

Systematic Studies on the Conducting Tissue of the Gametophyte in Musci

(11) Anatomical Characteristics of Stems in Some Species of Leucobryaceae

Isawo KAWAI

Department of Biology, Faculty of Science, Kanazawa University

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Abstract The inner structures of the stem in five species of Leucobryaceae are observed, and the stems of the five species show the same types in some characteristics. (Q-LSI-LRH-CA type). Also in the stems of Leucobryaceae, some regularity can be seen among some of the anatomical characteristics of the stem in cross and longitudinal sections as in Amblystegiaceae and Dicranaceae. They are the type of interior differentiation of the stem (III and IV types), comparison of the size of the cells of the hadrom and that of the cells of the leptom (M and N types), shape of cells of the hadrom (HRE and HRH types), comparative thickness of the cell walls and the septum (end walls) of the hadrom (HSI and HTN types), and the comparative length of cells of the hadrom and the epidermis (H2A, H1.5A and HA types). These characteristics appear to be important in locating regularity among anatomical characteristics.

Introduction

As a result of observation of the various characteristics of the stem in Amblystegiaceae and Dicranaceae, some regularity can be seen among some of the anatomical characteristics of the stem in cross and longitudinal sections, that is, the type of interior differentiation of the stem, comparison of the size of the cells of the hadrom and that of the cells of the leptom, shape of cells of the hadrom, comparative thickness of the cell walls and the septum (end walls) of the hadrom, and the comparative length of cells of the hadrom and the epidermis. So the inner structure of the stem in five species of Leucobryaceae is observed from this point of view.

Materials and Methods

The materials used for this research are composed of specimens of mosses collected

in Japan. All the samples studied are deposited in the Moss Herbarium of Kanazawa University.

Leucobryum bowringii MITT.: Miyazaki (34900), Wakayama(39230), *Leucobryum javense* (BRID.) MITT.: Okinawa(39375), *Leucobryum neilgherrense* C.MUELL.: Mie (39355), Kumamoto (35198), Kyooto (39228), *Leucobryum scabrum* LAC.: Mie (37337), Kumamoto (35001), *Leucobryum textori* BESCH.: Toyama (32512), Kyooto (11983), Kanagawa (32579).

The hard mosses are boiled in water for about an hour in order to prevent the soft tissue from breaking. The inner structure of the stem is studied from transverse sections and longitudinal sections having a thickness of five microns. Gentian violet, acid fuchsin and potassium iodide iodine are used for staining anatomical preparations.

Observations and Discussion

I. Anatomical Characteristics in Stem Cross Sections

The inner structures of the stem in five species of Leucobryaceae are observed. In all the species dealt with in this paper, the stems of each species show the same type of the cell walls of the hadrom (Q type). In *Leucobryum scabrum* LAC., *Leucobryum javense* (BRID.) Mitt. and *Leucobryum textori* BESCH., the stems show a differentiation of tissues into an epidermis, cortex, leptom and a hadrom (III type), and the cells of the hadrom are as large as those of the leptom (M type). In *Leucobryum bowringii* MITT. and *Leucobryum neilgherrense* C.MUELL., the stems show a differentiation of tissues into an epidermis, cortex, leptom, hydrom sheath and a hadrom (IV type), and the cells of the hadrom are smaller than those of the leptom, N or N(M) types. In the stems of the other four species with the exception of *Leucobryum scabrum*, the hadrom is parenchymatous (R type).

As stated above, some regularity can be seen among the anatomical characteristics here listed. That is, the type of interior differentiation of the stem (III and IV types); comparative thickness of the cell walls of the hadrom and of the leptom (Q type); comparison of the size of the cells of the hadrom and that of the cells of the leptom (M and N types); and the thickness of the cell walls of the hadrom (R and S types), appear to be very important in making an investigation of the essential characteristics (Tab.1).

II. Anatomical Characteristics in the Longitudinal Sections of the Stem

As a result of examining the various characteristics, the following characteristics are selected; the cell-length of each tissues as the ratio to that of the epidermis (the cell-length of the epidermis is represented by the sign "A"), the shape of the cell (rectangular, rhombic and spindle), the thickness of the septum (as ratio to that of the cell walls). In *Leucobryum scabrum* LAC., the cell-length of the hadrom is more than twice the length of the epidermal cells (H₂A type), in *Leucobryum javense* (BRID.) MITT., longer than 1.5A, and in *Leucobryum textori* BESCH., *Leucobryum bowringii* MITT. and *Leucobryum neilgherrenese* C.MUELL., as long as the epidermal cells (H_A type). In

Tab. 1 Affinity regarding the anatomical characteristics in the cross section of the stem in five species of Leucobryaceae

The stem differentiates into an epidermis, cortex, leptom and a hadrom (III type) or into an epidermis, cortex, leptom, hydrom sheath and a hadrom (IV type)	III	III	III	IV	IV
Cell walls of the hadrom are thicker (O type), as thick (P type) or thinner (Q type) than those of the leptom	Q	Q	Q	Q	Q
Cells of the hadrom are larger (L type), as large (M type) or smaller (N type) than those of the leptom	M	M	M	N(M)	N
Cells of the hadrom are parenchymatous (R type) or not (S type)	S(R)	R	R(S)	R	R
Cells of the epidermal layer are parenchymatous (T type) or not (U type)	U	U	U	U	T
Epidermal cell walls are thicker (G type), as thick (H type) or thinner (I type) than those of the cortex	I	I	I	I	I
Cells of the epidermal layer are larger (V type), as large (W type) or smaller (X type) than those of the cortex	X	X	X	X	V
Number of the cell layers of the cortex is 1-4 cell layers (C type) or 4-7 cell layers (D type)	C	C	C	C	C
Number of the cell layers of the leptom is 1-4 cell layers (A type) or 4-13 cell layers (B type)	A	A	A	A	A
	<i>Leucobryum scabrum</i> LAC.	<i>Leucobryum javense</i> (BRID.) MITT.	<i>Leucobryum textori</i> BÆSCH.	<i>Leucobryum neilgherrense</i> C. MUELL.	<i>Leucobryum bowringii</i> MITT.

Tab. 2 Observation of the anatomical characteristics in the longitudinal section of the stem in five species of Leucobryaceae

Species	Length of cell (A: Length of cell in the epidermis)			Shape of cell				Thickness of the septum (Comparison with the longitudinal cell walls)		
	Cortex	Leptom	Hadrom	Epidermis	Cortex	Leptom	Hadrom	Cortex	Leptom	Hadrom
<i>Leucobryum scabrum</i> LAC.	C _A	L _{2A}	H _{2A}	E _{RE}	C _{RH}	L _{RH}	H _{RE}	C _{SI}	L _{SI}	H _{SI}
<i>Leucobryum javense</i> (BRID. MITT.)	C _A	L _A	H _{1.5A}	E _{RH}	C _{RH}	L _{RH}	H _{RE}	C _{SI}	L _{SI}	H _{SI}
<i>Leucobryum textori</i> BESCH.	C _A	L _A	H _A	E _{RE}	C _{RH}	L _{RH}	H _{RE}	C _{SI}	L _{SI}	H _{SI}
<i>Leucobryum bowringii</i> MITT.	C _A	L _{2A}	H _A	E _{RE}	C _{RH}	L _{RH}	H _{RH}	C _{SI}	L _{SI}	H _{SI}
<i>Leucobryum neilgherrense</i> C. MUELL.	C _A	L _{1.5A}	H _A	E _{RH}	C _{RH}	L _{RH}	H _{RH}	C _{SI}	L _{SI}	H _{TN}

C: Cortex, L: Leptom, H: Hadrom, E: Epidermis, RE: Rectangular, RH: Rhombic, SI: The septum is as thick as the longitudinal cell walls, TN: The septum is thinner than the longitudinal cell walls.

Tab. 3 Affinity regarding the anatomical characteristics in the cross and longitudinal sections of the stem

III or IV	Hadrom						Leptom			Cortex	Species
	Size	Shape	Thickness		Septum	Length	Septum	Shape	Length	Length	
			P or Q	R or S							
III	M	H _{RE}	Q	S	H _{SI}	H _{2A}	L _{SI}	L _{RH}	L _{2A}	C _A	<i>Leucobryum scabrum</i> LAC.
				R	H _{SI}	H _{1.5A}	L _{SI}	L _{RH}	L _A	C _A	<i>Leucobryum javense</i> (BRID.) MITT.
						H _A	L _{SI}	L _{RH}	L _A	C _A	<i>Leucobryum textori</i> BESCH.
IV	N	H _{RH}	Q	R	H _{SI}	H _A	L _{SI}	L _{RH}	L _{2A}	C _A	<i>Leucobryum bowringii</i> MITT.
					H _{TN}	H _A	L _{SI}	L _{RH}	L _{1.5A}	C _A	<i>Leucobryum neilgherrense</i> C. MUELL.

H: Hadrom, L: Leptom, C: Cortex, A: Length of the epidermal cells, TN: Thinner, SI: Similar, RE: Rectangular, RH: Rhombic

Leucobryum scabryum, *Leucobryum javense*, *Leucobryum textori* and *Leucobryum bowringii*, the septum of the hadrom is as thick as the vertical cell walls of the hadrom (H_{SI} type), but in *Leucobryum neilgherrense*, the septum of the hadrom is H_{TN} type. And *Leucobryum scabrum*, *Leucobryum javense* and *Leucobryum textori* have stems with rectangular hadrom (H_{RE} type), but in the other species hadrom are rhombic shaped (H_{RH} type).

III. Affinity Regarding the Anatomical Characteristics Seen in the Cross and Longitudinal Sections

The stems of five species show the same types regarding some of the characteristics (Q-L_{SI}-L_{RH}-C_A type). The stems of *Leucobryum scabrum*, *Leucobryum javense* and *Leucobryum textori*, which develop into an epidermis, cortex, leptom and a hadrom (III type), have the rectangular hadrom (H_{RE} type), the cells of the hadrom are as large as those of the leptom (M type), and the septum (end walls) of the hadrom is as thick as the vertical cell walls of the hadrom (H_{SI} type). The stems of *Leucobryum bowringii* and *Leucobryum neilgherrense*, which develop into an epidermis, cortex, leptom, hydrom sheath and a hadrom (IV type), have rhombic hadrom (H_{RH} type), the cells of the hadrom are smaller than those of the leptom (N type). In *Leucobryum scabrum* the cell-length of the hadrom is longer than twice the length of the epidermal cells (H_{2A} type), in *Leucobryum javense*, H_{1.5A} type, and in *Leucobryum textori*, H_A type. In the stem of *Leucobryum bowringii* the septum(end walls) of the hadrom is as thick as the vertical cell walls of the hadrom (H_{SI} type), in *Leucobryum neilgherrense* the septum(end walls) of the hadrom is H_{TN} type.

In the stems of Leucobryaceae, regularity can be seen among some of the anatomical characteristics of the stem in cross and longitudinal sections. They are the type of interior differentiation of the stem (III and IV types), comparison of the size of the cells of the hadrom with that of the cells of the leptom (M and N types), shape of cells of the hadrom (H_{RE} and H_{RH} types), comparative thickness of the cell walls with the septum(end walls) of the hadrom (H_{SI} and H_{TN} types), and the comparative length of cells of the hadrom and the epidermis (H_{2A}, H_{1.5A} and H_A types). These characteristics, among which some regularity has been observed also in the stems of Amblystegiaceae and Dicranaceae, appear to be important in making an investigation of the essential characteristics (Tab.3).

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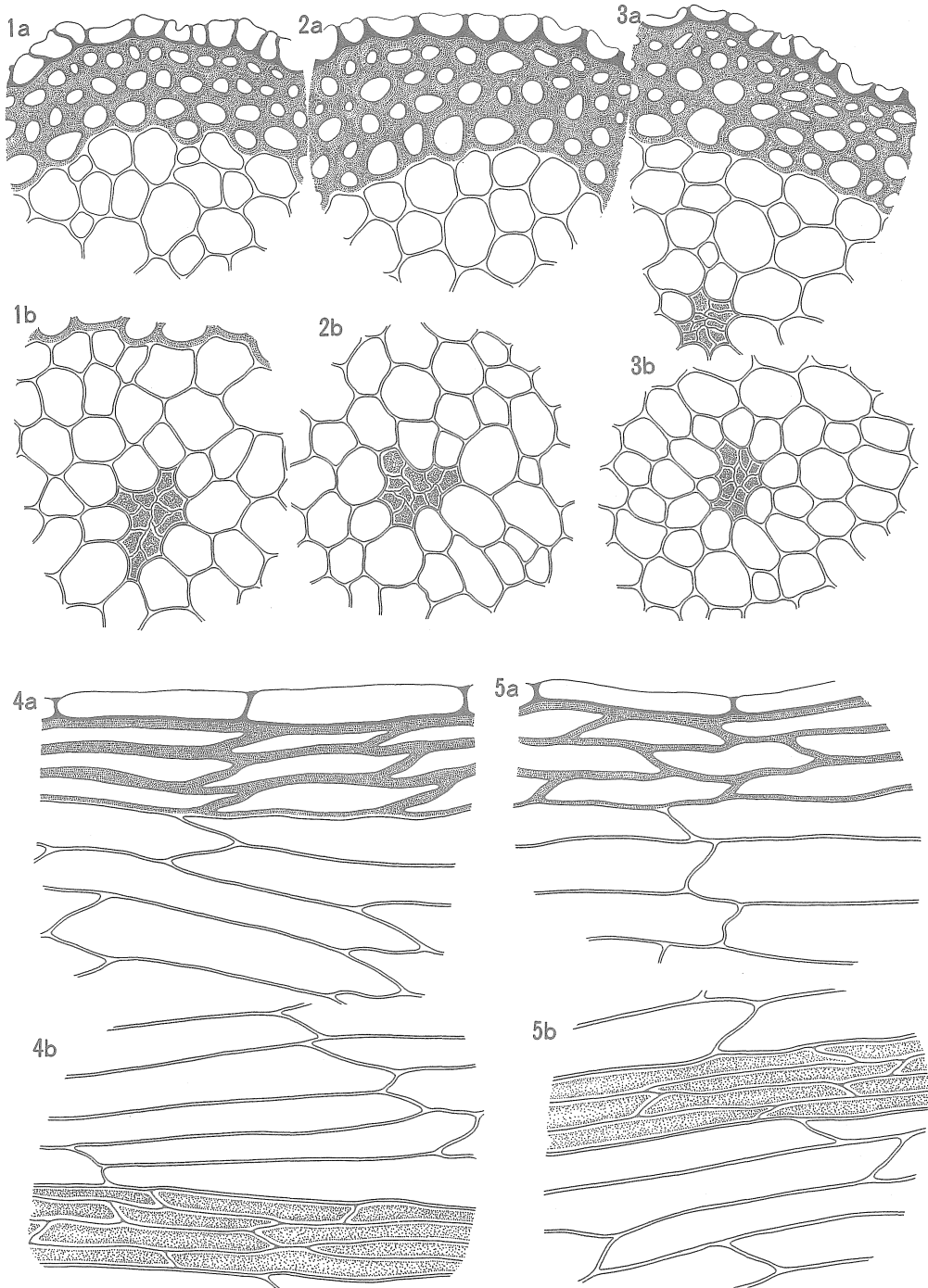


Plate I *Leucobryum bowringii* MITT. x 280

Fig. 1-3: Cross sections
a: Outer part of the stem

Fig. 4-5: Longitudinal sections
b: Central part of the stem

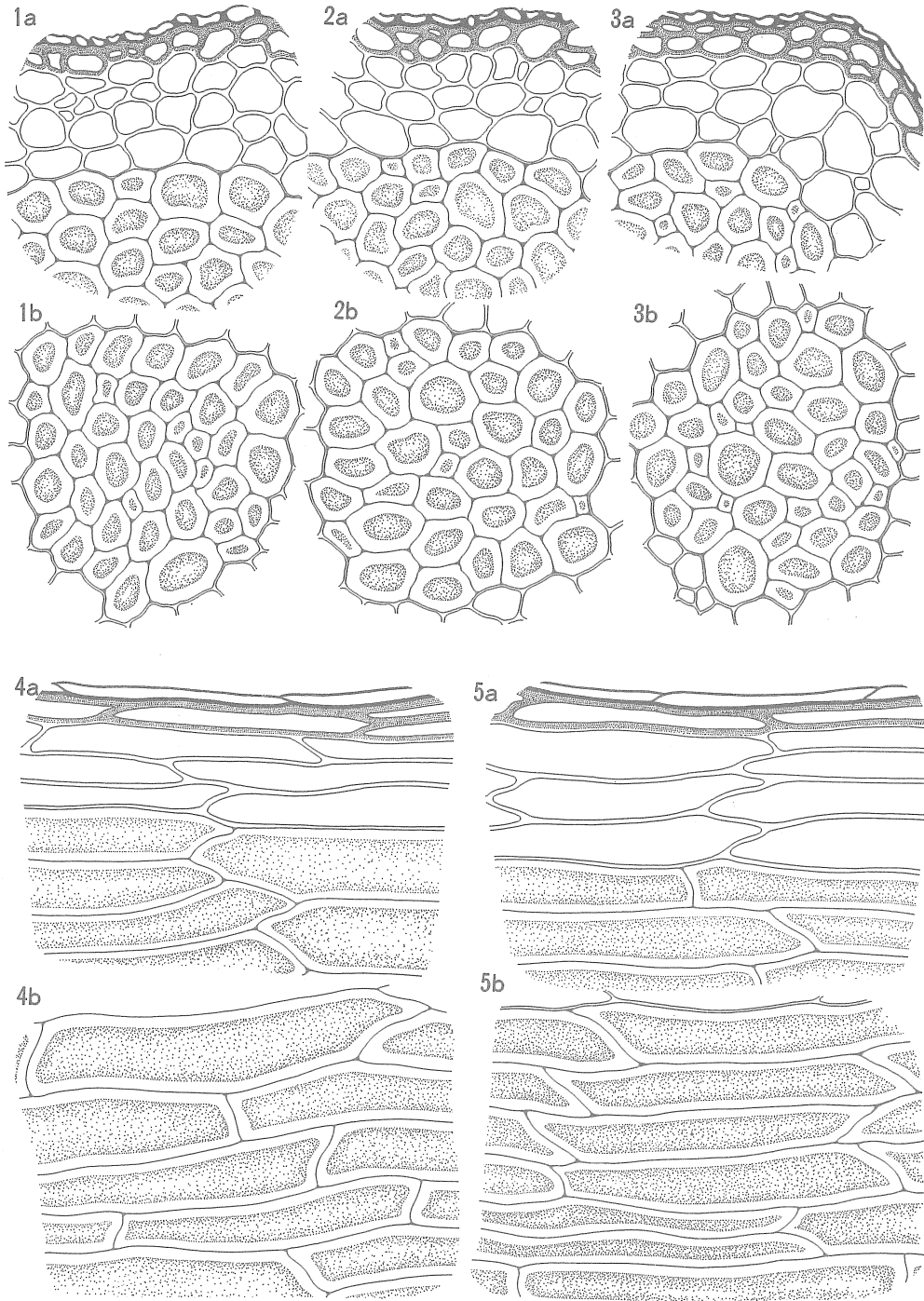


Plate II *Leucobryum javense* (BRID.) MITT. x 220

Fig. 1-3: Cross sections
a: Outer part of the stem

Fig. 4-5: Longitudinal sections
b: Central part of the stem

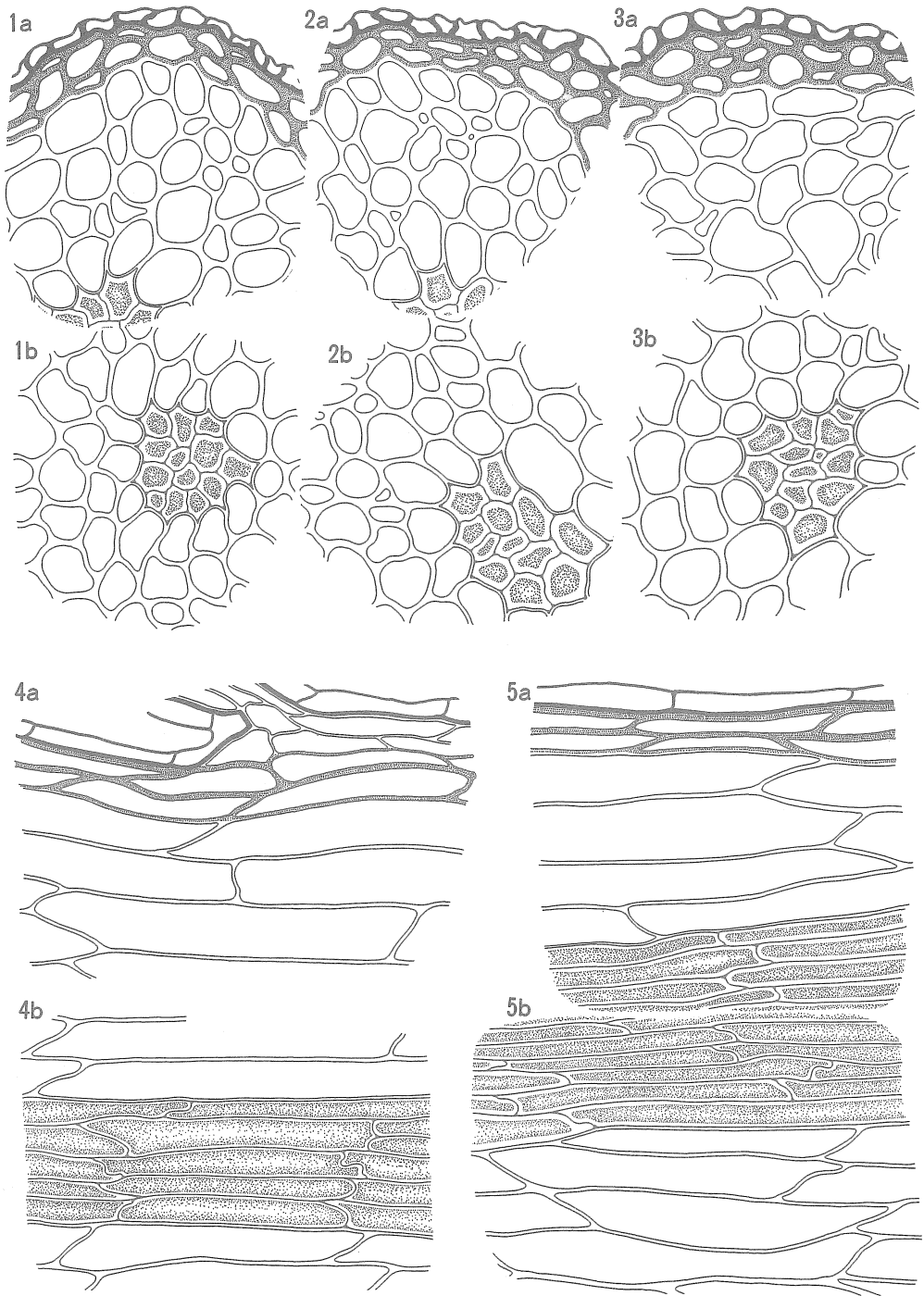


Plate III *Leucobryum neilgherrense* C.MUELL. x 280
 Fig. 1-3: Cross sections Fig. 4-5: Longitudinal sections
 a: Outer part of the stem b: Central part of the stem

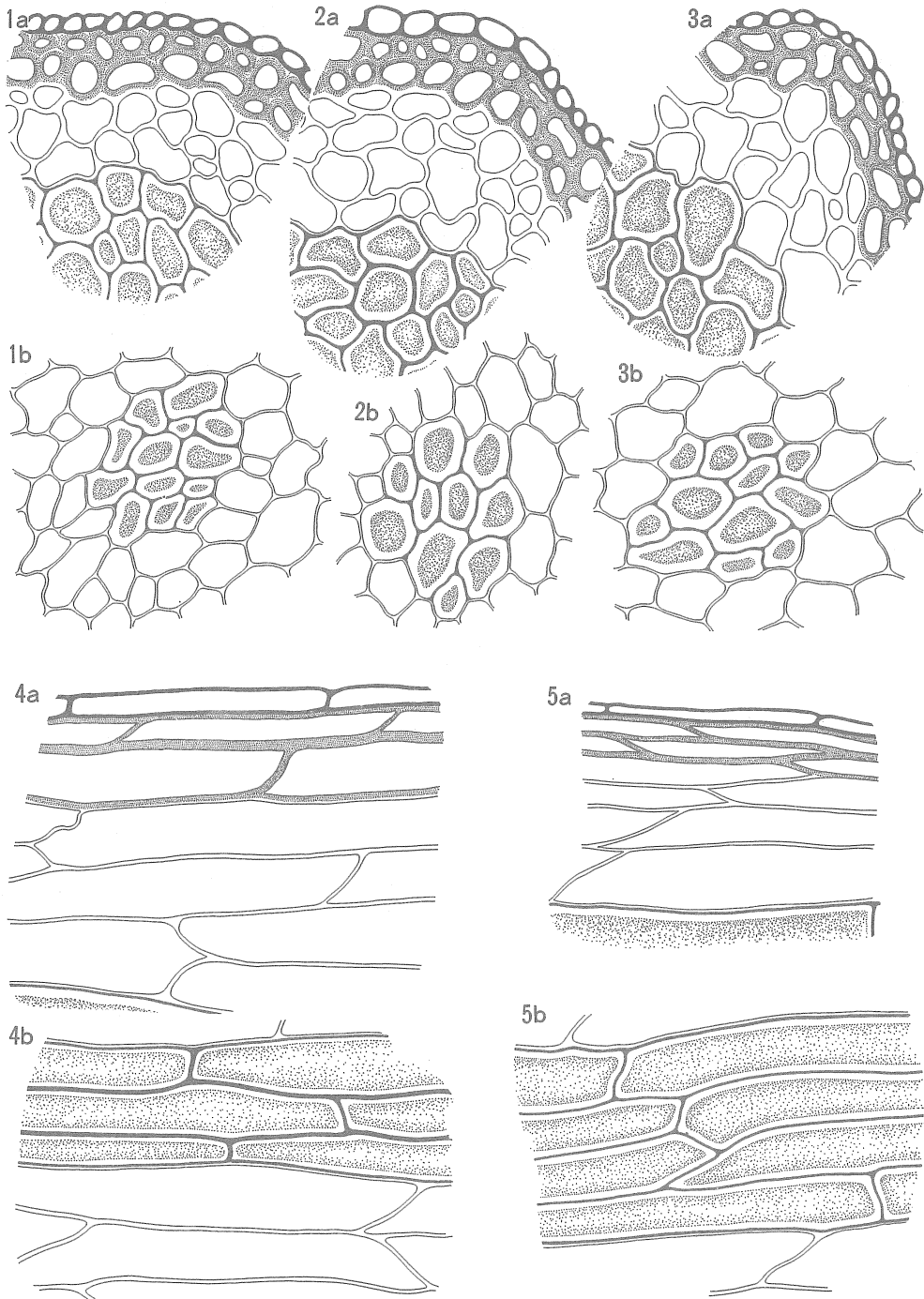


Plate IV *Leucobryum scabrum* LAC. x 220

Fig. 1-3: Cross sections

Fig. 4-5: Longitudinal sections

a: Outer part of the stem

b: Central part of the stem

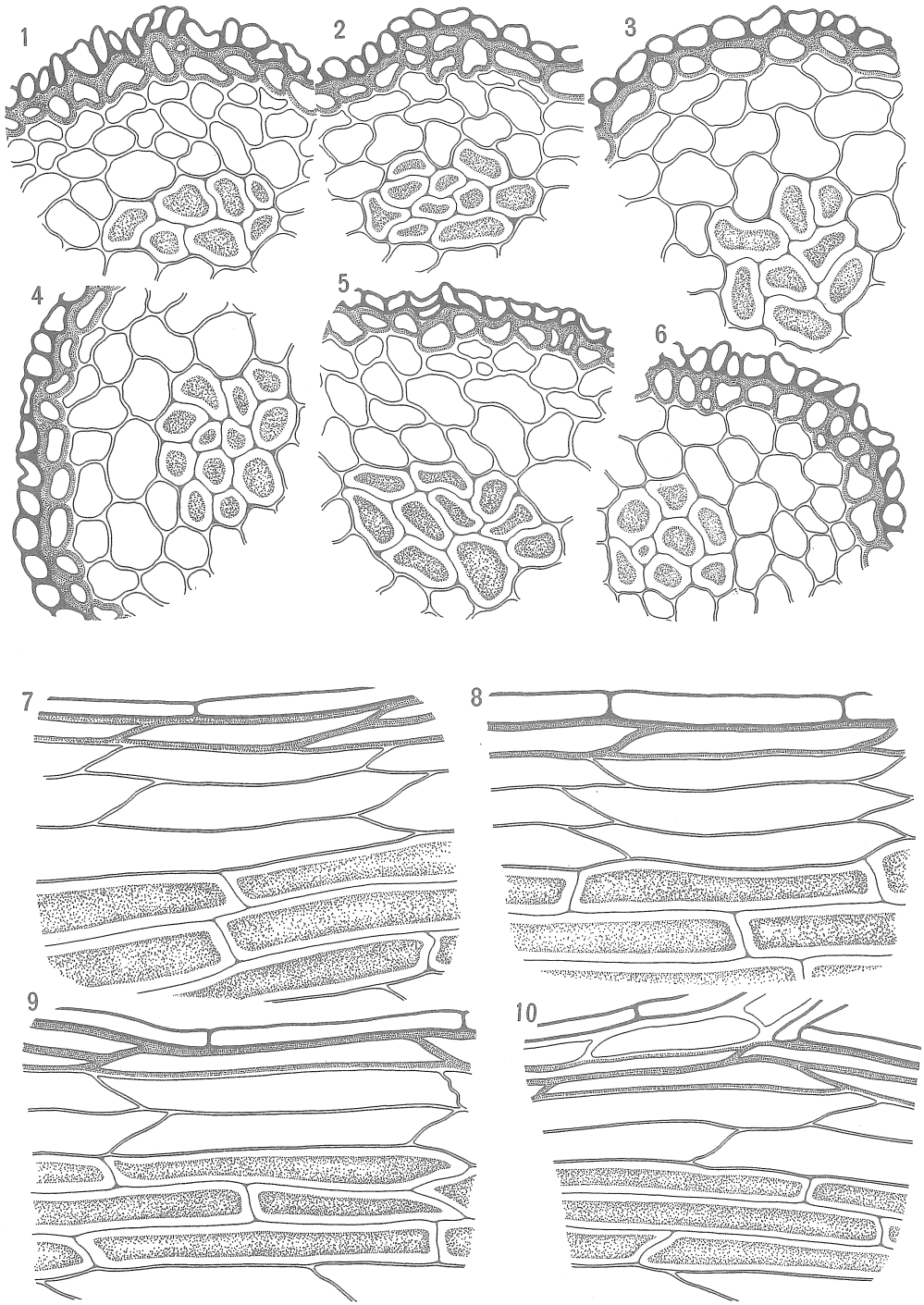


Plate V *Leucobryum textori* BESCH. x 280

Fig. 1-6 : Cross sections Fig. 7-10 : Longitudinal sections