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**The Genus *Calypogeja* Raddi in Central and South America**  
**III. Subgenus *Calypogeja*, subgroups 4 and 5**<sup>1</sup>

by

Hélène BISCHLER

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*Subgroup 4.*

*Analytical key to the species and varieties*

The characters are numbered and grouped as in the previous analytical keys. A formula of 6 figures will be obtained after analysis. The species and varieties and their typical formulae are listed in a table at the end of the key. The formula obtained from the analysis of a given specimen is compared with those in the table and the species or variety to which that specimen belongs will be that corresponding to the closest formula.

- A 1. Adult stems 1,4-3 mm broad (leaves included). Leaves regular in size and shape, not imbricate.  
2. Adult stems 1-1,6 mm broad (leaves included). Leaves irregular in size and shape, slightly imbricate.
- B 1. Stem width 100-140  $\mu$ . Cortical cells 51-102  $\mu$  long.  
2. Stem width 140-210  $\mu$ . Cortical cells 51-102  $\mu$  long.  
3. Stem width 210-280  $\mu$ . Cortical cells 102-110  $\mu$  long.
- C 1. Leaves with a distinct leaf margin and bilobed or bidentate apices.  
2. Leaves without distinct leaf margin and usually entire, pointed or apiculate apices.
- D 1. Marginal leaf cells 68-127  $\mu$  long, with oblique transverse walls and convex outer ones. Margin appearing crenulate.  
2. Marginal leaf cells 68-127  $\mu$  long, with perpendicular transverse and flat outer walls. Margin not crenulate.  
3. Marginal leaf cells 34-68  $\mu$  long, not distinct from the inner ones. Outer walls slightly convex, the margin thus appearing slightly crenulate.

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<sup>1</sup> The terms used in this paper are in accordance with the definitions given in the previous papers.

- E 1. Apical leaf cells thin walled.  
 2. Apical leaf cells with strongly thickened walls.
- F 1. Underleaves with a protuberance or a tooth on each outer edge. Underleaf lobes pointed, green.  
 2. Underleaves without protuberances or teeth on the outer edges. Underleaf lobes rounded, brownish.

	A	B	C	D	E	F
<i>C. lechleri</i> .....	1	1	1	1	1	1
<i>C. lechleri</i> var. <i>densifolia</i> .....	2	1	1	2	1	1
<i>C. rhombifolia</i> .....	1	2	2	3	2	2
<i>C. rhombifolia</i> var. <i>colombiana</i> ..	1	3	2	3	1	1

*Dichotomous key to the species and varieties.*

Stems 100-154  $\mu$  wide. Flagelliform branches and modified branches. The leaves on the latter are dimorphous, there being normal leaves and irregularly shaped, smaller ones. Leaf apex bilobed or bidentate. Leaf margins distinct, with marginal cells of 68-127 $\times$ 13-25  $\mu$ . Underleaves with pointed lobes and rounded or pointed sinus, always bearing on each outer edge a rounded protuberance or a tooth.

1. [***C. lechleri*** (Steph.) Steph.]

Plants 1,5-2,3 mm broad, the modified branches 0,5-1 mm broad (leaves included). Leaves not imbricate, regular in size and shape, irregular in the modified branches. Leaf margins composed, for normal and modified branches, of elongated cells with thick, yellowish and oblique transverse walls and convex outer ones, crenulate. Underleaves 1,1-2 times the width of the stem, in normal branches, in modified branches only equaling the width of the stem

***C. lechleri*** (Steph.) Steph. var. ***lechleri***.

Plants 1-1,6 mm broad (leaves included). Leaves imbricate, very irregular in shape and size. Leaf margins composed of elongated cells with thick, perpendicular transverse and flat outer walls, not crenulate. Underleaves twice the width of the stem. . . . . ***C. lechleri*** (Steph.) Steph. var. ***densifolia*** (Steph.) Bischler.

Stems 140-280  $\mu$  wide. No flagelliform or modified branches. Leaf apices usually entire, pointed or apiculate, but often also bidentate. Leaf margins indistinct, marginal cell dimensions 34-68 $\times$ 10-34  $\mu$ . Underleaves usually with rounded, rarely pointed lobes and pointed sinus, with or without a protuberance or a tooth on each outer edge . . . . . 2. [***C. rhombifolia*** (Spruce) Steph.]

Stem width 140-210  $\mu$ . Cortical stem cells 51-102  $\mu$  long. Leaf apices usually entire, but when bidentate, the teeth are unicellular and the sinus narrow and pointed. Apical leaf cells with strongly thickened walls. Underleaves small, 105-196  $\mu$  long, 140-245  $\mu$  wide, usually without teeth or protuberances. Lobes rounded, sinus pointed, 35-105  $\mu$  deep. Underleaf cells with thick, brownish walls. Appearance of the underleaves therefore brownish

***C. rhombifolia*** (Spruce) Steph. var. ***rhombifolia***.

Stem width 210-280  $\mu$ . Cortical stem cells 102-110  $\mu$  long. Leaf apices usually bidentate, with 1-3 celled teeth. Sinus broad, rounded. Apical leaf cells thin walled. Underleaves 245-315  $\mu$  long, 314-455  $\mu$  wide, often bearing a protuberance or a tooth on each outer edge. Lobes usually pointed, sinus pointed, 175-210  $\mu$  deep. Underleaf cells thin walled, underleaves therefore green

***C. rhombifolia*** (Spruce) Steph. var. ***colombiana*** Bischler.

1. — *Calypogeja lechleri* (Steph.) Steph. *Spec. Hep.* 3:412. Aug. 31, 1908 = *Kantia lechleri* Steph. *Hedwigia* 34:53. 1895.

*Stems* creeping, usually flexuose, 1-4 cm long, 1-2,3 mm broad (leaves included). Stem width 100-154  $\mu$ . Cortical cells thin walled, without trigones or with small ones. Cell dimensions: 51-102  $\times$  17-25  $\mu$ . *Rhizoides* variable in number, long or short, hyaline, yellowish or brownish, frequently branched. Rhizoides occur occasionally also on the leaf margins. *Lateral branches* variable in number. Asymmetrical stems and flagelliform branches have been observed. Peculiar branches with small and irregularly shaped leaves occur in a large number of specimens. *Leaves* usually hardly imbricate, or distant, 630-1150  $\mu$  long, 441-1150  $\mu$  wide. Ratio: length/width = 1,5-1/1. Dorsal edge almost straight. Ventral edge strongly curved and usually decurrent. Leaf insertion slightly arched. Leaf apex ascendant, bidentate or bilobed, rarely entire and apiculate. Teeth or lobes triangular, unicellular or paucicellular, pointed, erect or slightly divergent. They are often of different shapes on the same leaf, the inferior being usually more conspicuous. Sinus usually pointed and narrow, rarely rounded, 35-125  $\mu$  deep. Leaf margins usually well differentiated, composed of elongated cells with thick, oblique and yellowish transversal walls and convex outer ones. The margins of the leaves appear thus slightly crenulate, especially on the inferior and superior edges of the leaf. Leaf cells thin walled, with small or medium sized trigones. Cell dimensions: marginal 68-127  $\times$  13-25  $\mu$ , apical 25-34  $\times$  17-34  $\mu$ , central 34-68  $\times$  25-34  $\mu$ , basal 42-76  $\times$  25-34  $\mu$ . *Underleaves* 1,1-2 times the width of the stem, 110-280  $\mu$  long, 136-280  $\mu$  wide. Not decurrent. Ratio: length/width = 1/1-1,6. Outer edges rounded or straight, with a 1-2 cellular tooth or a rounded protuberance on each side. The underleaf shape is very variable. Apex divided to 5/10-8/10 of the underleaf length into two narrow and pointed lobes, which may be erect or convergent. Sinus rounded or pointed, usually narrow, 60-140  $\mu$  deep. Underleaf cells thin walled, with small trigones or none at all. Cell dimensions: central 30-68  $\times$  20-30  $\mu$ , marginal 25-51  $\times$  13-42  $\mu$ . *Inflorescences* dioecious. ♂ with very small, bidentate bracteoles. ♀ solitary or in pairs. Bracts convex, small, bilobed to 1/2 with incurved lobes. *Cuticle* usually papillose, more rarely smooth.

*HAB.:* *C. lechleri* forms lax or dense, olive, yellowish or dark green mats. It is frequently associated with other Hepaticae, growing on damp soil or shaded rocks. It has been gathered most frequently at medium altitude, but also from sea level up to 4000 m.

*LECTOTYPE:* PERU: St. Gavan, s.d., *Lechler s.n.* (G n° 1806).

*DISTR.:* SOUTH AMERICA: Brazil, Bolivia, Colombia, Dutch Guiana, Peru. CENTRAL AMERICA: Costa Rica.

*OBS.:* STEPHANI cites four specimens of *C. lechleri* (Steph.) Steph. with his original diagnosis. Three of them are kept in his collection. The specimen from Chile seems to be lost; to it corresponds n° 1269 (G) of STEPHANI'S *Icones Hepaticarum*.

Two other specimens were drawn in the *Icones* by STEPHANI: the brazilian (G n° 1266) and the peruvian (G n° 1268). The first bears a short description on the herbarium label and the name "*C. continua* Steph. n. sp." It belongs

clearly to *C. lechleri*. The latter bears STEPHANI's whole original description. It has therefore been chosen as the lectotype.

SPRUCE's description of *Kantia leptoloma* Spruce (*Trans. Proc. Bot. Soc. Edinburgh* 15:414. Nov. 1885) matches *C. lechleri* exactly. But the type of the SPRUCE species seems to be lost. A comparison was thus not possible.

Many of the herbarium specimens of *C. lechleri* show peculiar branches with smaller, irregularly shaped and often imbricated leaves, like those normally found in *C. densifolia* (Steph.) Steph. The occurrence of such branches of the "densifolia" type could correspond to an abrupt change in habitat conditions. *C. densifolia* could thus be considered to be an abnormal plant.

The union of *C. densifolia* and *C. lechleri* as synonyms would probably be justified. However, the material of the first being poor and its appearance quite different from a *C. lechleri* without abnormal branches, it seemed to be more useful to keep it separate from the latter species, but to consider it as a variety of *C. lechleri*.

*C. lechleri* is very well defined. Its ascendant leaf apices and its very peculiar leaf margins separates it easily from all other species of the genus.

#### Varieties

##### *C. lechleri* (Steph.) Steph. var. *lechleri*.

*ICONES*: This paper, fig. 31; STEPHANI, *Icones Hepaticarum* ined. in hb G n<sup>os</sup> 1266, 1268, 1269.

*Stems* fairly flexuose, 1,5-2,3 mm broad (leaves included). *Lateral branches* usually numerous. Flagelliform branches have been observed. Peculiar branches, with small and irregularly shaped, mostly distant, leaves, are frequent. Their breadth is 0,5-1 mm (leaves included). The leaf margins are, as in the normal branches, slightly crenulate, the transversal walls of the marginal cells being oblique, the outer ones convex. The underleaves reach the same width as the stem. The leaf and underleaf cells are slightly smaller than they are in normal leaves and underleaves. *Leaves* hardly imbricate, regular in shape and size, with the exception of those of the modified branches. Leaf margins well differentiated, composed of elongated cells with thick, yellowish and oblique transversal walls and convex outer ones. The leaf margins appear thus to be slightly crenulate. Cell dimensions: central 34-68 × 25-34 μ, basal 51-76 × 25-34 μ. *Underleaves* 1,1-2 times the width of the stem. On the modified branches they only equal the width of the stem. Cell dimensions: central 30-68 × 20-30 μ, marginal 34-51 × 13-42 μ.

*HAB.* and *DISTR.*: Correspond to those of the species.

Material studied: BRAZIL: Pao d'Assucar, Aug. 1884, *Ule* 32 (G); prov. S. Paulo, Santos, Sororocaba, Dec. 20, 1874, *Mosen* s.n. (G n<sup>o</sup> 1817). BOLIVIA: Yungas de La Paz, s.d., *Buchtien* s.n. (hb Herzog); s.d., *s.col.*, s.n. (MANCH). COLOMBIA: Santander del Norte, Catatumbo, Cerro del Tirador, cerca de Las Mercedes, 1000 m, May 18, 1959, *Bischler* 2290, 2591 B, 2669 C (G).

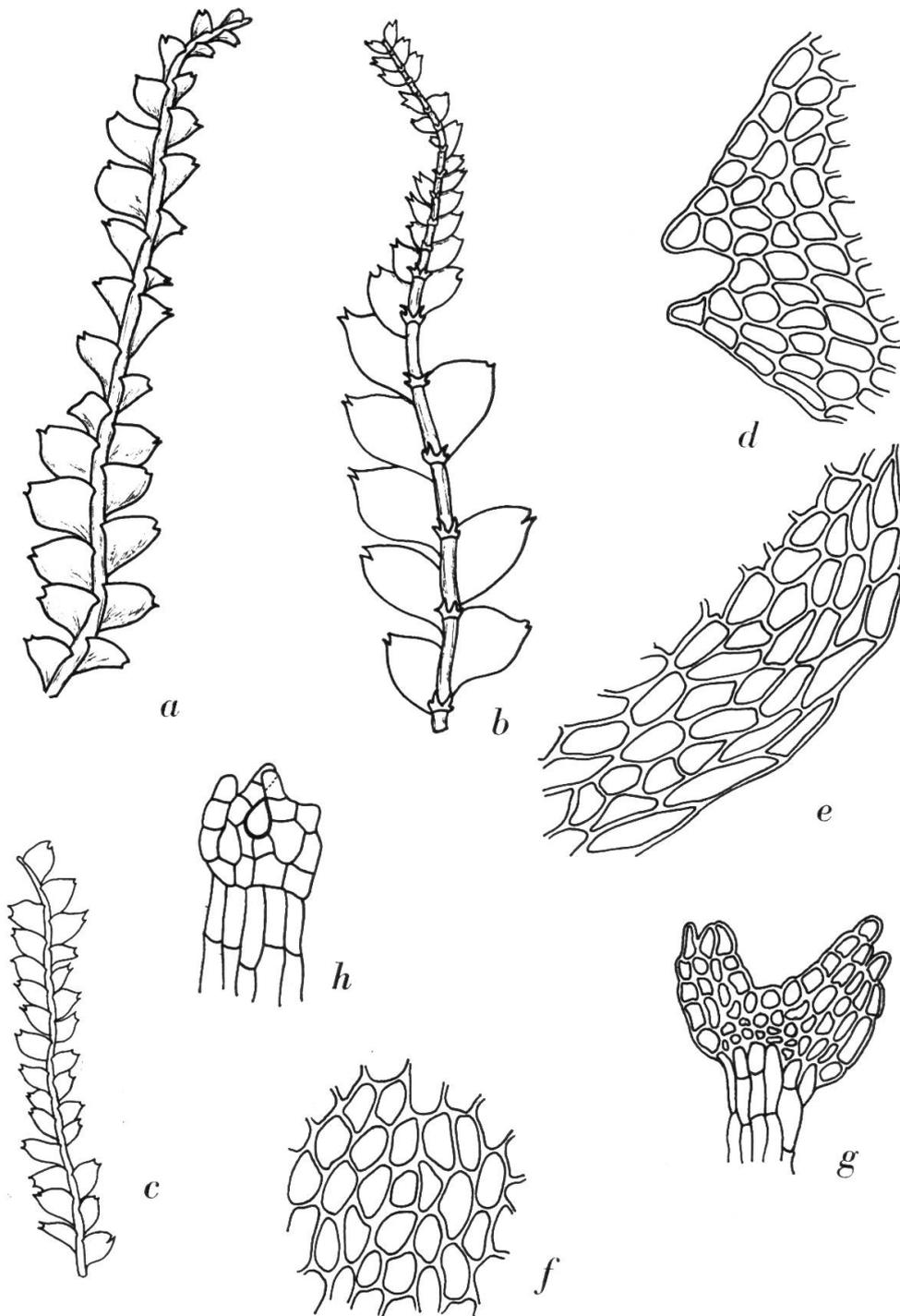


FIG. 31. — *Calypogeja lechleri* (Steph.) Steph. var. *lechleri* (lectotype).  
*a*, stem, dorsal aspect,  $\times 15$  — *b*, stem, ventral aspect,  $\times 15$  — *c*, modified stem,  $\times 15$  —  
*d*, leaf apex,  $\times 150$  — *e*, margin on the ventral edge of the leaf,  $\times 150$  — *f*, cells in the  
 basal region of the leaf,  $\times 150$  — *g*, underleaf,  $\times 100$  — *h*, underleaf of a modified  
 branch,  $\times 100$ .

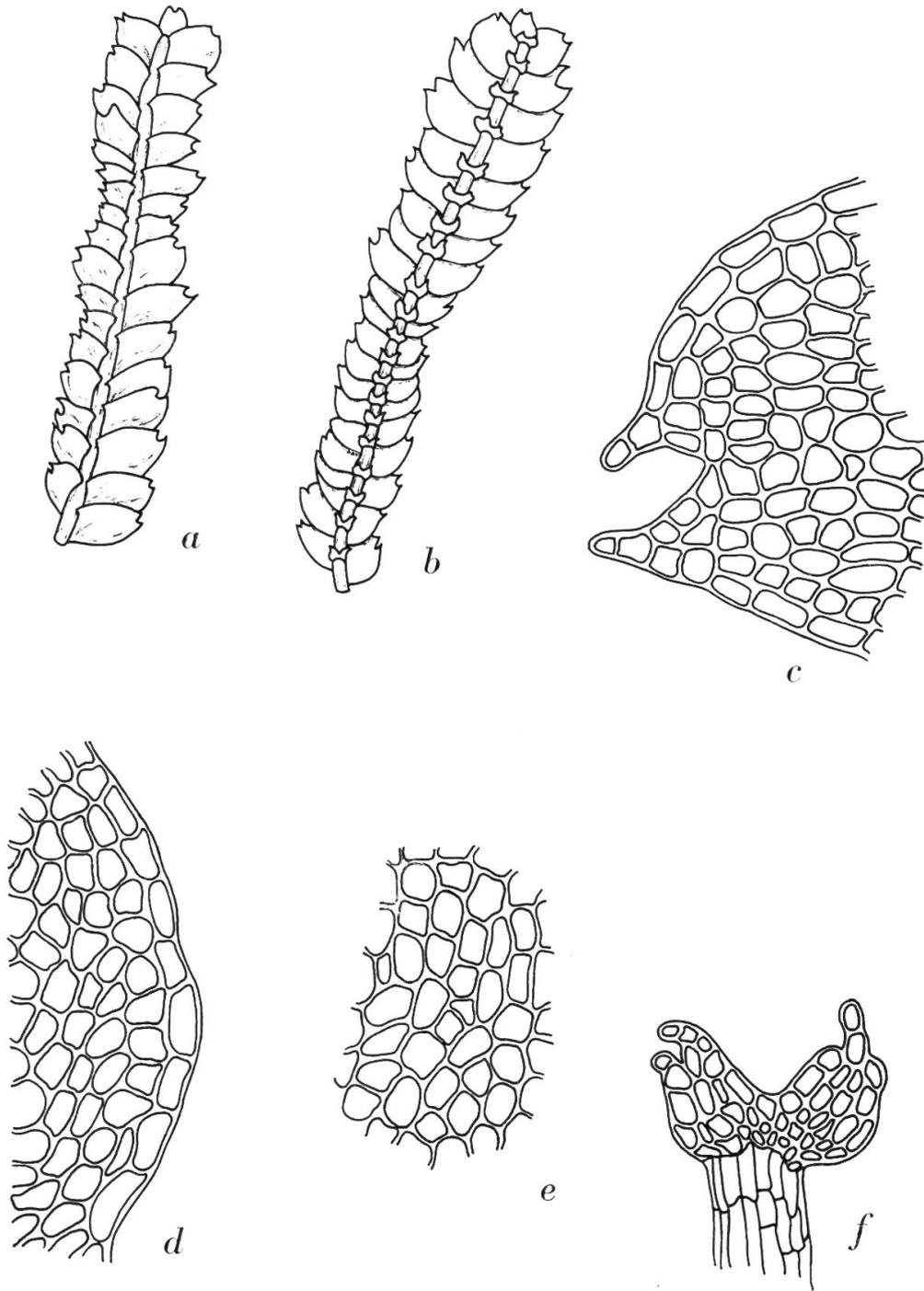


FIG. 32. — *Calypogeja lechleri* (Steph.) Steph. var. *densifolia* (Steph.) Bischler (type).  
*a*, stem, dorsal aspect,  $\times 15$  — *b*, stem, ventral aspect,  $\times 15$  — *c*, leaf apex,  $\times 150$  —  
*d*, margin on the ventral edge of the leaf,  $\times 150$  — *e*, cells in the basal region of the  
leaf,  $\times 150$  — *f*, underleaf,  $\times 100$ .

DUTCH GUIANA: Surinam, s.d., *Sande-Lacoste s.n.* (G n° 1816). PERU: Sandia, 900 m, 1902, *Weberbauer 1244 p.p.* (G). COSTA RICA: Vicinity of Orosi, Province of Cartago, March 30, 1924, *Standley 39843 p.p.* (hb Herzog).

**C. lechleri** (Steph.) Steph. var. **densifolia** (Steph.) Bischler comb. nov. = *Kantia densifolia* Steph. *Hedwigia* **34**:52. 1895 = *Calypogeja densifolia* (Steph.) Steph. *Spec. Hep.* **3**:408. Aug. 31. 1908.

*ICONES*: This paper, fig. 32; STEPHANI, *Icones Hepaticarum* ined. in hb G n° 1261.

*Stems* not flexuose, 1-1,6 mm broad (leaves included). *Lateral branches* rare. No flagelliform branches. *Leaves* imbricate, very irregular in shape and size. Leaf margins differentiated, composed of elongated cells with perpendicular transverse and flat outer walls. The leaf margin thus does not appear crenulate. Cell dimensions: central  $39 \times 30 \mu$ , basal  $42 \times 27 \mu$ . *Underleaves* twice the width of the stem. Cell dimensions: central  $23-30 \times 23-30 \mu$ , marginal  $22-25 \times 22-25 \mu$ .

*HAB.*: Var. *densifolia* forms dense, olive or dark green mats on damp soil. It has been gathered probably at low altitude.

*TYPE*: BRAZIL. s.d., *Ule 166* (G).

*DISTR.*: SOUTH AMERICA: Brazil.

*OBS.*: Var. *densifolia* can easily be distinguished from the normal stems of var. *lechleri* by its smaller size, its irregularly shaped and more imbricate leaves, its less conspicuous leaf margins and its smaller leaf and underleaf cells.

From the modified branches of var. *lechleri* it can be distinguished by its slightly larger size, its more imbricate leaves, its less conspicuous leaf margins which do not appear crenulate, and its larger underleaves which attain twice the width of the stem.

2. — **Calypogeja rhombifolia** (Spruce) Steph. *Spec. Hep.* **3**:399. Jul. 31, 1908 = *Kantia rhombifolia* Spruce, *Trans. Proc. Bot. Soc. Edinburgh* **15**:413. Nov. 1885 = *Calypogeja suberectifolia* Steph. *Spec. Hep.* **3**:402. Jul. 31, 1908.

*Stems* creeping, fairly fleshy, 1-6 cm long, 1,4-3 mm broad (leaves included). Stem width  $140-280 \mu$ . Cortical cells thin walled, with small trigones or none at all. Cell dimensions:  $51-110 \times 17-34 \mu$ . *Rhizoides* few, long or short, hyaline or brownish. They are occasionally completely lacking on young stems. *Lateral branches* usually rare. No flagelliform branches. *Leaves* hardly imbricate, usually adjacent,  $690-1500 \mu$  long,  $575-1380 \mu$  wide. Ratio: length/width = 1,3-1/1-1,2. Dorsal edge almost straight. Ventral edge strongly curved and decurrent. Leaf insertion slightly arched. Leaf apex variable, always ascendant, most frequently entire, pointed or apiculate, more rarely bidentate with narrow, pointed, unicellular or 2-3 celled teeth which can be erect or slightly divergent. Sinus usually narrow, rounded or pointed,  $10-84 \mu$  deep. Leaf margins composed of cells of irregular size and fairly convex outer walls, forming an indistinct layer. The leaf margins appear thus to be slightly crenulate.

Apical leaf cells usually thick walled, central and basal with thin walls and small or medium sized trigones. Cell dimensions: marginal  $34-68 \times 10-34 \mu$ , apical  $25-42 \times 17-34 \mu$ , central  $42-76 \times 20-34 \mu$ , basal  $60-102 \times 25-42 \mu$ . *Underleaves* 1-2,2 times the width of the stem,  $105-315 \mu$  long,  $140-455 \mu$  wide. Not decurrent. Ratio: length/width = 1,2-1/1-1,8. Outer edges rounded, usually without teeth or protuberances. Very rarely however, there may be found, on one or both sides, a rounded protuberance or a tooth. Apex divided to 3/10-8/10 of the underleaf length into two broad or narrow, mostly triangular, rounded or pointed, lobes which can be erect or slightly divergent. Sinus usually pointed,  $35-210 \mu$  deep. Underleaf cells usually with thick, brownish walls and small trigones or none at all. The underleaf thus frequently appears to be of a brownish colour. Cell dimensions: marginal  $25-51 \times 17-34 \mu$ , central  $34-68 \times 17-34 \mu$ . *Inflorescences* dioecious. ♀ composed of 2-4 pairs of convex, imbricate bracts which are nearly of the same size as the leaves. They are irregularly divided to 7/10 of their length into two pointed lobes by a pointed sinus. *Cuticle* slightly papillose or striate, rarely smooth.

*HAB.*: *C. rhombifolia* forms lax, yellowish, light or dark green mats on damp soil, bark, or shaded rocks. It has been gathered from 200 to 800 m.

*TYPE*: ECUADOR: Andes Quitenses, fl. Bombonasa, s.d., *Spruce s.n.* (MANCH).

*DISTR.*: SOUTH AMERICA: Colombia, Ecuador. CENTRAL AMERICA: Dominica, Guadeloupe.

*OBS.*: *C. rhombifolia* shows a very great variability in its leaf apices. All intermediates exist between an entire pointed, through an apiculate, to a bidentate apex, on the leaves of a same mat, or frequently, a same stem. STEPHANI grouped all specimens with mostly entire leaf apices under *C. rhombifolia*, and all those with mostly bidentate leaf apices under *C. suberectifolia* Steph. The two species show no other difference between them, they are therefore considered as synonyms.

*C. rhombifolia* seems to have a tropical distribution, from low altitudes. Its very regular stems and leaf shape make it a typical representative of the relatively less variable, tropical *Calypogeja* which never exceed an altitude of more than 1000 m in their habitat.

The only close relative of this species in the genus is *C. lechleri* (Steph.) Steph., its leaf shape and general habit being almost the same, it also has no leaf margins and varied leaf apices.

#### *Varieties*

#### ***C. rhombifolia* (Spruce) Steph. var. *rhombifolia*.**

*ICONES*: This paper, fig. 33; STEPHANI, *Icones Hepaticarum* ined. in hb G n<sup>os</sup> 1227, 1278.

*Stems* quite fleshy,  $140-210 \mu$  wide. Dimensions of the cortical cells:  $51-102 \times 17-34 \mu$ . *Leaf* apices entire, pointed or apiculate, more rarely bidentate. Teeth mostly unicellular. Sinus usually narrow and pointed. Apical cells with strongly

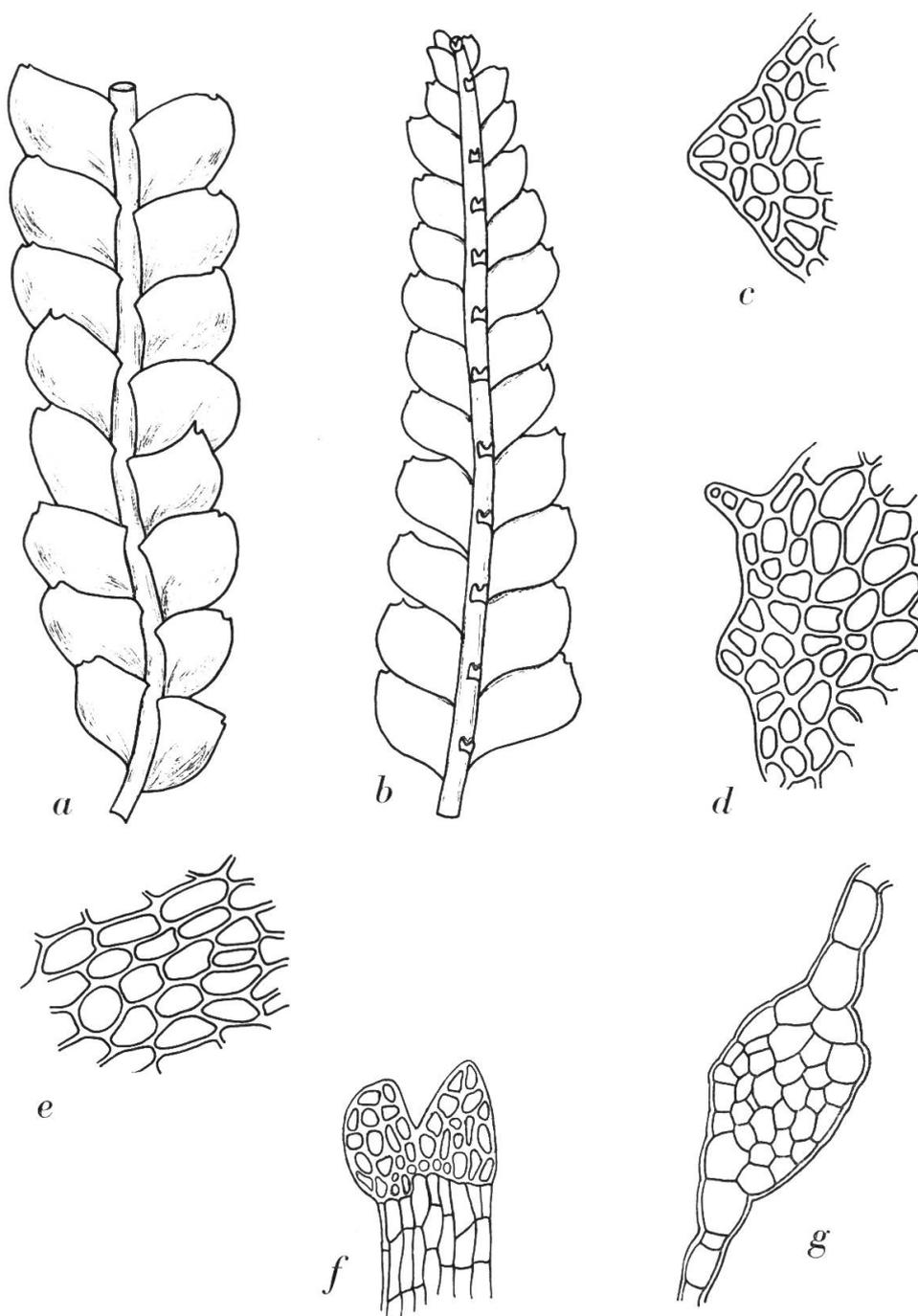


FIG. 33. — *Calypogeja rhombifolia* (Spruce) Steph. var. *rhombifolia* (type).  
*a*, stem, dorsal aspect,  $\times 15$  — *b*, stem, ventral aspect,  $\times 15$  — *c*, leaf apex,  $\times 150$  —  
 leaf apex,  $\times 150$  — *e*, cells in the basal region of the leaf,  $\times 150$  — *f*, underleaf,  $\times 100$  —  
*g*, stem cross section,  $\times 150$ .

thickened walls, central and basal ones thin walled. *Underleaves* 1-1,4 times the width of the stem, 105-196  $\mu$  long, 140-245  $\mu$  wide. Outer edges rounded, usually without protuberances or teeth. Apex divided to 3/10-7/10 of the underleaf length into two, usually broad and rounded, lobes. Sinus pointed, 35-105  $\mu$  deep. Underleaf cells with thick, brownish walls causing the whole organ to appear brownish.

*HAB.* and *DISTR.*: Correspond to those of the species.

Material studied: COLOMBIA: Antioquia, près Puerto Valdivia, au bord du Rio Cauca, 800 m, Jul. 12, 1956, *Bischler 8, 12* (G); Choco, au bord de la route Quibdo-Bolivar, à 20 km de Quibdo, 350 m, Apr. 20, 1957, *Bischler 167* (G); Intendencia del Meta. Rio Guayabero, 10 km al sur del caño Lozada, 350-500 m, Jan. 18, 1959, *Bischler 1640* (G). ECUADOR: *Hepaticae spruceanae amazonicae et andinae*, Andes Quitenses, fl. Bombonasa, s.d., *Spruce s.n.* (G n<sup>os</sup> 1810, 1811, BM, K, LD, M). DOMINICA: s.d., *Elliott 1026 p.p., 1642, 1652, 1713, 2104, 2124* (G), *1044* (G, M). GUADELOUPE: s.d., *Duss 523* (G).

**C. rhombifolia** (Spruce) Steph. var. **colombiana** Bischler var. nov.

*ICONES*: This paper, fig. 34.

*Caules* carnosus, cellulis corticalibus elongatis, 102-110  $\mu$  longis. *Folia* bidentata, cellulis parietibus tenuibus. *Amphigastria* magna, viridia, caule 1,3-2,2 latiora, 245-315  $\mu$  longa, 315-455  $\mu$  lata, ad 6/10-7/10 bilobata lobis triangulatis acutis, sinu acuto, 175-210  $\mu$ . *Stems* fleshy, 210-280  $\mu$  wide. Cortical cell dimensions: 102-110  $\times$  30-34  $\mu$ . *Leaf* apices usually bidentate, more rarely entire, pointed or apiculate. Teeth unicellular or 2-3 celled. Sinus usually broad and rounded. Leaf cells thin walled, from top to base. *Underleaves* 1,3-2,2 the width of the stem, 245-315  $\mu$  long, 315-455  $\mu$  wide. Outer edges rounded, bearing usually on each side a protuberance or a tooth. Apex divided to 6/10-7/10 of the underleaf length into two broad, usually sharply pointed, lobes. Sinus pointed, 175-210  $\mu$  deep. Colour of the underleaves, green.

*HAB.*: Var. *colombiana* forms lax mats on damp soil; usually they are light green in colour. It has been gathered at 500 to 600 m.

*TYPE*: COLOMBIA: Valle, à 43 km de Buenaventura, parois de rochers au bord de la route Cali-Buenaventura, 500 m, Aug. 3, 1958, *Bischler 477* (G).

*DISTR.*: SOUTH AMERICA: Colombia.

Other material studied: COLOMBIA: Valle, à 43 km de Buenaventura, parois de rochers au bord de la route Cali-Buenaventura, 500 m, Aug. 3, 1958, *Bischler 475* (G); Valle, à 49 km de Buenaventura, parois de rochers au bord de la route Cali-Buenaventura 600 m, Aug. 3, 1958, *Bischler 443 B* (G).

*OBS.*: The main distinctive features of var. *colombiana* from var. *rhombifolia* are its slightly more robust habit and its less thickened apical leaf cells. Its underleaves are larger and show a strong tendency to have protuberances or teeth on their outer edges.

Var. *colombiana* seems to be confined to the pacific coast of Colombia.

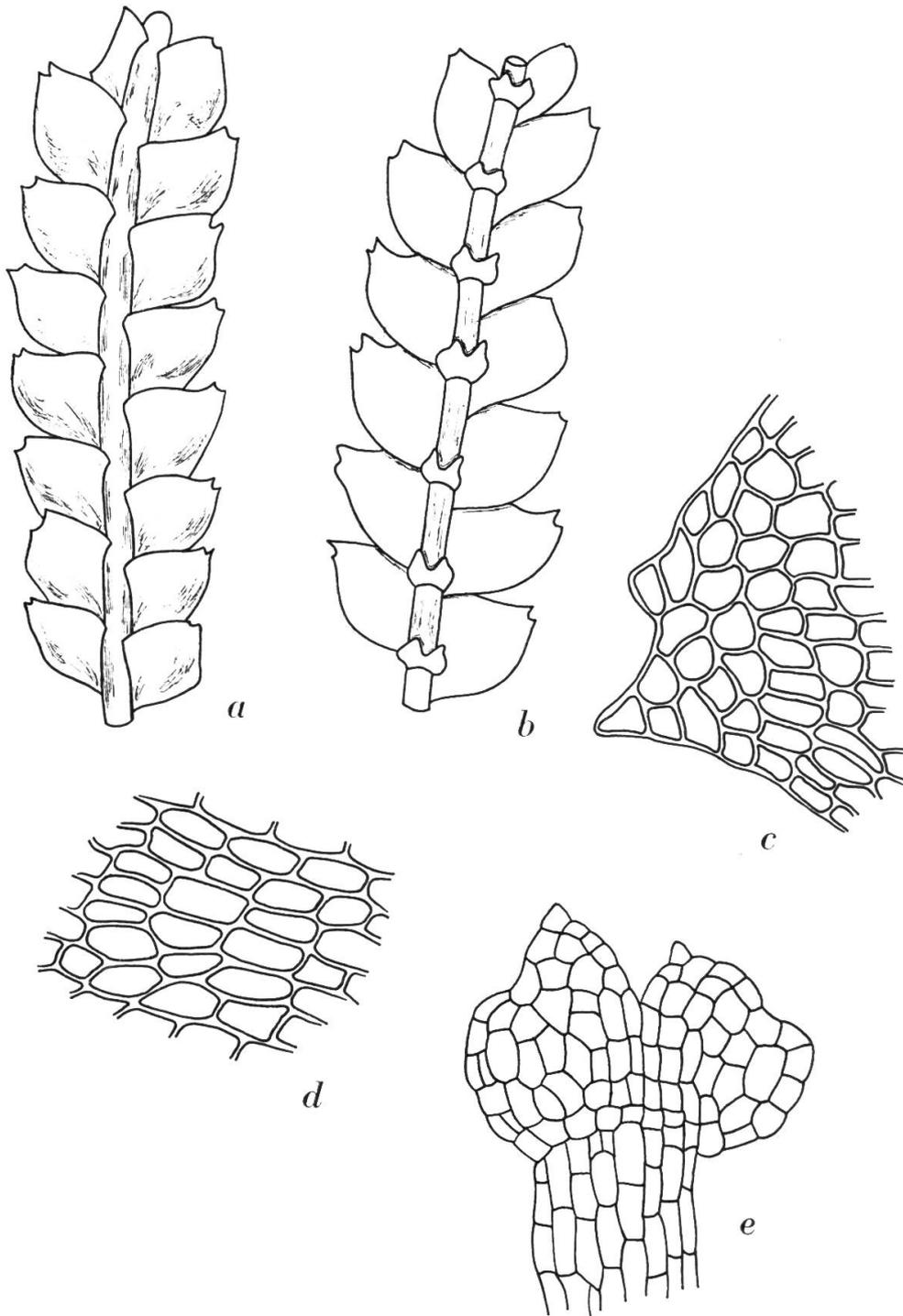


FIG. 34. — *Calypogeja rhombifolia* (Spruce) Steph. var. *colombiana* Bischler (type).  
*a*, stem, dorsal aspect,  $\times 15$  — *b*, stem, ventral aspect,  $\times 15$  — *c*, leaf apex,  $\times 150$  —  
*d*, cells in the basal region of the leaf,  $\times 150$  — *e*, underleaf,  $\times 100$ .

*Subgroup 5.**Analytical key to the species.*

- A 1. Plants with a papillose cuticle ; robust, more than 3 mm broad (leaves included).  
2. Plants with a smooth cuticle ; smaller, less than 3 mm broad (leaves included).
- B 1. Leaves nearly rectangular. Dorsal and ventral edges quite straight, parallel to each other. Ratio : length/width of the leaves = 1,5-2,5/1.  
2. Leaves oval shaped. Dorsal and ventral edges curved, not parallel. Ratio : length/width of the leaves = 1,4-1/1.  
3. Leaves falcate. Dorsal edges strongly curved. Ventral edges concave curved, becoming nearly parallel to the dorsals. Ratio : length/width of the leaves = 1,6-2/1.
- C 1. Leaves bilobed or bidentate, with narrow, pointed, usually slightly divergent, lobes or teeth and rounded sinus, 34-140  $\mu$  deep.  
2. Leaves bilobed, with broad, pointed, erect, lobes and pointed sinus, 150  $\mu$  deep.
- D 1. Leaf margins indistinct, composed of rectangular cells which are 34-68  $\mu$  long.  
2. Leaf margins distinct, composed of elongated, transparent cells which are 68-119  $\mu$  long.
- E 1. Leaf cells large, at the apex 42-60  $\mu$  long, at the base 80-136  $\mu$  long.  
2. Leaf cells smaller, at the apex 34  $\mu$  long, at the base at maximum 68  $\mu$  long.
- F 1. Underleaves with rounded sinus, wider than long (ratio : length/width = 1/1,2-2,5).  
2. Underleaves with pointed sinus, as long as wide.
- G 1. Underleaf cells in the centre of the organ never more than 68  $\mu$  long, with small trigones or none at all.  
2. Underleaf cells in the centre of the organ more than 85  $\mu$  long, usually with medium sized to conspicuous trigones.

	A	B	C	D	E	F	G
<i>C. amazonica</i> .....	1	1	1	1	1	1	1
<i>C. miquelii</i> .....	2	1	2	1	2	1	1
<i>C. falcata</i> .....	1	3	1	2	1	1	2
<i>C. laxa</i> .....	2	2	1	2	1	1	1
<i>C. uncinatula</i> .....	2	2	1	1	2	2	2

*Dichotomous key to the species.*

Leaves nearly rectangular, with dorsal and ventral edges quite straight, parallel to each other ; or leaves falcate, with strongly curved dorsal edges and concave ventral edges, the two being symmetrical, nearly parallel along the main part of the leaf. Ratio : length/width of the leaves = 1,5-2,5/1. Stem width usually 175-210  $\mu$ . Underleaves with teeth on their outer edges and divergent, pointed lobes. Sinus rounded. Cuticle usually papillose

Leaves rectangular, with dorsal and ventral edges nearly straight and parallel to each other. Breadth of the stems 2,3-4,5 mm (leaves included). No distinct leaf

- margins. Marginal cells rectangular, 34-68  $\mu$  long. Underleaf cells small, in the centre of the organ at most 68  $\mu$  long.
- Leaves bilobed or bidentate, with narrow, pointed, usually slightly divergent lobes or teeth and rounded sinus, 34-105  $\mu$  deep. Leaf cells large, at the apex 42-60  $\mu$  long, at the base 51-127  $\mu$  long. Underleaves with small to medium sized trigones. Cuticle papillose. . . . . 3. **C. amazonica** (Spruce) Steph.
- Leaves bilobed, with broad, pointed, erect lobes and pointed sinus, 150  $\mu$  deep. Leaf cells smaller, at the apex 34  $\mu$  long, at the base at most 68  $\mu$  long. Underleaves without trigones. Cuticle smooth. . . . . 4. **C. miquelii** Mont.
- Leaves falcate, with strongly curved dorsal edges and concave ventral edges, the two being symmetrical, parallel along the main part of the leaf. Breadth of the stems 4,6-5 mm (leaves included). Leaf margins distinct, composed of elongate, transparent cells which are 76-119  $\mu$  long. Underleaf cells in the centre of the organ 68-102  $\mu$  long . . . . . 5. **C. falcata** Bischler.
- Leaves oval. Dorsal and ventral edges curved, asymmetrical, not parallel. Ratio: length/width of the leaves = 1,4-1/1. Stem width 140-175  $\mu$ . Underleaves usually with protuberances on their outer edges, only rarely with teeth. Lobes erect, pointed. Sinus rounded or pointed. Cuticle usually smooth
- Leaves with distinct margins, composed of elongate, transparent cells, 68-110  $\mu$  long. Leaf cells large, at the apex 42-51  $\mu$  long, at the base 51-85  $\mu$  long. Underleaf cells small, in the centre of the organ 42-60  $\mu$  long. Underleaves with erect, pointed lobes and rounded sinus, wider than long (ratio: length/width = 1/1,2-1,8) . . . . . 6. **C. laxa** Gottsche & Lindenb.
- Leaves without distinct leaf margins. Marginal cells rectangular, at most 60  $\mu$  long. Leaf cells small, at the apex 34  $\mu$  long, at the base at most 68  $\mu$  long. Underleaf cells larger, in the centre of the organ 93  $\mu$  long. Underleaves usually with erect, pointed lobes and pointed sinus, as long as wide
7. **C. uncinatula** Herzog.

3. — **Calypogeja amazonica** (Spruce) Steph. *Spec. Hep.* 3:412. Aug. 31, 1908. = *Kantia amazonica* Spruce, *Trans. Proc. Bot. Soc. Edinburgh* 15:415. Nov. 1885.

*ICONES*: This paper, fig. 35; STEPHANI, *Icones Hepaticarum* ined. in hb G n° 1259.

*Stems* creeping, flexuose, 1-5 cm long, 2,3-4,8 mm broad (leaves included). Stem width 130-230  $\mu$ . Cortical cells thin walled or slightly thickened; trigones small or medium sized, rarely absent. Cell dimensions: 85-144  $\times$  17-42  $\mu$ . *Rhizoides* usually numerous, variable in length, hyaline or brownish, frequently branched. *Lateral branches* few in number, usually long. No flagelliform branches. The stems show a tendency to be markedly asymmetrical. *Leaves* hardly imbricate or distant, slightly convex and frequently creased, 910-2185  $\mu$  long, 525-1380  $\mu$  wide. Ratio: length/width = 1,5-2,5/1. Dorsal edge quite straight. Ventral edge nearly parallel to the dorsal and usually strongly decurrent. Leaf insertion slightly arched. Leaf apex bidentate or bilobed, usually with narrow, pointed, erect or divergent lobes or teeth. Sinus usually wide and rounded, rarely pointed and less wide, 34-105  $\mu$  deep. Leaf margins not distinct. Leaf cells with thin or slightly thickened walls. Trigones medium sized or large. Cell dimensions: marginal 34-110  $\times$  17-42  $\mu$ , apical 30-60  $\times$  25-51  $\mu$ ,

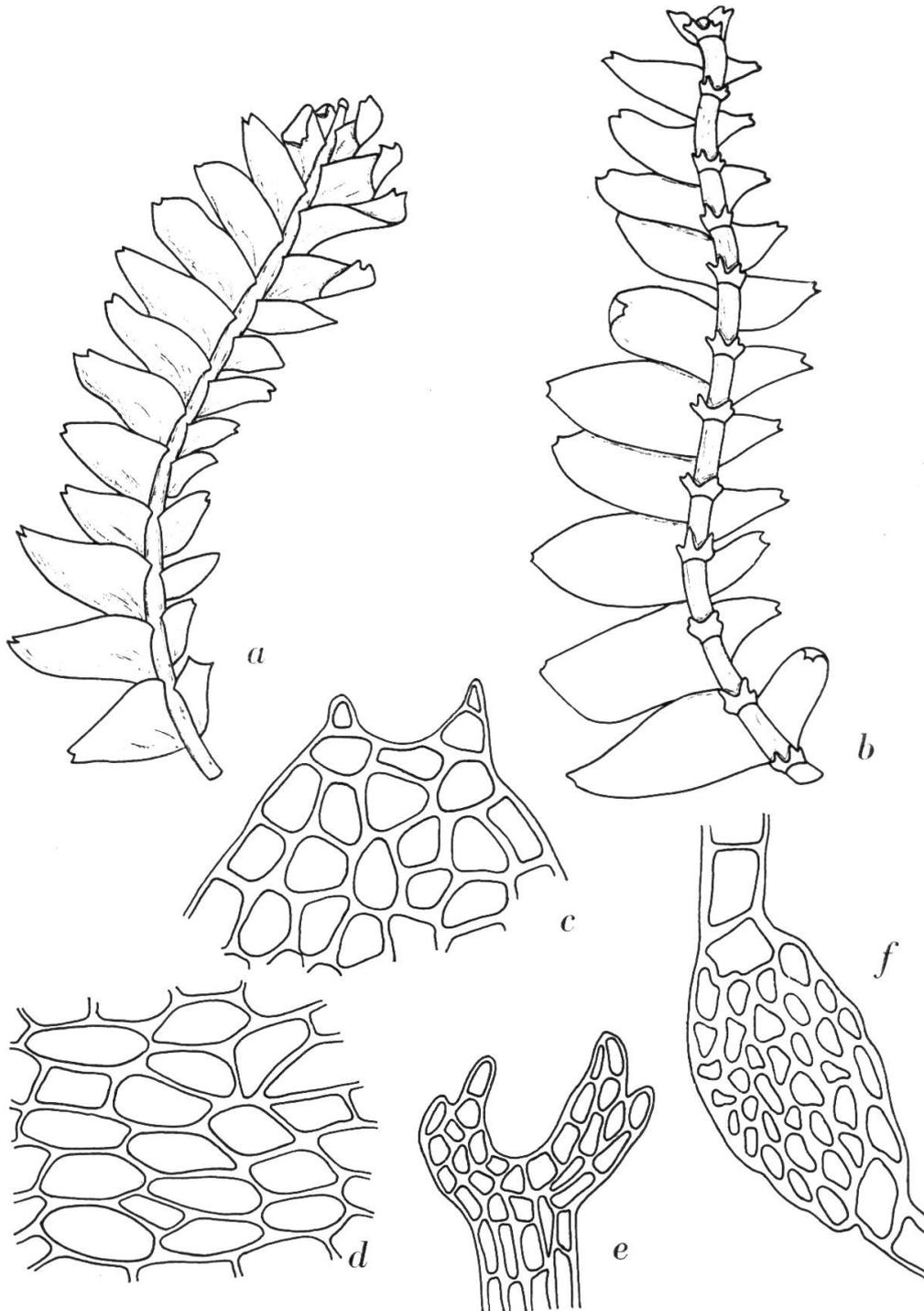


FIG. 35. — *Calypogeja amazonica* (Spruce) Steph. (lectotype).  
 a, stem, dorsal aspect,  $\times 15$  — b, stem, ventral aspect,  $\times 15$  — c, leaf apex,  $\times 150$  —  
 d, cells in the basal region of the leaf,  $\times 150$  — e, underleaf,  $\times 100$  — f, stem cross section,  
 $\times 100$ .

central  $42-102 \times 25-60 \mu$ , basal  $51-127 \times 25-51 \mu$ . *Underleaves* 1,2-2,4 times the width of the stem,  $105-350 \mu$  long,  $210-500 \mu$  wide. Not decurrent. Ratio: length/width = 1/1,2-2,5. Outer edges straight or slightly rounded, bearing on each side a 1-4 celled tooth. Apex divided to 4/10-8/10 of the underleaf length into two narrow and pointed lobes which usually are divergent, rarely erect. Sinus rounded and wide, rarely pointed and narrower,  $70-280 \mu$  deep. Underleaf cells with thin or slightly thickened walls. Trigones small or medium sized, rarely large. Cell dimensions: marginal  $34-68 \times 25-42 \mu$ , central  $34-68 \times 20-40 \mu$ . *Inflorescences* monoicous. ♂ and ♀ opposite; ♀ with 2-4 pairs of small, very convex bracts which are irregularly 2-3 lobed. Marsupia cylindrical, bearing many rhizoides. Capsule cylindrical. ♂ with 3-5 pairs of small, bilobed bracts. *Cuticle* usually strongly papillose.

*HAB.*: *C. amazonica* forms light green, olive or whitish, usually dense, mats on damp soil, sand, more rarely on rotten wood or bark. It is frequently associated with other Hepaticae. It has been gathered at low altitudes, up to 1000 m, but has been found at levels up to 2000 m.

*LECTOTYPE*: BRAZIL: Tauau, s.d., *Spruce s.n.* (MANCH).

*DISTR.*: SOUTH AMERICA: Brazil, Colombia, Paraguay, Venezuela. CENTRAL AMERICA: Dominica.

Other material studied: BRAZIL: San Gabriel, Rio Negro, s.d., *Spruce s.n.* (MANCH); *Hepaticae Spruceanae, Amazonicae et Andinae*, Silva Amazonica, Manaus, s.d., *Spruce s.n.* (G n° 1854); fl. Negro et Uaupes, s.d., *Spruce s.n.* (G n° 1855, LD, M); Serra do Araripe, Ceara, Aug. 1933, *Lützelburg 26560 p.p.* (hb HERZOG). BRAZIL AND VENEZUELA: *Hepaticae Spruceanae, Amazonicae et Andinae*, Silva Amazonica, San Carlos et fl. Uaupes, s.d., *Spruce s.n.* (G n°s 1852, 1853, BM, MANCH). COLOMBIA: Antioquia, forêt près de Yarmal, 2300 m, Jul. 11, 1956, *Bischler 77* (G); Valle, à 43 km de Buenaventura, parois de rochers au bord de la route Cali-Buenaventura, 500 m, Aug. 3, 1958, *Bischler 474* (G); Santander del Norte, Catatumbo, Campo Tibu, Bosque al borde del rio Tibu, 200 m, May 15, 1959, *Bischler 2453* (G); Santander del Norte, Catatumbo, Cerro del Tirador, cerca de Las Mercedes, 1000 m, May 18, 1959, *Bischler 2584 A* (G); Santander del Norte, Catatumbo, Petrolea y alrededores, 250-350 m, May 20, 1959, *Bischler 2645* (G). PARAGUAY: Cerro Leon, March 20, 1885, *Balansa 4335* (G). DOMINICA: s.d., *Elliott 1210, 1256, 1890* (G), 1887 (G, M).

*OBS.*: Two gatherings of original material of *C. amazonica* are kept in the SPRUCE collection, the first from Tauau, the second from San Gabriel. Both are cited by SPRUCE, but the first seems to correspond better to the original description. It is therefore chosen as the lectotype of the species.

SPRUCE (*l.c.*: 416) describes a variety to *C. amazonica*: var. *inaequifoliata* Spruce. It would differ from the var. *amazonica* by its very strongly asymmetrical stems, the leaves being reduced on one side to little scales or be lacking completely. The underleaves on the same side would also be reduced to a few cells, the far side being normal. No representative of this variety could be

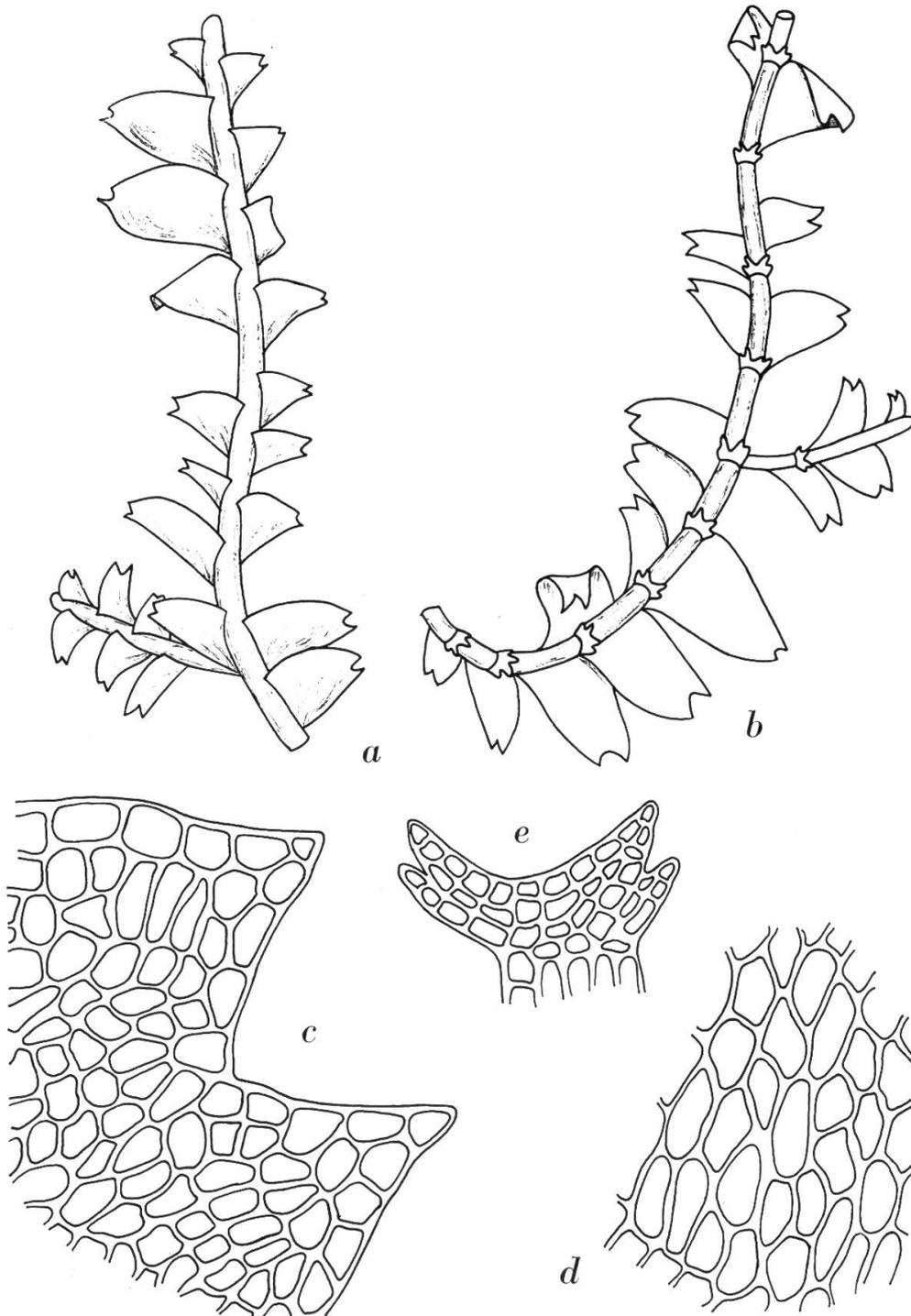


FIG. 36. — *Calypogeja miquelii* Mont. (type).  
*a*, stem, dorsal aspect,  $\times 15$  — *b*, stem, ventral aspect,  $\times 15$  — *c*, leaf apex,  $\times 150$  —  
*d*, cells in the basal region of the leaf,  $\times 150$  — *e*, underleaf,  $\times 100$ .

obtained from the SPRUCE collection, and the type, from Uaupes river, seems to be lost.

*C. amazonica* is a very variable species. The only characteristics which are relatively stable are its leaf shape and its strongly asymmetrical and often creased stems, which distinguish it from all other tropical american species of the genus. Its distribution seems to be very large, it is probably one of the most common *Calypogeja* of the low tropical and subtropical zones.

4. — *Calypogeja miquelii* Mont. in Gottsche, Lindenb. & Nees, *Syn. Hep.*: 200. 1845 = *Kantia miquelii* (Mont.) Trev. *Mem. R. Ist. Lombardo* ser. 3. Cl. Sci. 4:425. 1877.

*ICONES*: This paper, fig. 36.

*Stems* creeping, fairly flexuose, 1-3 cm long, 2,2-2,8 mm broad (leaves included). Stem width 204  $\mu$ . Cortical cells thin walled. Trigones lacking. Cell dimensions: 119  $\times$  17-35  $\mu$ . *Rhizoides* numerous, fairly long, hyaline. *Lateral branches* numerous. No flagelliform branches. Frequently the stems are asymmetrical. *Leaves* hardly imbricate or distant, 1050-1100  $\mu$  long, 600-700  $\mu$  wide. Ratio: length/width = 1,5-1,8/1. Dorsal edge slightly curved. Ventral edge slightly curved and strongly decurrent. Insertion slightly arched. Leaf apex divided into two, usually triangular, pointed lobes by a V-shaped (sometimes rounded) sinus, 153  $\mu$  deep. Leaf margins not distinct. Leaf cells thin walled, with medium sized trigones. Cell dimensions: marginal 60-68  $\times$  25  $\mu$ , apical 34  $\times$  34  $\mu$ , central 68  $\times$  25  $\mu$ , basal 68  $\times$  34  $\mu$ . *Underleaves* 1,2-1,5 times the width of the stem, 150-204  $\mu$  long, 250-300  $\mu$  wide. Not decurrent. Ratio: length/width = 1/1,5-1,8. Outer edges straight or slightly rounded, bearing on each side a 1-3 celled, pointed tooth. Apex divided to 6-7/10 of the underleaf length into two pointed and narrow, divergent lobes. Sinus wide and rounded, 90-127  $\mu$  deep. Underleaf cells thin walled. No trigones. Cell dimensions: central 42  $\times$  22  $\mu$ , marginal 34  $\times$  13-25  $\mu$ . *Sterile*. *Cuticle* smooth.

*HAB.*: *C. miquelii* is said to form light green mats on damp soil and rotten wood, but it has also been observed growing as an epiphyllous plant. It has been gathered at low altitudes only.

*TYPE*: DUTCH GUIANA: Surinam, s.d., *Miquel s.n.* (P) (portion in hb G, n° 1842).

*DISTR.*: SOUTH AMERICA: Dutch Guiana. CENTRAL AMERICA: Cuba.

Other material studied: CUBA: Mountains of Rangel Dec, s.d., *Wright s.n.* (FH).

*OBS.*: The specimen cited from Portorico (Hampe & Gottsche, *Linnaea* 25: 345. 1852) and those from Guadeloupe (Besch. & Spruce, *Bull. Soc. Bot. France* 36. Suppl.: 184. 1889) do not seem to exist any more.

SPRUCE (*Bull. Soc. Bot. France* 36. Suppl.: 184. 1889) describes a variety to this species: var. *oppositifolia* Spruce. Type: Guadeloupe, s.d., *L'Herminier*. It would differ from var. *miquelii* by its more robust stems, 8 cm long, its sub-

opposite, imbricate and convex leaves which are of the same length and width, its more conspicuous underleaves with outer edges bearing 2-3 protuberances. The underleaves are bilobed, the lobes being rounded and separated by a rounded, shallow sinus. Unfortunately no representative of this variety could be found. According to the description, it would be quite closely related to *C. biapiculata* (Spruce) Steph. and its relationship to *C. miquelii* Mont. seems to be very obscure.

STEPHANI (*Spec. Hep.* 3:405. Aug. 31. 1908) described *C. miquelii* with bilobed underleaves without protuberances or teeth, and drew it thus in his *Icones* (hb G n° 1273). But the type specimen clearly shows the underleaves to be bisbifid. It is quite possible that Stephani overlooked the fact, owing to the bad state of the material at his disposal. STEPHANI'S definition of the species has therefore to be considered as erroneous.

*C. miquelii*, is closely related to *C. amazonica* (Spruce) Steph., having in common with it its peculiar leaf shape. However, its very deep leaf sinus and the triangular, quite broad, lobes, and its smaller leaf and underleaf cells, keep it separate from the latter species.

##### 5. — *Calypogeja falcata* Bischler spec. nov.

*ICONES*: This paper, fig. 37.

*Caules* prostrati, parum ramosi, saepe asymmetrici, cellulis corticalibus elongatissimis. *Folia* parum imbricata, recte patula, falcata, apice bidentata lobis acutis, sinu rotundato, 1,5 × minime longiora quam lata, in basi decurrentia, margine cellulis longioribus pellucidis limbata. Cellulae magnae, parietibus tenuibus trigonis parvis instructis, apicales 42-51 × 34-42 μ, basiales 85-136 × 47-51 μ. *Amphigastria* 1,5-2,5 × latiora quam caulis, recte inserta, bisbifida, apice 7/10-9/10 divisa, lobis divergentibus acutis interioribus longioribus. Cellulae magnae, parietibus tenuibus trigonis parvis instructis, centrales 68-102 × 34-42 μ. *Sterilis*. *Cuticula* laevis laeviterque striolata. *Stems* creeping, 2-3 cm long, 4,6-5 mm broad (leaves included). Stem width 175-210 μ. Cortical cells strongly elongated, with usually thickened walls and quite conspicuous trigones. Cell dimensions: 119-144 × 34-42 μ. *Rhizoides* numerous, variable in length, hyaline or brownish. *Lateral branches* rare. No flagelliform branches. The stems are often asymmetrical. *Leaves* hardly imbricate, 2300-2530 μ long, 1380-1610 μ wide. Ratio: length/width = 1,6-1,7/1. Dorsal edge strongly curved. Ventral edge concave and strongly decurrent. The aspect of the leaf appears thus to be falcate. Leaf insertion slightly arched. Leaf apex bidentate, with teeth formed by 1-3 cells in a single row. The teeth are pointed and erect. Sinus rounded, narrow, 70-140 μ deep. Leaf margins distinct, especially so on the young leaves, composed of transparent and elongated cells. Leaf cells thin walled. Trigones small towards the apex, small or medium sized at the base. Cell dimensions: marginal 76-119 × 25-34 μ, apical 42-51 × 34-42 μ, central 68-102 × 34-60 μ, basal 85-136 × 47-51 μ. *Underleaves* 1,5-2,5 times the width of the stem, 280-385 μ long, 385-455 μ wide. Not decurrent. Ratio: length/width = 1/1-1,6. Outer edges straight, bearing usually on each side a narrow and pointed, 1-3 celled tooth or a rounded protuberance. These are occasionally missing on one side. Apex divided to 7/10-9/10 of the underleaf length into

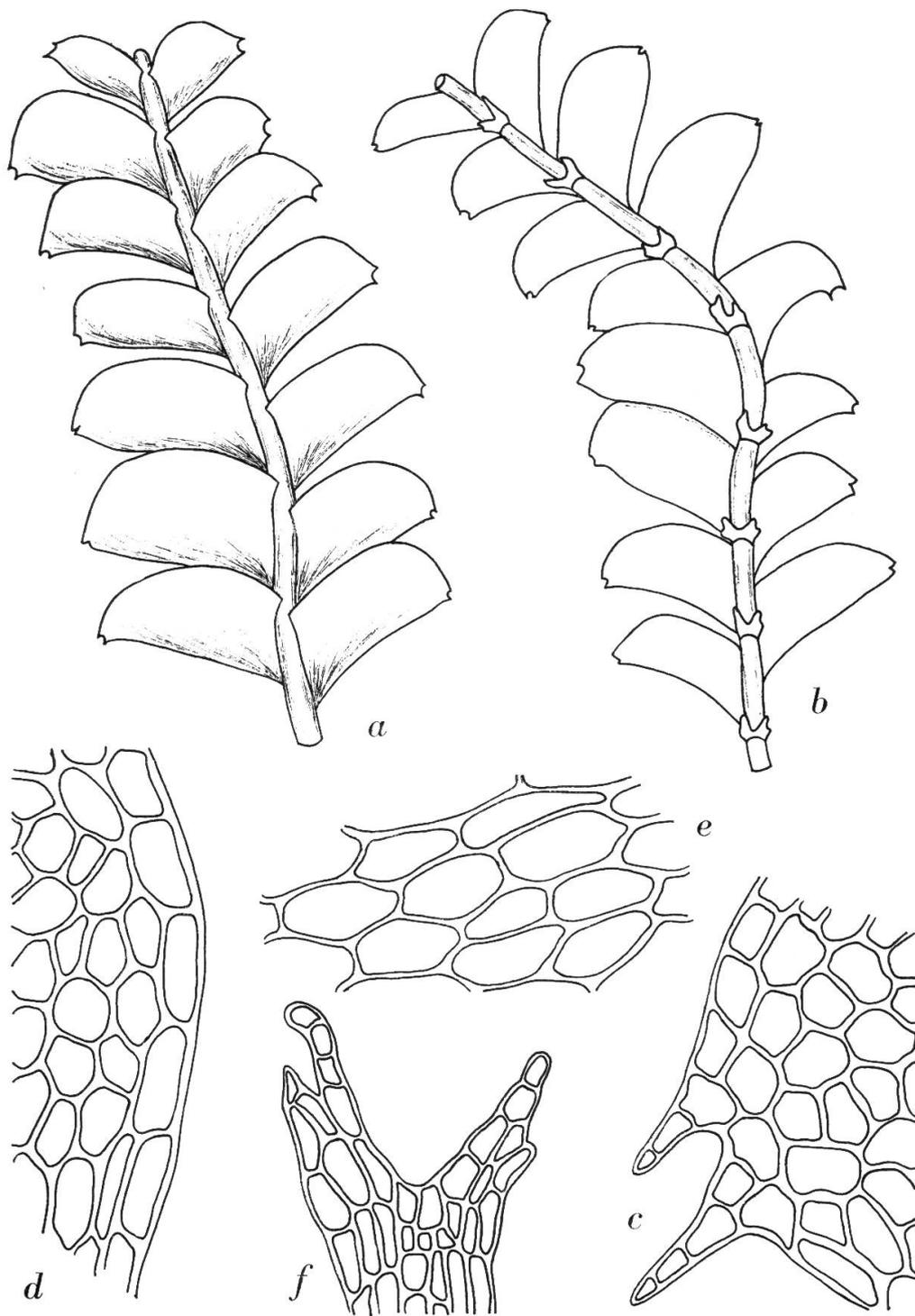


FIG. 37. — *Calypogeja falcata* Bischler (type).

*a*, stem, dorsal aspect,  $\times 15$  — *b*, stem, ventral aspect,  $\times 15$  — *c*, leaf apex,  $\times 150$  — *d*, margin on the ventral edge of the leaf,  $\times 150$  — *e*, cells in the basal region of the leaf,  $\times 150$  — *f*, underleaf,  $\times 100$ .

two narrow, pointed and divergent lobes, which are 2 cells wide at their base. Sinus wide, rounded, 175-315  $\mu$  deep. Underleaf cells thin walled. Trigones medium sized. Cell dimensions: central 68-102  $\times$  34-42  $\mu$ , marginal 60-85  $\times$  25-40  $\mu$ . *Sterile*. *Cuticle* smooth or slightly striate.

*HAB.*: *C. falcata* forms lax, light or yellowish green mats on damp soil, frequently associated with other Hepaticae. It has been gathered at low altitude.

*TYPE*: DOMINICA: s.d., *Elliott 2127* (G) (sub *C. lophocoleoides* Steph.).

*DISTR.*: CENTRAL AMERICA: Dominica.

Other material studied: DOMINICA: s.d., *Elliott 2128* (G).

*OBS.*: *C. falcata* has a very peculiar leaf shape, which separates it from all other american *Calypogeja*. By its underleaf shape and its leaf margins it seems to be related to *C. laxa* Gottsche & Lindenb., from which it differs by its leaf structure.

6. — ***Calypogeja laxa*** Gottsche & Lindenb. in Gottsche, Lindenb. & Nees, *Syn. Hep.*: 713. 1847 = *Kantia laxa* (Gottsche & Lindenb.) Trev. *Mem. R. Ist. Lombardo* ser. 3. *Cl. Sci.* 4:425. 1877 = *Kantia subtropica* Steph. *Hedwigia* 34:54. 1895 = *Calypogeja subtropica* (Steph.) Steph. *Spec. Hep.* 3:410. Aug. 31, 1908.

*ICONES*: This paper fig. 38: STEPHANI, *Icones Hepaticarum* ined. in hb G n° 1280.

*Stems* creeping, 1-2,5 cm long, 2,5-3,1 mm broad (leaves included). Stem width 153-175  $\mu$ . Cortical cells thin walled or slightly thickened, with small trigones. Cell dimensions: 102-127  $\times$  20-34  $\mu$ . *Rhizoides* numerous, long, hyaline or brownish. *Lateral branches* rare. Flagelliform branches and asymmetrical stems occur frequently. *Leaves* hardly imbricate, 945-1500  $\mu$  long, 700-1150  $\mu$  wide. Ratio: length/width = 1,3-1,2/1. Dorsal edge curved. Ventral edge slightly curved and decurrent. Leaf insertion arched. Leaf apex bidentate or bilobed, with usually narrow, pointed, erect or slightly divergent lobes or teeth. Sinus wide, rounded, 60-70  $\mu$  deep. Leaf margin distinct, composed of elongated, transparent cells, visible especially on the younger leaves. On the older it can become interrupted and thus indistinct. Leaf cells thin walled, with small or medium sized trigones. Cell dimensions: marginal 68-110  $\times$  25-42  $\mu$ , apical 42-51  $\times$  34-51  $\mu$ , central 42-68  $\times$  34-51  $\mu$ , basal 51-85  $\times$  42-51  $\mu$ . *Underleaves* 1-1,8 times the width of the stem, 136-230  $\mu$  long, 238-272  $\mu$  wide. Not decurrent. Ratio length/width = 1/1,2-1,8. Outer edges rounded, or nearly straight, bearing on each side a pointed, 1-3 celled tooth, or a rounded protuberance. Apex divided to 5/10-8/10 of the underleaf length into two narrow, pointed, erect or divergent lobes. Sinus wide, rounded, 68-175  $\mu$  deep. Underleaf cells thin walled, with small trigones or none at all. Cell dimensions: marginal 42-60  $\times$  25-30  $\mu$ , central 34-60  $\times$  25-34  $\mu$ . *Inflorescences* dioecious? ♀ marsupia 2-3 mm long, bearing rhi-

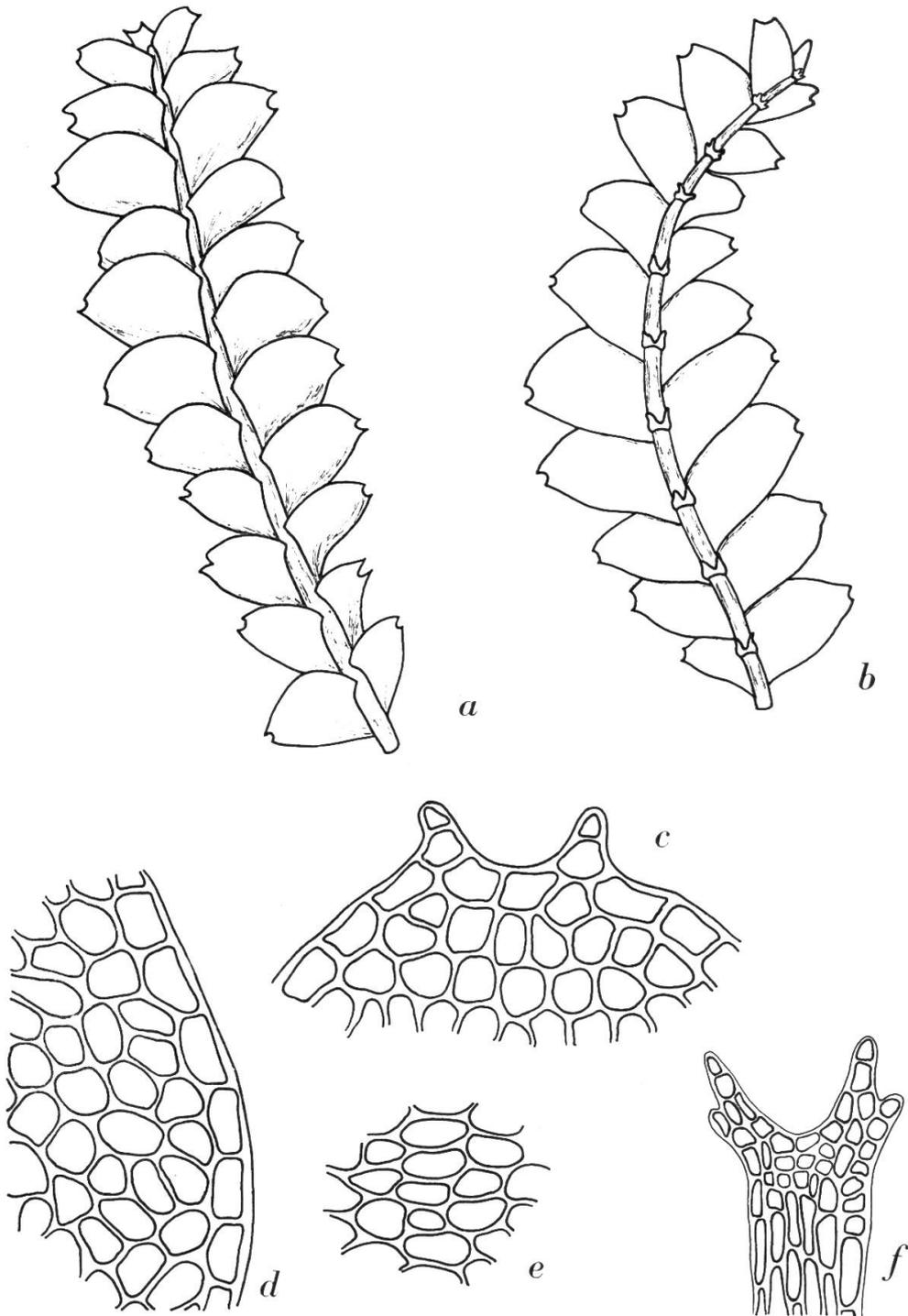


FIG. 38. — *Calypogeja laxa* Gottsche & Lindenb. (neotype).  
 a, stem, dorsal aspect,  $\times 15$  — b, stem, ventral aspect,  $\times 15$  — c, leaf apex,  $\times 150$  —  
 d, margin on the ventral edge of the leaf,  $\times 150$  — e, cells in the basal region of the leaf,  
 $\times 150$  — f, underleaf,  $\times 100$ .

zoides. Pedicel 1-1,5 cm long, white, twisted. Capsule with four orange coloured, 2 mm long, valves. Elaters 2- spiraled. Spores yellow, rounded. *Cuticle* slightly papillose or smooth.

*HAB.*: *C. laxa* forms lax or dense, light green mats on damp soil, frequently associated with other Hepaticae. It has been gathered at medium and low altitude.

*NEOTYPE*: MEXICO: Huatasco, March 1842, *Liebman 375 p.p.* (W).

*DISTR.*: SOUTH AMERICA: Brazil. CENTRAL AMERICA: Mexico.

Other material studied: BRAZIL: Rio de Janeiro, 1889, *Ule 104* (G).

*OBS.*: GOTTSCHÉ & LINDENBERG (*Syn. Hep.*: 713. 1847) cite two type localities: Huatasco and Mirador. Both collections were made by LIEBMAN in Mexico. But the authors did not cite LIEBMAN's collection numbers.

GOTTSCHÉ (*Mex. Leverm.*: 221. 1863) cites with the same localities *Liebman n<sup>os</sup> 345, 409 b.* *N<sup>o</sup> 345* seems to be lost, *n<sup>o</sup> 409 b.* does not belong to *C. laxa* Gottsche & Liddénb., it represents a plant without leaf margins (in the original description the authors speak about the elongated marginal leaf cells of the species) and corresponds in all features to *C. peruviana* Nees & Mont. But an other specimen, *n<sup>o</sup> 375*, kept in the LINDENBERG collection, contains, with *C. peruviana* Nees & Mont. var. *integrifolia* (= var. *subintegra* Gottsche, Lindénb. & Nees), *C. laxa*. It has to be chosen as the neotype of the species, no other original material being available. It would however be possible that the number cited by GOTTSCHÉ should not be *n<sup>o</sup> 345*, but *n<sup>o</sup> 375*, some error having occurred. In this case, the chosen type would be a lectotype.

STEPHANI (*Spec. Hep.* 3:406. Aug. 31, 1908) probably did not see the type of *C. laxa*. What he kept in his collection under this name are all *C. peruviana* Nees & Mont., likewise the *Icon* (G n<sup>o</sup> 1267). As a result, he described a new species with the characteristics of *C. laxa*, which he named *C. subtropica* Steph. The two species are synonyms.

*C. laxa* can be easily distinguished from *C. amazonica* (Spruce) Steph., *C. miquelii* Mont. and *C. falcata* Bischler by its different leaf shape, which is oval, the length being only slightly different from the width, and the dorsal and ventral edges both slightly curved. From *C. uncinatula* Herzog, which has very similar leaves, it can be separated principally by its distinct leaf margins.

#### 7. — *Calypogeja uncinatula* Herzog, *Hedwigia* 67:250. 1927.

*ICONES*: This paper, fig. 39.

*Stems* creeping, 2-3,5 cm long, 2,5 mm broad (leaves included). Stem width 140  $\mu$ . Cortical cells thin walled. Trigones lacking. Cell dimensions: 93-100  $\times$  17  $\mu$ . *Rhizoides* few, long, hyaline. *Lateral branches* rare. No flagelliform branches. *Leaves* distant, frequently incurved, 1276  $\mu$  long, 910  $\mu$  wide. Ratio: length/width = 1,4/1.

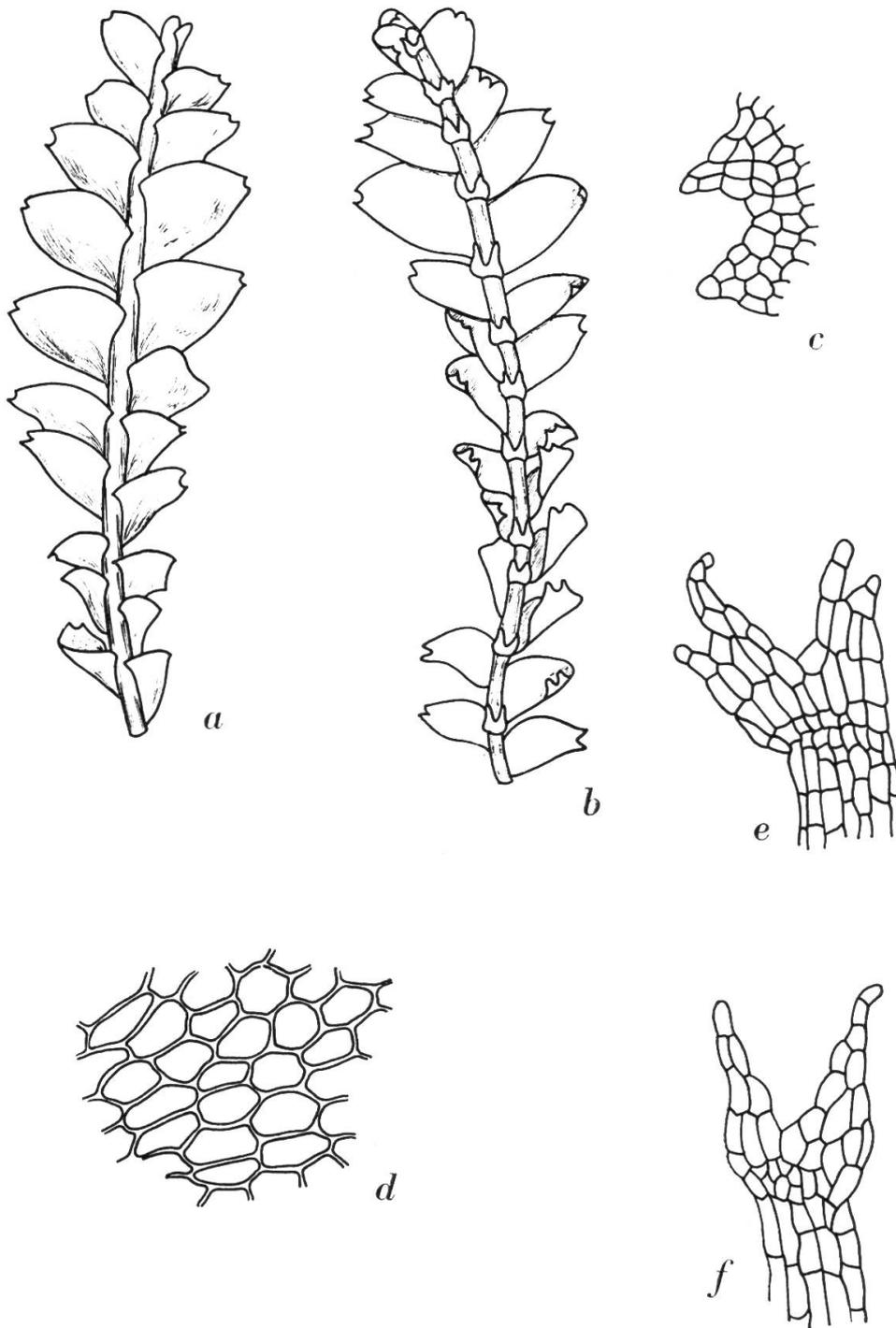


FIG. 39. — *Calypogeja uncinatula* Herzog (type).

*a*, stem, dorsal aspect,  $\times 15$  — *b*, stem, ventral aspect,  $\times 15$  — *c*, leaf apex,  $\times 150$  — *d*, cells in the basal region of the leaf,  $\times 150$  — *e*, underleaf,  $\times 100$  — *f*, underleaf,  $\times 100$ .

Dorsal edge curved. Ventral edge slightly curved and more or less decurrent. Leaf insertion slightly arched. Leaf apex bilobed or bidentate, with narrow, pointed, erect or divergent lobes. Sinus pointed or rounded, narrow or wide, 105  $\mu$  deep. Leaf margins indistinct. Leaf cells thin walled, with medium sized trigones. Cell dimensions: marginal 60  $\times$  34  $\mu$ , apical 34  $\times$  25  $\mu$ , central 51  $\times$  34  $\mu$ , basal 68  $\times$  34  $\mu$ . *Underleaves* twice the width of the stem, 280  $\mu$  long, 280  $\mu$  wide. Not decurrent. Ratio: length/width = 1/1. Outer edges rounded, bearing on each side a narrow, pointed, 1-4 celled tooth or a rounded protuberance. Apex divided to 6/10 of the underleaf length into two narrow and pointed lobes, which can be erect or divergent. Sinus usually pointed, 175  $\mu$  deep. Underleaf cells thin walled, with medium sized trigones. Cell dimensions: marginal 60  $\times$  34  $\mu$ , central 93  $\times$  25  $\mu$ . *Sterile. Cuticle smooth.*

*HAB.:* *C. uncinatula* forms light green or yellowish mats on damp soil. It has been gathered at low altitude.

*TYPE:* BRAZIL: Ilha da Queimada Grande, São Paulo, Nov. 4, 1920. *Gehrt 221* (hb Herzog).

*DISTR.:* SOUTH AMERICA: Brazil.

*OBS.:* HERZOG speaks in the original description of 1-2 celled, plane and curved papillae which should exist on the leaf apices and the underleaves. They were not observed, either they had disappeared or completely collapsed during the years the specimen was kept in the herbarium.

The general aspect of *C. uncinatula* is very like that of *C. laxa* Gottsche & Lindenb., but the latter species shows distinct leaf margins. The oval leaf shape of *C. uncinatula* distinguishes it from *C. amazonica* (Spruce) Steph., *C. miquelii* Mont. and *C. falcata* Bischler.

#### *Dubia*

From the following species, no original material was available. The types seem to be lost.

***Calypogeja annabanensis*** Steph. *Bibl. Bot.* 87:223. 1916 (nomen nudum).

*TYPE:* BOLIVIA: Sine loco natali, *Herzog s.n.*

*OBS.:* STEPHANI described later a *C. annabanensis* Steph. (*Spec. Hep.* 6:447. Jan. 30, 1924) from Annabon Island, but without mention of the bolivian specimen, which is probably not conspecific.

***Calypogeja fistulata*** Mitten, Thompson & Murray, *Rep. Chall. Exp.* 1,3:85. 1884.

*TYPE:* JUAN FERNANDEZ, s.d., *Saunders s.n.*

*OBS.*: MITTEN, in his original diagnosis, did not mention the underleaves of the species, it is therefore possible that it does not belong to the genus *Calypogeja*. It has been completely overlooked since its description.

***Calypogeja leptoloma*** (Spruce) Steph. *Spec. Hep.* 3:412. Aug. 31, 1908 = *Kantia leptoloma* Spruce, *Trans. Proc. Bot. Soc. Edinburgh* 15:414. Nov. 1885.

*TYPE*: BRAZIL: In trunco carioso ad Panuré fl. Uaupes, s.d., *Spruce s.n.*

*OBS.*: *C. leptoloma* (Spruce) Steph. is probably closely related with *C. lechleri* (Steph.) Steph., or conspecific. Both species have the same leaf margins and correspond in all the features which SPRUCE mentions in his original diagnosis of *C. leptoloma* (Spruce) Steph. Only the inflorescences seem to be dioecious in *C. lechleri* (Steph.) Steph., paroicous in *C. leptoloma* (Spruce) Steph. No other species of *Calypogeja* is known until now with paroicous inflorescences.

STEPHANI did not see the type of *C. leptoloma* (Spruce) Steph. His figure (*Icones Hepaticarum* ined. G n° 1270) is an interpretation of SPRUCE's diagnosis.

The following species, cited from South or Central America, do not exist in this area:

*Calypogeja sullivantii* Austin, distributed in the exsiccatae "Fungi (!) Cubenses Wrightiani". It corresponds to *C. miquelii* Mont.

*Calypogeja trichomanis* (L.) Corda, cited by Hampe & Gottsche (*Linnaea* 25:345. 1852) from Portorico and by Gottsche (*Ann. Sci. Nat. Paris* ser. 5, 1: 139. 1864) from Colombia and (*Mex. Leverm.*:220. 1863) from Mexico. The portorican and colombian specimens belong to *C. peruviana* Nees & Mont., the mexican specimen could not be discovered.

In the STEPHANI collection there are two other specimens of *C. trichomanis* (L.) Corda, the first from Guatemala (G n° 1804), which belongs to *C. peruviana* Nees & Mont., the second, from Ecuador (G n° 1805) is *C. andicola* Bischler.

#### *Excludenda*

The following species do not belong to the genus *Calypogeja*:

*Calypogeja euthemona* Spruce, *Trans. Proc. Bot. Soc. Edinburgh* 15:449. Nov. 1885 = *Gongylanthus euthemonus* (Spruce) Steph. *Spec. Hep.* 3:43. Apr. 30, 1906.

*Calypogeja granatensis* (Gottsche) Steph. *Hedwigia* 31:13. 1892 = *Gongylanthus granatensis* (Gottsche) Steph. *Spec. Hep.* 3:41. Apr. 30, 1906.

*Calypogeja oniscoides* Spruce, *Trans. Proc. Bot. Soc. Edinburgh* 15:448. Nov. 1885 = *Gongylanthus oniscoides* (Spruce) Steph. *Spec. Hep.* 3:42. Apr. 30, 1906.

*Calypogeja pringlei* Underwood (nomen nudum). Type: Underwood & Cook, *Hepaticae americanae exsiccatae* n° 106 = *Gongylanthus pringlei* Steph. *Spec. Hep.* 3:44. Apr. 30, 1906.

*Calypogeja uleana* (Steph.) Steph. *Spec. Hep.* 3:396. Jul. 31, 1908 (= *Kantia uleana* Steph. *Hedwigia* 34:54. 1895) = *Chiloscyphus* (?) sp.

#### *Herbarium names*

*Calypogeja contigua* Steph. in herb. = *Calypogeja lechleri* (Steph.) Steph.

*Calypogeja peruviana* Nees & Mont. var. *integrifolia* in herb. = *Calypogeja subintegra* (Gottsche, Lindenb. & Nees) Bischler.

*Calypogeja portoricensis* (Steph.) Evans f. *laxa* Steph. in herb. = *Calypogeja lophocoleoides* Steph.

*Calypogeja puiggariana* Steph. in herb. = *Calypogeja puiggarii* Steph.

*Jungermannia cellularis* Sprengel in herb. = *Calypogeja cellulosa* (Sprengel) Steph.

*Kantia granulata* Gottsche in herb. = *Calypogeja cyclostipa* (Spruce) Steph.

*Kantia trichomanis* (L.) Lindb. var. *granulosa* Gottsche in herb. = *Calypogeja mastigophora* (Spruce) Steph.

*Mastigobryum decursivum* Lac. in herb. = *Calypogeja lechleri* (Steph.) Steph.

*Saccogyna puiggariana* Gottsche in herb. = *Calypogeja puiggarii* Steph.

#### *Discussion on the subdivision of the genus Calypogeja into subgenera*

*Calypogeja* Raddi is a clearly defined and fairly homogenous genus. Its components have no near relation to species of other groups of Hepaticae with incubous leaves. Its subdivision into more or less numerous small genera seems at the present state of knowledge not justified for the following reasons:

- a) the genus is composed of a relatively small number of species. It is therefore still easy to handle.
- b) smaller genera would be less clearly defined and the homogeneity of the old genus would be destroyed.
- c) the distinctive features between the natural groups in the genus are not of such a character that they could be employed as distinctive generic features.

The existing small genera, such as *Mnioloma* Herzog, and *Metacalypogeia* (Hattori) Inoue can not be maintained without splitting the remaining components of the genus into more small genera, the distinctive features between them and *Calypogeja* being of the same order as those between the groups in the interior of the genus. The genus has thus been kept in its widest sense.

The subgenera of the neotropical *Calypogeja* are separated essentially on the basis of cell dimorphism which exists in the subgenera 1 and 2 between

the cortical and inner stem cells, the marginal and inner leaf cells, and the leaf and underleaf cells. This dimorphism is relatively stable, but can vary more or less within the species at the extreme limits of the subgenera.

*Type of branching and stem structure in South and Central American Calypogeja.*

All species from South and Central America of *Calypogeja* appeared to have branches of the intercalary type. They arise from one half of the ventral segment, and never in the middle of it (cf. fig. 40a). This fact has been observed for the vegetative and sexual branches. Between them no difference of origin or localisation exists. No other type of branching has been found within the genus.

Usually the stems of the species of *Calypogeja* are built up of cells of the same size throughout. However, in the subgenera *Mnioloma* (Herzog) Bischler and *Caracoma* Bischler the cortical row of cells has thickened, brownish walls. The stem cross section appears thus to have a coloured ring. This peculiarity in *Mnioloma* (Herzog) Bischler confirms the near relation which this, formerly independent genus, has with the subgenus *Caracoma* Bischler. It is an additional justification for the union of both, as independent subgenera, subordinated to the genus *Calypogeja* (cf. fig. 40b and c).

Subgenus *Calypogeja* and its *subgroups* 1 to 4 have homogenous stem cross sections. *Subgroup* 5 shows a strong tendency to have a much larger cell on each side (fig. 41h). The significance of this fact is unknown, but is very constantly observed in all specimens. The absence of such larger cells in *C. muscicola* Steph., which shows in its outer aspect a great resemblance to the species of *subgroup* 5 and seemed first to be intermediate between *subgroups* 1 and 5, was an additional reason to classify the species in *subgroup* 1.

The species of *subgroups* 3 and 5 have very elongated cortical cells in their stems. This fact does not seem to bear any relation to the inner structure of the stems (cf. fig. 41f), as seen in cross section.

#### CONCLUSIONS

No research on the physiology and genetics of the tropical species of *Calypogeja* has been carried out, in this sense no results have been available to supplement the morphological data. Only rare fresh material could be studied, the characteristics of the oil bodies are therefore not included. Very few fertile plants have been examined; they are rare in the tropical areas and their fructifications very ephemeral. The classification is thus based exclusively upon the distinctive vegetative features of the species.

Many dubia remain still, for which no material was available. This is especially true for some species and varieties described by SPRUCE. However, from his exsiccatae, eight of the eleven probably parallel series have been examined, and the determinations have been found in all cases exact.

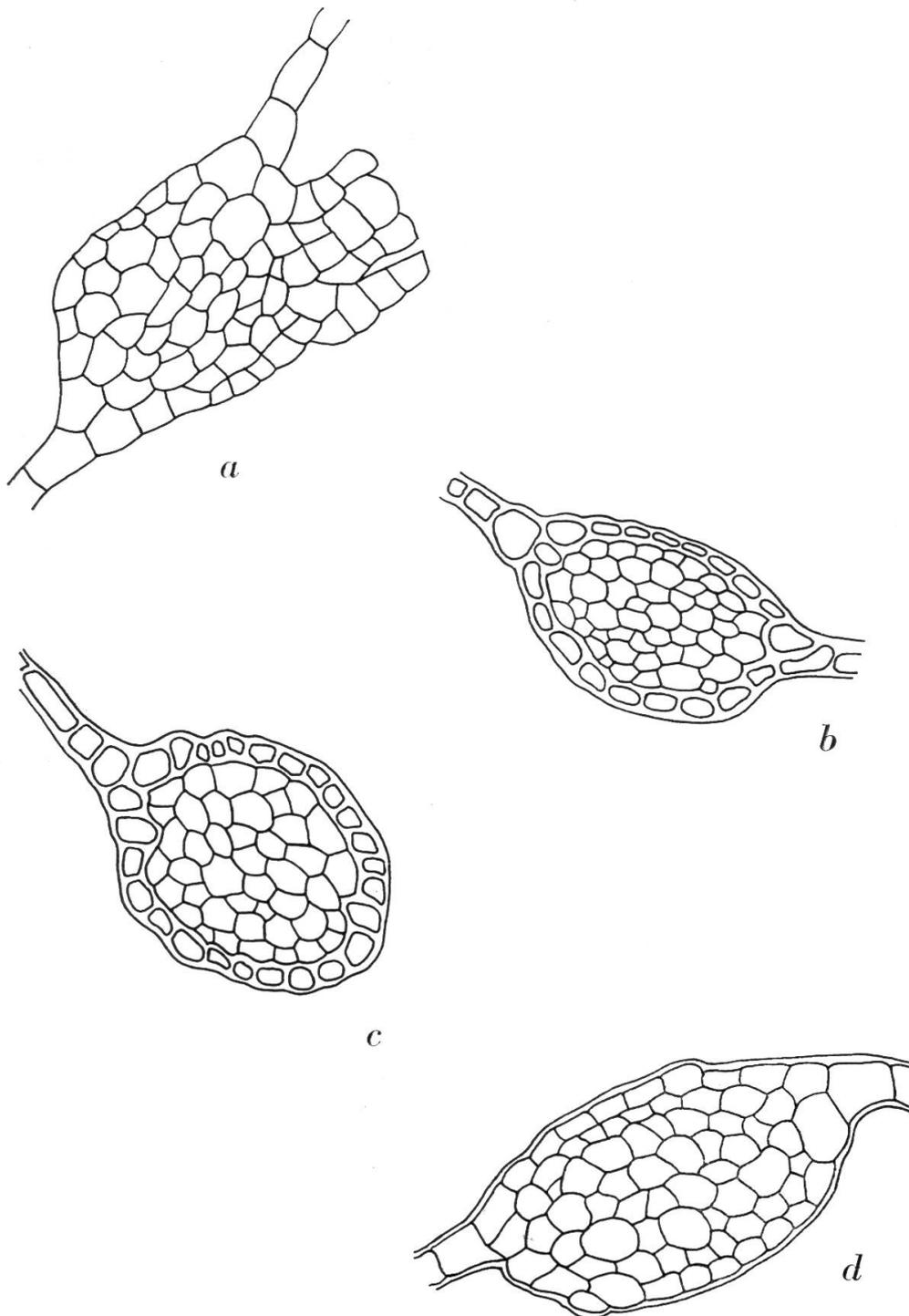
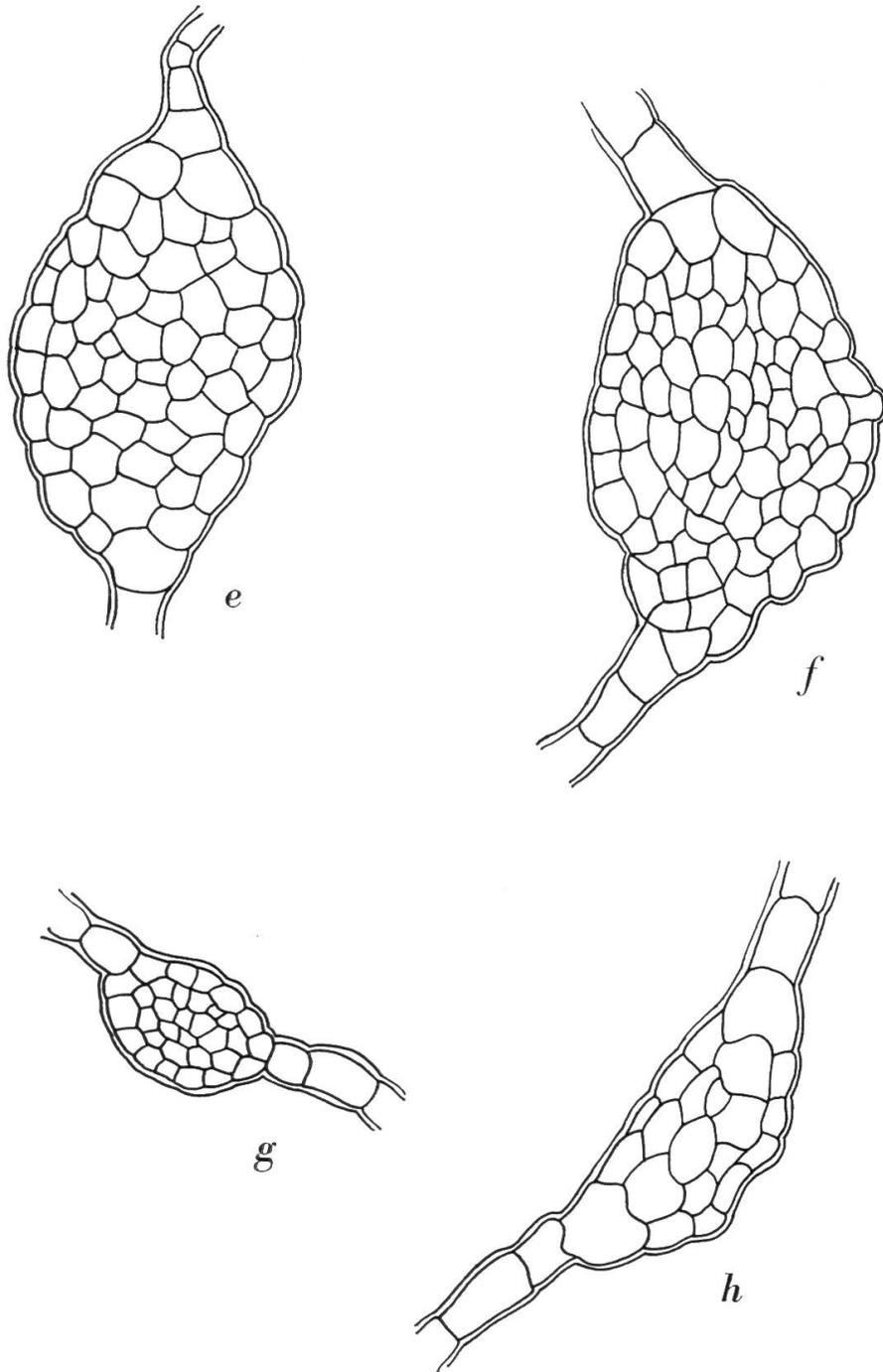


FIG. 40. — Stem cross sections.

*a*, *C. lophocoleoides* Steph. (branching) — *b*, Subgenus *Mnioloma* (Herzog) Bischler: *C. rhynchophylla* (Herzog) Bischler — *c*, Subgenus *Caracoma* Bischler: *C. caespitosa* (Spruce) Steph. — *d*, Subgenus *Calypogeja*, subgroup 1: *C. heterophylla* (Steph.) Steph. (all  $\times 150$ ).

FIG. 41. — Stem cross sections (*contd.*)

*e*, Subgenus *Calypogeja*, subgroup 2: *C. grandistipula* (Steph.) Steph. — *f*, Subgenus *Calypogeja*, subgroup 3: *C. tenax* (Spruce) Steph. — *g*, Subgenus *Calypogeja* subgroup 4: *C. lechleri* (Steph.) Steph. — *h*, Subgenus *Calypogeja*, subgroup 5: *C. falcata* Bischler (all  $\times 150$ ).

With the advancement of the monographic studies in *Calypogeja* it is possible that the subdivisions of the genus and the subgenera and their delimitation will change. Their distribution patterns have to be completed with the results obtained from the study of the species of the other continents.

*Distribution of the Central and South American Calypogeja.*

Few considerations concerning the distribution of the species of *Calypogeja* can be made at this point. Our knowledge of the occurrence of the plants is limited, rare or inadequate collections having been made in most tropical areas, where the genus is best represented. In particular, extensive zones of tropical America have never been touched by the collectors of Hepaticae.

The monospecific subgenus *Mnioloma* (Herzog) Bischler seems to be endemic in Central America.

The subgenus *Caracoma* Bischler appears restricted to the tropical and subtropical areas of low altitude, from sea level up to 1000 m, and is represented on all continents, north and south of the equator. However, its greatest diversification is found in tropical America, especially in the upper basin of the Amazon and the adjacent eastern valleys of the Andes, where eight species of the sixteen known until now are represented. The most abundant and widespread species in tropical America, but restricted to the continent, is *C. caespitosa* (Spruce) Steph.

*C. nephrostipa* (Spruce) Steph., *C. fissistipula* Bischler and *C. parallelogramma* (Spruce) Steph. are represented only in the basin of the Amazon. To the andean valleys exclusively belong *C. cyclostipa* (Spruce) Steph. and *C. retusa* Bischler.

*C. cellulosa* (Sprengel) Steph. and *C. elliottii* Steph. seem to grow only in the West Indies. *C. crenulata* Bischler, in addition to a widespread distribution in the West Indies, occurs also in Brazil.

Subgenera *Mnioloma* (Herzog) Bischler and *Caracoma* Bischler are composed of relatively well defined and stable species with few adaptive possibilities and they are therefore limited to the stable microclimates of the hot and humid areas. It is possible that *Caracoma* Bischler constitutes, with its highly specialized species in their cell dimorphism, the oldest component of *Calypogeja*, which seems to be an old genus with typical tropical distribution.

Subgenus *Calypogeja* has been recorded from the tropical and subtropical areas, north and south of the equator, on all continents, where it seems to be best represented in medium ranges of altitude. From the northern temperate zones, a few but very widely distributed and polymorphous species are known. From the southern temperate zone, only very rare representatives of the genus have been recorded, and none of them seem to grow in temperate South America.

In America, the few species, mostly endemic, known exclusively from the hot and humid areas are, like those of *Caracoma* Bischler, well defined and often showing peculiar forms which can be taken as highly specialized, like

the leaf shape of *C. tenax* (Spruce) Steph. or the very strong imbrication of leaves and underleaves in the species of *subgroup 2*. On the other extreme of altitude, some well defined species, belonging to *subgroup 1*, are confined to the very high mountains of the tropical and subtropical areas, where they are endemic to certain regions, such as *C. muscicola* Steph., *C. andicola* Bischler and *C. oblata* Herzog.

The species from the medium range of altitude and the nearly cosmopolitan ones are all extremely polymorphous. They grow in frequently changing microclimates which oblige the plants to permanent adaptation. This fact explains in part their great variability, and also the most developed diversification of the subgenus in such open habitats where novelties have some possibility of subsisting.

The same type of habitat exists in the northern temperate zones, where the species of the genus are comparatively polymorphous. Many common features exist between the first and the latter and the direction of variability is the same for both groups. Hence there are, amongst north temperate species, typical representatives of the subgroups established for the tropical american *Calypogeja*, such as *C. fissa* (L.) Raddi and *C. trichomanis* (L.) Corda for *subgroup 1*, and *C. arguta* Nees & Mont. for *subgroup 2*.

Nearly cosmopolitan and widely distributed species are, in South and Central America and the West Indies, *C. peruviana* Nees & Mont. and *C. heterophylla* (Steph.) Steph. from *subgroup 1*, *C. lechleri* (Steph.) Steph. from *subgroup 4* and *C. amazonica* (Spruce) Steph. from *subgroup 5*. At medium ranges of altitude are found, more or less widely distributed, from *subgroup 1*: the species *C. lophocoleoides* Steph., *C. subintegra* (Gottsche, Lindenb. & Nees) Bischler, and *C. biapiculata* (Spruce) Steph.; from *subgroup 4* and *5*: the species *C. rhombifolia* (Spruce) Steph., *C. laxa* Gottsche & Lindenb. and *C. miquelii* Mont.

#### *Specimens cited*

BALANSA: 4335 *amazonica*.

BANG: 899 *p.p. cyclostipa*.

BISCHLER: 8, 12 *rhombifolia* – 77 *amazonica* – 167 *rhombifolia* – 443/A *caespitosa* – 443/B *rhombifolia* var. *colombiana* – 474 *amazonica* – 475, 477 *rhombifolia* var. *colombiana* – 528, 530 *andicola* – 600 *heterophylla* – 601 *peruviana* – 738, 1140/B *andicola* – 1640 *rhombifolia* – 1914 *peruviana* – 2201 *andicola* – 2273/E, 2287/F *peruviana* – 2290 *lechleri* – 2453 *amazonica* – 2573 *caespitosa* – 2584/A *amazonica* – 2584/B *heterophylla* – 2591/A *caespitosa* – 2591/B *lechleri* – 2644 *peruviana* – 2645 *amazonica* – 2669/A *heterophylla* – 2669/B *caespitosa* – 2669/C *lechleri* – 3022/G. 3031/F *peruviana*.

DUSS: 18, 26 *biapiculata* – 27 *lophocoleoides* – 167 *heterophylla* – 508 *subintegra* var. *dussiana* – 523 *rhombifolia* – 1032 *biapiculata*.

- ELLIOTT: 937 *heterophylla* – 1026 p.p., 1044 *rhombifolia* – 1110, 1111 *crenulata* – 1117 *elliottii* – 1136 *lophocoleoides* – 1137 *biapiculata* – 1139 *elliottii* – 1183 *lophocoleoides* – 1210, 1256 *amazonica* – 1627 *biapiculata* – 1642, 1652 *rhombifolia* – 1699 *biapiculata* – 1713 *rhombifolia* – 1820 *lophocoleoides* – 1867, 1883 *biapiculata* – 1887 *amazonica* – 1888 *peruviana* – 1890 *amazonica* – 1901 *elliottii* – 1904, 1922, 1988 *biapiculata* – 2104 *rhombifolia* – 2117 *biapiculata* – 2124 *rhombifolia* – 2127, 2128 *falcata* – 2138, 2147 *peruviana* – 2195 *biapiculata* – 2236 *elliottii* – 2248, 2276 p.p. *biapiculata* – 2276 p.p., 2290 *crenulata* – 2293, 2305 *biapiculata*.
- FUNCK & SCHLIM: 360 *peruviana*.
- GEHRT: 221 *uncinatula*.
- HERZOG: 3892 *muscicola* – 4587 *heterophylla* var. *subrotunda*.
- LIEBMAN: 239 b, 243 *peruviana* – 375 p.p. *laxa* – 375 p.p. *subintegra* – 409 b, 447 *peruviana*.
- LÜTZELBURG: 26560 p.p. *amazonica*.
- PITTIER: 6018 *heterophylla*.
- PUIGGARI: 766 p.p. *heterophylla* – 766a *biapiculata*.
- STANDLEY: 39843 p.p. *rhynchophylla* – 39843 p.p. *lechleri* – 48694 *heterophylla* var. *subrotunda*.
- ULE: 32 *lechleri* – 44 *heterophylla* – 104 *laxa* – 166 *lechleri* var. *densifolia* – 174 p.p. *peruviana* – 396 *heterophylla* var. *subrotunda* – 595 *cyclostipa*.
- WEBERBAUER: 1244 p.p. *lechleri*.

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