

## Observations on the liverwort flora of the surroundings of Santiago, Central Chile

S. Robbert GRADSTEIN<sup>a\*</sup> & Jorge CUVERTINO<sup>b</sup>

<sup>a</sup>*Museum National d'Histoire Naturelle, Département Systématique et Évolution, CP 39, 57 rue Cuvier, 75231 Paris Cedex, France*

<sup>b</sup>*Universidad Bernardo O'Higgins, Centro de Investigación en Recursos Naturales y Sustentabilidad, Fábrica 1990, Santiago, Chile*

**Abstract** – The Mediterranean liverwort flora of the surroundings of Santiago, Central Chile, has been little studied. This paper reports 21 species from the area, including one species new to Central Chile (*Cephaloziella divaricata*), 9 new to the Metropolitan region (*Cephaloziella divaricata*, *Clevea spathysii*, *Fossombronia* sp., *Frullania pluricarinata*, *Lejeunea globosiflora*, *Leptoscyphus expansus*, *Lethocolea radicata*, *Riccardia* sp., *Targionia hypophylla*) and 6 new to Quillota province (*Clasmatocolea vermicularis*, *Clevea spathysii*, *Gongylanthus dusenii*, *Lethocolea radicata*, *Lunularia cruciata*, *Symphyogyna circinata*). Taxonomic notes are provided on selected species of particular interest. Most of the species grow terrestrially; *Frullania pluricarinata* and *Lejeunea globosiflora* occur epiphytic on bark in dry Mediterranean forest. *Riccia* is the most species-rich genus in the area. Three *Riccia* species, *R. crystallina*, *R. nigrella* and *R. trichocarpa*, have characteristic disjunct ranges, occurring in Mediterranean and subtropical regions of the northern and southern hemisphere but not in the Tropics. Oil bodies are newly reported for the endemic *Gongylanthus dusenii* and *Lejeunea globosiflora*; the latter species is fully described and illustrated for the first time.

**New floristic report / Marchantiophyta / Mediterranean liverworts / Chile / *Cephaloziella divaricata* / *Frullania pluricarinata* / *Gongylanthus dusenii* / *Lejeunea globosiflora* / Disjunct distribution / Taxonomy**

### INTRODUCTION

Chile is an extraordinarily diverse country in terms of climate and vegetation, ranging from subtropical desert in the north to boreal tundra vegetation in the south. As a result, the country has a rich bryophyte region including 890 species, subspecies and varieties of mosses and 553 of liverworts and hornworts (Müller, 2009; Hässel de Menéndez & Rubies, 2009). Nevertheless, most taxa occur in southern Chile, which has a cool and humid climate. Relatively few species are known from the hot and dry central and northern parts of the country.

This paper deals with liverworts of Central Chile, specifically the surroundings of the capital Santiago (Metropolitan region, Valparaiso region). The area has a pronounced Mediterranean climate, with a pronounced hot and

\* Correspondence and reprints: gradstein@mnhn.fr

dry summer and cooler and moist winter season (e.g., Arroyo *et al.*, 1999). The natural vegetation in the area mainly includes rather dry Mediterranean woodlands which are usually heavily disturbed by grazing and fire. The seasonal, Mediterranean nature of the vegetation is reflected in the bryophyte flora, which is conspicuous during winter and early spring but largely vanishes during the prolonged dry season.

Thus far, 86 liverwort species have been reported from the Metropolitan and Valparaíso regions (Hässel de Menéndez & Rubies, 2009; Romero *et al.*, 2012). Most floristic efforts have been made in the surroundings of Valparaíso, the former capital of the country, whereas little work was done near Santiago. As a result, 82 liverwort species are currently known from the Valparaíso region while only 18 species are known from Metropolitan region. The earliest liverwort collectors were Carlo Bertero and Claude Gay, who made the first plant collections in the country, Bertero in 1828-1829 and Gay between 1830 and 1841. Further liverwort collections in the Metropolitan and Valparaíso regions were made by, e.g., Paul Dusén, Nathaniel Costes, Gerhard Helmut Schwabe, Rolf Santesson and Manuel Mahú in the 20th and late 19th centuries, and Elizabeth Barrera, Victor Ardiles and Carolina Villagrán in the present century. Their materials are mostly kept in PC, NY, BM, JE, MO, BA, S and SGO.

During the last week of September 2014 the authors collected liverworts in the surroundings of Santiago. Localities visited included the nature reserves Alto de Cantillana (Maipo province) and Aguas de Ramón (Santiago Province), both in the Metropolitan region very near to the capital, and in nature reserve La Campana, ca. 60 km north of Santiago in the Valparaíso region (Quillota province).

This paper provides a listing of the species recorded, a brief review of floristic knowledge of the Metropolitan region and Quillota province, as well as taxonomic notes (morphology, distribution, habitat) on selected species of particular interest.

## RESULTS AND DISCUSSION

### Floristic knowledge of the liverworts of the Metropolitan Region and Quillota province, Central Chile

Thus far, 18 liverwort species had been reported from the Metropolitan region and 10 from Quillota province (Hässel de Menéndez & Rubies, 2009; Romero *et al.*, 2012). They include the following taxa:

**Metropolitan region** (species marked with an asterisk occur above 1000 m): *Asterella chilensis*, \**Clasmatocolea rigens*, *Cryptomitrium tenerum*, \**Hygrolembidium andinum*, *Lophocolea muricata*, *Lunularia cruciata*, \**Marchantia berteroana*, *M. polymorpha*, *Metzgeria divaricata*, *Plagiochasma rupestre*, *Riccia crystallina*, *R. nigrella*, *R. sorocarpa*, *R. trichocarpa*, *Solenostoma crassulum* (1), *Sphaerocarpos stipitatus*, *S. "michelii/texanus"*, \**Symphyogyna rubritincta*.

**Quillota province:** *Asterella chilensis*, *Fossombronia pusilla*, *Frullania glomerata*, *F. quillotensis*, *F. reicheana*, *F. trineris*, *Plagiochasma rupestre*, *Porella chilensis*, *Riccia crystallina*, *Sauteria chilensis*.

During our fieldwork in September 2014 we found 21 species of liverworts in the Metropolitan region (21 in Altos de Cantillana and 4 in Aguas de Ramón) and 8 in Quillota province (La Campana) (Table 1). Based on our collections, *Cephaloziella divaricata* is new to Central Chile (this species may previously have been recorded erroneously under the name *C. gemmata*, however). Furthermore, 9 species are new to the Metropolitan region (*Cephaloziella divaricata*, *Clevea spathysii*, *Fossombronia* sp., *Frullania pluricarinata*, *Lejeunea globosiflora*, *Leptoscyphus expansus*, *Lethocolea radicata*, *Riccardia* sp., *Targionia hypophylla*) and 6 are new to Quillota province (*Clasmatocolea vermicularis*, *Clevea spathysii*, *Gongylanthus dusenii*, *Lethocolea radicata*, *Lunularia cruciata*, *Symphyogyna circinata*). As a result, the number of species known from the Metropolitan region has risen to 27, that of Quillota province to 16. Most of the species grow terrestrially; *Frullania pluricarinata* and *Lejeunea globosiflora* occur epiphytic on bark in Mediterranean forest. *Riccia* with four species (*R. crystallina*, *R. nigrella*, *R. sorocarpa*, *R. trichocarpa*) is the most species-rich genus in the area.

Table 1. Liverwort species found by the authors in the surroundings of Santiago, Central Chile

Species	Altos de Cantillana (Maipo prov.)	Aguas de Ramón (Santiago prov.)	La Campana (Quillota prov.)
<i>Asterella chilensis</i> (Nees & Mont.) A. Evans	+		
<i>Cephaloziella divaricata</i> (Sm.) Schiffn.	+		
<i>Clasmatocolea vermicularis</i> (Lehm.) Grolle	+		+
<i>Clevea spathysii</i> (Lindenb.) Müll. Frib.	+	+	+
<i>Cryptomitrium tenerum</i> (Kunth) Underw.	+		
<i>Fossombronia</i> sp.	+	+	+
<i>Frullania pluricarinata</i> Gottsche	+	+	
<i>Gongylanthus dusenii</i> Steph.	+?		+
<i>Lejeunea globosiflora</i> (Steph.) Steph.	+		
<i>Leptoscyphus expansus</i> (Lehm.) Grolle	+		
<i>Lethocolea radicata</i> (Lehm. & Lindenb.) Grolle	+		+
<i>Lunularia cruciata</i> (L.) Lindb.	+	+	+
<i>Plagiochasma rupestre</i> (J.R. Forst. & G. Forst.) Steph.	+		
<i>Riccardia</i> sp. (nov.?)	+		
<i>Riccia crystallina</i> L.	+		+
<i>Riccia nigrella</i> DC.	+		
<i>Riccia sorocarpa</i> Bisch.	+		
<i>Riccia trichocarpa</i> M. Howe	+		
<i>Sphaerocarpos stipitatus</i> Lindenb.	+		
<i>Sphaerocarpos</i> sp.	+		
<i>Symphyogyna circinata</i> Nees & Mont.	+		+
<i>Targionia hypophylla</i> L.	+		

**Note:** *Metzgeria divaricata* A. Evans, a poorly known species described Central Chile (“near Santiago”, 1882, *Philippi* 24), is very similar to the widespread neotropical *M. myriopoda* Lindb. Both taxa share paired hairs on thallus margins, 2-celled wide dorsal costa surface and 4-celled ventral costa surface, abundance of gemmae, and dioicy (see Evans, 1923; Schuster, 1992a; Costa, 2008). Possibly, *M. divaricata* is a synonym of *M. myriopoda*; this needs further study.

Romero *et al.* (2012) cited “*Sphaeocarpus texanus/michelii*” from the Metropolitan region (Altos de Cantillana). Both species have been recorded from Chile in the 19th century but recent reports refer only to *Sphaerocarpus texanus* (Hässel de Menéndez & Villagrán, 2007). This needs further study.

### Notes on selected species collected

***Cephaloziella divaricata* (Sm.) Schiffn.** (Syn.: *Cephaloziella byssacea* auct.)

**Specimen examined.** Nature Reserve “Altos de Cantillana”, ca 400 m, in dry mediterranean woodland area disturbed by cattle grazing, on bare soil along trail, 23 September 2014, Gradstein & Cuvertino 12411 (ster., c. gemm.) (SGO, PC).

Plants very small, green to dull brown, prostrate to ascending (gemmaiparous shoots), in small, loose patches. Stems to 1 cm long, 0.06-0.07 mm wide, simple or sparingly branched. Leaves distant, transverse to slightly oblique and succubous, dimorphic: large leaves obliquely spreading, bifid to 1/2 and with narrow sinus, lobes erect, broadly triangular, to 10 cells wide at base; small leaves patent squarrose, bifid to 2/3, lobes wide-diverging and with wide sinus, narrowly triangular, 4-7 cells wide at base; leaf margins entire, lobe apex subacute, terminating in one cell. Leaf cells thin-walled, (sub)rectangular, rather large, 15-25(-28) × 10-15 μm, cuticle smooth. Underleaves present on all stems, small, bluntly and narrowly triangular with short-bifid apex. Sterile. Gemmae pale green, ellipsoid, 2-celled, smooth, thin-walled, produced at the tips of ascending shoots.

*Cephaloziella divaricata* is a widespread, subcosmopolitan species. Our material from Central Chile is sterile and stands out by rather large thin-walled cells, 15-28 μm long, and a fully smooth cuticle. Although leaf cells in *C. divaricata* are mostly thick-walled, sterile phenotypes with thin-walled cells have been reported from North America and Europe (e.g., Schuster, 1980; Gradstein & van Melick, 1996; Paton, 1999). However, leaf cells size in *C. divaricata* and most other species of the genus generally does not exceed 22 μm; our identification should therefore be considered tentative. An effort should be made to find fertile material of this species in Central Chile, where it is apparently new. Previously, *C. divaricata* was recorded from Tierra del Fuego (Hässel de Menéndez & Rubies, 2009). In addition, the latter authors recorded *C. byssacea* from Chile based on records of Schuster (e.g., Schuster, 1980). However, as shown by Grolle (1983) the correct name for the latter species should be *C. divaricata*.

Hässel de Menéndez & Villagrán (2007) reported *Cephaloziella gemmata* J.J. Engel from Central Chile. This species, which was originally described from the Magallanes region (Riesco I.), strongly differs from our plant by toothed leaf margins and papillose cell walls, and is a synonym of *C. verrucosa* Steph. according to Váña *et al.* (2014).

***Clasmatocolea vermicularis* (Lehm.) Grolle** (Syn.: *Chiloscyphus vermicularis* [Lehm.] Hässel)

**Specimens examined.** Nature Reserve “Altos de Cantillana”, ca 400 m, on wet rock in rivulet, with *Phaeomegaceros squamuliger* (Spruce) J.C. Villarreal and *Symphogyna*

*circinata*, 23 September 2014, *Gradstein & Cuvertino s.n.* (obs.). Nature Reserve “La Campana”, Sector “Palmas de Ocoa”, ca. 500 m, abundant on soil over rocks in rivulet, with *Symphyogyna circinata*, 28 September 2014, *Gradstein & Cuvertino 12427* (ster.) (SGO, PC).

*Clasmatocolea vermicularis* is widespread in temperate regions of the southern hemisphere and in high mountains of tropical America, Africa and New Guinea (Engel, 1980; Váa & Engel, 2013). The species is a rheophyte and characteristically occurs on wet rocks in rivulets or on moist, loamy soil of river banks, seepage gulleys, etc. In Central Chile it often grows associated with *Symphyogyna circinata* and *Vittia pachyloma* (Mont.) Ochyra. Recent molecular evidence (Hentschel *et al.*, 2007) indicates that this species should be kept in the genus *Clasmatocolea* and not transferred to *Chiloscyphus* as proposed by Hässel de Menéndez (1996).

### ***Frullania pluricarinata* Gottsche**

**Specimens examined.** Nature Reserve “Altos de Cantillana”, ca 400 m, dry mediterranean woodland disturbed by cattle grazing, common on bark of trees, with *Lejeunea globosiflora*, 23 September 2014, *Gradstein & Cuvertino 12414* (c. per.) (SGO, PC); *ibid.*, on rock, sparse, *Gradstein & Cuvertino 12415* (c. per.) (SGO, PC). Reserve “Aguas de Ramon” NE of Santiago, on bark of *Cryptocaria alba* (“peumo”) in river valley, ca 400 m, 29 September 2014, *Gradstein, Osorio & Cuvertino 124* (c. gyn. juv.) (SGO, PC).

*Frullania pluricarinata* is readily recognized by the small, monoicous plants with suborbicular leaves which tend to become squarrose when moist and are sometimes caducous, saccate lobules with a narrow flattened base and without beak, small underleaves bifid to ca. 1/4 of their length and, especially, 8-10-keeled perianths. The leaf lobules may be saccate or explanate.

The species has a highly disjunct range in Latin America, occurring between 1800-3350 m in northern C America (Mexico, Guatemala) and the northern Andes (Colombia, Ecuador), and again at much lower elevation, from sea level to 800 m, in the Mediterranean region of Central Chile at 30°- 40° S. Lat. (Yuzawa, 1991; Schäfer-Verwimp, 2013). Yuzawa (1991) recorded only a single locality from Chile (Prov. Concepción: Talcahuano “Talchahusno”) but based on our observations the species is rather common around Santiago and is probably widespread in Central Chile. The species is a xerophyte and grows on bark of trees, occasionally on rock, in dry woodlands, in parks and on roadside trees. In Central Chile it is a typical epiphyte of Mediterranean woodlands. The Chilean habitat of *F. pluricarinata* is similar to that of *Lejeunea globosiflora* and in the Altos de Cantillana Reserve the two species commonly occur together on trees.

### ***Gongylanthus dusenii* Steph.**

**Specimen examined.** Nature Reserve “La Campana”, Sector “Palmas de Ocoa”, ca. 500 m, rather dry mediterranean vegetation, on soil along trail, with *Lethocolea radicata*, 28 September 2014, *Gradstein & Cuvertino 12426-A* (ster.) (SGO, PC).

Leaves with opposite bases, broadly ovate to tongue-shaped, leaf surface weakly concave, becoming flat above; young leaves green (not reddish), densely imbricate and suberect, appressed, older leaves becoming colorless, more laxly imbricate and obliquely to widely spreading; leaf apex broadly rounded, leaf margins crenulate. Leaf cells in dorsal half of leaf quadrate to subrectangular, 20-30 µm long, in ventral half of leaf conspicuously more elongate, ca 30-50 µm long, ventral margin often bordered by one or more rows of narrow elongate cells to 80(-100) µm long; cells walls thin, trigones minute, cuticle smooth; oil bodies colorless, 3-8 per cell, small, rounded, 5-6 µm in diameter, faintly granular,

*Jungermannia*-type, colorless when fresh, becoming brownish upon degeneration; cell walls in the ventral half of young leaves often lined on inner side by a broad, colorless thickening layer, which vanishes in older leaves. Underleaves lacking. Rhizoids long, colorless to pale brown, scattered.

*Gongylanthus dusenii* is a rare endemic species from Central Chile, known from two collections: the type from Valparaiso Province (*Dusén 137*, 1896) and a specimen collected by Manuel Mahú in Chacabuco Province north of Santiago (Mahú, 1988; Váa *et al.*, 2012). Probably the species is more common in the area and has been overlooked. It grows on bare soil or rock on steep road sides, often together with *Lethocolea radicata*, and in the field the two species are confusingly similar. However, under the microscope *G. dusenii* is readily separated from *L. radicata* by the smooth cuticle and colorless oil bodies, 3-8 per cell (cuticle densely papillose, oil bodies brown and one per cell in *L. radicata*). Moreover, the surface of leaves in *G. dusenii* is slightly concave, the leaf bases are opposite, the leaf margins are crenulate and the ventral leaf margin is usually bordered by narrow elongate cells (leaf surface flat to convex, bases alternate, margins entire, ventral margin not bordered in *L. radicata*). Oil bodies of *G. dusenii* are reported here for the first time.

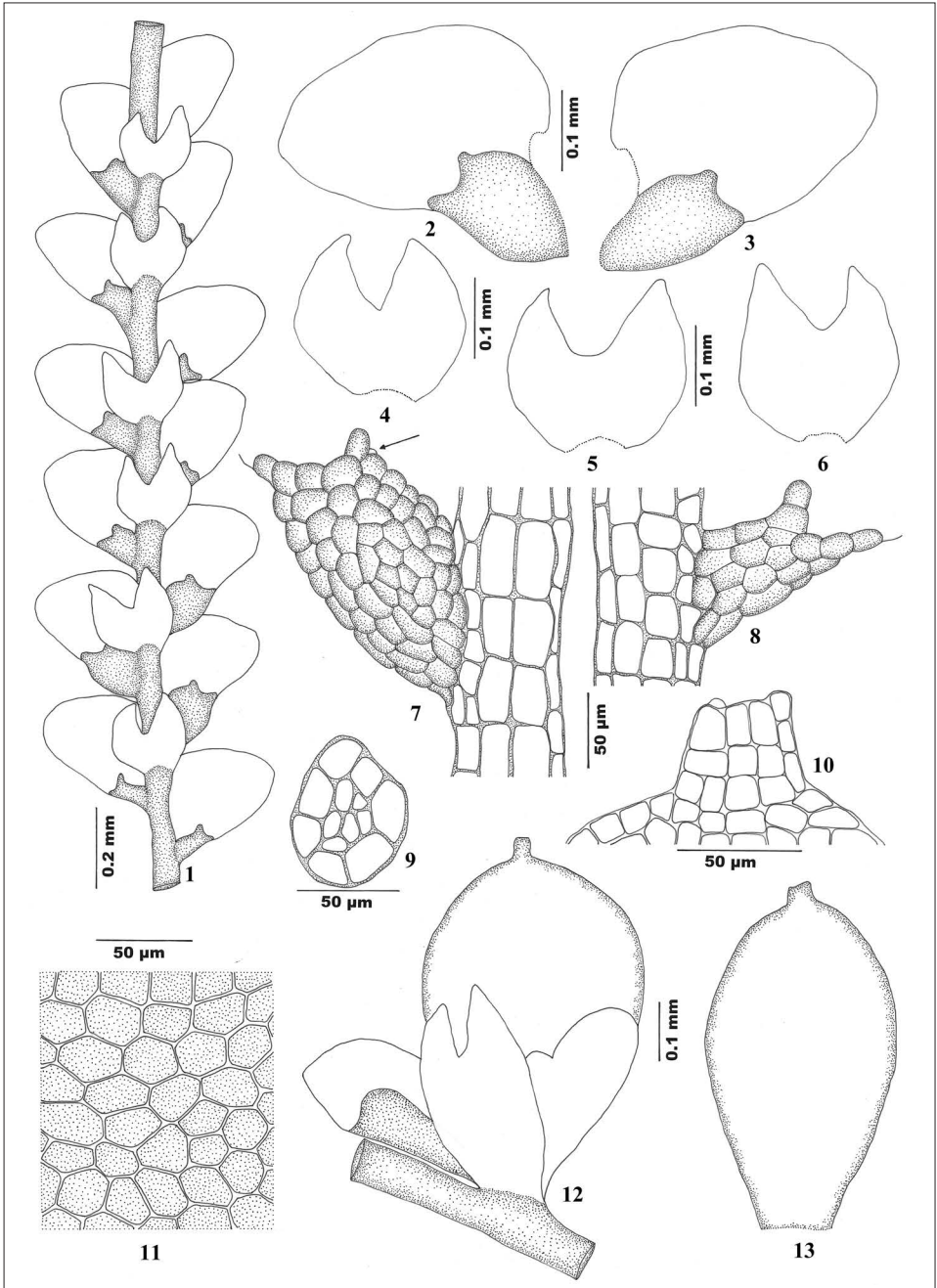
*Gongylanthus dusenii* is morphologically rather similar to *G. muelleri* (Gottsche) Steph. from tropical America (Mexico to Ecuador), but leaves in the latter species are more flat and narrowed to the apex. *Gongylanthus ericetorum* (Raddi) Nees from mediterranean-atlantic regions of Europe and from tropical Africa is also rather similar to *G. dusenii* but differs by having a papillose cuticle.

### *Lejeunea globosiflora* (Steph.) Steph.

**Figs 1-13**

**Specimens examined.** Nature Reserve “Altos de Cantillana”, ca 400 m, common in bark of trees in dry mediterranean woodland disturbed by cattle grazing, with *Frullania pluricarinata*, 23 September 2014, Gradstein & Cuvertino 12416, 12417 (c. gyn. immat.), 12418 (c. per., c. andr.) (SGO, PC).

Plants small, 0.3-0.6 mm wide, pale green, forming dense mats on bark of trees, stems strongly fragmenting, irregularly pinnate, branches *Lejeunea*-type. Stems very thin, 0.06-0.08 mm in diameter, consisting of 7 epidermis cells surrounding about the same number of inner cells, epidermis cells much larger than inner cells, walls of stem cells colorless, thin or slightly thickened, small trigones present; ventral merophyte 2 cells wide. Leaves distant to subimbricate, obliquely spreading when moist, somewhat convex. Leaf lobes ovate, leaf apex narrowly rounded to obtuse, plane, margins entire or slightly crenulate, ventral margin forming a wide angle with the keel. Leaf cells thin-walled, with minute trigones; cuticle rough by minute papillae; oil bodies colorless, 5-7 per cell, narrowly ellipsoid (rounded when seen from the side), small, rather coarsely granular, *Calypogeia*-type. Leaf lobules large, ca. 1/2 the lobe length, frequently reduced, ovate, inflated, keel smooth, curved, free margin straight, incurved, apex with a short, 1-celled tooth, hyaline papilla in a small sinus proximal to the tooth, margin between apex and sinus  $\pm$  truncate, shortly continuing into ventral lobe margin. Underleaves distant to subimbricate, rather large, 3 $\times$  stem width, suborbicular, bifid to 1/2-2/3 of underleaf length, tips obtuse to acute, 1-celled, sinus rather wide, rounded, margins entire or slightly angular (tooth lacking), insertion line shallowly curved. Dioicous. Androecia (2 broken ones seen, between mats of female plants) made up of 8 pairs of large, swollen bracts, bracteoles absent. Gynoecia terminal on long branches, with one lejeuneoid innovation, the innovation sometimes fertile; female bracts and bracteole larger than the leaves, obliquely spreading, enveloping the lower half of the perianth, bracts and bracteoles in 1-2 series, bract lobe and lobule with rounded to



Figs 1-13. *Lejeunea globosiflora* (Steph.) Steph. **1.** Part of plant in ventral view. **2, 3.** Leaves. **4, 5, 6.** Underleaves. **7.** Stem portion and leaf lobule (hyaline papilla shown by arrow). **8.** Stem portion and reduced leaf lobule. **9.** Cross-section of stem. **10.** Beak of perianth. **11.** Median cells of leaf lobe, showing rough cuticle. **12.** Gynoecium with mature perianth. **13.** Perianth. All drawn by Gaik-Ee Lee from *Gradstein & Cuvertino 12418* (PC).

obtuse apex, bracteole oval, bifid to 1/4. Perianth conspicuous, globose to obpyriform, exerted to 1/2 of its length, eplicate, apex somewhat depressed, beak very short, inconspicuous, 2 cells long; perianth base not elongate. Sporophyte not observed.

*Lejeunea globosiflora* is endemic to the Mediterranean region of Central Chile (Coquimbo – Chiloé) and Central Argentina (Neuquén – N Chubut), between 30°-42° S. Lat. (Solari, 1983; Villagrán *et al.*, 2005; Hässel de Menéndez & Rubies, 2009), where it occurs on bark in rather dry Mediterranean woodlands and scrub at low elevations. The habitat of the species is similar to that of *Frullania pluricarinata*, with which it often grows associated. *Lejeunea globosiflora* resembles the neotropical *L. laetevirens* Nees *et* Mont. (*L.* subg. *Nanolejeunea* R.M. Schust.) by the very small, pale-green plants with strongly fragmenting stems, the obliquely spreading leaves with rather narrowly rounded to obtuse apex and entire margins, the rather large, inflated lobules which are often reduced, the finely asperulate cuticle, the rather deeply bifid (to 1/2-2/3) suborbicular underleaves, and dioicy. It clearly differs, however, by the male bracteoles being restricted to the base of the male spike or lacking and by eplicate perianths. In *L. laetevirens*, and in other members of subg. *Nanolejeunea*, bracteoles are present throughout the male spike and perianths are 5-keeled (Reiner-Drehwald, 2010).

A description of the oil bodies of *L. globosiflora* and a full illustration of the species are provided here for the first time.

***Leptoscyphus expansus* (Lehm.) Grolle** (Syn.: *Leptoscyphus chiloscypoides* [Lindenb. & Lehm.] Gottsche, *Leptoscyphus huidobroanus* [Mont.] Gottsche)

**Specimens examined.** Nature Reserve “Altos de Cantillana”, ca. 400 m, southern entrance of the reserve along main road, dry mediterranean vegetation, growing in dense mats on soil on steep cut road bank, 23 September 2014, *Gradstein & Cuvertino 12410* (c.per., c. spor.) (SGO, PC).

Characteristic of *Leptoscyphus expansus* are 1) plants pale brown, growing in large, pure mats on soil on a cut road bank; 2) leaves undivided, succubous, lamina upright (not spreading outwards), dorsal surface slightly concave to flat; 3) cells with small trigones and smooth cuticle; 4) oil bodies 2-4 per cell, colorless to grayish, ellipsoid, 9-12 × 5-7 µm, or rounded, 5-7 µm in diameter, finely granular, *Jungermannia*-type; 5) deeply bifid underleaves small, not wider than stem, a deeply bifid and with 1-2 additional teeth on outer margins, bases free or on one side slightly attached to leaf base, and 6) perianths flattened, mouth wide, entire.

*Leptoscyphus expansus* is a widespread Afroamerican species, that occurs in Central and Southern Chile and Argentina, on southern temperate and subantarctic islands eastwards to Kerguelen, and in S and E Africa northwards to Kenya and Zaire (Vána & Engel, 2013). In the New World, however, the species is restricted to southern-temperate and southern – Mediterranean regions and is unknown from tropical America. Hässel de Menéndez (2001) described the southern S American plants under the name *L. chiloscypoides* and separated the latter species from *L. expansus* based on the perianth mouth, being toothed in *L. expansus* and entire in *L. chiloscypoides*. However, Grolle (1962) in his monograph of the genus *Leptoscyphus* and Vána & Engel (2013) found that the perianth mouth is variable in *L. expansus* and can be entire or toothed. Consequently, they recognized only one variable species, *L. expansus*. Here, we follow the latter concept.

Vanderpoorten *et al.* (2010) recently excluded *L. chiloscypoides* from *Leptoscyphus* based on molecular study and transferred the species to *Chiloscyphus*. However, this transfer was rejected by Vána & Engel (2013); for a discussion see the latter authors.



***Lethocolea radicata* (Lehm. & Lindenb.) Grolle**

**Specimen examined.** Nature Reserve “Altos de Cantillana”, ca 400 m, rather dry mediterranean vegetation, abundant on bare soil on steep road bank, 23 September 2014, *Gradstein & Cuvertino s.n.* (obs.). Nature Reserve “La Campana”, Sector “Palmas de Ocoa”, ca 500 m, rather dry mediterranean vegetation, on soil along trail, with *Gongylanthus dusenii*, 28 September 2014, *Gradstein & Cuvertino 12426-B* (ster.) (SGO, PC).

Leaves alternate, broadly tongue-shaped, leaf surface flat to convex; young leaves tinged with reddish, densely imbricate, parallel and densely appressed to each other, older leaves green to colorless, laxly imbricate, spreading, margins straight to undulate; leaf apex broadly rounded, margins entire. Leaf cells quadrate to subrectangular, in dorsal half of leaf 20-35(-50)  $\mu\text{m}$  long, in ventral half of leaf larger and becoming colorless, ca. 30-50(-80)  $\mu\text{m}$  long, ventral margin unbordered; cell walls thin, trigones small to well-developed, cuticle densely papillose; oil bodies brown, 1(-2) per cell, rather large, ellipsoid, 15-20  $\times$  8-10  $\mu\text{m}$ , surface finely papillose. Underleaves lacking. Ventral side of stem with long stolons (?; not seen). Rhizoids long, colorless to pale brown, scattered.

*Lethocolea radicata* is widespread in Central and Southern Chile and Argentina, from Valparaiso (including Juan Fernandez Archipelago) southwards to Patagonia (Tierra del Fuego and Malvinas Islands); in addition the species occurs on southern temperate islands eastwards to the southern Indian Ocean (Marion, Prince Edward, Crozet and Possession Is.) but is apparently lacking in South Africa (Vána & Engel, 2013). In Central Chile the species grows on earth banks in dry Mediterranean vegetation together with *Gongylanthus dusenii* and *Leptoscyphus expansus*, and in the field the three species may be confusingly similar. *Lethocolea radicata* is readily separated from the other two species by the strongly papillose cuticle of leaf cells and large, brown oil bodies, one per cell. In the other two species the cuticle is smooth and the oil bodies are colorless. *Gongylanthus dusenii* differs furthermore by having opposite leaves with flat to concave surface, crenulate leaf margins, and a border of narrowly elongate cells along the ventral leaf margin, while *Leptoscyphus expansus* differs by the presence of underleaves, rhizoids in bundles from underleaf bases, and sporophytes surrounded by a perianth (marsupium in *Gongylanthus* and *Lethocolea*).

Oil bodies from *Lethocolea radicata* are reported here for the first time and are similar to those of the neotropical *L. glossophylla*, as described by Gradstein *et al.* (1977).

***Riccardia* sp. (nov.?)**

**Specimens examined.** Nature Reserve “Altos de Cantillana”, ca 400 m, on wet soil at base of tree along rivulet, 23 September 2014, *Gradstein & Cuvertino 12423* (c. andr., c. gyn.) (SGO, PC).

Plants prostrate, to 2.5 cm long and ca. 1.6 mm wide, glossy green, irregularly 1-2(-3)-pinnate, branches alternate to subopposite, when 1-pinnate branches short, when 2-pinnate primary branches becoming as long as the main axis and secondary branches short; tertiary branches rudimentary. Axis flat, to 0.2 mm thick, ca. 8 $\times$  as wide as thick, 5-6 cells thick, unwinged or narrowly winged by 1 cell, margins entire, acute in transverse section. Branches plump, margins with a narrow, 1-cell wide, interrupted wing especially at the apex,  $\pm$  crenulate, apex 3-5-lobed-incised; several thick-walled, club-shaped papillae present below the apex, especially at the incisions. All thallus cells thin-walled, epidermis cells green, ca. 20-35  $\mu\text{m}$  high, the inner cells colorless, ca. 40-60  $\mu\text{m}$  high, > 2 $\times$  larger than epidermis cells. Oil bodies brownish, almost absent in the epidermis, present

in 10(-20)% of epidermis cells, present in all inner cells, 1-3 per cell, uniform in size and shape, short ellipsoid with pointed tips, surface finely papillose. Monoicous, with numerous short female branches, occasionally a slender male branch present beside a female branch; male branch short, with 4 antheridial cavities, the cavities very close to each other, separated by one layer of cells, margins of the antheridial branches with enlarged, expanded cells; antheridia ellipsoid, ca.  $130 \times 75 \mu\text{m}$ .

The most characteristic features of this species are: 1) the very flat, irregularly 1-2(-3)-pinnate, monoicous thalli, which are *ca* Bx as wide as thick, unwinged or with a narrow (1-cell wide) wing on branches, and are made up of very thin-walled cells; 2) the epidermis cells 2× smaller than inner cells and almost devoid of oil bodies; 3) the 3-5-lobed-incised branch apices. Our plants do not fit any of the *Riccardia* species from Chile described by Evans (1921) and Hässel de Menéndez (1972). Thus far, only one species, *R. corralensis* (Steph.) A. Evans, was recorded from Central Chile, in the provinces Petorca and Valparaíso (Hässel de Menéndez & Rubies, 2009). The latter species clearly differs from our plants by having narrowly filamentose thalli, less than 3x as wide as thick and biconvex in cross section. By the structure of the thallus and the lack of oil bodies in most epidermis cells, our material is similar to *R. cataractarum* (Spruce) Hell from Paraguay, southeastern Brazil and Bolivia (Hell, 1969; Meenks & De Jong, 1985; Gradstein & Costa, 2003). However, *R. cataractarum* is a more robust and less branched plant, with thalli to 5 cm long and more than 2 mm wide, 1-pinnate, short branches and rounded, not-incised branch apices. Moreover, *R. cataractarum* is dioicous and seems to grow in permanently wet habitats, e.g., near waterfalls. In contrast, the habitat of our specimen dries up in summer. Possibly our plant represents a new species. Study of more material from Central Chile is needed.

***Riccia crystallina* L.** (Syn.: *Riccia ochrospora* Lindenb.)

**Specimen examined.** Nature Reserve “Altos de Cantillana”, *ca* 400 m, dry mediterranean woodland area, common on bare soil along trail, 23 September 2014, *Gradstein & Cuvertino s.n.* (obs.).

*Riccia crystallina* occurs in Mediterranean and subtropical regions of the northern and southern hemisphere but not in the Tropics. In Central Chile the species was first collected by Bertero (nr. 1279) around 1830. This material was apparently a mixture of *R. crystallina* (type of *R. ochrospora* Lindenb.) and *R. sorocarpa* DC. (type of *R. antarctica* Steph.) (Bischler *et al.*, 2005). The current Chilean range of *R. crystallina* includes the Metropolitan region and the Quillota, Cachapoal and Valdivia provinces (Hässel de Menéndez & Rubies, 2009; this paper). Based on our observations, the species seems to be common in the Mediterranean region of Central Chile.

***Riccia nigrella* DC.**

**Specimen examined.** Nature Reserve “Altos de Cantillana”, *ca* 400 m, in dry mediterranean woodland area, on bare soil of trail in meadow, 23 September 2012, *Gradstein & Cuvertino 12412* (c.sp.) (SGO, PC).

Like *Riccia crystallina*, *R. nigrella* occurs in Mediterranean and subtropical regions of the northern hemisphere and again in South Africa and Australia, but not in the Tropics. The species was first recorded from Chile (Metropolitan region) by Müller (1955), and subsequently by Hugonnot (2007) and Hässel de Menéndez & Rubies (2009). Our material fits *R. nigrella* very well by the conspicuous, dark violet to blackish scales and thallus margins, and the rather small spores, 65-80  $\mu\text{m}$  in diameter and covered by an irregularly and

incompletely reticulate ornamentation. It differs from typical *R. nigrella*, however, by the slightly broader thallus, ca. 1.5 mm wide and 2× wider than thick (to 1.2 mm wide and 1.5× wider than thick in *R. nigrella*; Bischler *et al.*, 2005) and the absence of a spore wing. According to V. Hugonnot (pers. com.), however, wingless spores are not unusual in *R. nigrella*.

***Riccia sorocarpa* Bisch.** (Syn.: *Riccia antarctica* Steph., *Riccia chilensis* Steph.)

**Specimen examined.** Nature Reserve “Altos de Cantillana”, ca 400 m, in dry mediterranean woodland area, on bare soil of trail in meadow, 23 September 2014, *Gradstein & Cuvertino 12413* (c.sp.) (SGO, PC).

*Riccia sorocarpa* occurs widespread in the temperate and Mediterranean regions of the northern hemisphere, and scattered in tropical America (Mexico, Costa Rica, Peru, E Brazil) and Mediterranean regions of the southern hemisphere, including Central Chile (Bischler *et al.* 2005). The species is keyed by Bischler *et al.* (2005) as having winged spores but in the material from Altos de Cantillana the spores are fully wingless. Moreover, they are rather large, ca. 100 µm in diameter (Bischler *et al.*, 2005: 70-97 µm). Most authors report winged spores in *R. sorocarpa* (e.g., Hässel de Menéndez 1968), but Jovet-Ast (1991) in her treatment of *Riccia* L. subg. *Riccia* from Latin America observed spores without wing in the type of *R. antarctica* (= *R. sorocarpa*) from Chile, and also in specimens from Mexico and Peru. In addition, Schuster (1992b) described *R. sorocarpa* subsp. *arctica* R.M. Schust. from Greenland characterized by wingless spores.

Jovet-Ast (1991) considered the material of *Riccia antarctica* in the Montagne herbarium (PC) as the holotype of this species, but based on the protologue (“herb. Nees sub *R. glauca* var. *major*”; Stephani 1898) the holotype of *R. antarctica* should be in STR.

***Riccia trichocarpa* M. Howe** (Syn.: *Riccia canescens* Steph.)

**Specimen examined.** Nature Reserve “Altos de Cantillana”, ca 400 m, in dry mediterranean woodland area, on bare soil along the road near the visitors centre, 23 September 2014, *Gradstein & Cuvertino s.n.* (obs.).

Like *Riccia crystallina* and *R. nigrella*, *R. trichocarpa* occurs in subtropical and Mediterranean regions of the northern and southern hemisphere, but is absent or very rare in the Tropics (Bischler *et al.*, 2005). The species was first reported from Central Chile by Mahú (1994) who identified the Chilean material as *R. ciliata* Hoffm. subsp. *canescens* (Steph.) R.M. Schust. (= *R. canescens*). The latter taxon is a synonym of *R. trichocarpa* (Jovet-Ast, 1983; Bischler *et al.*, 2005).

***Symphyogyna circinata* Nees & Mont.**

**Specimens examined.** Nature Reserve “Altos de Cantillana”, ca 400 m, on wet rock in rivulet, with *Phaeomegaceros squamuliger*, 23 September 2014, *S.R. Gradstein & J. Cuvertino 12421* (c.sp.) (SGO, PC). Nature Reserve “La Campana”, Sector “Palmas de Ocoa”, ca 500 m, on wet soil over rock in rivulet, with *Clasmatocolea vermicularis*, 28 September 2014, *Gradstein & Cuvertino 12425* (c.gyn.) (SGO, PC).

*Symphyogyna circinata* was treated in detail by Evans (1927) and Hässel de Menéndez (1961), who found that the species was very close to *S. brasiliensis* Nees, a common neotropical species characterized by entire thallus margins. Morphologically, the two species differ mainly by the occasional occurrence of a small, 1-celled tooth on the thallus margins in *S. circinata* (teeth lacking in *S. brasiliensis*). Hässel de Menéndez (1961) also suggested a difference in size of spores and thallus margins cells, but these characters overlap. The two species

have very different geographical distributions, *S. brasiliensis* being common and widespread in tropical America and Africa whereas *S. circinata* occurs in the Mediterranean and temperate regions of southern South America (and on Tristan da Cunha), the type being from the Valparaiso region (Vaña & Engel, 2013). In addition, there are a few reports of *S. circinata* from S Brazil and from páramo in the tropical Andes (Colombia, Bolivia); these reports need confirmation. Since the morphological differences between *S. brasiliensis* and *S. circinata* are very slight but their ranges different, *S. circinata* might be treated as a subspecies of *S. brasiliensis*. This needs study by molecular methods.

An interesting morphological feature of the Chilean material was the very long rhizomatous part of the thallus, to 1-1.5 cm long up and measuring half or more of the thallus branch length. Evans (1927) also noted long rhizomes in *S. circinata* but according to Hässel de Menéndez (1961) rhizomes may be absent or present in this species. In *S. brasiliensis* rhizomes are generally short, less than 0.5 cm long (e.g., Uribe & Aguirre, 1995).

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