

## Prothallia of the ferns from Thailand

by

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Lately, I had an opportunity to observe the prothallia of the Thai ferns by means of culture from their spores. The spores provided by Dr. M. Tagawa soon after collections made on two botanical trips to Thailand by himself and his colleagues. The first trip was taken during March to April of 1965, the second from November of 1965 to February of 1966 by the Kyoto University Botanical Expedition to Thailand, 1965-66 under his leadership. The total number of spores provided was 80 in packets including 42 genera and 65 species of ferns.

The culture of the prothallia from those spores was successfully carried out, from June 1965 to May 1966 for the first collection, and from March 1966 to April 1967 for the second collection, at Koishikawa Botanic Gardens of the University of Tokyo. Among the spores from which the culture of prothallia was tried, 47 species of 31 genera in 57 packets were available for my observation.

The present report deals with a description of the prothallia of these fern species. Information on suggested specimens or the corresponding ones from which spores were obtained is given within M. Tagawa and K. Iwatsuki's publications:

1. On a small collection of Thailand ferns, in *Southeast Asian Studies* 3 (3): 70-89, 1965.
2. Enumeration of Thai pteridophytes collected during 1965-66, in *Southeast Asian Studies* 5 (1): 23-120, 1967.

For convenience in preparing the present paper, I arranged species, genera, subfamilies and families in accordance with the above mentioned enumerations.

I am heartily grateful to Dr. M. Tagawa for his kind provision of the spores of many valuable and interesting ferns, and also to the staff members of Koishikawa Botanic Gardens for their help with my work on the culture of prothallia. Thanks are also due to Prof. J. Ashida for various aid rendered in the course of this study.

### SCHIZAEACEAE

#### 1. *Lygodium flexuosum* (L.) Sw.

Figs. 1, 2

Prothallium bilateral, broad heart-shaped, strikingly assurgent along the midrib and in lower part so strongly uplifted as to the margins close together; apex deeply rounded or acutely cordate, and inner sides of lobes closed or overlapping above the

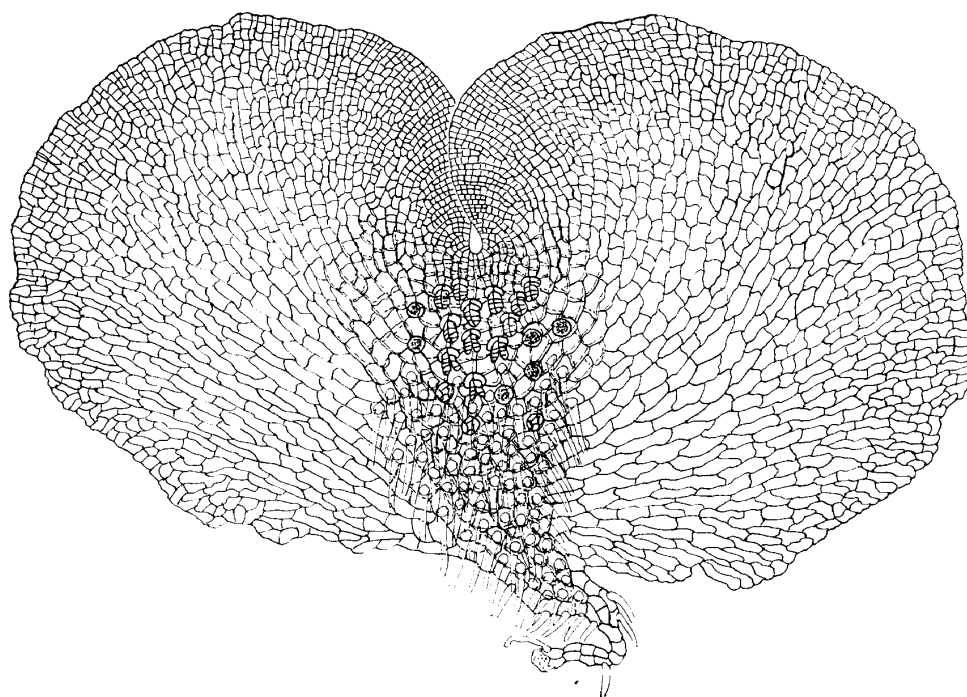


Fig. 1 *Lygodium flexuosum* (L.) Sw.

bottom of sinus; lower part of the thallus rounded, acutely narrowing towards the tailed base. Mostly aprotoneous. Basal cell or the original cell large and globoid, completely wrapped in the spore coat, the primary rhizoid inserted at the upper side of original cell, extending over the basal side of one of the secondary cells. Wings equal in size, upper sidewise or broadwise expanded, the margins almost entire or undulate; wing cells narrowly or broadly irregular in shape, with strikingly undulate side wall; marginal cells arranged with minute intercellular notch, broad or elongate, with slightly convex or almost flat free side. Midrib strikingly gutter-shaped, cushioned from the base nearly to the apex; cushion obovate, 7-8 cells thick in the heavier part. Rhizoids along the midrib from the base of thallus to the middle of cushion, almost hyaline. Archegonia gregarious on the upper median of cushion; neck mostly medium sized, slender, sometimes long but slender; neck cells mostly 4 at the anterior and 3 at the posterior side, rarely 6 at the anterior and 4-5 at the posterior side, the lowermost cells of each tier large and cushioning the neck. Antheridia on the upper part of cushion arranged so as to surround the archegonia, globoid, 90-110  $\mu$  in diameter, almost always 5 celled; two basal cells very flaty, tiered or rarely alternatively tiered by oblique wall; ring cell barrel-shaped and widely covered with cap cells; the cap always divided into two cells, and one of them always inscribed obliquely in the other.

Material. Chiangmai: Doi Chiangdao, 3 Jan. 1966.

The prothallium of this species is similar to that of *L. japonicum* Thunb., but differs from that of *L. microstachyum* Desv. in the location of its antheridia. In the

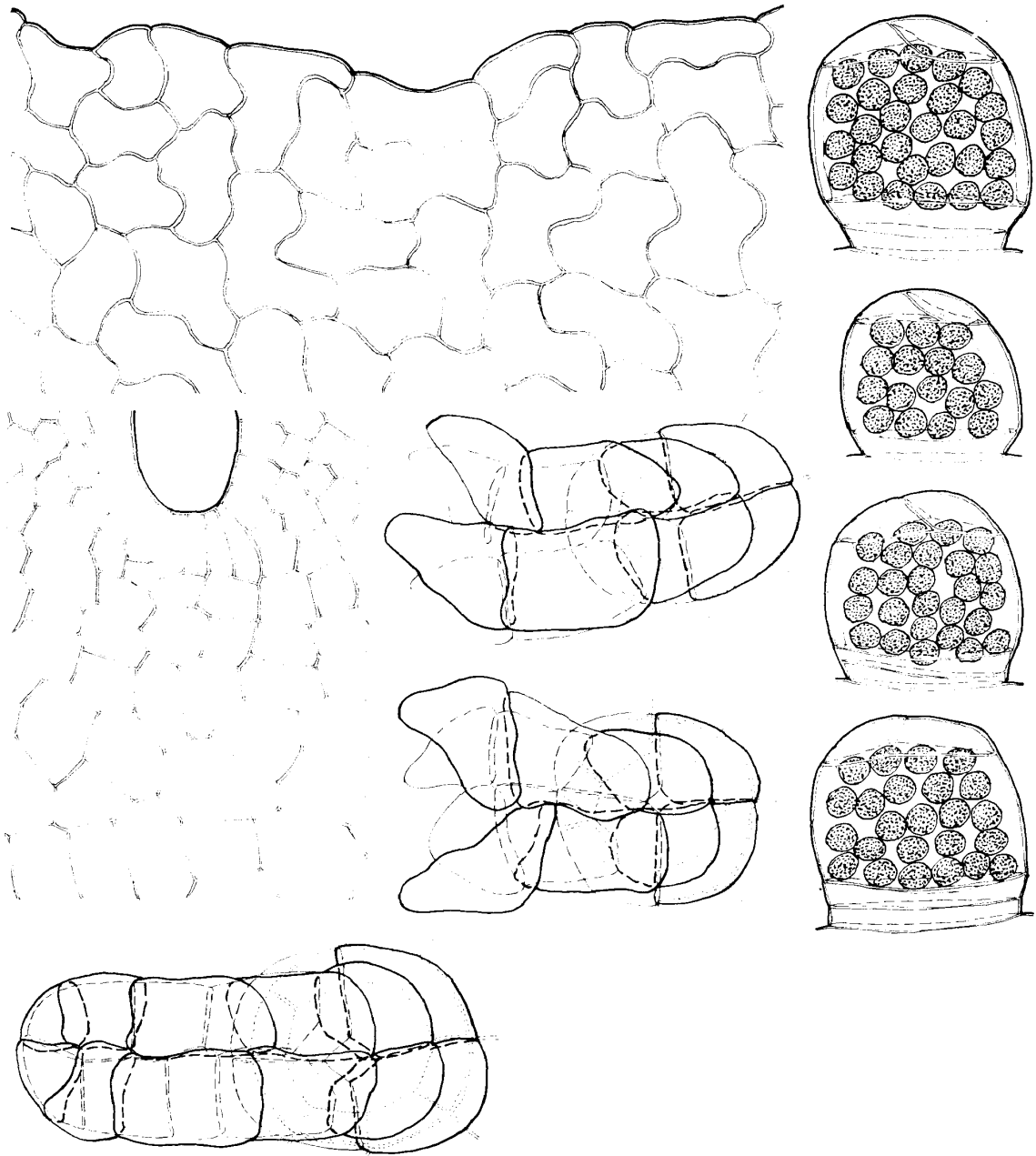


Fig. 2 *Lygodium flexuosum* (L.) Sw.

latter species, the antheridia occur on the lower part of cushion and keep apart below the archegonial group.

#### CYATHEACEAE

##### 2. *Cyathea gigantea* (Wall. ex Hook.) Holtt.

Figs. 3, 4

Prothallium bilateral, handsome heart-shaped, more or less deeply rounded, narrowly or acutely cordate, and inner sides of lobes approaching together and usually closed or overlapped above the bottom of sinus; lower part of the thallus cuneate

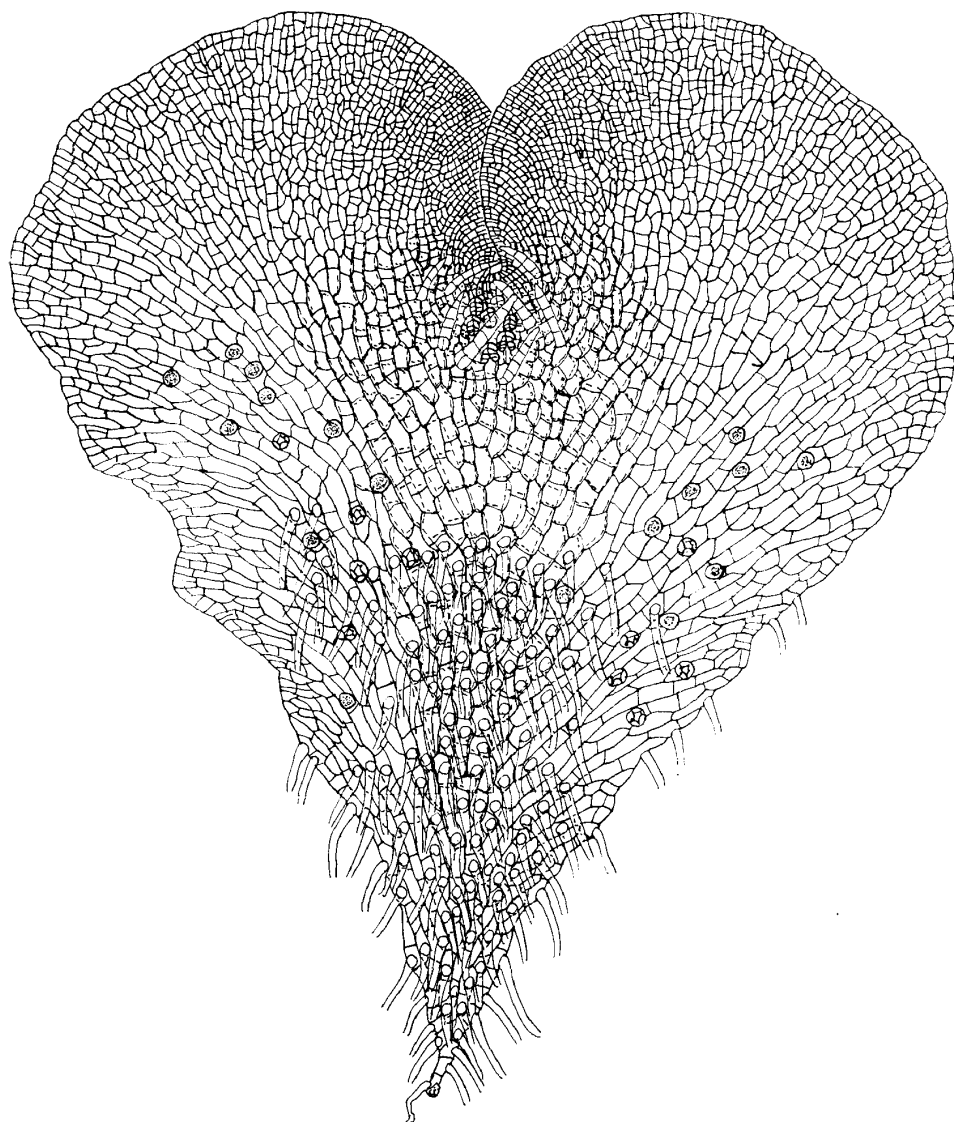


Fig. 3 *Cyathea gigantea* (Wall. ex Hook.) Holtt.

or rounded, steeply narrowing the base. Protonema 2-4 cells long; original cell cylindrical, protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, upwards or upper sidewise expanded, and margins slightly undulate; wing cells elongate or isodiametric polygonal, with slightly undulate side wall; marginal cells arranged with minute intercellular notch, elongate or isodiametric polygonal, with slightly convexed free side. Midrib gutter-shaped, cushioned from the lower part to near the apex; cushion large in size, obovate, 6-8 cells thick in the heavier part. Some multicellular hairs or scaly multicellular hairs on both sides of the archegonial area in the distal median of the cushion in confused line, 4-7 cells long, and scaly ones two cells wide at the lowest. Rhizoids on the lower part of thallus, pale brown in colour. Archegonia gregarious on the distal median of cushion, some in number; neck rather small in

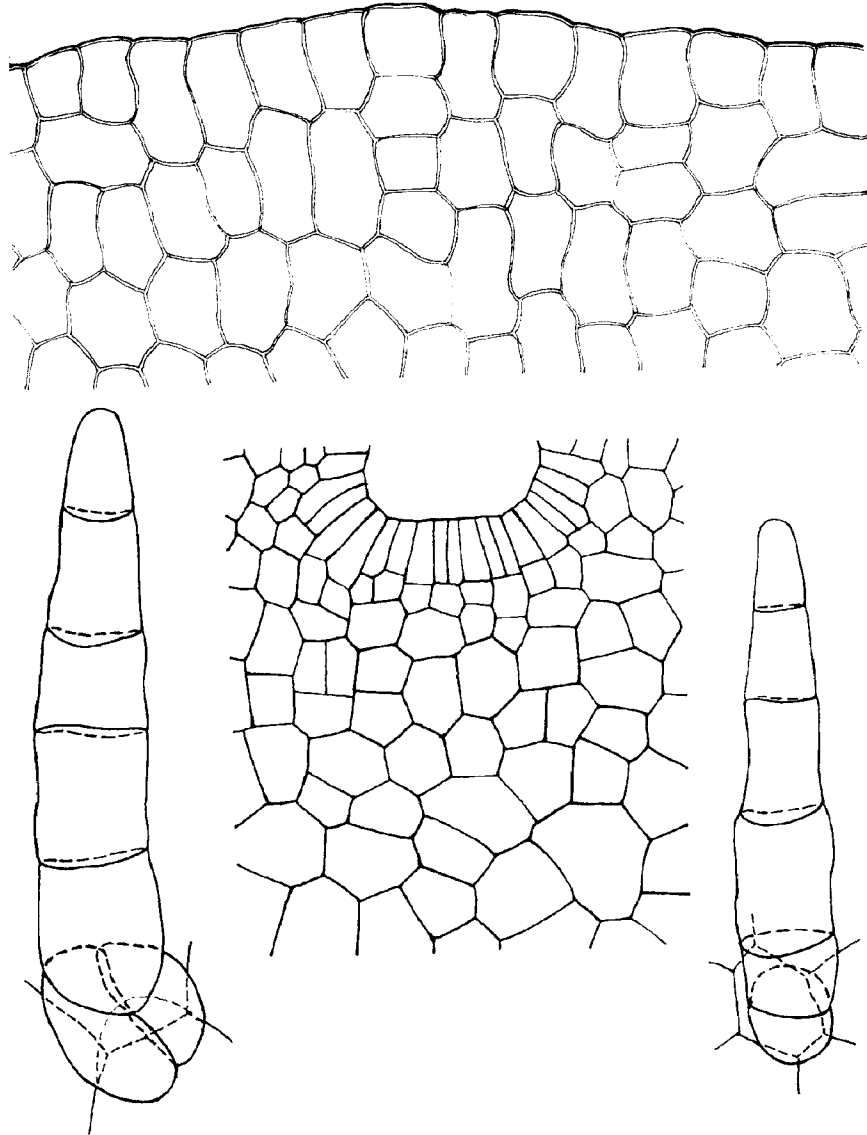


Fig. 4 *Cyathea gigantea* (Wall. ex Hook.) Holtt.

size, mostly verruciform, almost straight or somewhat bending; neck cells in four tiers of 4-5 cells each. Antheridia laminal on the lower part of the wings aside to the cushion, globoid, 85-100  $\mu$  in diameter, consisting of 5 cells; basal cells always two, very flat, edge-shaped and alternatively tiered by oblique wall; ring cell barrel-shaped and widely covered with cap cells; cap cells always two, one of them always small in size and inscribed obliquely in the other large one.

Material. Chiangmai: Doi Suthep, 31 Dec. 1965.

The peculiar multicellular hairs scaly or not and their peculiar location on the thallus as seen in the present material are characteristic of the genus *Cyathea*. I know from my experience that some specific variations in form and structure of the hairs are found in some Southeast Asian and Pacific species of *Cyathea*, though I have no particulars yet.

## POLYPODIACEAE

3. *Pyrrosia adnascens* (Sw.) Ching.

Figs. 5~7

Prothallium bilateral, heart-shaped, conspicuously assurgent along the midrib, more or less ruffled; apex shallowly and widely rounded and steeply cordate, the inner sides of lobes opened like funnel above the bottom of sinus; lower part of the thallus rounded, acutely narrowing towards the base, and the base of thallus almost always cordate. Protonema 3-4 cells long; original cell globoid, completely wrapped in the spore coat, and primary rhizoid inserted at the upper side of original cell extending over the basal side of secondary cell of the protonema. Wings almost equal in size, broadwise expanded, the margins undulate; wing cells isodiametric polygonal, with almost straight side wall, collenchymatous; marginal cells smoothly arranged, broad or isodiametric polygonal, with concave free side. Midrib strikingly gutter-shaped, cushioned from the middle upward; cushion small in size, obovate or obovate-oblong, 2-3 cells thick. Trichomes very sparse margins and on both surfaces of upper part of the thallus, verruciform, 40-60  $\mu$  long and 25-35  $\mu$  wide at base, with nucleus in the middle and small chloroplasts, glandular, the secretion cap thickened upside. Some peculiar multicellular branched hairs occurring also on both surfaces near the apex; trunk of hairs mostly 3-6 cells long, curving upward; trunk cells cylindrical but irregular in shape, with numerous large chloroplasts and rather like vegetative cells; terminal cell narrowed and longer, with minute chloroplasts; subterminal cell of trunk almost always branching off a trichome-like cell on a side opposite to the terminal cell. Rhizoids on the lower part of thallus, widely spreading to wings, and along the midrib to the upper and nesting above the cushion, brown coloured and more or less toughish. Archegonia numerous all over the cushion; neck medium sized, more or less claviform, bending backwards; neck cells in four tiers 5-6 at the anterior side and 4-5 at the posterior side. Antheridia confined to the basal part of thallus, globoid, 50-60  $\mu$  in diameter; basal cell a little lower than the ring cell, upper wall funnel-shaped.

Material. Chiangmai: Mae Klang waterfall, north of Chom Thong, 22 Mar. 1965.

The prothallium of this species differs from that of *Pyrrosia lingua* (Thunb.) Farw. (Momose, prothallia of the Japanese Ferns 593. 1967) especially in having peculiar multicellular hairs on the apical region of thallus and globoid antheridia with funnel-like upper wall of the basal cell, and from that of *P. tricuspis* (Sw.) Tagawa (Momose, op. cit. 595) in having multicellular hairs of peculiar feature. In the latter species, the prothallium has a few unicellular long hairs of peculiar feature on upper margins of the wings in addition to the ordinary trichomes and

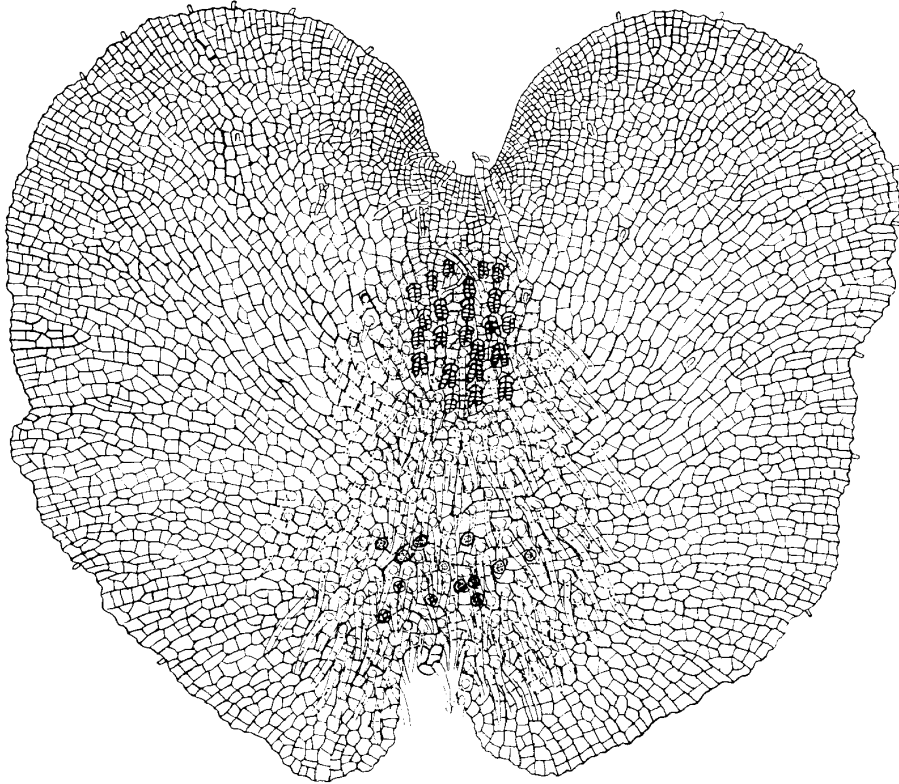


Fig. 5 *Pyrrisia adnascens* (Sw.) Ching.

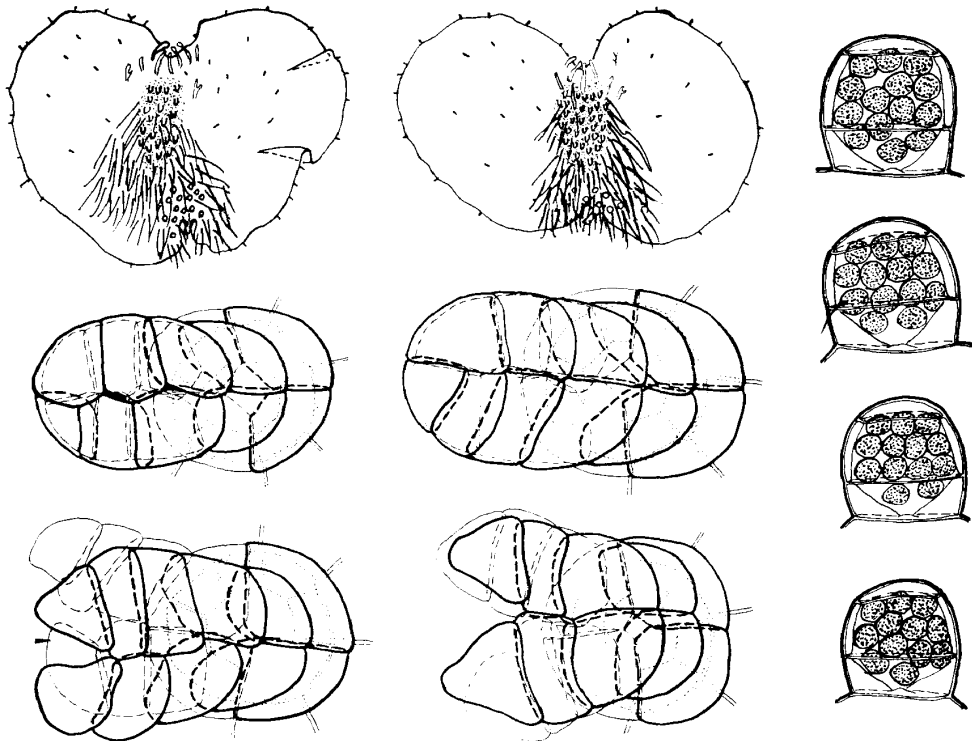


Fig. 6 *Pyrrisia adnascens* (Sw.) Ching.

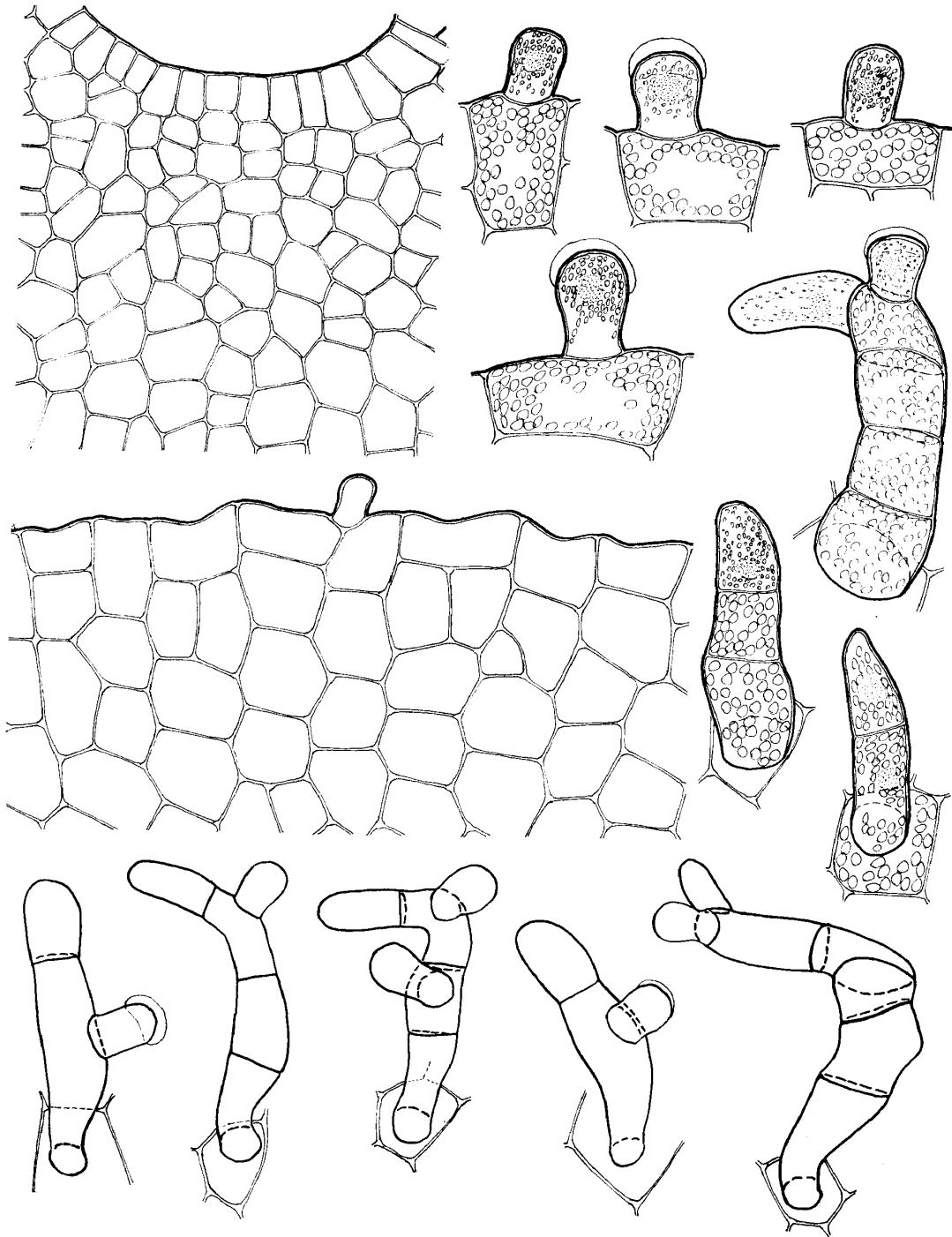


Fig. 7 *Pyrrosia adnascens* (Sw.) Ching.

the branched multicellular hairs. According to my experience, the feature of multicellular hairs of *P. adnascens* is quite peculiar and specific, not only in *Pyrrosia* but in other genera of Polypodiaceae.

4. **Belvisia revoluta** (Blume) Copel.

Figs. 8, 9

Prothallium bilateral, rather broad heart-shaped, strikingly recurved along the



midrib and somewhat ruffled; apex more or less deeply or rather shallowly rounded and acutely cordate, and the inner sides of lobes approaching and closed together above the bottom of sinus; lower part of the thallus rounded, acutely narrowing towards the tailed base. Protonema 3-6 cells long; original cell large sized, globoid, completely wrapped in the spore coat, and primary rhizoid inserted at the upper side of original cell extending over the the basal side of secondary cell of the protonema. Wings equal in size, broadwise expanded, margins more or less undulate; wing cells isodiametric or elongate polygonal, with almost straight side wall, collenchymatous; marginal cells smoothly arranged, elongate or isodiametric polygonal, with almost flat free side. Midrib strikingly gutter-shaped, inconspicuously cushioned from the middle upwards; cushion very small, 2-3 cells thick. A few trichomes on both surfaces of near the apex and rarely on margins, cylindrical, 45-55  $\mu$  in length and 25-30  $\mu$  in basal width, with nucleus in the middle and minute chloroplasts; glandular, secretion capping the top, thicken to upside. Rhizoids sparsely on the lower part of thallus spreading aside to wings, brown, toughish. Some archegonia on all over the small cushion; neck small in size, bending towards posterior; neck cells in four tiers, 5 at the anterior and 4 at the posterior sides. Antheridia along the midrib from the lower midway to the lower part of cushion and contacting with the archegonial group, globoid, 65-75  $\mu$  in diameter; basal cell equal in height and width with ring cell, upper wall funnel-like immersed to the base; very often born on a desk cell.

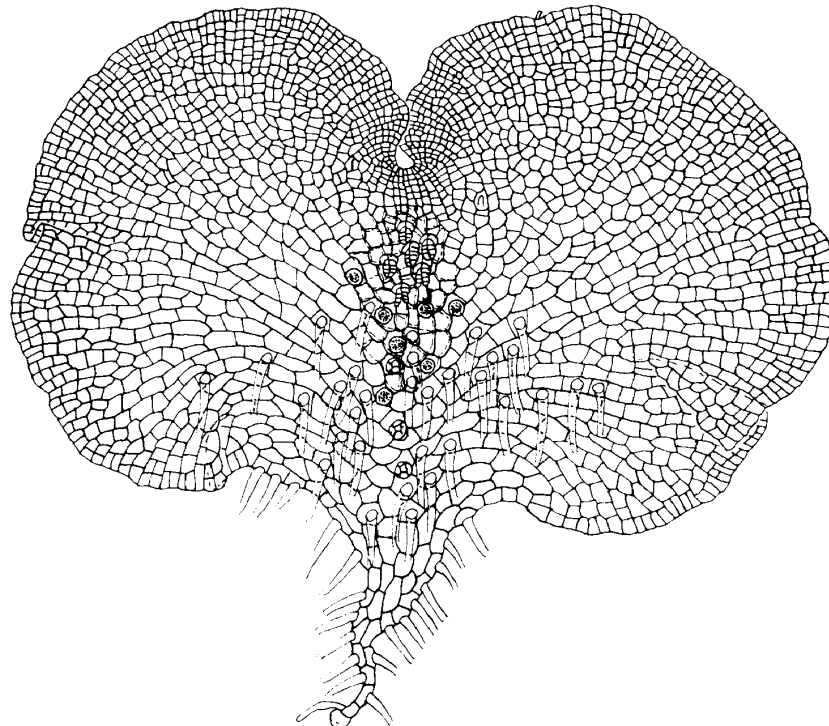


Fig. 8 *Belvisia revoluta* (Blume) Copel.

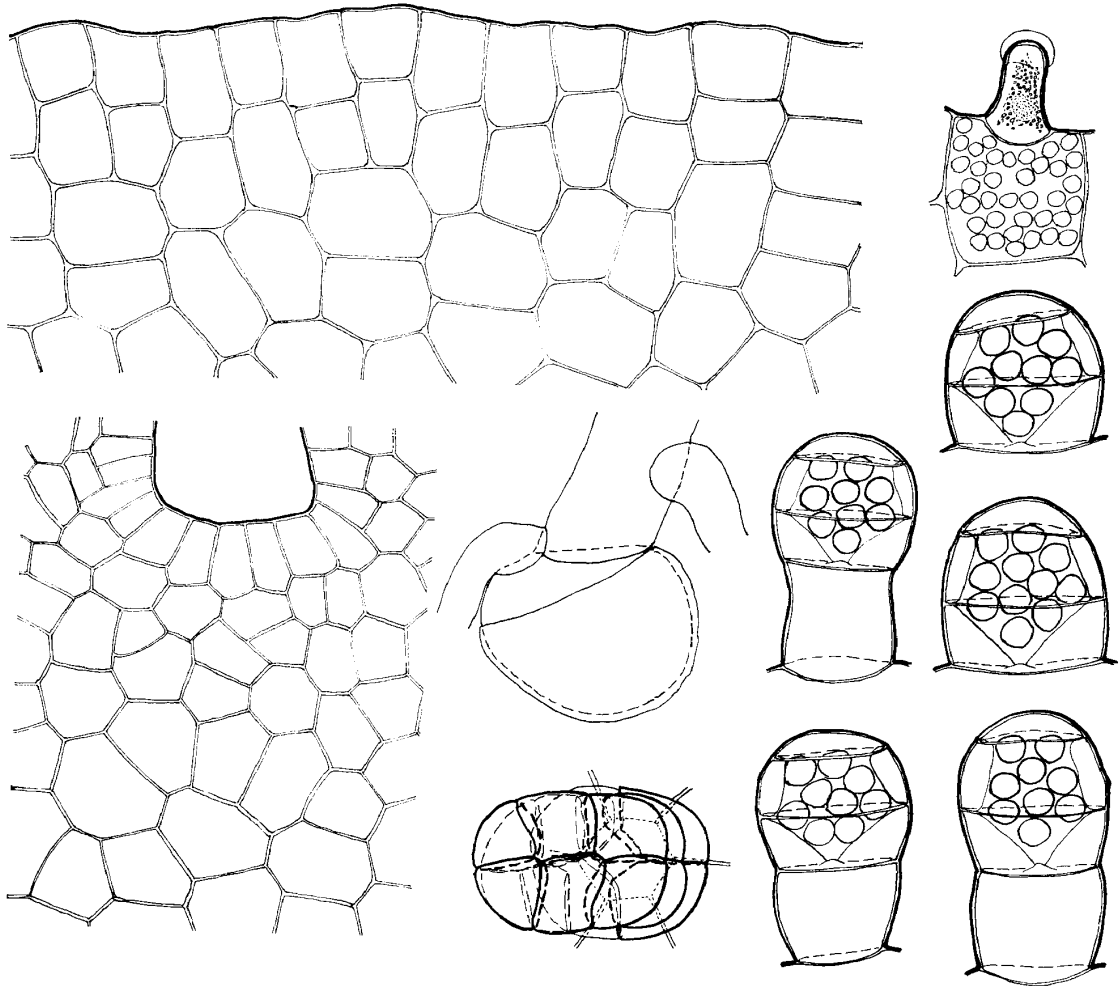


Fig. 9 *Belvisia revoluta* (Blume) Copel.

Material. Loei: Phu Kradung, 26 Nov. 1965.

The prothallium of the present material is clearly distinguishable from that of *Belvisia callifolia* (Christ) Copel. in having some trichomes on the apical region of thallus and antheridia born along the midrib from the lower midway to the lower part of cushion and contacting with the archegonial group. In the latter species, the thallus is quite naked and the location of antheridia is confined to the basal or lower part of thallus and is keeping apart below the archegonial group.

5. *Lemmaphyllum carnosum* (Hook.) Presl.

Figs. 10, 11

Prothallium bilateral, obovate and elongate heart-shaped, flattened; apex shallowly or more or less deeply rounded and acutely cordate, and inner sides of lobes approaching and closed together above the bottom of sinus; lower part of the thallus gently narrowing towards the base. Protonema 4-6 cells long; original cell globoid, completely wrapped in the spore coat, and primary rhizoid inserted at the upper side of original cell extending over the basal side of secondary cell of the protonema.

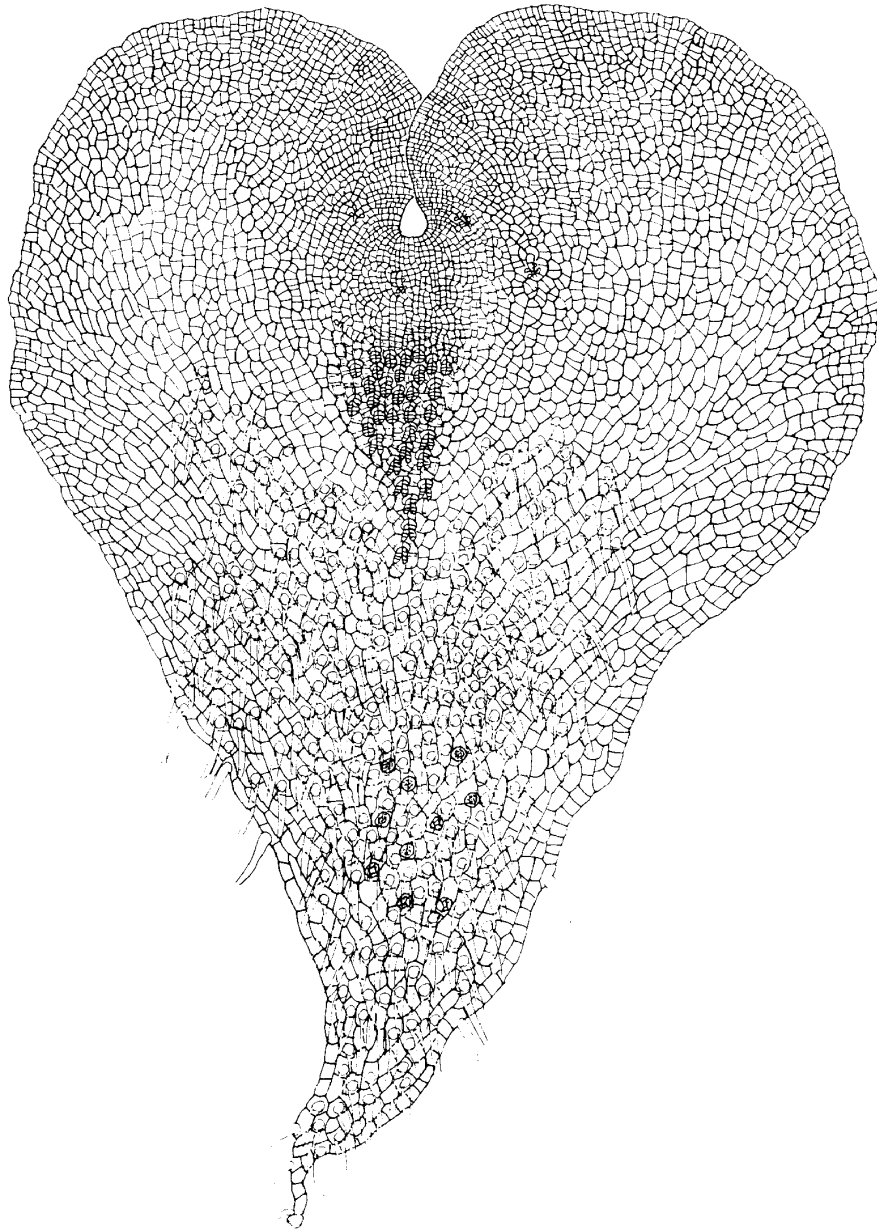


Fig. 10 *Lemmaphyllum carnosum* (Hook.) Presl.

Wings equal in size, upward expanded, margins slightly undulate; wing cells isdiametric or broad polygonal, with almost straight side wall, collenchymatous; marginal cells smoothly arranged, elongate or broad polygonal, with flat free side. Midrib cushioned from the middle to below the apex; cushion small in size, obovate, 2-3 cells thick. Some multicellular branched hairs on both surfaces of near the apex; trunk of hairs 2-3 cells, curved towards apex, terminal cell obovoid or globoid and clubbed, lower cell or cells cylindrical and always branching one or two trichome like branch cells. Rhizoids superficial, on the lower part of thallus spreading aside and upward to wings, and nesting above the cushion, brown in colour and

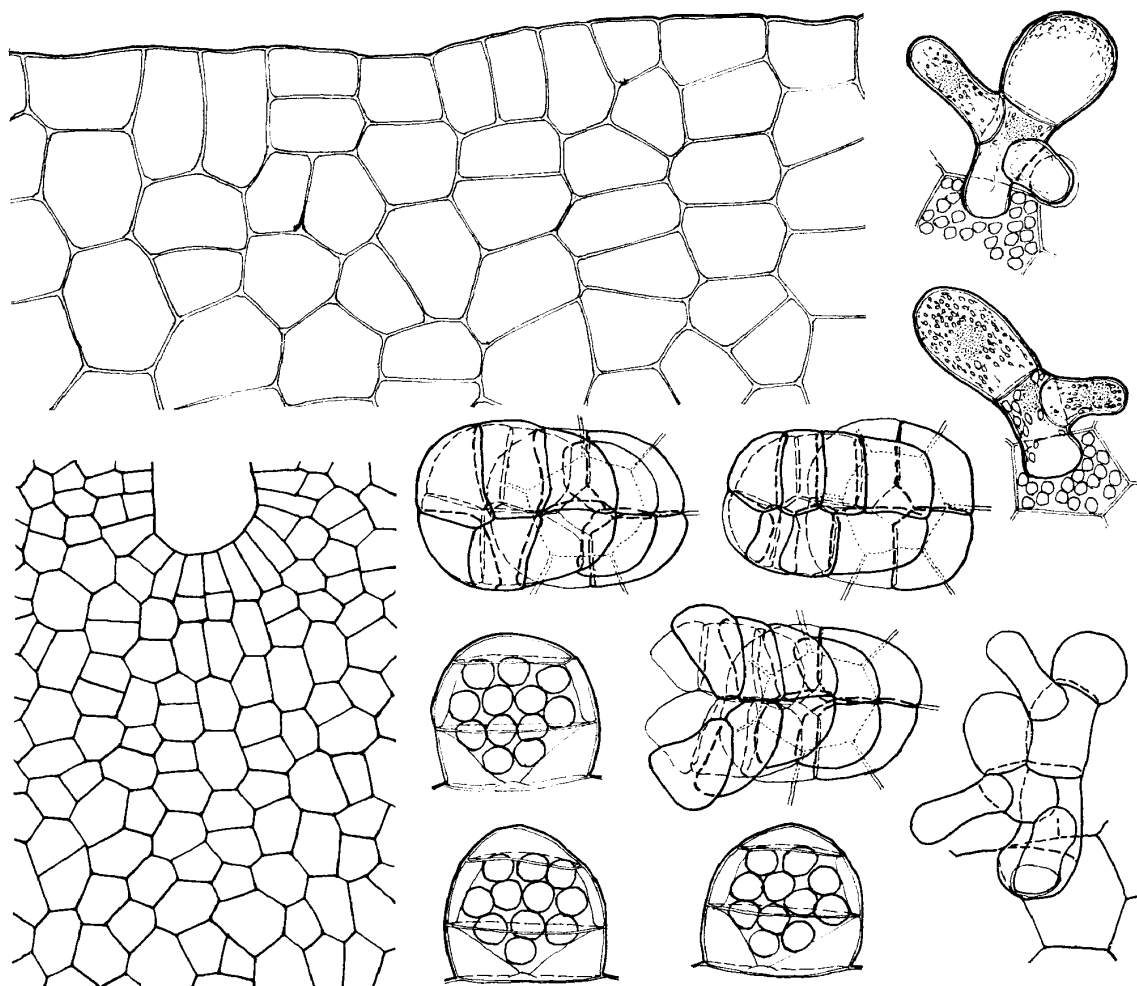


Fig. 11 *Lemmaphyllum carnosum* (Hook.) Presl.

more or less toughish. Archegonia on all over the cushion, numerous; neck small-sized, claviform, bending towards posterior; neck cells in four tiers, 5 at the anterior and 3-4 at the posterior sides, lowermost cells of each tiers large and cushioning the neck. Antheridia on the lower part of thallus along the midrib and apart below from the archegonial group, globoid, 70-75  $\mu$  in diameter; basal cell almost equal in height with ring cell, upper wall funnel-like immersed to the base.

Material. Chiangmai: Doi Chiangdao, 4 Jan. 1966.

The prothallium of the present material is, in principle, like that of *L. microphyllum* Presl (Momose, op. cit. 586). Both species have branched multicellular hairs of similar features only. This fact seems to be a character of *Lemmaphyllum*.

6. *Microsorium rubidum* (Kunze) Copel.

Figs. 12, 13

Prothallium bilateral, roundish, broad heart-shaped, almost flat; apex more or less deeply rounded and acutely cordate, and inner sides of lobes closed together above the bottom of sinus; lower part of the thallus rounded, steeply narrowing

towards the base. Protonema 3-5 cells long; original cell large-sized, globoid, completely wrapped in the spore coat, and primary rhizoid inserted at the upper side of original cell extending over the basal side of secondary cell of the protonema. Wings equal in size, broadwise expanded, margins almost entire; wing cells almost isodiametric polygonal, with almost straight side wall; marginal cells smoothly arranged, broad or isodiametric or elongate polygonal, with flat free side. Midrib cushioned from the middle nearly to the apex; cushion small, obovate, 2-3 cells thick. Some trichomes on upper margins and both surfaces near the apex, cylindrical, 40-60  $\mu$  in length, 22-25  $\mu$  in basal width and 18-22  $\mu$  in mid-width, with a nucleus at the base and numerous minute chloroplasts, glandular, secretion capped at the top, thickened upside. Some multicellular branched hairs also on both surfaces near the apex; trunk almost two cells long, curved towards the apex, lower cell branching a trichome-like cell to the opposite side. Rhizoids superficial, on the lower part of thallus widely along the midrib from the base of thallus to the middle and nesting above the cushion, and spreading aside to wings, brown coloured and more or less toughish. Archegonia on all over the cushion; neck rather large and thick, claviform, bending, towards posterior; neck cells in four tiers, 5 at the anterior and 4 at the posterior sides, lowermost cells of each tier large and cushioning the neck. Antheridia on the basal part of thallus, grouped along the midrib, globose, 85-100  $\mu$  in diameter; basal cell almost equal in height and width with ring cell, upper wall funnel-like, immersed to the base; ring cell

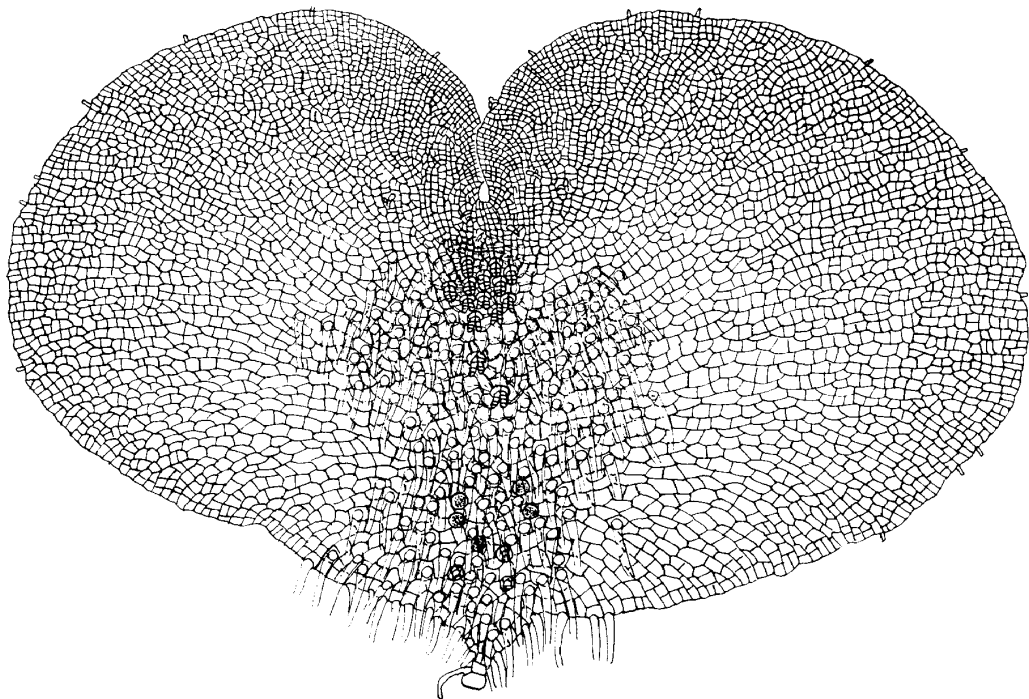


Fig. 12 *Microsorium rubidum* (Kunze) Copel.

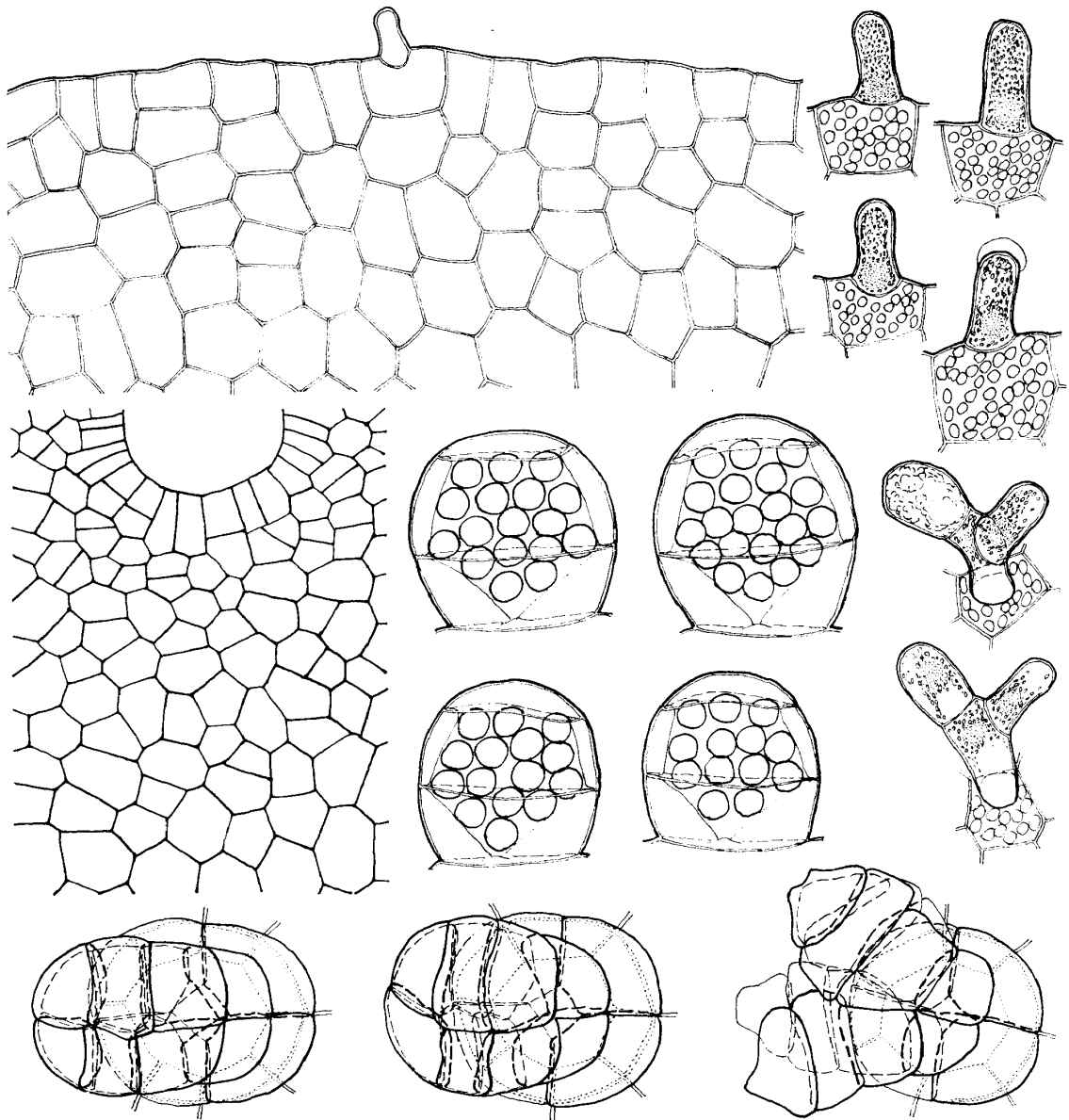


Fig. 13 *Microsorium rubidum* (Kunze) Copel.

widely covered with rounded cap cell.

Material. Nakawn Sritamarat: Khao Luang, interior of Wat Kiri Wang, 17 Jan. 1966.

The prothallium of the present material is distinct from that of *M. punctatum* (L.) Copel., the typical form of the genus (Momose, op. cit. 597), in having some ordinary trichomes on the margins of wings in addition to branched multicellular hairs on both surfaces near the apex.

7. *Microsorium nigrescens* (Blume) Copel.

Figs. 14, 15

Prothallium bilateral, broad heart-shaped, almost flattened; apex shallowly rounded and steeply cordate, and inner sides of lobes funnel-like, opened above the bottom

of sinus; lower part of the thallus founded or more or less cuneate, steeply narrowing towards the base. Protonema 3-6 cells long; original cell large-sized, globoid, completely wrapped in the spore coat, and primary rhizoid inserted at the upper side of original cell extending over the basal side of secondary cell of the protonema. Wings equal in size, broadwise expanded, margins almost entire; wing cells almost isodiametric polygonal with almost straight or slightly curved side wall; marginal cells smoothly arranged, broad or isodiametric or elongate polygonal with almost flat or slightly concaved free side. Midrib cushioned from the upper middle to near the apex; cushion small in size, obovate or obovate-oblong, 2-3 cells thick. Some trichomes on upper margins and a few on both surfaces near apex, cylindrical, 45-60  $\mu$  length, 22-23  $\mu$  in basal width and 15-17  $\mu$  in mid-width, with nucleus at the base and small chloroplasts; glandular, secretion capped at the top, almost uniformly thickened. Some multicellular branched hairs on both surfaces near the apex; trunk of hairs mostly two cells long, curved towards apex, lower cell branching a trichome-like cell to the opposite side. Rhizoids superficial, on the lower part of cushion widely spreading aside to wings and nesting above the cushion, brown-coloured and more or less toughish. Archegonia on all over the cushion; neck small in size, claviform, bending towards posterior; neck cells in four tiers, 5-6 at the anterior and 4 at the posterior sides, lowermost cells of each tier somewhat large



Fig. 14 *Microsorium nigrescens* (Blume) Copel.

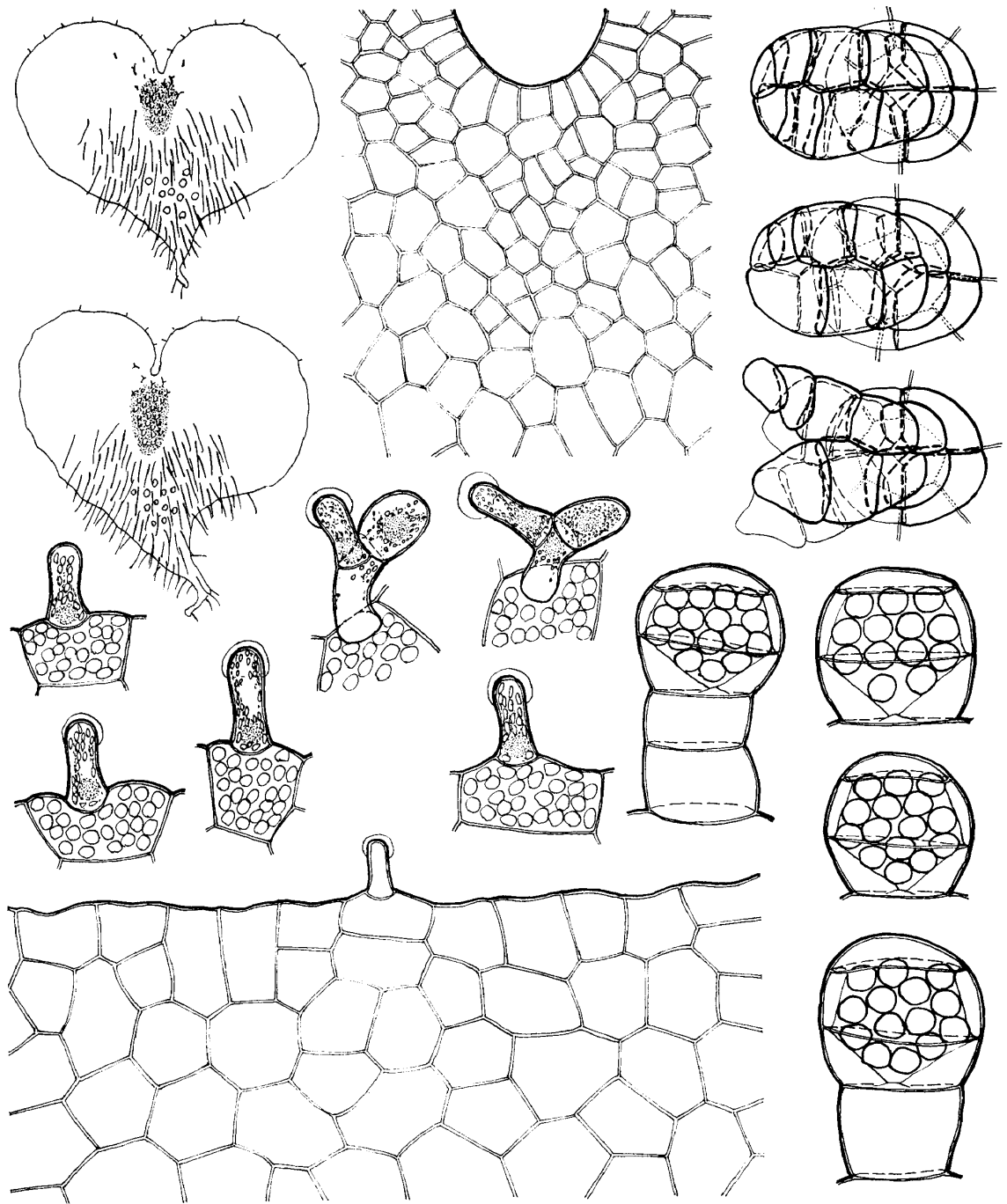


Fig. 15 *Microsorium nigrescens* (Blume) Copel.

and cushioning the neck. Antheridia on the lower part of thallus, grouping along the midrib, globose, 75-85  $\mu$  in diameter; basal cell almost equal in height and width with ring cell, upper wall funnel-like, immersed to the base; rind cell widely covered with rounded cap cell; often born on cylindrical desk cell, 1-2 cells long.

Material. Trang: Khao Chong, March 1965 (from the cultivated plant at Kyoto). The prothallium of the present material is quite similar to that of *M. rubidum*



(Kunze) Copel.

8. *Polypodium persicifolium* Desv.

Figs. 16, 17

Prothallium bilateral, handsome heart-shaped, assurgent along the midrib; apex more or less deeply rounded and acutely cordate, and inner sides of lobes slightly approaching together and often closed above the bottom of sinus; lower part of the thallus rounded, steeply narrowing towards the base, Protonema 4-6 cells long; original cell large-sized, globoid, completely wrapped in the spore coat, and primary rhizoid inserted at the upper side of original cell extending over the basal side of secondary cell of the protonema. Wings equal in size, upper sidewise expanded, margins almost entire; wing cells isodiametric or elongate polygonal, with almost straight side wall; marginal cells smoothly arranged, isodiametric or elongate polygonal, with concave free side. Midrib gutter-shaped, cushioned from the upper middle to near the apex, cushion very small in size, obovate-oblong, 2-3 cells thick. Trichomes sparsely on more or less upper margins or very sparsely on both surfaces of near the apex, cylindrical and tapered, minute, 33-50  $\mu$  in length and 20-23  $\mu$  in basal width, with nucleus in the middle and numerous minute chloroplasts;

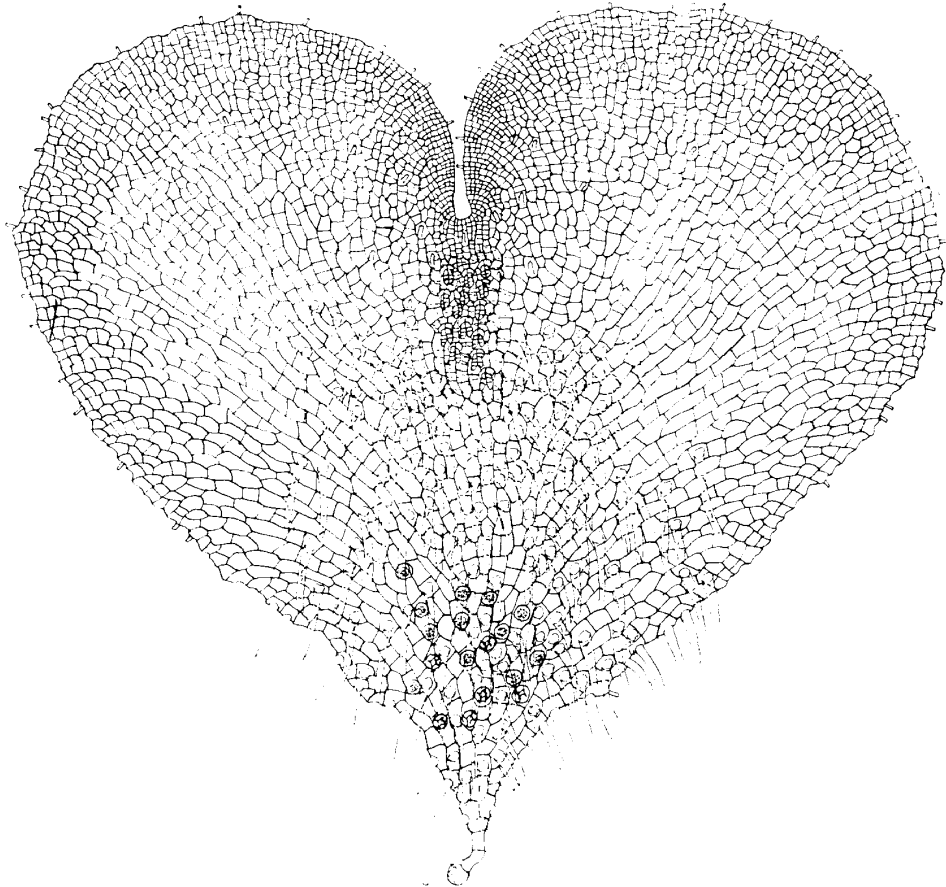


Fig. 16 *Polypodium persicifolium* Desv.

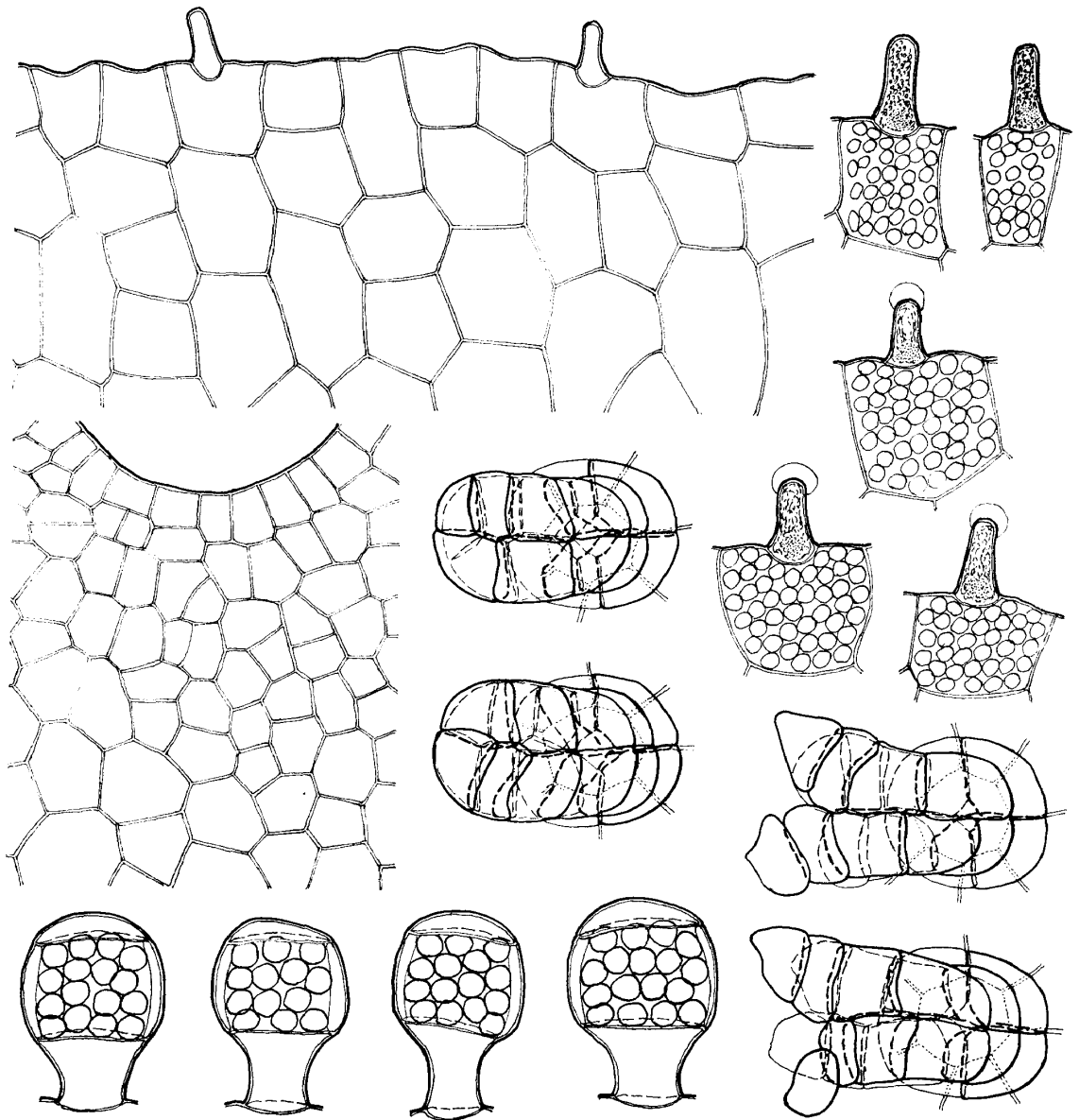


Fig. 17 *Polypodium persicifolium* Desv.

glandular, secretion capped at the top, thickened upside. Rhizoid superficial, on the lower part of thallus spreading aside to wings and nesting above the cushion, brown in colour and toughish. Archegonia gregarious, on all over the cushion; neck small in size, rather slender, bending towards posterior; neck cells in four tiers, 5-6 at the anterior and 3-4 at the posterior sides, lowermost cells in each tier somewhat large and cushioning the neck. Antheridia on the basal part of thallus along the midrib, capitate, 65-75  $\mu$  in diameter; basal cell strikingly narrower than ring cell, narrowing towards the base, upper wall flat; ring cell barrel-shaped, and widely covered with rounded cap cell.

Material. Nakawn Sritamarat: Khao Luang, 20 Jan. 1966.

9. *Aglaomorpha coronans* (Wall. ex Mett.) Copel.

Figs. 18, 19

Prothallium bilateral, rather broad heart-shaped, more or less assurgent along the midrib; apex deeply rounded and acutely cordate, and inner sides of lobes approaching and closed together above the bottom of sinus; lower part of the thallus rounded, acutely or steeply narrowing towards the base. Protonema 2-5 cells long; original cell globoid, completely wrapped in the spore coat, and primary rhizoid inserted at the upper side of original cell extending over the basal side of secondary cell of the protonema. Wings equal in size, upper sidewise expanded, margins more or less undulate; wing cells elongate or isodiametric polygonal with lightly curved side wall; marginal cells arranged with minute intercellular notch or almost smoothly, elongate or isodiametric polygonal with concave free side. Midrib somewhat gutter-shaped, cushioned from the middle to near the apex; cushion small in size, obovate, 2-3 cells thick. Trichomes very sparsely on margins and both surfaces of the thallus, verruciform, 30-40  $\mu$  in height and 27-30  $\mu$  in basal width, with nucleus in the middle and small chloroplasts; glandular, secretion capped at the top, thickened upside. Some multicellular branched hairs also on both surfaces near the apex; trunk 2-3 cells long, bending towards apex; terminal cell globoid or ovoid, protoplasmic contents sooner or later replaced by tubercular contents; lower cell or cells cylindrical and with rather large chloroplasts, branching a trichome-like cell to the opposite side. Rhizoids on the lower part of thallus spreading aside to wings, brown in colour and more or less toughish. Archegonia on all over the cushion, many in number; neck small in size, more or less claviform,

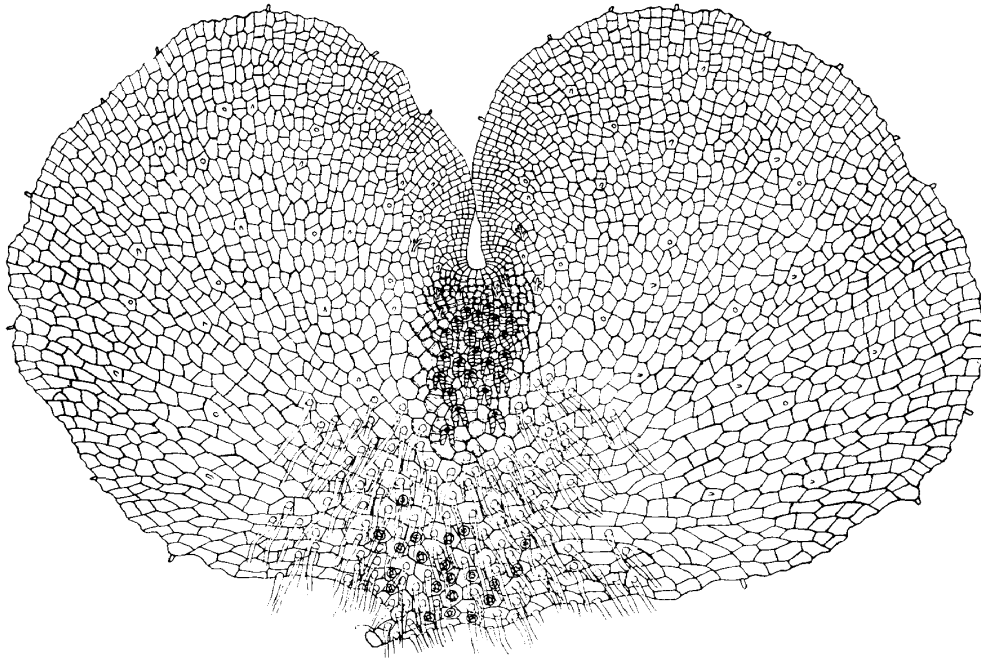


Fig. 18 *Aglaomorpha coronans* (Wall. ex Mett.) Copel.

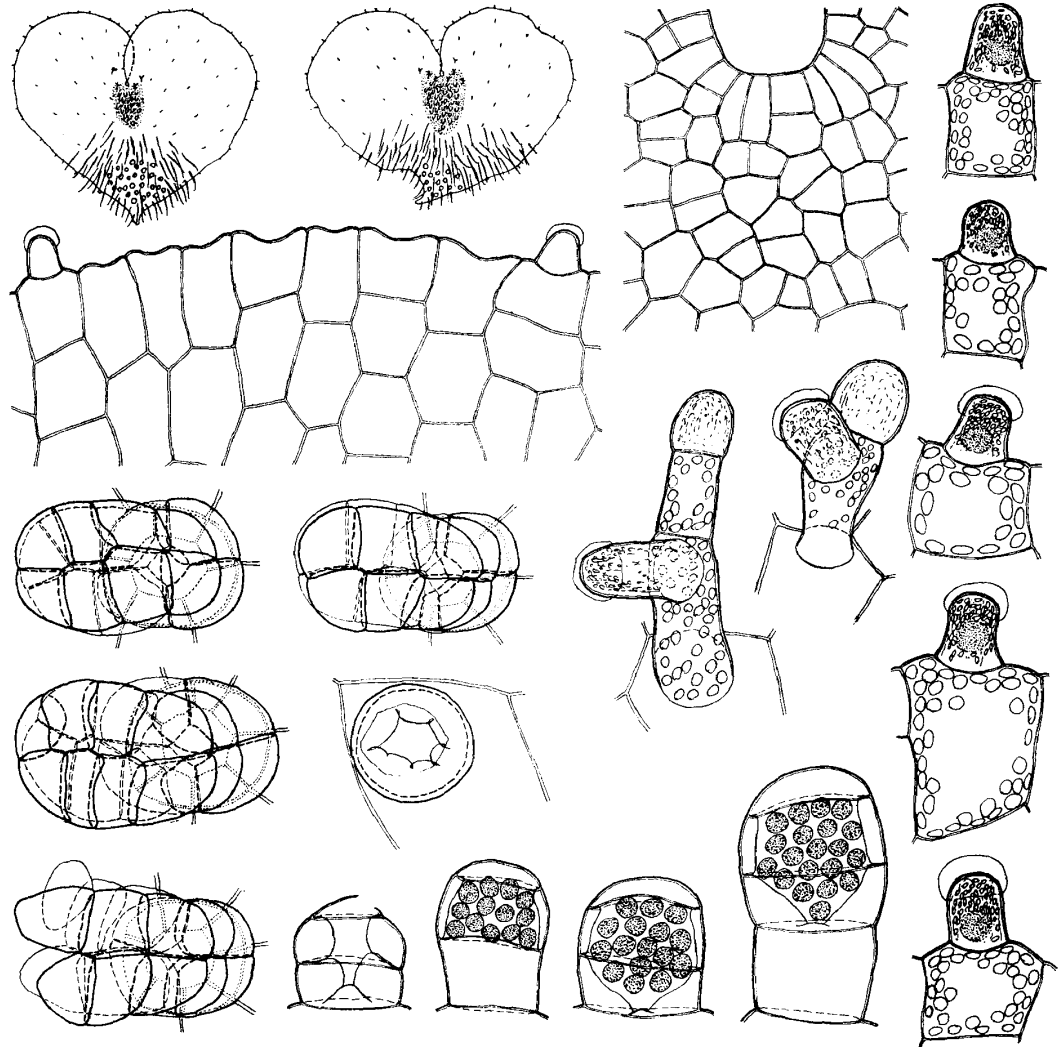


Fig. 19 *Aglaomorpha coronans* (Wall. ex Mett.) Copel.

bending towards posterior; neck cells in four tiers, 5-6 at the anterior and 3-4 at the posterior sides. Antheridia confined to the basal part of thallus, globose 50-70  $\mu$  in diameter; basal cell almost equal in height and width with ring cell, upper wall funnel-like, immersed to the base or rarely flat; cap cell rounded and widely covering the ring cell; sometimes born on a disk cell.

Material. Chiangmai: Doi Suthep, 20 March 1965.

#### THELYPTERIDACEAE

##### 10. *Thelypteris torresiana* (Gaud.) Alston.

Figs. 20, 21

Prothallium bilateral, broad heart-shaped, assurgent along the midrib; apex deeply rounded and acutely or steeply cordate, and inner sides of lobes funnel-like, opened above the bottom of sinus; lower part of the thallus rounded, acutely narrowing towards the base. Protonema 1-3 cells long; original cell cylindrically

protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, upper sidewise or broadwise expanded, margins undulate; wing cells elongate or isodiametric polygonal with more or less curved side wall; marginal cells arranged with minute intercellular notch, mostly isodiametric polygonal with convex or sometimes slightly concave free side. Midrib gutter-shaped, cushioned from the lower midway to near the apex; cushion rather small in size, obovate or obovate-oblong, 4-5 cells thick in the heavier part. Trichomes more or less densely or sparsely on margins and sometimes on both surfaces of near the apex, cylindrical, 90-125  $\mu$  in length, 25-28  $\mu$  in mid-width, with nucleus in the middle and numerous minute chloroplasts; glandular, secretion almost uniformly capping the top, spherical; rarely two cells long. Rhizoids along the midrib from the base of thallus to the middle of cushion, almost hyaline or brownish. Archegonia gregarious on the distal median of cushion, not so many in number; neck medium sized, bending towards posterior; neck cells in four tiers, 5-6 at the anterior and 3-4 at the posterior sides, lowermost cell large and cushioning the neck. Antheridia on the upper part of cushion, mixed with archegonia, ellipsoidal, 85-100  $\mu$  in diameter; basal cell always lower than ring cell, upper wall funnel-like, immersed to the base; ring cell barrel-shaped, more or less widely covered with rounded or a little flattened cap cell.

Material. Chiangmai: Mae Klang water fall, north of Chom Thong, 22 March 1965.

The prothallium of the present material is identical with that of Himalayan plants from Darjeeling (unpublished), and is distinguishable from that of Ryukyu

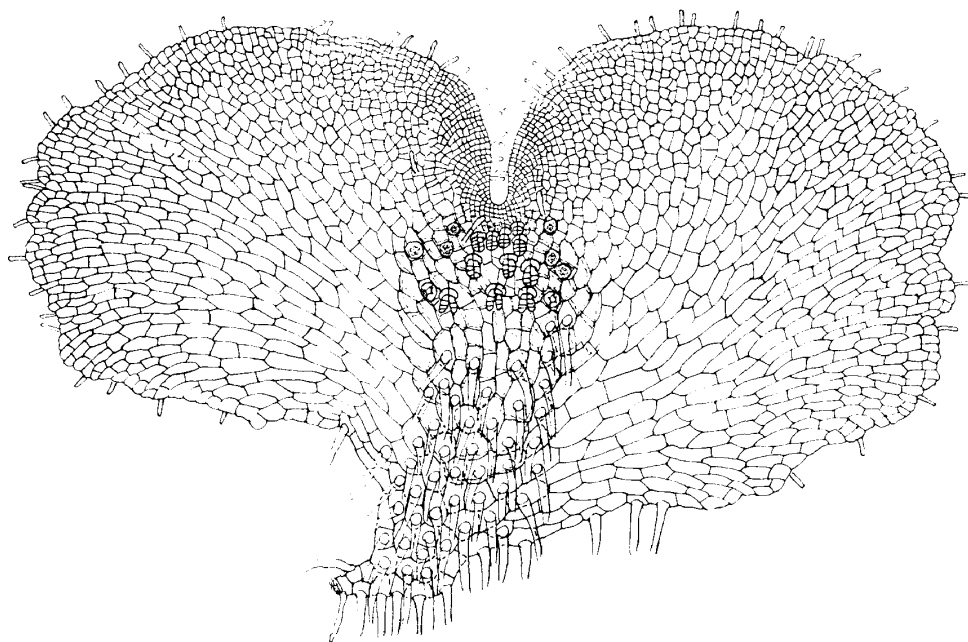


Fig. 20 *Thelypteris torresiana* (Gaud.) Alston.

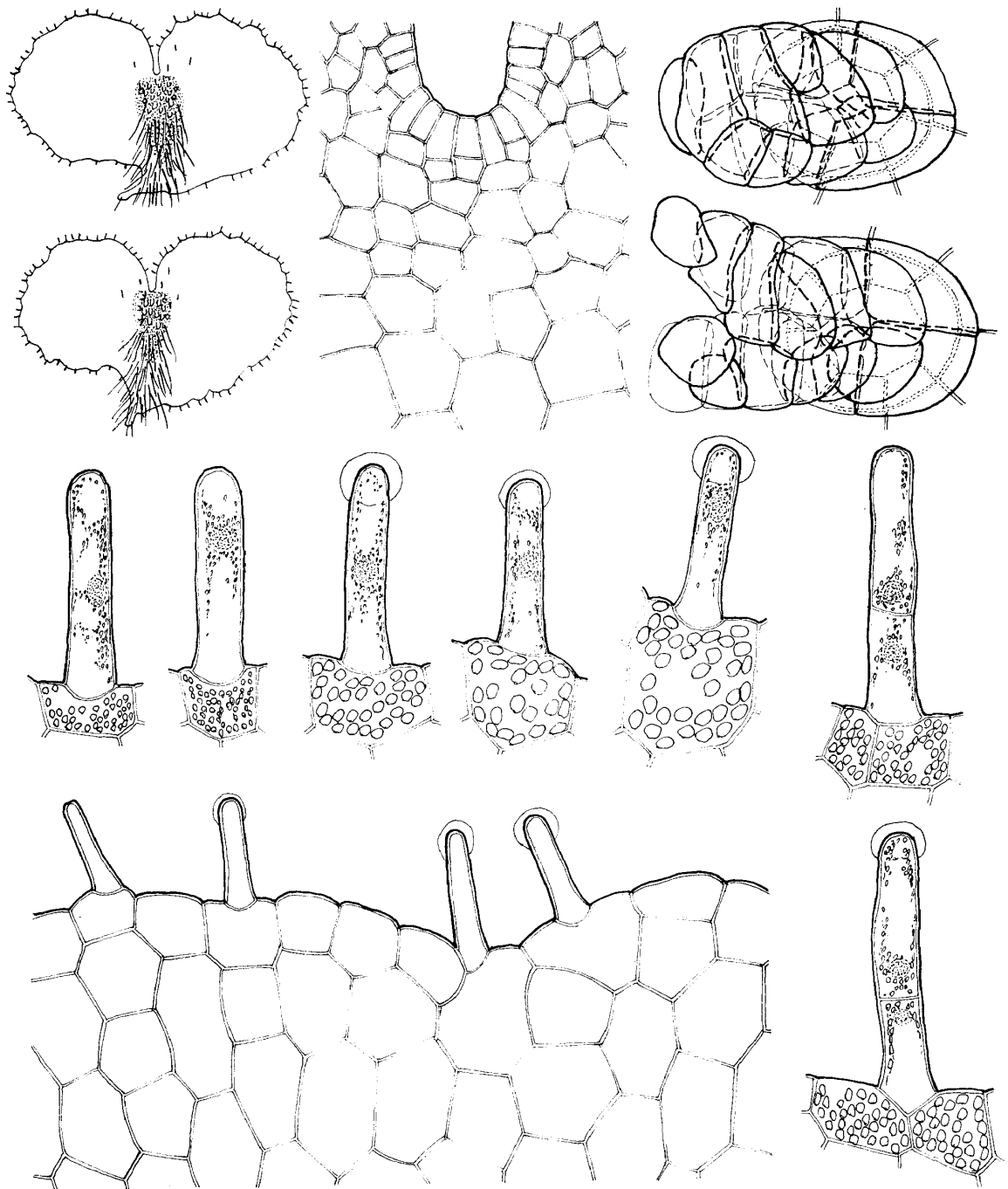


Fig. 21 *Thelypteris torresiana* (Gaud.) Alston.

or Taiwan plants (Momose, op. cit. 489, as *T. uliginosa*) by having 1) marginal cells of the wings with convex free side, 2) larger trichomes with the nucleus situated mostly in the middle, and 3) archegonia with rather large neck with many neck cells. In the latter plants, trichomes measure 65-95  $\mu$  in mid-width, and the nucleus of the trichomes is situated at the basal part.

Including the allied species, *T. torresiana* needs further intensive studies on the

plants from various localities.

11. *Thelypteris crinipes* (Hook.) K. Iwats.

Figs. 22, 23

Prothallium bilateral, broad heart-shaped, assurgent along the midrib; apex more or less shallowly rounded and widely cordate, and inner sides of lobes funnel-like opened above the bottom of sinus; lower part of the thallus rounded, acutely narrowing towards the base. Protonema 2-3 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, broadwise expanded, margins undulate; wing cells elongate polygonal with almost straight or slightly curved side wall; marginal cells arranged with minute intercellular notch, elongate polygonal with concave free side. Midrib gutter-shaped, cushioned from the lower midway to near the apex; cushion small in size, obovate-oblong, 4-5 cells thick in the heavier part. Trichomes sparsely on margins and sometimes on both surfaces near the apex, verruciform or clavate, 30-50  $\mu$  in length, 17-20  $\mu$  in basal width and 10-13  $\mu$  in mid-width, comparatively minute in size, with nucleus in the middle and small chloroplasts; glandular, secretion almost spherical, covering the top and thickened upwards, light yellowish. Rarely a few bristles also on the dorsal surface near the apex. Rhizoids along the midrib on the base of thallus to the middle of cushion, slightly brownish. Archegonia gregarious on the distal median of cushion; neck small, bending towards posterior; neck cells in four tiers, 5-7 at the anterior and 3-4 at the posterior sides, lowermost cell of each tiers large and cushioning the neck. Antheridia on the upper part of cushion mixed with archegonia, ellipsoidal or ovoid, 80-90  $\mu$  in diameter; basal cell always lower than ring cell, upper wall

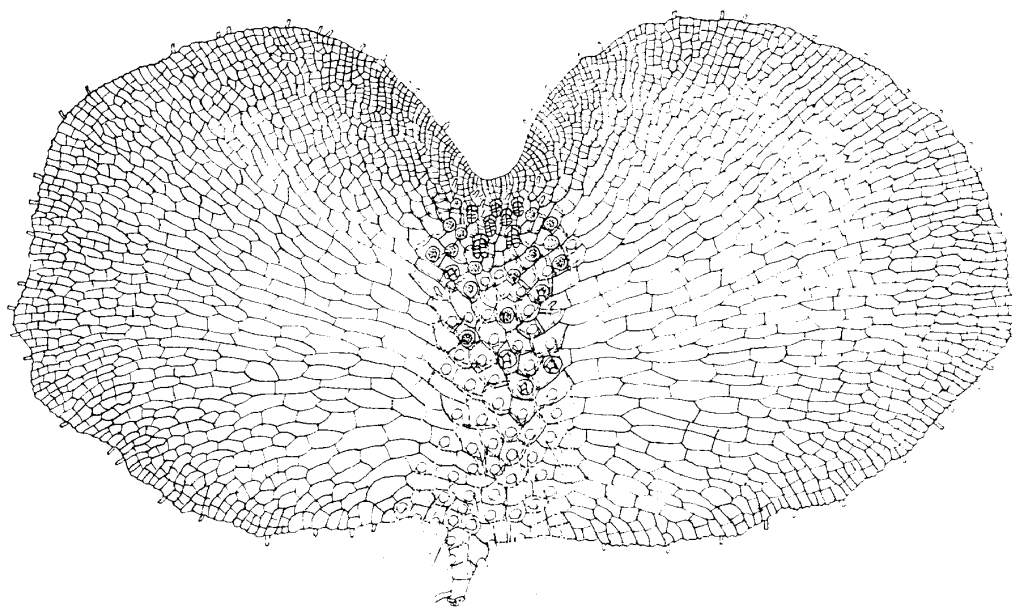


Fig. 22 *Thelypteris crinipes* (Hook.) K. Iwats.

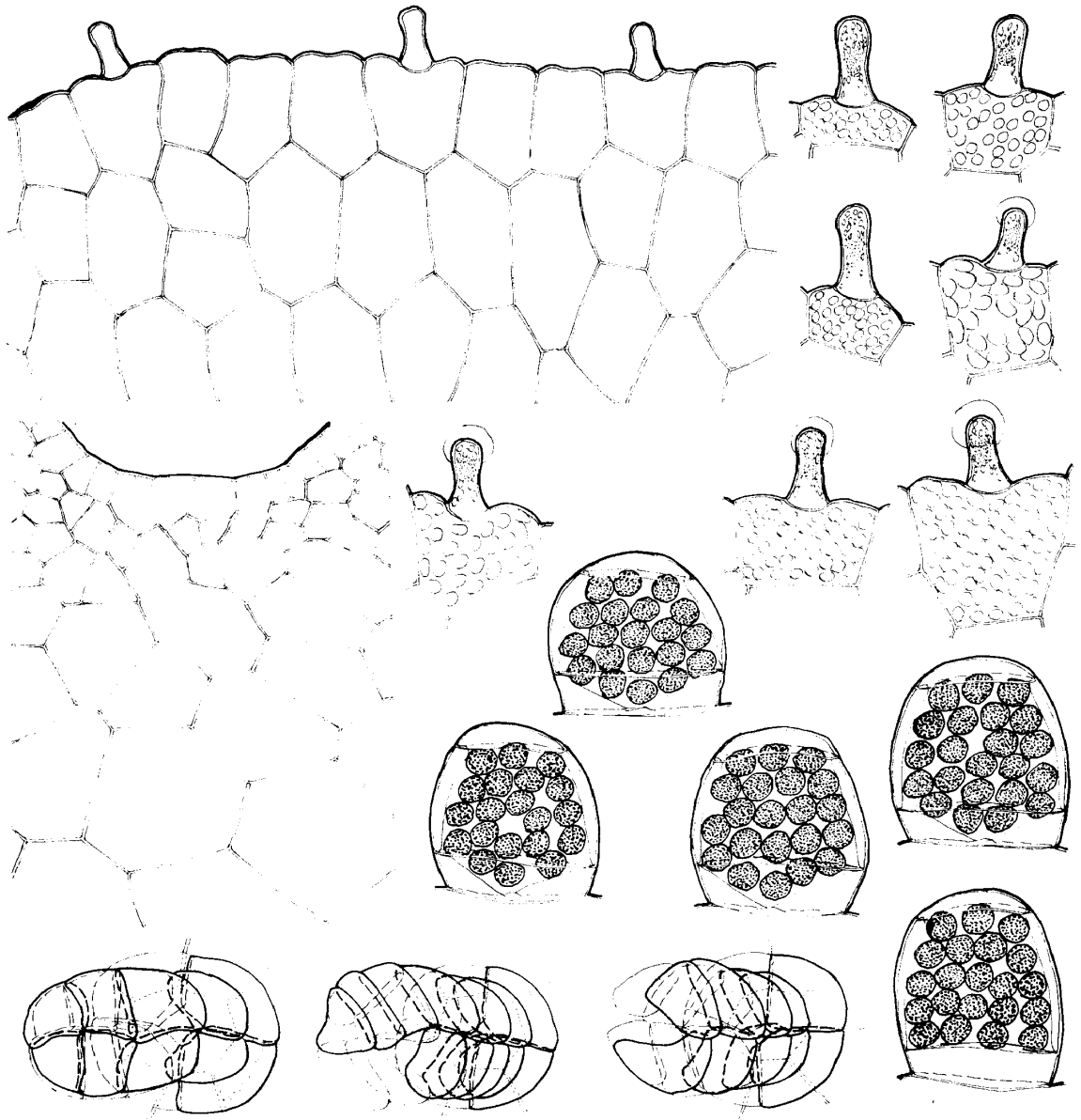


Fig. 23 *Thelypteris crinipes* (Hook.) K. Iwats.

funnel-like, immersed to the base; ring cell barrel-shaped, covered with rounded cap cell.

Material. Chiangmai: Doi Suthep, 21 March 1965.

The prothallium of the present material looks, in appearance, to be like that of *T. torresiana*, but is distinct, in details, from that in having 1) marginal cells of the wings with clearly concave free side, 2) minute and clavate trichomes with yellow secretion, 3) a few trichomes rarely on the dorsal surface of thallus, and 4) archegonia with the neck of ordinary features.

12. ***Thelypteris arida*** (Don) Morton.

Figs. 24, 25

Prothallium bilateral, heart-shaped, assurgent along the midrib; apex deeply



rounded and acutely cordate, and inner sides of lobes funnel-like, opened above the bottom of sinus; lower part of the thallus cuneate, steeply narrowing towards the base. Protonema 2-4 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, upper sidewise expanded, margins slightly undulate; wing cells isodiametric or elongate polygonal with more or less curved wide wall; marginal cells arranged with minute intercellular notch, elongate or isodiametric polygonal, with more or less concave free side. Midrib conspicuously gutter-shaped, cushioned from the lower midway to near the apex; cushion obovoid, 4-5 cells thick in the heavier part. Trichomes sparsely on margins and on upper part of both surfaces near the apex, verruciform or cylindrical, 45-55  $\mu$  in length and 20-25  $\mu$  in basal width, with nucleus in the upper part and small chloroplasts; glandular, secretion almost spherical, covering the upper part, almost uniformly thickened. Rhizoids along the midrib from the base of thallus to the middle of cushion, almost hyaline or brownish. Archegonia gregarious on the upper median of cushion; neck medium-sized or sometimes small-sized, bending towards posterior; neck cells in four tiers, 5 at the anterior and 4 at the posterior sides, lowermost cells of each tier large and cushioning the neck. Antheridia on all over the cushion and mixed with archegonia, conical, conico-ellipsoid or ellipsoid, 80-85  $\mu$  in diameter; basal cell always



Fig. 24 *Thelypteris arida* (Don) Morton.

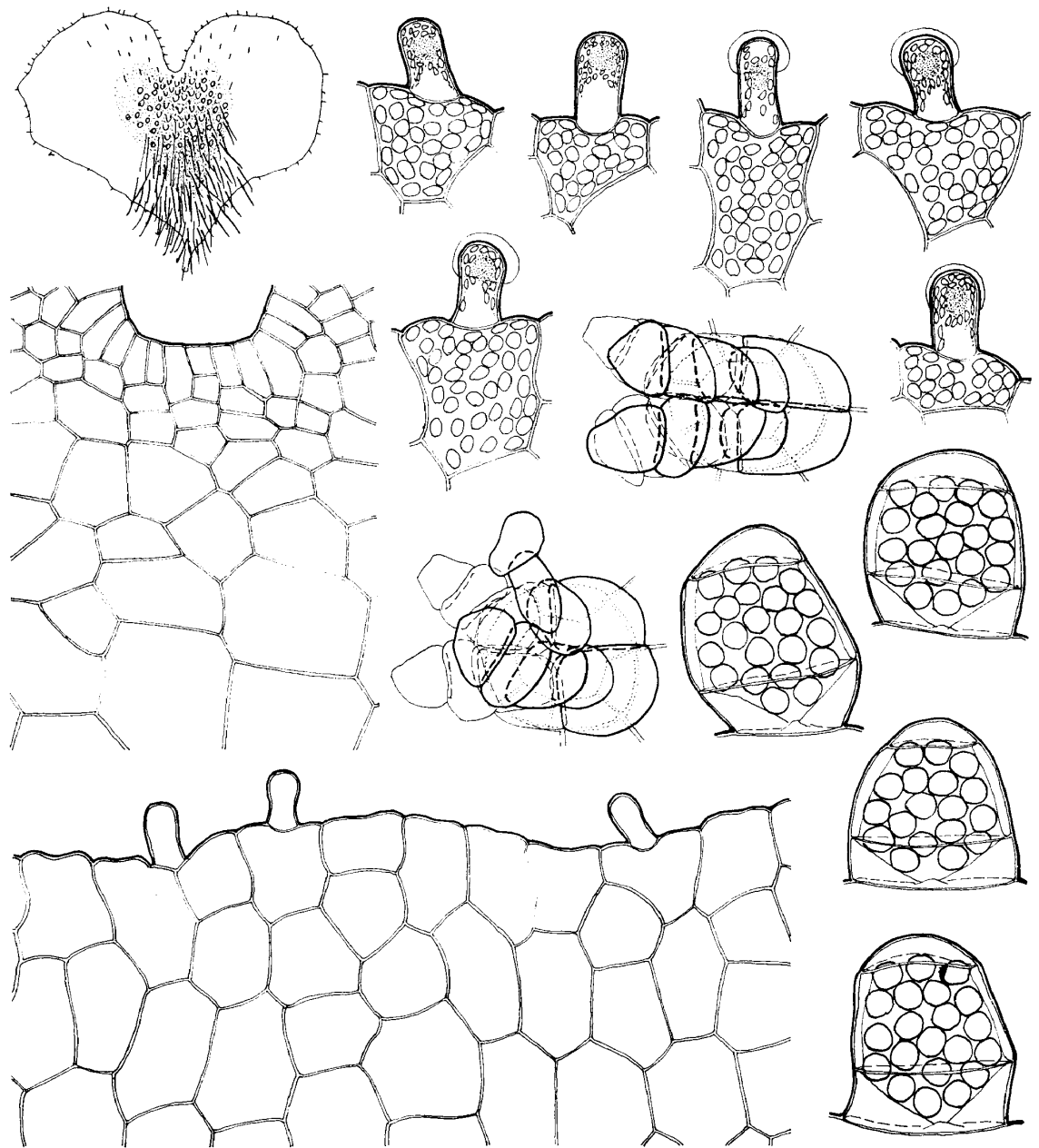


Fig. 25 *Thelypteris arida* (Don) Morton.

lower than ring cell, upper wall funnel-like, imersed to the base; ring cell barrel-shaped, covered with rounded or obliquely angulate cap cell.

Material. Chiangmai : Doi Suthep, 17 Dec. 1965.

According to my investigation on the Japanese plants (Momose, op. cit. 496-504), prothallia of the *Cyclosorus* are divided into two types. The first is the type of *Thelypteris* (*Cyclosorus*) *gongyloides* and *T. acuminata*, in which the thallus has clavate trichomes only and the antheridia occur on the lower part of thallus below the archegonia. The other is the type of *T. parasitica*, *T. dentata* and *T. subpubescens*,

in which the thallus has clavate trichomes and also bristles, and the antheridia occur on all over the cushion mixed with archegonia. In the present material, the thallus has trichomes only, and the antheridia occur on all over the cushion mixed with archegonia. Then the prothallium of this species shows another type of the above two. I have found this type of prothallia within the *Glaphyopteris* group: *T. erubescens* (Momose, loc. cit. 492) and *T. subochthodes* (Momose, loc. cit. 494).

13. ***Thelypteris interrupta*** (Willd.) K. Iwats.

Figs. 26, 27

Prothallium bilateral, rather broad heart-shaped, conspicuously assurgent along the midrib; apex shallowly or more or less deeply, widely rounded and acutely cordate, and inner sides of lobes funnel-like opened above the bottom of sinus; lower part of the thallus rounded, acutely narrowing towards the base. Protonema 2-4 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, broadwise expanded, margins undulate; wing cells isodiametric or elongate polygonal, with almost straight or more or less curved side wall; marginal cells arranged with minute intercellular notch, mostly isodiametric, with strikingly and more or less undulately convex free side. Midrib conspicuously gutter-shaped,

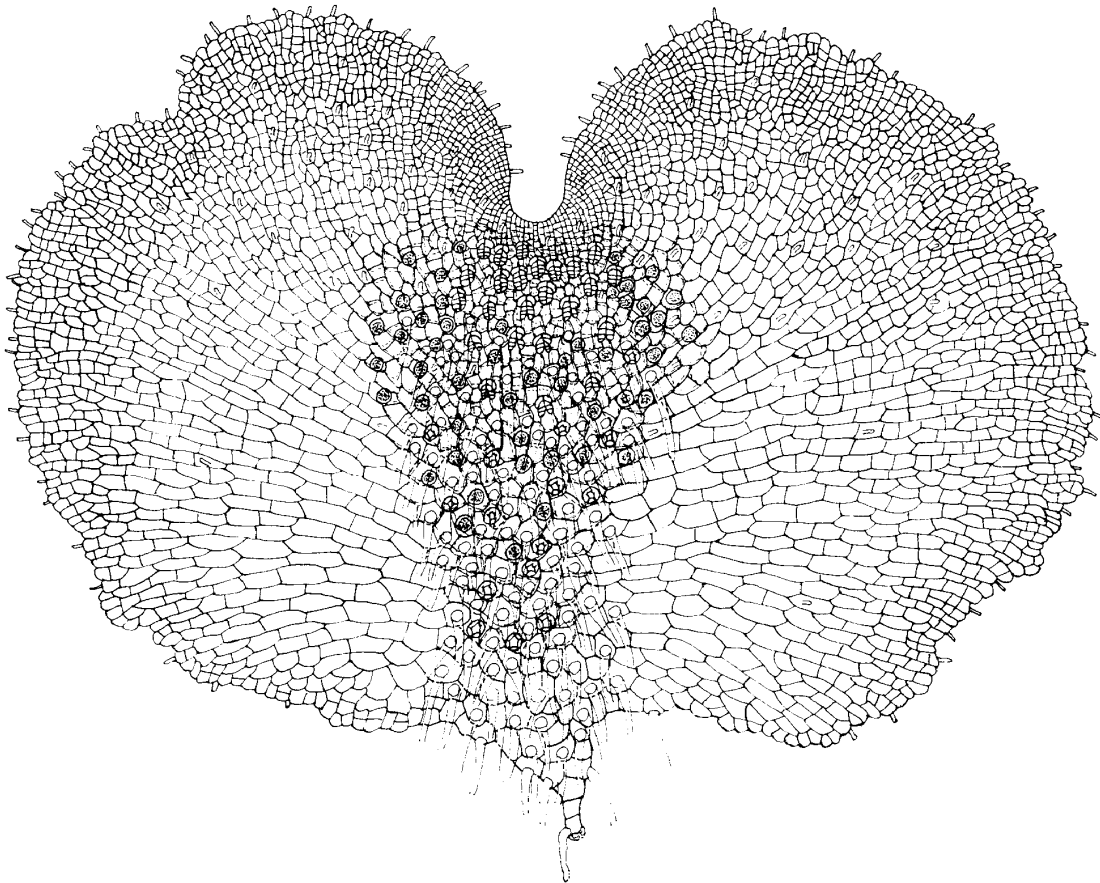


Fig. 26 *Thelypteris interrupta* (Willd.) K. Iwats.

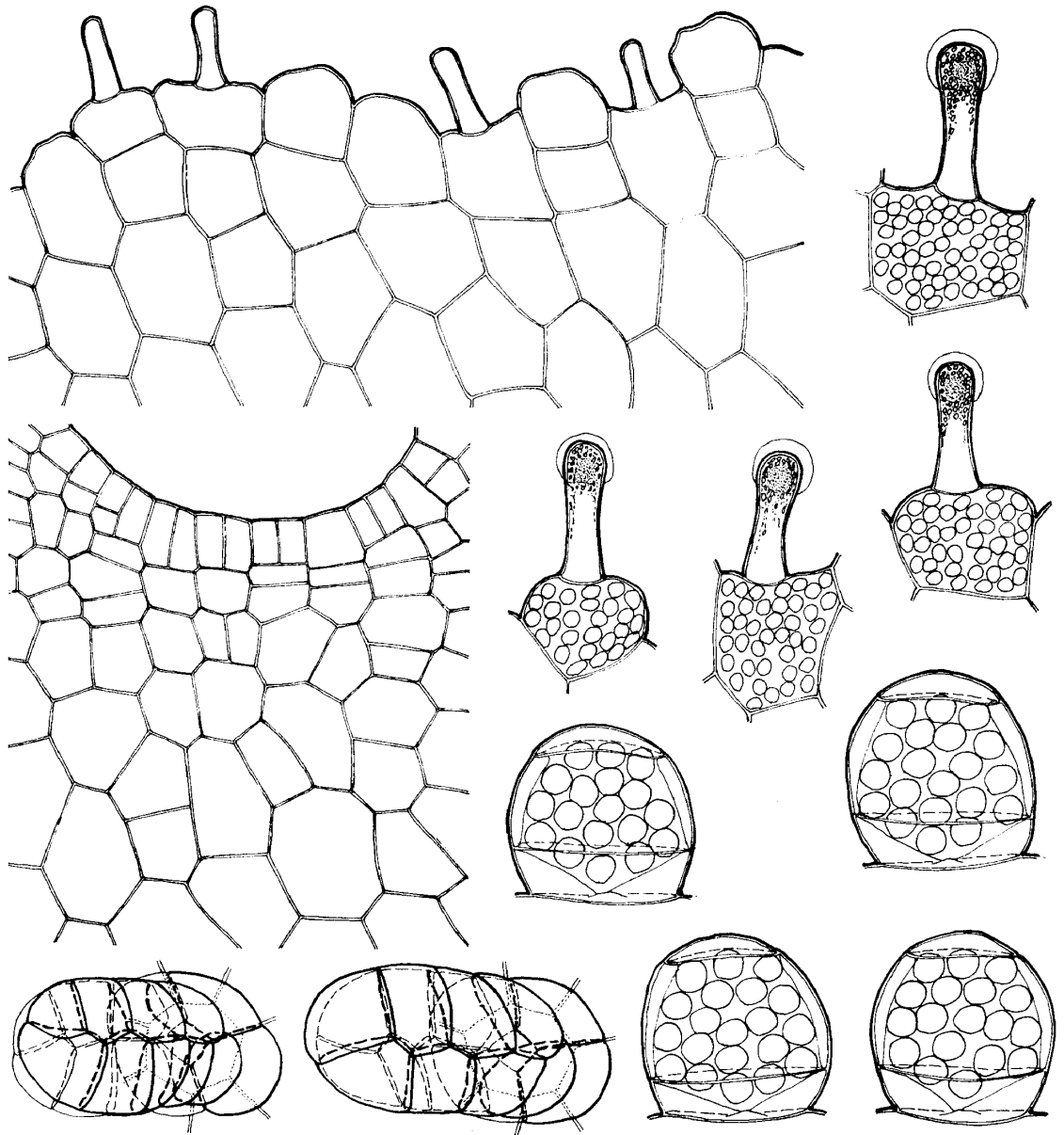


Fig. 27 *Thelypteris interrupta* (Willd.) K. Iwats.

cushioned from the lower midway to near the apex; cushion obovate, 4-6 cells thick in the heavier part. Trichomes sparsely on margins and on upper part of both surfaces of the thallus, cylindrical or more or less clavate, 65-80  $\mu$  in length, 20-23  $\mu$  in basal width and 15-17  $\mu$  in mid-width, with nucleus in the head and small chloroplasts; glandular, secretion almost uniformly covering the head, spherical. Rhizoids along the midrib from the base of thallus to the middle of cushion, brownish. Archegonia gregarious on the upper median of cushion, rather many in number; neck medium sized, bending towards posterior; neck cells in four tiers, 5-6 at the anterior and 3-4 at the posterior sides. Antheridia on all over the cushion and mixed with archegonia, globoid, 85-92  $\mu$  in diameter; basal cell always lower

than ring cell, upper wall funnel-like, immersed to the base.

Material. Loei: Phu Kradung, 30 Nov. 1965.

The prothallium of this species belongs to the same type as *T. arida* in 1) having trichomes only and 2) antheridia occurring on all over the cushion mixed with archegonia, but differs from it by longer and clavate trichomes and strikingly and more or less undulately convex free side of marginal cells of the wings. The features of the free side of marginal cells are the peculiar character of this species.

14. ***Thelypteris polycarpa*** (Blume) K. Iwats.

Figs. 28, 29

Prothallium bilateral, broad heart-shaped, conspicuously assurgent along the midrib; apex deeply, widely rounded and steeply cordate, and innersides of lobes funnel-like, divergent above the bottom of sinus; lower part of the thallus cuneate, steeply narrowing towards the base. Protonema 2-5 cells long; original cell cylindrically protruding out of the sinus, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, upper sidewise expanded, margins undulate; wing cells isodiametric polygonal with more or less curved side wall; marginal cells almost smoothly arranged, almost always broad polygonal with waved-convex free side. Midrib conspicuously gutter-shaped, cushioned from the lower midway to near the apex; cushion obovate, 4-6 cells thick in the heavier parts. Some trichomes on upper part of margins and both surfaces near the apex, verruciform or al-

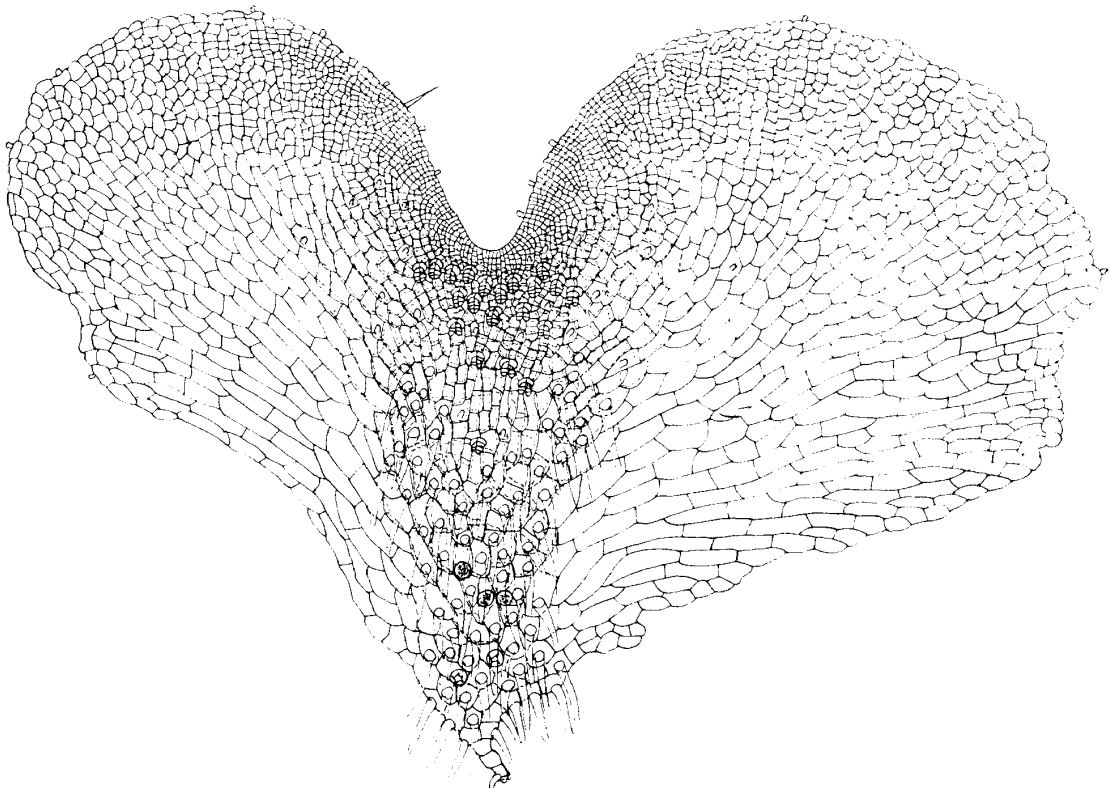


Fig. 28 *Thelypteris polycarpa* (Blume) K. Iwats.

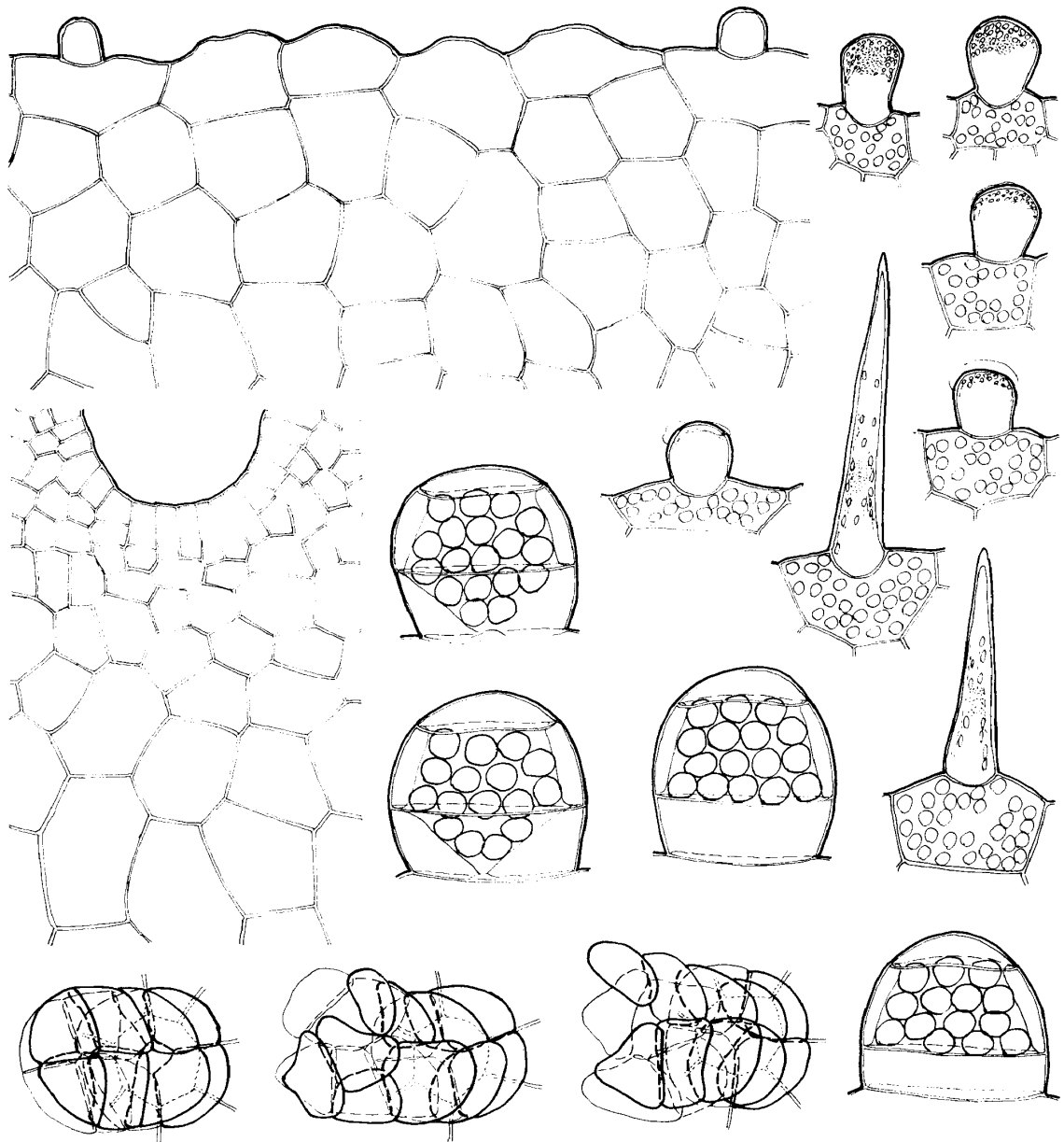


Fig. 29 *Thelypteris polycarpa* (Blume) K. Iwats.

most obovoid,  $35-45\mu$  in length and  $25-28\mu$  in basal width, with nucleus at the top and small chloroplasts, and contents localized to the top, peculiar in features; glandular, secretion incompletely capped on the top, light golden-yellow. Some bristles also on the dorsal surface near the apex and a few on upper margins, spinescent,  $120-170\mu$  in length and  $27-30\mu$  in basal width. Rhizoids along the midrib from the base of thallus to the middle of cushion and nested above the archegonial group, almost hyaline or brownish. Archegonia gregarious on the upper median of cushion, rather many in number; neck small, verruciform, slightly bending towards posterior; neck cells in four tiers, 4-5 at the anterior and 3-4 at the posterior sides.

Antheridia on the lower part of thallus along the midrib, and apart below the archegonial group, globoid, 90-100  $\mu$  in diameter; basal cell more or less lower than ring cell, upper wall funnel-like, immersed to the base or flat.

Material. Trang: Khao Chong, 29 March 1965.

The prothallium of this species is distinguishable from the other species within *Thelypteris* by its peculiar characters: 1) not clavate but obovoid trichomes with protoplasmic contents localized to the top in peculiar manner, 2) golden-yellow secretion capping the trichomes, and 3) almost smoothly arranged and almost always broad polygonal marginal cells of the wings.

15. ***Thelypteris multilineata*** (Wall. ex Hook.) Morton. Figs. 30, 31

Prothallium bilateral, rather broad heart-shaped, assurgent along the midrib; apex more or less deeply rounded and acutely cordate, and inner sides of lobes funnel-like opened above the bottom of sinus; lower part of the thallus rounded, steeply or acutely narrowing towards the base. Protonema 2-4 cells long; original cell cylindrically protected out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, upper sidewise or broadwise

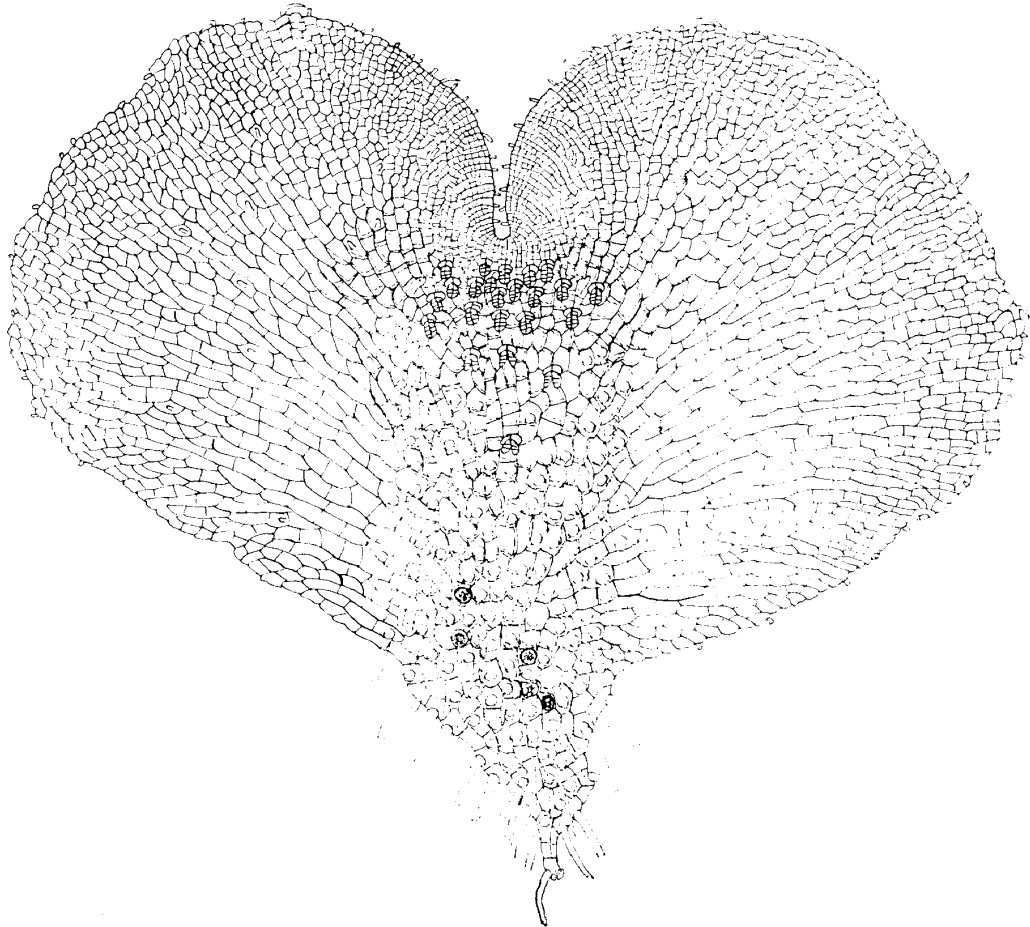


Fig. 30 *Thelypteris multilineata* (Wall. ex Hook.) Morton.

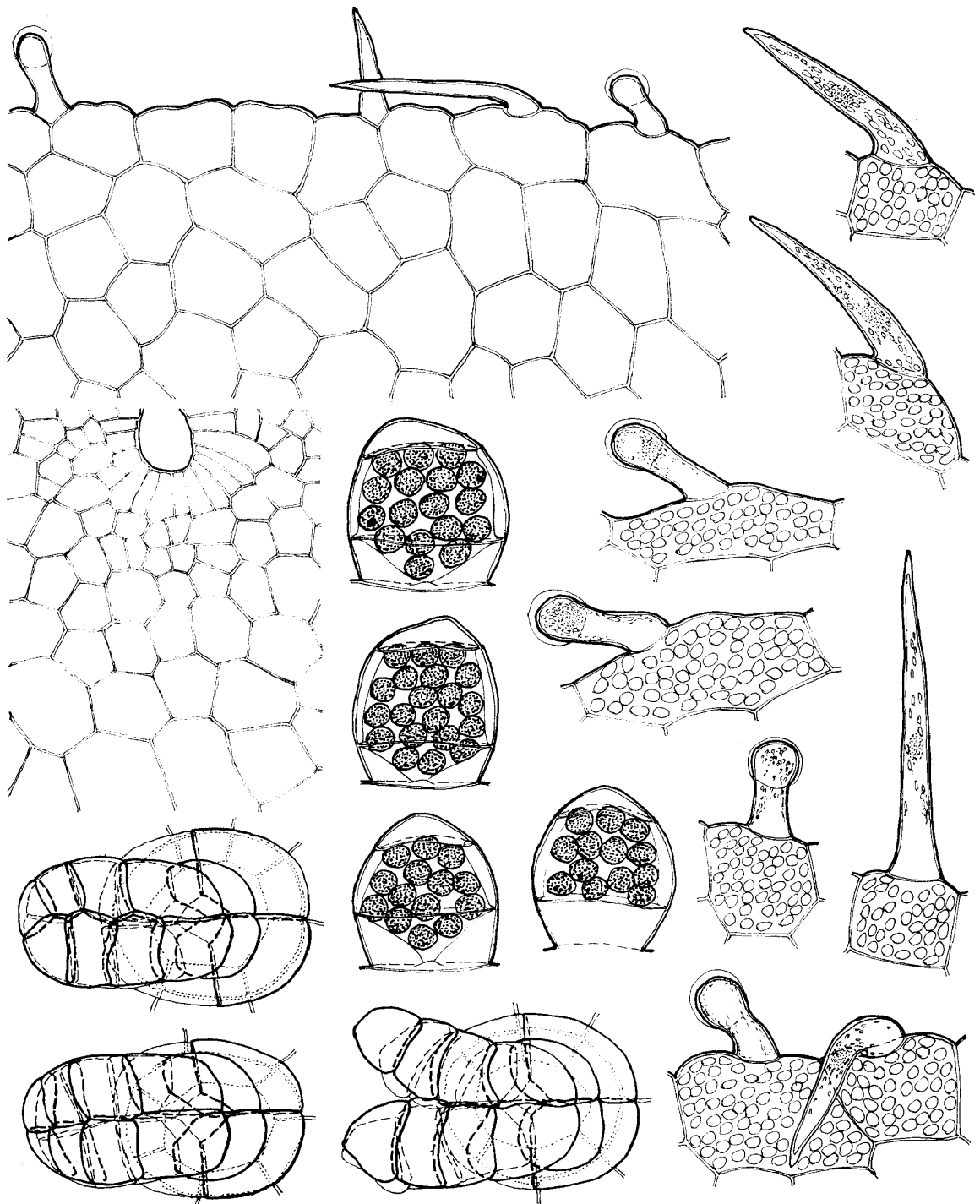


Fig. 31 *Thelypteris multilineata* (Wall. ex Hook.) Morton.

expanded, margins undulate; wing cells almost isodiametric polygonal with almost straight or more or less curved side wall; marginal cells arranged with minute intercellular notch, isodiametric or broad polygonal with slightly concave free side. Midrib gutter-shaped, cushioned from the lower midway to near the apex; cushion obovate, 5-6 cells thick in the heavier part. Trichomes sparsely on margins and



very sparsely on both surfaces of the thallus, marginal ones mostly curving towards inferior, clavate, 50-65  $\mu$  in length, 23-25  $\mu$  in basal width and 15-18  $\mu$  in mid-width, with nucleus in the upper and small chloroplasts when young; glandular, secretion covering the head, almost spherical, uniformly or thickened above, golden-yellow. Some bristles also on upper margins and on dorsal surface near the apex, marginal ones mostly curving towards inferior, spinescent, 100-180  $\mu$  in length and 18-20  $\mu$  in basal width. Rhizoids along the midrib from the base of thallus to the upper middle of cushion and nesting above the archegonial group, brownish in colour. Archegonia gregarious on the upper median of cushion, rather many in number; neck medium sized, slender, bending towards posterior; neck cells in each tier large and cushioning the neck. Antheridia on the lower parts of thallus along the midrib and apart below archegonia, ellipsoidal, 75-85  $\mu$  in diameter; basal cell lower than ring cell, upper wall funnel-like, immersed to the base or rarely flat; ring cell covered with angulate cap cell.

Material. Chiangmai: Doi Suthep, 20 March 1965.

According to my unpublished data, the prothallium of the present material is quite identical with that of Himalayas (E. Nepal) and differs from that of Malaya (Klian lutan, upper Perak, M. Mollethworth-Allen 4861) in the character of hairy appendages. In the latter, clavate trichomes on margins are almost straight and smaller sized than in the former; and bristles grow on both surfaces near the apex and rarely on margins of the wings and the marginal ones are almost straight. The Malayan plant is distinguished by Holttum (Flora of Malaya vol. II Ferns of Malaya 297. 1954) as a variety of the Himalayan plant.

#### DENNSTAEDTIACEAE

##### Dennstaedtioideae

16. **Microlepia speluncae** (L.) Moore var. **pubescens** (Hook.) Sledge. Figs. 32, 33

Prothallium bilateral, heart-shaped, assurgent along the midrib; apex more or less deeply rounded and acutely cordate, and inner sides of lobes approaching and closed together above the bottom of sinus; lower part of the thallus rounded, steeply narrowing towards the base. Protonema 2-4 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, upper sidewise expanded, margins undulate; wing cells elongate or isodiametric polygonal with almost straight side wall; marginal cells arranged with minute intercellular notch, broad or isodiametric polygonal with convex free side. Midrib gutter-shaped, cushioned from the basal midway to near the apex; cushion obovate, 5-6 cells thick in the heavier part. Rhizoids along the midrib from the base of thallus to the middle of cushion, almost hyaline or

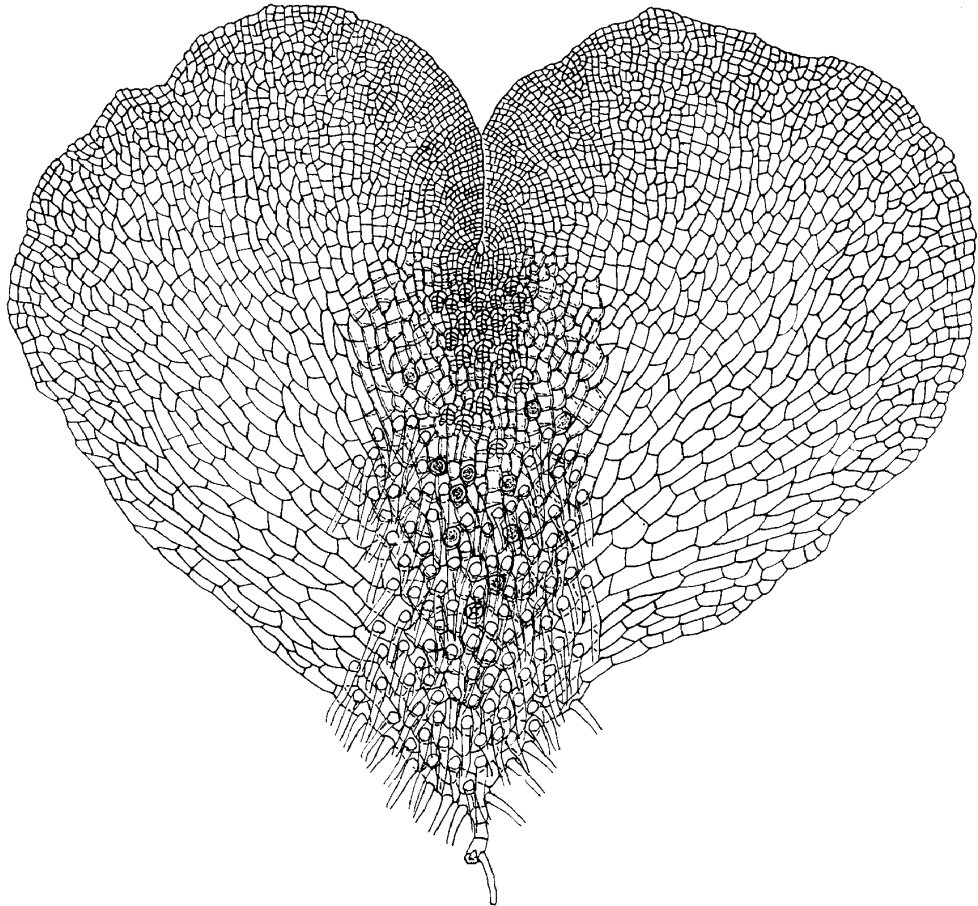


Fig. 32 *Microlepidia speluncae* (L.) Moore var. *pubescens* (Hook.) Sledge.

brownish in colour and delicate. Archegonia gregarious on the upper median of cushion, more or less many in number; neck rather thick and short, verruciform, slightly bending towards posterior; neck cells 5 at the anterior and 3-5 at the posterior sides. Antheridia along the midrib on cushion and in upper mixed with archegonia, globoid, 85-90  $\mu$  in diameter; basal cell equal in height and width with ring cell, upper wall funnel-like, immersed to the base.

Material. Chiangmai: Doi Suthep, 20 March 1965.

The prothallium of this variety is like that of the type variety.

17. *Microlepidia platyphylla* (Don) J. Smith.

Figs. 34, 35

Prothallium bilateral, rather broad heart-shaped, assurgent along the midrib; apex deeply rounded and acutely cordate, and inner sides of lobes mostly opened above the bottom of sinus; lower part of the thallus more or less rounded or cuneate, steeply narrowing towards the base. Protonema 2-4 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, upper sidewise expanded, margins slightly undulate; wing cells isodiametric polygonal with slightly curved or almost

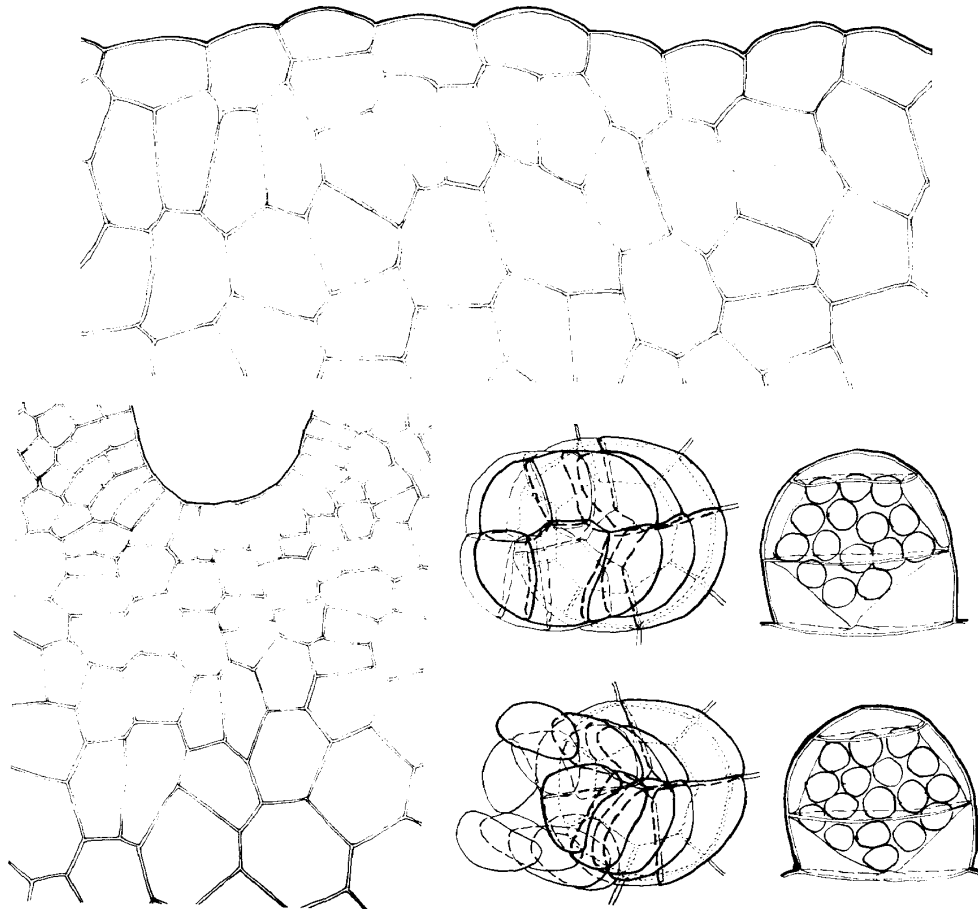


Fig. 33 *Microlepidia speluncae* (L.) Moore var. *pubescens* (Hook.) Sledge.

straight side wall; marginal cells arranged with minute intercellular notch, isodiametric or elongate polygonal with more or less concave free side. Midrib gutter-shape, cushioned from the basal midway to near the apex; cushion obovate or narrowly obovate, 5-6 cells thick in the heavier part. Rhizoids along the midrib from the base of thallus to the middle of cushion, almost hyaline or brownish in colour, delicate. Archegonia on the distal median of cushion, some in number; neck rather large in size, thick and long, bending towards posterior; neck cells 6 at the anterior and 4 at the posterior sides. Antheridia along the midrib from the lower to the middle of cushion and apart below archegonia, globoid, 80-90  $\mu$  in diameter; basal cell more or less lower than ring cell, upper wall funnel-like, immersed to the base.

Material. Chiangmai: Doi Suthep, 21 March 1965.

The prothallium of this species differs from the last one in the features of marginal cells of the wings and in the position of antheridia.

#### Davallioideae

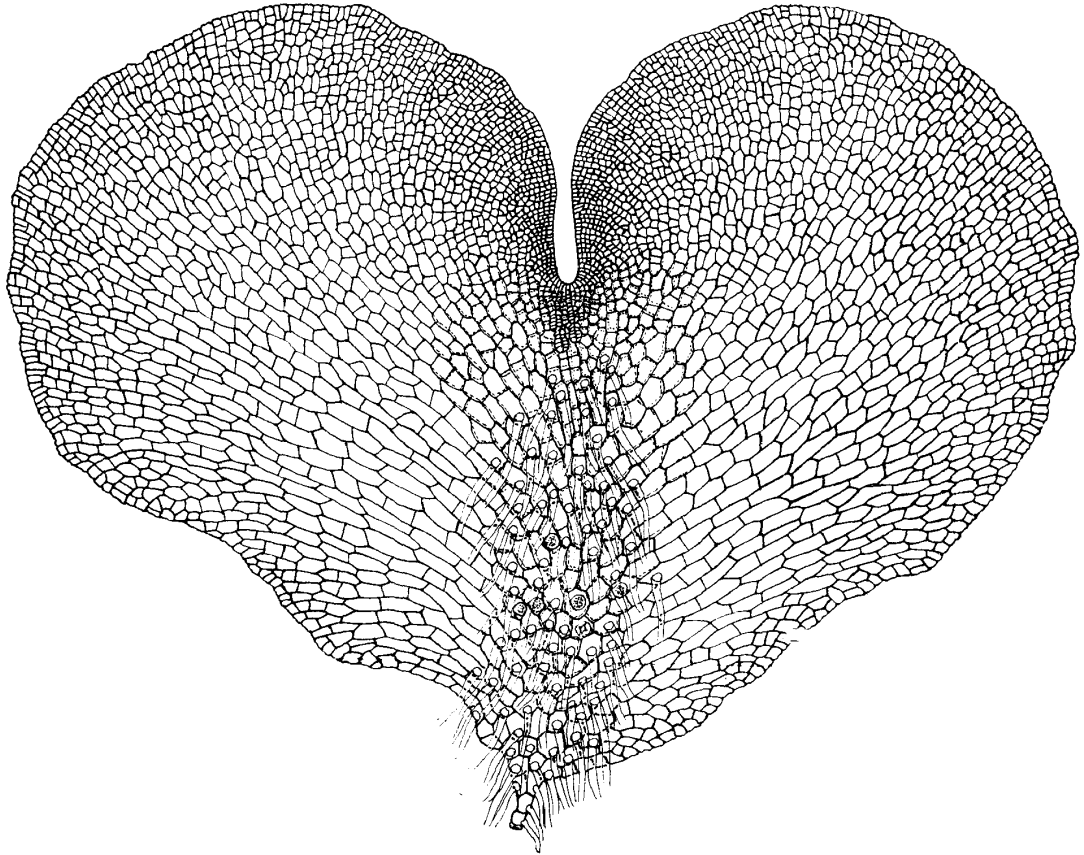


Fig. 34 *Microlepidia platyphylla* (Don) J. Smith.

18. *Araiostegia faberiana* (C. Chr.) Ching.

Figs. 36, 37

Prothallium bilateral, heart-shaped, assurgent along the midrib; apex less deeply rounded and acutely cordate, and inner sides of lobes opened above the bottom of sinus; lower part of the thallus cuneate or rounded, steeply narrowing towards the tailed base. Protonema 4-7 cells long; original cell globose, completely wrapped in the spore coat; primary rhizoid inserted at the upper side of original cell extending over the basal side of secondary cell of the protonema. Wings equal in size, upper sidewise expanded, margins undulate; wing cells isodiametric polygonal; marginal cells almost smoothly arranged, isodiametric polygonal; marginal cells almost smoothly arranged, isodiametric polygonal with flat free side. Midrib gutter-shaped, cushioned from the upper midway to near the apex; cushion small in size, round or obovate, 2-3 cells thick. Trichomes sparsely on margins and less sparsely on both surfaces near the apex, varruciform or cylindrical, 35-45  $\mu$  in height and 21-24  $\mu$  in basal width, with nucleus in the lower part and small chloroplasts; glandular, secretion capped on the top, thickened upside. Rhizoids superficial, on the lower part of thallus spreading aside to wings, almost hyaline. Archegonia on all over the cushion, many in number; neck small in size, somewhat claviform, curved

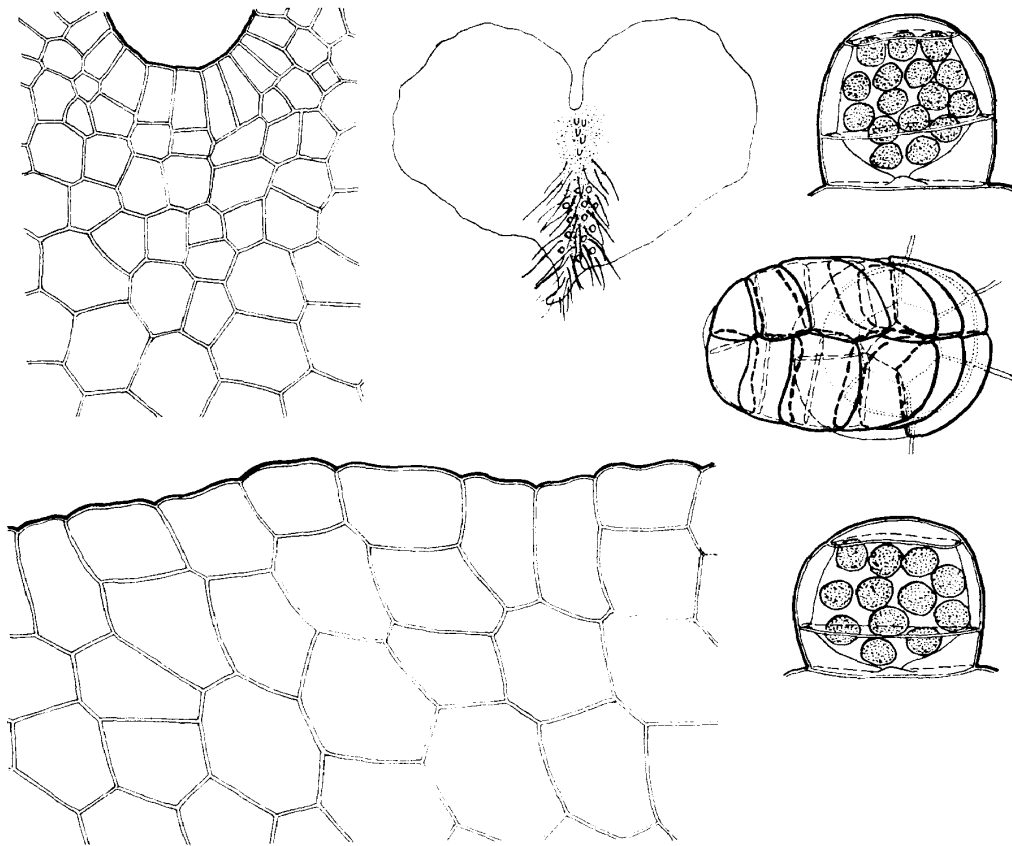


Fig. 35 *Microlepidia platyphylla* (Don) J. Smith.

towards posterior; neck cells in four tiers, 5-7 at the anterior side and 4 at the posterior side. Antheridia confined to the basal part of thallus, ellipsoid, obovoid or pyriform, 53-67  $\mu$  in diameter; basal cell almost equal in height and more or less narrower than ring cell, cylindrical or narrowing towards the base, upper wall flat or rarely funnel-like, immersed to the base; ring cell barrel-shaped, covered with round or somewhat conical cap cell; sometimes born on a stalk-like desk cell.

Material. Chiangmai: Doi Inthanon, 20 Dec. 1965.

#### Oleandroideae

##### 19. *Nephrolepis hirsutula* (Forst.) Presl.

Prothallium bilateral, broad heart-shaped, assurgent along the midrib; apex deeply rounded and steeply cordate, and inner sides of lobes funnel-like, opened above the bottom of sinus; lower part of the thallus rounded or cuneate, steeply narrowing towards the base. Protonema 2-3 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, broadwise or upper sidewise expanded, margins undulate; wing cells isodiametric polygonal; marginal cells arranged with minute intercellular notch, mostly isodiametric polygonal with concave free side. Midrib

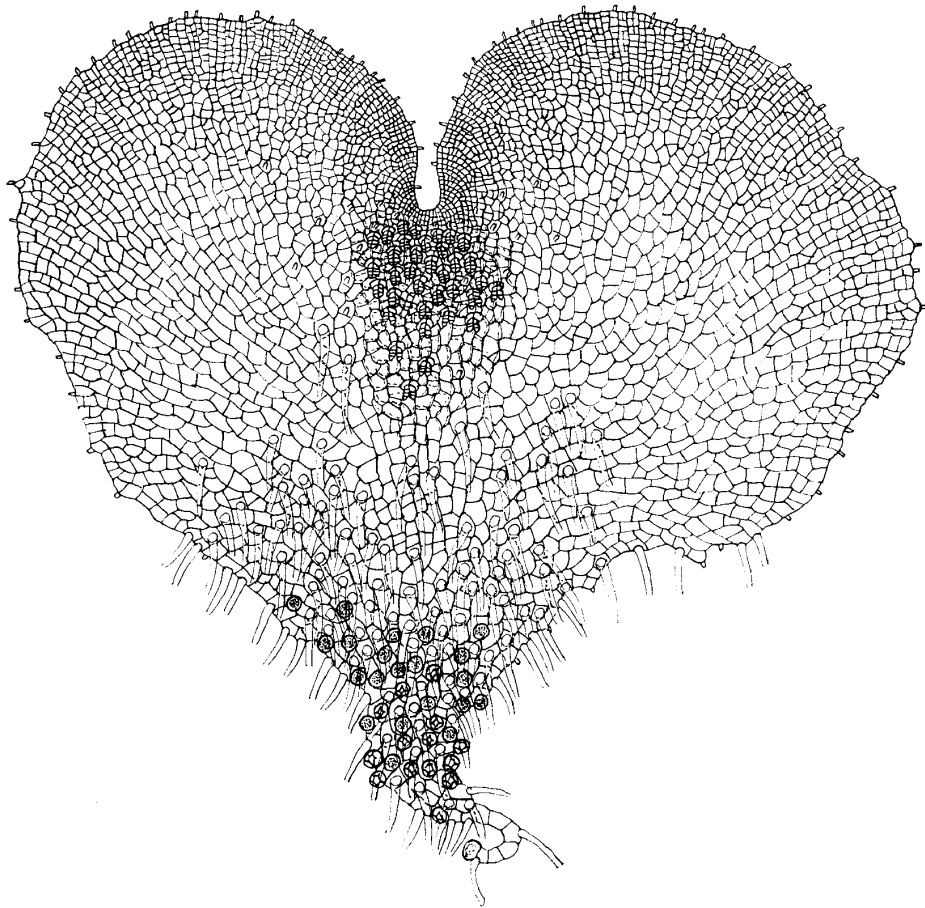


Fig. 36 *Araiostegia faberiana* (C. Chr.) Ching.

conspicuously gutter-shaped, cushioned from the lower midway to near the apex; cushion obovate, 4-5 cells thick in the heavier part. Trichomes sparsely on margins and both surfaces of the thallus, unicellular, cylindrical, 75-100  $\mu$  in height, 20-25  $\mu$  in basal width and 17-20  $\mu$  in mid-width, with nucleus in the upper midway and small chloroplasts; glandular, secretion capping the top, spherical, thickened upside. Rhizoids on the lower part of thallus along the midrib to the middle of cushion, almost hyaline or brownish. Archegonia on the distal median of cushion; neck rather large in size, slender or claviform, bending towards posterior; neck cells in four tiers, 6-7 at the anterior and 4-5 at the posterior sides, lowermost cells of each tiers large and cushioning the neck. Antheridia on the cushion mixed with archegonia, obovoid, 70-80  $\mu$  in diameter; basal cell narrower and shorter than ring cell, narrowed below, upper wall always flat; ring cell barrel-shaped, broadly covered with large cap cell; sometime born on a desk cell.

Material. Chiangmai: Doi Suthep, 31 Dec. 1965.

The prothallium of the present material is identical with that of the Ryukyu material (Momose, J. Jap. Bot. 20: 212. 1944).

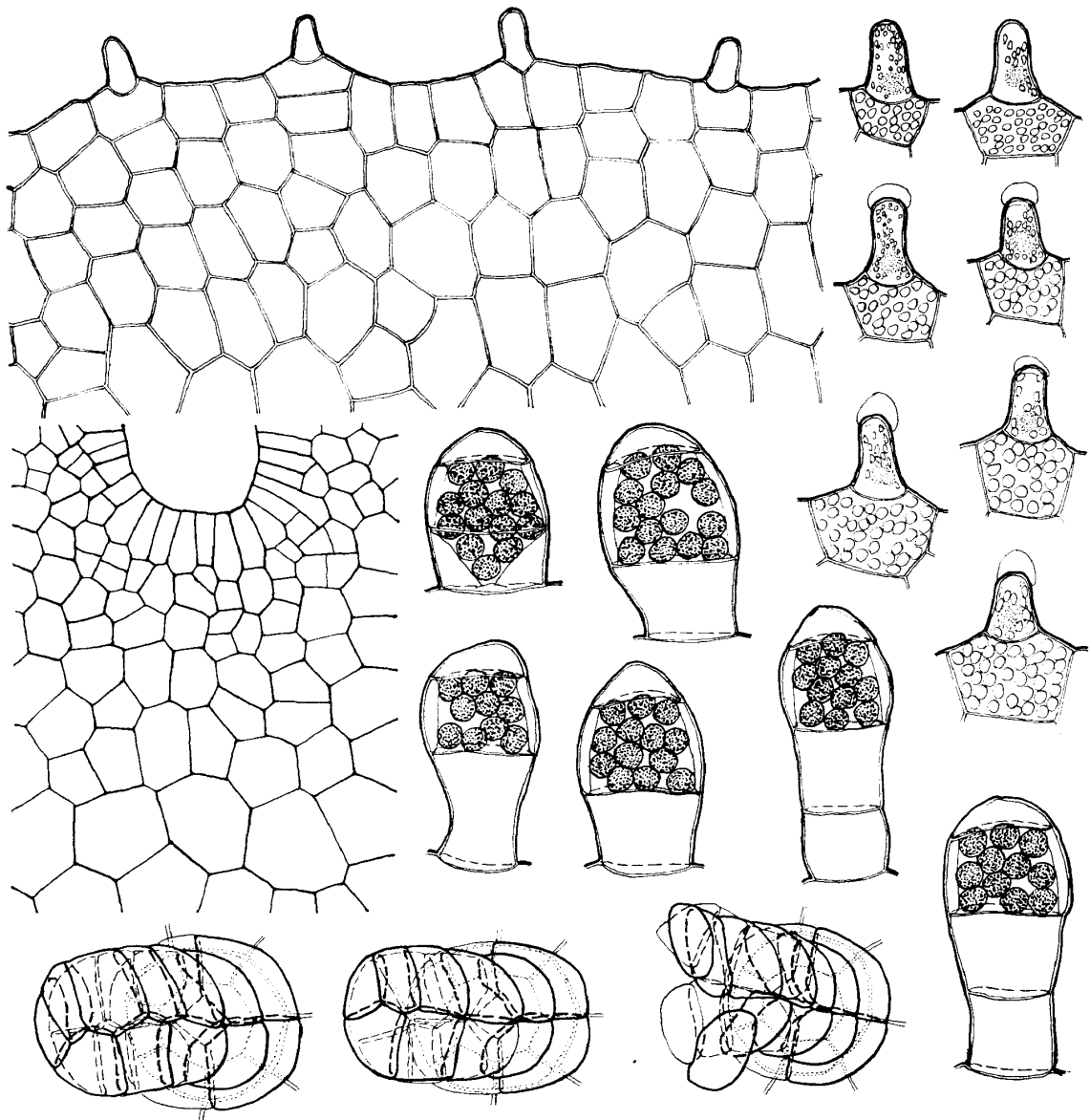


Fig. 37 *Araiostegia faberiana* (C. Chr.) Ching.

20. *Oleandra musifolia* (Blume) Presl.

Figs. 38, 39

Prothallium bilateral, heart-shaped, conspicuously assurgent along the midrib and basal part of the thallus so uplifted that the margins close together; apex deeply rounded and acutely cordate, and inner sides of lobes closed together and conspicuously overlapping above the bottom of sinus; lower part of the thallus rounded or cuneate, acutely narrowing towards the tailed base. Protonema 2-4 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, upper sidewise expanded, margins undulate and toothed with projection of trichome bearing cell; wing cells elongate polygonal or isodiametric; marginal cells arranged with minute

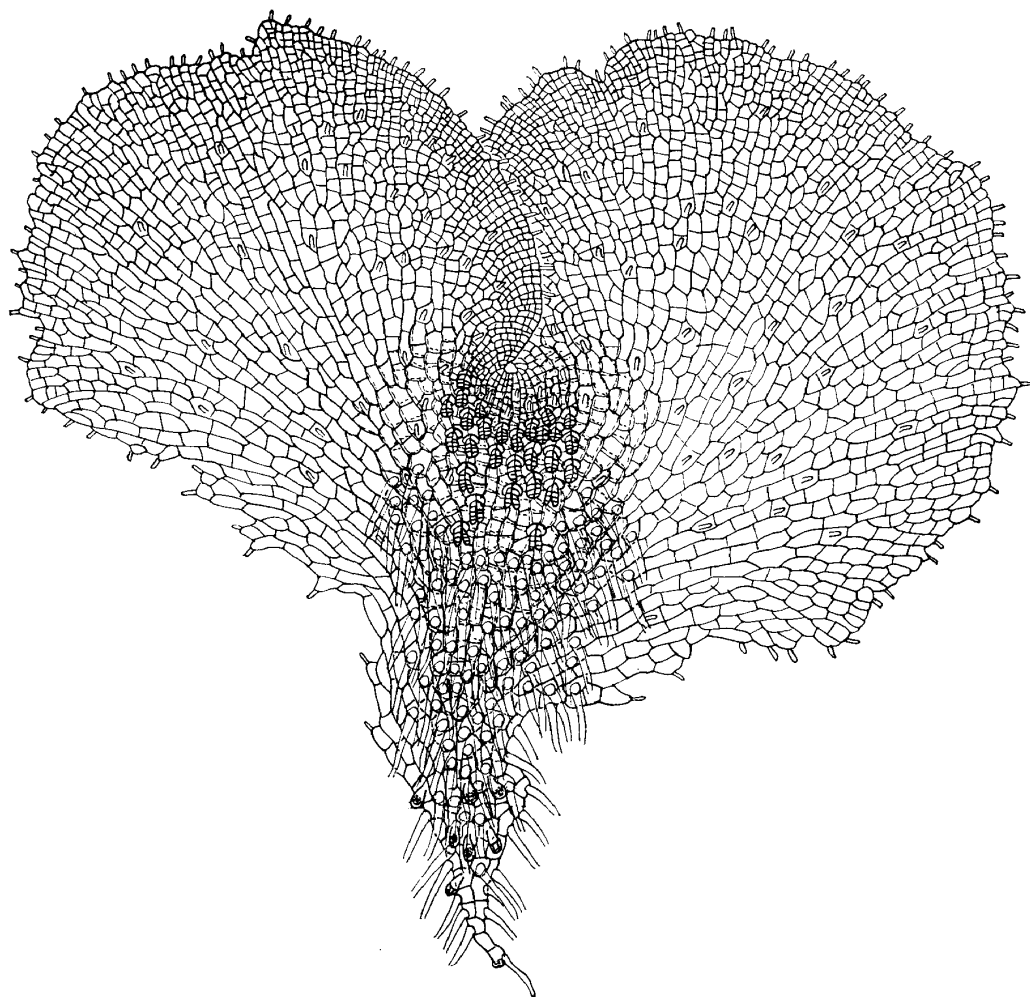


Fig. 38 *Oleandra musifolia* (Blume) Presl.

intercellular notch, elongate polygonal or isodiametric with convex free side. Midrib conspicuously gutter-shaped, cushioned from the lower midway to near the apex, obovate, 4-5 cells thick in the heavier part. Trichomes densely on margins and sparsely on both surfaces of the thallus, unicellular, cylindrical, 40-70  $\mu$  in length, 20-25  $\mu$  in basal width and 15-18  $\mu$  in mid-width, with nucleus in the middle and small chloroplasts; glandular, secretion entirely capping the top, spherical, almost uniformly thickened. Rhizoids on the midrib from the base to the middle of cushion and nested above archegonium group, light brown. Archegonia on the distal median of cushion, many in number, neck small in size, claviform, bending towards posterior; neck cells in four tiers, 5-6 at the anterior and 3-4 at the posterior sides, lowermost cells of each tier large and cushioning the neck. Antheridia confined to the base of thallus, capitate or pyriform, 70-80  $\mu$  in diameter, pendulate towards posterior; basal cell shorter and narrower than ring cell, cylindrical or narrowed below, upper wall flat; ring cell barrel-shaped, broadly covered with large cap cell.



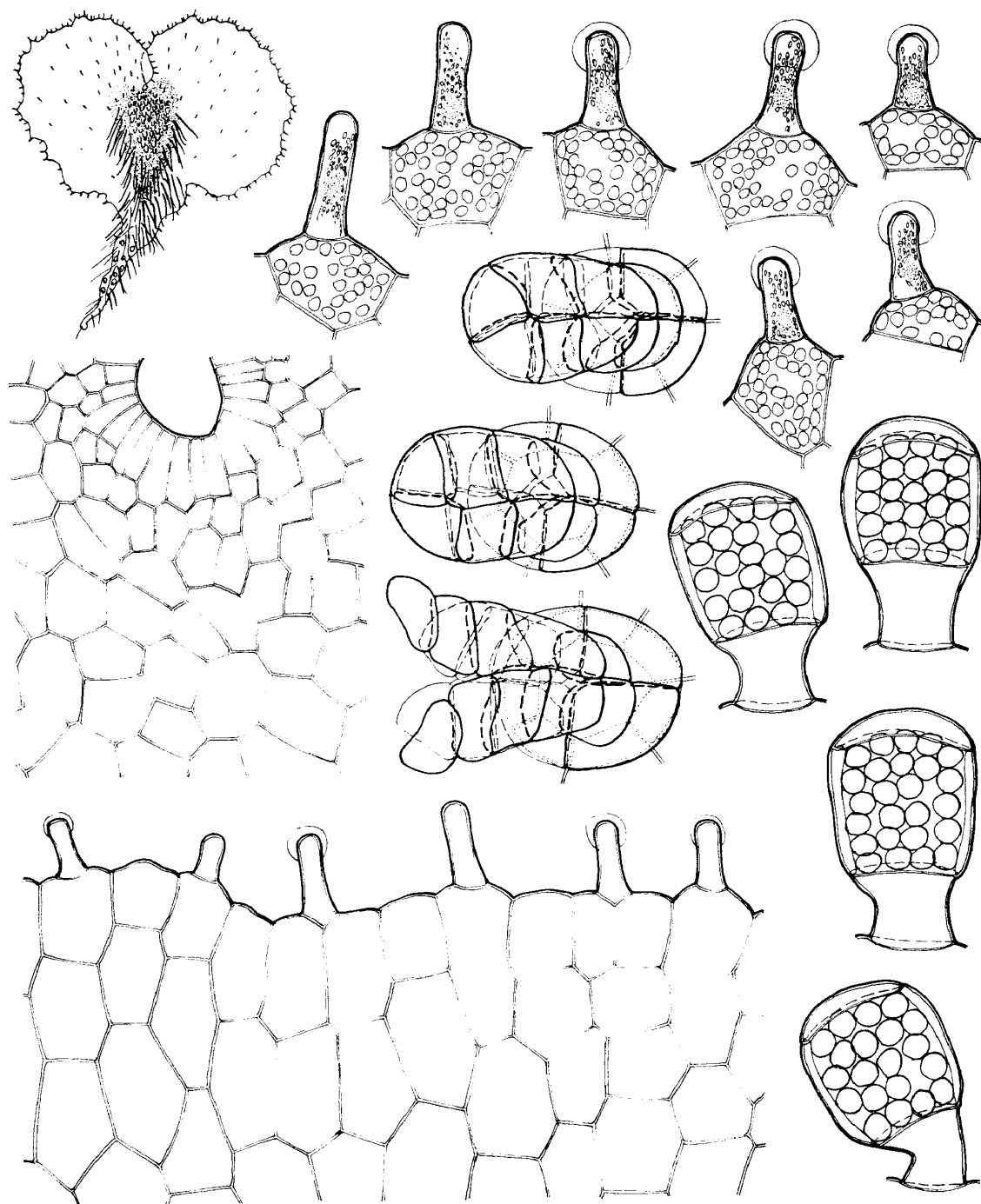


Fig. 39 *Oleandra musifolia* (Blume) Presl.

Material. Loei: northeastern ridge of Phu Luang, 5 Dec. 1965.

Pteridoideae

21. *Pteridium aquilinum* (L.) Kuhn var. *wightianum* (J. Ag.) Tryon. Figs. 40, 41  
Prothallium bilateral, rather broad heart-shaped, assurgent along the midrib: apex shallowly or less deeply rounded and acutely cordate, and inner sides of lobes

funnel-like, opened or closed together above the bottom of sinus; lower part of the thallus rounded, acutely or sharply narrowing towards the tailed base. Protonema 2-4 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, broadwise or lower sidewise expanded, margins undulate; wing cells isodiametric or elongate polygonal with almost straight side wall; marginal cells arranged with minute intercellular notch, broad or elongate polygonal, with convex free side. Midrib gutter-shaped, cushioned from the lower midway to near the apex; cushion obovate, 4-5 cells thick in the heavier part. Rhizoids along the midrib from the base of thallus to the middle of cushion, almost hyaline. Archegonia gregarious on the distal median of cushion, not so many in number; neck medium sized, more or less claviform, bending towards posterior; neck cells in four tiers, 5 at the anterior and 3-4 at the posterior side, lowermost cells in each tier large and cushioning the neck. Antheridia strictly confined to the base of thallus, ellipsoidal, 70-80  $\mu$  in diameter; basal cell equal in height and width with ring cell, upper wall funnel-like, immersed to the base or sometimes flat.

Material. Chiangmai: Doi Suthep, 21 March 1965.

The prothallium of this variety is, in general, similar to that of the Japanese form, *P. aquilinum* var. *latiusculum* (Desv.) Underw., but differs from the latter in marginal cells of the wings. In the latter variety, the free side of marginal cell

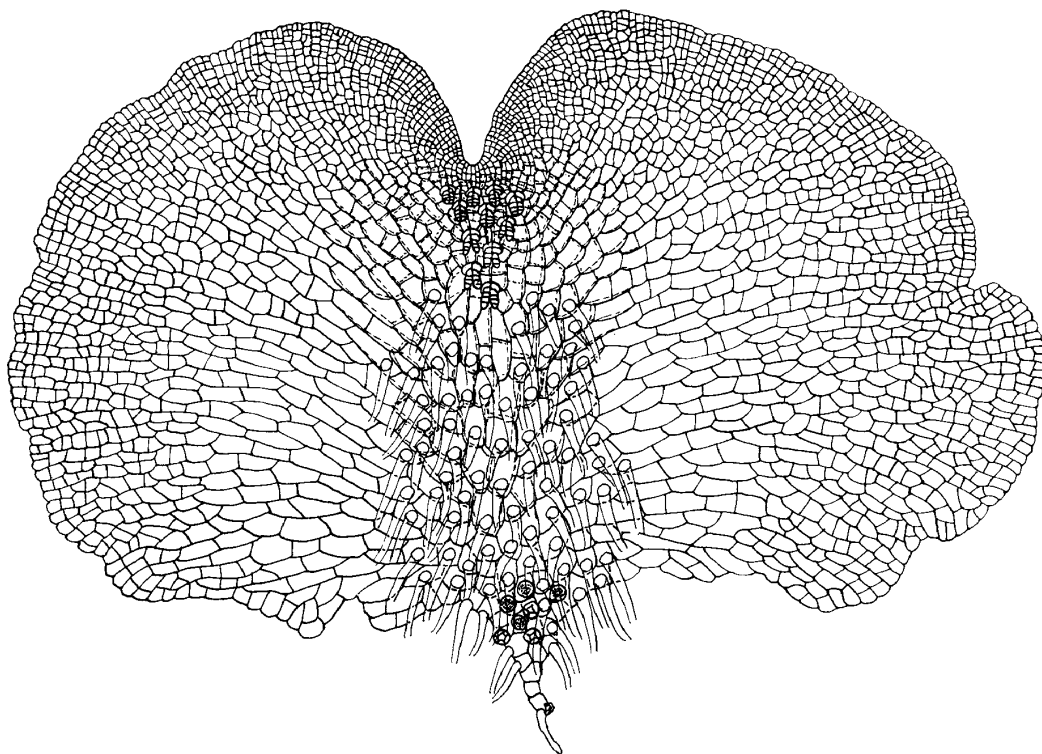


Fig. 40 *Pteridium aquilinum* (L.) Kuhn var. *wightianum* (J. Ag.) Tryon.

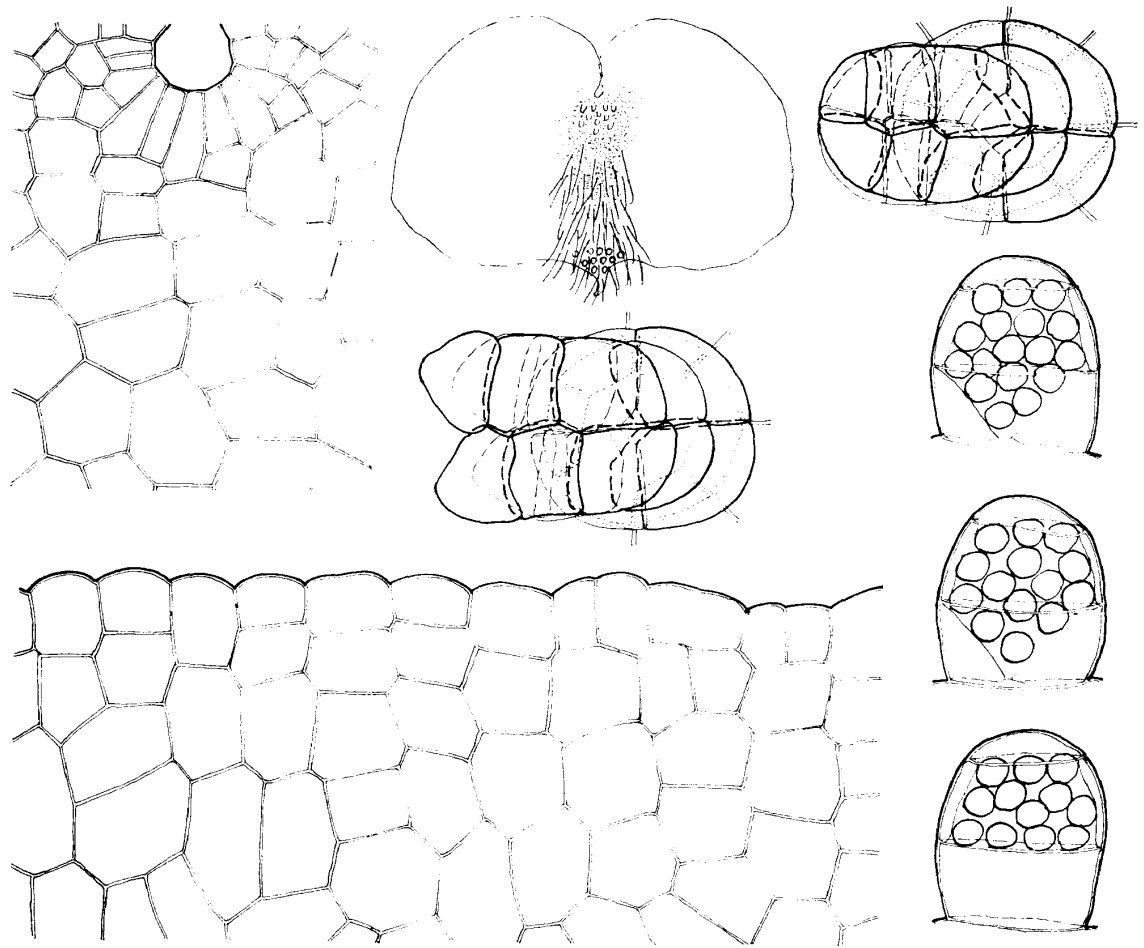


Fig. 41 *Pteridium aquilinum* (L.) Kuhn var. *wightianum* (J. Ag.) Tryon.

is always concave, not convex as in the present variety.

## 22. *Pteris vittata* L.

Prothallium conspicuously asymmetrical, oblique and broad heart-shaped, strikingly assurgent or uplifted along the midrib; apex deeply rounded and acutely cordate and inner sides of lobes approaching together and mostly closed above the bottom of sinus; lower part of the thallus rounded, acutely or sharply narrowing towards the obliquely tailed base. Protonema 2-5 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower part of original cell. Wings unequal in size and shape, dominate wing broad-wise or lower sidewise expanded and recessive wing upper sidewise expanded, margins more or less undulate; wing cells isodiametric or elongate polygonal with almost straight side wall; marginal cells arranged with minute intercellular notch, isodiametric or elongate polygonal with concave free side. Midrib strikingly gutter-shaped, cushioned from the base to near the apex; cushion obovate or broad-obovate, 5-6 cells thick in the heavier part. Rhizoids along the midrib from the base of

thallus to the middle of cushion, almost hyaline or brownish in colour. Archegonia gregarious on the upper median of cushion, not so many in number; neck medium sized, slightly tapered, bending towards posterior; neck cells in four tiers, 5-6 at the anterior and 3-4 at the posterior sides. Antheridia on all over the cushion and mixed with archegonia, globoid, 75-85  $\mu$  diameter; basal cell lower than ring cell, upper wall funnel-like, immersed to the base.

Material. Chiangmai: Mae Klang water-fall, north of Chom Thong, 22 March 1965; Doi Suthep, 31 Dec. 1965.

The prothallia of the present materials are identical with those of the Japanese plants (Momose, op. cit. 118). This species is distinguishable from the other species of *Pteris* by its own peculiar characters: 1) the outer coat of spore is almost colourless and reticulately sculptured, 2) the heart-shaped thallus is extremely or conspicuously asymmetrical, and 3) the wing is strikingly uplifted along the midrib and the thallus shows a peculiar figure.

23. *Pteris biaurita* L.

Fig. 42

Prothallium more or less asymmetrical, rather broad heart-shaped, assurgent along the midrib; apex more or less deeply and widely rounded and steeply cordate, and inner sides of lobes opened above the bottom of sinus; lower part of the thallus rounded, acutely narrowing towards the base. Protonema 3-5 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower part of original cell. Wings somewhat unequal in size, upper sidewise expanded, margins undulate; wing cells elongate or isodiametric polygonal with almost straight side wall; marginal cells arranged with minute intercellular notch, elongate or isodiametric polygonal with convex free side. Midrib gutter-shaped,

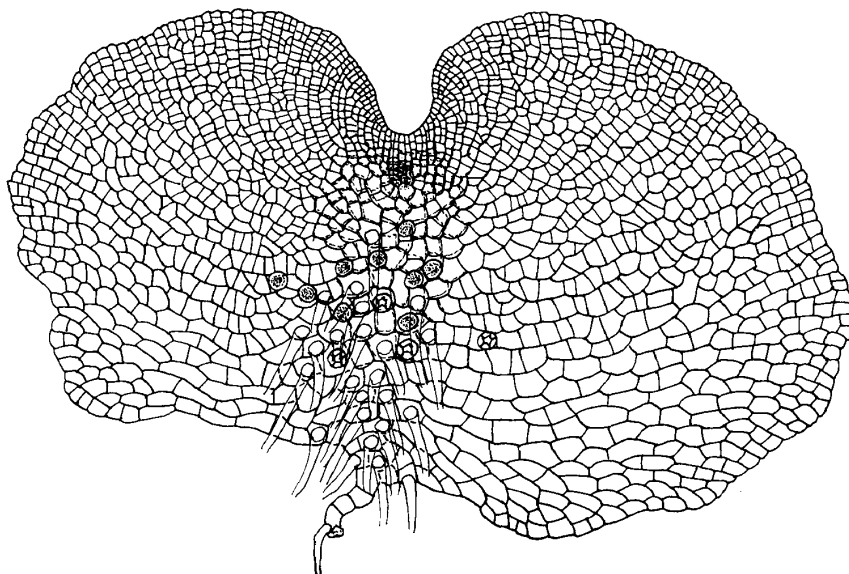


Fig. 42 *Pteris biaurita* L.

cushioned at distal part; cushion small, obovate, 3-4 cells thick at the heavier part. Rhizoid along the midrib from the base of thallus to the midway, almost hyaline or brownish in colour. Apogamous, budding on distal median of cushion near the apex, no archegonia. Antheridia sometimes gregarious on the middle of midrib, globose, 85-90  $\mu$  in diameter; basal cell equal in height and width with ring cell, upper wall funnel-like, immersed to the base.

Material. Chiangmai: Doi Suthep, 20 March 1965; 31 Dec. 1965.

24. *Pteris decrescens* Christ.

Figs. 43, 44

Prothallium almost bilateral, elongate obdeltoid-heart-shaped, conspicuously asurgent along the midrib and at the lower part strongly recurved; apex deeply rounded and acutely cordate, and inner sides of lobes approaching together and

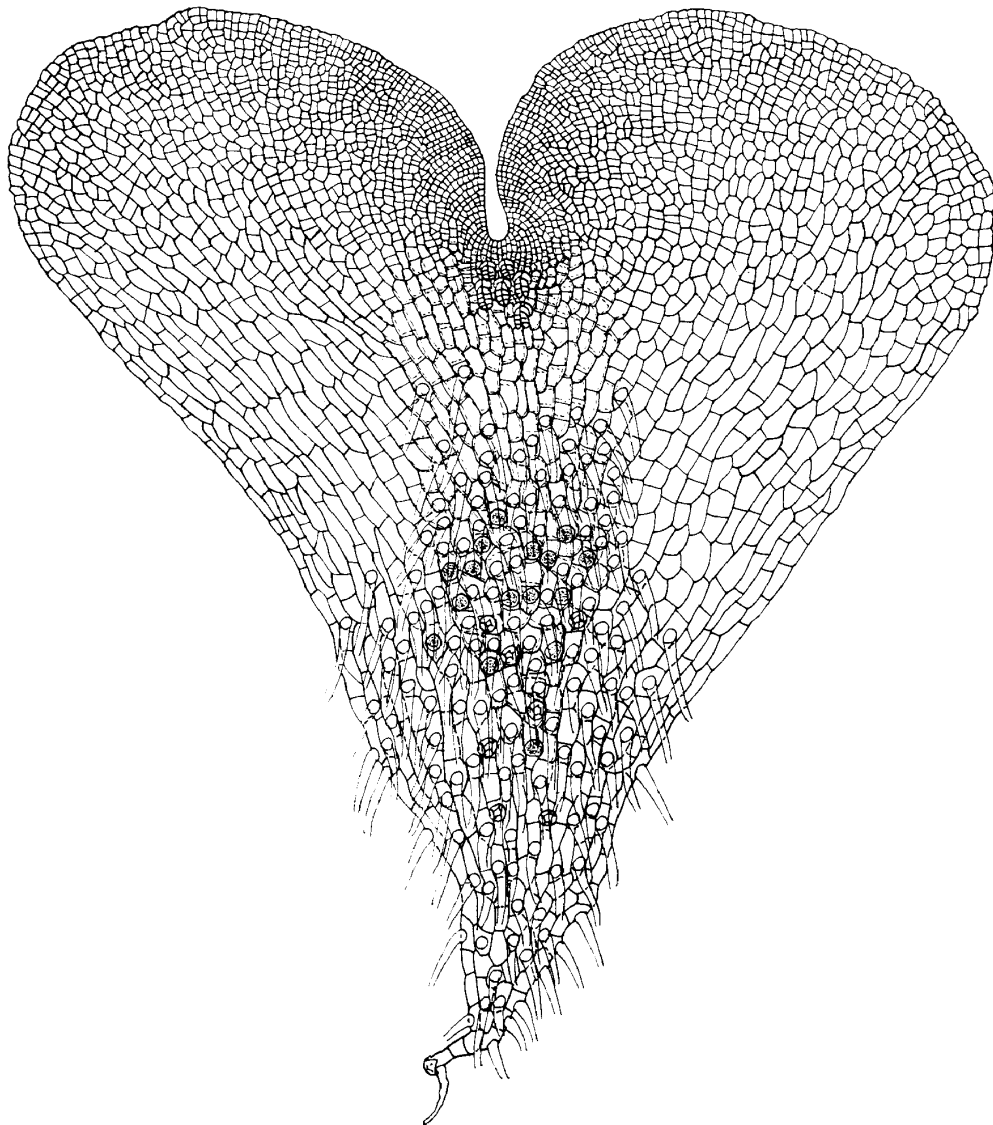


Fig. 43 *Pteris decrescens* Christ.

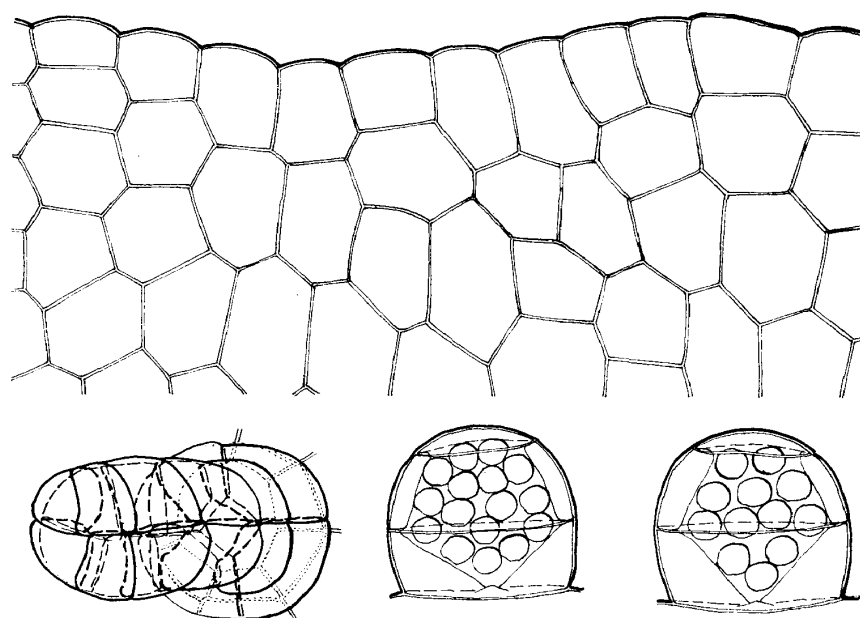


Fig. 44 *Pteris decrescens* Christ.

sometimes closed above the bottom of sinus; lower part of the thallus cuneate, gently narrowing towards the base. Protonema 2-4 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size and shape, upper sidewise expanded, margins almost entire; wing cells isodiametric or elongate polygonal with straight side wall; marginal cells arranged with minute intercellular notch, isodiametric or elongate polygonal with convex free side. Midrib conspicuously gutter-shaped, cushioned from the lower midway to near the apex, cushion elongate obovate, 4-5 cells thick in the heavier part. Rhizoids on the lower part of thallus and along the midrib to the middle of cushion, almost hyaline or brownish in colour. Archegonia on the distal median of cushion, some in number; neck slender and long, bending towards posterior; neck cells in four tiers, 6 at the anterior and 4 at the posterior sides. lowermost cell of each tier large and cushioning the neck. Antheridia along the midrib from the lower part of thallus to the middle of cushion and apart below from archegonia, globose, 80-90  $\mu$  in diameter; basal cell almost equal in height and width with ring cell, upper wall funnel-like, immersed to the base.

Material. Chiangmai: Doi Iothanon, 20 Dec. 1965.

25. *Pteris longipes* Don.

Figs. 45, 46

Prothallium more or less asymmetrical heart-shaped, strikingly assurgent along the midrib; apex more or less deeply rounded, steeply cordate, and inner sides of lobes funnel-like, opened above the bottom of sinus; lower part of the thallus cuneate, steeply narrowing towards the base. Protonema 3-6 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower

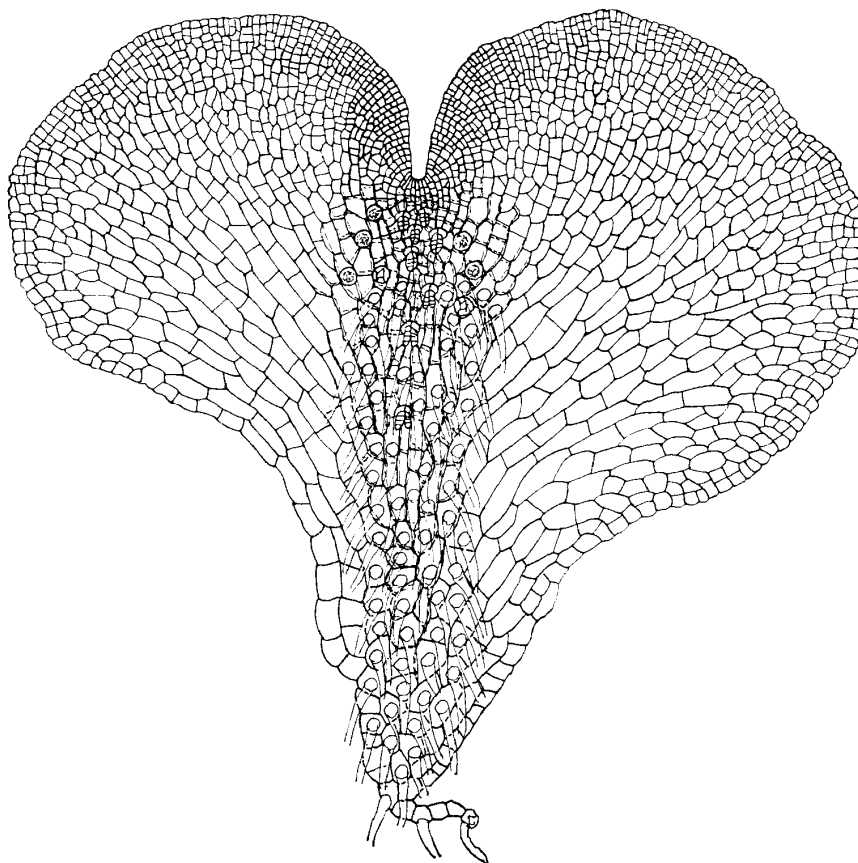


Fig. 45 *Pteris longipes* Don.

side of original cell. Wings more or less unequal in size, upper sidewise expanded, margins slightly undulate; wing cells isodiametric or elongate polygonal, with almost straight side wall; marginal cell arranged with minute intercellular notch, isodiametric or elongate polygonal, smaller sized, with concave or waved free side. Midrib strikingly gutter-shaped, cushioned from the basal midway to near the apex; cushion narrow and elongate obovate, 4-5 cells thick in the heavier part. Rhizoids along the midrib from the base of thallus to the upper part of cushion, light-brown in colour. Archegonia along the upper median of cushion, some in number; neck medium sized, tapered, bending towards posterior, dehiscing reservedly; neck cells 4-5 at the anterior and 3-4 at the posterior side, lowermost cells in each tier large and cushioning the neck. Antheridia on the upper part of cushion and mixed with archegonia, globose or globoid, 80-100  $\mu$  in diameter; basal cell almost equal in width and height with ring cell, upper wall funnel-like, immersed to the base.

Material. Chiangmai: Doi Suthep, 20 March 1965.

#### Asplenoideae

##### 26. *Asplenium nidus* L.

Prothallium bilateral, broad heart-shaped, almost flat or slightly assurgent along

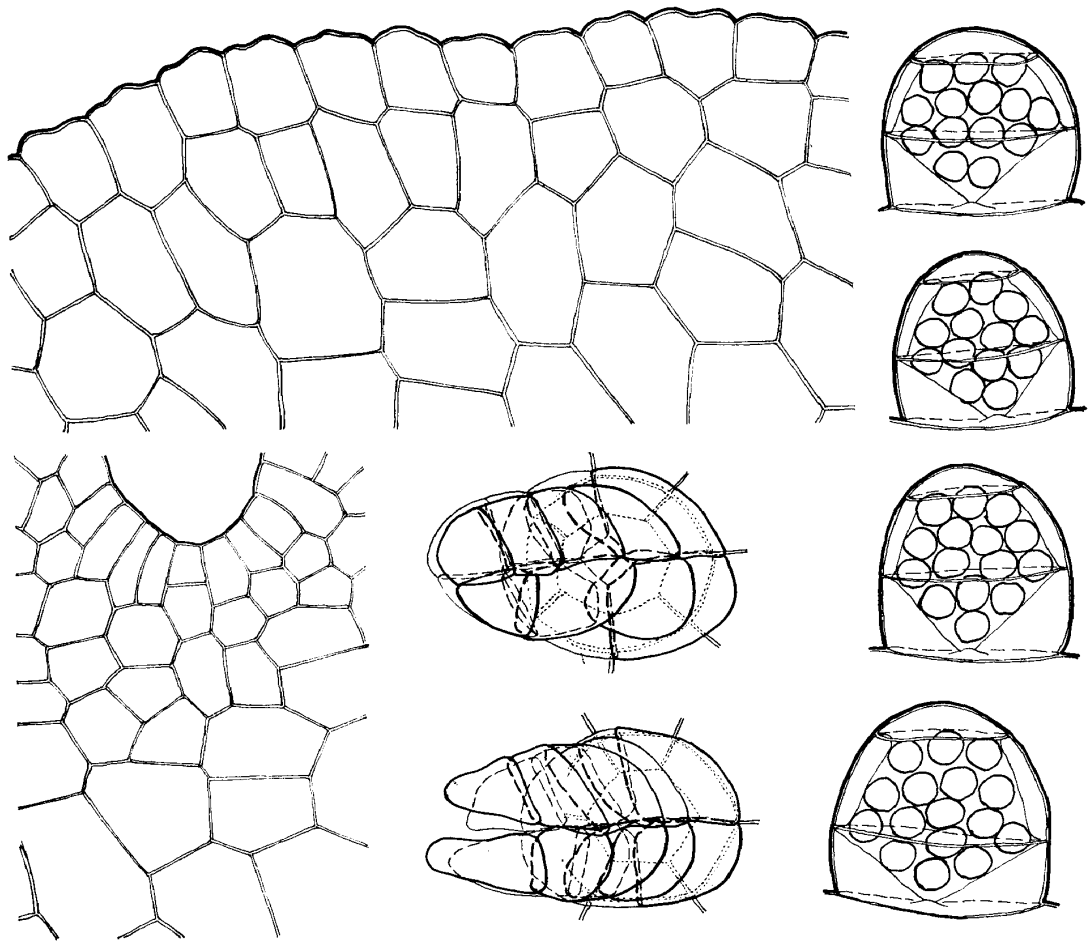


Fig. 46 *Pteris longipes* Don.

the midrib; apex deeply rounded and acutely cordate, and inner sides of lobes approaching together and closed or opened above the bottom of sinus; lower part of the thallus rounded, steeply narrowing towards the base. Protonema 2-4 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, broadwise or upper sidewise expanded, margins almost entire; wing cells almost isodiametric polygonal with almost straight side wall, more or less collenchymatous; marginal cells smoothly arranged, isodiametric or somewhat elongate polygonal with almost flat or somewhat concave free side. Midrib cushioned from the middle to near the apex and slightly concave; cushion small in size, rounded or basal obovate, 2-3 cells thick. Naked. Rhizoids superficial, on the lower part of thallus spreading aside to wings and nesting above the cushion, light brown in colour. Archegonia on all over the cushion, many in number; neck rather large and thick, cylindrical, bending towards posterior; neck cells in four tiers, 5-6 at the anterior and 4 at the posterior sides. Antheridia on the lower part of thallus and apart below the arche-



gonial group, globoid, 60-75  $\mu$  in diameter; basal cell almost equal in height and width with ring cell, upper wall funnel-like, immersed to the base.

Material. Trang: Khao Chong, 30 April 1965.

The prothallium of the present material is identical with that of the plants in the Bonins, the Ryukyus and Yukushima of Japan (Momose, J. Jap. Bot. 17: 388. 1941; Proth. Jap. Ferns 533. 1967).

27. ***Asplenium ensiforme*** Wall. ex Hook. et Grev.

Prothallium bilateral, handsome heart-shaped, slightly assurgent along the midrib; apex more or less deeply rounded and acutely cordate, and inner sides of lobes approaching together or not above the bottom of sinus; lower part of the thallus rounded or cuneate, steeply or acutely narrowing towards the base. Protonema 1-4 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, upper sidewise or broadwise expanded, margins fractionally denticulate in consequence of projection of trichome bearing marginal cell or cells; wing cells isodiametric polygonal with almost straight side wall; marginal cells smoothly arranged, isodiametric or somewhat elongate polygonal with almost flat free side. Midrib slightly gutter-shaped, cushioned from the middle to near the apex; cushion small in size, obovate or elongate obovate, 2-4 cells thick in the heavier part. Trichomes more or less densely on margins and sparsely on both surfaces of the thallus, verruciform, mastoid or clavate, 50-85  $\mu$  in height and 40-50  $\mu$  in basal width, with nucleus in the middle or upper part and large chloroplasts; surface trichomes usually longer than the marginal ones, cylindrical or clavate, sometimes two or more cells long; marginal cell or cells projected out of the margins. Rhizoids on the lower part of thallus spreading aside to lower margin of wings and along the midrib to the middle, almost hyaline. Archegonia on all over the cushion; neck rather small in size, bending towards posterior; neck cells in four tiers, 5-6 at the anterior and 4 at the posterior sides, lowermost cell of each tiers conspicuously large and cushioning the neck. Antheridia on the basal part of thallus and apart below the archegonial group, globoid or ellipsoid, 75-90  $\mu$  in diameter; basal cell almost equal in height and width with ring cell, and upper wall funnel-like, immersed to the base; cap cell angulate; sometimes inclined towards posterior.

Material. Chiangmai: Doi Inthanon, 20 Dec. 1965.

The trichomes of this species are quite similar to the vegetative cells in the features of their protoplasmic contents. I have observed the trichomes of such a peculiar type in various species of *Asplenium*.

Blechnoideae

28. ***Blechnum orientale*** L.

Prothallium bilateral, heart-shaped, conspicuously assurgent along the midrib and the basal part so uplifted as to margins approaching together; apex deeply rounded and acutely cordate, and inner sides of lobes closed and overlapped above the bottom of sinus; lower part of the thallus rounded, acutely narrowing towards the cuneately tailed base. Protonema 2-3 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, broadwise or upper sidewise expanded, margins undulate and trichome bearing cells sometimes toothed by projecting outgrowths; wing cells isodiametric or elongate polygonal with almost straight side wall; marginal cells arranged with minute intercellular notch, isodiametric polygonal with convex free side. Midrib conspicuously gutter-shaped, cushioned from basal midway of the thallus to near the apex; cushion obovate, 4-5 cells thick in the heavier part. Trichomes sparsely on margins and both surfaces of the thallus, cylindrical, 35-60  $\mu$  in length, 23-28  $\mu$  in basal width and 18-28  $\mu$  in mid-width, with nucleus in the middle and rather large chloroplasts; glandular, secretion, capping the top, thickened upside. Rhizoids on the lower part of thallus along the midrib to the middle of cushion, brown in colour and toughish. Archegonia gregarious on the distal median of cushion, some in number; neck medium sized, more or less slender, bending towards posterior; neck cells in four tiers, 6-7 at the anterior and 4-5 at the posterior sides, lowermost cells of each tier large and cushioning the neck. Antheridia on the upper part of cushion and mixed with archegonia, obovoid or pyriform, 65-75  $\mu$  in diameter; basal cell lower and narrower than ring cell, almost cylindrical, upper wall flat and sometimes slightly concave; ring cell barrel-shaped; cap cell widely covering the ring cell and obliquely angulated above.

Material. Chiangmai: Doi Suthep, 31 Dec. 1965.

The prothallium of the present material is identical with that of the Yakushima plants (Momose, op. cit. 514).

29. *Brainea insignis* (Hook.) J. Smith.

Figs. 47, 48

Prothallium bilateral, heart-shaped, conspicuously assurgent along the midrib and basal part so uplifted as to margins close together; apex deeply rounded and acutely cordate, and inner sides of lobes approaching and often closed together; lower part of the thallus rounded, acutely narrowing towards the tailed base. Protonema 2-4 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the basal part of original cell. Wings equal in size, broadwise or upper sidewise expanded, margins undulate and trichome bearing cells often toothed by projecting outgrowth; wing cells isodiametric or elongate, with undulate side wall; marginal cells arranged with minute intercellular notch, isodiametric, elongate or broad polygonal with concave free side. Midrib

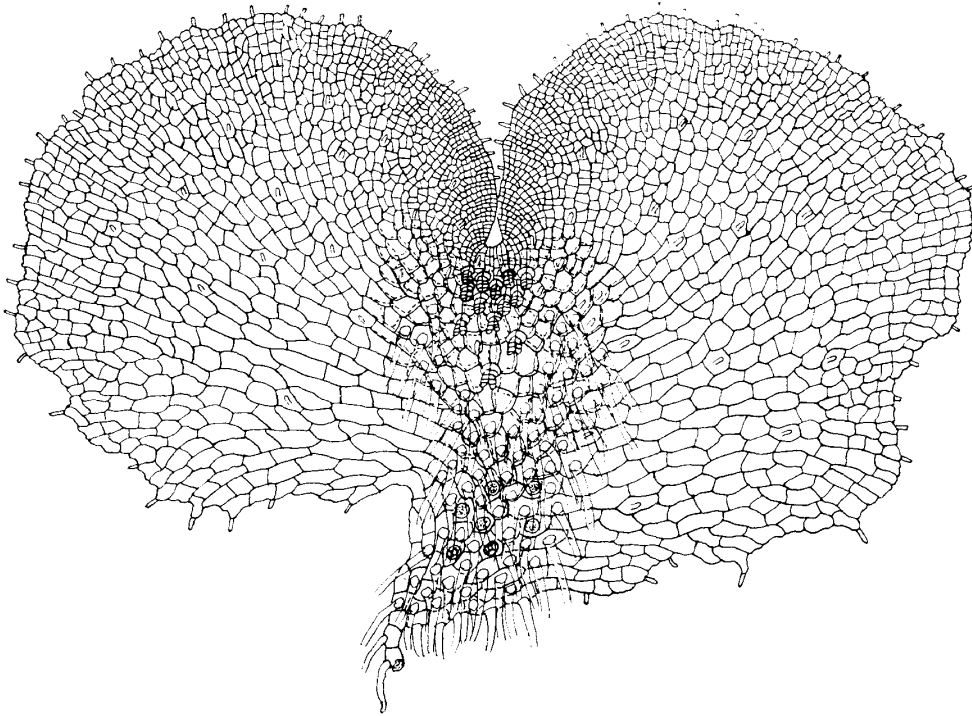


Fig. 47 *Brainea insignis* (Hook.) J. Smith.

conspicuously gutter-shaped, cushioned from the basal midway to near the apex; cushion obovate, 4-5 cells thick in the heavier part. Trichomes sparsely on margins and more sparsely on both surfaces of the thallus, cylindrical, 50-75  $\mu$  in length, 21-25  $\mu$  in basal width and 15-17  $\mu$  in mid-width, with nucleus in the middle or upper middle and rather large chloroplasts; glandular, secretion capping the top, conspicuously thicken upside and often conical. Rhizoids along the midrib from the base of thallus to the middle of cushion and nested above the archegonial group, brown in colour and toughish. Archegonia gregarious on the distal median of cushion, not so many in number; neck often tapered, bending towards posterior; neck cells in four tiers, 5 at the anterior and 3-4 at the posterior sides, lowermost cells of each tier large and cushioning the neck. Antheridia on the lower part of thallus and apart below the archegonial group, globoid or ellipsoid, 85-95  $\mu$  in diameter; basal cell always lower than ring cell, upper wall concave below; ring cell barrel-shaped and widely covered with rounded cap cell.

Material. Chiangmai: Doi Suthep, 20 March 1965. Cultivated.

#### Lomariopsidoideae

#### 30. *Elaphoglossum yunnanense* (Baker) C. Chr.

Figs. 49, 50

Prothallium bilateral, elongate heart-shaped or spatulate heart-shaped, mostly narrow spatulate, conspicuously ruffled or crispate; apex shallowly, narrowly round-

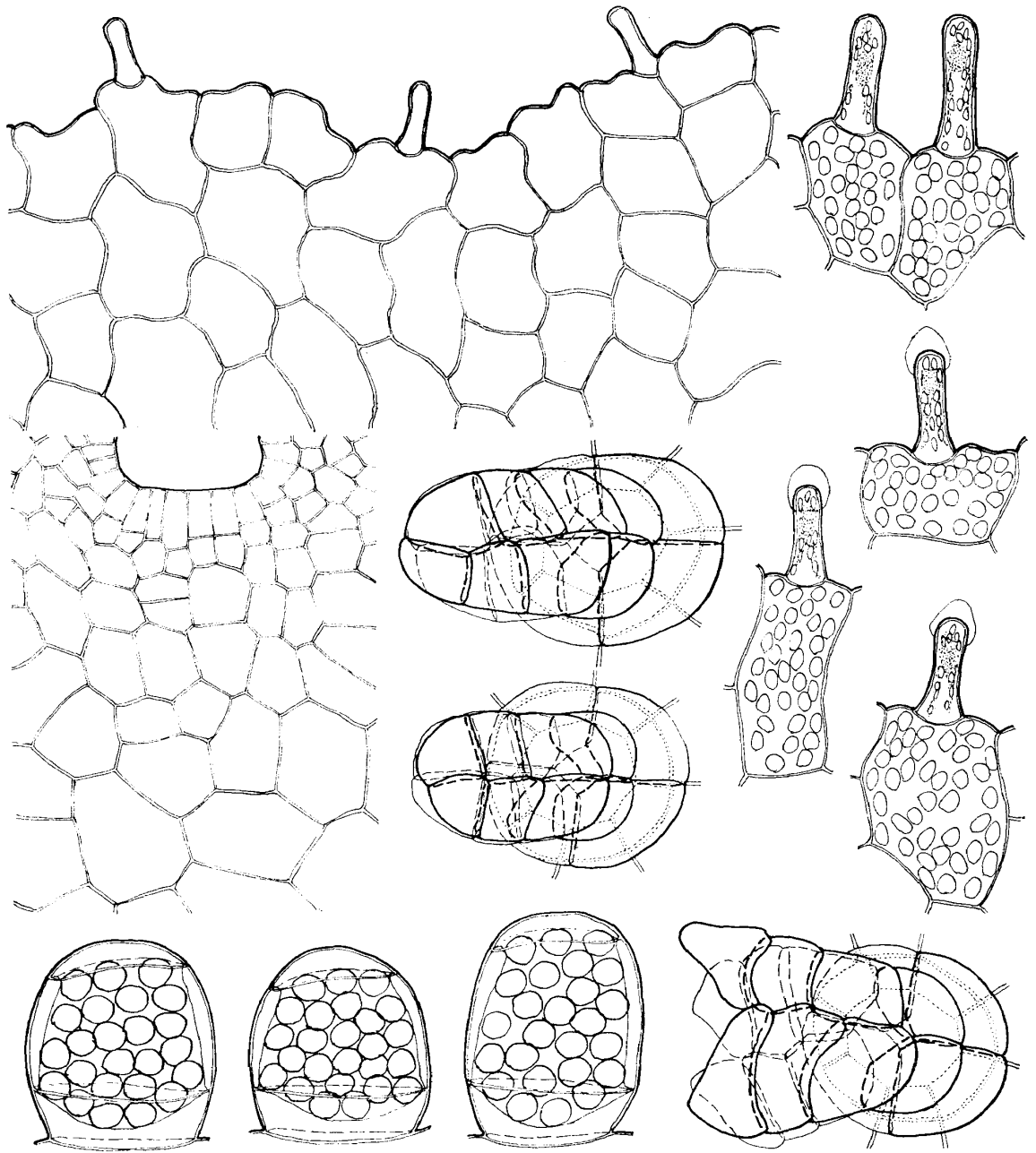


Fig. 48 *Brainea insignis* (Hook.) J. Smith.

ed and acutely cordate, and inner sides of lobes approaching and mostly closed together above the bottom of sinus; lower part of the thallus cuneate, gently narrowing towards the base. Wings almost equal in size, upward or upper sidewise expanded, margins undulate; wing cells almost isodiametric polygonal with straight or slightly curved side wall; marginal cells smoothly arranged, almost isodiametric or broad polygonal with almost flat free side. Midrib narrowly cushioned from the upper midway to near the apex; cushion narrowed belt-like, irregular and sometimes discontinuous, 2-3 cells thick and a few to some cells wide, some trichomes

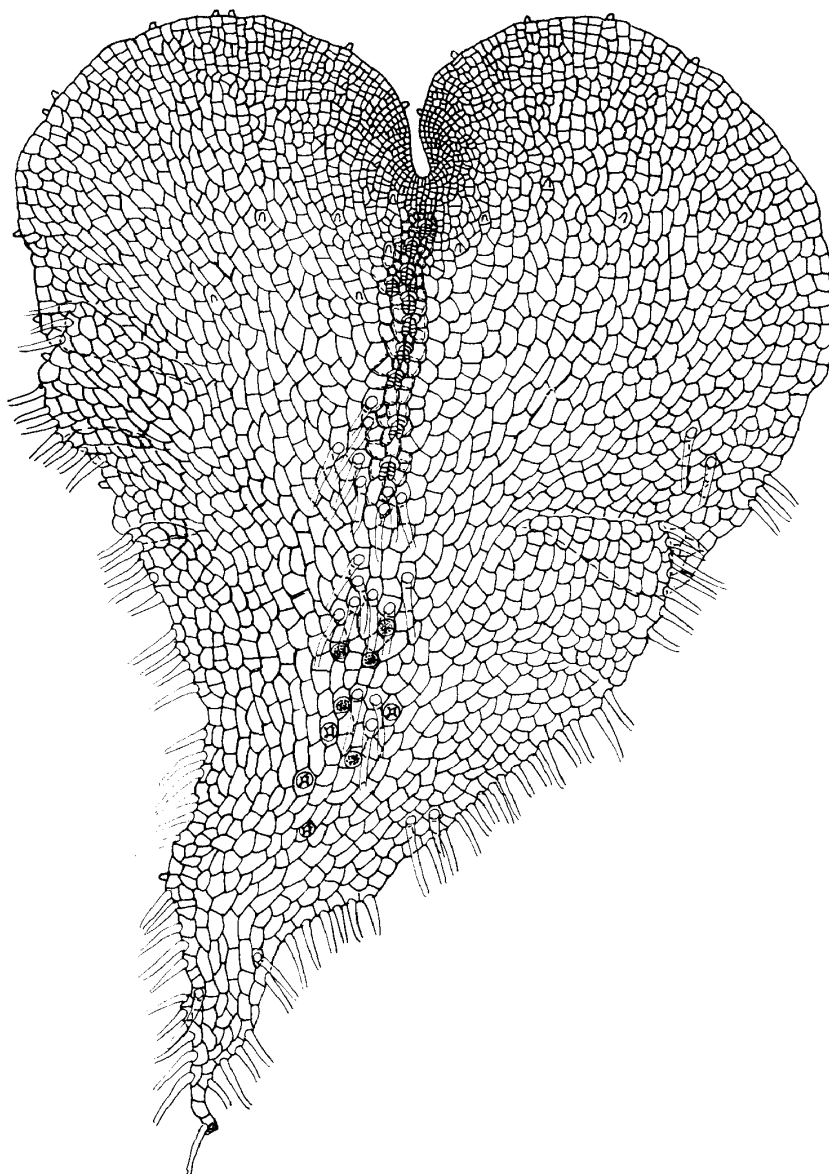


Fig. 49 *Elaphoglossum yunnanense* (Baker) C. Chr.

on upper margins and on both surfaces near the apex of thallus, conical or verruciform,  $45-57 \mu$  in height and  $35-50 \mu$  in basal width, with nucleus in the middle and numerous small chloroplasts; glandular, secretion uniformly capping the upper part. Rhizoids gregarious here and there on lower margins and sometimes on the midrib, deep-brown and tough. Archegonia along narrow cushion; neck more or less large and thick, rather verruciform, bending towards posterior; neck cells in four tiers, 5-6 at the anterior and 4 at the posterior sides, lowermost cells of each tier large and cushioning the neck. Antheridia on the lower part of thallus along the midrib and apart below the archegonial group, globose,  $80-100 \mu$  in diameter; basal cell equal in width and height with ring cell, upper wall funnel-like, immersed

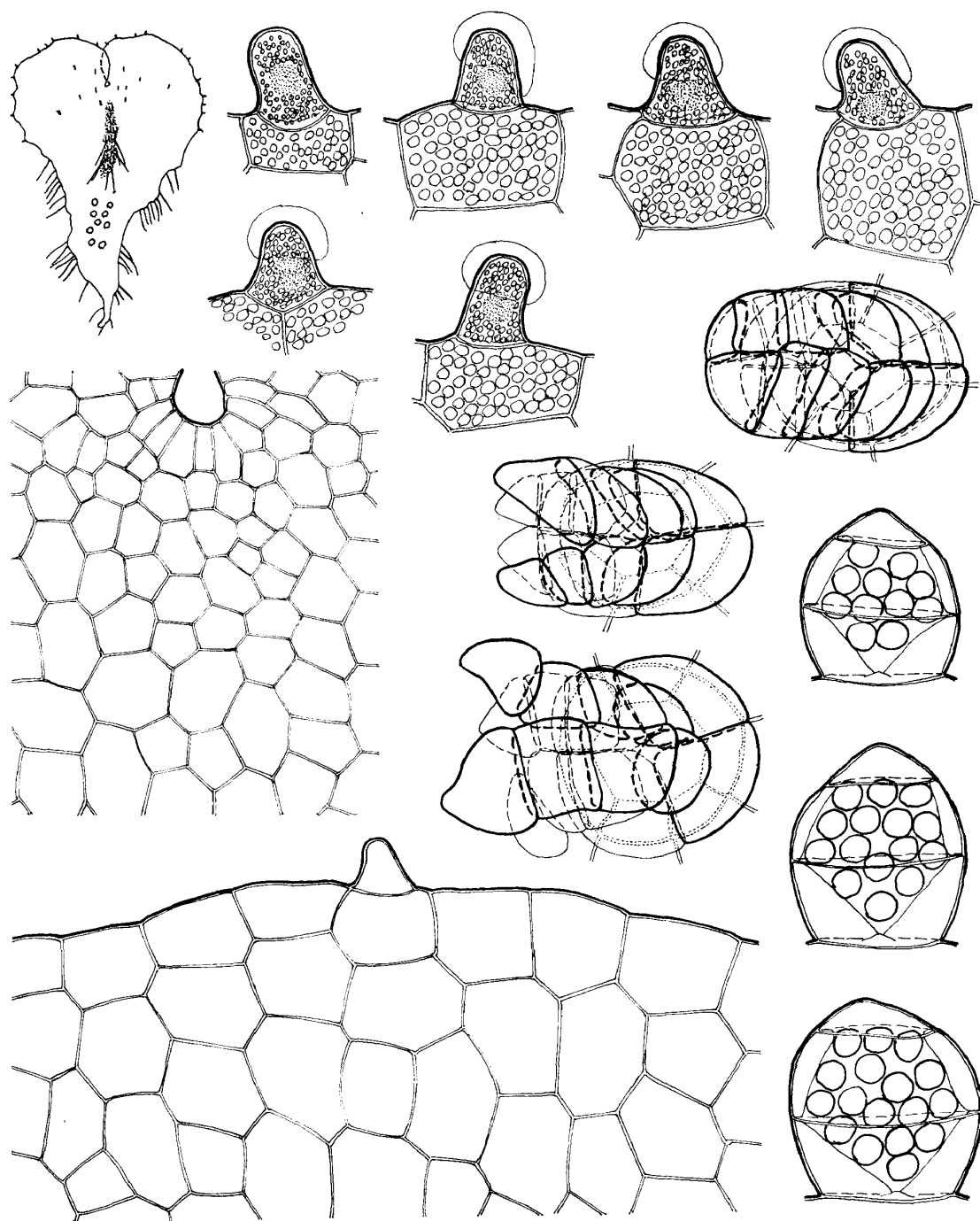


Fig. 50 *Elaphoglossum yunnanense* (Baker) C. Chr.

to the base; cap cell conically angulate above.

Material. Loei: north ridge of Phu Luang, 5 Dec. 1965.

According to A.G. Stokey and L.R. Atkinson (*Phytomorph.* 7: 275-292. 1957), the thalli of various species of *Elaphoglossum* are divided into two types: the broad type and the narrow type. The thallus of the present material belongs to the narrow type.

31. *Bolbitis sinensis* (Baker) K. Iwats.

Figs. 51, 52

Prothallium bilateral, more or less obdeltoid heart-shaped; almost flat and more or less ruffled with age; apex shallowly and acutely cordate, and inner sides of lobes closed together or opened above the bottom of sinus; lower part of the thallus cuneate, steeply narrowing towards the base. Protonema 2-5 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the basal side of original cell. Wings equal in size, broadwise or upper sidewise expanded, margins almost entire or slightly undulate; wing cells isodiametric or

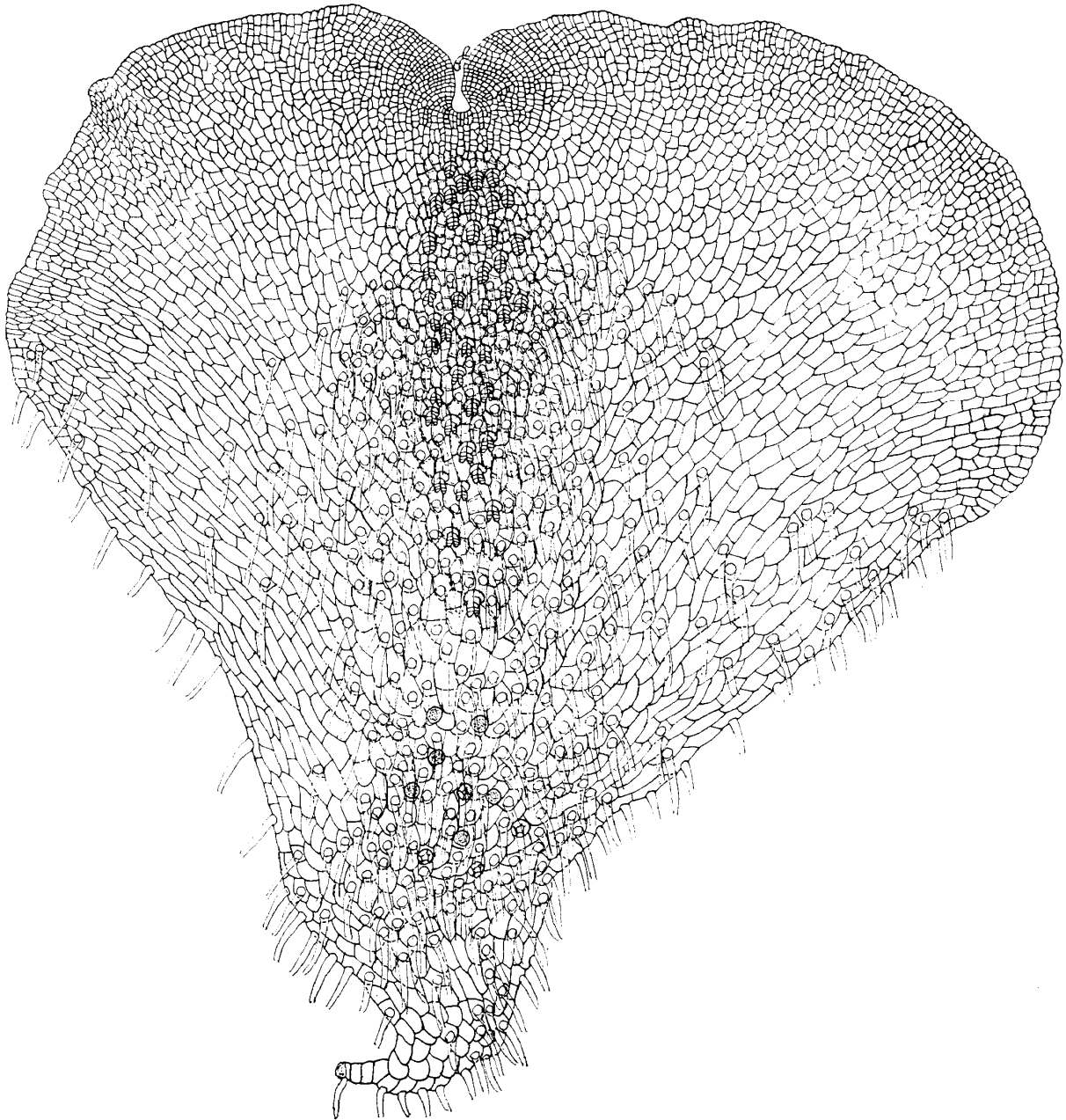


Fig. 51 *Bolbitis sinensis* (Baker) K. Iwats.

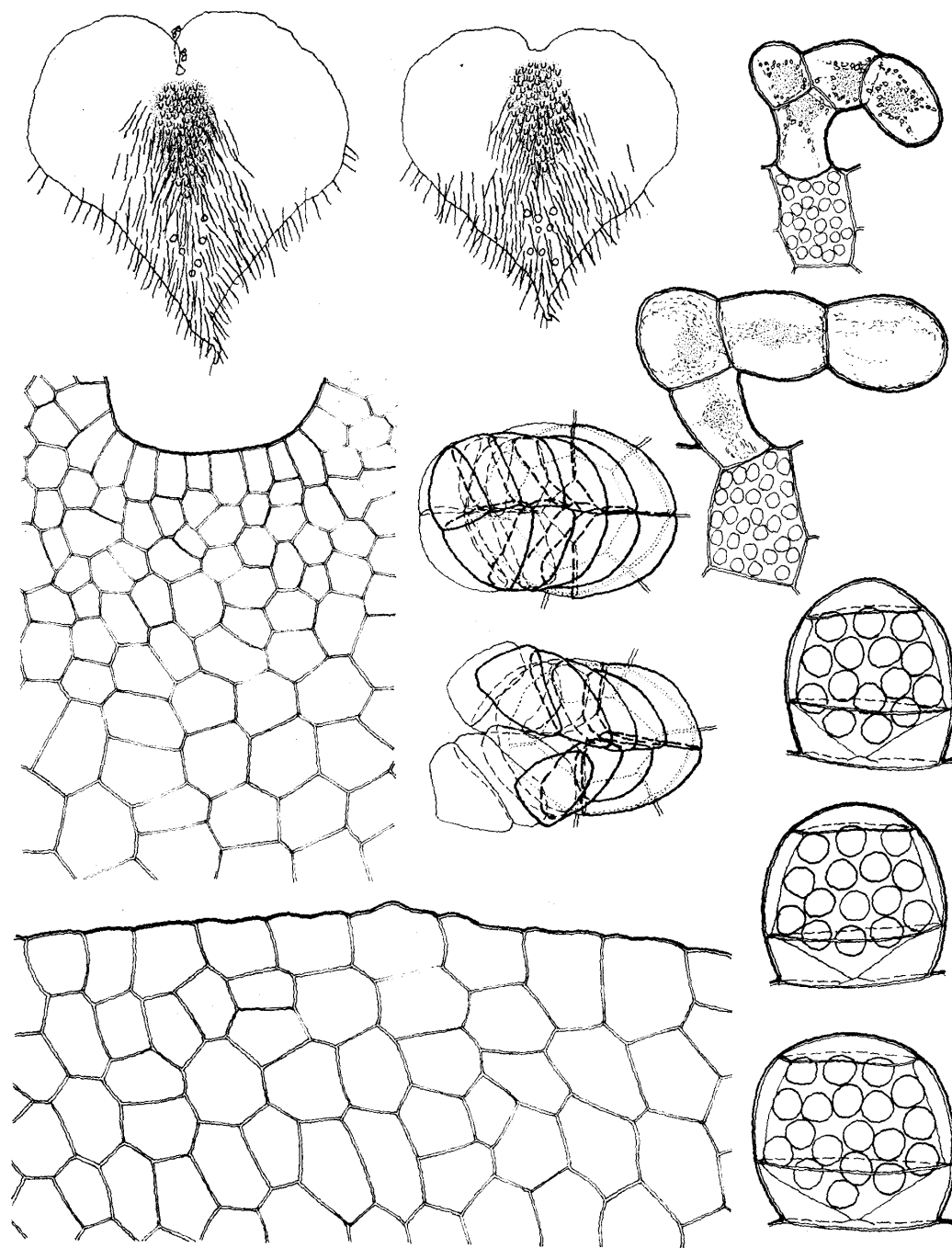


Fig. 52 *Bolbitis sinensis* (Baker) K. Iwats.

elongate polygonal with straight side wall; marginal cells arranged with minute intercellular notch or almost smoothly, isodiametric or elongate polygonal with almost flat or slightly concave free side. Midrib slightly gutter-shaped at the lower, cushioned from the upper midway to near the apex; cushion more or less small in size, obovate or narrowed obovate, 3-4 cells thick in the heavier part. A few



peculiar multicellular hairs sometimes on the margins near the apex, 3-4 cells long, bending towards the apex; a branched cell cut off to the opposite side at the upper side of lowermost cell by an oblique wall to cross the upper wall of lowermost cell, so as to hairs assuming T-shape. Rhizoids superficial, widely on the lower part of thallus spreading aside to the lower half of wings and along the midrib to the middle of cushion, lightly blackish brown in colour. Archegonia on all over the cushion, many in number; neck rather large, thick and short, slightly bending towards posterior; neck cells in four tiers, 4-6 at the anterior and 4 at the posterior sides. Antheridia on the lower part of thallus along the midrib and apart below the cushion, globose, 90-110  $\mu$  in diameter; basal cell lower than ring cell, upper wall funnel-like, immersed to the base.

Material. Chiangmai: Doi Chiangdao, 4 Jan. 1966.

Such a peculiar type of multicellular hairs as seen in the present material has been recorded in some species of *Bolbitis*: *B. quoyana* (A.G. Stokey, Amer. Fern J. 50: 78. 1960) and *B. subcordata* (Momose, op. cit. 510).

32. *Bolbitis virens* (Wall. ex Hook. et Grev.) Schott. Figs. 53, 54

Prothallium bilateral, handsome heart-shaped, almost flat; apex more or less deeply rounded and acutely cordate, and inner sides of lobes approaching and mostly closed together above the bottom of sinus; lower part of thallus cuneate or more or less rounded, steeply narrowing towards the base. Protonema 2-4 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoids inserted at the lower side of original cell. Wings equal in size, upper sidewise expanded, margins almost entire; wing cells isodiametric and broad or elongate polygonal with straight side wall; marginal cells almost smoothly arranged, broad polygonal with almost flat or slightly convex free side. Midrib cushioned from the midway to near the apex; cushion small in size, ovate-oblong, 3-4 cells thick. Rhizoids on the lower part of thallus, spreading aside to the wings and along the midrib to the middle of cushion, lightly blackish brown in colour. Archegonia on all over the cushion, many in number; neck thick and short, verruciform, almost straight or slightly bending towards the base; neck cells in four tiers, 4 at the anterior and 3-4 at the posterior sides, lowermost cells of each tiers large and cushioning the neck. Antheridia on the basal part of thallus, ellipsoid, obovoid or capitate, 80-95  $\mu$  in diameter; basal cell narrower and lower than ring cell, narrowing towards the base, upper wall flat.

Material. Chiangmai: Doi Suthep, 20 March 1965.

The prothallium of the present material is clearly distinguishable from that of the above species by the characters: 1) marginal cells of the wings are almost always broad polygonal in shape and their free side is almost flat or slightly

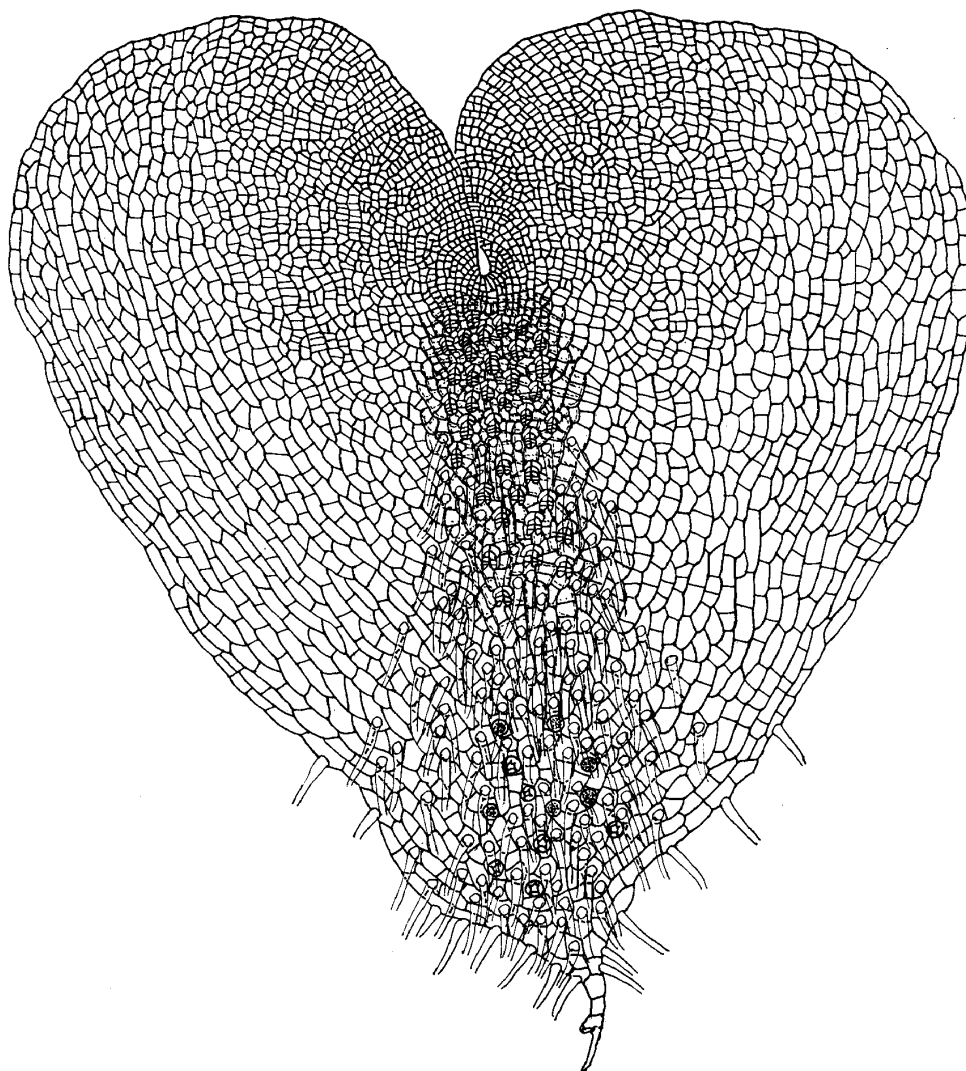


Fig. 53 *Bolbitis virens* (Wall. ex Hook. et Grev.) Schott.

convex, 2) the thallus is quite naked, 3) the neck of archegonia is thicker and larger, and neck cells in four tiers are less in number, and 4) antheridia are obovoid or capitate and the upper wall of the basal cell is strictly flat.

#### Dryopteridoideae

#### 33. *Acrophorus stipellatus* Moore.

Fig. 55

Prothallium bilateral, obdeltoid heart-shaped, slightly assurgent along the midrib; apex shallowly or less deeply rounded and steeply cordate, and inner sides of lobes funnel-like, opened above the bottom of sinus; lower part of the thallus cuneate, steeply or gradually narrowing towards the base. Protonema 2-3 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of the original cell. Wings equal in size, upwards to upper sidewise expanded, margins slightly undulate; wing cells isodiametric or

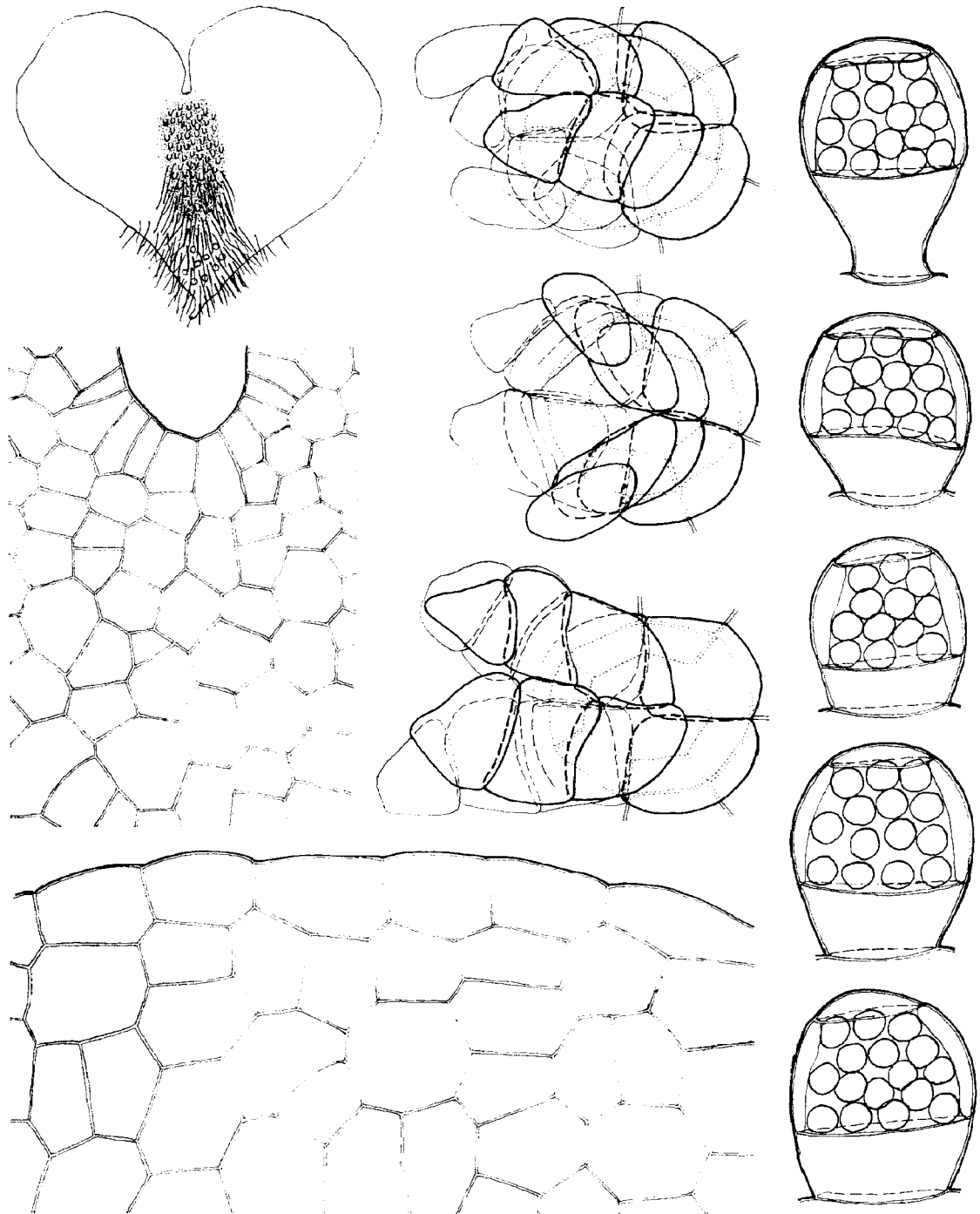


Fig. 54 *Bolbitis virens* (Wall. ex Hook. et Grev.) Schott.

elongate polygonal, side wall slightly curved; marginal cells arranged with minute intercellular notch, isodiametric and broad or elongate polygonal with convex free side. Midrib gutter-shaped, cushioned from the lower midway to near the apex; cushion elongate obdeltoid or elongate obovate, 4-5 cells thick in the heavier part. Trichomes less densely or sparsely on margins and sparsely on both surfaces of the thallus, unicellular, clavate, 50-65  $\mu$  in length, 20-25  $\mu$  in basal width and 17-20  $\mu$  in

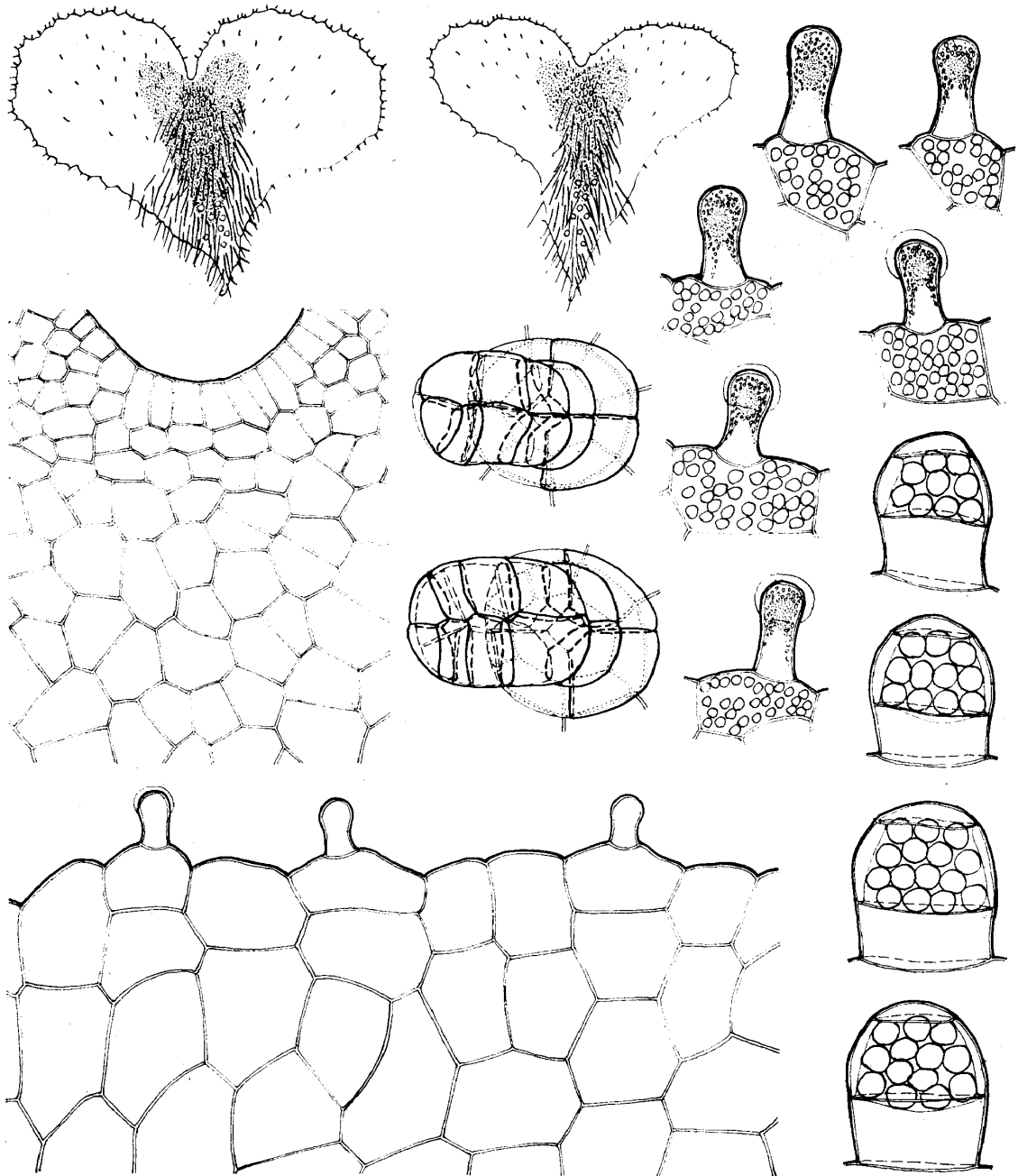


Fig. 55 *Acrophorus stipellatus* Moore.

mid-width, with nucleus in the upper part and rather minute chloroplasts; glandular, secretion covering the upper part, spherical, uniformly thickened, not so thick. Rhizoids on the lower part of thallus along the midrib to the middle of cushion and nested above archegonial group, almost hyaline. Archegonia on the distal median of cushion, rather many in number; neck small in size, bending towards posterior; neck cells in four tiers, 5-6 at the anterior and 3-4 at the posterior sides, and lowermost cells of each tier large and cushioning the neck. Anther-

idia on the lower part of thallus along the lower midrib, ellipsoid or obovoid, 60-75  $\mu$  in diameter; basal cell more or less shorter than ring cell, upper wall flat and sometimes concave below.

Material. Chiangmai: Doi Inthanon, 20 Dec. 1965.

The prothallium of the present material is identical in principle with that of the Yakushima plant (Momose, op. cit. 202) and of the Himalayan plant (unpublished). While in the Japanese plant, the apex of the thallus is more deeply cordate and the inner sides of lobes are usually approaching each other and closed above the bottom of sinus; and in the Himalayan plant, the size of the wing cells is comparatively smaller than that of others.

34. **Diacalpe aspidioides** Blume.

Figs. 56, 57

Prothallium bilateral, heart-shaped, conspicuously assurgent along the midrib; apex shallowly rounded and steeply cordate, and inner sides of lobes funnel-like, divergent above the bottom of sinus; lower part of the thallus rounded or cuneate, steeply narrowing towards the base. Protonema 2-4 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, upward or upper sidewise expanded,

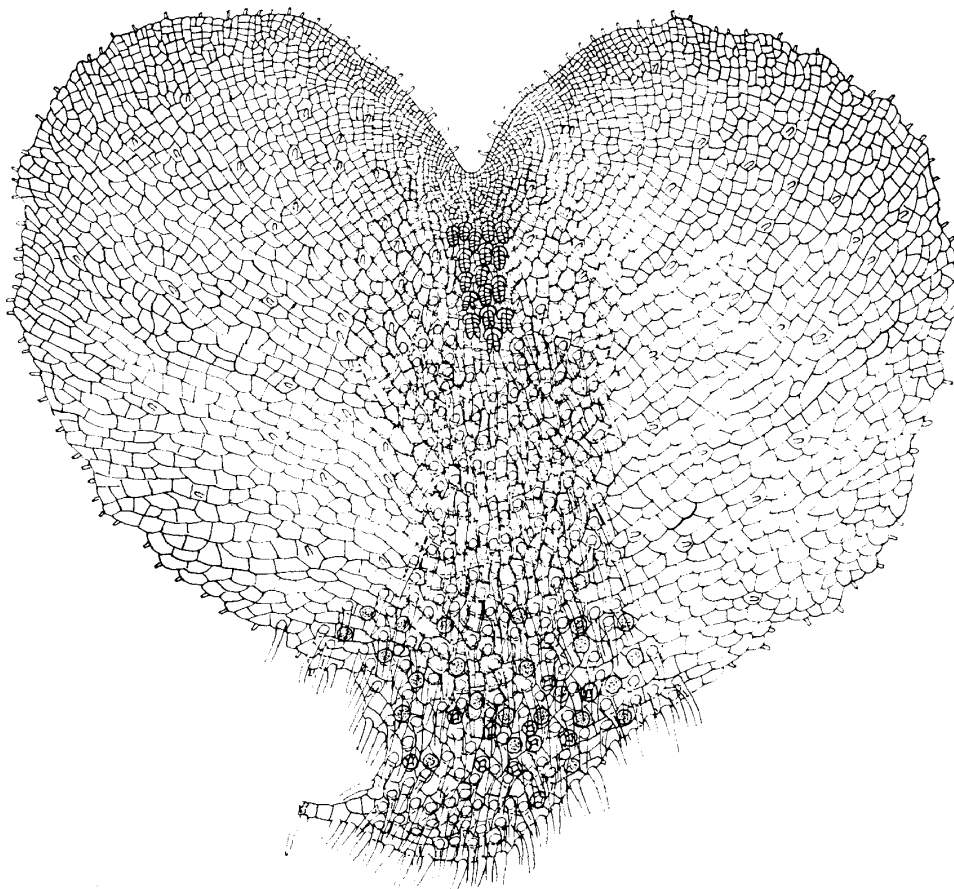


Fig. 56 *Diacalpe aspidioides* Blume.

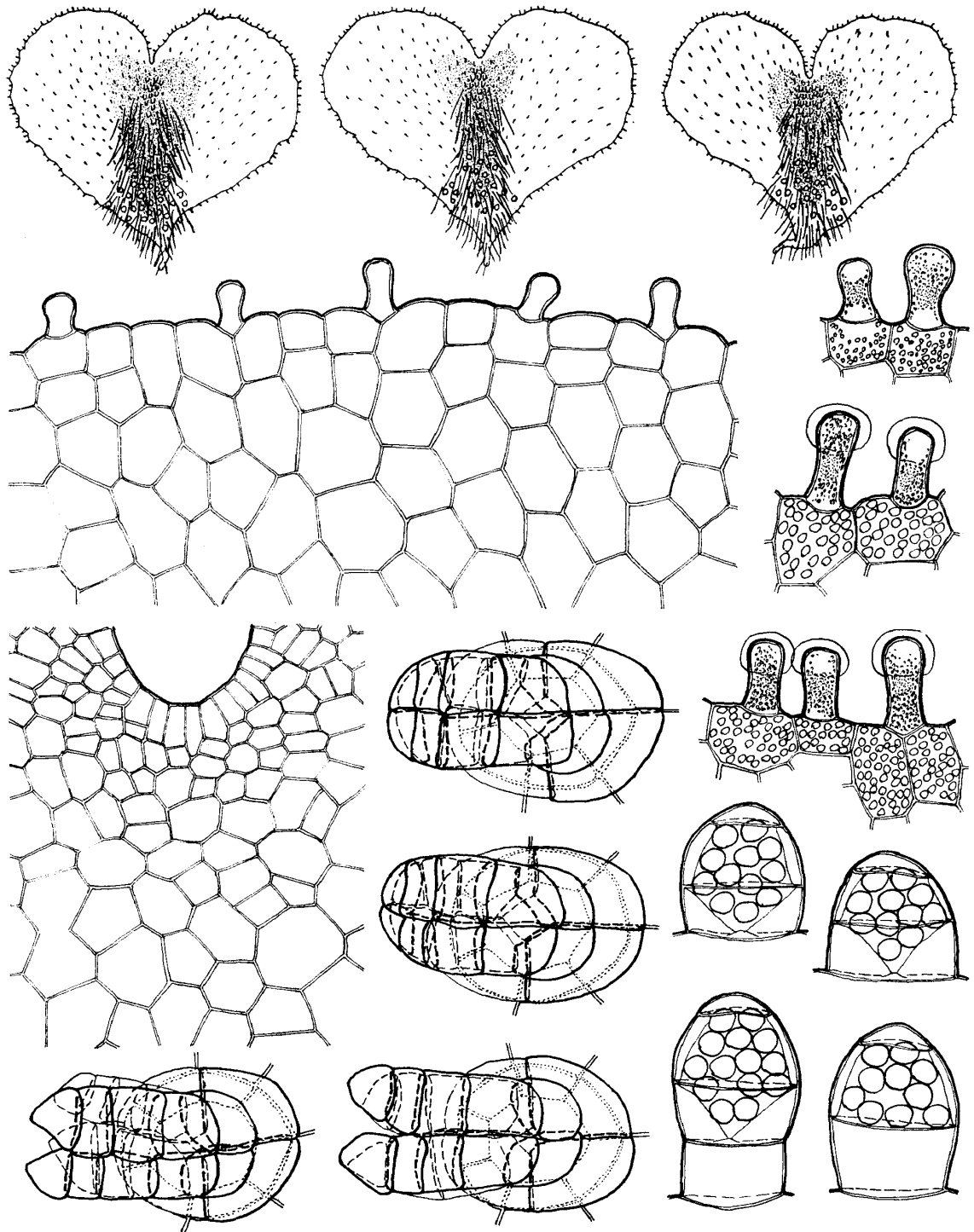


Fig. 57 *Diacalpe aspidioides* Blume.

margins slightly undulate; wing cells isodiametric polygonal; marginal cells arranged with minute intercellular notch, isodiametric polygonal with convex free side. Midrib conspicuously gutter-shaped, cushioned from the lower midway to near the apex; cushion elongate obovate or narrowed obdeltoid, 5-6 cells thick in

the heavier part. Trichomes densely on margins and sparsely on both surfaces of the thallus, unicellular, cylindrical or clavate, 35-57  $\mu$  in length, 20-22  $\mu$  in basal width and 15-20  $\mu$  in mid-width, with nucleus in the middle and numerous minute chloroplasts; glandular, secretion covering the upper part, almost spherical, uniformly thickened. Rhizoides on the lower part of thallus along the midrib to the middle of cushion and nested above archegonial group, light brown in colour. Archegonia on the distal median of cushion; neck rather small in size and slender, bending towards posterior; neck cells in four tiers, 6 at the anterior and 4-5 at the posterior sides, and lowermost cells of each tier large and cushioning the neck. Antheridia on the lower part of thallus along the midrib to the lower part of cushion and apart below the archegonial group, ellipsoidal, 65-70  $\mu$  in diameter; basal cell almost equal in height and with ring cell, upper wall funnel-like, immersed to the base or rarely flat; rarely born on a desk cell.

Material. Chiangmai: Doi Inthanon, 20 Dec. 1965. Loei: Phu Kradung, 28 Nov. 1965.

The prothallia of the above two materials are identical with each other and also with that of the Himalayan plant (unpublished). The above description and the figure are basing on the Doi Inthanon material.

35. *Didymochlaena truncatula* (Sw.) J. Smith.

Figs. 58~60

Prothallium bilateral, roundish heart-shaped, almost flat; apex shallowly or more or less deeply rounded and acutely cordate, and inner sides of lobes approaching and closed together above the bottom of sinus; lower part of the thallus more or less cuneate or rounded, steeply narrowing towards the base. Protonema 2-4 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, broadwise or upper sidewise expanded, margins slightly undulate; wing cells isodiametric polygonal with straight side wall; marginal cells smoothly arranged, isodiametric or broad polygonal with flat or slightly convex free side. Midrib slightly concave, cushioned from the lower midway to near the apex; cushion large in size, obovate, 4-5 cells thick in the heavier part. Peculiar multicellular hairs on upper margins near the apex, 2-3 cells long or abnormally unicellular, bending towards apex; each cells deformed cylindrical and irregularly tiered, lowermost cell sometimes branching a cell to the opposite side; protoplasmic contents of each cells sooner or later disappearing and replaced by amorphous, colourless or slightly tanned contents, or becoming empty. Rhizoides on the lower part of thallus spreading aside on lower margins, and along the midrib to the middle of cushion and nesting above the archegonial group, almost hyaline or brownish. Archegonia gregarious on the distal median of cushion; neck rather large and thick, bending

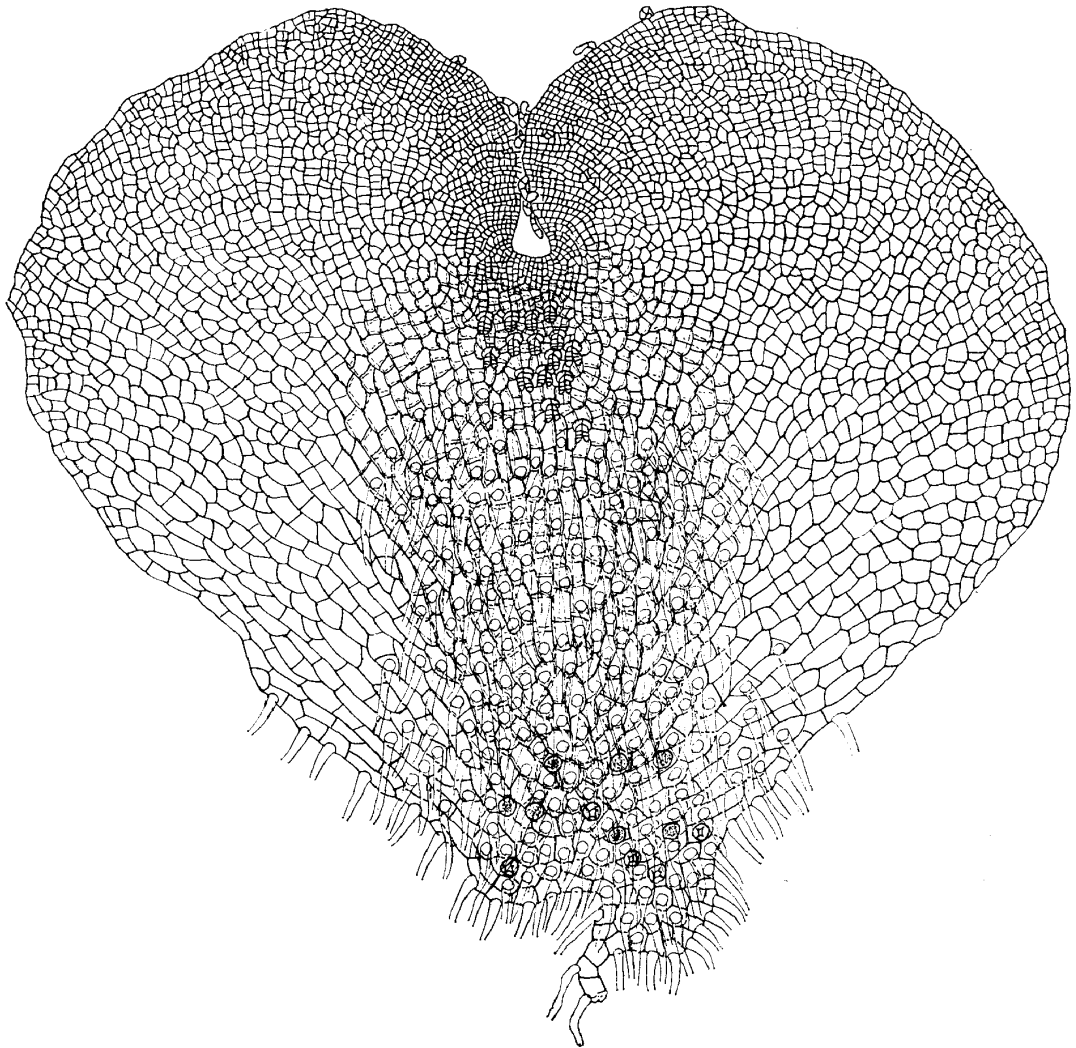


Fig. 58 *Didymochlaena truncatula* (Sw.) J. Smith.

towards posterior; neck cells in four tiers, 5-6 at the anterior and 4 at the posterior sides, rarely some cells longitudinally or obliquely divided into two, sometimes lowermost cell of each tier large and cushioning the neck. Antheridia on the basal part of thallus globoid or ellipsoid, 75-85  $\mu$  in diameter; basal cell more or less lower than ring cell, upper wall funnel-like, immersed to the base or sometimes flat; sometimes born on a desk cell.

Material. Nakawn Sritamarat: Khao Luang, 18 Jan. 1966. Chiangmai: northern slope of Doi Pacho, 27 Dec. 1965.

This species is regarded as the only species representing the genus. Although the plants are polymorphic by localities and a number of local forms or species may be recognized, Holttum mentioned (in *Ferns of Malaya* 483, 1954) that the Malayan plants of *Didymochlaena* were all very uniform, and certainly represented only one species.



The prothallia obtained from the above two materials were quite identical with each other. Then the description and the figures were taken from the Khao Luang material. Basing on the present materials, the prothallium of this species may be characterized as follows: 1) the thallus is roundish or paniculate heart-shaped, and almost flat, 2) the apex of the thallus is shallowly cordate with a wide bottom of the sinus, 3) the marginal cells of the wings are almost smoothly arranged and their free side is almost flat, 4) the cushion is particularly large in size, but thin, only 4-5 cells thick in the heavier part, 5) the rhizoids grow on the lower

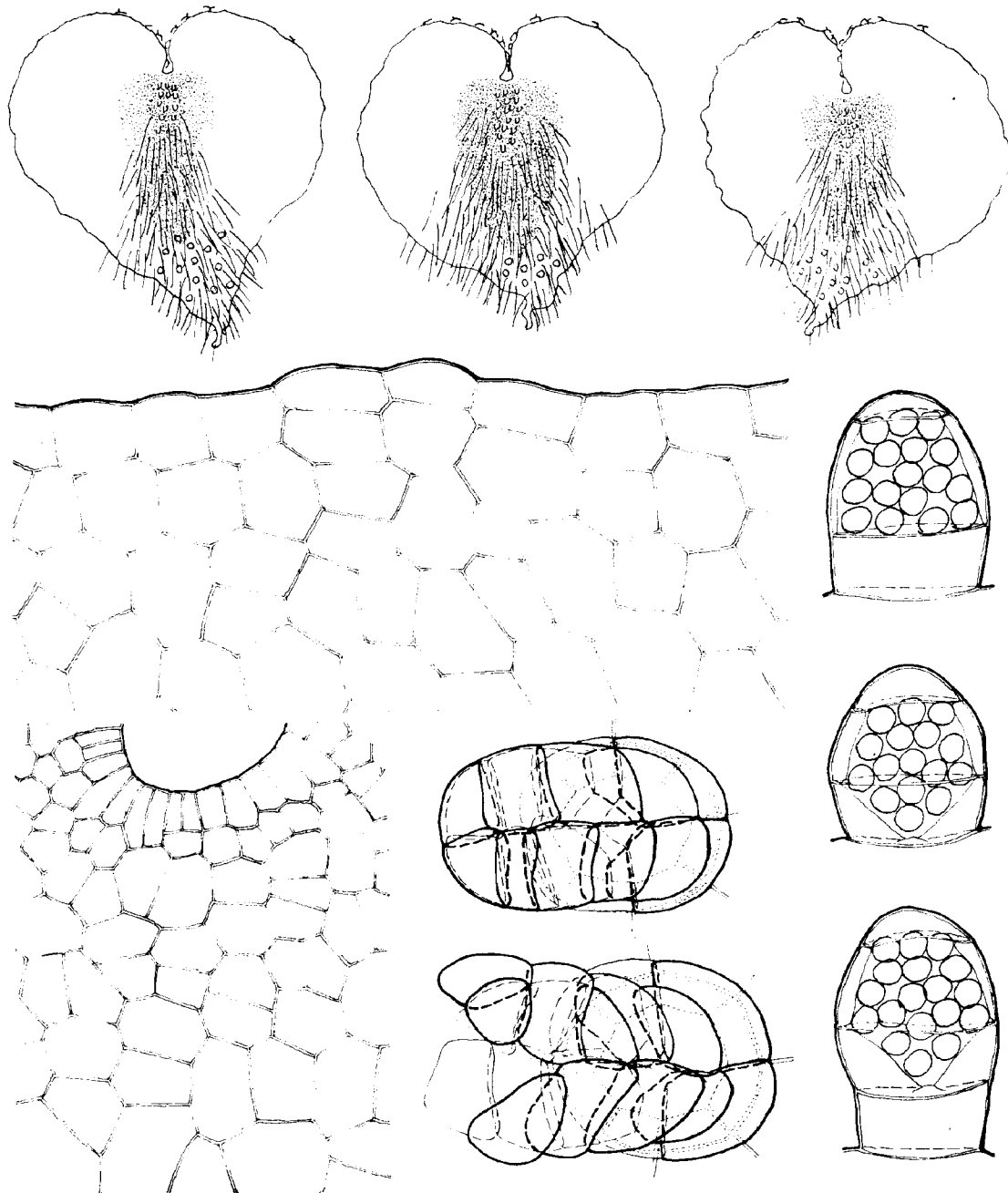


Fig. 59 *Didymochlaena truncatula* (Sw.) J. Smith.

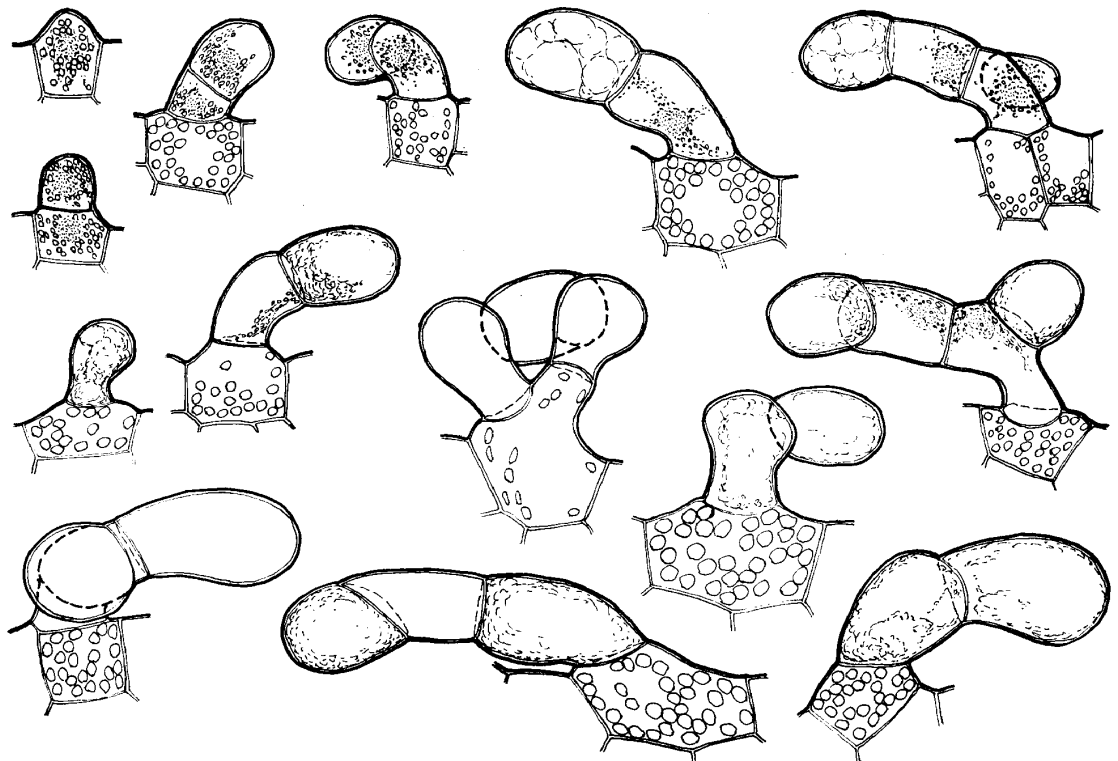


Fig. 60 *Didymochlaena truncatula* (Sw.) J. Smith.

part of thallus spreading aside along the lower part of margins and along the midrib to the middle of cushion, 6) the peculiar multicellular hairs are present on the upper margins near the apex.

As regards the prothallia of *Didymochlaena*, A.G. Stokey and L.R. Atkinson (Phytomorph. 4: 310. 1954) have presented a detailed account of the naked thallus of *D. sinuata* Desv. Their spores from which they made their cultures were collected from a cultivated plant at Jardin Botanique de l'Etat, Brussels (original locality of the plant unknown). I have also confirmed the naked thallus of *D. truncatula* based on a cultivation of the spores sent from Botanischer Garten der München-Nymphenburg (original locality of the plant unknown). This prothallium of my own is well like that of their *D. sinuata*. According to Copeland (Genera Filicum 113. 1947), *D. sinuata* is not regarded as distinct from *D. truncatula*. Accordingly the prothallia devoid of hairs of any type in all stages may be common in the cultivated plants of *Didymochlaena* in Europe. The presence of hairs and their types are considered to indicate the biosystematic relationship of the species or the genera, and much more intensive studies on the plants from various localities are needed. The prothallium of *D. truncatula*, so far as concerned with the Thai plants, is distinct from those of the cultivated plants in Europe in having peculiar multicellular hairs on the upper margins near the apex of thallus. It is a noteworthy fact that a similar type of hairs is found in some species of *Bolbitis*: *B.*

*quoyana* (A.G. Stokey, Amer. Fern J. 50: 78. 1960), *B. subcordata* (Momose, op. cit. 510) and *B. sinensis*. Furthermore, hairs of these species are restricted to the upper margins near the apex of thallus as in *Didymochlanna*.

36. *Dryopteris cochleata* (Kunze) C. Chr.

Figs. 61, 62

Prothallium bilateral, heart-shaped, assurgent along the midrib; apex deeply rounded and acutely cordate, and inner sides of lobes funnel-like, opened above the bottom of sinus; lower part of the thallus cuneate, steeply narrowing towards the base. Protonema 2-5 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoids inserted at the lower side of the original cell. Wings equal in size, upper sidewise expanded; margins denticulate or fimbriate by projection of trichome bearing cell or cells; wing cells elongate or isodiametric polygonal; marginal cells arranged with minute intercellular notch or almost

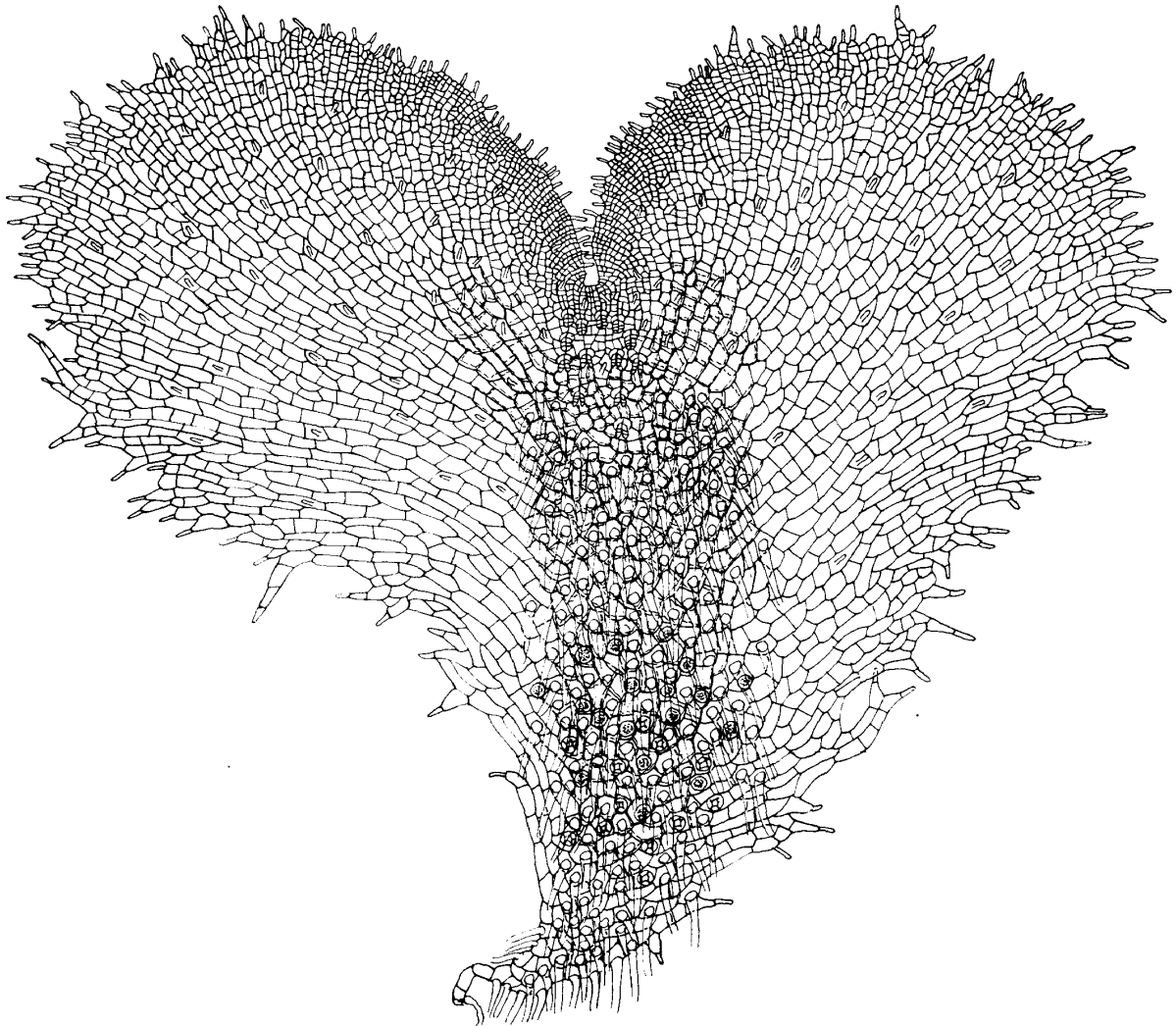


Fig. 61 *Dryopteris cochleata* (Kunze) C. Chr.

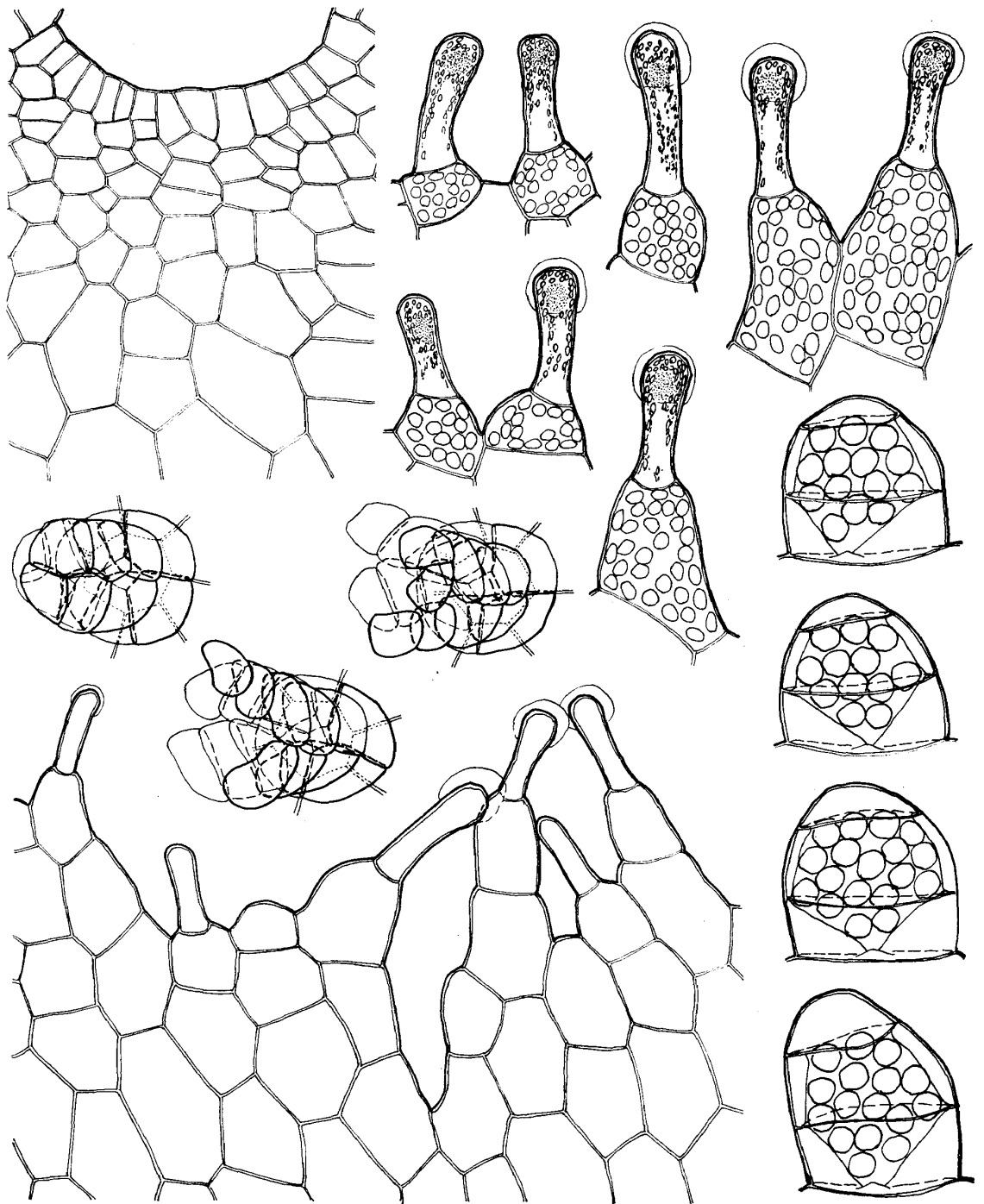


Fig. 62 *Dryopteris cochleata* (Kunze) C. Chr.

smoothly, various shaped by their condition, with convex or almost flat free side. Midrib conspicuously gutter-shaped, cushioned from the lower midway to near the apex; cushion elongate obovate, 5-6 cells thick in the heavier part. Trichomes densely on margins and sparsely on both surfaces of the thallus, unicellular, clavate, 60-90  $\mu$  in length, 22-25  $\mu$  in basal width and 15-20  $\mu$  in mid-width, with a

nucleus in the top and small chloroplasts; glandular, secretion completely covering the top, spherical, uniformly thickened. Rhizoids along the midrib from the base of thallus to the upper part of midrib, not mixed with archegonia, brownish in colour. Archegonia gregarious on the distal median of cushion; neck small and short, verruciform, bending towards posterior; neck cells in four tiers, 4-5, rarely 6, at the anterior and 3-4 at the posterior sides, and lowermost cells in each tier large and cushioning the neck. Antheridia on the lower part of thallus globoid or rarely ellipsoid, 85-90  $\mu$  in diameter; basal cell equal in height and width with ring cell, upper wall funnel-like, immersed to the base; cap cell rotundate or round-angular.

Material. Chiangmai: Ban Yang, at middle elevation of Doi Inthanon, 16 Dec. 1965; Doi Chiangdao, 3 Jan. 1966.

The prothallium of this species is distinct from those of other members of *Dryopteris* in having fimbriate margins of the thallus and small sized neck of the archegonia. Although the marginal cells bearing hairs project out of the margin of wings in *Dryopteris* generally, this feature is particularly stressed in this species.

#### Tectarioideae

##### 37. *Heterogonium gurupahense* (C. Chr.) Holtt.

Figs. 63, 64

Prothallium bilateral, obovate, oblong-obovate or spatulate, slightly assurgent along the midrib and more or less ruffled; apex widely and gently emarginate; lower part of the thallus gently narrowing towards the base. Protonema 3-6 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, margins undulate; wing cells isodiametric or elongate polygonal, with straight side wall; marginal cells arranged with minute intercellular notch, isodiametric or elongate polygonal, with concave free side. Midrib slightly gutter-shaped, cushioned from the lower part to near the apex; cushion belt-shaped, long and narrow, 4-5 cells thick in the heavier part. Trichomes sparsely on margins and both surfaces of the thallus, unicellular, cylindrical, 45-67  $\mu$  in length and 23-30  $\mu$  in basal width, with a nucleus in the middle and small chloroplasts; glandular, secretion capping the top, thickened upside. Some multicellular branched hairs also on both surfaces near the apex and a few on upper margins; trunk ceratoid, curved towards apex, 2-4 cells long, with nucleus and some small chloroplasts within granular contents; terminal cell conical, conical ovoid or conical oblong, sometimes also with a few oil drops; lowermost cell or cells branching a trichome-like cell to the opposite side, branched cell narrower than ordinal trichomes and gloriously capped with secretion, rarely 2 cells long. Rhizoids on the lower part of thallus and along the midrib

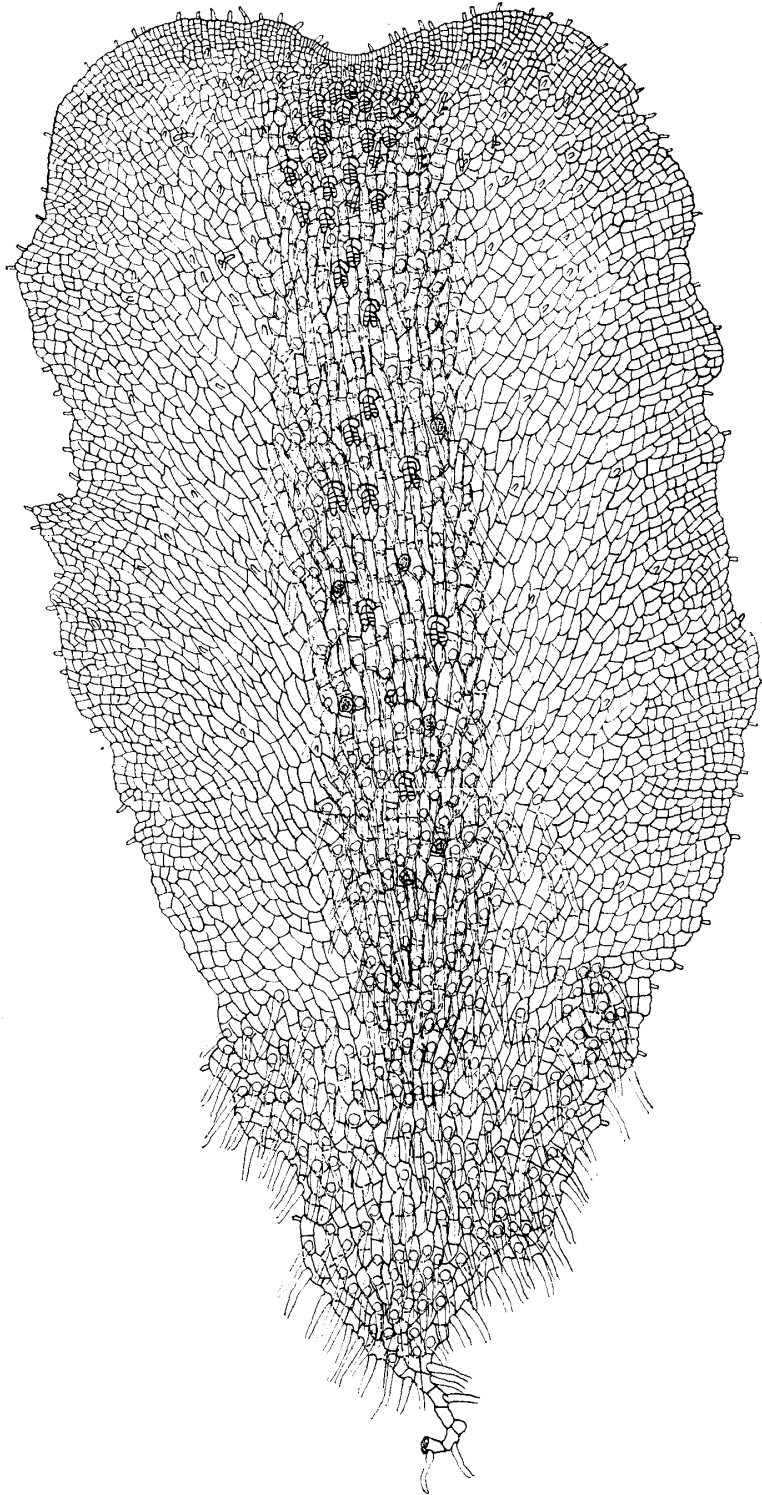


Fig. 63 *Heterogonium gurupahense* (C. Chr.) Holtt.

to the upper part of cushion, light brown in colour. Archegonia scattered on the midrib from the lower part to the distal; neck rather small in size, curved towards posterior; neck cells in four tiers, 5 at the anterior and 3-4 at the posterior sides,

lowermost cells of each tier large and cushioning the neck, rarely neck cells in irregular tiers and the neck massive. Antheridia scattered on the midrib, mixed with archegonia, globoid, 65-75  $\mu$  in diameter; basal cell lower than ring cell, upper wall funnel-like, immersed to the base.

Material: Nakawn Sritamarat: eastern slope of Khao Luang, 17 Jan. 1966.

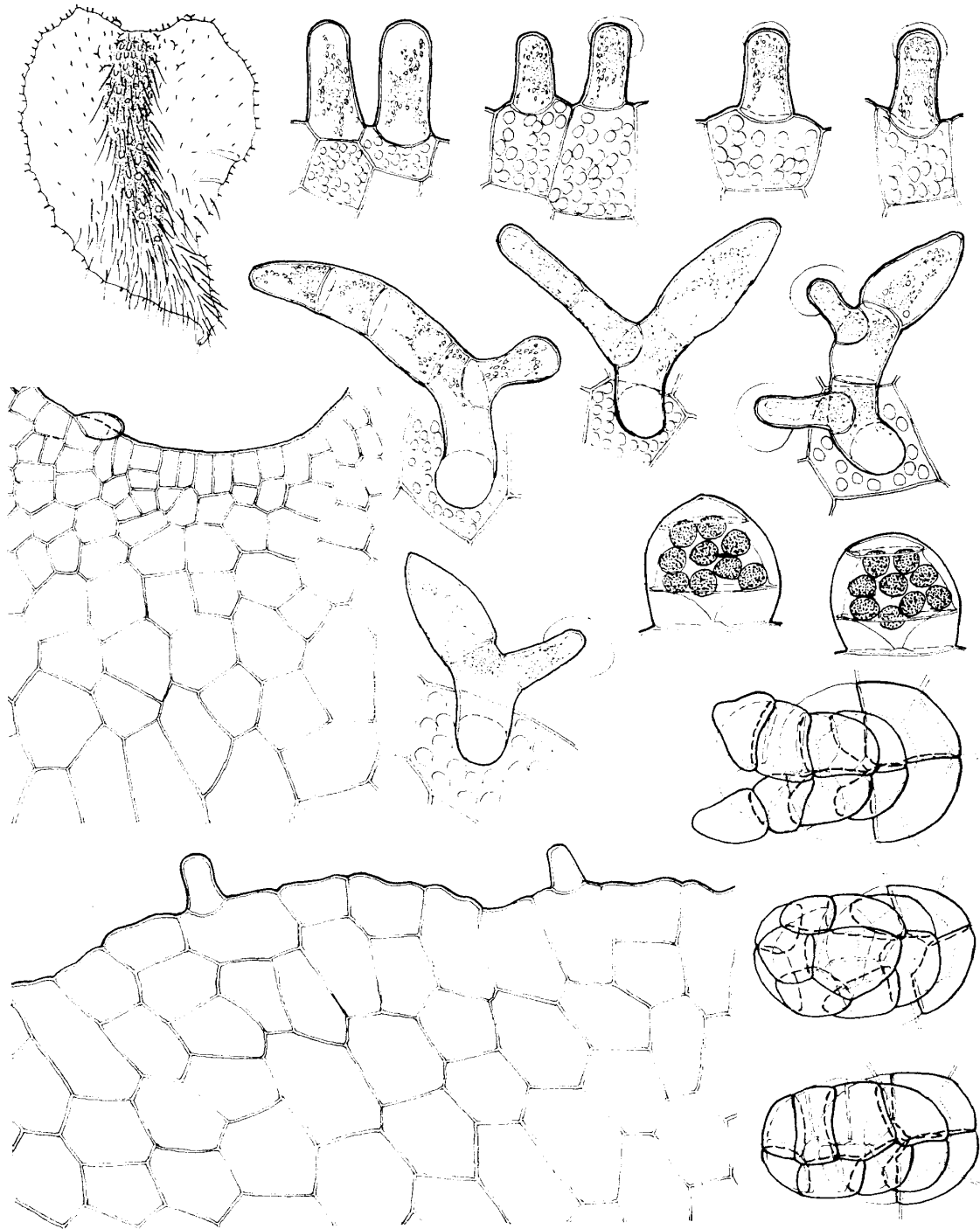
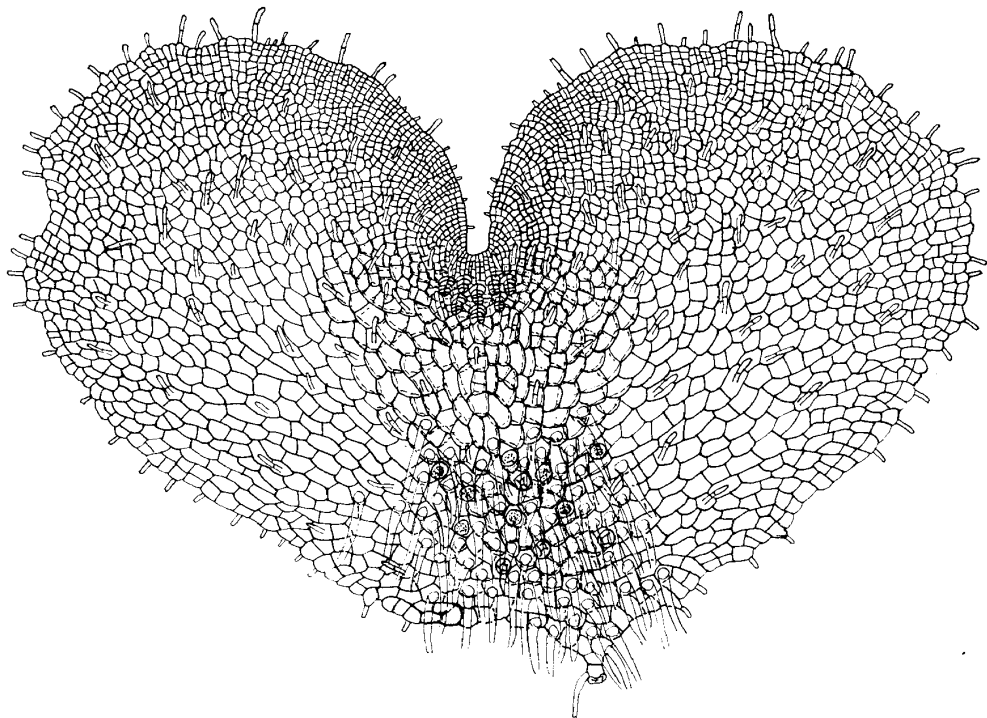


Fig 64 *Heterogonium gurupahense* (C. Chr.) Holtt.

38. *Arcypteris irregularis* (Presl) Ching.

Figs. 65~67

Prothallium bilateral, broad heart-shaped, assurgent along the midrib; apex deeply or less deeply rounded and acutely cordate, and inner sides of lobes funnel-like, opened above the bottom of sinus; lower part of the thallus rounded or sometimes cuneate, acutely or steeply narrowing towards the base. Protonema 2-3 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, upper sidewise or broadwise expanded, margins slightly undulate; wing cells isodiametric or somewhat elongate polygonal with almost straight side wall; marginal cells arranged with minute intercellular notch, isodiametric, elongate or broad polygonal with convex or slightly concave free side. Midrib somewhat gutter-shaped, cushioned from the lower midway to near the apex; cushion obovate or broad obovate, 4-6 cells thick in the heavier part. Three types of trichomes or hairs sparsely on margins and on both surfaces of the thallus. Ordinary trichomes unicellular, cylindrical with clubbed head, 90-135  $\mu$  in length, 23-30  $\mu$  in basal width and 17-20  $\mu$  in mid-width, with a nucleus in the clubbed head small chloroplasts; glandular, secretion capped upon the clubbed head, thickened upside. Multicellular hairs a few on upper margins and many on both surfaces of the thallus, mostly two cells long, trichome-like, cylindrical, uppermost cell glandular, sometimes with secretion capped on clubbed head. Peculiar glandular hairs also on upper margins and on

Fig. 65 *Arcypteris irregularis* (Presl) Ching.



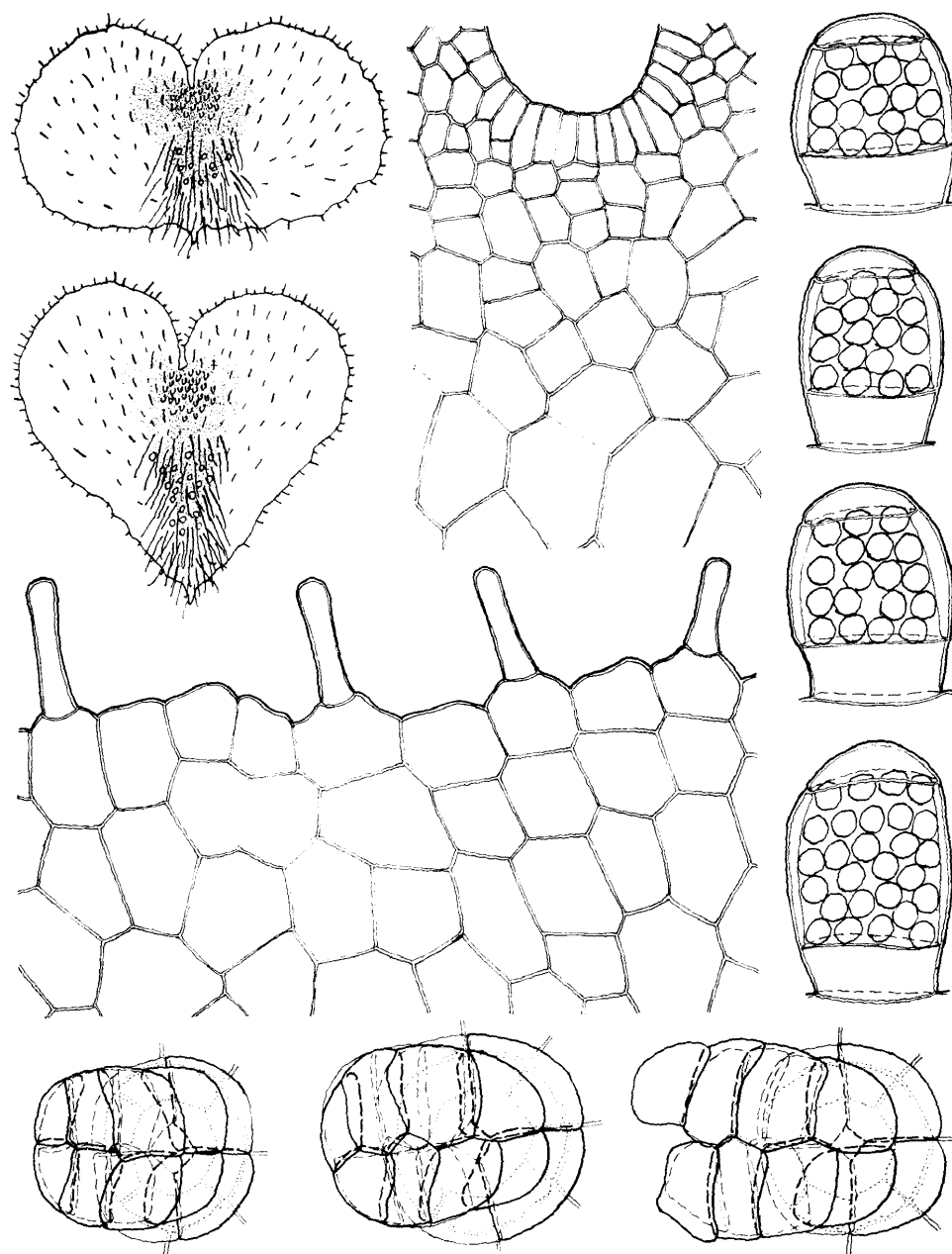


Fig. 66 *Arcypteris irregularis* (Presl) Ching.

both surfaces of the upper part of thallus, unicellular, cylindrical, with nucleus in the middle and minute chloroplasts dispersed throughout in the cell, and almost whole body uniformly covered with golden yellow secretion. Rhizoids on the lower part of thallus along the midrib to the lower part of cushion, light brown in colour. Archegonia gregarious on the distal median of cushion; neck rather large in size, thick and claviform, curved towards posterior; neck cells in four tiers, 5 at the

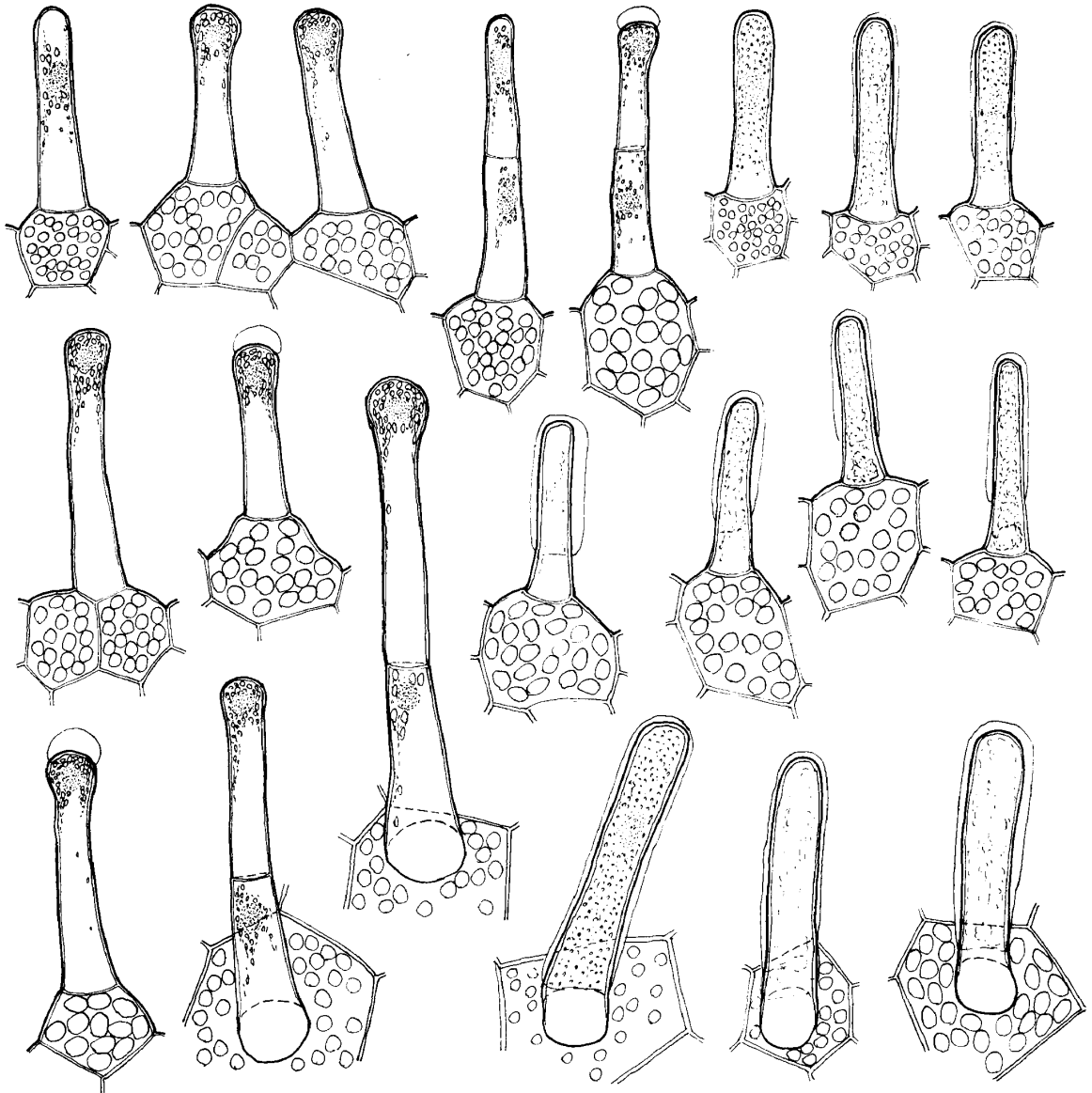


Fig. 67 *Arcypteris irregularis* (Presl) Ching.

anterior and 3-4 at the posterior sides; lowermost cells of each tier large and cushioning the neck. Antheridia on the lower part of cushion and apart below archeogonial group, globoid, ellipsoid, or obovoid, 75-90  $\mu$  in diameter; basal cell more or less narrower and conspicuously lower than ring cell, upper wall flat in general; ring cell barrel-shaped, and cap cell rounded above.

Material. Trang: Khao Chong, 29, 30 March 1965.

#### Athyrioideae

39. *Diplazium cordifolium* Blume.

Figs. 68, 69

Prothallium bilateral, elongate obdeltoid heart-shaped, somewhat ruffled, conspi-

cuously assurgent along the midrib and lower part of the thallus, so uplifted that the margins closed together; apex shallowly rounded and steeply cordate, and inner sides of lobes funnel-like, opened above the bottom of sinus; lower part of the thallus cuneate, gently narrowing towards the base. Protonema 2-4 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, upward to upper sidewise expanded, margins undulate; wing cells isodiametric, elongate or broad polygonal, collenchymatous with almost straight or slightly curved side wall; mar-

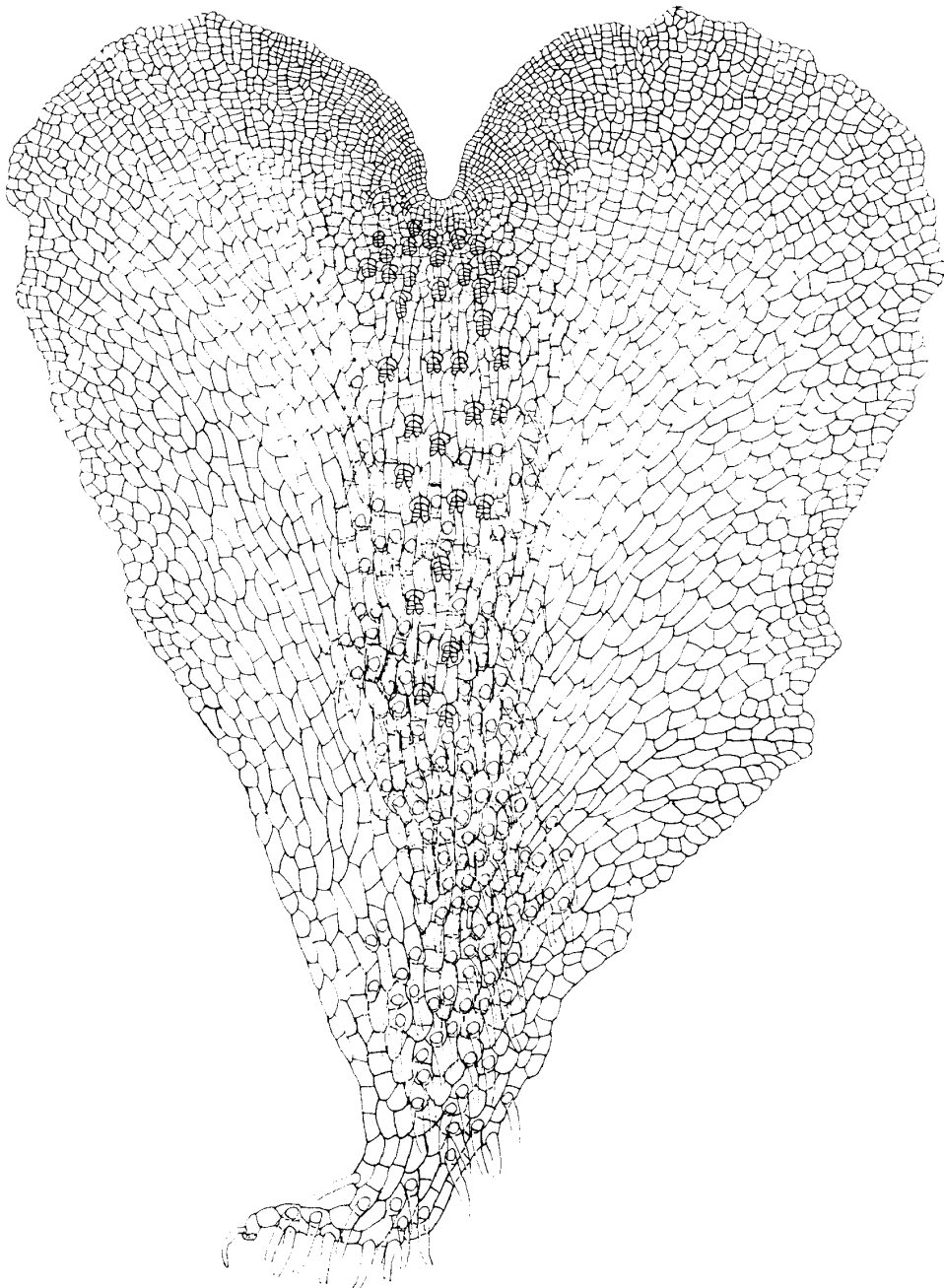


Fig. 68 *Diplazium cordifolium* Blume.

ginal cell arranged with minute intercellular notch, elongate and isodiametric or broad polygonal with slightly convex or concave free side, midrib conspicuously gutter-shaped, cushioned from the lower midway to near the apex; cushion oblong-ovate, long and narrow, 4-5 cells thick in the heavier part. Some peculiar multicellular hairs on both surfaces of near the apex, 2-7 cells long, bending towards apex;

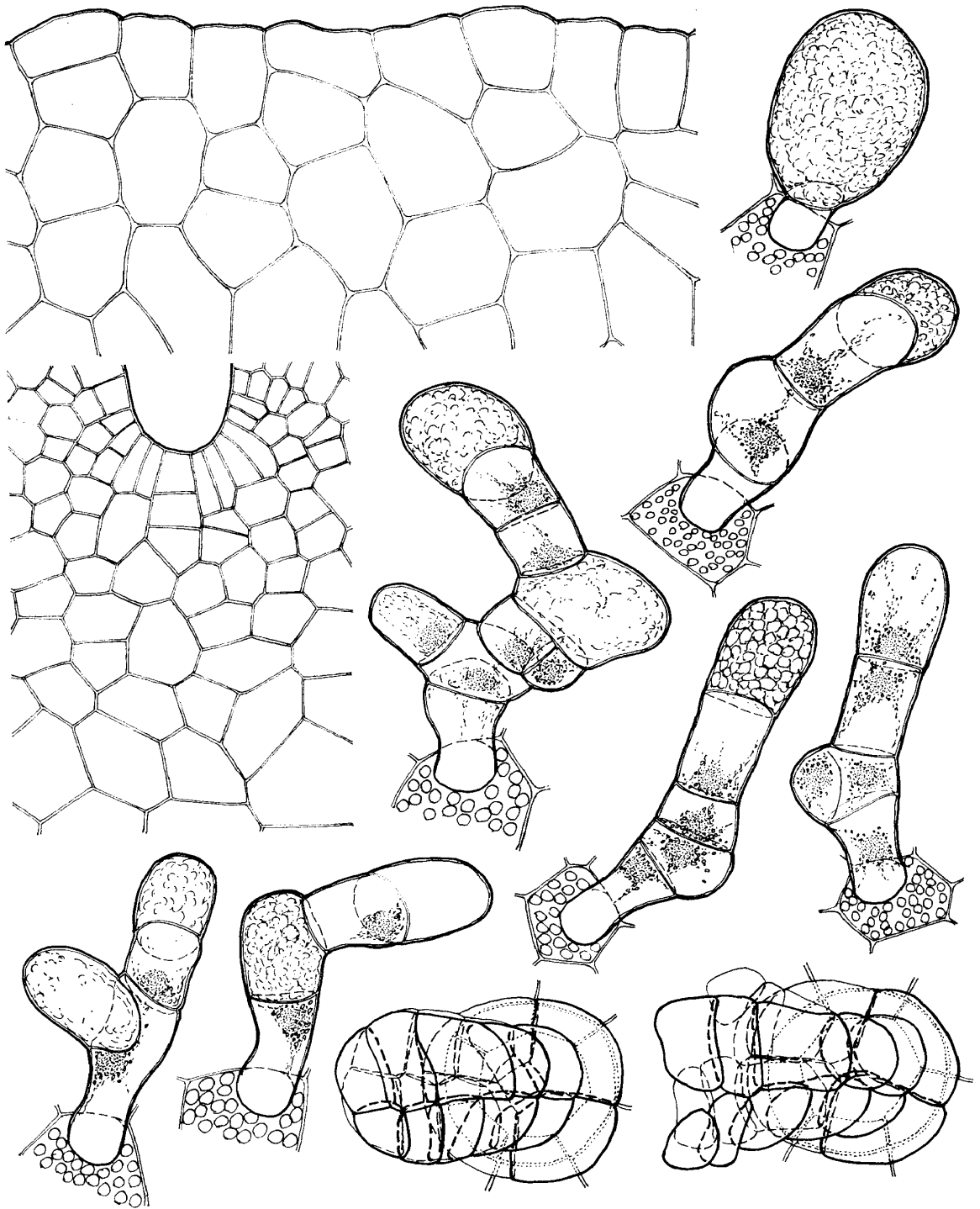


Fig. 69 *Diplazium cordifolium* Blume.

cells in tier various in form, lowermost cell broadening above, secondary cell always deformedly clubbed and often cut off a branch cell to the side, and terminal cell ellipsoid; protoplasmic contents of terminal cell, clubbed cell and branched cell sooner or later disappeared and replaced by granular or tubercular, colourless or slightly tanned contents, or becoming empty. Rhizoids along the midrib from the base of thallus to the upper part of cushion, light brown in colour. Archegonia along the median of cushion from the middle to the distal, rather many in number; neck claviform, bending towards posterior; neck in four tiers, 6 at the anterior and 4 at the posterior sides, lowermost cells of each tier large and cushioning the neck. Antheridia unknown.

Material. Nakawn Sritamarat: Khao Luang, 18 Jan. 1966.

Three packets of the spores were used for culture: one is of 'simple form' and the other two of 'pinnate form'; and somewhat poor cultures were obtained from the one of the simple form. In spite of my careful examination, the hermaphroditic or male thallus could not be found in the present culture.

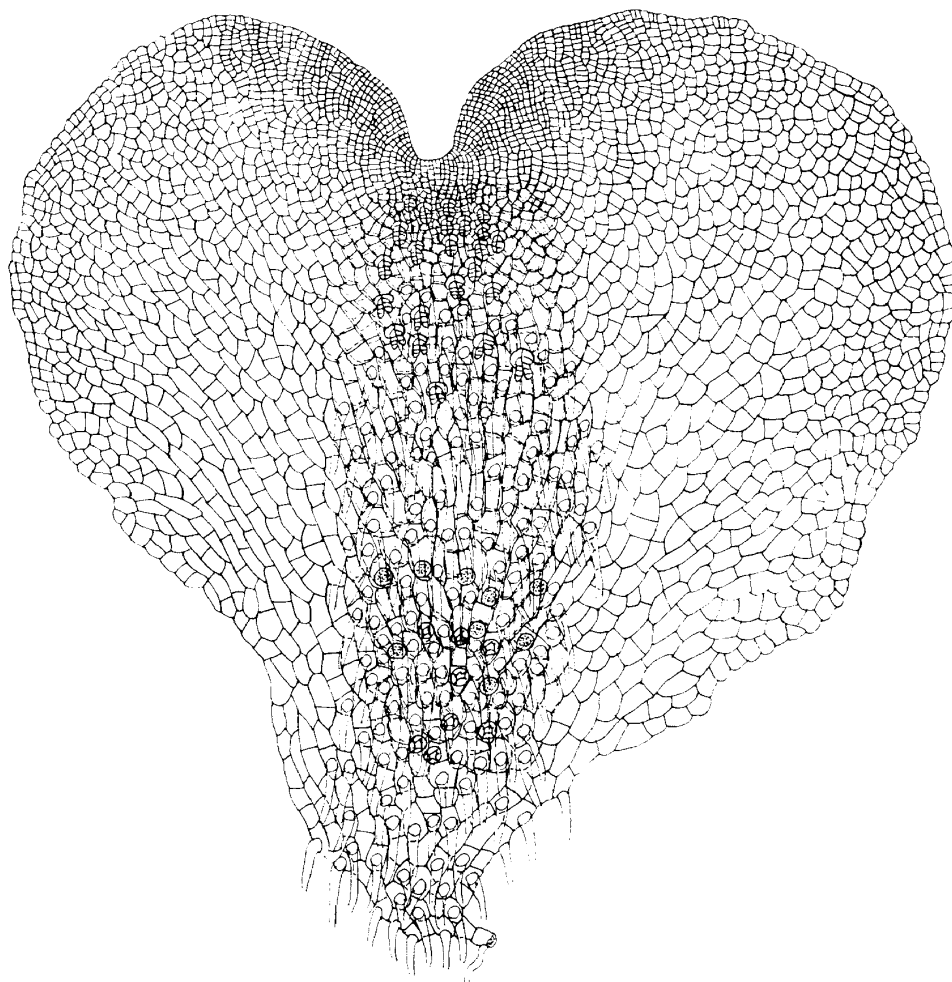


Fig. 70 *Diplazium tomentosum* Blume.

The prothallium of the present material is quite peculiar in having the collenchymatous wing cells and the peculiar multicellular hairs on both surfaces near the apex of thallus. These characters are not yet found within the species of *Diplazium* and allied genera. The presence of the peculiar type of the multicellular hairs on the thallus and the location of hairs restricted on both surfaces of near the apex of thallus are particularly noteworthy. I have found a somewhat similar type of multicellular hairs in *Bolbitis subcordata*, *B. sinensis*, *Didymochlaena*; while the location of hairs in these species is restricted on the upper margins of near the apex of thallus and not as in this species.

According to I. Manton (Holtt. Ferns of Malaya, appendix. 1954), the Malaya plants are very irregular in meiosis and the chromosome number counts  $2n = \text{over } 200$ ; and the plants could be pentaploid or hexaploid hybrids which in Malaya can perhaps reproduce apogamously. But I could not find any sign of apogamy in my cultures of the present materials. The prothallium of this species needs further study intensively on various forms and various localities.

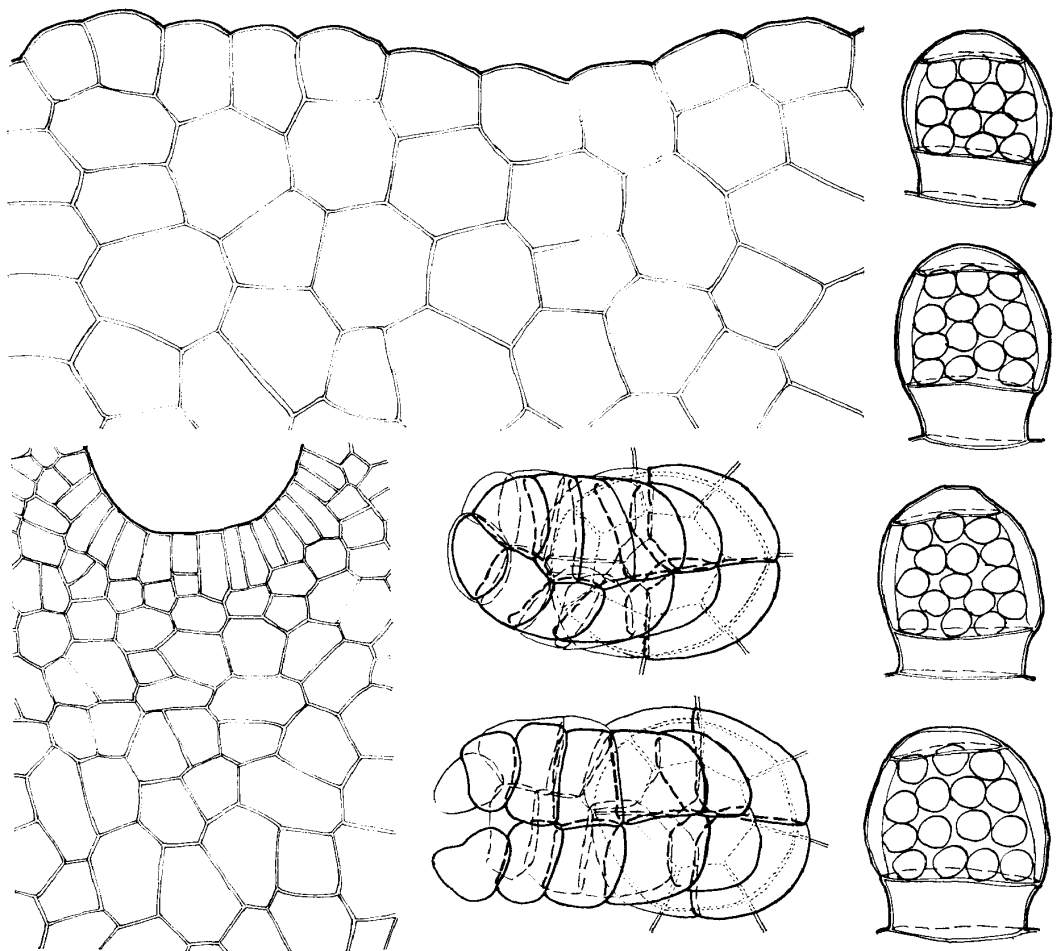


Fig. 71 *Diplazium tomentosum* Blume.

40. *Diplazium tomentosum* Blume.

Figs. 70, 71

Prothallium bilateral, heart-shaped, assurgent along the midrib; apex shallowly rounded and steeply cordate, and inner sides of lobes funnel-like, opened above the bottom of sinus; lower part of the thallus rounded or cuneate, steeply narrowing towards the base. Protonema 2-3 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, upper sidewise expanded, margins undulate; wing cells isodiametric polygonal with almost straight side wall; marginal cell arranged with minute intercellular notch, isodiametric polygonal and more or less smaller than wing cells with convex free side. Midrib gutter-shaped, cushioned from the lower midway to near the apex; cushion oblong or ovate-oblong, 5-6 cells thick in the heavier part. Rhizoids along the midrib from the base of thallus to the upper part of the midrib, almost hyaline or brownish. Archegonia gregarious on the upper median of cushion; neck medium sized, rather long and tapered, bending towards posterior; neck cells in four tiers, 6-7 at the anterior and 4-5 at the posterior sides, lowermost cells in each tier large and cushioning the neck. Antheridia on the lower part of cushion and apart below from the archegonial group, capitate, 68-85  $\mu$  in diameter; basal cell narrower and conspicuously lower than ring cell, upper wall always flat.

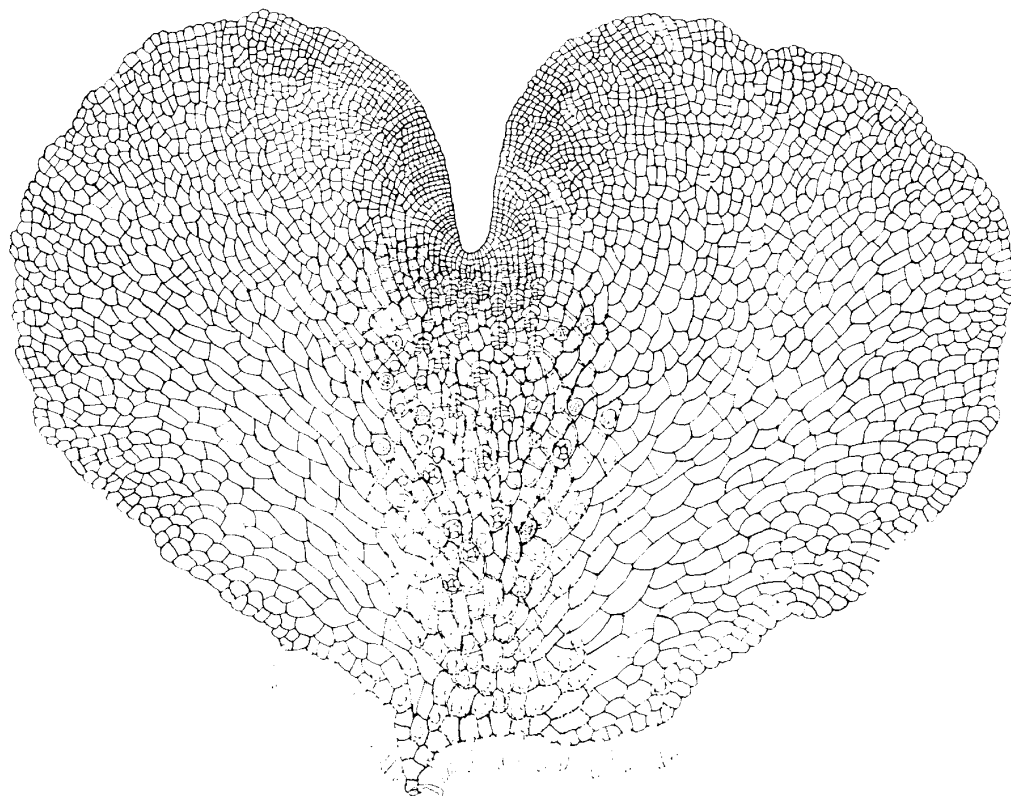


Fig. 72 *Diplazium polypodioides* Blume.

Material. Nakawn Sritamarat : Khao Luang, 20 Jan. 1966.

41. *Diplazium polypodioides* Blume.

Figs. 72, 73

Prothallium bilateral, heart-shaped, conspicuously assurgent along the midrib; apex more or less deeply rounded and steeply cordate, and inner sides of lobes opened above the bottom of sinus; lower part of the thallus rounded, steeply narrowing towards the base. Protonema 2-3 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, upper sidewise expanded, margins undulate; wing cells isodiametric or elongate polygonal, with straight side wall; marginal

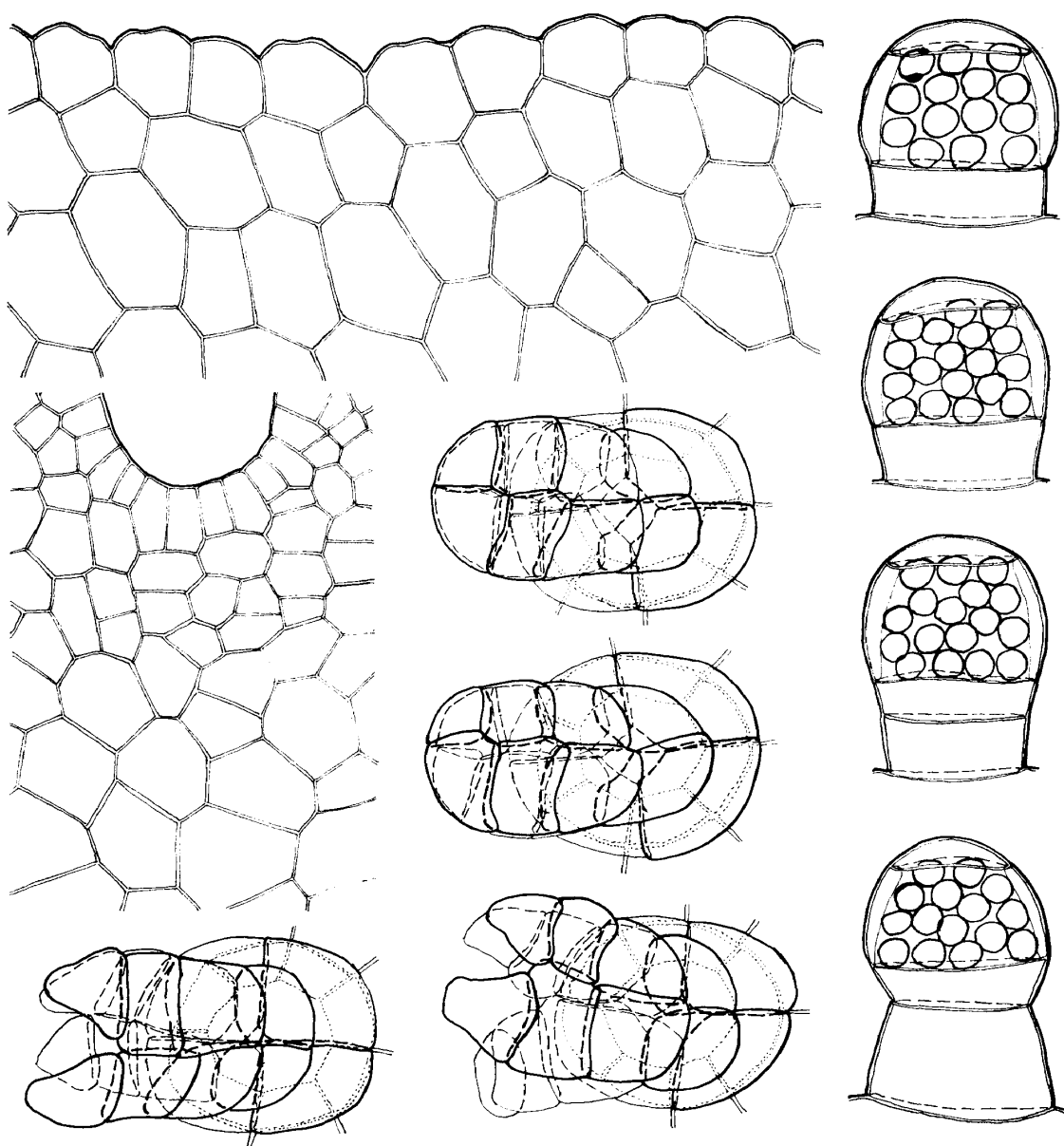


Fig. 73 *Diplazium polypodioides* Blume.



cells arranged with minute intercellular notch, isodiametric polygonal with undulately or smoothly convex free side. Midrib conspicuously gutter-shaped, cushioned from the lower midway to near the apex; cushion obovate, 5-6 cells thick in the heavier part, naked. Archegonia gregarious on the upper median of midrib; neck medium sized, slightly claviform, bending towards posterior; neck cells in four tiers, 5 at the anterior and 4 at the posterior sides, lowermost cell in each tier large and cushioning the neck. Antheridia on almost all over the cushion and mixed with archegonia, capitate, obovoid or globoid, 85-90  $\mu$  in diameter; basal cell conspicuously lower and more or less narrower than ring cell, upper wall flat; ring cell barrel-shaped and covered with rounded cap cell; often born on a desk cell.

Material. Chiangmai: Mae Klang water-fall, north of Chom Thong, 22 March 1965.

The prothallium of the present material is distinct from that of *D. tomentosum* in having 1) the apex of thallus more or less deeply cordate, 2) the neck of archegonia consisting of less numbered neck cells, and 3) the antheridia born on almost

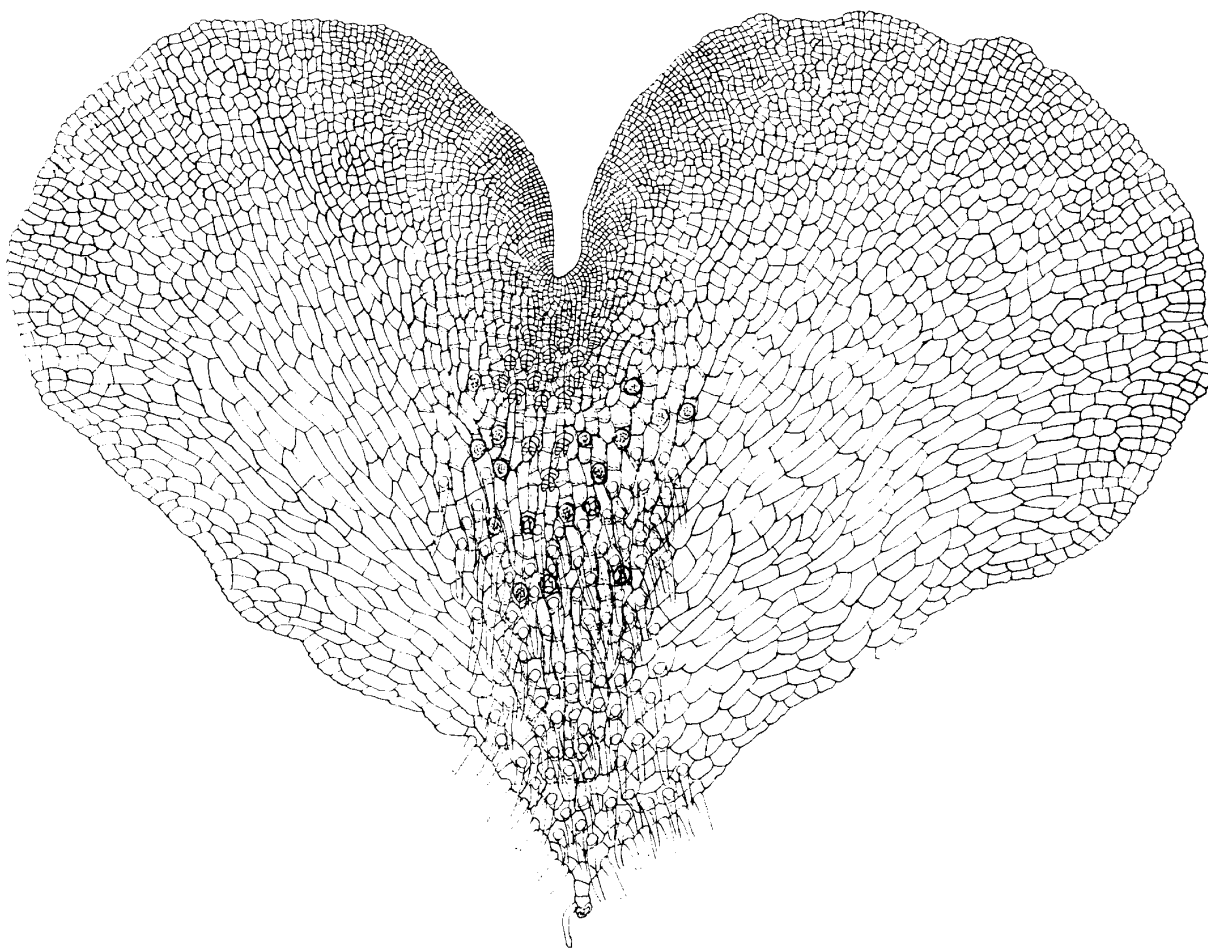


Fig. 74 *Diplazium simplicivenium* Holtt.

all over the cushion and associated with archegonia.

42. *Diplazium simplicivenium* Holtt.

Figs. 74, 75

Prothallium bilateral, rather broad heart-shaped, slightly assurgent along the midrib; apex deeply rounded and acutely cordate, and inner sides of lobes funnel-like, opened above the bottom of sinus; lower part of the thallus cuneate, steeply narrowing towards the base. Protonema 2-4 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, upper sidewise expanded, margins undulate; wing cells isodiametric or elongate polygonal, with slightly curved side wall; marginal cells arranged with minute intercellular notch, isodiametric or elongate polygonal, with concave free side. Midrib slightly gutter-shaped, cushioned from the lower midway to near the apex; cushion obovate, 4-6 cells thick in the heavier part. Rhizoids along the midrib from the base of thallus to the middle of cushion, almost hyaline. Archegonia gregarious, on the upper median of cushion; neck small in size, verruciform, bending towards posterior; neck cells in four tiers, 4-

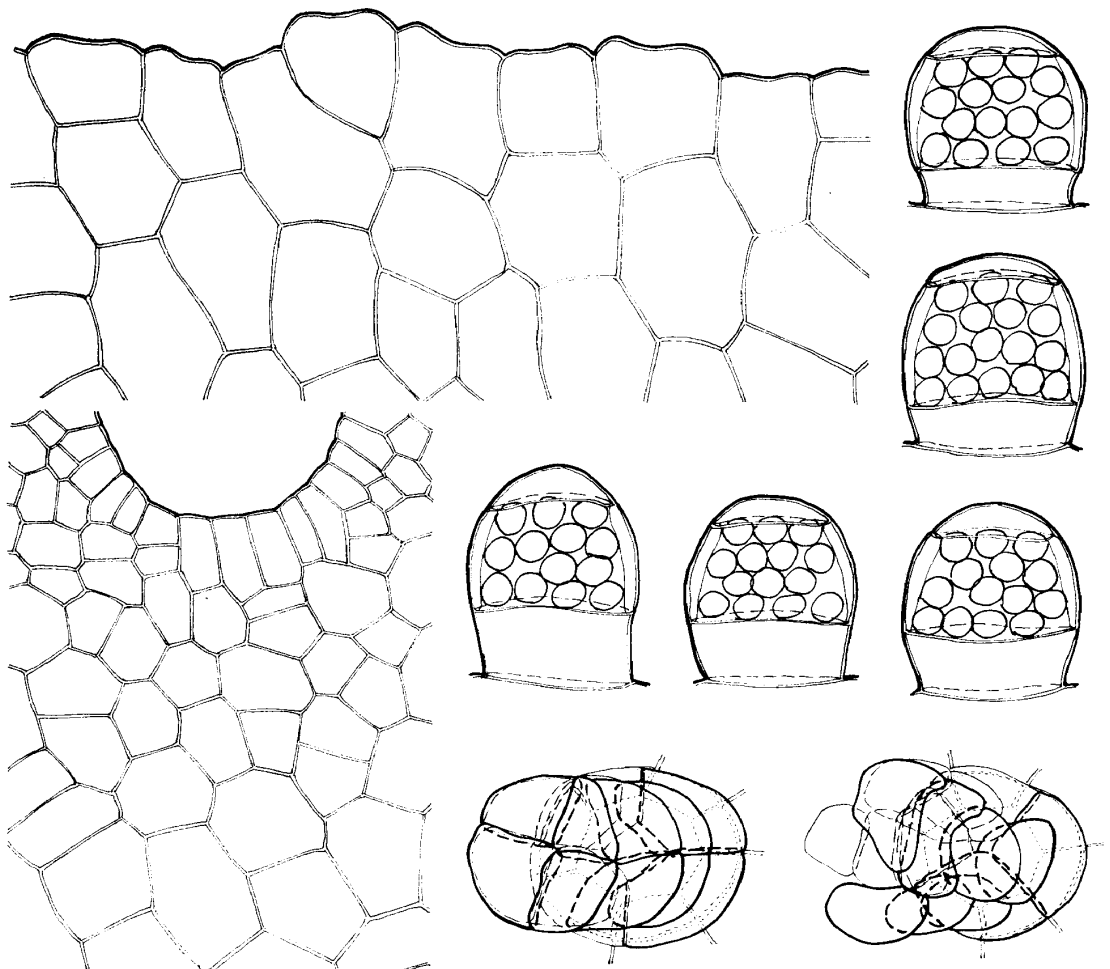


Fig. 75 *Diplazium simplicivenium* Holtt.

5 at the anterior and 3-4 at the posterior sides. Antheridia on the cushion from the lower to the upper middle, globose, obovoid or capitate, 75-85  $\mu$  in diameter; basal cells more or less narrower and conspicuously lower than ring cell, upper wall always flat.

Material. Trang: Khao Chong, 30 April 1965.

The prothallium of the present material is well like that of *D. polypodioides*, but is distinguishable from that in having the marginal cell of wings with concave free side and the archegonia with smaller neck.

43. *Hypodematium crenatum* (Forsk.) Kuhn.

Figs. 76~78

Prothallium bilateral, broad heart-shaped, conspicuously assurgent or recurved along the midrib and cushioned area widely concave below; apex shallowly, widely rounded and gently sinuate, and inner sides of lobes funnel-like, divergent above the bottom of sinus; lower part of the thallus cuneate, steeply narrowing towards the obliquely tailed base. Protonema 2-3 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings equal in size, upper sidewise or broadwise expanded, margins irregularly dentate and denticulate by projection of trichome bearing cell or cells; wing cells almost isodiametric, irregular, rounded-polygonal; marginal cells arranged with minute intercellular notch, isodiametric polygonal or irregular shaped

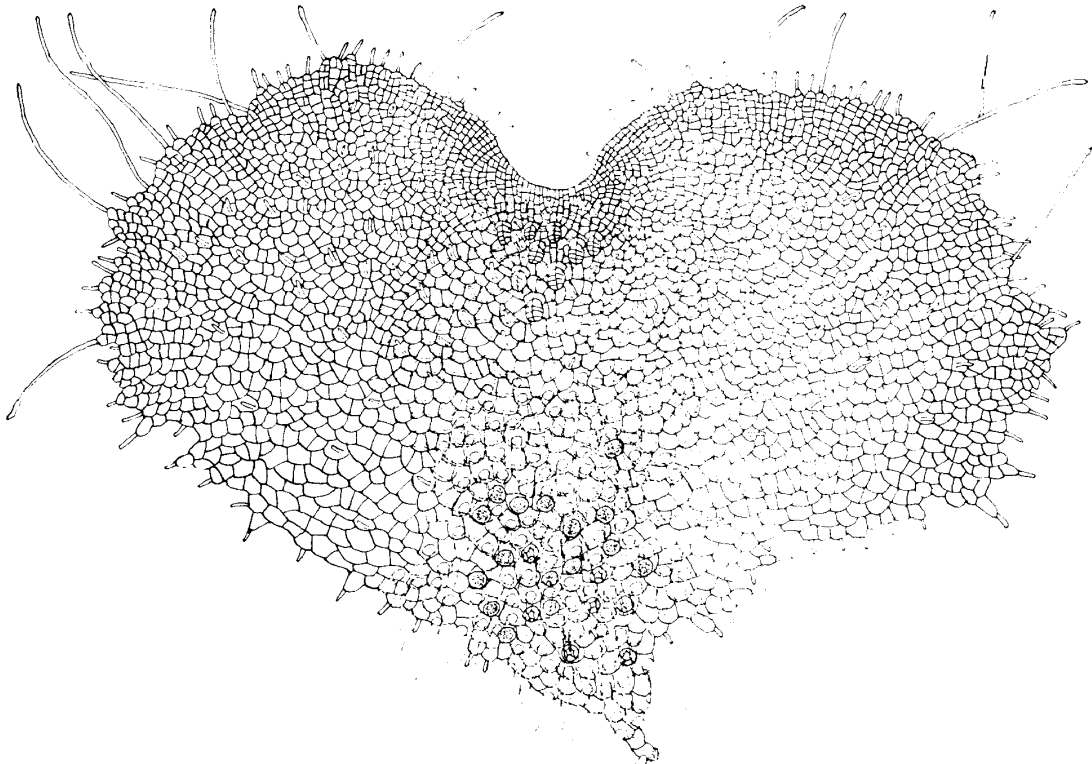


Fig. 76 *Hypodematium crenatum* (Forsk.) Kuhn.

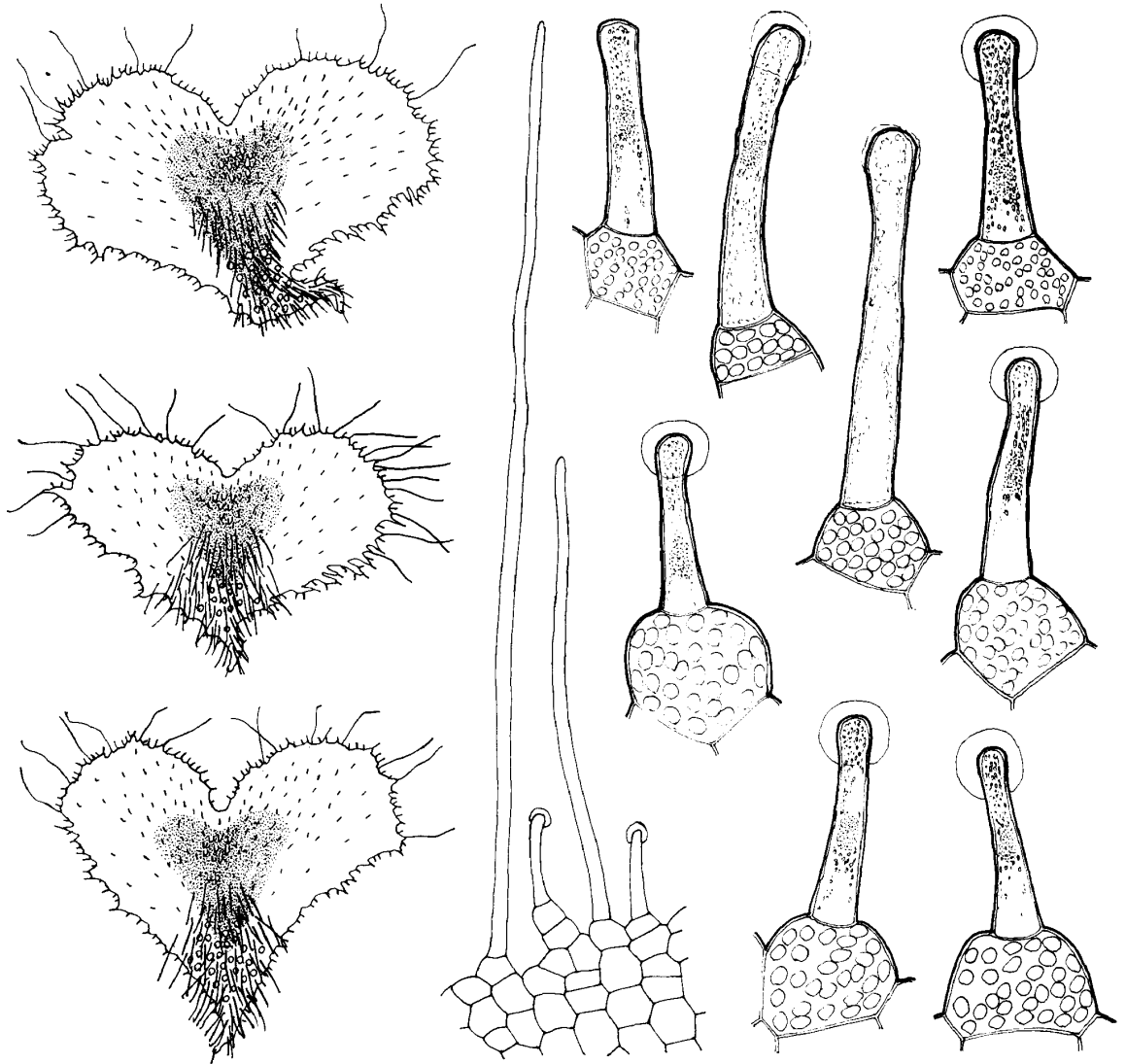


Fig. 77 *Hypodematium crenatum* (Forsk.) Kuhn

with convex free side. Midrib widely gutter-shaped or concave below, cushioned from the lower midway to near the apex, very large, obovate or obdeltoid-obovate, 4-5 cells thick in the heavier part. Trichomes densely on margins and sparsely on both surfaces of the thallus, unicellular, cylindrical and mostly tapered, 90-150, rarely 190  $\mu$  in length and 21-28  $\mu$  in basal width, with nucleus in the middle and rather minute chloroplasts; glandular, secretion gloriously covering the top, spherical, uniformly thickened. Some long hairs also on upper margins and rarely on dorsal surface, unicellular, flagelli-form, 680-1500  $\mu$  in length. Rhizoids on the lower part of thallus along the midrib to the middle of cushion, light brown in colour. Archegonia on the distal median of cushion, some in number; neck rather large in size, slender, bending towards posterior; neck cells in four tiers, 6 at the anterior and 4 at the posterior sides, lowermost cells of each tier large and cushioning the neck.

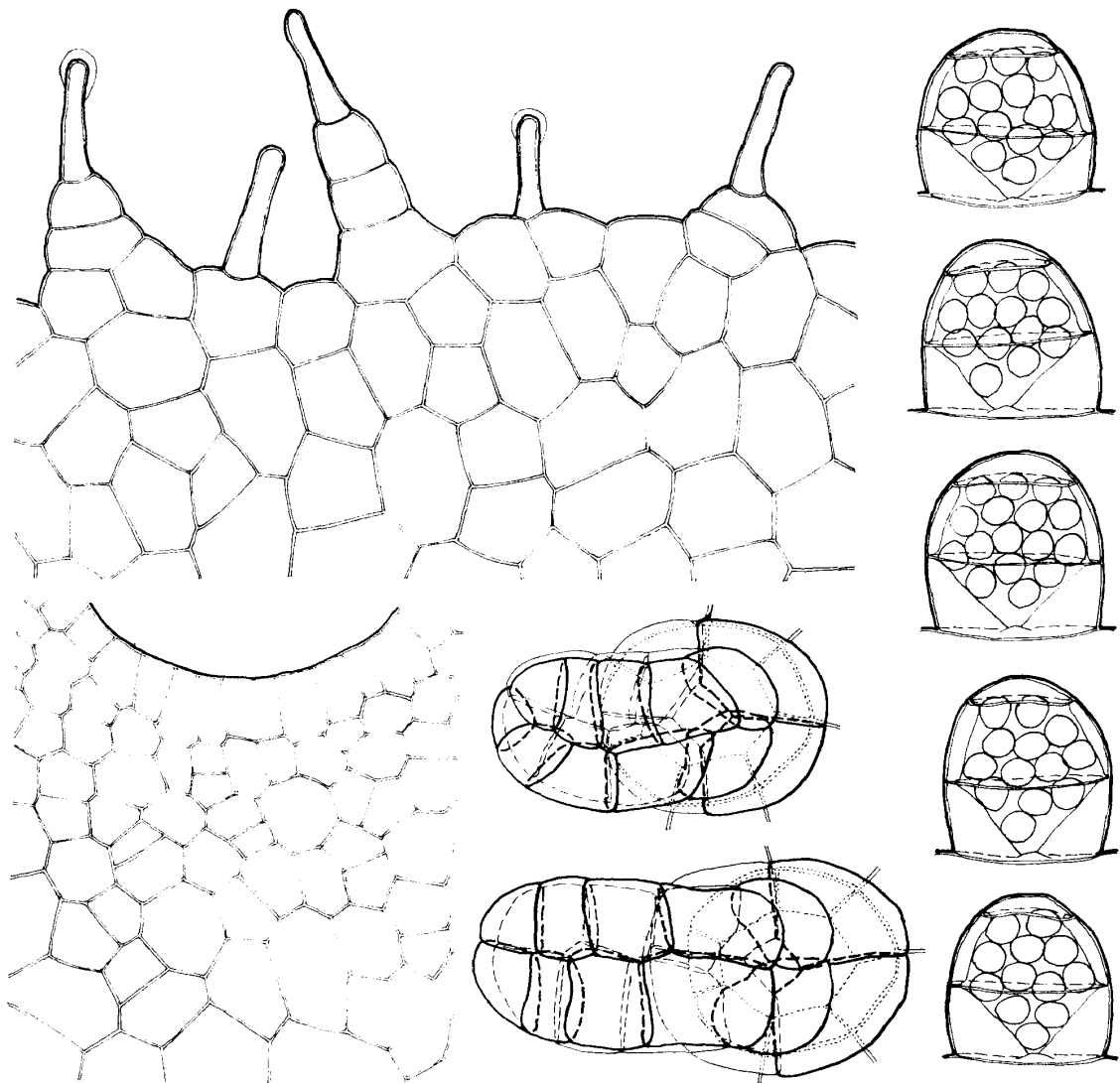


Fig. 78 *Hypodematium crenatum* (Forsk.) Kuhn.

Antheridia on the lower part of thallus, globoid, 75-85  $\mu$  in diameter ; basal cell equal in height and width with ring cell, upper wall funnel-like, immersed to the base.

Material. Chiangmai : Doi Chiangdao, 5 Jan. 1966.

The prothallium of the present material is clearly distinguishable from that of the Japanese plants, *H. fauriei* (Momose, op. cit. 200) in: 1) the apex of thallus shallowly and widely sinuate, and inner sides of lobes funnel-like, divergent above the bottom of sinus, 2) wing cells comparatively small in size, 3) the cushion comparatively large but thin and 4-5 cells thick in the heavier part, 4) the long hairs usually on upper margins of the wings but rarely on the dorsal surface of the thallus, 5) the neck of archegonia rather large and neck cells in four tiers, 6) at the anterior side.

As regards prothallia of *Hypodematium crenatum*, D.S. Loyal give an account in J. Ind. Bot. Soc. 39: 133. 1960, basing on the Indian plants, though his account is

so failing details that I don't make special reference to him. At his Text-fig. 5, he illustrates long hairs also on the submarginal region of the ventral surface associating with marginal ones. If so, the prothallium of the Indian plants may be distinct from that of the Thai plants as well as that of the Japanese ones.

ADIANTACEAE

44. *Coniogramme fraxinea* (Don) Diels var. *serrulata* (Blume) Hieron.

Figs. 79, 80

Prothallium bilateral, heart-shaped, assurgent along the midrib; apex more or less deeply rounded and acutely cordate, and inner sides of lobes funnel-like, opened above the bottom of sinus; lower part of the thallus cuneate, steeply narrowing towards the base. Protonema 2-3 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings almost equal in size, upper sidewise expanded, margins more or less undulate; wing cells elongate or isodiametric polygonal with almost straight or slightly curved side wall; marginal cells arranged with minute intercellular notch,

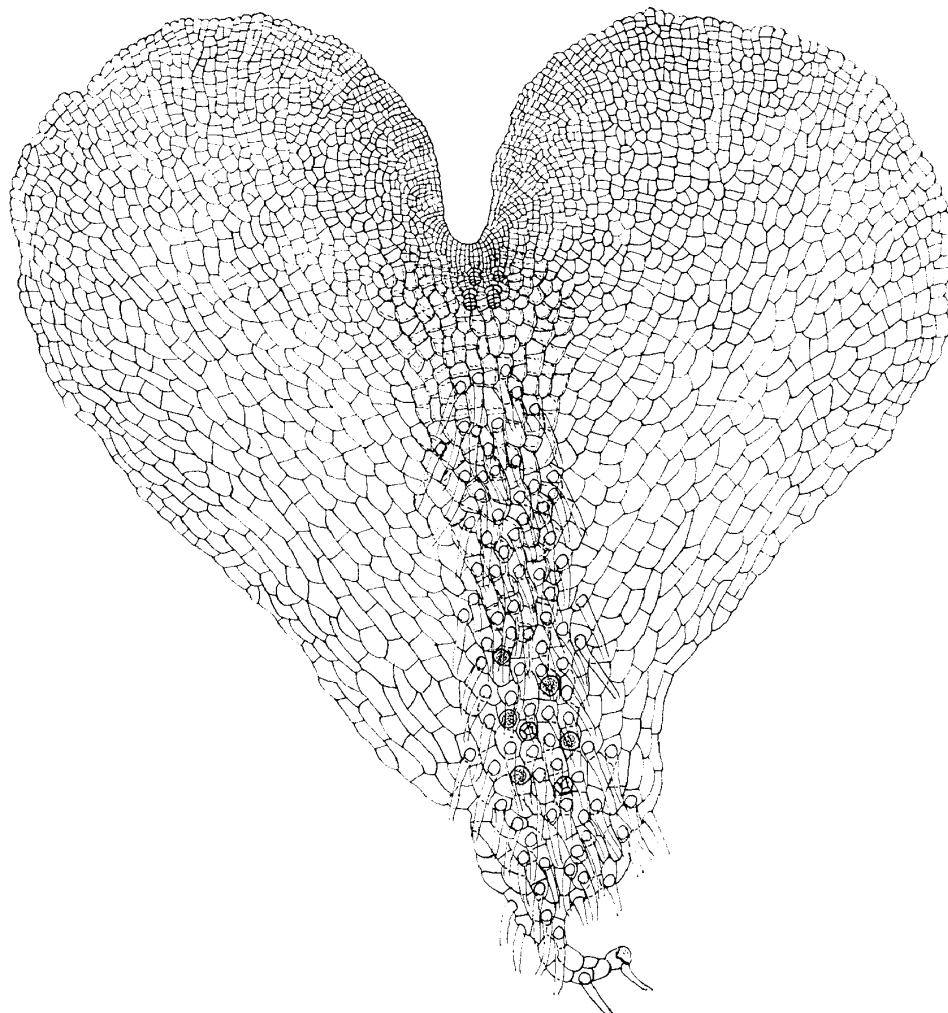


Fig. 79 *Coniogramme fraxinea* (Don) Diels var. *serrulata* (Blume) Hieron.

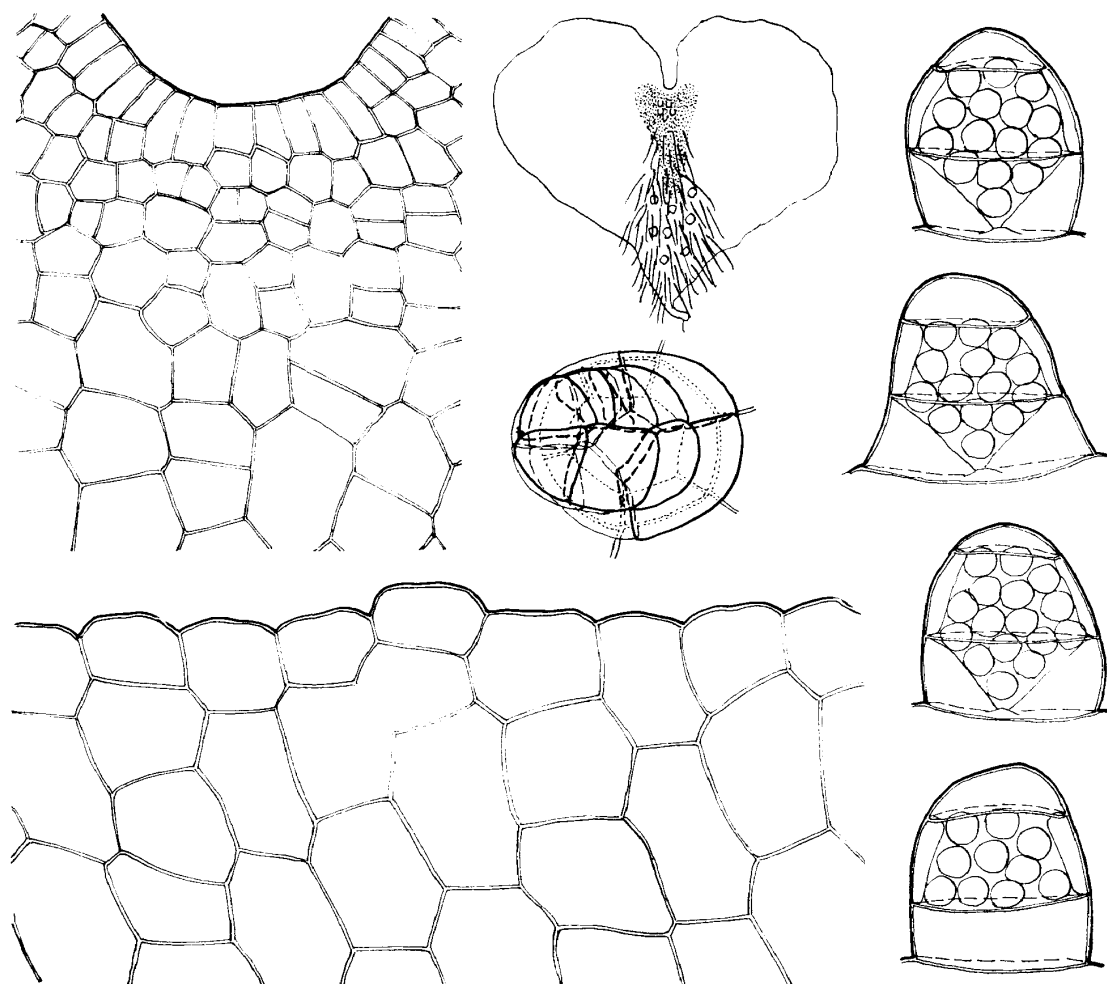


Fig. 80 *Coniogramme fraxinea* (Don) Diels var. *serrulata* (Blume) Hieron.

smaller sized, rather broad polygonal with convex free side. Midrib gutter-shaped, cushioned from the midway to near the apex; cushion narrowed and elongate obovate, small in size, 4-5 cells thick in the heavier part. Rhizoids along the midrib from the base of thallus to the middle of cushion, light brown in colour. Archegonia on the distal median of cushion, some in number; neck thick and short, verruciform, bending towards posterior; neck cells in four tiers, 4-5 at the anterior and 3 at the posterior sides, lowermost cells in each tier large and cushioning the neck. Antheridia on the lower part of thallus along the midrib and apart below from archegonia, ellipsoidal or conical, 80-100  $\mu$  in diameter; basal cell equal in height with ring cell, upper wall funnel-like, immersed to the base or rarely flat.

Material. Chiangmai: Doi Chiangdao, 4 Jan. 1966.

45. *Cheilanthes subrufa* Baker.

Figs. 81, 82

Prothallium more or less asymmetrical, oblique heart-shaped, strikingly recurved along the midrib and lower part of the thallus so uplifted as to both margins

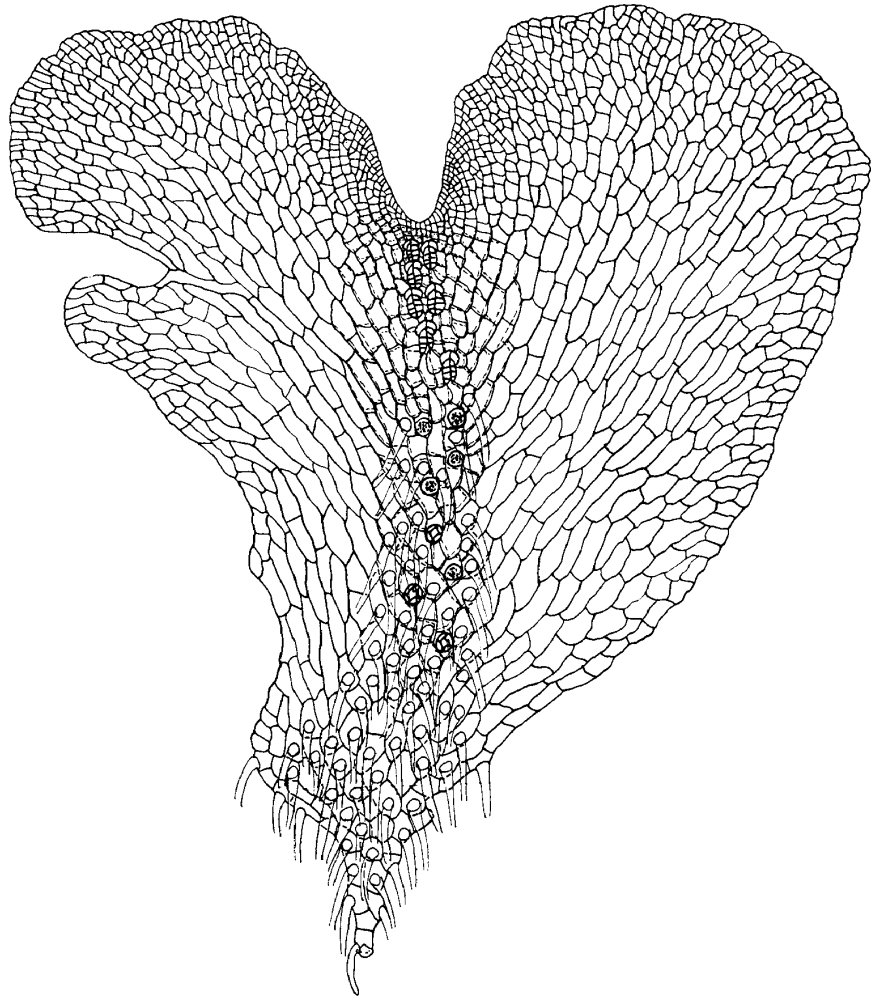


Fig. 81 *Cheilanthes subrufa* Baker.

close together; apex less deeply rounded and steeply cordate, and inner sides of lobes funnel-like, opened above the bottom of sinus; lower part of the thallus gently narrowing towards the base. Protonema 2-3 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings unequal in size and shape, upper sidewise expanded, margins undulate; wing cells conspicuously elongate polygonal, irregular-shaped, with undulate side wall; marginal cell smoothly arranged, elongate or broad polygonal, with almost flat or slightly concave free side. Midrib strikingly gutter-shaped, cushioned from the lower midway to near the apex; cushion narrowed and elongate obovate, 4-5 cells thick in the heavier part. Rhizoids along the midrib from the base of thallus to the middle of cushion, light brown in colour. Archegonia along the upper median of cushion, some in number; neck medium sized, cylindrical, bending towards posterior; neck cells in four tiers, 5-6 at the anterior, and 3-4 at the posterior sides, lowermost cells of each tier large and cushioning the neck. Antheridia



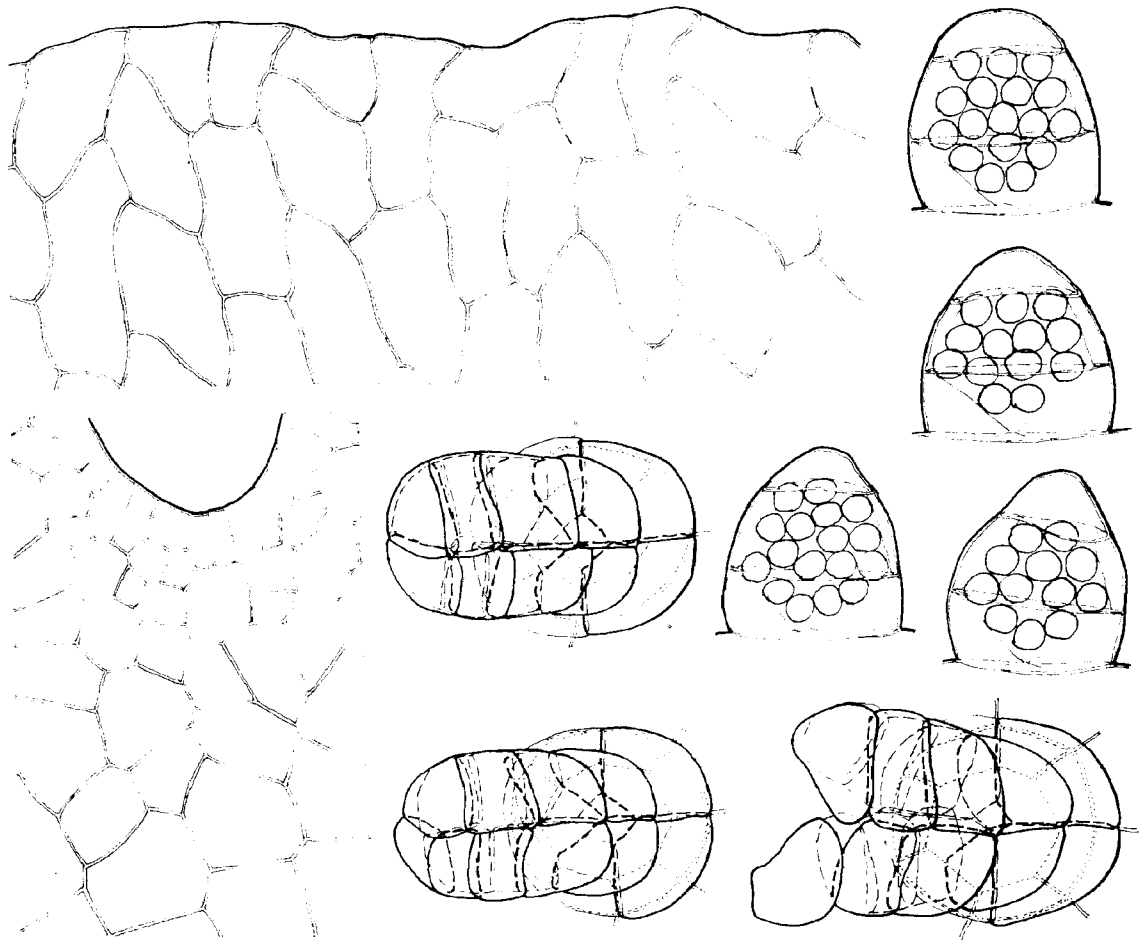


Fig. 82 *Cheilanthes subrufa* Baker.

along the midrib from the lower of cushion to the middle and continued to archegonia, globoid or conico-globoid, 80-90  $\mu$  in diameter; basal cell equal in height with ring cell, upper wall funnel-like, immersed to the base; ring cell narrowed above and covered with rounded or angulate cap cell.

Material. Chiangmai: Doi Chiangdao, 4 Jan. 1966.

46. *Cheilanthes farinosa* (Forsk.) Kaulf.

Figs. 83, 84

Prothallium more or less asymmetrical, oblique heart-shaped, strikingly recurved along the midrib and lower part of the thallus so uplifted as to both margins close together; apex deeply rounded and acutely cordate, and inner sides of lobes closed together or opened above the bottom of sinus; lower part of the thallus mostly arched towards recessive side, rounded at the dominant side and cuneate at the recessive side, steeply or gently narrowing towards the base. Protonema 2-3 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings somewhat unequal in size and shape, upward or upper sidewise expanded, margins undulate; wing cells conspi-

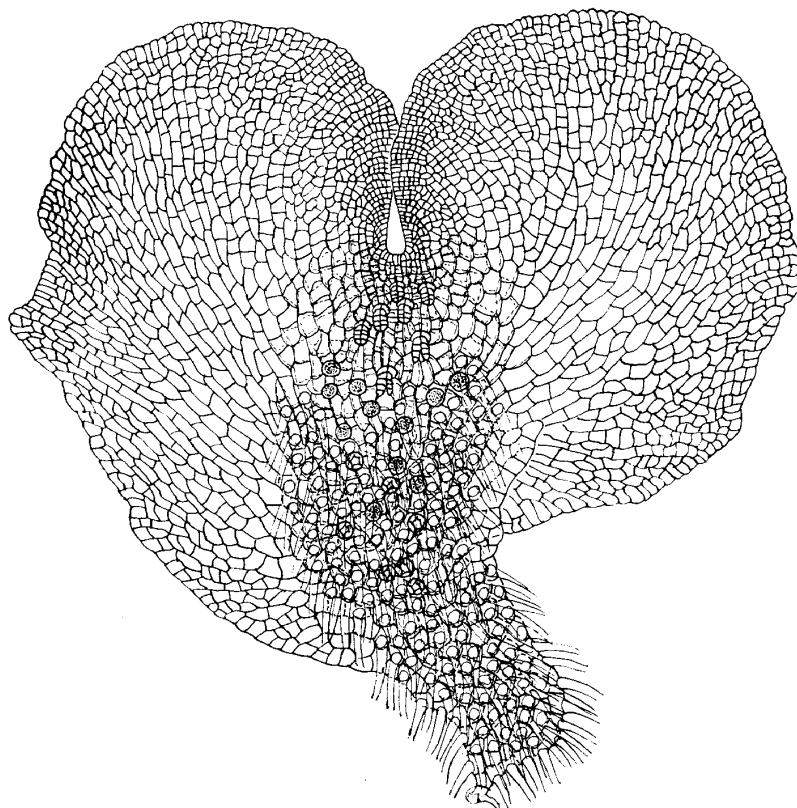


Fig. 83 *Cheilanthes farinosa* (Forsk.) Kaulf.

cuously elongate polygonal with undulate side wall; marginal cells arranged slightly with minute intercellular notch, elongate polygonal, with slightly convex free side. Midrib strikingly gutter-shaped, cushioned from the basal midway to near the apex; cushion obovate-oblong or lanceolate, 4-5 cells thick in the heavier part. Rhizoids along the midrib from the base of thallus to the middle of cushion, light brown in colour. Archegonia along the upper median of cushion, some in number; neck more or less large, verruciform or cylindrical, bending towards posterior, dehiscing reservedly; neck cells in four tiers, 5-6 at the anterior and 3-4 at the posterior sides, lowermost cells in each tier large and cushioning the neck. Antheridia on the cushion from the lower midway to the upper part and mixed with archegonia, conico-globoid, 85-110  $\mu$  in diameter; basal cell equal in height with ring cell, mostly wider towards the base, upper wall funnel-like, immersed to the base or rarely flat; ring cell covered with upwardly angulate cap cell.

Material. Chiangmai: en route from Mae Klang water-fall to Ban Yang, on approach to Doi Inthanon, 16 Dec. 1965.

According to G. Panigrahi (Nucleus 5: 53. 1963), the Indian species of *Aleuritopteris farinosa* (Forsk.) Fée complex are divided into three cyto-types; diploid and sexual species, amphidiploid and sexual species, and triploid and apogamous species;

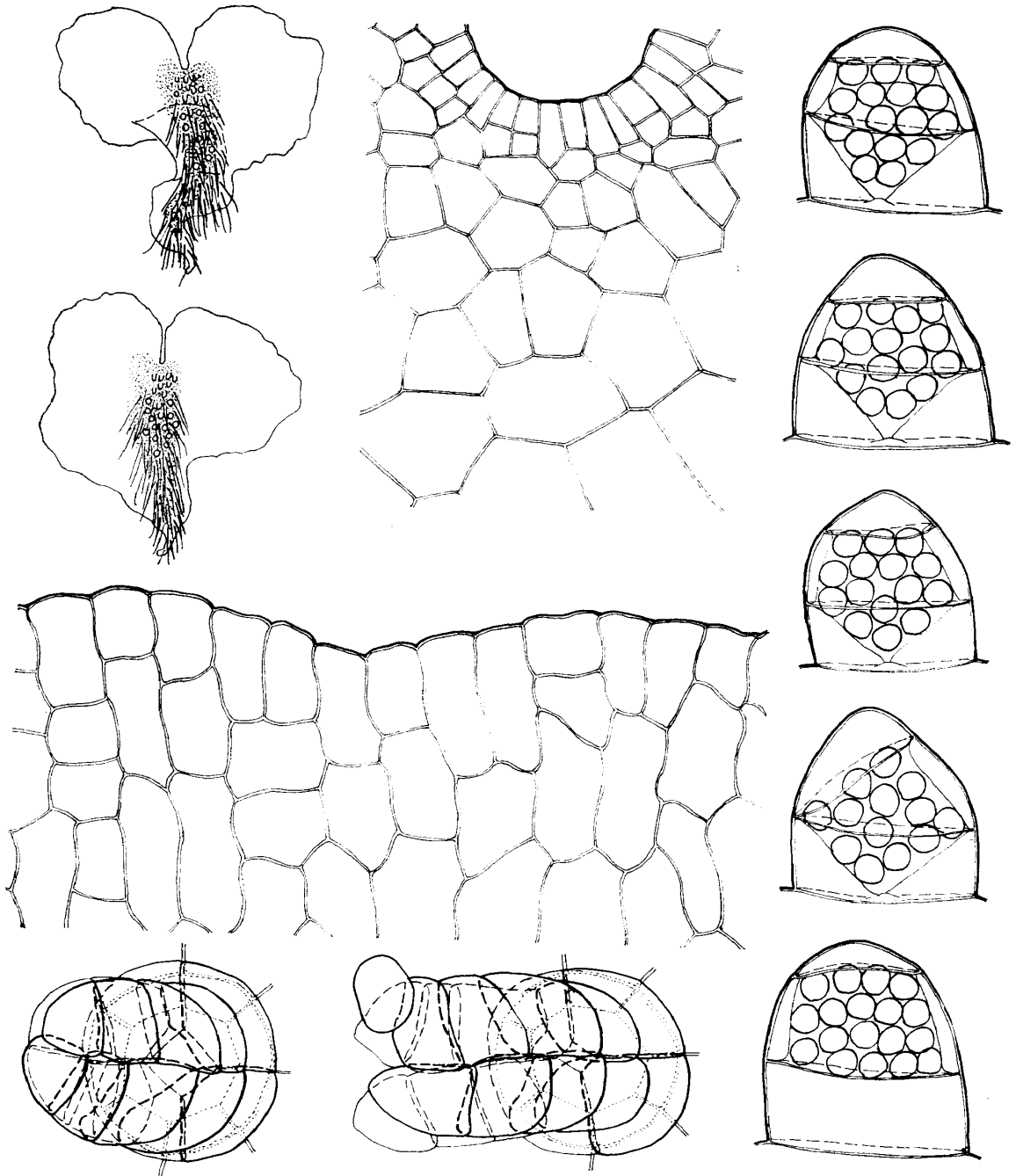


Fig. 84 *Cheilanthes farinosa* (Forsk.) Kaulf.

*A. farinosa* sensu stricto is triploid and apogamous.

As for the mode of reproduction in the *Aleuritopteris* group of *Cheilanthes*, I have also ascertained the fact that *Cheilanthes farinosa* obtained from the Royal Botanic Gardens, Kew, is strictly apogamous. However, every plant collected in Taiwan, Himalayas and Thailand are uniformly sexual. The allied species examined (*Cheilanthes argentea*, *C. krameri*, and *C. kuhni* var. *brandtii* from Japan, and *C. albo-marginata*, *C. anceps*, and *C. rufa* from Himalayas) are all sexual. *Cheilanthes*

*farinosa* complex needs further biosystematic studies.

47. ***Pityrogramma calomelanos* (L.) Link.**

Figs. 85, 86

Prothallium conspicuously asymmetrical, oblique and broad heart-shaped, strikingly assurgent along the midrib; apex more or less deeply rounded and acutely cordate, and inner sides of lobes mostly opened above the bottom of sinus; lower part of the thallus arched towards recessive side, rounded at the dominate side and cuneate at the recessive side, acutely or sharply narrowing toward the obliquely tailed base. Protonema 2-3 cells long; original cell cylindrically protruding out of the spore coat, and primary rhizoid inserted at the lower side of original cell. Wings unequal in size and shape, dominate wing mostly broadwise expanded and recessive wing mostly upper sidewise expanded, margins undulate; wing cells almost isodiametric polygonal, with straight side wall; marginal cells arranged with minute intercellular notch, isodiametric polygonal with convex free side. Midrib strikingly gutter-shaped, cushioned from the basal part to near the apex; cushion obovate, 5-6 cells thick in the heavier part. Rhizoids along the midrib from the base of thallus to the middle of cushion, almost hyaline or brownish in colour. Archegonia gregarious on the upper median of cushion, not so many in number; neck rather large and long, more or less tapered, bending towards posterior, always dehiscing reservedly; neck cells in four tiers, 5-6 at the anterior and 4 at the posterior sides. Antheridia on the upper part of cushion, mixed with archegonia,

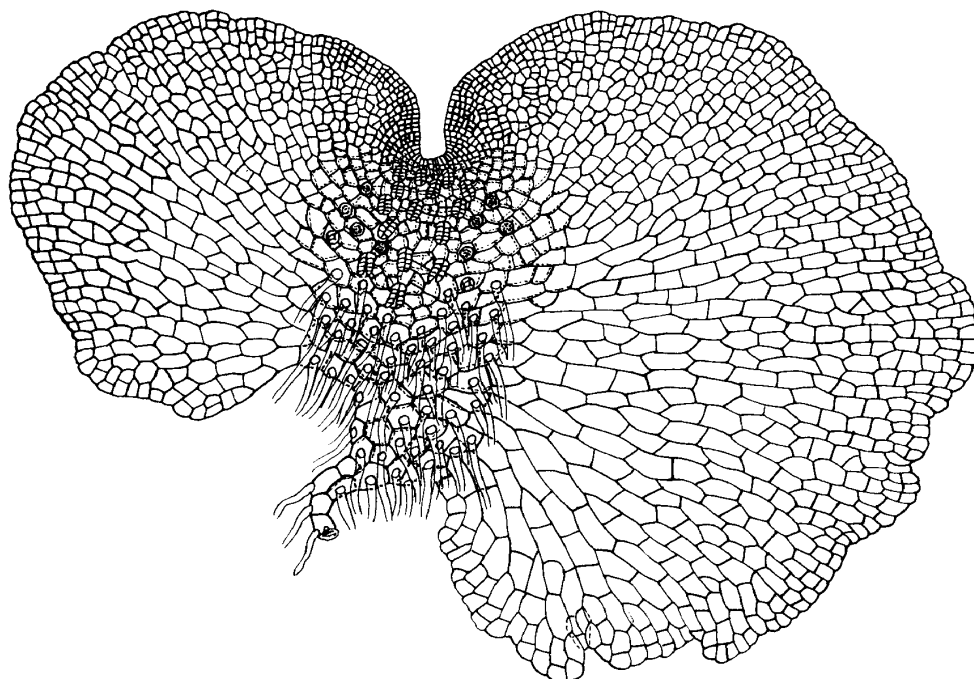


Fig. 85 *Pityrogramma calomelanos* (L.) Link.

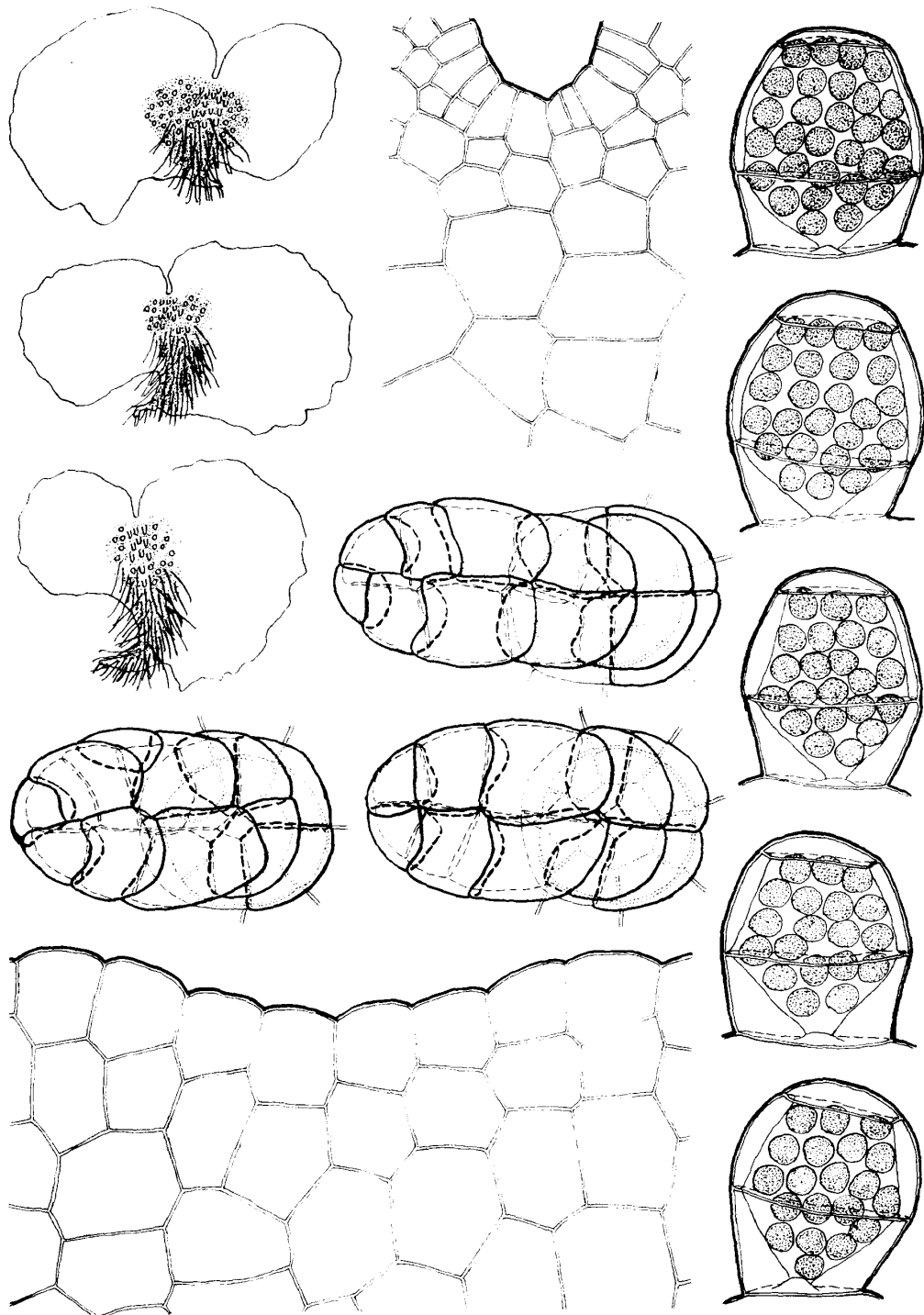


Fig. 86 *Pityrogramma calomelanos* (L.) Link.

ellipsoidal or obovoid, 90-100  $\mu$  in diameter; basal cell more or less lower than ring cell, upper wall funnel-like, immersed to the base.

Material. Chiangmai: Doi Suthep, 31 Dec. 1965.

*Alphabetical list of plant names included.*

Acrophorus stipellatus.....	130	Hypodematium crenatum.....	155
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Arcypteris irregularis .....	144	Microlepia platyphylla.....	106
Asplenium ensiforme .....	121	M. speluncae var. pubescens .....	105
A. nidus.....	119	Microsorium nigrescens .....	86
Belvisia revoluta .....	80	M. rubidum .....	84
Blechnum orientale .....	121	Nephrolepis hirsutula .....	109
Bolbitis sinensis.....	127	Oleandra musifolia .....	111
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D. simplicivenium .....	154	T. interrupta .....	99
D. tomentosum .....	151	T. multilineata .....	103
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Elaphoglossum yunnanense.....	123	T. torresiana .....	92
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### Postscript

After the publication of his comprehensive book *Prothallia of Japanese Ferns*, Dr. Shizuo Momose became severely ill with cancer. In the summer of 1967, he underwent a heavy operation for cancer of the throat. Though in poor health after the operation he continued his detailed studies on the prothallia of Thai ferns. It is with much regretful to note here that his death might have come earlier due to this hard work.

About 550 species of the pteridophytes are estimated to grow in Thailand. Forty-seven of these species are, here, examined in their gametophytic generation. The detailed observations by Dr. Momose have, however, been interrupted by his death. It is now impossible for us to expect further illustrations of the prothallia of Thai ferns.

Dr. Momose left the manuscript on the prothallia of Thai ferns almost ready for publication. This will be the first part of his work in this form. The rather voluminous paper has appeared here in its entirety by the good offices of the editors. It will be of keen interest for scientists engaged in this kind of investigation.

(Motozi Tagawa)