

## 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

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**Abstract** In bryophyte the cross sections of the stem in some species of Fissidentaceae, Grimmiaceae, Thuidiaceae, Entodontaceae, Mniaceae, Bartramiaceae, Dicranaceae, Hypnaceae and Polytrichaceae, have been considered, to find a coordination shown among the interior structures of gametophyte. Furthermore, of the sketches having been made public until the present, we studied those of Erpodiaceae(NOGUCHI 1952), Bartramiaceae(MATTERI 1968, 1973), Hookeriaceae(MATTERI 1972) and Pottiaceae(SAITO 1975), where we can see ten of our demarcations.

As many anatomical characteristics as possible, are observed, and an attempt is made to find a coordination among the anatomical characteristics of all the stems observed. Regarding the stems of Hypnaceae a coordination among the anatomical characteristics is discussed. In view of the results so far achieved, four characteristics, types of the interior differentiation(III-type), 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-, MN- and N-types), thickness of the epidermal cell walls(T- and U-types), seem to show high regularity. Therefore, interrelationship among interior structures of the stems in Hypnaceae is considered on the basis of these characteristics(Tab. 6). The stems of Hypnaceae are classified regarding the anatomical characteristics into five types, III-Q-N-U, III-Q-N-T, III-P-N-U, III-P-MN-U, III-P-M-U. Furthermore, the stems hitherto observed are classified into seventeen types, III-O-M-U, III-P-N-U, III-P-N-T, III-P-MN-U, III-P-M-U, III-P-M-T, III-Q-N-U, III-Q-N-T, III-Q-MN-U, III-Q-M-U, IV-Q-N-U, IV-Q-N-T, IV-P-N-U, IV-P-N-T, IV-O-N-U, VI-U-F and VI-U-E, by virtue of the anatomical characteristics. For the future these characteristics should be compared through all the stages of the life history from every point of view.

## Introduction

In bryophyte the interior differentiation of the stem begins from a segment which the apical cell of the stem cuts off, and the segment divides into the respective initial cells of several tissues. Each tissue is made from the respective initial. It seems important for the morphogenic study to consider what kind of units the segment first divides itself into. Does a segment divide into the initials of the epidermis and the central tissue, or does a segment divide into the initials of the epidermis, cortex and the central tissue? It is presumed that without solving the problem, we can not reduce the stem-tissue to its elements.

If that is the case, is the tissue of the stem certainly able to be analyzed into its elements through observation of the manner of division in the apical cell? As a matter fact, it is very difficult, because, if the distinction between tissues which have attained full growth is not understood, it is very difficult to make clear how a segment is to develop into mature tissues. So, first of all the distinction between tissues of the full growth stem should be roughly surveyed and the manner of division in the apical cell should be observed, and then we might with greater ease make clear the growing process from its initial to the fully grown tissue. It may be the initial step of systematic study that in such a manner, the gametophyte in life history is viewed in every light, and that the essential coordination existing in the mode of living of the gametophyte is discovered.

## Acknowledgments

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## Materials and methods

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

*Ctenidium capillifolium* (MITT.)BROTH.: Tokyo Pref. (11082), Oita Pref. (35162), *Ctenidium hastile* (MITT.)LINDB.: Ishikawa Pref. (33132), *Ectropothecium obtusulum* (CARD.)IWATS.: Wakayama Pref. (37362), *Ectropothecium zollingeri* (C.MUELL.)JAEG.: Taiwan (32718), *Eurohypnum leptothallum* (C.MUELL.)ANDO: Kyoto Pref. (34893), Yamaguchi Pref. (39193), *Gollania ruginosa* (MITT.)BROTH.: Kumamoto Pref. (37398), *Gollania varians* (MITT.)BROTH.: Toyama Pref. (36266), *Herzogiella perrobusta* (BROTH. ex CARD.)IWATS.: Miyagi Pref. (34930), *Homomallium connexum* (CARD.)BROTH.: Yamaguchi

Pref. (39192), *Hypnum calcicolum* ANDO: Hiroshima Pref. (39196), Saitama Pref. (39150), *Hypnum callichroum* ssp. *japonicum* ANDO: Gifu Pref. (39197), Nagano Pref. (39140), *Hypnum cupressiforme* HEDW.: Toyama Pref. (32629), Hokkaido Pref. (37353), Yamaguchi Pref. (39184), Hokkaido Pref. (39179), *Hypnum densirameum* ANDO: Hokkaido Pref. (39176), Yamanashi Pref. (39183), *Hypnum dieckii* REN. et CARD.: Hokkaido Pref. (39182), Ehime Pref. (39174), *Hypnum erectiusculum* SULL. et LEŠQ.: Shizuoka Pref. (39170), Kyoto Pref. (37296), Kumamoto Pref. (35212), Gifu Pref. (39143), *Hypnum fauriei* CARD.: Tottori Pref. (39194), *Hypnum fujiyamae* (BROTH.)PAR.: Yamanashi Pref. (39149), Gifu Pref. (10990), Ooita Pref. (35192), Hokkaido Pref. (39148), *Hypnum lindbergii* MITT.: Fukushima Pref. (39153), Tochigi Pref. (39171), Shizuoka Pref. (37151), Toyama Pref. (32541), Kumamoto Pref. (35069), *Hypnum oldhamii* (MITT.)JAEG. et SAUERB.: Mie Pref. (35171), Miyazaki Pref. (34897), Wakayama Pref. (32714), Niigata Pref. (35213), Miyazaki Pref. (39154), Hiroshima Pref. (39141), *Hypnum pallescens* (HEDW.) P.BEAUV.: Yamanashi Pref. (39188), Aomori Pref. (39177), *Hypnum plicatulum* (LINDB.)JAEG. et SAUERB.: Yamanashi Pref. (39186), Hokkaido Pref. (39187), *Hypnum plumaeforme* WILS.: Kagoshima Pref. (39181), Mie Pref. (37295), Kumamoto Pref. (35191), Hiroshima Pref. (39146), *Hypnum plumaeforme* WILS. v. *minus* BROTH. ex ANDO: Kumamoto Pref. (35036), *Hypnum sakuraii* (SAK.) ANDO: Ishikawa Pref. (37161), Ehime Pref. (39145), Nara Pref. (39151), *Hypnum tristo-viride* (BROTH.)PAR.: Tokushima Pref. (39178), Gifu Pref. (11957), Kumamoto Pref. (35033), Aomori Pref. (35034), Aichi Pref. (35953), *Isopterygium fauriei* CARD.: Gifu Pref. (34978), *Isopterygium minutirameum* (C.MUELL.)JAEG.: Wakayama Pref. (37294), *Isopterygium pohliaecarpum* (SULL. et LESQ.)JAEG.: Niigata Pref. (34899), Kumamoto Pref. (34976), Mie Pref. (37339), Tokyo Pref. (11082), Ooita Pref. (35162), *Isopterygium tosaense* BROTH.: Kumamoto Pref. (37520), Kumamoto Pref. (35094), *Ptilium crista-castrensis* (HEDW.)D.NOT.: Yamanashi Pref. (35163), *Pylaisiella cristata* (CARD.)IWATS. et NOG.: Toyama Pref. (32689), *Pylaisiella selwynii* (KINDB.) CRUM et all.: Hokkaido Pref. (37327), *Pylaisiella subcircinata* (CARD) IWATS et NOG.: Hyogo Pref. (37326), *Rhytidadelphus japonicus* (REIM.)KOP.: Hokkaido Pref. (37323), *Rhytidadelphus subpinnatus* (LINDB.)KOP.: Mie Pref. (34385), *Rhytidadelphus triquetrus* (HEDW.)WARNST.: Hokkaido Pref. (37422), Yamanashi Pref. (37374), *Stereodontopsis pseudo-revoluta* (REIM.) ANDO: Koochi Pref. (39144), *Taxiphyllum aomoriense* (BESCH.)IWATS.: Niigata Pref. (37322), *Taxiphyllum cuspidifolium* (CARD.)IWATS.: Osaka Pref. (34915), *Taxiphyllum subarcuatum* (BROTH.)IWATS.: Miyazaki Pref. (35189), *Taxiphyllum taxirameum* (MITT.)FL.: Kumamoto Pref. (34886), *Vesicularia ferriei* (CARD. et THÉR.)BROTH.: Aichi Pref. (37551), Aichi Pref. (35011), Niigata Pref. (37552), Niigata Pref. (35213), Kagoshima Pref. (34925), Tokyo Pref. (36225),

For anatomical studies, microtome sections of the moss are prepared by the ethylalcohol-butylalcohol-paraffin method, following BOUIN's fluid fixation. Before examination the hard moss is boiled in water for about an hour. The inner structure of the stem of gametophyte is studied from transverse section having a thickness of about 5  $\mu$ .

## Observation and discussion

### I. Coordination among the anatomical characteristics of the stem

The inner structures of the stem in some species of Fissidentaceae, Entodontaceae, Thuidiaceae, Mniaceae, Bartramiaceae, Dicranaceae and Polytrichaceae were hitherto observed in the search for coordination in the anatomical structures of the gametophyte in Musci. The anatomical characteristics, types of inner differentiation of the stem (III, IV and VI types), comparison in thickness of cell walls of the central tissue and of the internal cortex (O-, P- and Q-types), comparison between the size of cells of the central tissue and that of cells of the internal cortex (L-, M- and N-types), distinction between the central tissue and the internal cortex (J- and K-types) and cell-configurations of the central tissue, seem to show more coordination in all the species observed in these papers. The inner structure of the stem in forty-two species of Hypnaceae was observed, and we attempted to discover the coordination among anatomical characteristics of all the stems observed in this paper. We should like to consider whether the anatomical characteristics of the stems hitherto observed show any coordination.

#### (1) On the stem in Hypnaceae

When the stems of Hypnaceae are observed, it is thought that in addition to the eight anatomical characteristics of the stem hitherto observed, two other characteristics, namely, whether the epidermal cells are larger (V-type), as large (W-type) or smaller (X-type) than those of the external cortex, and, whether the epidermal cell walls are parenchymatous or not, should be made an object of investigation. Tab. 1 is the tabulated result of these observations.

Of the ten anatomical characteristics, the characteristics, which are clearly divisible into general types, are as follows: A- and B-types, C- and D-types, G-, H- and I-types, R- and S-types, T- and U-types, O-, P- and Q-types. The characteristics, which are not clearly able to be divided into such types, are as follows: V-, W- and X-types, L-, M- and N-types, J- and K-types. Consequently, the halfway type between M-type and N-type for instance is expressed as MN-type. When, of the border types, the anatomical characteristics have a stronger tendency towards M-type, it is expressed as M(N).

In Tab. 2, the inner structure of all the stems appears to differentiate into the epidermis, cortex and the central tissue (III-type). The stems of III-type are divided into two types: cell walls of the central tissue as thick (P-type) or thinner (Q-type) than those of the internal cortex. The type Q is found in the stems of *Vesicularia* and some species of *Hypnum*. The P-type is found in the stems of *Eurohypnum*, *Homomallium*, *Ctenidium*, *Gollania*, *Ptilium*, *Taxiphyllum*, *Ectropothecium*, *Herzogiella*, *Pylaisiella*, *Stereo-dontopsis*, *Isopterygium*, *Rhytidiadelphus* and some species of *Hypnum*. In all the stems of III-Q-type, distinction between the central tissue and the internal cortex is clear (J-type). The stems of III-P-type are classified into three types: distinction between



<i>Ctenidium hastile</i> (MITT.) LINDB.	*	3(3-4) C	G	X	S	U	MN	K J	P	III	II-6
<i>Ctenidium hastile</i> (MITT.) LINDB.	*	3(3-4) C	G	X	S	U	MN	K J	P	III	III-1
<i>Ctenidium hastile</i> (MITT.) LINDB.	*	3(3-4) C	G	X	S	U	MN	K J	P	III	III-2
<i>Ectropothecium obtusulum</i> (CARD.) IWATS.	*	3(2-4) C	I	W	R	U	M	K	P	III	III-3
<i>Ectropothecium obtusulum</i> (CARD.) IWATS.	*	3(2-4) C	I	W	R	U	M	K	P	III	III-4
<i>Ectropothecium obtusulum</i> (CARD.) IWATS.	*	3(2-4) C	I	W	R	U	M	K	P	III	III-5
<i>Ectropothecium obtusulum</i> (CARD.) IWATS.	*	3(2-4) C	I	W	R	U	M	K	P	III	III-6
<i>Ectropothecium obtusulum</i> (CARD.) IWATS.	*	3(2-4) C	I	W	R	U	M	K	P	III	IV-1
<i>Ectropothecium obtusulum</i> (CARD.) IWATS.	*	3(2-4) C	I	W	R	U	M	K	P	III	IV-2
<i>Ectropothecium obtusulum</i> (CARD.) IWATS.	*	3(3-4) C	I	W	R	U	M	K	P	III	IV-3
<i>Ectropothecium obtusulum</i> (CARD.) IWATS.	*	3(3-4) C	I	W	R	U	M	K	P	III	IV-4
<i>Ectropothecium zollingeri</i> (C. MUELL.) JAEG.	*	4(3-5) C	I	W	R	U	M(N)	K	P	III	IV-5
<i>Ectropothecium zollingeri</i> (C. MUELL.) JAEG.	*	3(3-4) C	I	W(V)	R	U	M(N)	K	P	III	IV-6
<i>Ectropothecium zollingeri</i> (C. MUELL.) JAEG.	*	4(4-5) D	I	W	R	U	M(N)	K	P	III	V-1
<i>Ectropothecium zollingeri</i> (C. MUELL.) JAEG.	*	4(3-5) C	I	W	R	U	M(N)	K	P	III	V-2
<i>Ectropothecium zollingeri</i> (C. MUELL.) JAEG.	*	4(3-4) C	I	W(V)	R	U	M(N)	K	P	III	V-3
<i>Ectropothecium zollingeri</i> (C. MUELL.) JAEG.	*	4(3-5) C	I	W	R	U	M(N)	K	P	III	V-4
<i>Ectropothecium zollingeri</i> (C. MUELL.) JAEG.	*	4(3-4) C	I	W	R	U	M(N)	K	P	III	V-5
<i>Eurohypnum leptothallum</i> (C. MUELL.) ANDO	5(5-6) B	4(3-4) C	H	W	S	U	N	J	P	III	V-6
<i>Eurohypnum leptothallum</i> (C. MUELL.) ANDO	5(5-7) B	3(3-4) C	H	W	S	U	N	J	P	III	V-7
<i>Eurohypnum leptothallum</i> (C. MUELL.) ANDO	5(5-6) B	3(3-4) C	H	W	S	U	N(M)	J	P	III	V-8
<i>Eurohypnum leptothallum</i> (C. MUELL.) ANDO	5(5-6) B	3(2-4) C	H	W	S	U	N	J	P	III	V-9
<i>Eurohypnum leptothallum</i> (C. MUELL.) ANDO	4(3-6) B	3(3-3) C	H	W	S	U	N(M)	J	P	III	VI-1
<i>Eurohypnum leptothallum</i> (C. MUELL.) ANDO	5(5-7) B	3(3-4) C	H	W	S	U	N	J	P	III	VI-2
<i>Eurohypnum leptothallum</i> (C. MUELL.) ANDO	5(5-6) B	3(3-3) C	H	W	S	U	N(M)	J	P	III	VI-3
<i>Eurohypnum leptothallum</i> (C. MUELL.) ANDO	4(3-5) B	3(2-4) C	H	W	S	U	N(M)	J	P	III	VI-4
<i>Gollania ruginosa</i> (MITT.) BROTH.	*	6(6-7) D	I	W	S	U	MN	K J	P	III	VI-5
<i>Gollania ruginosa</i> (MITT.) BROTH.	*	6(5-8) D	I	W	S	U	MN	K J	P	III	VI-6
<i>Gollania ruginosa</i> (MITT.) BROTH.	*	6(6-7) D	I	W	S	U	MN	K J	P	III	VI-7
<i>Gollania ruginosa</i> (MITT.) BROTH.	*	6(6-8) D	I	W	S	U	MN	K J	P	III	VI-8
<i>Gollania ruginosa</i> (MITT.) BROTH.	*	7(7-8) D	I	W(X)	S	U	MN	K J	P	III	VI-9
<i>Gollania ruginosa</i> (MITT.) BROTH.	*	6(6-8) D	I	W(X)	S	U	MN	K J	P	III	VII-1
<i>Gollania ruginosa</i> (MITT.) BROTH.	*	7(7-8) D	I	W(X)	S	U	MN	K J	P	III	VII-2
<i>Gollania ruginosa</i> (MITT.) BROTH.	*	6(6-8) D	I	W	S	U	MN	K J	P	III	VII-3
<i>Gollania varians</i> (MITT.) BROTH.	*	4(4-5) D	I	X	S	U	MN	K J	P	III	VII-4
<i>Gollania varians</i> (MITT.) BROTH.	*	5(4-6) D	I	X	S	U	MN	K J	P	III	VII-5
<i>Gollania varians</i> (MITT.) BROTH.	*	5(4-7) D	I	X	S	U	MN	K J	P	III	VII-6
<i>Gollania varians</i> (MITT.) BROTH.	*	4(4-6) D	I	X	S	U	MN	K J	P	III	VII-7
<i>Gollania varians</i> (MITT.) BROTH.	*	5(5-6) D	I	X	S	U	MN	K J	P	III	VII-8
<i>Gollania varians</i> (MITT.) BROTH.	*	5(4-5) D	I	X(W)	S	U	MN	K J	P	III	VIII-1
<i>Gollania varians</i> (MITT.) BROTH.	*	4(4-5) D	I	X(W)	S	U	MN	K J	P	III	VIII-2

<i>Herzogiella perrobusta</i> (BROTH. ex CARD.) IWATS.	*	3(3-4) C	I	W	R	U	M(N)	K	P	III	VIII-3
<i>Herzogiella perrobusta</i> (BROTH. ex CARD.) IWATS.	*	3(3-4) C	I	W(V)	R	U	M	K	P	III	VIII-4
<i>Herzogiella perrobusta</i> (BROTH. ex CARD.) IWATS.	*	3(3-4) C	I	W	R	U	M(N)	K	P	III	VIII-5
<i>Herzogiella perrobusta</i> (BROTH. ex CARD.) IWATS.	*	3(2-4) C	I	W	R	U	M	K	P	III	VIII-6
<i>Herzogiella perrobusta</i> (BROTH. ex CARD.) IWATS.	*	3(2-3) C	I	W	R	U	M	K	P	III	VIII-7
<i>Herzogiella perrobusta</i> (BROTH. ex CARD.) IWATS.	*	3(2-4) C	I	W	R	U	M(N)	K	P	III	VIII-8
<i>Herzogiella perrobusta</i> (BROTH. ex CARD.) IWATS.	*	3(3-5) C	I	W(V)	R	U	M(N)	K	P	III	VIII-9
<i>Herzogiella perrobusta</i> (BROTH. ex CARD.) IWATS.	*	3(3-4) C	I	W	R	U	M(N)	K	P	III	VIII-1
<i>Homomallium connexum</i> (CARD.) BROTH.	4(3-5) B	4(4-5) D	I	X	R	U	N	J	P	III	IX-2
<i>Homomallium connexum</i> (CARD.) BROTH.	4(3-5) B	4(3-5) D	I	X	R	U	N(M)	J	P	III	IX-3
<i>Homomallium connexum</i> (CARD.) BROTH.	5(4-7) B	4(4-5) D	I	X	R	U	N(M)	J	P	III	IX-4
<i>Homomallium connexum</i> (CARD.) BROTH.	4(4-7) B	4(3-5) D	I	X	R	U	N(M)	J	P	III	IX-5
<i>Homomallium connexum</i> (CARD.) BROTH.	3(2-4) A	4(3-5) D	I	X	R	U	N	J	P	III	IX-6
<i>Homomallium connexum</i> (CARD.) BROTH.	5(3-6) B	4(4-6) D	I	X	R	U	N(M)	J	P	III	X-1
<i>Hypnum calcicolum</i> ANDO	5(4-6) B	4(4-5) D	H(I)	X	S	U	N(M)	J	Q	III	X-2
<i>Hypnum calcicolum</i> ANDO	5(4-6) B	5(5-6) D	H(I)	X	S	U	N(M)	J	Q	III	X-3
<i>Hypnum calcicolum</i> ANDO	5(5-6) B	4(3-5) D	H(I)	X	S	U	N(M)	J	Q	III	X-4
<i>Hypnum calcicolum</i> ANDO	5(4-6) B	4(3-5) D	H(I)	X	S	U	N(M)	J	Q	III	X-5
<i>Hypnum calcicolum</i> ANDO	4(3-6) B	4(4-5) D	H(I)	X	S	U	N(M)	J	Q	III	X-6
<i>Hypnum calcicolum</i> ANDO	5(5-6) B	4(4-5) D	H(I)	X	S	U	N	J	Q	III	XI-1
<i>Hypnum calcicolum</i> ANDO	5(5-6) B	4(4-5) D	H(I)	X	S	U	N(M)	J	Q	III	XI-2
<i>Hypnum callichroum</i> ssp. <i>japonicum</i> ANDO	4(4-5) B	4(3-4) C	I	V	R	T	N	J	Q	III	XI-3
<i>Hypnum callichroum</i> ssp. <i>japonicum</i> ANDO	4(3-4) A	4(4-5) D	I	V	R	T	N	J	Q	III	XI-4
<i>Hypnum callichroum</i> ssp. <i>japonicum</i> ANDO	4(3-4) A	4(3-4) C	I	V	R	T	N	J	Q	III	XI-5
<i>Hypnum callichroum</i> ssp. <i>japonicum</i> ANDO	4(3-4) A	4(4-5) D	I	V	R	T	N	J	Q	III	XI-6
<i>Hypnum callichroum</i> ssp. <i>japonicum</i> ANDO	4(4-5) A	4(3-5) D	I	V	R	T	N	J	Q	III	XII-1
<i>Hypnum callichroum</i> ssp. <i>japonicum</i> ANDO	5(4-6) B	4(4-5) D	I	V	R	T	N	J	Q	III	XII-2
<i>Hypnum callichroum</i> ssp. <i>japonicum</i> ANDO	5(5-6) B	4(4-5) D	I	V	R	T	N	J	Q	III	XII-3
<i>Hypnum cupressiforme</i> HEDW.	5(4-6) B	4(3-4) C	H	W(V)	S	U	N	J	P	III	XII-4
<i>Hypnum cupressiforme</i> HEDW.	6(5-7) B	4(3-4) C	H(I)	W(V)	S	U	N(M)	J	P	III	XII-5
<i>Hypnum cupressiforme</i> HEDW.	4(4-5) B	4(3-4) C	H	W	S	U	N	J	P	III	XII-6
<i>Hypnum cupressiforme</i> HEDW.	5(5-6) B	3(3-4) C	H	W	S	U	N(M)	J	P	III	X III-1
<i>Hypnum cupressiforme</i> HEDW.	5(5-6) B	3(2-4) C	H	W	S	U	N	J	P	III	X III-2
<i>Hypnum cupressiforme</i> HEDW.	6(6-7) B	3(3-5) C	H	W(V)	S	U	N	J	P	III	X III-3
<i>Hypnum cupressiforme</i> HEDW.	4(3-4) A	4(3-4) C	H	W(X)	S	U	N	J	P	III	X III-4
<i>Hypnum dieckii</i> REN. et CARD.	5(5-6) B	4(4-5) D	I	V	S	T	N	J	Q	III	X III-5
<i>Hypnum dieckii</i> REN. et CARD.	4(4-5) B	4(4-5) D	I	V	S	T	N(M)	J	Q	III	X IV-1
<i>Hypnum dieckii</i> REN. et CARD.	4(3-6) B	5(5-6) D	I	V	S	T	N	J	Q	III	X IV-2
<i>Hypnum dieckii</i> REN. et CARD.	5(4-6) B	4(4-5) D	I	V	S	T	N(M)	J	Q	III	X IV-3
<i>Hypnum dieckii</i> REN. et CARD.	4(4-5) B	5(5-7) D	I	V	S	T	N	J	Q	III	X IV-4
<i>Hypnum dieckii</i> REN. et CARD.	4(4-7) B	5(5-6) D	I	V	S	T	N(M)	J	Q	III	X V-1

<i>Hypnum dieckii</i> REN. et CARD.	5(5-6) B	5(5-6) D	I	V	S	T	N(M)	J	Q	III	XV-2
<i>Hypnum densirameum</i> ANDO	5(4-5) B	4(3-4) C	I	V	R	U	N(M)	J	Q	III	XV-3
<i>Hypnum densirameum</i> ANDO	4(3-4) A	4(3-4) C	I	V(W)	R	U	N	J	Q	III	XV-4
<i>Hypnum densirameum</i> ANDO	4(3-4) A	4(3-4) C	I	V(W)	R	U	N	J	Q	III	XV-5
<i>Hypnum densirameum</i> ANDO	4(3-5) B	4(3-4) C	I	V	R	U	N	J	Q	III	XV-6
<i>Hypnum densirameum</i> ANDO	4(4-6) B	4(4-5) D	I	V	R	U	N(M)	J	Q	III	XVI-1
<i>Hypnum densirameum</i> ANDO	4(3-5) B	4(3-4) C	I	V	R	U	N(M)	J	Q	III	XVI-2
<i>Hypnum densirameum</i> ANDO	4(4-5) B	4(4-5) D	I	V	R	U	N(M)	J	Q	III	XVI-3
<i>Hypnum erectiusculum</i> SULL. et LESQ.	3(2-4) A	3(2-4) C	I	V	R	T	N	J	Q(J)	III	XVI-4
<i>Hypnum erectiusculum</i> SULL. et LESQ.	4(3-5) B	4(3-4) C	I	V	R	T	N	J	Q	III	XVI-5
<i>Hypnum erectiusculum</i> SULL. et LESQ.	3(3-4) A	3(3-4) C	I	V	R	T	N	J	Q	III	XVI-6
<i>Hypnum erectiusculum</i> SULL. et LESQ.	3(2-4) A	3(3-4) C	I	V	R	T	N	J	Q	III	XVII-1
<i>Hypnum erectiusculum</i> SULL. et LESQ.	4(4-5) B	3(2-4) C	I	V	R	T	N	J	Q	III	XVII-2
<i>Hypnum erectiusculum</i> SULL. et LESQ.	4(4-5) B	3(3-5) C	I	V	R	T	N	J	Q	III	XVII-3
<i>Hypnum erectiusculum</i> SULL. et LESQ.	3(3-4) A	3(2-4) C	I	V	R	T	N(M)	J	Q	III	XVII-4
<i>Hypnum erectiusculum</i> SULL. et LESQ.	3(3-4) A	3(2-4) C	I	V	R	T	N	J	Q	III	XVII-5
<i>Hypnum erectiusculum</i> SULL. et LESQ.	5(5-6) B	4(4-5) D	I	V	R	T	N	J	Q	III	XVII-6
<i>Hypnum erectiusculum</i> SULL. et LESQ.	4(4-5) B	4(3-4) C	I	V	R	T	N(M)	J	Q	III	XVII-7
<i>Hypnum erectiusculum</i> SULL. et LESQ.	5(4-6) B	4(4-6) D	I	V	R	T	N(M)	J	Q	III	XVIII-1
<i>Hypnum erectiusculum</i> SULL. et LESQ.	5(4-6) B	4(3-4) C	I	V	R	T	N(M)	J	Q	III	XVIII-2
<i>Hypnum erectiusculum</i> SULL. et LESQ.	5(4-7) B	4(4-6) D	I	V	R	T	N	J	Q	III	XVIII-3
<i>Hypnum erectiusculum</i> SULL. et LESQ.	4(4-5) B	4(3-4) C	I	V	R	T	N	J	Q	III	XVIII-4
<i>Hypnum erectiusculum</i> SULL. et LESQ.	5(4-6) B	4(4-5) D	I	V	R	T	N	J	Q	III	XVIII-5
<i>Hypnum erectiusculum</i> SULL. et LESQ.	4(4-5) B	4(3-4) C	I	V	R	T	N	J	Q	III	XVIII-6
<i>Hypnum erectiusculum</i> SULL. et LESQ.	3(3-4) A	4(4-5) D	I	V	R	T	N	J	Q	III	XIX-1
<i>Hypnum fauriei</i> CARD.	4(4-5) B	2(2-3) C	I	W	R	U	N	J	P	III	XIX-2
<i>Hypnum fauriei</i> CARD.	4(4-5) B	3(3-4) C	I	W	R	U	N	J	P	III	XIX-3
<i>Hypnum fauriei</i> CARD.	4(3-5) B	3(3-4) C	I	W	R	U	N	J	P	III	XIX-4
<i>Hypnum fauriei</i> CARD.	4(3-5) B	4(3-4) C	I	W	R	U	N	J	P	III	XIX-5
<i>Hypnum fauriei</i> CARD.	4(4-5) B	4(3-5) C	I	W	R	U	N	J	P	III	XIX-6
<i>Hypnum fauriei</i> CARD.	4(3-4) A	4(3-4) C	I	W	R	U	N	J	P	III	XX-1
<i>Hypnum fujiyamae</i> (BROTH.) PAR.	4(4-5) B	3(2-3) C	G	X	S	U	N	J	P	III	XX-2
<i>Hypnum fujiyamae</i> (BROTH.) PAR.	5(4-6) B	3(2-4) C	G	X	S	U	N	J	P	III	XX-3
<i>Hypnum fujiyamae</i> (BROTH.) PAR.	5(4-6) B	3(2-4) C	G	X	S	U	N	J	P	III	XX-4
<i>Hypnum fujiyamae</i> (BROTH.) PAR.	4(3-4) A	3(3-4) C	G	X	S	U	N	J	P	III	XX-5
<i>Hypnum fujiyamae</i> (BROTH.) PAR.	4(4-5) B	3(2-4) C	G	X	S	U	N	J	P	III	XX-6
<i>Hypnum fujiyamae</i> (BROTH.) PAR.	5(4-6) B	3(3-4) C	G	X	S	U	N	J	P	III	XXI-1
<i>Hypnum lindbergii</i> MITT.	3(3-5) B	3(3-4) C	I	V	R	T	N	J	Q	III	XXI-2
<i>Hypnum lindbergii</i> MITT.	3(3-4) A	3(2-4) C	I	V	R	T	N	J	Q	III	XXI-3
<i>Hypnum lindbergii</i> MITT.	3(2-3) A	3(3-4) C	I	V	R	T	N	J	Q	III	XXI-4
<i>Hypnum lindbergii</i> MITT.	3(2-3) A	3(2-4) C	I	V	R	T	N	J	Q	III	XXI-5



<i>Hypnum lindbergii</i> MITT.	4(3-4) A	3(3-4) C	I	V	R	T	N(M)	J	Q	III	XX I-6
<i>Hypnum lindbergii</i> MITT.	3(3-3) A	3(3-4) C	I	V	R	T	N	J	Q	III	XX II-1
<i>Hypnum lindbergii</i> MITT.	3(3-4) A	3(2-4) C	I	V	R	T	N	J	Q	III	XX II-2
<i>Hypnum lindbergii</i> MITT.	3(2-4) A	3(3-4) C	I	V	R	T	N(M)	J	Q	III	XX II-3
<i>Hypnum lindbergii</i> MITT.	4(4-5) B	3(3-4) C	I	V	R	T	N	J	Q	III	XX II-4
<i>Hypnum lindbergii</i> MITT.	4(4-5) B	3(2-4) C	I	V	R	T	N	J	Q	III	XX II-5
<i>Hypnum lindbergii</i> MITT.	5(4-5) B	3(3-4) C	I	V	R	T	N	J	Q	III	XX II-6
<i>Hypnum lindbergii</i> MITT.	5(5-6) B	3(3-4) C	I	V	R	T	N	J	Q	III	XX III-1
<i>Hypnum lindbergii</i> MITT.	4(3-4) A	3(3-4) C	I	V	R	T	N(M)	J	Q	III	XX III-2
<i>Hypnum lindbergii</i> MITT.	5(5-6) B	3(2-4) C	I	V	R	T	N	J	Q	III	XX III-3
<i>Hypnum oldhamii</i> (MITT.) JAEG. et SAUERB.	6(5-7) B	5(5-6) D	I	W(V)	S	U	N	J	P	III	XX III-4
<i>Hypnum oldhamii</i> (MITT.) JAEG. et SAUERB.	4(2-5) B	4(4-5) D	I	W	S	U	N(M)	J	P	III	XX III-5
<i>Hypnum oldhamii</i> (MITT.) JAEG. et SAUERB.	5(5-6) B	4(4-5) D	I	W(V)	S	U	N	J	P	III	XX III-6
<i>Hypnum oldhamii</i> (MITT.) JAEG. et SAUERB.	5(5-6) B	5(5-6) D	I	W	S	U	N	J	P	III	XX IV-1
<i>Hypnum oldhamii</i> (MITT.) JAEG. et SAUERB.	3(3-4) A	3(3-4) C	I	W(V)	S	U	N	J	P	III	XX IV-2
<i>Hypnum oldhamii</i> (MITT.) JAEG. et SAUERB.	4(3-5) B	3(2-4) C	I	W(V)	S	U	N	J	P	III	XX IV-3
<i>Hypnum oldhamii</i> (MITT.) JAEG. et SAUERB.	4(4-6) B	4(4-5) D	I	W(V)	S	U	N(M)	J	P	III	XX IV-4
<i>Hypnum oldhamii</i> (MITT.) JAEG. et SAUERB.	4(4-6) B	4(3-5) D	I	W(V)	S	U	N(M)	J	P	III	XX IV-5
<i>Hypnum oldhamii</i> (MITT.) JAEG. et SAUERB.	4(3-6) B	5(5-6) D	I	W(X)	S	U	N(M)	J	P	III	XX IV-6
<i>Hypnum oldhamii</i> (MITT.) JAEG. et SAUERB.	4(3-5) B	4(4-5) D	I	W	S	U	N(M)	J	P	III	XX V-1
<i>Hypnum pallescens</i> (HEDW.) P. BEAUV.	3(3-4) A	4(3-4) C	H	X	S	U	N	J	Q	III	XX V-2
<i>Hypnum pallescens</i> (HEDW.) P. BEAUV.	4(3-6) B	4(3-4) C	H	X	S	U	N(M)	J	Q	III	XX V-3
<i>Hypnum pallescens</i> (HEDW.) P. BEAUV.	3(2-4) A	4(3-4) C	H	X	S	U	N(M)	J	Q	III	XX V-4
<i>Hypnum pallescens</i> (HEDW.) P. BEAUV.	3(2-5) A	3(3-4) C	H	X	S	U	N	J	Q	III	XX V-5
<i>Hypnum pallescens</i> (HEDW.) P. BEAUV.	4(3-5) B	3(3-3) C	H	X	S	U	N(M)	J	Q	III	XX V-6
<i>Hypnum pallescens</i> (HEDW.) P. BEAUV.	3(3-4) A	3(3-4) C	H	X	S	U	N(M)	J	Q	III	XX VI-1
<i>Hypnum pallescens</i> (HEDW.) P. BEAUV.	3(3-4) A	3(3-4) C	H	X	S	U	N	J	Q	III	XX VI-2
<i>Hypnum plicatulum</i> (LINDB.) JAEG. et SAUERB.	3(3-4) A	2(2-3) C	I	V	R	T	N	J	Q	III	XX VI-3
<i>Hypnum plicatulum</i> (LINDB.) JAEG. et SAUERB.	3(3-4) A	2(2-3) C	I	V	R	T	N	J	Q	III	XX VI-4
<i>Hypnum plicatulum</i> (LINDB.) JAEG. et SAUERB.	4(4-5) B	3(3-4) C	I	V	R	T	N	J	Q	III	XX VI-5
<i>Hypnum plicatulum</i> (LINDB.) JAEG. et SAUERB.	4(3-4) A	2(1-3) C	I	V	R	T	N(M)	J	Q	III	XX VI-6
<i>Hypnum plicatulum</i> (LINDB.) JAEG. et SAUERB.	3(2-4) A	2(2-3) C	I	V	R	T	N	J	Q	III	XX VI-7
<i>Hypnum plicatulum</i> (LINDB.) JAEG. et SAUERB.	3(3-4) A	3(2-3) C	I	V	R	T	N(M)	J	Q	III	XX VI-8
<i>Hypnum plicatulum</i> (LINDB.) JAEG. et SAUERB.	4(4-5) B	3(3-3) C	I	V	R	T	N	J	Q	III	XX VII-1
<i>Hypnum plumaeforme</i> WILS.	8(8-9) B	6(5-6) D	I	W	R	U	N	J	Q	III	XX VII-2
<i>Hypnum plumaeforme</i> WILS.	5(4-6) B	4(4-5) D	I	W(X)	R	U	N(M)	J	Q	III	XX VII-3
<i>Hypnum plumaeforme</i> WILS.	5(5-7) B	5(4-6) D	I	W	R	U	N(M)	J	Q	III	XX VII-4
<i>Hypnum plumaeforme</i> WILS.	6(6-7) B	5(5-6) D	I	W(X)	R	U	N(M)	J	Q	III	XX VIII-1
<i>Hypnum plumaeforme</i> WILS.	6(5-8) B	5(5-6) D	I	W	R	U	N	J	Q	III	XX VIII-2
<i>Hypnum plumaeforme</i> WILS.	5(5-7) B	6(6-7) D	I	W(V)	R	U	N	J	Q	III	XX VIII-3
<i>Hypnum plumaeforme</i> WILS.	6(5-8) B	5(4-6) D	I	W	R	U	N	J	Q	III	XX VIII-4

<i>Hypnum plumaeforme v. minus</i> BROTH. ex ANDO	4(3-5) B	4(4-5) D	I	W(X)	R	U	N(M)	J	Q	III	XXIX-1
<i>Hypnum plumaeforme v. minus</i> BROTH. ex ANDO	4(3-6) B	4(4-5) D	I	W(X)	R	U	N	J	Q	III	XXIX-2
<i>Hypnum plumaeforme v. minus</i> BROTH. ex ANDO	4(4-6) B	3(3-4) C	I	W	R	U	N	J	Q	III	XXIX-3
<i>Hypnum plumaeforme v. minus</i> BROTH. ex ANDO	4(4-5) B	3(3-4) C	I	W	R	U	N(M)	J	Q	III	XXIX-4
<i>Hypnum plumaeforme v. minus</i> BROTH. ex ANDO	5(4-6) B	3(3-4) C	I	W(X)	R	U	N	J	Q	III	XXIX-5
<i>Hypnum plumaeforme v. minus</i> BROTH. ex ANDO	5(5-6) B	4(3-4) C	I	W	R	U	N	J	Q	III	XXIX-6
<i>Hypnum plumaeforme v. minus</i> BROTH. ex ANDO	4(3-5) B	5(4-6) D	I	W	R	U	N(M)	J	Q	III	XXX-1
<i>Hypnum sakurarii</i> (SAK.) ANDO	6(5-6) B	5(5-6) D	H	W(V)	R	U	N(M)	J	Q	III	XXX-2
<i>Hypnum sakurarii</i> (SAK.) ANDO	4(3-5) B	5(4-6) D	H	W	R	U	N	J	Q	III	XXX-3
<i>Hypnum sakurarii</i> (SAK.) ANDO	6(5-7) B	6(6-7) D	H	W(V)	R	U	N(M)	J	Q	III	XXX-4
<i>Hypnum sakurarii</i> (SAK.) ANDO	5(4-6) B	6(5-7) D	H	W	R	U	N	J	Q	III	XXXI-1
<i>Hypnum sakurarii</i> (SAK.) ANDO	5(4-5) B	7(5-8) D	H	W	R	U	N	J	Q	III	XXXI-2
<i>Hypnum sakurarii</i> (SAK.) ANDO	5(5-7) B	5(4-6) D	H	W(X)	R	U	N(M)	J	Q	III	XXXI-3
<i>Hypnum tristo-viride</i> (BROTH.) PAR.	*	2(2-3) C	H	W	S	U	M	K	P	III	XXXI-4
<i>Hypnum tristo-viride</i> (BROTH.) PAR.	*	2(2-3) C	H	W	S	U	M	K	P	III	XXXI-5
<i>Hypnum tristo-viride</i> (BROTH.) PAR.	*	2(2-3) C	H	W	S	U	M	K	P	III	XXXII-1
<i>Hypnum tristo-viride</i> (BROTH.) PAR.	*	2(2-3) C	H	W	S	U	M	K	P	III	XXXII-2
<i>Hypnum tristo-viride</i> (BROTH.) PAR.	*	2(2-3) C	H	W	S	U	M	K	P	III	XXXII-3
<i>Hypnum tristo-viride</i> (BROTH.) PAR.	*	2(2-3) C	H	W	S	U	M	K	P	III	XXXII-4
<i>Hypnum tristo-viride</i> (BROTH.) PAR.	*	2(1-3) C	H	W	S	U	M	K	P	III	XXXII-5
<i>Isopterygium fauriei</i> CARD.	*	1(1-2) C	G	X	R	U	M(N)	K	P	III	XXXII-6
<i>Isopterygium fauriei</i> CARD.	*	1(1-2) C	G	X	R	U	M(N)	K	P	III	XXXII-7
<i>Isopterygium fauriei</i> CARD.	*	1(1-2) C	G	X	R	U	M(N)	K	P	III	XXXII-8
<i>Isopterygium fauriei</i> CARD.	*	1(1-2) C	G	X	R	U	M(N)	K	P	III	XXXIII-1
<i>Isopterygium fauriei</i> CARD.	*	1(1-2) C	G	X	R	U	M(N)	K	P	III	XXXIII-2
<i>Isopterygium fauriei</i> CARD.	*	2(1-2) C	G	X	R	U	M(N)	K	P	III	XXXIII-3
<i>Isopterygium minutirameum</i> (C. MUELL.) JAEG.	*	1(1-3) C	I	X	R	U	M	K	P	III	XXXIII-4
<i>Isopterygium minutirameum</i> (C. MUELL.) JAEG.	*	2(1-2) C	I	X	R	U	M	K	P	III	XXXIII-5
<i>Isopterygium minutirameum</i> (C. MUELL.) JAEG.	*	1(1-2) C	I	X	R	U	M	K	P	III	XXXIII-6
<i>Isopterygium minutirameum</i> (C. MUELL.) JAEG.	*	1(1-2) C	I	X	R	U	M	K	P	III	XXXIV-1
<i>Isopterygium minutirameum</i> (C. MUELL.) JAEG.	*	1(1-2) C	I	X	R	U	M	K	P	III	XXXIV-2
<i>Isopterygium minutirameum</i> (C. MUELL.) JAEG.	*	1(1-3) C	I	X	R	U	M	K	P	III	XXXIV-3
<i>Isopterygium pohliaecarpum</i> (SULL. et LESQ.) JAEG.	*	3(3-4) C	G	X	R	U	M(N)	K	P	III	XXXIV-4
<i>Isopterygium pohliaecarpum</i> (SULL. et LESQ.) JAEG.	*	3(3-4) C	G	X	R	U	M(N)	K	P	III	XXXIV-5
<i>Isopterygium pohliaecarpum</i> (SULL. et LESQ.) JAEG.	*	3(3-4) C	G	X	R	U	M(N)	K	P	III	XXXIV-6
<i>Isopterygium pohliaecarpum</i> (SULL. et LESQ.) JAEG.	*	4(3-4) C	G	X(W)	R	U	M(N)	K	P	III	XXXIV-7
<i>Isopterygium pohliaecarpum</i> (SULL. et LESQ.) JAEG.	*	3(3-4) C	G	X	R	U	M(N)	K	P	III	XXXIV-8
<i>Isopterygium pohliaecarpum</i> (SULL. et LESQ.) JAEG.	*	3(3-4) C	G	X	R	U	M(N)	K	P	III	XXXV-1
<i>Isopterygium pohliaecarpum</i> (SULL. et LESQ.) JAEG.	*	3(3-4) C	G	X(W)	R	U	M(N)	K	P	III	XXXV-2
<i>Isopterygium pohliaecarpum</i> (SULL. et LESQ.) JAEG.	*	2(2-3) C	G	X	R	U	M	K	P	III	XXXV-3
<i>Isopterygium pohliaecarpum</i> (SULL. et LESQ.) JAEG.	*	2(2-3) C	G	X	R	U	M(N)	K	P	III	XXXV-4

<i>Isopterygium pohliaecarpum</i> (SULL. et LESQ.) JAEG.	*	2(2-3)C	G	X	R	U	M(N)	K	P	III	XXXV-5
<i>Isopterygium pohliaecarpum</i> (SULL. et LESQ.) JAEG.	*	3(2-3)C	G	X	R	U	M	K	P	III	XXXV-6
<i>Isopterygium pohliaecarpum</i> (SULL. et LESQ.) JAEG.	*	3(2-3)C	G	X(W)	R	U	M(N)	K	P	III	XXXV-7
<i>Isopterygium pohliaecarpum</i> (SULL. et LESQ.) JAEG.	*	3(2-3)C	G	X(W)	R	U	M(N)	K	P	III	XXXV-8
<i>Isopterygium pohliaecarpum</i> (SULL. et LESQ.) JAEG.	*	3(2-4)C	G	X(W)	R	U	M	K	P	III	XXXV-9
<i>Isopterygium pohliaecarpum</i> (SULL. et LESQ.) JAEG.	*	2(2-3)C	G	X	R	U	M(N)	K	P	III	XXXV-10
<i>Isopterygium pohliaecarpum</i> (SULL. et LESQ.) JAEG.	*	2(2-3)C	G	X(W)	R	U	M(N)	K	P	III	XXXV-11
<i>Isopterygium tosaense</i> BROTH.	*	1(1-1)C	H	X	S	U	M	K	P	III	XXXVI-1
<i>Isopterygium tosaense</i> BROTH.	*	1(1-1)C	H	X	S	U	M	K	P	III	XXXVI-2
<i>Isopterygium tosaense</i> BROTH.	*	1(1-2)C	H	X	S	U	M	K	P	III	XXXVI-3
<i>Isopterygium tosaense</i> BROTH.	*	1(1-2)C	H	X	S	U	M	K	P	III	XXXVI-4
<i>Isopterygium tosaense</i> BROTH.	*	1(1-1)C	H	X	S	U	M	K	P	III	XXXVI-5
<i>Isopterygium tosaense</i> BROTH.	*	1(1-2)C	H	X	S	U	M	K	P	III	XXXVI-6
<i>Ptilium crista-castrensis</i> (HEDW.) D. NOT.	*	3(3-3)C	G	X	R	U	MN	KJ	P	III	XXXVI-7
<i>Ptilium crista-castrensis</i> (HEDW.) D. NOT.	*	3(2-3)C	G	X	R	U	MN	KJ	P	III	XXXVI-8
<i>Ptilium crista-castrensis</i> (HEDW.) D. NOT.	*	3(3-3)C	G	X	R	U	MN	KJ	P	III	XXXVII-1
<i>Ptilium crista-castrensis</i> (HEDW.) D. NOT.	*	3(2-3)C	G	X	R	U	MN	KJ	P	III	XXXVII-2
<i>Ptilium crista-castrensis</i> (HEDW.) D. NOT.	*	3(2-4)C	G	X	R	U	MN	KJ	P	III	XXXVII-3
<i>Ptilium crista-castrensis</i> (HEDW.) D. NOT.	*	3(2-3)C	G	X	R	U	MN	KJ	P	III	XXXVII-4
<i>Pylaisiella cristata</i> (CARD.) IWATS. et NOG.	*	2(2-3)C	H	X	S	U	M(N)	K	P	III	XXXVII-5
<i>Pylaisiella cristata</i> (CARD.) IWATS. et NOG.	*	3(2-3)C	H	X(W)	S	U	M	K	P	III	XXXVII-6
<i>Pylaisiella cristata</i> (CARD.) IWATS. et NOG.	*	3(2-4)C	H	X(W)	S	U	M(N)	K	P	III	XXXVII-7
<i>Pylaisiella cristata</i> (CARD.) IWATS. et NOG.	*	2(2-3)C	H	X	S	U	M	K	P	III	XXXVII-8
<i>Pylaisiella cristata</i> (CARD.) IWATS. et NOG.	*	2(2-3)C	H	X	S	U	M(N)	K	P	III	XXXVIII-1
<i>Pylaisiella cristata</i> (CARD.) IWATS. et NOG.	*	1(1-2)C	H	X	S	U	M	K	P	III	XXXVIII-2
<i>Pylaisiella selwynii</i> (KINDB.) CRUM et all.	*	3(2-4)C	H	X	R	U	M(N)	K	P	III	XXXVIII-3
<i>Pylaisiella selwynii</i> (KINDB.) CRUM et all.	*	3(3-4)C	H	X	R	U	M(N)	K	P	III	XXXVIII-4
<i>Pylaisiella selwynii</i> (KINDB.) CRUM et all.	*	3(3-4)C	H	X	R	U	M(N)	K	P	III	XXXVIII-5
<i>Pylaisiella selwynii</i> (KINDB.) CRUM et all.	*	3(2-4)C	H	X	R	U	M(N)	K	P	III	XXXVIII-6
<i>Pylaisiella selwynii</i> (KINDB.) CRUM et all.	*	3(2-3)C	H	X	R	U	M(N)	K	P	III	XXXVIII-7
<i>Pylaisiella selwynii</i> (KINDB.) CRUM et all.	*	3(3-4)C	H	X(W)	R	U	M(N)	K	P	III	XXXVIII-8
<i>Pylaisiella selwynii</i> (KINDB.) CRUM et all.	*	3(3-4)C	H	X(W)	R	U	M(N)	K	P	III	XXXVIII-9
<i>Pylaisiella subcircinata</i> (CARD.) IWATS. et NOG.	*	2(2-3)C	I	W	R	U	M(N)	K	P	III	XXXIX-2
<i>Pylaisiella subcircinata</i> (CARD.) IWATS. et NOG.	*	3(2-3)C	I	W	R	U	M(N)	K	P	III	XXXIX-3
<i>Pylaisiella subcircinata</i> (CARD.) IWATS. et NOG.	*	3(3-4)C	I	W	R	U	M(N)	K	P	III	XXXIX-4
<i>Pylaisiella subcircinata</i> (CARD.) IWATS. et NOG.	*	4(3-4)C	I	W	R	U	M(N)	K	P	III	XXXIX-5
<i>Pylaisiella subcircinata</i> (CARD.) IWATS. et NOG.	*	3(2-3)C	I	W	R	U	M(N)	K	P	III	XXXIX-6
<i>Pylaisiella subcircinata</i> (CARD.) IWATS. et NOG.	*	2(2-3)C	I	W	R	U	M(N)	K	P	III	XL-1
<i>Rhytidadelphus japonicus</i> (REIM.) KOP.	*	2(1-3)C	G	X	R	U	M(N)	K	P	III	XL-2
<i>Rhytidadelphus japonicus</i> (REIM.) KOP.	*	2(2-4)C	G	X	R	U	M(N)	K	P	III	XL-3
<i>Rhytidadelphus japonicus</i> (REIM.) KOP.	*	2(2-3)C	G	X	R	U	M(N)	K	P	III	XL-4

<i>Rhytidiadelphus japonicus</i> (REIM.) KOP.	*	3(2-3)C	G	X	R	U	M(N)	K	P	III	XL-5
<i>Rhytidiadelphus japonicus</i> (REIM.) KOP.	*	3(2-4)C	G	X	R	U	M(N)	K	P	III	XL-6
<i>Rhytidiadelphus japonicus</i> (REIM.) KOP.	*	2(2-3)C	G	X	R	U	M(N)	K	P	III	XLI-1
<i>Rhytidiadelphus subpinnatus</i> (LINDB.) KOP.	*	3(3-4)C	G	X	R	U	M(N)	K	P	III	XLI-2
<i>Rhytidiadelphus subpinnatus</i> (LINDB.) KOP.	*	3(2-3)C	G	X	R	U	M(N)	K	P	III	XLI-3
<i>Rhytidiadelphus subpinnatus</i> (LINDB.) KOP.	*	3(2-4)C	G	X	R	U	M(N)	K	P	III	XLI-4
<i>Rhytidiadelphus subpinnatus</i> (LINDB.) KOP.	*	3(2-3)C	G	X	R	U	M(N)	K	P	III	XLI-5
<i>Rhytidiadelphus subpinnatus</i> (LINDB.) KOP.	*	2(2-3)C	G	X	R	U	M(N)	K	P	III	XLI-6
<i>Rhytidiadelphus subpinnatus</i> (LINDB.) KOP.	*	3(2-4)C	G	X	R	U	M(N)	K	P	III	XLI-7
<i>Rhytidiadelphus subpinnatus</i> (LINDB.) KOP.	*	3(2-3)C	G	X	R	U	M(N)	K	P	III	XLI-8
<i>Rhytidiadelphus triquetrus</i> (HEDW.) WARNST.	*	3(2-4)C	G	X	R	U	M(N)	K	P	III	XLI-9
<i>Rhytidiadelphus triquetrus</i> (HEDW.) WARNST.	*	4(2-4)C	G	X	R	U	M(N)	K	P	III	XLII-1
<i>Rhytidiadelphus triquetrus</i> (HEDW.) WARNST.	*	3(3-5)C	G	X	R	U	M(N)	K	P	III	XLII-2
<i>Rhytidiadelphus triquetrus</i> (HEDW.) WARNST.	*	3(3-4)C	G	X	R	U	M(N)	K	P	III	XLII-3
<i>Rhytidiadelphus triquetrus</i> (HEDW.) WARNST.	*	3(3-4)C	G	X	R	U	M(N)	K	P	III	XLII-4
<i>Rhytidiadelphus triquetrus</i> (HEDW.) WARNST.	*	4(4-5)C	G	X	R	U	M(N)	K	P	III	XLII-5
<i>Stereo-dontopsis pseudorevoluta</i> (REIM.) ANDO	*	4(3-4)C	I	V(W)	S	U	M	K	P	III	XLIII-1
<i>Stereo-dontopsis pseudorevoluta</i> (REIM.) ANDO	*	4(3-5)C	I	V(W)	S	U	M	K	P	III	XLIII-2
<i>Stereo-dontopsis pseudorevoluta</i> (REIM.) ANDO	*	4(3-4)C	I	V(W)	S	U	M	K	P	III	XLIII-3
<i>Stereo-dontopsis pseudorevoluta</i> (REIM.) ANDO	*	3(3-4)C	I	V	S	U	M	K	P	III	XLIII-4
<i>Stereo-dontopsis pseudorevoluta</i> (REIM.) ANDO	*	3(3-4)C	I	V	S	U	M	K	P	III	XLIII-5
<i>Stereo-dontopsis pseudorevoluta</i> (REIM.) ANDO	*	3(2-3)C	I	V	S	U	M	K	P	III	XLIII-6
<i>Stereo-dontopsis pseudorevoluta</i> (REIM.) ANDO	*	4(4-5)D	I	V	S	U	M	K	P	III	XLIV-1
<i>Taxiphyllum aomoriense</i> (BESCH.) IWATS.	*	2(1-2)C	G	X	R	U	MN	KJ	P	III	XLIV-2
<i>Taxiphyllum aomoriense</i> (BESCH.) IWATS.	*	2(2-3)C	G	X(W)	R	U	MN	KJ	P	III	XLIV-3
<i>Taxiphyllum aomoriense</i> (BESCH.) IWATS.	*	2(2-2)C	G	X	R	U	MN	KJ	P	III	XLIV-4
<i>Taxiphyllum aomoriense</i> (BESCH.) IWATS.	*	2(2-3)C	G	X(W)	R	U	MN	KJ	P	III	XLIV-5
<i>Taxiphyllum aomoriense</i> (BESCH.) IWATS.	*	2(2-3)C	G	X(W)	R	U	MN	KJ	P	III	XLIV-6
<i>Taxiphyllum aomoriense</i> (BESCH.) IWATS.	*	2(2-3)C	G	X(W)	R	U	MN	KJ	P	III	XLV-1
<i>Taxiphyllum cuspidifolium</i> (CARD.) IWATS.	*	3(2-4)C	I	V(W)	R	U	M(N)	K	P	III	XLV-2
<i>Taxiphyllum cuspidifolium</i> (CARD.) IWATS.	*	3(3-4)C	I	V	R	U	M(N)	K	P	III	XLV-3
<i>Taxiphyllum cuspidifolium</i> (CARD.) IWATS.	*	3(3-4)C	I	V	R	U	M(N)	K	P	III	XLV-4
<i>Taxiphyllum cuspidifolium</i> (CARD.) IWATS.	*	3(2-4)C	I	V(W)	R	U	M(N)	K	P	III	XLV-5
<i>Taxiphyllum cuspidifolium</i> (CARD.) IWATS.	*	3(2-4)C	I	V(W)	R	U	M(N)	K	P	III	XLV-6
<i>Taxiphyllum cuspidifolium</i> (CARD.) IWATS.	*	2(2-3)C	I	V(W)	R	U	M(N)	K	P	III	XLV-7
<i>Taxiphyllum subarcuratum</i> (BROTH.) IWATS.	*	2(2-3)C	I	W(V)	S	U	M	K	P	III	XLVI-1
<i>Taxiphyllum subarcuratum</i> (BROTH.) IWATS.	*	2(1-3)C	I	W(V)	S	U	M	K	P	III	XLVI-2
<i>Taxiphyllum subarcuratum</i> (BROTH.) IWATS.	*	3(1-3)C	I	W(V)	S	U	M	K	P	III	XLVI-3
<i>Taxiphyllum subarcuratum</i> (BROTH.) IWATS.	*	2(1-2)C	I	W(V)	S	U	M	K	P	III	XLVI-4
<i>Taxiphyllum subarcuratum</i> (BROTH.) IWATS.	*	2(1-3)C	I	W	S	U	M	K	P	III	XLVI-5
<i>Taxiphyllum subarcuratum</i> (BROTH.) IWATS.	*	3(2-3)C	I	W	S	U	M	K	P	III	XLVI-6

<i>Taxiphyllum taxirameum</i> (MITT.) FL.	*	2(2-2) C	G	X	R	U	M(N)	K	P	III	X L VII-1
<i>Taxiphyllum taxirameum</i> (MITT.) FL.	*	4(3-4) C	G	X(W)	R	U	M(N)	K	P	III	X L VII-2
<i>Taxiphyllum taxirameum</i> (MITT.) FL.	*	3(2-3) C	G	X(W)	R	U	M(N)	K	P	III	X L VII-3
<i>Taxiphyllum taxirameum</i> (MITT.) FL.	*	3(3-4) C	G	X(W)	R	U	M(N)	K	P	III	X L VII-4
<i>Taxiphyllum taxirameum</i> (MITT.) FL.	*	4(3-4) C	G	X(W)	R	U	M(N)	K	P	III	X L VII-5
<i>Taxiphyllum taxirameum</i> (MITT.) FL.	*	3(2-4) C	G	X(W)	R	U	M(N)	K	P	III	X L VII-6
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	5(4-6) B	1(1-2) C	I	W	R	U	N(M)	J	Q	III	X L VIII-1
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	4(4-5) B	1(1-2) C	I	W(X)	R	U	N	J	Q	III	X L VIII-2
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	5(4-6) B	1(1-2) C	I	W(V)	R	U	N	J	Q	III	X L VIII-3
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	6(5-6) B	2(1-2) C	I	W(V)	R	U	N(M)	J	Q	III	X L VIII-4
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	5(4-5) B	2(2-3) C	I	W	R	U	N(M)	J	Q	III	X L IX-1
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	6(5-6) B	2(1-2) C	I	W	R	U	N(M)	J	Q	III	X L IX-2
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	5(5-6) B	1(1-2) C	I	W(X)	R	U	N	J	Q	III	X L IX-3
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	4(3-4) A	3(2-3) C	I	W(V)	R	U	N(M)	J	Q	III	X L IX-4
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	4(3-4) A	3(3-4) C	I	W	R	U	N	J	Q	III	L-1
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	5(4-5) B	3(3-4) C	I	W(X)	R	U	N	J	Q	III	L-2
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	4(4-5) B	3(3-4) C	I	W	R	U	N	J	Q	III	L-3
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	4(4-5) B	3(2-4) C	I	W	R	U	N(M)	J	Q	III	L-4
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	5(4-6) B	3(2-3) C	I	W	R	U	N	J	Q	III	L-5
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	2(2-3) A	2(2-3) C	I	W	R	U	N	J	Q	III	L-6
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	2(2-3) A	3(3-4) C	I	W	R	U	N(M)	J	Q	III	L I-1
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	2(2-3) A	3(3-4) C	I	W	R	U	N(M)	J	Q	III	L I-2
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	2(2-3) A	3(2-3) C	I	W	R	U	N(M)	J	Q	III	L I-3
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	3(2-4) A	3(3-4) C	I	W	R	U	N	J	Q	III	L I-4
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	3(2-3) A	3(3-4) C	I	W	R	U	N(M)	J	Q	III	L I-5
<i>Vesicularia ferriei</i> (CARD. et THÉR.) BROTH.	3(2-3) A	3(3-3) C	I	W	R	U	N	J	Q	III	L I-6

Tab. 2 Affinity regarding the anatomical characteristics of the stem in some species of Hypnaceae

Species	A, B	C, D	G, H, I	V, W, X	R, S	T, U	L, M, N	J, K	O, P, Q	III
<i>Vesicularia ferriei</i>	B	C	I	W	R	U	N	J	Q	III
<i>Hypnum plumaeforme v. minus</i>	B	C	I	W	R	U	N	J	Q	III
<i>Hypnum plumaeforme</i>	B	D	I	W	R	U	N	J	Q	III
<i>Hypnum sakuraii</i>	B	D	H	W	R	U	N	J	Q	III
<i>Hypnum densirameum</i>	B	C	I	V	R	U	N	J	Q	III
<i>Hypnum pallescens</i>	A	C	H	X	S	U	N	J	Q	III
<i>Hypnum calcicolum</i>	B	D	H(I)	X	S	U	N(M)	J	Q	III
<i>Hypnum plicatulum</i>	A	C	I	V	R	T	N	J	Q	III
<i>Hypnum lindbergii</i>	A	C	I	V	R	T	N	J	Q	III
<i>Hypnum erectiusculum</i>	B	C	I	V	R	T	N	J	Q	III
<i>Hypnum callichroum ssp. japonicus</i>	A	D	I	V	R	T	N	J	Q	III
<i>Hypnum dieckii</i>	B	D	I	V	S	T	N	J	Q	III
<i>Hypnum tristo-viride</i>	*	C	H	W	S	U	M	K	P	III
<i>Hypnum fauriei</i>	B	C	I	W	R	U	N	J	P	III
<i>Hypnum fujiyamae</i>	B	C	G	X	S	U	N	J	P	III
<i>Hypnum oldhamii</i>	B	D	I	W(V)	S	U	N	J	P	III
<i>Hypnum cupressiforme</i>	B	C	H	W	S	U	N	J	P	III
<i>Eurohypnum leptothallum</i>	B	C	H	W	S	U	N	J	P	III
<i>Homomallium connexum</i>	B	D	I	X	R	U	N(M)	J	P	III
<i>Ctenidium hastile</i>	*	C	G	X	S	U	MN	KJ	P	III
<i>Ctenidium capillifolium</i>	*	C	I	W	S	U	MN	KJ	P	III
<i>Gollania ruginosa</i>	*	D	I	W	S	U	MN	KJ	P	III
<i>Gollania varians</i>	*	D	I	X	S	U	MN	KJ	P	III
<i>Ptilium crista-castrensis</i>	*	C	G	X	R	U	MN	KJ	P	III
<i>Taxiphyllum aomoriense</i>	*	C	G	X	R	U	MN	KJ	P	III
<i>Taxiphyllum subarcuatum</i>	*	C	I	W	S	U	M	K	P	III
<i>Taxiphyllum cuspidifolium</i>	*	C	I	V	R	U	M(N)	K	P	III
<i>Taxiphyllum taxirameum</i>	*	C	G	X(W)	R	U	M(N)	K	P	III
<i>Ectropothecium obtusulum</i>	*	C	I	W	R	U	M	K	P	III
<i>Ectropothecium zollingeri</i>	*	C	I	W	R	U	M(N)	K	P	III
<i>Herzogiella perrobusta</i>	*	C	I	W	R	U	M	K	P	III
<i>Pylaisiella subcircinata</i>	*	C	I	W	R	U	M(N)	K	P	III
<i>Pylaisiella selwynii</i>	*	C	H	X	R	U	M(N)	K	P	III
<i>Pylaisiella cristata</i>	*	C	H	X	S	U	M	K	P	III
<i>Stereo-dontopsis pseudorevolvula</i>	*	C	I	V	S	U	M	K	P	III
<i>Isopterygium tosaense</i>	*	C	H	X	S	U	M	K	P	III
<i>Isopterygium minutirameum</i>	*	C	I	X	R	U	M	K	P	III
<i>Isopterygium fauriei</i>	*	C	G	X	R	U	M(N)	K	P	III
<i>Isopterygium pohliaecarpum</i>	*	C	G	X	R	U	M(N)	K	P	III
<i>Rhytidiadelphus japonicus</i>	*	C	G	X	R	U	M(N)	K	P	III
<i>Rhytidiadelphus subpinnatus</i>	*	C	G	X	R	U	M(N)	K	P	III
<i>Rhytidiadelphus triquetrus</i>	*	C	G	X	R	U	M(N)	K	P	III

A, B: Number of the cell layers of the internal cortex. C, D: Number of the cell layers of the external cortex. G, H, I: Thickness of the epidermal cell walls. V, W, X: Size of the epidermal cells. R, S: Thickness of the cells of the central tissue. T, U: Thickness of the epidermal cells. L, M, N: Size of cells of the central tissue. J, K: Distinction between the central tissue and the internal cortex. O, P, Q: Thickness of the cell walls of the central tissue. III: The stem differentiates into the epidermis, cortex and the central tissue.

Tab. 3 Affinity regarding the anatomical characteristics of the stem in some species of Fissidentaceae, Pottiaceae, Erpodiaceae, Grimmiaceae, Hypnaceae, Entodontaceae, Hookeriaceae, Thuidiaceae, Mniaceae, Bartramiaceae, Dicranaceae and Polytrichaceae

Families	Genera	Number of the cell layers of the internal cortex is 1-4 cell layers (A-type) or 4-13 cell layers (B-type)	Number of the cell layers of the external cortex is 1-4 cell layers (C-type) or 4-7 cell layers (D-type)	Epidermal cell walls are thicker (G-type), as thick (H-type) or thinner (I-type) than those of the external cortex	Cells of the epidermal layer are larger (V-type), as large (W-type) or smaller (X-type) than those of the external cortex	Distinction between the hydrom and the sternom is clear (E-type) or not (F-type)	Cells of the central tissue are parenchymatous (R-type) or not (S-type)	Cells of the epidermal layer are parenchymatous (T-type) or not (U-type)	Cells of the central tissue are larger (J-type), as large (M-type) or smaller (N-type) than those of the internal cortex	Distinction between the central tissue and the internal cortex is clear (K-type) or not (L-type)	Cell walls of the central tissue are thicker (O-type), as thick (P-type) or thinner (Q-type) than those of the internal cortex	The stem differentiates into the epidermis, cortex, and the central tissue (III-type), into the epidermis, cortex, endodermis and the central strand (IV-type) or into the epidermis, cortex, endodermis, leptom, hydrom and the sternom (VI-type)
Fissidentaceae	<i>Fissidens</i>	A	C	G	W	*	R	U	M	J	O	III
Pottiaceae	<i>Tortella</i>	A	C	I	V	*	R	T	N	J	Q	III
Pottiaceae	<i>Weissia</i>	A	C	I	V	*	R	T	N	J	Q	III
Pottiaceae	<i>Weissia</i>	A	C	H	X	*	R	U	N	J	Q	III
Pottiaceae	<i>Weissia</i>	A	C	G	X	*	R	U	N	J	Q	III
Pottiaceae	<i>Anoetangium</i>	A	C	G	X	*	R	U	N	J	Q	III
Pottiaceae	<i>Trichostomum</i>	A	C	I	V	*	R	U(T)	N	J	Q	III
Pottiaceae	<i>Bryoerythrophyllum</i>	A	C	I(H)	V	*	R	U	N	J	Q	III
Pottiaceae	<i>Bryoerythrophyllum</i>	A	C	G	V	*	R	U	N	J	Q	III
Pottiaceae	<i>Barbula</i>	A	C	H	W	*	R	U	N	J	Q	III
Pottiaceae	<i>Barbula</i>	A	C	I	V	*	S	U	N	J	Q	III
Pottiaceae	<i>Didymodon</i>	A	C	H	W	*	R	U	N	J	Q	III
Pottiaceae	<i>Didymodon</i>	A	C	G	X	*	R	U	N	J	Q	III
Pottiaceae	<i>Didymodon</i>	A	C	G	X	*	R	U	N	J	Q	III
Pottiaceae	<i>Timmiella</i>	A	C	H	W	*	R	U	N	J	P	III
Pottiaceae	<i>Eucladium</i>	A	C	H	W	*	R	U	M	K	P	III
Pottiaceae	<i>Weisiopsis</i>	A	C	H	W	*	S	U	M	K	P	III
Pottiaceae	<i>Leptodontium</i>	A	C	G	X	*	S	U	M	K	P	III
Pottiaceae	<i>Gymnostomum</i>	A	C	I	X	*	S	U	M	K	P	III
Pottiaceae	<i>Gymnostomum</i>	A	C	H	W	*	S	U	M	K	P	III
Pottiaceae	<i>Gymnostomum</i>	A	C	I	V	*	S	T	M	K	P	III
Pottiaceae	<i>Pseudosymblypharis</i>	A	C	I	V	*	S	T	M	K	P	III
Erpodiaceae	<i>Solmsiella</i>	*	(C)	G	X	*	R	U	M	K	P	III
Erpodiaceae	<i>Aulacopilum</i>	*	(C)	H	W	*	S	U	M	K	P	III
Erpodiaceae	<i>Erpodium</i>	*	(C)	H	W	*	S	U	M	K	P	III
Erpodiaceae	<i>Erpodium</i>	*	(C)	G	W	*	R	U	MN	KJ	P	III
Erpodiaceae	<i>Venturiella</i>	*	(C)	G	X	*	R	U	MN	KJ	P	III
Erpodiaceae	<i>Glyphomitrium</i>	*	(C)	G	X	*	R	U	N	J	Q	III
Grimmiaceae	<i>Grimmia</i>	B	C	H	X	*	R	U	N	J	Q	III
Grimmiaceae	<i>Grimmia</i>	A	C	H	X	*	R	U	N	J	Q	III
Grimmiaceae	<i>Grimmia</i>	A	C	G	X	*	R	U	N	J	Q	III
Grimmiaceae	<i>Grimmia</i>	A	C	H	W	*	S	U	MN	J	Q	III
Grimmiaceae	<i>Grimmia</i>	A	C	G	W	*	S	U	MN	J	Q	III
Grimmiaceae	<i>Grimmia</i>	A	C	G	X	*	S	U	MN	J	Q	III
Grimmiaceae	<i>Grimmia</i>	A	C	H	W	*	S	U	M(N)	J	Q	III
Grimmiaceae	<i>Grimmia</i>	B	C	H	X	*	S	U	M(N)	J	Q	III
Grimmiaceae	<i>Grimmia</i>	A	C	G	X	*	S	U	M(N)	J	Q	III
Grimmiaceae	<i>Grimmia</i>	A	C	H	X	*	S	U	N	J	P	III
Grimmiaceae	<i>Grimmia</i>	*	C	H	W	*	S	U	M	K	P	III
Grimmiaceae	<i>Grimmia</i>	*	D	H	W	*	S	U	M	K	P	III
Grimmiaceae	<i>Grimmia</i>	*	C	H	X	*	S	U	M	K	P	III
Grimmiaceae	<i>Grimmia</i>	*	C	G	X	*	S	U	M	K	P	III
Grimmiaceae	<i>Grimmia</i>	*	C	G	X	*	R	U	M	K	P	III
Grimmiaceae	<i>Grimmia</i>	*	D	G	X	*	R	U	M	K	P	III
Hypnaceae	<i>Rhytidadelphus</i>	*	C	G	X	*	R	U	M	K	P	III
Hypnaceae	<i>Isopterygium</i>	*	C	G	X	*	R	U	M	K	P	III
Hypnaceae	<i>Isopterygium</i>	*	C	I	X	*	R	U	M	K	P	III
Hypnaceae	<i>Isopterygium</i>	*	C	H	X	*	S	U	M	K	P	III
Hypnaceae	<i>Stereo-dontopsis</i>	*	C	I	V	*	S	U	M	K	P	III
Hypnaceae	<i>Pylaisiella</i>	*	C	H	X	*	S	U	M	K	P	III
Hypnaceae	<i>Pylaisiella</i>	*	C	H	X	*	R	U	M	K	P	III
Hypnaceae	<i>Pylaisiella</i>	*	C	I	W	*	R	U	M	K	P	III
Hypnaceae	<i>Herzogiella</i>	*	C	I	W	*	R	U	M	K	P	III
Hypnaceae	<i>Ectropothecium</i>	*	C	I	W	*	R	U	M	K	P	III
Hypnaceae	<i>Taxiphyllum</i>	*	C	G	X	*	R	U	M	K	P	III
Hypnaceae	<i>Taxiphyllum</i>	*	C	I	V	*	R	U	M	K	P	III
Hypnaceae	<i>Taxiphyllum</i>	*	C	I	W	*	S	U	M	K	P	III
Hypnaceae	<i>Taxiphyllum</i>	*	C	G	X	*	R	U	MN	KJ	P	III
Hypnaceae	<i>Ptilium</i>	*	C	G	X	*	R	U	MN	KJ	P	III
Hypnaceae	<i>Gollania</i>	*	D	I	X	*	S	U	MN	KJ	P	III
Hypnaceae	<i>Gollania</i>	*	D	I	W	*	S	U	MN	KJ	P	III
Hypnaceae	<i>Ctenidium</i>	*	C	I	W	*	S	U	MN	KJ	P	III
Hypnaceae	<i>Ctenidium</i>	*	C	G	X	*	S	U	MN	KJ	P	III
Hypnaceae	<i>Homomallium</i>	B	D	I	X	*	R	U	N	J	P	III
Hypnaceae	<i>Eurohypnum</i>	B	C	H	W	*	S	U	N	J	P	III
Hypnaceae	<i>Hypnum</i>	B	C	H	W	*	S	U	N	J	P	III
Hypnaceae	<i>Hypnum</i>	B	D	I	W	*	S	U	N	J	P	III
Hypnaceae	<i>Hypnum</i>	B	C	G	X	*	S	U	N	J	P	III
Hypnaceae	<i>Hypnum</i>	B	C	I	W	*	R	U	N	J	P	III
Hypnaceae	<i>Hypnum</i>	*	C	H	W	*	S	U	M	K	P	III
Hypnaceae	<i>Hypnum</i>	B	D	I	V	*	S	T	N	J	Q	III
Hypnaceae	<i>Hypnum</i>	A	D	I	V	*	R	T	N	J	Q	III
Hypnaceae	<i>Hypnum</i>	B	C	I	V	*	R	T	N	J	Q	III
Hypnaceae	<i>Hypnum</i>	A	C	I	V	*	R	T	N	J	Q	III
Hypnaceae	<i>Hypnum</i>	B	D	H	X	*	S	U	N	J	Q	III
Hypnaceae	<i>Hypnum</i>	A	C	H	X	*	S	U	N	J	Q	III
Hypnaceae	<i>Hypnum</i>	A	C	I	V	*	R	U	N	J	Q	III
Hypnaceae	<i>Hypnum</i>	B	D	H	W	*	R	U	N	J	Q	III
Hypnaceae	<i>Hypnum</i>	B	D	I	W	*	R	U	N	J	Q	III
Hypnaceae	<i>Hypnum</i>	B	C	I	W	*	R	U	N	J	Q	III
Hypnaceae	<i>Vesicularia</i>	B	C	I	W	*	R	U	N	J	Q	III
Entodontaceae	<i>Entodon</i>	B	C	I	V	*	R	T	N	J	P	III
Entodontaceae	<i>Entodon</i>	B	C	H	X	*	R	U	N	J	P	III
Entodontaceae	<i>Entodon</i>	B	C	H	W	*	R	U	N	J	P	III
Entodontaceae	<i>Entodon</i>	B	D	H	W	*	R	U	N	J	P	III
Hookeriaceae	<i>Hookeria</i>	A	C	G	X	*	S	U	N	J	P	III
Hookeriaceae	<i>Achrohypnella</i>	*	C	G	X	*	S	U	M	K	P	III
Hookeriaceae	<i>Hookeriopsis</i>	*	C	I	V	*	S	U	M	K	P	III
Thuidiaceae	<i>Helodium</i>	B	C	I	W	*	R	U	N	J	P	III
Thuidiaceae	<i>Claopodium</i>	B	C	H	W	*	R	U	N	J	P	III
Thuidiaceae	<i>Claopodium</i>	A	C	G	X	*	S	U	N	J	P	III
Thuidiaceae	<i>Claopodium</i>	A	C	I	X	*	S	U	N	J	P	III
Thuidiaceae	<i>Claopodium</i>	B	C	G	W	*	S	U	N	J	P	III
Thuidiaceae	<i>Rautiella</i>	B	C	G	W	*	S	U	N	J	P	III
Thuidiaceae	<i>Haplocladium</i>	B	C	G	W	*	S	U	N	J	P	III
Thuidiaceae	<i>Haplocladium</i>	A	C	G	X	*	S	U	N	J	P	III
Thuidiaceae	<i>Haplocladium</i>	A	D	H	V	*	S	U	N	J	P	III
Thuidiaceae	<i>Haplocladium</i>	A	C	I	V	*	S	U	N	J	P	III
Thuidiaceae	<i>Thuidium</i>	B	C	I	V	*	S	U	N	J	P	III
Thuidiaceae	<i>Thuidium</i>	A	C	G	W	*	S	U	N	J	P	III
Thuidiaceae	<i>Thuidium</i>	B	C	G	W	*	S	U	N	J	P	III
Thuidiaceae	<i>Thuidium</i>	B	C	H	W	*	S	U	N	J	P	III
Thuidiaceae	<i>Anomodon</i>	*	C	G	X	*	S	U	MN	KJ	P	III
Thuidiaceae	<i>Anomodon</i>	*	C	H	W	*	S	U	MN	KJ	P	III
Thuidiaceae	<i>Anomodon</i>	*	C	H	W	*	S	U	M	K	P	III
Thuidiaceae	<i>Anomodon</i>	*	C	G	W	*	S	U	M	K	P	III
Thuidiaceae	<i>Haplohymentum</i>	*	C	G	W	*	S	U	M	K	P	III
Thuidiaceae	<i>Haplohymentum</i>	*	C	H	W	*	S	U	M	K	P	III
Thuidiaceae	<i>Haplohymentum</i>	*	C	I	W	*	S	U	M	K	P	III
Thuidiaceae	<i>Haplohymentum</i>	*	C	H	X	*	S	U	M	K	P	III
Thuidiaceae	<i>Haplohymentum</i>	*	C	I	V	*	S	U	M	K	P	III
Thuidiaceae	<i>Miyabea</i>	*	C	I	V	*	S	U	M	K	P	III
Thuidiaceae	<i>Miyabea</i>	*	C	H	W	*	S	U	M	K	P	III
Thuidiaceae	<i>Abietinella</i>	*	C	H	W	*	S	U	M	K	P	III
Thuidiaceae	<i>Boulaya</i>	*	C	H	W	*	S	U	M	K	P	III
Thuidiaceae	<i>Bryonoguchia</i>	*	C	G	X	*	S	U	M	K	P	III
Thuidiaceae	<i>Hylocomiopsis</i>	*	C	G	X	*	S	U	M	K	P	III
Thuidiaceae	<i>Herpetineuron</i>	B	C	H	W	*	R	U	N	J	Q	IV
Mniaceae	<i>Orthomiopsis</i>	A	C	I	W	*	R	U	N	J	Q	IV
Mniaceae	<i>Pseudobryum</i>	B	C	H	W	*	R	U	N	J	Q	IV
Mniaceae	<i>Platoniium</i>	A	C	H	W	*	R	U	N	J	Q	IV
Mniaceae	<i>Platoniium</i>	B	D	H	W	*	R	U	N	J	Q	IV
Mniaceae	<i>Platoniium</i>	B	D	G	W	*	R	U	N	J	Q	IV
Mniaceae	<i>Platoniium</i>	B	C	G	X	*	R	U	N	J	Q	IV
Mniaceae	<i>Rhizomnium</i>	A	C	G	X	*	R	U	N	J	Q	IV
Mniaceae	<i>Mnium</i>	A	C	G	X	*	R	U	N	J	Q	IV
Mniaceae	<i>Trachycystis</i>	B	C	G	X	*	R	U	N	J	Q	IV
Mniaceae	<i>Trachycystis</i>	A	C	G	X	*	R	U	N	J	Q	IV
Mniaceae	<i>Trachycystis</i>	B	D	G	X	*	R	U	N	J	Q	IV
Bartramiaceae	<i>Philonotis</i>	A	C	I	V	*	R	T	N	J	Q	IV
Bartramiaceae	<i>Breutelia</i>	B	C	I	V	*	R	T	N	J	Q	IV
Dicranaceae	<i>Onchophorus</i>	B	C	H	W	*	R	U	N	J	P	IV
Dicranaceae	<i>Leucoloma</i>	A	C	I	V	*	R	T	N	J	P	IV
Dicranaceae	<i>Thysanomitrium</i>	B	C	I	V	*	R	T	N	J	P	IV
Dicranaceae	<i>Campylopodium</i>	A	C	H	X	*	S	U	N	J	O	IV
Dicranaceae	<i>Dicranum</i>	B	C	H	X	*	S	U	N	J	O	IV
Dicranaceae	<i>Dicranum</i>	B	C	H	W	*	S	U	N	J	O	IV
Polytrichaceae	<i>Oligotrichum</i>	A	C	G	X	F	*	U	*	J	*	VI
Polytrichaceae	<i>Bartramioopsis</i>	B	D	G	X	F	*	U	*	J	*	VI
Polytrichaceae	<i>Pogonatum</i>	B	C	G	X	E	*	U	*	J	*	VI
Polytrichaceae	<i>Pogonatum</i>	B	D	G	X	E	*	U	*	J	*	VI
Polytrichaceae	<i>Pogonatum</i>	A	D	G	X	E	*	U	*	J	*	VI
Polytrichaceae	<i>Atrichum</i>	A	D	G	X	E	*	U	*	J	*	VI
Polytrichaceae	<i>Polytr</i>											

the central tissue and the internal cortex is clear(J-type) or not(K-type), or they are of an intermediate type(KJ-type); between K- and J-types. In the stems of type J, cells of the central tissue are smaller than those of the internal cortex(N-type). In the stems of type K, cells of the central tissue are as large as those of the internal cortex(M-type). In the stems of type KJ, cells of the central tissue are of an intermediate type(MN-type) between M- and N-types. In all the stems of III-Q-J-type, cells of the central tissue are smaller than those of the internal cortex(N-type). The stems of III-Q-J-N-type are classified into two types: epidermal cell walls are parenchymatous(T-type) or not(U-type). And the stems of both III-Q-J-N-U- and III-Q-J-N-T-types are classified into two types; cell walls of the central tissue are parenchymatous(R-type) or not(S-type). The characteristics of III-Q-J-N-U-R-type are found in the stems of *Vesicularia* and some species of *Hypnum*. The stems showing III-Q-J-N-U-S-, III-Q-J-N-T-R- and III-Q-J-N-T-S-types are peculiar to *Hypnum*. In all stems of III-P-J-N-, III-P-KJ-MN- and III-P-K-M-types, epidermal cell walls are not parenchymatous (U-type). All stems of III-P-J-N-, III-P-KJ-MN- and III-P-K-M-types are classified into two types: cell walls of the central tissue are parenchymatous (R-type) or not(S-type). The characteristics of III-P-K-M-U-S-type are found in the stems of *Hypnum*, *Taxiphyllum*, *Pylaisiella*, *Stereodontopsis* and *Isopterygium*. The III-P-K-M-U-R-type are found in the stems of *Taxiphyllum*, *Ectropothecium*, *Herzogiella*, *Pylaisiella*, *Isopterygium* and *Rhytidiadelphus*. The III-P-J-N-U-S-type are found in the stems of *Hypnum* and *Eurohypnum*, and the III-P-J-N-U-R-type in the stems of *Hypnum* and *Homomallium*. The characteristics of III-P-KJ-MN-U-S-type are found in the stems of *Ctenidium* and *Gollania*, and III-P-KJ-MN-U-R-type in the stems of *Ptilium* and *Taxiphyllum*.

## (2) On the stems in the families hitherto observed

We considered the cross sections of the stem of the nine families, Fissidentaceae, Entodontaceae, Thuidiaceae, Hypnaceae, Mniaceae, Bartramiaceae, Dicranaceae, Grimmiaceae, and Polytrichaceae, hitherto observed, and out of the sketches so far made public, we also considered the sketches of Erpodiaceae(NOGUCHI 1952), Bartramiaceae(MATTERI 1968, 1973), Hookeriaceae(MATTERI 1972) and Pottiaceae(SAITO 1975), where we can readily see ten of our demarcations(Tab. 3).

In all the families dealt with in this paper, the stems of each family, except Thuidiaceae, show similar types of interior differentiation; that is, the stems of Fissidentaceae, Pottiaceae, Erpodiaceae, Grimmiaceae, Hypnaceae, Entodontaceae and Hookeriaceae show a differentiation of tissues into an epidermis, external cortex, internal cortex and a central tissue (III-type). The stems of Mniaceae, Bartramiaceae and Dicranaceae show a differentiation of tissues into an epidermis, external cortex, internal cortex, endodermis and a central strand(IV-type). The stems of Polytrichaceae show a differentiation of tissues into an epidermis, external cortex, internal cortex, endodermis, leptom, hydrom and a stereom(VI-type).



It seems that the six characteristics, namely, comparison between thickness of cell walls of the central tissue and of the internal cortex (O-, P- and Q-types), distinction between the central tissue and the internal cortex (J- and K-types), comparison between the size of cells of the central tissue and that of cells of the internal cortex (L-, M- and N-types), thickness of the epidermal cell walls (T- and U-types), thickness of cell walls of the central tissue (R- and S-types), show some kind of order among the inner structures of the stems in each family.

Tab. 4 Coordination among the anatomical characteristics of the stem in the families

Fissidentaceae	III-O-J-M-U-R
Pottiaceae	III-Q-J-N-T-R, III-Q-J-N-U-R, III-Q-J-N-U-S, III-P-J-N-U-R III-P-K-M-T-R, III-P-K-M-U-S, III-P-K-M-T-S
Erpodiaceae	III-P-K-M-U-R, III-P-K-M-U-S, III-P-KJ-MN-U-R, III-Q-J-N-U-R
Grimmiaceae	III-Q-J-N-U-R, III-Q-J-MN-U-S, III-Q-J-M(N)-U-S, III-P-J-N-U-S III-P-K-M-U-S, III-P-K-M-U-R
Hypnaceae	III-P-K-M-U-R, III-P-K-M-U-S, III-P-KJ-MN-U-R, III-P-KJ-MN-U-S III-P-J-N-U-R, III-P-J-N-U-S, III-Q-J-N-T-S, III-Q-J-N-T-R III-Q-J-N-U-S, III-Q-J-N-U-R
Entodontaceae	III-P-J-N-T-R, III-P-J-N-U-R
Hookeriaceae	III-P-J-N-U-S, III-P-K-M-U-S
Thuidiaceae	III-P-J-N-U-R, III-P-J-N-U-S, III-P-KJ-MN-U-S, III-P-K-M-U-S IV-Q-J-N-U-R
Mniaceae	IV-Q-J-N-U-R
Bartramiaceae	IV-Q-J-N-T-R
Dicranaceae	IV-P-J-N-U-R, IV-P-J-N-T-R, IV-O-J-N-U-S
Polytrichaceae	VI-J-U-F, VI-J-U-E

Orderliness in the anatomical characteristics among the stems in each family is shown in Tab. 4. The stems of Fissidentaceae show a differentiation of tissues which is a III-O-J-M-U-R-type. The cross sections of the stem of Pottiaceae show a differentiation of tissues into III-Q-J-N-T-R-, III-Q-J-N-U-R-, III-Q-J-N-U-S-, III-P-J-N-U-R-, III-P-K-M-T-R-, III-P-K-M-U-S-, and III-P-K-M-T-S-types. The stems of Erpodiaceae show in III-P-K-M-U-R-, III-P-K-M-U-S-, III-P-KJ-MN-U-R- and III-Q-J-N-U-R-types. The stems of Grimmiaceae show six types: III-Q-J-N-U-R-, III-Q-J-MN-U-S-, III-Q-J-M(N)-U-S-, III-P-J-N-U-S-, III-P-K-M-U-S- and III-P-K-M-U-R-types. The cross sections of the stems of Hypnaceae show ten types, III-P-K-U-R-, III-P-K-M-U-S-, III-P-KJ-MN-U-R-, III-P-KJ-MN-U-S-, III-P-J-N-U-R-, III-P-J-N-U-S-, III-Q-J-N-T-S-, III-Q-J-N-T-R-, III-Q-

J-N-U-S- and III-Q-J-N-U-R-types. The stems of Entodontaceae show III-P-J-N-T-R- and III-P-J-N-U-R-types. The stems of Hookeriaceae show two types, III-P-J-N-U-S and III-P-K-M-U-S. The stems of Thuidiaceae are III-P-J-N-U-R-, III-P-J-N-U-S-, III-P-KJ-MN-U-S-, III-P-K-M-U-S- or IV-Q-J-N-U-R-types. The stems of Mniaceae show in IV-Q-J-N-U-R and Bartramiaceae in IV-Q-J-N-T-R. The stems of Dicranaceae show three types, IV-P-J-N-U-R, IV-P-J-N-T-R and IV-O-J-N-U-S. The stems of Polytrichaceae show two types, VI-J-U-F and VI-J-U-E. It is concluded that some families have good order in the anatomical characteristics among the stems of the family, but other families do not.

## II. What sort of an anatomical characteristic should be taken up for systematic study?

### (1) Anatomical characteristics of the stems hitherto observed

Tab. 5 is about anatomical characteristics observed in the previous papers(No.1—No.6)entitled“Systematic studies on the conducting tissue of the gametophyte in Musci”. In the first paper(KAWAI et IKEDA 1970), twelve characteristics of the stem in Polytrichaceae were considered. These anatomical characteristics of the stem were investigated, and No.11 and No.12 of the twelve characteristics seemed to possess some order. Accordingly, in the second paper(KAWAI 1970a)the characteristics of No.11 and No.12 and more recently No.13, No.14 and No.15, that is, the characteristics on the central tissue and the epidermal cell walls, were observed. In the number of cell layers of the cortex, we noticed a differentiation of tissues into an external cortex and an internal cortex, so that the number of the cell layers of the external cortex and the internal cortex was respectively counted. In the third paper(KAWAI 1970b) about Thuidiaceae, the characteristics, No.11, No.12, No.13 and No.15, and more recently No.16 and No.17 were considered, for in the stems of Thuidiaceae, No.14, thickness of cell walls of the central tissue did not seem to show good order. In the fourth paper(KAWAI 1970c), the characteristics No.11, No.12, No.13, No.16 and No.17 were observed, but the characteristic of No.15 did not seem to show good order. And recently the characteristics of No.18 and No.19 in Mniaceae were considered. Orderliness was not shown as for the characteristic whether cells of the central tissue are collenchymatous or not (characteristic No.13). In Polytrichaceae the characteristic, whether a distinction between the hydrom and the stereom is clear or not, seems to be more evident than distinction between the hadrom and the leptom(characteristic No.10). And the characteristic, whether cell walls of the central tissue are thick or not (characteristic No.14), seems to be an important one for Thuidiaceae. Accordingly, in the fifth paper(WATANABE et KAWAI 1975) the characteristics No.11, No.12, No.16, No.17, No.18, No.19, and newly No.10 and No.14 were observed. Size and thickness of the epidermal cell walls seem to be important for Hypnaceae, so that, in Hypnaceae dealt with in the sixth paper(KAWAI 1976) the characteristics, No.10, No.11, No.12, No.14, No.16, No.17, No.18, No.19 and newly No.15 and

Tab. 5 Anatomical characteristics of the stem hitherto observed in systematic studies on the conducting tissue of the gametophyte

	(1)KAWAI et IKEDA 1970	(2)KAWAI 1971	(3)KAWAI 1971	(4)KAWAI 1971	(5)WATANABE et KAWAI 1975	(6)KAWAI 1976
1. Diameter of the stem	●					
2. Number of the cell layers of the epidermis	●					
3. Width of the cortex	●					
4. Diameter of the central strand	●					
5. Diameter of the hadrom	●					
6. Number of the cell layers of the hadrom	●					
7. Cell number of the hadrom	●					
8. Number of the cell layers of the leptom	●					
9. Width of the leptom	●					
10. Distinction between the hadrom and the leptom is clear or not	●		●		●Hydrom, stereom	●
11. Number of the cell layers of the cortex	●	● Internal	●	●	●	●
		● External	●	●	●	●
12. Types of the inner structures of the stem	●	●	●	●	●	●
13. Cells of the central tissue are collenchymatous or not		●	●	●		
14. Cell walls of the central tissue are thick or not		●			●	●
15. Epidermal cell walls are thick or not		●	●			●
16. Distinction between the central tissue and the internal cortex is clear or not			●	●	●	●
17. Cell walls of the central tissue are thicker, as thick or thinner than those of the internal cortex			●	●	●	●
18. Epidermal cell walls are thicker, as thick or thinner than those of the external cortex				●	●	●
19. Cells of the central tissue are larger, as large or smaller than those of the internal cortex				●	●	●
20. Cells of the epidermal layer are larger, as large or smaller than those of the external cortex						●

No.20 were considered.

## (2) Discussion of some of the anatomical characteristics

### i) Width of the cell walls of the central tissue(S- and R-types, P- and Q-types)

Does the central tissue differentiate from the internal cortex? And how much does the central tissue specialize? In order to classify these, we considered whether cell walls of the central tissue are thinner(Q-type), as thick(P-type) or thicker(O-type) than those of the internal cortex. Cell walls of the central tissue, which are thinner than those of the internal cortex, show two types: parenchymatous and non-parenchymatous. And the central tissues of IV-type, which differentiate more than the stem of III-type, seem to be all parenchymatous. Accordingly, it may be important whether the central tissue is parenchymatous(R-type) or not (S-type).

On the other hand, the stems, of which both the central tissue and the internal cortex are parenchymatous, seem to be all III-type. The stems, of which only the central tissue is parenchymatous, seem to belong to the more differentiated IV-type or III-type. Accordingly, it may be important that cell walls of the central tissue are thinner than those of the internal cortex.

### ii) Size of cells of the central tissue(M- and N-types)

We find intermediate types, MN, M(N) and N(M), as to the characteristic whether cells of the central tissue are as large(M-type) or smaller (N-type) than those of the internal cortex; that is, MN-type is the one where the central tissue is composed of cells, which are smaller than cells of the internal cortex and of cells, which are as large as those of the internal cortex. So the MN-type may belong to neither M-type nor to the N-type. M(N)-type is those where the central tissue is composed of many cells, which are as large as those of the internal cortex, and of few cells, which are smaller than those of the internal cortex. So M(N)-type may belong to M-type. Similarly, N(M)-type are those where the central tissue is composed of many cells, which are smaller than those of the internal cortex, and of few cells, which are large as those of the internal cortex. So N(M)-type may belong to N-type. Accordingly, it is suited for the purpose that the cell-size of the central tissue should be divided into three, M-, MN- and N-types.

### iii) Distinction between the central tissue and the internal cortex(J- and K-types)

After studies into differentiation of the central tissue, we drew a comparison between the central tissue and the internal cortex on size of cells and thickness of cell walls, that is,

- (1) Cell walls of the central tissue are thicker(O-type), as thick (P-type) or thinner (Q-type) than those of the internal cortex.
- (2) Cell walls of the central tissue are parenchymatous(R-type) or not(S-type).
- (3) Cells of the central tissue are larger(L-type), as large(M-type) or smaller (N-type) than those of the internal cortex.
- (4) Distinction between the central tissue and the internal cortex is clear(J-type) or

not(K-type).

Of the four characteristics on difference between the central tissue and the internal cortex, the characteristics of M-, MN- and N-types, and of P- and Q-types may be good demarcations, but the demarcations of J- and K-types may not be always well fitted to differentiation of the central tissue, for the characteristics of J- and K-types may overlap each other. This problem requires further examination.

iv) **Width of the epidermal walls(T- and U-types)**

Width of the epidermal walls was first considered in the second paper(KAWAI 1971a). But in the fourth paper(KAWAI 1971c) we thought that we should consider rather whether the epidermal cell walls are thicker (G-type), as thick(H-type) or thinner(I-type) than those of the external cortex, than whether the epidermal cell walls are thick or not. And in the observation on Hypnaceae(KAWAI 1976) it was found that the epidermal cell walls are extremely thin. We now think that we should consider whether the epidermal cell walls are parenchymatous (T-type) or not (U-type), and whether cells of the epidermal layer are larger(V-type), as large(W-type) or smaller(X-type) than those of the external cortex. The stems of T-type are mostly V-I-type. Accordingly, there is a point of view that as to thickness of the epidermal cell walls, we should consider only either T-type or I-type. On the other hand, there is another point of view that, as for thickness of the epidermal cell walls, we should consider both T-type and I-type, for it doesn't always follow that the stems of T-type are all I-type. Which is a more essential characteristic; that the epidermal cell walls are extremely thin, or that the epidermal cell walls are thinner than those of the external cortex? Regarding this problem, the stems of Hypnaceae have to be compared with those of Leucobryaceae, Bartramiaceae, Dicranaceae, having types of epidermal cell walls similar to each other. Furthermore, an important problem still to be solved, is how in the epidermal cell walls the stems of Hypnaceae are related to those of Sphagnaceae.

(3) **Relationship among the stems regarding the anatomical characteristics**

i) **On the stems in forty-two species of Hypnaceae**

As many anatomical characteristics as possible, are observed, and in the stems of Hypnaceae a coordination among the anatomical characteristics is discussed. In view of the results so far achieved, four characteristics: types of the interior differentiation (III-type), comparison in thickness between cell walls of the central tissue and those of the internal cortex (P- and Q-type), comparison in size between cells of the central tissue and the internal cortex(M-, MN- and N-types), thickness of the epidermal cell walls (T- and U-types), seem to show great regularity. Interrelationship among structures of the stems in Hypnaceae are considered on the basis of these characteristics. In Tab. 6, the interior differentiation of all the species in Hypnaceae are III-type. The stems having III-type are classified into two types; the cell walls of the central tissue are as thick(P-type) or thinner(Q-type) than those of the internal cortex. In the stem of III-Q-type, cells of the central tissue are all found to be N-type. The stems of

Tab. 6 Relationship among the stems of forty-two species of Hypnaceae regarding the anatomical characteristics

III	Q	N	U	III-Q-N-U	<i>Vesicularia</i> <i>Hypnum</i>	
			T	III-Q-N-T	<i>Hypnum</i>	
	P	N	U	III-P-N-U	<i>Hypnum</i> <i>Eurohypnum</i> <i>Homomallium</i>	
			MN	U	III-P-MN-U	<i>Ctenidium</i> <i>Gollania</i> <i>Ptilium</i> <i>Taxiphyllum</i>
			M	U	III-P-M-U	<i>Taxiphyllum</i> <i>Ectropothecium</i> <i>Herzogiella</i> <i>Pylaisiella</i> <i>Stereo-dontopsis</i> <i>Isopterygium</i> <i>Rhytidiadelphus</i> <i>Hypnum</i>

III-Q-N-type are divided into two types, T and U, on the ground of the characteristic about the configuration of the epidermal cell walls. The III-Q-N-U-type is found in *Vesicularia* and some species of *Hypnum*. The III-Q-N-T-type is found in some species of *Hypnum*.

The III-P-type is divided into three types, N, MN and M, on the ground of the characteristic of the cell-size of the central tissue. All the stems of these three types show U-type of the epidermal cell walls.

The III-P-N-U-type is found in some species of *Hypnum*, *Eurohypnum*, *Homomallium*. The III-P-MN-U-type is found in the stems of *Ctenidium*, *Gollania* and some species of *Taxiphyllum*. The III-P-M-U-type is found in some species of *Taxiphyllum*, *Ectropothecium*, *Herzogiella*, *Pylaisiella*, *Stereo-dontopsis*, *Isopterygium*, *Rhytidiadelphus* and some species of *Hypnum*. The stems of Hypnaceae are classified regarding the anatomical characteristics, into five types; III-Q-N-U, III-Q-N-T, III-P-N-U, III-P-MN-U and III-P-M-U. A problem for the future is, how important the grouping and the anatomical characteristics considered in this paper are for systematic study.

#### ii) On the stems in some species of the families hitherto observed

The stems hitherto observed are classified into three types, III-, IV- and VI-types, on the ground of the characteristics of the interior differentiation of the stem (Tab.7). The stems of III- and IV-types are respectively divided into three types, O-, P- and Q-types, regarding thickness of cell walls of the central tissue.

Tab. 7 Relationship among the stems of some species of the families hitherto observed regarding the anatomical characteristics

III	O	M	U	III-O-M-U	Fissidentaceae	
	P	N	U	III-P-N-U	Pottiaceae Grimmiaceae Hypnaceae Entodontaceae Hookeriaceae Thuidiaceae	
			T		III-P-N-T	Entodontaceae
		MN	U	III-P-MN-U	Hypnaceae Thuidiaceae	
		M	U	III-P-M-U	Pottiaceae Grimmiaceae Hypnaceae Erpodiaceae Hookeriaceae Thuidiaceae	
			T		III-P-M-T	Pottiaceae
		Q	N	U	III-Q-N-U	Pottiaceae Grimmiaceae Hypnaceae Erpodiaceae
				T		III-Q-N-T
			MN	U	III-Q-MN-U	Grimmiaceae
	M		U	III-Q-M-U	Grimmiaceae	
	IV	Q	N	U	IV-Q-N-U	Thuidiaceae Mniaceae
			T	IV-Q-N-T		Bartramiaceae
		P	N	U	IV-P-N-U	Dicranaceae
				T	IV-P-N-T	Dicranaceae
O	N	U	IV-O-N-U	Dicranaceae		
VI	U		F	VI-U-F	Polytrichaceae	
	U		E	VI-U-E	Polytrichaceae	

All the stems of **III-O**-type show **M**-type of the central tissue and **U**-type of the epidermal cell walls. This **III-O-M-U**-type is found in the stems of Fissidentaceae.

The stems of **III-P**-type are divided into three types, **N**-, **MN**- and **M**-types, by virtue of the characteristic of cell-size of the central tissue. The **III-P-N**-type is divided into two types, **U**- and **T**-types, through thickness of the epidermal cell walls. The **III-P-N-U**-type is found in the stems of Pottiaceae, Grimmiaceae, Hypnaceae, Entodontaceae, Hookeriaceae and Thuidiaceae. The **III-P-N-T**-type is found in the stems of Entodontaceae. The **III-P-MN-U**-type is found in the stems of some species of Hypnaceae and Thuidiaceae. The **III-P-M**-type is classified into two types, **T** and **U**, according to the characteristic about the thickness of epidermal cell walls. The **III-P-M-U**-type is found in the stems of Pottiaceae, Grimmiaceae, Hypnaceae, Erpodiaceae, Hookeriaceae and Thuidiaceae, and the **III-P-M-T**-type is found in the stems of Pottiaceae.

The **III-Q**-type is divided into three types, **N**-, **MN**- and **M**-types, on the ground of the characteristic of the cell-size of the central tissue. The **III-Q-N**-type is divided into two types, **U** and **T**, and the **III-Q-N-U**-type is found in the stems of Pottiaceae, Grimmiaceae, Hypnaceae, Erpodiaceae, and the **III-Q-N-T**-type is found in the stems of Pottiaceae and Hypnaceae. And the **III-Q-MN-U**-type and **III-Q-M-U**-type are both found in the stems of Grimmiaceae.

The **IV-Q-N**-type is classified into two types, **U** and **T**. The **IV-Q-N-U**-type is found in the stems of Thuidiaceae and Mniaceae, and the **IV-Q-N-T**-type is found in the stems of Bartramiaceae. The **IV-P-N**-type is divided into **U** and **T**, and both types are found in the stems of Dicranaceae. The **IV-O-N-U**-type is found in the stems of Dicranaceae.

The **VI**-type, all of which show **U**-type of the epidermal cell walls, are classified into two types, **F** and **E**, on the ground of the characteristic about the differentiation of hadrom. Both **VI-U-F**-type and **VI-U-E**-type are found in the stems of Polytrichaceae.

As stated above, the stems hitherto observed, are classified into seventeen types by virtue of the anatomical characteristics. These characteristics and the grouping should be compared at every stage of the life cycle from every point of view.

### References

- ANDO, H. (1957) The *Hypnum* species restricted to Japan and adjacent areas (2). Journ. Sci. Hiroshima Univ. 8:1-18.
- (1958a) The *Hypnum* species restricted to Japan and adjacent areas (3). Journ. Sci. Hiroshima Univ. 8: 167-208.
- (1958b) *Tutigaea*, a new genus of Hypnaceae from Japan. Journ. Jap. Bot. 33: 175-181.
- (1966) A revision of the Chinese Cupressinae described by C. Muell. Bot. Mag. Tokyo 79: 759-769.
- (1968) Some little known species of the Asiatic *Hypnum*. Journ. Jap. Bot. 43: 171-183.



- (1969) *Miscellanea bryologica Asiae Orientalis*(1) *Hikobia* 5 : 179–188.
- (1971) *Miscellanea bryologica Asiae Orientalis* (2) *Hikobia* 6 : 36–46.
- (1972) Studies on the genus *Hypnum* HEDW. (1) *Journ. Sci. Hiroshima Univ.* 14 : 53–73.
- (1973a) Studies on the genus *Hypnum* HEDW. (2) *Journ. Sci. Hiroshima Univ.* 14 : 165–207.
- (1973b) Revision des especes africaines de *Gollania*(Hypnaceae) *Rev. Bryol. et Lichénol.* 39 : 529–538.
- (1973c) *Miscellanea bryologica Asiae Orientalis* (3) *Hikobia* 6 : 203–216.
- BOWERS, M.C. (1968) A cytotaxonomic study of the genus *Mnium* in Colorado. *Rev. Bryol. et Lichénol.* 36 : 167–202.
- FRYE, T.C. (1946) *Pogonatum convolutum* (HEDW.)P.BEAUV. *Bryologist* 49 : 36–40.
- and M.W.DUCKERING(1946) *Pogonatum flexuosum* (MUELL.)BROTH. *Bryologist* 49 : 141–146.
- (1947) *Oligotrichum tenuirostre* (HOOK.)J.AEG. *Bryologist* 50 : 64–65.
- and M.W.DUCKERING(1948) *Atrichum polycarpum* (SCHIMP.)MITT. *Bryologist* 51 : 170–174.
- (1948b) *Atrichum oerstedianum* (MUELL.)MITT. *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.
- (1967a) Structure et différenciation des tissus conducteurs dans le gamétophyte des *Polytrichum*. *Nat. Monspeliensia Bot.* 18 : 293–298.
- (1967b) Sur la comparaison des tissus conducteurs des bryophytes et des plants vasculaires. *C. R. Acad. Sc. Paris.* 264 : 901–903.
- et F. PRÉVOST(1968a) Cytologie végétale—Infrastrure des tissus conducteurs dans le gamétophyte de *Polytrichum formosum* HEDW. *C. R. Acad. Sc. Paris.* 267 : 2120–2122.
- (1968b) L'évolution des tissus conducteurs chez les mousses s. str.(Bryopsida). *Rev. Bryol. et Lichénol.* 36 : 111–113.
- (1968c) Remarques sur le phloème des cryptogames vasculaires et son évolution. *C. R. Acad. Sc. Paris.* 266 : 2190–2192.
- (1969a) Observations sur les traces foliaires des mousses s. str. (Bryopsida). I. Les hydroides et leurs relations avec le cylindre central. *Rev. Bryol. et Lichénol.* 36 : 721–728.
- (1969b) Sur l'évolution des tissus conducteurs chez les mousses s. str.(Bryopsida). une interprétation nouvelle. *Rev. Bryol. et Lichénol.* 36 : 729–731.
- (1969c) Histologie végétale—nouvelles observations sur le leptome de la tige feuillée des *Polytrichum*. *C. R. Acad. Sc. Paris.* 269 : 2530–2533.
- (1969d) Cytologie végétale—Différenciation 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 phloème(leptome) dans la tige feuillée de quelques mousses Polytrichales. *C. R. Acad. Sc. Paris.* 271 : 1361–1363.
- (1970b) Biologie cellulaire—étude histochimique, 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.
- et J. BERTHIER(1971-1972) La ramification et ses conséquences anatomiques dans la tige aérienne feuillée des Polytrichales (étude morphogénétique et histologique de quelques espèces appartenant aux genres *Polytrichum*, *Pogonatum*, et *Dendrologotrichum*)*Rev. Bryol. et Lichénol.* 38 : 177-240.
- (1972a) Observations sur les traces foliaires des mousses s. str. II. Etude, chez quelques Polytrichales, des éléments à caractères "Phloémiens". *Nove Hedwigia* 23 : 735-766.
- (1972b) Les tissus conducteurs des Bryophytes l'information scientifique 5 : 207-219.
- (1973a) Studies on the development of the conducting tissue-system in the gametophytes of some Polytrichales I. Miscellaneous notes on apical segmentation, growth of gametophytes, and diversity in histo-anatomical structures. *Journ. Hattori Bot. Lab.* 37 : 211-227.
- (1973b) Diversity of structure of the water-conducting elements in liverworts and mosses. *Journ. Hattori Bot. Lab.* 37 : 229-234.
- HOLZINGER, J.M. (1905) Some recently described North American *Polytricha*. *Bryologist* 8 : 28-31.
- HÖRMANN, H. (1959) Zur Morphologie und Anatomie von *Climacium dendroides* WEB. et MOHR. und *Thamnum alopecurum* B.S.G. *Nova Hedwigia* 2 : 201-208.
- (1963) Beitrag zur 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. (1959) A revision of the Japanese species of 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. *Ibid.* 26 : 63-74.
- (1965) Notes on the genus *Dolichotheca*, with special reference to the Japanese species. *Ibid.* 28 : 202-208.
- (1967a) Bryological miscellanies XVIII. *Ibid.* 30 : 105-112.
- et A.J. Sharp(1967b) The bryogeographical relationships between eastern Asia and North America. *Ibid.* 30 : 152-180.
- (1970) A revision of *Plagiothecium* and its related genera from Japan and her adjacent areas. *Ibid.* 33 : 331-380.
- KAWAI, I. (1962) Cytological 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.BEAUW. *Ann. Rep. Bot. Garden, Kanazawa Univ.* 2 : 1-25.
- (1969b) ————. (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.
- KOPONEN, T. (1968) Generic revision of Mniaceae Mitt. Ann. Bot. Fenn. 5 : 117-151.
- (1975) *Tayloria pocsii*, spec. nova (Musci, Splachnaceae) from Mt. Kilimanjaro, Tanzania. Ann. Bot. Fenn. 12 : 22-24.
- 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.
- 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-patagónicas II. Ibid. 4 : 243-280.
- (1973a) El genero *Breutelia* (Bartramiaceae, Musci) en la region Andino-patagónica. Ibid. 4 : 321-360.
- (1973b) Revision de las Hypopterygiaceae (Musci) Austrosuda mericanas. Bol. Soc. Arg. Bot. 15 : 229-250.
- 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. Ibid 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) ———. (4) The genus *Ptychomitrium*. Ibid. 12 : 1-26.
- (1956) ———. (5) The genus *Distichophyllum*. Ibid. 17 : 19-31.
- and T. Osada (1960) ———. (6) The genus *Atrichum*. Ibid. 23 : 122-147.
- (1972) On the delimitation of the genera of Hylocomiaceae and Rhytidiaceae. Ibid. 35 : 155-168.
- (1974a) Musci japonici X. The genus *Rhacomitrium*. Ibid. 38 : 337-369.
- (1974b) ———. XI. The families Disceliaceae, Ephemeraceae, Oedipodiaceae, Splachnaceae and Schistostegaceae. Ibid. 38 : 387-404.
- 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) ———. II. The genera *Polytrichum*, *Oligotrichum*, *Bartramiopsis* and *Atrichum*, and phytogeography. Ibid. 29 : 1-52.
- and S. UENO (1966b) On the structure of the stem and the foot of *Rhacelopodopsis camsi* THÉR. 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) Anatomical studies in the Polytrichaceae. I. The gametophore 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.
- 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. *Brachydontium*, *Atractylocarpus*, *Amphidium*, *Rhabdoweisia*, *Tayloria*, *Rhacocarpus*, *Trachypodopsis*. *Bull. Jard. Bot. Nat. Belg.* 43: 333-348.
- (1975a) ———. II. *Oreoweisia*, *Eriopus*, *Cyclodictyon*, *Hookeriopsis*, *Lepidopilidium*, *Lepidopilum*. *Bull. Jard. Bot. Nat. Belg.* 45: 103-124.
- (1975b) ———. III. *Physcomitrella magdalanae*, sp. nov. *Bull. Jard. Bot. Nat. Belg.* 45: 131-135.
- 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.
- 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* SCHIMP. *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.

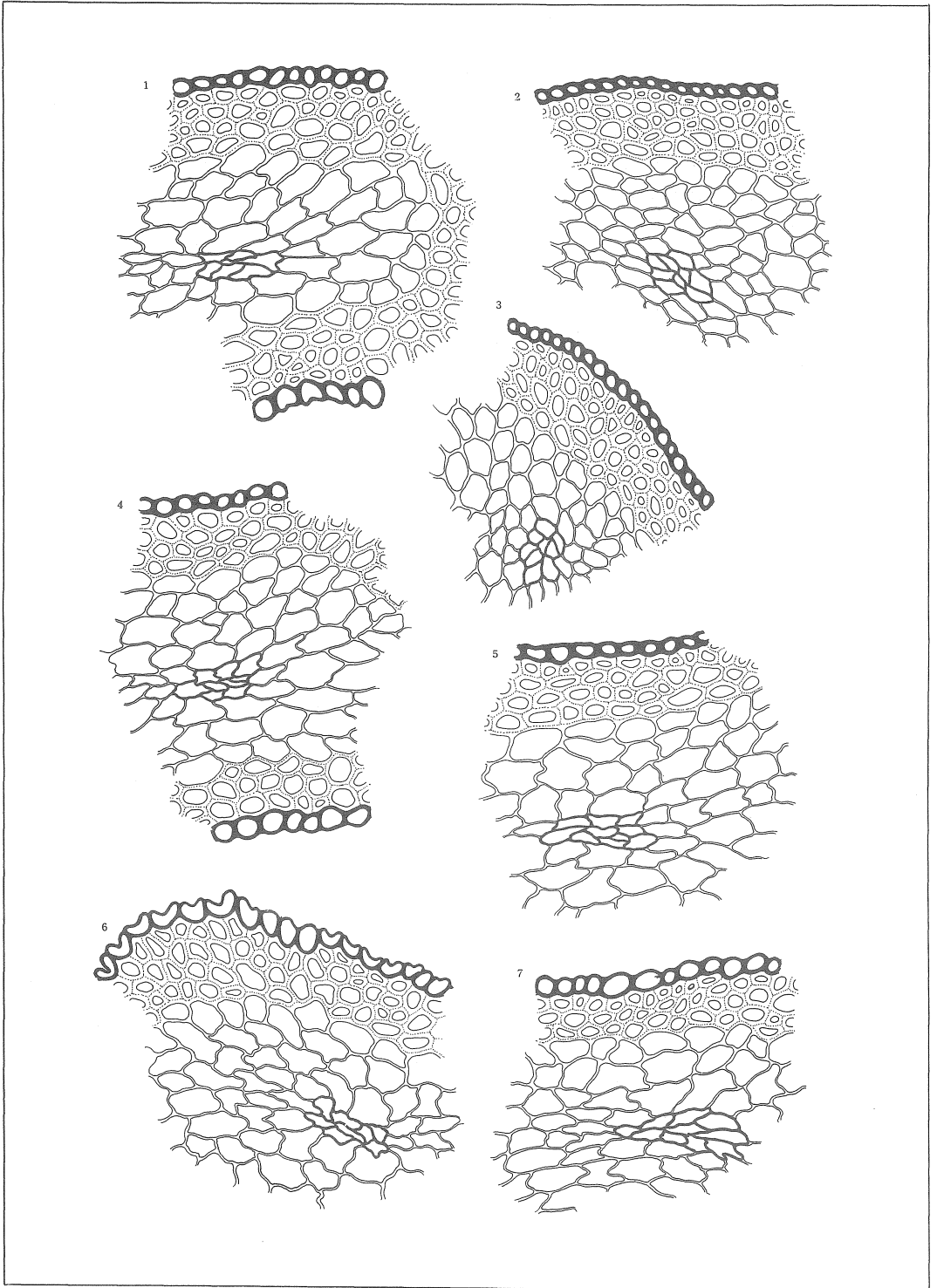


Plate I. Cross sections of stem

Fig. 1-7: *Clenidium capillifolium* (MITT.) BROTH. × 240

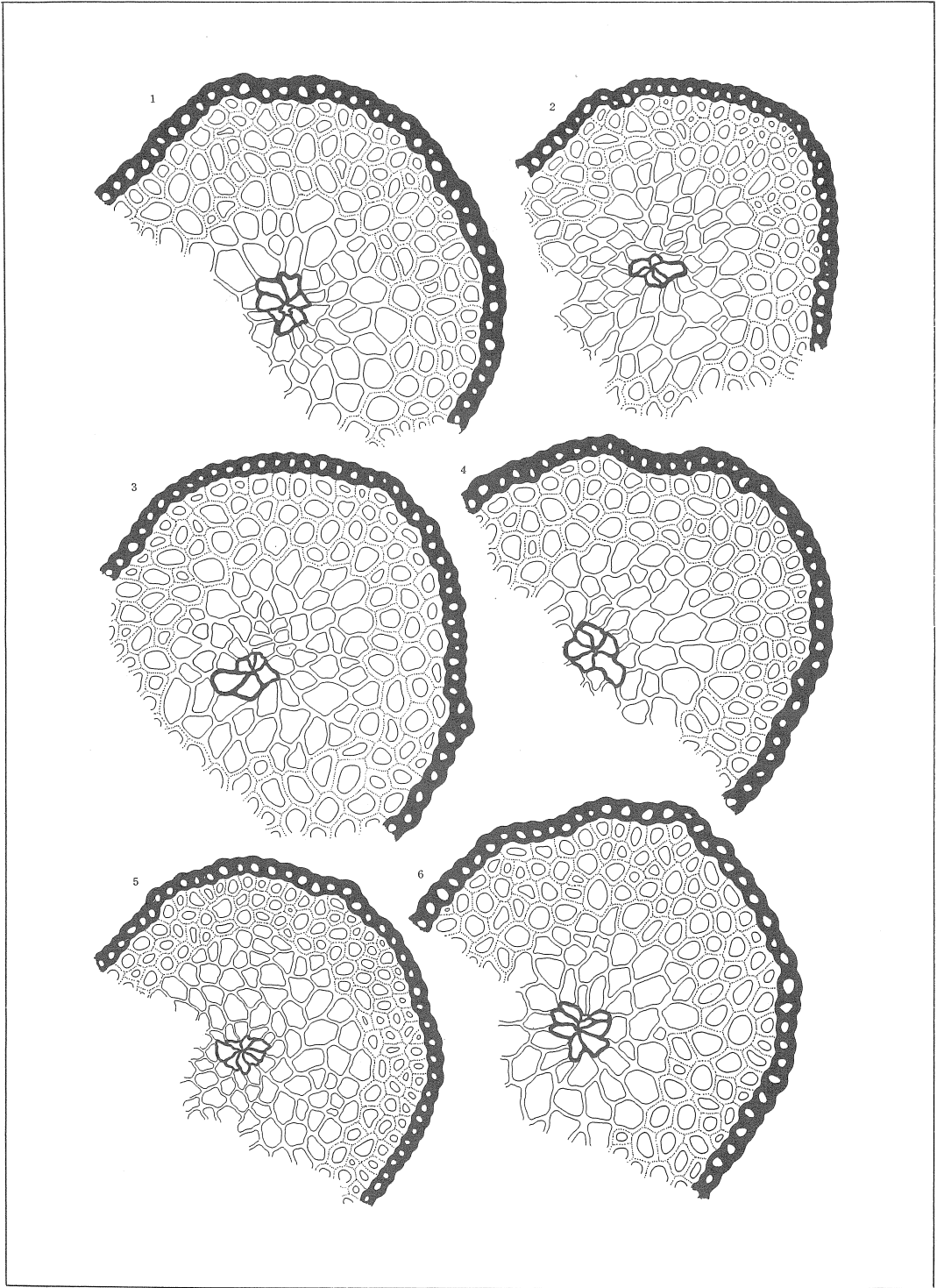


Plate II. Cross sections of stem

Fig. 1-6: *Ctenidium hastile* (MITT.) LINDB.  $\times 240$

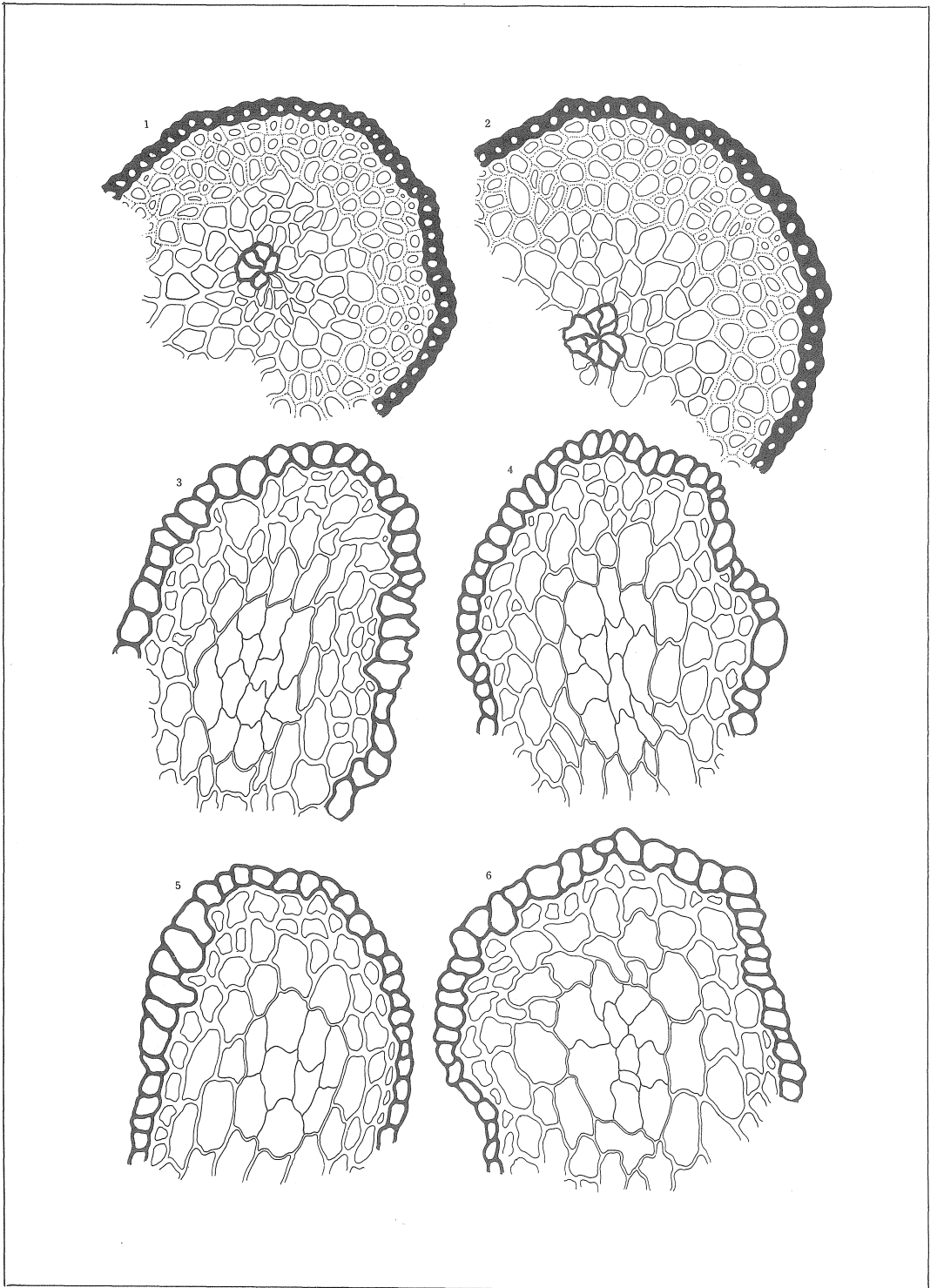


Plate III. Cross sections of stem

Fig. 1-2: *Ctenidium hastile* (MITT.) LINDB.  $\times 240$

Fig. 3-6: *Ectropothecium obtusulum* (CARD.) IWATS.  $\times 240$

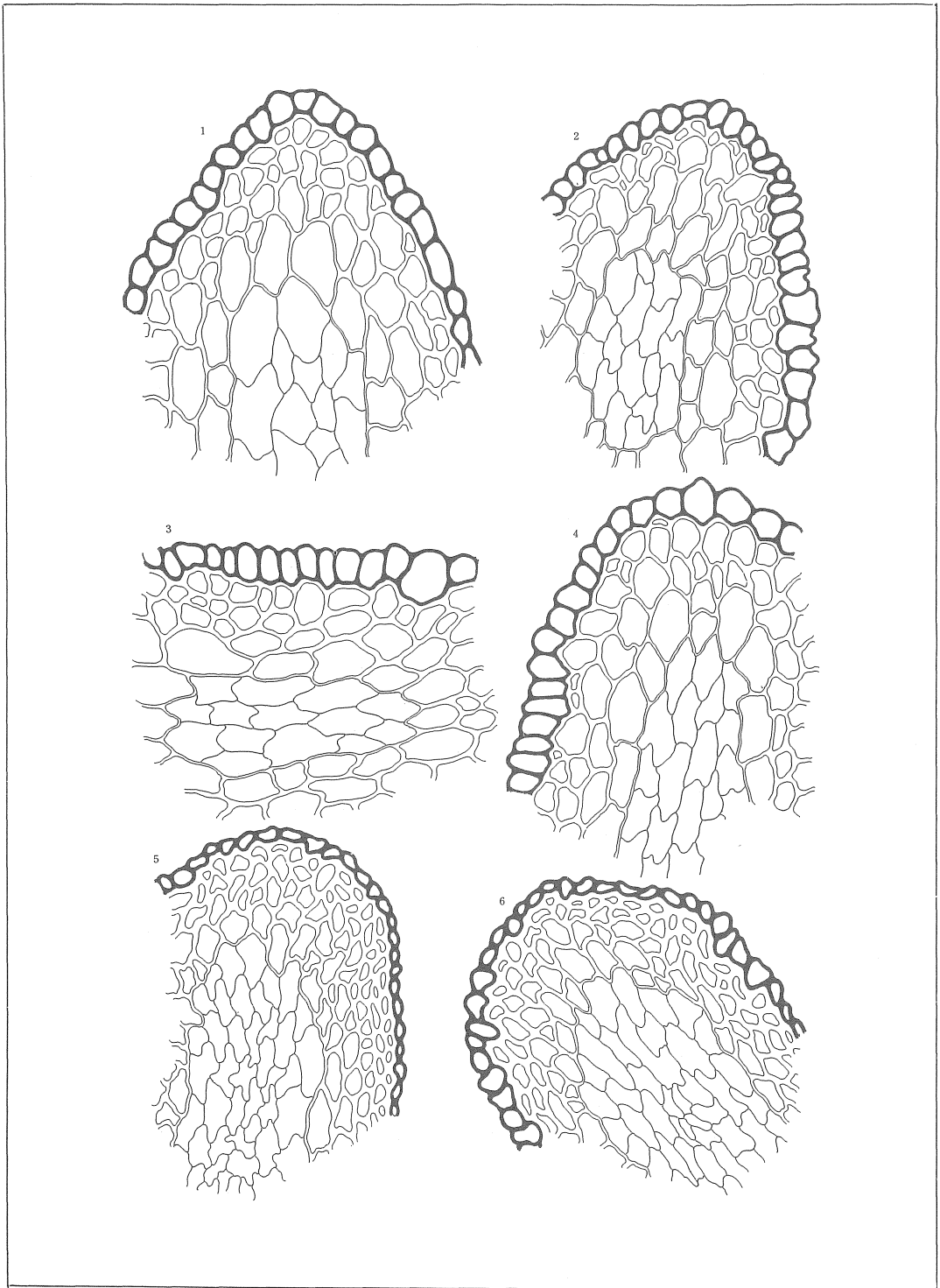


Plate IV. Cross sections of stem

Fig. 1-4 : *Ectropothecium obtusulum* (CARD.)IWATS.  $\times 240$

Fig. 5-6 : *Ectropothecium zollingeri* (C.MUELL.)JAEG.  $\times 240$



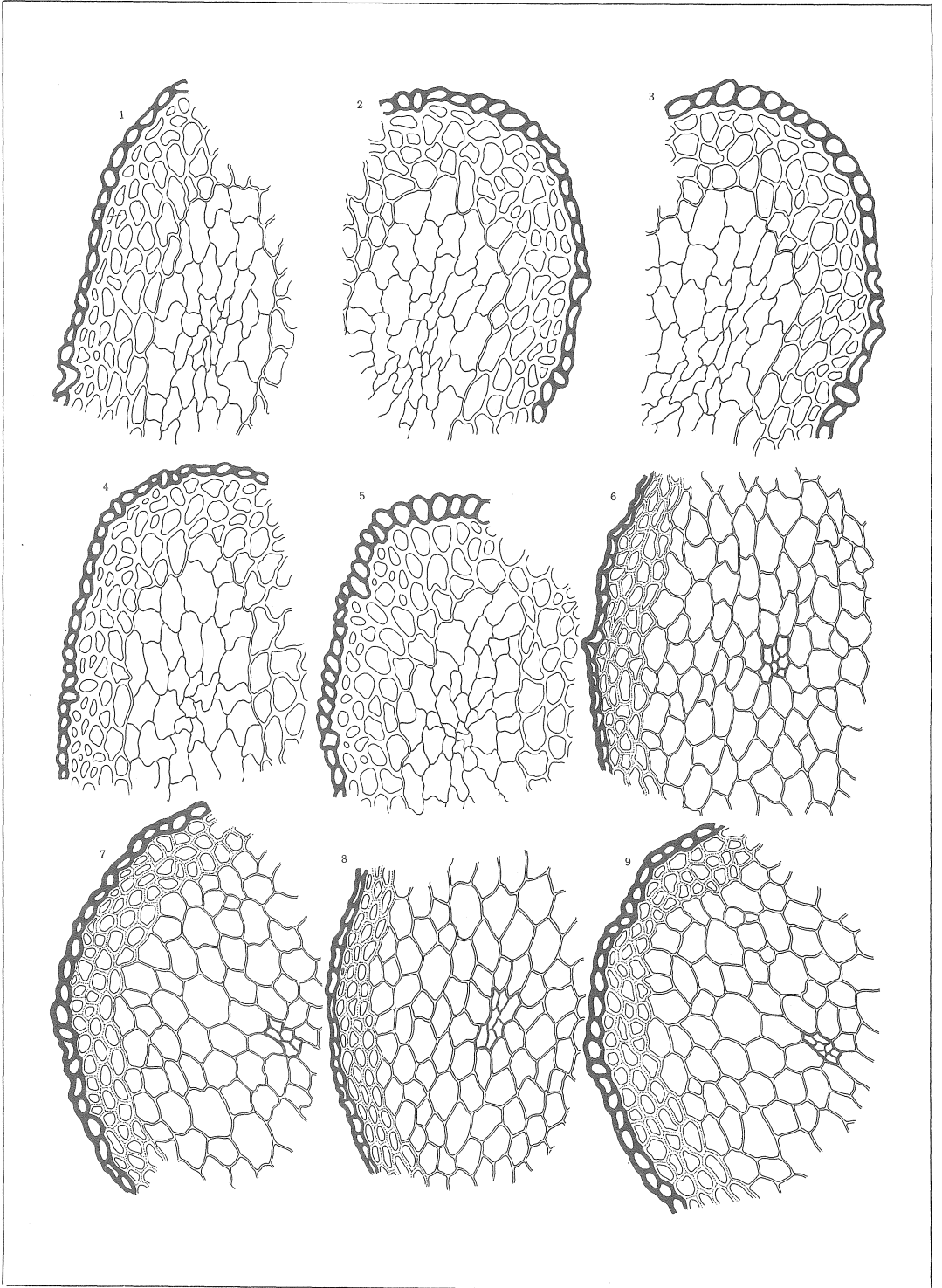


Plate V. Cross sections of stem

Fig. 1-5: *Ectropothecium zollingeri* (C.MUELL.)JAEG.  $\times 240$

Fig. 6-9: *Eurohypnum leptothallum* (C.MUELL.)ANDO  $\times 240$

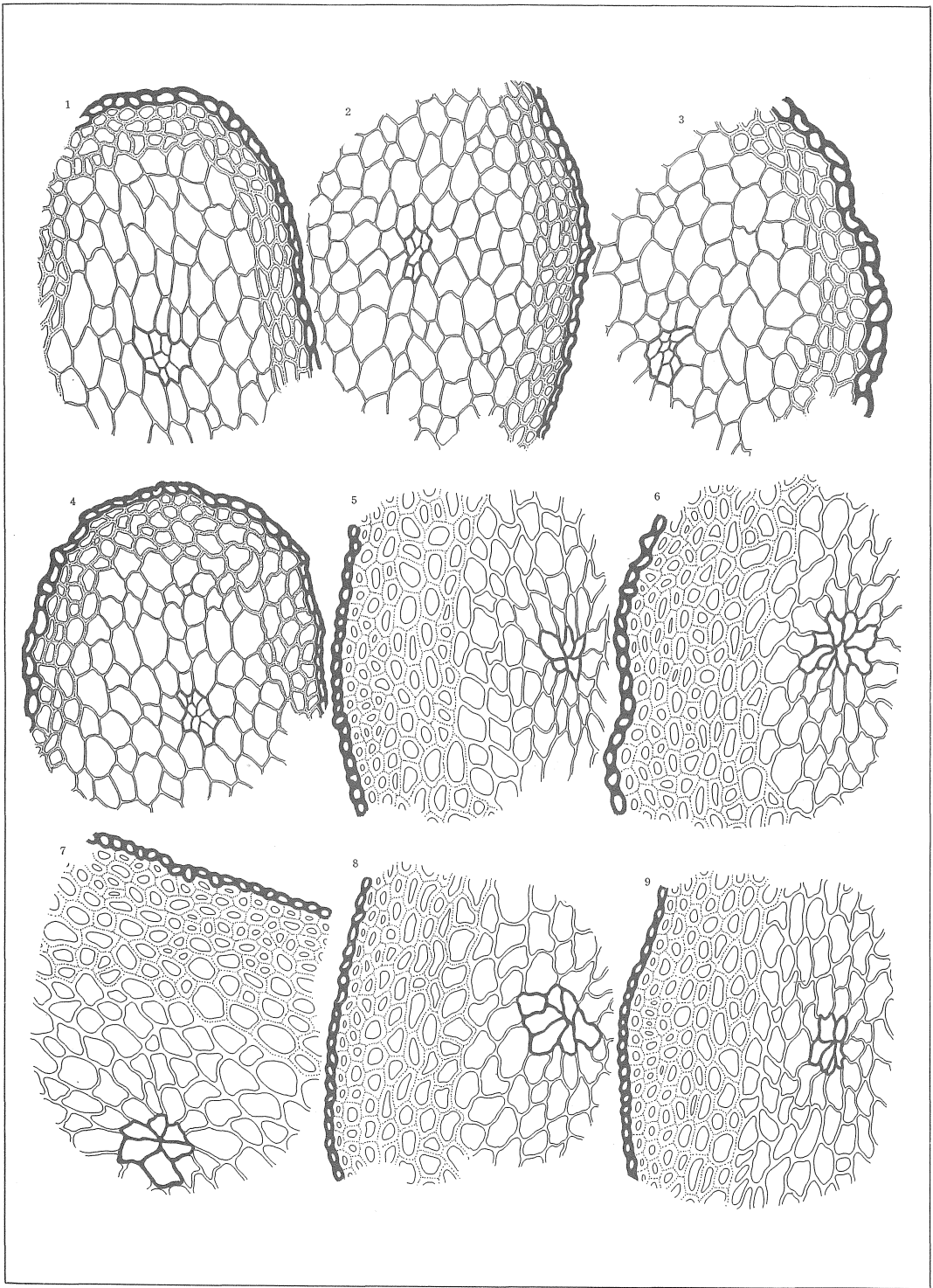


Plate VI. Cross sections of stem

Fig. 1-4 : *Eurohypnum leptothallum* (C.MUELL.)ANDO  $\times 240$

Fig. 5-9 : *Gollania ruginosa* (MITT.)BROTH.  $\times 240$

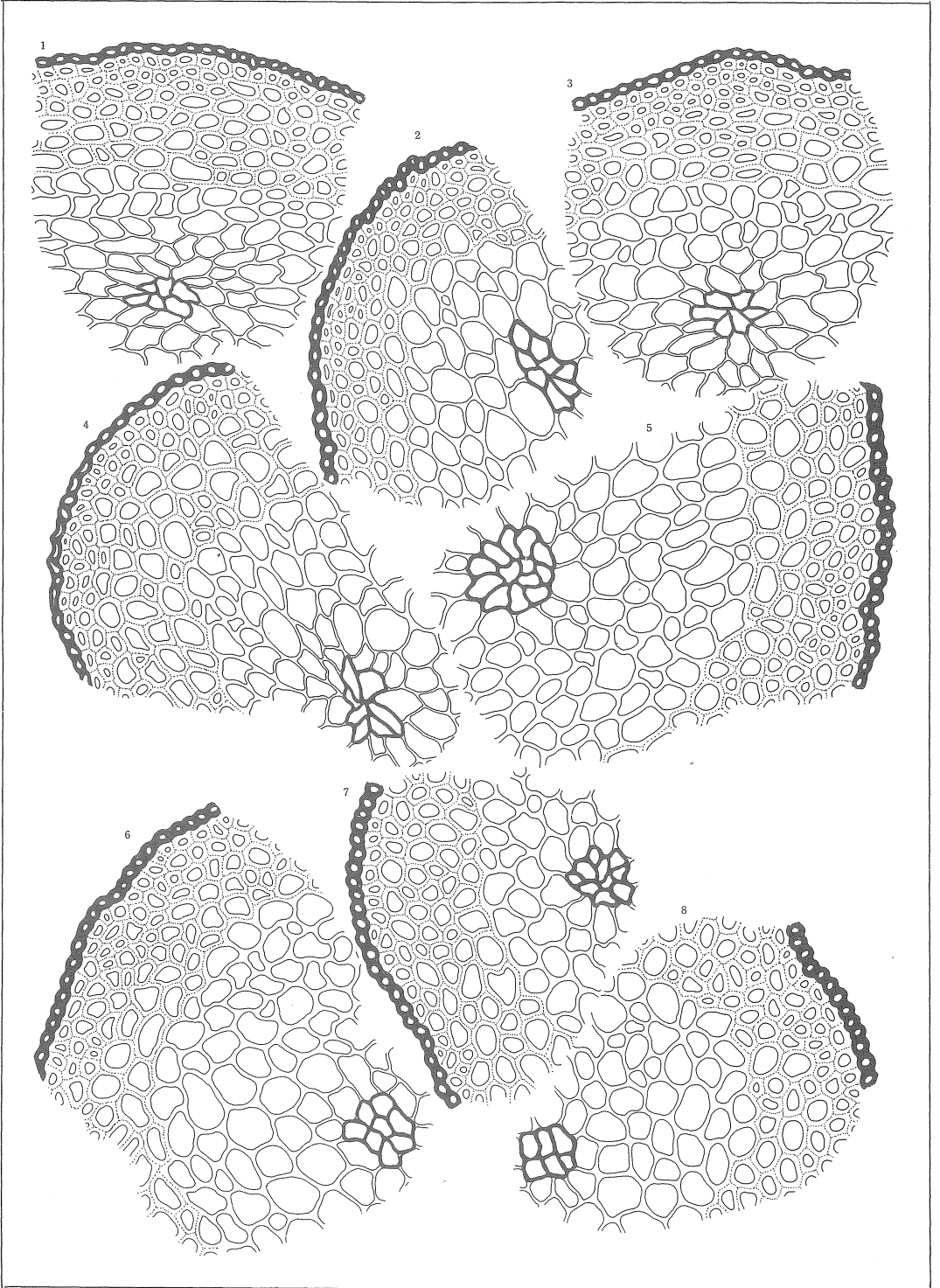


Plate VII. Cross sections of stem

Fig. 1-3: *Gollania ruginosa* (MITT.) BROTH.  $\times 240$

Fig. 4-8: *Gollania varians* (MITT.) BROTH.  $\times 240$

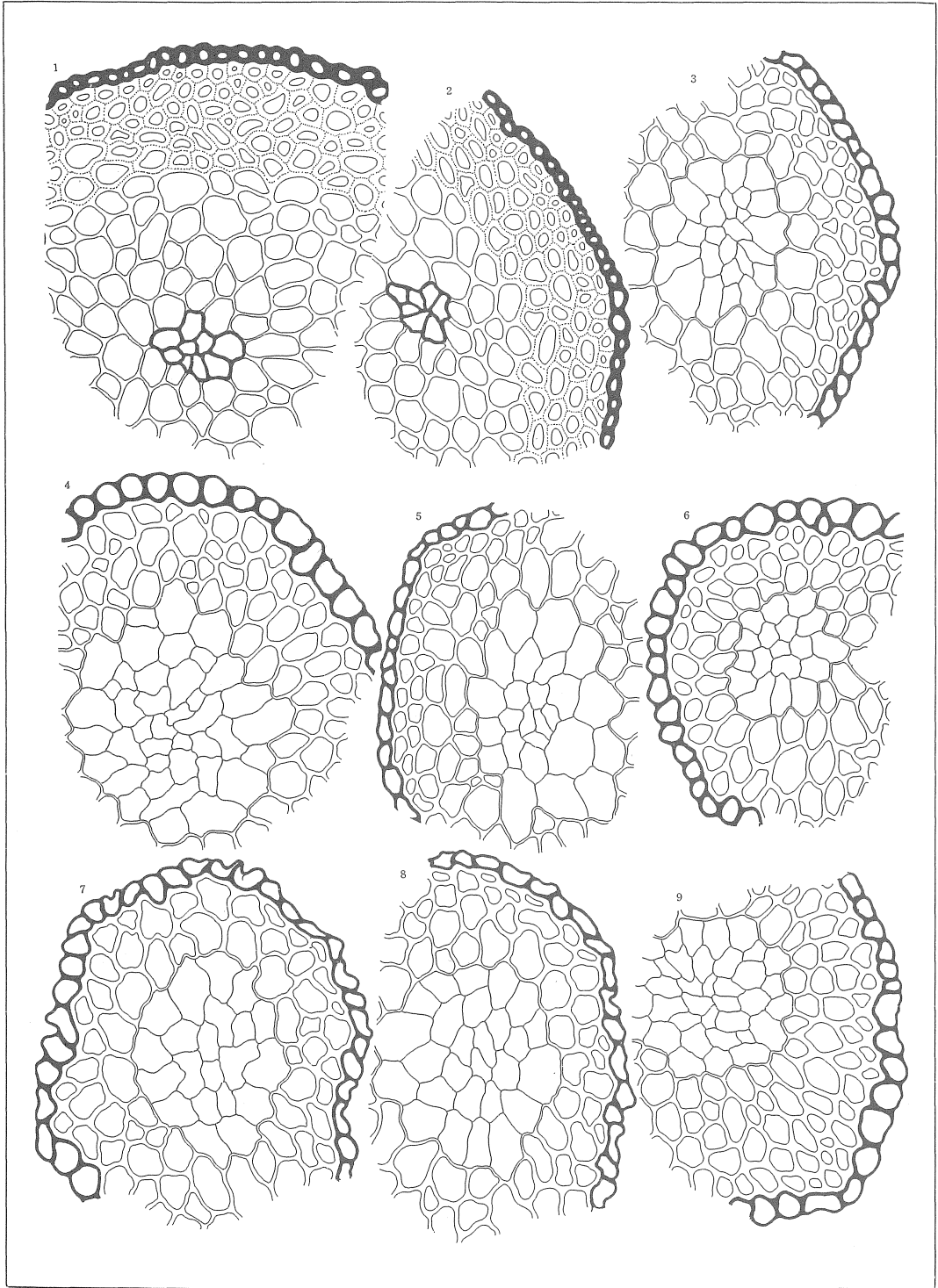


Plate VIII. Cross sections of stem

Fig. 1-2: *Gollania varians* (MITT.) BROTH.  $\times 240$

Fig. 3-9: *Herzogiella perrobusta* (BROTH. ex CARD.) IWATS.  $\times 240$

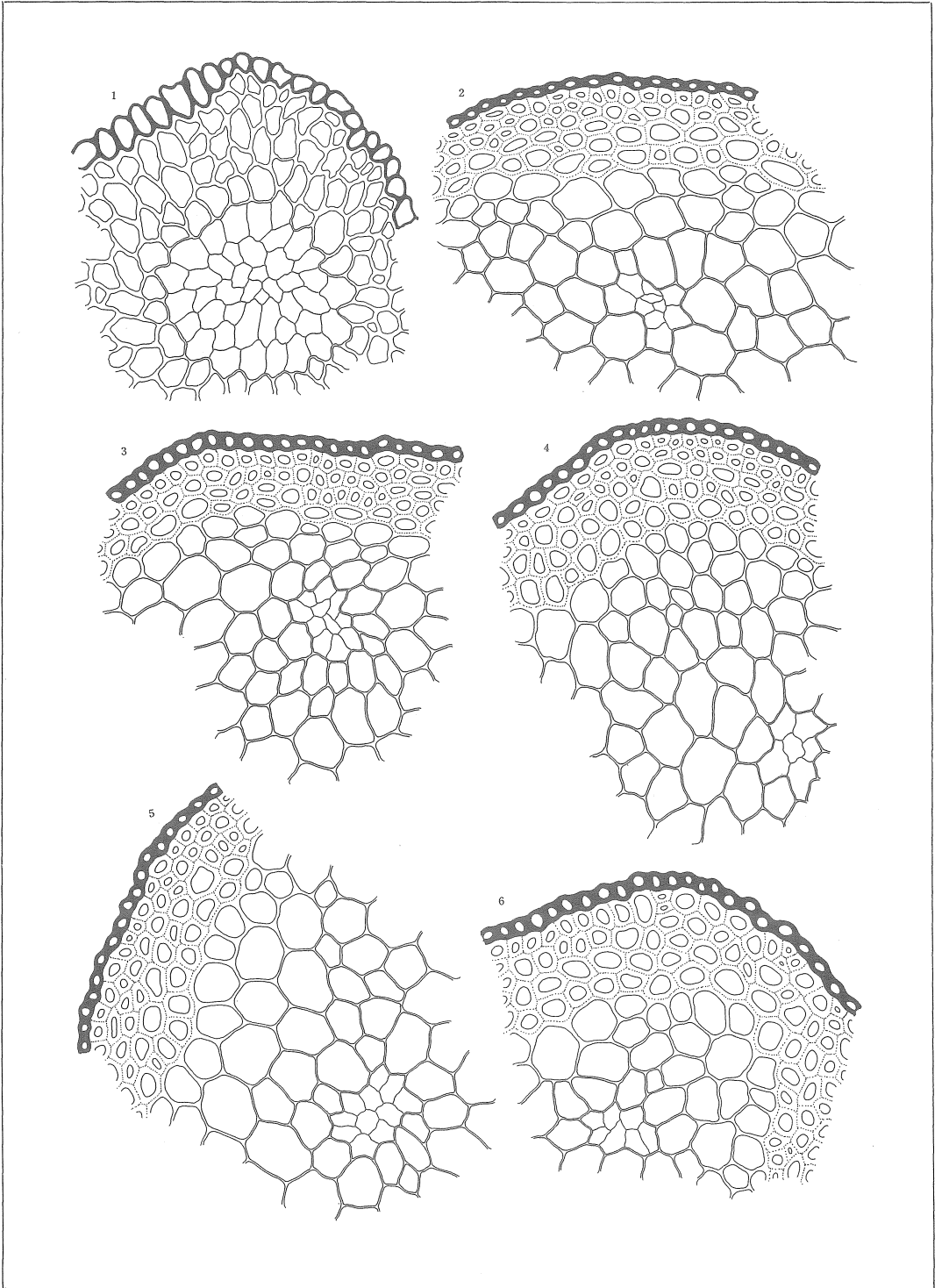


Plate IX. Cross sections of stem

Fig. 1: *Herzogiella perrobusta* (BROTH. ex CARD.)IWATS.  $\times 240$

Fig. 2-6: *Homomallium connexum* (CARD.)BROTH.  $\times 240$

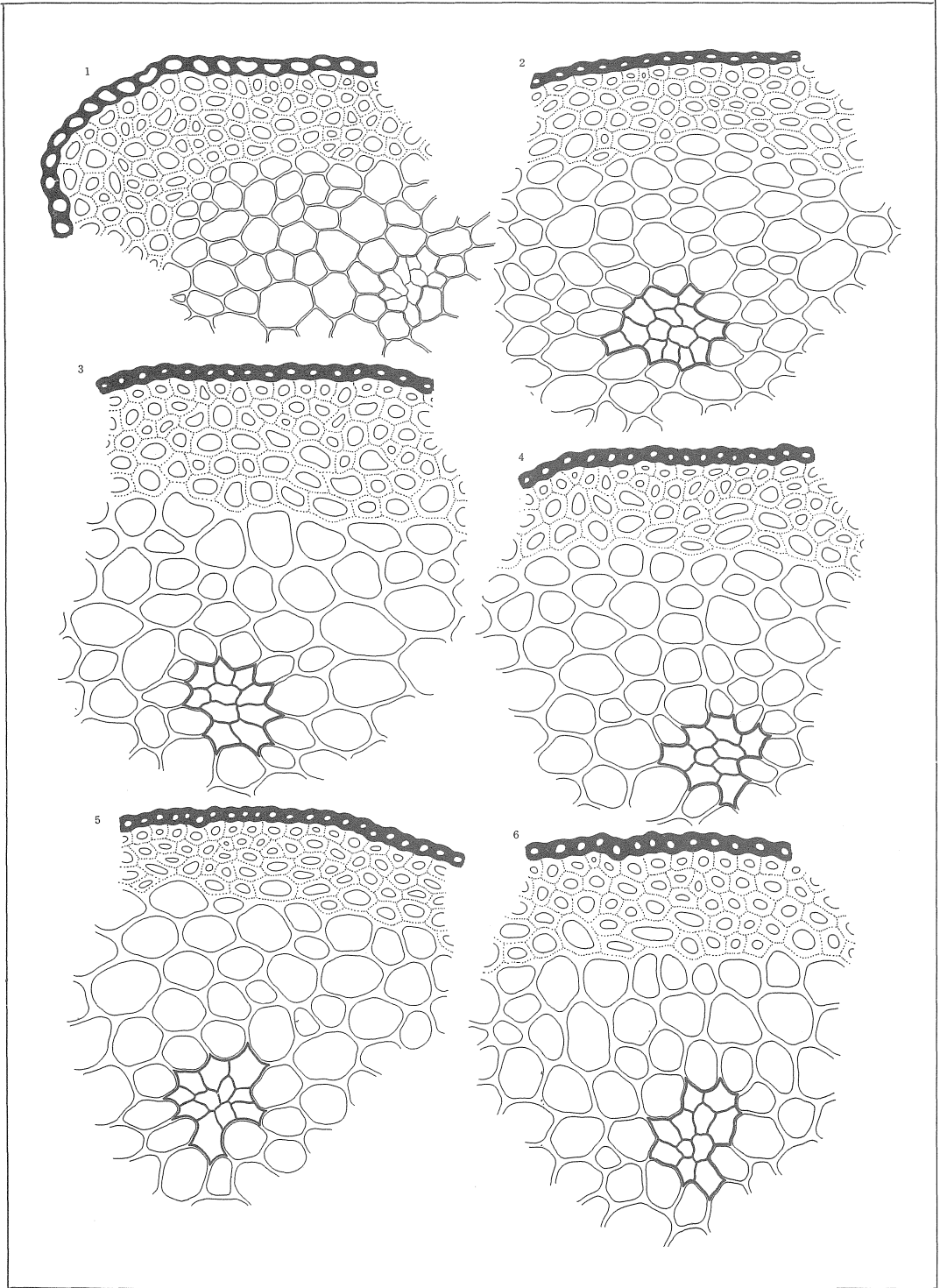


Plate X. Cross sections of stem

Fig. 1: *Homomallium connexum* (CARD.)BROTH.  $\times 240$

Fig. 2-6: *Hypnum calcicolum* ANDO  $\times 240$

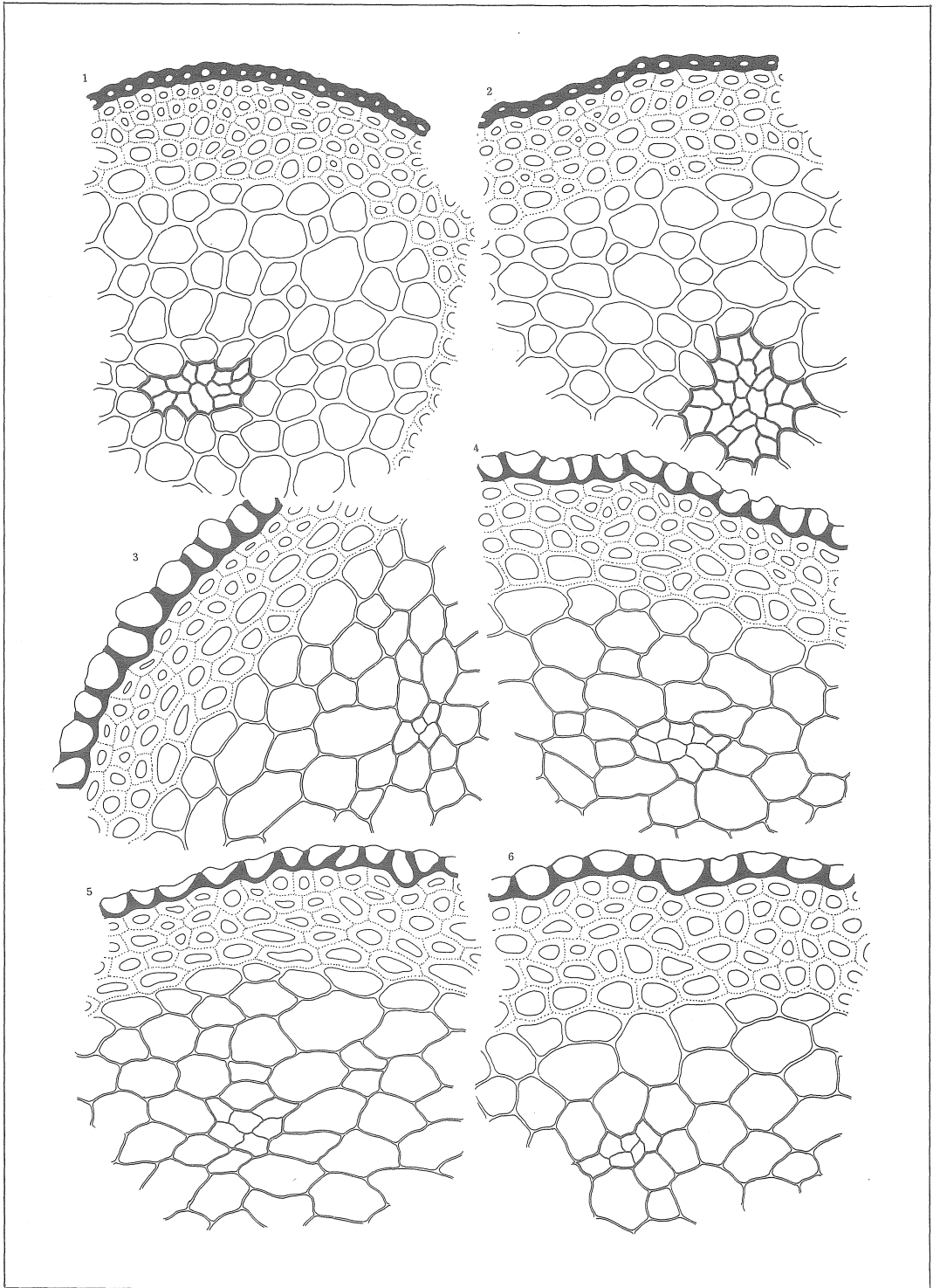


Plate XI. Cross sections of stem

Fig. 1-2: *Hypnum calcicolum* ANDO × 240

Fig. 3-6: *Hypnum callichroum* ssp. *japonicum* ANDO × 240

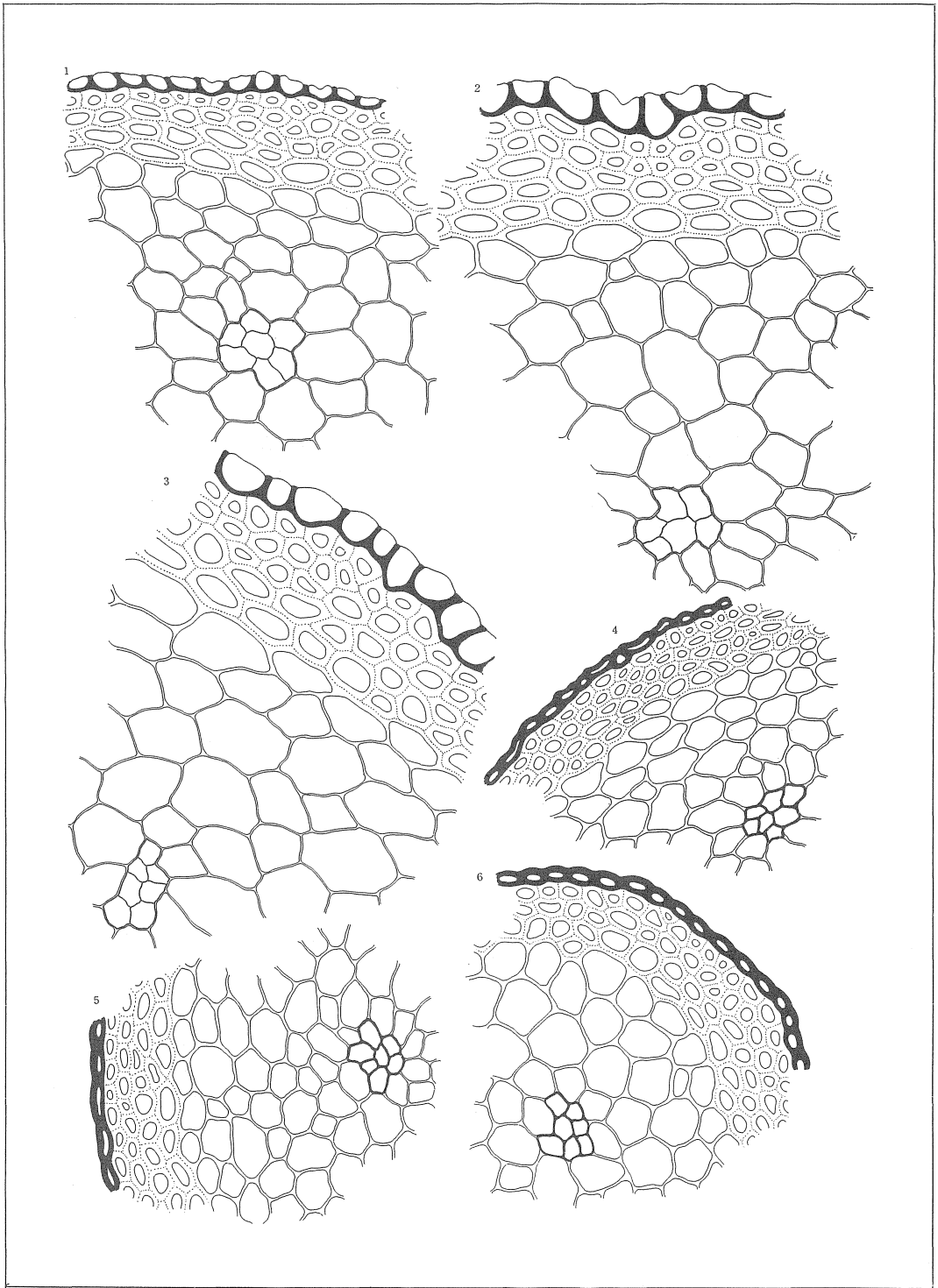


Plate XII. Cross sections of stem

Fig. 1-3: *Hypnum callichroum* ssp. japonicum ANDO  $\times 240$

Fig. 4-6: *Hypnum cupressiforme* HEDW.  $\times 240$



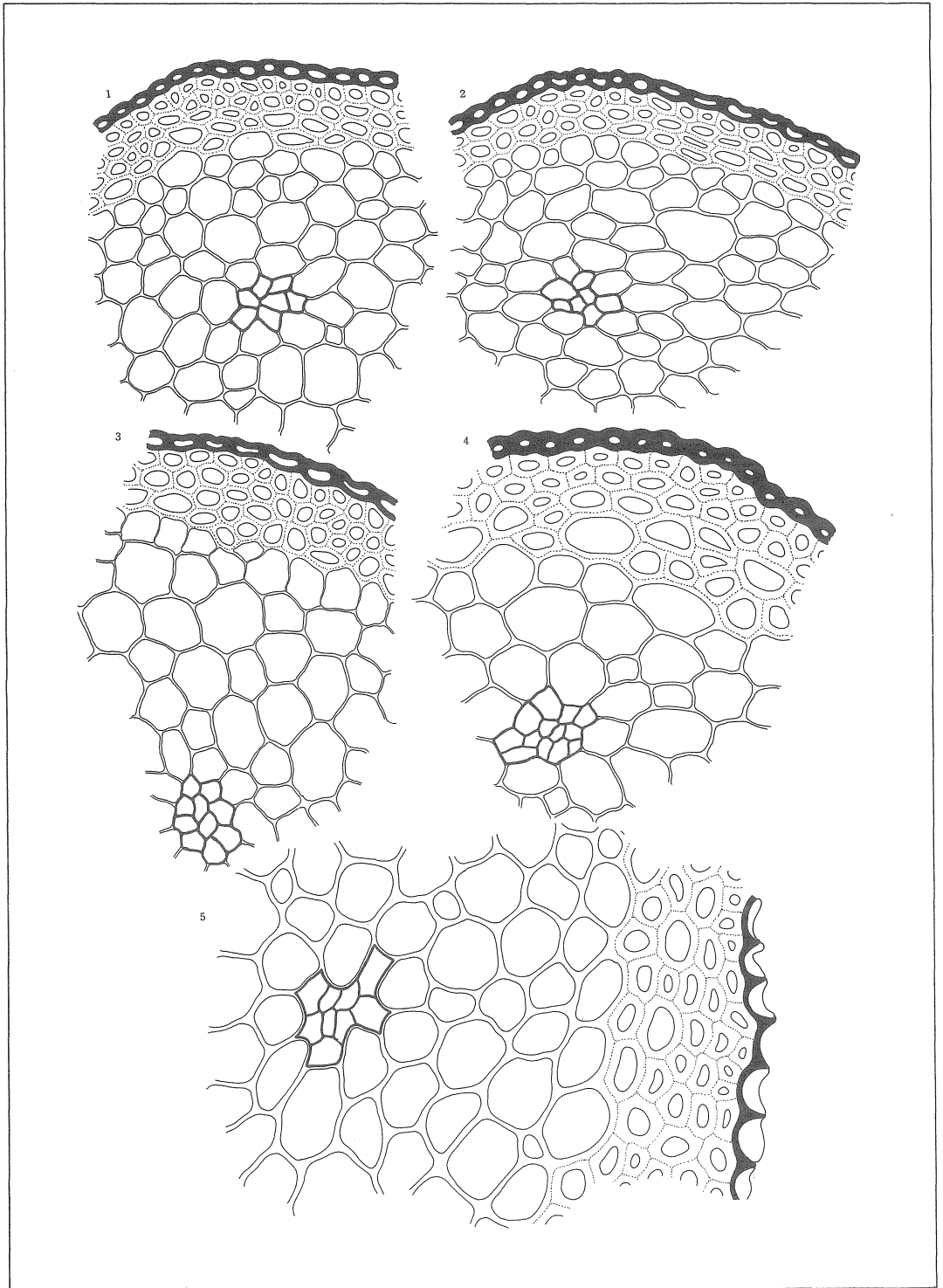


Plate XIII. Cross sections of stem

Fig. 1-4: *Hypnum cupressiforme* HEDW.  $\times 240$ Fig. 5: *Hypnum dieckii* REN. et CARD.  $\times 240$

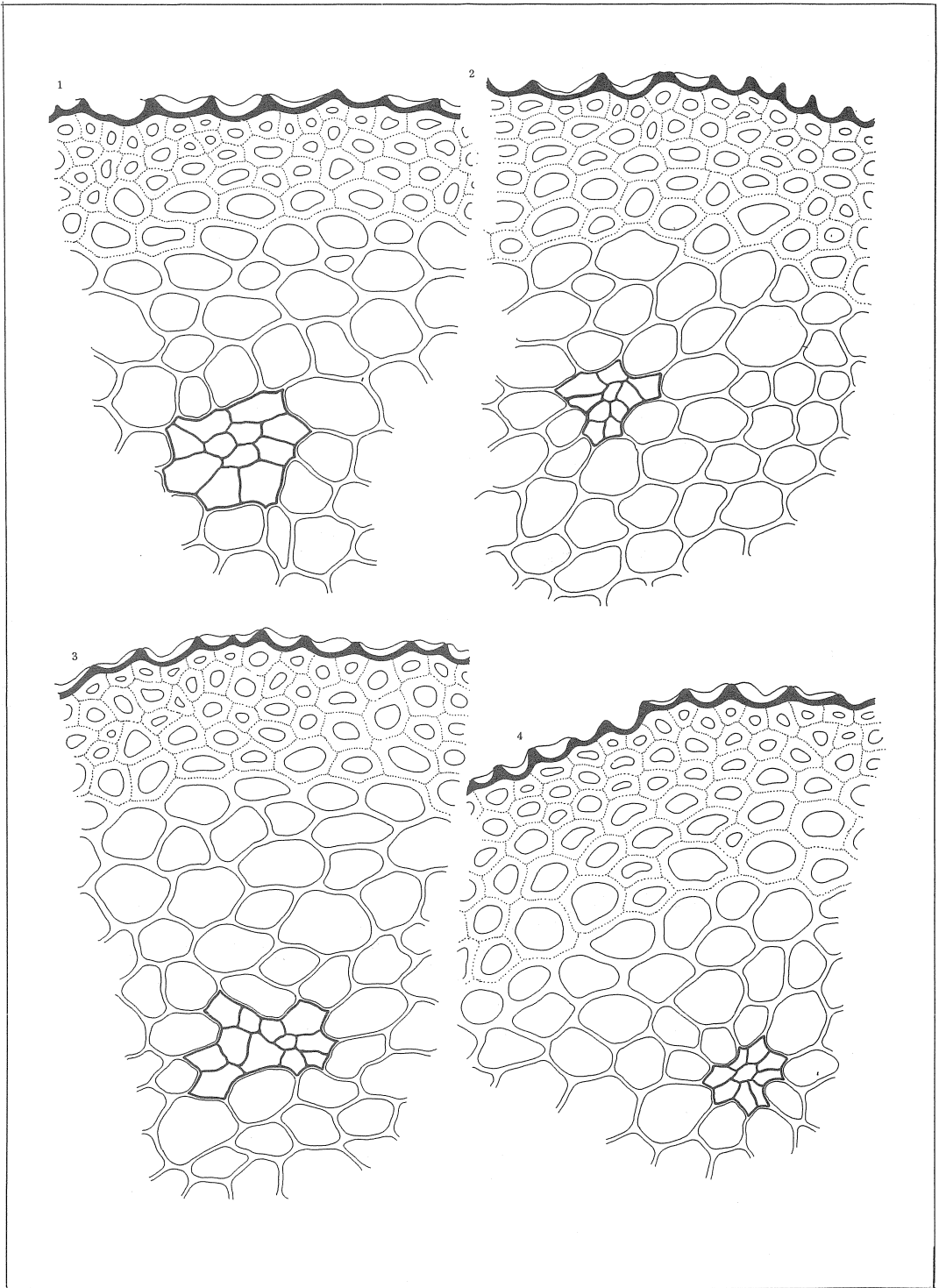


Plate XIV. Cross sections of stem

Fig. 1-4: *Hypnum dieckii* REN. et CARD. × 240

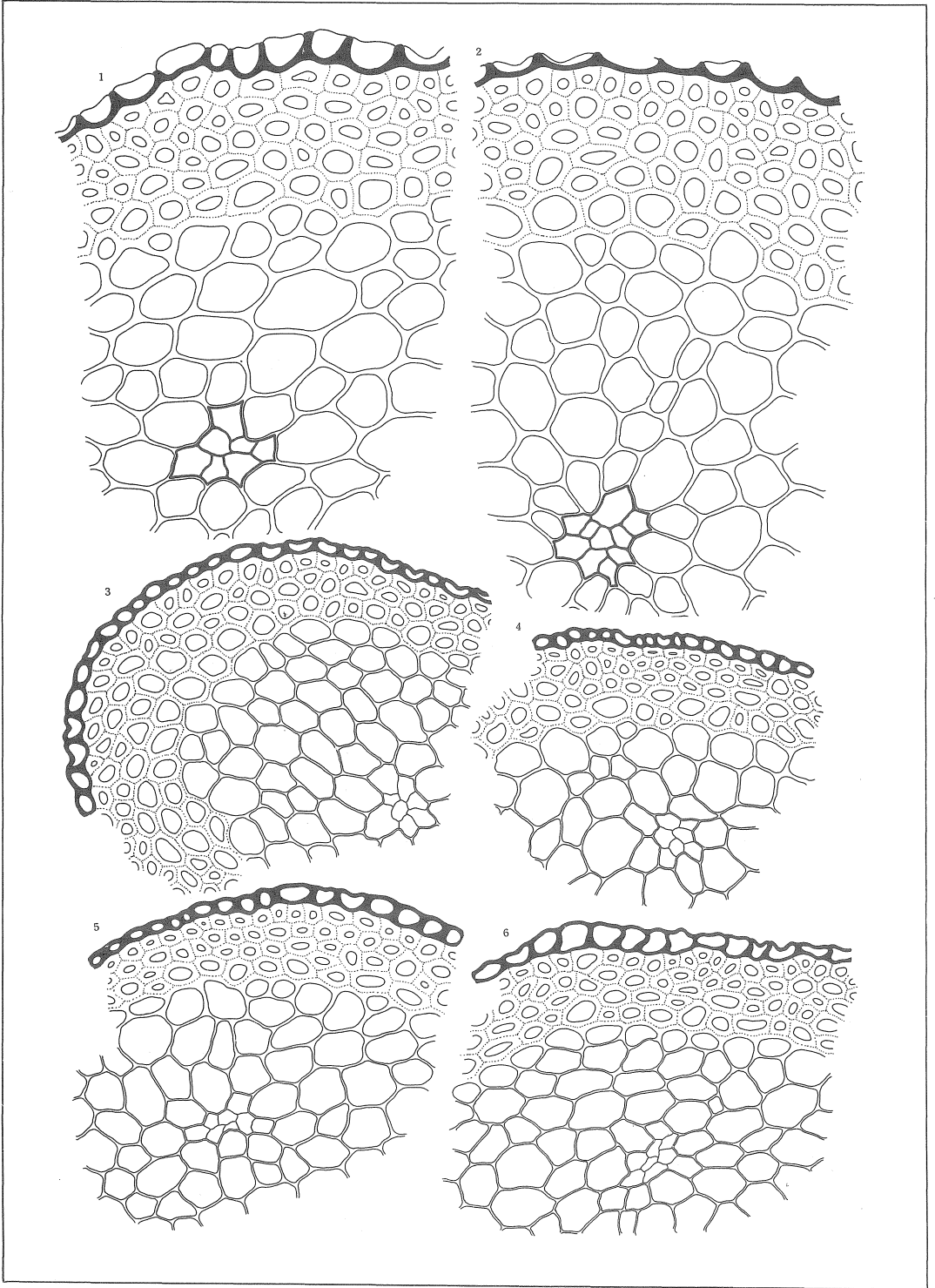


Plate XV. Cross sections of stem

Fig. 1-2: *Hypnum dieckii* REN. et CARD.  $\times 240$

Fig. 3-6: *Hypnum densirameum* ANDO  $\times 240$

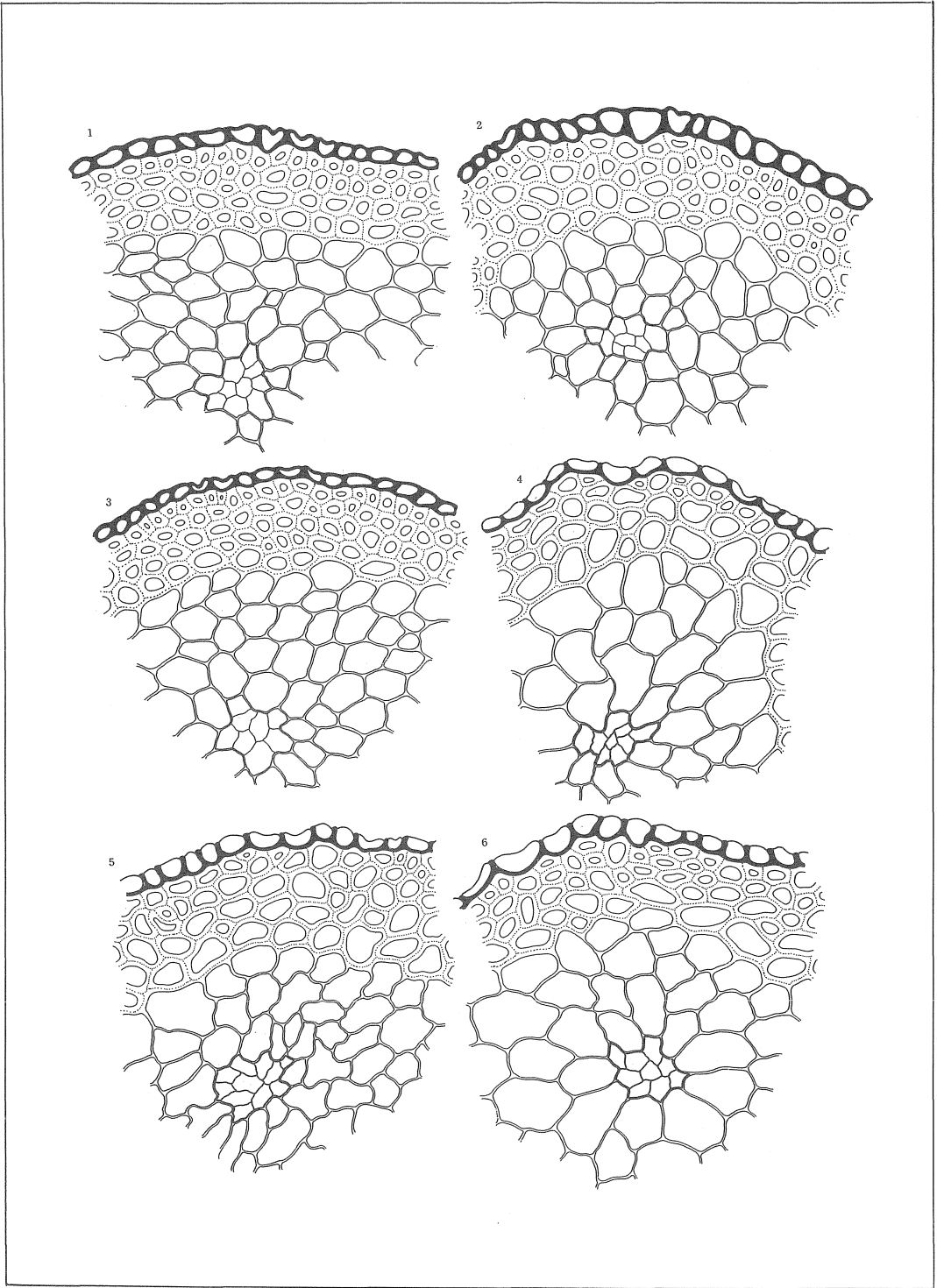


Plate XVI. Cross sections of stem

Fig. 1-3: *Hypnum densirameum* ANDO ×240

Fig. 4-6: *Hypnum erectiusculum* SULL. et LESQ. ×240

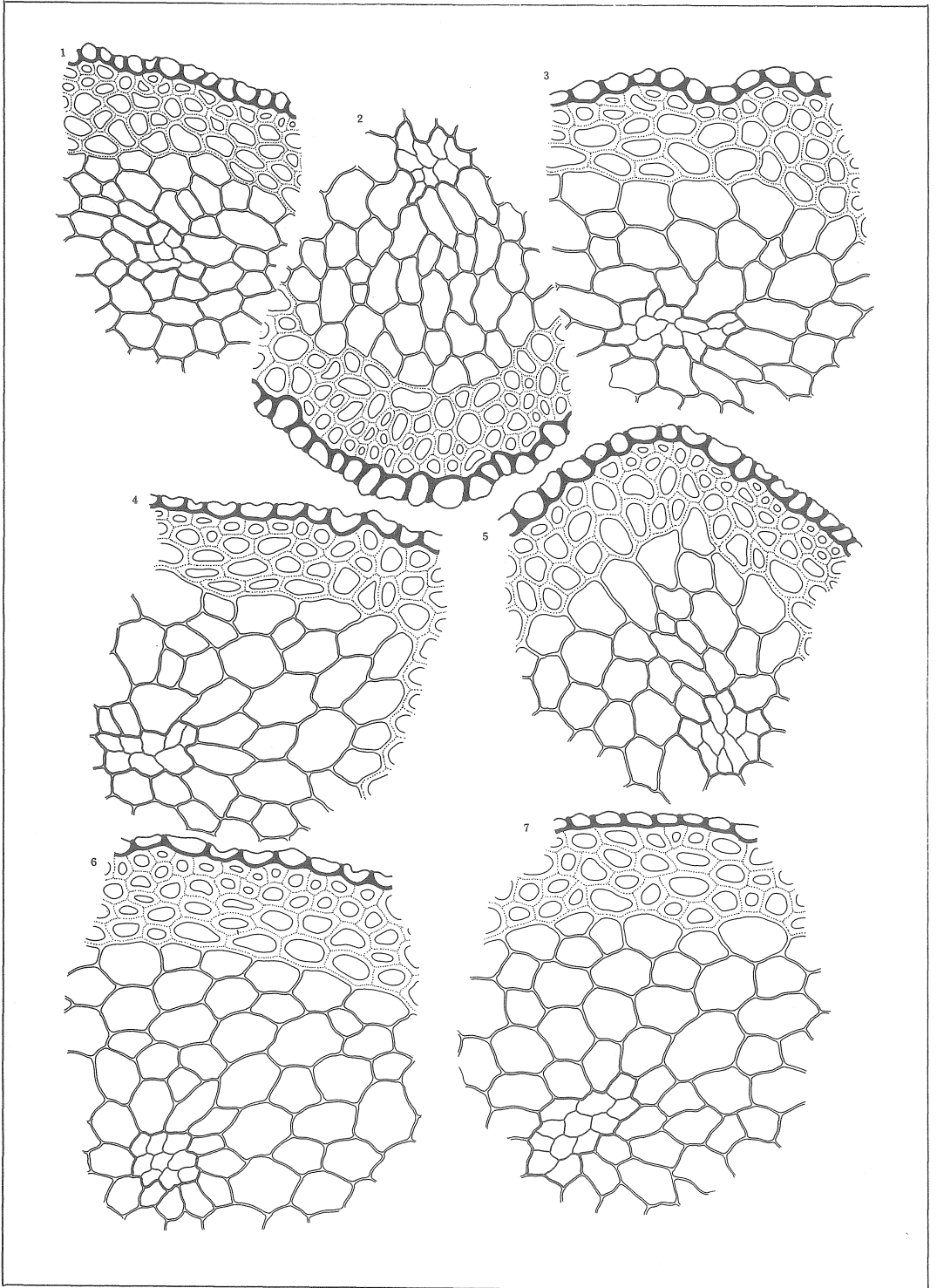


Plate XVII. Cross sections of stem

Fig. 1-7: *Hymnum erectiusculum* SULL. et LESQ. ×240

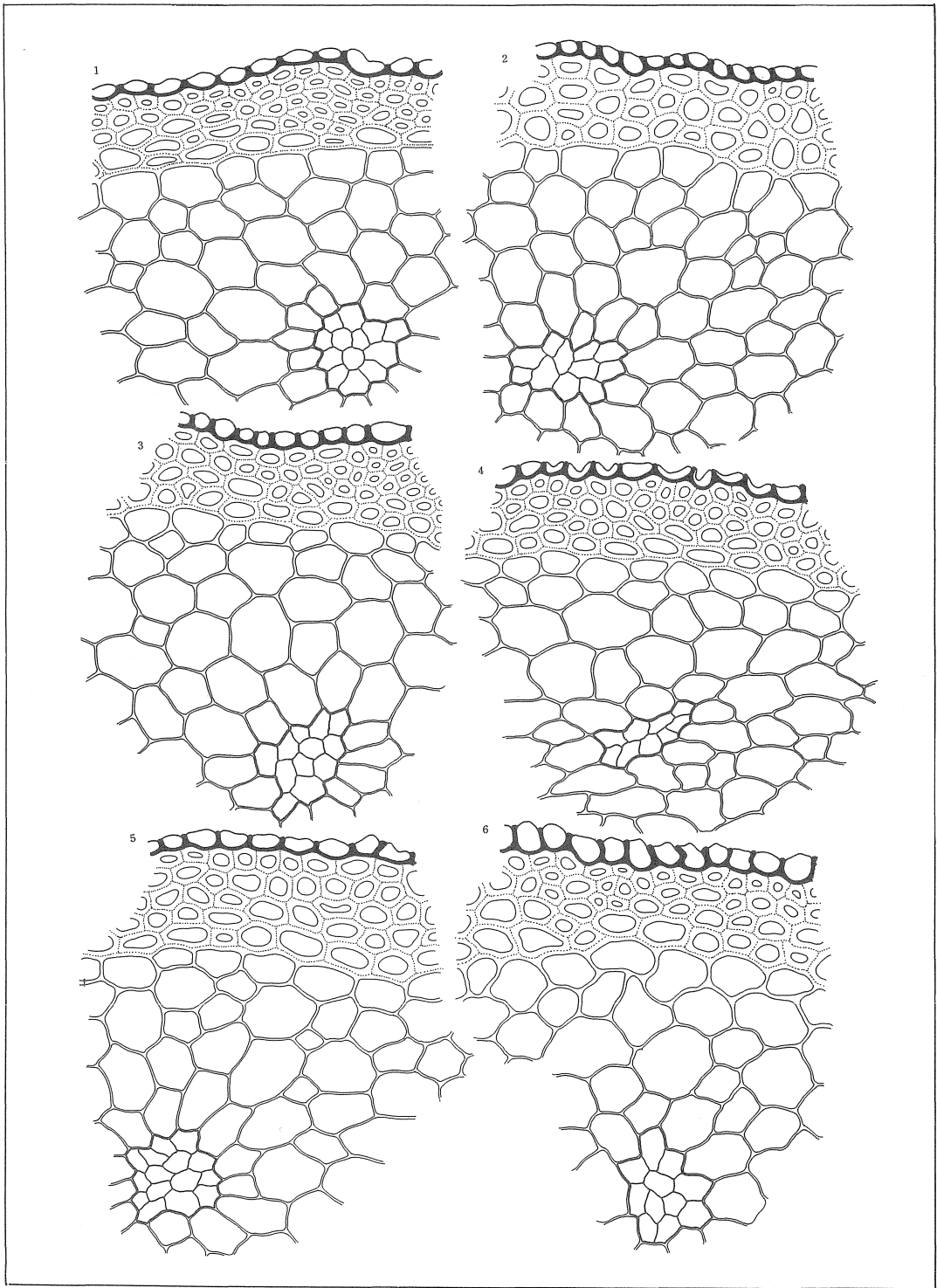


Plate XVIII. Cross sections of stem

Fig. 1-6: *Hypnum erectiusculum* SULL. et LESQ.  $\times 240$

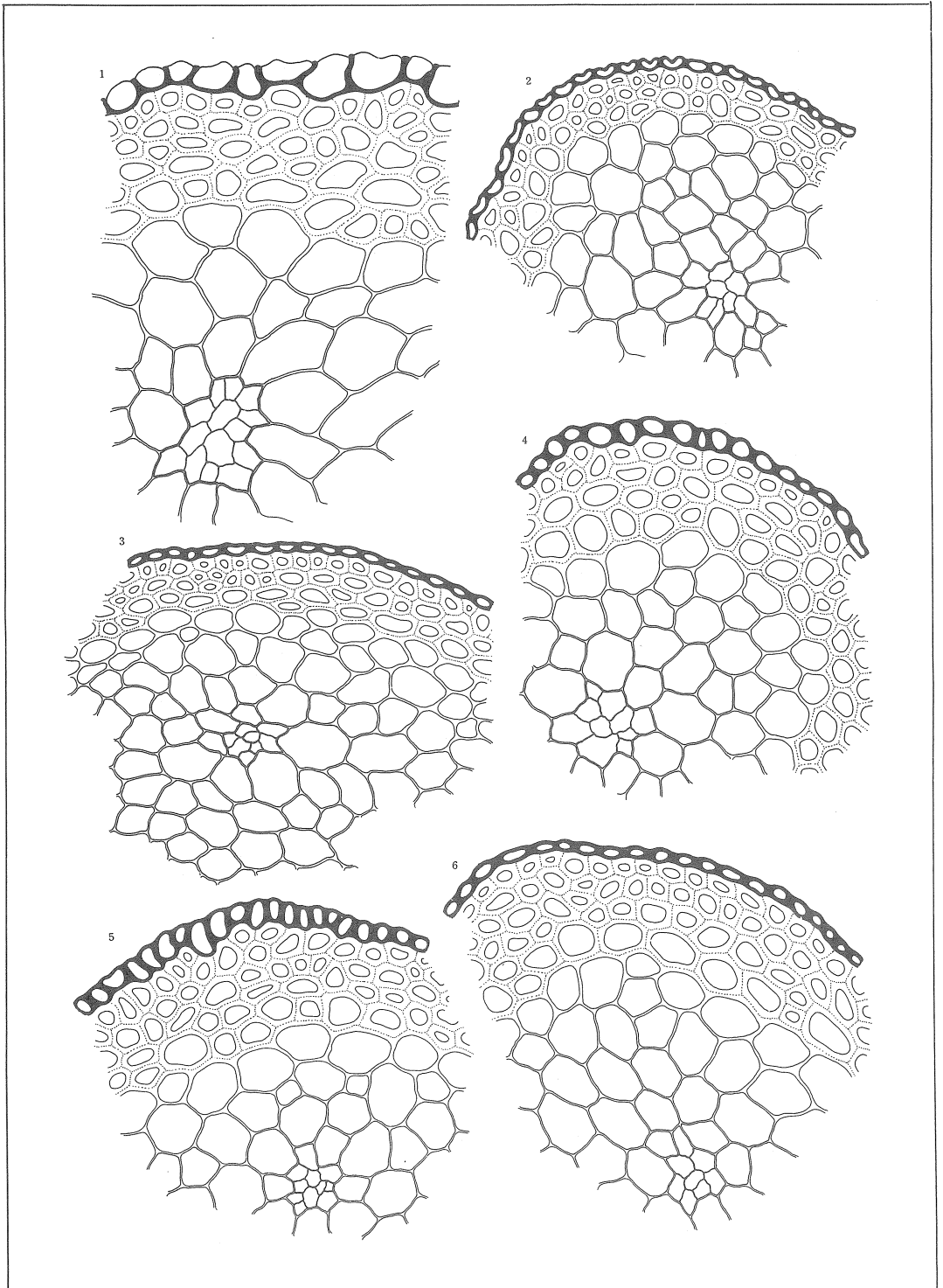


Plate XIX. Cross sections of stem

Fig. 1: *Hypnum erectiusculum* SULL. et LESQ.  $\times 240$

Fig. 2-6: *Hypnum fauriei* CARD.  $\times 240$

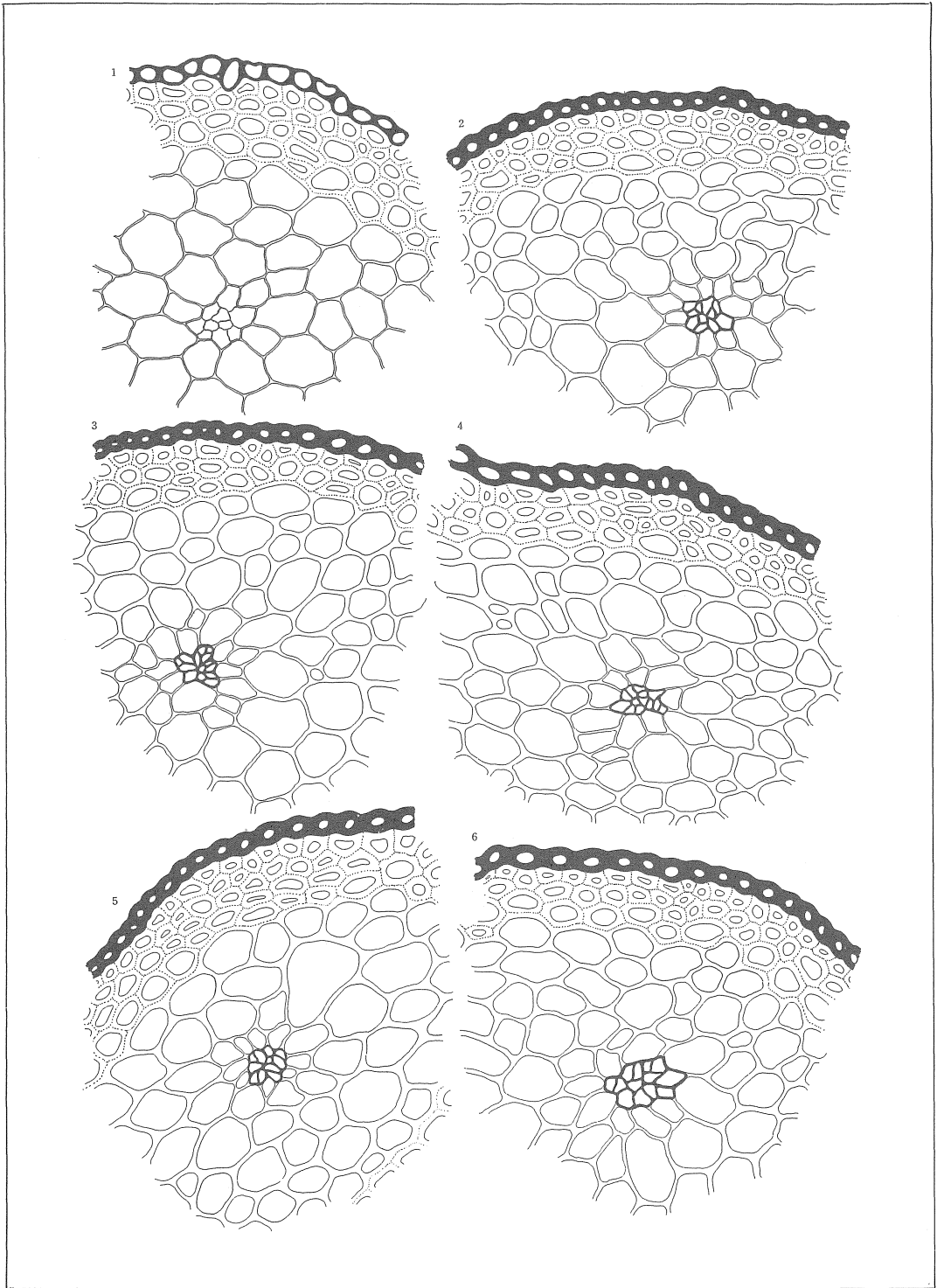


Plate XX. Cross sections of stem

Fig. 1: *Hypnum fauriei* CARD.  $\times 240$

Fig. 2-6: *Hypnum fujiyamae* (BROTH.)PAR.  $\times 240$



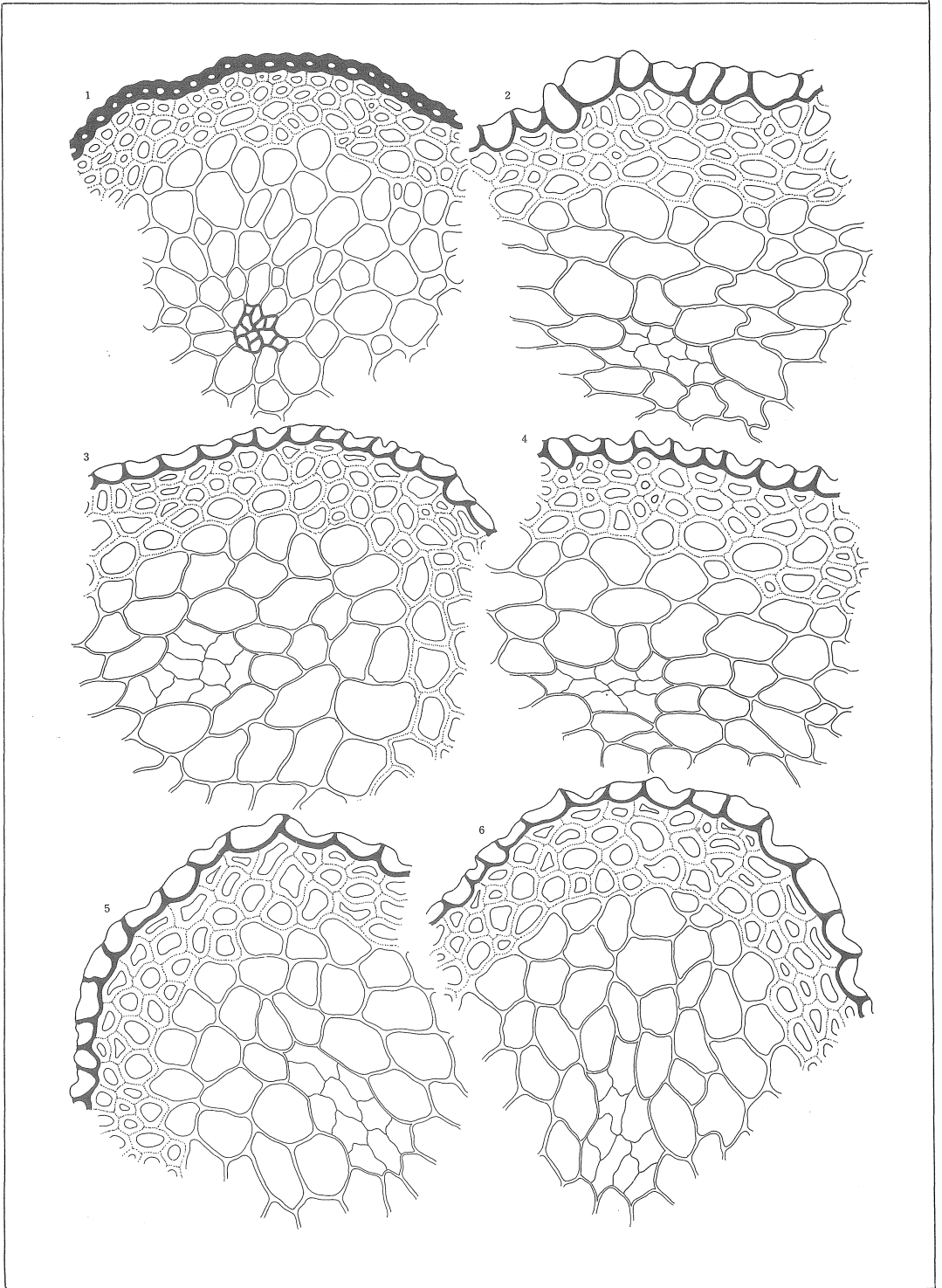


Plate XXI. Cross sections of stem

Fig. 1: *Hypnum fujiyamae* (BROTH.) PAR.  $\times 240$

Fig. 2-6: *Hypnum lindbergii* MITT.  $\times 240$

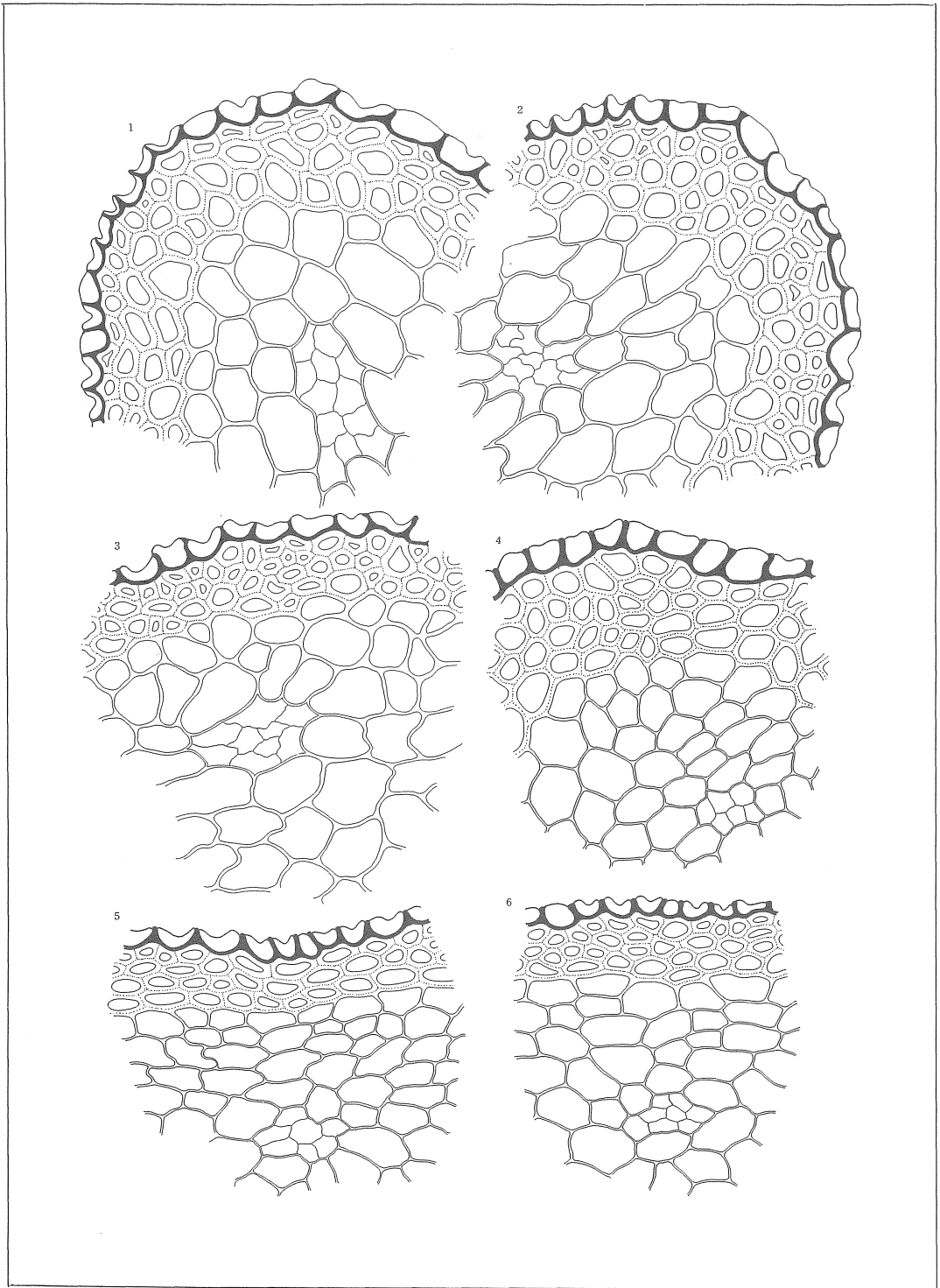


Plate XXII. Cross sections of stem  
Fig. 1-6: *Hypnum lindbergii* MITT.  $\times 240$

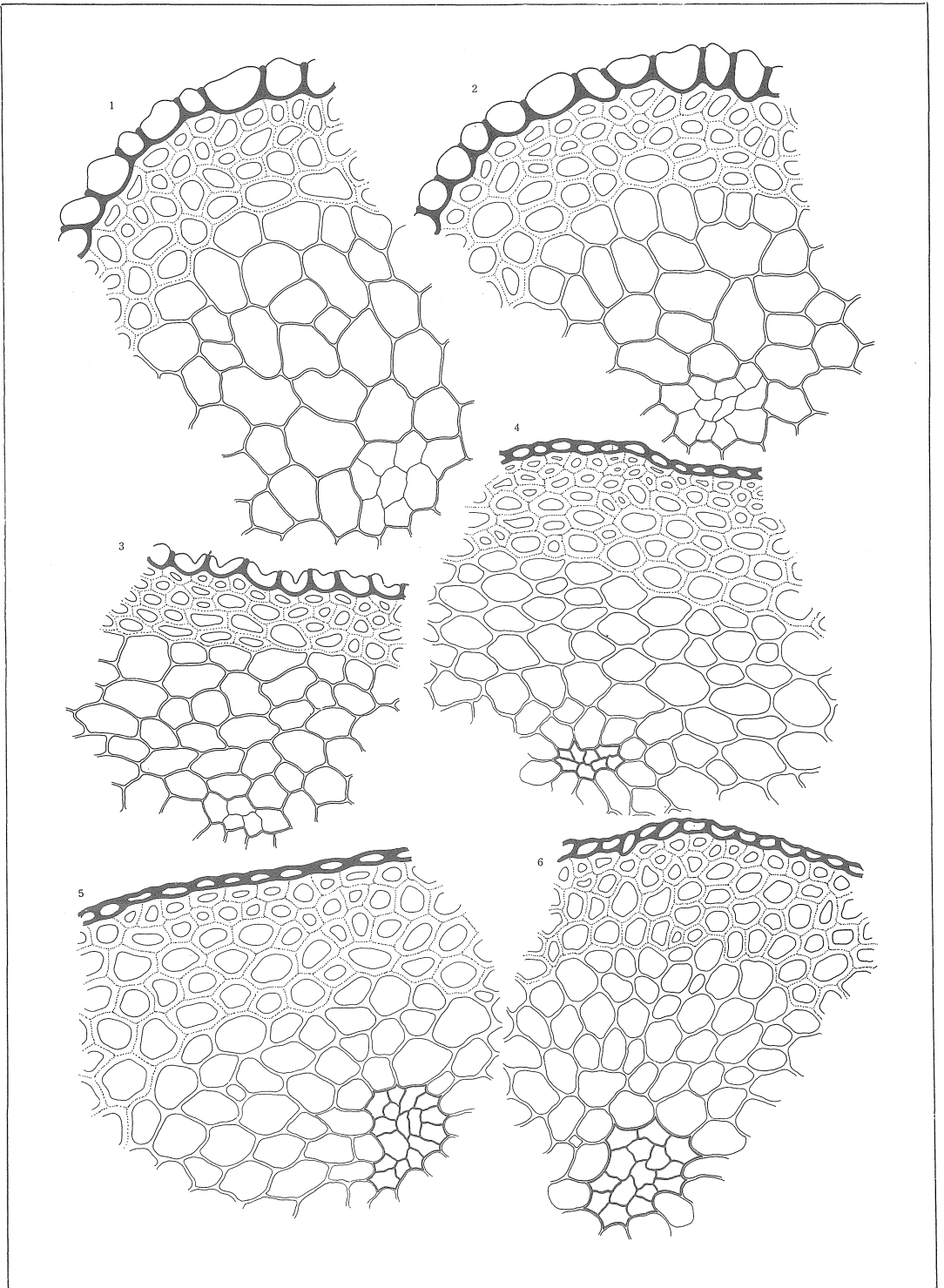


Plate XXIII. Cross sections of stem

Fig. 1-3: *Hypnum lindbergii* MITT. × 240

Fig. 4-6: *Hypnum oldhamii* (MITT.)JAEG. et SAUERB. × 240

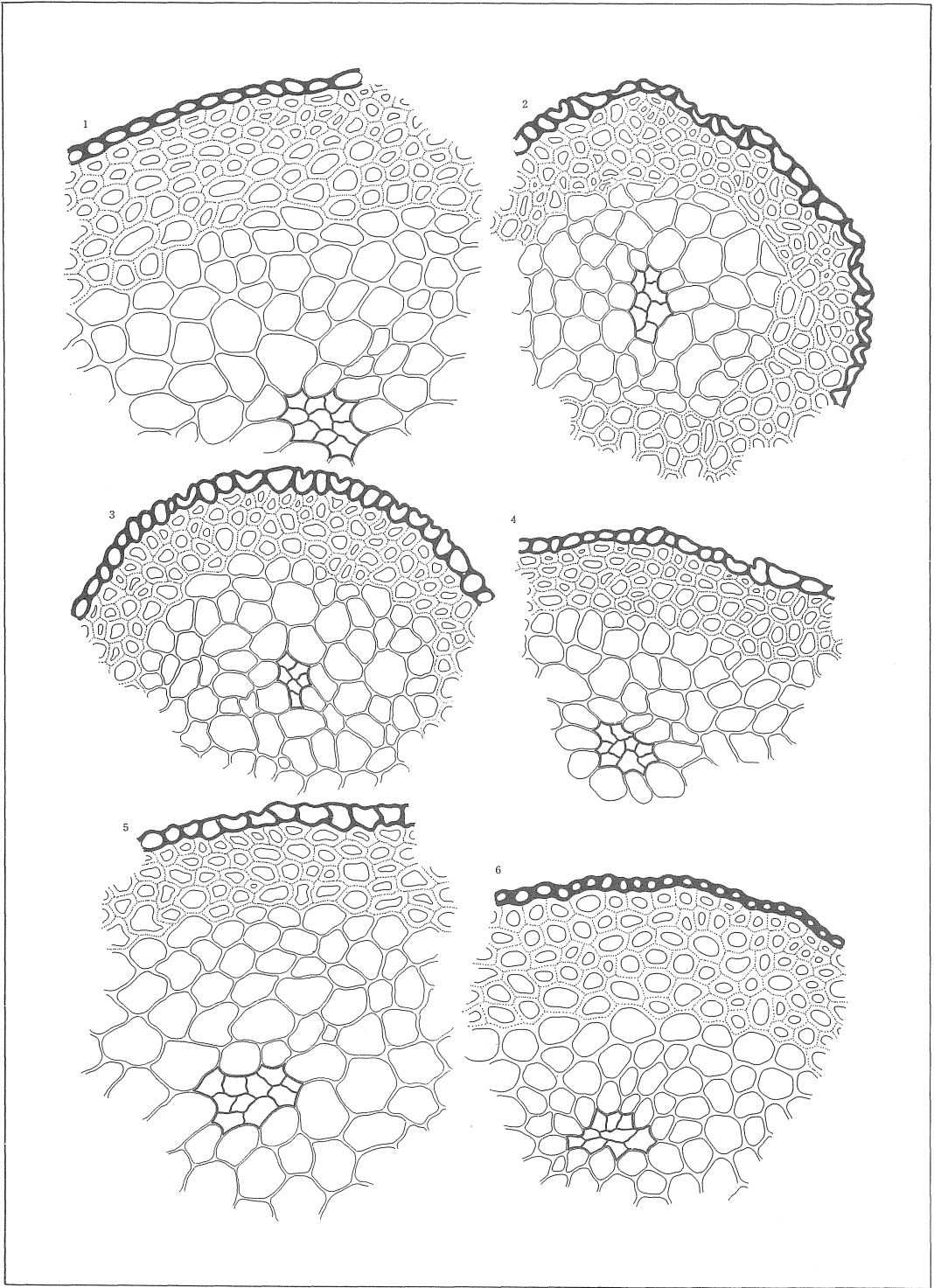


Plate XXIV. Cross sections of stem

Fig. 1-6: *Hypnum oldhamii* (MITT.)JAEG. et SAUERB.  $\times 240$

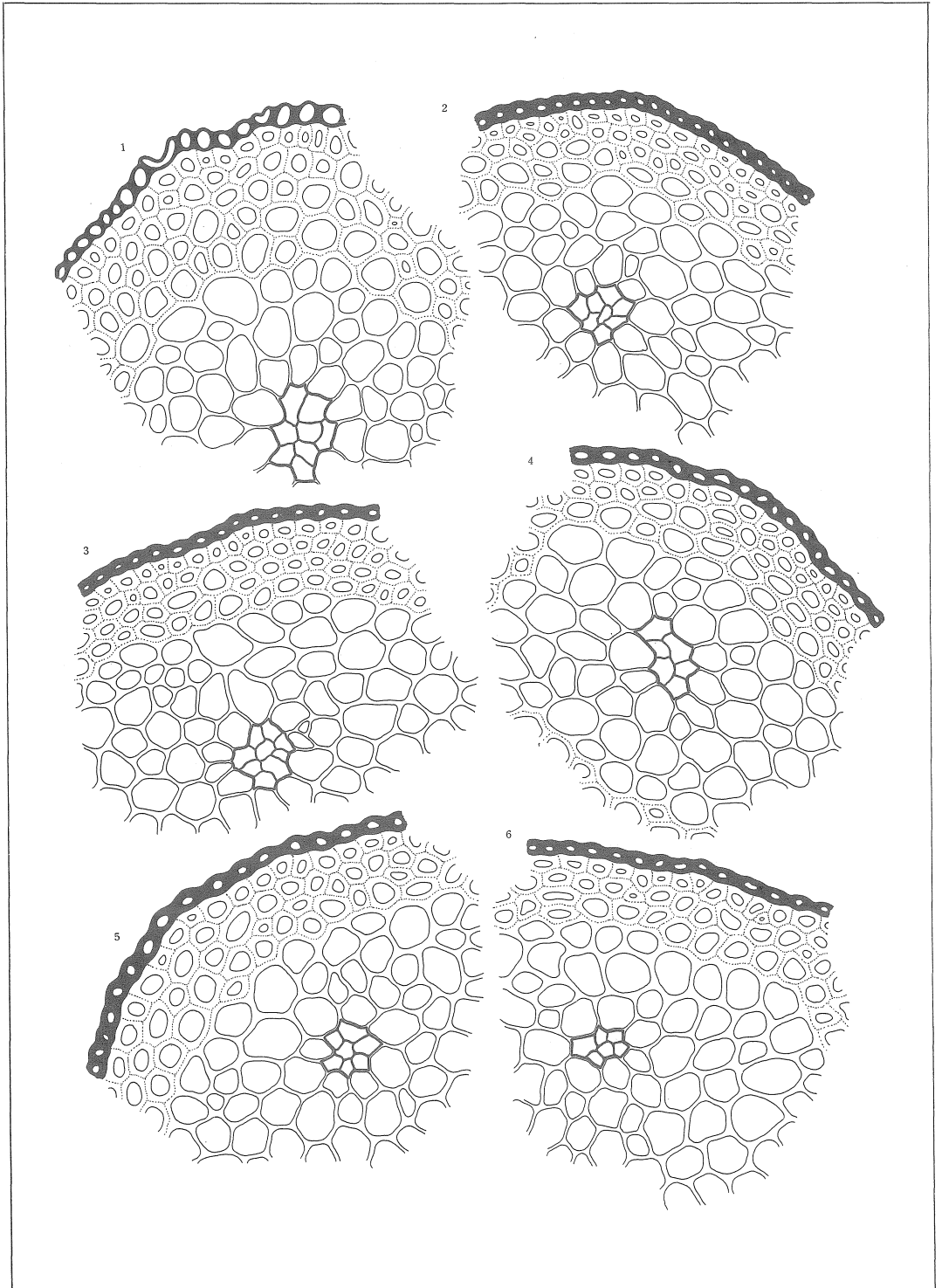


Plate XXV. Cross sections of stem

Fig. 1: *Hypnum oldhamii* (MITT.)JAEG. et SAUERB.  $\times 240$

Fig. 2-6: *Hypnum pallescens* (HEDW.)P.BEAUV.  $\times 240$

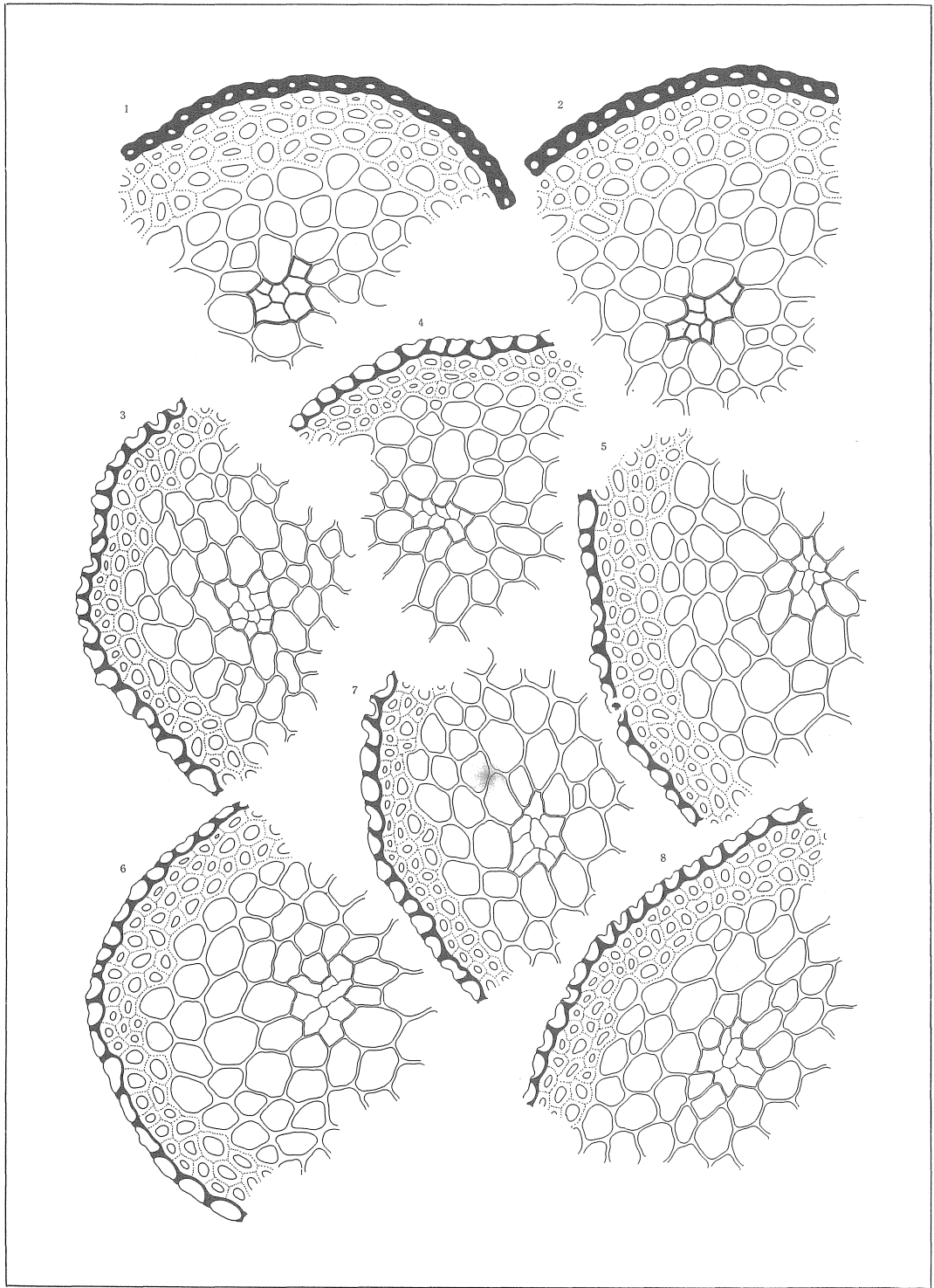


Plate XXVI. Cross sections of stem

Fig. 1-2 : *Hypnum pallescens* (HEDW.)P.BEAUV. ×240

Fig. 3-8 : *Hypnum plicatulum* (LINDB.)J.AEG. et SAUERB. ×240

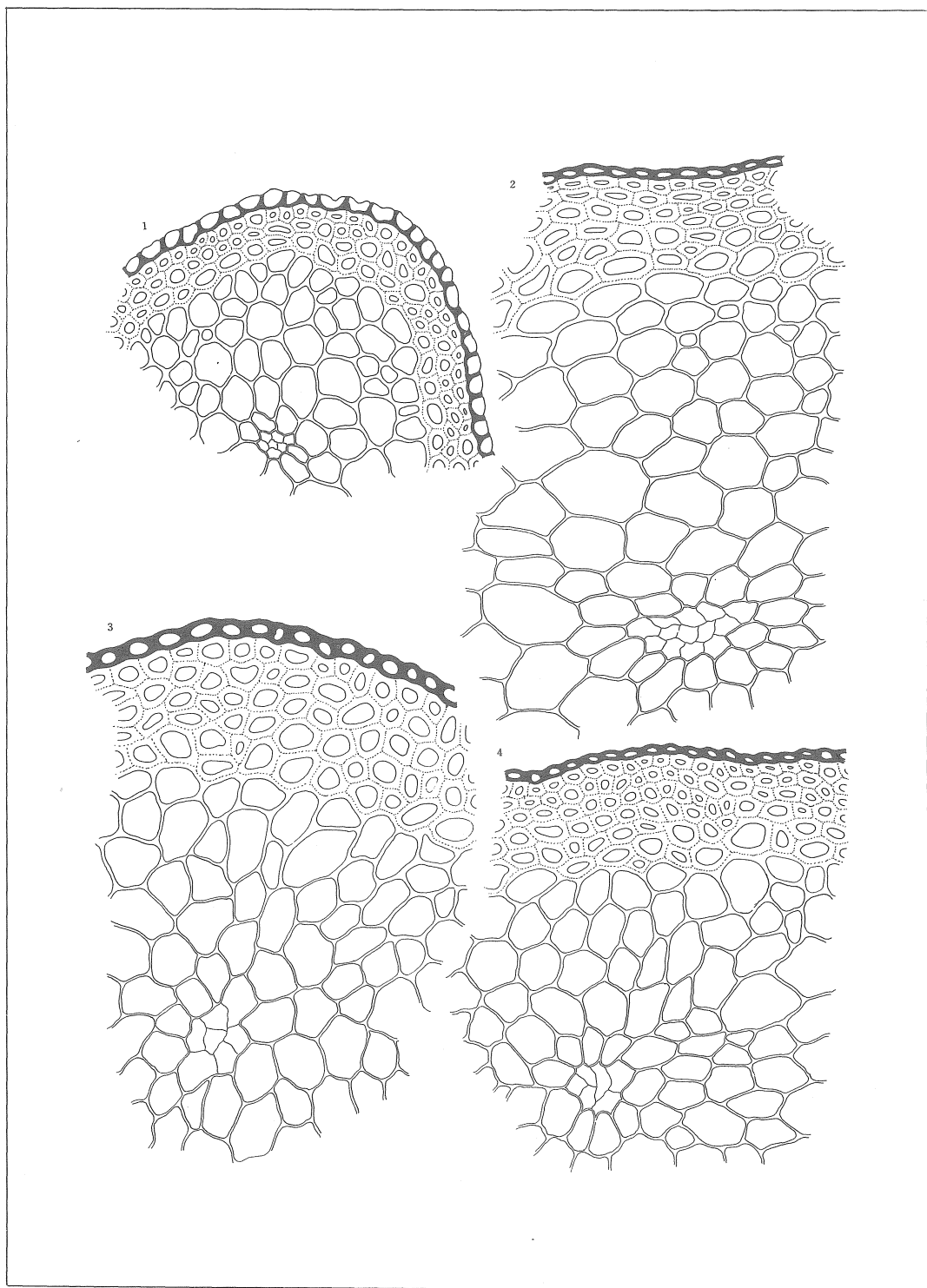


Plate XXVII. Cross sections of stem

Fig. 1: *Hypnum plicatulum* (LINDB.)JAEG. et SAUERB.  $\times 240$

Fig. 2-4: *Hypnum plumaeforme* WILS.  $\times 240$

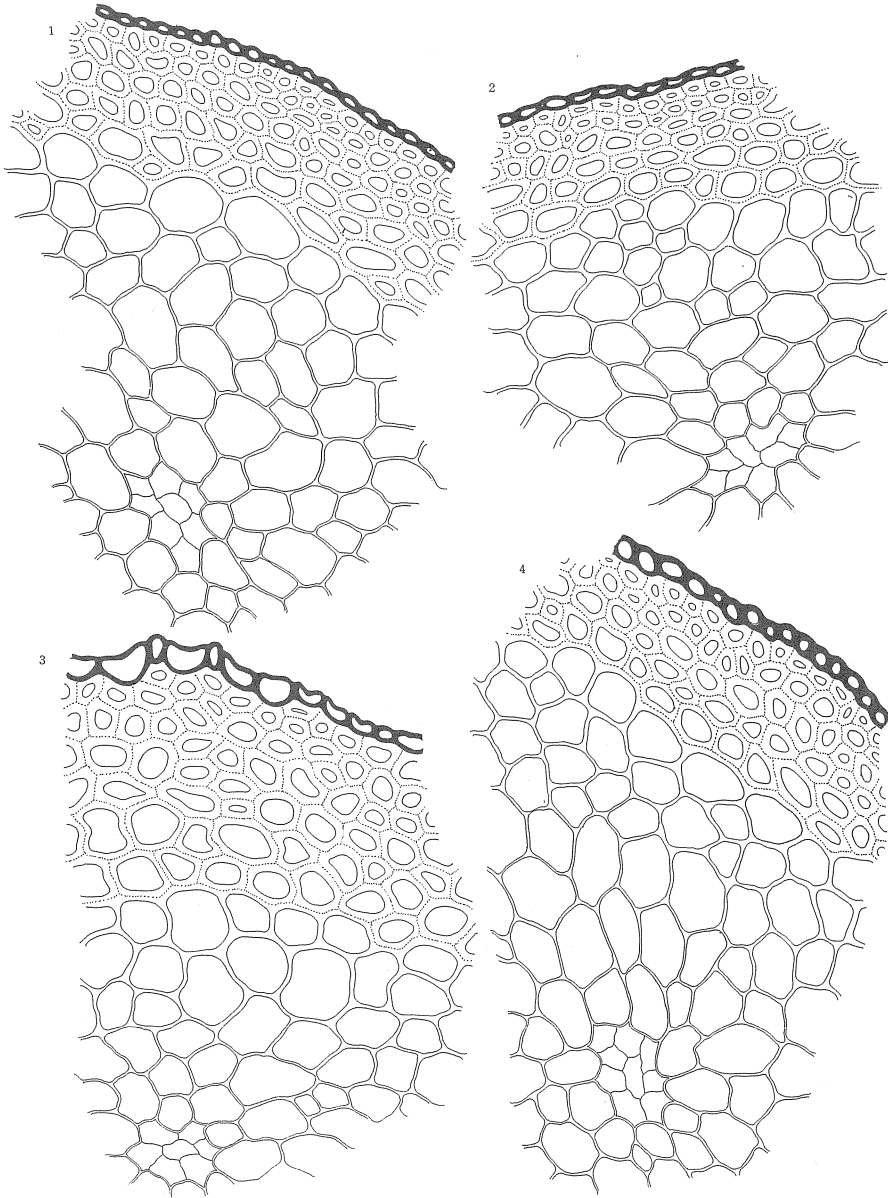


Plate XXVIII. Cross sections of stem  
Fig. 1-4: *Hypnum plumaeforme* WILS.  $\times 240$



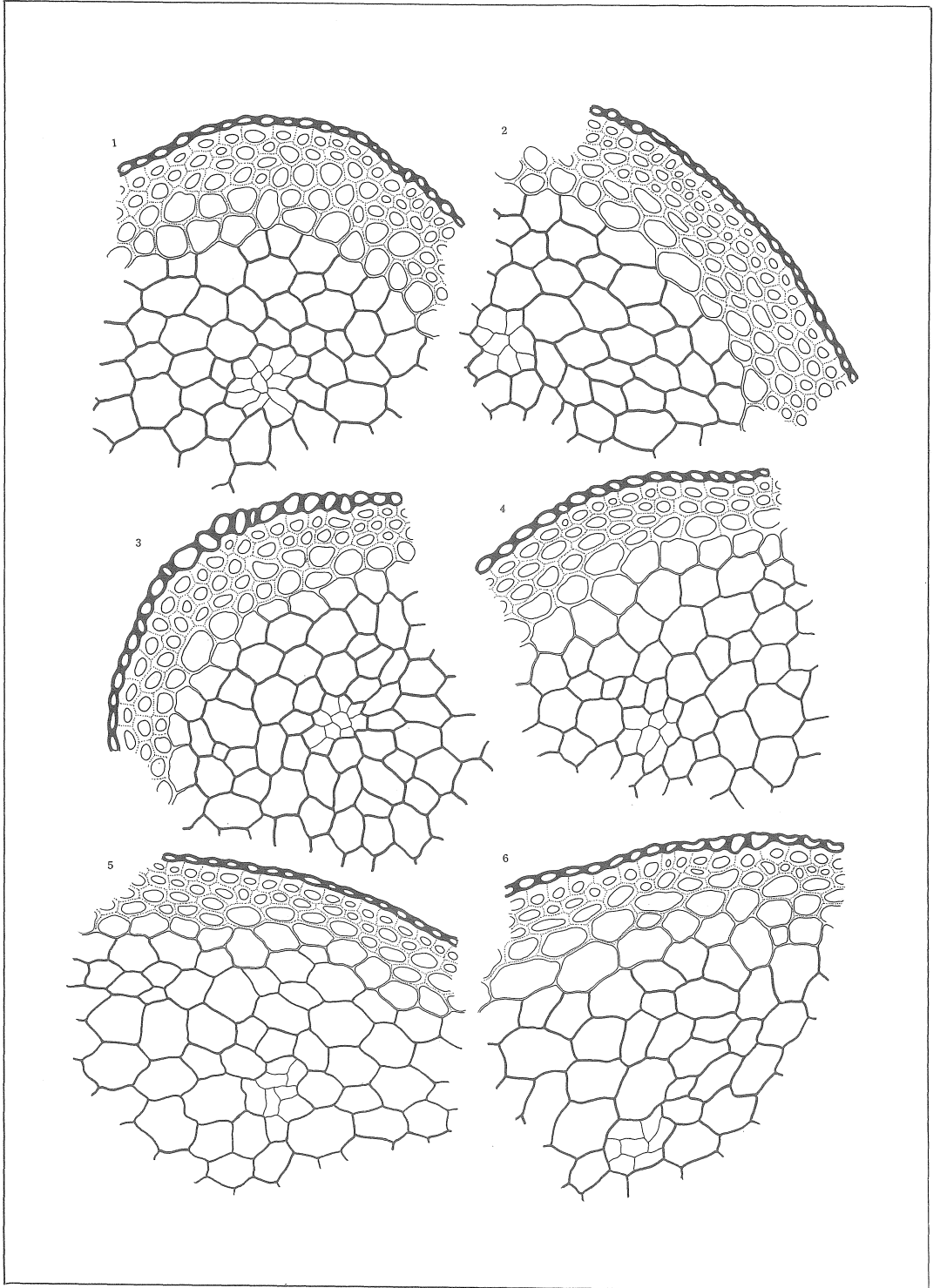


Plate XXIX. Cross sections of stem

Fig. 1-6: *Hypnum plumaeforme* WILS. v. *minus* BROTH. ex ANDO × 240

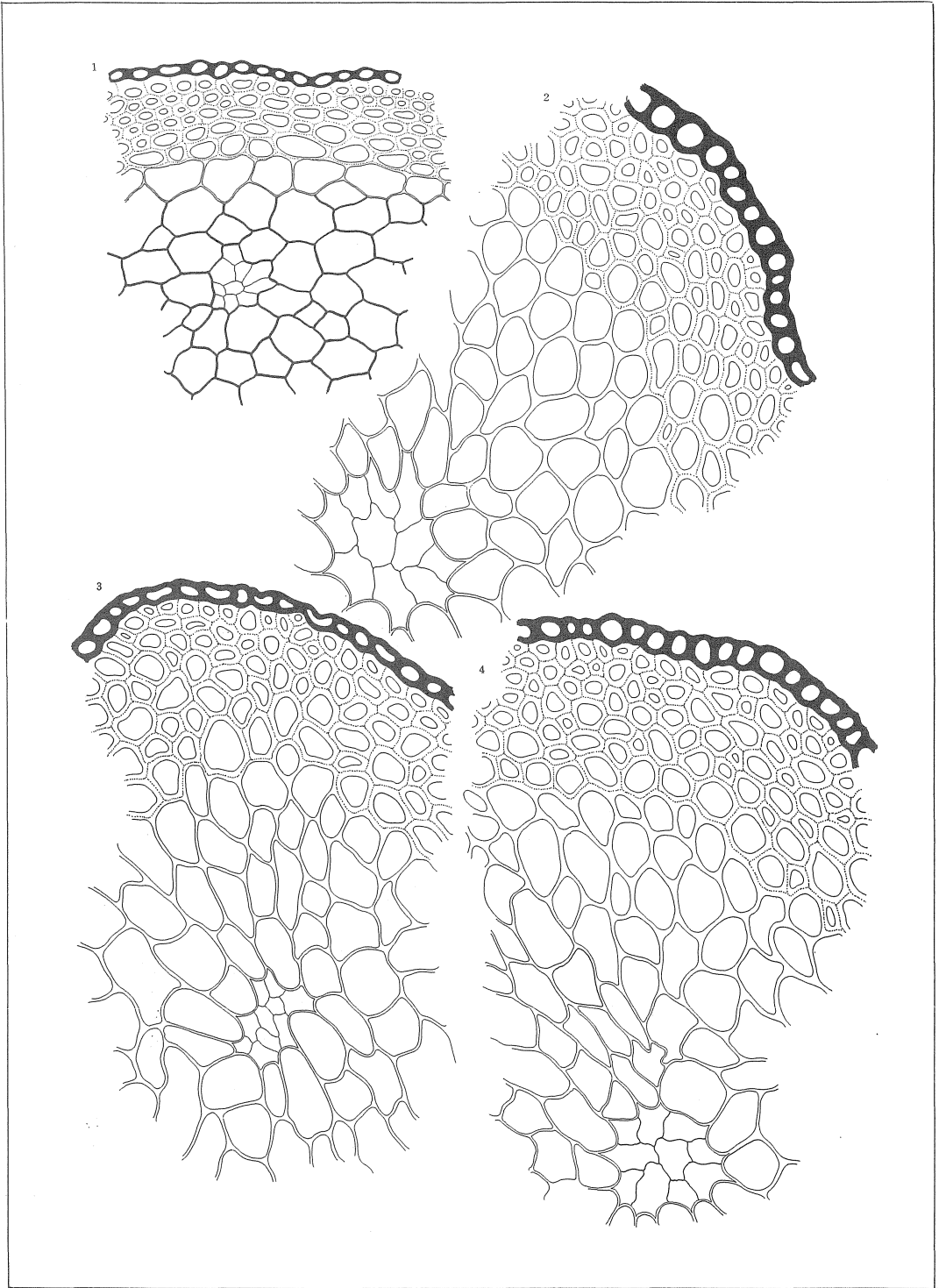


Plate XXX. Cross sections of stem

Fig. 1: *Hypnum plumaeforme* WILS. v. *minus* BROTH. ex ANDO  $\times 240$

Fig. 2-4: *Hypnum sakuraii* (SAK.) ANDO  $\times 240$

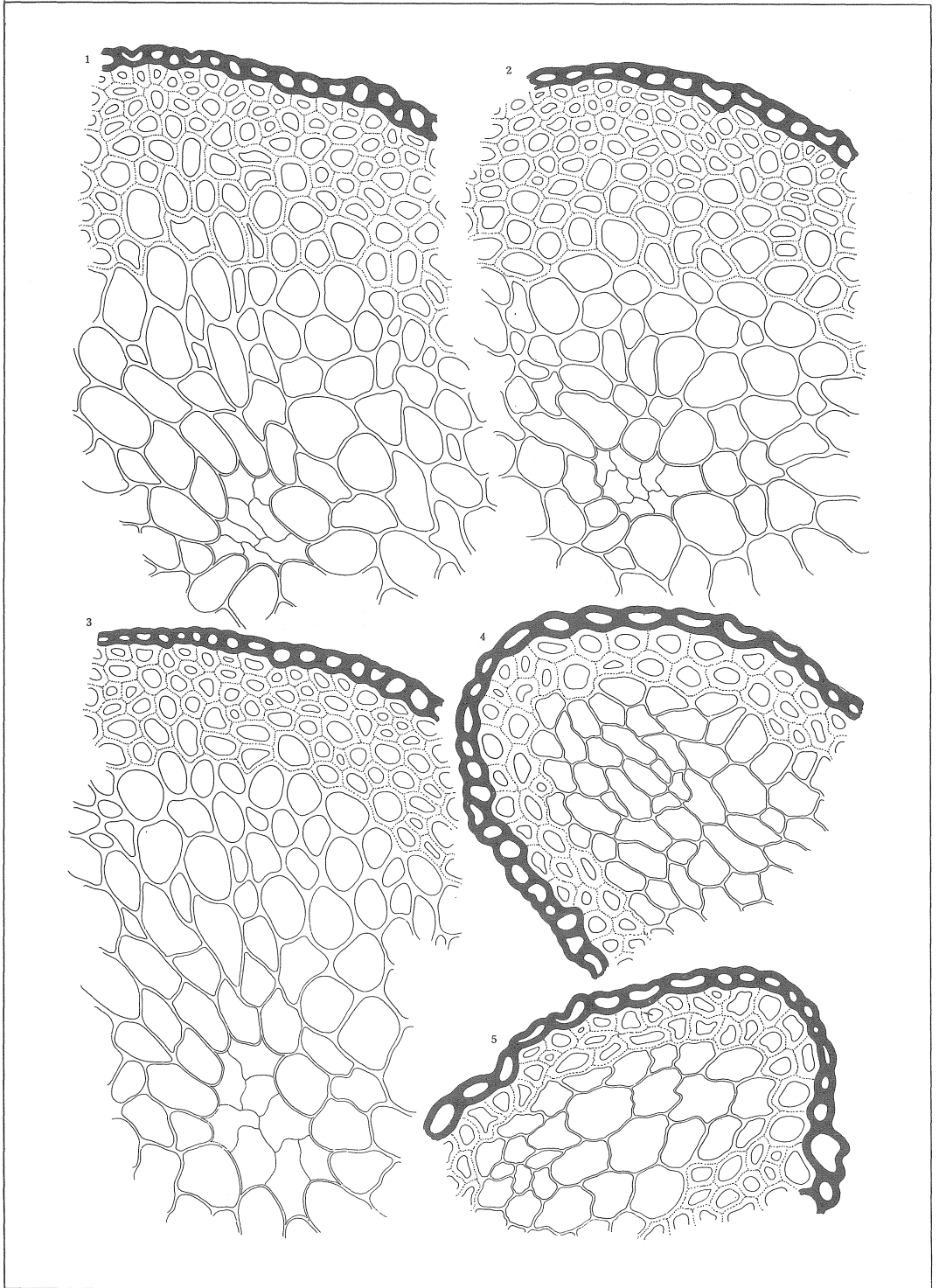


Plate XXXI. Cross sections of stem

Fig. 1-3: *Hypnium sakuraii* (SAK.) ANDO  $\times 240$

Fig. 4-5: *Hypnium tristo-viride* (BROTH.) PAR.  $\times 240$

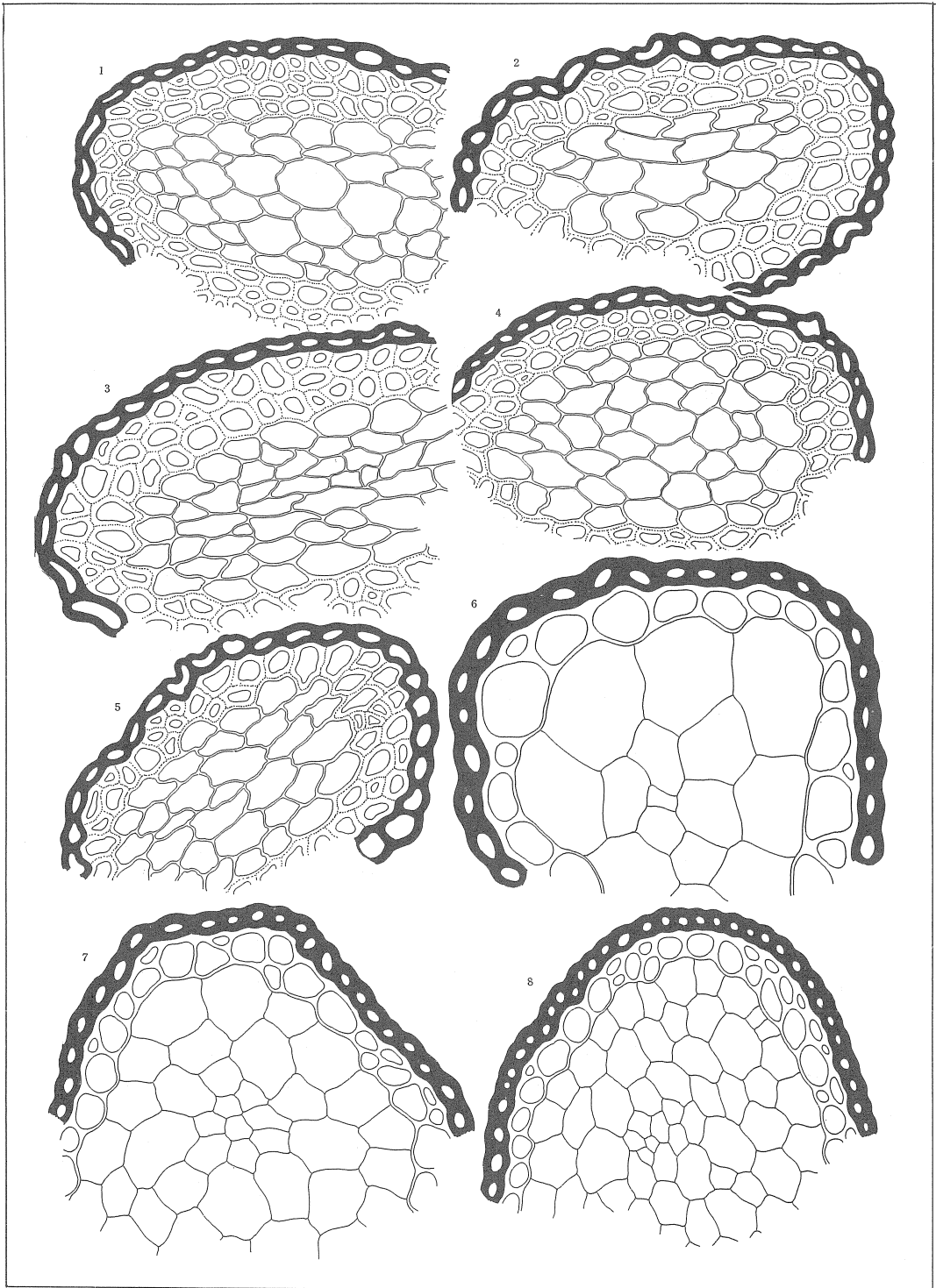


Plate XXXII. Cross sections of stem ,  
Fig. 1-5 : *Hypnum tristo-viride* (BROTH.)PAR.  $\times 240$   
Fig. 6 : *Isopterygium fauriei* CARD.  $\times 400$   
Fig. 7-8 : *Isopterygium fauriei* CARD.  $\times 240$

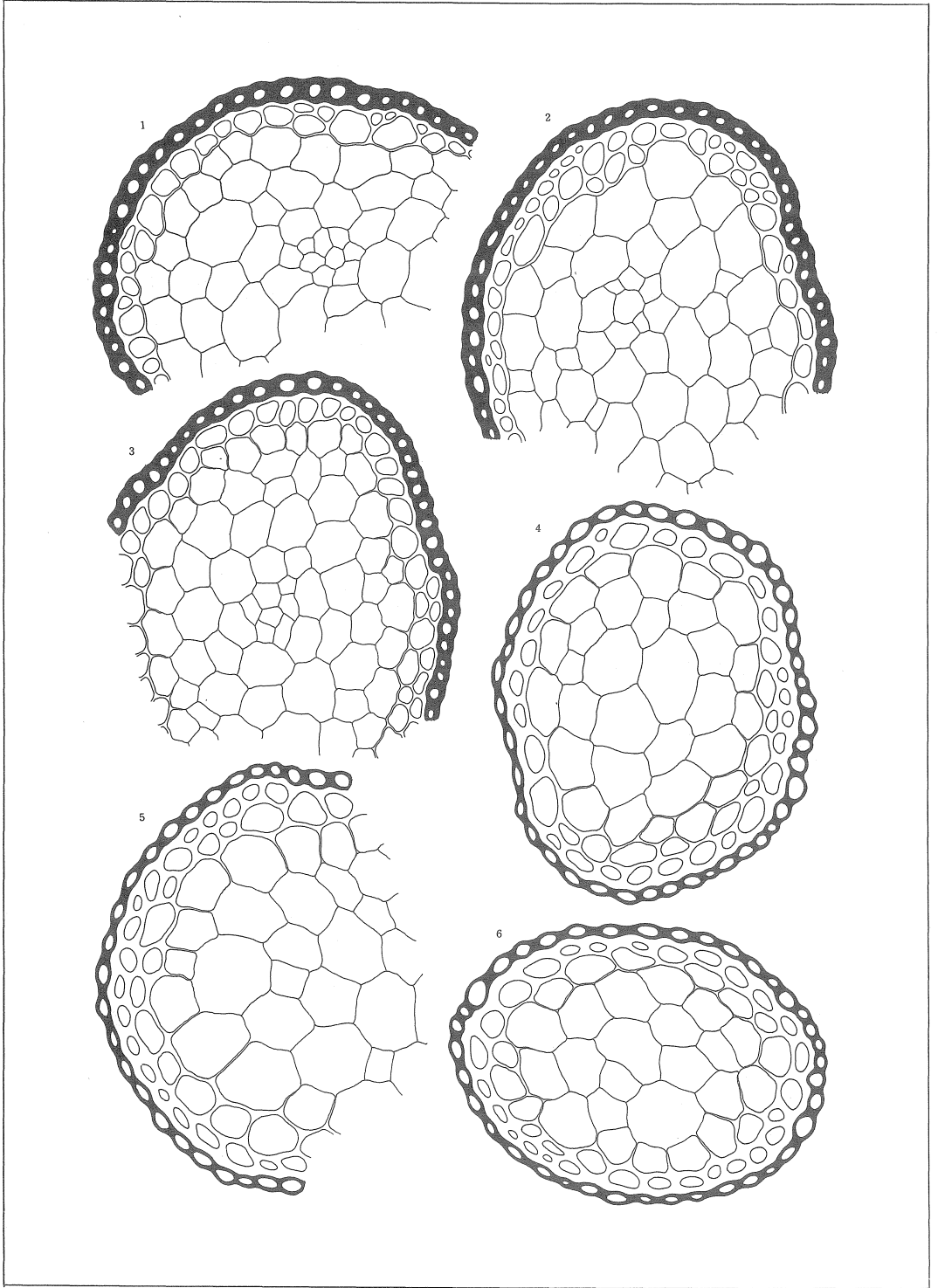


Plate XXXIII. Cross sections of stem

Fig. 1-3: *Isopterygium fauriei* CARD.  $\times 240$

Fig. 4-6: *Isopterygium minutirameum* (C.MUELL.)JAEG.  $\times 240$

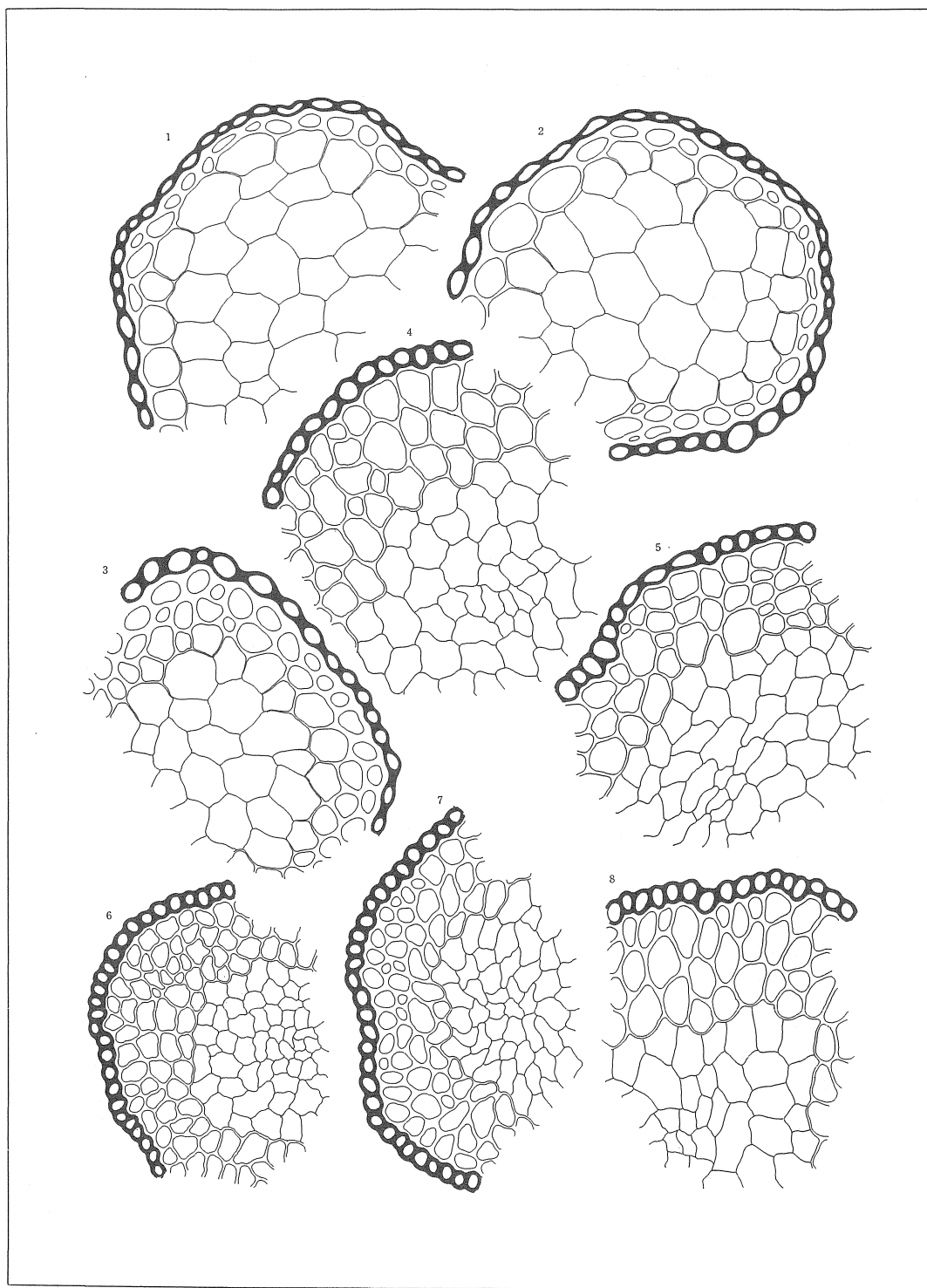


Plate XXXIV. Cross sections of stem

Fig. 1-3: *Isopterygium minutirameum* (C.MUELL.)JAEG.  $\times 240$

Fig. 4-8: *Isopterygium pohliaecarpum* (SULL. et LESQ.)JAEG.  $\times 240$

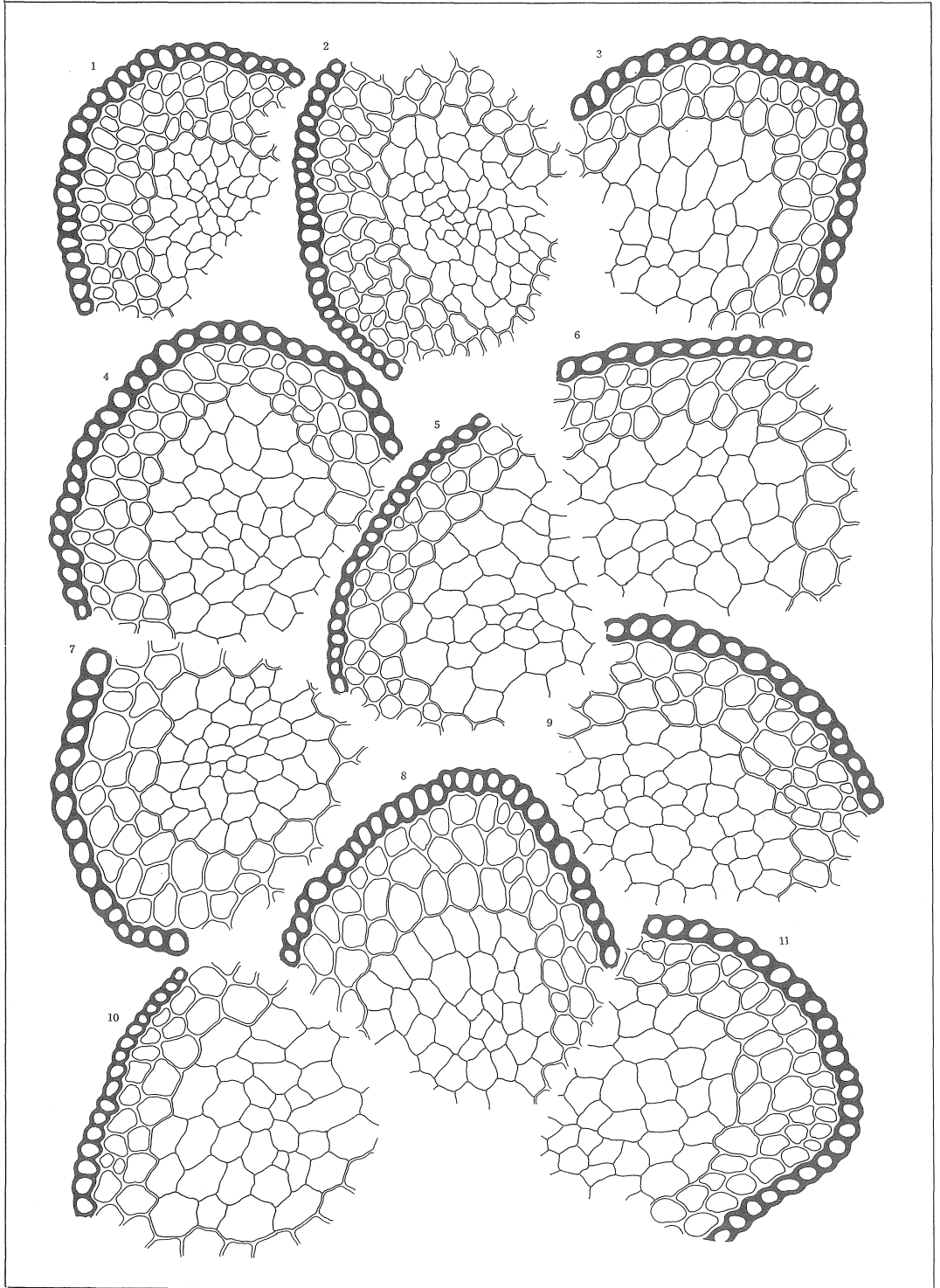


Plate XXXV. Cross sections of stem

Fig. 1-11: *Isopterygium pohliaecarpum* (SULL. et LESQ.)JAEG.  $\times 240$

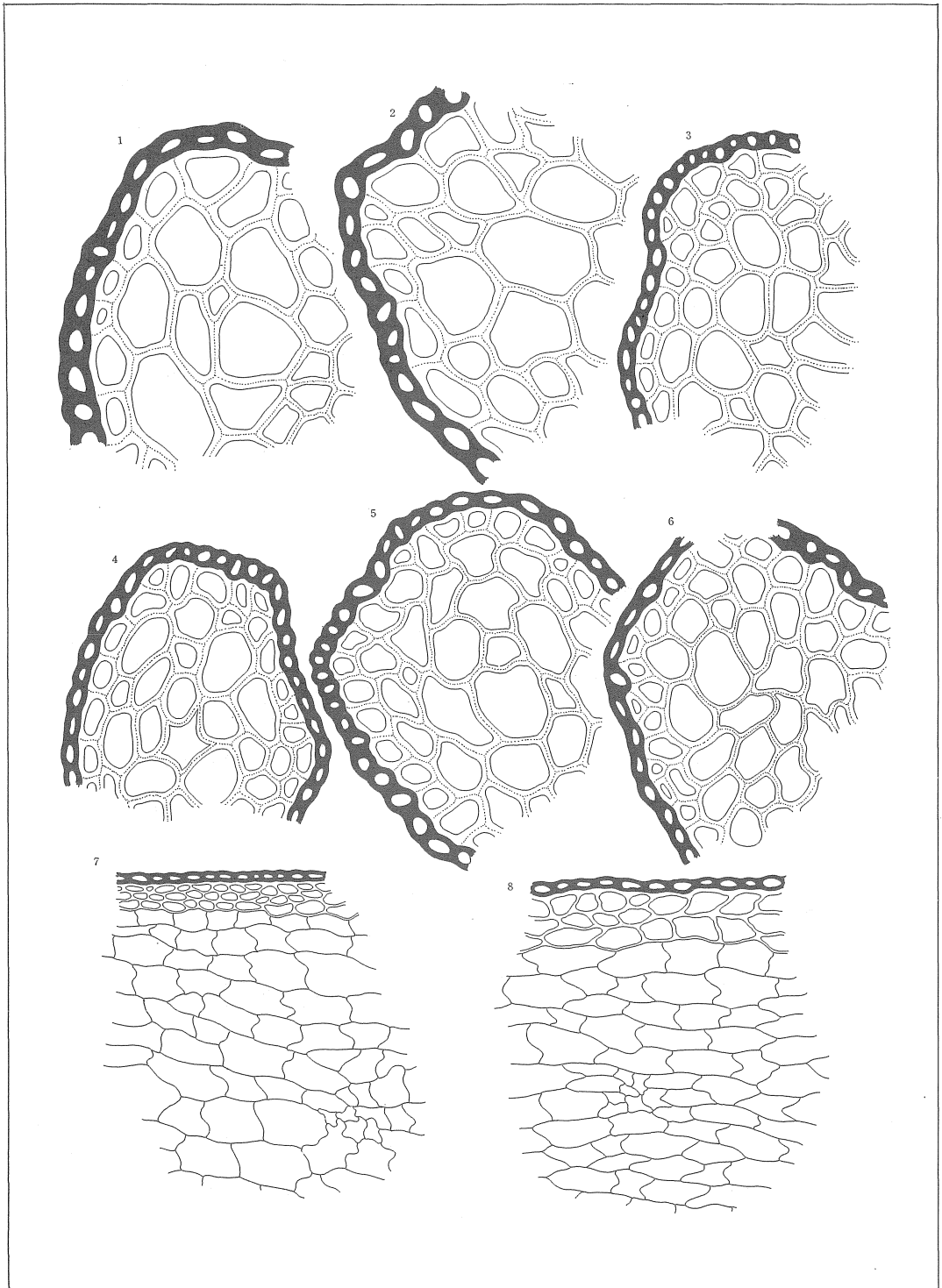


Plate XXXVI. Cross sections of stem

Fig. 1-2 : *Isopterygium tosaense* BROTH.  $\times 600$

Fig. 3-6 : *Isopterygium tosaense* BROTH.  $\times 400$

Fig. 7-8 : *Ptilium crista-castrensis* (HEDW.)D.NOT.  $\times 240$



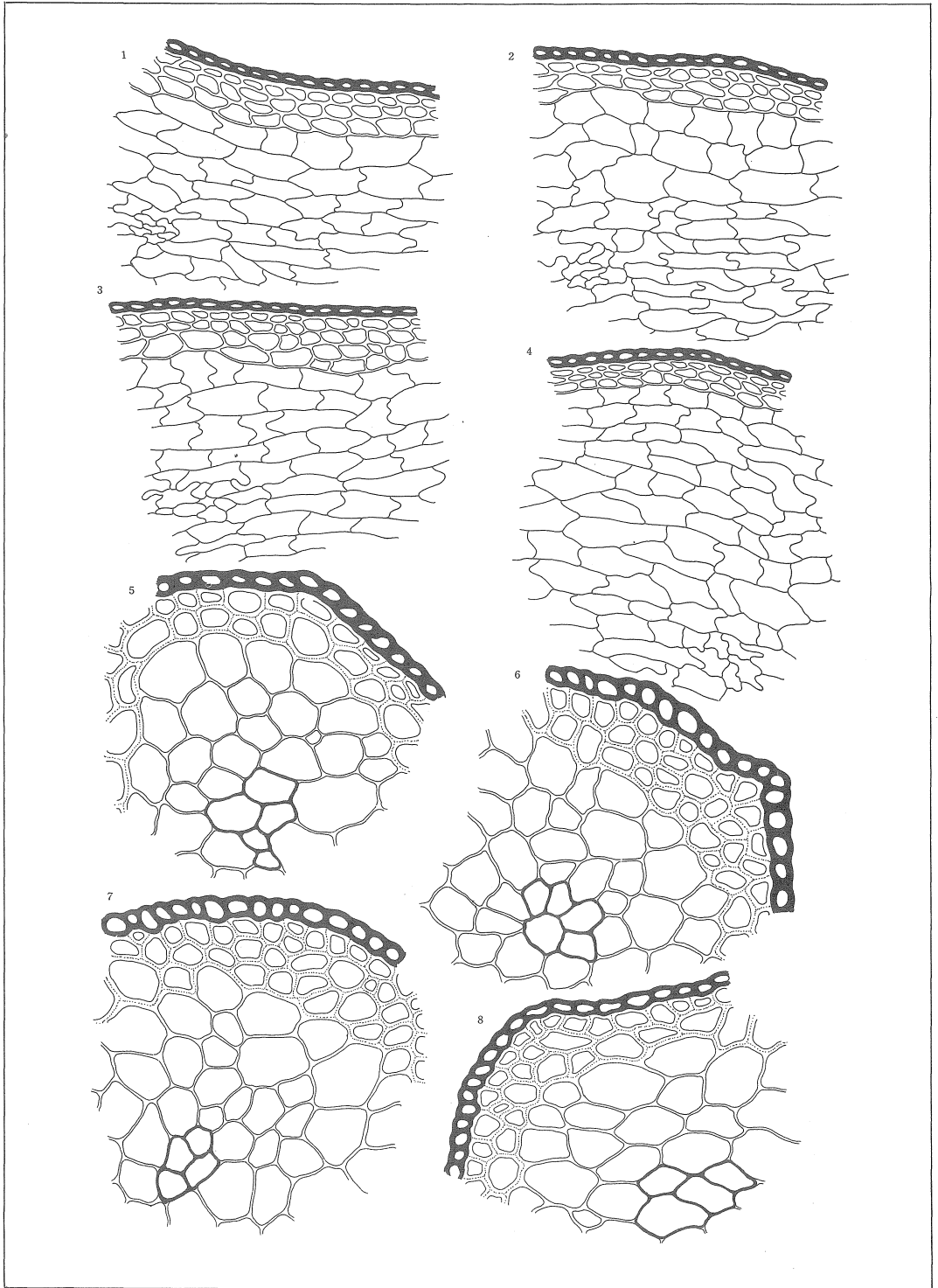


Plate XXXVII. Cross sections of stem

Fig. 1-4: *Ptilium crista-castrensis* (HEDW.)D.NOT.  $\times 240$

Fig. 5-8: *Pylaisiella cristata* (CARD.)IWATS. et NOG.  $\times 240$

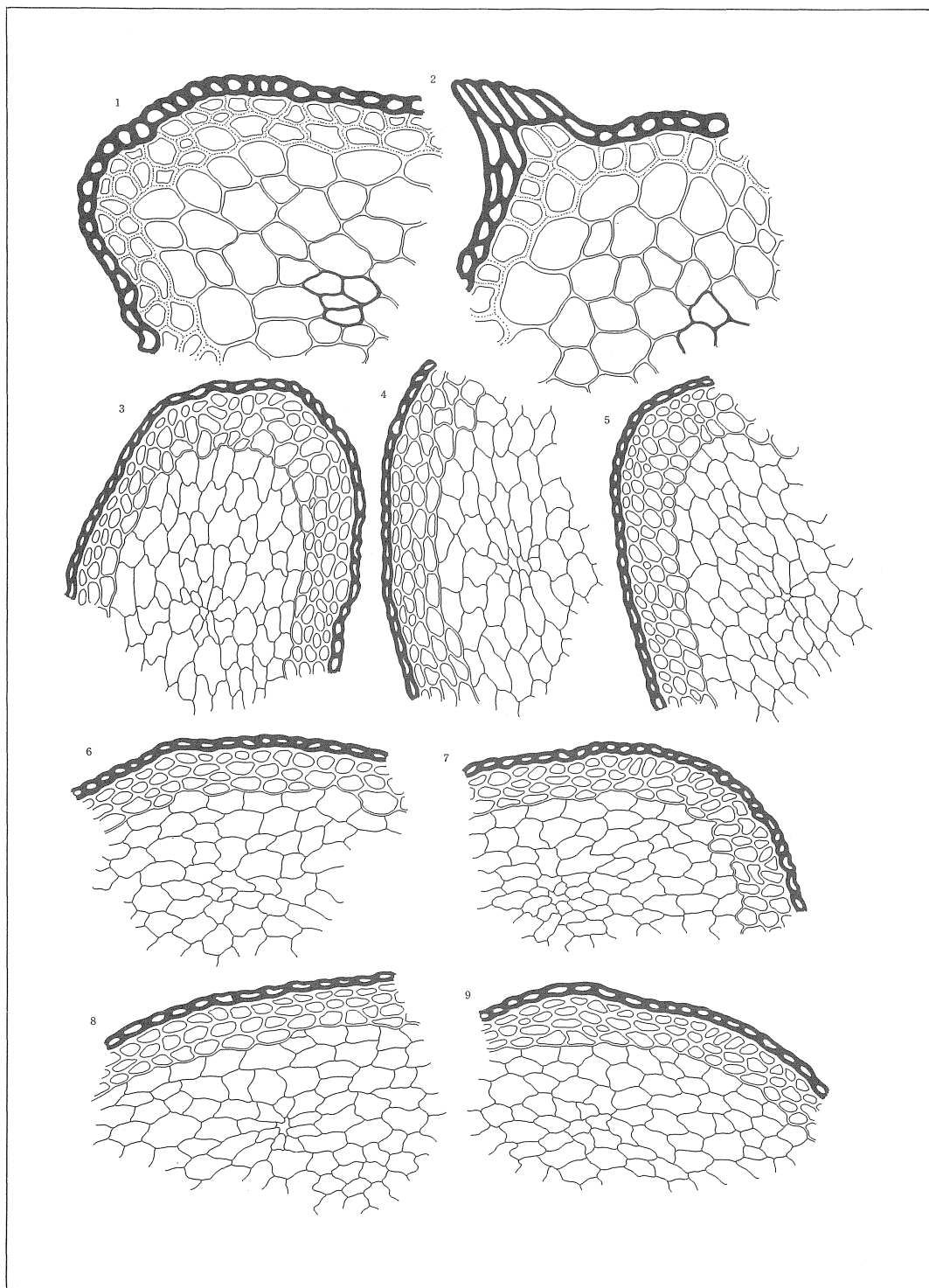


Plate XXXVIII. Cross sections of stem

Fig. 1-2: *Pylaisiella cristata* (CARD.)IWATS. et NOG.  $\times 240$

Fig. 3-9: *Pylaisiella selwynii* (KINDB.)CRUM et all.  $\times 240$

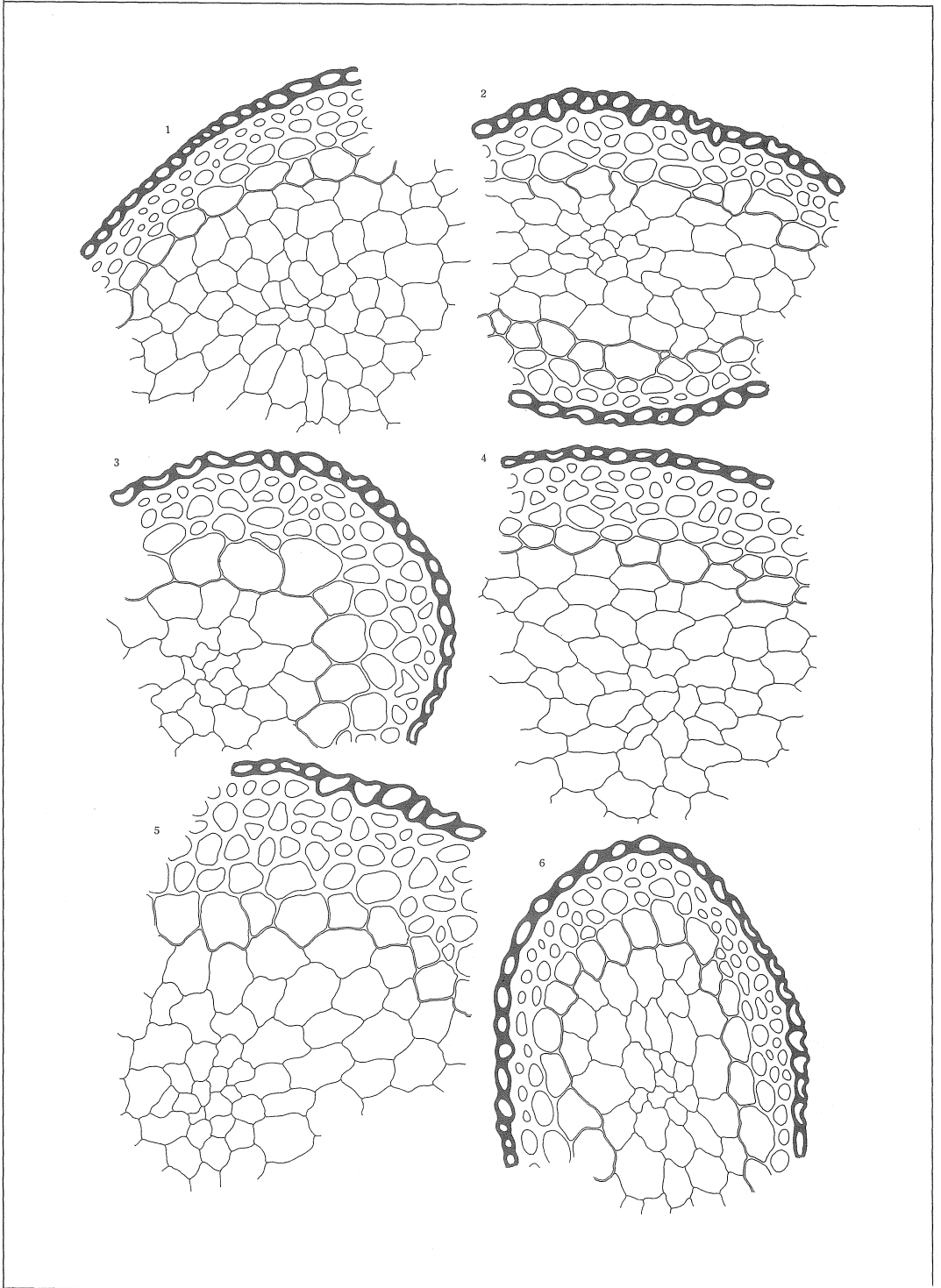


Plate XXXIX. Cross sections of stem

Fig. 1-6: *Pylaisiella subcircinata* (CARD.)IWATS. et NOG.  $\times 240$

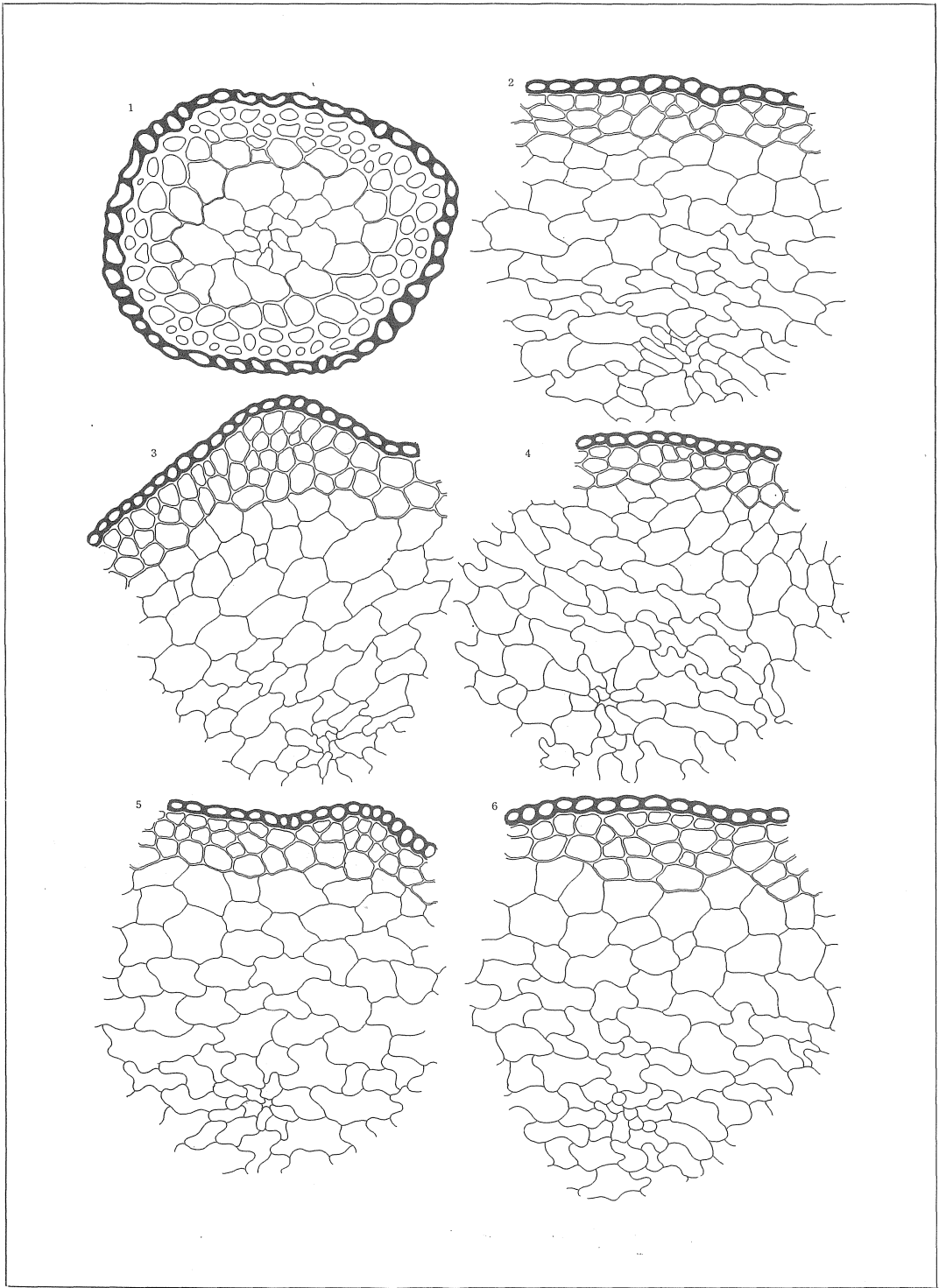


Plate XL. Cross sections of stem

Fig. 1: *Pylaisiella subcircinata* (CARD.)IWATS. et NOG.  $\times 240$

Fig. 2-6: *Rhytidiadelphus japonicus* (REIM.)KOP.  $\times 240$

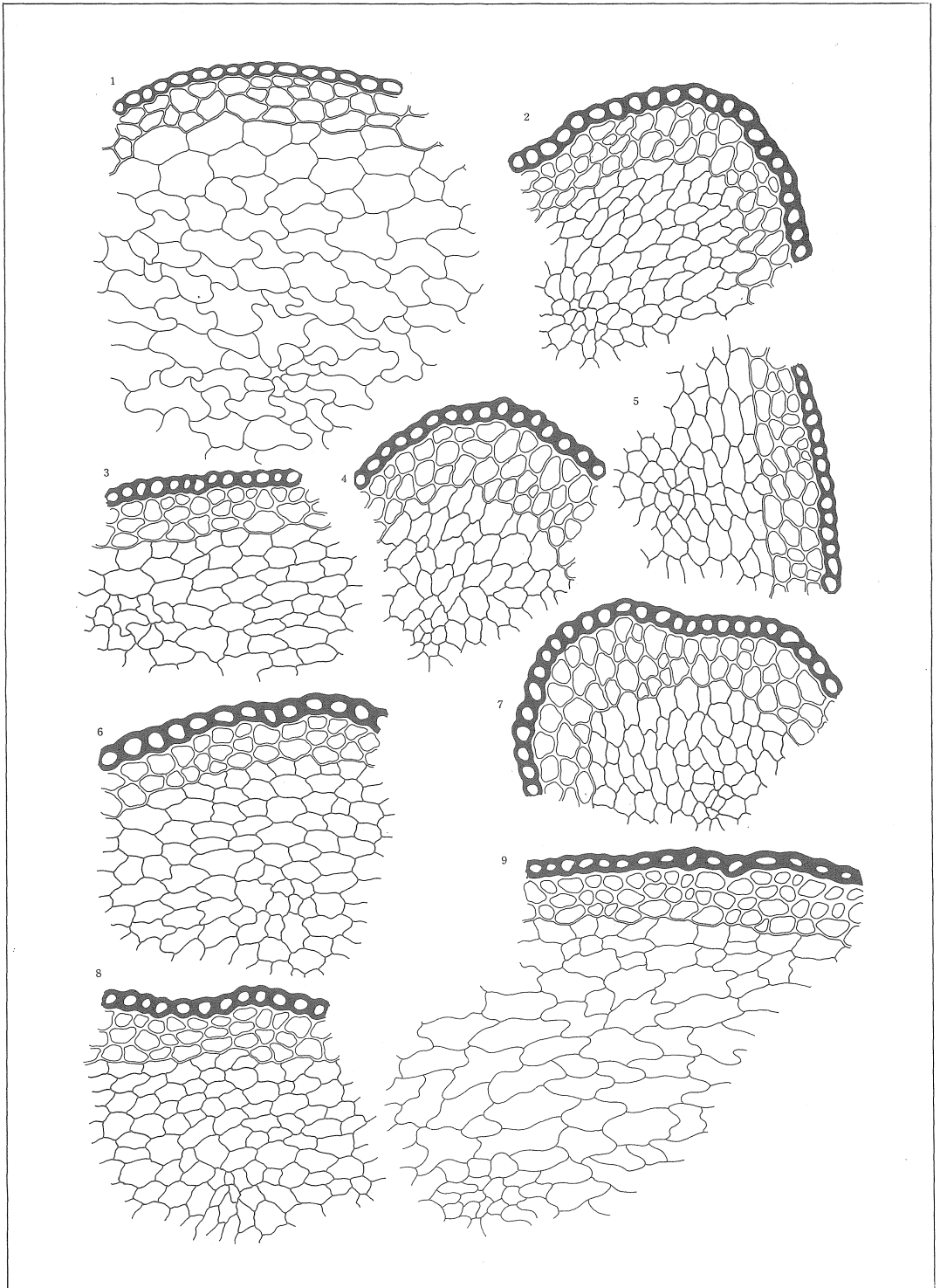


Plate XLI. Cross sections of stem

Fig. 1: *Rhytidadelphus japonicus* (REIM.)KOP.  $\times 240$

Fig. 2-8: *Rhytidadelphus subpinnatus* (LINDB.)KOP.  $\times 240$

Fig. 9: *Rhytidadelphus triquetrus* (HEDW.)WARNST.  $\times 240$

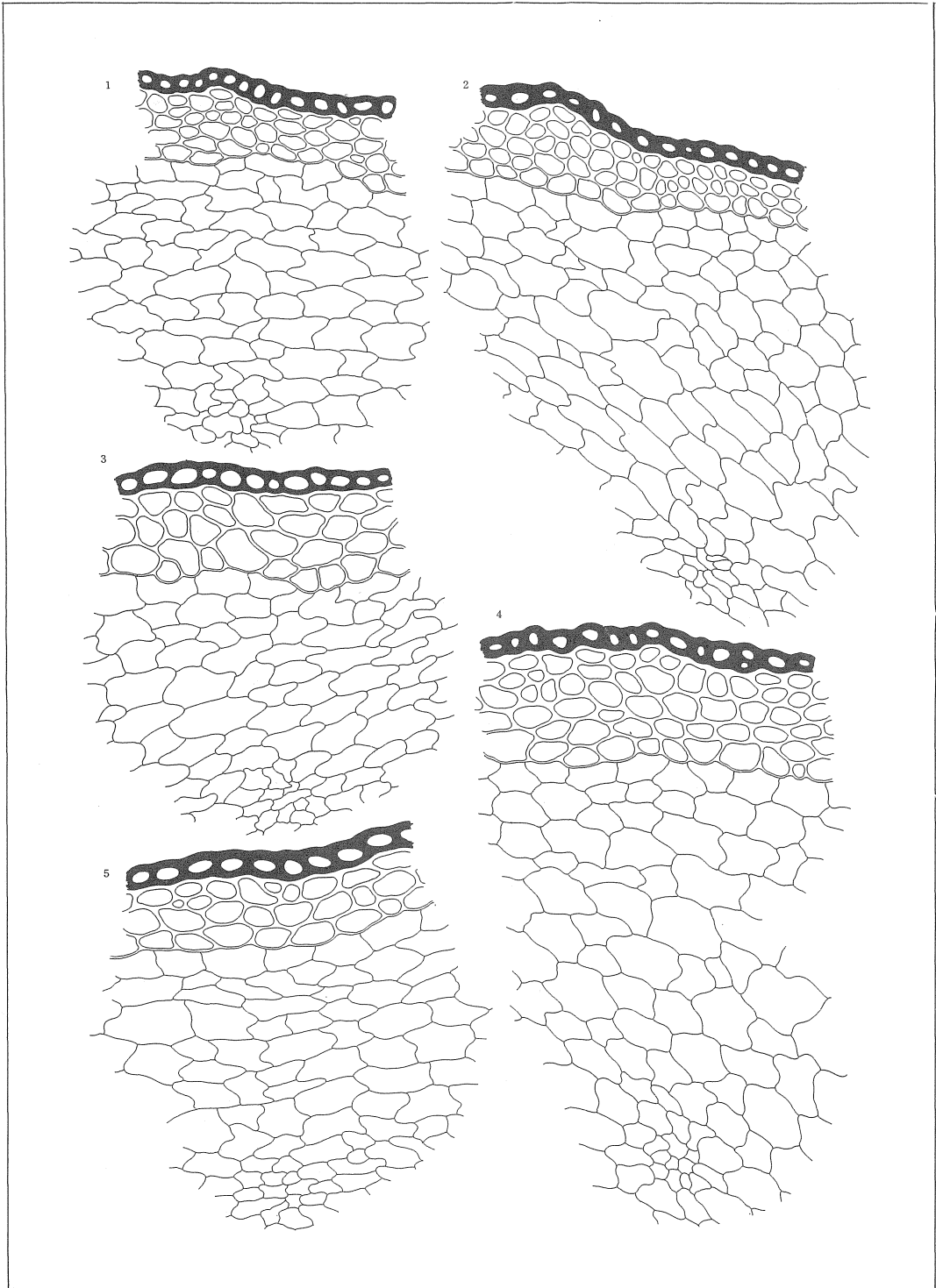


Plate XLII. Cross sections of stem

Fig. 1-5: *Rhytidiadelphus triquetrus* (HEDW.)WARNST.  $\times 240$

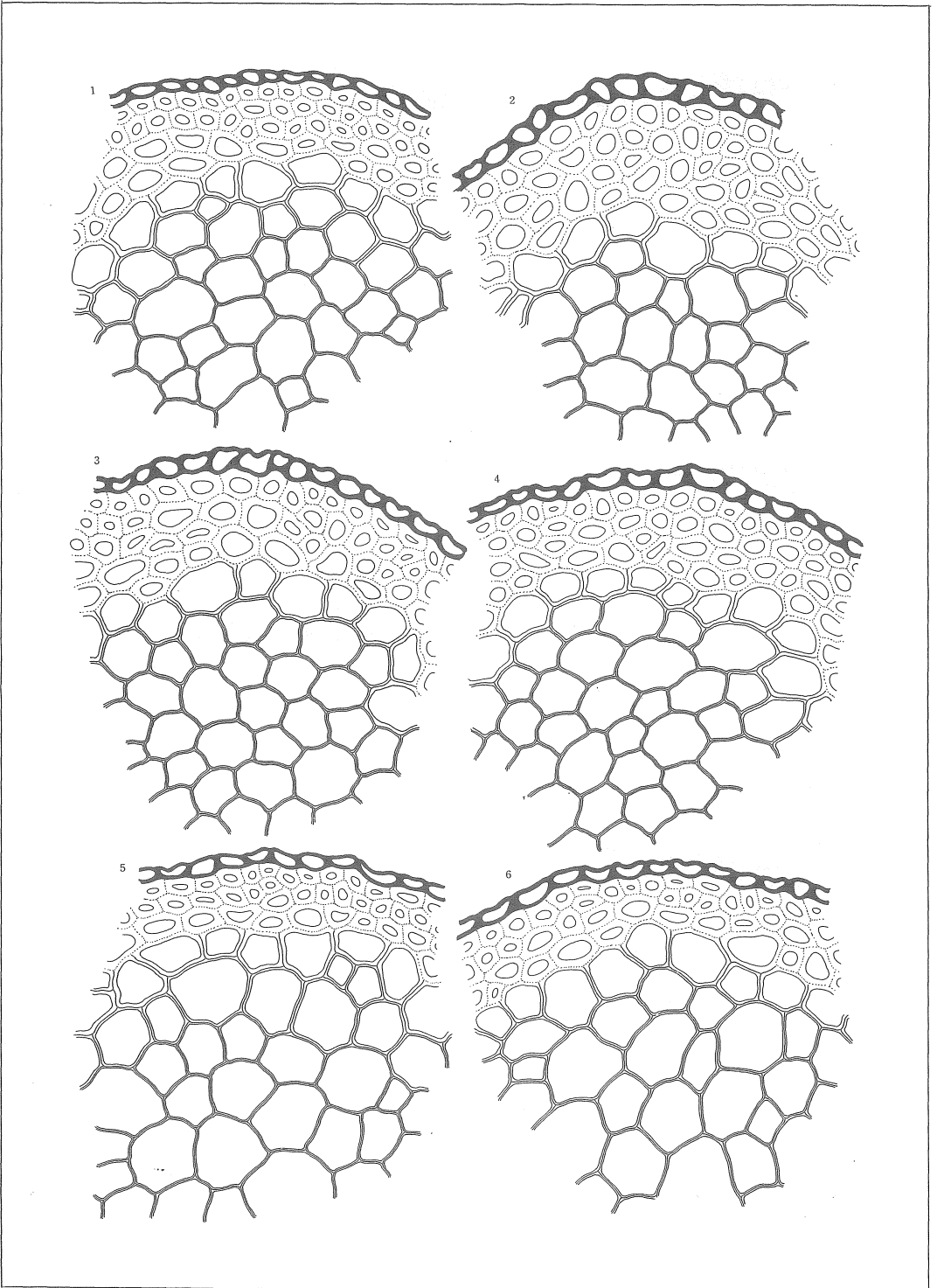


Plate XLIII. Cross sections of stem

Fig. 1-6: *Stereo-dontopsis pseudorevoluta* (REIM.) ANDO  $\times 240$

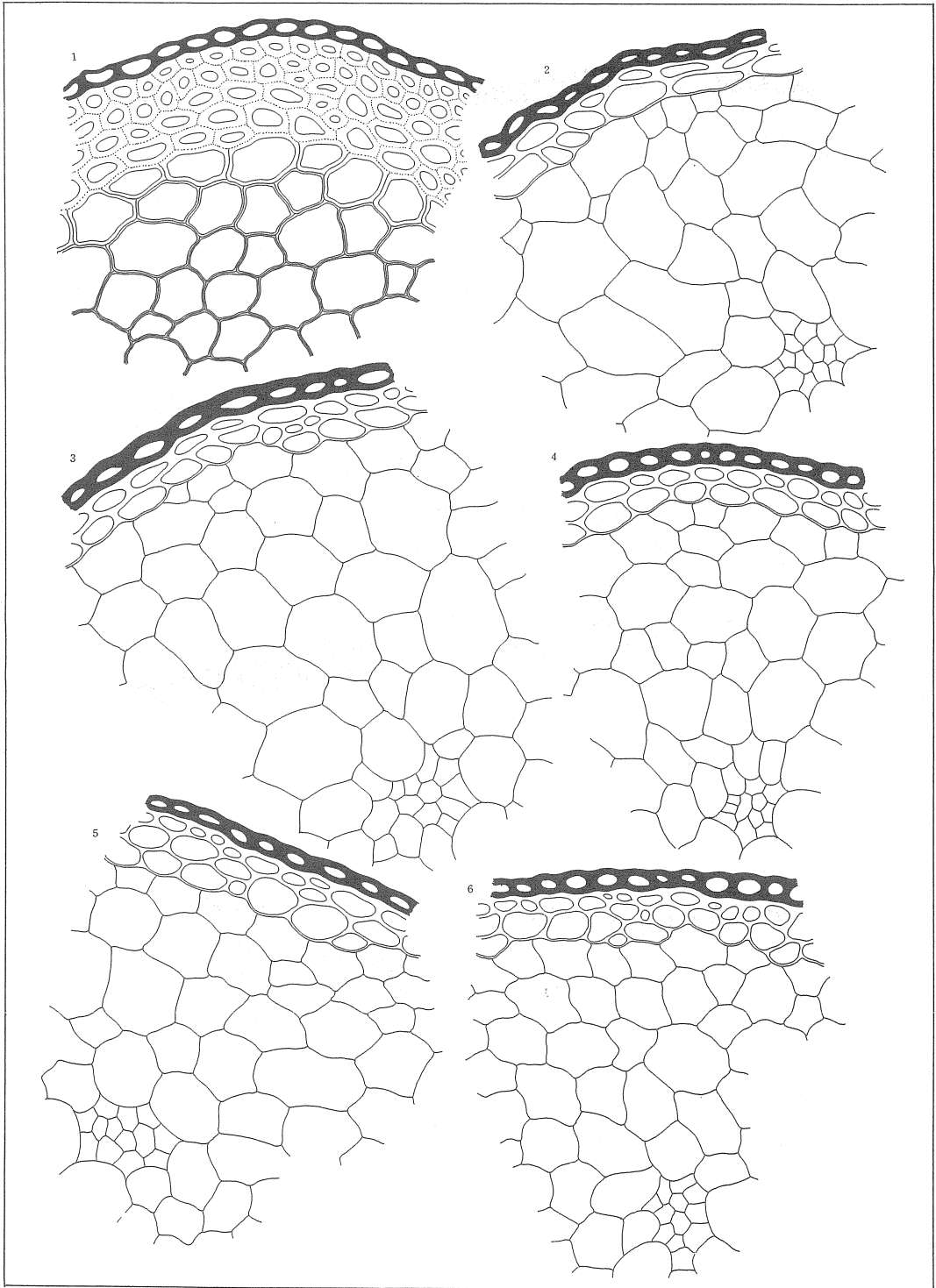


Plate XLIV. Cross sections of stem

Fig. 1: *Stereodontopsis pseudorevoluta* (REIM.) ANDO  $\times 240$

Fig. 2-6: *Taxiphyllum aomoriense* (BESCH.) IWATS.  $\times 240$



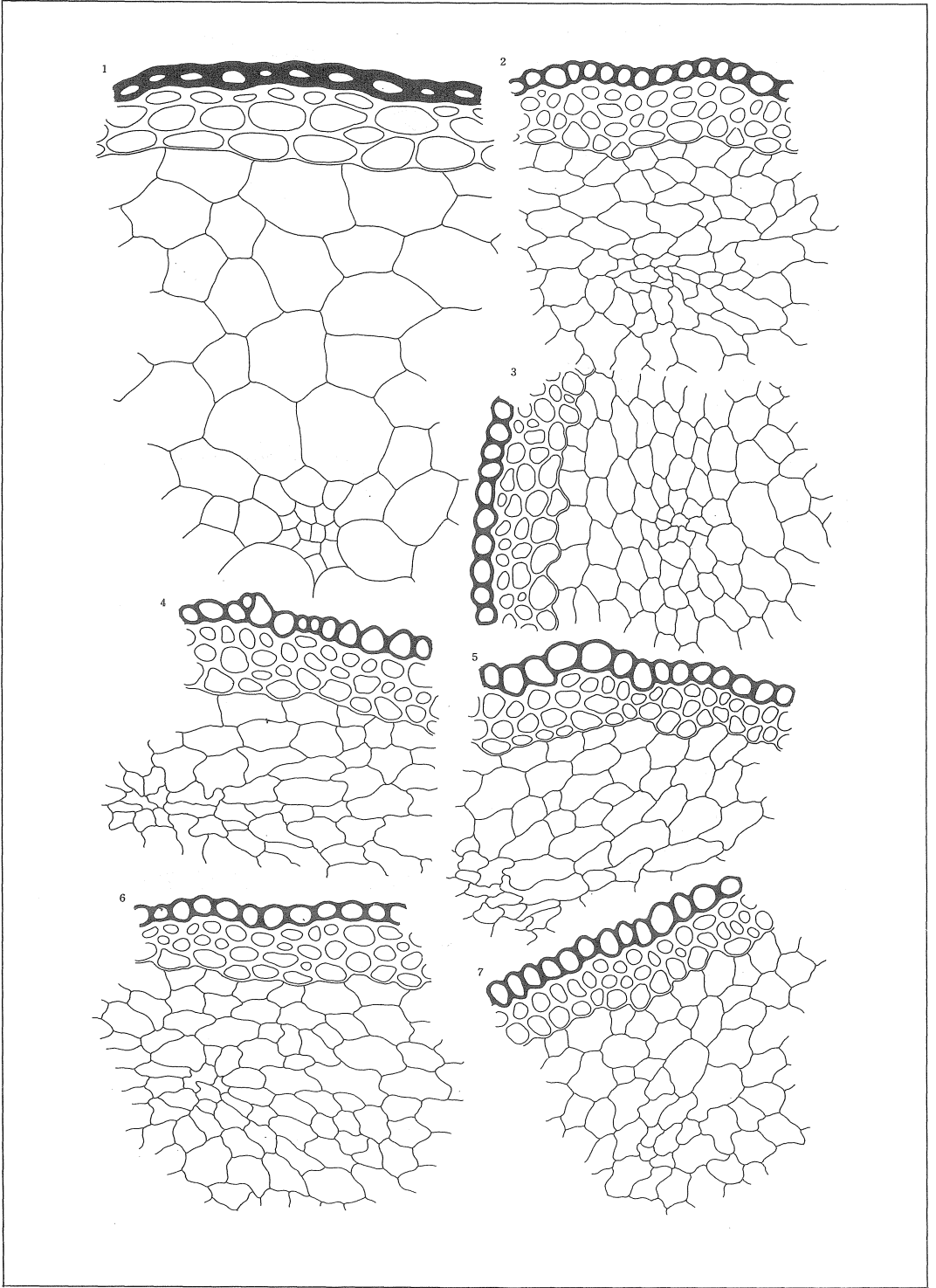


Plate XLV. Cross sections of stem

Fig. 1: *Taxiphyllum aomoriense* (BESCH.)IWATS.  $\times 240$

Fig. 2-7: *Taxiphyllum cuspidifolium* (CARD.)IWATS.  $\times 240$

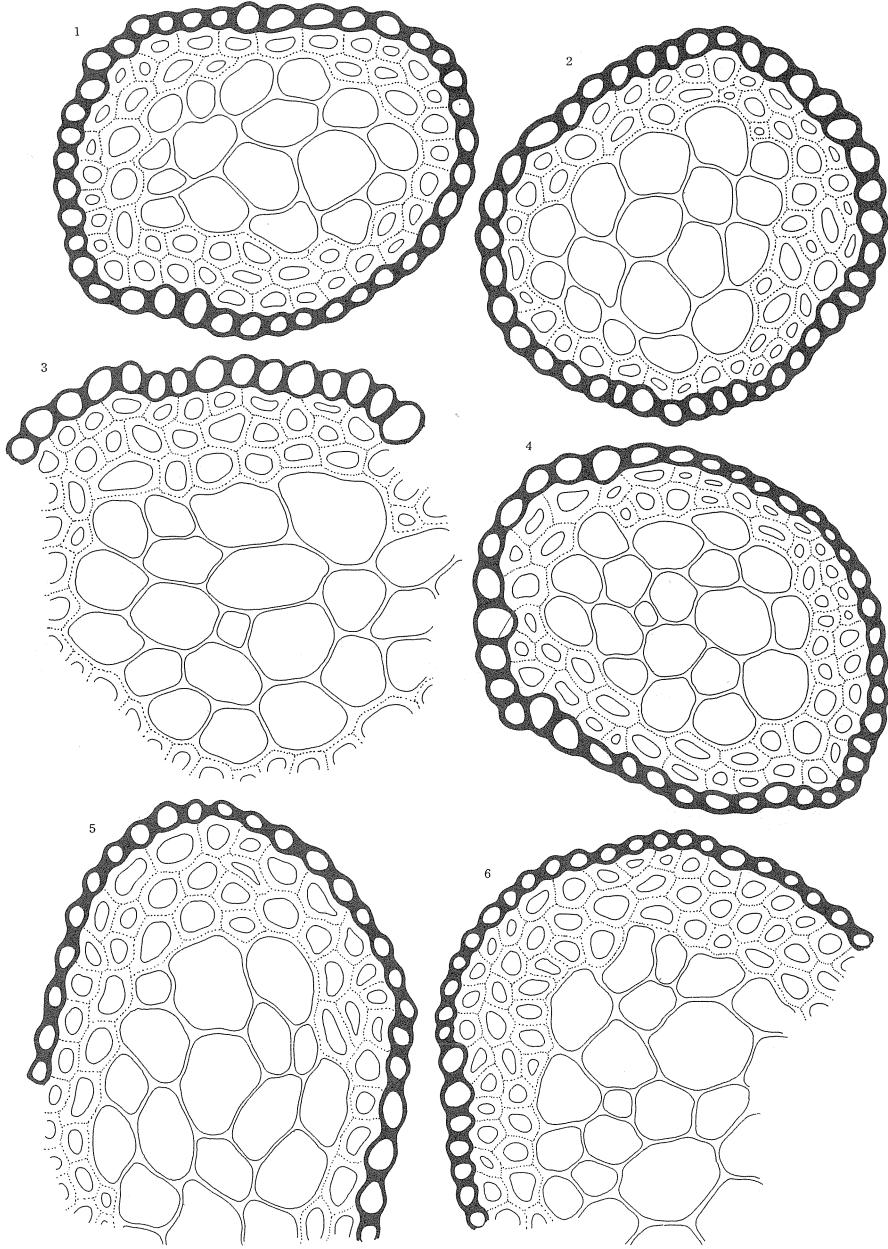


Plate XLVI. Cross sections of stem

Fig. 1-6: *Taxiphyllum subarcuratum* (BROTH.)IWATS. × 400

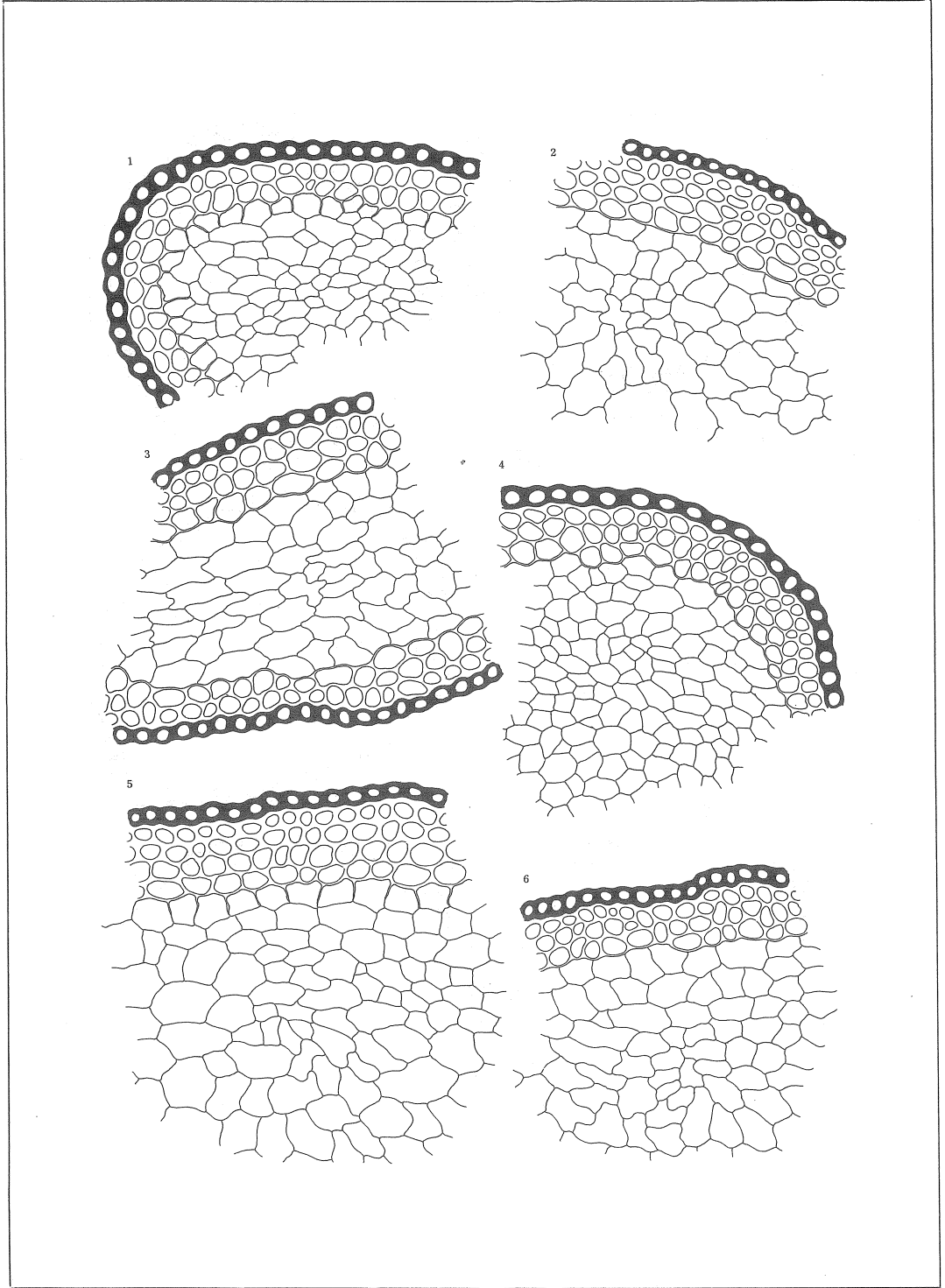


Plate XLVII. Cross sections of stem  
Fig. 1-6: *Taxiphyllum taxirameum* (MITT.) FL. × 400

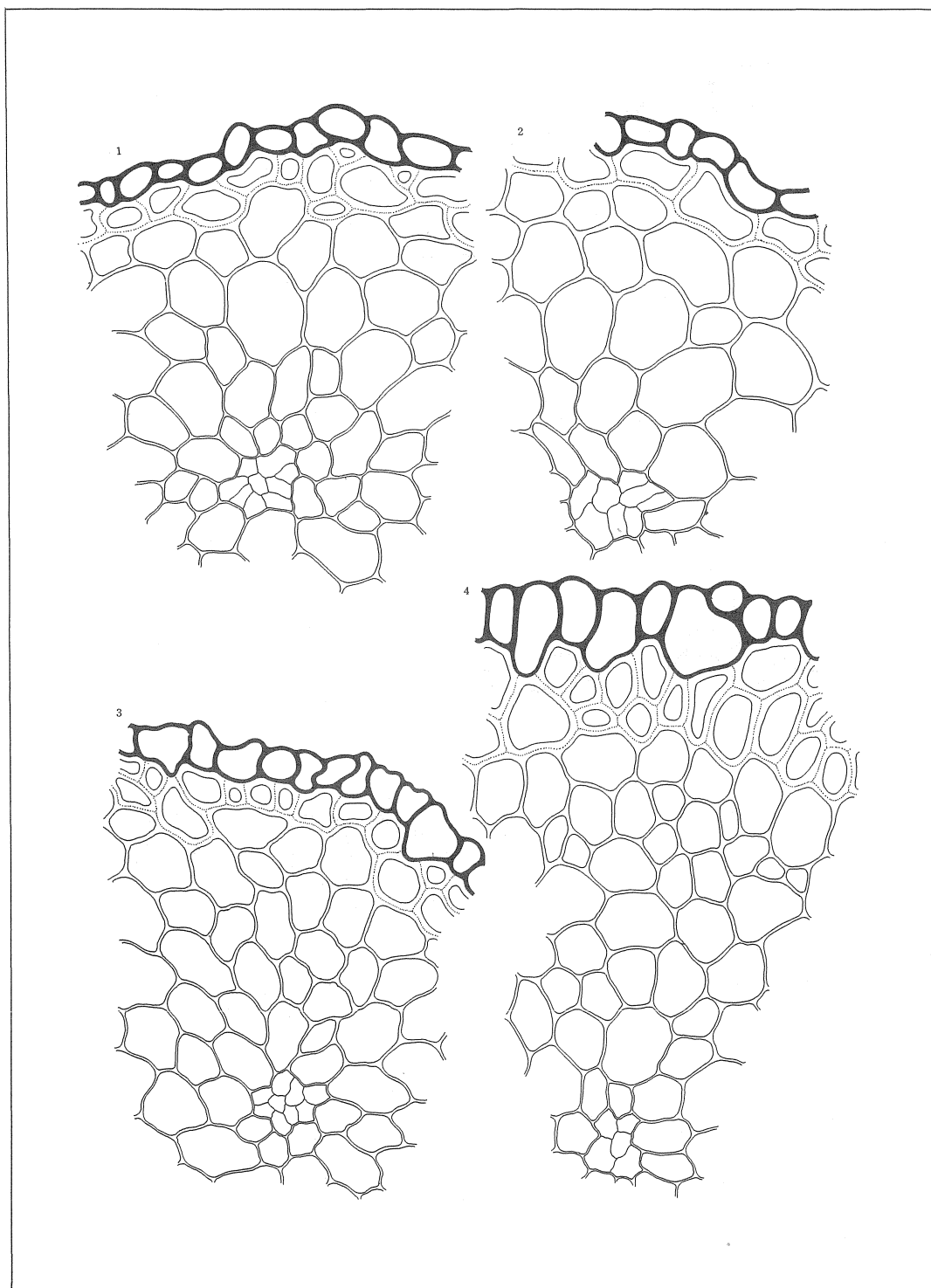


Plate XLVIII. Cross sections of stem

Fig. 1-4: *Vesicularia ferriei* (CARD. et THÉR.)BROTH. × 240

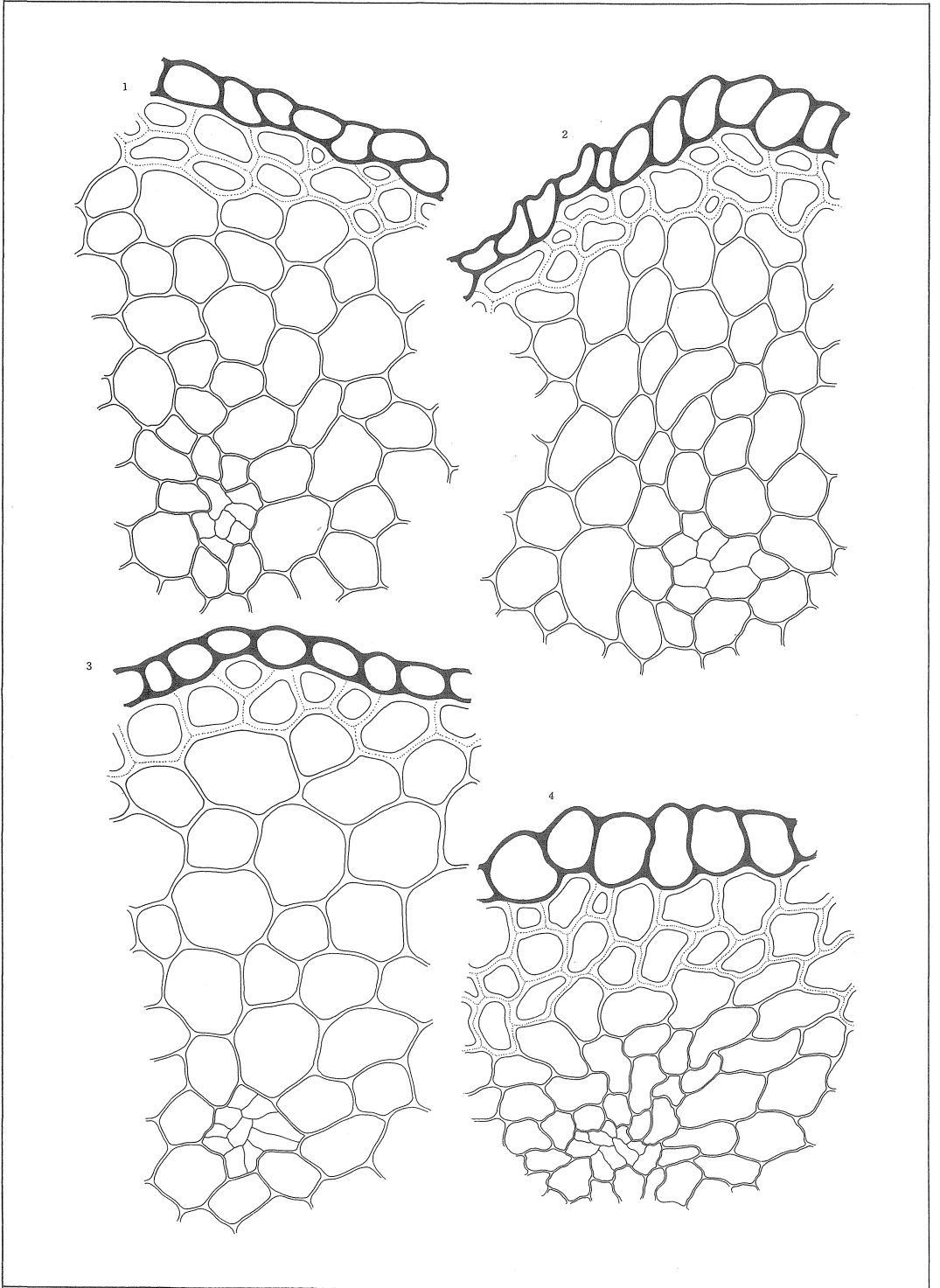


Plate XLIX. Cross sections of stem

Fig. 1-4: *Vesicularia ferriei* (CARD. et THÉR.) BROTH.  $\times 240$

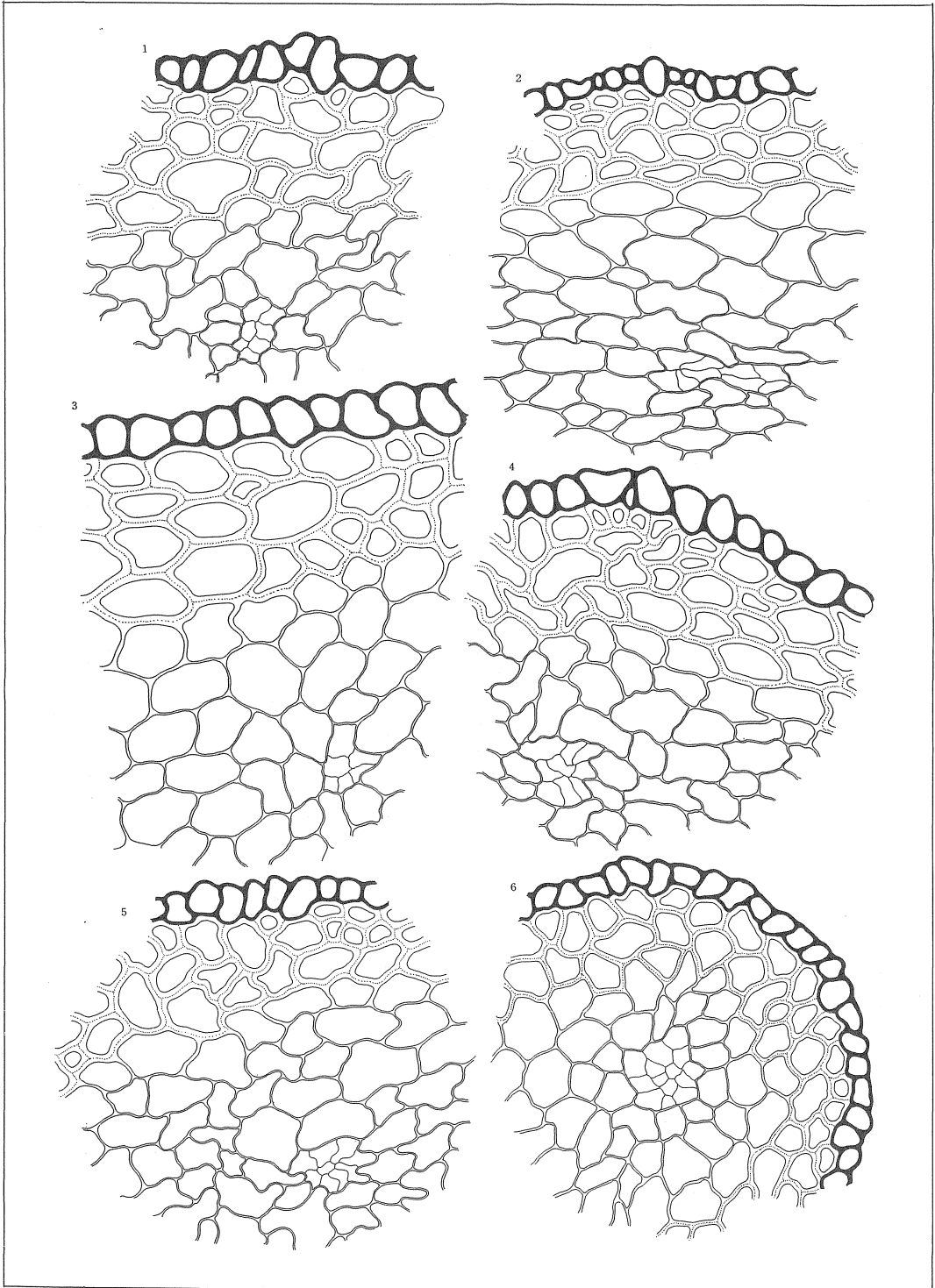


Plate L. Cross sections of stem

Fig. 1-6: *Vesicularia ferriei* (CARD. et THÉR.) BROTH. ×240

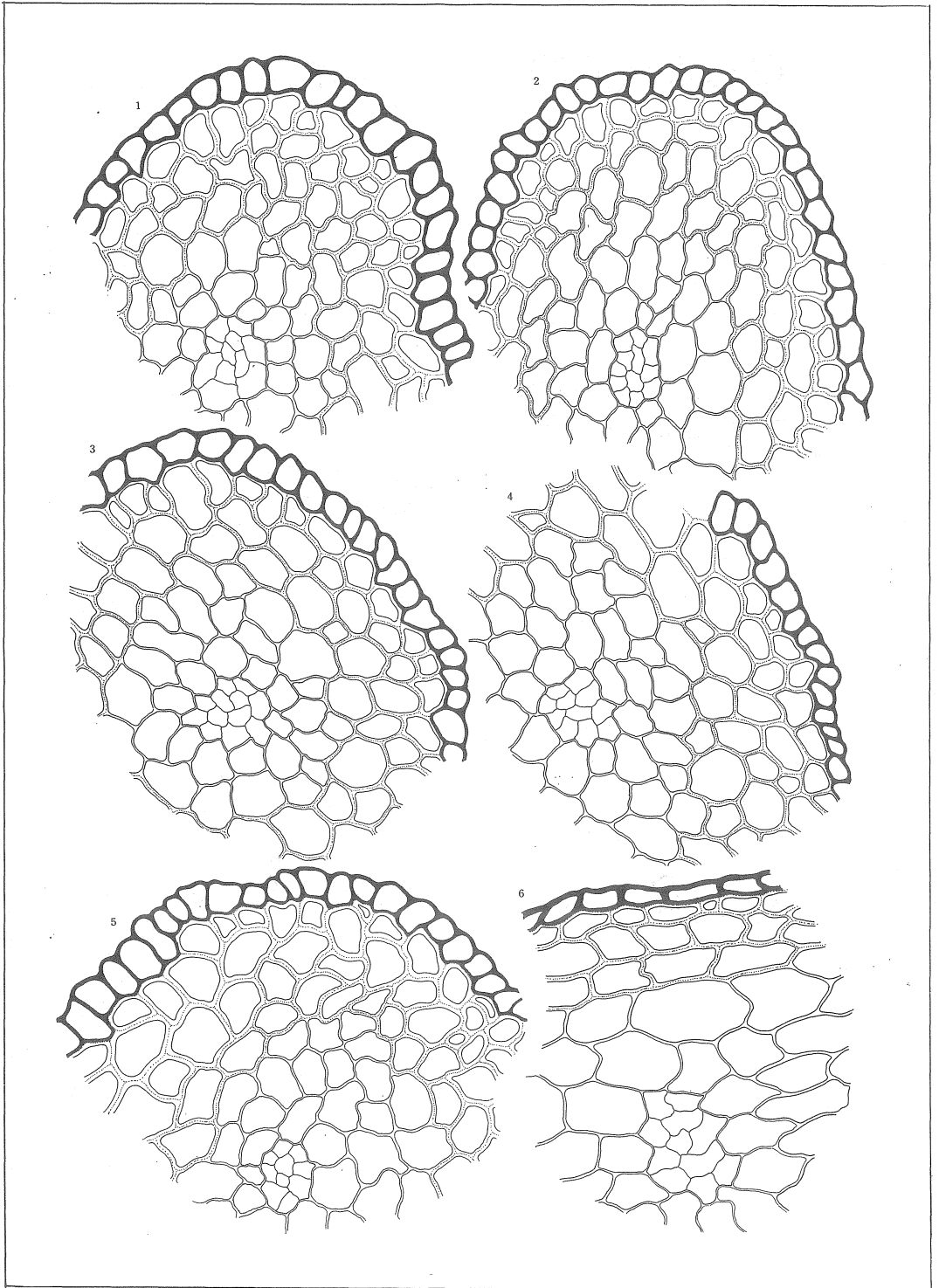


Plate LI. Cross sections of stem

Fig. 1-6: *Vesicularia ferriei* (CARD. et THÉR.) BROTH.  $\times 240$