STUDIES ON COLOMBIAN CRYPTOGAMS

IIC. HEPATICAE – OIL BODY STRUCTURE AND ECOLOGICAL DISTRIBUTION OF SELECTED SPECIES OF TROPICAL ANDEAN JUNGERMANNIALES

BY

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Lophocolea coadunata (Sw.) Nees (fig. 24)

Oil bodies in leaves variable in number, (2–)3–8(–13) per cell; subglobose to, more rarely, ellipsoid, 4–8(–12) × 4–6 μm; colourless, rather coarsely to finely granulose-papillose, becoming homogeneous upon degeneration (Colombia, Cundinamarca, Cleef 78b, 3410b, 397b; ibid., Cauca, Cleef 679).

Variation in number and morphology of the oil bodies apparently is characteristic for Lophocoleaceae, since it has been found not only in this and the other species of *Lophocolea* reported here but also in European material of *Lophocolea* and *Chiloscyphus* (unpubl. obs.).

Distribution and ecology:

According to Fulford (1976) *Lophocolea coadunata* is a widespread species of tropical America. It is closely related to the holarctic *L. bidentata*!

In Colombia *L. coadunata* is a common forest liverwort in the Central and Eastern Cordillera, growing on all kinds of substrates: terrestric, epiphytic, epiphyllic and epilitic, and on organic debris. The species always grows in shaded habitats. Its altitudinal distribution in Colombia ranges about 1600 to 4100 m. Most collections are from *Weinmannia* forests in the Subandean and Andean belt; occasionally *L. coadunata* was found in open páramo, where it usually occurs in sheltered, shaded places on organic debris. The highest records (4120 m) are from the bryophyte-rich condensation zone in the superpáramo of the Cerro Nevado de Sumapaz, where it grows in *Senecio niveo-aureus* – *Breutelia* sp. vegetation covering limestone slopes.

Lophocolea trapezoidea Mont.

Oil bodies in leaves variable in number, (3–)4–8(–12) per cell; large, ellipsoid and rather coarsely granulose to smaller, globose and more finely granulose, 5–12 × 4–7 μm, when ellipsoid tapering to acute or apiculate points; colourless, becoming homogeneous upon degeneration (Colombia, Boyacá, Cleef 2299; ibid. Tolima, van der Hammen & Jaramillo 3379; Galapagos Is., Santa Cruz, Media Luna, Gradstein, Lanier & Weber H57).

Distribution and ecology:

This species was recorded by Fulford (1976) as widespread in tropical America, from the base of the mountains up to 3800 m. Here it is reported for the first time from the Galapagos Islands.

Lophocolea trapezoidea is a very common epiphytic and terrestric liverwort in Colombia, collected between 2600 and 3800 m in the Central and Eastern Cordillera. Most records are from the humid upper Andean *Weinmannia* forest and the adjacent subpáramo thickets. The uppermost collection is from open grass-páramo at 3800 m, where *L. trapezoidea* was growing in dense *Calamagrostis* bunches, especially over decayed parts of the tussock.

Lophozia incisa (Schrad.) Dum.

Oil bodies small, present in all leaf cells except for the apical cells on the teeth, 8–15 per cell; globose to subellipsoid, 4–5 × 3–4 μm; homogeneous and almost hyaline, becoming slightly grayish on age (Colombia, Cundinamarca, Cleef 55d, det. R. Grolle).

Schuster (1969) reports slightly smaller and much more numerous (17–50!) oil bodies in *L. incisa* from North America. The material on which our observations are based is rather poor and probably a shade form, which Dr. Grolle annotated as "*L. incisa* fo. *minuta*".

Distribution and ecology:

Lophozia incisa is common and widespread throughout the Holarctic. It is also known from a few localities in the mountains of Mexico, Colombia and Peru at high altitudes (Robinson 1967).

In the Colombian Andes this species is frequently seen at high elevations; it is recorded from the Eastern and Central Cordillera between 3270 and about 4500 m, mostly growing above 4000 m on mineral soil and in rock fissures in the superpáramo belt, where it is quite common. Here it was also once collected in a *Distichia* cushion bog (4285 m). At lower altitudes *L. incisa* occurs occasionally on steep shaded banks of streamlets.

Microlejeunea colombiana Bischler (fig. 25)

Oil bodies in leaf lobes 2–4 per cell; globose to ellipsoid, 3–9 × 3–4 μm; colourless, coarsely granulose with less than 10 droplets per oil body (Colombia, Cundinamarca, Cleef 3200).

Distribution and ecology:

Bischler et al. (1963) indicated that *Microlejeunea colombiana* is known from the Colombian and Peruvian Andes, at altitudes from 2000–3200 m in wet, primary forests.

In the Colombian Eastern Cordillera near Bogotá and in the Sierra Nevada de Santa Marta this species was mostly found epiphytically in the humid Subandean and Andean forests. Bischler also reported leaves and earth as a substrate for this liverwort.

Neesioscyphus sp. (fig. 26)

Oil bodies in leaves 2–3(–4) per cell; bluntly ellipsoid, more rarely globose, large, 10–16 × 5–6 μm, when globose c. 6 μm; pale-hyaline, finely papillose-granulose (Colombia, Cundinamarca, Cleef 3379; ibid., Tolima, van der Hammen & Jaramillo 3326; Ecuador, Páramo de El Angel, Gradstein, Lanier & Weber s.n.).

According to Grolle (in litt.) this plant most closely resembles *Neesioscyphus homophyllus* (Nees) Grolle from Brazil (Grolle 1964, 1966), particularly in the shape of the underleaf.

Our plant however stands out by its sharply acuminate leaf lobes (bluntish in *N. homophyllus*) and therefore probably has to be described as a new species.

Distribution and ecology:

This species is so far known by a few collections from Colombia (Central and Eastern Cordillera) and by one collection from northern Ecuador (Páramo de El Angel), at altitudes ranging from 3250 to 3900 m. It has been found in the shrubby subpáramo and in the grass-párámo belt, as a pioneer on damp, shaded, bare soil (e.g. in a trench dug by men), and also (Tolima) in the humid upper *Weinmannia* cloud forest at 3300 m.

Odontoschisma falcifolium Steph.

Oil bodies in leaves variable, 2–5 per cell or (in Cleef 3516) 3–8(–11) per cell, in basal leaf cells not becoming more numerous; broadly ellipsoid, 8–15 × 5–7 μm, or smaller, globose, 4–6 μm in diam.; colourless, rather coarsely granulose-papillose, becoming almost homogeneous on age (Colombia, Cundinamarca, Grabandt & Idrobo 346; ibid., Santander, Cleef, Garcia & Jaramillo 3516).

Distribution and ecology:

Odontoschisma falcifolium is widely distributed in tropical South America, Colombia, Venezuela, Guyanas, Brazil and Peru; in lowland forests and savannas, and in mountain forests up into the open páramo at 3600 m. Fulford (1968) noted that this species grows in many different habitats: logs, tree trunks, rock and soil.

In Colombia this species occurs from the warm tropical Amazonian rainforest area in Vaupés at about 200 m up to the cold grass-páramo bogs of the Eastern Cordillera at 3600 m. Our collections are mainly from the upper Andean *Weinmannia* forest and the páramos.

Odontoschisma longiflorum (Tayl.) Steph. (fig. 27)

Oil bodies in leaf cells numerous, almost filling up the lumen, 8–15 in median cells, up to 20 in basal cells; globose to subellipsoid, 5–10 μm; colourless, rather finely granulose-papillose, becoming homogeneous on age (Colombia, Cundinamarca, Cleef 3410d).

Distribution and ecology:

According to Fulford (1968) this species is known from the mountain

forests of the West Indies, Colombia, Venezuela, Ecuador and Brazil, at about 1000–3200 m.

In Colombia it is a species typical for the humid Andean forest belt where it was found between 1700 and 3220 m. Records are from the Eastern Cordillera and the Serranía de la Macarena, where it mainly grows in shaded places over logs and litter in the Subandean and Andean *Weinmannia* and *Quercus* forests.

Omphalanthus filiformis (Sw.) Nees (fig. 28)

Oil bodies in median leaf cells 3–6 per cell, along leaf margin 2–3 per cell, towards leaf base up to 8 per cell; large, filling up ½–2/3 of the lumen, elongate and bluntly ellipsoid or bone-shaped to subglobose, 7–15 × 5–8 μm, becoming smaller towards leaf margin (6–10 × 2,5–5 μm); colourless, coarsely granulose-papillose ("botryoidal"); in stem cortex oil bodies smaller and more numerous, 8–12 per cell (Colombia, Santander, Cleef, Garcia & Jaramillo 3511; Galapagos Is., Santa Cruz, Mt. Crocker area, Gradstein, Lanier & Weber H21).

Distribution and ecology:

Evans (1907) characterised this species as a common element of mountain forests in tropical America.

In Colombia, *Omphalanthus filiformis* is a very common, epiphytic or terrestric liverwort of the humid Subandean and Andean forests of the Central and Eastern Cordillera and of the Sierra Nevada de Santa Marta. We have only few collections from páramos: from very humid subpáramo dwarfshrub and from páramo dwarf forest on moraines on the eastern slopes of the Sierra Nevada del Cocuy. The altitudinal range of the species in Colombia is from 1500 m (or lower?) to the upper zone of the grass páramo at 3900 m.

Omphalanthus jackii (Steph.) Gradst. *comb. nov.*

(*Lejeunea* (subg. *Peltolejeunea*) *jackii Steph.*, Hedwigia 31: 13. 1892; *Peltolejeunea jackii* (Steph.) Schiffn., in Engl. & Prantl, Nat. Pfl.-fam. I, 3(1): 131. 1893; Herzog, Svensk Bot. Tidskr. 46: 86, fig. 16. 1952).

Oil bodies 2–5 per cell; ellipsoid with bluntish points, 7–13 × 3,5–6 μm; colourless, coarsely granulose (Galapagos Is., Pinzón, Gradstein & Sipman H481).

The oil bodies in *Omphalanthus jackii* are similar to those in *O. ovalis* (see below). Reasons for transferring this species to *Omphalanthus* are given under the latter species.

Distribution and ecology:

Omphalanthus jackii is a rather rare neotropical species, known only from a few localities in Ecuador (including Galapagos Is.) and Peru. So far we have no records of Colombia.

In the Galapagos archipelago, *O. jackii* occurs on the islands of Pinzón, Rábida, Santiago and Pinta in summit scrub and in mesic *Zanthoxylum*

fagara woodlands on southern exposed slopes. It grows in dense, yellowish-green, pendulous mats on branches of low trees.

Omphalanthus ovalis (Lindenb. & Gott.) Gradst. *comb. nov.*

(*Lejeunea ovalis* Lindenb. & Gott., Synopsis Hepat.: 754. 1847; *Peltolejeunea ovalis* (Lindenb. & Gott.) Schiffn., in Engl. & Prantl, Nat. Pfl.-fam. I, 3(1): 131. 1893).

Oil bodies in leaves 2–4(–5) per cell, rather narrowly and bluntish ellipsoid to subglobose, 6–13 × 4–6 μm, colourless, coarsely granulose-papillose (Galapagos Is., Santa Cruz, Gradstein, Lanier & Weber H56).

The oil bodies in *O. ovalis* are similar to those in *O. filiformis* except for their somewhat smaller size.

Schuster (1963) reduced *Peltolejeunea* (Spruce) Schiffn., of which *Lejeunea ovalis* (Lindenb. & Gott.) is the generitype, to subgeneric rank under *Omphalanthus* Lindenb., because the only diagnostic difference between the two groups seemed to be the perianth which is 5-carinate in *Peltolejeunea* and terete in *Omphalanthus*. Bischler (1965) studied the stem anatomy in the two groups and found that *Omphalanthus* (including *O. filiformis*) has a rather uniform stem-structure, the cortex cells not being larger than the medullary cells, whereas in *Peltolejeunea* (including *O. jackii* and *O. ovalis*) the cortex cells were said to be distinctly larger than the medullary cells. My observations in fresh Galapagos material of *O. filiformis*, *O. ovalis* and *O. jackii* do not substantiate Bischler's data: in my material stem structure is essentially similar. All species have thickwalled stem cells (strongly so in *O. filiformis* and *O. ovalis*), the walls being uniformily yellowish and rather similar in size, except for the dorsal cortex cells which are slightly larger (1,2 ×). Since Bischler's observations were based on 19th century collections from the Stephani herbarium I presume that the discrepancies in our findings are based on the age of her material or misidentification[1]).

I have also studied the sporophyte in *Peltolejeunea ovalis* from Galapagos material (Gradstein H56), and found that it is similar to the sporophyte in *Omphalanthus* (Gradstein 1975: 138) by its 12:4 seta and its cylindric spores covered by numerous rosettes. I therefore fully agree with Schuster (l.c.) that *Peltolejeunea* and *Omphalanthus* are to be combined [S.R. G.].

Distribution and ecology:

The species has so far been reported from mountain forests of the Andes and of Costa Rica. It is quite common in the humid woodlands on the Galapagos Islands, at altitudes of about 250–750 m.

[1]) For example, among specimens of *Peltolejeunea* studied by Bischler is the type of *Peltolejeunea galapagona* Steph. (Galápagos, leg. Andersson *s.n.*). I have studied this material and found it to be *Dicranolejeunea axillaris* (Nees & Mont.) Schiffn. Bischler's illustration of the stem structure in *Peltolejeunea galapagona* Steph. (Bischler 1965, Pl. IV: 52) indeed fits the stem of *Dicranolejeunea axillaris*!

In Colombia this species was found distributed all along the Andes in the humid Subandean cloud forests around 2000 m, mostly as an epiphyte.

Plagiochila jelskii Loitlesb.

Oil bodies c. 5 per cell; subglobose, averaging 5 μm in diam.; colourless, finely granulose-papillose (Costa Rica, Cordillera de Talamanca, Cleef & Fournier 10199c, det.H.Inoue).

Distribution and ecology:

Previously known only by the type collection from Peru, the species has now been found in Costa Rica at 3325 m, in *Swallenochloa* subpáramo, associated with *Syzygiella anomala*. The species has yet to be discovered in Colombia.

Porella squamulifera (Tayl.) Trevis.

Oil bodies present in all leaf cells, numerous, 20–25 per cell; very small ellipsoid to subglobose, 2–4(–5) × 1–1,5 μm, glistening and homogeneous (Colombia, Cundinamarca, Cleef 3421).

Distribution and ecology:

Porella squamulifera is according to Swails (1970) distributed in the tropical Andes of Colombia, Ecuador, Peru and Bolivia, growing on decaying wood in mountain forests.

In Colombia this species is typical for the humid Subandean and Andean forest belt of the Cordillera Oriental, where it was collected between 1200 and 3500 m as an epiphyte.

Pseudocephalozia quadriloba (Steph.) Schust. (fig. 29)

Oil bodies present in all cells of leaves, resembling those of *Lepidozia*, 2–3 per cell; rather irregularly globose to ellipsoid, 4–9(–12) × 3–7 μm; colourless, coarsely granulose-papillose, becoming homogeneous on age, falling apart in small portions upon degeneration; in stem cortex cells oil bodies much smaller and more numerous, up to 10 per cell (Colombia, Cundinamarca, Cleef 2923c).

In their monograph of the genus *Pseudocephalozia* Schust., Schuster and Engel (1974) distinguished two sections: sect. *Pseudocephalozia* (with *P. paludicola* Schust. from Tasmania as the generitype) and sect. *Lobulatae*. *P. quadriloba* belongs to the sect. *Lobulatae*.

The oil bodies of *Pseudocephalozia*, known so far from two species of the sect. *Pseudocephalozia*, were described as "colorless, large and conspicuous, coarsely botryoidal, (1–)2–6 per cell". This description fully fits the oil bodies of *P. quadriloba*.

Distribution and ecology:

Pseudocephalozia quadriloba is a typical subantarctic-neotropical-montane species (Schuster & Engel 1974), known from Tierra del Fuego, the high Andes of Peru, Colombia (3335–4100 m) and Venezuela (3850 m) and from

Costa Rica (2600 m). According to Schuster & Engel (l.c.) the species is extremely common in *Sphagnum* bogs and other open, boggy vegetation types in Tierra del Fuego from almost sea-level to 650 m.

In Colombia, most records so far are from páramo bogs in the Eastern Cordillera: 1) subpáramo bog of *Sphagnum magellanicum, Blechnum loxense* and the giant *Puya goudotiana* near Bogotá; 2) a boggy valley floor with *Sphagnum magellanicum* and *Espeletia* sp. at 3745 m in the Páramo de la Rusia, and 3) a floating *Distichia* bog at 4100 m in the Sierra Nevada del Cocuy, growing over cushions of *Oreobolus* sp. In addition, the species was found once in a boggy *Swallenochloa* bamboo páramo at 3850 m (Páramo de la Rusia). *Pseudocephalozia quadriloba* apparently always grows on organic debris, in pure patches or diffuse over other plants.

Scapania portoricensis Hampe & Gott.

Oil bodies in median leaf-lobe cells 4–8 per cell, towards the base 8–15 per cell, along the margin of the lobe 2–5 per cell; irregularly ellipsoid to triangular to globose, 8–12 × 5–6 μm; colourless, finely papillose within a distinct membrane (Colombia, Tolima, van der Hammen & Jaramillo 3373).

Distribution and ecology:

Scapania portoricensis is a polymorphic, neotropical representative of this mainly Holarctic genus. According to Herzog (1928) the species is rather common and widespread in the mountains of tropical America between 1500 and about 3700 m.

In the Colombian Andes this conspicuous, reddish liverwort inhabits exclusively the humid and extreme humid mountain forests ranging between 1700 and 3750 m. *S. portoricensis* is most common in the humid upper *Weinmannia* cloud forests, where it grows epiphytically and over humid rocks. Remarkable is its absence (so far!) in the *Quercus* forests of the Colombian Eastern Cordillera.

Stephaniella paraphyllina Jack

Oil bodies rare, present only in a few green cells of the leaves and in cells of the green paraphyllia, 3–5 per cell, globose, small, colourless, finely papillose (Ecuador, Páramo de Cotopaxi, Gradstein, Sipman & de Vries 121).

The genus *Stephaniella* is a morphologically highly specialised element of the high Andes, possessing long stolons and very densely imbricated, almost a-chlorophyllose leaves, which form a protective sheet over a dense layer of green paraphyllia, originating from the dorsal side of the stem. Oil bodies appear to be lacking in cells without chlorophyll, but are present in the green cells. A similar condition is found in the genus *Gongylanthus*, which in the Andes grows in somewhat similar, yet less extreme habitats.

Distribution and ecology:

According to Grolle (1969) *Stephaniella paraphyllina* occurs in the

mountains of Mexico and Central America, throughout the tropical Andes, on Mt. Itatiaia (Brazil) and in South Africa.

In Colombia this inconspicuous terrestric species is only known from the páramos of the Sierra Nevada de S. Marta (Winkler 1969, 1976; Schmitt & Winkler 1968) and the Eastern Cordillera, especially on the dry sides of the mountains, ranging in altitude from 2700 to 4400 m. *Stephaniella paraphyllina* always grows partially buried in mineral, mostly sandy soil in open, exposed sites. It is most frequent in the upper bunchgrass-páramo, colonizing open places with dry, bare, stony soil, e.g. on moraines.

Syzygiella anomala (Lindenb. & Gott.) Steph.

Oil bodies in leaves 6–10 per cell; globose, 5–7 μm in diam.; colourless, finely granulose-papillose (Costa Rica, Cordillera de Talamanca, Cleef & Fournier 10199).

In his monograph of the genus *Syzygiella*, Inoue (1967) reported oil bodies in *S. variegata* and *S. subintegerrima*, from Indomalesia.

The oil bodies in *S. anomala* seem quite similar to those in *S. variegata* (Lindenb.) Spruce.

Distribution and ecology:

Syzygiella anomala is distributed along the mountains of Central and South America, as Inoue (1967) indicated, between 1500 and 3600 m. This large liverwort is apparently typical for the humid upper *Weinmannia* forest and the lower subpáramo. The few collections of the Colombian Andes show an altitudinal distribution between 2830 and 3620 m in the Central and Eastern Cordillera, occurring both epiphytic and terrestric. In Costa Rica, the specimen studied here was collected together with *Plagiochila jelskii* at 3350 m in the humid bamboo subpáramo in the Cordillera de Talamanca, between stems of *Swallenochloa*.

Syzygiella integerrima Steph. (fig. 30)

Oil bodies in leaves 2(–3) per cell; subglobose to bluntly ellipsoid, 5–10 × 4–6 μm; finely granulose-papillose (Colombia, Tolima, van der Hammen & Jaramillo 3278).

S. integerrima has fewer oil bodies per cell than other species of the genus in which oil bodies are known (which have 4–12 oil bodies per cell).

Distribution and ecology:

Syzygiella integerrima is according Inoue (1967) so far only known from Guadeloupe (type!) and the Serra Itatiaia in Brazil. Our specimens represent its first record from the tropical Andes and from Colombia.

So far we have two Colombian collections, from the Eastern and Central Cordillera where it was found in *Weinmannia* cloud forest between 2920 and 3550 m, probably growing as an epiphyte.

Taxilejeunea debilis (Lehm. & Lindenb.) Steph.

Oil bodies in leaves 5–10 per cell, small, globose to broadly ellipsoid, colourless, finely

granulose-papillose (Colombia, Cundinamarca, upper Andean forest, epiphyte, 3050 m, Florschütz 4485)

According to Evans (1921) this species is closely allied to *T. pterogonia*, but differs by its dioicous inflorescence, smooth perianth keels, entire female involucre, and the ± lunulate sinus of the underleaves. The oil bodies in *T. debilis* are apparently similar to those in *T. pterogonia*.

Distribution and ecology:

This species is widely distributed in tropical America and has been found on soil, rocks and trees (Evans 1921). We have no previous records from Colombia.

Taxilejeunea lusoria (Lindenb. & Gott.) Steph.

Oil bodies in leaves 4–10 per cell; ellipsoid to globose, c. 4–8 × 3–4 μm; finely granulose-papillose, becoming homogeneous on age (Galapagos Is., Santa Cruz, Mt. Crocker area, Gradstein, Lanier & Weber H16).

The oil bodies in *T. lusoria* are essentially similar to those in *T. pterogonia*.

Distribution and ecology:

Probably rather common in Central and tropical South America. New to the Galapagos Islands, where it was found in the very humid upper woodland zone on the island of Santa Cruz, growing on fern debris and pendulous on shrubs.

In Colombia the species has been recorded from the Central Cordillera (Herzog 1955, Robinson 1967) and the Sierra Nevada de Santa Marta (Winkler 1976), at altitudes of about 1500–3200 m.

Taxilejeunea pterogonia (Lehm. & Lindenb.) Schiffn.

Oil bodies in median leaf cells 4–7 per cell, up to 12 in basal cells, ellipsoid and tapering to narrow points, or subglobose, c. 4–8 × 3–4 μm, colourless, finely granulose-papillose (Galapagos Is., Santa Cruz, Mt. Crocker area, Gradstein, Lanier & Weber H20).

According to Schuster & Hattori (1954), oil bodies in *Taxilejeunea* are either numerous (more than 10) and homogeneous (e.g. *T. obtusangula*) or few (less than 10) and segmented (e.g. *T. conformis*, *T. vallis-gratiae*). Those in *T. pterogonia* and *T. lusoria* agree with the latter condition.

Distribution and ecology:

Taxilejeunea pterogonia is probably the most common neotropical species of this large genus, occurring in all humid lowland, Subandean and Andean forests in the Colombian Andes between about 300 and 3400 m. *T. pterogonia* is a conspicuous, diaphanous, light-greenish, pendulous liverwort in the humid Andean mountain forests. Other, still unidentified species of the genus are occasionally found in sheltered places in the humid Andean grass-páramo up to about 4000 m.

Telaranea nematodes (Gott. ex Aust.) Howe

Oil bodies present in all cells of leaves and stem cortex, in median leaf cells 4–10 per cell, becoming progressively smaller and fewer towards leaf apex; globose to ellipsoid, 5–8(–10) × 4–6 μm; colourless, finely papillose but not distinctly granulose; in cortex cells more numerous, 5–15 per cell, slightly longer in shape with rather sharp ends (Colombia, Cundinamarca, Grabandt & Idrobo 287).

Grolle (1975) pointed out that *T. nematodes* (Gott. ex Aust.) Howe is the correct name for the plant described by Fulford (1966) as *Telaranea sejuncta* (Ångstr.) Fulf. The oil bodies in our Colombian plants fit the generic description of *Telaranea* by Schuster (1966): "oil-bodies... finely botryoidal", but disagree with his description of oil bodies in *T. nematodes* which are said to be homogeneous ("appearingly"). From descriptions of oil bodies in Asiatic and Australasian species of the genus (Inoue 1967, Schuster 1968) it appears that oil bodies in *Telaranea* are very finely granulose-papillose to almost homogeneous.

Distribution and ecology:

According to Fulford (1966) *Telaranea nematodes* is widespread throughout tropical and warm temperate America, extending northwards along the coast of the United States to New York, eastwards to the westcoast of Ireland, West Pyrenees, the Azores and into tropical and South Africa.

In Colombia this tiny, filamentous liverwort has an ample altitudinal range, occurring from the warm tropical Amazonian rainforest at about 200 m up to the cold and humid grass-páramo of the tropical Andes at 3760 m, always in humid vegetation types. It grows epiphytic, terrestric and over organic matter, often in mats of bryophytes.

Triandrophyllum subtrifidum (Hook. f. & Tayl.) Fulf. & Hatch. (inclus. *T.s.* var. *trifidum* (Gott.) Solari)

Oil bodies in upper leaf-lobe cells 2–4 per cell, at leaf-lobe base 5–7 per cell, at leaf base 7–12 per cell; bluntly ellipsoid to subglobose, c. 8–16 × 5–7 μm, colourless, finely to somewhat coarsely granulose-papillose (Ecuador, Páramo de Cotopaxi, Gradstein, Sipman & De Vries 22).

Hässel de Menendez & Solari (1975) reported much smaller oilbodies (3–4 × 2–3 μm!) in *T. subtrifidum* from Tierra de Fuego. The species indeed appears to be a highly variable taxon.

The material available from Colombia shows a variation from rather robust, almost purely trifid plants at lower altitudes to small, bifid plants at the highest elevations.

Distribution and ecology:

A subantarctic species, which extends northwards to New Zealand and in America throughout the Andes into Central America, reaching Costa Rica and Guatemala.

In Andean Colombia this darkish-green, terrestric and epilitic liverwort has been collected between 2830 and 4520 m. Most collections are from the upper páramo belt, where it abounds on humid superpáramo outcrops on the volcanoes of the Central Cordillera. Lower down *Triandrophyllum subtrifidum* occurs on humid, open places in the grass páramo and subpáramo as well as on tracks in the upper Andean cloud forest. Bischler et al. (nr. 900) once collected this species submerged in a streamlet in the headwaters of Río Caquetá at 3000 m.

Tylimanthus setaceo-ciliatus Steph.

Oil bodies in the upper portion of the leaves 5–8(–10) per cell, towards leaf base 10–15 per cell, heteromorphic, each cell with a few small, globose and a few larger, bluntly to sharply ellipsoid oil bodies; when globose 3–7 μm, when ellipsoid 10–15 × × 6–8 μm; pale hyaline to brownish in colour, finely granulose-papillose (Colombia, Tolima, van der Hammen & Jaramillo 3232 & 3382, det. R. Grolle).

In the genus *Tylimanthus* oil bodies have been reported in *T. diversifolius*, *T. flavicans* and *T. urvilleanus* by Hässel de Menendez & Solari (1972). The oil bodies in *T. setaceo-ciliatus* seem to resemble most closely those of *T. urvilleanus*.

Distribution and ecology:

A rare, terrestric and epiphytic (?) liverwort, previously only known from the Ecuadorian type collection. Up to now we recorded 4 additional localities from the Colombian Andes, between 3100 and 4000 m.

The lowermost record is from very humid upper Andean cloud forest with *Alnus jorullensis* and *Weinmannia* sp. on the South slope of the volcano Nevado del Tolima in the Central Cordillera.

In the Eastern Cordillera the species was collected in different vegetation types of the grass páramo belt: at 3670 m near Bogotá in open páramo on humid places in a small boggy valley; at 3765 m on the slopes of the Cerro Nevado de Sumapaz in the shelter of a humid *Diplostephium revolutum* dwarf forest; and at 4000 m in the Páramo de Guantiva in open *Calamagrostis effusa* bunchgrass páramo.

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REFERENCES

Arnell, S. – Hepaticae of South Africa. Stockholm, 411 p. (1963).

Bischler, H. – The genus *Calypogeja* Raddi in Central and South America II. Subgenus *Calypogeja*, Subgroups 1, 2 and 3. Candollea 18, 53–93 (1962).

Bischler, H. – Le genre *Drepanolejeunea* en Amérique Centrale et Méridionale. Revue Bryol. Lichénol. 33, 15–179 (1964).

Bischler, H. – Recherches sur l'anatomie de la tige chez les Lejeuneaceae. II. Les sous-familles Lejeuneoideae, tribu Ptychantheae, Nipponolejeuneoideae et Myriocoleoideae. Revue Bryol. et Lichénol. 33, 399–458 (1965).

Bischler, H., C. E. B. Bonner & H. A. Miller – Studies in Lejeuneaceae VI. The genus *Microlejeunea* Steph. in Central and South America. Nova Hedwigia 5, 359–411 (1963).

Bonner, C. E. B. – Index Hepaticarum, Parts I–VI, Weinheim, Lehre, 739 p. (1962–66).

Clark, L. & R. D. Svihla. – *Frullania riojaneirensis* (Raddi) Spruce. The Bryologist 48, 56–58 (1945).

Cleef, A. M. – Characteristics of neotropical páramo vegetation and its subantarctic relations. Erdwiss. Forsch. 13, 29 p. (1977).

Cleef, A. M. (in press) – Secuencia altitudinal de la vegetación de los páramos de la Cordillera Oriental, Colombia. Proc. 4. Int. Symp. Trop. Ecol., Panama.

Crandall-Stotler, B. J. – Light, ultrastructural, and chemical investigations of the oil-bodies of *Radula obconica*. A.B.L.S. meeting University of Alberta, Edmonton (1971).

Crandall-Stotler, B. J. – Sporophyte anatomy and shoot-sporophyte relationship of *Leucosarmentum portoricense* Fulf. (Hepaticae). Revue Bryol. Lichénol. 40, 5–16 (1974).

Cuatrecasas, J. – Observaciones geobotánicas en Colombia. Trab. Musc. Nac. Cienc. Nat. Ser. Bot. 27 (1934).

Cuatrecasas, J. – Aspectos de la vegetación natural de Colombia. Rev. Acad. Col. Cienc. E. F. Nat. 10, 40 (1958).

Evans, A. W. – Hepaticae of Puerto Rico. VII. *Stictolejeunea, Neurolejeunea, Omphalanthus* and *Lopholejeunea*. Bull. Torrey Bot. Club 34, 1–34 (1907).

Evans, A. W. – Hepaticae. Yale Peruvian Expedition of 1911. Trans. Connecticut Acad. Arts Sci. 18, 291–345 (1914).

Evans, A. W. – *Taxilejeunea pterogonia* and certain allied species. Bull. Torrey Bot. Club 48, 107–136 (1921).

Florschütz, P. A. & J. Florschütz-de Waard. – Studies on Colombia Cryptogams I. Variation of characters in South American species of *Campylopus*. Journ. Hattori Bot. Lab. 38, 111–114 (1974)

Fulford, M. H. – Manual of the leafy Hepaticae of Latin America. I. Mem. New York Bot. Gard. 11(1), 1–172 (1963).

Fulford, M. H. – Manual of the leafy Hepaticae of Latin America. II. Mem. New York Bot. Gard. 11(2), 173–276 (1966).

Fulford, M. H. – Manual of the leafy Hepaticae of Latin America III. Mem. New York Bot. Gard. 11(3), 277–392 (1968).

Fulford, M. H. – Manual of the leafy Hepaticae of Latin America IV. Mem. New York Bot. Gard. 11(4), 393–535 (1976).

Gradstein, S. R. – Studies on Lejeuneaceae subfam. Ptychanthoideae III. A taxonomic monograph of the genus *Acrolejeunea* (Hepaticae), with an arrangement of the genera of Ptychanthoideae. Bryophyt. Biblioth. 4, 162 p. (1975).

Grolle, R. – Monographie der Lebermoosgattung *Leptoscyphus* Mitt. Nova Acta Leopold. N.F. 25 (161), 1–143, pls. 1–25 (1962).

Grolle, R. – Ueber *Kurzia* v. Martens. Revue Bryol. Lichénol. 32, 166–180 (1964).

Grolle, R. – *Neesioscyphus* – eine neue Lebermoosgattung mit gedrehten Sporogonklappen. Österr. Bot. Zeitschr. 111, 19–36 (1964).

Grolle, R. – Ueber *Gymnanthe concinna* und *Lethocolea*. Bot. Mag. Tokyo 78, 79–84 (1965).

Grolle, R. – Notulae hepaticologicae XIV. Zwei weitere *Neesioscyphus* – Arten. Revue Bryol. Lichénol. 34, 182–186 (1966).

Grolle, R. – *Dicranolejeunea* auf den Atlantischen Inseln. Trans. Brit. Bryol. Soc. 5, 95–99 (1966).

Grolle, R. – Grossdisjunktionen in Artarealen Lateinamerikanischer Lebermoose. Fittkau et al. (eds.), Biogeography and Ecology in South America, II, p. 562–582. Junk, The Hague (1969).

Grolle, R. – *Jamesoniella* und Verwandte. Feddes Repert. 82, 1–99 (1971).

Grolle, R. – Zur Kenntnis von *Adelanthus* Mitt. Journ. Hattori Bot. Lab. 35, 325–370 (1972).

Grolle, R. – Miscellanea hepaticologica 141–150. Journ. Bryol. 8, 483–492 (1975).

Hammen, T. v. d. – The Pleistocene changes of vegetation and climate in tropical South America. Journ. Biogeogr. 1, 3–26 (1974).

Hässel de Menendez, G. G. & S. S. Solari. – Sinopsis de las especies andinopatagónicas del género "*Tylimanthus*" (Hepaticae). Darwiniana 17, 568–591 (1972).

Hässel de Menendez, G. G. & S. S. Solari. – Flora Criptogámica de Tierra de Fuego XV, 1 (Calobryales, Jungermanniales), 181 p. (1975).

Hatcher, R. E. – A monograph of the genus *Isotachis* (Hepaticae) I. Nova Hedwigia 2, 573–608 (1960).

Hatcher, R. E. – A monograph of the genus *Isotachis* (Hepaticae) II. Nova Hedwigia 3, 1–35 (1961).

Hattori, S. – Oil-bodies of Japanese Hepaticae (1). Journ. Hattori Bot. Lab. 5, 69–97 (1951).

Hattori, S. – Oil-bodies of Japanese Hepaticae (2). Journ. Hattori Bot. Lab. 10, 63–78 (1953).

Herzog, Th. – *Scapania portoricensis* Hpe et G. Annls. Bryol. 1, 91–112 (1928)

Herzog, Th. – Die Bryophyten der Andenreisen von C. Troll (Bolivia, Columbia, Panama). Hedwigia 74, 79–114 (1934).

Herzog, Th. – Hepaticae aus Columbia und Peru. Feddes Repert. 57, 156–203 (1955).

Inoue, H. – Studies on oil bodies of some Malayan liverworts. Journ. Hattori Bot. Lab. 30, 54–70 (1967).

Inoue, H. – A new species of *Calypogeia* Raddi. Journ. Jap. Bot. 43, 468–472 (1968).

Inoue, H. – Illustrations of Japanese Hepaticae. I. Tokyo, 189 p. (1974).

Inoue, H. – Illustrations of Japanese Hepaticae. II. Tokyo, 193 p. (1976).

Inoue, H. & R. M. Schuster – A monograph of the New Zealand and Tasmanian Plagiochilaceae. Journ. Hattori Bot. Lab. 34, 1–225 (1971).

Jones, E. W. – African Hepatics XIX. The *Lejeunea flava* complex. Trans. Brit. Bryol. Soc. 5(3), 548–562 (1968).

Jones, E. W. – African Hepatics XXIX. Some new or little-known species and extensions of range. Journ. Bryol. 9, 43–54 (1976).

Jovet-Ast, S. – Le genre *Colura*. Revue Bryol. Lichénol. 22, 206–312 (1953).

Jovet-Ast, S. – Compléments a la connaissance des *Colura*: èspeces et localités nouvelles. Revue Bryol. Lichénol. 42, 909–922 (1976).

Müller, K. – Untersuchungen über die Ölkörper der Lebermoose. Ber. Deutsch. Bot. Gesellsch. 57, 325–370. (1939).

Müller, K. – Die Lebermoose Europas. Rabenhorst's Krytogamen Flora Bnd. VI, 1365 p. (1951–58).

Robinson, H. – Preliminary studies on the Bryophytes of Colombia. The Bryologist 70, 1–61 (1967).

Schmitt, U. & S. Winkler. – Systematische Untersuchungen über die foliosen Lebermoosgattung *Stephaniella* Jack. Osterr. Bot. Zeitschr. 115, 120–133 (1968).

Schuster, R. M. – North American Lejeuneaceae VI. *Lejeunea*: introduction and keys; subgenus *Lejeunea* (I). J. Elisha Mitchell Scie. Soc. 73, 122–197 (1957).

Schuster, R. M. – An annotated synopsis of the genera and subgenera of Lejeuneaceae. I. Introduction; annotated keys to subfamilies and genera. Nova Hedwigia Beih. 9, 203 p. (1963).

Schuster, R. M. – Studies on antipodal Hepaticae I. Annotated keys to the genera of antipodal Hepaticae with special reference to New Zealand and Tasmania. Journ. Hattori Bot. Lab. 26, 185–309 (1963).

Schuster, R. M. – Studies on Antipodal Hepaticae. II. *Archeophylla* Schuster and *Archeochaete* Schuster, new genera of Blepharostomaceae. Trans. Brit. Bryol. Soc. 4, 801–817 (1965).

Schuster, R. M. – The Hepaticae and Anthocerotae of North America I. Columbia Univ. Press, New York, 802 p. (1966).

Schuster, R. M. – The Hepaticae and Anthocerotae of North America II. Columbia Univ. Press, New York, 1062 p. (1969).

Schuster, R. M. – The Hepaticae and Anthocerotae of North America III. Columbia Univ. Press, New York, 880 p. (1974).

Schuster, R. M. – Studies on Hepaticae, XXIX–XLIV. A miscellany of new taxa and new range extensions. Nova Hedwigia 15, 437–529 (1968).

Schuster, R. M. & J. J. Engel – A monograph of the genus *Pseudocephalozia* (Hepaticae). Journ. Hattori Bot. Lab. 38, 665–701 (1974).

Schuster, R. M. & S. Hattori – The oil bodies of the Hepaticae II. The Lejeuneaceae. J. Hattori Bot. Lab. 11, 11–86 (1954).

Solari, S. S. – Miscelánea Briológica (Hepaticae) I. Bol. Soc. Arg. Bot. XV, 197–203 (1973).

Solari, S. S – Miscelánea Briológica (Hepaticae) III. Darwiniana 20, 387–390 (1976).

Spruce, R. – Hepaticae Amazonicae et Andinae. Trans. Proc. Bot. Soc. Edinburgh 15, i–xi, 1–590 (1884–85).

Stotler, R. – The genus *Frullania* subgenus Frullania in Latin America. Nova Hedwigia 18, 397–555 (1969).

Stotler, R. – The biosystematic approach in the study of Hepaticae. Journ. Hattori Bot. Lab. 41, 37–46 (1976).

Swails, L. F. – The genus *Porella* in Latin America. Nova Hedwigia 12, 201–292 (1970).

Vaňa, J. – Studien über die *Jungermannioideae* (*Hepaticae*). 4. *Jungermannia* Subg. *Plectocolea* und Subg. *Solenostoma*: Allgemeines, süd- und mittelamerikanische Arten. Folia Geobot. Phytotax. Praha 9, 179–208 (1974).

Winkler, S. – Systematisch-anatomische Untersuchungen über die marsupialen Lebermoose der Sierra Nevada de Santa Marta in Kolumbien. Mitt. Inst. Colombo-Alemán Invest. Cient. 3, 59–76 (1969).

Winkler, S. – Die Hepaticae der Sierra Nevada de Santa Marta, Kolumbien I. Terrestrische, epixyle und epipetrische Arten. Revue Bryol. Lichénol. 42, 789–827 (1976).