Polytrichum commune*, the terrestrial portion is differentiated into an epidermis, cortex, leptom, hydrom sheath, stereome and a hydrom, and is present true leaf traces.

The upper-portion of subterranean gametophyte (the rhizome-like organization), which has not leaves (true leaf traces), is differentiated into an epidermis, cortex, hypodermal- and radial-strands, leptom, hydrom sheath and a hydrom, and the stereome and the leaf traces are absent.

The under-portion of subterranean gametophyte is differentiated into a parenchyma, hypodermal- and radial-strands, leptom and a hydrom. The epidermis, cortex and the hydrom sheath are absent, and the three hypodermal strands bear several rhizoids.

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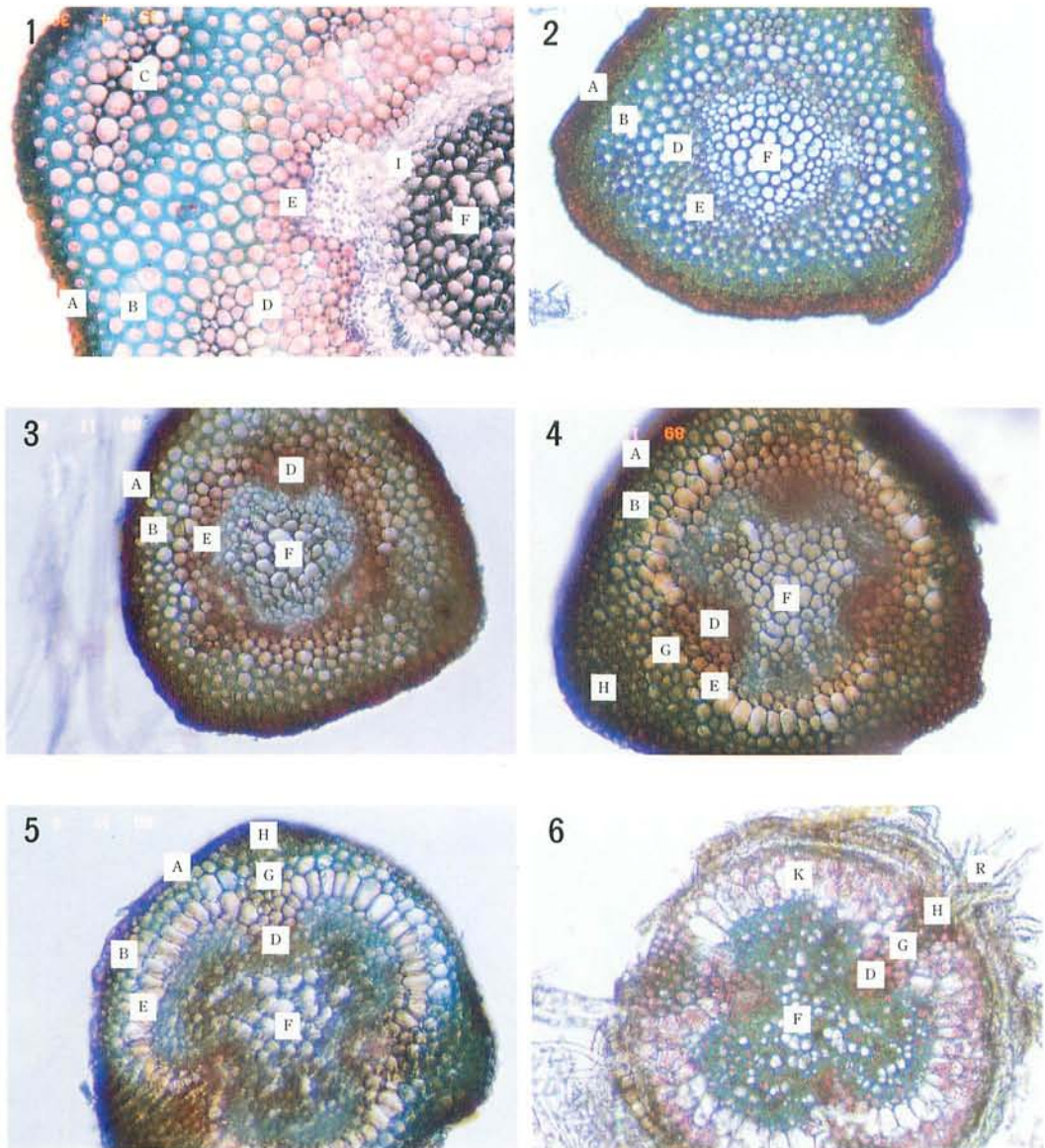


Plate I. Cross sections of the stem and the rhizome-like organization

- Fig. 1 Stem A : Epidermis, B : Cortex, C : Leaf trace, D : Leptom, E : Hydrom sheath, F : Hydrom, I : stereome.
- Fig. 2 Under portion of stem A : Epidermis, B : Cortex, D : Leptom, E : Hydrom sheath, F : Hydrom.
- Fig. 3 Upper portion of rhizome-like organization A : Epidermis, B : Cortex, D : Leptom, E : Hydrom sheath, F : Hydrom.
- Fig. 4 Rhizome-like organization A : Epidermis, B : Cortex, D : Leptom, E : Hydrom sheath, F : Hydrom, G : Radial strand, H : Hypodermal strand.
- Fig. 5 Under portion of rhizome-like organization A : Epidermis, B : Cortex, D : Leptom, E : Hydrom sheath, F : Hydrom, G : Radial strand, H : Hypodermal strand.
- Fig. 6 The lowest portion of rhizome-like organization D : Leptom, F : Hydrom, G : Radial strand, H : Hypodermal strand, K : Parenchyma, R : Rhizoids.

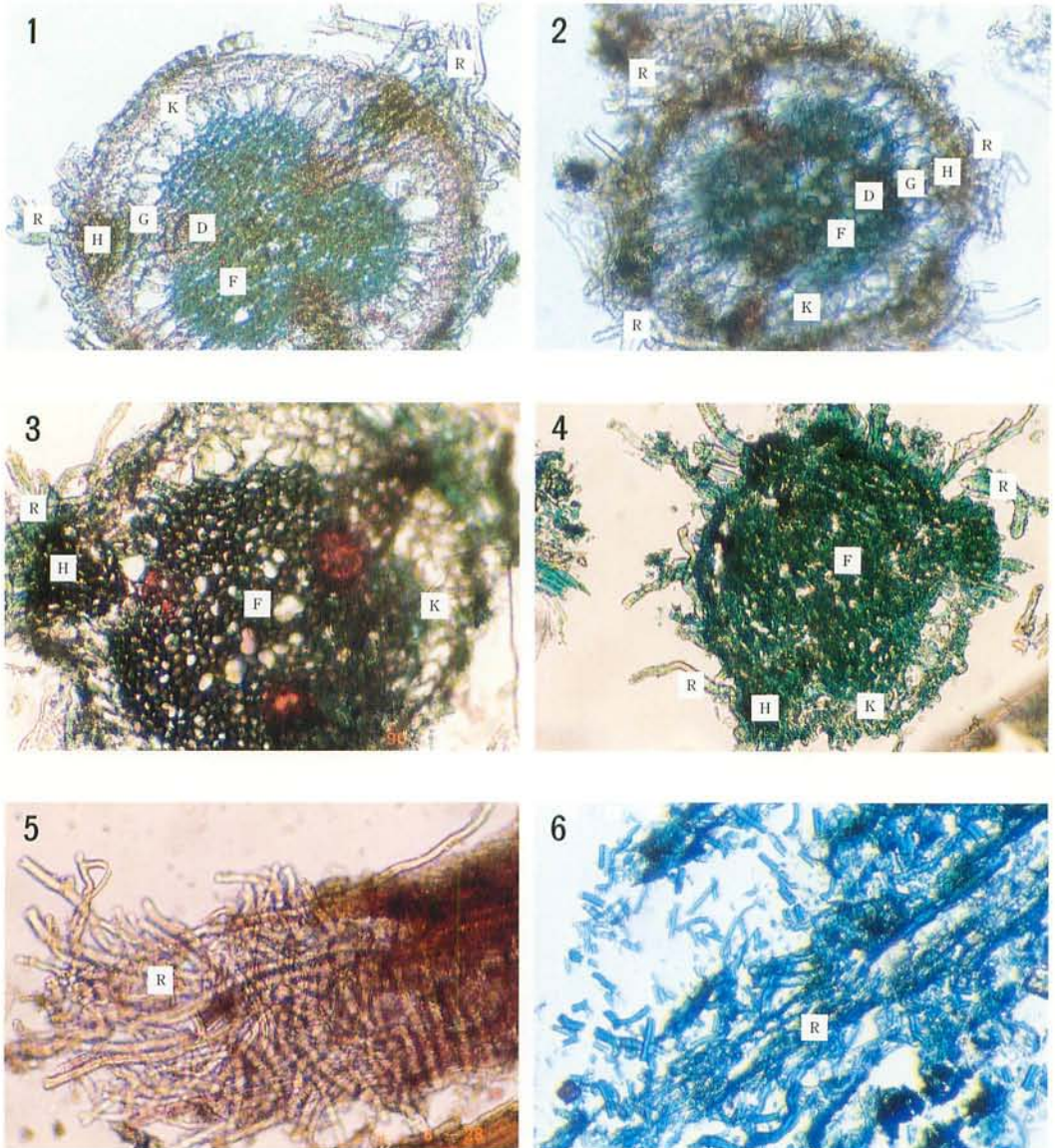


Plate II. Cross sections of the lowest portion of rhizome-like organization and the apex of under portion of gametophyte.

Fig. 1 and 2 The lowest portion of rhizome-like organization D : Leptom, F : Hydrom, G : Radial strand, H : Hypodermal strand, K : Parenchyma, R : Rhizoids.

Fig. 3 — 6 The apex of under portion of gametophyte F : Hydrom, H : Hypodermal strand, K : Parenchyma, R : Rhizoids.

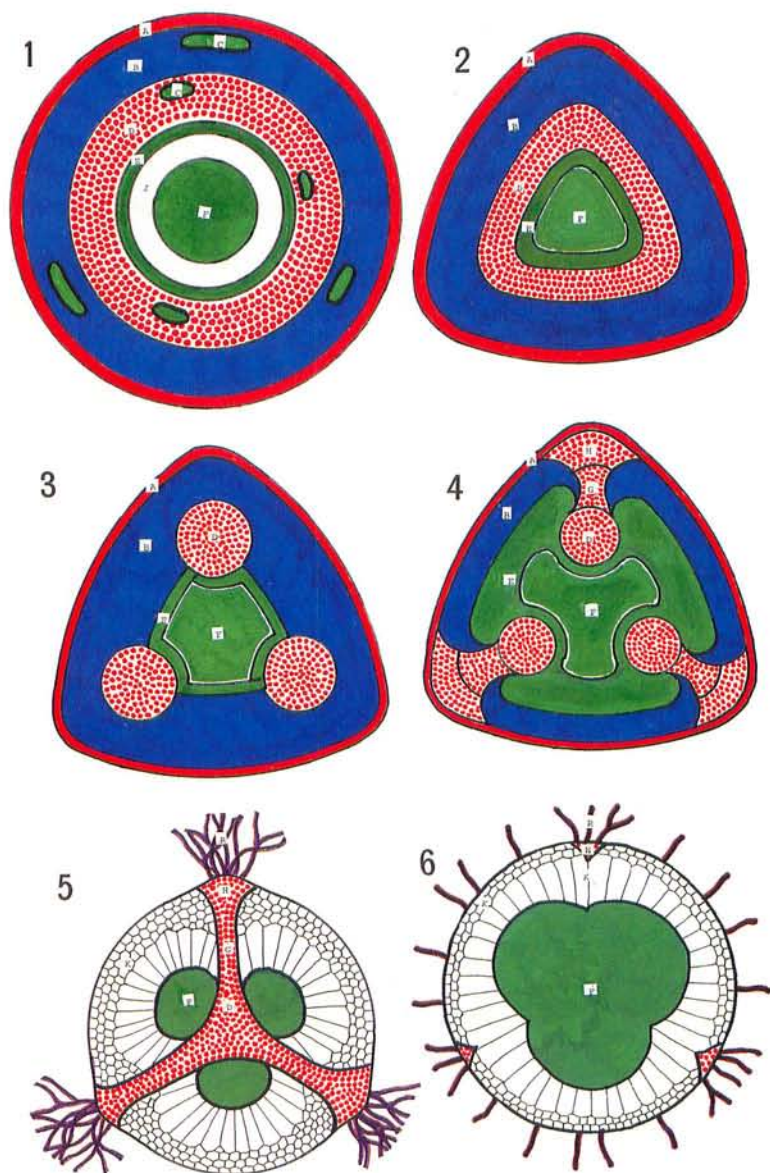


Plate III. Diagrams of the cross-sections in different portions of gametophyte

- Fig. 1 The stem A : Epidermis, B : Cortex, C : Leaf trace, D : Leptom, E : Hydrom sheath, F : Hydrom, I : Stereome.
- Fig. 2 Under portion of the stem A : Epidermis, B : Cortex, D : Leptom, E : Hydrom sheath, F : Hydrom.
- Fig. 3 Upper portion of the rhizome-like organization A : Epidermis, B : Cortex, D : Leptom, E : Hydrom sheath, F : Hydrom.
- Fig. 4 Middle portion of the rhizome-like organization A : Epidermis, B : Cortex, D : Leptom, E : Hydrom sheath, F : Hydrom, G : Radial strand, H : Hypodermal strand.
- Fig. 5 The lowest portion of the rhizome-like organization D : Leptom, F : Hydrom, G : Radial strand, H : Hypodermal strand, K : Parenchyma, R : Rhizoid.
- Fig. 6 The apex of the under portion of gametophyte K : Parenchyma, F : Hydrom, H : Hypodermal strand, R : Rhizoid.