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(7) On the Essential Coordination Among the Anatomical Characteristics of the Stems in the Some Species of Isobryales

Isawo KAWAI

Department of Biology, Faculty of Science, Kanazawa University

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Abstract Many regular phenomena are found through the life history of plants. It can easily be imagined that regular phenomena support the life of a plant. What kind of regular phenomena does the individual plant live by? Which regular phenomena are in common among many individuals? And in what kind of plants are such regular phenomena found? It should be the initial step of systematic study to discover the race's intent on how the race makes its life and which direction the race follows.

With this end in view, it becomes necessary to make clear what sort of phenomena and characteristics are in common among the species belonging to the identical genus, family, and order.

Isn't it reasonable to think that these regular phenomena and the characteristics which are in common among the identical genus and family are more essential characteristics? Until now the cross sections of the stem in many species have been considered in order to show some coordination seen among the interior structures of the gametophyte. In this paper the inner structure of the stem in fifty-six species of Isobryales is considered.

Furthermore, in this paper the process of segmentation is divided into four periods of cell division, which are in accordance with the order of cell division as KAWAI (1974) suggested (Tab. 3). The first-division period is for the forming of the segments, the period in which the organs are formed, is called the second-division period, and the period in which tissues are formed, is called the third-division period. The period in which tissues are attained full growth, is called the forth-division period. Many of the anatomical characteristics hitherto observed, which are closely connected with the cutting at the early-stage of the ontogeny, seems to show high regularity, especially, **III, IV, VI**-types, **O, P, Q**-types, **L, M, N**-types and **R, S**-types. One of the important characteristics concerning the **III, IV, VI**-types, was divided into six types by KAWAI et IKEDA (1970), but the division may call for a partial revision with reference to the research data of HÉBANT (1973, 1974, 1976, 1977) and KAWAI (1977).

We considered the cross sections of the stem of the eighteen families hitherto observed, and out of the sketches so far made public, we also considered the sketches of seventeen families, where we could roughly see nine of our characteristics.

As discussed above, in many genera, families, and orders, the stems of the species belonging to an identical genus, family, and order, show common anatomical characteristics concerning III, IV, VI-types, O, P, Q-types, L, M, N-types, R, S-types, and T, U-types. Through research into the coordination of anatomical characteristics and ontogeny of the stem, we should like to discover in the future the essential characteristics, and carry out research on systematic studies in conformity with essential characteristics.

Introduction

It should be the initial step of systematic study to view the life history of the gametophyte in every light in order to discover the essential coordination existing in its mode of life. First of all, the distinction between tissues in the mature stems should be roughly surveyed along with the observation of the manner of division in the apical cell. Then, we might with greater ease be able to make clear the growing process from its initial phase to the fully grown tissue. If the distinction between tissues that have attained full growth is not understood, it is very difficult to make clear how a segment developes into a mature tissue.

Cross sections of the stem in some species of Fissidentaceae, Grimmiaceae, Thuidiaceae, Entodontaceae, Mniaceae, Bartramiaceae, Dicranaceae, Hypnaceae and Polytrichaceae, have been studied, in order to find some coordination in the interior structures of the gametophyte. Furthermore, from the sketches made public up to the present, we studied those of Erpodiaceae (NOGUCHI 1952), Bartramiaceae (MATTERI 1968, 1973), Hookeriaceae (MATTERI 1972) and Pottiaceae (SAITO 1975), and ten of our demarcations have been recognized.

What sort of anatomical characteristics should be taken up for systematic study? For solving this problem, we believe it is necessary to observe the interior structures of many species, and consider the origins of each tissue in the stem. The paper on the hadrom by HÉBANT (1973) is very useful for this study on the origin of each tissue. He states, "The hydroids of the central strand originate from the most central part of the segments which are cut off from the apical cell. The rapid cleavage of the lower part of the segment is a characteristic of primitive mosses with well-developed conducting strands. After a short time, however, the future hydroids stop dividing, their subsegment development is characterized by great enlargement, and by notable elongation. These phenomena are related to an important change in their vacuolar systems. In the aerial leafy stem of most of the Polytrichales, as well as in other mosses having an axial conducting strand, all the cells of the most internal part of each segment differentiate into hydroids. In certain cases, however, one part only of these cells differentiates into hydroids; the others yield elements with characteristics of parenchyma. In mature stems, these cells usually exhibit thickened walls, and are therefore called stereids."

Cell walls of the central tissue are thicker (O-type), as thick (P-type) or thinner

(**Q**-type) than those of the internal cortex; cells of the central tissue are larger (**L**-type), as large (**M**-type) or smaller (**N**-type) than those of the internal cortex; cells of the central tissue are parenchymatous (**R**-type) or not (**S**-type), and these three so far observed may be characteristics of the hadrom.

HÉBANT (1973) describes the leptom as follows: "With the light microscope, the young leptoids can easily be recognized due to their precocious elongation, and to the important development of their nucleus and nucleolus. The origin of the leptoids in the cells derive from the upper part of the initial of the central tissue, which is delimited by the first division of the segment. These cells of conducting parenchyma form the junction between the 'Deuters' of the leaf traces and the typical leptoids of the central system. Together the leptoids and the cells of conducting parenchyma constitute, at the periphery of the axial strand of hydroids, a continuous network through the apertures of which run the hydroids of the leaf traces."

The leptom (cells of the leptoid element) in the species of Polytrichales may correspond to the internal cortex in *Climacium*, and the hadrom may be equivalent to what we call the central tissue. Essntial characteristics may be found after the relationship of the anatomical characteristics is considered, and the coordination of the internal structures used in the classification system is surveyed.

The Significance of Essential Characteristics in Systematic Studies

Many regular phenomena are found in the life cycle of the plant. It may be easily imagined that the regular phenomena support the life of the plant. What kind of regular phenomena does the individual plant live by? Which regular phenomena are in common with many individual plants? And in what kind of plants are such regular phenomena found?

It should be the initial step of systematic study to discover the race's intent, that is, —how the race makes the life and, which direction the race causes it to flow. With this end in view it becomes necessary to make clear what sort of phenomena are in common among the species belonging to the same genus, family, and identical order. Among some observed phenomena and characteristics, we find that some are not in common concerning the identical genus or family. However, in others there is found a coordination among the identical genus or family. Can't it be thought that these regular phenomena and characteristics in common among the identical genus or family are the more essential characteristics, and that these essential characteristics support the life of the plant?

Taxonomy should be studied in order to discern the life of the plant. The very foundation of the race may be reflected in the mirror of the essential characteristics. In this sense, it is thought that the essential characteristics are vitally important related to taxonomic study.

Materials and Methods

The materials used for this research were composed of specimens of mosses collected in Japan. All the samples studied were deposited in the Moss Herbarium of Kanazawa University.

Fontinalaceae — *Dichelyma japonicum* CARD.: Shiga (39388), *Fontinalis hypnoides* HARTM.: Niigata (35244), Hyoogo (37357).

Hedwigiaceae — *Hedwigia ciliata* (HEDW.) EHRH.: Kumamoto (35201).

Leucodontaceae — *Dozya japonica* LAC.: Tokushima (36201), Kanagawa (32566), *Leucodon exaltatus* C. MUELL.: Shimane (35039), Kumamoto (35048), Wakayama (39358), Aichi (35049), Gifu (11093), Shimane (37515), *Leucodon noguchii* IWATS.: Kumamoto (35950), *Leucodon sapporensis* BESCH.: Iwate (39227).

Trachypodiaceae —*Duthiella flaccida* (CARD.) BROTH.: Oosaka (37309), Mie (37363), Kumamoto (35243), Wakayama (37390), *Duthiella speciosissima* BROTH.: Aichi (35169), Shiga (34950), Saitama (32545), Kyooto (37308), *Duthiella wallichii* (MITT.) C. MUELL.: Kumamoto (35229), *Trachypus bicolor* REINW. et HORNSCH.: Kumamoto (35075), Kyooto (37318). *Trachypus humilis* LINDB.: Miyazaki (35202).

Pterobryaceae — *Calyptothecium hookeri* (MITT.) BROTH.: Kumamoto (35241), *Calyptothecium urvilleanum* (C. MUELL.) BROTH.: Kagoshima (37344), *Myuriopsis sinica* (MITT.) NOG.: Ibaragi (11985), *Myurium assimile* (BROTH.) SEKI: Wakayama (39200), *Myurium fragile* (CARD.) BROTH.: Wakayama (34982), *Pterobryum arbuscula* MITT.: Ibaragi (32690), Kumamoto (35228).

Meteoriaceae — *Aerobryum speciosum* DOZ. et MOLK.: Kagoshima (37351), *Barbella flagellifera* (CARD.) NOG.: Wakayama (39378), *Barbella enervis* (THWAIT. et MITT.) FL.: Nara (37346), Wakayama (37380), *Barbella pendula* (SULL.) FL.: Saitama (36242), *Chrysocladium retrorsum* (MITT.) FL.: Nara (37343), *Floribundaria floribunda* (DOZ. et MOLK.) FL.: Kumamoto (37303), *Floribundaria aurea* (MITT.) BROTH. ssp. *nipponica* (NOG.) NOG.: Wakayama (37358), Wakayama (34883), *Floribundaria pseudofloribunda* FL.: Kumamoto (35006), Kumamoto (37495). *Meteoriopsis reclinata* (C. MUELL.) FL.: Formosa (32693), Kumamoto (35239), *Meteorium buchananii* (BRID.) BROTH. ssp. *helminthocladulum* (CARD.) NOG.: Iwate (39226), Saitama (37514), *Meteorium buchananii* (BRID.) BROTH. var. *cuspidatum* (OKAM.) NOG.: Mie (39359), *Meteorium miquelianum* (C. MUELL.) FL.: Kumamoto (35242), *Pseudobarbella attenuata* (THWAIT. et MITT.) NOG.: Koochi (39361), Mie (37425), *Pseudobarbella levieri* (REN. et CARD.) NOG.: Kumamoto (39391), Nara (37282).

Neckeraceae — *Bissetia lingulata* (MITT.) BROTH.: Tokushima (11013), *Homaliadelphus targionianus* (MITT.) DIX. et P. VARD.: Iwate (39394), Kumamoto (35238), Saitama (37523), Saitama (35078), *Homaliodendron scalpellifolium* (MITT.) FL.: Wakayama (34890), Kumamoto (37436), *Neckera borealis* NOG.: Hokkaidoo (37292), Hokkaidoo (35076), *Neckera flexiramea* CARD.: Tokushima (11043), Kumamoto (35096), *Neckera humilis* MITT.: Ishikawa (11058), Niigata (35203), *Neckera muratae* NOG.: Okayama (39354), *Neckera pennata* HEDW.: Yamanashi (37432), *Neckera pusilla* MITT.: Shimane (35204),

Kyooto (37431), Hyoogo (34904), *Neckera yezoana* BESCH.: Hokkaidoo (39363), *Neckeropsis calcicola* NOG.: Mie (37332), Shiga (34985), *Neckeropsis nitidula* (MITT.) FL.: Shizuoka (11043), *Neckeropsis obtusata* (MONT.) FL.: Koochi (39364), Wakayama (37331), Kumamoto (35184), *Pinnatella makinoi* (BROTH.) BROTH.: Kumamoto (37285), Kumamoto (35234), *Thamnobryum alopecurum* (HEDW.) NIEUWL.: Hokkaidoo (35073), *Thamnobryum plicatulum* (LAC.) IWATS.: Kumamoto (37369), *Thamnobryum sandei* (BESCH.) IWATS.: Saitama (36238), Ishikawa (32529), Tokushima (33026), Kyooto (37368), *Thamnobryum sandei* (BESCH.) IWATS.: Saitama (36238), Ishikawa (32529), Tokushima (33026), Kyooto (37368), *Thamnobryum sandei* (BESCH.) Iwats. var. *cymbifolium* (CARD.) NOG. et IWATS,: Kumamoto (35008), Kumamoto (37557).

Lembophyllaceae — *Dolichomitra cymbifolia* (LINDB.) BROTH.: Tokushima (36278), Kumamoto (39389), Aichi (35205), Shizuoka (36262), Tokushima (36277), *Dolichomitra cymbifolia* (LINDB.) BROTH. var. *subintegerrima* OKAM.: Hyoogo (37382), Shizuoka (36261), *Dolichomitriopsis crenulata* OKAM.: Niigata (34929), Gifu (32508), Hyoogo (37364), Niigata (37310), Gifu (36260), *Dolichomitriopsis diversiformis* (MITT.) NOG.: Gifu (11074), Ooita (35037), Gifu (36259), Wakayama (39390), Shizuoka (36271), Gifu (11075), Ooita (37529), Tokushima (32509), Gifu (32510), Mie (32565), *Isothecium subdiversiforme* BROTH.: Saitama (36140), Shizuoka (36272), *Neobarbella pilifera* (BROTH. et YAS.) NOG.: Miyazaki (37512), Nara (34983), Miyazaki (34991).

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

Observation and Discussion

I. Observation of the anatomical characteristics of the stem in Isobryales

Cross sections of the stem in many species have been studied in order to find some coordination among the interior structures of the gametophyte. In this paper, the inner structures of the stem in fifty-six species of Isobryales (Fontinalaceae, 2 species; Neckeraceae, 18 species; Lembophyllaceae, 6 species; Hedwigiaceae, 1 species; Leucodontaceae, 4 species; Pterobryaceae, 6 species; Meteoriaceae, 14 species; Trachypodiaceae, 5 species) was observed (see Table 1).

In all the families dealt with in this paper, the stems of each family, with the exception of Trachypodiaceae (only *Duthiella* has the stem of IV-type), show a same type of interior differentiation. Namely, the stems of Climaciaceae, Fontinalaceae, Neckeraceae, Lembophyllaceae, Hedwigiaceae, Leucodontaceae, Pterobryaceae, Meteoriaceae, and Trachypodiaceae (only *Trachypus*) show a differentiation of tissues into an epidermis, external cortex, internal cortex, and a central tissue (III-type). In the stems of Climaciaceae, Fontinalaceae, Neckeraceae, Lembophyllaceae, Hedwigiaceae, Leucodontaceae, Pterobryaceae, and Trachypodiaceae (only *Trachypus*), the cell

Tab. 1 Anatomical characteristics of the stems in fifty-six species of Isobryales

Number of the figures in the Plate		I-1	I-2	I-3	I-4	I-5	I-6
The stem differentiates into an epidermis, cortex and a central tissue (**III**-type) or into an epidermis, cortex, endodermis and a central strand (**IV**-type)		III	III	III	III	III	III
Cell walls of the central tissue are thicker (**O**-type), as thick (**P**-type) or thinner (**Q**-type) than those of the internal cortex		P	P	P	P	P	P
Cells of the central tissue are larger (**L**-type), as large (**M**-type) or smaller (**N**-type) than those of the internal cortex		M	M	M	M	M	M
Cells of the central tissue are parenchymatous (**R**-type) or not (**S**-type)		S	S	S	S	S	S
Cells of the epidermal layer are parenchymatous (**T**-type) or not (**U**-type)		U	U	U	U	U	U
Epidermal cell walls are thicker (**G**-type), as thick (**H**-type) or thinner (**I**-type) than those of the external cortex		H	H	H	H	H	H
Cells of the epidermal layer are larger (**V**-type), as large (**W**-type) or smaller (**X**-type) than those of the external cortex		X	X	X	X	X	X
Number of the cell layers of the external cortex is 1-4 cell layers (**C**-type) or 4-7 cell layers (**D**-type)	Type	D	D	D	D	D	D
	Layers	4(3-5)	4(4-5)	5(5-5)	3(4-5)	5(5-5)	5(4-5)
Number of the cell layers of the internal cortex is 1-4 cell layers (**A**-type) or 4-13 cell layers (**B**-type)	Type	*	*	*	*	*	*
	Layers						
		Dichelyma japonicum CARD.	*Dichelyma japonicum* CARD.	*Dichelyma japonicum* CARD.	*Dichelyma japonicum* CARD.	*Dichelyma japonicum* CARD.	*Dichelyma japonicum* CARD.

Fontinalis hypnoides HARTM.	*	1(1-2)C	X	H	U	R	M	P	III	II-1
Fontinalis hypnoides HARTM.	*	1(1-2)C	X	H	U	R	M	P	III	II-2
Fontinalis hypnoides HARTM.	*	1(1-2)C	X	H	U	R	M	P	III	II-3
Fontinalis hypnoides HARTM.	*	2(1-3)C	X	H	U	R	M	P	III	II-4
Fontinalis hypnoides HARTM.	*	1(1-2)C	X	H	U	R	M	P	III	II-5
Fontinalis hypnoides HARTM.	*	2(2-3)C	X	H	U	R	M	P	III	II-6
Hedwigia ciliata (HEDW.) EHRH.	2(2-4)A	3(3-4)C	X	I	U	S	M	P	III	III-1
Hedwigia ciliata (HEDW.) EHRH.	2(2-4)A	3(3-4)C	X	I	U	S	M	P	III	III-2
Hedwigia ciliata (HEDW.) EHRH.	3(3-5)A	3(3-3)C	X	I	U	S	M	P	III	III-3
Hedwigia ciliata (HEDW.) EHRH.	3(3-5)A	3(3-4)C	X	I	U	S	M	P	III	III-4
Hedwigia ciliata (HEDW.) EHRH.	3(3-4)A	3(3-4)C	X	I	U	S	M	P	III	III-5
Hedwigia ciliata (HEDW.) EHRH.	3(3-6)A	3(3-3)C	X	I	U	S	M	P	III	III-6
Dozya japonica LAC.	6(6-7)B	4(4-5)D	W	I	U	S	M(N)	P	III	IV-1
Dozya japonica LAC.	6(6-8)B	4(3-5)D	W	I	U	S	M(N)	P	III	IV-2
Dozya japonica LAC.	6(6-7)B	5(4-5)D	W	I	U	S	M(N)	P	III	IV-3
Dozya japonica LAC.	6(5-6)B	4(4-4)D	W	I	U	S	M(N)	P	III	IV-4
Dozya japonica LAC.	6(6-6)B	4(4-4)D	W	I	U	S	M(N)	P	III	IV-5
Dozya japonica LAC.	6(5-7)B	4(4-5)D	W	I	U	S	M(N)	P	III	IV-6
Leucodon exaltatus C. MUELL.	7(6-7)B	3(3-4)C	W	H	U	S	M(N)	P	III	V-1
Leucodon exaltatus C. MUELL.	7(6-8)B	3(3-4)C	W	H	U	S	M(N)	P	III	V-2
Leucodon exaltatus C. MUELL.	6(5-6)B	3(3-4)C	W(V)	H	U	S	M(N)	P	III	V-3
Leucodon exaltatus C. MUELL.	6(6-7)B	2(2-3)C	W(X)	H	U	S	M(N)	P	III	V-4
Leucodon exaltatus C. MUELL.	6(6-7)B	3(3-4)C	W(X)	H	U	S	M(N)	P	III	V-5
Leucodon exaltatus C. MUELL.	6(6-7)B	3(3-4)C	W(X)	H	U	S	M(N)	P	III	V-6
Leucodon noguchii IWATS.	*	4(4-5)D	X	H	U	S	M	P	III	VI-1
Leucodon noguchii IWATS.	*	4(4-5)D	X	H	U	S	M	P	III	VI-2
Leucodon noguchii IWATS.	*	4(4-4)D	X	H	U	S	M	P	III	VI-3
Leucodon noguchii IWATS.	*	4(4-5)D	X	H	U	S	M	P	III	VI-4
Leucodon noguchii IWATS.	*	4(4-5)D	X	H	U	S	M	P	III	VI-5
Leucodon noguchii IWATS.	*	4(4-4)D	X	H	U	S	M	P	III	VI-6
Leucodon sapporensis BESCH.	6(5-8)B	4(3-4)C	X	H	U	S	M(N)	P	III	VII-1
Leucodon sapporensis BESCH.	6(6-8)B	3(3-4)C	X	H	U	S	M(N)	P	III	VII-2
Leucodon sapporensis BESCH.	7(7-8)B	3(3-4)C	X	H	U	S	M(N)	P	III	VII-3
Leucodon sapporensis BESCH.	6(5-7)B	4(3-4)C	X	H	U	S	M(N)	P	III	VII-4
Leucodon sapporensis BESCH.	7(7-9)B	3(3-4)C	X	H	U	S	M(N)	P	III	VII-5
Leucodon sapporensis BESCH.	6(5-6)B	4(3-4)C	X	H	U	S	M(N)	P	III	VII-6

Duthiella flaccida (CARD.) BROTH.	5(4-5)B	2(1-2)C	X	I	U	R	N(M)	Q	IV	VIII-1
Duthiella flaccida (CARD.) BROTH.	5(4-5)B	2(2-3)C	X(W)	I	U	R	N	Q	IV	VIII-2
Duthiella flaccida (CARD.) BROTH.	5(4-5)B	2(2-1)C	X	I	U	R	N	Q	IV	VIII-3
Duthiella flaccida (CARD.) BROTH.	5(4-6)B	2(1-2)C	X(W)	I	U	R	N	Q	IV	VIII-4
Duthiella flaccida (CARD.) BROTH.	5(4-6)B	2(2-3)C	X	I	U	R	N	Q	IV	VIII-5
Duthiella flaccida (CARD.) BROTH.	4(3-5)B	2(1-3)C	X	I	U	R	N	Q	IV	VIII-6
Duthiella speciosissima BROTH.	11(10-13)B	5(5-6)D	X	H	U	R	N	Q	IV	IX-1
Duthiella speciosissima BROTH.	10(10-13)B	4(4-5)D	X	H	U	R	N	Q	IV	IX-2
Duthiella speciosissima BROTH.	12(11-14)B	5(5-6)D	X	H	U	R	N	Q	IV	IX-3
Duthiella speciosissima BROTH.	12(11-14)B	4(3-4)D	X	H	U	R	N	Q	IV	X-1
Duthiella speciosissima BROTH.	12(11-13)B	5(5-6)D	X	H	U	R	N	Q	IV	X-2
Duthiella speciosissima BROTH.	10(9-13)B	4(3-4)D	X	H	U	R	N	Q	IV	X-3
Duthiella wallichii (MITT.) C. MUELL.	5(5-6)B	5(5-6)D	X	I	U	R	N	Q	IV	XI-1
Duthiella wallichii (MITT.) C. MUELL.	5(4-7)B	4(4-5)D	X	I	U	R	N	Q	IV	XI-2
Duthiella wallichii (MITT.) C. MUELL.	8(7-9)B	5(4-5)D	X	I	U	R	N	Q	IV	XI-3
Duthiella wallichii (MITT.) C. MUELL.	7(6-8)B	4(4-5)D	X	I	U	R	N	Q	IV	XII-1
Duthiella wallichii (MITT.) C. MUELL.	5(5-6)B	4(3-5)D	X	I	U	R	N	Q	IV	XII-2
Duthiella wallichii (MITT.) C. MUELL.	6(5-7)B	4(3-4)D	X	I	U	R	N	Q	IV	XII-3
Trachypus bicolor REINW. et HORNSCH.	7(6-8)B	4(4-5)D	X	G	U	S	M(N)	P	III	XIII-1
Trachypus bicolor REINW. et HORNSCH.	6(6-7)B	4(4-5)D	X	G(H)	U	S	M(N)	P	III	XIII-2
Trachypus bicolor REINW. et HORNSCH.	5(5-6)B	4(3-5)D	X	G	U	S	M(N)	P	III	XIII-3
Trachypus bicolor REINW. et HORNSCH.	5(5-6)B	4(3-4)D	X	G	U	S	M(N)	P	III	XIV-1
Trachypus bicolor REINW. et HORNSCH.	5(5-6)B	4(4-5)D	X	G	U	S	M(N)	P	III	XIV-2
Trachypus bicolor REINW. et HORNSCH.	7(6-8)B	4(4-5)D	X	G	U	S	M(N)	P	III	XIV-3
Trachypus humilis LINDB.	5(5-7)B	4(4-4)C	X	I	U	S	M	P	III	XV-1
Trachypus humilis LINDB.	5(5-5)B	3(3-3)C	X(W)	I	U	S	M	P	III	XV-2
Trachypus humilis LINDB.	5(4-5)B	4(3-4)C	X	I	U	S	M	P	III	XV-3
Trachypus humilis LINDB.	5(5-6)B	3(3-3)C	X	I	U	S	M	P	III	XV-4
Trachypus humilis LINDB.	5(5-6)B	3(3-3)C	X	I	U	S	M	P	III	XV-5
Trachypus humilis LINDB.	5(5-6)B	4(3-4)C	X	I	U	S	M	P	III	XV-6
Trachypus humilis LINDB.	4(4-5)B	3(3-4)C	X	I	U	S	M	P	III	XV-7
Trachypus humilis LINDB.	5(5-6)B	3(3-4)C	X(W)	I	U	S	M	P	III	XV-8
Calyptothecium hookeri (MITT.) BROTH.	4(4-5)B	4(3-4)C	X	G	U	S	M	P	III	XVI-1
Calyptothecium hookeri (MITT.) BROTH.	5(5-6)B	3(3-4)C	X	G	U	S	M	P	III	XVI-2
Calyptothecium hookeri (MITT.) BROTH.	5(5-6)B	4(3-5)C	X	G	U	S	M	P	III	XVI-3
Calyptothecium hookeri (MITT.) BROTH.	5(5-6)B	4(3-4)C	X	G	U	S	M	P	III	XVII-1
Calyptothecinm hookeri (MITT.) BROTH.	4(4-5)B	4(3-4)C	X	G	U	S	M	P	III	XVII-2
Calyptothecium hookeri (MITT.) BROTH.	4(4-5)B	4(3-4)C	X	G	U	S	M	P	III	XVII-3

Calyptothecium urvilleanum (C. MUELL.) BROTH.	5(5-6)B	4(3-5)C	X	H(G)	U	S	M	P	III	XVIII-1
Calyptothecium urvilleanum (C. MUELL.) BROTH.	5(5-6)B	4(3-4)C	X(W)	H	U	S	M	P	III	XVIII-2
Calyptothecium urvilleanuu (C. MUELL.) BROTH.	5(5-6)B	4(4-5)C	X	H	U	S	M	P	III	XVIII-3
Calyptothecium urvilleanum (C. MUELL.) BROTH.	5(5-6)B	4(3-5)C	X	H	U	S	M	P	III	XIX-1
Calyptothecium urvilleanum (C. MUELL.) BROTH.	6(5-6)B	3(3-4)C	X	H	U	S	M	P	III	XIX-2
Calyptothecium urvilleanum (C. MUELL.) BROTH.	6(6-8)B	3(3-4)C	X	H	U	S	M	P	III	XIX-3
Myuriopsis sinica (MITT.) NOG.	6(6-7)B	3(3-4)C	X	H	U	S	M(N)	P	III	XX-1
Myuriopsis sinica (MITT.) NOG.	6(5-6)B	3(3-4)C	X	H	U	S	M(N)	P	III	XX-2
Myuriopsis sinica (MITT.) NOG.	6(5-7)B	4(3-4)C	X	H	U	S	M(N)	P	III	XX-3
Myuriopsis sinica (MITT.) NOG.	5(5-6)B	4(4-5)D	X	H	U	S	M(N)	P	III	XXI-1
Myuriopsis sinica (MITT.) NOG.	6(5-7)B	3(3-4)C	X	H	U	S	M(N)	P	III	XXI-2
Myuriopsis sinica (MITT.) NOG.	6(5-7)B	3(2-4)C	X	H	U	S	M(N)	P	III	XXI-3
Myurium assimile (BROTH.) SEKI	2(1-3)A	2(2-3)C	X	I	U	S	M	P	III	XXII-1
Myurium assimile (BROTH.) SEKI	2(2-4)A	2(2-3)C	X	I	U	S	M	P	III	XXII-2
Myurium assimile (BROTH.) SEKI	3(2-3)A	2(2-3)C	X(W)	I	U	S	M	P	III	XXII-3
Myurium assimile (BROTH.) SEKI	3(2-4)A	2(2-3)C	X	I	U	S	M	P	III	XXII-4
Myurium assimile (BROTH.) SEKI	3(2-3)A	2(2-3)C	X(W)	I	U	S	M	P	III	XXII-5
Myurium assimile (BROTH.) SEKI	2(1-3)A	2(2-3)C	X	I	U	S	M	P	III	XXII-6
Myurium fragile (CARD.) BROTH.	4(4-5)B	3(3-4)C	W(X)	I	U	S	M	P	III	XXIII-1
Myurium fragile (CARD.) BROTH.	2(2-3)A	3(2-3)C	W	I	U	S	M	P	III	XXIII-2
Myurium fragile (CARD.) BROTH.	2(1-3)A	2(2-3)C	W(X)	I	U	S	M	P	III	XXIII-3
Myurium fragile (CARD.) BROTH.	2(2-3)A	2(2-3)C	W	I	U	S	M	P	III	XXIII-4
Myurium fragile (CARD.) BROTH.	2(2-3)A	2(1-2)C	W(X)	I	U	S	M	P	III	XXIII-5
Myurium fragile (CARD.) BROTH.	4(4-5)B	3(3-3)C	W(X)	I	U	S	M	P	III	XXIII-6
Pterobryum arbuscula MITT.	4(4-5)B	4(4-5)D	X	I	U	S	M	P	III	XXIV-1
Pterobryum arbuscula MITT.	4(4-5)B	5(4-5)D	X	I	U	S	M	P	III	XXIV-2
Pterobryum arbuscula MITT.	4(4-5)B	5(5-5)D	X	I	U	S	M	P	III	XXIV-3
Pterobryum arbuscula MITT.	4(4-5)B	4(4-5)D	X	I	U	S	M	P	III	XXV-1
Pterobryum arbuscula MITT.	4(4-5)B	5(5-6)D	X	I	U	S	M	P	III	XXV-2
Pterobryum arbuscula MITT.	5(4-6)B	5(4-6)D	X	I(H)	U	S	M	P	III	XXV-3
Aerobryum speciosum DOZ. et MOLK.	6(5-7)B	4(4-5)D	X	I	U	R	N	Q	III	XXVI-1
Aerobryum speciosum DOZ. et MOLK.	4(3-5)B	4(4-5)D	X	I	U	R	N	Q	III	XXVI-2
Aerobryum speciosum DOZ. et MOLK.	5(5-6)B	4(4-5)D	X	I	U	R	N	Q	III	XXVI-3
Aerobryum speciosum DOZ. et MOLK.	5(4-7)B	4(4-5)D	X	I(H)	U	R	N	Q	III	XXVI-4
Aerobryum speciosum DOZ. et MOLK.	4(4-5)B	4(4-5)D	X	I	U	R	N	Q	III	XXVII-1
Aerobryum speciosum DOZ. et MOLK.	3(2-4)A	4(4-5)D	X	I	U	R	N	Q	III	XXVII-2
Barbella flagellifera (CARD.) NOG.	2(2-3)A	2(1-3)C	X(W)	I	U	R	M	Q	III	XXVII-3
Barbella flagellifera (CARD.) NOG.	2(2-3)A	2(1-2)C	X	I	U	R	M	Q	III	XXVII-4
Barbella flagellifera (CARD.) NOG.	2(1-2)A	2(1-2)C	X	I(H)	U	R	M	Q	III	XXVII-5
Barbella flagellifera (CARD.) NOG.	2(1-2)A	2(2-3)C	X(W)	I(H)	U	R	M	Q	III	XXVII-6
Barbella flagellifera (CARD.) NOG.	2(1-2)A	2(1-2)C	X(W)	I(H)	U	R	M	Q	III	XXVIII-1
Barbella flagellifera (CARD.) NOG.	1(1-2)A	2(1-2)C	X	I	U	R	M	Q	III	XXVIII-2

Barbella enervis (THWAIT. et MITT.)FL.	2(2-3)A	2(2-4)C	X(W)	H	U	R	M	Q	III	XXVIII-3
Barbella enervis (THWAIT. et MITT.)FL.	3(2-3)A	3(2-4)C	X(W)	H	U	R	M	Q	III	XXVIII-4
Barbella enervis (THWAIT. et MITT.)FL.	2(2-3)A	3(2-3)C	X(W)	H	U	R	M	Q	III	XXVIII-5
Barbella enervis (THWAIT. et MITT.)FL.	2(2-3)A	3(2-3)C	X	H	U	R	M	Q	III	XXVIII-6
Barbella enervis (THWAIT. et MITT.)FL.	2(2-3)A	3(2-3)C	X	H	U	R	M	Q	III	XXIX-1
Barbella enervis (THWAIT. et MITT.)FL.	3(2-3)A	2(2-3)C	X	H	U	R	M	Q	III	XXIX-2
Barbella pendula (SULL.) FL.	2(2-3)A	2(2-3)C	X	H(G)	U	R	M(N)	Q	III	XXIX-3
Barbella pendula (SULL.) FL.	4(3-4)A	3(3-3)C	X	H	U	R	M(N)	Q	III	XXIX-4
Barbella pendula (SULL.) FL.	4(4-3)A	3(3-4)C	X	H	U	R	M(N)	Q	III	XXIX-5
Barbella pendula (SULL.) FL.	3(2-3)A	2(2-3)C	X	H	U	R	M(N)	Q	III	XXIX-6
Barbella pendula (SULL.) FL.	3(2-3)A	3(2-3)C	X	H	U	R	M(N)	Q	III	XXX-1
Barbella pendula (SULL.) FL.	3(3-4)A	3(2-3)C	X	H	U	R	M(N)	Q	III	XXX-2
Chrysocladium retrorsum (MITT.) FL.	5(5-6)B	4(3-4)C	X	H	U	R	N(M)	Q	III	XXX-3
Chrysocladium retrorsum (MITT.) FL.	4(4-5)B	3(3-4)C	X	H	U	R	N(M)	Q	III	XXX-4
Chrysocladium retrorsum (MITT.) FL.	5(4-6)B	3(3-4)C	X	H	U	R	N(M)	Q	III	XXX-5
Chrysocladium retrorsum (MITT.) FL.	4(4-6)B	4(4-4)C	X	H	U	R	N(M)	Q	III	XXX-6
Chrysocladium retrorsum (MITT.) FL.	5(5-6)B	4(3-4)C	X	H	U	R	N(M)	Q	III	XXXI-1
Chrysocladium retrorsum (MITT.) FL.	4(4-6)B	3(3-4)C	X	H	U	R	N(M)	Q	III	XXXI-2
Floribundaria floribunda (DOZ. et MOLK.) FL.	5(5-6)B	4(3-4)C	X	I	U	R	N	Q	III	XXXII-1
Floribundaria floribunda (DOZ. et MOLK.) FL.	5(5-6)B	3(3-4)C	X	I	U	R	N	Q	III	XXXII-2
Floribundaria floribunda (DOZ. et MOLK.) FL.	5(5-6)B	4(3-4)C	X	I	U	R	N	Q	III	XXXII-3
Floribundaria floribunda (DOZ. et MOLK.) FL.	5(5-6)B	4(3-4)C	X	I	U	R	N	Q	III	XXXIII-1
Floribundaria floribunda (DOZ. et MOLK.) FL.	6(5-7)B	4(4-5)D	X	I	U	R	N	Q	III	XXXIII-2
Floribundaria floribunda (DOZ. et MOLK.) FL.	5(5-6)B	4(3-4)C	X	I	U	R	N	Q	III	XXXIII-3
Floribundaria aurea ssp. *nipponica* (NOG.) NOG.	5(6-7)B	4(4-6)D	X(W)	I	U	R	N	Q	III	XXXIV-1
Floribundaria aurea ssp. *nipponica* (NOG.) NOG.	5(5-6)B	4(4-6)D	X	I	U	R	N	Q	III	XXXIV-2
Floribundaria aurea ssp. *nipponica* (NOG.) NOG.	5(5-7)B	5(4-6)D	X	I	U	R	N(M)	Q	III	XXXIV-3
Floribundaria aurea ssp. *nipponica* (NOG.) NOG.	5(5-6)B	4(4-6)D	X	I	U	R	N	Q	III	XXXV-1
Floribundaria aurea ssp. *nipponica* (NOG.) NOG.	4(4-5)B	3(3-4)C	X	I	U	R	N	Q	III	XXXV-2
Floribundaria aurea ssp. *nipponica* (NOG.) NOG.	4(4-5)B	4(3-6)D	X(W)	I	U	R	N	Q	III	XXXV-3
Floribundaria pseudofloribunda FL.	4(4-5)B	3(3-4)C	X	I	U	R	N	Q	III	XXXVI-1
Floribundaria pseudofloribunda FL.	4(3-5)A	3(3-4)C	X	I	U	R	N	Q	III	XXXVI-2
Floribundaria pseudofloribunda FL.	4(3-5)A	3(3-4)C	X	I	U	R	N	Q	III	XXXVI-3
Floribundaria pseudofloribunda FL.	3(2-4)A	3(3-4)C	X	I	U	R	N	Q	III	XXXVI-4
Floribundaria pseudofloribunda FL.	3(3-4)A	2(2-3)C	X	I	U	R	N	Q	III	XXXVII-1
Floribundaria pseudofloribunda FL.	4(3-4)A	2(2-3)C	X	I	U	R	N	Q	III	XXXVII-2
Meteoriopsis reclinata (C.MUELL.) FL.	4(4-6)B	3(3-4)C	X	H	U	R	M(N)	Q	III	XXXVII-3
Meteoriopsis reclinata (C.MUELL.) FL.	5(5-7)B	3(3-4)C	X	H	U	R	M(N)	Q	III	XXXVII-4
Meteoriopsis reclinata (C.MUELL.) FL.	4(4-5)B	4(4-5)D	X	H	U	R	M(N)	Q	III	XXXVII-5
Meteoriopsis reclinata (C.MUELL.) FL.	4(4-5)B	4(3-4)C	X	H	U	R	M	Q	III	XXXVII-6
Meteoriopsis reclinata (C.MUELL.) FL.	5(4-5)B	4(3-4)C	X	H	U	R	M(N)	Q	III	XXXVIII-1
Meteoriopsis reclinata (C.MUELL.) FL.	5(5-6)B	4(3-4)C	X	H	U	R	M(N)	Q	III	XXXVIII-2

Meteorium buchananii ssp. *helminthocladulum* (CARD.) NOG.	5(3-6)B	4(3-4)C	X	H	U	R	M	Q	III	XXXVIII-3
Meteorium buchananii ssp. *helminthocladulum* (CARD.) NOG.	5(4-8)B	5(4-6)D	X	H	U	R	M	Q	III	XXXVIII-4
Meteorium buchananii ssp. *helmiuthocladulum* (CARD.) NOG.	4(3-5)B	5(5-6)D	X	H	U	R	M(N)	Q	III	XXXVIII-5
Meteorinm buchananii ssp. *helminthocladulum* (CARD.) NOG.	4(4-5)B	4(4-5)D	X	H	U	R	M(N)	Q	III	XXXVIII-6
Meteorium buchananii ssp. *heiminthocladulum* (CARD.) NOG.	3(2-4)A	4(4-5)D	X	H	U	R	M(N)	Q	III	XXXIX-1
Meteorium buchananii ssp. *helminthocladulum* (CARD.) NOG.	3(3-4)A	4(3-5)D	X	H	U	R	M(N)	Q	III	XXXIX-2
Meteorium buchananii v. *cuspiadtum* (OKAM.) NOG.	4(3-4)A	4(4-4)C	X	H	U	R	M(N)	Q	III	XXXIX-3
Meteorium buchananii v. *cuspidatum* (OKAM.) NOG.	5(4-6)B	4(3-4)C	X	H	U	R	M(N)	Q	III	XXXIX-4
Meteorium buchananii v. *cuspidatum* (OKAM.) NOG.	5(4-5)B	4(3-4)C	X	H	U	R	M(N)	Q	III	XXXIX-5
Meteorium buchananii v. *cuspidatum* (OKAM.) NOG.	2(2-3)A	4(4-5)C	X	H	U	R	M(N)	Q	III	XXXIX-6
Meteorium buchananii v. *cuspidatum* (OKAM.) NOG.	3(2-5)A	4(3-5)C	X	H	U	R	M(N)	Q	III	XL-1
Meteorium buchananii v. *cuspidatum* (OKAM.) NOG.	4(3-5)A	4(4-5)C	X	H	U	R	M(N)	Q	III	XL-2
Meteorium miquelianum (C. MUELL.) FL.	4(4-5)B	4(4-4)D	X	H	U	R	M(N)	Q	III	XL-3
Meteorium miquelianum (C. MUELL.) FL.	5(5-7)B	4(4-5)D	X	H	U	R	M(N)	Q	III	XL-4
Meteorium miquelianum (C. MUELL.) FL.	4(4-5)B	4(4-5)D	X	H	U	R	M(N)	Q	III	XL-5
Meteorium miquelianum (C. MUELL.) FL.	4(3-6)B	4(4-5)D	X	H	U	R	M(N)	Q	III	XL-6
Meteorium miquelianum (C. MUELL.) FL.	5(4-6)B	3(3-4)C	X	H	U	R	M(N)	Q	III	XLI-1
Meteorium miquelianum (C. MUELL.) FL.	4(3-6)B	4(3-5)D	X	H	U	R	M(N)	Q	III	XLI-2
Pseudobarbella attenuata (THWAIT. et MITT.) NOG.	4(4-6)B	4(4-4)C	X	H	U	R	N(M)	Q	III	XLI-3
Pseudobarbella attenuata (THWAIT. et MITT.) NOG.	4(2-5)A	3(3-4)C	X	H	U	R	N(M)	Q	III	XLI-4
Pseudobarbella attenuata (THWAIT. et MITT.) NOG.	5(4-6)B	4(3-5)C	X	H	U	R	N(M)	Q	III	XLI-5
Pseudobarbella attenuata (THWAIT. et MITT.) NOG.	4(3-5)B	4(4-4)C	X	H	U	R	N(M)	Q	III	XLI-6
Pseudobarbella attenuata (THWAIT. et MITT.) NOG.	4(3-6)B	4(3-4)C	X	H	U	R	N(M)	Q	III	XLII-1
Pseudobarbella attenuata (THWAIT. et MITT.) NOG.	4(3-5)B	4(3-4)C	X	H	U	R	N(M)	Q	III	XLII-2
Pseudobarbella levieri (REN. et CARD.) NOG.	5(5-6)B	4(4-5)D	X	I	U	R	N(M)	Q	III	XLII-3
Pseudobarbella levieri (REN. et CARD.) NOG.	4(3-4)A	4(4-4)D	X	I	U	R	N(M)	Q	III	XLII-4
Pseudobarbella levieri (REN. et CARD.) NOG.	5(5-6)B	4(4-4)D	X	I	U	R	N(M)	Q	III	XLII-5
Pseudobarbella levieri (REN. et CARD.) NOG.	4(3-5)B	4(4-5)D	X	I	U	R	N(M)	Q	III	XLII-6
Pseudobarbella levieri (REN. et CARD.) NOG.	5(4-5)B	4(4-4)D	X	I	U	R	N(M)	Q	III	XLIII-1
Pseudobarbella levieri (REN. et CARD.) NOG.	4(3-5)B	4(4-5)D	X	I	U	R	N(M)	Q	III	XLIII-2
Bissetia lingulata (MITT.) BROTH.	4(3-5)B	4(3-4)C	X	G	U	S	M	P	III	XLIII-3
Bissetia lingulata (MITT.) BROTH.	4(3-5)B	4(4-5)D	X	G	U	S	M	P	III	XLIII-4
Bissetia lingulata (MITT.) BROTH.	5(4-6)B	3(3-3)C	X	G(H)	U	S	M	P	III	XLIII-5
Bissetia lingulata (MITT.) BROTH.	5(5-6)B	3(3-4)C	X	G	U	S	M	P	III	XLIII-6
Bissetia lingulata (MITT.) BROTH.	5(5-7)B	3(3-3)C	X	G	U	S	M	P	III	XLIV-1
Bissetia lingulata (MITT.) BROTH.	4(4-5)B	3(3-4)C	X	G	U	S	M	P	III	XLIV-2
Homaliadelphus targionianus (MITT.) DIX. et VARD.	3(2-4)A	3(3-3)C	X	G	U	S	M	P	III	XLIV-3
Homaliadelphus targionianus (MITT.) DIX. et VARD.	3(2-4)A	3(2-3)C	X	H	U	S	M	P	III	XLIV-4
Homaliadelphus targionianus (MITT.) DIX. et VARD.	2(2-3)A	3(3-4)C	X	H	U	S	M	P	III	XLIV-5
Homaliadelphus targionianus (MITT.) DIX. et VARD.	3(2-4)A	2(2-3)C	X	H	U	S	M	P	III	XLIV-6
Homaliadelphus targionianus (MITT.) DIX. et VARD.	3(2-4)A	3(3-4)C	X	H	U	S	M	P	III	XLV-1
Homaliadelphus targionianus (MITT.) DIX. et VARD.	3(2-4)A	3(3-4)C	X	H	U	S	M	P	III	XLV-2

Homaliodendron scalpellifolium (MITT.) FL.	8(6-10)B	7(7-7)D	X	I	U	S	M	P	Ⅲ	XLV-3
Homaliodendron scalpellifolium (MITT.) FL.	7(6-11)B	7(7-8)D	X	I	U	S	M	P	Ⅲ	XLV-4
Homaliodendron scalpellifolium (MITT.) FL.	8(8-11)B	8(8-9)D	X	I	U	S	M	P	Ⅲ	XLVI-1
Homaliodendron scalpellfiolium (MITT.) FL.	8(8-9)B	6(6-7)D	X	I	U	S	M	P	Ⅲ	XLVI-2
Homaliodendron scalpellifolium (MITT.) FL.	7(6-9)B	6(6-7)D	X	I	U	S	M	P	Ⅲ	XLVI-3
Homaliodendron scalpellifolium (MITT.) FL.	6(6-8)B	7(6-8)D	X	I	U	S	M	P	Ⅲ	XLVII-1
Neckera borealis NOG.	7(7-8)B	4(4-5)D	X	I(H)	U	S	M	P	Ⅲ	XLVII-2
Neckera borealis NOG.	7(6-8)B	5(5-6)D	X	I	U	S	M	P	Ⅲ	XLVII-3
Neckera borealis NOG.	6(6-9)B	5(4-5)D	X	I	U	S	M	P	Ⅲ	XLVIII-1
Neckera borealis NOG.	7(6-9)B	4(3-4)C	X	I	U	S	M	P	Ⅲ	XLVIII-2
Neckera borealis NOG.	7(6-8)B	4(4-5)D	X	I	U	S	M	P	Ⅲ	XLVIII-3
Neckera borealis NOG.	6(6-8)B	4(4-4)D	X	I	U	S	M	P	Ⅲ	XLIX-1
Neckera flexiramea CARD.	4(4-5)B	4(3-5)D	X	I	U	S	M	P	Ⅲ	XLIX-2
Neckera flexiramea CARD.	4(3-5)B	4(4-5)D	X	I	U	S	M	P	Ⅲ	XLIX-3
Neckera flexiramea CARD.	4(4-5)B	4(4-4)D	X	I	U	S	M	P	Ⅲ	XLIX-4
Neckera flexiramea CARD.	5(4-6)B	4(4-4)D	X	I	U	S	M	P	Ⅲ	XLIX-5
Neckera flexiramea CARD.	4(3-6)B	4(3-4)C	X	I	U	S	M	P	Ⅲ	L-1
Neckera flexiramea CARD.	6(5-6)B	4(3-4)C	X	I	U	S	M	P	Ⅲ	L-2
Neckera humilis MITT.	6(6-8)B	4(4-5)D	X	I	U	S	M	P	Ⅲ	L-3
Neckera humilis MITT.	7(6-8)B	4(4-5)D	X	I	U	S	M	P	Ⅲ	L-4
Neckera humilis MITT.	6(5-8)B	5(5-5)D	X	I	U	S	M	P	Ⅲ	LI-1
Neckera humilis MITT.	6(5-7)B	4(4-5)D	X	I	U	S	M	P	Ⅲ	LI-2
Neckera humilis MITT.	5(5-6)B	5(5-5)D	X	I	U	S	M	P	Ⅲ	LI-3
Neckera humilis MITT.	6(5-7)B	5(5-5)D	X	I	U	S	M	P	Ⅲ	LII-1
Neckera muratae NOG.	5(5-7)B	4(4-4)D	X	I	U	S	M	P	Ⅲ	LII-2
Neckera muratae NOG.	4(3-4)A	4(3-4)C	X	I	U	S	M	P	Ⅲ	LII-3
Neckera muratae NOG.	4(4-5)B	4(4-4)D	X	I	U	S	M	P	Ⅲ	LII-4
Neckera muratae NOG.	5(4-5)B	4(4-5)D	X	I	U	S	M	P	Ⅲ	LII-5
Neckera muratae NOG.	5(4-5)B	5(4-6)D	X(W)	I	U	S	M	P	Ⅲ	LIII-1
Neckera muratae NOG.	5(4-5)B	4(4-5)D	X(W)	I	U	S	M	P	Ⅲ	LIII-2
Neckera pennata HEDW.	6(5-7)B	5(4-5)D	X	I	U	S	M	P	Ⅲ	LIII-3
Neckera pennata HEDW.	5(4-6)B	5(5-5)D	X(W)	I	U	S	M	P	Ⅲ	LIII-4
Neckera pennata HEDW.	5(4-6)B	4(4-4)D	X	I	U	S	M	P	Ⅲ	LIII-5
Neckera pennata HEDW.	4(3-5)B	4(3-4)C	X(W)	I	U	S	M	P	Ⅲ	LIII-6
Neckera pennata HEDW.	4(3-5)B	5(5-5)D	X	I	U	S	M	P	Ⅲ	LIV-1
Neckera pennata HEDW.	4(3-5)B	4(4-5)D	X	I	U	S	M	P	Ⅲ	LIV-2
Neckera pusilla MITT.	6(6-7)B	4(4-5)D	X	I	U	S	M	P	Ⅲ	LIV-3
Neckera pusilla MITT.	6(5-6)B	4(4-5)D	X	I	U	S	M	P	Ⅲ	LIV-4
Neckera pusilla MITT.	5(4-6)B	4(4-4)D	X	I	U	S	M	P	Ⅲ	LIV-5
Neckera pusilla MITT.	6(5-6)B	5(4-5)D	X	I	U	S	M	P	Ⅲ	LIV-6
Neckera pusilla MITT.	5(4-6)B	4(4-5)D	X	I	U	S	M	P	Ⅲ	LV-1
Neckera pusilla MITT.	5(4-6)B	4(4-5)D	X	I	U	S	M	P	Ⅲ	LV-2

Neckera yezoana BESCH.	5(5-7)B	4(3-5)D	X	I	U	S	M	P	III	L V-3
Neckera yezoana BESCH.	6(6-7)B	4(4-4)D	X	I(H)	U	S	M	P	III	L V-4
Neckera yezoana BESCH.	7(6-9)B	5(4-6)D	X	I(H)	U	S	M	P	III	L VI-1
Neckera yezoana BESCH.	7(7-10)B	5(4-6)D	X	I(H)	U	S	M	P	III	L VI-2
Neckera yezoana BESCH.	7(7-9)B	5(4-5)D	X	I H	U	S	M	P	III	L VI-3
Neckera yezoana BESCH.	8(8-10)B	5(4-5)D	X	I	U	S	M	P	III	L VII-1
Neckeropsis calcicola NOG.	5(4-7)B	4(4-5)D	W	I	U	S	M	P	III	L VII-2
Neckeropsis calcicola NOG.	4(3-5)B	3(3-4)C	W	I	U	S	M	P	III	L VII-3
Neckeropsis calcicola NOG.	4(3-4)A	3(3-4)C	W	I	U	S	M	P	III	L VII-4
Neckeropsis calcicola NOG.	4(4-5)B	3(3-4)C	W	I	U	S	M	P	III	L VII-5
Neckeropsis calcicola NOG.	5(5-6)B	3(3-4)C	W(X)	I	U	S	M	P	III	L VIII-1
Neckeropsis calcicola NOG.	4(3-4)A	4(4-5)D	X	I	U	S	M	P	III	L VIII-2
Neckeropsis nitidula (MITT.) FL.	4(3-6)B	4(4-4)D	X	I	U	S	M	P	III	L VIII-3
Neckeropsis nitidula (MITT.) FL.	4(3-6)B	4(4-5)D	X(W)	I	U	S	M	P	III	L VIII-4
Neckeropsis nitidula (MITT.) FL.	4(3-6)B	5(4-5)D	X	I	U	S	M	P	III	L VIII-5
Neckeropsis nitidula (MITT.) FL.	4(4-5)B	5(5-5)D	X	I	U	S	M	P	III	L VIII-6
Neckeropsis nitidula (MITT.) FL.	4(3-5)B	4(4-5)D	X(W)	I	U	S	M	P	III	L IX-1
Neckeropsis nitidula (MITT.) FL.	5(4-5)B	5(5-5)D	X(W)	I	U	S	M	P	III	L IX-2
Neckeropsis obtusata (MONT.) FL.	4(4-5)B	4(3-4)C	X	I	U	S	M	P(O)	III	L IX-3
Neckeropsis obtusata (MONT.) FL.	4(3-5)B	3(3-4)C	X	I	U	S	M	P	III	L IX-4
Neckeropsis obtusata (MONT.) FL.	5(4-6)B	4(3-4)C	X(W)	I	U	S	M	P	III	L IX-5
Neckeropsis obtusata (MONT.) FL.	5(4-5)B	4(3-4)C	X	I	U	S	M	P	III	L IX-6
Neckeropsis obtusata (MONT.) FL.	5(4-6)B	4(4-4)C	X	I	U	S	M(N)	P	III	L X-1
Neckeropsis obtusata (MONT.) FL.	4(4-6)B	4(4-4)C	X(W)	I	U	S	M(N)	P	III	L X-2
Pinnatella makinoi (BROTH.) BROTH.	4(3-4)A	5(5-5)D	X	I	U	S	M	P	III	L X-3
Pinnatella makinoi (BROTH.) BROTH.	6(4-6)B	5(4-5)D	X(W)	I	U	S	M	P	III	L X-4
Pinnatella makinoi (BROTH.) BROTH.	4(3-6)B	5(5-5)D	X	I	U	S	M	P	III	L X-5
Pinnatella makinoi (BROTH.) BROTH.	5(4-6)B	5(5-6)D	X	I	U	S	M	P	III	L X-6
Pinnatella makinoi (BROTH.) BROTH.	4(3-6)B	5(5-5)D	X	I	U	S	M	P	III	L XI-1
Pinnatella makinoi (BROTH.) BROTH.	4(3-6)B	4(4-5)D	X	I	U	S	M	P	III	L XI-2
Thamnobryum alopecurum (HEDW.) NIEUWL.	8(7-9)B	6(5-6)D	VW	I	U	S	M	P	III	L XI-3
Thamnobryum alopecurum (HEDW.) NIEUWL.	7(7-9)B	5(5-6)D	W(X)	I(H)	U	S	M	P	III	L XI-4
Thamnobryum alopecurum (HEDW.) NIEUWL.	7(6-8)B	5(5-5)D	W	I	U	S	M	P	III	L XII-1
Thamnobryum alopecurum (HEDW.) NIEUWL.	7(6-8)B	5(5-6)D	W	I	U	S	M(N)	P	III	L XII-2
Thamnobryum alopecurum (HEDW.) NIEUWL.	7(6-8)B	4(4-5)D	W(X)	I	U	S	M(N)	P	III	L XII-3
Thamnobryum alopecurum (HEDW.) NIEUWL.	7(6-8)B	4(4-5)D	W	I	U	S	M(N)	P	III	L XIII-1
Thamnobryum plicatulum (LAC.) IWATS.	7(7-8)B	3(3-4)C	V(W)	H	U	S	M(N)	P(O)	III	L XIII-2
Thamnobryum plicatulum (LAC.) IWATS.	7(7-8)B	3(3-4)C	V	H	U	S	M(N)	P	III	L XIII-3
Thamnobryum plicatulum (LAC.) IWATS.	8(6-9)B	3(3-4)C	V	H	U	S	M(N)	P(O)	III	L XIV-1
Thamnobryum plicatulum (LAC.) IWATS.	9(8-10)B	4(3-4)C	V	H(I)	U	S	M(N)	P(O)	III	L XIV-2
Thamnobryum plicatulum (LAC.) IWATS.	9(9-10)B	4(3-4)C	V	H(I)	U	S	M(N)	P(O)	III	L XIV-3
Thamnobryum plicatulum (LAC.) IWATS.	9(8-10)B	3(3-4)C	V	H(I)	U	S	M(N)	P(O)	III	L XV-1

Thamnobryum sandei (BESCH.) IWATS.	6(5-10)B	4(4-4)C	X(W)	G	U	S	M(N)	P	Ⅲ	LXV-2
Thamnobryum sandei (BESCH.) IWATS.	6(5-8)B	4(4-4)C	X	G(H)	U	S	M(N)	P	Ⅲ	LXV-3
Thamnobryum sandei (BESCH.) IWATS.	7(7-10)B	4(4-5)D	X	G	U	S	M(N)	P	Ⅲ	LXV-4
Thamnobryum sandei (BESCH.) IWATS.	9(9-10)B	5(5-5)D	X	G	U	S	M(N)	P	Ⅲ	LXV-5
Thamnobryum sandei (BESCH.) IWATS.	9(8-9)B	5(5-5)D	X	G	U	S	M(N)	P	Ⅲ	LXVI-1
Thamnobryum sandei (BESCH.) IWATS.	7(6-9)B	5(4-5)D	X	G	U	S	M(N)	P	Ⅲ	LXVI-2
Thamnobryum sandei v. *cymbifolium* (CARD.) NOG. et IWATS.	3(2-4)A	3(2-3)C	X(W)	I	U	S	M	P	Ⅲ	LXVI-3
Thamnobryum sandei v. *cymbifolium* (CARD.) NOG. et IWATS.	3(3-4)A	3(3-3)C	X	I	U	S	M	P	Ⅲ	LXVI-4
Thamnobryum sandei v. *cymbifolium* (CARD.) NOG. et IWATS.	3(2-4)A	3(3-3)C	X	I	U	S	M	P	Ⅲ	LXVI-5
Thamnobryum sandei v. *cymbifolium* (CARD.) NOG. et IWATS.	4(4-5)B	2(2-2)C	X	I	U	S	M	P	Ⅲ	LXVI-6
Thamnobryum sandei v. *cymbifolium* (CARD.) NOG. et IWATS.	3(2-4)A	3(2-4)C	X(W)	I	U	S	M	P	Ⅲ	LXVII-1
Thamnobryum sandei v. *cymbifolium* (CARD.) NOG. et IWATS.	3(3-5)A	3(3-3)C	X(W)	I	U	S	M(N)	P	Ⅲ	LXVII-2
Dolichomitra cymbifolia (LINDB.) BROTH.	5(5-6)B	3(3-3)C	X	G	U	S	M(N)	P	Ⅲ	LXVII-3
Dolichomitra cymbifolia (LINDB.) BROTH.	5(5-6)B	3(3-4)C	X	G	U	S	M(N)	P	Ⅲ	LXVII-4
Dolichomitra cymbifolia (LINDB.) BROTH.	5(4-7)B	4(4-5)D	X	G	U	S	M(N)	P	Ⅲ	LXVII-5
Dolichomitra cymbifolia (LINDB.) BROTH.	5(5-6)B	3(2-4)C	X	G	U	S	M(N)	P	Ⅲ	LXVII-6
Dolichomitra cymbifolia (LINDB.) BROTH.	7(5-8)B	5(4-5)D	X	G	U	S	M(N)	P	Ⅲ	LXVIII-1
Dolichomitra cymbifolia v. *subintegerrima* OKAM.	5(5-6)B	3(3-4)C	X(W)	G	U	S	M(N)	P	Ⅲ	LXVIII-2
Dolichomitra cymbifolia v. *subintegerrima* OKAM.	5(5-7)B	4(4-5)D	X	G	U	S	M(N)	P	Ⅲ	LXVIII-3
Dolichomitra cymbifolia v. *subintegerrima* OKAM.	5(4-5)B	4(4-4)D	X	G	U	S	M(N)	P	Ⅲ	LXIX-1
Dolichomitra cymbifolia v. *subintegerrima* OKAM.	5(5-6)B	5(5-5)D	X	G	U	S	M(N)	P	Ⅲ	LXIX-2
Dolichomitra cymbifolia v. *subintegerrima* OKAM.	6(5-7)B	5(4-5)D	X	G	U	S	M(N)	P	Ⅲ	LXIX-3
Dolichomitra cymbifolia v. *subintegerrima* OKAM.	5(5-6)B	4(4-4)D	X	G	U	S	M(N)	P	Ⅲ	LXX-1
Dolichomitriopsis crenulata OKAM.	6(5-8)B	4(4-5)D	X	I	U	S(R)	M(N)	P(Q)	Ⅲ	LXX-2
Dolichomitriopsis crenulata OKAM.	6(5-7)B	4(4-5)D	X(W)	I	U	S(R)	M(N)	P(Q)	Ⅲ	LXX-3
Dolichomitriopsis crenulata OKAM.	6(5-7)B	4(4-5)D	X	I	U	S(R)	M(N)	P(Q)	Ⅲ	LXXI-1
Dolichomitriopsis crenulata OKAM.	6(5-7)B	4(4-5)D	X(W)	I	U	S(R)	M(N)	P(Q)	Ⅲ	LXXI-2
Dolichomitriopsis crenulata OKAM.	6(5-8)B	4(4-5)D	X	I	U	S(R)	M(N)	P(Q)	Ⅲ	LXXI-3
Dolichomitriopsis crenulata OKAM.	6(5-7)B	5(3-5)D	X	I	U	S(R)	M(N)	P(Q)	Ⅲ	LXXII-1
Dolichomitriopsis diversiformis (MITT.) NOG.	5(4-6)B	4(4-5)D	X	I	U	S	M(N)	P	Ⅲ	LXXII-2
Dolichomitriopsis diversiformis (MITT.) NOG.	5(5-6)B	5(4-5)D	X	I	U	S	M(N)	P	Ⅲ	LXXII-3
Dolichomitriopsis diversiformis (MITT.) NOG.	5(5-6)B	5(5-5)D	X	I	U	S	M(N)	P	Ⅲ	LXXIII-1
Dolichomitriopsis diversiformis (MITT.) NOG.	4(4-5)B	5(4-5)D	X	I	U	S	M(N)	P	Ⅲ	LXXIII-2
Dolichomitriopsis diversiformis (MITT.) NOG.	4(4-6)B	4(4-5)D	X	I	U	S	M(N)	P	Ⅲ	LXXIII-3
Dolichomitriopsis diversiformis (MITT.) NOG.	4(4-5)B	5(4-5)D	X	I	U	S	M(N)	P	Ⅲ	LXXIV-1
Isothecium subdiversiforme BROTH.	5(5-6)B	2(2-3)C	W	I	U	S	M(N)	P	Ⅲ	LXXIV-2
Isothecium subdiversiforme BROTH.	5(5-6)B	4(3-4)C	X	I	U	S	M(N)	P	Ⅲ	LXXIV-3
Isothecium subdiversiforme BROTH.	6(5-7)B	3(3-4)C	X	I	U	S	M(N)	P	Ⅲ	LXXIV-4
Isothecium subdiversiforme BROTH.	7(6-8)B	3(3-4)C	X(W)	I	U	S	M(N)	P	Ⅲ	LXXV-1
Isothecium subdiversiforme BROTH.	6(5-7)B	3(2-3)C	X(W)	I	U	S	M(N)	P	Ⅲ	LXXV-2
Isothecium subdiversiforme BROTH.	5(5-6)B	4(4-4)C	X(W)	I	U	S	M(N)	P	Ⅲ	LXXV-3

Neobarbella pilifera (BROTH. et YAS.) NOG.	5(5-5)B	3(3-4)C	X(W)	I	U	S	M	P	Ⅲ	LXXVI-1
Neobarbella pilifera (BROTH. et YAS.) NOG.	4(3-4)A	4(4-4)C	X	I	U	S	M	P	Ⅲ	LXXVI-2
Neobarbella pilifera (BROTH. et YAS.) NOG.	5(4-5)B	4(3-4)C	X	I	U	S	M	P	Ⅲ	LXXVI-3
Neobarbella pilifera (BROTH. et YAS.) NOG.	4(4-5)B	3(3-4)C	X	I	U	S	M	P	Ⅲ	LXXVI-4
Neobarbella pilifera (BROTH. et YAS.) NOG.	3(2-4)A	4(4-4)C	X	I	U	S	M	P	Ⅲ	LXXVI-5
Neobarbella pilifera (BROTH. et YAS.) NOG.	5(4-5)B	4(3-4)C	X	I	U	S	M	P	Ⅲ	LXXVI-6

walls of the central tissue are as thick as those of the internal cortex (P-type), but the stems of Meteoriaceae and Trachypodiaceae (only *Duthiella*) show a **Q**-type (the cell walls of the central tissue are thinner than those of the internal cortex). Next, in Climaciaceae, Meteoriaceae (*Chrysocladium, Pseudobarbella, Aerobryum, Floribundaria*), and Trachypodiaceae (only *Duthiella*), the cells of the central tissue are smaller than those of the internal cortex (N-type). However, Fontinalaceae, Neckeraceae, Lembophyllaceae, Hedwigiaceae, Leucodontaceae, Pterobryaceae, and Meteoriaceae (*Meteoriopsis, Meteorium, Barbella*) have **M**-type stems. The central tissues of Climaciaceae, Fontinalaceae (only *Dichelyma*), Neckeraceae, Lembophyllaceae, Hedwigiaceae, Leucodontaceae, Pterobryaceae, and Trachypodiaceae (only *Trachypus*) are not parenchymatous (S-type), but in Fontinalaceae (only *Fontinalis*), Meteoriaceae, and Trachypodiaceae (*Duthiella*), the central tissue of the stem is parenchymatous (**R**-type).

There is something in common among the characteristics of the interior structure of the stem in the species belonging to the identical family (see Table 2). In Climaciaceae, the stems of the species are of the identical type of **III-P-N(M)-S-U-H-X**; in Fontinalaceae, **III-P-M-U-H-X**; in Neckeraceae, **III-P-M-S-U**; in Lembophyllaceae, **III-P-M(N)-S-U**; in Hedwigiaceae, **III-P-M-S-U-I-X**; in Leucodontaceae, **III-P-M(N)-S-U**; in Pterobryaceae, **III-P-M-S-U**; in Meteoriaceae, **III-Q-R-U-X**; and in Trachypodiaceae, **III-P-M-S-U** or **IV-Q-N-R-U**.

As stated above, some regularity can be seen among the anatomical characteristics of the stems in all species belonging to the identical family, except Trachypodiaceae. From these facts, the anatomical characteristics mentioned above, that is, the type of inner differentiation of the stem (**III**-and **IV**-types); comparative thickness of the cell walls of the central tissue and of the internal cortex (**P**-and **Q**-types); comparison of the size of the cells of the central tissue and that of the cells of the internal cortex (**M**- and **N**-types); and the thickness of the cell walls of the central tissue (**R**-and **S**-types), appear to be very important in making an investigation of the essential characteristics.

II. What sort of anatomical characteristics should be taken up for systematic study?

(1) Examination of the essential character of the interior structure resulting from the process of division in the apical cell of the stem

In *Climacium*, the ontogeny of the apex of the stem was investigated, and the process of cell division of the apical cell was roughly clarified (KAWAI 1977). There are different views of how to deal with the segmentation of the apical cell of the stem. In this paper the process of segmentation is divided into several periods of cell division, which correlate with the order of cell division, as KAWAI (1974) suggested. A series of cell divisions in each period are simplified, and the ontogeny of the stem apex is investigated in relation to the modes of the cell division.

The period in which a large apical cell (meristematic cell) is situated on the pointed end of the stem and separates the segments, is called the first-division period. The period in

Tab. 2 Affinity regarding the anatomical characteristics of the stem in fifty-eight species of Isobryales

Family	Species	BI	AII-b	AII-a			BII			Type
Climaciaceae	*Climacium dendroides*	B	D	X	I(H)	U	S	N(M)	P	III
	Climacium japonicum	B	C	X	H	U	S	N(M)	P	III
Fontinalaceae	*Fontinalis hypnoides*	*	C	X	H	U	R	M	P	III
	Dichelima japonicum	*	D	X	H	U	S	M	P	III
Neckeraceae	*Homaliadelphus targionianus*	A	C	X	H	U	S	M	P	III
	Bissetia lingulata	B	C	X	G	U	S	M	P	III
	Homaliodendron scalpellifolium	B	D	X	I	U	S	M	P	III
	Neckeropsis nitidula	B	D	X	I	U	S	M	P	III
	Neckeropsis obtusata	B	C	X	I	U	S	M	P	III
	Neckeropsis calcicola	B	C	W	I	U	S	M	P	III
	Neckera borealis	B	D	X	I	U	S	M	P	III
	Neckera flexiramea	B	D	X	I	U	S	M	P	III
	Neckera humilis	B	D	X	I	U	S	M	P	III
	Neckera muratae	B	D	X	I	U	S	M	P	III
	Neckera pennata	B	D	X	I	U	S	M	P	III
	Neckera pusilla	B	D	X	I	U	S	M	P	III
	Neckera yezoana	B	D	X	I(H)	U	S	M	P	III
	Pinnatella makinoi	B	D	X	I	U	S	M	P	III
	Thamnobryum alopecurum	B	D	W	I	U	S	M	P	III
	Thamnobryum sandei v. *cymbifolium*	A	C	X	I	U	S	M	P	III
	Thamnobryum sandei	B	D	X	G	U	S	M(N)	P	III
	Thamnobryum plicatulum	B	C	V	H	U	S	M(N)	P	III
Lembophyllaceae	*Dolichomitra cymbifolia*	B	C	X	G	U	S	M(N)	P	III
	Dolichomitra cymbifolia v. *subintegerrima*	B	D	X	G	U	S	M(N)	P	III
	Neobarbella pilifera	B	C	X	I	U	S	M	P	III
	Isothecium subdiversiforme	B	C	X(W)	I	U	S	M(N)	P	III
	Dolichomitriopsis diversiformis	B	D	X	I	U	S	M(N)	P	III
	Dolichomitriopsis crenulata	B	D	X	I	U	S(R)	M(N)	P(Q)	III
Hedwigiaceae	*Hedwigia ciliata*	A	C	X	I	U	S	M	P	III
Leucodontaceae	*Leucodon noguchii*	*	D	X	H	U	S	M	P	III
	Leucodon exaltatus	B	C	W	H	U	S	M(N)	P	III
	Leucodon sapporensis	B	C	X	H	U	S	M(N)	P	III
	Dozya japonica	B	D	W	I	U	S	M(N)	P	III

Pterobryaceae	*Pterobryum arbuscula*	B	D	X	I	U	S	M	P	III
	Myurium assimile	A	C	X	I	U	S	M	P	III
	Myurium fragile	A	C	W	I	U	S	M	P	III
	Calyptothecium hookeri	B	C	X	G	U	S	M	P	III
	Calyptothecium urvilleanum	B	C	X	H	U	S	M	P	III
	Myuriopsis sinica	B	C	X	H	U	S	M(N)	P	III
Meteoriaceae	*Meteorium buchananii* ssp. *helminthocladulum*	B	D	X	H	U	R	M(N)	Q	III
	Meteorium buchananii v. *cuspidatum*	A(B)	C	X	H	U	R	M(N)	Q	III
	Meteorium miquelianum	B	D	X	H	U	R	M(N)	Q	III
	Meteoriopsis reclinata	B	C	X	H	U	R	M(N)	Q	III
	Barbella pendula	A	C	X	H	U	R	M(N)	Q	III
	Barbella enervis	A	C	X	H	U	R	M	Q	III
	Barbella flagellifera	A	C	X	I(H)	U	R	M	Q	III
	Floribundaria pseudofloribunda	A	C	X	I	U	R	N	Q	III
	Floribundaria aurea ssp. *nipponica*	B	D	X	I	U	R	N	Q	III
	Floribundaria floribunda	B	C	X	I	U	R	N	Q	III
	Aerobryum speciosum	B	D	X	I	U	R	N	Q	III
	Pseudobarbella levieri	B	D	X	I	U	R	N(M)	Q	III
	Pseudobarbella attenuata	B	C	X	H	U	R	N(M)	Q	III
	Chrysocladium retrorsum	B	C	X	H	U	R	N(M)	Q	III
Trachypodiaceae	*Trachypus humilis*	B	C	X	I	U	S	M	P	III
	Trachypus bicolor	B	D	X	G	U	S	M(N)	P	III
	Duthiella flaccida	B	C	X	I	U	R	N	Q	IV
	Duthiella wallichii	B	D	X	I	U	R	N	Q	IV
	Duthiella speciosissima	B	D	X	H	U	R	N	Q	IV

BI-cell seems to develop into a leptom-system (the internal cortex); AII-b-cell seems to develop into a cortex of the stem (the external cortex); AII-a-cell seems to develop into an epidermis of the stem (the epidermis); BII-cell seems to develop into a hadrom-system (the central tissue).

which the segments develope into the initial organs, is named the second-division period. The period forming the initial tissues, is named the third-division period (see Table 3).

In the first-division period (the period that forms the segments) the apical cell of the stem separates the segments into three directions. If these segments are named **I-1, II-1, III-1, I-2, II-2** and **III-2**, in the order formed, the segments **I-1, II-1** and **III-1** arrange themselves in triangular form this follows for the **I-2, II-2,** and **III-2** segments too. The segment **I-2** is formed on top of the **I-1**, the segment **II-2** on top of the **II-1**, and the segment **III-2** on top of the **III-1**. The segments **I-1, I-2,** etc. are categorized as the segment **I** series, and in the same way, the segments **II-1, II-2,** are placed in the segment **II** series, and the segments **III-1, III-2,** etc., in the segment **III** series. Due to the fact that the apical cell cuts the segments obliquely with three cutting planes on a spiral course, the mode of the cell division is called, "Drei geneigt geschnittenen Furchungsgeschichter-Typ (**DGS**)."

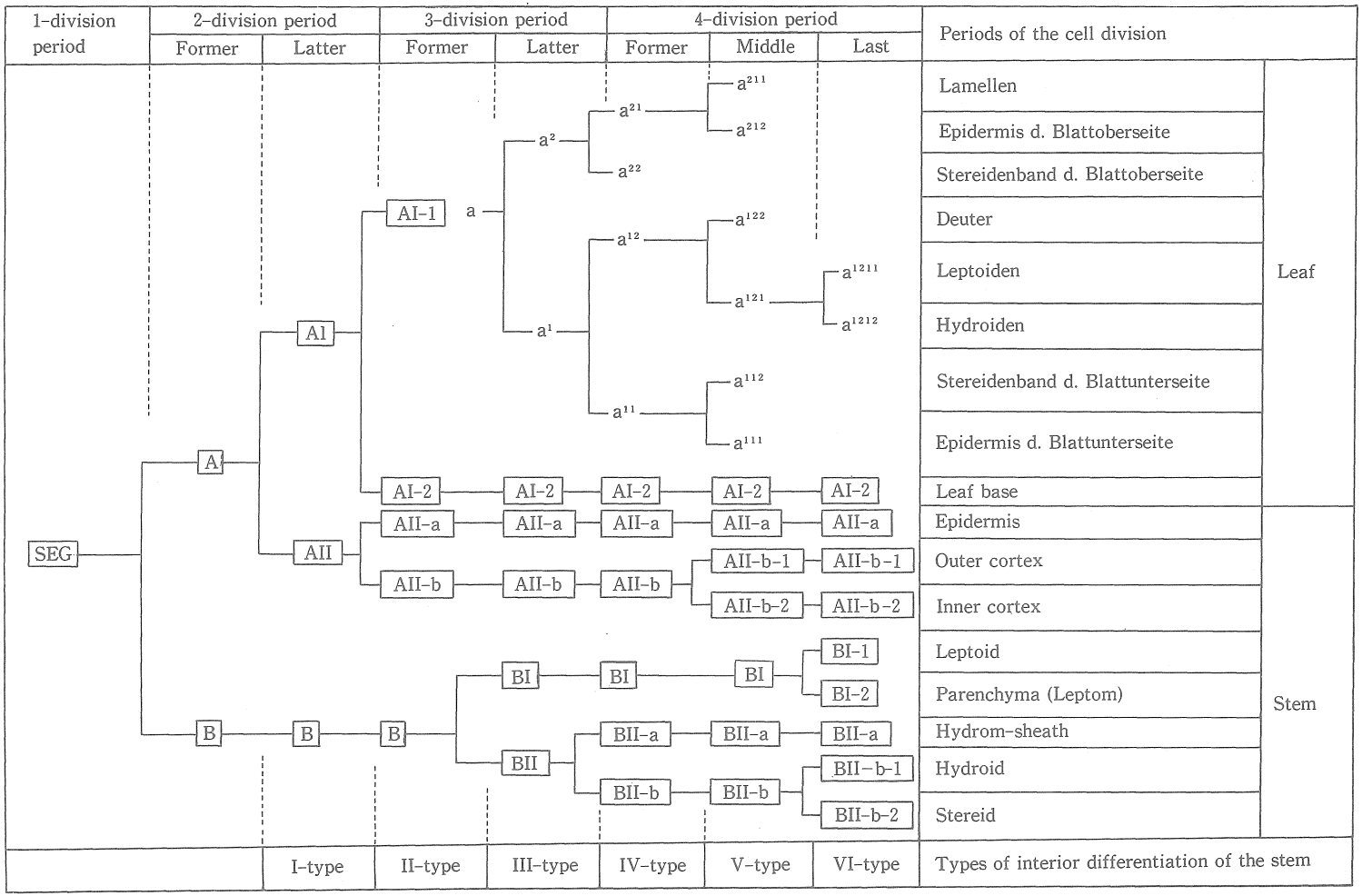
In the second-division period (the period forming the initial organs), the segment which has been divided twice obliquely and again divided transversely into large and small cells, is composed of five cells (the initial organs). Since in the ontogeny the segments are cut off in two directions. This mode of cell division is called "Zwei geneigt geschnittenen Furchungsgeschichter-Typ (**ZGS**)." The two top cells which are the initial leaf(**AI**-origin), are bisymmetrical. The two cells in the middle part which are the initial epidermal layers (**AII**-origin), are also bisymmetrical. The basal cell is the initial central tissue(**B**-origin).

In the third-division period (the period forming the tissue) all the initial organs divided by a transverse section, form the initial tissues, that is, the **AI**-origin is divided into the **AI-1** and AI-2, the **AII**-origin into the **AII-a** and **AII-b**, and the **B**-origin into the **BI** and **BII**.

The segment which is formed by the **DGS** mode of cell division in the first-division period, separates obliquely into two **A** cells and a **B** cell by a series of two divisions in the earlier half of the second-division period. In the latter half of the second-division period the **A** cells are transversely divided into **AI** cells and **AII** cells. The **AI** cells appear to develop into a leaf, the **AII** cells into the cortical layers of the stem, and the **B**cell into the axial cylinder of the stem. In the earlier half of the third-division period the **AI** cells and the **AII** cells are respectively divided into **AI-1** and **AI-2** cells, **AII-a** and **AII-b** cells, all by transverse sections. The **AI-1** cells seem to become lamina, the **AI-2** cells leaf base, the **AII-a** cells epidermis of the stem, and the **AII-b** cells the cortex of the stem. The stem consists of an epidermis , cortex, and an axial cylinder. In the latter half of the third-division period, the **B** cell is divided into **BI** and **BII** cells by a transverse section. The **BI** cell seems to develop into a leptom-system, and the **BII** cell into a hadrom-system. The structure of the stem is epidermis — cortex — leptom — hadrom.

In the earlier half of the forth-division period the **BII** cell is divided into the **BII-a**

Tab. 3 Relationship between the ontogeny of the stem and the types of interior differentiation



a¹, a², etc.: after W. Frey (1970)

and **BII-b** cells. The **BII-a** cell seems to be differentiated into a hydromsheath, and the **BII-b** cell into a hadrom-system. The structure of the stem is an epidermis, cortex, leptom system, hydromsheath system, and a hadrom system. Since the **AII-b** cell is divided into **AII-b-1**(outer cortex) and **AII-b-2** (inner cortex) in the middle stage of the forth-division period, the structure of the stem appears to show an epidermis — outer cortex — inner cortex — leptom — hydrom sheath — hadrom development. In the latter half of the forth-division period the **BI** and **BII-b** cells are respectively divided into **BI-1** and **BI-2** cells, **BII-b-1** and **BII-b-2** cells, by transverse sections. The **BI-1** cell seems to develop into a leptoid, the **BI-2** cell into a parenchyma, the **BII-b-1** cell into a hydroid, and the **BII-b-2** cell into a stereid. The interior structure of the stem consists of epidermis, outer cortex, inner cortex, leptoid, parenchyma, hydrom sheath, hydroid, and a stereid.

HÉBANT (1973, 1974, 1976, 1977) examined the organization of the stem in Polytrichales, through a light and electron microscope, and made a detailed study of the conducting tissue. He stated the following: "The hydroids of the central strand originate from the most central part of the segment, which are cut off from the apical cell." (HÉBANT 1973) Judging from the above mentioned, the initial cell of the hydroid seems to be the **BII-b** or **BII-b-1** cells as shown in Table 3. He also stated the following: "In the aerial leafy stems of *Dawsonia longiseta* and *D. polytrich* all these cells differentiate as hydroids. In the aerial leafy stems of all the other species of *Dawsonia* one part only of these cells differentiates into hydroids; the others yield stereid." (HÉBANT 1976) Considering this statement, it seems that the **BII** cell which all differentiates into hydroids in one species, develops, however, into hydroids and stereids in other species.

HÉBANT discussed the leptoid as follows: "Leptoids originate within apical derivatives from just below the level of the first perclinal wall which divides each segment." (HÉBANT 1976) "The origin of the leptoids is in the cells deriving from the upper part of the initial cell of the central tissue, which is delimited by the first division of the segment." (HÉBANT 1973) In this paper, the leptoids appear to originate from **BI** or **BI-1** cells, in Table 3. Through the observation of the stem of *Climacium* (KAWAI 1977) the **AII-b** cell seems to differentiate into a cortex (hitherto called "external cortex"), and the **AII-a** cell seems to differentiate into an epidermis. On the ontogeny of a leaf, FREY's full investigation (1970) is shown in Table 3.

On the concept of the conducting strand, HÉBANT stated the following in "The conducting tissue of Bryophyte". "In the present review, this expression (the conducting strand) will be used only when at least a strand of clearly defined water-conducting cells is present. Identification of true strands on sections of either living or fixed material is easy since their constituent elements are dead and empty when mature. At this point, particular mention must also be made of the specialized elements devoid of protoplast at maturity, which are found in such bryophytes as *Sphagnum, Leucobryum,* etc. "(HÉBANT 1977) Among the interior structures of the stem the conducting tissue must be one of the most important. However it is difficult to identify and to clearly define each conducting

tissue (leptoid, hydroid, stereid and hydrom sheath etc.) in all bryophyte, because in certain species (e. g. *Sphagnum, Andreaea,* etc.) each conducting tissue is in the process of development. It is also difficult to determine a relationship between the conducting tissue of bryophyte and spermatophyte. It is necessary for research to shed light on the problem of the relationship between the conducting tissues of sporophyte and gametophyte in bryophyte. And following that, the relationship between the conducting tissue of sporophyte in bryophyte and in spermatophyte should be brought to light. However, in regard to the sporophyte and gametophyte, first there are problems to be solved as to the origin of the tissue and the identification of the homologous tissue. Systematic studies on the conducting tissue of the gametophyte in Musci should be founded on systematic studies of the conducting tissue in the vegetable kingdom. However, we cannot wait too long for the system of the conducting tissue in the vegetable kingdom to be perfected. Accordingly, we have to do research into problems we are able to wrestle with at the present stage of science. Perhaps one of these problems is to difine the essential characteristics of tissues.

Among the anatomical characteristics hitherto observed, the following four items seem to show high regularity: type of the interior differentiation (**III**-and **IV**-types); comparison in thickness between cell walls of the central tissue and those of the internal cortex (**P**- and **Q**-types); comparison between cell-size of the central tissue and that of the internal cortex (**M**- and **N**-types); and thickness of the cell walls of the central tissue (**R**- and **S**-types) which are closely connected with division at the early stage of the ontogeny. As one of the most important characteristics, the types of interior differentiation were separated into six areas by KAWAI et IKEDA (1970). Since then a series of papers on the conducting tissue of the stem in Polytrichales by HÉBANT (1973, 1974, 1976, 1977) and in *Climacium* by KAWAI (1977) were made public, and have helped to clarify some difficult points. The areas of division call for a partial revision in light of this published research:

I-type: cortical layer — axial cylinder
II-type: epidermis — cortex — axial cylinder
III-type: epidermis — cortex — leptom — hadrom
IV-type: epidermis — cortex — leptom — hydrom sheath — hadrom
V-type: epidermis — outer cortex — inner cortex — leptom — hydrom sheath — hadrom
VI-type: epidermis — outer cortex — inner cortex — leptom — parenchyma — hydrom sheath — hydrom — stereom

(2) Affinity among the genera of Meteoriaceae

NOGUCHI(1976) did research into the systematic study of Meteoriaceae, and published his results. In the paper, he discussed the affinity among the genera of Meteoriaceae, expressing an opinion concerning karyotypes in some genera already studied by INOUE and MOMII (1971). NOGUCHI stated the following: "According to INOUE and MOMII, the karyotype of

Meteorium is derived from that of *Floribundaria floribunda* through that of *Meteoriopsis* by the reduction and change of medium-sized chromosomes. Morphologically, *Meteorium* has greatly differentiated from *Floribundaria floribunda* during a long course of evolution."

Anatomically too, the stem of *Meteorium* differs greatly from that of *Floribundaria.* He also stated the following on the relationship among *Barbella, Meteoriopsis* and *Pseudobarbella: "Barbella* and *Pseudobarbella* are closely related to each other. I think that the genus most related to those two genera is *Meteoriopsis* which differs slightly from *Barbella* by the recurved or divergent foliation, and from *Pseudobarbella* by the short setae." Anatomically, the stems of *Barbella* and *Meteoriopsis* have a great deal in common with each other. However, the stem of *Pseudobarbella* differs from those of *Barbella* and *Meteoriopsis.* Concerning *Meteorium,* NOGUCHI stated: "It should be noted that the cells of *Papillaria,* which is closed related to *Meteorium,* are multipapillose and are regarded as primitive." As stated above, the stem of *Meteorium* with a M-type may be more primitive than those of *Floribundaria, Aerobryum, Pseudobarbella,* and *Chrysocladium,* according to anatomical observation.

As in the above mentioned discussion, a part of the affinity among the stems of each genus regarding the anatomical characteristics appears to be in accord with the NOGUCHI-system and INOUE-MOMII-system, but the rest may not always be so. All things considered, however, doesn't the anatomical affinity among the stems of Meteoriaceae have some relativity to the NOGUCHI-and INOUE-MOMII-system?

(3) The natural order among the anatomical characteristics of the stem

We studied the cross sections of the stem of the eighteen families already observed: Fissidentaceae, Entodontaceae, Thuidiaceae, Hypnaceae, Mniaceae, Bartramiaceae, Dicranaceae, Grimmiaceae, Polytrichaceae, Climaciaceae, Fontinalaceae, Neckeraceae, Lembophyllaceae, Hedwigiaceae, Leucodontaceae, Pterobryaceae, Meteoriaceae and Trachypodiaceae. Out of the sketches so far made public, we also examined the sketches of Plagiotheciaceae (IWATSUKI 1970, 1974), Sematophyllaceae (IWATSUKI 1963, SEKI 1968), Hypnaceae (ANDO 1957, 1966, 1972, 1973a,b,c, 1975), Rhytidiaceae (NOGUCHI 1972), Hylocomiaceae (NOGUCHI 1972), Fabroniaceae (IWATSUKI et SHARP 1967b), Leskeaceae (NOGUCHI 1953), Thuidiaceae (WATANABE 1972), Hookeriaceae (MATTERI 1972, 1975, ZANDER et HEGEWALD 1976), Hypopterygiaceae (NOGUCHI 1951), Bartramiaceae (MATTERI 1968, 1973), Ptychomitriaceae (NOGUCHI 1954), Orthotrichaceae (IWATSUKI 1959a), Dicranaceae (TAKAKI 1962, IWATSUKI et SHARP 1967), Pottiaceae (SAITO 1975), Erpodiaceae (NOGUCHI 1952), Grimmiaceae (NOGUCHI 1974), where we could determine ten of our demarcations.

According to Table 4, the stems of almost all the genera except for a few, have many anatomical characteristics in common in the species belonging to a genus. The stems of almost all the families also have anatomical characteristics in common in the species belonging to a family, except for Hylocomiaceae, Fabroniaceae, Trachypodiaceae and Pottiaceae. Furthermore, some characteristics are found in common even among the species belonging to an identical order.

Tab. 4 Regularity among the anatomical characteristics of the stem in the classification system of Musci

Order	Family	Genus	Similarity of genus	Similarity of family	Similarity of order
HYPOBRYALES	ENTODONTACEAE	*Entodon*	Ⅲ-P-N-R	Ⅲ-P-N-R	Ⅲ-U-(P)
	PLAGIOTHECIACEAE	*Plagiothecium*	Ⅲ-P-M(N)-X	Ⅲ-P-M	
		Isopterygiopsis	Ⅲ-P-M(N)-R-T-I-V		
	SEMATOPHYLLACEAE	*Clastobryella*	Ⅲ-P-M-S-U-H-W	Ⅲ-P-M-S-U	
		Clastobryum	Ⅲ-P-M-S-U		
		Acroporium	Ⅲ-P-M-S-U		
		Sematophllum	Ⅲ-P-M-S-U		
		Trichosteleum	Ⅲ-P-M-S-U		
		Rhaphidostichum	Ⅲ-P-M-S-U		
	HYPNACEAE	*Rhytidiadelphus*	Ⅲ-P-M-R-U-X-G	Ⅲ-P-M-U	
		Isopterygium	Ⅲ-P-M-U-X		
		Sterodontopsis	Ⅲ-P-M-S-U-V-I		
		Pylaisiella	Ⅲ-P-M-U		
		Herzogiella	Ⅲ-P-M-R-U-W-I		
		Ectropothecium	Ⅲ-P-M-R-U-W-I		
		Taxiphyllum	Ⅲ-P-U-C		
		Ptilium	Ⅲ-P-M(N)-U-R-X-G		
		Gollania	Ⅲ-P-M(N)-U		
		Ctenidium	Ⅲ-P-M(N)-U-S		
		Homomallium	Ⅲ-P-N-U-R-X-I		
		Eurohypnum	Ⅲ-P-N-U-S-W-H		
		Hypnum	Ⅲ-N		
		Vesicularia	Ⅲ-Q-N-R-U-W-I		
	RHYTIDIACEAE	*Rhytidium*	Ⅲ-Q-N(M)-R-U-H-W	Ⅲ-Q-N(M)-R-U-H-W	
	HYLOCOMIACEAE	*Macrothamnium*	Ⅲ-Q-N(M)-R-U-H-W	Ⅲ-U	
		Hylocomium	Ⅲ-P-M-S-U-W		
		Leptocladiella	Ⅲ-P-M-S-U-H-X		
	FABRONIACEAE	*Schwetschkeopsis*	Ⅲ-P-M-R-U-H-W-C	Ⅲ-R	
		Pterygophyllum	Ⅲ(Ⅳ)-Q-N-R-T-I-V-C		
		Pseudoracelopus	Ⅲ(Ⅳ)-Q-N-R-T-I-V-C		
	LESKEACEAE	*Okamuraea*	Ⅲ-Q-MN-R-U-H	Ⅲ-Q-MN-R-U-H	
	THUIDIACEAE	*Helodium*	Ⅲ-P-N-U-R-W-I	Ⅲ-P-U-S(Ⅳ-Q-N-R)	
		Claopodium	Ⅲ-P-N-U-(S)		
		Rauiella	Ⅲ-P-N-U-S-W-G		
		Haplocladium	Ⅲ-P-N-U-S		
		Thuidium	Ⅲ-P-N-U-S		
		Anomodon	Ⅲ-P-M(N)-U-S		

		Haplohymenium	Ⅲ-P-M-U-S		
		Miyabea	Ⅲ-P-M-U-S		
		Abietinella	Ⅲ-P-M-U-S-W-H		
		Boulaya	Ⅲ-P-M-U-S-W-H		
		Bryonoguchia	Ⅲ-P-M-U-S-X-G		
		Hylocomiopsis	Ⅲ-P-M-U-S-X-G		
		Herpetineuron	Ⅳ-Q-N-U-R-W-H		
ISOBRYALES	CLIMACIACEAE	*Climacium*	Ⅲ-P-N(M)-S-U-X	Ⅲ-P-N(M)-S-U-X	Ⅲ-(P)-(M)-(S) (Ⅳ-Q-N-R)
	FONTINALACEAE	*Fontinalis*	Ⅲ-P-M-R-U-H-X	Ⅲ-P-M-U-H-X	
		Dichelyma	Ⅲ-P-M-S-U-H-X		
	NECKERACEAE	*Homaliadelphus*	Ⅲ-P-M-S-U-H-X	Ⅲ-P-M-S-U	
		Bissetia	Ⅲ-P-M-S-U-G-X		
		Homaliodendron	Ⅲ-P-M-S-U-I-X		
		Neckeropsis	Ⅲ-P-M-S-U-I		
		Neckera	Ⅲ-P-M-S-U-V-I-X		
		Pinnatella	Ⅲ-P-M-S-U-I-X		
		Thamnobryum	Ⅲ-P-M-S-U		
	LEMBOPHYLLACEAE	*Dolichomitra*	Ⅲ-P-M(N)-S-U-G-X	Ⅲ-P-M-S-U	
		Neobarbella	Ⅲ-P-M-S-U-I-X		
		Isothecium	Ⅲ-P-M-S-U-I-X		
		Dolichomitriopsis	Ⅲ-P-M-S-U-X-D		
	HEDWIGIACEAE	*Hedwigia*	Ⅲ-P-M-S-U-I-X	Ⅲ-P-M-S-U-I-X	
	LEUCODONTACEAE	*Leucodon*	Ⅲ-P-M-S-U-H	Ⅲ-P-M-S-U	
		Dozya	Ⅲ-P-M-S-U-I-W		
	PTEROBRYACEAE	*Pterobryum*	Ⅲ-P-M-S-U-I-W	Ⅲ-P-M-S-U	
		Myurium	Ⅲ-P-M-S-U-I		
		Calyptothecium	Ⅲ-P-M-S-U		
		Myuriopsis	Ⅲ-P-M-S-U-H-X		
	METEORIACEAE	*Meteorium*	Ⅲ-Q-M-R-U-H-X	Ⅲ-Q-R-U	
		Meteoriopsis	Ⅲ-Q-M-R-U-H-X		
		Barbella	Ⅲ-Q-M-R-U-X		
		Floribundaria	Ⅲ-Q-N-R-U-I-X		
		Chrysocladium	Ⅲ-Q-N-R-U-H-X		
		Pseudobarbella	Ⅲ-Q-N-R-U-X		
		Aerobryum	Ⅲ-Q-N-R-U-I-X		
	TRACHYPODIACEAE	*Trachypus*	Ⅲ-P-M-S-U-X	U-X	
		Duthiella	Ⅳ-Q-N-R-U-X		
	HOOKERIACEAE	*Achrohypnella*	Ⅲ-P-M-U-S-X-G	Ⅲ-P-M-S-(U)	
		Hookeriopsis	Ⅲ-P-M-U-S-V-I		
		Distichophyllum	Ⅲ-P-M-U-S-H-W		
		Schimperobryum	Ⅲ-P-M-S-U-I-W(X)		

HOOKERIALES		*Sauloma*	Ⅲ-P-M-S-U-I-V		Ⅲ-P-(U) (Ⅳ-Q)
		Leptodontiella	Ⅲ-P-M-S-T-I-V		
		Hookeria	Ⅲ-P-N-U-S-X-G		
		Eriopus	Ⅲ-P-N-S		
		Pterygophyllum	Ⅲ(Ⅳ)-Q-N-R-U-H-V		
	HYPOPTERYGIACEAE	*Lepidium*	Ⅲ-Q-M-R-U-G-W		
		Catharomnium	Ⅲ(Ⅳ)-P-N-R-U-H-X(W)		
		Cyathophorella	Ⅲ(Ⅳ)-P-N-R-U-H-W	(Ⅲ)-(P)-(N)-R-U (Ⅳ-Q-N)	
		Hypopterygium	Ⅳ-Q-N-R-U-I-V		
EUBRYALES	MNIACEAE	*Orthomniopsis*	Ⅳ-Q-N-U-R-W-I	Ⅳ-Q-N-U-R	Ⅳ-Q-N-R
		Pseudobryum	Ⅳ-Q-N-U-R-W-H		
		Plagiomnium	Ⅳ-Q-N-U-R		
		Rhizomnium	Ⅳ-Q-N-U-R-X-G		
		Mnium	Ⅳ-Q-N-U-R-X-G		
		Trachycystis	Ⅳ-Q-N-U-R-X-G		
	BARTRAMIACEAE	*Philonotis*	Ⅳ-Q-N-T-R-V-I	Ⅳ-Q-N-T-R-V-I	
		Breutelia	Ⅳ-Q-N-T-R-V-I		
ORTHOTRICHALES	PTYCHOMITRIACEAE	*Ptychomitrium*	Ⅲ(Ⅳ)-Q-N-U	Ⅲ(Ⅳ)-Q-N-U	Ⅲ-U
	ORTHOTRICHACEAE	*Ulota*	Ⅲ-P-M-S-U	Ⅲ-P-M-S-U	
DICRANALES	DICRANACEAE	*Trematodon*	Ⅳ-Q-N-R-U-X-H	Ⅳ-N-(R)-U	Ⅳ-N-(R)-U
		Aongstroemia	Ⅳ(Ⅲ)-Q-N-R-T-C		
		Onchophorus	Ⅳ-P-N-U-R-W-H		
		Leucoloma	Ⅳ-P-N-U-R-W-I		
		Thysanomitrium	Ⅳ-P-N-T-R-V-I		
		Campylopodium	Ⅳ-O-N-U-S-X-H		
		Dicranum	Ⅳ-O-N-U-S-H		
POTTIALES	POTTIACEAE	*Tortella*	Ⅲ-Q-N-T-R-V-I	Ⅲ-U-(R)	Ⅲ-U-(R)
		Weissia	Ⅲ-Q-N-R		
		Anoectangium	Ⅲ-Q-N-U-R-X-G		
		Trichostomum	Ⅲ-Q-N-U(T)-R-V-I		
		Bryoerythrophyllum	Ⅲ-Q-N-U-R-V-G		
		Barbella	Ⅲ-Q-N-U		
		Didymodon	Ⅲ-N-U-R-X-G		
		Timmiella	Ⅲ-P-N-U-R-W-H		
		Eucladium	Ⅲ-P-M-U-R-W-H		
		Weisiopsis	Ⅲ-P-M-U-S-W-H		
		Leptodontium	Ⅲ-P-M-U-S-X-G		
		Gymnostomum	Ⅲ-P-M-S		
		Pseudosymblepharis	Ⅲ-P-M-T-S-V-I		

GRIMMIALES	ERPODIACEAE	*Solmsiella*	Ⅲ-P-M-U-R-X-G	Ⅲ-P-M-U	Ⅲ-M-U
		Aulacopilium	Ⅲ-P-M-U-S-W-H		
		Venturiella	Ⅲ-P-M-U-R-X-G		
		Glyphomitrium	Ⅲ-Q-N-U-R-X-G		
	GRIMMIACEAE	*Grimmia*	Ⅲ-(M)-U-(S)	Ⅲ-M-S-U	
		Rhacomitrium	Ⅲ-P-M-S-U-X		
FISSIDENTALES	FISSIDENTACEAE	*Fissidens*	Ⅲ-O-M-U-R-W-G	Ⅲ-O-M-U-R-W-G	Ⅲ-O-M-U-R-W-G
POLYTRICHALES	POLYTRICHACEAE	*Oligotrichum*	Ⅵ-U-F-X-G	Ⅵ-U-X-G	Ⅵ-U-X-G
		Bartramiopsis	Ⅵ-U-F-X-G		
		Pogonatum	Ⅵ-U-E-X-G		
		Atrichum	Ⅵ-U-E-X-G		
		Polytrichastrum	Ⅵ-U-E-X-G		
		Polytrichum	Ⅵ-U-E-X-G		

PLAGIOTHECIACEAE: after IWATSUKI (1970, 1974), SEMATOPHYLLACEAE: after IWATSUKI (1963), SEKI (1968), HYPNACEAE: after ANDO (1957, 1966, 1972, 1973a, b, c, 1975), NOGUCHI (1972), IWATSUKI et SCHOFIELD (1973), RHYTIDIACEAE: after NOGUCHI (1972), HYLOCOMIACEAE: after NOGUCHI (1972), FABRONIACEAE: after IWATSUKI et SCHARP (1967), LESKEACEAE: after NOGUCHI (1953), THUIDIACEAE: after WATANABE (1972), WATANABE et KAWAI (1975), HOOKERIACEAE: after MATTERI (1972, 1975), ZANDER u. HEGEWALD (1976), HYPOPTERYGIACEAE: after NOGUCHI (1951), BARTRAMIACEAE: after MATTERI (1968, 1973), PTYCHOMITRIACEAE: after NOGUCHI (1954), ORTHOTRICHACEAE: after IWATSUKI (1959), DICRANACEAE: after TAKAKI (1962), IWATSUKI et SCHARP (1967), POTTIACEAE: after SAITO (1975), ERPODIACEAE: after NOGUCHI (1952), GRIMMIACEAE: after NOGUCHI(1974).

Next, it should be considered which characteristics are in common among more species. The characteristic described as the type of interior differentiation (**III**-, **IV**- and **VI**-types) in the stems of all genera (134 genera) is in common among the stems of the identical genus. The characteristics of whether the cell walls of the central tissue are thicker (**O**-type), as thick (**P**-type), or thinner (**Q**-type), than those of the internal cortex, and whether cells of the central tissue are larger (**L**-type), as large (**M**-type), or smaller (**N**-type), than those of the internal cortex, are found in common among the species belonging to a genus in almost all of the genera (127 genera). And the characteristics of whether cells of the central tissue are parenchymatous (**R**-type) or not (**S**-type), and whether cells of the epidermal layer are parenchymatous (**T**-type) or not (**U**-type) are found in common in a fairly large number of genera (118–123 genera). In almost all of the families (28 families), the stems of the species belonging to an identical family have the same type of interior differentiation. The stems of many families have the characteristics concerning the thickness of the cell walls of the central tissue (**P**,**Q**,**R** and **S**), and of the epidermis (**T** and **U**), and concerning the cell-size of the central tissue (**M** and **N**) which are in common among the species belonging to a family. The stems in the order show the same tendency as in the family, that is, the common characteristics are **III**.**IV**.**VI**-types, **O**.**P**.**Q**-types, **L**.**M**.**N**-types, **R**.**S**-types, and **T**.**U**-types. The anatomical characteristics in each order also show the same tendency as in the family.

As discussed above, in many genera, families, and orders, the stems of the species belonging to an identical genus, family, and order show common anatomical characteristics of **III**.**IV**.**VI**-types, **O**,**P**,**Q**-types, **L**.**M**.**N**-types, **R**.**S**-types and **T**.**U**-types. Through research on coordination among anatomical characteristics and on the ontogeny of the stem, we should like to discover the essential characteristics. As we are still at an early stage in our study, many more experiments should be made until the systematic study can be considered to be in conformity with essential anatomical characteristics.

References

ANDO, H.(1957) The *Hypnum* species restricted to Japan and adjacent areas(2). Journ. Sci. Hiroshima Univ. 8: 1–18.

——— (1966) A revision of the Chinese Cupressinae described by C.Müller. Bot. Mag. Tokyo 79: 759–769.

——— (1972) Studies on the genus *Hypnum* HEDW.(1). Journ. Sci. Hiroshima Univ. 14: 53–73.

——— (1973a) Studies on the genus *Hypnum* HEDW.(II). Journ. Sci. Hiroshima Univ. 14: 165–207.

——— (1973b) Revision des especes africaines de *Gollania*(Hypnaceae). Rev. Bryol. et Lichenol. 39: 529–538.

——— (1973c) Miscellanea bryologica Asiae Orientalis III. Hikobia 6: 203–216.

——— (1975) Remarque sur l'identite d, *Hypnum ravaudii* BOULAY. Rev. Bryol. Lichenol. 41: 277–281.

BOWERS, M.C. (1968) A cytotaxonomic study of the genus *Mnium* in Colorado. Rev. Bryol. et Lichenol. 36: 167–202.

CRUM, H. and M. R. CROSBY(1974) A new *Sphagnum* from high altitude Costa Rica. Ann. Missouri Bot.

Garden 61: 904–906.

——— (1975) Notes on the distribution of *Sphagnum tenellum*. Contr. Univ. Mich. Herb. 11: 85–87.

——— (1977) *Sphagnum quinquefarium* in the American West. Bryologist 80: 156–158.

FREY, W.(1970) Blattentwicklung bei Laubmoosen. Nova Hedwigia 20: 463–556.

——— (1971) Blattentwicklung bei *Timmia austriaca* HEDW. Nova Hedwigia 21: 119–136.

———(1974a) Bau und Entstehung der Zentralstrangverzweigung bei Laubmoosen (Musci). Nova Hedwigia 25: 211–223.

———(1974b) Entwicklungsgeschichtliche Untersuchungen an *Hypnodendron dendroides* (BRID.)TOUW. (Hypnodendraceae, Musci). Nova Hedwigia 25: 229–249.

FRYE, T.C.(1946a) *Pogonatum convolutum* (HEDW.)P.BEAUV. Bryologist 49: 36–40.

——— and M.W.DUCKERING(1946b) *Pogonatum flexuosum* (MUELL.)BROTH. Bryologist 49: 141–146.

———(1947) *Oligotrichum tenuirostre* (HOOK.)JAEG. Bryologist 50: 64–65.

———and M.W.DUCKERING(1948a) *Atrichum polycarpum* (SCHIMP.)MITT. Bryologist. 51: 170–174.

——— (1948b) *Atrichum oerstedianum* (MUELL.)MiITT. Bryologist 51: 242–246.

——— (1948c) *Pogonatum semipellucidum*. Bryologist 51: 248–250.

——— (1949a) *Atrichum ligulatum* MITT. Bryologist 52: 68–71.

——— (1949b) *Atrichum selwyni* and remarks about related species. Bryologist 52: 201–207.

HÉBANT, C.(1964) Sur les leptoides des bryophytes. C.R.Acad. Sc. Paris 258: 3339–3341.

——— (1966a) Différenciation des tissus conducteurs dans la tige feuillée. De *Polytrichum juniperinum* WILLD. C.R.Acad. Sc. Paris 262: 2585–2588.

——— (1966b) Précisions nouvelles, sur la signification et la répartition des tissus conducteurs dans la tige feuillée des mousses. C. R. Acad. Sc. Paris 263: 1065–1068.

———(1967) Structure et différenciation des tissus conducteurs dars le gamétophyte des *Polytrichum*. - Nat. Monspeliensia, Bot. 18: 293–298.

——— (1968) L'évolution des tissus conducteurs chez les mousses s. str. (Bryopsida). Rev. Bryol. et Lichénol. 36: 111–113.

——— (1969a) Sur l'évolution des tissus conducteurs chez les mousses s. str. (Bryopsida) une interprétation nouvelle. Rev. Bryol. et Lichénol. 36: 729–731.

——— (1969b) Histologie végétale-Nouvelles observations sur le leptome de la tige feuillée des *Polytrichum*. C.R.Acad. Sc. Paris 269: 2530–2533.

——— (1969c) Cytologie végétale — Differenciation des tissus conducteurs dans la tige feuillée de *polytrichum juniperinum* WILLD. aspects infrastructuraux observés au cours de la différenciation des hydroides. C.R.Acad. Sc. Paris 268: 2893–2895.

——— (1970a) Histologie végétale — Aspects infrastructuraux observés au cours de la différenciation du phloéme(leptome) dans la tige feuillée de quelques mousses Polytrichales. C.R.Acad. Sc. Paris 271: 1361–1363.

——— (1970b) Biologie cellulaire — étude histochimigue, histoenzymologique et infrastructurale de la différenciation des tissus conducteurs dans la tige feuillée de quelques mousses Polytrichales. C.R.Acad. Sc. Paris 271: 1986–1989.

——— (1970c) A new look at the conducting tissues of mosses(bryopsida): Their structure, distribution, and significance. Phytomorphology 20: 390–410.

——— (1973) Studies on the development of the conducting tissue-system in the gametophytes of some Polytrichales I. Miscellaneus notes on apical segmentation, growth of gametophytes, and diversity in histo-anatomical structures. Jonrn. Hattori Bot. Lab. 37: 211–227.

——— (1974) Studies on the development of the conducting tissue-system in the gametophytes of some Polytrichales. II. Development and structure at maturity of the hydroids of the central

strand. Journ. Hattori Bot. Lab. 38: 565–607.

——— (1975) The phloem (leptome) of Bryophytes. Phloem transport: 211–215. New York.

——— (1976a) Studies on the development of the conducting tissue-system in the gametophyte of some Polytrichales. III. Further observations on leptoids, with particular reference to their endoplasmic reticulum. Protoplasma 87: 79–90.

——— (1976b) Comparative anatomy of the gametophytes in *Dawsonia*(Polytrichales, Musci). Journ. Hattori Bot. Lab. 40: 221–246.

——— (1977) The conducting tissues of Bryophytes. Vaduz.

HOLZINGER, M. (1905) Some recently described North American Polytricha. Bryologist 8: 28–31.

HÖRMANN, H.(1959) Zür Morphologie und Anatomie von *Climacium dendroides* WEB. et MOHR. und *Thamnium alopecurum* B.S.G. Nova Hedwigia 2:201–208.

——— (1963) Beitrag zür Anatomie von *Pogonatum baldwini* (MUELL.) PAR. Nova Hedwigia 5: 279–282.

IRELAND, R. (1969) A taxonomic revision of the genus *Plagiothecium* for N. America, N. Mexico. Musie nat. sci. natur. pub. bot. 1: 1–118.

IWATSUKI, Z. (1959a) Bryological miscellanies, VII–XI. Journ. Hattori Bot. Lab. 20: 236–247.

——— (1959b) A revision of the Japanese species the genus *Ulota*. Journ. Hattori Bot. Lab. 21: 138–156.

——— (1963a) A revision of the East Asiatic species of the genus *Anomodon*. Journ. Hattori Bot. Lab. 26: 27–62.

——— (1963b) Bryological miscellanies XII–XIII. Journ. Hattori Bot. Lab. 26: 63–74.

——— (1965) Notes on the genus *Dolichotheca*, with special reference to the Japanese species. Journ. Hattori Bot. Lab. 28: 202–208.

——— (1966) Critical reexamination of the asiatic mosses reported by Sullivant and Lesquereux in 1857 and 1859. Journ. Hattori Bot. Lab. 29: 53–69.

——— (1967a) Critical or otherwise interesting *Fissidens* species in Japan. Journ. Hattori Bot. Lab. 30: 91–104.

——— (1967b) Bryological miscellanies XVIII. Journ. Hattori Bot. Lab. 30: 105–112.

——— (1967c) The bryogeographical relationships between eastern Asia and North America. Journ. Hattori Bot. Lab. 30: 152–180.

——— (1969a) Bryological miscellanies XIX–XX. Journ. Hattori Bot. Lab. 32: 269–289.

——— (1969b) Notes on Japanese *Fissidens*. Journ. Hattori Bot. Lab. 32: 311–318.

——— (1970) A revision of *Plagiothecium* and its related genera from Japan and her adjacent areas. Journ. Hattori Bot. Lab. 33: 331–380.

——— and W.B.SCHOFIELD(1973) The taxonomic position of *Campylium adscendens* (LINDB.)MITT. Journ. Hattori Bot. Lab. 37: 609–615.

——— (1974) Notes on the moss flora of Hokkaido. Journ. Hattori Bot. Lab. 38: 657–663.

——— and A. NOGUCHI(1975) Mosses of north Borneo II. Journ. Hattori Bot. Lab. 39: 315–333.

KAWAI, I.(1962) Cytohistological observation on the stem of the mosses on the beach of the Bay of Tsukumo-wan. Ann. Rep. Noto Marine Lab. Kanazawa Univ. 2: 1–12.

——— (1965) Studies on the genus *Grimmia*, with reference to the affinity of gametophyte. Sci. Rep. Kanazawa Univ. 10: 79–132.

——— (1969a) Studies on the affinity of the conducting tissue of the sporophyte in the Musci. (1) *Pogonatum spinulosum* MITT. and *Atrichum undulatum* (HEDW.)P.BEAUV. Ann. Rep. Bot. Garden, Kanazawa Univ. 2: 1–25.

———(1969b) Studies on the affinity regarding the conducting tissue of the sporophyte in the Musci.

(2) On the seta in some species of the family Polytrichaceae. Sci. Rep. Kanazawa Univ. 14: 39–57.

——— and K. IKEDA(1970) Systematic studies on the conducting tissue of the gametophyte in Musci. (1) On the affinity regarding the conducting tissue of some species of the Polytrichaceae. Sci. Rep. Kanazawa Univ. 15: 71–98.

——— (1971a) ———. (2) On the affinity regarding the inner structure of the stem in some species of Dicranaceae, Bartramiaceae, Entodontaceae and Fissidentaceae. Ann. Rep. Bot. Garden, Kanazawa Univ. 4: 18–39.

——— (1971b) ———. (3) On the affinity regarding the inner structure of the stem in some species of Thuidiaceae. Sci. Rep. Kanazawa Univ. 16: 21–60.

——— (1971c) ———. (4) On the affinity regarding the inner structure of the stem in some species of Mniaceae. Sci. Rep. Kanazawa Univ. 16: 83–111.

——— (1974) Die systematische Forschung auf Grund der Zellteilungsweise für die Bryophyten I. Ein Vorschlag zur systematischen Untersuchung auf Grund der Zellteilungsweisen jedes Organs in der Lebensgeschichte. Sci. Rep. Kanazawa Univ. 19: 47–78.

——— (1976) Systematic studies on the conducting tissue of the gametophyte in Musci. (6) On the essential coordination among the anatomical characteristics of the stem in some species of Hypnaceae. Sci. Rep. Kanazawa Univ. 21: 47–124.

——— (1977) Die systematische Forschung auf Grund der Zellteilungsweise für die Bryophyten II. Die Zellteilungsweisen der Gametophyten in der Lebensgeschichte — (1) *Climacium*. Sci. Rep. Kanazawa Univ. 22: 45–90.

KOPONEN, A.(1975) *Tayloria pocsii*, spec. nova (Musci, Splachnaceae) from Mt. Kilimanjaro, Tanzania. Ann. Bot. Fenn. 12: 22–24.

KOPONEN, T.(1968) Generic revision of Mniaceae. Mitt. Ann. Bot. Fenn. 5: 117–151.

KUC, M.(1969) Some mosses from an Antarctic Oasis. Rev. Bryol. et Lichénol. 36: 655–672.

LEWINSKY, J.(1974a) Some new or noteworthy mosses from West Greenland. Bryologist 77: 74–77.

——— (1974b) The family Plagiotheciaceae in Denmark. Lindbergia 2: 185–217.

LORENTZ, P.G.(1867) Studien zur vergleichenden Anatomie der Laubmoose II. Flora 50: 529–540, 545–558.

MÄGDEFRAU, K.(1973) *Hydropogon fontinaloides* (HOOK.)BRID., ein periodisch Hydro-aërophytisches Laubmoos des Orinoco und Amazonas. Herzogia 3: 141–149.

MATTERI, C.M.(1968) Las especies de *Philonotis* (Bartramiaceae) del sur de Argentina. Rev. Mus. Arg. Cs. Nat. Bernardino Rivadavia, Bot. 3: 185–234.

——— (1972) Las Hookeriaceae(Musci) Andino-patagonicas II. Rev. Mus. Arg. Cs. Nat. Bernardino Rivadavia Bot. 4: 243–280.

——— (1973a) El genero *Breutelia* (Bartramiaceae, Musci) en la region Andino-patagonica. Rev. Mus. Arg. Cs. Nat. Bernardino Rivadavia Bot. 4: 321–360.

———(1973b) Revision de las Hypopterygiaceae(Musci) Austrosudamericanas. Bol. Soc. Arg. Bot. 15: 229–250.

———(1975) Las Hookeriaceae(Musci) Andino-patagonicas, I. Nova Hedwigia 26: 649–724.

MESSMER, L.W. and T.C. FRYE(1947) The *Polytrichum juniperinum* group between South America and the United States. Bryologist 50: 259–268.

NOGUCHI, A.(1951) Musci japonici (1) Hypopterygiaceae. Journ. Hattori Bot. Lab. 6: 24–32.

——— (1952a) Musci japonici (2) Erpodiaceae. Journ. Hattori Bot. Lab. 8: 5–16.

——— (1952b) Mosses of Climaciaceae. Bot. Rep. Ooita Univ. 15: 65–77.

——— (1953) Musci japonici (3) The genus *Okamuraea*. Journ. Hattori Bot. Lab. 9: 1–15.

——— (1954) Musci japonici IV. The genus *Ptychomitrium*. Journ. Hattori Bot. Lab. 12: 1–26.

——— (1956) Musci japonici V. The genus *Distichophyllum*. Journ. Hattori Bot. Lab. 17: 19–31.

——— and T.OSADA (1960) Musci japonica VI. The genus *Atrichum*. Journ. Hattori Bot. Lab. 23: 122–147.

———(1972) On the delimitation of the genera of Hylocomiaceae and Rhytidiaceae. Journ. Hattori Bot. Lab. 35: 155–168.

———(1974a) Musci japonici X. The genus *Rhacomitrium*. Journ. Hattori Bot. Lab. 38: 337–369.

——— (1974b) Musci japonici XI. The families Disceliaceae, Ephemeraceae, Oediopodiaceae, Splachnaceae and Schistostegaceae. Journ. Hattori Bot. Lab. 38: 387–404.

——— (1976) A taxonomic revision of the family Meteoriaceae of Asia. Journ. Hattori Bot. Lab. 41: 231–357.

OSADA, T. and A. NOGUCHI(1962) *Pogonatum inflexum* (LINDB.)PAR. and its allies. Journ. Jap. Bot. 37: 361–365.

——— (1965) Japanese Polytrichaceae I. Introduction and the genus *Pogonatum*. Journ. Hattori Bot. Lab. 28: 171–201.

——— (1966a) Japanese Polytrichaceae II. The genera *Polytrichum, Oligotrichum, Bartramiopsis* and *Atrichum*, and phytogeography. Journ. Hattori Bot. Lab. 29: 1–52.

——— and S. UENO(1966b) On the structure of the stem and the foot of *Rhacelopodopsis camsi* THER. Biol. Fukuokana 6: 19–21.

ROBINSON, H.(1962) Generic revision of North American Brachytheciaceae. Bryologist 65: 73–146.

SAITO. K.(1968) *Rhacomitrium lanuginosum* (HEDW.)BRID. was found in Oshima. Miscell. Bryol. Lich. 4: 191.

——— (1975) A monograph of Japanese Pottiaceae(Musci). Journ. Hattori Bot. Lab. 39: 373–537.

SCHEIRER, D.C.(1972) Anatmical studies in the polytrichaceae. I. The gametophor of *Dendroligotrichum dendroides* (HEDW.)BROTH. Bryologist 75: 305–314.

——— (1973) Hydrolysed walls in the water-conducting cells of *Dendroligotrichum*(Bryophyta): Histochemistry and ultrastructure. Planta(Berl.) 115: 37–46.

——— (1975) Anatomical studies in the Polytrichaceae. II. Histochemical observations on thickened lateral walls of Hydroids of *Dendroligotrichum*. Bryologist 78: 113–123.

———(1976) Some fine structural observations on the rhizome of *Dendroligotrichum* (Bryophyta). Protoplasma 89: 323–337.

SCHOFIELD, W.B.(1966a) A new species of *Trematodon* from Western North America. Bryologist 69: 202–204.

——— (1966b) *Acanthocladium* (Sect. *Tanythrix*) in North America. Bryologist 69: 334–338.

SEKI, T. (1968) A revision of the family Sematophyllaceae of Japan with special reference to a statistical demarcation of the family. Journ. Sci. Hiroshima Univ. 12: 1–80.

SLOOVER, J.L.D.(1971) *Hypnum pratense* (RABENH.)KOCH. ex HARTM. en Belgique. Lejeunia Revue Bot. 60: 1–4.

——— (1973) Note de bryologie africaine I. *Brachdontium, Atractylocarpus, Amphidium, Rhabdoweisia. Tayloria, Rhacocarpus, Trachypodopsis.* Bull. Jard. Bot. Nat. Belg.43: 333–348.

——— (1975a) Note de bryologigue africaine II. *Oreoweisia, Eriopus, Cyclodictyon, Hookeriopsis, Lepidopilidium., Lepidopilum.* Bull. Jard. Bot. Nat. Belg. 45: 103–124.

——— (1975b) Note de bryologie africaine III. *Physcomitrella magdalenae,* sp. nov. Bull. Jard. Bot. Nat. Belg. 45: 131–135.

——— (1975c) Note de bryologie africaine IV. *Breutelia.* Bull. Jard. Bot. Nat. Belg. 45: 237–271.

——— (1975d) Note de bryologie africaine V. *Anacolia, Leiomela, Cyathophorella.* Bull. Jard. Bot. Nat. Belg. 45: 313–321.

STEERE, W.C.(1958) *Oligotrichum falcatum,* a new species from Arctic Alaska. Bryologist 61: 115–118.

SUZUKI, H.(1966) Musci. The flora of Eastern Himalaya: 537–542.

——— (1967) Notes on the section Squarrosa of *Sphagnum.* Journ. Sci. Hiroshima Univ. 11: 247–264.

TAKAKI, N.(1962) A revision of Japanese *Trematodon.* Journ. Hattori Bot. Lab. 25: 263–278.

TANSLEY, A. G. (1901) Notes on the conducting tissue-system in Bryophyta. Annales Bot. 15: 1–38.

TIXIER, P.(1969) La notion de protothalle sa place dans le cycle des mosses. Cas de *Sematophyllum phaenicum* (C.M.)FL. Ann. Fac. Sc. Phnom. Penh.: 101–116.

TOUW, A.(1971) A taxonomic revision of the Hypnodendraceae(Musci). Blumea 19: 211–354.

VITIKAINEN, O.(1969) On the taxonomy and distribution of *Grimmia anomala* HAMP. and *G. Hartmanii* SHIMP. Ann. Bot. Fenn. 6: 236–242.

WARENHAM, R.(1946) A new species, *Atrichum paraphyllum* WARENH. Bryologist 49: 85–88.

WATANABE, R.(1972) A revision of the family Thuidiaceae in Japan and adjacent areas. Journ. Hattori Bot. Lab. 36: 171–320.

———and I. KAWAI(1975) Systematic studies on the conducting tissue of the gametophyte in Musci (5) What is expected of systematics regarding the inner structure of the stem in some species of Thuidiaceae. Sci. Rep. Kanazawa Univ. 20: 21–76.

ZANDER, R.H. and E. HEGEWALD(1976) *Leptodontiella,* gen. nov. and *Leptodontium* from Peru. Bryologist 79: 16–21

——— (1977) The tribe Pleuroweisieae (Pottiaceae, Musci) in Middle America. Bryologist 80: 233–269.

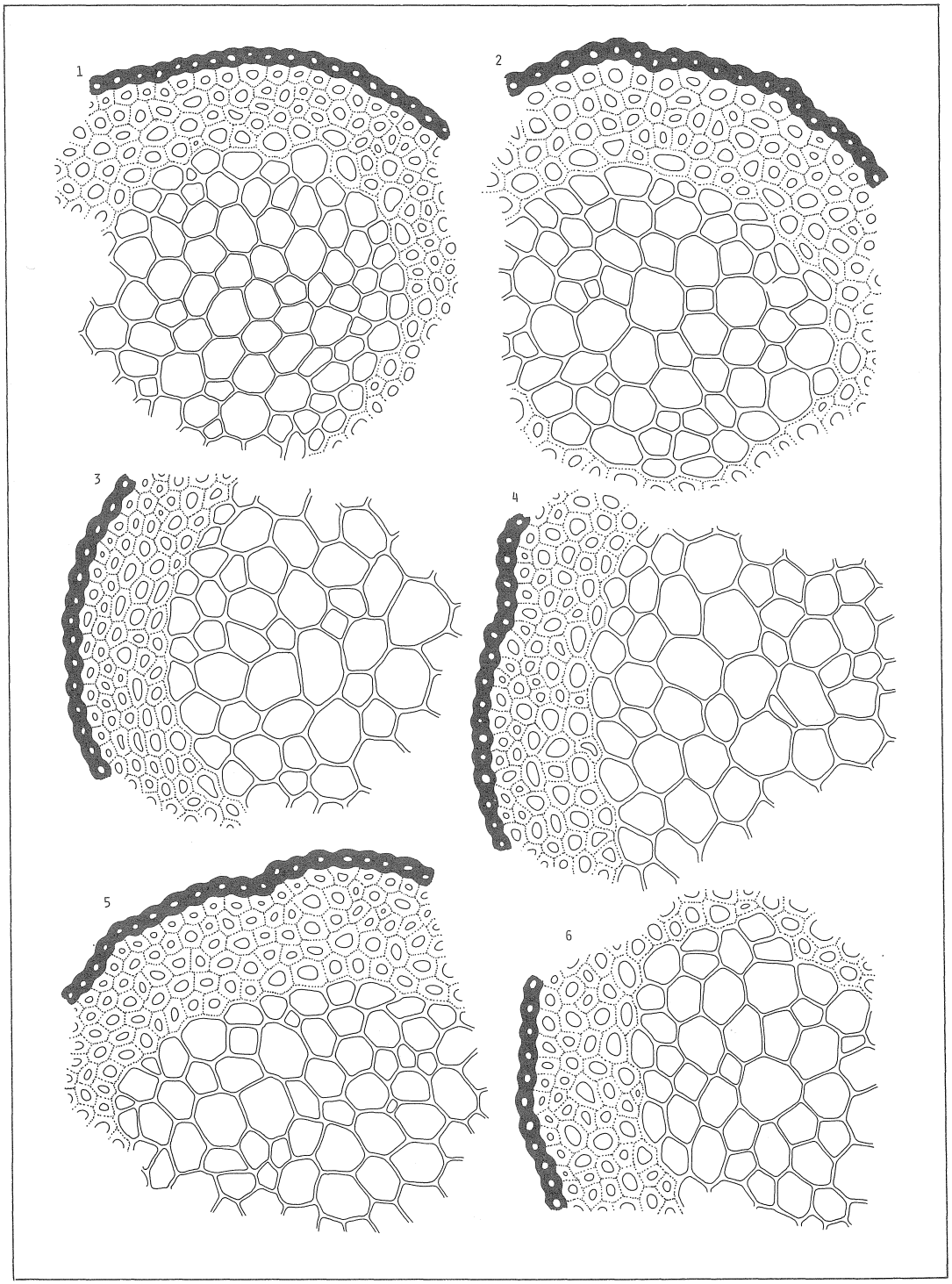


Plate I Cross sections of the stem
Fig. 1–6 : *Dichelyma japonicum* CARD. ×240

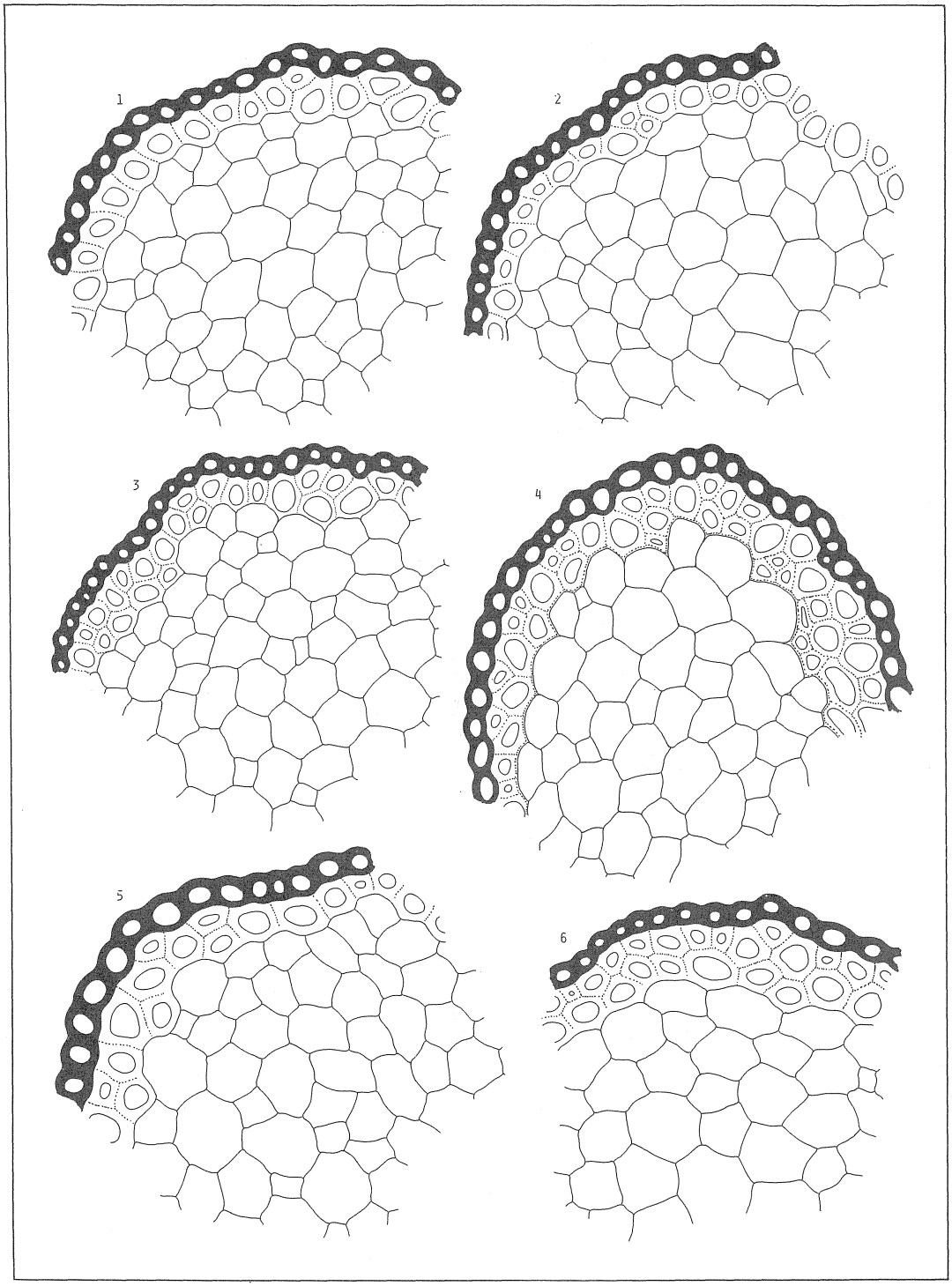


Plate II Cross sections of the stem
Fig. 1–6 : *Fontinalis hypnoides* HARTM. ×360

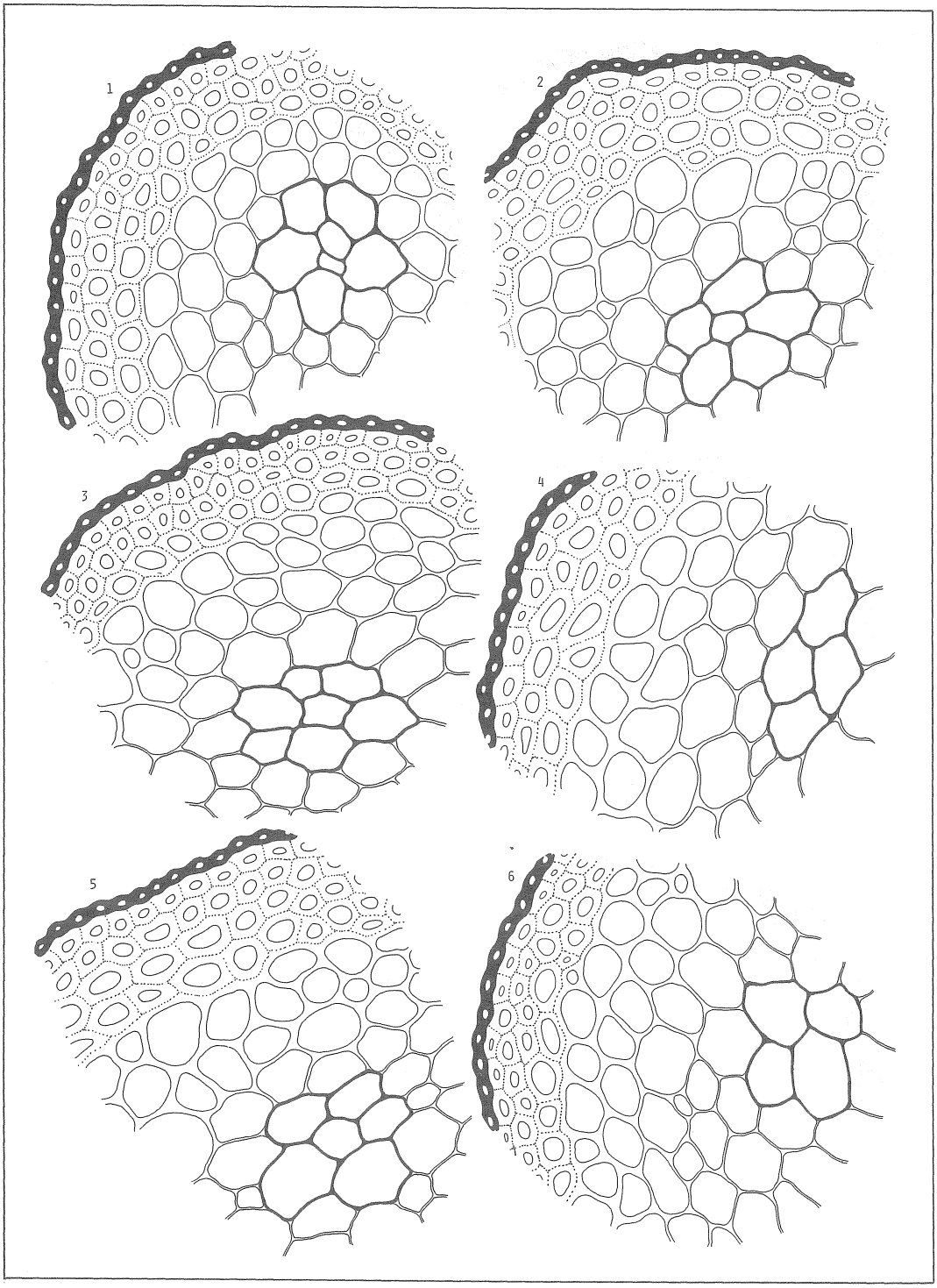


Plate III Cross sections of the stem
Fig. 1-6 : *Hedwigia ciliata* (HEDW.) EHRH. ×240

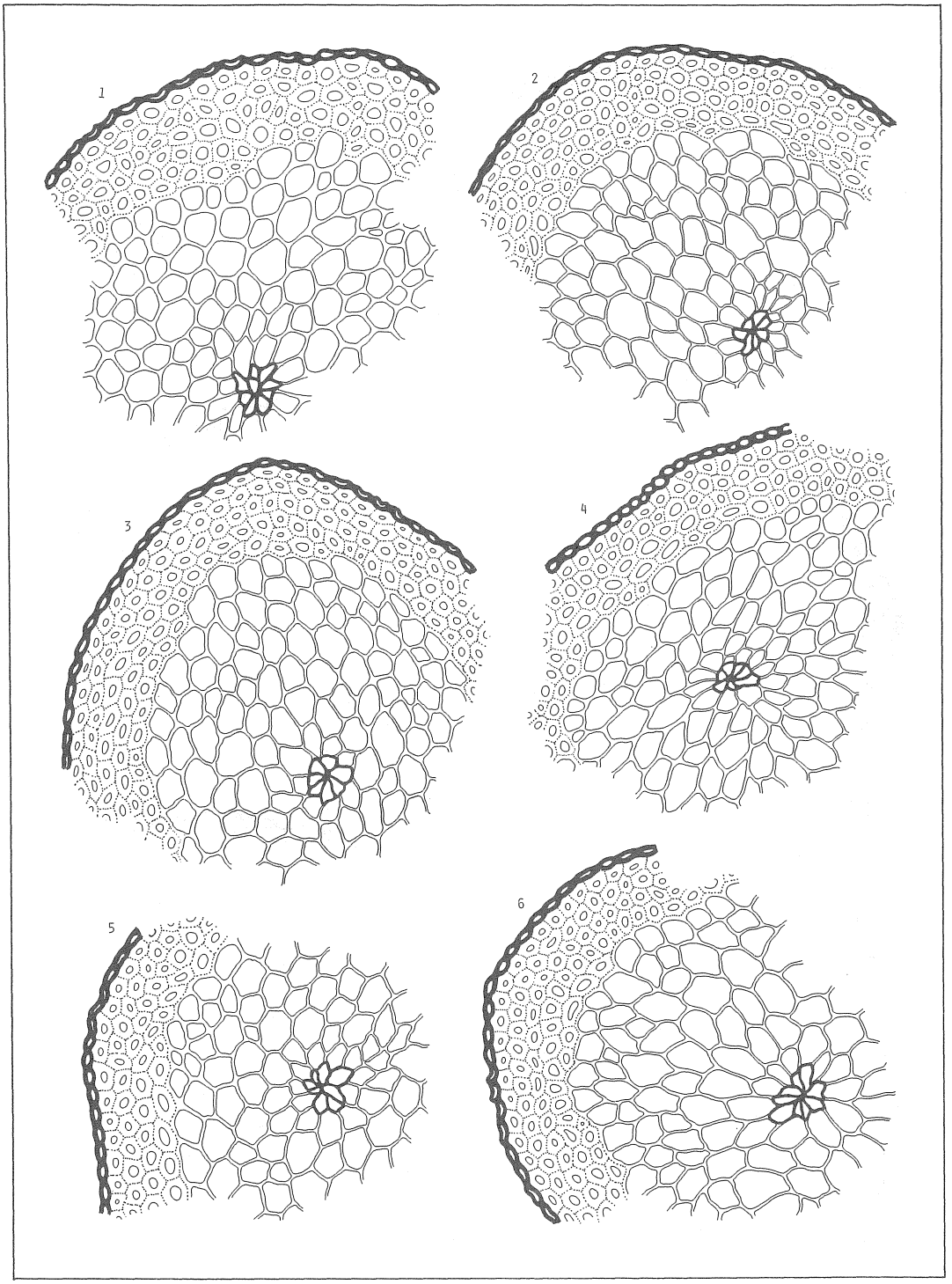


Plate IV Cross sections of the stem
Fig. 1–6 : *Dozya japonica* LAC. ×240

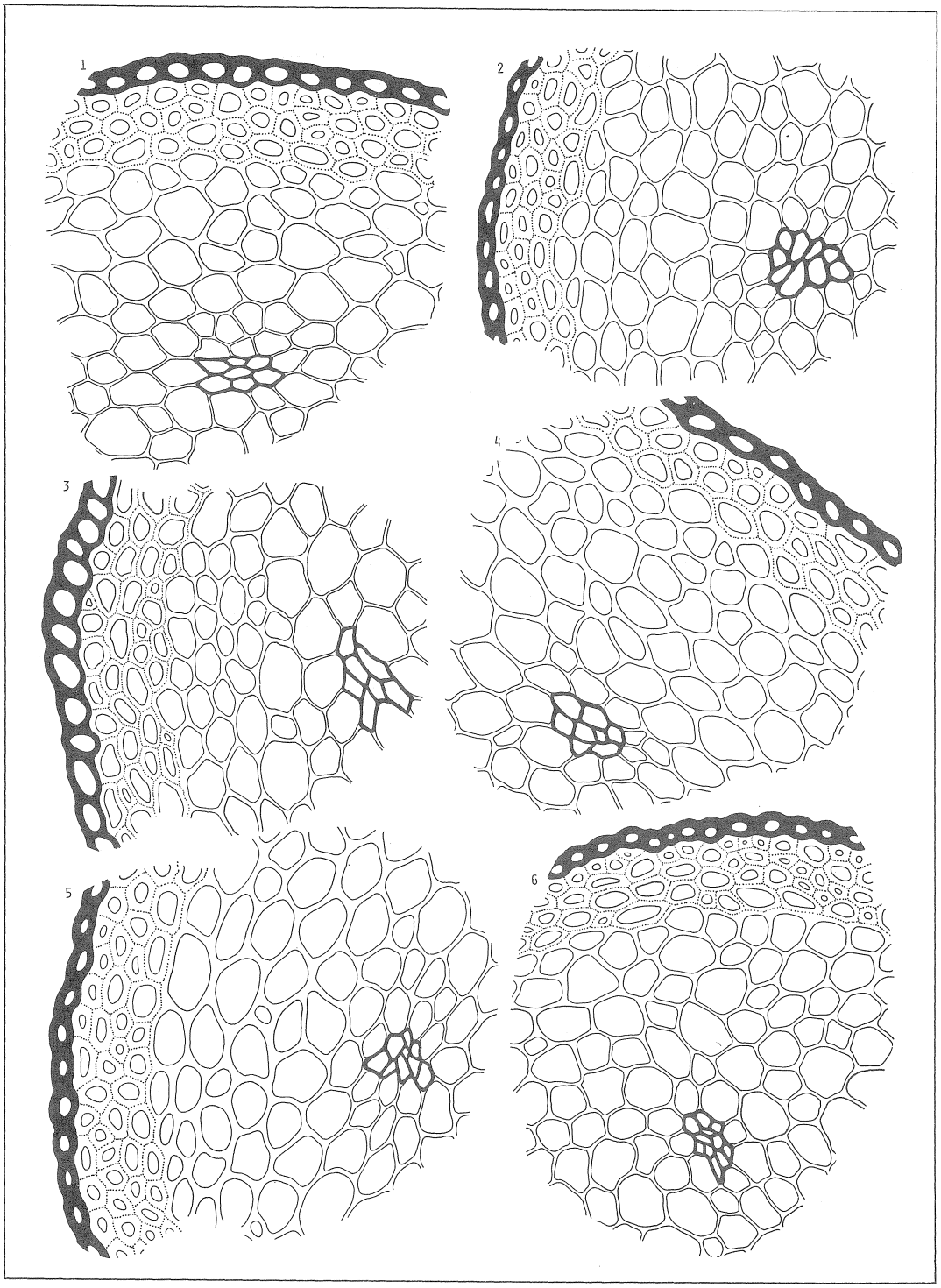


Plate V Cross sections of the stem
Fig. 1–6 : *Leucodon exaltatus* C. MUELL. ×240

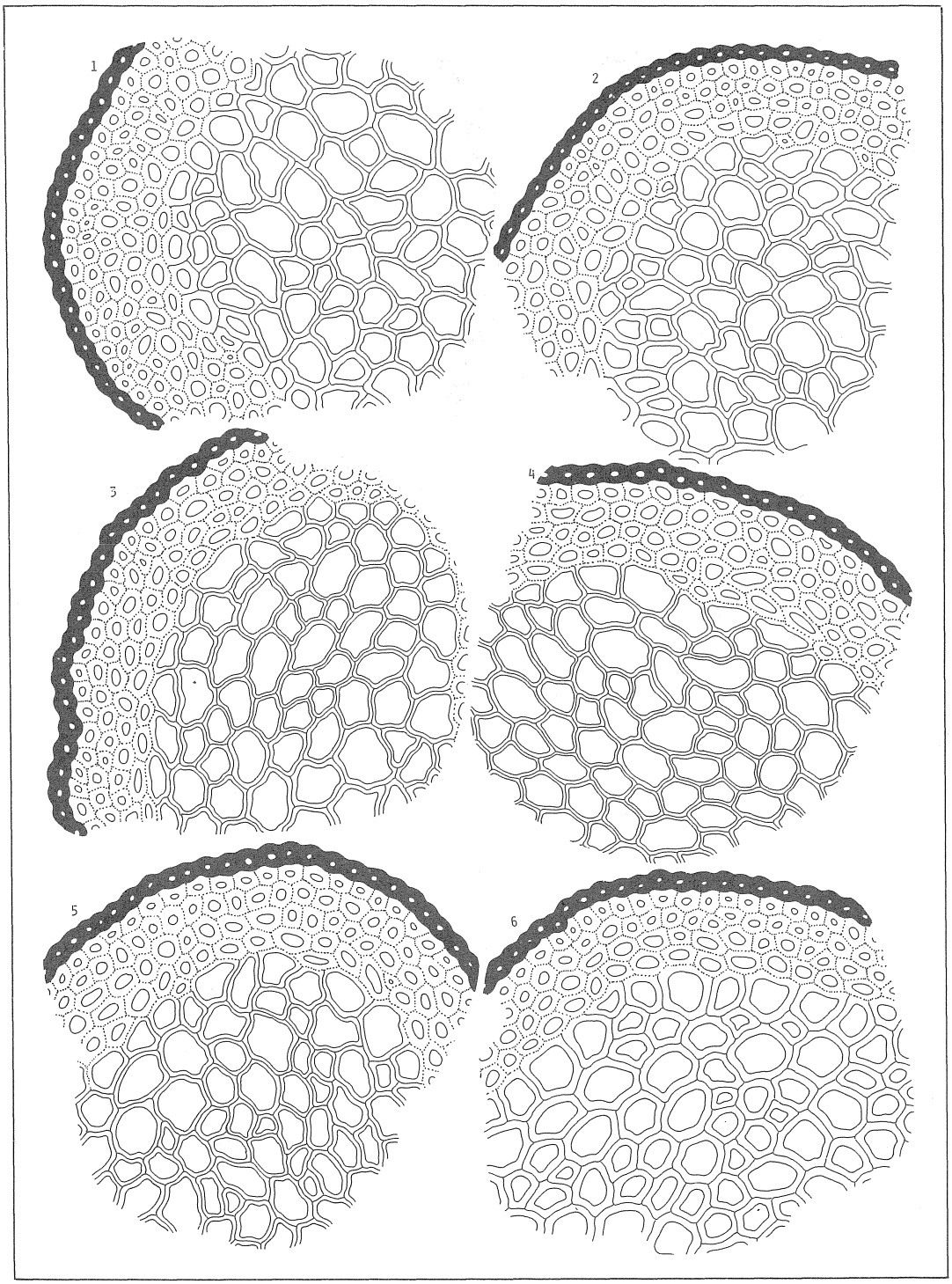


Plate VI Cross sections of the stem
Fig. 1-6: *Leucodon noguchii* IWATS. ×240

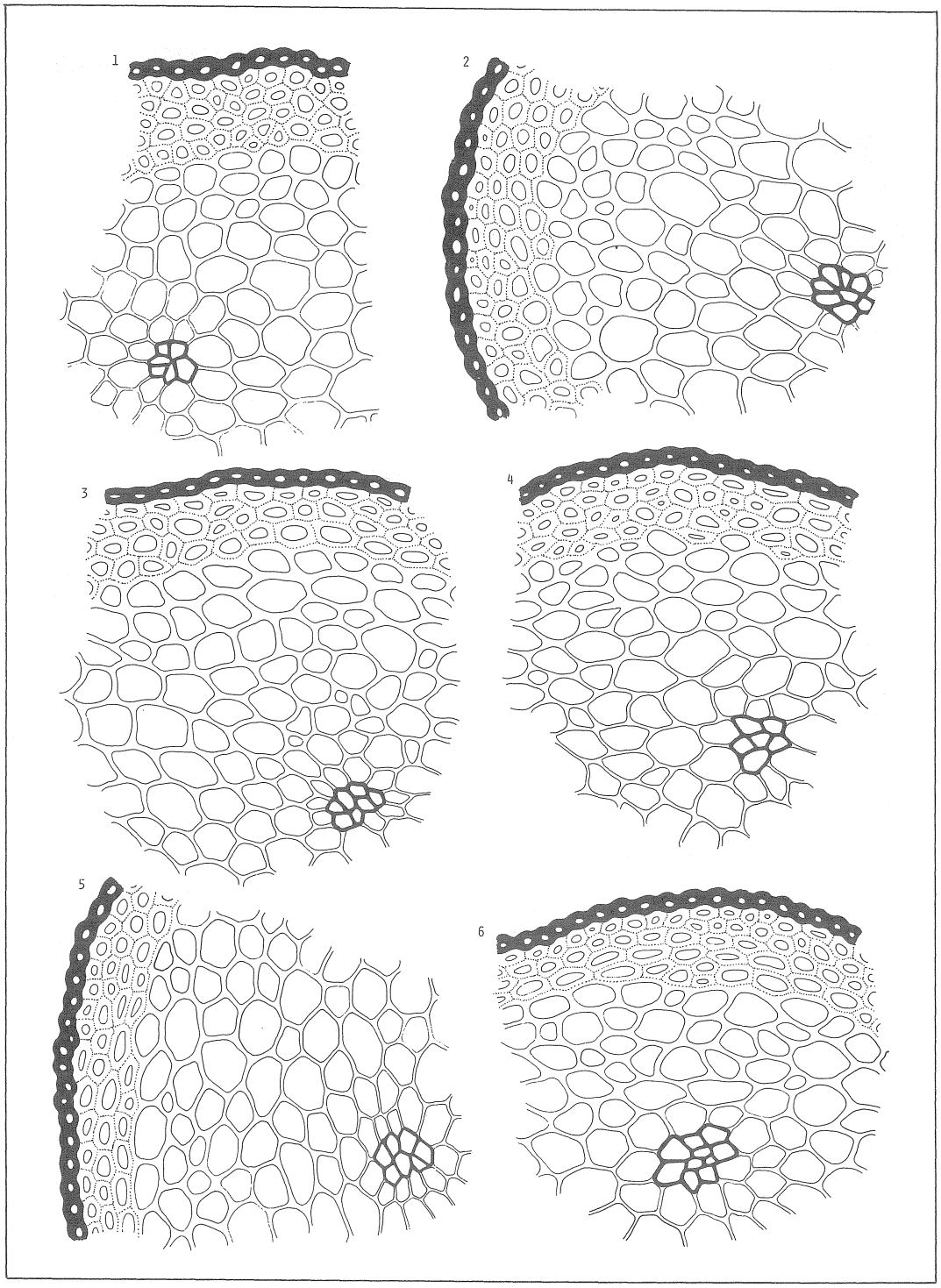


Plate VII Cross sections of the stem
Fig. 1–6: *Leucodon sapporensis* BESCH. ×240

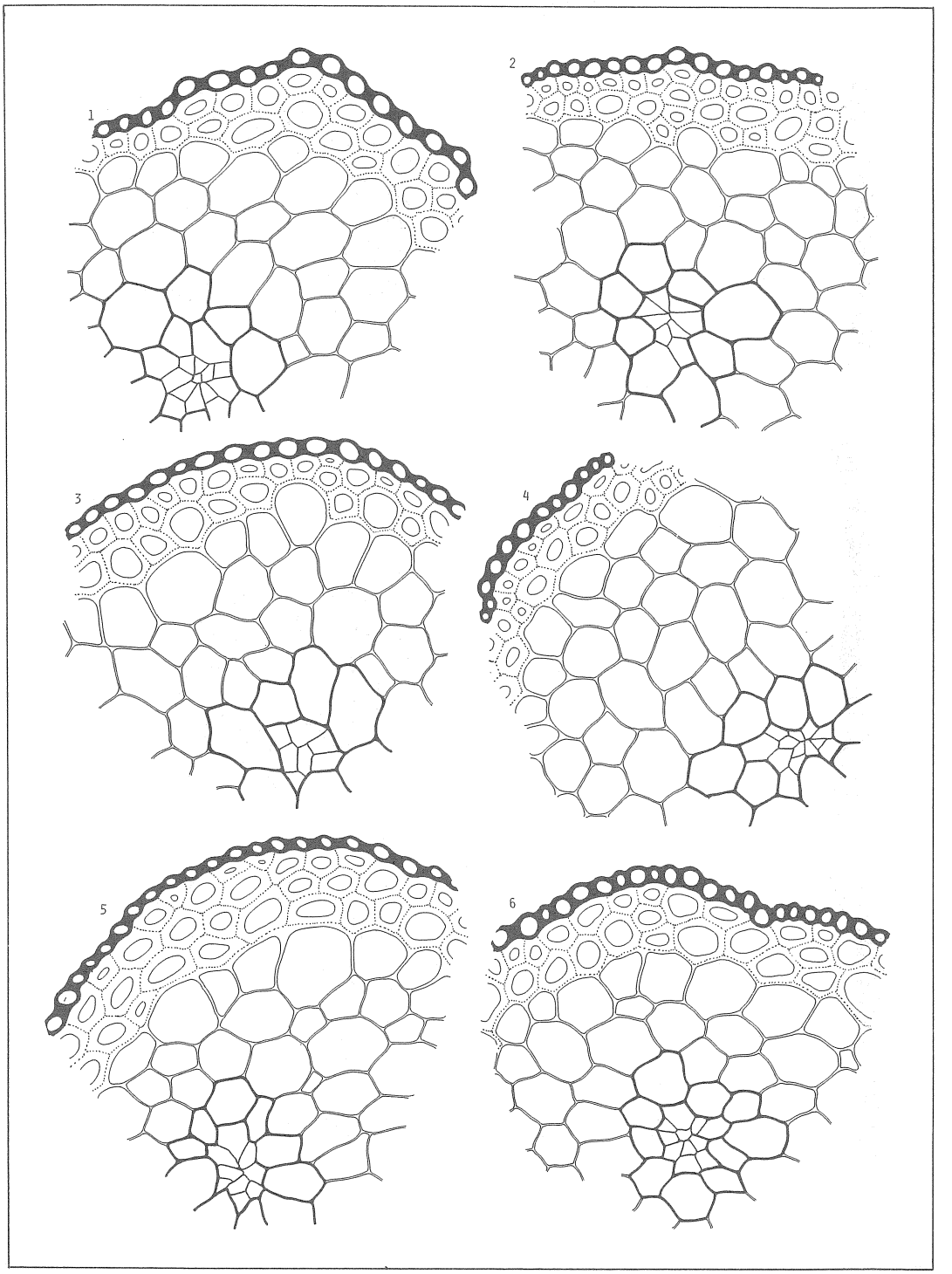
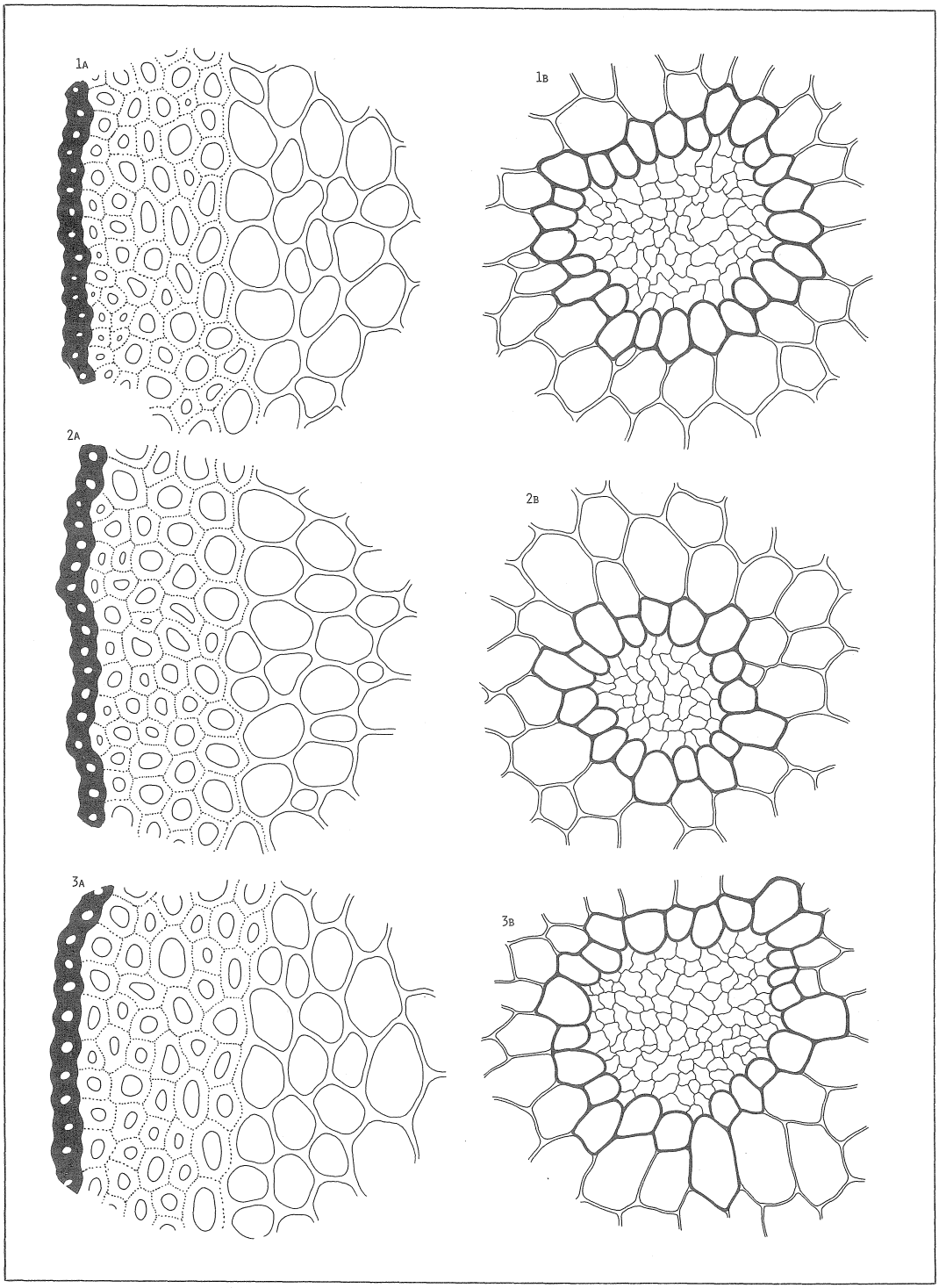


Plate VIII Cross sections of the stem
Fig. 1–6 : *Duthiella flaccida* (CARD.) BROTH. ×360



Pldte IX Cross sections of the stem
Fig. 1–3 : *Duthiella speciosissima* BROTH. ×360
A : Outer part of the stem
B : Central part of the stem

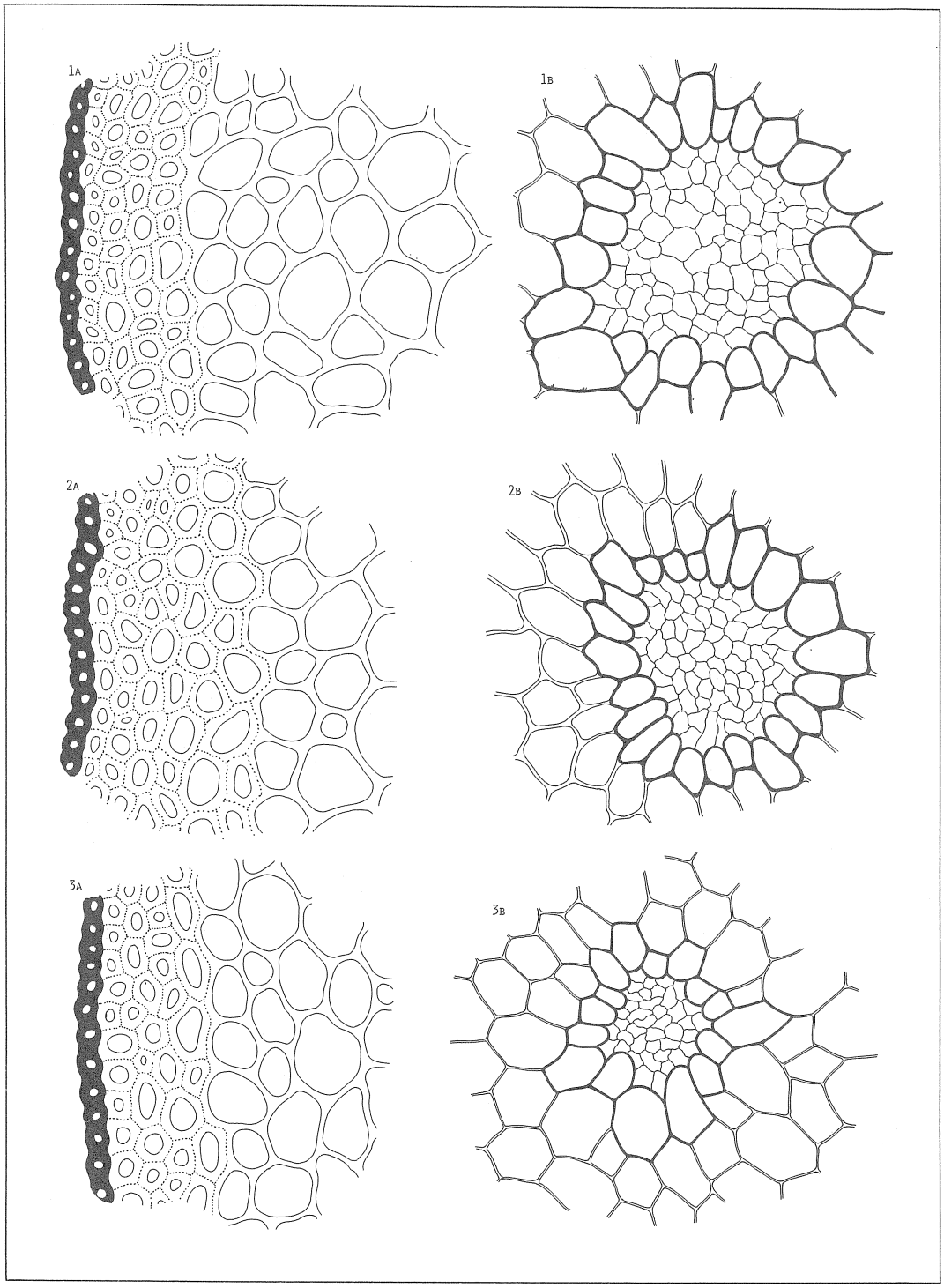


Plate X Cross sections of the stem
Fig. 1–3 : *Duthiella speciosissima* BROTH. ×360
A : Outer part of the stem
B : Central part of the stem

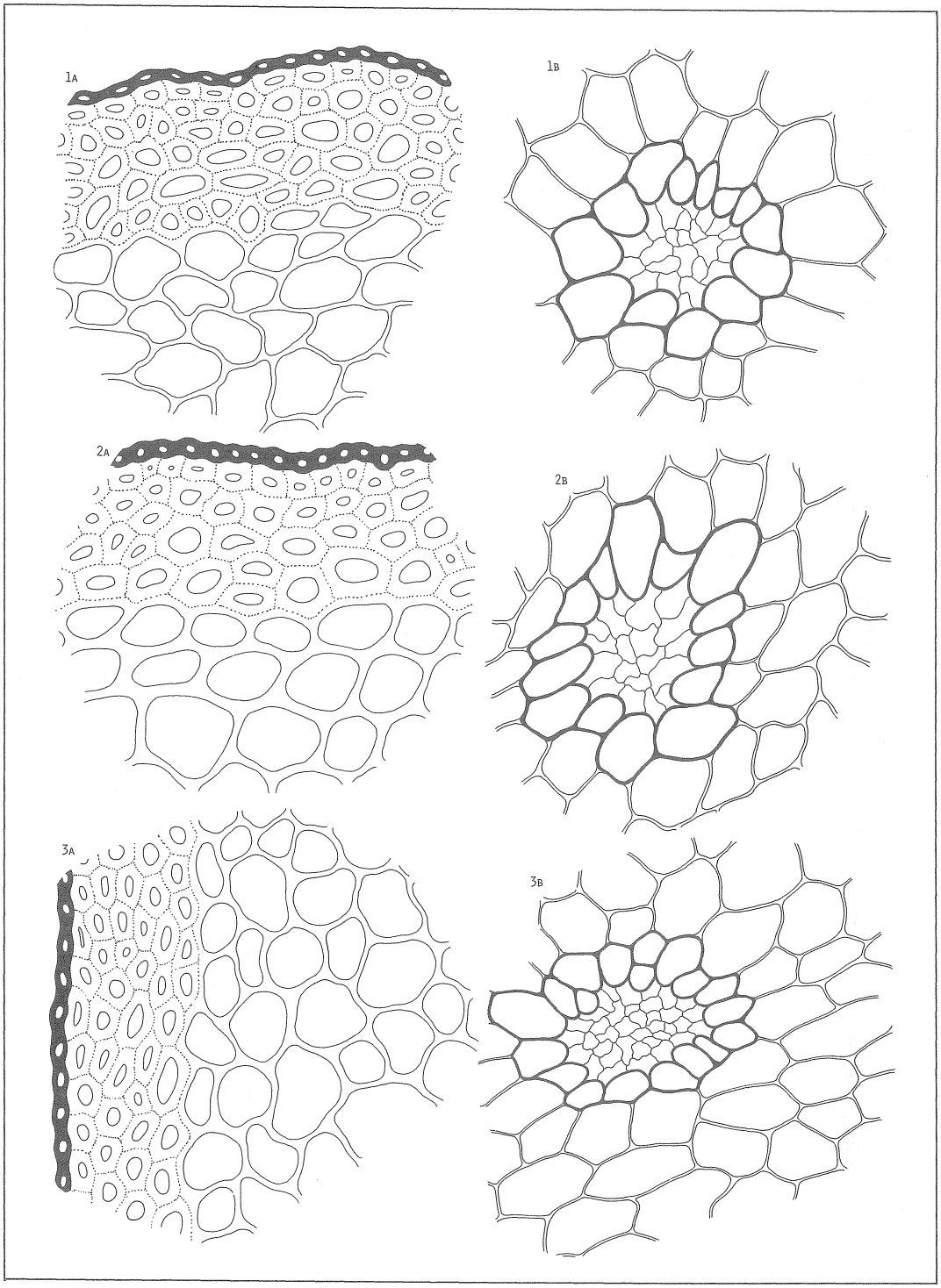
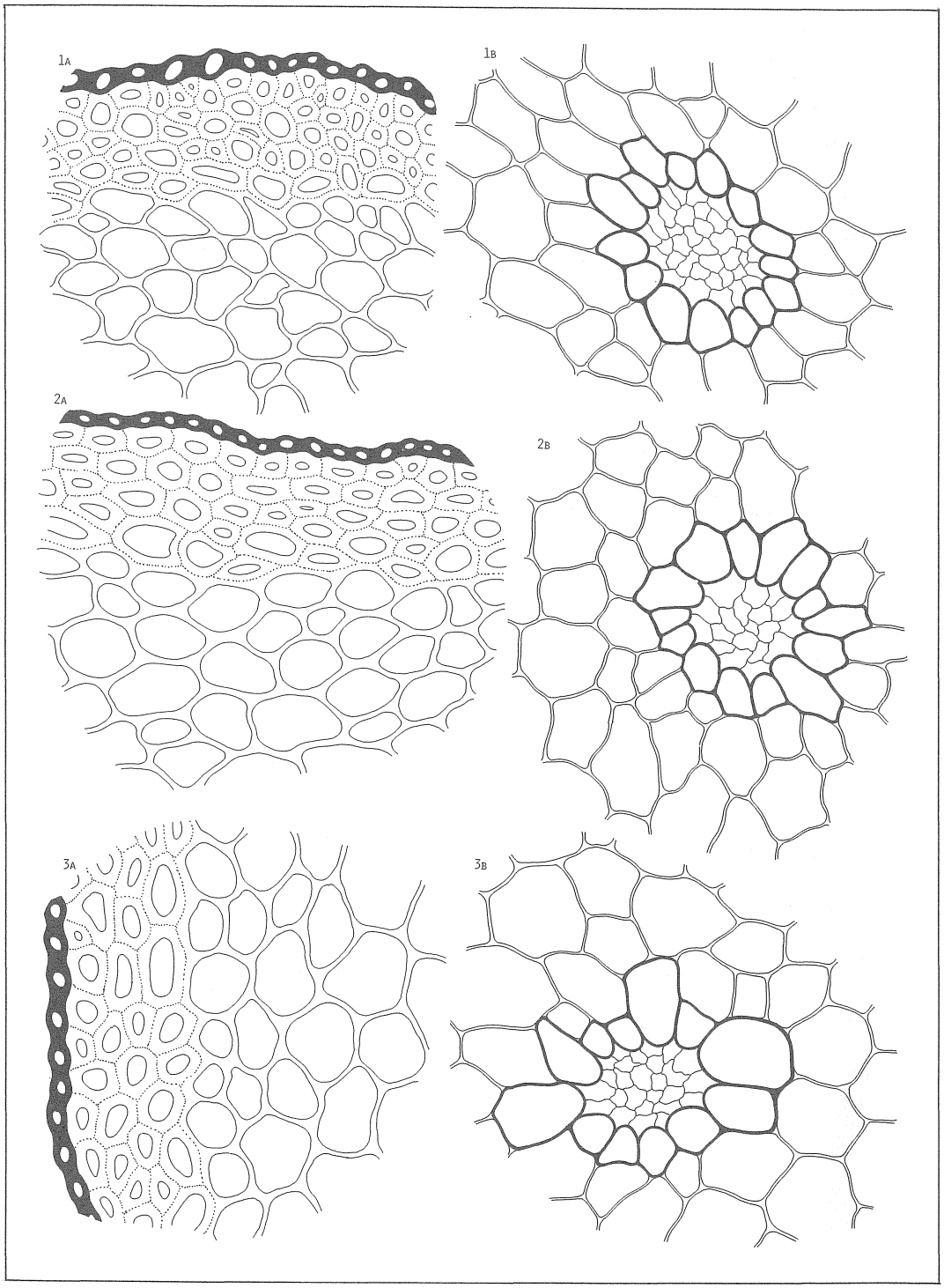


Plate XI Cross sections of the stem
Fig. 1–3 : *Duthiella wallichii* (MITT.) C. MUELL. ×360
A : Outer part of the stem
B : Central part of the stem



Platt XII Cross sections of the stem
Fig. 1–3 : *Duthiella wallichii* (MITT.) C. MUELL. ×360
A : Outer part of the stem
B : Central part of the stem

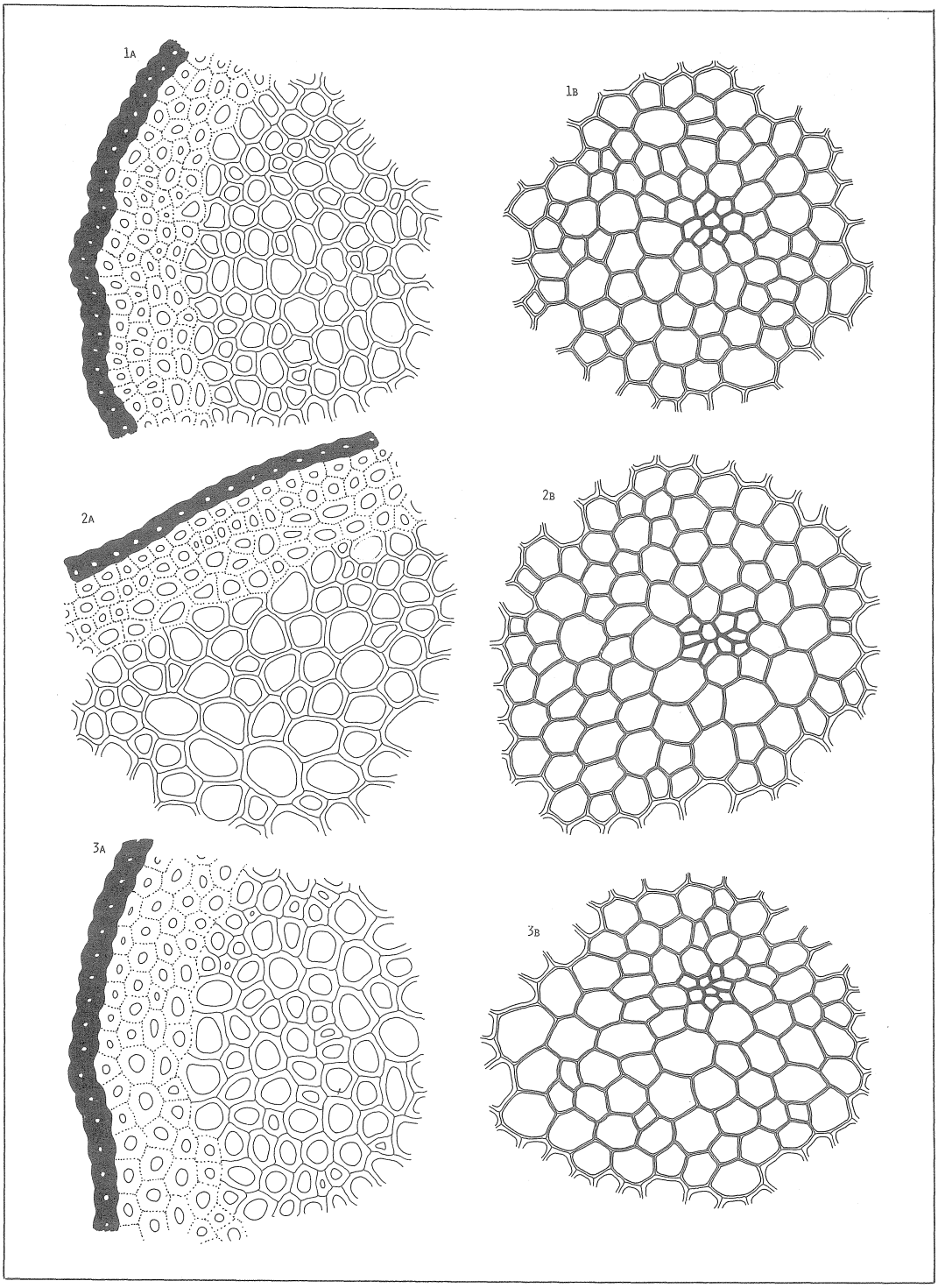


Plate XIII Cross sections of the stem
Fig. 1-3 : *Trachypus bicolor* REINW. et HORNSCH. ×360
A : Outer part of the stem
B : Central part of the stem

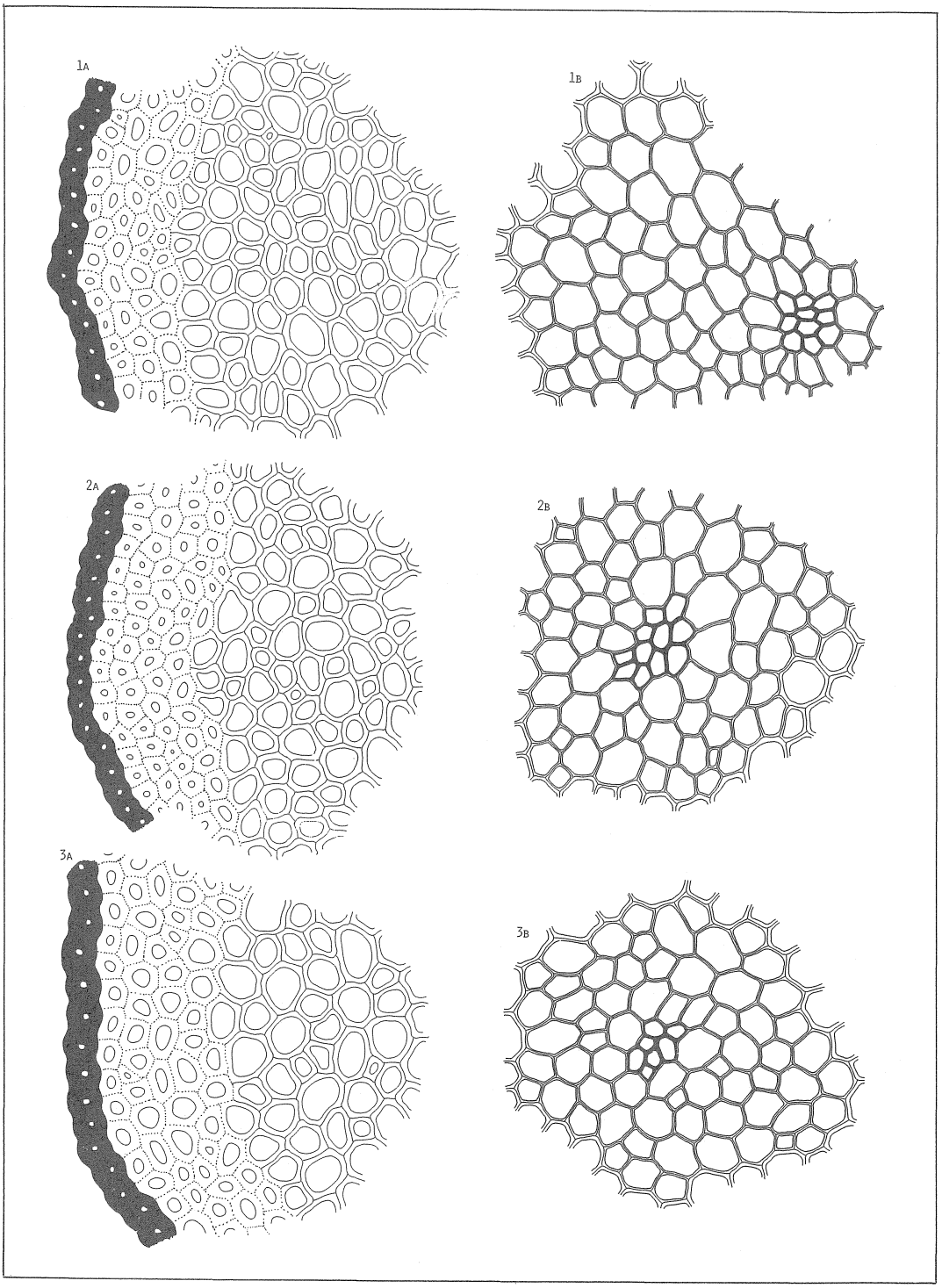


Plate XIV Cross sections of the stem
Fig. 1–3 : *Trachypus bicolor* REINW. et HORNSCH. ×360
A : Outer part of the stem
B : Central part of the stem

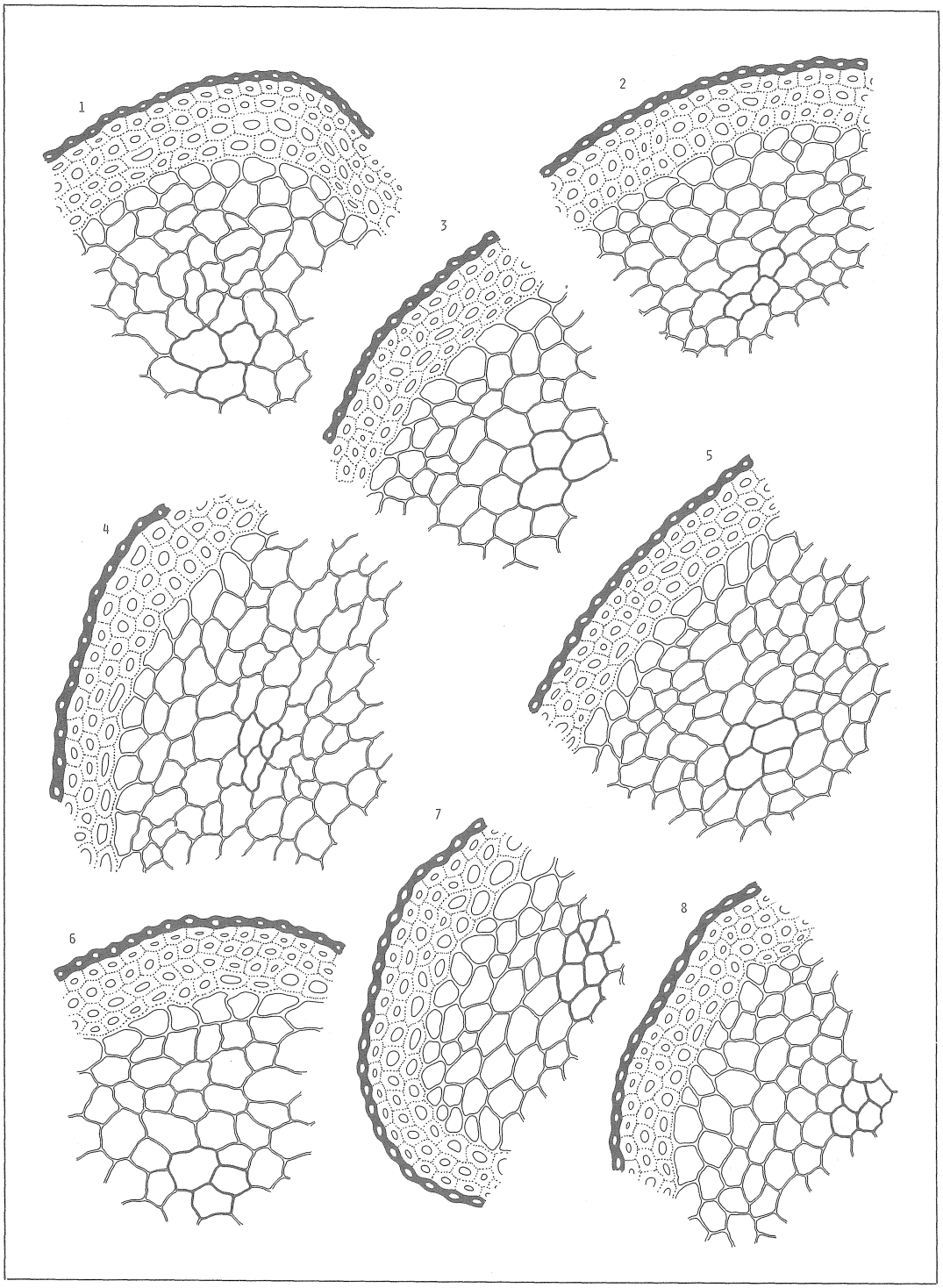


Plate XV Cross sections of the stem
Fig. 1–8: *Trachypus humilis* LINDB. ×360

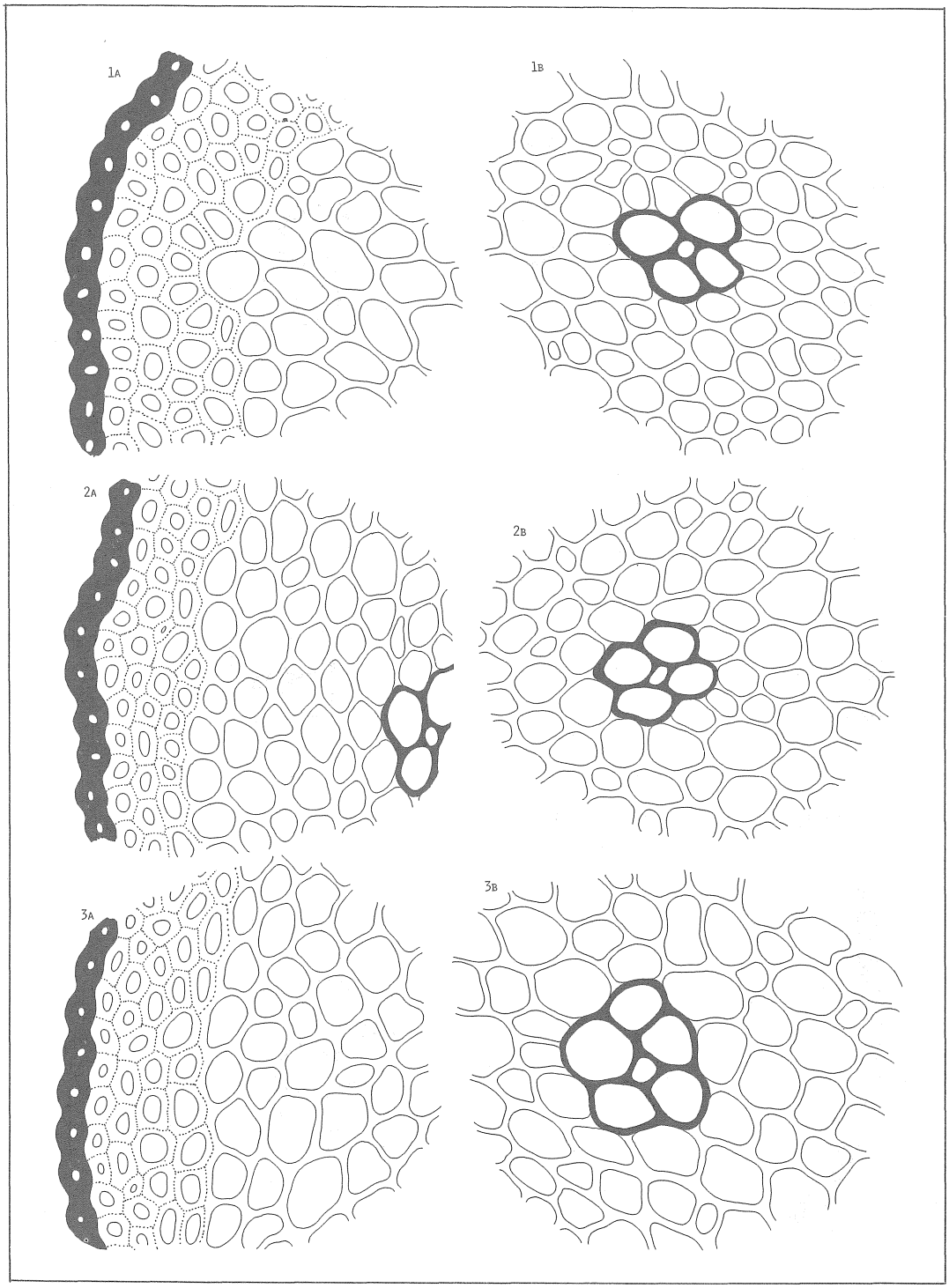


Plate XVI Cross-sections of the stem
Fig. 1-3 : *Calyptothecium hookeri* (MITT.) BROTH. ×360
A : Outer part of the stem
B : Central part of the stem

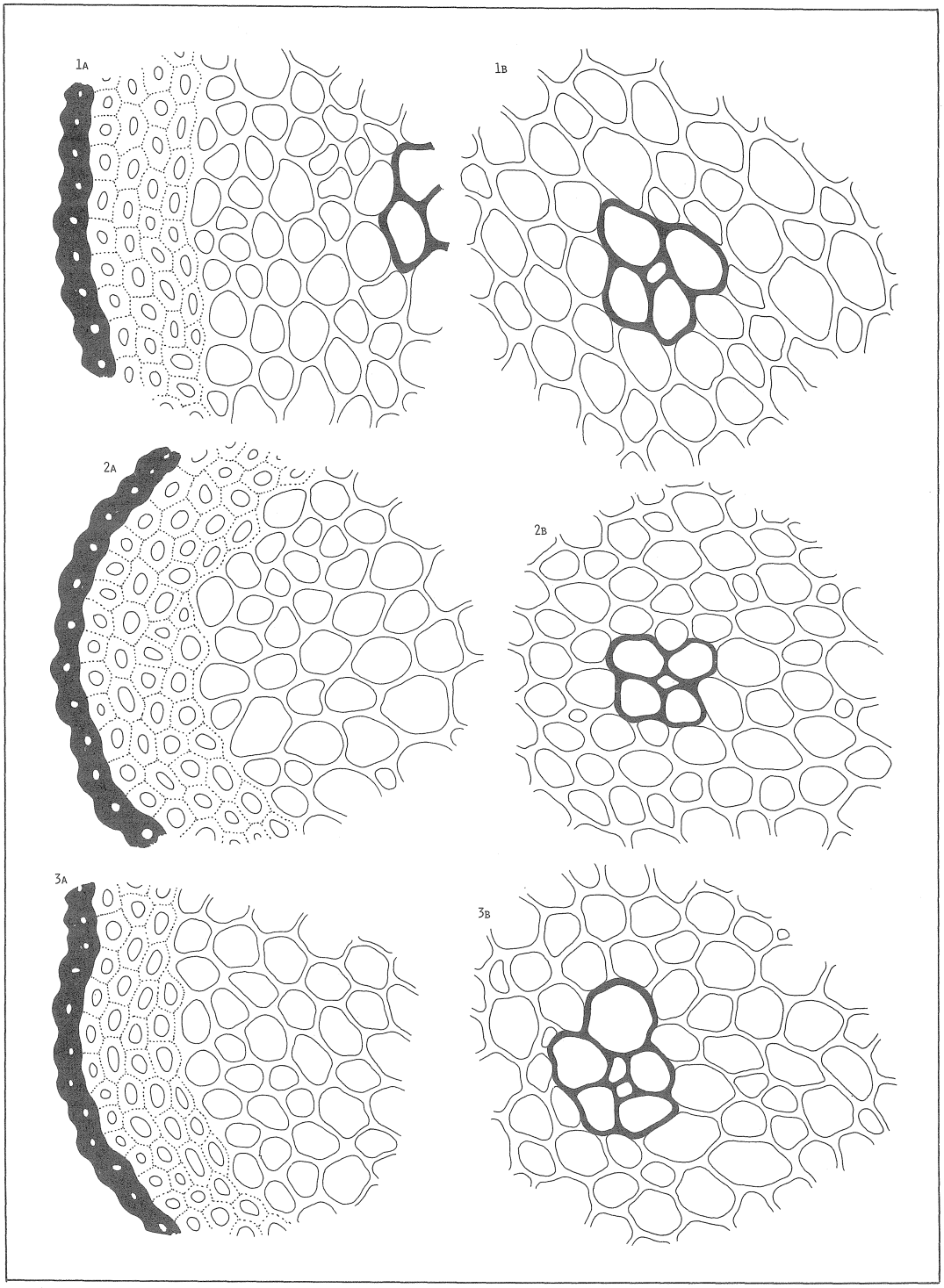


Plate XVII Cross sections of the stem
Fig. 1-3 *Calyptothecium hookeri* (MITT.) BROTH. ×360
A : Outer part of the stem
B : Central part of the stem

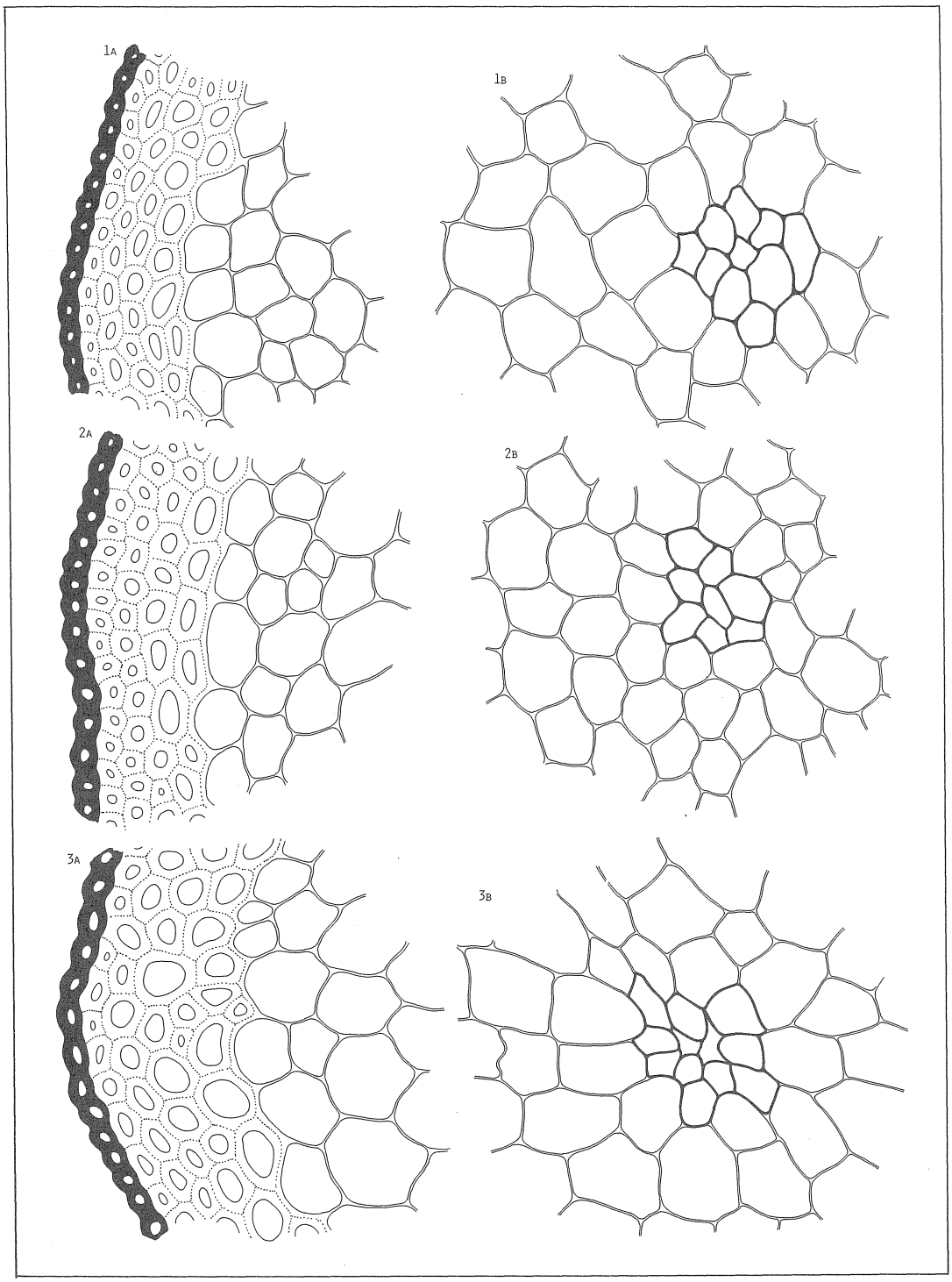


Plate XVIII Cross sections of the stem
Fig. 1–3 : *Calyptothecium urvilleanum* (C. MUELL.) BROTH. ×360
A : Outer part of the stem
B : Central part of the stem

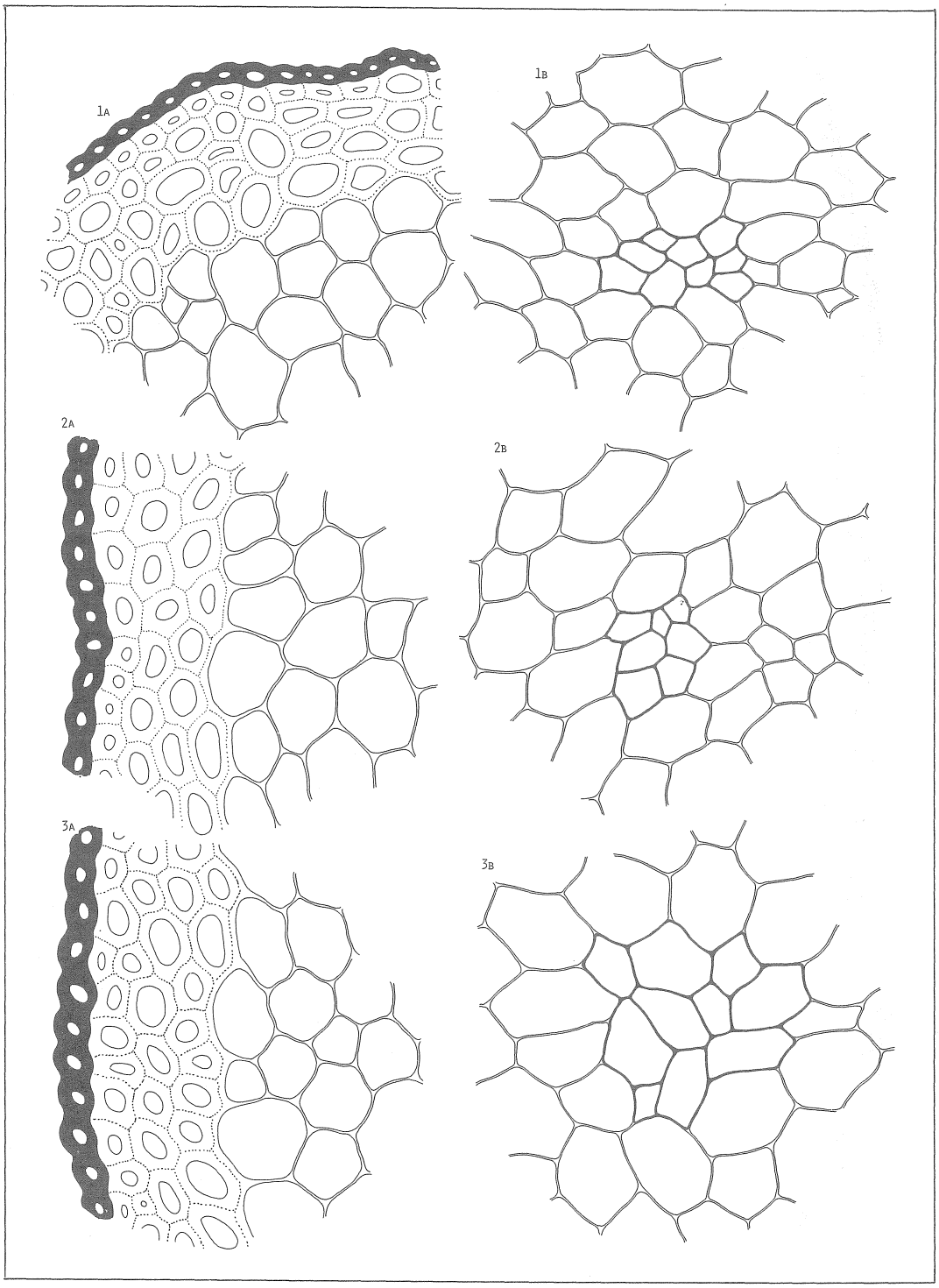


Plate XIX Cross sections of the stem
Fig. 1–3 : *Calyptothecium urvilleaum* (C. MUELL.) BROTH. ×360
A : Outer part of the stem
B : Central part of the stem

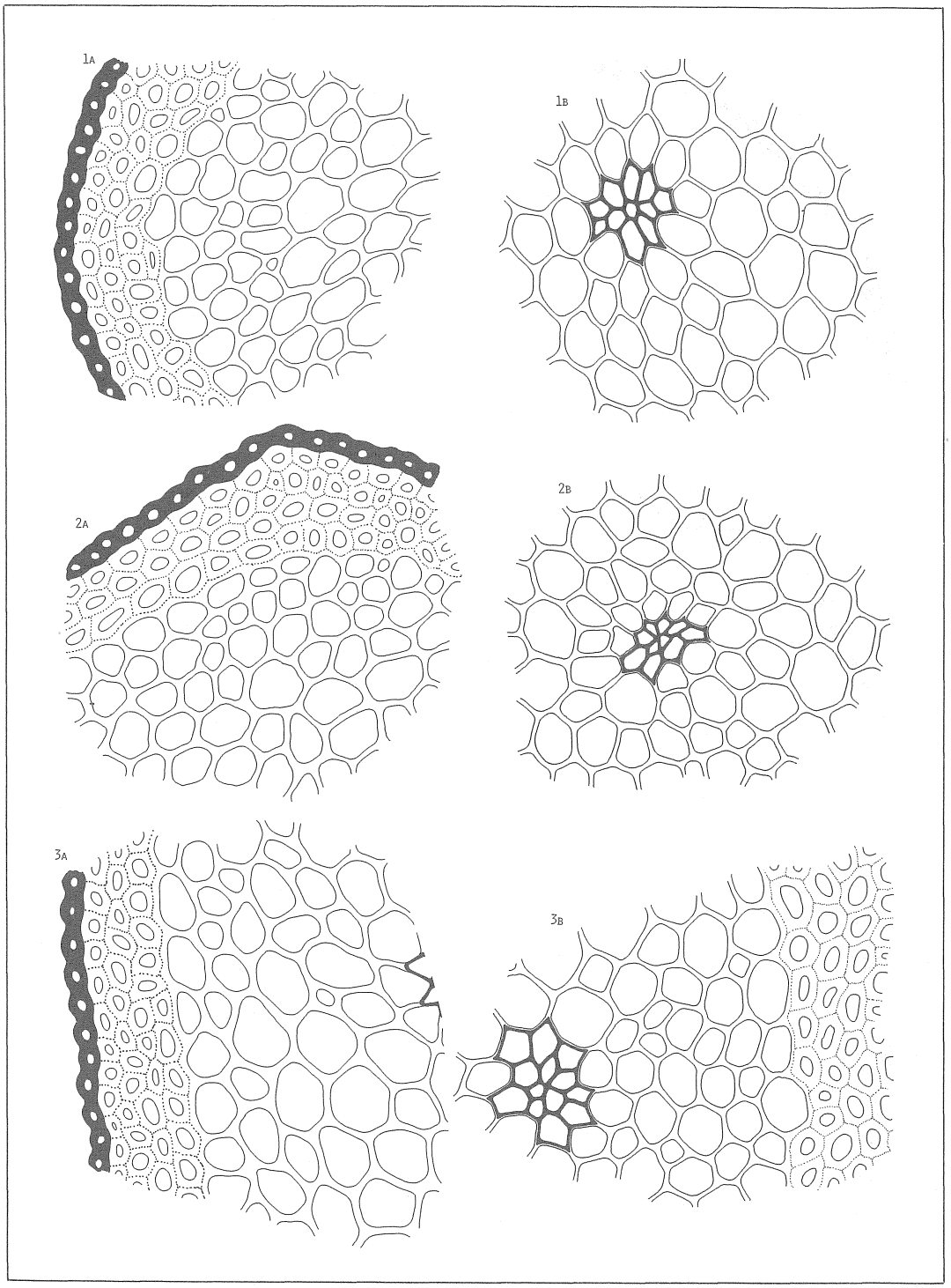


Plate XX Cross sections of the stem
Fig. 1–3 : *Myuriopsis sinica* (MITT.) NOG. ×360
A : Outer part of the stem
B : Central part of the stem

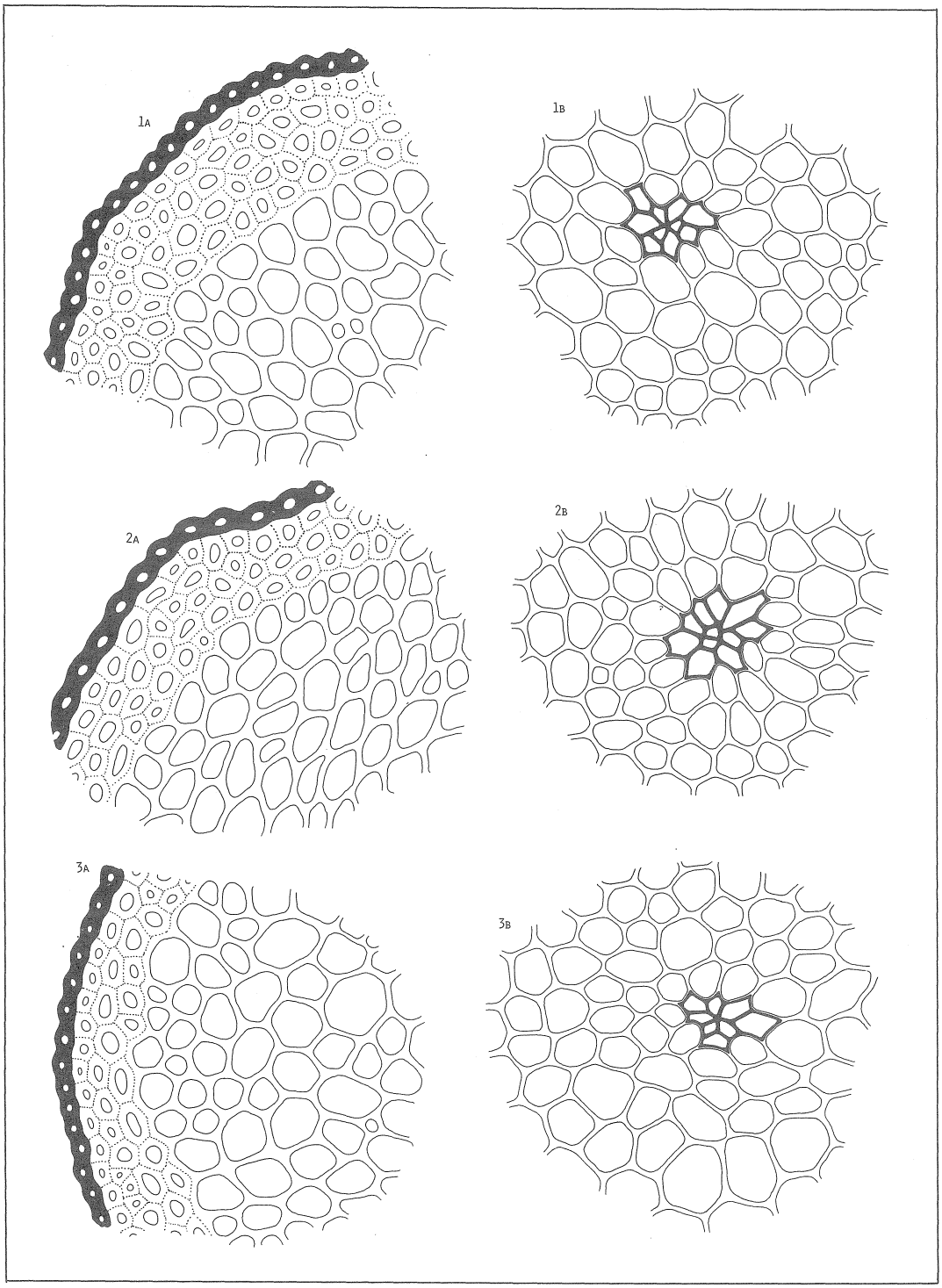


Plate XXI Cross sections of the stem
Fig. 1-3 : *Myuriopsis sinica* (MITT.) NOG. ×360
A : Outer part of the stem
B : Central part of the stem

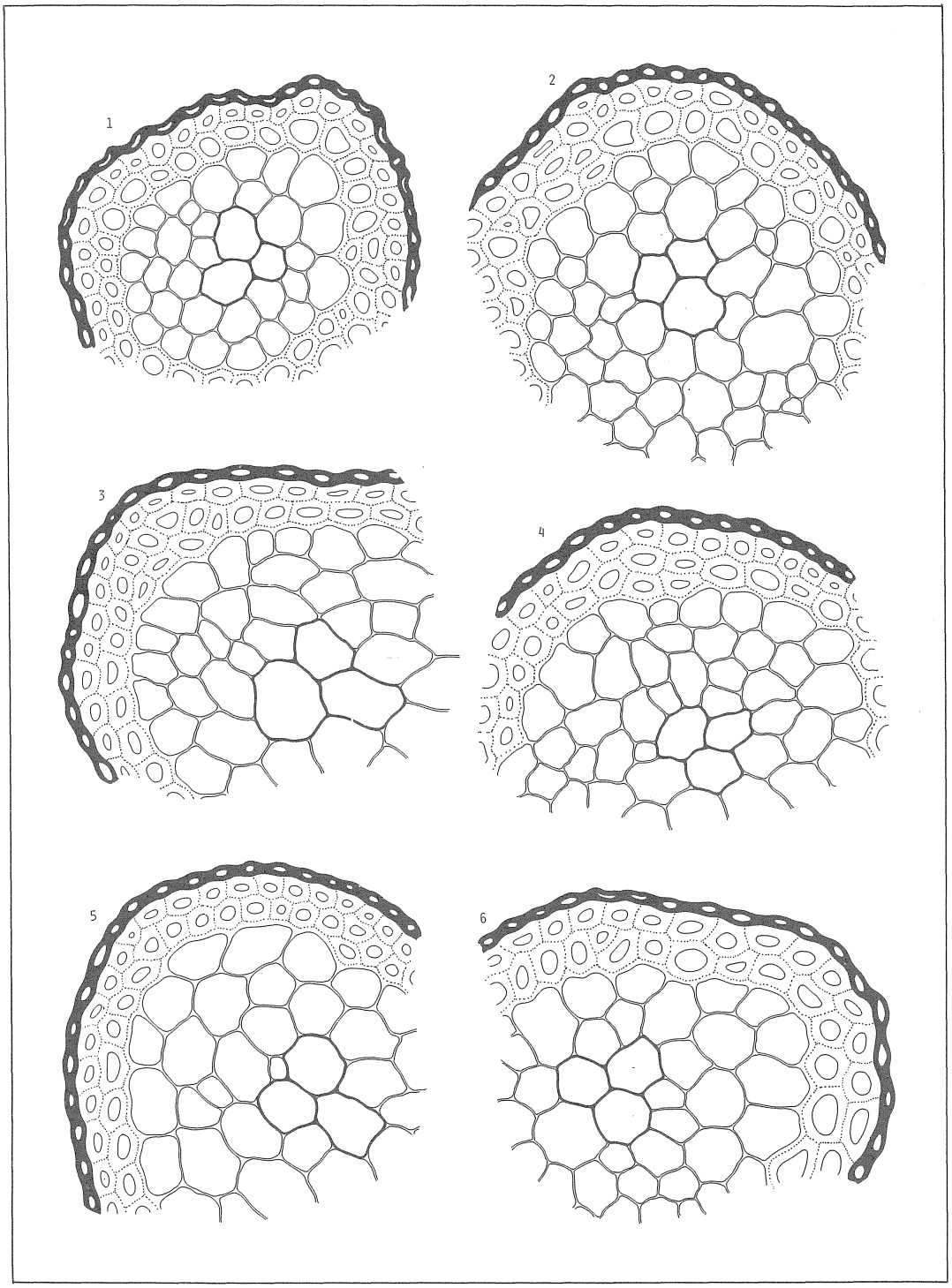


Plate XXII Cross sections of the stem
Fig. 1–6 : *Myurium assimile* (BROTH.) SEKI ×360

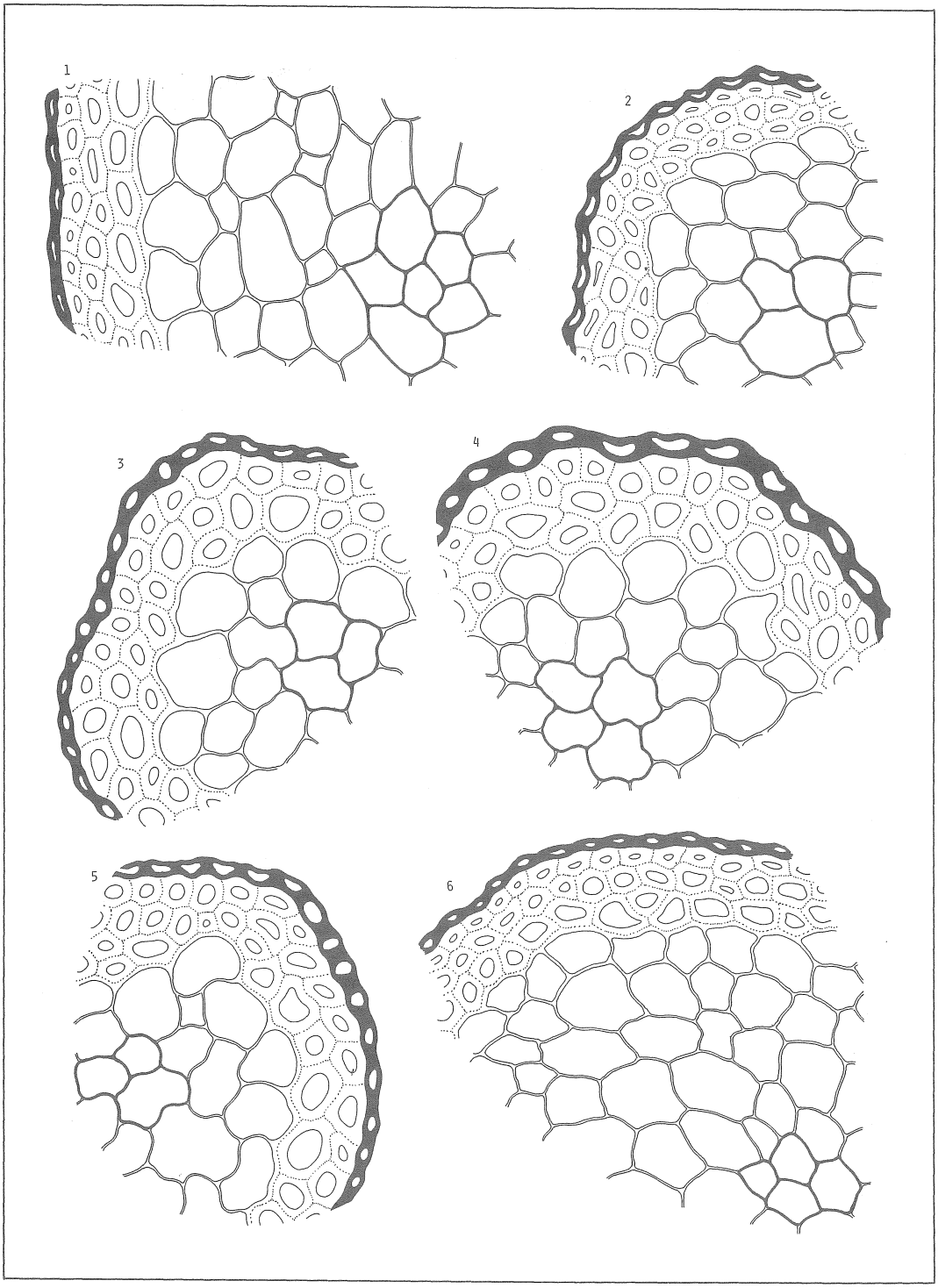


Plate XXIII Cross sections of the stem
Fig. 1–6 : *Myurium fragile* (CARD.) BROTH. ×360

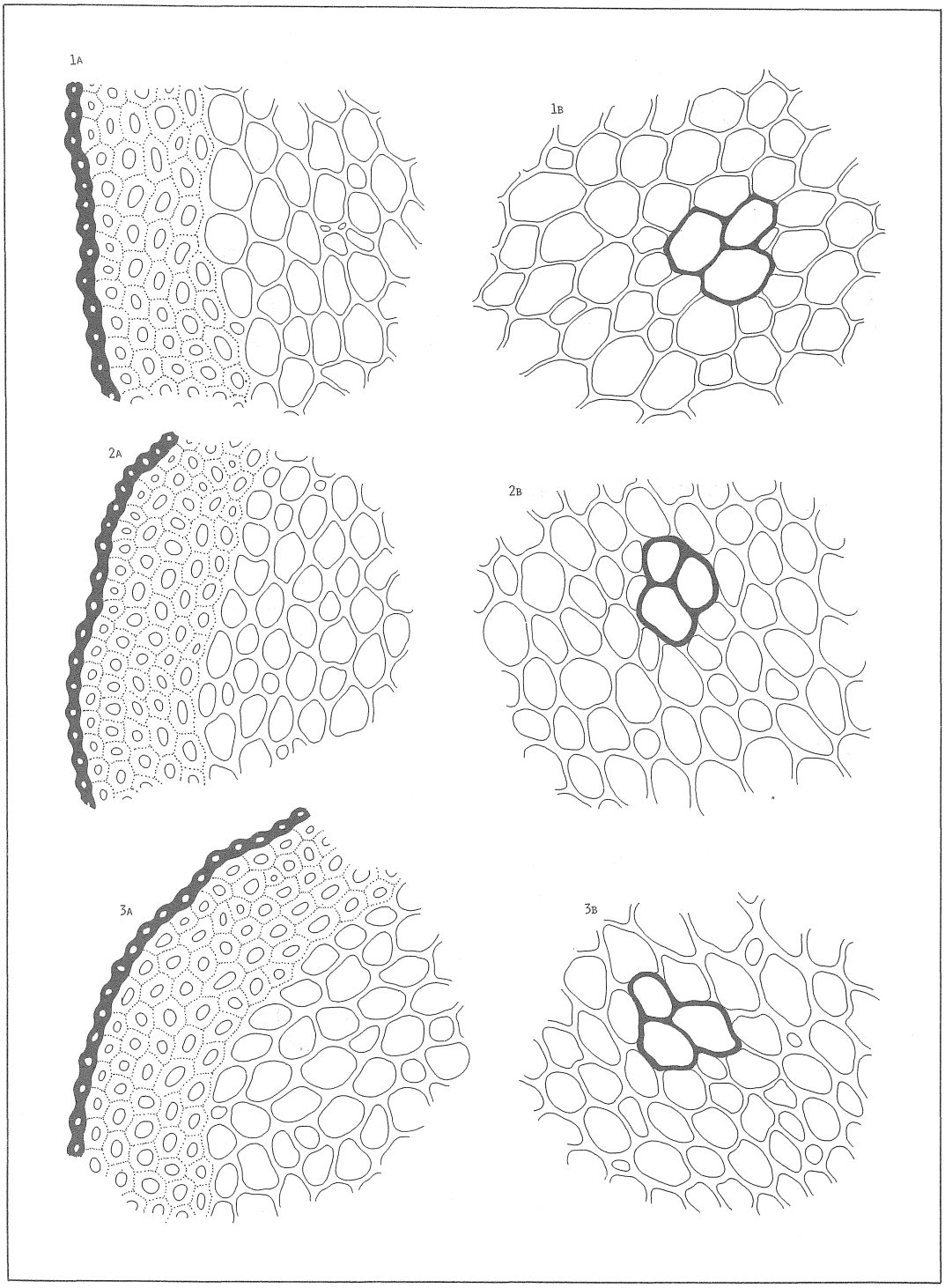


Plate XXIV Cross sections of the stem
Fig. 1-3 : *Pterobryum arbuscula* MITT. ×360
A : Outer part of the stem
B : Central part of the stem

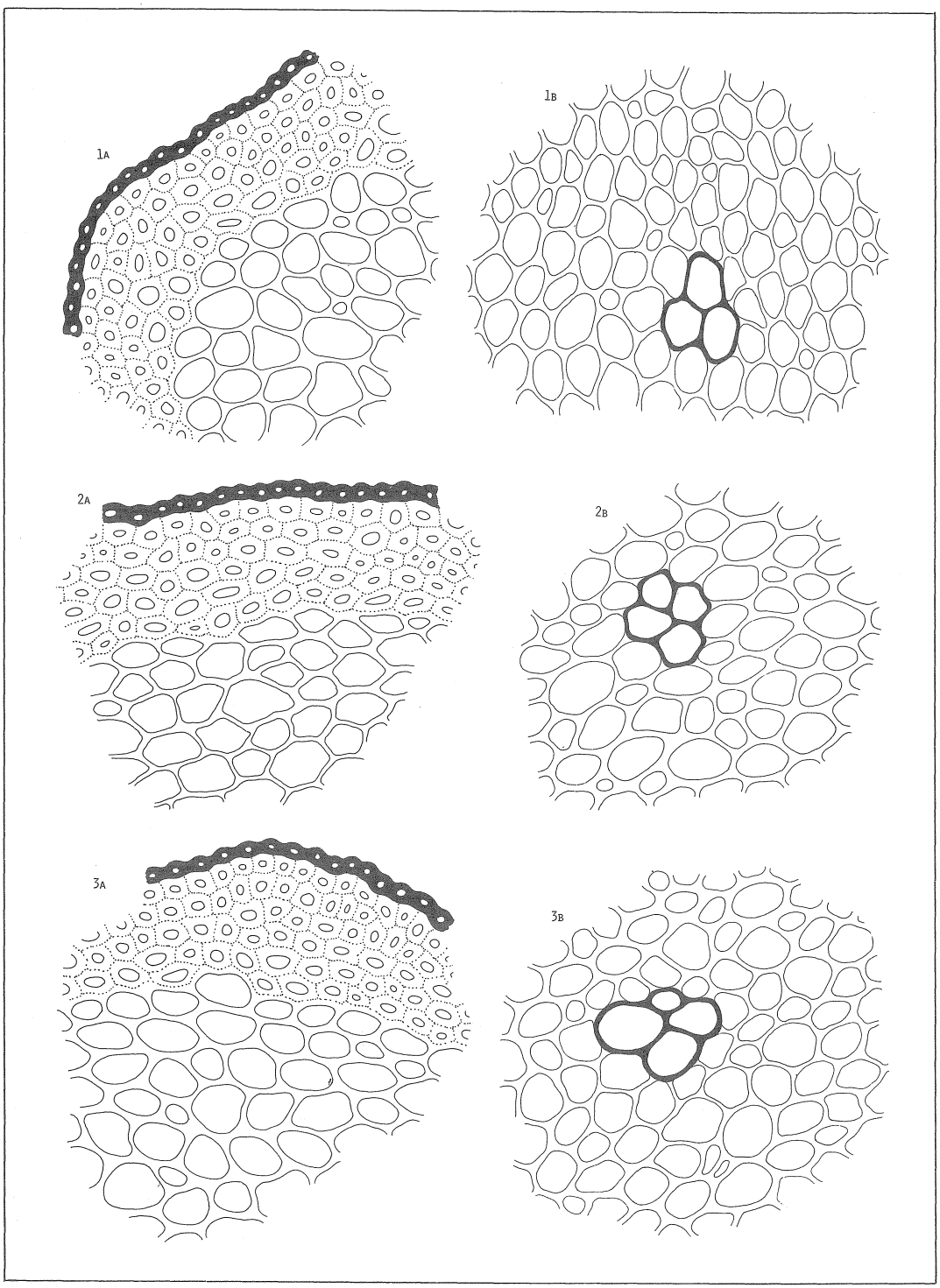


Plate XXV Cross sections of the stem
Fig. 1–3 : *Pterobryum arbuscula* MITT. ×360
A : Outer part of the stem
B : Central part of the stem

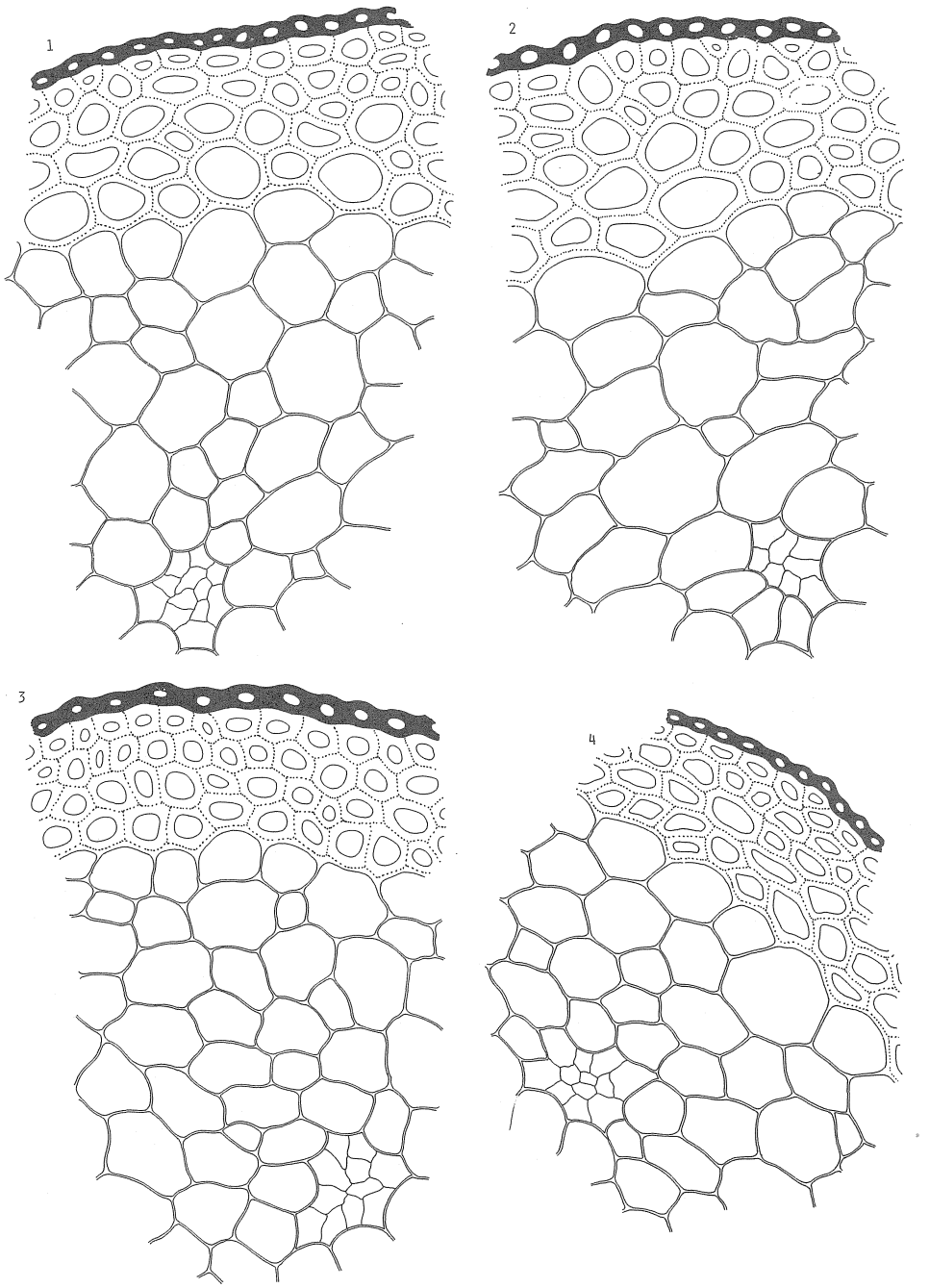


Plate XXVI Cross sections of the stem
Fig. 1–4 : *Aerobryum speciosum* DOZ. et MOIK. ×360

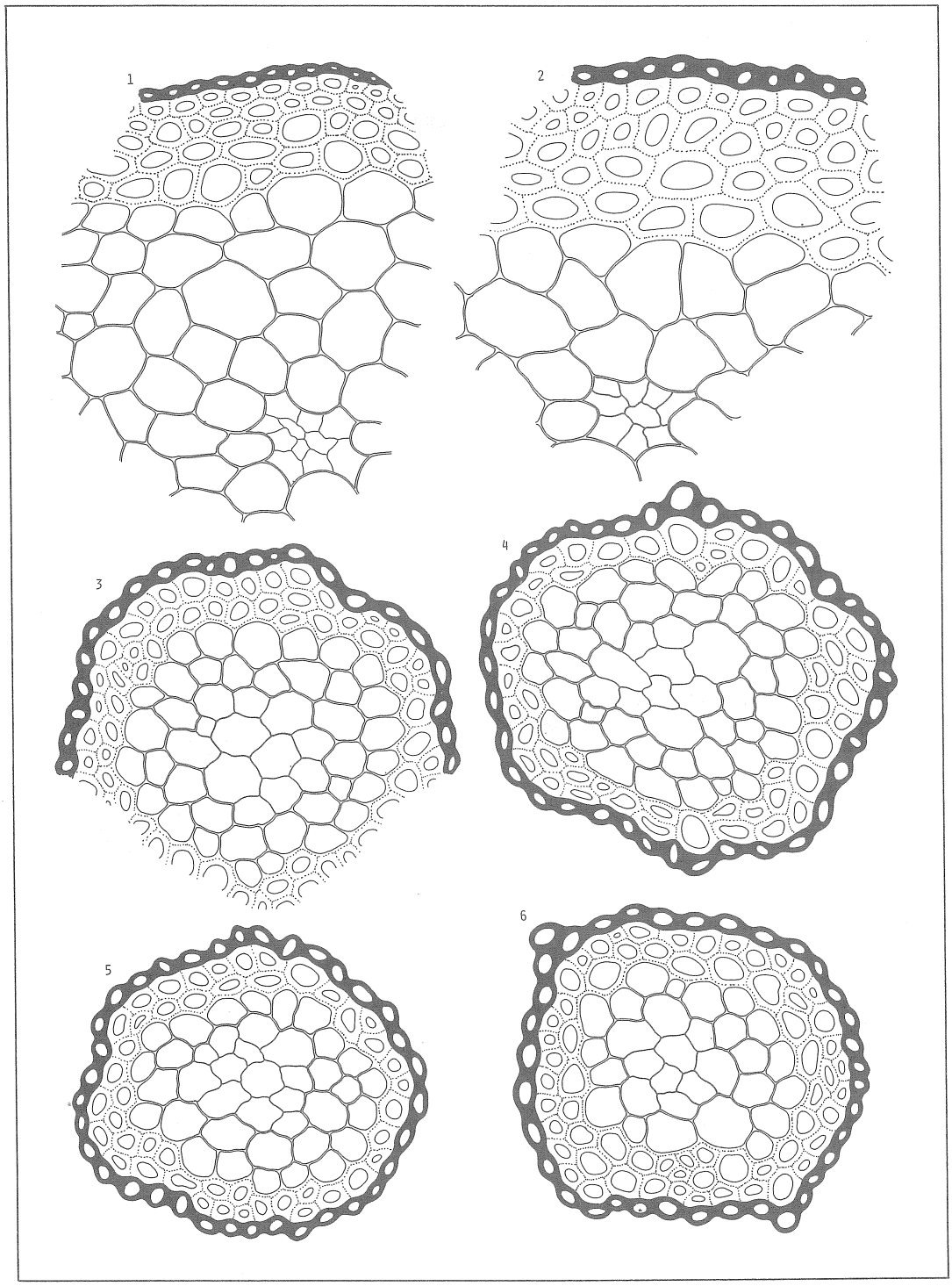


Plate XXVII Cross sections of the stem
Fig. 1–2 : *Aerobryum speciosum* DOZ. et MOLK. ×360
Fig. 3–6 : *Barbella flagellifera* (CARD.) NOG. ×360

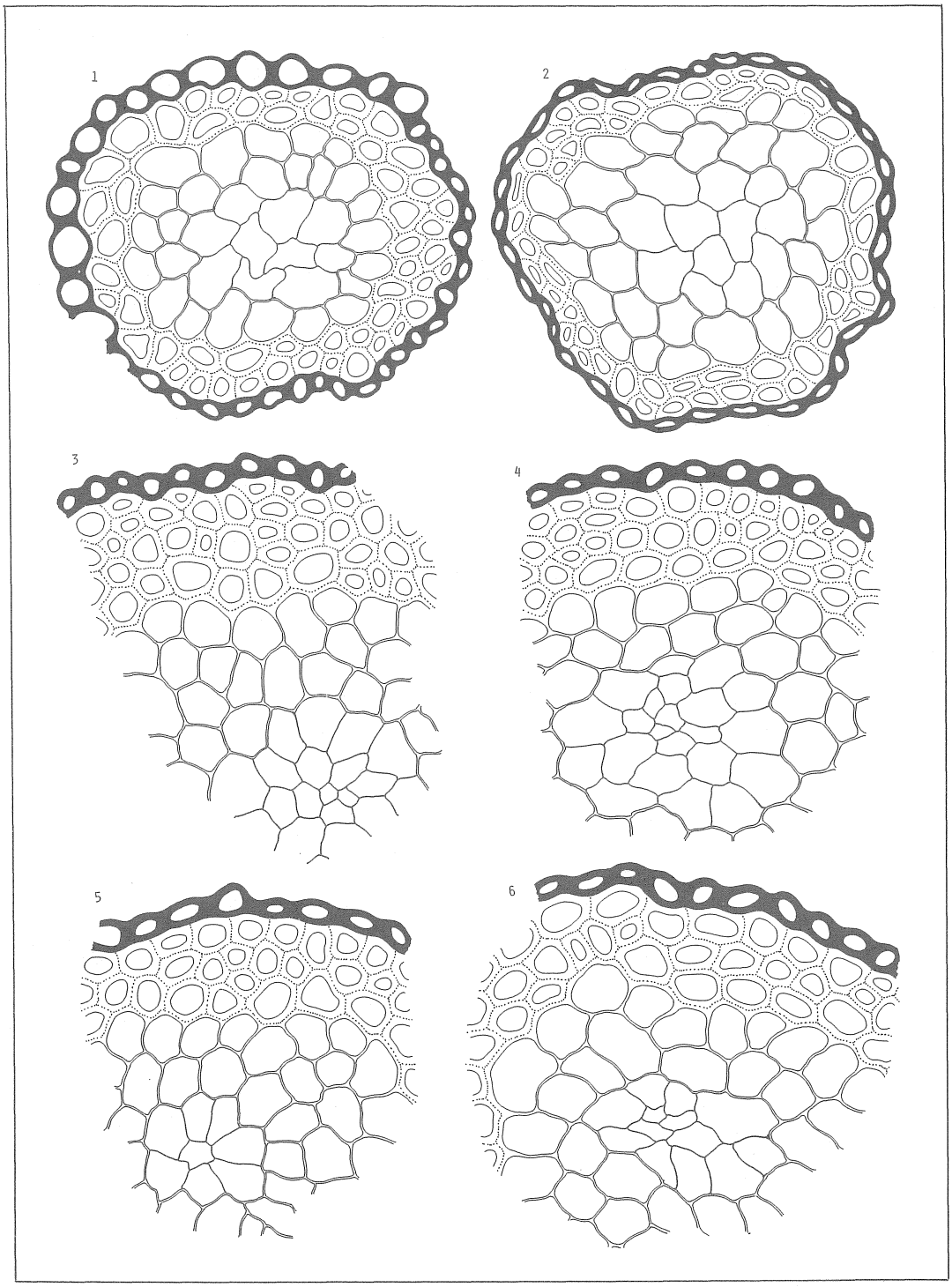


Plate XXVIII Cross sections of the stem
Fig. 1–2 : *Barbella flagellifera* (CARD.) NOG. ×360
Fig. 3–6 : *Barbella enervis* (THWAIT. et MITT.) FL. ×360

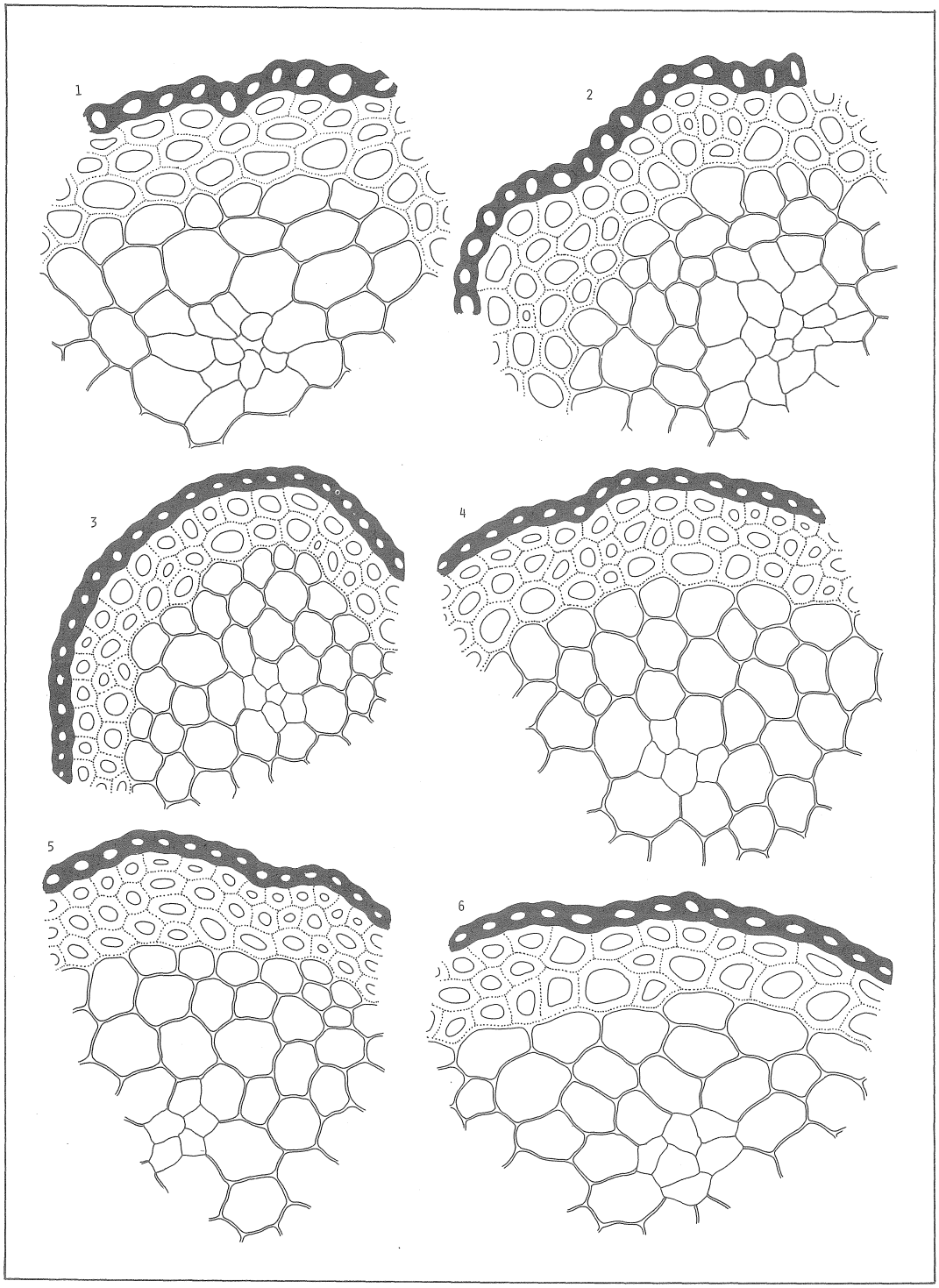


Plate XXIX Cross sections of the stem
Fig. 1–2 : *Barbella enervis* (THWAIT. et MITT.)FL. ×360
Fig. 3–6 : *Barbella pendula* (SULL.)FL. ×360

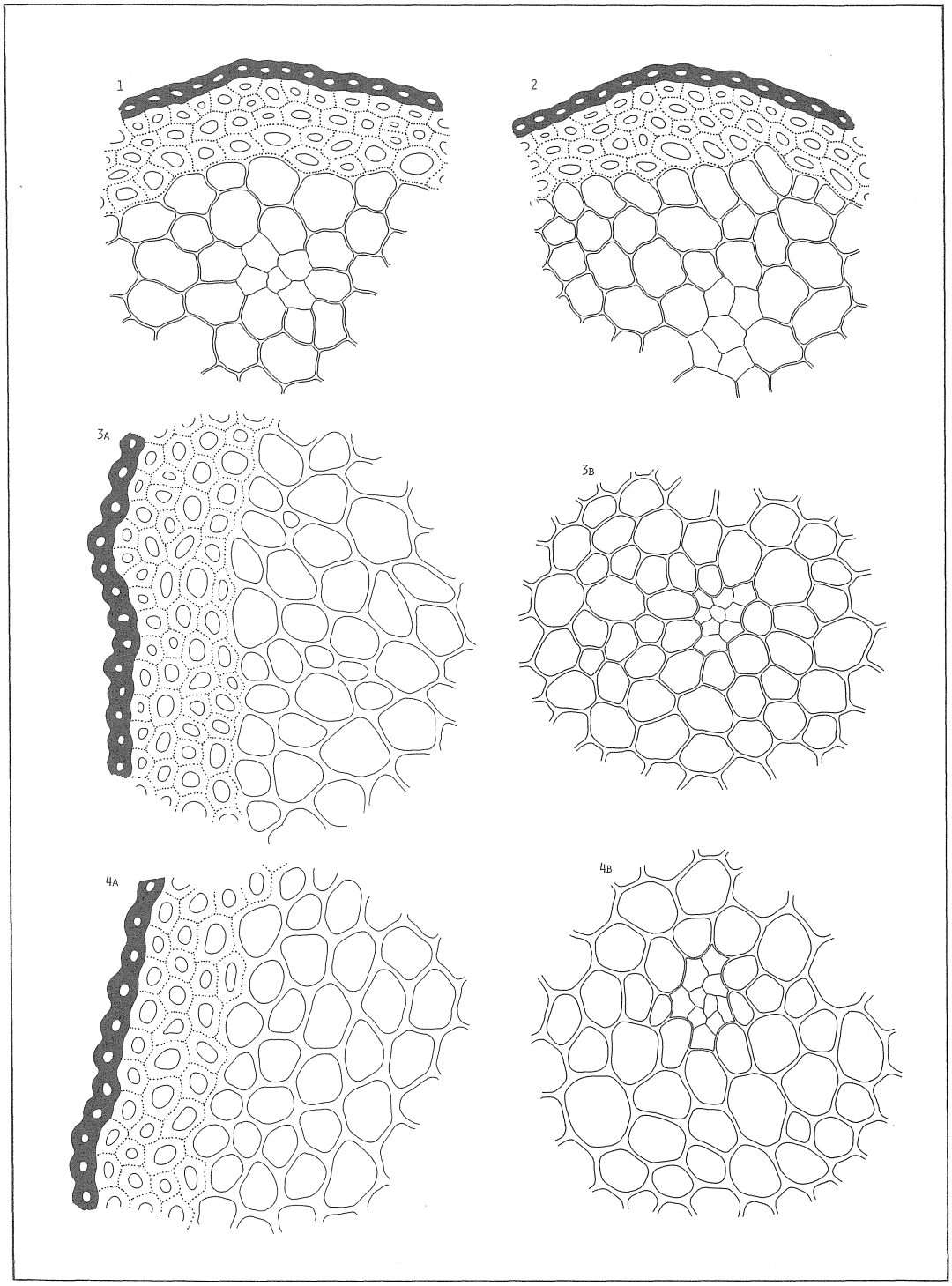


Plate XXX Cross sections of the stem
Fig. 1–2 : *Barbella pendula* (SULL.)FL. ×360
Fig. 3–4 : *Chrysocladium retrorsum* (MITT.) FL. ×360
A : Outer part of the stem
B : Central part of the stem

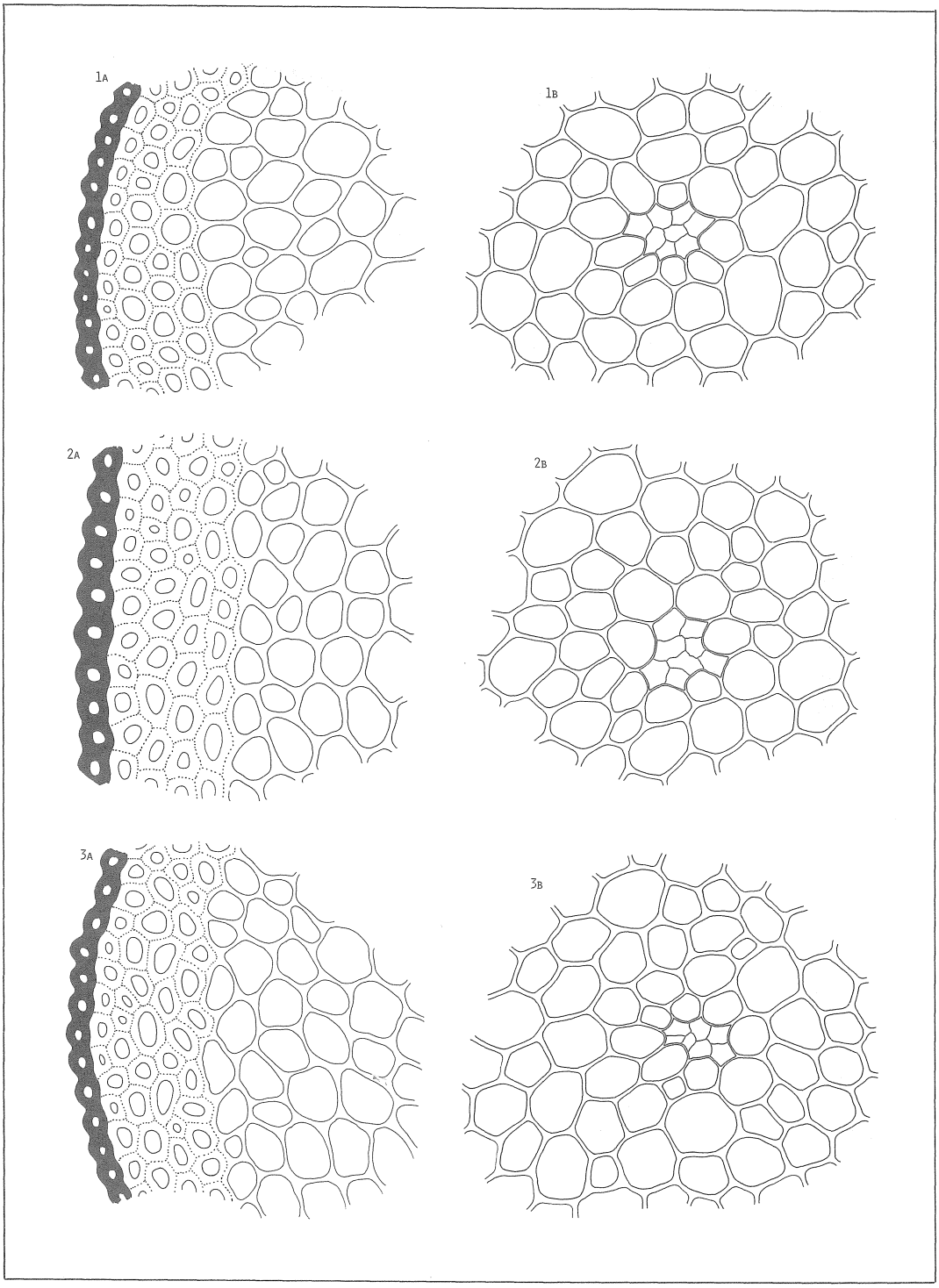


Plate XXXI Cross sections of the stem
Fig. 1–3 : *Chrysocladium retrorsum* (MITT.) FL. ×360
A : Outer part of the stem
B : Central part of the stem

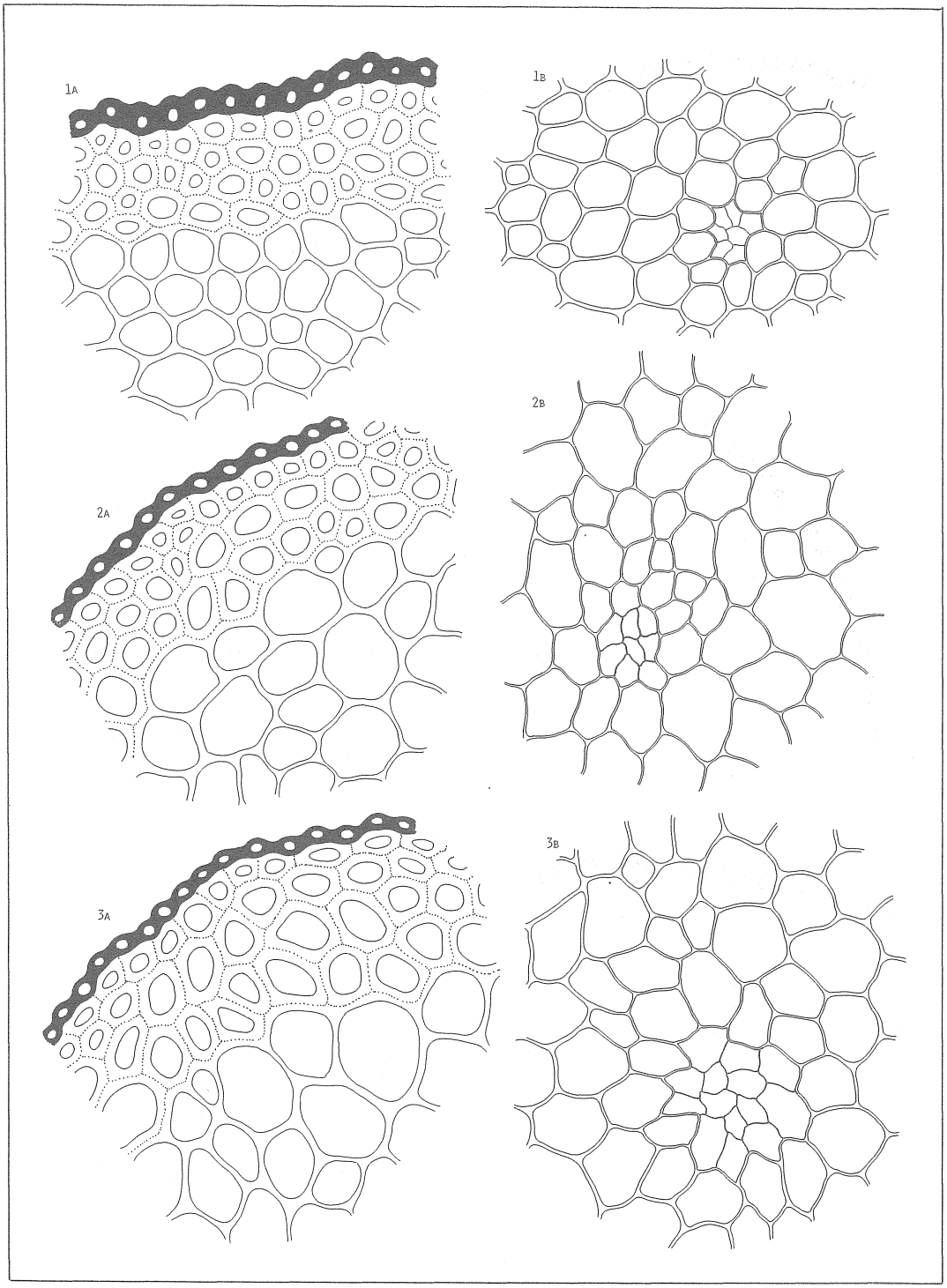


Plate XXXII Cross sections of the stem

Fig. 1-3 : *Floribundaria floribunda* (DOZ. et MOLK.)FL. ×360

A : Outer part of the stem

B : Central part of the stem

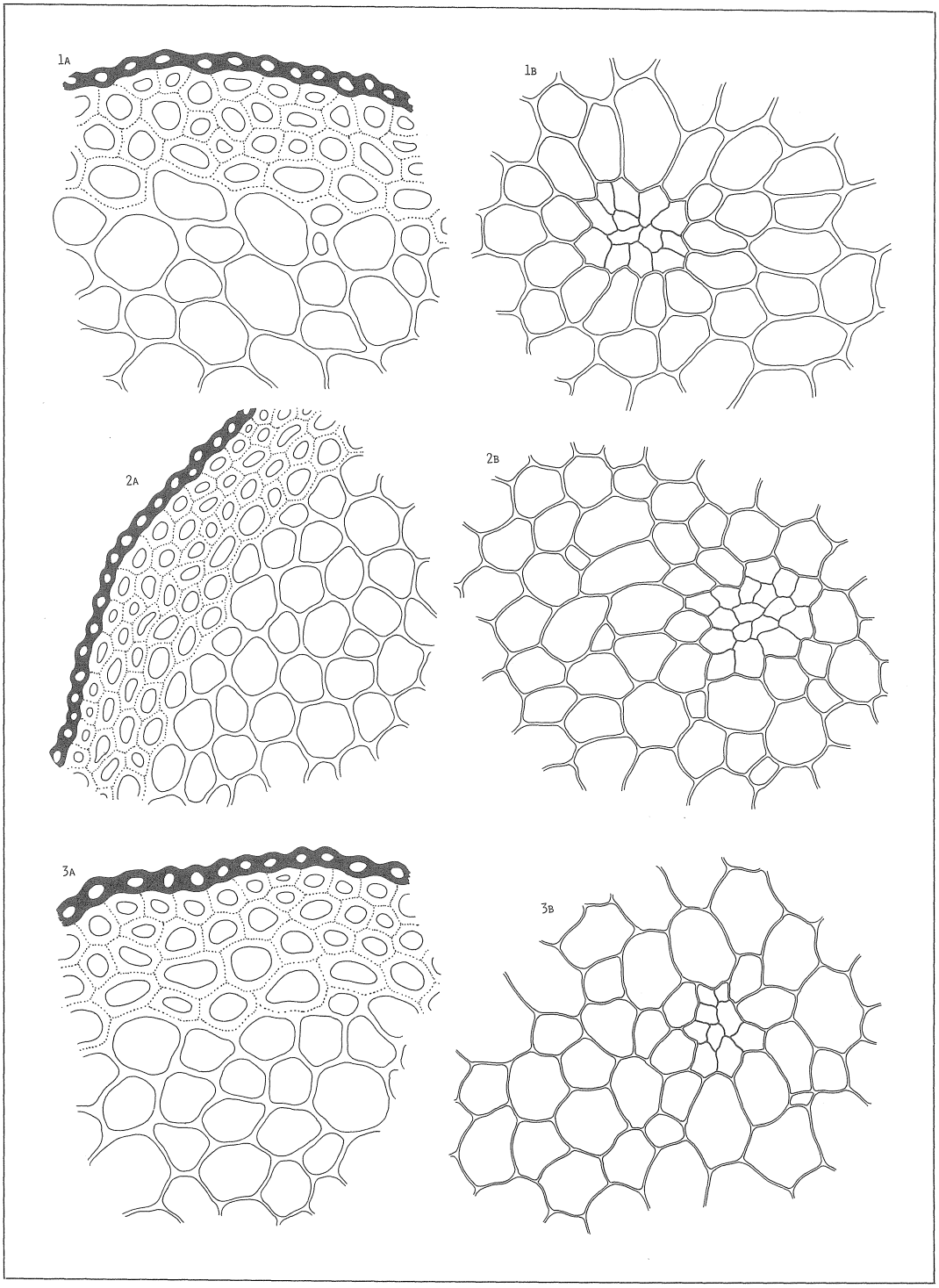


Plate XXXIII Cross sections of the stem
Fig. 1-3 : *Floribundaria floribunda* (DOZ. et MOIK.) FL. ×360
A : Outer part of the stem
B : Central part of the stem

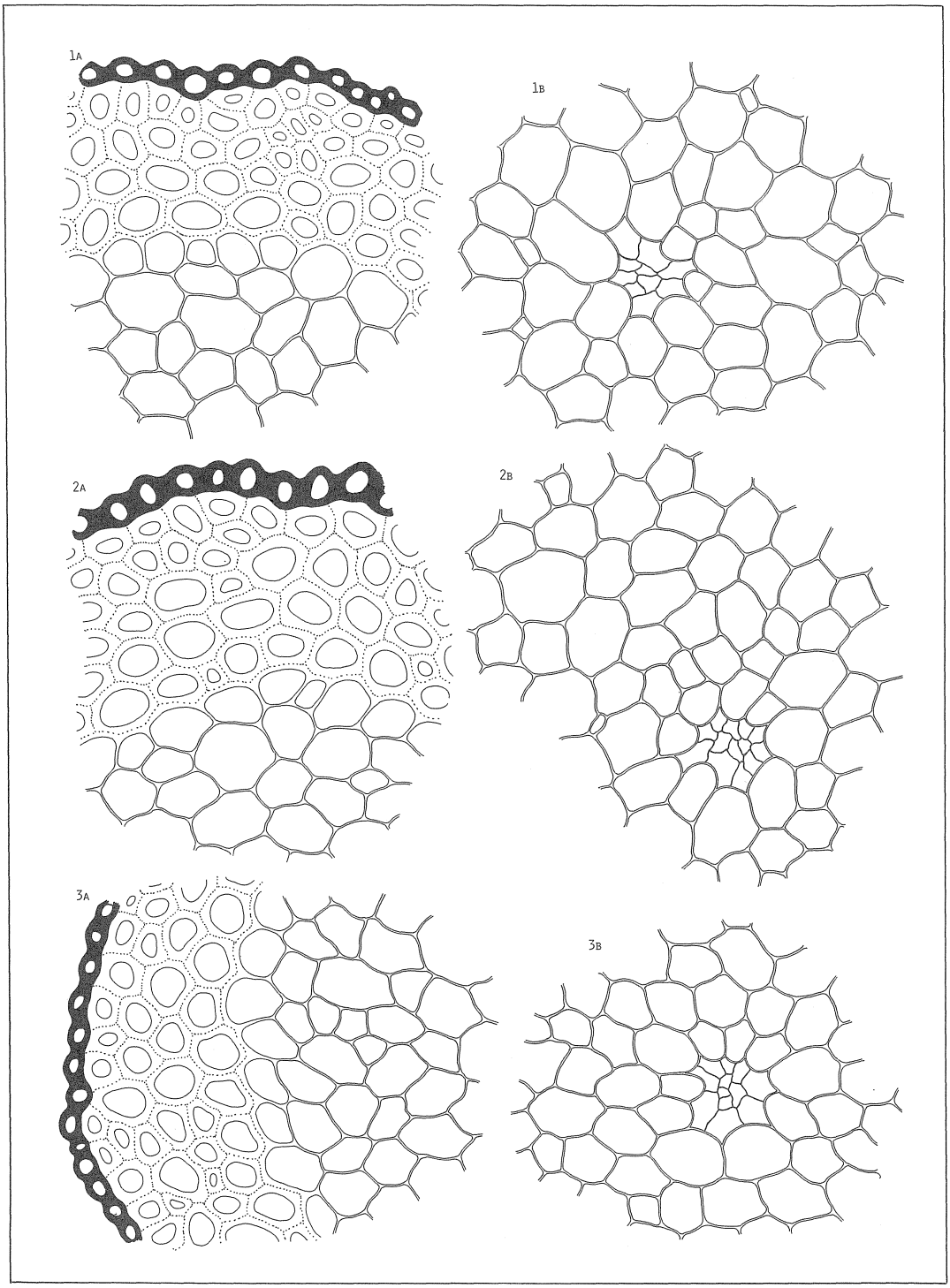


Plate XXXIV Cross sections of the stem

Fig. 1–3 : *Floribundaria aurea* (MITT.) BROTH. ssp. *nipponica* (NOG.) NOG. ×360

A : Outer part of the stem

B : Central part of the stem

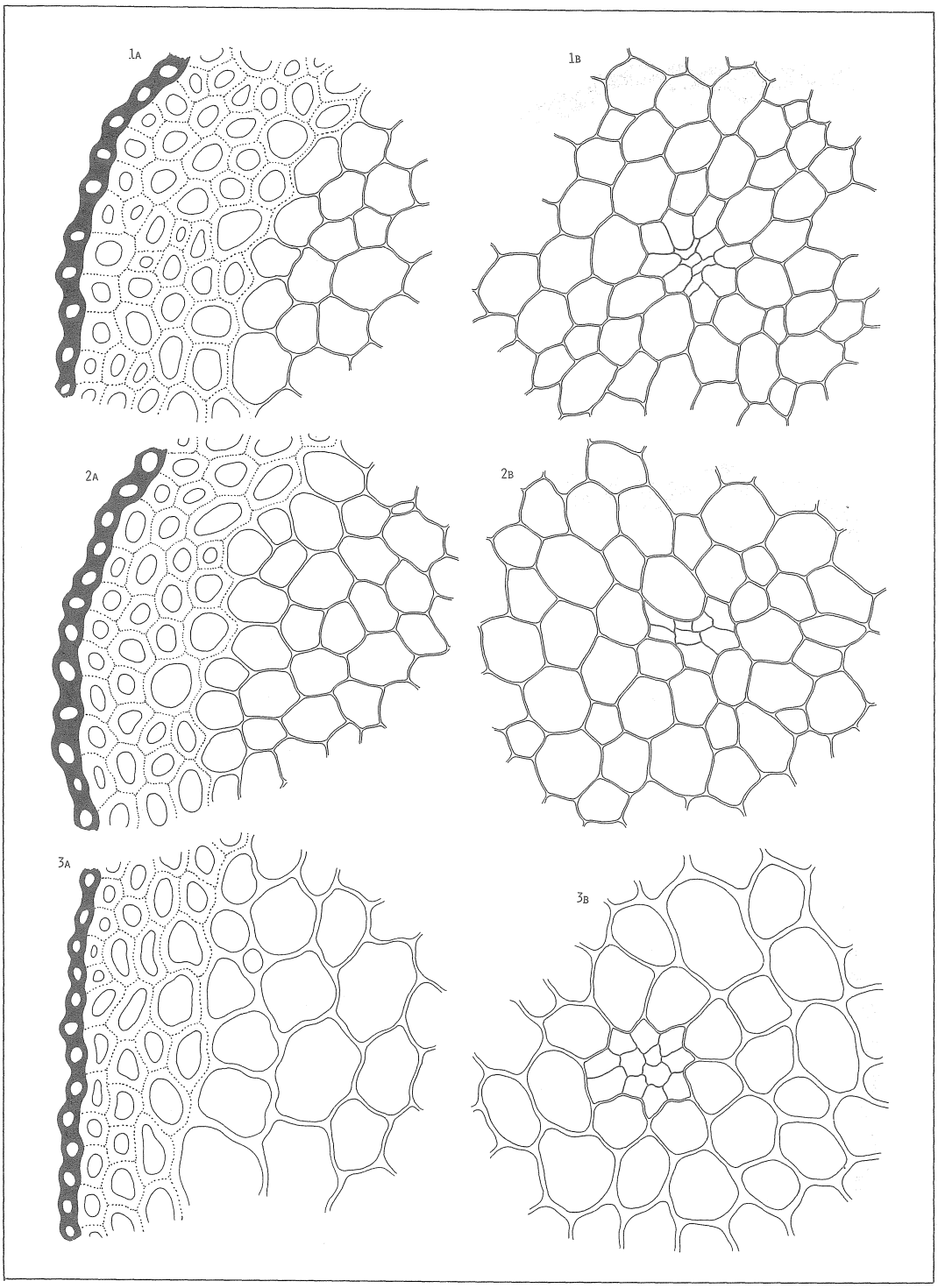


Plate XXXV Cross sections of the stem
Fig. 1–3 : *Floribundaria aurea* (MITT.) BROTH. ssp. *nipponica* (NOG.) NOG. ×360
A : Outer part of the stem
B : Central part of the stem

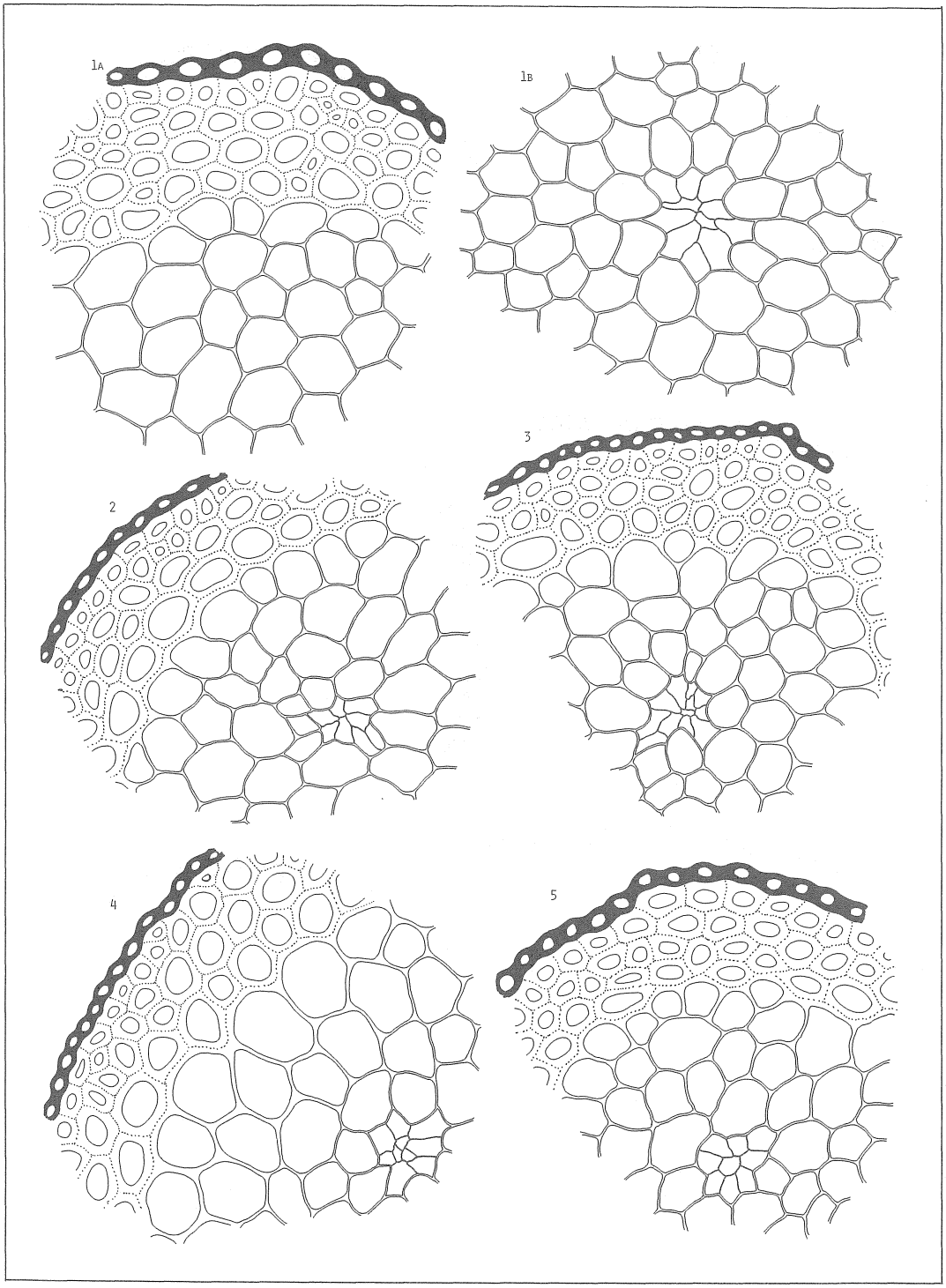


Plate XXXVI Cross sections of the stem

Fig. 1 : *FIoribundaria aurea* (MITT.) BROTH. ssp. *nipponica* (NOG.) NOG. ×360

A : Outer part of the stem

B : Central part of the stem

Fig. 2–5 : *Floribundaria pseudofloribunda* FL. ×360

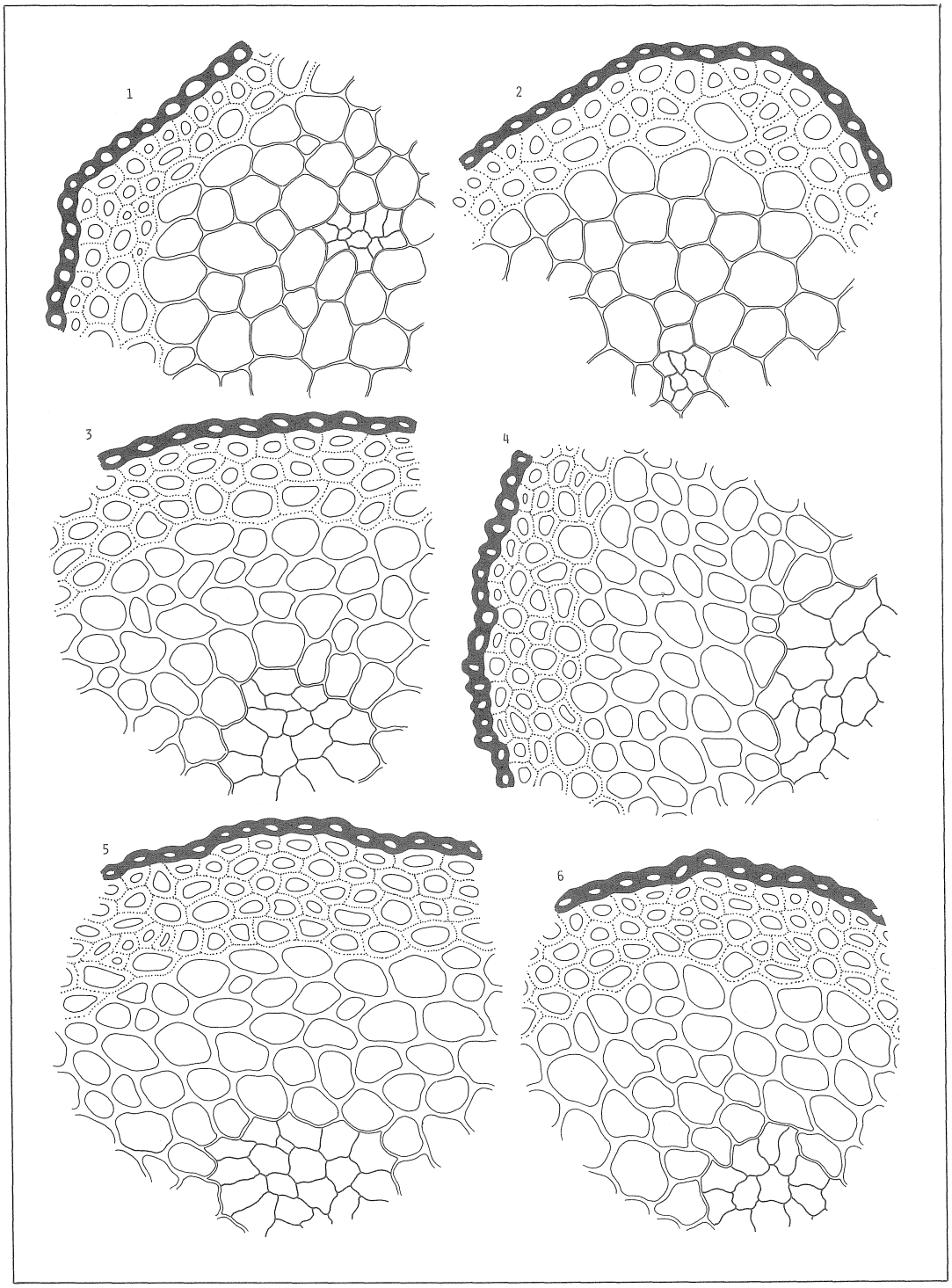


Plate XXXVII Cross sections of the stem
Fig. 1–2 : *Floribundaria pseudofloribunda* FL. ×360
Fig. 3–6 : *Meteoriopsis reclinata* (C. MUELL.) FL. ×360

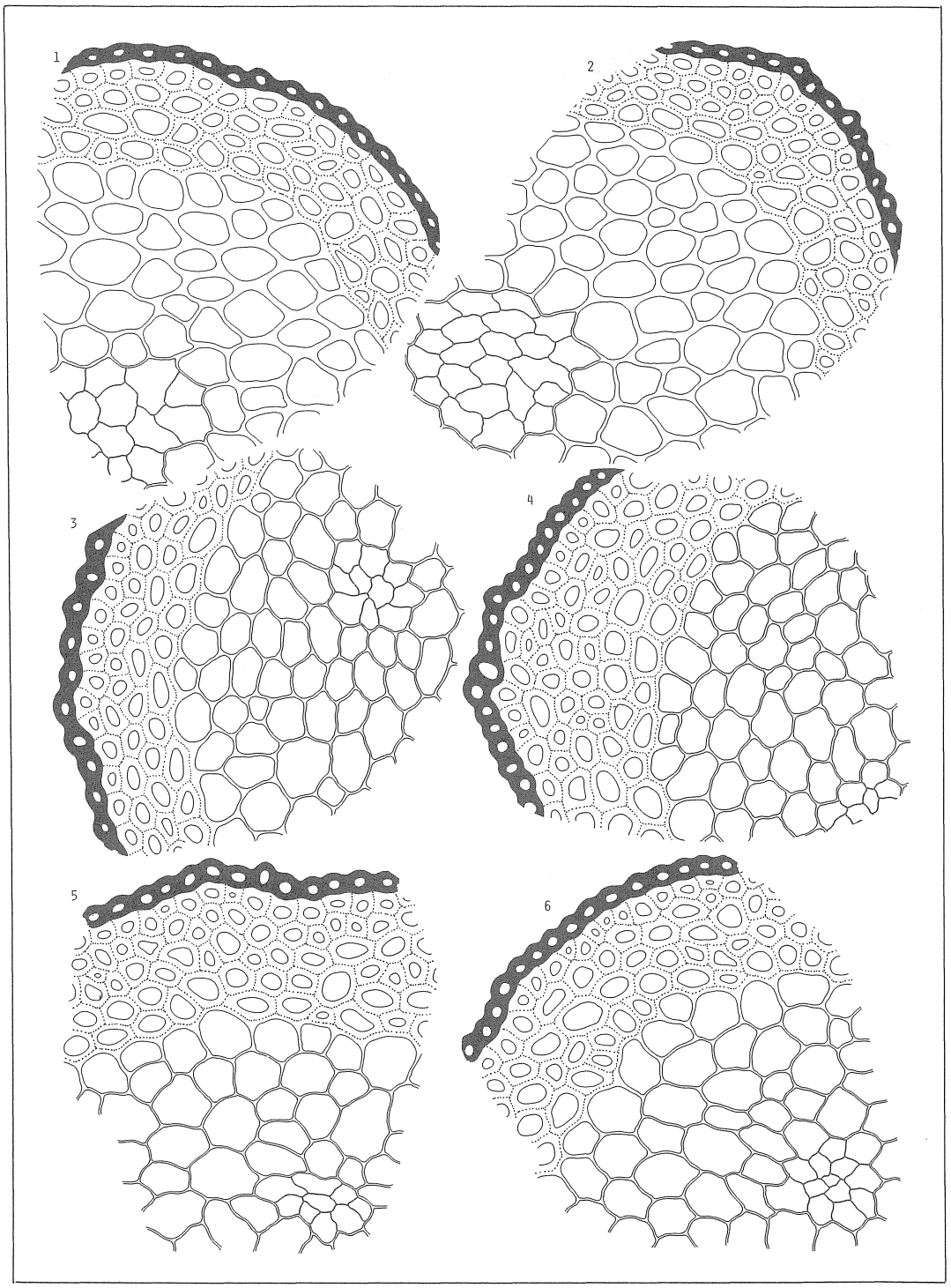


Plate XXXVIII Cross sections of the stem
Fig. 1–2 : *Meteoriopsis reclinata* (C. MUELL.) FL. ×360
Fig. 3–6 : *Meteorium buchananii* ssp. *helminthocladium* (CARD.) NOG. ×360

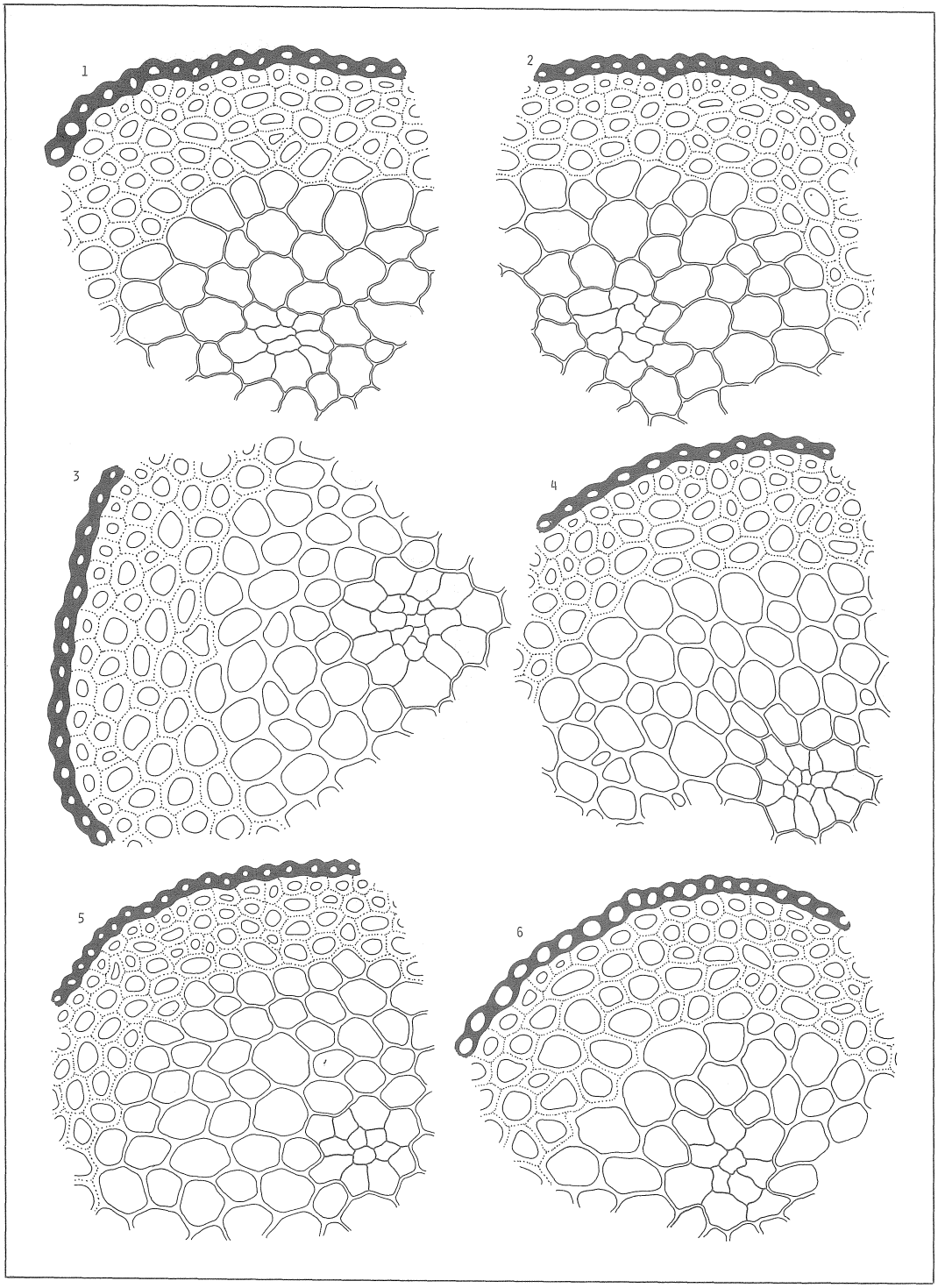


Plate XXXIX Cross sections of the stem
Fig. 1–2 : *Meteorium buchananii* ssp. *helminthocladium* (CARD.) NOG. ×360
Fig. 3–6 : *Meteorium buchananii* v. *cuspidatum* (OKAM.) NOG. ×360

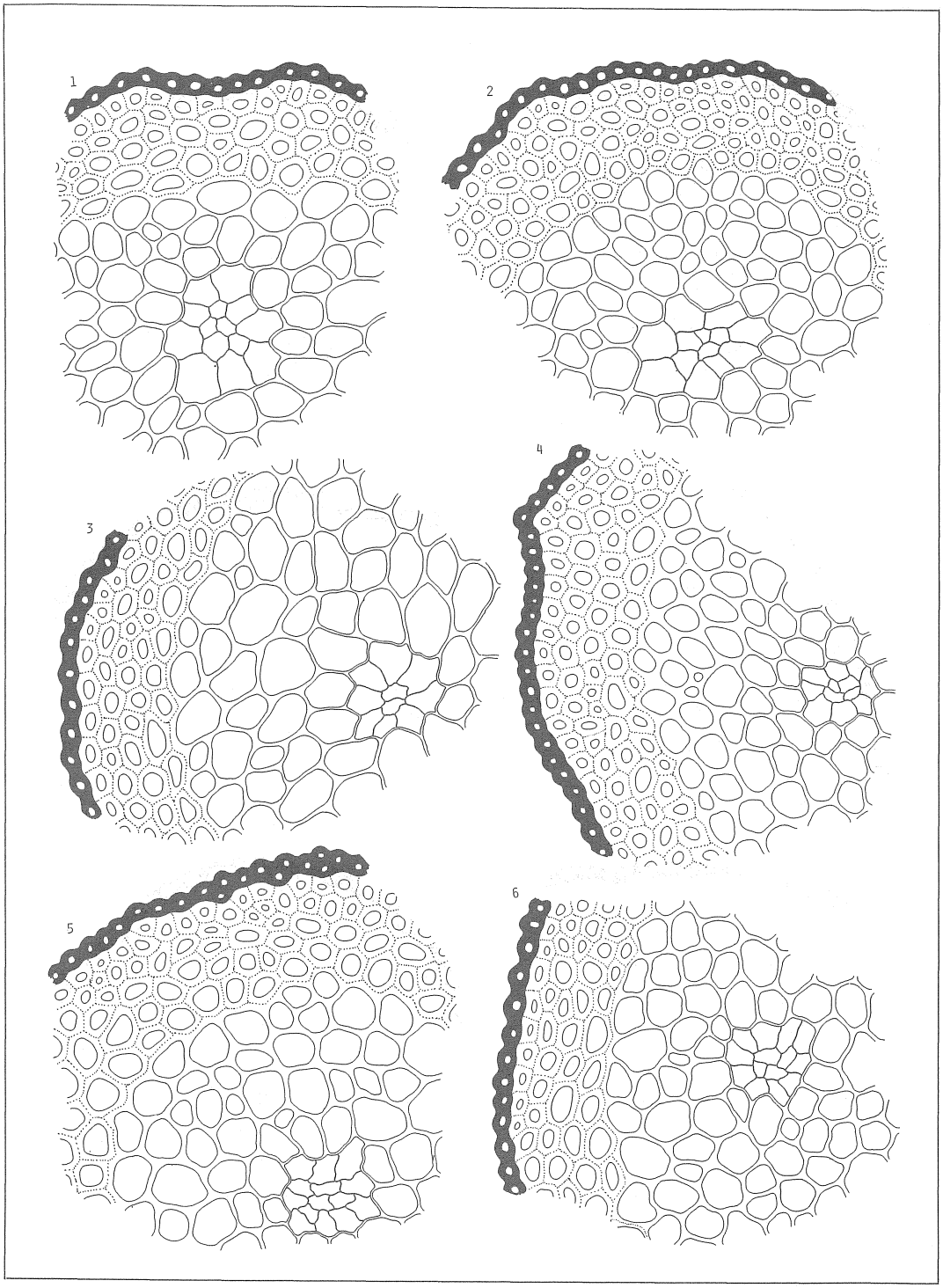


Plate XL Cross sections of the stem
Fig. 1–2 : *Meteorium buchananii* v. *cuspidatum* (OKAM.)NOG. ×360
Fig. 3–6 : *Meteorium miquelianum* (C. MUELL.) FL. ×360

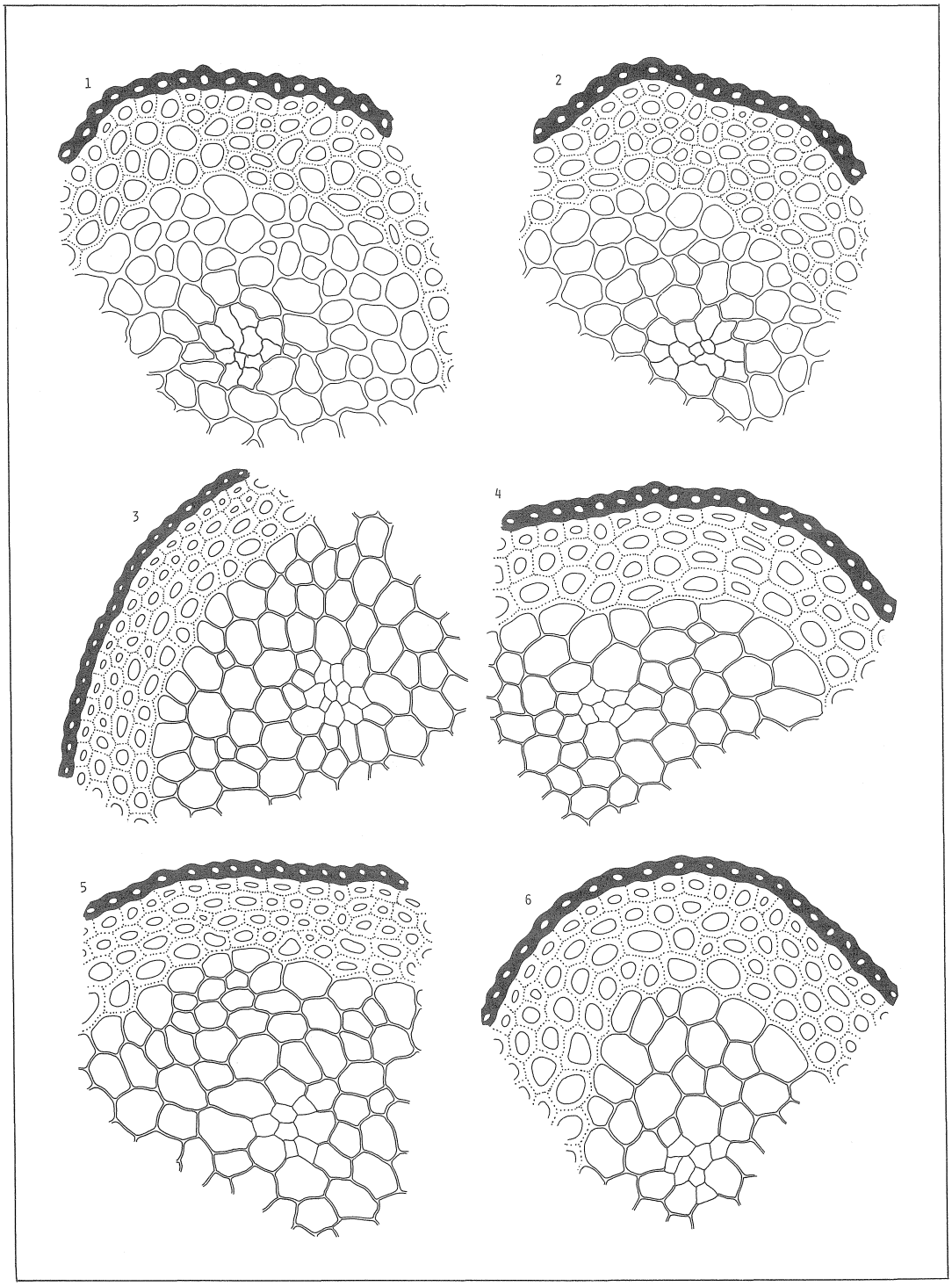


Plate XLI Cross sections of the stem
Fig. 1-2 : *Meteorium miquelianum* (C. MUELL.) FL. ×360
Fig. 3-6 : *Pseudobarbella attenuata* (THWAIT. et MITT.) NOG. ×360

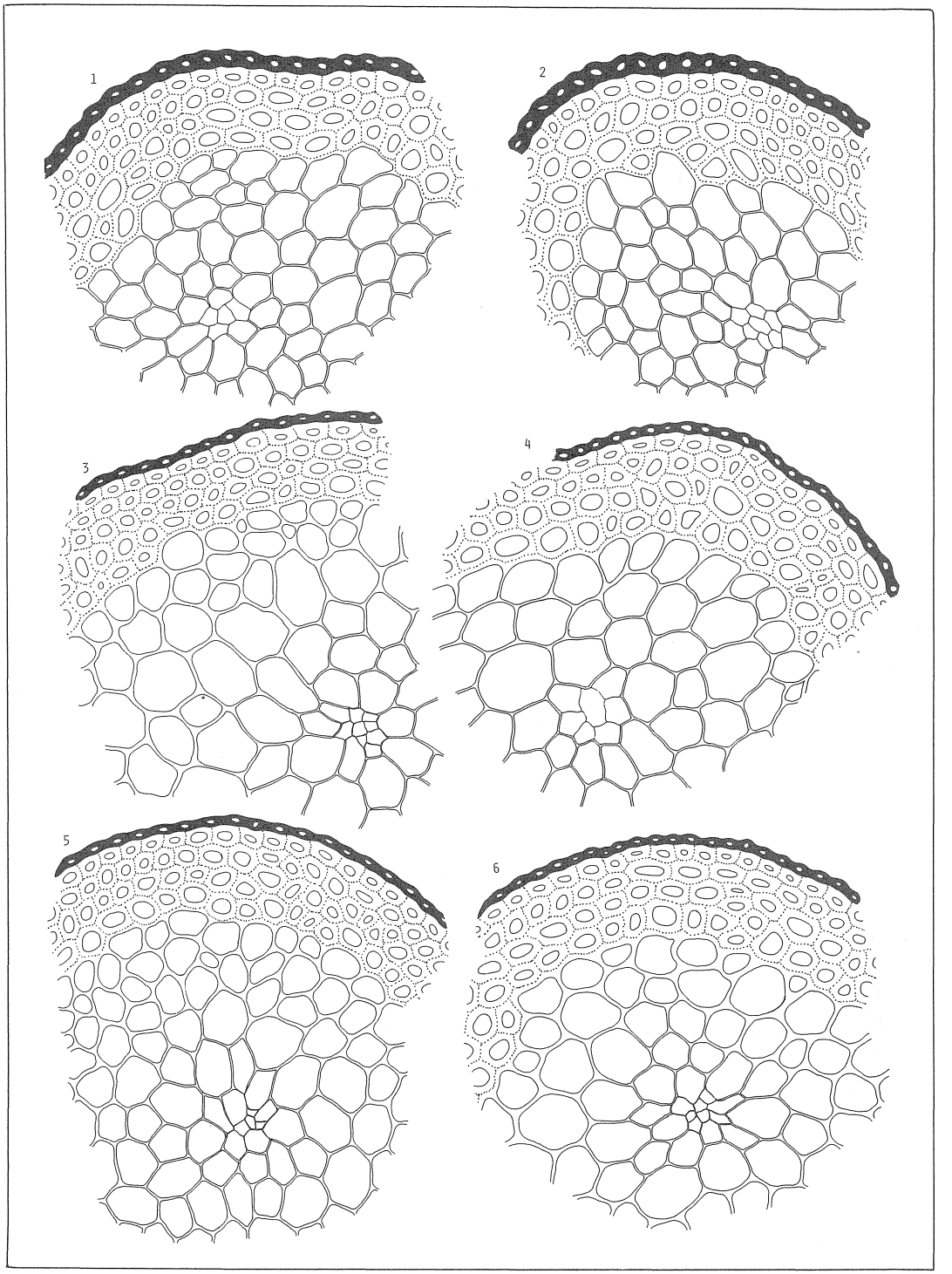


Plate XLII Cross sections of the stem
Fig. 1–2 : *Pseudobarbella attenuata* (THWAIT. et MITT) NOG. ×360
Fig. 3–6 : *Pseudobarbella levieri* (REN. et CARD.) NOG. ×360

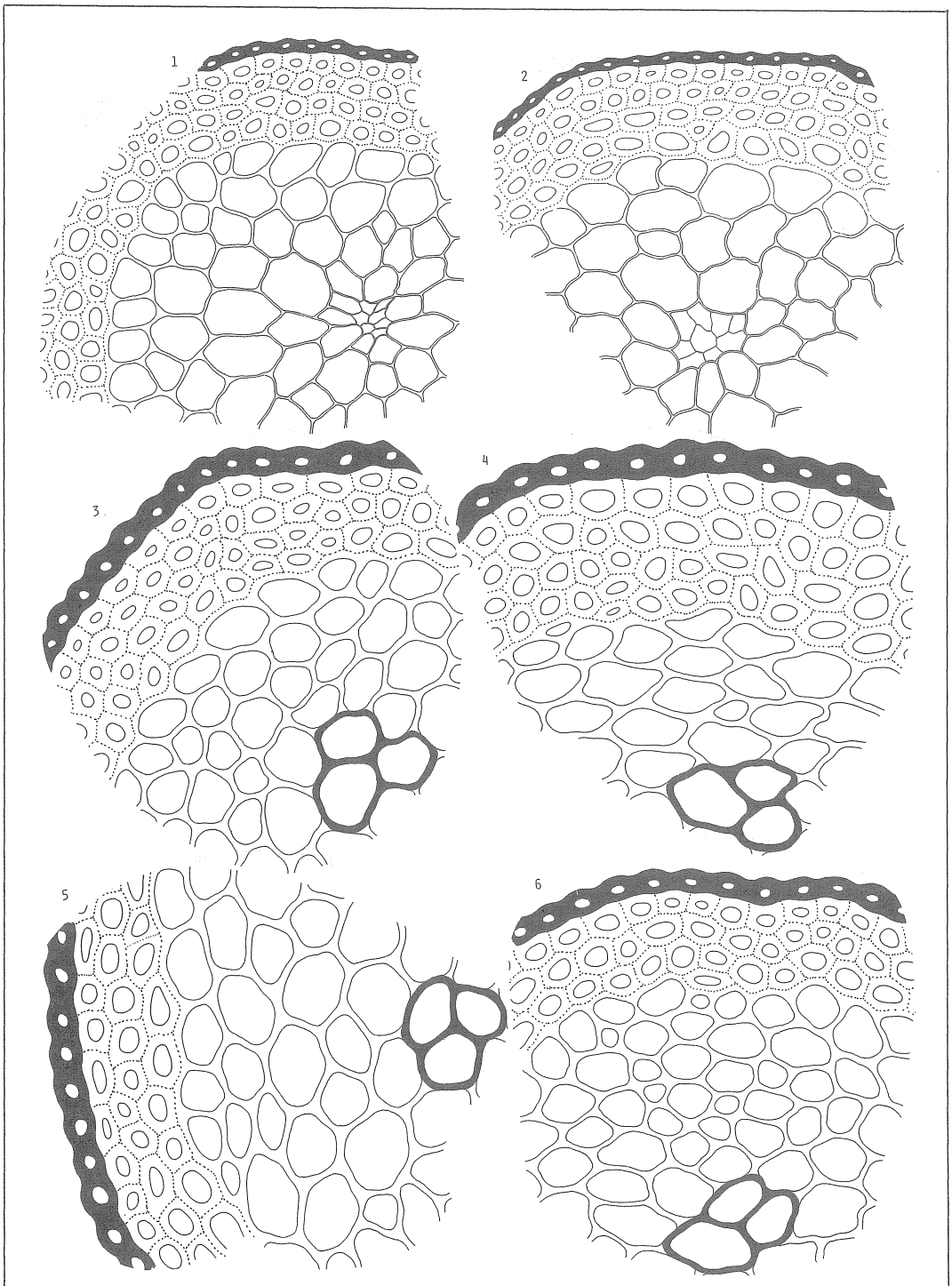


Plate XLIII Cross sections of the stem
Fig. 1–2 : *Pseudobarbella levieri* (REN. et CARD.) NOG. ×360
Fig. 3–6 : *Bissetia lingulata* (MITT.) BROTH. ×360

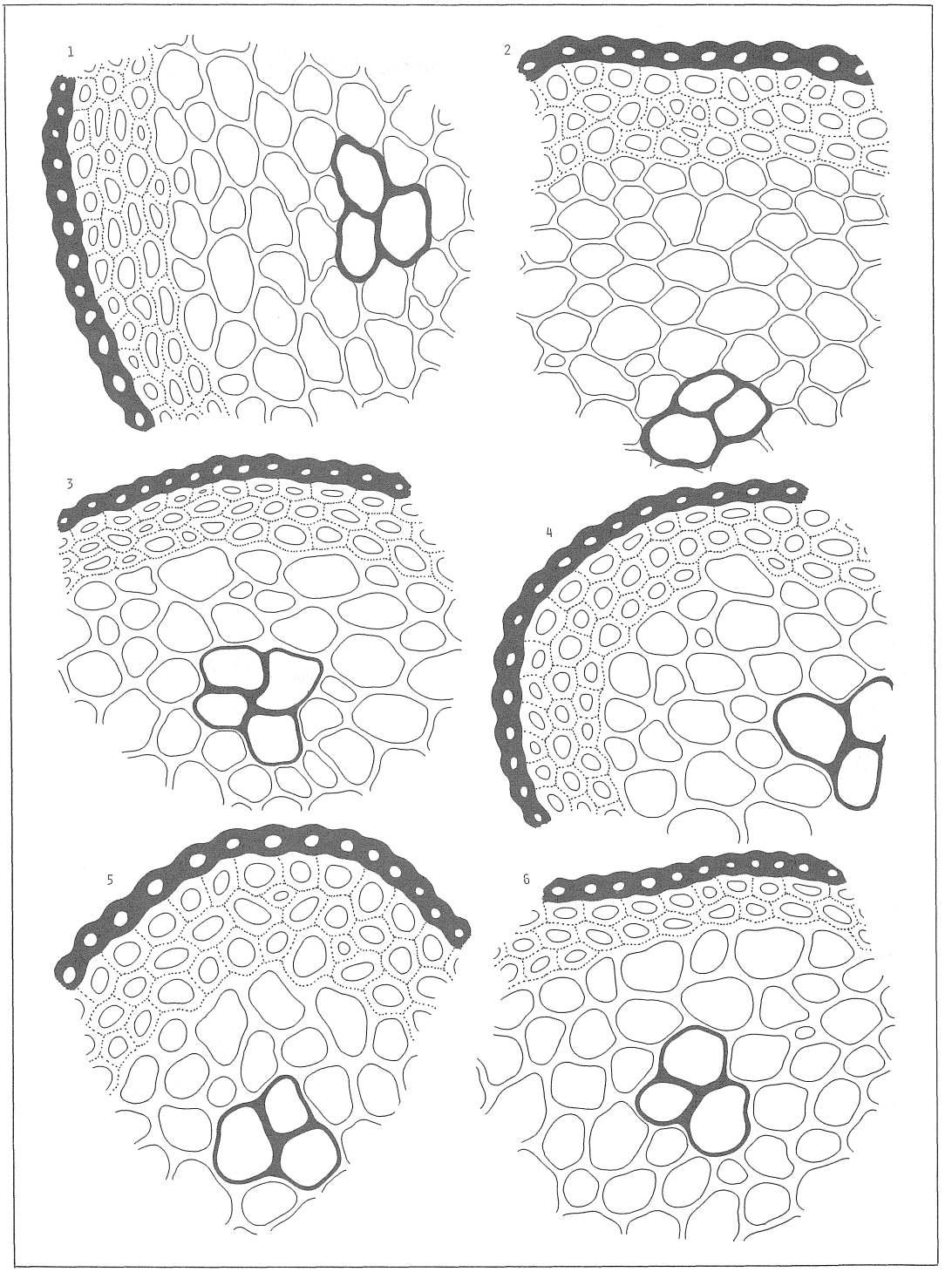


Plate XLIV Cross sections of the stem
Fig. 1-2 : *Bissetia lingulata* (MITT.) BROTH. ×360
Fig. 3-6 : *Homaliadelphus targionianus* (MITT.) DIX. et P. VARD. ×360

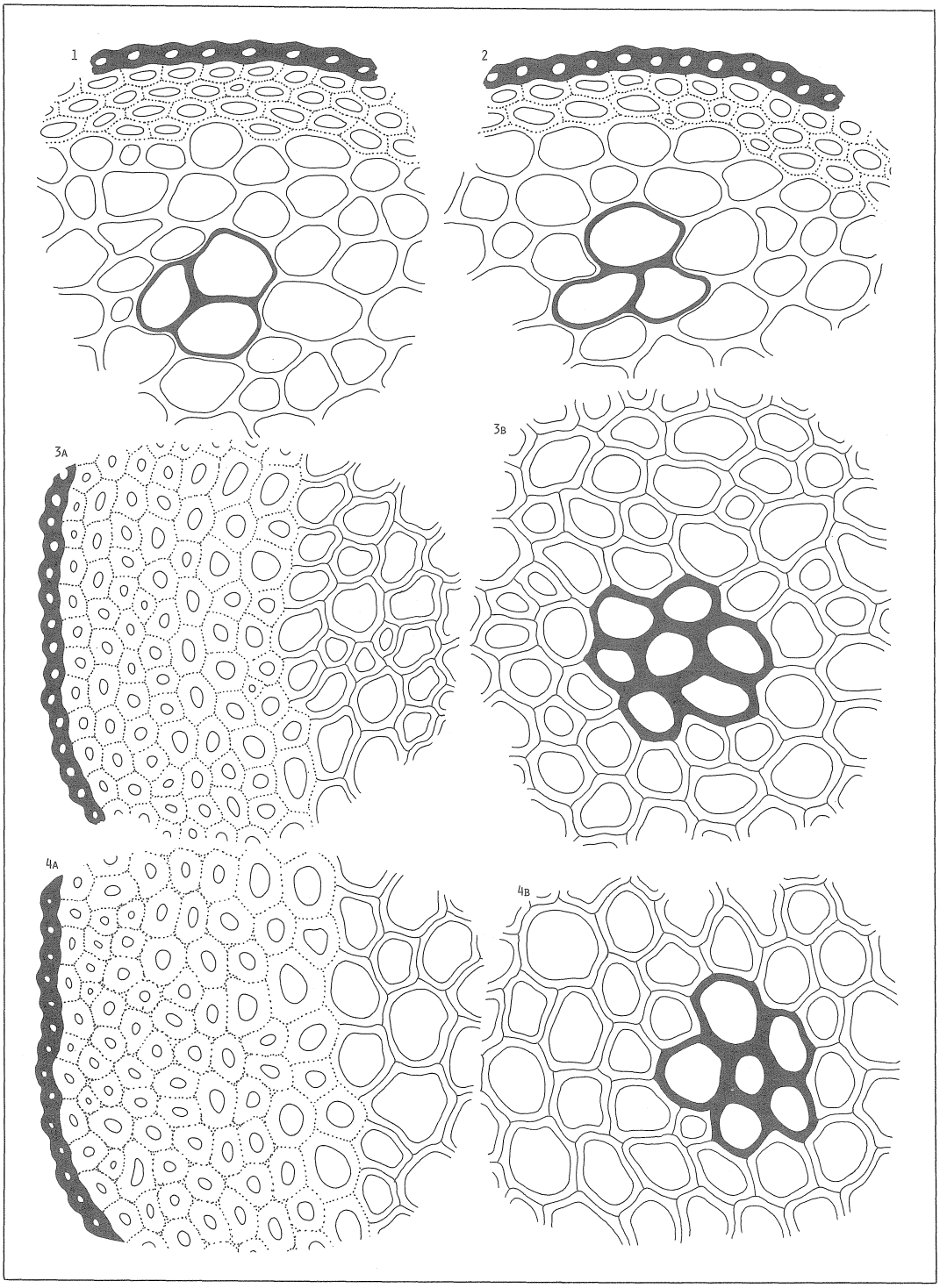


Plate XLV Cross sections of the stem
Fig. 1–2 : *Homaliadelphus targionianus* (MITT.) DIX. et P. VARD. ×360
Fig. 3–4 : *Homaliodendron scalpellifolium* (MITT.) FL. ×360
A : Outer part of the stem
B : Central part of the stem

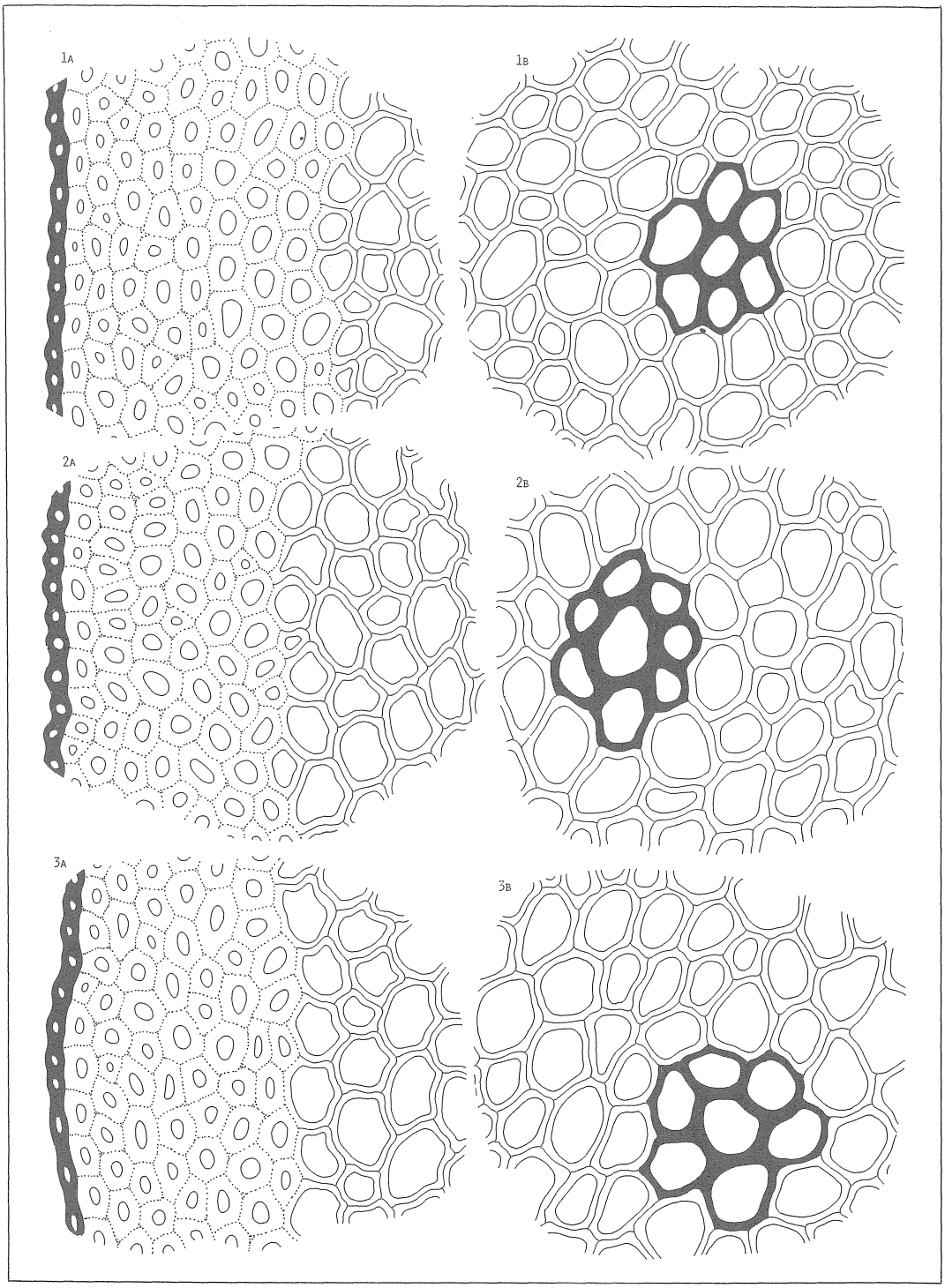


Plate XLVI Cross sections of the stem

Fig. 1–3 : *Homaliodendron scalpellifolium* (MITT.) FL. ×360

A : Outer part of the stem

B : Central part of the stem

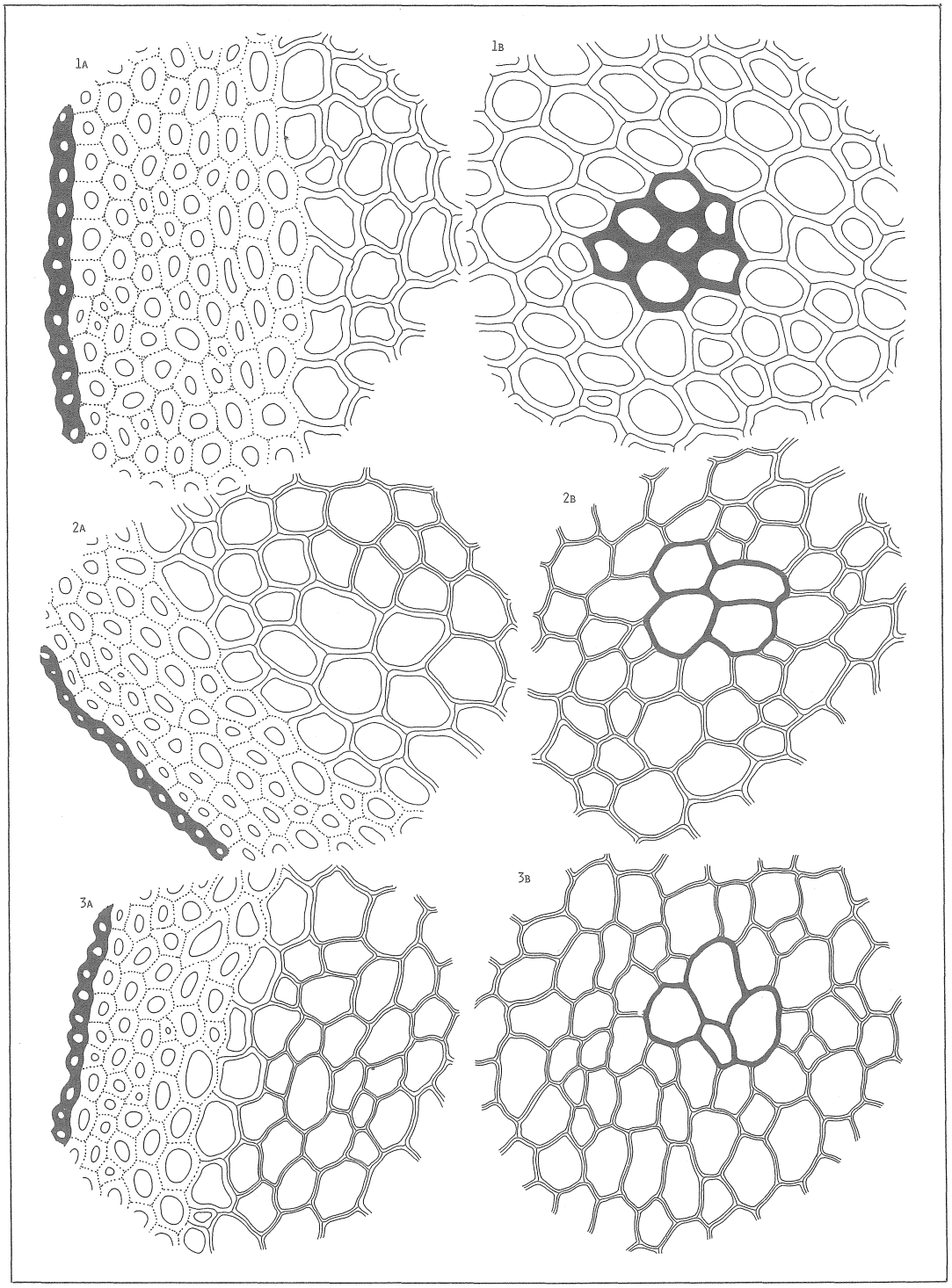


Plate XLVII Cross sections of the stem
Fig. 1 : *Homaliodendron scalpellifolium* (MITT.) FL. ×360
Fig. 2–3 : *Neckera borealis* NOG. ×360
A : Outer part of the stem
B : Central part of the stem

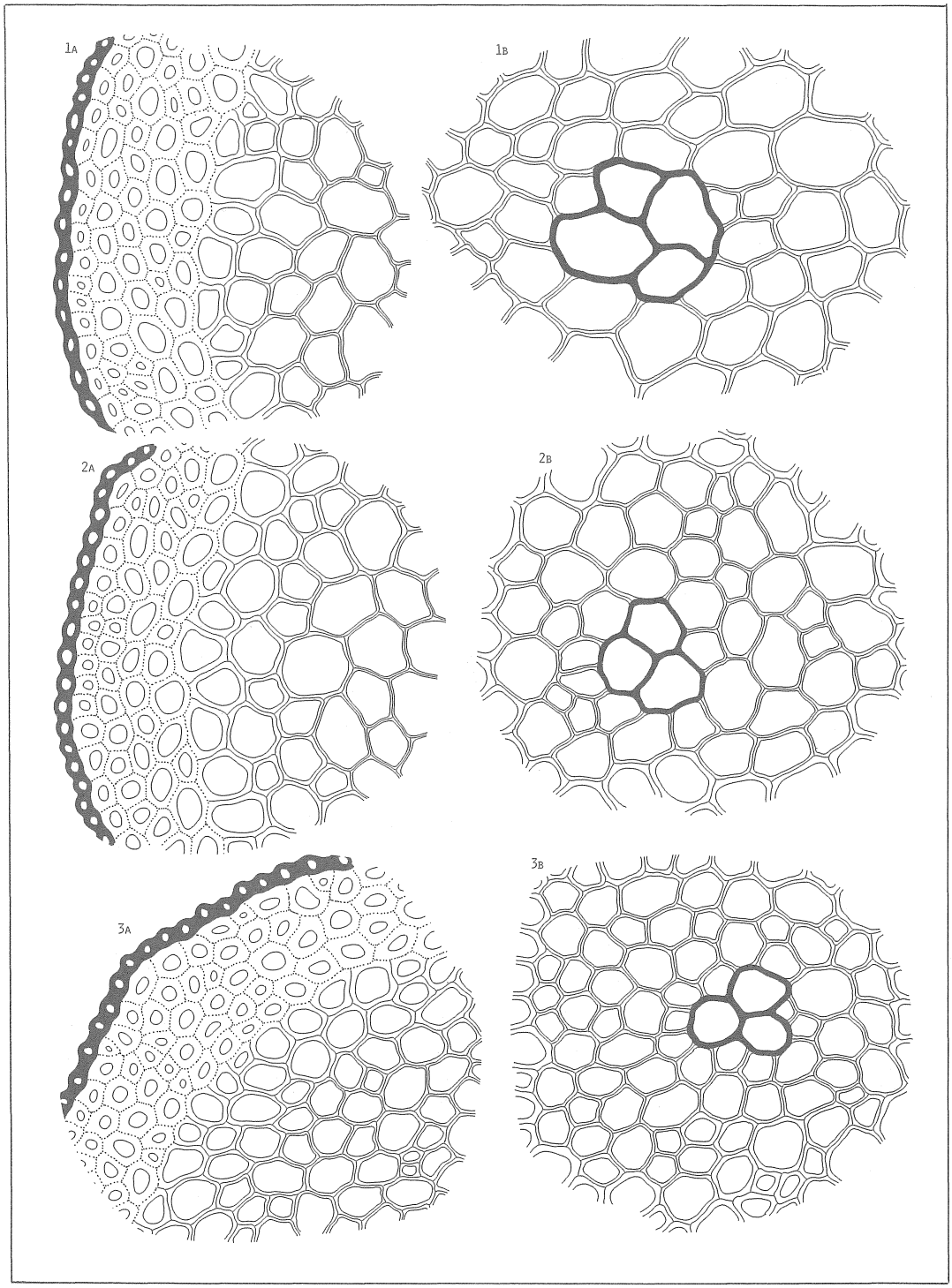


Plate XLVIII Cross sections of the stem
Fig. 1–3 : *Neckera borealis* NOG. ×360
A : Outer part of the stem
B : Central part of the stem

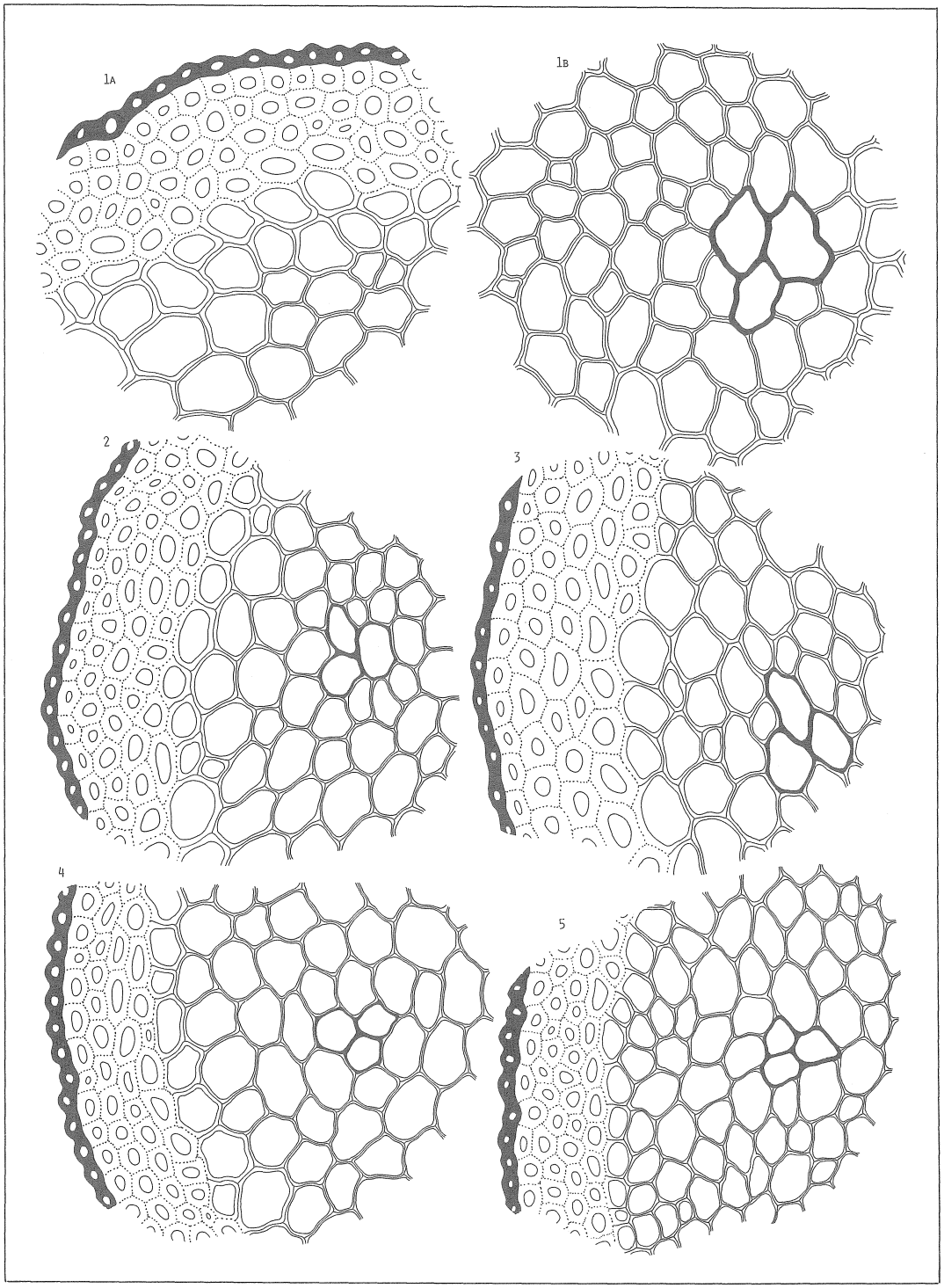


Plate XLIX Cross sections of the stem
Fig. 1 : *Neckera borealis* NOG. ×360
A : Outer part of the stem
B : Central part of the stem
Fig. 2–5 : *Neckera flexiramea* CARD. ×360

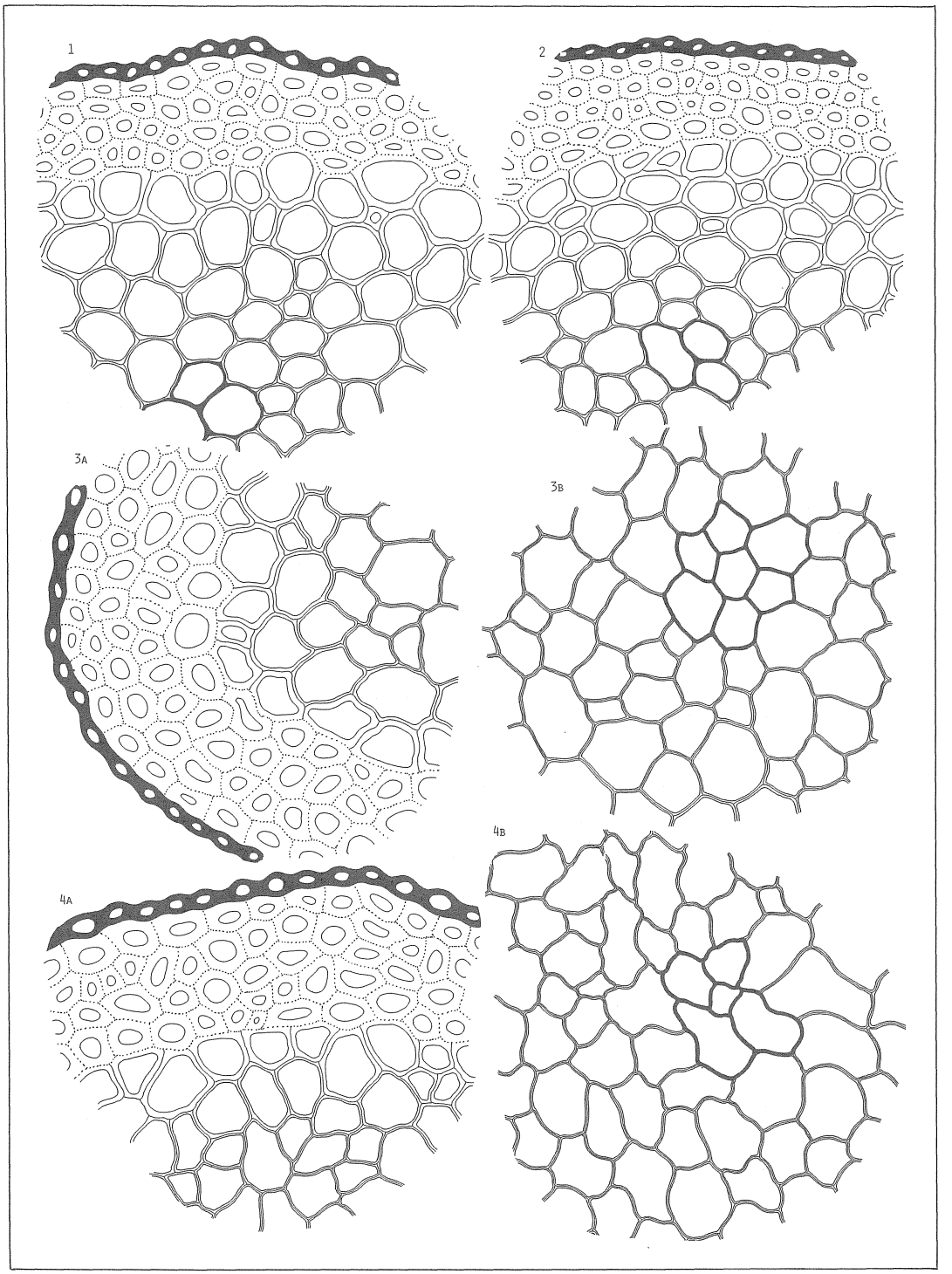


Plate L Cross sections of the stem
Fig. 1–2 : *Neckera flexiramea* CARD. ×360
Fig. 3–4 : *Neckera humilis* MITT. ×360
A : Outer part of the stem
B : Central part of the stem

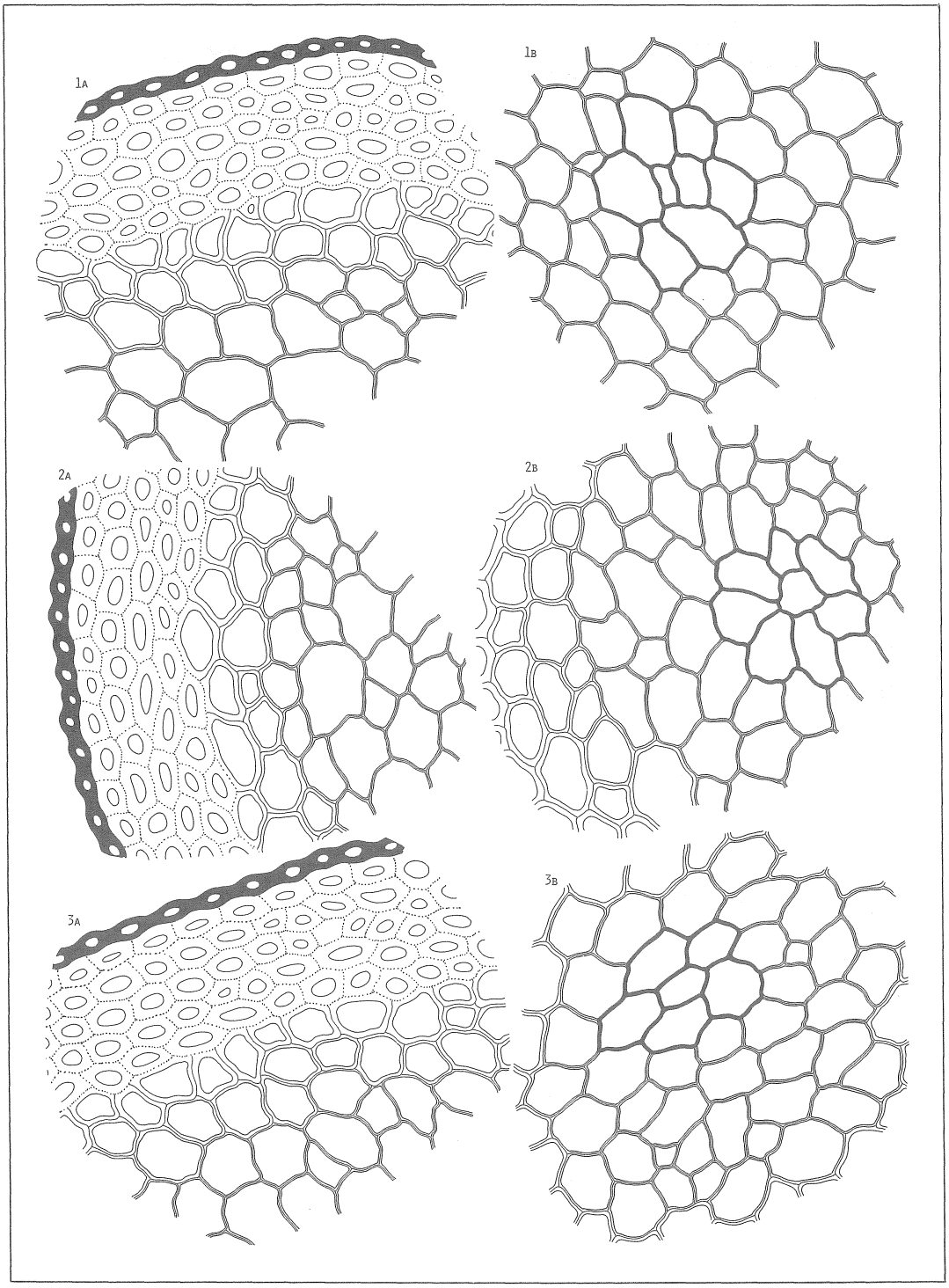


Plate LI Cross sections of the stem
Fig. 1–3 : *Neckera humilis* MITT. ×360
A : Outer part of the stem
B : Central part of the stem

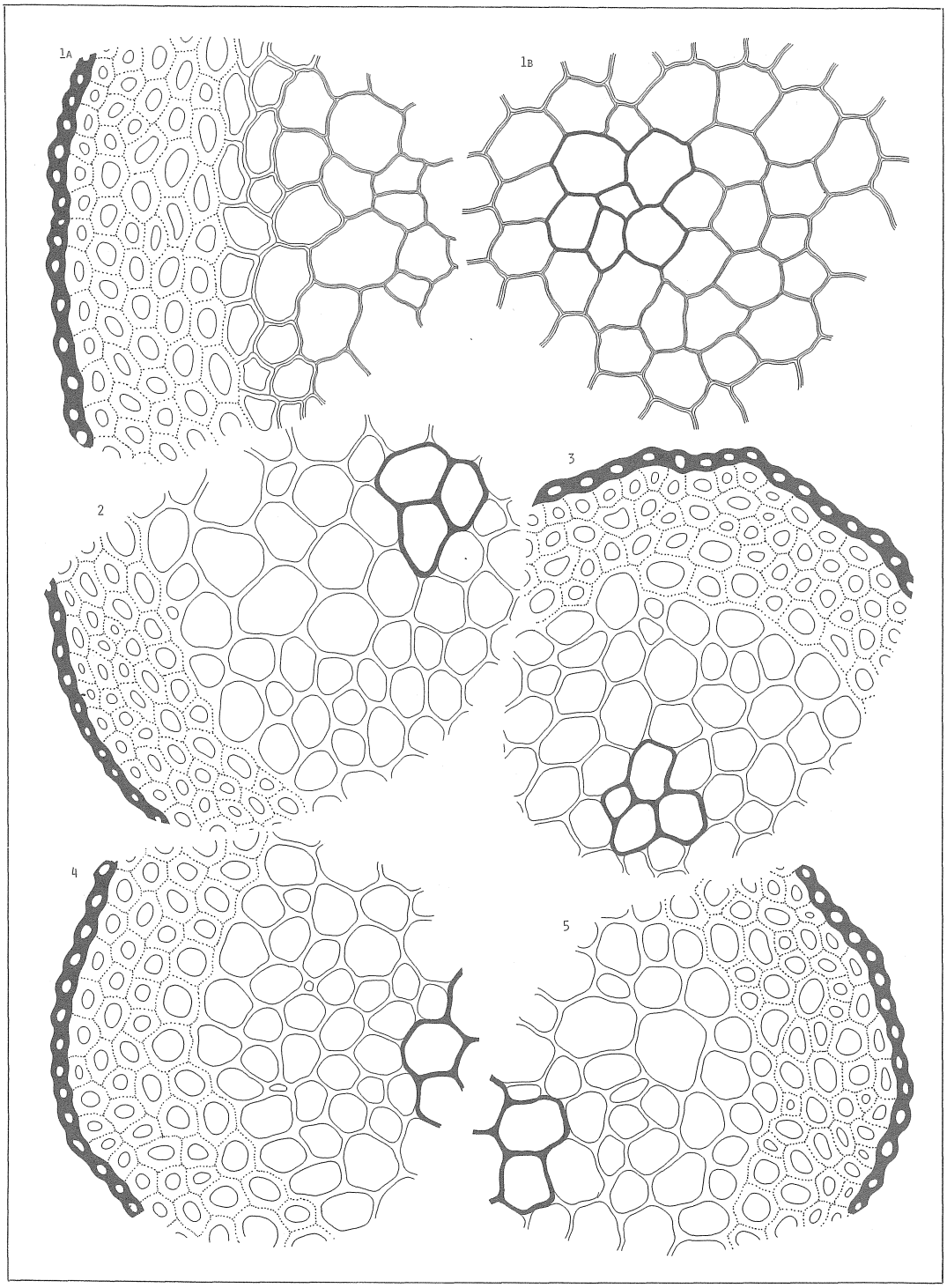


Plate LII Cross sections of the stem
Fig. 1 : *Neckera humilis* MITT. ×360
A : Outer part of the stem
B : Central part of the stem
Fig. 2–5 : *Neckera muratae* NOG. ×360

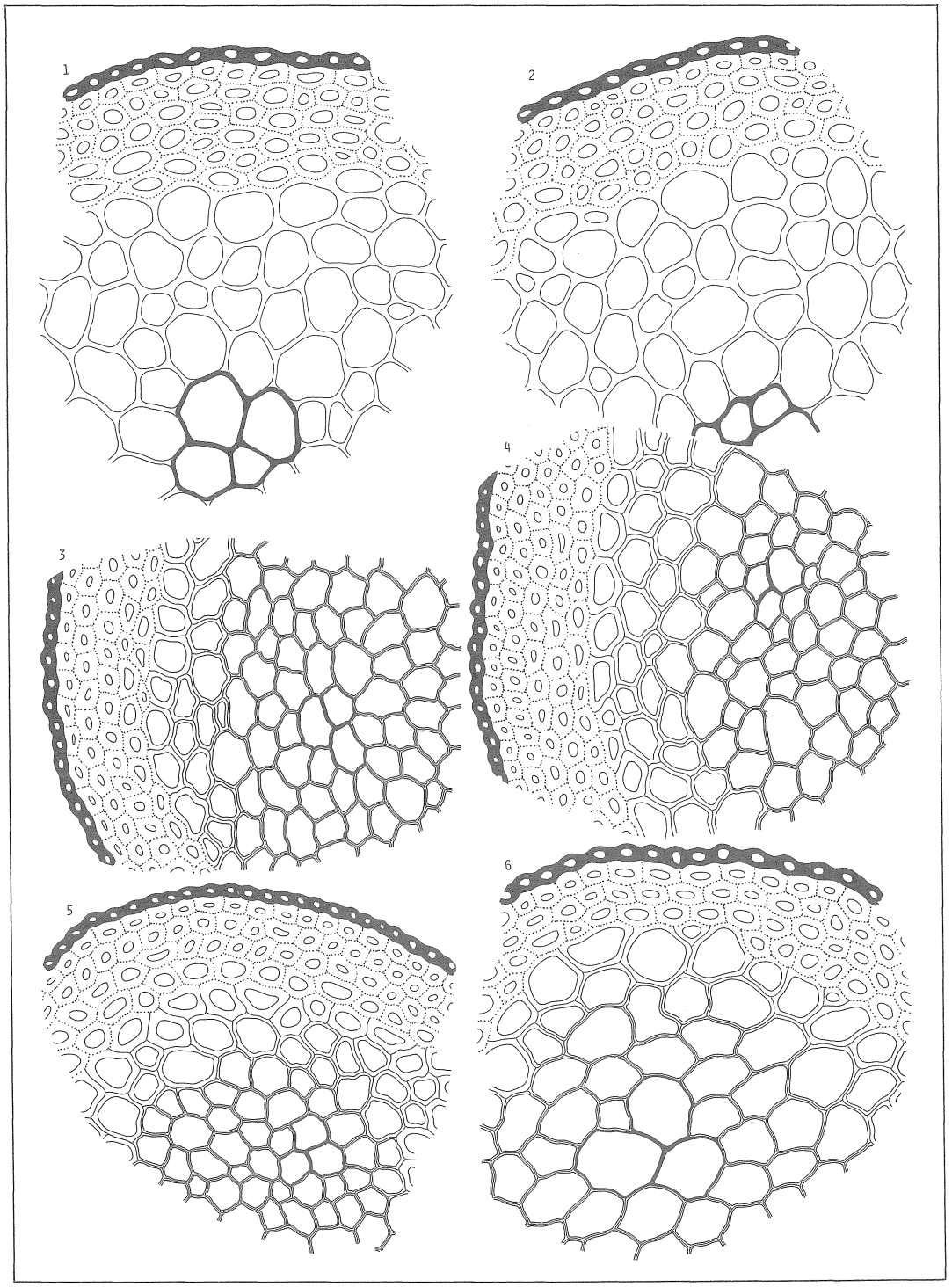


Plate LIII Cross sections of the stem
Fig. 1-2 *Neckera muratae* NOG. ×360
Fig. 3-6 : *Neckera pennata* HEDW. ×360

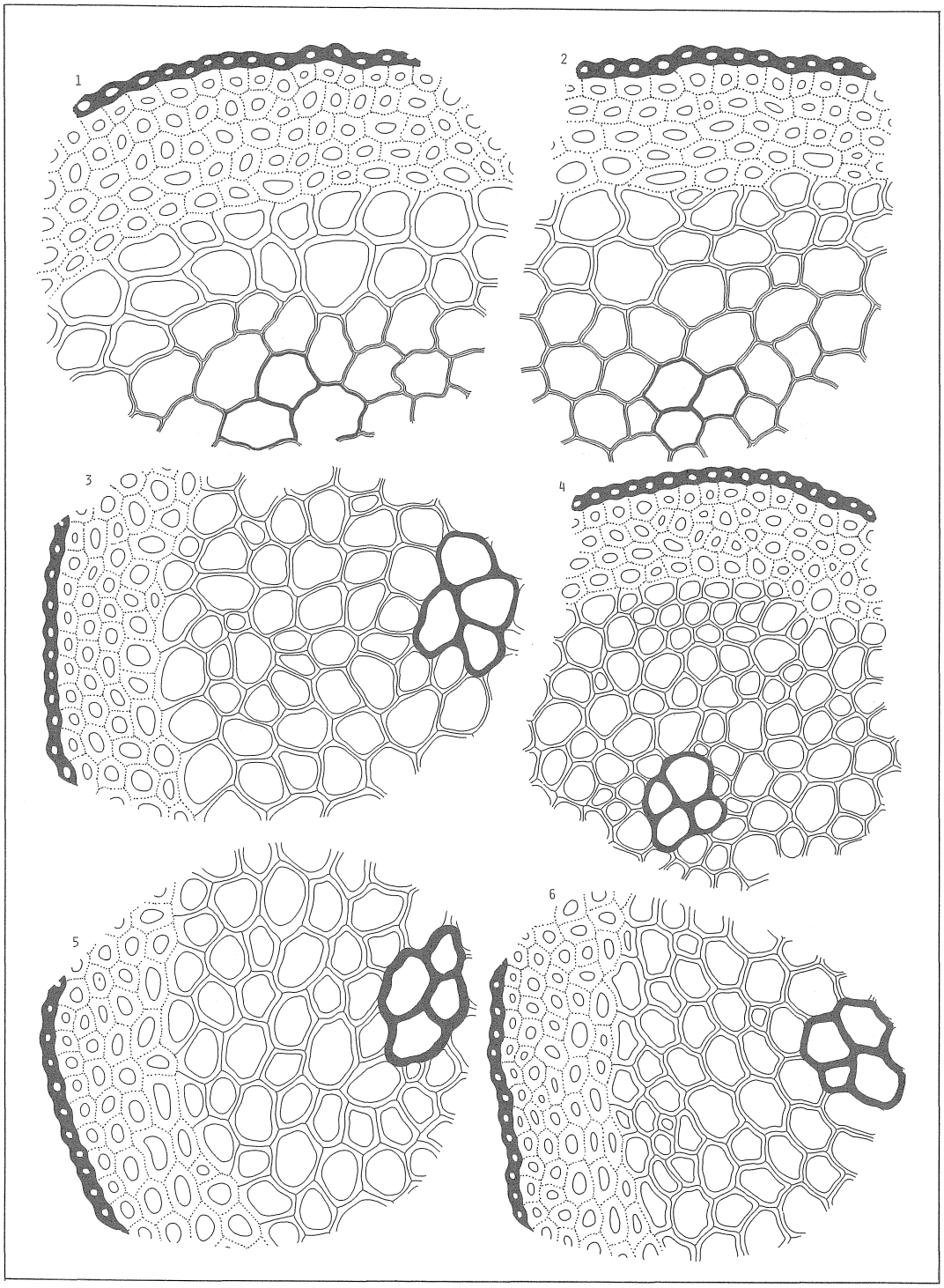


Plate LIV Cross sections of the stem
Fig. 1–2 : *Neckera pennata* HEDW. ×360
Fig. 3–6 : *Neckera pusilla* MITT. ×360

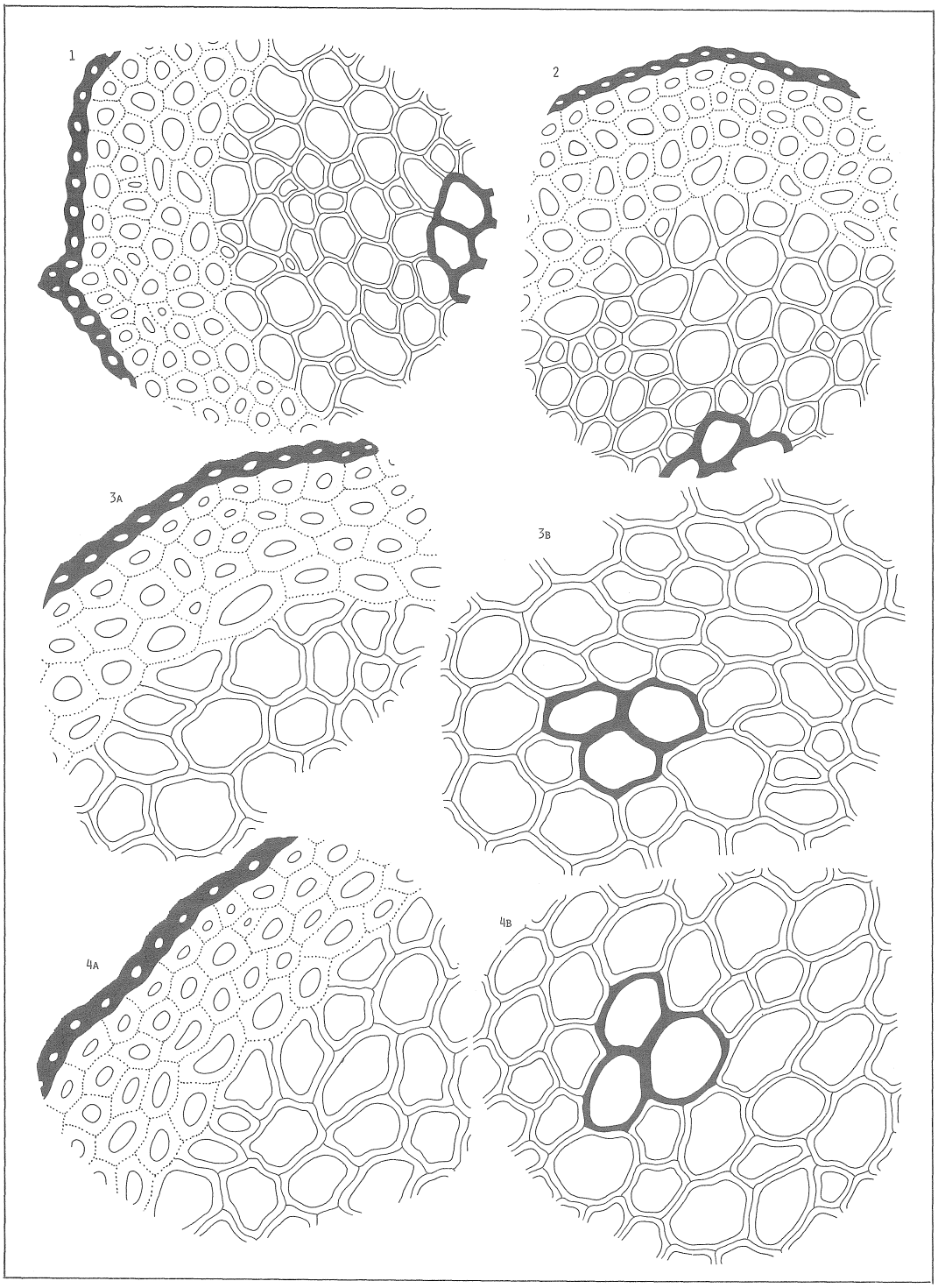


Plate LV Cross sections of the stem
Fig. 1–2 : *Neckera pusilla* MITT. ×360
Fig. 3–4 : *Neckera yezoana* BESCH. ×360
A : Outer part of the stem
B : Central part of the stem

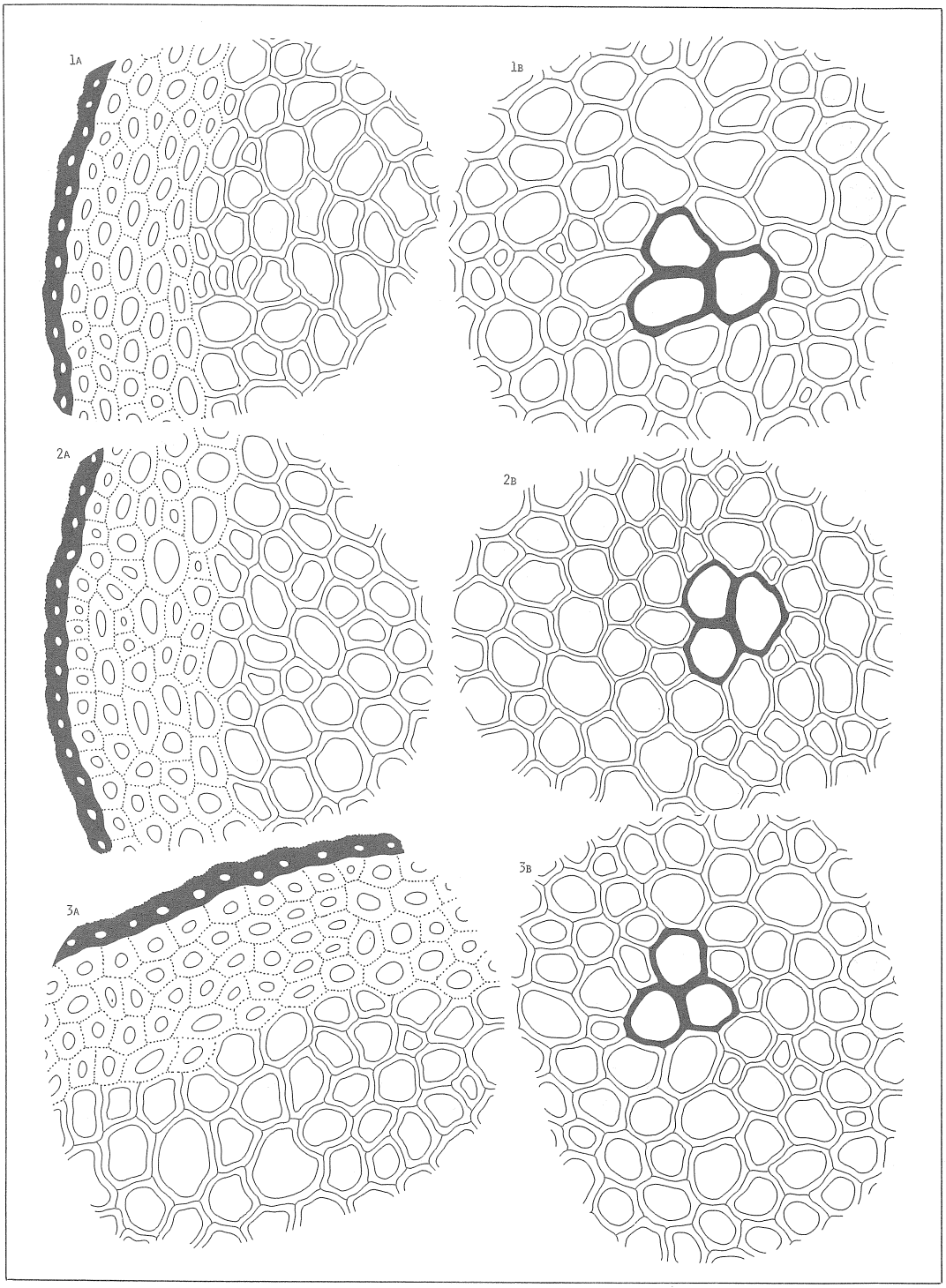


Plate LVI Cross sections of the stem.
Fig. 1–3 : *Neckera yezoana* BESCH. ×360
A : Outer part of the stem
B : Central part of the stem

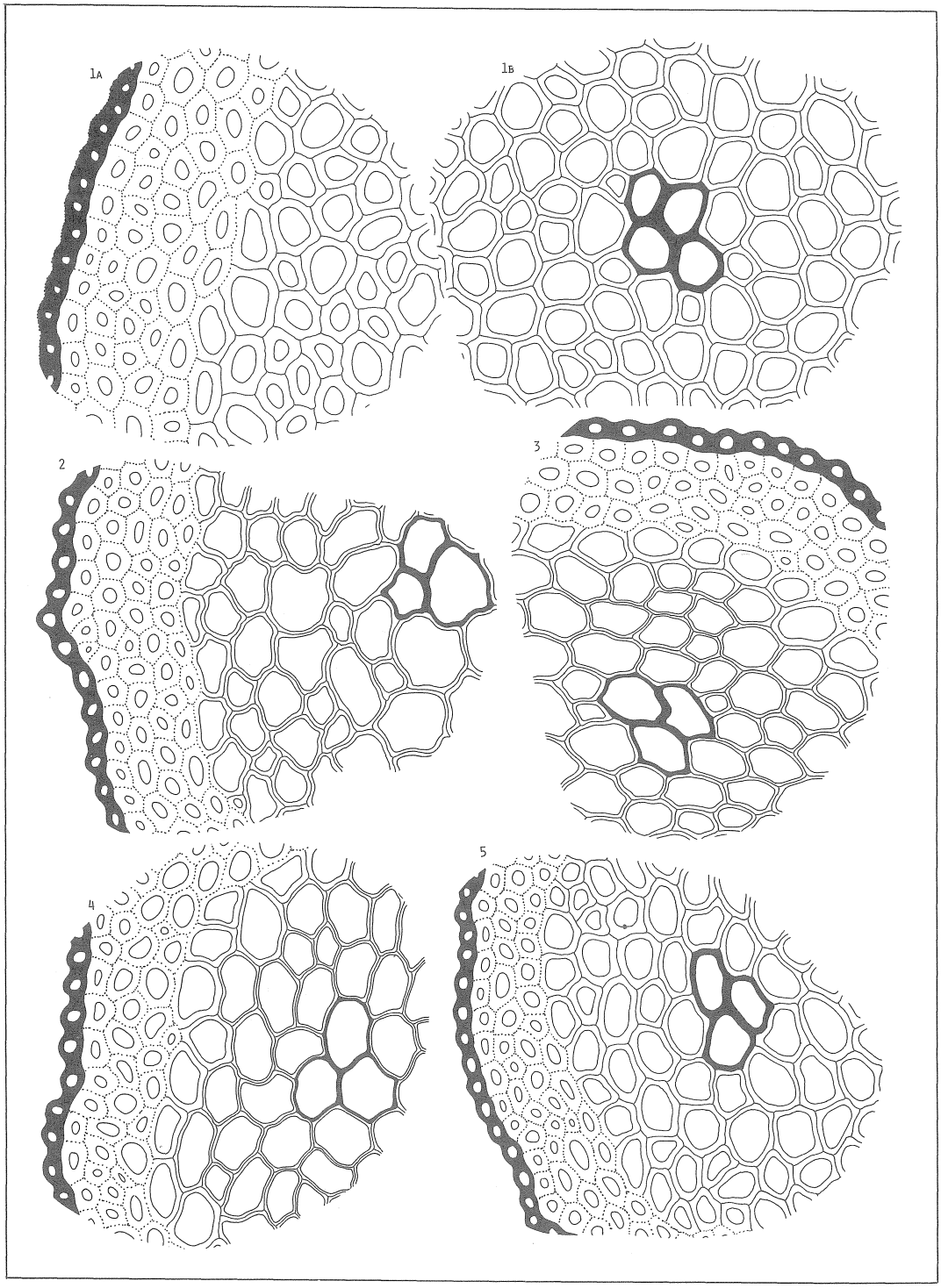


Plate LVII Cross sections of the stem
Fig. 1 : *Neckera yezoana* BESCH. ×360
A : Outer part of the stem
B : Central part of the stem
Fig. 2–5 : *Neckeropsis calcicola* NOG. ×360

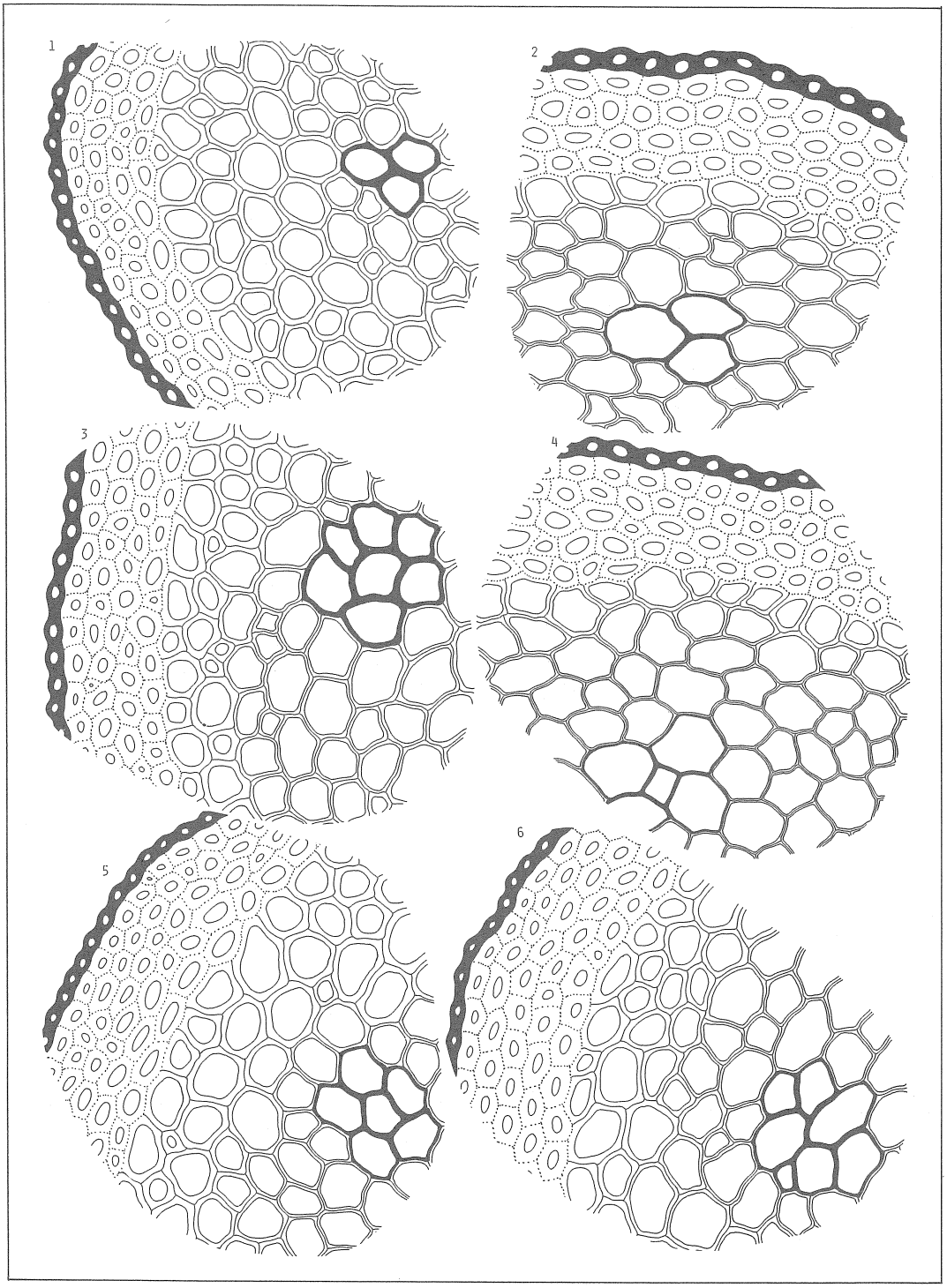


Plate LVIII Cross sections of the stem
Fig. 1–2 : *Neckeropsis calcicola* NOG. ×360
Fig. 3–6 : *Neckeropsis nitidula* (MITT.) FL. ×360

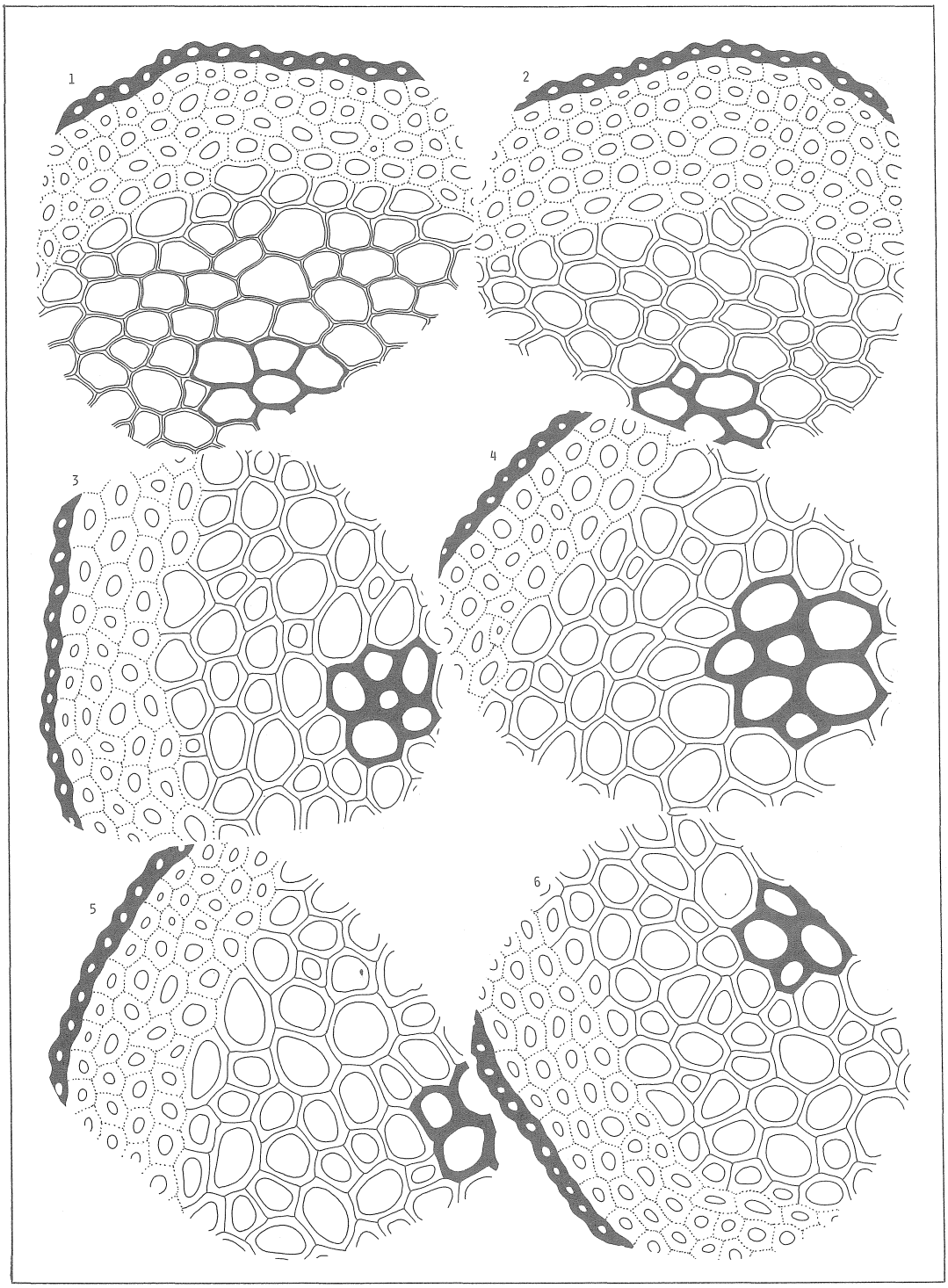


Plate LIX Cross sections of the stem
Fig. 1-2 : *Neckeropsis nitidula* (MITT.) FL. ×360
Fig. 3-6 : *Neckeropsis obtusata* (MONT.) FL. ×360

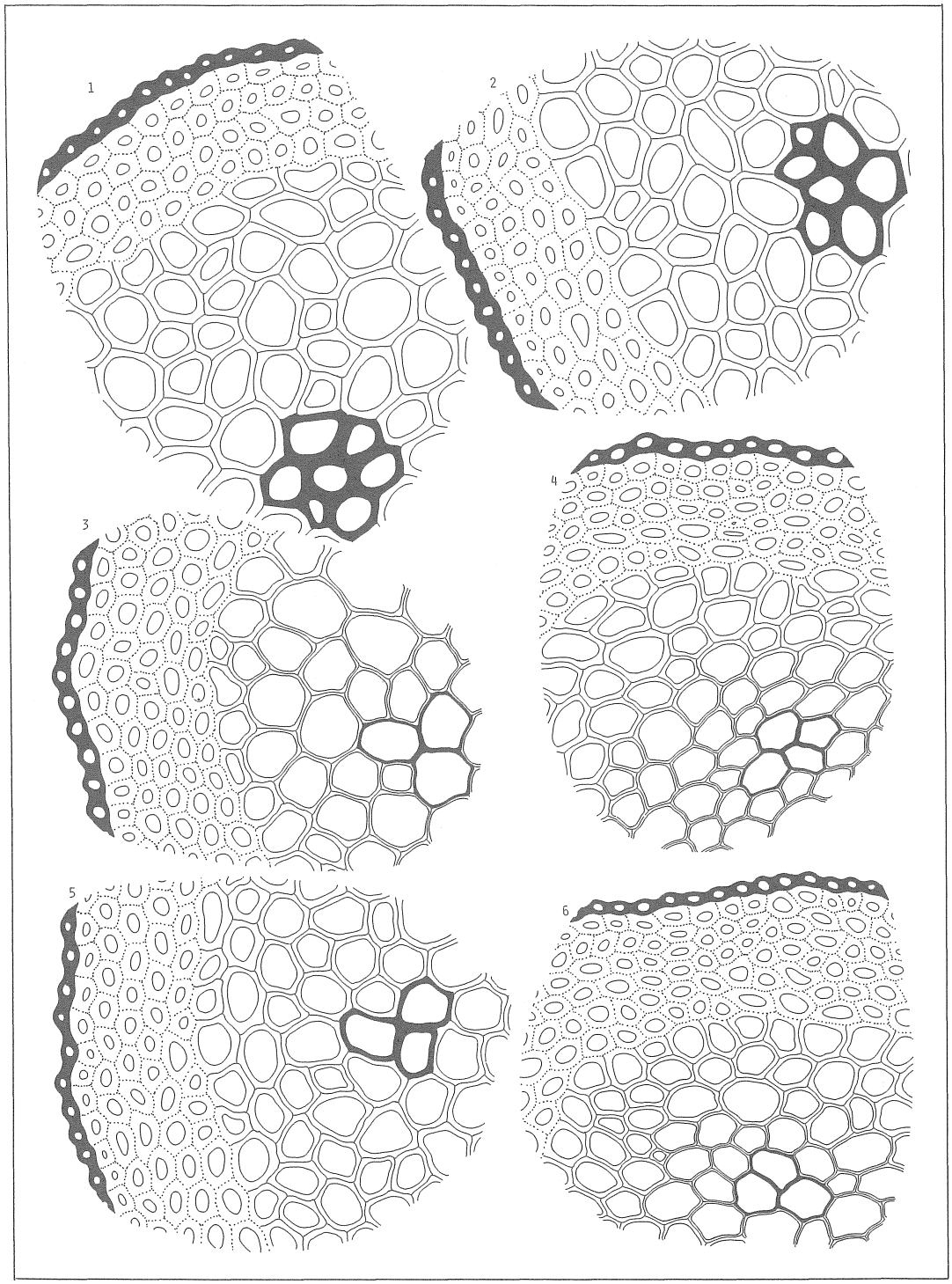


Plate LX Cross sections of the stem
Fig. 1–2 : *Neckeropsis obtusata* (MONT.) FI. ×360
Fig. 3–6 : *Pinnatella makinoi* (BROTH.) BROTH. ×360

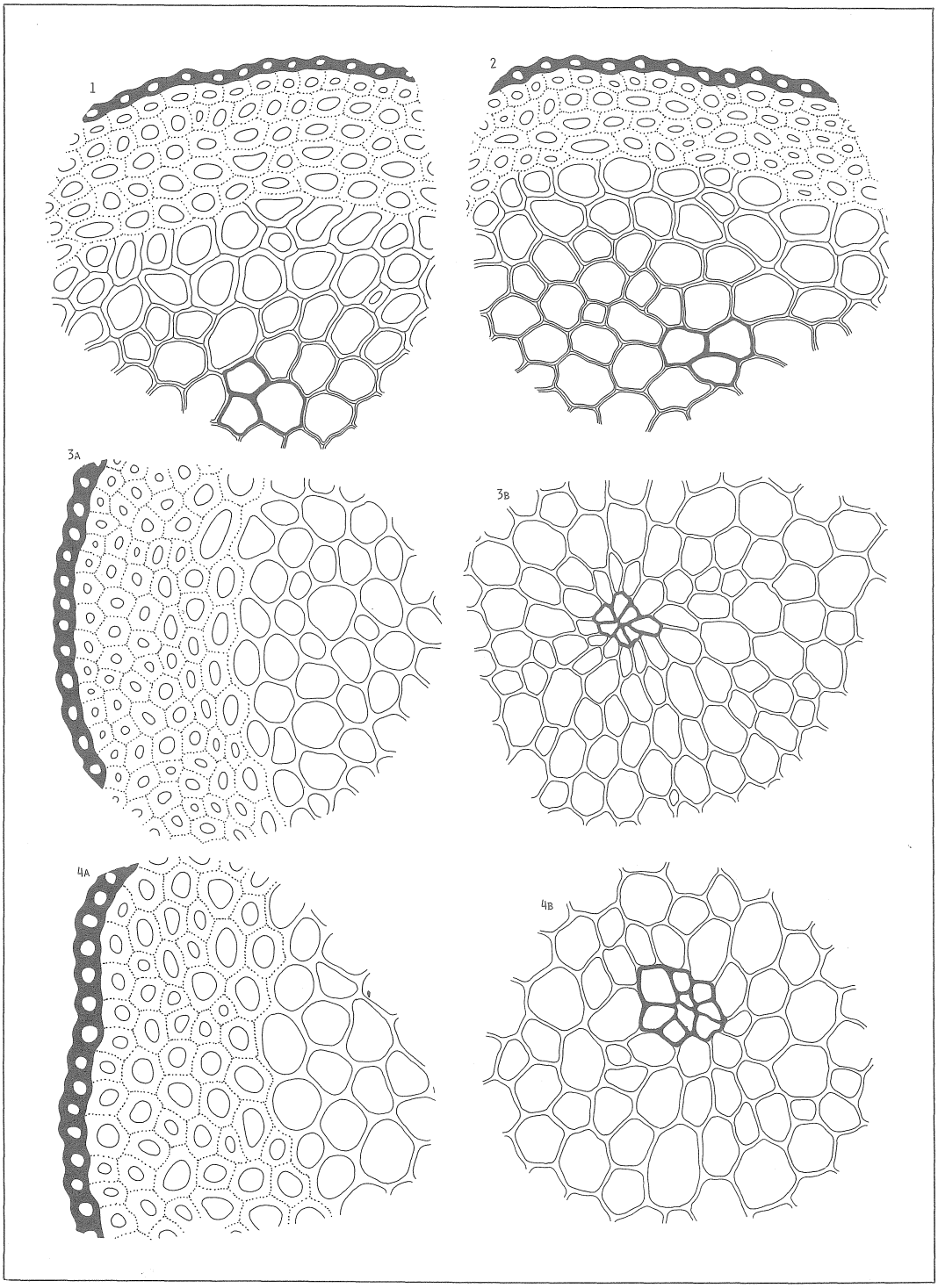


Plate LXI Cross sections of the stem
Fig. 1–2 : *Pinnatella makinoi* (BROTH.) BROTH. ×360
Fig. 3–4 : *Thamnobryum alopecurum* (HEDW.) NIEUWL. ×360
A : Outer part of the stem
B : Central part of the stem

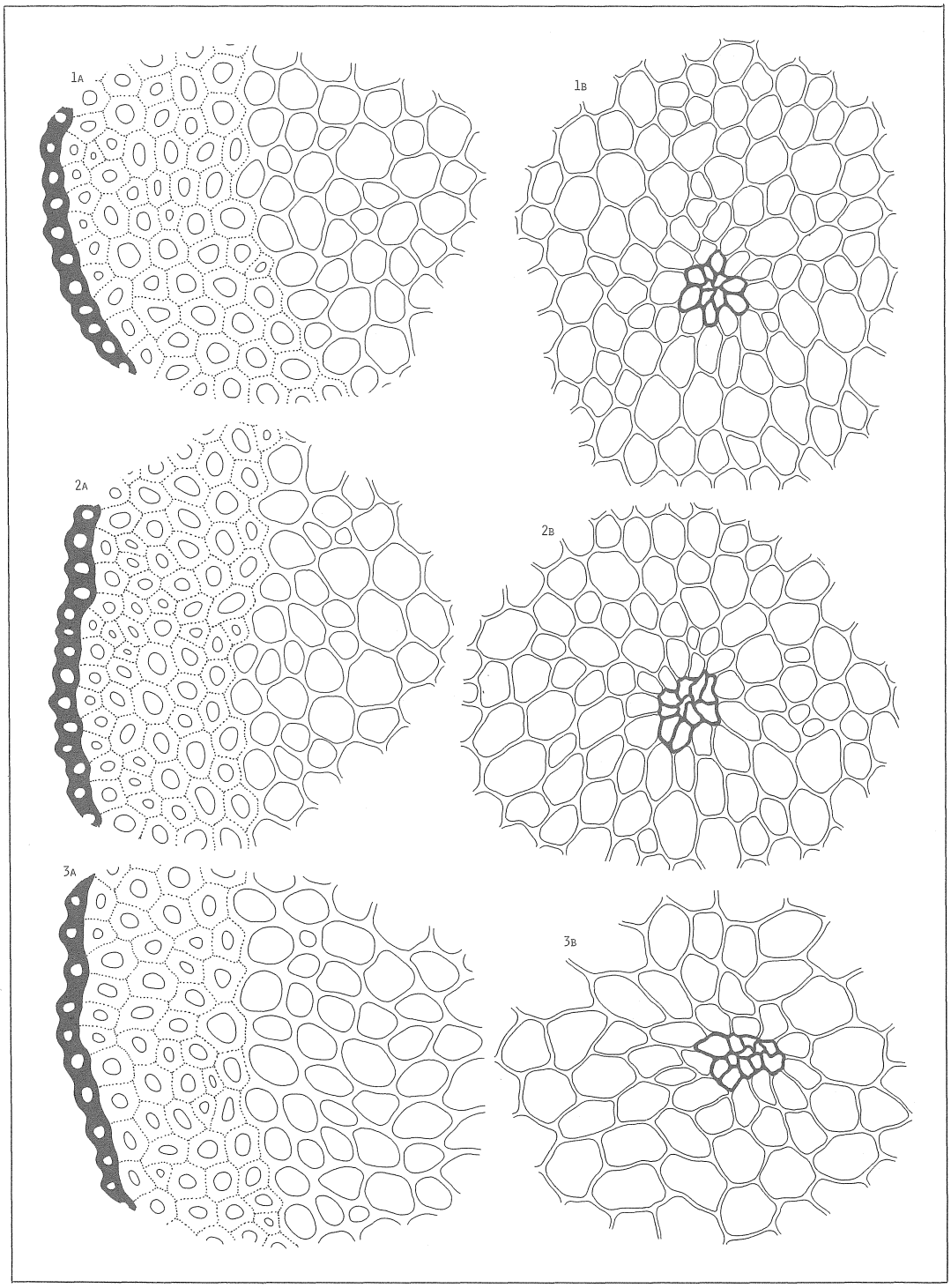


Plate LXII Cross sections of the stem
Fig. 1–3 : *Thamnobryum alopecurum* (HEDW.) NIEUWL. ×360
A : Outer part of the stem
B : Central part of the stem

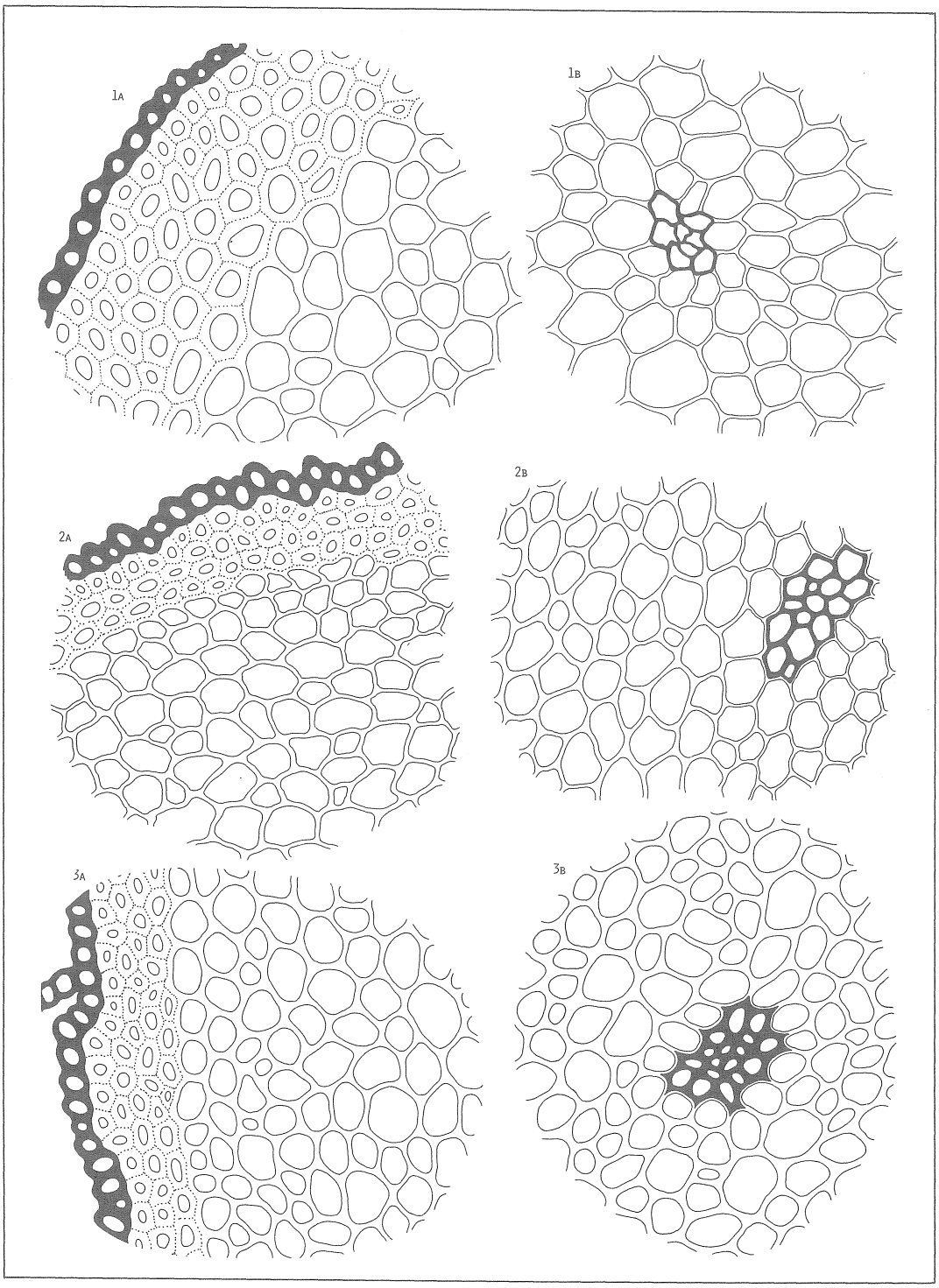


Plate LXIII Cross sections of the stem
Fig. : *Thamnobryum alopecurum* (HEDW.) NIEUWL. ×360
Fig. 2–3 : *Thamnobryum plicatulum* (LAC.) IWATS. ×360
A : Outer part of the stem
B : Central part of the stem

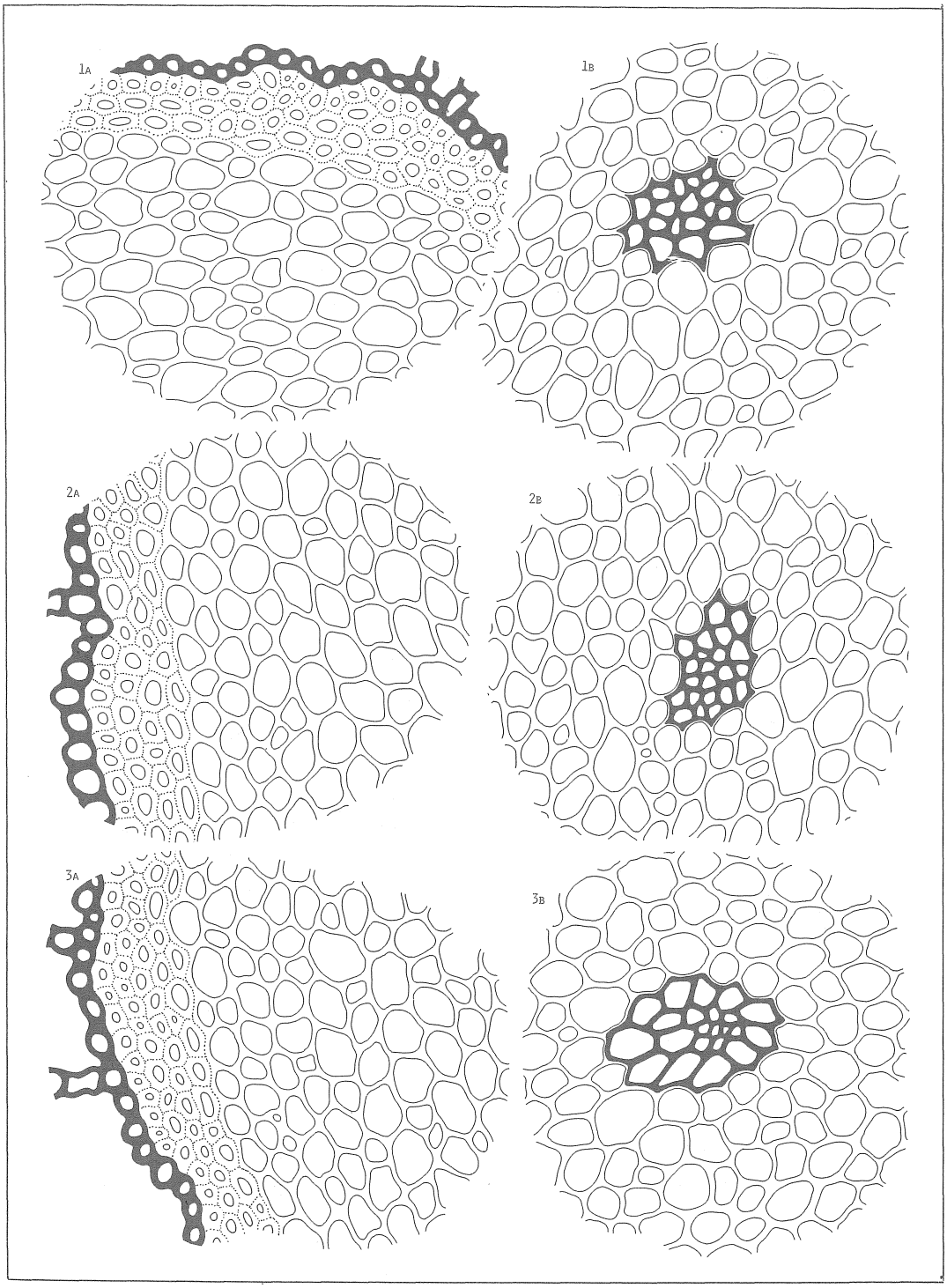


Plate LXIV Cross sections of the stem
Fig. 1–3 : *Thamnobryum plicatulum* (LAC.) IWATS. ×360
A : Outer part of the stem
B : Central part of the stem

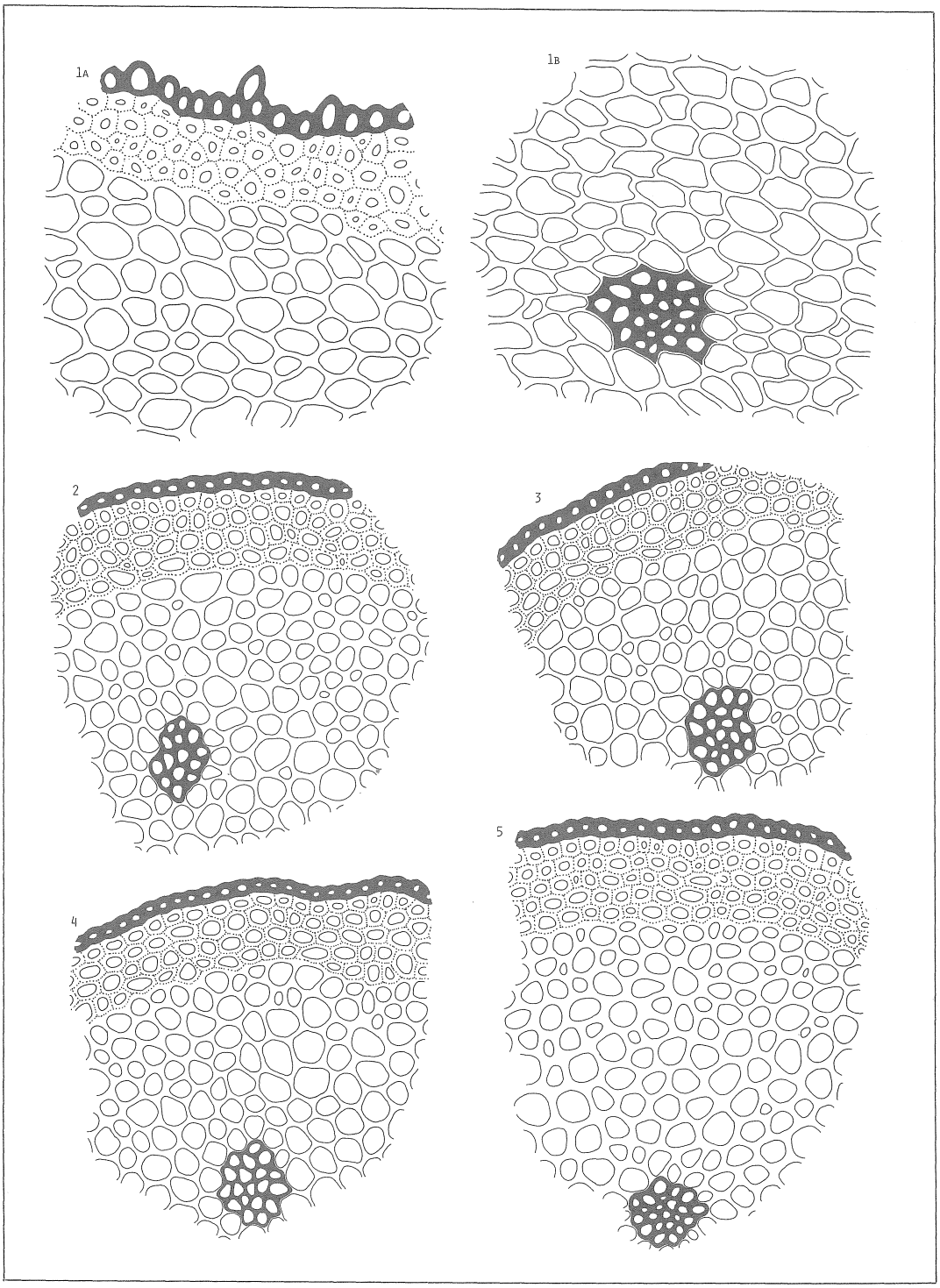


Plate LXV Cross sections of the stem

Fig. 1 : *Thamnobryum plicatulum* (LAC.) IWATS. ×360

A : Outer part of the stem

B : Central part of the stem

Fig. 2–5 : *Thamnobryum sandei* (BESCH.) IWATS. ×240

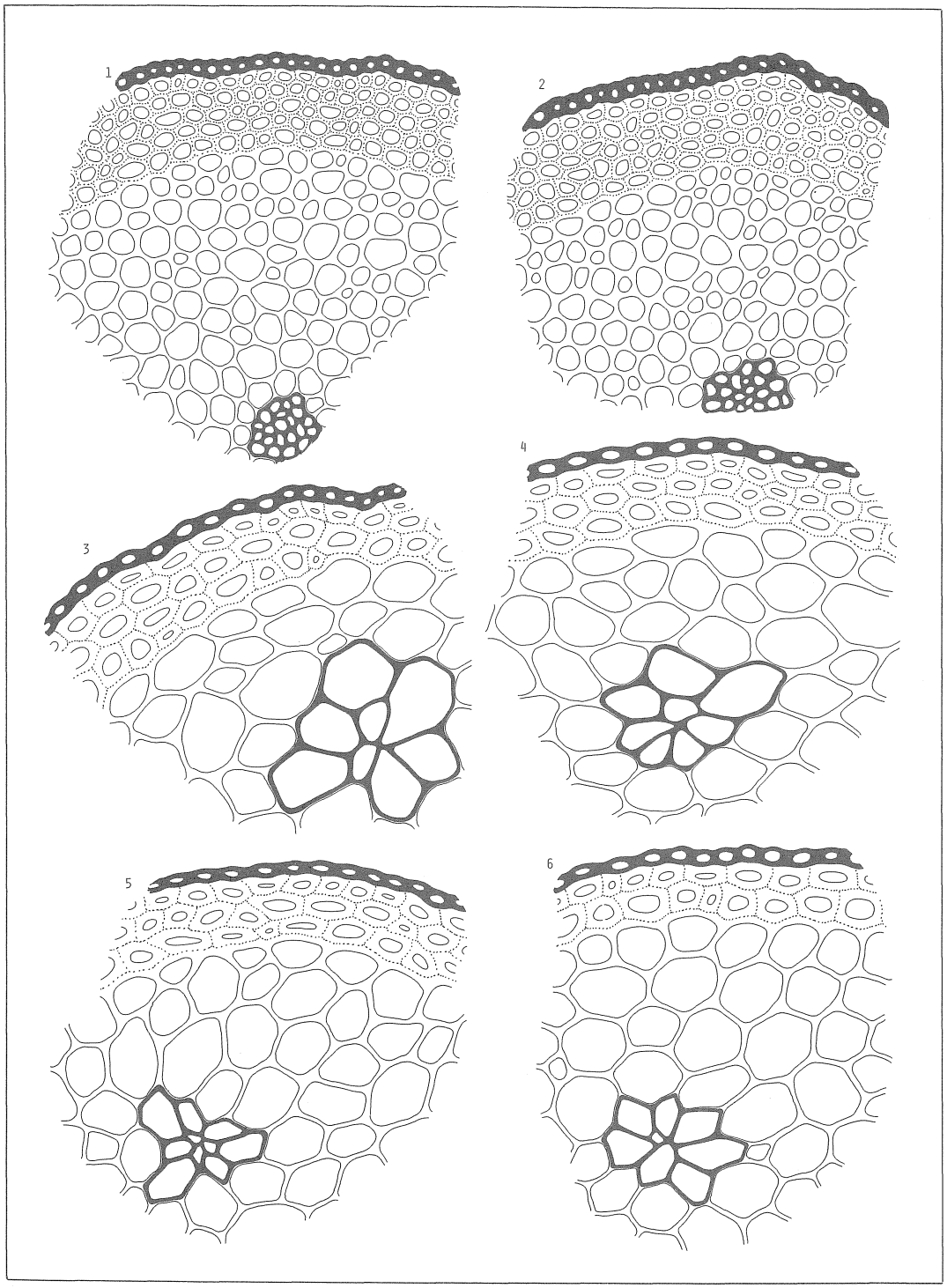


Plate LXVI Cross sections of the stem
Fig. 1–2 : *Thamnobryum sandei* (BESCH.) IWATS. ×3240
Fig. 3–6 : *Thamnobryum sandei* v. *cymbifolium* (CARD.) NOG. et IWATS. ×360

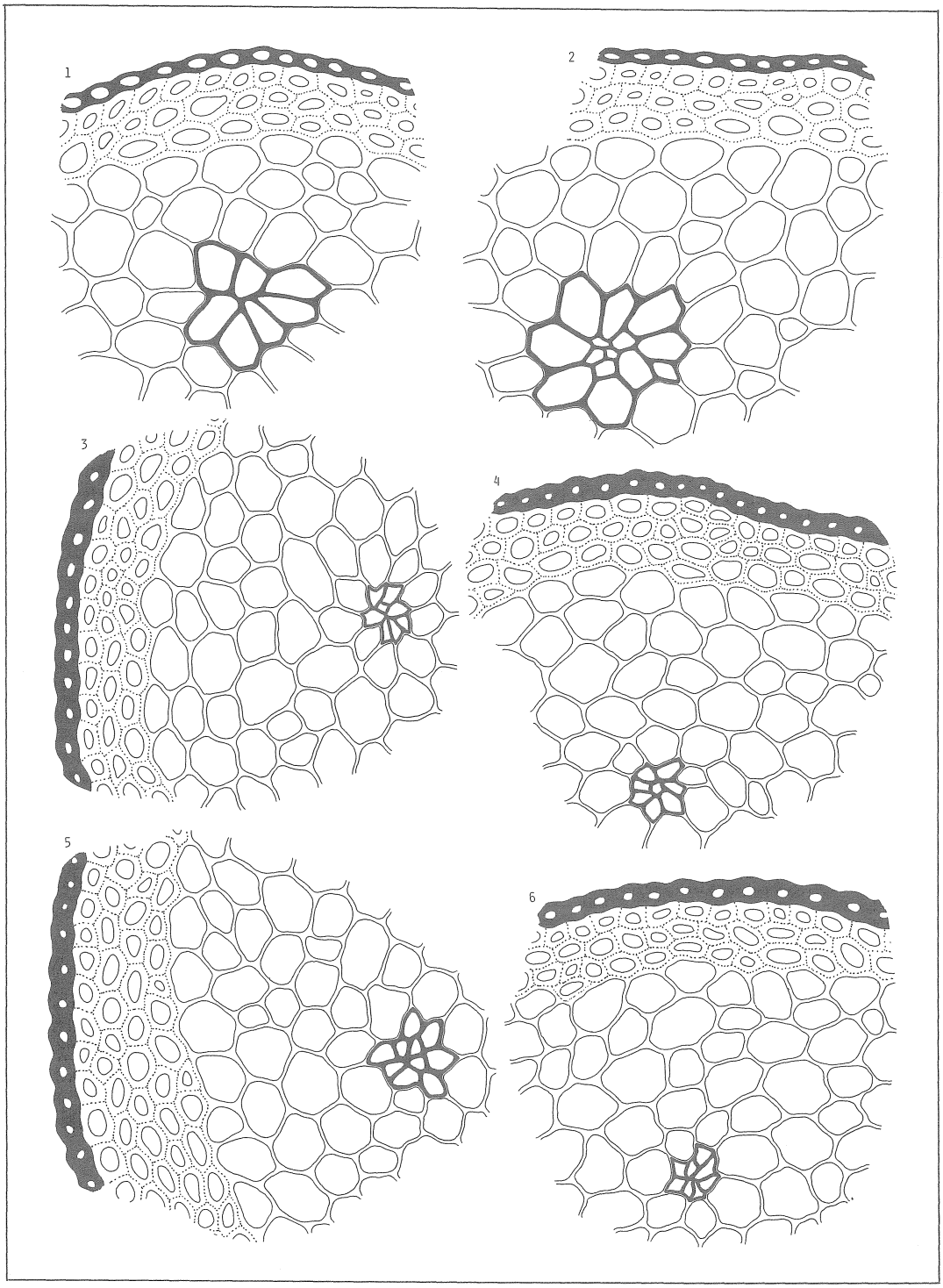


Plate LXVII Cross sections of the stem
Fig. 1-2 : *Thamnobryum sandei* v. *cymbifolium* (CARD.) NOG. et IWATS. ×360
Fig. 3-6 : *Dolichomitra cymbifolia* (LINDB.) BROTH. ×360

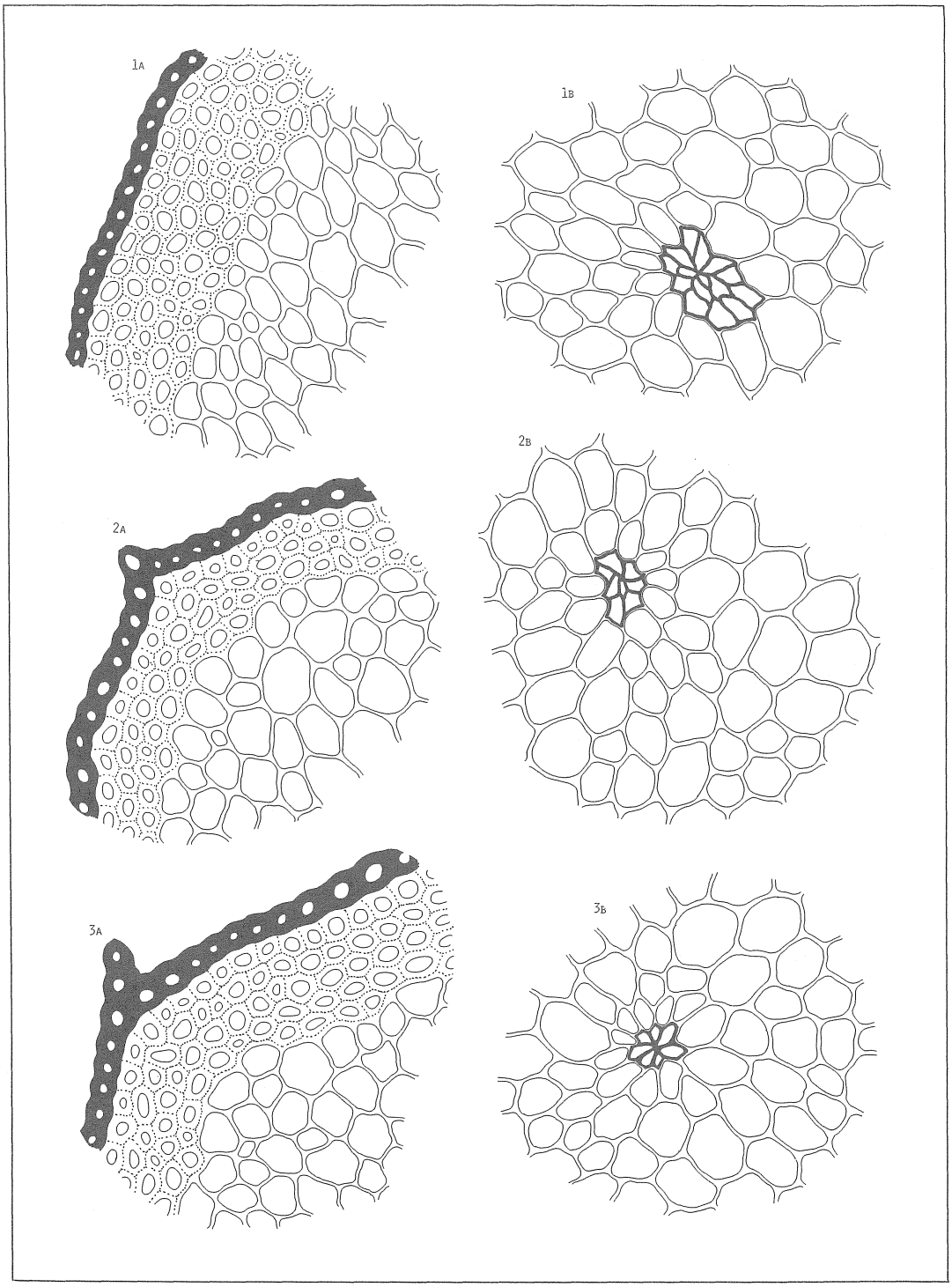


Plate LXVIII Cross sections of the stem
Fig. 1 : *Dolichomitra cymbifolia* (LINDB.) BROTH. ×360
Fig. 2–3 : *Dolichomitra cymbifolia* v. *subintegerrima* OKAM. ×360
A : Outer part of the stem
B : Central part of the stem

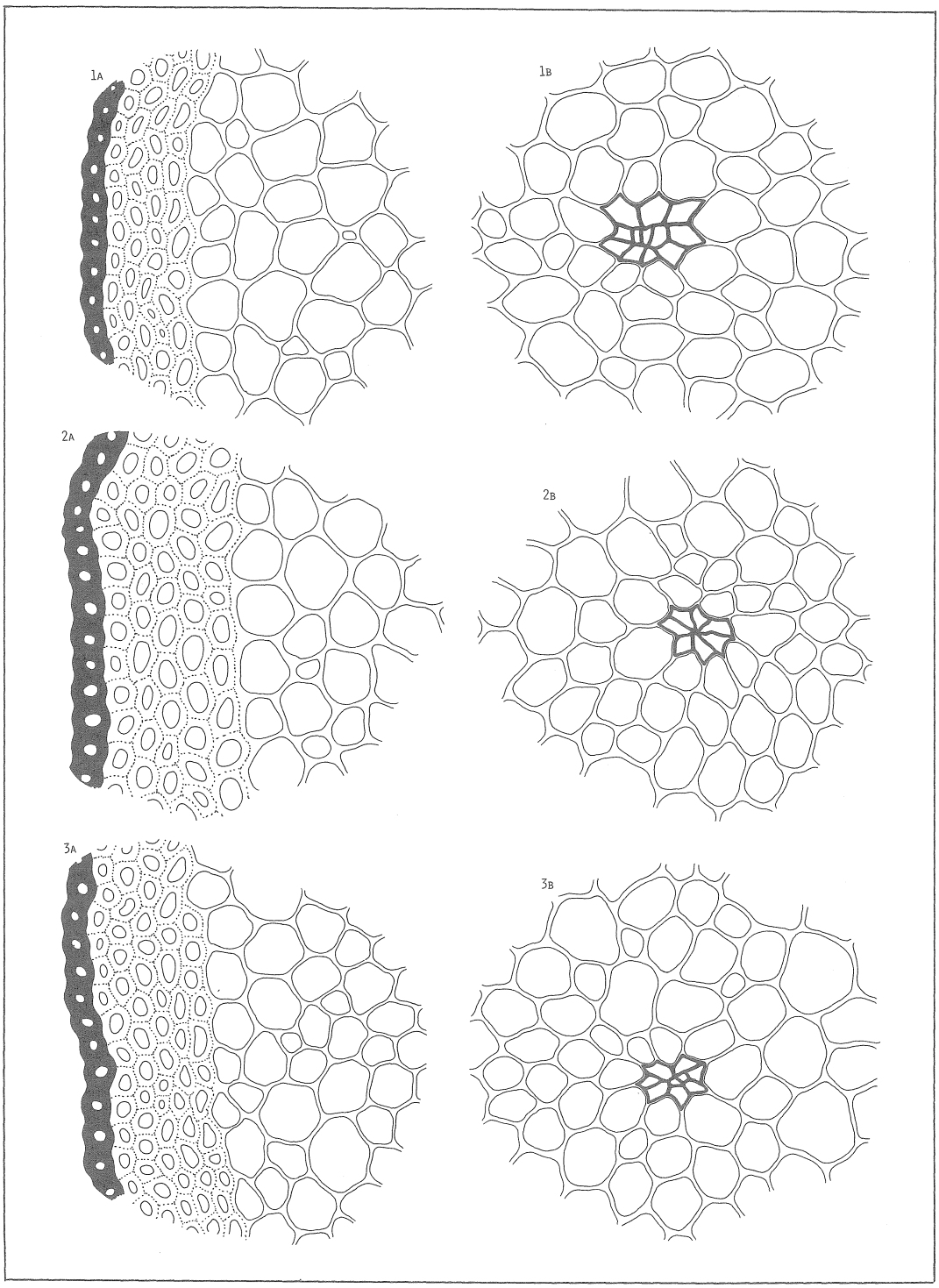


Plate LXIX Cross sections of the stem
Fig. 1–3 : *Dolichomitra cymbifolia* v. *subintegerrima* OKAM. ×360
A : Outer part of the stem
B : Central part of the stem

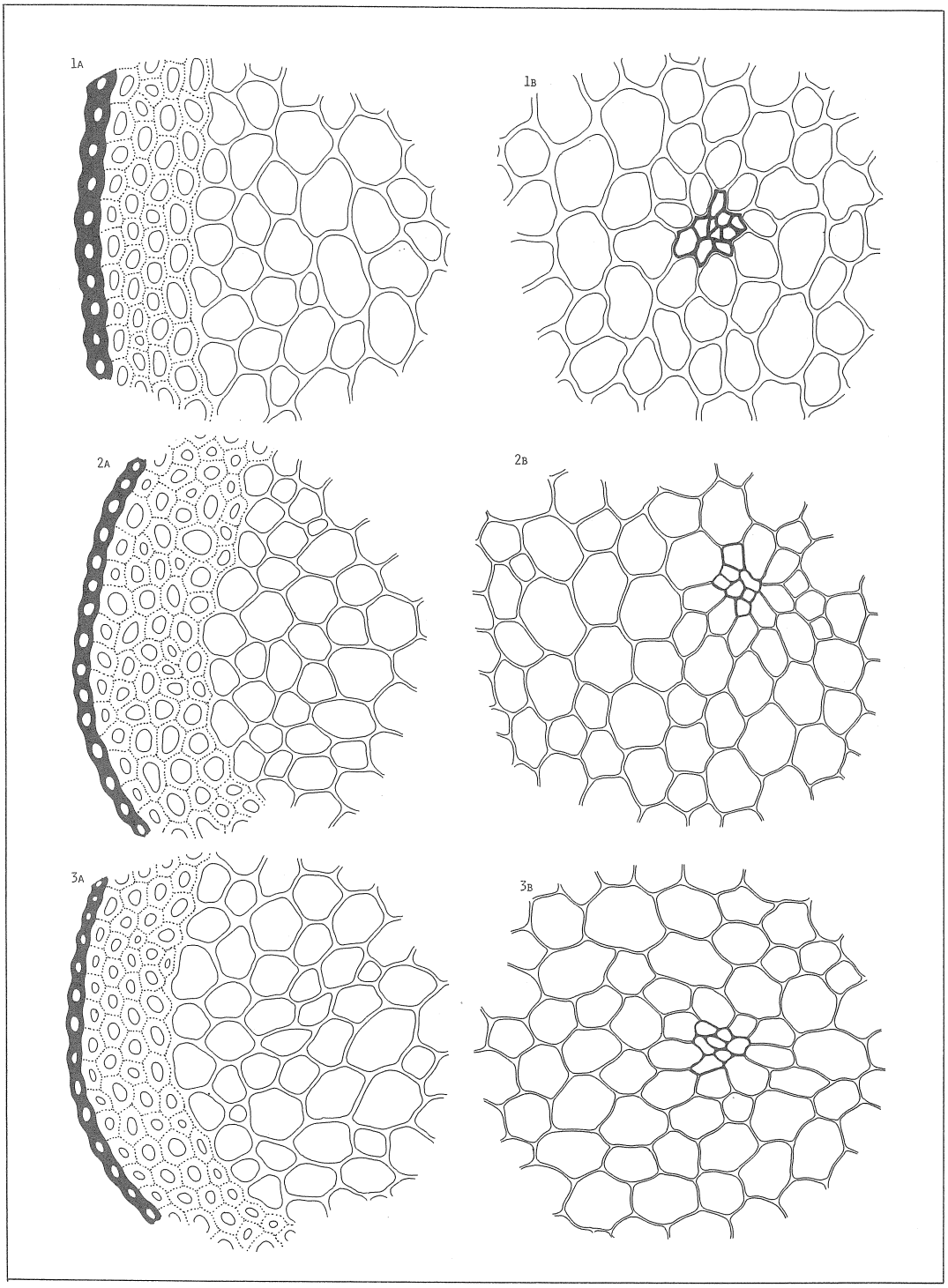


Plate LXX Cross sections of the stem

Fig. 1 : *Dolichomitra cymbifolia* v. *subintegerrima* OKAM. ×360

Fig. 2–3 : *Dolichomitriopsis crenulata* OKAM. ×360

A : Outer part of the stem

B : Central part of the stem

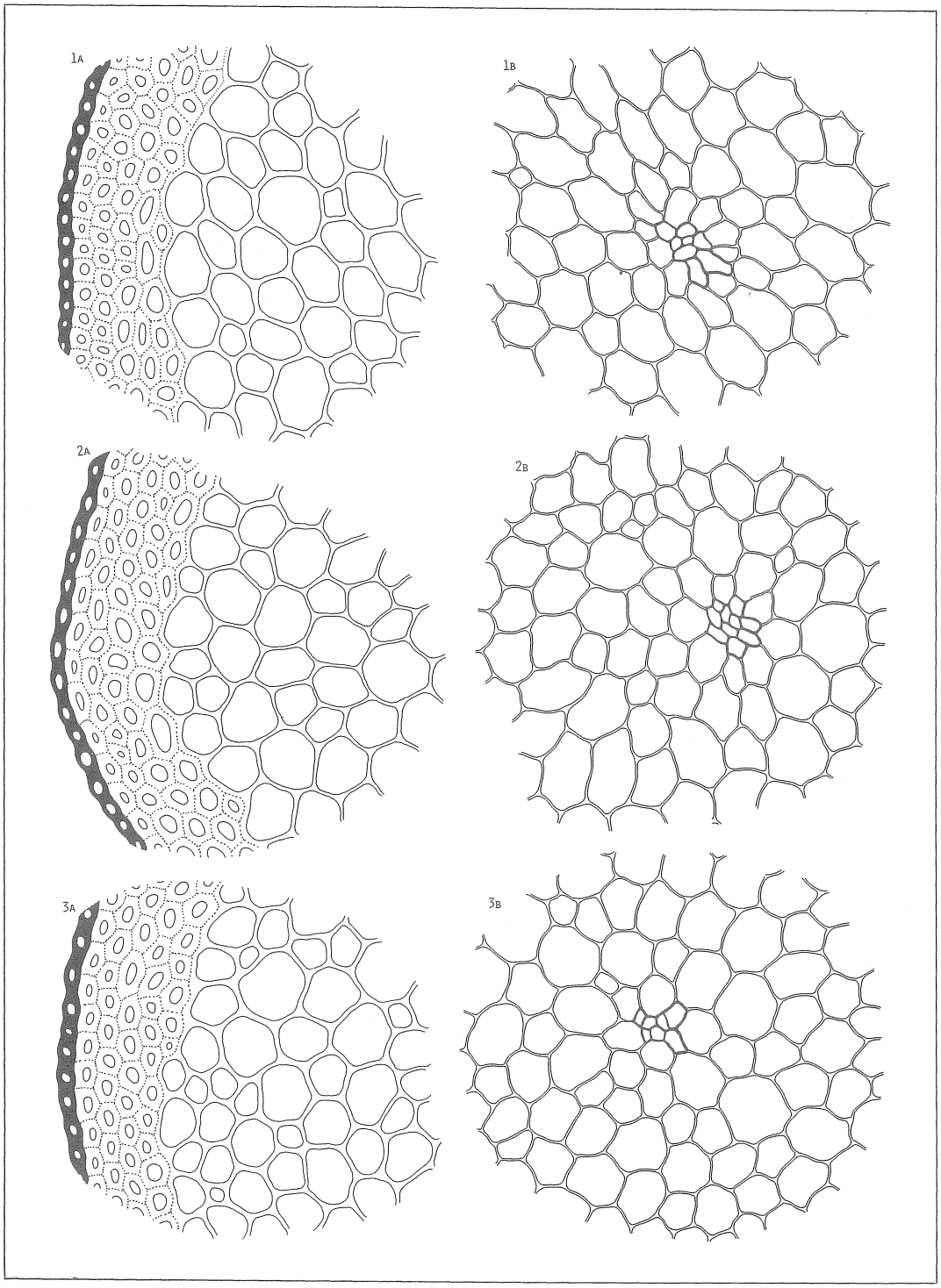


Plate LXXI Cross sections of the stem
Fig. 1-3 : *Dolichomitriopsis crenulata* OKAM. ×360
A : Outer part of the stem
B : Central part of the stem

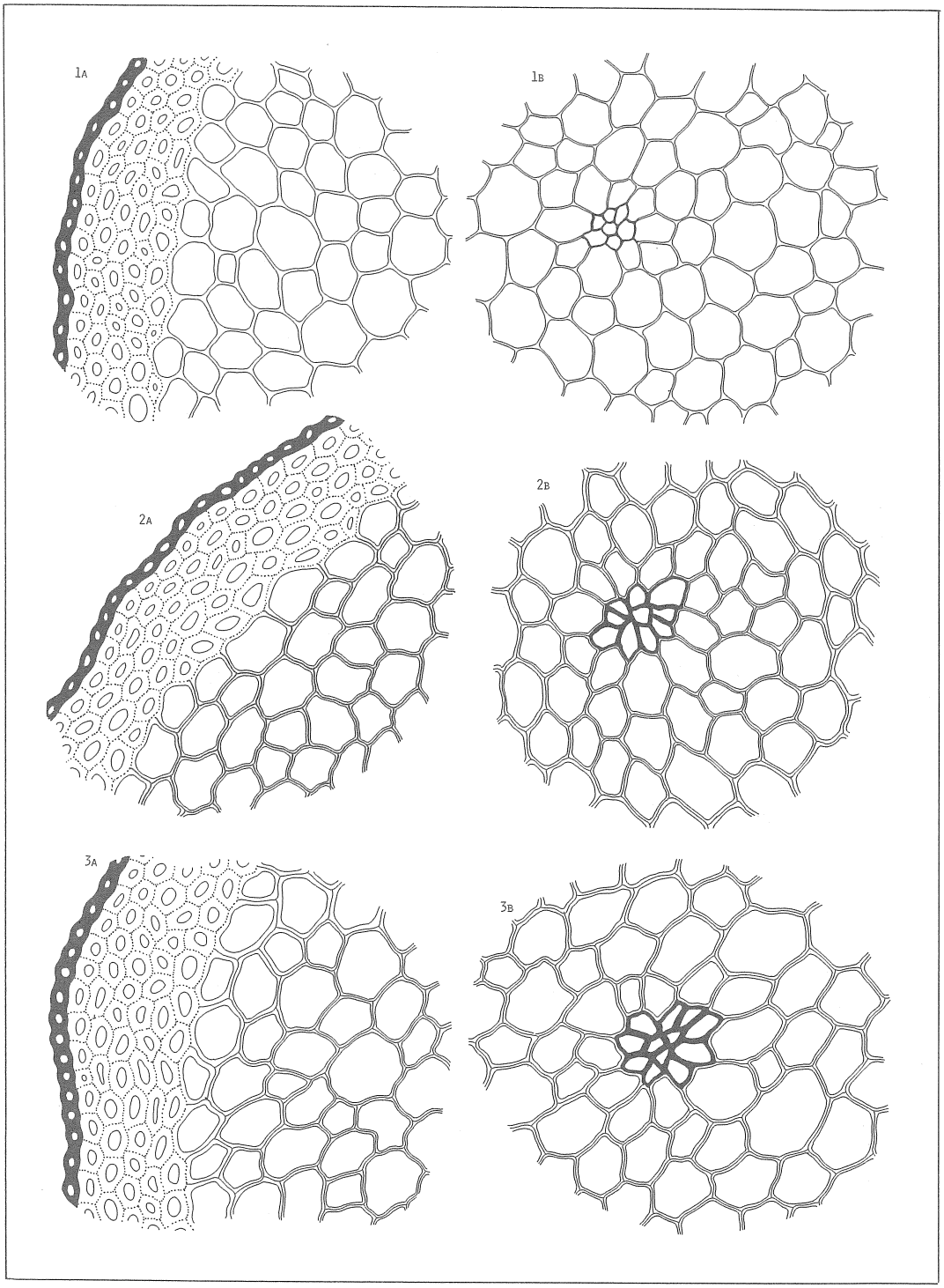


Plate LXXII Cross sections of the stem
Flg. 1 : *Dolichomitriopsis crenulata* OKAM. ×360
Fig. 2–3 : *Dolichomitriopsis diversiformis* (MITT.) NOG. ×360
A : Outer part of the stem
B : Central part of the stem

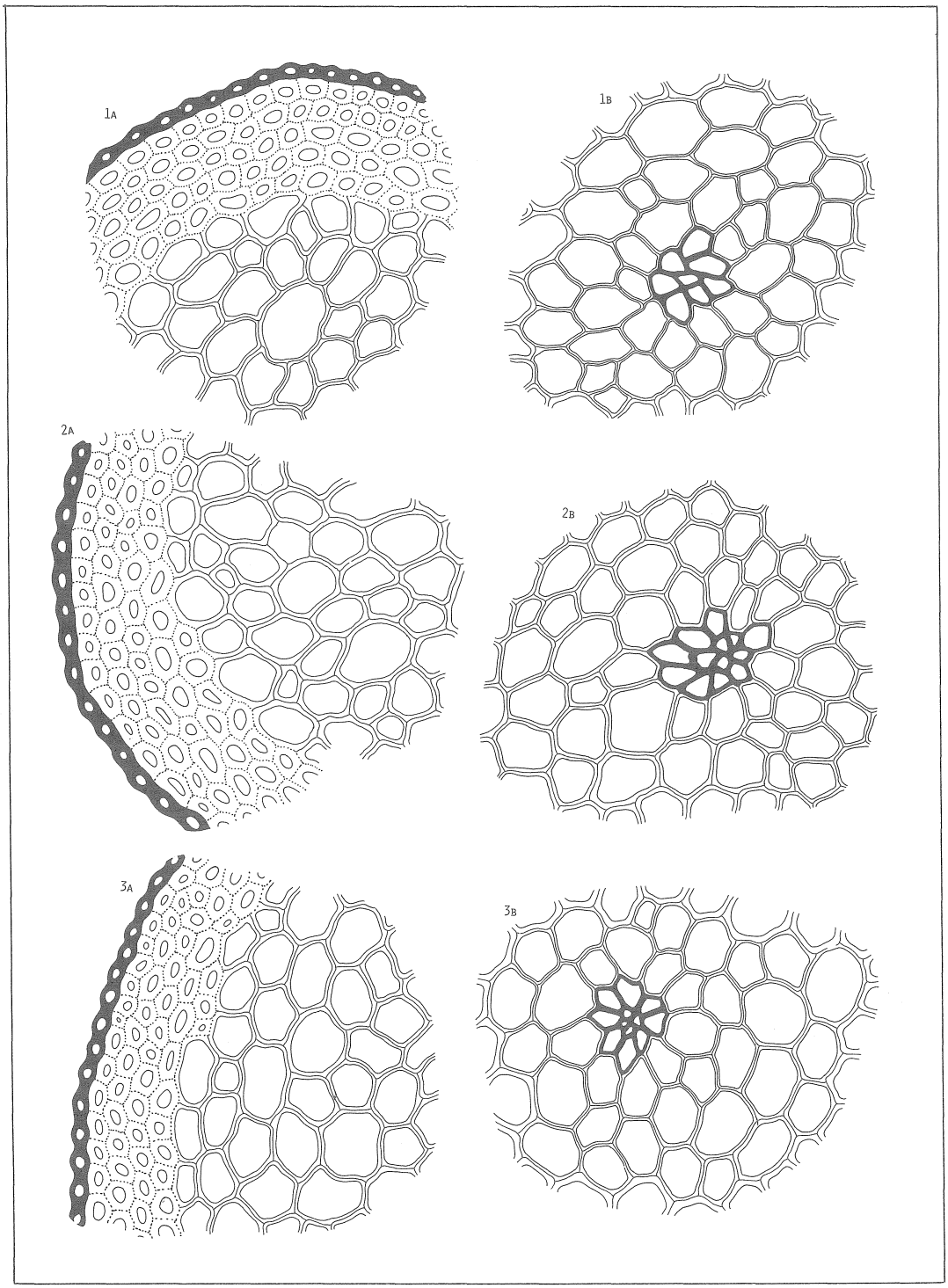


Plate LXXIII Cross sections of the stem
Fig. 1–3 : *Dolichomitriopsis diversiformis* (MITT.) NOG. ×360
A : Outer part of the stem
B : Central part of the stem

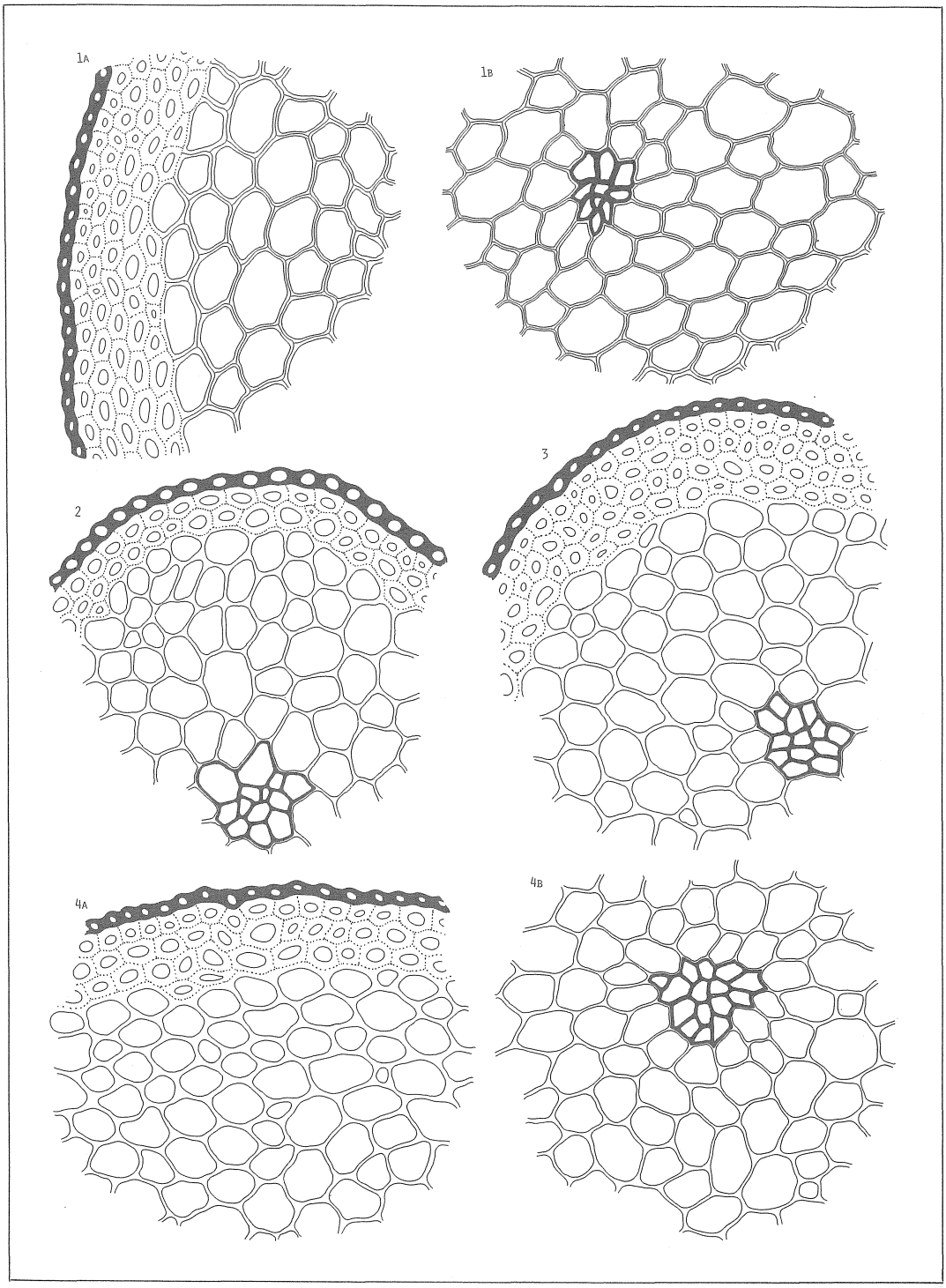


Plate LXXIV Cross sections of the stem
Fig. 1 : *Dolichomitriopsis diversiformis* (MITT.) NOG. ×360
Fig. 2–4 : *Isothecium subdiversiforme* BROTH. ×360
A : Outer part of the stem
B : Central part of the stem

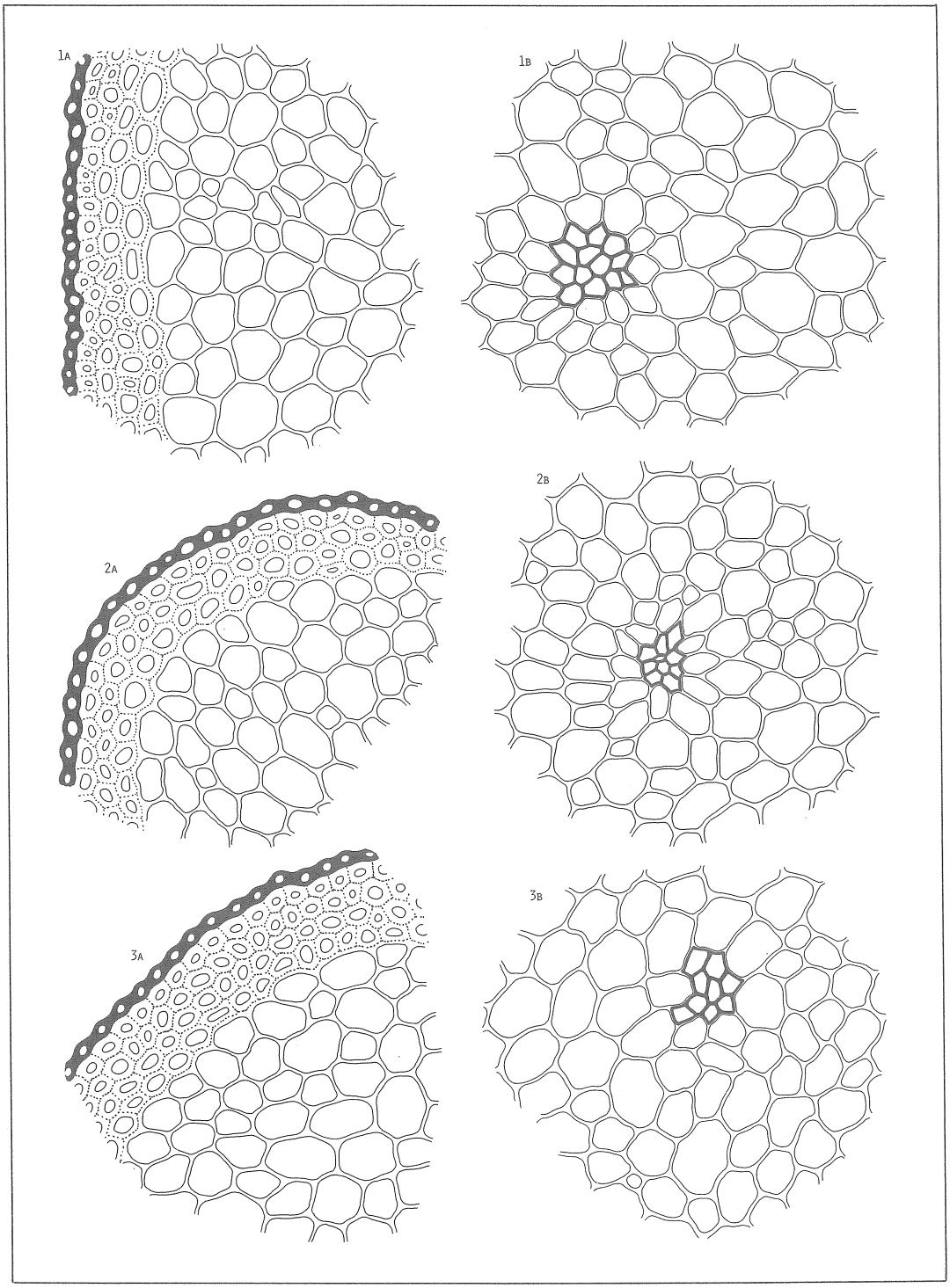


Plate LXXV Cross sections of the stem
Fig. 1–3 : *Isothecium subdiversiforme* BROTH. ×360
A : Outer part of the stem
B : Central part of the stem

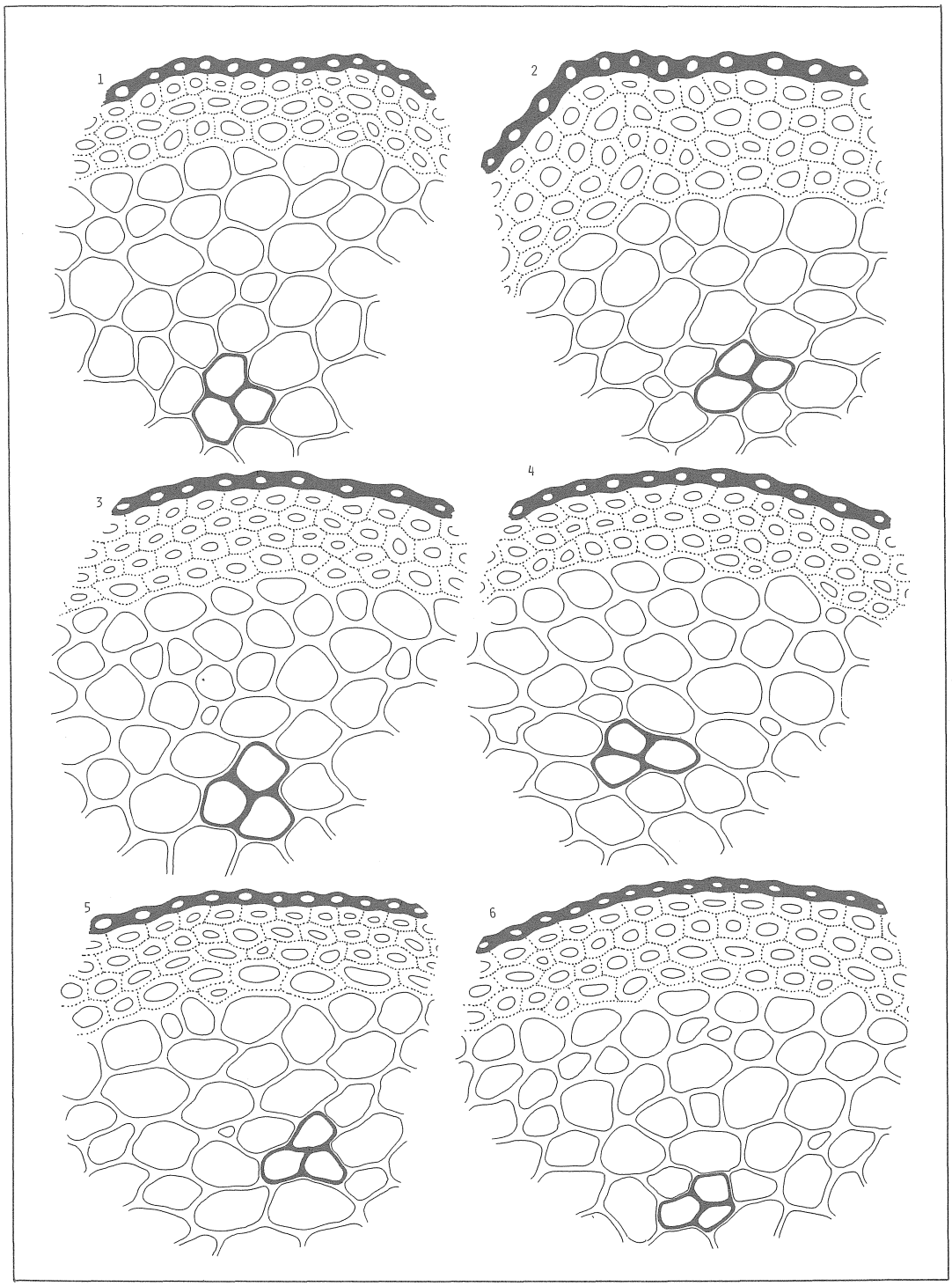


Plate LXXVI Cross sections of the stem
Fig. 1–6 : *Neobarbella pilifera* (BROTH. et YAS.) NOG. ×360