

THE LIVERWORTS (MARCHANTIOPHYTA) OF THE STATE OF GOIÁS, BRAZIL

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ABSTRACT: This treatment provides keys and descriptions to 64 species, in 17 families and 36 genera, of the liverworts (Marchantiophyta) known from the state of Goiás, Brazil. Fourteen species (7 genera, 2 families) are reported new to Goiás. *Calypogeia peruviana* Nees & Mont. var. *subintegra* Gottsche, Lindenb. & Nees is new to Brazil. The majority of the taxa are common and widespread in tropical America; eleven are rare ones that have been little collected.

KEY WORDS: Flora, Goiás, liverworts, Marchantiophyta, morphology, taxonomy.

RESUMO: Este tratado apresenta chaves e descrições de 64 espécies, de 17 famílias e 36 gêneros, de hepáticas (Marchantiophyta) conhecidas do Estado de Goiás, Brasil. Quatorze espécies (7 gêneros, 2 famílias) são reportadas como novas para Goiás. *Calypogeia peruviana* Nees & Mont. var. *subintegra* Gottsche, Lindenb. & Nees é nova para Brasil. A maioria dos taxa são comuns e amplamente distribuídos na América tropical, e onze espécies são raras e pouco coletadas.

PALAVRAS-CHAVE: Flora, Goiás, Marchantiophyta, morfologia, taxonomia.

INTRODUCTION

The liverworts (Marchantiophyta) of the state of Goiás are little known. This is a first treatment providing keys and descriptions to all families, genera, and species of liverworts recorded from the state. The information provided may serve as a first introduction to the liverworts of Goiás and is in part compiled from *The Hepaticae and Anthocerotae of Brazil* (Gradstein & Costa, 2003). Sixty-four species (17 families, 36 genera) are reported, including 14 species (7 genera, 2 families) new to Goiás and one variety new to Brazil. Many of them are known only from one collection. All new taxa were collected by the second author. One species of hornwort, not treated here, was recently collected by P. Câmara (Câmara & Costa, in press).

The number of liverwort species known from Goiás is similar to that known of Mato Grosso (65 spp.) and is almost ten percent of the total number of species found in Brazil, estimated at 700-750 species. Ten states of Brazil, most of them in Amazonia and the Atlantic coastal region, have more species than Goiás, and fifteen have fewer species. The majority of the liverwort species recorded from the state of Goiás are common and widespread species of tropical America. Eleven species collected in Goiás are rare taxa that have been little collected in Brazil or elsewhere:

Aphanolejeunea azorica (V. Allorge & Jovet-Ast) Bernecker & Pócs – Known only from Macaronesia (Europe), Ecuador, and Brazil.

Aphanolejeunea longifolia Jovet-Ast – Rare neotropical species, only three collections from Brazil.

Calypogeia peruviana Nees & Mont. var. *subintegra* Gottsche, Lindenb. & Nees – Rare variety, previously only known from Mexico; new to Brazil.

Cheilolejeunea revoluta (Herzog) Gradst. & Grolle – Known only from a few collections from southeastern Brazil and the northern Andes.

Cololejeunea submarginata Tixier – Rare neotropical species.

Cronisia weddellii (Mont.) Grolle – Rare neotropical species, mainly occurring in caatinga and cerrado; the type species is from Goiás.

Kurzia brasiliensis Steph. – Rare endemic species of Brazil.

Lejeunea polyantha Mont. – Only known from three old collections from Amazonia; not collected since more than a hundred years.

Lophocolea heterophylla (Schrad.) Dumort. – Common in temperate regions of the Northern Hemisphere, rare in the tropics where it is known only from five localities: one in Cuba, one in Colombia, and three in Brazil.

Lophocolea mandonii Steph. – Rare species, only known from Bolivia and three localities in Brazil.

Micropterygium lechleri Reimers – Rare species from central Brazil and Colombia.

MORPHOLOGY OF LIVERWORTS

Liverworts (Marchantiophyta or Hepaticae) include about 5000-6000 species worldwide and are probably the most primitive group of the extant land plants (Heinrichs et al., 2005). Together with mosses (Bryophyta s.str.) and hornworts (Anthocerotophyta) they belong to the bryophytes (Bryophyta s.l.). Differences between the three groups are shown in Table 1. The life cycle of liverworts is characterized by an alternation of two generations: a gametophyte (= the generation that produces gametes for sexual reproduction) and a sporophyte (= the generation that produces spores for dispersal). Like in other bryophytes, the gametophyte of liverworts is

the green plant and the sporophyte is attached to the gametophyte, is not free-living, and derives nutrients for its growth from the gametophyte. The gametophyte of liverworts consists of stem and leaves ("leafy liverworts") or a thallus ("thalloid liverworts"), and is attached to the substrate by one-celled hairs, the rhizoids. Liverworts and other bryophytes do not have roots. The sporophyte produces spores, which germinate into a protonema from which the new gametophyte arises.

1. Leafy liverworts (Jungermanniales)

The leaves of leafy liverworts are only one cells thick, lack a midrib or costa, and are generally arranged in three rows: two lateral rows and a ventral row (= underleaves). The underleaves are usually smaller than the leaves and are sometimes lacking. The position of the lateral leaves may be transverse, incubous, or succubous. In incubous leaves the dorsal leaf margin lies on top of the ventral margin of the adjacent younger leaf, in succubous leaves it is just the other way around. Another characteristic of liverwort leaves is that they are sometimes divided into two or more lobes or filaments. The lobes may be unequal in size, the dorsal lobe usually being larger than the ventral one (sometimes, however, the dorsal lobe is smaller). A small ventral lobe or lobule is found in many epiphytic liverworts including Frullaniaceae, Lejeuneaceae, Porellaceae, and Radulaceae. In the genus *Ceratolejeunea* the lobule of branch base leaves is sometimes very large, such enlarged lobules are called **utricle**.

The stems of leafy liverworts are usually rather thin and can be variously branched. Sometimes the epidermis consists of large, thinwalled cells and is called a **hyalodermis**. There are two basic kinds of branches, **intercalary branches** and **terminal branches**. Intercalary branches originate from inner cells of the stem, have a small collar around the base, and usually are at right angles (90°) with the stem. There are three main types of intercalary branches:

Bazzania type: branch originating from ventral side of stem, from underleaf axil.

Plagiochila type: branch originating from lateral side of stem, from leaf axil.

Table 1. Differences between liverworts, mosses, and hornworts.

	Liverworts	Mosses	Hornworts
Plants	With stem and leaves in 2-3 rows, or thalloid	With leaves usually in a spiral, never thalloid	Thalloid
Branches	From leaf initial cells, stem epidermis, or inner stem cells	From stem epidermis	Lacking
Leaves	Undivided or lobed; midrib lacking	Undivided; midrib present or lacking	Lacking
Cells	With numerous small chloroplasts; trigones and oil bodies usually present	With numerous small chloroplasts; trigones usually lacking; no oil bodies	With 1-2 large chloroplasts; trigones lacking; no oil bodies
Rhizoids	Unicellular	Pluricellular	Unicellular
Sporophyte	Growth by one apical cell; fully covered until maturity by the calyptra and by special protective organs (perianth, marsupium, or involucre)	Growth by an apical cell; upper part when young covered by the calyptra; further protective organs lacking	Growth by a basal meristem; basal part covered by an involucre; calyptra lacking
Seta	Fragile, elongates after spore maturation	Rigid, elongates before spore maturation	Lacking
Capsule	Rounded to cylindrical; dehiscence at once by (1-)4 valves; elaters present; columella and peristome lacking	Rounded to cylindrical; dehiscence at once by an operculum; elaters lacking; columella and peristome usually present	Cylindrical to narrow filiform; dehiscence gradually by 2 valves; elaters and columella present, peristome lacking
Spore maturation	Synchronous (all at same time), before elongation of seta	Synchronous (all at same time), after elongation of seta	Asynchronous (gradual)
Protonema	Very small, thalloid, producing one gametophyte	Filamentous, producing several gametophytes	Very small, thalloid, producing one gametophyte

Lejeunea type: branch originating from lateral side of stem, from behind the leaf.

Terminal branches originate from a leaf initial or stem epidermis cell, lack a collar, and usually are at oblique angles (45-60°) with the stem. When originating from a leaf initial cell, the leaf associated with the branch is a half-leaf. Three terminal branch types may be distinguished:

Frullania type: branch originating from a ventral leaf initial cell so that it replaces the ventral half of a leaf. The branch is therefore associated with a half-leaf on its dorsal side.

Kurzia type: branch originating from a dorsal leaf initial cell and therefore associated with a half-leaf on its ventral side.

Radula type: branch originating from a stem epidermis cell and therefore associated with an unmodified leaf.

The leaf cells vary in shape and often have collenchymatous thickenings called **trigones**. The cells usually have chloroplasts and oil bodies when fresh. The oil bodies are cell organelles unique to liverworts and contain terpenoids. Their number per cell, size, and structure varies and is taxonomically important. In some liverworts they are finely or coarsely segmented, in others they are quite homogeneous. Oil bodies can only be observed in fresh material. In the leaves of Frullaniaceae and some members of Lejeuneaceae specialized cells occur that have one very large oil body and lack chloroplasts; these cells are called ocelli. The distribution of ocelli within the plant is an important taxonomic character.

Reproductive organs or gametangia are produced on stems or branches and are surrounded by bracts. The male gametangia

or antheridia are usually spherical in shape and attached to the stem by a thin stalk. The female gametangia or archegonia are produced at the tip of long or short shoots and are usually surrounded by a thin tubular organ, the perianth. The perianth is very small before fertilization but becomes greatly enlarged after fertilization, emerging beyond the bracts and enveloping and protecting the young sporophyte. The perianth varies considerably in shape and structure and provides important taxonomic characters. In some taxa, the perianth is replaced by a fleshy, tubular structure, the **marsupium** or **perigynium**, which develops from stem tissue or from the calyptra (= modified fertilized archegonium). Like the perianth, the function of the **marsupium** is the protection of the developing sporophyte.

In Lejeuneaceae, the presence or absence of **innovations** (= branches originating directly below the perianth) and the leaf sequence of **innovations** are important generic characters. As to the leaf sequence, two different types of **innovations** are distinguished: **lejeuneoid innovations**, in which the basalmost leafy appendage is a lateral leaf, and **pycnolejeunoid innovations**, in which it is an underleaf.

The sporophyte of liverworts is composed of a small foot, anchoring the sporophyte into the gametophyte, a stalk or seta, and a capsule containing the spores. The sporophyte is enveloped within the calyptra until spores are mature. The seta remains very short until the spores are ripe; thereafter it elongates quickly, within one or a few days, by rapid elongation of its cells. The elongated seta is colorless and usually very delicate. The mature capsule is spherical or cylindrical and dehisces usually by four valves. Within the mature capsules, there are spores and unicellular **elaters**. The latter are narrowly elongate organs provided with one or more spirally thickened bands that may become compressed upon dehiscence of the capsule, causing rotation and movement of the **elaters** (hygroscopic movement). The function of the **elaters** is to help release the spores from the capsule. In most leafy liverworts the **elaters**

are free inside the capsule but in Lejeuneaceae and Frullaniaceae they are attached to the top and the bottom of the capsule wall. When the capsule opens and the valves bend backwards, these attached **elaters** become considerably stretched. Suddenly, they break loose at their basal ends and usually swing into the air, thereby violently ejecting the spores. The spores of the liverworts germinate into a tiny, thalloid protonema. Each protonema gives rise to only one new gametophyte, different from mosses which have protonemata that may give rise to more than one gametophyte.

Vegetative reproduction is very common in liverworts and may take place by simple regeneration from leaf or stem cells, by special organs or gemmae produced on the surface or margins of leaves, by caducous or fragmenting leaves, and by caducous branches.

2. Thalloid liverworts (Marchantiales, Metzgeriales)

Thalloid liverworts have a dorsiventrally flattened gametophyte or thallus, more or less resembling green ribbon. The thallus is usually dichotomously branched, occasionally pinnate, and variable in its internal structure. In Metzgeriales the thallus is internally simple and multistratose throughout, or is composed for most of its width of a single layer of cells, the thallus wings, while the central portion is multistratose, resembling a midrib. In Marchantiales the thallus is internally differentiated, having green, chlorophyllous tissue on the dorsal side and colorless tissue on the ventral side. The green tissue usually contains air chambers that open by pores to the upper thallus surface. The walls of the air chambers are usually visible on the dorsal thallus surface as thin lines, forming a reticulate pattern. The pores are often surrounded by rings of cells. The thallus cells may have chloroplasts and several oil bodies (Metzgeriales), or the oil bodies may be solitary in specialized oil cells (Marchantiales). The rhizoids are smooth or, in Marchantiales, of two types: smooth rhizoids and tuberculate ones, the latter

having peg-like projections on the inner walls. The ventral surface of the thallus of the Marchantiales is often covered by scales in two or more rows, that may be colorless or with a deep purple to black coloration.

The antheridia of thalloid liverworts are produced on the thallus surface, naked or surrounded by an involucre, or inside the thallus in antheridial chambers. In Marchantiaceae the antheridial chambers are located on stalked receptacles, the **antheridiophore**. The archegonia are embedded inside the thallus, on the thallus surface, on swollen organs called receptacles. The latter may become stalked after fertilization; the stalked female receptacle is called **archegoniophore**. The archdegonia and young sporophytes are usually surrounded by (0-)1-2 involucre; the inner one is called the **pseudoperianth**. The **pseudoperianth** resembles the perianth of Jungermanniales but the latter originates from leaves whereas the **pseudoperianth** is of thallus origin.

The sporophyte of thalloid liverworts is basically similar to that of the leafy liverworts but the mode of dehiscence of the capsule is variable (by 1-4 valves or operculum) and the seta is very short or lacking in Marchantiales. During its development, the sporophyte is fully enveloped by the calyptra as usual in liverworts. The mature spores vary in size and in Marchantiales they are often very large and with a richly ornamented outer surface. These large spores are very resistant against drought and frost and retain their ability to germinate for many years. The **elaters** are free within the capsule except in some members of Metzgeriales, in which the **elaters** are attached like a brush to special capsule wall tissue, the **elaterophore**. In Ricciaceae the sporophyte develops within the thallus, lacks **elaters** and a seta, and has no special mechanism of capsule dehiscence.

Vegetative reproduction in thalloid liverworts may be by simple regeneration from thallus cells or by gemmae produced on the thallus surface (Metzgeriales) or in specialized, cup-like structures (*Marchantia*, *Lunularia*).

INTRODUCTORY KEY

1. Plants with leaves 2
 2. Leaves in two lateral rows, without thickened midrib; a third, ventral row of smaller leaves (= underleaves) present or absent. Rhizoids unicellular. Seta of sporophyte fragile, colorless, elongating after development of the capsule and maturation of the spores. Mature capsule opening by 4 valves, peristome lacking. **Elaters** present among spores **Leafy liverworts**
 2. Leaves spirally arranged, rarely in rows, with or without thickened midrib. Rhizoids pluricellular. Seta of sporophyte firm, usually yellowish, reddish, or brown pigmented, elongating before development of the capsule. Mature capsule opening by an operculum, peristome present or lacking. **Elaters** lacking **Mosses (Bryophyta)**
1. Plants thalloid, without leaves 3
 3. Thallus unistratose throughout, without midrib **Fern prothallus**
 3. Thallus more than one cell thick, or unistratose and with a midrib
 4. Thallus cells with 1(-2) large chloroplasts. Capsules long-cylindrical to linear, green, turning black after dehiscence, dehiscing gradually from the apex downwards **Hornworts (Anthocerotophyta)**
 4. Thallus cells with numerous small chloroplasts. Capsules globose to ellipsoidal, black, dehiscing at once **Thalloid liverworts**

LEAFY LIVERWORTS

Key to the families of leafy liverworts

1.
small).
 2. Underleaves present (sometimes very small).
 3. Lobule for most of its length attached to the lobe along a keel; keel and lobule usually widely diverging from the stem. Plants variously colored but never reddish or purple **Lejeuneaceae**
 3. Lobule almost free from the lobe, keel lacking or short; lobule oriented more or less parallel to the stem or obliquely diverging.
 4. Underleaves undivided. Lobules plane, narrow elongated, with rounded apex. Plants green to brown, robust **Porellaceae**
 4. Underleaves bifid. Lobules usually inflated, sac-like (sometimes plane, then with acute apex). Plants reddish or purple, sometimes green **Frullaniaceae**
 2. Underleaves lacking.
 5. Plants very small, less than 1 mm wide. Stems very thin, epidermis of only 5 rows of cells. Rhizoids from the ventral surface of the stem. Leaf cells with many small, colorless oil bodies **Lejeuneaceae**
 5. Plants larger. Stems rigid, epidermis of numerous thick-walled cells. Rhizoids in tufts from the lobule. Leaf cells with 1-2 large, brownish oil bodies **Radulaceae**
1. Leaves not differentiated into lobe and lobule.
 6. Underleaves present (sometimes very small).
 7. Leaves shallowly or deeply divided into segments (lobes, filaments, teeth).
 8. Leaves 3-4-fid **Lepidoziaceae**
 8. Leaves 2-fid.
 9. Leaves divided to the middle **Lepidoziaceae**
 9. Leaf apex less deeply divided.
 10. Leaves incubous. Lateral branches lacking **Calypogeiaceae**
 10. Leaves succubous. Lateral branches present or lacking.
 11. Plants green to reddish. Leaf apex asymmetrically bilobed, the lobes unequal in size. Lateral branches lacking **Balantiopsidaceae**
 11. Plants green or brown, never reddish. Leaf apex symmetrically bilobed, the lobes \pm equal in size. Lateral branches present **Geocalycaceae**
 7. Leaves undivided.
 12. Leaves folded and keeled, with a conspicuous wing in the upper half. Stem base with leafless stolons **Lepidoziaceae**
 12. Leaves not folded and keeled, without wing. Stolons lacking.
 13. Leaves incubous **Calypogeiaceae**
 13. Leaves succubous **Geocalycaceae**
 6. Underleaves lacking.
 14. Leaf margins toothed. Leaf base decurrent and reaching the dorsal midline of the stem **Plagiochilaceae**
 14. Leaf margins entire. Leaf base not reaching the dorsal midline of the stem, leaves laterally inserted.
 15. Leaf apex truncate or short-bifid. Leaf cells very large, 50-100 μ m long, completely thin-walled. Rhizoids in tufts **Lepidoziaceae**
 15. Leaf apex rounded (bifid in species not known from Goiás). Leaf cells smaller, with trigones. Rhizoids scattered **Cephaloziaceae**

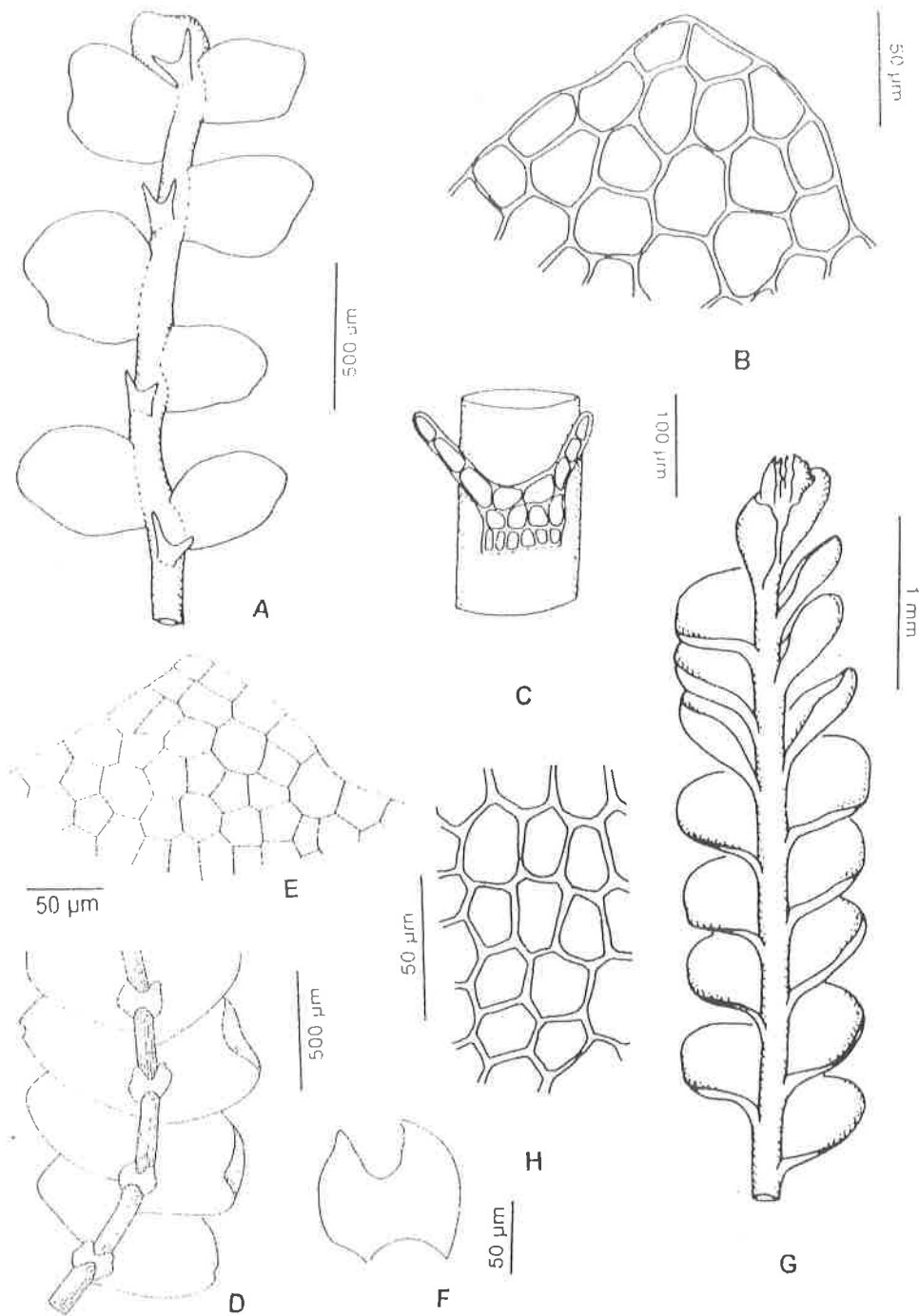


Figure 1 - **A-C.** *Neesioscyphus argillaceus* (Nees) Grolle. **A.** Habit. **B.** Margin cells of leaf. **C.** Underleaf. - **D-F.** *Calypogeia peruviana* Nees & Mont. **D.** Habit. **E.** Margin cells of leaf. **F.** Underleaf. - **G-H.** *Odontoschisma longiflorum* (Tayl.) Steph. **G.** Habit. **H.** Median cells of leaf. (**A-C, G-H** from Gradstein & Costa, 2003, **D-F** from Fulford, 1968; reproduced with permission).

BALANTIOPSISIDACEAE

Branches usually ventral-intercalary the lobes usually unequal in size, occasionally terminal, *Frullania*-type; stolons lacking. Stems with or without thick-walled cortex. Leaves transverse to succubous, 2(-4)-fid, margins entire or sharply toothed. Cells \pm rectangular, usually thin-walled without trigones, cuticle smooth or striate-papillose; oil bodies granular,

colorless, 2-5 per cell. Underleaves similar to the lateral leaves but smaller. Rhizoids in bundles from underleaf bases. Gametoezia on long shoots. Sporophyte surrounded by a perigynium, marsupium, or fleshy perianth. Seta of numerous cells (cross-section). Capsule cylindrical, wall 3-4-layered, valves spirally twisted. Vegetative reproduction unknown.

Neesioscyphus Grolle, Österr. Bot. Zeitschr. 111: 19. 1964.

Plants ca. 1 mm wide, pale green to reddish, creeping. Branches purely ventral-intercalary. Stems without thick-walled cortex. Leaves succubous, shallowly 2-lobed, the lobes usually unequal in size, leaves about as long as wide, flat or weakly concave, leaf tips rounded or acute, margins entire or somewhat toothed. Underleaves about 1/3 the size of the leaves. Sporophyte produced in a fleshy perianth. A neotropical genus of 5 spp.; 4 species in Brazil.

1. *Neesioscyphus argillaceus* (Nees) Grolle, Österr. Bot. Zeitschr. 111: 24. 1964. (Fig. 1A-C)

On soil in cerrado vegetation. New record from Goiás: cerrado vegetation along BR 153 near Mara Rosa, 480 m, Schäfer-Verwimp & Verwimp 9825 (PRC, SP, hb. Schäfer-Verwimp). General distribution: tropical Andes, Brazil; new to the state of Goiás.

CALYPOGEIACEAE

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Branches exclusively ventral-intercalary, usually only few; stolons lacking. Leaves incubous, undivided or short-bifid, margins entire or finely crenulate, sometimes bordered. Cells thin-walled, smooth or finely papillose; oil bodies granular. Underleaves small, undivided or bifid. Rhizoids in bundles from underleaf bases. Gametoecia born on very short ventral branches. Sporophyte in a fleshy, subterranean marsupium. Seta of numerous cells (cross-section). Capsule cylindrical, wall 2-layered, valves spirally twisted. Vegetative reproduction by gemmae produced on flagelliform shoots or by caducous leaves.

Calypogeia Raddi, Jungermanniogr. Etrusca: 31. 1818.

Plants 1-2 mm wide, creeping, pale-green, stems usually not or little branched. Leaf apex short-bifid or undivided, margins entire. Cells with small trigones, cuticle smooth or papillose. Oil bodies colorless, sepia, or bluish, coarsely granular. Underleaves bifid, sometimes with an additional tooth on the outer margins. Vegetative reproduction by gemmae. A widespread tropical and temperate genus of ca. 30 spp.; 7 species in Brazil.

1. *Calypogeia peruviana* Nees & Mont. var. *subintegra* Gottsche, Lindenb. & Nees, Syn. Hep. 1844. (Fig. 1D-F)

Bischler (1962) and Fulford (1968) treated this variety as a separate species, *C. subintegra* (Gottsche, Lindenb. & Nees) Bischler. However, the only known difference between *C. subintegra* and *C. peruviana* is in the leaf apex, which is rounded or emarginate in *C. subintegra* and bifid in *C. peruviana* (note: the latter species has sepia oil bodies; in *C. subintegra* oil bodies are unknown). We therefore prefer to treat *C. subintegra* as a variety of *C. peruviana*; similar variation in leaf apex is seen in the variable holarctic *C. fissa* (L.) Raddi. *Calypogeia peruviana* is widespread in the Neotropics and Brazil; var. *subintegra*, however, is only known from Mexico. New record from Goiás: gallery forest 18 km E of Colinas, on humid sandy soil, 500 m, Schäfer-Verwimp & Verwimp 9832/A (SP, hb. Schäfer-Verwimp). General distribution: Mexico. New record for Brazil.

CEPHALOZIACEAE

Branches variable; stolons sometimes present. Leaves succubous, inserted laterally on the stem. Cells usually large. Underleaves usually lacking or small. Rhizoids scattered. Gametoecia on leading shoots or on short ventral branches; female bracts and bracteoles isophyllous. Sporophyte surrounded by a perianth. Seta of 12 rows of cells: 8 outer rows and 4 inner rows. Capsule elongate, wall 2-layered. Vegetative reproduction by gemmae common.

Odontoschisma (Dumort.) Dumort., Recueil Observ. Jungerm.: 19. 1835.

Plants 0.5-2.5 mm wide, glossy green to yellowish-brown or reddish-brown, little-branched, with a few ventral, stoloniform branches, creeping or ascending from a stoloniform base. Stems rigid, of rather uniform thick-walled cells. Leaves succubous, undivided, inserted laterally on the stems as usual in the family (insertion line not reaching the dorsal stem-midline), flat to strongly concave, orbicular or ovate, with a

broad, rounded apex, margins sometimes bordered by thicker-walled cells. Cells ± isodiametric, thin-walled or with large trigones, cuticle smooth or papillose; oil bodies rather large, 2-5 per cell, finely granular. Underleaves lacking or minute. Rhizoids scattered from ventral stem surface, often lacking. Gametangia on short ventral branches near stem base. Gemmae produced at the tips of upright flagelliform shoots. Dioicous, usually sterile. A tropical-holarctic genus (10-12 spp.); 4 species in Brazil.

- 1. Leaf cells with large trigones, cell-lumen rounded or stellate. Cuticle papillose *O. falcifolium*
- 1. Leaf cells with very small trigones, cell-lumen quadrate. Cuticle smooth..... *O. longiflorum*

1. *Odontoschisma falcifolium* Steph., Sp. Hepat. 3: 369. 1908.

On rotten wood, humus, rock, or soil in moist forests. Uncommon, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region. New record from Goiás: Alto Paraiso, Chapada dos Veadeiros, 840 m, Schäfer-Verwimp & Verwimp 9850 (PRC, SP, hb. Schäfer-Verwimp). General distribution: northern South America.

2. *Odontoschisma longiflorum* (Tayl.) Steph., Sp. Hepat. 3: 370. 1908. (Fig. 1G-H)

On rock and rotten wood in moist montane forests. Uncommon, in Brazil recorded from the Planalto and the Atlantic coastal region. Report from Goiás: see Fulford (1968). General distribution: tropical America.

FRULLANIACEAE

Description: see *Frullania*. Gradstein and Costa (2003) treated Frullaniaceae as a synonym of Jubulaceae but recent molecular-phylogenetic studies indicate that the two families are distinct (Heinrichs et al., 2005).

Frullania Raddi, Jungermannogr. Etrusca: 9. 1818.

Plants 0.5-2.5 mm wide, reddish to purplish, sometimes green, creeping, ascending

or pendent, regularly or irregularly 1-3-pinnately branched. Branches *Frullania* type; innovations absent. Stems rigid. Leaves divided into three portions: a large dorsal lobe, a small ventral lobe (= lobule) hidden under the dorsal lobe, and a small stylus between the lobule and stem. Leaf lobe incubous, undivided, usually ovate-orbicular, the apex rounded to acute to acuminate, the margins entire, rarely toothed. Leaf lobule almost free from the dorsal lobe, inflated and transformed into a water-sac or flattened. Stylus usually linear and minute, rarely large. Cells with trigones and intermediate thickenings, cell walls often irregularly sinuose, cuticle smooth; oil bodies finely granular; ocelli sometimes present. Underleaves present, 2-lobed. Rhizoids in bundles from underleaf bases. Dioicous or monoicous. Androecia usually on a very short, globose male branch. Gynoecia on short or elongate shoots. Perianths flattened or inflated, with 0-12 keels, the mouth contracted into a beak. Sporophyte surrounded by a beaked perianth. Foot of the sporophyte not penetrating into the stem. Seta very short, thick. Capsule globose, wall 2-layered. Elaters attached to the capsule valves, arranged vertically inside the capsule. Spores large, multicellular. Vegetative reproduction rare, by caducous or fragmenting leaves. A large, worldwide genus of over 200 spp.; more than 30 species in Brazil.

- 1. Leaves squarrose when moist.
 - 2. Leaves brittle. Lobules very narrowly attached to the lobe (by only few cells). Plants 1-1.5 mm wide. Perianth surface rough by tubercles and scale-like outgrowths *F. ericoides*
 - 2. Leaves not brittle. Lobules widely attached to the lobe. Plants 1.5-2.5 mm wide. Perianth surface smooth *F. gibbosa*
- 1. Leaves not squarrose when moist.
 - 3. Lobules large, with a long, flat appendage at the base. Perianth with 4 keels *F. riojaneirensis*
 - 3. Lobules small, without flat appendage. Perianth with 0-3 keels.
 - 4. Plants less than 1 mm wide, prostrate. Leaf apex rounded, never apiculate. Perianth with 3 keels *F. kunzei*

4. Plants larger, ascending from the substrate. At least part of the leaves apiculate. Perianth without keels, terete.
..... *F. brasiliensis*

1. *Frullania brasiliensis* Raddi, Critt. Bras.: 12. 1822. (Fig. 2A-C)

On bark of trees, logs, or rock in moist forests. A very common species, in Brazil recorded from the Planalto and the Atlantic coastal region. In the state of Goiás recorded from Alto Paraiso, Chapada dos Veadeiros, Schäfer-Verwimp & Verwimp 9879 (JE). General distribution: tropical America.

2. *Frullania ericoides* (Nees) Mont., Ann. Sci. Nat., sér. 2, 12: 51. 1839.

Xerotolerant epiphyte, on bark in open woodlands, scrub, plantations, and parks, also on rock. A very common species, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region. In the state of Goiás recorded from Mineiros, Schäfer-Verwimp & Verwimp 8545 (SP, JE). Distribution: pantropical.

3. *Frullania gibbosa* Nees, Ann. Sci. Nat. Bot., sér. 2, 14: 333. 1840.

On bark and rock, usually in rather dry, open places, to 1200 m. A common species, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region. New record from Goiás: Alto Paraiso, Chapada dos Veadeiros, 820-840 m, Schäfer-Verwimp & Verwimp 9853, 9865, 9869 (SP, hb. Schäfer-Verwimp). General distribution: tropical America; new record for the state of Goiás.

4. *Frullania kunzei* (Lehm. & Lindenb.) Lehm. & Lindenb., in Gottsche et al., Syn. Hepat.: 460. 1845. (Fig. 2D-E)

On bark in forest canopies, open woodland, scrub, and open areas, also on rock, to 2400 m. A common species, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region. New records from Goiás: Alto Paraiso, Chapada dos Veadeiros, Cachoeira do Rio Preto, 680 m, Schäfer-Verwimp & Verwimp 9877 (SP, hb. Schäfer-Verwimp); Serra Dourada on GO-070 SE of Goiás town, on rock in pas-

ture, 520 m, Schäfer-Verwimp & Verwimp 8669 (SP, hb. Schäfer-Verwimp). General distribution: tropical America; new record for the state of Goiás.

5. *Frullania riojaneirensis* (Raddi) Ångstr., Öfvers. Förh. Kongl. Svenska Vetensk.-Akad. 33: 88. 1876.

On bark and rock in forest canopies, open woodlands, and orchards, to 1100 m. Common, reported from Amazonia, the Planalto, and the Atlantic coastal region. In the state of Goiás recorded from Serra Dourada ca. 35 km SE of Goiás town, Schäfer-Verwimp & Verwimp 8682 (SP, JE). General distribution: pantropical.

GEOCALYCEAE

Branches variable, stolons or flagella usually lacking. Stems without hyalodermis, cortex not differentiated. Leaves succubous, usually almost horizontal in position, insertion reaching dorsal midline of stem. Underleaves present, often toothed and connected with the leaves. Rhizoids usually in tufts from stem at underleaf bases. Archegonia on elongated shoots or short branches. Sporophyte surrounded by a perianth or a marsupium, perianth 3-keeled or laterally compressed. Seta of numerous rows of cells. Capsule wall 3-8-layered. Vegetative reproduction rare.

1. Leaves apex undivided ... *Leptoscyphus*
1. Leaf apex bifid..... *Lophocolea*

Leptoscyphus Mitt., J. Bot. Kew Gard. Misc. 3: 358. 1851.

Plants 1-4 mm wide, green to brown, creeping, irregularly branched. Leaves succubous, undivided, concave or almost flat, ovate-orbicular to oblong, apex rounded or truncate, margins usually entire. Cells with small or large trigones, cuticle smooth or papillose; oil bodies finely granular. Underleaves connected to the leaves, 2-lobed and often toothed. Rhizoids in bundles or scattered. Dioicous. Androecia on elongate shoots or short ventral branches. Perianths on long shoots, inflated or laterally

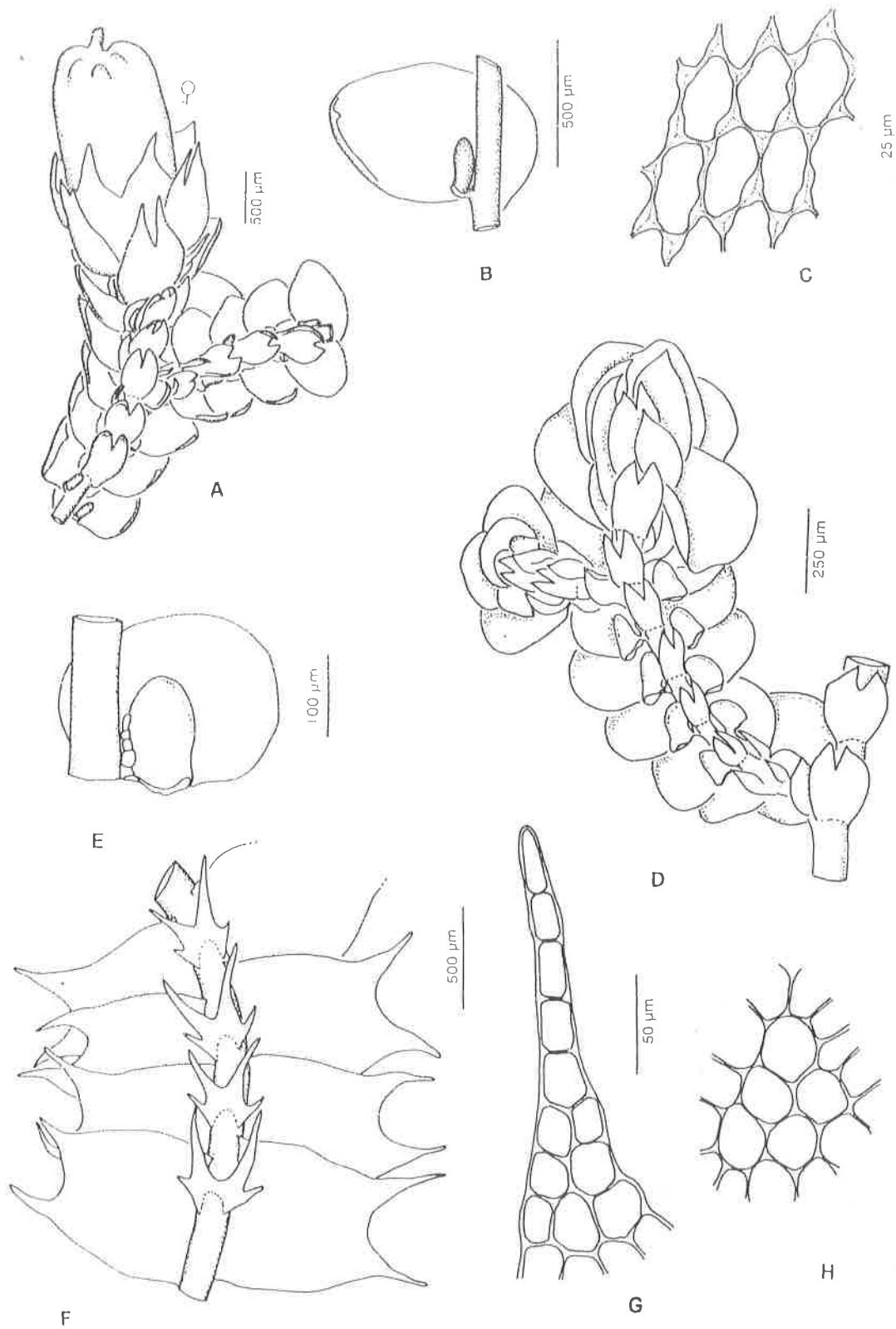


Figure 2 - **A-C.** *Frullania brasiliensis* Raddi. **A.** Habit. **B.** Portion of stem with leaf, ventral view. **C.** Median cells of leaf. - **D-E.** *Frullania kunzei* (Lehm. & Lindenb.) Lehm. & Lindenb. **D.** Habit. **E.** Portion of stem with leaf, ventral view. - **F-H.** *Lophocolea bidentata* (L.) Dumort. **F.** Habit. **G.** Lobe of leaf. **H.** Median cells of leaf. (**A-H** from Gradstein & Costa, 2003; reproduced with permission).

flattened, 2-keeled. Vegetative reproduction by caducous leaves. A genus of 17 species, mostly in tropical America and Africa; 5 species in Brazil.

1. *Leptoscyphus amphibolius* (Nees) Grolle, Nova Acta Leop. 25: 45. 1962.

On soil and trunk bases in moist montane forests. Common, in Brazil recorded from the Planalto and the Atlantic coastal region. Report from Goiás: see Fulford (1976). General distribution: tropical America.

Lophocolea (Dumort.) Dumort., Recueil Observ. Jungerm.: 17. 1835.

Plants small to large, (0.6-)1-5 mm wide, pale green to pale brown, creeping, irregularly branched. Branches *Frullania*-type or intercalary, lateral or ventral. Leaves succubous, alternate to \pm opposite, ovate-orbicular to rectangular, apex truncate, 2-lobed or with a few teeth or cilia, rarely rounded-entire, margins entire or toothed to ciliate. Cells usually thin-walled, trigones lacking or small, rarely large, cuticle smooth or papillose; oil bodies usually finely granular. Underleaves free or connected to the leaves, 2-lobed, often toothed. Rhizoids in bundles near underleaf bases. Dioicous or monoicous. Gametocia on elongate shoots. Perianths 3-keeled, long-exserted beyond the bracts. A large, worldwide genus of over 100 spp.; ca. 15 species in Brazil.

1. Leaf apex varying from rounded to truncate, emarginate, or short bifid on single stems *L. heterophylla*

1. Leaf apex always bifid.
2. Stem leaves asymmetrical, ventral margin arched, dorsal margin almost straight. Leaf lobes often somewhat connivent. Rare *L. mandonii*
2. Stem leaves symmetrical. Leaf lobes not connivent. Common *L. bidentata*

1. *Lophocolea bidentata* (L.) Dumort., Recueil Observ. Jungerm.: 17. 1835.(Fig. 2F-H)

On soil banks, decaying wood, bark, or rock. Common, in Brazil recorded from Amazonia, the Planalto, and the Atlantic

coastal region. Record from Goiás: see Fulford (1976, as *L. condunata* [Sw.] Nees). General distribution: subcosmopolitan.

2. *Lophocolea heterophylla* (Schrad.) Dumort., Recueil Observ. Jungerm.: 18. 1835.

On tree trunks and logs in mesic, semi-evergreen forest. Rare in Brazil, recorded only from two localities, in Pernambuco and São Paulo. New record from Goiás: gallery forest 18 km east of Colinas, on humid, sandy soil, 500 m, Schäfer-Verwimp & Verwimp 9832 (hb. Schäfer-Verwimp). General distribution: common and widespread in temperate regions of the Northern Hemisphere, in the tropics only known from Cuba, Colombia, and Brazil; new record for the state of Goiás.

3. *Lophocolea mandonii* Steph., Sp. Hepat. 3: 149. 1907.

On rock and soil. A rare species, in Brazil known only from Minas Gerais (Caldas) and Rio de Janeiro (Itatiaia). New record from Goiás: gallery forest 18 km east of Colinas, on humid, sandy soil, 500 m, Schäfer-Verwimp & Verwimp 9829 (hb. Schäfer-Verwimp). General distribution: Bolivia, Brazil; new record for the state of Goiás.

LEJEUNEACEAE

Branches *Lejeunea*-type, sometimes *Frullania*-type; innovations of the *Radula*-type; stolons lacking. Leaves incubous, alternate, divided into a large dorsal lobe and a small ventral lobule, the lobule broadly attached to the dorsal lobe along a keel; stylus reduced. Underleaves present or lacking. Rhizoids in tufts from underleaf bases. Perianth beaked, containing only one archeogonium. Sporophyte with reduced foot, not penetrating the stem. Seta very short, thin, usually 16 or 20 rows of cells. Capsule globose, wall 2-layered. Elaters attached to the capsule valves, arranged vertically inside capsule, spirals well-developed or reduced. Spores large, germination endosporic. Vegetative reproduction common.

1. Underleaves present.
 2. Underleaves bifid.
 3. Plants minute, less than 0.5 mm wide. Lobules very large, on average 2/3 lobe length (some lobules may be reduced, however). Leaves suberect, almost parallel to the stem. *Microlejeunea*
 3. Plants larger. Lobules smaller. Leaves spreading.
 4. Plants brownish-green. Leaves with one to several ocelli near leaf base. Branch bases sometimes with 1-2 hugely inflated lobules (= utricles). Perianth with horns *Ceratolejeunea*
 4. Plants green. Ocelli and utricles lacking. Perianth without horns.
 5. Leaf cells usually with large trigones and with very large oil bodies, often more than 1/2 x cell lumen in length and only 1-3 per cell; remnants of oil bodies remaining visible in dry material. Lobules not reduced, hyaline papilla distal to the lobule tooth *Cheilolejeunea*
 5. Leaf cells usually with small trigones and small oil bodies, less than 1/4 x cell lumen in length and more than 4 per cell; remnants of oil bodies usually lacking in dry material. Lobules sometimes reduced, hyaline papilla proximal to the lobule tooth ... *Lejeunea*
 2. Underleaves undivided (sometimes slightly emarginate).
 6. Plants pinnate, branches *Frullania*-type. Leaves toothed *Bryopteris*
 6. Plants irregularly branched, branches *Lejeunea*-type. Leaves entire, rarely with a few teeth.
 7. Leaves convolute when dry.
 8. Leaf apex acute. Underleaves and bracts toothed. Perianth with 3 keels *Thysananthus*
 8. Leaf apex rounded. Underleaves and gynoecium entire. Perianth with 3-10 keels.
 9. Lobules with 3-10 teeth. Perianth with 5-10 keels.
 10. Plants with small flagelliform branches producing caducous leaves. Plants not turning blackish in older portions. Innovations lacking *Acrolejeunea*
 10. Flagelliform branches and caducous leaves lacking. Plants turning blackish in older portions. Innovations present *Frullanoides*
 9. Lobules with 1-2 teeth or teeth lacking. Perianth with 3-4 keels.
 11. Plants olive green to brown. Innovations lacking. Female bract apices acute-acuminate *Schiffneriolejeunea*
 11. Plants deep green to black. Innovations present. Female bract apices rounded *Mastigolejeunea*
 7. Leaves spreading when dry.
 12. Plants dull whitish to pale yellowish in color. Ventral leaf margin rolled inwards (plane in species not known from Goiás). Innovations present *Leucolejeunea*
 12. Plants green to brown or black. Ventral leaf margins plane. Innovations lacking.
 13. Plants dark green to blackish. Median leaf cells isodiametrical, trigones not cordate. Perianth keels ciliate-laciniate *Lopholejeunea*
 13. Plants pale green to pale brown. Median leaf cells longer than wide, trigones cordate. Perianth keels smooth *Caudalejeunea*
1. Underleaves lacking.
 14. Some or all branches without collar at the base. Leaves frequently reduced and without lobule *Aphanolejeunea*
 14. All branches with a collar at the base. Leaves never reduced *Cololejeunea*

Acrolejeunea (Spruce) Schiffn., in Engler & Prantl, Nat. Pflanzenfam. 1, 3: 119, 128. 1893.

Plants ca. 1 mm wide, glossy yellow-green to yellow-brown, creeping. Stems fragile, with a hyalodermis; ventral merophyte 4-6 cells wide. Leaves wide-spreading and often \pm squarrose, when dry strongly convolute, apex rounded, margins entire. Cells slightly longer than wide, trigones cordate; oil bodies homogeneous; ocelli lacking. Lobules 2/5-1/2 leaf length, never reduced, with (2-)3-8 teeth. Underleaves undivided, margins entire, insertion line shallowly curved. Gynoecia without innovations. Perianths with 5-10 smooth keels. Vegetative reproduction by tiny caducous leaves produced on upright flagelliform shoots. A pantropical genus of 15 spp.; 2 species in Brazil.

1. *Acrolejeunea emergens* (Mitt.) Steph., in Engler, Pflanzenwelt Ostafrikas C: 65. 1895.

Xerotolerant epiphyte of bark in open forest and on isolated trees in cultivated areas, to 500 m. Common, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region; in Goiás recorded from Formoso. New record from Goiás: Mineiros, 680 m, Schäfer-Verwimp & Verwimp 8547 (SP, hb. Schäfer-Verwimp). General distribution: tropical America, Africa, India.

Aphanolejeunea A. Evans, Bull. Torrey Bot. Club 38: 272. 1911.

Plants minute, less than 0.5 mm wide, pale green, creeping. Stems zig-zag, very thin, of 5 outer rows of cells and 1 inner row, with hyalodermis; ventral merophyte only 1 cell wide. Leaves distant, spreading, with a very short insertion, ovate-lanceolate, usually of three types: normal size (with or without a lobule) and smaller size, flat, without lobule; leaf surface smooth or rough by conically elevated cells, leaf apex rounded to acuminate, margins often crenulate-denticulate. Cells thin-walled with small trigones, cuticle smooth or papillose; oil bodies in most cases minute, smooth or finely granular; ocelli lacking. Lobules almost as large as the lobe or much smaller, more or less inflated when well-developed, with 1-2 teeth. Underleaves absent; rhizoids in small bundles from the

ventral side of the stem, near the base of each leaf. Gynoecia on short or long branches, with 1-2 innovations. Perianths inflated, 5-keeled or without keels, smooth or papillose. Vegetative reproduction by disciform gemmae from leaf margins. A pantropical genus of ca. 50 spp.; 18 species in Brazil. Very close to *Cololejeunea* and sometimes treated as a synonym of the latter.

1. Leaf surface rough with conically elevated cells. Leaf apex truncate. Lobule less than half lobe length *A. truncatifolia*

1. Leaf surface smooth. Leaf apex rounded to acute

2. Leaves lanceolate, apex acute. First lobule tooth 1-celled, short and blunt *A. longifolia*

2. Leaves broad elliptical, apex rounded or obtuse. First lobule tooth 2-celled, long and falcate *A. azorica*

1. *Aphanolejeunea azorica* (V. Allorge & Jovet-Ast) Bernecker & Pócs, in Gradstein & Costa, Mem. N. Y. Bot. Garden 97: 109. 2003.

On bases of trunks, ca. 500 m. A very rare species, in Brazil only recorded from Goiás: south of Itaberai, Vital 4985 (GOET). General distribution: Europe (Azores, Madeira), Ecuador and Brazil (Goiás).

2. *Aphanolejeunea longifolia* Jovet-Ast, Rev. Bryol. Lichénol. 16: 23. 1947.

On living leaves, to 850 m. Uncommon, in Brazil recorded from Goiás (In the state of Goiás recorded from Alto Paraíso, Chapada dos Veadeiros, Schäfer-Verwimp & Verwimp 9844 (EGR, G, GOET, JE, SP, STU), Sergipe, and Santa Catarina. General distribution: tropical America.

3. *Aphanolejeunea truncatifolia* Horik., J. Sci. Hiroshima Univ., Ser. 3, Div. 2, Bot. 2: 284. 1934.

On living leaves and bark of trees, occasionally on rock, to 1400 m. Widespread species, in Brazil reported from Amazonia, the Planalto, and the Atlantic coastal region; in Goiás recorded from Alto Paraíso, Chapada dos Veadeiros, Schäfer-Verwimp & Verwimp 9851/A (EGR, JE, SP). General distribution: pantropical.

Bryopteris (Nees) Lindenb., in Gottsche et al., Syn. Hepat.: 284. 1845.

Plants robust, to 25 cm long, 2-4 mm wide, green to brown, dendroid, erect to pendent from a rhizome-like shoot, pinnate or forked. Stems rigid, with a dark-brown cortex of thick-walled cells in 3-5 layers surrounding a colorless, thin-walled medulla, epidermis cells 2 × larger than subepidermis cells; ventral merophyte more than 10 cells wide. Leaves wide-spreading, when dry usually convolute, apex pointed, margins often toothed. Cells longer than wide, trigones cordate, intermediate thickenings numerous, to 3 per wall; oil bodies homogeneous; ocelli lacking. Lobules small, to 1/4 leaf length, without or with 1(-4) teeth. Underleaves undivided, quadrate to spatulate, apex sharply toothed, insertion line straight. Gynoecia on short branches without innovations. Perianths with 3 smooth keels. A small Afro-American genus of 3 spp.; 2 species in Brazil.

1. *Bryopteris filicina* (Sw.) Nees, in Gottsche et al., Syn. Hepat.: 286. 1845.

On bark and logs in rain forests, occasionally on moist rock, to 2000 m. Common, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region; in the state of Goiás recorded from Formoso, Irwin et al. 15559 (NY, US). General distribution: tropical America.

Caudalejeunea (Steph.) Schiffn., in Engler & Prantl, Nat. Pflanzenfam. 1, 3: 119, 129. 1893.

Plants 1.5-2 mm wide, green to brown, creeping to ascending. Branches *Lejeunea*-type. Stems with a hyalodermis; ventral merophyte 4 cells wide. Leaf lobes obliquely spreading and somewhat falcate, when dry spreading or appressed to stem, apex obtuse, margins entire or toothed. Cells longer than wide, trigones cordate, intermediate thickenings 1-2 per wall; oil bodies homogeneous; ocelli lacking. Lobules 1/3-2/5 leaf length, sometimes reduced, with 2-3 teeth. Underleaves emarginate, margins entire, bases decurrent, insertion line curved. Gynoecia without innovations. Peri-

anths with 3(-5) sharp keels, keels smooth or dentate. Vegetative reproduction by disciform gemmae from dorsal surfaces of the leaves. A pantropical genus of ca. 15 spp.; 1 species in Brazil.

1. *Caudalejeunea lehmanniana* (Gottsche) A. Evans, Bull. Torrey Bot. Club 34: 554. 1907.

On living leaves, twigs, or branches in rather open situations, in forest gaps, at forest margins, and in secondary forests or scrub, to 700 m. A rather common neotropical species, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region. New record from Goiás: Alto Paraiso, Chapada dos Veadeiros, Cachoeira do Rio Preto, 680 m, growing in a mat of *Frullania brasiliensis*, Schäfer-Verwimp & Verwimp 9879 p.p. (hb. Schäfer-Verwimp). General distribution: tropical America, West Africa; new record for the state of Goiás.

Ceratolejeunea (Spruce) J.B. Jack & Steph., Hedwigia 31: 13, 16. 1892.

Plants 0.5-2 mm wide, glossy greenish-brown to dark brown, creeping to ascending or pendent. Stems with hyalodermis; ventral merophyte 2 cells wide. Leaf lobes wide-spreading, apex rounded to acute, margins entire or toothed. Cells with elongate, triradiate trigones or uniformly thick-walled, the walls pale brown, cuticle smooth, rarely elevated papillose; oil bodies small, finely granular; ocelli present or absent, when present 1-10 at leaf base or in a row, rarely in underleaves. Lobules 1/6-1/3(-1/2) leaf length, sometimes reduced, inflated, at branches bases sometimes much enlarged, forming utricles, apical tooth 1-celled, short or long, hyaline papilla proximal. Underleaves bifid or undivided, small or large, insertion line shallowly curved to deeply arched. Gynoecia on long or short branches, with 1-2 pycnolejeuneoid innovations. Perianths normally with 4 keels extended above into narrow, horn-like or bulbous projections. Vegetative reproduction by caducous leaves. A pantropical genus of ca. 30 spp.; 11 species in Brazil.

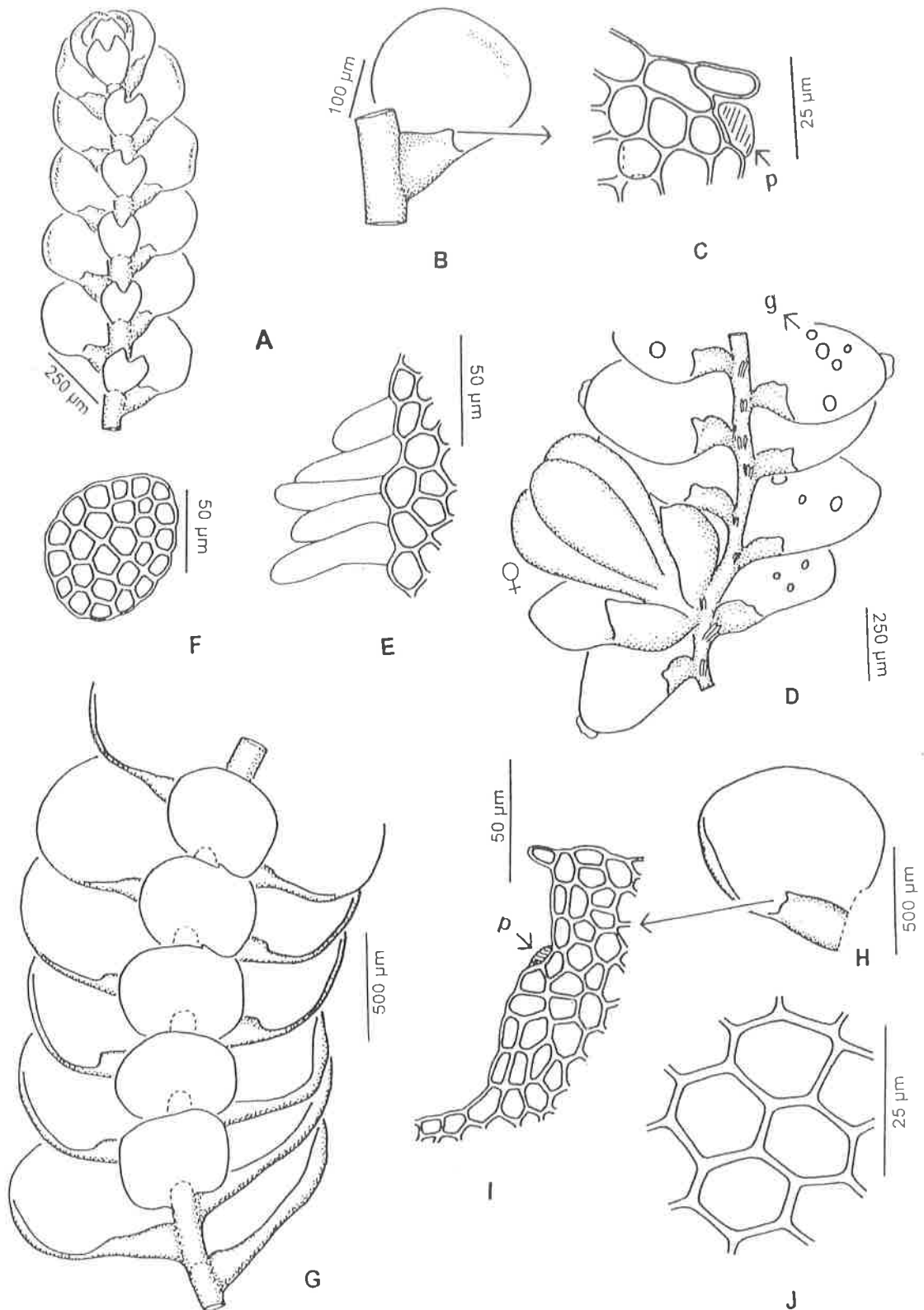


Figure 3 - **A-C.** *Cheilolejeunea rigidula* (Mont.) R. M. Schust. **A.** Habit. **B.** Portion of stem with leaf, ventral view. **C.** Apex of lobule with distal hyaline papilla (p = papilla). - **D-F.** *Cololejeunea cardiocarpa* (Mont.) A. Evans **D.** Habit (g = gemma). **E.** Apex of lobe. **F.** Gemma. **G-J.** *Leucolejeunea xanthocarpa* (Lehm. & Lindenb.) A. Evans **G.** Habit. **H.** Leaf. **I.** Apex of lobule (p = papilla). **J.** Median cells of leaf (**A-J** from Gradstein & Costa, 2003; reproduced with permission).

1. *Ceratolejeunea laetefusca* (Aust.) R.M. Schust., J. Elisha Mitchell Sci. Soc. 72: 306. 1956.

On bark and rock, to 1300 m. A rather common species, in Brazil recorded from Amazonia and the Atlantic coastal region. New record from Goiás: Alto Paraiso, Chapada dos Veadeiros, on shady rock near Cachoeira do Rio Preto, 680 m, growing in a mat of *Cheilolejeunea rigidula*, Schäfer-Verwimp & Verwimp 9887 p.p. (hb. Schäfer-Verwimp). General distribution: tropical America; new record for the state of Goiás.

Cheilolejeunea (Spruce) Schiffn., in Engler & Prantl, Nat. Pflanzenfam. 1, 3: 118, 124. 1893.

Plants 0.5-2 mm wide, dull pale green to olive-green, creeping to ascending, rarely pendent. Stems rather fragile or rigid, usually with enlarged epidermis, cells \pm thick-walled; ventral merophyte 2(-6) cells wide. Leaves suberect to wide-spreading, convex, apex rounded to acute, plane or recurved, margins entire or sinuate. Cells plane or bulging with a broad, lenticular papilla, trigones small to large, intermediate thickenings scarce; oil bodies usually very large, filling the entire cell lumen, 1-3(-5) per cell, sausage-shaped, granular; ocelli lacking. Lobules 1/10-1/2 leaf length, ovate to globose, strongly inflated with inflexed free margin, usually constricted at the apex, apical tooth 1-celled, short or long, hyaline papilla distal. Underleaves small or large, bifid, rarely undivided, margins entire, insertion line shallowly curved to arched. Gynoecia on long or short shoots, with or without innovations. Perianths with 4-5 smooth keels. Vegetative reproduction rare, by caducous leaves. A large pantropical genus of ca. 60-70 spp.; ca. 15 species in Brazil.

1. At least some leaf tips acute or bluntly pointed *C. acutangula*

1. Leaf apices uniformly broadly rounded.
2. Plants very small, to 0.65 mm wide. Trigones of leaf cells small and not sharply delimited, cell walls looking somewhat evenly thickened

..... *C. discoidea*

2. Plants larger. Trigones usually conspicuous and well-delimited.

3. Underleaves shallowly bifid (to 1/4), margins recurved ... *C. revoluta*

3. Underleaves bifid to 1/3 or more, margins plane.

4. Underleaves small, not wider than long, 2-3.5 \times stem width, distant, bases cuneate. Dioicous. ...
..... *C. rigidula*

4. Underleaves large, wider than long, 4-6 \times stem width, imbricate or nearly so, bases broadly rounded. Autoicous. *C. trifaria*

1. *Cheilolejeunea acutangula* (Nees) Grolle, J. Hattori Bot. Lab. 45: 173. 1979.

On bark and rock in moist, shaded places. Uncommon species, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region; in the state of Goiás recorded from Alto Paraiso, Chapada dos Veadeiros, Schäfer-Verwimp & Verwimp 9902 (JE, SP). General distribution: tropical America.

2. *Cheilolejeunea discoidea* (Lehm. & Lindenb.) Kachr. & R.M. Schust., J. Bot. Linn. Soc. 56: 509. 1961.

On bark in moist forest, scrub, and on isolated trees, to 2400 m. Uncommon species, in Brazil recorded from the Atlantic Coastal Region and one locality in Mato Grosso. New records from Goiás: Mineiros, gallery forest at the border with Mato Grosso, epiphytic, 680 m, Schäfer-Verwimp & Verwimp 8551 (SP, hb. Schäfer-Verwimp); Serra Dourado on GO 070 southeast of Goiás city, epiphytic in pasture, 520 m, Schäfer-Verwimp & Verwimp 8669/A (hb. Schäfer-Verwimp). General distribution: tropical America; new record for the state of Goiás.

3. *Cheilolejeunea revoluta* (Herzog) Gradst. & Grolle, J. Hattori Bot. Lab. 74: 59. 1993.

On rock and bark in shaded, humid, montane environments. A rare species, in Brazil only recorded from the Planalto (Goiás, Minas Gerais, Espírito Santo; see Gradstein et al. [1993]). General distribution: Brazil, Colombia, and Costa Rica.

4. *Cheilolejeunea rigidula* (Mont.) R.M. Schust., *Castanea* 36 : 102. 1971. (Fig. 3A-C)

On bark of trees in lowland rain forests, scrub, plantations, on isolated trees, etc., also on rock. A common species, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region; in the state of Goiás recorded from Alto Paraiso, Chapada dos Veadeiros, Schäfer-Verwimp & Verwimp 9881 (JE). General distribution: tropical America.

5. *Cheilolejeunea trifaria* (Reinw. et al.) Mizut., *J. Hattori Bot. Lab.* 27 : 132. 1964.

On rock, soil, or bark of trees, in shaded or open places, along roads, etc. A common species, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region; in the state of Goiás recorded from Alto Paraiso, Chapada dos Veadeiros, Schäfer-Verwimp & Verwimp 9881 (JE). General distribution: pantropical.

Cololejeunea (Spruce) Schiffn., in Engler & Prantl, *Nat. Pflanzenfam.* 1, 3: 117,121. 1893.

Plants very small, 0.5-1.2(1.8) mm wide, pale or dull green, creeping. Stems usually zigzag, thin (30-80 µm diam.), with hyalodermis, of 5-6(-8) outer rows of cells and 1 inner row; ventral merophyte 1-2(-4) cells wide. Leaves spreading, ovate-obovate to narrowly lanceolate, insertion very short (only a few cells), apex rounded to acute-acuminate, margins entire to denticulate, many times with a hyaline border of dead cells. Cells thin-walled without or with small trigones, cuticle smooth or papillose; oil bodies finely granular; ocelli lacking or present as a more or less sharply delimited nerve. Lobules small or large, usually inflated and with a long keel, sometimes reduced or flattened with a short keel, apex with (0)-1-2 teeth, hyaline papilla proximal. Underleaves absent; rhizoids in small bundles from the ventral side of the stem, near the base of each leaf. Gynoecia on short or long branches, with 0-2 innovations. Perianths inflated 5-keeled or flattened 4- or 2-keeled, smooth or papillose. Vegetative reproduction by disciform gemmae from leaf surfaces. A large pantropical genus of ca. 150

spp.; 22 species in Brazil. Very close to *Aphanolejeunea* and sometimes united with the latter genus.

1. Leaves with a crenulate hyaline border. Leaf apex without fingerlike cells protruding from the apex *C. submarginata*

1. Hyaline border lacking. Leaf apex with fingerlike cells protruding from the apex ..
..... *C. cardiocarpa*

1. *Cololejeunea cardiocarpa* (Mont.) A. Evans, *Mem. Torrey Bot. Club* 8: 172. 1902. (Fig. 3D-F)

On living leaves and rock. Rather common, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region; in the state of Goiás recorded from Alto Paraiso, Chapada dos Veadeiros, Schäfer-Verwimp & Verwimp 9863 (JE, SP). General distribution: pantropical.

2. *Cololejeunea submarginata* Tixier, *Bradea* 6: 40. 1908.

On living leaves. A rare species, in Brazil recorded from Amazonia, Alagoas, Goiás (Serra Dourado ca 35 km SE of Goiás town, Schäfer-Verwimp & Verwimp 8678 [JE, SP]), and Mato Grosso. General distribution: tropical America.

Frullanoides Raddi, *Critt. Brasil.*: 13. 1822.

Plants 1-3 mm wide, green to black, creeping or ascending, often forked branched. Stems with a hyalodermis; ventral merophyte 4-12 cells wide. Leaves wide-spreading, when dry convolute, apex rounded to acute, margins entire or toothed. Cells slightly longer than wide, walls often with blackish pigmentation, trigones cordate; oil bodies homogeneous; ocelli lacking. Lobules 1/3-2/3 leaf length, never reduced, with 3-11 teeth. Underleaves undivided, margins entire, bases rounded or auriculate, insertion line straight to deeply arched. Gynoecia with 2 innovations. Perianths with 5-10 smooth keels. A mostly neotropical genus of 7 spp.; 4 species in Brazil.

1. *Frullanoides liebmanna* (Lindenb. & Gottsche) Van Slageren, *Meded. Bot. Mus. Herb. Rijksuniv. Utrecht* 544: 102. 1985.

On bark and rock in rather open, dry environments, in the canopy and margins of evergreen forests, scrub, plantations, and isolated trees. Rather common species, in Brazil recorded from Acre, Pernambuco, Goiás (Morrinho, *Vital 6148* [SP, U]), Mato Grosso, Minas Gerais, and Paraná. General distribution: scattered throughout tropical America.

Lejeunea Lib., Ann. Gén. Sci. Phys. 6: 372. 1820.

Plants 0.5-1.5 mm wide, pale green to brown, usually glossy, creeping, sometimes pendent. Stems usually fragile, rarely rigid, with or without hyalodermis; ventral merophyte 2(-10) cells wide. Leaves spreading, apex rounded to apiculate, plane, margins entire or somewhat crenulate, seldom toothed. Cells plane, usually thin-walled with small or minute trigones, occasionally with intermediate thickenings; oil bodies small, finely granular or homogeneous, cuticle smooth or finely papillose; ocelli lacking. Lobules usually less than 1/3 leaf length, sometimes reduced, ovate, apical tooth short or very long; hyaline papilla proximal. Underleaves bifid, usually small with shallowly curved insertion, rarely large and cordate. Gynoecea on long or short shoots, with (0-)1-2 innovations. Perianths with 0-5 keels, the keels sometimes 2-winged, smooth or ornamented with lacinia and cilia, rarely auriculate or with plate-like extensions. Vegetative reproduction by caducous leaves or fragmentation. A large pantropical genus of more than 100 spp.; 30-40 species in Brazil.

1. Stems rigid, ventral merophyte more than 4 cells wide. Plants growing in or near running water, densely pinnate, with numerous short sexual branches ..
..... *L. polyantha*
1. Stems thin, fragile, ventral merophyte 2 cells wide.
 2. Lobule tooth 5-10 cells long. Underleaves small, less than 3 x stem width *L. trinitensis*
 2. Lobule tooth 1 cell long. Underleaves large, more than 3 x stem width. Leaves longer than wide. *L. flava*

1. *Lejeunea flava* (Sw.) Nees, Naturgesch. Europ. Leberm. 3: 277. 1838.

On bark and rock in rain forest, scrub, plantations, parks, and on free standing trees, also on soil. A very common species, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region. In the state of Goiás recorded from Alto Paraiso, Chapada dos Veadeiros, Schäfer-Verwimp & Verwimp 9851/B (JE). General distribution: pantropical.

2. *Lejeunea polyantha* Mont., Ann. Sci. Nat., Bot., ser. 4, 5: 350. 1856.

A rheophyte, characterized by the large, brownish plants with thick, rigid stems. This species has also been placed in the *Neopotamolejeunea*, as *N. polyantha* (Mont.) E. Reiner (Gradstein & Costa, 2003). Pendent epiphyte on branches of trees and shrubs along rivers, sometimes submerged, in lowland rain forest areas. Very rare species, reported only from Amazonia and northern Goiás (see Reiner-Drehwald, 2000, under *N. polyantha*). General distribution: Brazil, Venezuela.

3. *Lejeunea trinitensis* Lindenb., in Gottsche et al., Syn. Hepat.: 381. 1845.

On living leaves, bark of trees, logs, or rock at lower elevations. Rather common, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region. Report from Goiás: see Gradstein & Costa (2003). General distribution: tropical America, Africa.

Leucolejeunea A. Evans, Torrey 7: 225. 1907.

Plants 1-2 mm wide, to 2 cm long, dull whitish-, grayish- or yellowish-green, sometimes turning pale brown, creeping. Stems of thick walled, pale cells, epidermis not or slightly enlarged; ventral merophyte 2-4 cells wide. Lef lobes wide-spreading, convex, apex rounded, margins entire or crenulate, ventral margin sometimes inflexed. Cells (sub)isodiametric, sometimes mamilliose, trigones small to medium-sized, intermediate thickenings scarce; oil bodies very large, only 1-3 per cell, sausage-shaped, coarsely granular; ocelli lacking. Lobules 1/2 leaf length, ovate to rectangular, truncate, inflated, apex with a short or long, 1-6 celled tooth, hyaline papilla distal. Underleaves undivided, wider

than long, margins plane or incurved, insertion line curved. Gynoecia on long or short shoots, usually with 1-2 innovations. Perianths with 4-5 smooth keels. Vegetative reproduction rare. A pantropical genus of 13 spp.; 4 species in Brazil.

1. *Leucolejeunea xanthocarpa* (Lehm. & Lindenb.) A. Evans, Bull. Torrey Bot. Club 36: 216. 1912. (Fig. 3G-J)

On bark and rock in evergreen and semi-evergreen forest and scrub. A common species, in Brazil recorded from the Atlantic coastal region; in Goiás recorded from Rio Preto (see Gradstein & Costa 2003). The involute ventral leaf margin is characteristic of this species. General distribution: pantropical.

Lopholejeunea (Spruce) Schiffn., in Engler & Prantl, Nat. Pflanzenfam. 1, 3: 119, 129. 1893.

Plants rather small, 1-2 mm wide, glossy green to black (or brown), usually creeping. Stems rather fragile, with a hyalodermis; ventral merophyte 4 cells wide. Leaves wide-spreading, when dry not appressed or convolute, apex rounded to apiculate, margins entire. Cells (sub)isodiametric, walls often with blackish pigmentation, trigones simple-triangular or radiate; oil bodies homogeneous; ocelli lacking. Lobules 1/4-1/2 leaf length, sometimes reduced, strongly inflated in the lower half, with 0-1 teeth. Underleaves undivided, margins entire, insertion line curved. Gynoecia without innovations. Perianths with 4-5 dentate-laciniate keels. Vegetative reproduction not observed in neotropical species. A large pantropical genus of ca. 40 spp.; 3 species in Brazil.

1. *Lopholejeunea nigricans* (Lindenb.) Schiffn., Consp. Hepat. Archip. Ind.: 293. 1898.

On bark and rock in moist forests. Rather common, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region; in Goiás recorded from Chapada dos Veadeiros, Irwin *et al.* 33217 (NY, U). General distribution: pantropical.

Mastigolejeunea (Spruce) Schiffn., in Engler & Prantl, Nat. Pflanzenfam. 1, 3: 120, 129. 1893.

Plants 1.5-2.5 mm wide, glossy deep green to dark green, becoming blackish or dark brown with age, creeping or ascending. Stems rigid, with enlarged dorsal epidermis, epidermis ± brown; ventral merophyte 5-10 cells wide. Leaves wide-spreading, when dry appressed to the lateral side of the stem, apex rounded, margins entire. Cells slightly longer than wide, trigones cordate; oil bodies coarsely granular; ocelli lacking. Lobules 1/4-1/2 leaf length, with 1(-3) teeth, free margin plane or inflexed. Underleaves undivided, with entire margins and straight or weakly curved insertion line. Gynoecia with 1(-2) innovations. Perianths with 3(-10) smooth keels. A pantropical genus of ca. 15 spp.; 3 species in Brazil.

1. *Mastigolejeunea auriculata* (Wilson) Schiffn., in Engler & Prantl, Nat. Pflanzenfam. 1, 3: 129. 1893.

Common, xero-tolerant epiphyte on bark in rather open, well-illuminated environments: in the canopy, in gaps, and at the edges of moist forests, in scrub, plantations, and parks, also on rock, to 1500 m. Common species, in Brazil recorded from Amazonia (but not from inner Amazonia), the Planalto, and the Atlantic coastal region; in Goiás recorded from Formoso. New record from Goiás: Alto Paraíso, Chapada dos Veadeiros, near Cachoeira do Rio Preto, Schäfer-Verwimp & Verwimp 9883 (hb. Schäfer-Verwimp). General distribution: pantropical.

Microlejeunea Steph., Hedwigia 27: 61. 1888.

Plants very small, less than 0.5 mm wide, dull pale green, creeping. Stems zig-zag, very thin, of thick-walled cells, without hyalodermis, of 7 outer rows of cells and 3 smaller inner rows; ventral merophyte 2 cells wide. Leaf lobes distant, suberect, with very large lobules (more than 1/2 the size of the lobe), apex rounded to acute, margins entire or crenulate. Cells small, 15-25 µm long, thin-walled or thick-walled; oil bodies small, finely granular; ocelli usually present, 1-3 at lobe base. Lobules 0.5-0.8 leaf length, sometimes reduced, strongly swollen, apical tooth rat-

her long and curved, hyaline papilla proximal. Underleaves bifid, very small. Dioicous. Gynoecia on long or short shoots, with 1-2 lejeuneoid innovations; bracts \pm winged. Perianths inflated-pyriform, with up to smooth keels. Vegetative reproduction usually lacking. A pantropical-temperate genus of ca. 20 spp.; 9 species in Brazil.

1. *Microlejeunea capillaris* (Gottsche) Steph., Sp. Hepat. 5: 819. 1915.

On bark at low elevations. Rare in Brazil, recorded from Santa Catarina and São Paulo. New record from Goiás: Alto Paraiso, Chapada dos Veadeiros, at western border of national park, 840 m, *Schäfer-Verwimp & Verwimp 9845* (SP, hb. Schäfer-Verwimp). General distribution: scattered in tropical America; new record for the state of Goiás.

Schiffneriolejeunea Verd., Ann. Bryol. 6: 89. 1933.

Plants 1-2 mm wide, green to glossy brown, creeping or ascending. Stems rather rigid, with enlarged dorsal epidermis, epidermis brown; ventral merophyte 4-8 cells wide. Leaves wide-spreading, when dry convolute and wrapped around the stem, apex rounded, margins entire. Cells slightly longer than wide, trigones cordate; oil bodies coarsely granular; ocelli lacking. Lobules 1/3-1/2 leaf length, sometimes reduced, with 1-2 teeth, free margin not inflexed. Underleaves undivided, with entire margins and straight or weakly curved insertion line. Gynoecia without innovations. Perianths with 4-6 smooth keels, the keels inflated-swollen. A pantropical genus of 14 spp.; 2 species in Brazil.

1. *Schiffneriolejeunea polycarpa* (Nees) Gradst., J. Hattori Bot. Lab. 38: 335. 1974.

Xerotolerant epiphyte, on bark and rotten wood in open woodlands, scrub, plantations, and on roadside trees. Common species, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region; in the state of Goiás recorded from Chapada dos Veadeiros, *Irwin et al. 33228* (NY, U). General distribution: tropical America, Africa, India.

Thysananthus Lindenb., in Lehmann, Nov. Stirp. Pug. 8: 24. 1844.

Plants rather robust, to 6 cm long, 2-4 mm wide, dull olive green to dark green to black or dark brown with age, ascending or pendent. Stems rigid, without enlarged epidermis, the epidermis strongly thick-walled and brown; ventral merophyte 6-10 cells wide. Leaves wide-spreading, when dry convolute, apex acute, margins entire or toothed. Cells longer than wide, trigones cordate; oil bodies coarsely granular; ocelli lacking. Lobules small, to 1/4 leaf length, never reduced, with 1-2 teeth, free margin plane or inflexed. Underleaves undivided, spatulate and often squarrose, apex truncate to emarginate, margins usually toothed, insertion line straight. Gynoecia with 1(-2) innovations, bracts toothed. Perianths with 3 toothed keels. A pantropical genus of ca. 10 spp.; 1 species in Brazil.

1. *Thysananthus amazonicus* (Spruce) Schiffn., in Engler & Prantl, Nat. Pflanzenfam. 1, 3: 130. 1893.

On tree trunks, branches, and twigs in lowland and submontane rain forests and in scrub, usually in the canopy or in rather open situations, to 1000 m. Uncommon, in Brazil recorded from Amapá, Acre, Amazonia, Pará, Goiás (Alto Paraiso, Chapada dos Veadeiros, *Schäfer-Verwimp & Verwimp 9864* [JE, SP]), Mato Grosso. General distribution: northern South America, Costa Rica, Cuba.

LEPIDOZIACEAE

Branches variable; stolons or flagella often present. Leaves incubous, succubous, or transverse, usually divided into several segments or teeth, rarely undivided, leaf insertion usually extending to dorsal midline of stem. Underleaves usually present. Rhizoids in tufts from underleaf bases. Archegonia on short ventral branches. Sporophyte surrounded by a 3-keeled perianth. Seta thin, of 8 or 16 outer rows of large cells surrounding many (rarely only 4) small inner cells. Capsule elongate, wall 2-layered. Vegetative reproduction by caducous leaves; gemmae lacking.

- 1. Leaves divided to the base into 3-4 linear filaments. Plants very small, usually less than 0.5 mm wide.
 - 2. Plants whitish-green. Filaments 1 cell wide throughout, made up of smooth, thin-walled rectangular cells *Telaranea*
 - 2. Plants brownish. Filaments 2-3 cells wide at the base, made up of papillose, thick-walled, quadrate cells (cells rectangular in species not recorded from Goiás) *Kurzia*
- 1. Leaves not divided to the base into 2-4 linear filaments. Plants larger.
 - 3. Leaf cells very large, 50-100 µm long, completely thin-walled. Leaves longitudinally inserted, flat, leaf apex with 1-2 sausage-shaped slime papillae. Underleaves reduced *Zoopsidella*
 - 3. Leaf cells smaller, thick-walled or with trigones. Leaves obliquely inserted or transverse, leaf apex without slime papillae. Underleaves present.
 - 4. Leaf divided to the middle or more into 2-4 lobes. Plants less than 1 mm wide.
 - 5. Leaves 2-3-lobed, ovate to elliptical. Plants usually pale green *Paracromastigum*
 - 5. Leaves 4-lobed. Plants brown *Kurzia*
 - 4. Leaf less deeply divided. Plants larger.
 - 6. Leaves ± folded and keeled, with a conspicuous wing in the upper half, leaf apex usually undivided. Plants irregularly branched *Micropterygium*
 - 6. Leaves not folded and keeled, without wing. Leaf apex shallowly divided into 3 teeth. Plants regularly forked branched *Bazzania*

Bazzania S.F. Gray, Nat. Arr. Brit. Pl. 1: 704, 775. 1821.

Plants 1-6 mm wide, deep green to olive-green or brown, creeping, usually forked branched and with numerous long, ventral flagella. Stems rigid. Leaves incubous, wide-spreading, ovate-rectangular, apex truncate and divided into 2-3 large teeth (rarely undivided), margins entire, rarely toothed. Cells with small or large trigones, cuticle smooth or papillose, a nerve of elongated cells sometimes present; oil bodies large, ± homogeneous. Underleaves large, undivided or shallowly lobed, margins entire or toothed, underleaf bases sometimes united with the leaves on one or both sides. Rhizoids scattered from ventral stem surface. Dioicous, frequently sterile. Vegetative reproduction common, by caducous leaves. About 100 species worldwide; 16 in Brazil.

1. *Bazzania aurescens* Spruce, Trans. & Proc. Bot. Soc. Edinburgh 15: 374. 1885. (Fig. 4A)

On shaded rock, logs, or bark in moist forest. Uncommon, in Brazil recorded from Amazonia, Goiás, Minas Gerais, and São Paulo. General distribution: tropical America.

Kurzia G. Martens, Flora 53: 417. 1870.

Plants very small, 0.3-0.4 mm wide, usually brown, creeping, pinnate. Stems fragile.

Leaves minute, transverse, rarely succubous, deeply divided into 4 subulate or narrow-triangular segments, the segments straight or incurved, 2-3(-4) cells wide at the base, margins entire. Cells thick-walled, without trigones, cuticle papillose; oil bodies finely granular. Underleaves about half the size of the leaves, deeply 2-4-lobed, the segments often unequal in length. Rhizoids scattered from ventral stem surface. Dioicous, frequently sterile. A genus of about 30 species worldwide; 3 in Brazil.

1. Leaf segments triangular, mostly 4 cells wide at base. Leaf lamina at least 3 cells high *K. brasiliensis*

1. Leaf segments subulate, 2-3 cells wide at base. Leaf lamina only 1(-2) cells high. Leaf cells quadrate *K. capillaris*

1. *Kurzia brasiliensis* (Steph.) Grolle, Rev. Bryol. Lichénol. 32: 174. 1963.

On rotten wood and shaded rock in moist forest. Uncommon, in Brazil recorded from Roraima, the Planalto, and the Atlantic coastal region. Report from Goiás: see Gradstein & Costa (2003). General distribution: endemic to Brazil.

2. *Kurzia capillaris* (Sw.) Grolle, Rev. Bryol. Lichénol. 32: 173. 1963.

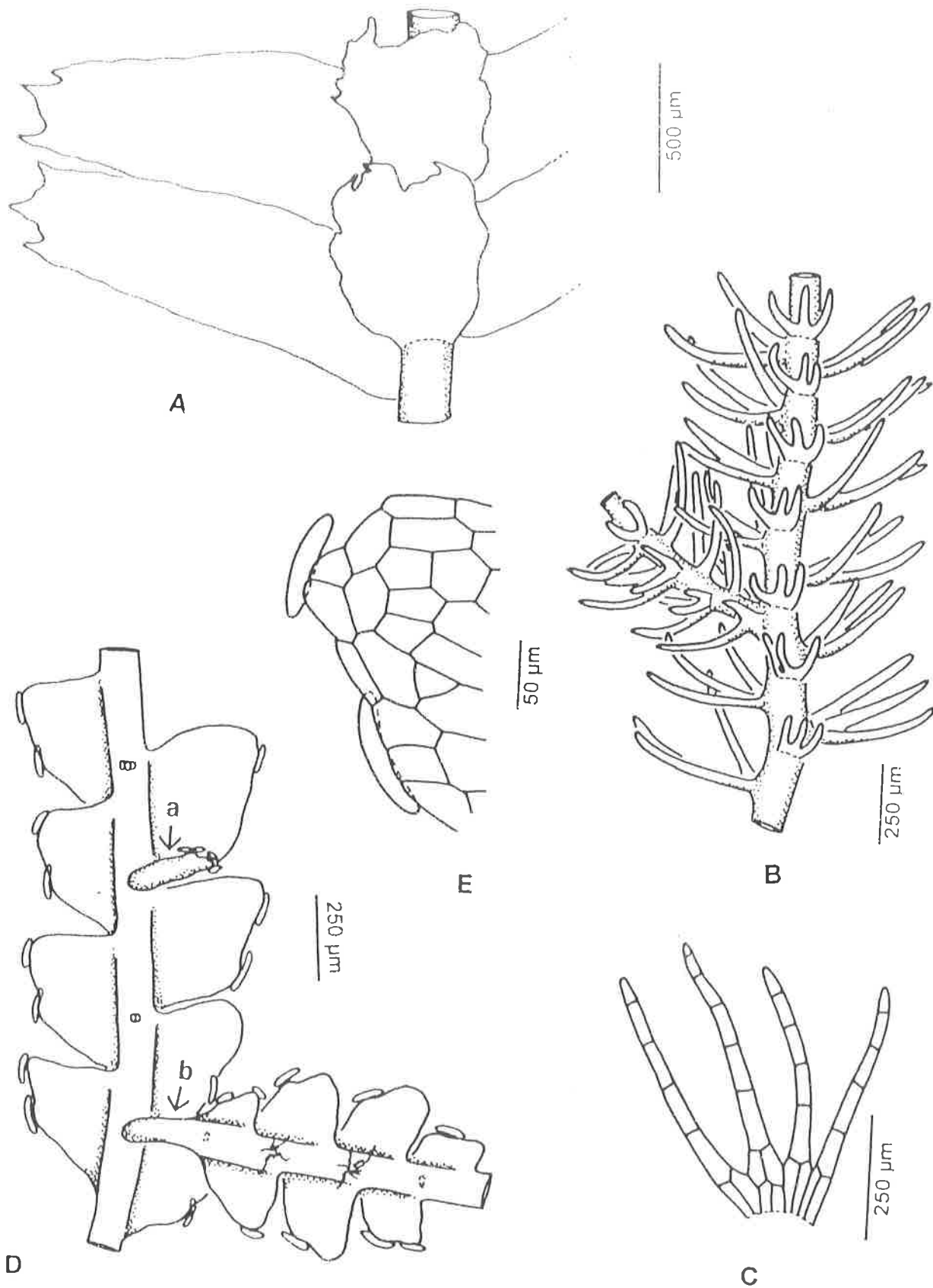


Figure 4 - A. *Bazzania aurescens* Spruce, habit, ventral view. **B-C.** *Telaranea nematodes* (Gottsche ex Austin) M. A. Howe **B.** Habit, ventral view. **C.** Leaf. **D-E.** *Zoopsidella macella* (Steph.) R. M. Schust. **D.** Habit, ventral view (a = short ventral-intercalary stoloniform branch with reduced leaves at the tip; b = ventral-intercalary branch with developed leaves). **E.** Leaf apex with two slime papilla. (A-J from Gradstein & Costa, 2003; reproduced with permission).

On shaded rock, bark, or soil in moist forest. Common, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region. In the state of Goiás recorded from Alto Paraiso, Chapada dos Veadeiros, *Schäfer-Verwimp & Verwimp 9871* (JE, SP). General distribution: tropical America, Africa.

Micropterygium Lindenb. et al., in Gottsche et al., Syn. Hepat. 233. 1845.

Plants 1-2 mm wide, green to brown, leafy stems ascending from a branched rhizome system, irregularly branched. Stems rigid, with a thick-walled, brown, 1-2-layered cortex surrounding smaller, thin-walled medulla cells. Leaves transverse or succubous, orbicular to lanceolate, concave to complicate and keeled with a conspicuous wing in the upper half, the wing sometimes reduced, apex usually undivided, margins entire or toothed. Cells small, 10-20 μm , usually thick-walled, cuticle smooth or papillose; oil bodies granular. Underleaves present, smaller to almost as large as the leaves. Rhizoids scattered from ventral stem surface. Dioicous, frequently sterile. A neotropical genus of ca. 20 spp.; 8 species in Brazil.

1. *Micropterygium lechleri* Reimers, Hedwigia 73: 184. 1933.

Rare species from moist clay, sand, logs, or bark at low elevations. A rare species, in Brazil recorded from Goiás and Mato Grosso. In the state of Goiás recorded from Alto Paraiso, Chapada dos Veadeiros, *Schäfer-Verwimp & Verwimp 9836* (JE, SP). General distribution: Colombia, Brazil.

2. *Micropterygium leiophyllum* Spruce, Trans. & Proc. Bot. Soc. Edinburgh 15: 386. 1885.

On logs, bark, or rock in lowland rain forests and submontane woodlands. A common Amazonian species, in Brazil recorded from Roraima, Rondônia, Amazonia, Pará, Goiás (Chapada dos Veadeiros), and Mato Grosso. In the state of Goiás recorded from Alto Paraiso, Chapada dos Veadeiros, *Schäfer-Verwimp & Verwimp 9903* (JE, SP). General distribution: Amazon Basin southwards to Mato Grosso.

Paracromastigum Fulford & J. Tayl., Brittonia 13: 336. 1961.

Plants very small, to 1 mm wide, pale green to yellow or greenish-brown, creeping or ascending from a stoloniform base, irregularly branched. Stems fragile. Leaves suberect to wide-spreading, succubous, plane or concave, ovate to elliptical, narrowed to the base, 2-3-lobed to leaf middle or more shallowly, the segments triangular to lanceolate. Cells quadrate to rectangular, with thin or uniformly thickened walls, cuticle finely papillose; oil bodies lacking or finely granular. Underleaves similar to the leaves or smaller. Rhizoids scattered from ventral stem surface. Usually dioicous. A small southern-temperate genus with two species in tropical America, including Brazil.

1. *Paracromastigum pachyrhizum* (Nees) Fulford, Mem. New York Bot. Garden 11: 390. 1968.

On steep, moist earth, frequently on cut road banks. Uncommon species, in Brazil recorded from Goiás (Alto Paraiso, Chapada dos Veadeiros, *Schäfer-Verwimp & Verwimp 9873* (JE, SP), Minas Gerais, Espírito Santo, Rio de Janeiro, and São Paulo. General distribution: tropical America.

Telaranea (Spruce) Schiffn., in Engler & Prantl., Nat. Pflanzenfam. 1, 3: 103. 1893.

Plants very small, filamentous, usually less than 0.5 mm wide (sometimes larger), whitish green, pinnate or irregularly branched. Branches mostly *Frullania*-type, occasionally ventral-intercalary. Stems with a hyalodermis. Leaves transverse, divided to the base into (2-)3 filaments, the filaments only 1 cell wide. Cells rectangular, the walls uniformly thin, cuticle smooth; oil bodies finely granular. Underleaves 1/4-1/2 the length of the leaves, consisting of two or three 1-3 cells long filaments. A tropical and southern-temperate genus of ca. 30 spp.; 1 species in Brazil.

1. *Telaranea nematodes* (Gottsche ex Austin) M.A. Howe, Bull. Torrey Bot. Club 29: 284. 1902. (Fig. 4B-C)

On soil and rotten wood in moist, shaded environments. Common species, in Brazil reported from Amazonia and the Atlantic coastal region. New record from Goiás: Mineiros, gallery forest near the border with Mato Grosso, on moist sandy soil, 680 m, *Schäfer-Verwimp & Verwimp 8556* (SP, hb. Schäfer-Verwimp).

General distribution: tropical America, tropical Africa and western Europe; new record for the state of Goiás.

Zoopsideella R.M. Schust., Nova Hedwigia 10: 24. 1965.

Plants 0.5-1 mm wide, whitish-green, creeping, irregularly branched. Branches ventral-intercalary, occasionally *Frullania*-type; ventral branches usually stoloniform. Stems thin, dorsal side 2 cells wide, hyalodermis present. Leaves very flat and wide-spreading, succubous and almost horizontally inserted on the lateral side of the stem (dorsal side of the stem leaf-free), quadrate to elongate, shallowly 2-lobed or undivided, upper margins usually with two sausage-shaped slime papillae. Cells large, thin-walled, cuticle smooth; oil bodies small, granular. Underleaves reduced. Perianths cylindrical, mouth with long, bristle-like lacinia. Seta of 8 outer and 4 inner rows of cells. A neotropical genus of ca. 7 spp.; 2 species in Brazil.

1. *Zoopsideella macella* (Steph.) R.M. Schust., Nova Hedwigia 10: 42. 1965. (Fig. 4D-E)

On decaying wood in moist forests. Previously only known from Amazonia. New record from Goiás: Alto Paraiso, Chapada dos Veadeiros, on moist soil near creek, 850 m, Schäfer-Verwimp & Verwimp 9875 (SP, hb. Schäfer-Verwimp). General distribution: northern and Central Brazil; new record for the state of Goiás.

PLAGIOCHILACEAE

Description: see *Plagiochila*.

Plagiochila (Dumort.) Dumort., Recueil Observ. Jungerm.: 14. 1835.

Plants small to very robust, (0.5-)1-10 mm wide, green to brown, creeping, ascending or pendent, often dendroid with erect leafy shoots arising from a creeping rhizome-like stem, irregularly branched to regularly pinnate. Stems usually with a brown cortex of thick-walled cells in several layers. Leaves succubous, orbicular to ovate to oblong to almost linear, often asymmetrical, with reflexed dorsal margin and decurrent bases, apex undivided or 2-3-lobed, margins usually toothed especially along the apical and ventral margins, teeth at the apex often larger. Cells thinwalled or with conspicuous trigones, cuticle

smooth or rough; oil bodies usually finely granular. Underleaves usually lacking, sometimes present and very small. Rhizoids scattered from ventral stem surface, often lacking. Dioicous. Male spikes long, terminal or intercalary. Gynoecia on short or long shoots, with or without innovations. Perianth laterally flattened, the mouth usually ciliate. Seta thick, made up of numerous rows of cells. Capsule wall 4-9-layered. Vegetative reproduction common, by tiny leafy shoots developing from the leaf surfaces or by caducous or fragmenting leaves. The largest genus of hepatics with ca. 350 species worldwide; more than 30 species in Brazil.

1. Terminal branches present. Ventral leaf bases long decurrent, ampliate, forming a crest, the stem hardly visible. Leaves rectangular. Perianth enveloped by bracts. Asexual reproduction by small propagula from ventral leaf surfaces *P. raddiana*

1. Terminal branches lacking. Ventral leaf bases short decurrent, not ampliate, not forming a crest, the stem clearly visible. Leaves subrectangular (mid-leaf cells 15-30 µm wide). Perianth "naked," not enveloped by bracts. Asexual reproduction by caducous leaves ...
..... *P. simplex*

1. *Plagiochila raddiana* Lindenb., Sp. Hepat.: 9. 1839. (Fig. 5A-B)

On bark and rock in forest and scrub. Common species, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region. New records from Goiás: Alto Paraiso, Chapada dos Veadeiros, Rio Sao Miguel, on bark, ca. 800 m, Schäfer-Verwimp & Verwimp 9852, 9858 (SP, hb. Schäfer-Verwimp); in dense cerrado vegetation along GO 070 ca. 35 km southeast of Goiás Velha, ca. 600 m, Schäfer-Verwimp & Verwimp 8681 (SP, hb. Schäfer-Verwimp). General distribution: tropical America; new record for the state of Goiás.

2. *Plagiochila simplex* (Sw.) Lindenb., Sp. Hepat.: 20. 1839.

On bark and rock in forest and scrub. Common species, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region. New record from Goiás: Alto Paraiso, Chapada dos Veadeiros, on shaded rock in canyon of Rio Preto,

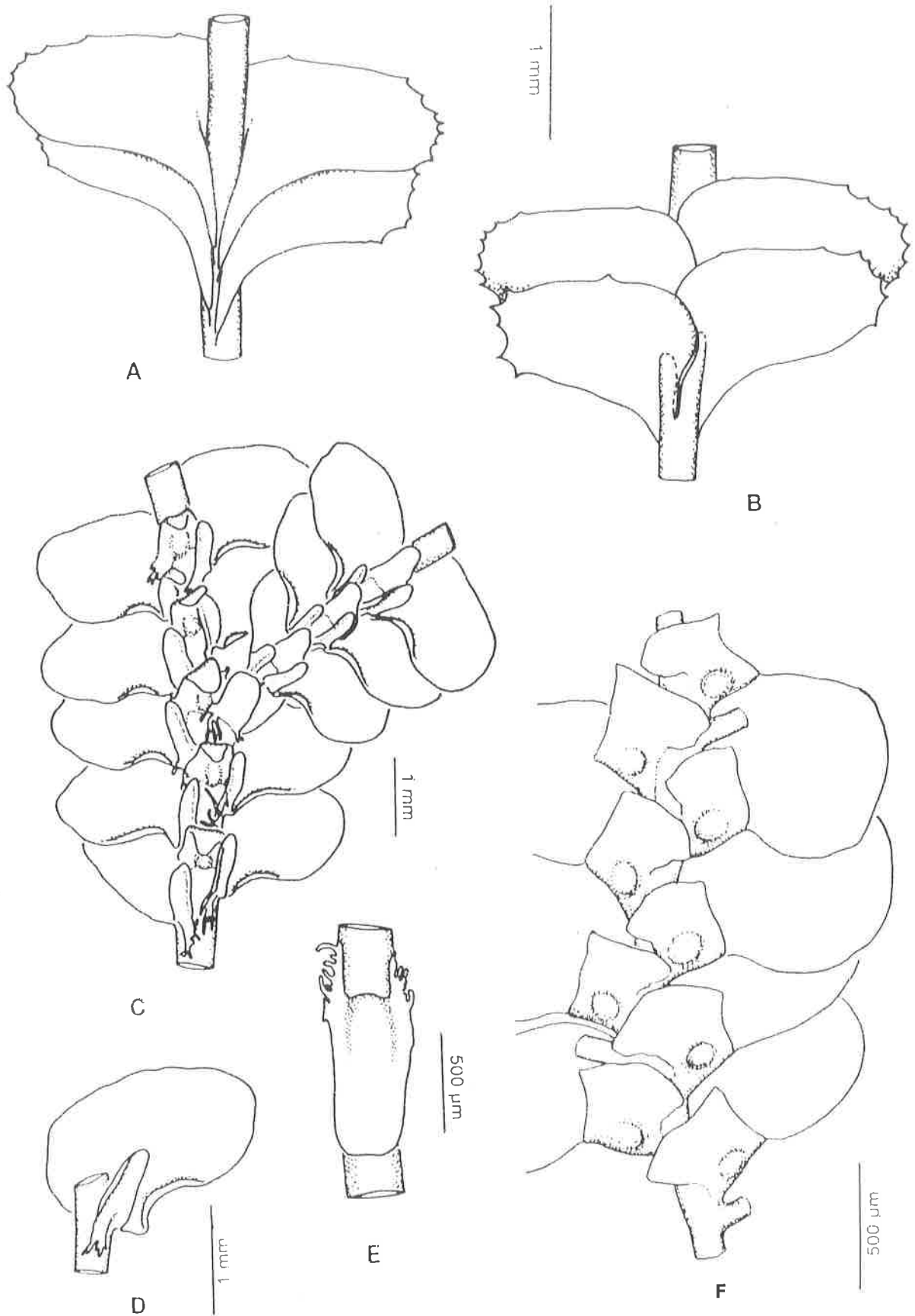


Figure 5 - **A-B.** *Plagiochila raddiana* Lindenb. **A.** Habit, dorsal view. **B.** Habit, ventral view. **C-E.** *Porella swartziana* (Weber) Trevis **C.** Habit, ventral view. **D.** Portion of stem with leaf, ventral view. **E.** Portion of stem with underleaf, ventral view. **F.** *Radula angulata* Steph., Habit, ventral view (**A-E** from Gradstein & Costa, 2003; reproduced with permission).

ca. 900 m, sparse, *Schäfer-Verwimp* & *Verwimp* 9897 (SP, hb. Schäfer-Verwimp). General distribution: tropical America; new record for the state of Goiás.

Additional record:

3. *Plagiochila aliena* Gottsche, Mexik. Leverm.: 22. 1863.

A poorly known and taxonomically doubtful species, in Brazil only recorded from the state of Goiás (Fulford, 1958); habitat unknown. General distribution: tropical America.

PORELLACEAE

Description: see *Porella*.

Porella L., Sp. Pl.: 1106. 1753.

Plants robust, 5-20 cm long and 3-7 mm wide, green to brown, creeping or pendent, pinnate. Stems brown, rigid, with a thick-walled cortex. apex of the lobe rounded or mucronate, margins entire or toothed, bases sometimes ciliate-laciniate. Lobules almost free from the dorsal lobe, flat and elongate, parallel to the stem or somewhat spreading, margins entire to toothed-ciliate or laciniate, apex broadly rounded. Cells with trigones and smooth cuticle; oil bodies small and homogeneous, numerous per cell. Underleaves large, longer than wide, undivided, apex broadly rounded. Rhizoids in bundles from underleaf bases. Dioicous. Gametocia on short branches. Sporophyte surrounded by a bluntly 3-keeled perianth. Seta short and thick. Capsule wall 3-6-layered. Elaters free, not attached to the capsule valves. Spores large, multicellular, germination endosporous within the unopened capsule. Vegetative reproduction unknown. A genus of about 50 species worldwide; 4 in Brazil.

1. *Porella swartziana* (Weber) Trevis., Mem. Reale Inst. Lombardo Sci. Mat. Nat., ser. 3, 4: 407. 1877. (Fig. 5C-E)

On bark, logs, rock, or soil in mesic woodlands. Rather common species, in Brazil recorded from the Planalto and the Atlantic coastal region. Report from Goiás: see Gradstein & Costa (2003). General distribution: tropical America.

RADULACEAE

Description: see *Radula*.

Radula Dumort., Comment. Bot.: 112.1822.

Plants 1-10 cm long, ca. 1-3 mm wide, dull pale green to bright green, rarely brownish, creeping, sometimes pendent, (bi)pinnate. Branches *Radula*-type. Stems rigid, without hyalodermis. Leaves incubous, divided into a large dorsal lobe and a small ventral lobe (= lobule), apex of lobe rounded (occasionally acute), margins entire. Lobules broadly attached to the dorsal lobe by a keel and to the stem, quadrate to oblong. Cells thin-walled or with small trigones, cuticle smooth; oil bodies very large, brown, 1-2 per cell. Underleaves lacking. Rhizoids in bundles from the lobules. Usually dioicous. Sporophyte surrounded by a flattened, 2-keeled perianth. Seta short and thick. Capsule wall 2-3-layered. Elaters free, not attached to the capsule valves. Spores unicellular or multicellular. Vegetative reproduction by large, multicellular gemmae or caducous leaf segments. A genus of about 200 species worldwide; about 30 in Brazil.

- 1. Leaf margins with discoid gemmae. Apex of lobule not elongate *R. aurantii*
- 1. Discoid gemmae lacking. Apex of lobule narrowly elongate *R. angulata*

1. *Radula angulata* Steph., Hedwigia 23: 114. 1884. (Fig. 5F)

On bark. Common, in Brazil recorded from the Planalto and the Atlantic coastal region. Report from Goiás: see Gradstein & Costa (2003). General distribution: tropical America.

2. *Radula aurantii* Spruce, Bull. Soc. Bot. France 36 (Suppl.): 194. 1890.

This species has been considered a synonym of *R. tectiloba* Steph. (e.g., Gradstein & Costa, 2003); here we follow Reiner-Drehwald (1994), who treated them as separate species and assigned the Brazilian specimens to *R. aurantii*. On bark, rotten wood, or rock in moist forest. Common species, in Brazil recorded from the Planalto and the Atlantic coastal region. Report from Goiás: see Gradstein & Costa (2003). General distribution: tropical America.

THALLOID LIVERWORTS

Key to the families of thalloid liverworts

1. All rhizoids with smooth walls. Thallus dorsal surface without pores, ventral surface lacking scales or slime papillae; interior of thallus homogeneous, without air chambers. Oil bodies valves Simple thalloid liverworts (Metzgeriales).
 2. Thallus \pm pinnate, without midrib or midrib present on branches. Gametangia on thallus margins or short lateral branches. Not yet recorded from the State of Goiás **Aneuraceae**
 2. Thallus forked, with a narrow midrib. Gametangia on the dorsal or ventral side of the midrib.
 3. Thallus less than 3 mm wide, margins with numerous hairs. Midrib without central strand. Gametangia on the ventral side of the midrib **Metzgeriaceae**
 3. Thallus more than 3 mm wide, margins without hairs. Midrib with a central strand (clearly visible under low magnification, without dissection). Gametangia on the dorsal side of the midrib **Pallaviciniaceae**
1. Rhizoids of two types, with smooth walls and with tuberculate walls. Ventral surface of thallus with scales or slime papillae, dorsal surface with or without pores; interior of thallus complex, with air chambers. Oil bodies restricted to specialized oil cells without chloroplast, lacking in green cells. Capsule wall of only one layer of cells, dehiscing variously but not by 4 valves. Complex thalloid liverworts (Marchantiales).
 4. Gemma receptacles present on dorsal surface of thallus.
 5. Gemma receptacles cup-shaped. Not yet recorded from Goiás **Marchantiaceae** (*Marchantia*)
 5. Gemma receptacles a lunate scale. Not yet recorded from Goiás **Lunulariaceae** (*Lunularia*)
 4. Gemma receptacles absent.
 6. Thallus growing in (partial) rosettes or floating on water. Upper surface of the thallus usually with a median groove, pores small or lacking. Air chambers lacking or inconspicuous. Sporophyte embedded in the thallus **Ricciaceae**
 6. Thallus not growing in rosettes and not floating on water. Upper surface of the thallus without median groove, pores usually present. Air chambers present. Sporophyte not embedded in the thallus.
 7. Ventral surface of the thallus without scales. Thallus translucent, very thin, 2-layered. Sporophytes embedded in a notch at the thallus apex ... **Cyathodiaceae**
 7. Ventral scales present throughout. Thallus thicker, differentiated into midrib and wings. Sporophytes various but not positioned in a notch at the thallus apex.
 8. Sporophytes produced on stalked receptacles. Air chambers in several layers (at least in median portion of the thallus), without photosynthetic filaments ... **Aytoniaceae**
 8. Stalked receptacles lacking. Air chambers in one layer, usually with photosynthetic filaments.
 9. Thallus completely black when dry, margins and underside dark purplish-black. Sporophyte in a dark, swollen, mussel-like involucre below the thallus apex **Targioniaceae**
 9. Thallus not black when dry, margins and underside green or tinged with purple. Sporophyte on the thallus surface, embedded in a calyptra and protected by a scale-like involucre **Corsiniaceae**

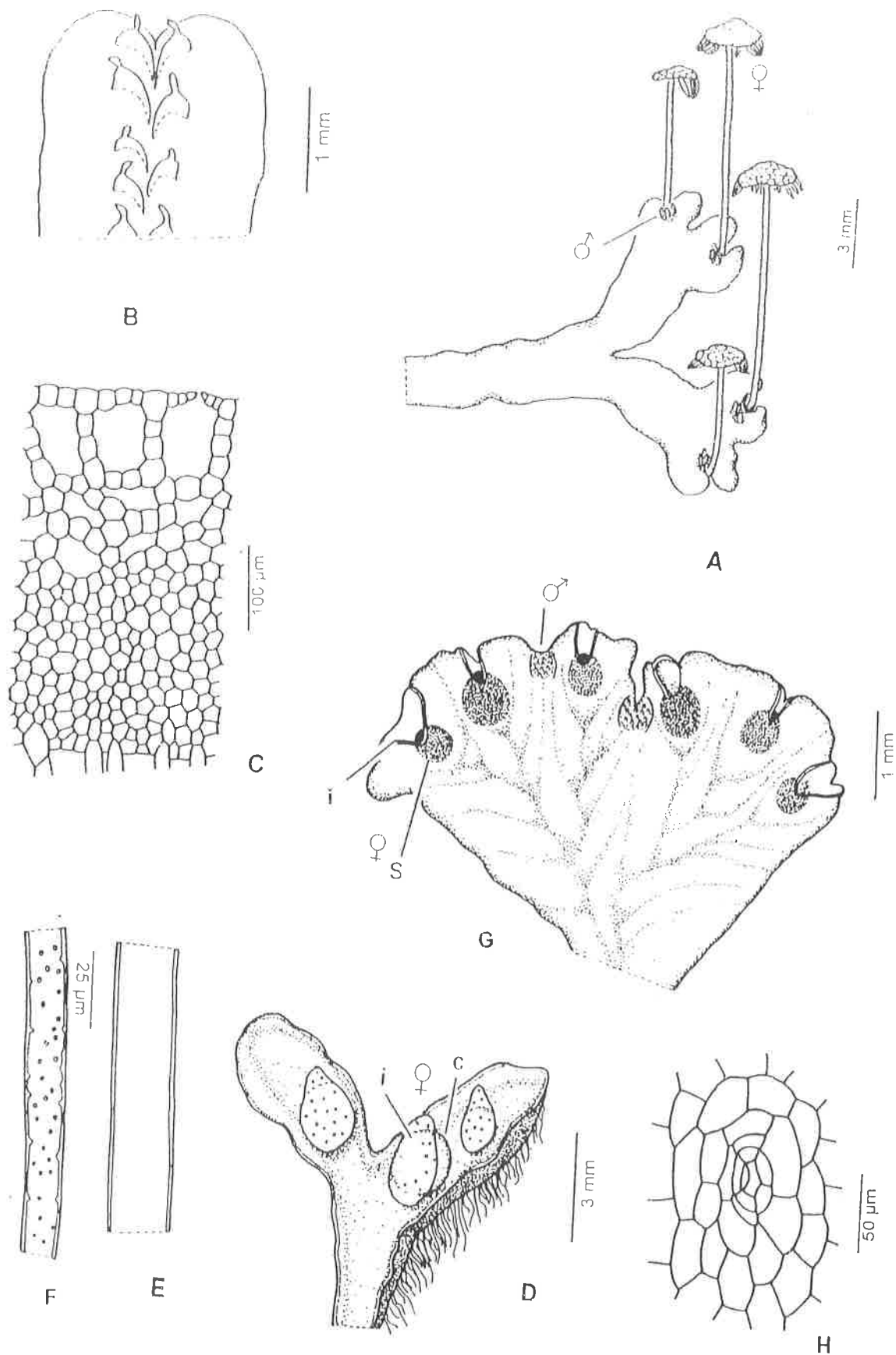


Figure 6 - A-C. *Asterella venosa* (Lehm. & Lindenb.) A. Evans **A.** Habit with androecia at base of archegoniophores, dorsal view. **B.** Thallus with scales, ventral view. **C.** Cross section of thallus middle. **D-F.** *Cronisia weddellii* (Mont.) Grolle **D.** Habit with female branch (i = involucre, c = calyptra). **E.** Portion of rhizoid with smooth wall. **F.** Portion of rhizoid with tuberculate wall. **G-H.** *Cyathodium cavernarum* Kunze **G.** Habit (i = involucre, s = sporophyte). **H.** Pore (**A-H** from Gradstein & Costa, 2003; reproduced with permission).

AYTONIACEAE

Thallus with simple pores, surrounded by 1-several rings of differentiated cells. Air chambers in 2 or more layers, filaments lacking. Ventral scales large, in 2 rows. Antheridia embedded in the dorsal surface of the thallus or in receptacles; archegonia in receptacles surrounded by a 2-lipped involucre. Female receptacles stalked after fertilization. Sporophyte sometimes surrounded by a pseudoperianth (*Asterella*). Seta very short. Capsule opening by an operculum. Spores usually large. Vegetative reproduction lacking.

Asterella P. Beauv., in Cuvier, Dict. Sci. Nat. 3: 257. 1805.

Thallus rigid, 1.5-8 mm wide, green to reddish-purple. Dorsal surface of thallus reticulate and with simple pores; epidermis cells with or without trigones. Thallus underside usually reddish-purple, scales with 1-4 appendages. Air chambers in several layers, without filaments. Monoicous or dioicous. Antheridia in irregular dorsal groups or cushions. Female receptacles arising from thallus apex on a stalk with 1 furrow; receptacle strongly papillose above and 2-5-lobed, segments with a small group of archegonia underneath, surrounded by a cup-shaped involucre. Each fertilized archegonium (and sporophyte) surrounded by a large pseudoperianth, splitting above into 8-16 narrow segments. A genus of about 60 species worldwide; 1 in Brazil.

1. *Asterella venosa* (Lehm. & Lindenb.) A. Evans, Contr. U. S. Natl. Herb. 20: 286. 1920. (Fig. 6A-C)

Along rivulets in rather dry, shaded places, below 1000 m. Common in Brazil but rare elsewhere, in Brazil recorded from the Planalto and southern Brazil. Report from Goiás: see Bischler et al. (2005). General distribution: a disjunct, amphotropical species, occurring in Mexico, Brazil, Uruguay, and Argentina, but lacking in the equatorial regions of tropical America.

CORSINIACEAE

Thallus with simple pores, the pores surrounded by only one ring of differentiated cells. Air chambers in one layer, with or without

filaments. Ventral scales scattered or in 2 rows. Stalked receptacles lacking. Antheridia in linear receptacles along the median line of the thallus. Archegonia in depressions along the median line of the thallus, often covered by a scale- or hood-like involucre. Pseudoperianth lacking. Seta very short. Capsule cleistocarpous. Spores large. Elaters \pm reduced. Vegetative reproduction lacking.

Cronisia Berk., Intr. Crypt. Bot.: 434. 1857.

Thallus small, to 3 cm long, 2-6 mm wide, light green, underside red to purplish or purplish-brown, forked. Dorsal surface of thallus finely reticulate, with small pores surrounded by a ring of 5-10 cells, the pores sometimes strongly elevated. Thallus underside with scales in 2 rows, each scale with one or several filiform, simple or branched appendages. Monoicous. Sporophytes in groups of 1-2 in depressions on the thallus surface entirely covered by the scale-like involucre. A small neotropical genus of 2 spp.; 1 species in Brazil.

1. *Cronisia weddellii* (Mont.) Grolle, J. Bryol. 9: 432. 1977. (Fig. 6D-F)

On moist soil in caatinga and cerrado, at low elevations. An uncommon neotropical species, in Brazil recorded from Piauí, Ceará, Alagoas, Pernambuco, Bahia, Goiás, Mato Grosso, and Espírito Santo. The type of the species is from the state of Goiás (*Weddell s.n.*, see Vital [1974b], Bischler et al. [2005]). General distribution: dry regions of tropical America.

CYATHODIACEAE

Description: see *Cyathodium*.

Cyathodium Kunze, in Lehmann, Nov. Stirp. Pug. 6: 17. 1834.

Thallus delicate, translucent, to 1.5 cm long, 1-4 mm wide, pale green to yellowish-green to glaucous-green, not tinged with purple, often forming partial rosettes, thin, 2-layered, sometimes slightly thicker in the middle, thallus margins often irregularly lobed. Dorsal surface of thallus reticulate, with pores, epidermal cells thin-walled. Ventral scales usually reduced, in 2 rows near the thallus apex, scales with slime papillae at the margins and apex, and sometimes with a small appendage. Air chambers in 1 layer, without

filaments. Monoicous or dioicous. Sporophytes 1-4 in a notch at the apex of the thallus, surrounded by a 2-valved involucre. Vegetative reproduction sometimes by gemmae from thallus margins and by tubers. A pantropical genus of ca. 14 spp.; 1 species in Brazil.

1. *Cyathodium cavernarum* Kunze, in Lehmann, Nov. Stirp. Pug. 6: 17. 1834. (Fig. 6G-H)

On moist soil and rock in shaded places, e.g., in small caves along streams and on the humid bases of calcareous cliffs, to 1200 m. The species is mainly restricted to the cerrado regions of Brazil; in the State of Goiás collected in the Serra do Lobeira, Itaberai (Vital, 1974a; Bischler et al., 2005). General distribution: pantropical.

METZGERIACEAE

Description: see *Metzgeria*.

Metzgeria Raddi, Jungermannogr. Etrusca: 34. 1818.

Thallus thin and with a narrow midrib, pale green to yellowish, sometimes blue when dry, 0.5-15 cm long, to 2(-3) mm wide, prostrate to erect or pendent, forked, rarely irregularly pinnate, with numerous hairs along the margins, on the underside of the midrib, and, sometimes, on the ventral surface of the thallus. Hairs unicellular, arising singly or in pairs, sometimes in groups of 3-5. Thallus surface plane to deeply concave with inflexed margins. Midrib 2-8 cells wide, epidermis cells larger than the inner cells; central strand absent. Oil bodies absent or very small, homogeneous. Ventral scales lacking. Monoicous or dioicous. Gametangia on highly abbreviated branchlets on the ventral side of the midrib, the antheridia inside a globose sac, the archegonia hidden under a thallus flap. Sporophyte surrounded by a fleshy calyptra; pseudoperianth lacking. Capsule spherical to ovoid, opening by 4 valves, wall 1-2-layered. Spores small, unicellular. Elaters 1-spiralled, attached to valve apices. Vegetative reproduction by gemmae or caducous branches. A genus of about 100 species worldwide; 26 in Brazil.

- 1. Thallus margin cells with only 1 hair each. Dorsal surface of midrib 2 cells wide
..... *M. furcata*
- 1. At least some thallus margin cells with 2 hairs. Dorsal surface of midrib more than 2 cells wide.

- 2. Thallus bordered by differentiated margin cells *M. lechleri*
- 2. Thallus not bordered *M. dichotoma*

1. *Metzgeria dichotoma* (Sw.) Nees, in Gottsche et al., Syn. Hepat.: 504. 1846.

On bark, rotten wood, or rock. Not common, in Brazil recorded from the Planalto and the Atlantic coastal region. In the state of Goiás recorded from Alto Paraiso, Chapada dos Veadeiros, Schäfer-Verwimp & Verwimp 9859 (JE, RB). General distribution: tropical America.

2. *Metzgeria furcata* (L.) Dumort., Recueil Obs. Jungerm.: 26. 1835.

On bark, living leaves, and soil. Rather common, in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region. General distribution: subcosmopolitan.

3. *Metzgeria lechleri* Steph., Sp. Hepat. 1: 290. 1899. (Fig. 7A-C)

On bark. Rather common, in Brazil recorded from the Planalto and the Atlantic coastal region. General distribution: tropical America.

PALLAVICINIACEAE

Thallus with a swollen midrib and a unistratose lamina, margins without hairs. Midrib with on 1-3 central strands. Oil bodies finely granular. Ventral scales lacking. Gametangia on the dorsal surface of the midrib, the antheridia in a long band hidden under lacinate scales, the archegonia in small groups surrounded by a scale or a tubular involucre. Sporophyte surrounded by a pseudoperianth or a fleshy calyptra. Capsule ellipsoidal to narrow-cylindrical, opening by 1-4 valves. Spores small, unicellular. Elaters free, not attached to capsule valves. Vegetative reproduction rare.

Symphyogyna Nees & Mont., Ann. Sci. Nat., Bot. sér. 2, 5: 66. 1836.

Thallus green, about 2-6 cm long, 3-6 mm wide, mostly prostrate, occasionally erect-dendroid from a prostrate rhizome and with a stalk-like lower half, simple or forked, sometimes with ventral branches. Midrib to 1/6 of the thallus width, with 1(-3) central strands of narrow, thick-walled cells. Thallus wings

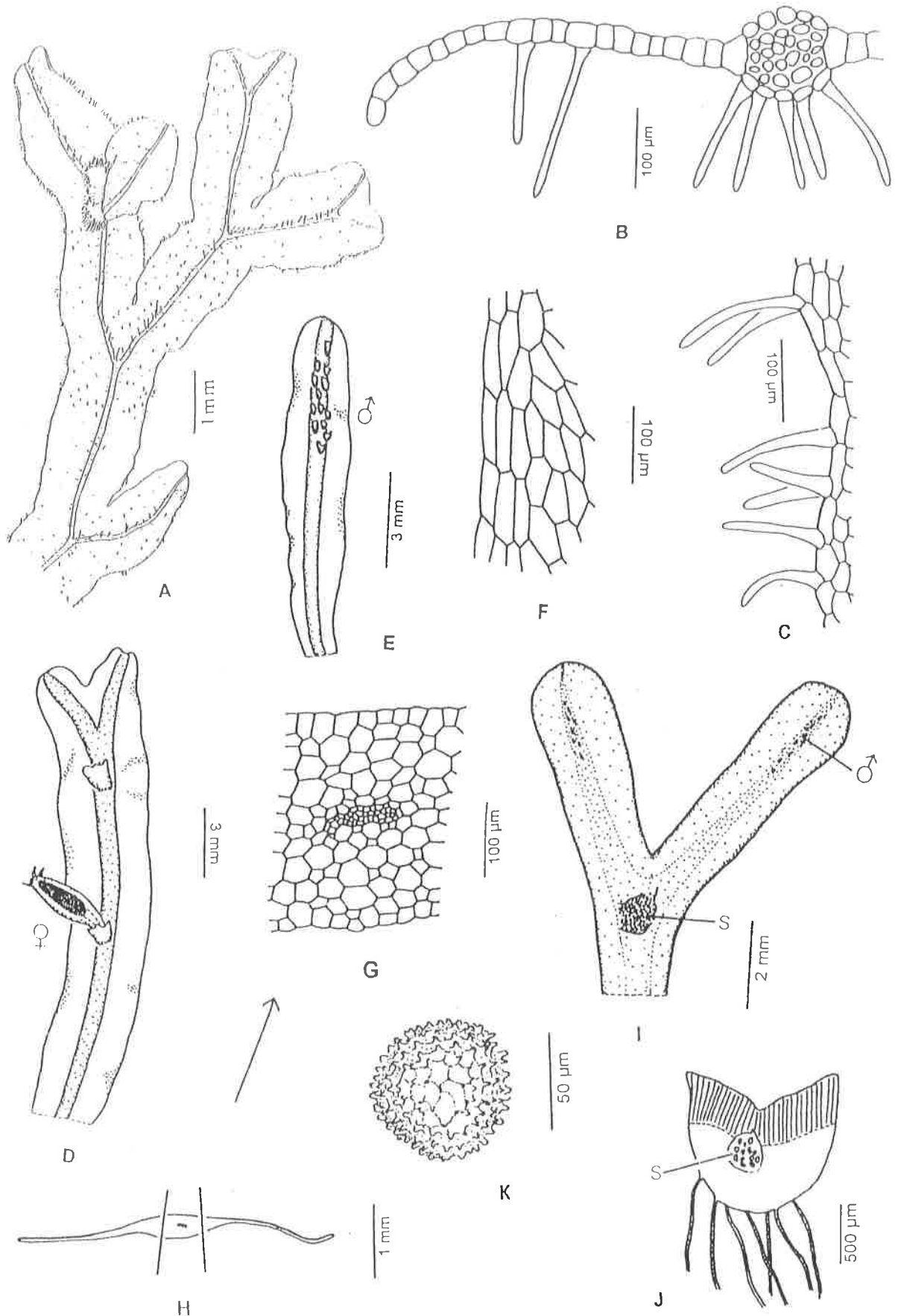


Figure 7 - A-C. *Metzgeria lechleri* Steph. **A.** Habit, ventral view. **B.** Cross section of thallus. **C.** Marginal hairs. **D-H.** *Symphyogyna brasiliensis* (Nees) Nees & Mont. **D.** Habit with female branch and young sporophyte, dorsal view. **E.** Habit with androecia, dorsal view. **F.** Thallus margin. **G.** Cross section through thallus middle, showing central strand. **H.** Cross section through thallus. **I-K.** *Riccia plano-biconvexa* Steph. **I.** Habit with androecia and mature sporophyte (s = sporophyte), dorsal view. **J.** Cross section of thallus (s = spores). **K.** Spore, distal view (**A-C** from Costa, 1999, **D-K** from Gradstein et al., 2001; reproduced with permission).

undivided or lobed, sometimes bordered by narrow cells, the margins entire or toothed, without slime hairs. Archegonia in clusters scattered on the midrib, each cluster protected by a tiny scale, a closed involucre lacking. A tropical and southern-temperate genus of ca. 25 spp.; 5 species in Brazil.

1. Thallus margin sharply toothed, without border. (Thallus not lobed) *S. leptothelia*
1. Thallus margin entire, with a border or rectangular cells. (Thallus not lobed)
..... *S. brasiliensis*

1. *Symphyogyna brasiliensis* (Nees) Nees & Mont., Ann. Sci. Nat. Bot., sér. 5: 67. 1836. (Fig. 7D-H)

On moist soil, rotten wood, or rock, in shaded places in the mountains. Common in Brazil recorded from Amazonia, the Planalto, and the Atlantic coastal region. Report from Goiás: see Gradstein & Costa (2003). Widespread in tropical America and Africa.

2. *Symphyogyna leptothelia* Tayl., London J. Bot. 5: 408. 1846.

On moist soil in the mountains. Uncommon species, in Brazil recorded from Goiás (Alto Paraiso, Chapada dos Veadeiros, *Schäfer-Verwimp & Verwimp 9868* [JE, SP]), Minas Gerais, Espírito Santo, São Paulo, and Paraná. General distribution: tropical America.

RICCIACEAE

Description: see *Riccia*.

Riccia L., Sp. Pl.: 1138. 1753.

Thallus small, 0.5-4 mm wide, forked, often forming rosettes, green, grayish-green or glaucous, often tinged with red or purple. Dorsal surface of thallus with a median groove, usually not clearly reticulate, pores small or lacking. Thallus margins acute or obtuse, sometimes with cilia or with scales projecting beyond the margin, the flanks of the thallus usually steep-sloping. Air chambers present or lacking. Ventral scales small or large, in 1-2 rows. Monoicous or dioicous. Antheridia and archegonia embedded in the thallus. Involucres lacking; calyptrae 2-layered after fertilization. Seta lacking. Capsules globose, embedded in the thallus, cleistocarpous. Spores very large, 60-150 µm in diameter, sometimes remaining in tetrads.

Elaters lacking. A genus of about 150 species worldwide; 29 in Brazil.

1. Dorsal surface of thallus with small pores. Air chambers present (cross section). Aquatic or terrestrial *R. stenophylla*
1. Dorsal surface of thallus without pores. Air chambers lacking. Terrestrial.
 2. Spores rounded, inner surface granulose, outer surface areolate
..... *R. vitalii*
 2. Spores angular, inner and outer surfaces both areolate.
 3. Spores with 7-9 areoles across the outer surface. Cells in the dorsal portion of the thallus with 2 thickening bands (cross section) *R. weinionis*
 3. Spores usually with 9-11 areoles across the distal surface. Thickening bands lacking *R. plano-biconvexa*

1. *Riccia plano-biconvexa* Steph., Bih. Kongl. Svenska Vetensk.-Akad. Handl. 23: 29. 1897. (Fig. 7I-K)

On sandy, granitic, or clayey soil, on soil over rocks, exposed on seasonal river banks, on borders of ponds, in pastures, between paving stones in towns, in caatinga or in gardens, at low elevations. Common in Brazil, reported from the Planalto, Atlantic coastal region, and southern Brazil. Not recorded by Gradstein & Costa (2003); reported from the state of Tocantins ("Goiás") by Bischler et al. (2005) based on a collection from Tocantinópolis, *Vital 2989* (SP). General distribution: Costa Rica, Ecuador, Brazil, Paraguay, Argentina.

2. *Riccia stenophylla* Spruce, Bull. Soc. Bot. France 36 (Suppl.): 195. 1890.

On moist soil on the banks of rivers and ponds, or floating on stagnant water, at low elevations. Rather common species, in Brazil recorded from the Planalto, Atlantic coastal region, and southern Brazil; in the state of Goiás collected in Ceres (Bischler et al., 2005). General distribution: widespread in tropical and subtropical America.

3. *Riccia vitalii* Jovet-Ast, Mem. New York Bot. Gard. 46: 283. 1987.

On moist siliceous soil in rather dry, open places. Common in the Planalto but very rare

elsewhere; in the state of Goiás collected in Santa Teresa de Goiás and in the state of Tocantins at Tocantinópolis (Bischler et al., 2005). General distribution: Planalto region of Brazil, Costa Rica.

4. *Riccia weinionis* Steph., Sp. Hepat. 1: 18. 1898.

The species name is sometimes spelled "wainionis" (e.g., Gradstein & Costa, 2003), however "weinionis" is the correct spelling (Bischler et al., 2005). On shaded soil over rock (usually limestone) in rather dry regions. Common species, in Brazil recorded from the Planalto and the Atlantic coastal region; in the state of Goiás collected in Santa Teresa de Goiás (Bischler et al., 2005). General distribution: tropical America.

TARGIONIACEAE

Description: see *Targionia*.

Targionia L., Sp. Pl.: 1136. 1753.

Thallus leathery, linear, to 4 cm long, 2-4 mm wide, deep green, margins and ventral surface black or blackish-purple, dry thalli narrowly linear and entirely black. Dorsal surface of thallus finely reticulate, with small whitish pores, epidermal walls smooth or papillose, with bulging trigones. Thallus underside with dark purple scales in 2 rows, each scale with a lanceolate appendage. Air chambers in 1 layer, with filaments. Monoicous or dioicous. Sporophytes 1-3 in a large, purplish, mussel-like involucre, projecting forward from beneath the apex of the thallus. A small subtropical-mediterranean genus of 3 spp.; 1 species in Brazil.

1. *Targionia hypophylla* L., Sp. Pl.: 1136. 1753.

On moist, compact soil and over rock in rather dry areas, usually in partial shade, to 1200 m. This widespread species is apparently very rare in Brazil and was reported only from Goiás (Itaberai; see Vital, 1974a, Bischler et al. 2005) and Rio Grande do Sul. General distribution: subcosmopolitan.

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