



## Taxonomy and systematics

# The leafy liverworts (Marchantiophyta) of the Valley of Mexico

## *Las hepáticas foliosas (Marchantiophyta) del valle de México*

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### Abstract

The leafy liverwort flora from the Valley of Mexico has been less explored than the moss flora in the same region. There are no taxonomic, floristic or phytogeographic studies for this plant group, although in the literature there are sporadic reports. This contribution records 73 species, 1 variety and 1 subspecies of leafy liverworts that occur in the Valley of Mexico based on the review of the literature and examination of herbarium specimens. Lejeuneaceae (16 species) and Frullaniaceae (12 species) are the most diverse families of the region. A key and a brief description of each taxon are provided. Thirty one species recorded in the literature and/or found in herbarium collections at MEXU were not found in the field. Environmental degradation, lack of collecting in inaccessible areas, and inaccurate or incorrect data collection may account for their current absence.

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**Keywords:** Artificial key; Basin of Mexico; Frullaniaceae; Lejeuneaceae

### Resumen

La flora de hepáticas del valle de México ha sido poco estudiada en comparación con la flora de musgos de la misma región. No hay trabajos taxonómicos, florísticos o fitogeográficos de hepáticas foliosas, aunque la literatura cita esporádicamente algunos ejemplares. En este estudio, con base en la revisión de la literatura, de ejemplares de herbario y de recolectas recientes, se registraron 73 especies, una variedad y una subespecie de hepáticas foliosas. Las Lejeuneaceae (16 especies) y las Frullaniaceae (12 especies) son las familias más diversas de la región. Esta contribución incluye una clave para la identificación y una breve descripción para cada taxón. Por otro lado, 31 especies registradas en la literatura y/o encontradas en los acervos de MEXU no fueron halladas en el campo. Es probable que la contaminación ambiental, la falta de recolecta en zonas inaccesibles o los datos históricos de colecta inexactos o incorrectos expliquen su ausencia actual.

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**Palabras clave:** Clave artificial; Cuenca de México; Frullaniaceae; Lejeuneaceae

### Introduction

The so called Valley of Mexico (or more properly named, the Basin of Mexico) is located in the central-eastern region of the Trans-Mexican Volcanic Belt, in the contact zone between

the Nearctic and Neotropical floristic regions (Delgadillo, 1992; Romero & Velázquez, 1999; Rzedowski & Rzedowski, 2005). It comprises the entire surface of the City of Mexico, the fourth part of the State of Mexico, about 7% of Hidalgo, and small areas of the states of Tlaxcala, Puebla and Morelos (Rzedowski & Rzedowski, 2005).

The bryophyte flora of the Valley of Mexico is one of the best known in Mexico. Cárdenas and Delgadillo (2009) listed and illustrated ~367 species and varieties of mosses, but there are only fragmentary records for its leafy liverwort flora. Parker

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(1954) recognized several genera and species of leafy liverworts from the Valley of Mexico (*Lophocolea bidentata* (L.) Dumort., *Plagiochila* sp., *Porella platyphylla* (L.) Pfeiff., *Dicranolejeunea incongrua* (Lindenb. & Gottsche) Steph., *Microlejeunea* sp. and *Strepsilejeunea* sp.). Taxonomic, floristic, and phyto-geographic studies on leafy liverworts are nonexistent, so that the contribution of Parker (1954) is the only study for the leafy liverworts of the region, although in the bryological literature specimens from the Valley of Mexico are sporadically cited.

This contribution provides an artificial key and a brief description of the leafy liverwort species from the Valley of Mexico.

## Materials and methods

Based on reviewed literature and examination of herbarium specimens in the Bryophyte Collection in the National Herbarium (MEXU), a preliminary list of 80 species of leafy liverworts from the Valley of Mexico was obtained. The list was depurated, i.e., the names in synonymy or invalid were deleted, and then the list included 66 species names.

A total of 307 specimens of leafy liverworts were collected in various types of vegetation from March 2009 to April 2010, in the following localities within the Valley of Mexico: Los Dinamos, Ajusco volcano, Desierto de los Leones, Reserva Ecológica del Pedregal de San Ángel, from Mexico City; Huixquilucan, Llano Grande, Parque Nacional Izta-Popo,

Tlalmanalco, San Rafael, Cerro Gordo, Presa Iturbide, Villa del Carbón, Sierra de Alcaparrosa, from the State of Mexico and Parque Nacional El Chico from Hidalgo. In some localities in Mexico City (e.g., Milpa Alta, Parque Tezozomoc, Bosque de Chapultepec, Bosque de Tlalpan and Xochimilco) no leafy liverworts were found. All specimens were collected in Mexico and are deposited in MEXU.

Based on the preliminary list and the collected specimens, an artificial key of the species from the Valley of Mexico as well as a brief description for each species are provided. The names of the species were updated according to the Söderström et al. (2016).

## Results

The leafy liverwort flora of the Valley of Mexico comprises 73 species, 1 variety and 1 subspecies included in ca. 23 families; 10 species are new records for the Valley, and 1 for Mexico: *Stephaniella rostrata* U. Schmitt.

The Lejeuneaceae is the family with the largest number of species (16 species), followed by Frullaniaceae (12 species). Adelanthaceae, Anastrophyllaceae, Cephaloziaceae, Plagiochilaceae, Lepidoziaceae, Solenostomataceae and Stephaniellaceae had 3 to 6 species each. The remaining families are represented by less than 2 species each.

Thirty-one species have been recorded in the literature, but were not collected in the Valley of Mexico by the senior author.

## Key to the species of leafy liverworts of the Valley of Mexico.

- 
1. Leaf base 2-3 layers of cells thick. Antheridia and archegonia on abaxial surface of stem ..... 2
  1. Leaf base 1 layer of cells thick. Antheridia axillary, archegonia terminal or on the branches ..... 3
  2. Stem with large tubercles; reddish rhizoids. Plicate leaves, shortly rectangular with rounded angles, slightly longer than wide ..... *Fossombronia lamellata*
  2. Stem without tubercles; brown rhizoids. No plicate leaves, semicircular, wider than long ..... *Noteroclada confluens*
  3. Leaf apex deeply divided into several filiform segments, leaf segments 1-7 cells at base ..... 4
  3. Leaf apex undivided or divided into several not filiform segments, leaf segments 7 or more cells at base ..... 8
  4. Leaves succubous, with bisbifid apex, leaf segments with opposite or verticillate cilia. Leaf cells striate-papillose ..... *Trichocolea floccosa*
  4. Leaves incubous or transverse, apex tridentate or deeply divided into 2-4 segments without cilia. Leaf cells striate-papillose, verruculose or smooth ..... 5
  5. Leaves with tridentate apex, leaf segments 3-7 cells wide at base ..... *Bazzania stolonifera*
  5. Leaves with divided apex deeply divided, leaf segments 1-4 cells wide at base ..... 6
  6. Leaves inserted transversely. Leaf segments 1-2 cells at base. Trigones lacking. Leaf cells striate-papillose or verruculose. Underleaves and leaves similar .... 7
  6. Leaves incubous. Leaf segments 2-4 cells at base. Trigones weakly differentiated. Leaf cell smooth. Underleaves quadrifids ..... *Lepidozia reptans*
  7. Leaf apex divided into 4 segments. Leaf cells strongly verruculose. Perianth with 3 keels ..... *Kurzia capillaris*
  7. Leaf apex divided into 3-4 segments. Leaf cells strongly striate-papillose. Perianth without keels ..... *Blepharostoma trichophyllum*
  8. Leaves differentiated into lobe and lobule ..... Key 1
  8. Leaves not differentiated into lobe and lobule ..... 9
  9. Leaf apex undivided ..... Key 2
  9. Leaf apex divided into 2-3 segments ..... Key 3
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### Key 1. Leaves differentiated into lobe and lobule

- 
1. Underleaves absent. Lobule plane, broadly attached to stem. Gemmae present on antical margin of the leaf, discoid ..... *Radula quadrata*
  1. Underleaves present. Lobule plane or sac-like, narrowly or broadly attached to stem. Gemmae absent on antical margin of the leaf ..... 2
  2. Lobule broadly attached to lobe through a long keel ..... 3
  2. Lobule narrowly attached to lobe through a short keel ..... 20
  3. Underleaves undivided ..... 4
  3. Underleaves divided or subtruncate ..... 10
  4. Perianth ciliate or lacinate. Ventral merophyte 2-4 cells wide ..... 5
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4. Perianth without cilia or lacinia. Ventral merophyte 4-11 cells wide	7
5. Perianth with 3 keels, 2 lateral dentate or ciliate and 1 postical broadly rounded, entire or with a little teeth or cilia, without antical keel. Perianth with 2 innovations. Leaves ovate or orbicular	6
5. Perianth with 4 keels, 2 laterals and 2 postical, sometimes one antical; all keels dentate-ciliate. Innovations lacking. Leaves ovate-oblong	<i>Lopholejeunea nigricans</i>
6. Leaves orbicular. Lobule ca. $\frac{1}{2}$ - $\frac{2}{3}$ lobe length, sometimes smaller than lobe; first lobule tooth 3-6 cells long. Postical keel of perianth without cilia	<i>Acanthocoleus juddii</i>
6. Leaves ovate. Lobule ca. $\frac{1}{2}$ lobe length; first lobule tooth 2 cells long. Postical keel of perianth with a little cilia	<i>Acanthocoleus aberrans</i> var. <i>laevis</i>
7. Leaves ovate, erect-patent. Ventral merophyte 4-5 cells wide. Perianth inflated 3-4 keels, the keels entire and rounded. Underleaves insertion line arched	8
7. Leaves ovate-oblong, spreading. Ventral merophyte 6-11 cells wide. Perianth strongly flattened dorsoventrally, without keels. Underleaves insertion line strongly arched	<i>Marchesinia brachiata</i>
8. Perianth with 4 keels, 2 laterals and 2 postical. Lobule free margin with 3 teeth. Paraphyllia on the abaxial surface of the stem, lamellate	<i>Brachiolejeunea laxifolia</i>
8. Perianth with 8 keels, 2 laterals and 1 postical. Lobule free margin with 2 teeth. Paraphyllia on the stem lacking	9
9. Lobule free margin with teeth spaced from each other by 3-4 marginal cells longer than median cells	<i>Blepharolejeunea incongrua</i>
9. Lobule free margin with teeth spaced from each other by 3-5 marginal cells as large as the median cells	<i>Blepharolejeunea securifolia</i>
10. Leaf apex obtuse to acute or rarely shortly apiculate	11
10. Leaf apex rounded	15
11. Underleaves distant from each other, apex subtruncated, segments of the underleaves divergent. Trigones poorly developed	<i>Harpalejeunea molleri</i>
11. Underleaves distant to contiguous from each other, apex clearly bifid, segments of the underleaves not divergent. Trigones well-developed	12
12. Hyaline papilla distal. Leaf apex obtuse to acute. Leaf lobules well-developed, inflated	13
12. Hyaline papilla proximal. Leaf apex acute to shortly apiculate. Leaf lobules obsolete	14
13. Underleaves ovate	<i>Strepsilejeunea</i> sp.
13. Underleaves obtuse	<i>Strepsilejeunea obtusistipula</i>
14. Leaves distant to contiguous. Leaf apex acute to rarely acuminate. Underleaves $\frac{2}{5}$ - $\frac{1}{2}$ -bifid	<i>Lejeunea cordistipula</i>
14. Leaves imbricate. Leaf apex acute to shortly apiculate. Underleaves $\frac{1}{3}$ -bifid	<i>Lejeunea flaccida</i>
15. Leaf cells papillose	16
15. Leaf cells smooth	17
16. Underleaves ovate-rhomboid, lateral margins angled at mid-blade. Perianth keels smooth	<i>Lejeunea laetevirens</i>
16. Underleaves oval, lateral margins rounded to shortly spread at mid-blade. Perianth keels bicarinate	<i>Lejeunea laetevirens</i>
17. Leaf lobule vestigial, its base formed by 5-7 cells and a filiform tooth (5-) 6-7 cells long and 1-2 (-3) cells wide. Underleaves distant from each other	<i>Lejeunea trinitensis</i>
17. Leaf lobule well-developed, inflated, its base formed by more than 8 cells, with a small tooth 1-2 cells long. Underleaves distant to contiguous from each other	18
18. Leaves oblong. Underleaves $\frac{1}{2}$ -bifid	<i>Lejeunea seriata</i>
18. Leaves ovate. Underleaves $\frac{1}{6}$ -bifid	19
19. Ocelli 1 (-3) only in some leaves. Lobules reaching $\frac{3}{4}$ the leaf length. Underleaves segments 2-3 cells wide at base	<i>Microlejeunea bullata</i>
19. Ocelli lacking. Lobules reaching less than $\frac{1}{2}$ the leaf length. Underleaves segments 5-8 cells wide at base	<i>Lejeunea capensis</i>
20. Postical leaf margin entire, slightly undulate. Leaf lobule flat (laminated). Stem paraphyllia ciliate. Underleaves undivided. Perianth campanulate	<i>Porella leiboldii</i>
20. Postical leaf margin entire, not undulate. Leaf lobule inflated, sac-like. Stem paraphyllia lacking. Underleaves divided. Perianth not campanulate	21
21. Leaf lobules cylindrical or clavate	22
21. Leaf lobules galeate or cucullate	24
22. Lobules clavate, distant from the stem. Leaves ovate, without basal appendages. Trigones triangular	<i>Frullania caulisequa</i>
22. Lobules cylindrical, very close to the stem. Leaves ovate or obovate-oblong, with auricles at base. Trigones cordate and sometimes sinuous	23
23. Leaves obovate-oblong, apex acute to mucronate, incurved. Postical leaf margin reflexed. Underleaves semicircular, sometimes orbicular	<i>Frullania triquetra</i>
23. Leaves ovate, apex apiculate, not incurved. Leaf margin reflexed throughout. Underleaves broadly ovate	<i>Frullania atrata</i>
24. Perianth with 8-12 keels	25
24. Perianth with 3-4 keels	26
25. Laminal portion of lobule narrowly triangular, not undulate, not extending beyond the postical leaf margin so the keel is short. Underleaves obovate-oblong, basal appendages short. Margin of the inner female bracts entire, apex obtuse	<i>Frullania pluricarinata</i>
25. Laminal portion of lobule oblong-ligulate, strongly undulate, extending beyond the postical leaf margin so the keel is long. Underleaves broadly reniform, basal appendages long. Margin of the inner female bracts with 5-10 teeth, apex acute	<i>Frullania obscura</i>
26. Underleaves obovate-oblong	<i>Frullania tetraptera</i>
26. Underleaves ovate, orbicular or reniform	27
27. Laminal portion of lobule extending beyond the postical leaf margin. Inner female bracteole connate more than $\frac{1}{2}$ of its length with the lobules of the female bracts	<i>Frullania riojaneirensis</i>
27. Laminal portion of lobule not extending beyond the postical leaf margin. Inner female bracteole connate less than $\frac{1}{2}$ of its length or almost free with the lobules of the female bracts	28
28. Leaves squarrose	29
28. Leaves not squarrose	30
29. Stylus filiform. Underleaves ovate-orbicular, not auriculate at base. Intermediate thickenings abundant throughout the leaf	<i>Frullania ericoides</i>
29. Stylus foliose. Underleaves reniform, auriculate at base. Intermediate thickenings scarce only at leaf base	<i>Frullania gibbosa</i>
30. Laminal portion of lobule triangular	<i>Frullania arsenii</i>
30. Laminal portion of lobule with other forms	31
31. Underleaves narrowly or broadly ovate, $\frac{1}{3}$ - $\frac{1}{2}$ -bifid	32
31. Underleaves orbicular or almost orbicular, $\frac{1}{5}$ - $\frac{1}{4}$ -bifid	<i>Frullania cuencensis</i>
32. Perianth pyriform or obovate. Underleaves narrowly ovate	<i>Frullania inflata</i>
32. Perianth oblong-elliptical. Underleaves broadly ovate	<i>Frullania cuencensis</i>

## Key 2. Leaf apex undivided.

1. Leaf margins slightly or strongly dentate	2
1. Leaf margins entire	7
2. Antical leaf margin plane, recurved or reflexed. Trigones confluent; vitta weakly developed in the basal and mid-leaf	3
2. Antical leaf margin plane or incurved. Trigones not confluent; vitta lacking	4
3. Ventral-type branches. Leaves ovate-orbicular. Leaf insertion transverse	<i>Adelanthus lindenbergianus</i>
3. Lateral-type branches. Leaves ovate to ovate-oblong. Leaf insertion succubous	<i>Plagiochila bifaria</i>
4. Abaxial leaf surface with numerous propagules	5
4. Abaxial leaf surface without propagules	6
5. Leaves widely spreading. Teeth present on the apex and on the postical leaf margin	<i>Plagiochila patula</i>
5. Leaves narrowly spreading. Teeth present only at leaf apex	<i>Plagiochila xalapensis</i>
6. Leaves ovate-orbicular; margins finely dentate. Trigones cordate. Stem with 1-3 cell layers thick in section	<i>Plagiochila asplenioides</i>
6. Leaves ovate-oblong; margins strongly dentate. Trigones triangular. Stem with 3-4 cell layers thick in section	<i>Plagiochila diversifolia</i>
7. Leaves succubous, opposite	8
7. Leaves succubous, alternate	10
8. Antical leaf margins connate, plane. Postical leaf margin not connate, undulate, with elongate cells. Leaf apex rounded. Leaf cells smooth	9
8. Antical and postical leaf margins connate. Antical margin revolute, the postical margin slightly undulate, cells not elongate. Leaf apex subacute to slightly bifid. Leaf cells papillose	<i>Syzygiella anomala</i>
9. Leaves concave	<i>Gongylanthus liebmanianus</i>
9. Leaves plane or almost plane	<i>Gongylanthus muelleri</i>
10. Leaves lingulate. Cells of the postical leaf margin strongly elongate	11
10. Leaves variable in shape, but not ligulate. Cells of the postical leaf margin not or slightly elongate	12
11. Sporophyte developing within the perianth. Leaf cells smooth	<i>Solenostoma amplexifolia</i>
11. Sporophyte developing within the marsupium. Leaf cells strongly papillose	<i>Lethocolea glossophylla</i>
12. Leaves closely imbricate. Plants with axillary paraphyllia	13
12. Leaves distant, contiguous, or sometimes imbricate. Plants without paraphyllia	15
13. Leaves longitudinally plicate. Stolons lacking. Paraphyllia lanceolate	<i>Stephaniellidium sleumeri</i>
13. Leaves plicate lacking. Stolons present. Paraphyllia filiform or biseriate	14
14. Leaves oblate or ovate, wider than long or as wide as long. Leaf apex obtuse, entire	<i>Stephaniella paraphyllina</i>
14. Leaves largely ovate, longer than wide, sometimes as long as wide. Leaf apex acute, prolonged, slightly serrulate or prorulose	<i>Stephaniella rostrata</i>
15. Leaf cells papillose	16
15. Leaf cells smooth	17
16. Leaves spreading. Postical marginal cells slightly elongate	<i>Solenostoma sphaerocarpum</i>
16. Leaves appressed. Postical marginal cells shortly rectangular	<i>Syzygiella autumnalis</i>
17. Rhizoids originating from the stem epidermal cells	<i>Solenostoma decolor</i>
17. Rhizoids originating from the leaf base	<i>Solenostoma callithrix</i>

## Key 3. Leaf apex divided into 2 or more segments.

1. Underleaves present, conspicuous or formed by a few cells	2
1. Underleaves lacking	9
2. Leaves succubous, incubous or inserted almost longitudinally	3
2. Leaves inserted transversely or almost transversely	6
3. Leaves incubous. Leaf apex usually trifid, rarely bifid; leaf cells papillose	<i>Triandrophyllum subtrifidum</i>
3. Leaves succubous. Leaf apex bifid, rarely trifid toward the stem base; leaf cells smooth	4
4. Leaves usually with 1 tooth on the postical margin; antical margin incurved. Leaves $\frac{1}{2}$ - $\frac{1}{3}$ -bifid. Underleaves formed by a few cells	<i>Plagiochila exigua</i>
4. Leaves without tooth on the postical margin; antical margin not incurved. Leaves $\frac{1}{3}$ - $\frac{1}{4}$ -bifid. Underleaves well-differentiated, deeply bifid	5
5. Leaves $\frac{1}{4}$ -bifid. Underleaves with a long filament on the lateral margins	<i>Lophocolea bidentata</i>
5. Leaves $\frac{1}{3}$ -bifid. Underleaves without a filament on the lateral margins	<i>Lophocolea parca</i>
6. Plants less than 0.5 mm wide. Leaves $\frac{1}{2}$ -bifid, segments triangular, obtuse or acute. Vitta lacking	7
6. Plants more than 5 mm wide. Leaves $\frac{2}{3}$ -bifid, segments longly acuminate. Vitta bifurcated near of the leaf sinus	<i>Herbertus juniperoideus</i> subsp. <i>acanthelium</i>
7. Leaves without teeth on the lateral margins. Leaf cells smooth to weakly verruculose. Underleaves formed by more than 8 cells, lanceolate, only present in some branches	<i>Cephaloziella divaricata</i>
7. Leaves sometimes with 1-2 teeth on the lateral margins. Leaf cells smooth to strongly papillose. Underleaves formed by less than 8 cells, lanceolate to asymmetrically bifid, present in all branches	8
8. Marginal leaf cells protruding; leaf segments green, without reddish-magenta tinged. Leaf cells smooth	<i>Cephaloziella</i> sp.
8. Marginal leaf cells protruding, with 1-2 teeth on the lateral margins; leaf segments reddish-magenta tinged. Leaf cells strongly papillose	<i>Cephaloziella divaricata</i>
9. Stem with hyalodermis	10
9. Stem without hyalodermis	13
10. Leaves inserted transversely or almost transversely, $\frac{1}{2}$ -bifid	11
10. Leaves succubous, $\frac{2}{5}$ - $\frac{1}{2}$ -bifid	12
11. Postical margin of the leaf forming an inflated sac. Leaf segments longly triangular, 5-8 cells at base, leaf ending in 4-7 apical cells	<i>Nowellia curvifolia</i>

11. Postal margin of the leaf not forming an inflated sac. Leaf segments short and narrowly triangular, 3-4 cells at base, leaf ending in 1-3 apical cells .....	<i>Cephalozia crossii</i>
12. Stem cross section with 11-12 cortical cells in one layer and 12 medullary cells. Leaves 1/2-bifid. Leaf cells smooth .....	<i>Cephalozia bicuspadata</i>
12. Stem cross section with 10-11 cortical cells in one layer and 14-15 medullary cells. Leaves 2/5-bifid. Leaf cells finely verruculose .....	<i>Fuscocephalozia catenulata</i>
13. Antical margin of the leaf inserted transversely, postal margin oblique .....	14
13. Leaves succubous or transverse .....	18
14. Leaf segments ovate-lanceolate .....	<i>Anastrophyllum auritum</i>
14. Leaf segments triangular .....	15
15. Plants less than 0.5 mm wide. Leaves symmetrically bifid. Gemmae on adaxial surface of the leaf, almost cubical, red, one-celled. Leaf cells smooth or finely verruculose .....	<i>Crossocalyx hellerianus</i>
15. Plants more than 0.5 mm wide. Leaves asymmetrically bifid, antical segment smaller or narrower than the postal segment. Gemmae present or lacking. Leaf cells papillose .....	16
16. Leaves ovate to broadly ovate. Trigones confluent. Gemmae not seen .....	17
16. Leaves ovate, sometimes quadrate. Trigones triangular. Gemmae angled, red, multicellular (2-4-celled) .....	<i>Sphenolobus minutus</i>
17. Antical and postal margins of the leaf incurved .....	<i>Anastrophyllum auritum</i>
17. Postal margin of the leaf plane, antical margin slightly recurved .....	<i>Anastrophyllum tubulosum</i>
18. Leaves transversely inserted .....	19
18. Leaves succubous .....	20
19. Leaves strongly imbricate, ovate, 1/5-1/3-bifid. Leaf segments slightly longer than wide or as long as wide .....	<i>Marsupella miniata</i>
19. Leaves contiguous to imbricate, ovate-orbicular, bifid less than 1/5 their length. Leaf segments wider than long .....	<i>Marsupella emarginata</i>
20. Leaf cells smooth .....	21
20. Leaf cells papillose .....	22
21. Plants less than 0.7 mm wide. Leaves distant to contiguous, bifid; apex of segments obtuse. Leaf cells without trigones. Gemmae not seen .....	<i>Cylindrocolea rhizantha</i>
21. Plants more than 0.7 mm wide. Leaves imbricate, bifid to quadrifid; apex of segments acute-apiculate, ending in one long tooth one-celled. Leaf cells with tiny trigones. Gemmae uni- or bicellular, angled .....	<i>Schistochilopsis incisa</i>
22. Leaves asymmetrically bifid to trifid, to 1/10 their length. Apex of segments acute-acuminate. Gemmae red, bicellular, ovoid, clustered on the stem tip .....	<i>Tritomaria exsecta</i>
22. Leaves asymmetrically bifid, to 1/3 their length. Apex of segments obtuse-acute. Gemmae not seen .....	<i>Acrobolbus wilsonii</i>

*Distinctive characters of the species of leafy liverworts from the Valley of Mexico.* The following descriptions contain only the diagnostic gametophytic characters. Sporophytic characters are not included because the sporophytes are inconspicuous in the leafy liverworts. The characters of taxonomic importance are: insertion and leaf shape, cell shape, presence or absence of trigones, ocelli and vitta; presence or absence of underleaves and their shape; rhizoid color. In most groups the shape and ornamentation of the gynoecium are useful features for taxonomic identification. In Lejeuneaceae and Cephaloziaceae the morphology of epidermis and medulla of the stem are meaningful.

An \* indicates new records for the Valley of Mexico; \*\* correspond to new records for Mexico, and ●, species recorded in the literature and found in MEXU herbarium, but not in recent collections. The remaining species are those reported in the literature and that were also found in this study.

### 1. *Acanthocoleus aberrans* var. *laevis* Gradst.

Leaves ovate. Mid-leaf cells shortly elongate. Ventral merophyte 2 (-4) cells wide. Inner female bracteole with margin plane, entire, apex rounded. Perianth with 2 lateral dentate or ciliate keels and 1 postal rounded with a few tooth or cilia only in the distal section.

Specimens examined: Distrito Federal: Cuajimalpa de Morelos, Desierto de los Leones, 2,958 m, C. Juárez-Martínez 85. Magdalena Contreras, Cuarto Dinamo, 3,100 m, C. Juárez-Martínez 162, 163, 168, 169, 255, 256; entre el Cuarto y el Tercer Dinamo, 3,100 m, C. Juárez-Martínez 178a. Estado de

México: Tlalmanalco, Parque Ecoturístico Dos Aguas, 2,692 m, C. Juárez-Martínez 288. Hidalgo: Epazoyucan, Peñas Cargadas, cerca de Tezuantla, 2,700 m, C. Juárez-Martínez 147.

References: Gradstein (1994); Kruijt (1988).

### 2. *Acanthocoleus juddii* Kruijt ●

Leaves broad, orbicular. Leaf lobules large, rectangular, with a conspicuous tooth. Ventral merophyte 2 cells wide. Perianth with 2 lateral keels winged in the distal section and 1 ventral keel rounded, without cilia.

References: Gradstein (1994); Kruijt (1988).

### 3. *Acrobolbus wilsonii* Nees

Leaves asymmetrically and deeply bifid, antical segment of the leaf narrower than the postal segment; leaf segments obtuse to acute. Leaves usually with 1 tooth on the antical and postal margins. Trigones triangular, small. Leaf cells papillose.

Specimens examined: Distrito Federal: Above Convento Desierto de los Leones near Mexico City, 10,300 ft, A. J. Sharp 54. Magdalena Contreras, Cuarto Dinamo, 3,100 m, C. Juárez-Martínez 259c.

References: Fulford and Sharp (1990).

### 4. *Adelanthus lindenbergianus* (Lehm.) Mitt. ●

Branches ventral-intercalary. Antical margin of the leaf reflexed, entire; antical and postal margins dentate. Trigones

large, confluent, vitta weakly developed in mid-leaf base. Leaf cells smooth.

Specimens examined: Estado de México: Iztaccíhuatl (19°06' N, 98°39' W), 4,000 m, A. M. Cleef and C. Delgadillo M. 10.275.

References: Fulford and Sharp (1990); Grolle (1972).

5. *Anastrophyllum auritum* (Lehm.) Steph. •

Leaves asymmetrically bifid up to 1/3–2/5 their length or less, antical segment narrower than the postical segment, antical and postical margins incurved; leaf base decurrent. Trigones large, confluent. Leaf cells thickened and papillose. Perianth mouth hyaline. Gemmae not seen.

Specimens examined: Estado de México: Nevado de Toluca, S facing slope of the crater (19°04' N, 99°45' W), 4,020 m, C. Delgadillo M. 2239, 2268. Portion NW of Popocatepetl (19°02' N, 98°38' W), C. Delgadillo M. 2118.

References: Engel and Braggins (1998); Fulford and Sharp (1990).

6. *Anastrophyllum tubulosum* (Nees) Grolle •

Leaves broadly ovate, asymmetrically bifid up to 1/4–2/5 their length; leaf segments broadly triangular with apex and sinus acute; leaf base not decurrent. Trigones large, confluent, with convex sides. Leaf cells papillose. Gemmae not seen.

References: Fulford and Sharp (1990); Váña, Söderström, Hagborg, and Von Konrat (2013).

7. *Bazzania stolonifera* (Sw.) Trevis. •

Leaves broadly spreading, imbricate, asymmetrically ovate-elongate. Leaf apex tridentate; teeth acute to obtuse, mostly unequal, 3–7 cells long, 3–7 cells wide at base, the sinuses broad. Leaf margins straight to undulate. Underleaves with a broad hyaline margin of thin-walled cells. Sporophyte capsule ovoid-cylindrical, the wall with 4–5 cell layers.

References: Fulford (1963); Fulford and Sharp (1990).

8. *Blepharolejeunea incongrua* (Lindenb. et Gottsche) van Slageren et Kruijt

Leaves imbricate. Leaf apex rounded to apiculate, incurved. Ventral merophyte (-2) 4 cells wide. Inner female bracts obovate, apex rounded, incurved to apiculate, the margins entire. *B. incongrua* is characterized by marginal cells of the lobule larger and longer than the inner cells of the lobule.

Specimens examined: Estado de México: Huixquilucan, La Cañada, 5 km al SE del centro de Huixquilucan (19°22' N, 99°22' W), 3,047 m, A. Cárdenas S. 6785b.

References: Fulford and Sharp (1990); Gradstein (1994); Slageren and Kruijt (1985).

9. *Blepharolejeunea securifolia* (Steph.) R.M. Schust.

Leaves imbricate. Leaf apex rounded, incurved. Ventral merophyte 4 cells wide. Inner female bracts ovate, apex rounded, incurved, the margins entire. Spores rectangular. *B. securifolia* may be confused with *B. incongrua*, but in the former species the marginal cells of the lobule are the same size as the inner cells of the lobule.

Specimens examined: Estado de México: Villa del Carbón, 16 km al S de El Cerrito (19°35' N, 99°30' W), 3,270 m, A. Cárdenas S. 6787a, C. Juárez-Martínez 193b, 200b; 6 km al S de El Cerrito (19°37' N, 99°31' W), 3,030 m, A. Cárdenas S. 6792a; 8 km al W de Paso de Cortés (19°4' N, 98°41' W), 3,140 m, C. Juárez-Martínez 107; Isidro Fabela, Presa Iturbide (19°31' N, 99°28' W), 3,220 m, C. Juárez-Martínez 186b.

References: Fulford and Sharp (1990); Gradstein (1994); Slageren and Kruijt (1985).

10. *Blepharostoma trichophyllum* (L.) Dumort. •

Leaves and underleaves of same size, divided to the base into 3–4 filiform segments, each segment with 1 cell at base; cells of segments rectangular. Leaf and underleaf cells strongly striate-papillose. Perianth long, cylindrical, without keels, mouth with numerous long cilia.

References: Fulford and Sharp (1990); Schuster (1985).

11. *Brachiolejeunea laxifolia* (Taylor) Schiffn.

Lobule margin with 3 teeth (two in *Blepharolejeunea incongrua* and *B. securifolia*). Lamellate paraphyllia on the dorsal surface of the stem (lacking in *Blepharolejeunea*). Perianth with 4 keels (2 laterals and 2 postical; in *Blepharolejeunea* only 3 keels, 2 laterals and 1 postical).

Specimens examined: Hidalgo: El Chico, cerca de Peña del Cuervo (20°11' N, 98°43' W), 2,740 m, C. Juárez-Martínez 141b, 142.

References: Fulford and Sharp (1990); Gradstein (1994).

12. *Cephalozia bicuspidata* (L.) Dumort.

Stem with an enlarged, transparent cortex (= hyalodermis), with 12 medullary cells and 11–12 cortical cells. Leaves succubous, distant, 1/2-bifid, ovate to almost rectangular; leaf segments with 4–8 cells at base and ending in 1–2 cells at the tip. Trigones lacking. Leaf cell walls thin and smooth. Perianth long, cylindrical, mouth crenulate.

Specimens examined: Estado de México: falda SW del Iztaccíhuatl (19°8' N, 98°42' W), 3,670 m, C. Delgadillo M. 1700b. Villa del Carbón, 16 km al S de El Cerrito (19°35' N, 99°30' W), 3,270 m, C. Juárez-Martínez 195.

References: Fulford (1968); Fulford and Sharp (1990); Gottsche (1863).

13. *Cephalozia crossii* Spruce \*

Stem cross section with 6 medullary cells and 6–7 cortical cells. Leaves subtransverse, distant, 1/2-bifid, ovate; leaf segments with 3–4 cells at base and ending in 1–3 cells at the tip. Cells of the segments and the sinus quadrate. Trigones lacking. Leaf cell walls thin and smooth.

Specimens examined: Hidalgo: Tianguistengo, ca. 2 km S de Santa Monica (20°43' N, 98°40' W), 1,700 m, A. Cárdenas S. 6846 p.p.

References: Fulford (1968); Fulford and Sharp (1990).

14. *Cephalozia divaricata* (Sm.) Schiffn. \*

Hyalodermis lacking. Leaves very small, distant scarcely wider than the stem, transversally inserted, sometimes oblique, 1/2-bifid or more. Leaf apex acute to obtuse, base of segments (7) 9–10 cells wide. Leaf cells smooth to strongly verrucose, uniformly thick-walled, trigones lacking. Underleaves present, lanceolate, sometimes asymmetrically bifid. Gemmae 2-celled, ovoid and reddish, clustered on the stem tip.

Specimens examined: Distrito Federal: Magdalena Contreras, Cuarto Dinamo (19°16' N, 99°17.7' W), 3,100 m, C. Juárez-Martínez 166b. Estado de México: Tepotzotlán, Cima de la Sierra de Alcaparrosa (19°45' N, 99°16' W), 2,660 m, C. Juárez-Martínez 215.

References: Fulford (1976); Fulford and Sharp (1990).

15. *Crossocalyx hellerianus* (Nees ex Lindenb.) Meyl. ●

Plant filiform, ~0.5 mm wide. Leaves deeply and symmetrically bifid. Leaf cells smooth to scarcely verruculose. Gemmae one-celled, almost cubical, red tinged on the adaxial surface of the leaf.

References: Fulford and Sharp (1990).

16. *Cylindrocolea rhizantha* (Mont.) R.M. Schust. ●

Stem without hyalodermis. Leaves distant to contiguous, 1/2-bifid, ovate, attached laterally to the stem, dorsal surface of stem leaf-free; segments triangular, apex obtuse. Trigones lacking. Leaf cell walls thin-walled and smooth. Underleaves lacking.

Specimens examined: Distrito Federal: Pedregal de San Ángel, alrededores de Ciudad Universitaria (19°20' N, 99°11' W), C. Delgadillo M. 2101.

References: Fulford (1976); Fulford and Sharp (1990).

17. *Fossombronina lamellata* Steph.

Leaves plicate, 2 or more cell layers thick in the lower half, shortly rectangular. Stems with long tubercles and reddish to purplish rhizoids. Mid-leaf cells oblong. Leaf cells thin-walled and smooth, trigones lacking.

Specimens examined: Distrito Federal: Magdalena Contreras, Cuarto Dinamo (19°16' N, 99°17.7' W), 3,100 m, C. Juárez-Martínez 158.

References: Schuster (1992).

18. *Frullania arsenii* Steph. \*

Leaf base with basal appendages. Distal margins of the leaf strongly incurved. Trigones small, triangular, weakly sinuose, intermediate thickenings scarce. Lobules galeate, laminar portion broadly triangular, short. Stylus large, lanceolate. Underleaves 3–4 × the width of the stem, almost orbicular, distant from each other, 1/5–1/4-bifid. Perianth with 4 keels.

Specimens examined: Estado de México: Extremo NW del Iztaccíhuatl (19°12' N, 98°42' W), 3,320 m, A. Cárdenas S. 6763.

References: Fulford and Sharp (1990); Yuzawa (1991).

19. *Frullania atrata* (Sw.) Dumort. ●

Leaf base with one auricle. Leaf margins incurved, leaf apex sharply apiculate. Trigones sinuose, intermediate thickenings, abundant at leaf base. Lobules cylindrical. First branch amphigastrium with margin entire, apex undivided and recurved. Underleaves broadly ovate, margins strongly recurved, base with 2 auricles pronounced. Plants usually growing pendent, very slender (less than 1 mm wide), very dark, almost blackish in color.

References: Fulford and Sharp (1990); Uribe and Gradstein (2003).

20. *Frullania caulisequa* (Nees) Nees \*

Leaves ovate, apex incurved, rounded, leaf base without basal appendages. Trigones of the leaf base nodulose, and larger than the trigones of the leaf apex, intermediate thickenings scarce. First branch amphigastrium bifid, ovate, plane. Unlike other species of *Frullania*, *F. caulisequa* has lobules distant from the stem, obovate. Underleaves small, plane, ovate, loosely imbricate, apex obtuse.

Specimens examined: Estado de México: Villa del Carbón, 16 km al S de El Cerrito (19°35' N, 99°30' W), 3,270 m, C. Juárez-Martínez 192.

References: Holz and Gradstein (2005); Yuzawa (1988).

21. *Frullania cuencensis* Taylor

Leaves imbricate to loosely imbricate, ovate to orbicular; distal margins strongly incurved. Trigones large. Basal appendages of the leaf large. Lobules beaked, laminar portion of the lobule narrowly triangular. Underleaves distant from each other, almost orbicular, 3–4 × the width of the stem; 1/5–1/4-bifid. Dioicous.

Specimens examined: Distrito Federal: Magdalena Contreras, Cuarto Dinamo (19°16' N, 99°17.7' W), 3,100 m, C. Juárez-Martínez 164, 270. Tlalpan, Ajusco, cerca del albergue (19°13' N, 99°16' W), 3,305 m, C. Juárez-Martínez 236, 237, 238. Estado de México: 8 km al W de Paso de Cortés (19°04' N, 98°41' W), 3,140 m, A. Cárdenas S. 6753, C. Juárez-Martínez 104, 108. Extremo NW del Iztaccíhuatl, Llano Grande (19°12' N, 98°42' W), 3,320 m, C. Juárez-Martínez 123. Huixquilucan,

La Cañada, 5 km al SE del centro de Huixquilucan (19°19' N, 99°22' W), 3,047 m, A. Cárdenas S. 6785a, C. Juárez-Martínez 183. Isidro Fabela, Presa Iturbide (19°31' N, 99°28' W), 3,220 m, C. Juárez-Martínez 186a, 187. Temascalapa, Cima del Cerro Gordo (19°45' N, 98°49' W), 2,910 m, A. Cárdenas S. 6782, 6783, C. Juárez-Martínez 153. Tepotzotlán, Cima de la Sierra de Alcaparrosa (19°45' N, 99°16' W), 2,660 m, C. Juárez-Martínez 217. Tlalmanalco, 16 km al E de San Rafael (19°14' N, 98°42' W), 3,140 m, A. Cárdenas S. 6764. Villa del Carbón, 16 km al S del El Cerrito (19°35' N, 99°30' W), 3,270 m, A. Cárdenas S. 6787b, 6788, C. Juárez-Martínez 196, 197, 198, 199, 200a. Hidalgo: El Chico, 5 km al W de Pueblo Nuevo, cerca del Parque Nacional el Chico (20°8' N, 98°41' W), 2,660 m, A. Cárdenas S. 6774.

References: [Fulford and Sharp \(1990\)](#); [Yuzawa \(1991\)](#).

## 22. *Frullania ericoides* (Nees) Mont.

Leaves squarrose (dry and wet), fragile, broadly ovate, imbricate, basal appendages strongly auriculate. Trigones sinuose, intermediate thickenings abundant throughout leaf, asymmetrical, strongly nodulose. Stylus filiform. Underleaves ovate to orbicular, plane, imbricate, not auriculate at base. Female bracteole usually connate with one of the lateral margins only (sometimes with both lateral margins). Dioicous.

Specimens examined: Distrito Federal: Desierto de los Leones, 1.5 km al S del Convento (19°19' N, 99°18' W), R. M. Mercado 6. Estado de México: Tepotzotlán, Cima de la Sierra de Alcaparrosa (19°45' N, 99°16' W), 2,660 m, C. Juárez-Martínez 225.

References: [Fulford and Sharp \(1990\)](#).

## 23. *Frullania gibbosa* Nees •

Leaves squarrose when wet and appressed when dry, almost imbricate, basal appendages semirovate. Trigones nodulose, intermediate thickenings scarce. Stylus very large, foliose. Underleaves reniform to orbicular, imbricate, auriculate at base. Female bracteole connate with the bracts on both lateral margins. Autoicous.

References: [Fulford and Sharp \(1990\)](#); [Yuzawa \(1991\)](#).

## 24. *Frullania inflata* Gottsche •

Leaves ovate to suborbicular; leaf apex obtuse to rounded, leaf base appendiculate. Leaf lobule galeate. Stylus triangular to ovate, 2 cells wide at base, 2–8 (–9) cells long. Underleaves flat, ovate, narrowed toward base, 1/3–1/2-bifid. Female bracteole either free or connate with one or both bracts, bidentate, margins entire or with 1 or 2 small teeth near base. Perianth ¾ exserted, inflated when mature, pyriform or obovate, abruptly narrowed into a short beak.

References: [Fulford and Sharp \(1990\)](#); [Clark and Svihla \(1944\)](#).

## 25. *Frullania obscura* (Sw.) Dumort. •

Lobules helmet-shaped (galeate), beaked, laminar section of the lobule extending beyond of the postical leaf margin, entire, strongly undulate. Trigones large, nodulose, with occasional intermediate thickenings. Underleaves large, broadly reniform with basal appendages large, sometimes their margins undulate. Inner female bracteole highly connate with the bracts on both sides. Perianth with 8–10 keels.

Specimen examined: Estado de México: On Popocatepetl, 11 km E of Amecameca (19°04' N, 98°41' W), 3,000 m, J. J. den Held & F. A. van Rhijn HH4.

References: [Fulford and Sharp \(1990\)](#); [Gradstein \(2012\)](#); [Yuzawa \(1991\)](#).

## 26. *Frullania pluricarinata* Gottsche

Leaves contiguous to imbricate, ovate, slightly squarrose, basal appendages semirovate. Trigones well-differentiated, intermediate thickenings lacking at the mid-leaf, present at the leaf base. Underleaves obovate to oblong, distant to contiguous from each other, bifid to 1/4. Laminar portion of the lobule not prolonged beyond the postical leaf margin. Inner female bracteole shortly bifid, highly connate with the bracts on both lateral margins. Perianth with 8–12 keels.

Specimens examined: Distrito Federal: Coyoacán, Jardín Botánico Exterior, Ciudad Universitaria, Reserva Ecológica del Pedregal de San Ángel (19°19' N, 99°11' W), 2,324–2,328 m, C. Juárez-Martínez 274, 276, 283. Estado de México: 8 km al W de Paso de Cortés (19°04' N, 98°41' W), 3,140 m, C. Juárez-Martínez 105.

References: [Fulford and Sharp \(1990\)](#); [Yuzawa \(1991\)](#).

## 27. *Frullania riojaneirensis* (Raddi) Spruce

Leaves ovate, imbricate, distal margins slightly incurved. Trigones nodulose, intermediate thickenings frequent. Laminar portion of the lobule prolonged beyond of the postical leaf margin. Underleaves orbicular, cordate at base, distant to contiguous from each other. Inner female bracteole highly connate with the female bracts. Perianth with 4 keels.

Specimens examined: Hidalgo: El Chico, cerca de Peña del Cuervo (20°11' N, 98°43' W), 2,740 m, C. Juárez-Martínez 143.

References: [Fulford and Sharp \(1990\)](#); [Yuzawa \(1991\)](#).

## 28. *Frullania tetraptera* Nees & Mont.

Leaves ovate, imbricate, distal margins incurved, basal appendages semirovate. Trigones triangular, intermediate thickenings scarce at leaf base. Lobules not beaked, laminar portion of the lobule narrowly triangular. Underleaves obovate to oblong, contiguous to distant from each other, 1/6–1/5-bifid. Perianth with 4 keels. Autoicous.

Specimens examined: Distrito Federal: Magdalena Contreras, Cuarto Dinamo, 3,030 m, C. Juárez-Martínez 11, 12; (19°16' N, 99°17.7' W), 3,100 m, C. Juárez-Martínez 73, 74, 75, 265. Tlalpan, El Ajusco, cerca de El Abrevadero. R. M. Fonseca



57; El Ajusco, cerca del albergue (19°13' N, 99°16' W), 3,305 m, C. Juárez-Martínez 241. Estado de México: 8 km al W de Paso de Cortés (19°04' N, 98°41' W), 3,140 m, C. Juárez-Martínez 102, 106. 0.14 km al NE del Iztaccíhuatl (19°14' N, 98°42' W), 3,140 m, C. Juárez-Martínez 124, 125, 127. Isidro Fabela, Presa Iturbide (19°31' N, 99°28' W), 3,220 m, C. Juárez-Martínez 185, 188, 189. Llano Grande, 3,030 m, C. Juárez-Martínez 17, 18, 19, 20, 21, 22. Llano Grande, extremo NW del Iztaccíhuatl (19°12' N, 98°42' W), 3,320 m, C. Juárez-Martínez 122. Temascalapa, Cima del Cerro Gordo (19°45' N, 98°49' W), 2,910 m, A. Cárdenas S. 6784, C. Delgadillo M. 7261, 7262, C. Juárez-Martínez 148, 151. Summit of Cerro Gordo, west of Santiago Tolman, immediately north of Teotihuacán (19°45' N, 98°49' W), 3,050 m, A. T. Whittemore 4077. Tepotzotlán, Cima de la Sierra de Alcaparrosa (19°45' N, 99°16' W), 2,680 m, C. Juárez-Martínez 218; 2,660 m C. Juárez-Martínez 219, 220. Tlalmanalco, 16 km al E de San Rafael (19°14' N, 98°42' W), 3,140 m, A. Cárdenas S. 6765. Villa del Carbón, 16 km al S de El Cerrito (19°35' N, 99°30' W), 3,270 m, C. Juárez-Martínez 193a, 194; 6 km al S de El Cerrito (19°37' N, 99°31' W), 3,030 m, A. Cárdenas S. 6792b, C. Juárez-Martínez 208; 5 km al SE de Villa del Carbón (19°41' N, 99°26' W), 2,510 m, C. Juárez-Martínez 211. Hidalgo: Epazoyucan, Peñas Cargadas, cerca de Tezuantla (20°06' N, 98°38' W), 2,700 m, C. Juárez-Martínez 145. El Chico, Pueblo Nuevo, cerca de la entrada al Parque Nacional El Chico (20°09' N, 98°41' W), 2,760 m, C. Juárez-Martínez 138, 139. El Chico, 5 km al W de Pueblo Nuevo, cerca del Parque Nacional El Chico (20°08' N, 98°41' W), 2,660 m, C. Delgadillo M. 7259, C. Juárez-Martínez 137. Parque Nacional El Chico, cerca del Valle de los Enamorados (20°10' N, 98°42' W), 2,872 m, R. M. Fonseca 58.

References: Fulford and Sharp (1990); Yuzawa (1991).

### 29. *Frullania triquetra* Lindenb. & Gottsche \*

Leaf base with one auricle, postical leaf margin reflexed, apex incurved, acute to mucronate. Trigones cordate, large. Lobules cylindrical. Underleaves semirotund, sometimes orbicular, margins recurved, base auriculate. First branch underleaf entire, ovate and revolute.

Specimens examined: Hidalgo: Epazoyucan, Peñas Cargadas, cerca de Tezuantla (20°06' N, 98°38' W), 2,700 m, C. Juárez-Martínez 146. Parque Nacional El Chico, cerca de Peña del Cuervo (20°11' N, 98°43' W), 2,740 m, A. Cárdenas S. 6779.

References: Fulford and Sharp (1990); Stotler (1969).

### 30. *Fuscocephalozia catenulata* (Huebener) Vána & L. Söderstr. •

Stems with 14–15 medullary cells and 10–11 cortical cells; hyalodermis present. Leaves succubous, contiguous to imbricate,  $2/5$ -bifid, ovate, antical leaf base decurrent; leaf segments connivent, with 3–5 cells wide base and ending in 1–2 cells at the tip. Trigones lacking. Leaf cells thin and smooth to finely verruculose.

References: Fulford and Sharp (1990); Gottsche (1863).

### 31. *Gongylanthus liebmanianus* (Lindenb. & Gottsche) Steph.

Leaves opposite, concave, imbricate. Antical margin of the leaf connate, postical margins not connate. Cells of the postical leaf margin strongly elongated, sometimes red tinged. Trigones lacking or small. Leaf cells smooth. Rhizoids numerous, brown.

Specimens examined: Distrito Federal: Magdalena Contreras, Cuarto Dinamo (19°16' N, 99°17.7' W), 3,100 m, C. Juárez-Martínez 165, 166a. Tlalpan, Ajusco, cerca del albergue (19°13' N, 99°16' W), 3,305 m, C. Juárez-Martínez 243. Estado de México: Toluca, outer N slope of the cráter of Nevado de Toluca volcano (19°17' N, 99°46' W), 4,050 m, T. Pócs 9548 C. Volcán Popocatepetl (19°02' N, 98°38' W), 4,000 m, A. M. Cleef 10–242. Ladera W del Popocatepetl (19°01' N, 98°41' W), 3,920 m, C. Delgadillo M. 2194. Extremo NW del Iztaccíhuatl (19°13' N, 98°41' W), 3,470 m, A. Cárdenas S. 6761a. S end of Iztaccíhuatl, (19°07' N, 98°37' W), C. Delgadillo M. 1994 b. S end of Iztaccíhuatl (19°06' N, 98°39' W), C. Delgadillo M. 2036. Summit of Cerro Gordo, west of Santiago Tolman, immediately north of Teotihuacán (19°45' N, 98°49' W), 3,050 m, A. T. Whittemore 4087. La Joya de Alcalican, south slope of Iztaccíhuatl (19°07' N, 98°39' W), 3,950 m, A. T. Whittemore 4102, 4103. Hidalgo: Parque Nacional El Chico, cerca de Peña del Cuervo (20°11' N, 98°43' W), 2,740 m, A. Cárdenas S. 6777a.

References: Fulford and Sharp (1990); Gottsche (1863).

### 32. *Gongylanthus muelleri* (Gottsche) Steph.

Leaf opposite, imbricate. Antical margin of the leaf connate, postical margin not connate. Cells of the postical leaf margin elongated, sometimes red tinged. Trigones lacking or small. Leaf cells thin and smooth. Rhizoids numerous, brown. *Gongylanthus muelleri* may be confused with *G. liebmanianus*, but *G. muelleri* has plane leaves.

Specimens examined: Distrito Federal: Magdalena Contreras, Cuarto Dinamo (19°16' N, 99°17.7' W), 3,100 m, C. Juárez-Martínez 167, 173, 252. Tlalpan, Ajusco, cerca del albergue (19°13' N, 99°16' W), 3,305 m, C. Juárez-Martínez 234. Above Contreras, A. J. Sharp 100-a. Tlalpan, Ajusco, a 400 m al W del albergue (19°13' N, 99°16' W), 3,299 m, C. Juárez-Martínez 250. Estado de México: S end of Iztaccíhuatl (19°07' N, 98°37' W), C. Delgadillo M. 1992b. Extremo NW del Iztaccíhuatl (19°12' N, 98°42' W), 3,320 m, A. Cárdenas S. 6762a. Temascalapa, Cima del Cerro Gordo (19°15' N, 98°49' W), 2,910 m, C. Juárez-Martínez 150; (19°45' N, 98°49' W), 2,910 m, C. Delgadillo M. 7263, C. Juárez M. 149. Tepotzotlán, Cima de la Sierra de Alcaparrosa (19°45' N, 99°16' W), 2,680 m, C. Juárez-Martínez 213. Hidalgo: Parque Nacional El Chico, cerca de Peña del Cuervo (20°11' N, 98°43' W), 2,740 m, A. Cárdenas S. 6776a, C. Juárez-Martínez 141a.

References: Fulford and Sharp (1990); Gottsche (1863); Vaña, Grolle, and Long (2012).

33. *Harpalejeunea molleri* (Steph.) Grolle \*

Leaves ovate, concave, imbricate, falcate when wet. Leaf apex obtuse to acute, incurved. Trigones inconspicuous. Lobule inflated with 1 tooth, free margin strongly involute. Ventral merophyte 2 cells wide. Underleaves distant from each other, apex subtruncate, segments divergent, 4–6 cells at base.

Note: It is recommended to review the description and taxonomy of *Harpalejeunea cinchonae*.

References: Fulford and Sharp (1990); Grolle (1989); Grolle and Reiner-Drehwald (1999).

34. *Herbertus juniperoideus* subsp. *acanthelius* (Spruce) K. Feldberg & Heinrichs •

Leaves  $\frac{2}{3}$ -bifid, falcate; leaf segments longly and finely acuminate, ending in a hair-like row of 3–10 cells, segments overlapping at the base. Vitta very broad, bifurcating high up in the lamina, near the sinus. Trigones and intermediate thickenings well-differentiated, knob-like. Leaf cells papillose. Underleaves similar to leaves but more symmetrical.

References: Feldberg and Heinrichs (2006); Fulford and Sharp (1990).

35. *Kurzia capillaris* (Sw.) Grolle •

Leaves transversally inserted, divided in 4 subulate, 2-cells wide segments; segment cells quadrate to shortly rectangular. Leaf cells thickened and verruculose. Underleaves trifid to quadrid, about half the size of the leaves. Perianths on short branches, with 3 keels.

References: Fulford and Sharp (1990).

36. *Lejeunea capensis* Gottsche

Stem cross section with 5–8 layers of cortical cells and 7 medullary cells. Ventral merophyte 2 cells wide. Leaves ovate, plane. Trigones and intermediate thickenings lacking or very small. Leaf cells finely papillose. Underleaves distant to imbricate, 2–4 × the width of the stem,  $\frac{1}{3}$ – $\frac{2}{5}$ -bifid. Gynoecia on long shoots, with 1(-2) innovations. Perianth inflated, without keels, emerging among the bracts up to  $\frac{1}{3}$ – $\frac{1}{4}$  its length.

Specimens examined: Distrito Federal: Magdalena Contreras, entre el Cuarto y el Tercer Dinamo (19°16' N, 99°17.6' W), 3,100 m, C. Juárez-Martínez 178b. Estado de México: Villa del Carbón, 6 km al S de El Cerrito (19°37' N, 99°31' W), 3,030 m, C. Juárez-Martínez 202.

References: Fulford and Sharp (1990); Holz and Gradstein (2005); Reiner-Drehwald and Schäfer-Verwimp (2008).

37. *Lejeunea cordistipula* Lindenb. & Gottsche •

Leaves distant to contiguous, ovate. Leaf apex acute or rarely acuminate, ending in 1–2 cells. Trigones with 3 convex sides,

intermediate thickenings present. Leaf lobule inconspicuous, formed by 5–8 cells. Underleaves distant from each other, ovate,  $\frac{2}{5}$ – $\frac{1}{2}$ -bifid; segments long, triangular.

References: Fulford and Sharp (1990); Gottsche, Lindenberg, and Nees (1847).

38. *Lejeunea flaccida* Lindenb. & Gottsche •

Leaves imbricate, ovate-cordate, flaccid; leaf apex acute to shortly apiculate. Ventral merophyte 2 cells wide. Underleaves ovate-cordate,  $\frac{1}{3}$ -bifid. Perianth pyriform.

References: Fulford and Sharp (1990); Gottsche et al. (1847).

39. *Lejeunea laetevirens* Nees & Mont.

Plants very small, 0.4–0.8 mm wide. Stems very fragile, in cross section of 7–8 cortical cells and (3) 5–6 medullary cells. Ventral merophyte 2 cells wide. Leaves obliquely spreading, ovate-oblong, plane, distant to contiguous; leaf apex rounded. Leaf cells finely papillose. Lobules inflated, ca.  $\frac{2}{5}$  × leaf length. Hyaline papilla proximal. Underleaves ovate-rhomboid, distant from each other, bifid to  $\frac{1}{2}$ , angled at mid-blade. Perianth slightly flattened, with 5 smooth keels.

Specimens examined: Distrito Federal: Coyoacán, Jardín Botánico Exterior, Ciudad Universitaria, Reserva Ecológica del Pedregal de San Ángel (19°19' N, 99°11' W), 2,328 m, C. Juárez-Martínez 277; 2,324 m, C. Juárez-Martínez 282a, 284. Estado de México: Tlalmanalco, Parque Ecoturístico Dos Aguas (19°12.6' N, 98°44.2' W), 2,692 m, C. Juárez-Martínez 293.

References: Fulford and Sharp (1990); Reiner-Drehwald (2000).

40. *Lejeunea seriata* Lindenb. & Gottsche •

Leaves imbricate, oblong, apex rounded, entire; postical margin suberect. Lobule small, inflated. Underleaves  $\frac{1}{2}$ -bifid, distant from each other, small, rotund, lateral margins not angled. Perianth oblong-obovate.

References: Fulford and Sharp (1990); Gottsche et al. (1847).

41. *Lejeunea trinitensis* Lindenb.\*

Leaves ovate, contiguous to loosely imbricate, flat; leaf apex broadly rounded. Ventral merophyte 2 cells wide. Lobule very small, with a very long, erect tooth, the tooth 5–7 cells long, 1–2 (-3) cells wide, wider at base. Hyaline papilla apical, on the tip of the tooth.

Specimens examined: Distrito Federal: Coyoacán, Jardín Botánico Exterior, Ciudad Universitaria, Reserva Ecológica del Pedregal de San Ángel (19°19' N, 99°11' W), 2,324 m, C. Juárez-Martínez 280, 282b.

References: Fulford and Sharp (1990); Reiner-Drehwald (2000); Schuster (1980).

42. *Lepidozia reptans* (L.) Dumort. •

Leaves incubous, contiguous; leaf apex divided into 3–4 segments, the segments 2–4 cells wide at base, cells quadrate-hexagonal; apex of the segments acute. Leaf cells thin and smooth. Underleaves quadrifid, 2–3 cells wide at base.

References: Fulford (1966); Fulford and Sharp (1990).

43. *Lethocolea glossophylla* (Spruce) Grolle \*

Leaves succubous, lingulate, margins entire, apex rounded. Cells along the postical leaf margin strongly elongate, forming a conspicuous border that is evident with polarized light; in leaf cross section these marginal cells are thicker and more rounded than the other leaf cells. Leaf cells papillose. Sporophyte developed within a marsupium.

Specimens examined: Distrito Federal: Magdalena Contreras, Cuarto Dinamo (19°16' N, 99°17.7' W), 3,100 m, C. Juárez-Martínez 78, 174, 258, 259b, 264; entre el Cuarto y el Tercer Dinamo (19°16' N, 99°17.2' W), 3,100 m, C. Juárez-Martínez 176, 179. Tlalpan, Ajusco, cerca del albergue (19°13' N, 99°16' W), 3,305 m, C. Juárez-Martínez 244b. Estado de México: Tlalmanalco, 14 km al E de San Rafael (19°13' N, 98°44' W), 2,820 m, A. Cárdenas S. 6767.

References: Gradstein, Churchill, and Salazar-Allen (2001).

44. *Lophocolea bidentata* (L.) Dumort.

Plants very pale-green. Leaves succubous, almost longitudinally inserted, ovate, contiguous, plane, widely spreading, ¼-bifid, sometimes trifid toward the stem base, apices acute-acuminate. Trigones lacking. Leaf cells thin and smooth. Underleaves small, deeply bifid with a long filament on each side of the blade, free from the leaves.

Specimens examined: Distrito Federal: Desierto de los Leones (recorrido Convento-Cruz Blanca-La Venta) (19°19' N, 99°19' W), C. Delgadillo M. 396, E. Lyonnet 1622. Magdalena Contreras, Cuarto Dinamo (19°16' N, 99°17.7' W), 3,100 m, C. Juárez-Martínez 66, 67, 68, 71, 72, 76, 79, 155, 157, 161, 172a, 268. Tlalpan, Ajusco, a 400 m al W del albergue (19°13' N, 99°16' W), 3,299 m, C. Juárez-Martínez 248, 251. Tlalpan, Ajusco, cerca del albergue (19°13' N, 99°16' W), 3,305 m, C. Juárez-Martínez 231, 233b, 235, 240, 247. Cuajimalpa de Morelos, Desierto de los Leones (19°19' N, 99°18.6' W), 2,958 m, C. Juárez-Martínez 99a. Estado de México: 0.14 km al NE del Iztaccíhuatl (19°14' N, 98°42' W), 3,140 m, C. Juárez-Martínez 126. 8 km al W de Paso de Cortés (19°04' N, 98°41' W), 3,140 m, C. Juárez-Martínez 100, 101. Huixquilucan, La Cañada, al SW de Huixquilucan (19°19' N, 99°22' W), 3,074 m, A. P. Peña R. 113c; (19°19' N, 99°19' W), 3,045 m, A. P. Peña R. 7. Huixquilucan, La Cañada, 5 km al SE del centro de Huixquilucan (19°19' N, 99°22' W), 3,047 m, C. Juárez-Martínez 182, 181. Temascalapa, Cima del Cerro Gordo (19°45' N, 98°49' W), 2,910 m, C. Juárez-Martínez 152. Tepotzotlán, Cima de la Sierra de Alcaparrosa (19°45' N, 99°16' W), 2,660 m, C. Juárez-Martínez 224, 227. Tlalmanalco, 12 km al NE de San Rafael (19°13' N, 98°44' W), 2,820 m, C. Juárez-Martínez 129. Villa del Carbón, 6 km

al S de El Cerrito (19°37' N, 99°31' W), 3,030 m, C. Juárez-Martínez 203, 204, 205, 206b. Hidalgo: El Chico, 5 km al W de Pueblo Nuevo, cerca del Parque Nacional El Chico (20°08' N, 98°41' W), 2,660 m, C. Delgadillo M. 7258.

References: Fulford and Sharp (1990); Fulford (1976); Gottsche (1863).

45. *Lophocolea parca* (Gottsche) Fulford & Sharp •

Leaves succubous almost longitudinal, ovate to quadrate, ½-bifid. Underleaves ovate, distant from each other, deeply bifid, without filaments on the blade margins.

Note: No specimen of *L. parca* was examined but if its underleaves are connate from the leaves the species is placed within *Cryptolophocolea*.

References: Fulford and Sharp (1990).

46. *Lopholejeunea nigricans* (Lindenb.) Schiffn. •

Plants usually blackish-green. Ventral merophyte 4 cells wide. Leaf apex plane or incurved, rounded or acute, margins entire, occasionally distally dentate. Trigones small to medium, intermediate thickenings present. Leaf lobule inflated, with a one-celled tooth. Underleaves ovate to suborbicular, apex undivided, insertion curved or arched. Gynoecium without innovation. Perianth long exerted beyond the bracts, with 4–5 dentate-ciliate keels.

References: Fulford and Sharp (1990); Gradstein (1994).

47. *Marchesinia brachiata* (Sw.) Schiffn. •

Ventral merophyte 6–11 cells wide. Leaves ovate-oblong, apex rounded, entire or toothed. Lobule small, flat, 2–4-toothed. Underleaves broadly obovate-orbicular, entire, margins plane or recurved, the base strongly decurrent, insertion line strongly arched. Gynoecia with 2 innovations. Perianth strongly flattened dorsoventrally, lateral keels entire.

References: Fulford and Sharp (1990); Gradstein (1994).

48. *Marsupella emarginata* (Ehrh.) Dumort.

Plants with stolons. Leaves transversally inserted, ovate-orbicular, contiguous to imbricate, less than 1/5-bifid; segments wider than long, the apex rounded to acute, sometimes discolored. Underleaves lacking.

Specimens examined: Distrito Federal: Tlalpan, Ajusco, cerca del albergue (19°13' N, 99°16' W), 3,305 m, C. Juárez-Martínez 239, 245. Estado de México: NW portion of Popocatepetl (19°03' N, 98°41' W), C. Delgadillo M. 2164. La Joya, extremo SW del volcán Iztaccíhuatl, 8 km al N de Paso de Cortés (19°08' N, 98°39' W), 3,963 m, C. Juárez-Martínez 113. Llano Grande, extremo NW del Iztaccíhuatl (19°13' N, 98°41' W), 3,500 m, C. Juárez-Martínez 118b, 119. S end of Iztaccíhuatl (19°07' N, 98°37' W), C. Delgadillo M. 1991, 1992a, 2006. Iztaccíhuatl (19°11' N, 98°38' W), 4,000 m, A. M. Cleef & C. Delgadillo M. 10268. Nevado de Toluca, N facing slope of the

crater (19°10' N, 99°45' W), C. Delgadillo M. 1885. Nevado de Toluca, S facing slope of the crater (19°04' N, 99°45' W), 4,020 m, C. Delgadillo M. 2236.

References: Fulford and Sharp (1990); Gottsche (1863); Váña, Söderström, Hagborg, Konrat, and Engel (2010).

#### 49. *Marsupella miniata* (Lindenb. & Gottsche) Grolle

Plants with stolons. Leaves transversally inserted, ovate, densely imbricate,  $1/5$ – $1/3$ -bifid; segments slightly longer than wide or as long as wide. Apex of the segments, usually, discolored, ending in 1 or 2 cells. Leaf cells with trigones large and confluent. Underleaves lacking.

Specimens examined: Distrito Federal: Magdalena Contreras, Cuarto Dinamo (19°16' N, 99°17.7' W), 3,100 m, C. Juárez-Martínez 254. Estado de México: La Joya, extremo SW del volcán Iztaccíhuatl (19°08' N, 98°39' W), 3,963 m, C. Juárez-Martínez 109.

References: Fulford and Sharp (1990); Gottsche (1863); Váña et al. (2010).

#### 50. *Microlejeunea bullata* (Taylor) Steph.

Plants very small, less than 0.5 mm wide, stems zig-zag. Leaf lobules large, reaching up to  $3/4$  leaf length, globose, with entire keel. Ocelli sometimes present at base and mid-leaf. Underleaves very small, deeply  $1/2$ – $2/3$ -bifid; the segments suberect, rarely connivent, base of segment 2–3 cells wide. Lateral margins of the inner female bracts weakly crenulate, keel winged. Perianth with 4 keels.

Specimens examined: Estado de México: Tlalmanalco, Parque Ecoturístico Dos Aguas (19°12.6' N, 98°44.2' W), 2,692 m, C. Juárez-Martínez 291.

References: Bischler, Bonner, and Miller (1963); Fulford and Sharp (1990).

#### 51. *Noteroclada confluens* Taylor

Plants large, ca. 1 cm wide. Leaves widely spreading, of 2–3 cell layers, wider than long, apex rounded. Trigones lacking. Leaf cells thin and smooth. Rhizoids pale brown. Underleaves and archegonia on the abaxial surface of the stem.

Specimens examined: Distrito Federal: Magdalena Contreras, Cuarto Dinamo (19°16' N, 99°17.7' W), 3,100 m, C. Juárez-Martínez 257, 260, 261, 262, 263.

References: Gradstein et al. (2001); Spruce (1885).

#### 52. *Nowellia curvifolia* (Dicks.) Mitt. •

Stem with large, thin-walled cortex cells, forming a hyalodermis (like in *Cephalozia*). Postical leaf margin forming an inflated sac up to  $1/2$  the length of the leaf, globose, necklace-like. Leaf segments triangular and long and finely acuminate, cells thin-walled, quadrate to shortly rectangular. Underleaves lacking.

References: Fulford and Sharp (1990); Fulford (1968); Gottsche (1863); Grolle (1968).

#### 53. *Plagiochila asplenoides* (L.) Dumort.

Branching irregular, intercalary. Stem cross section with 1–3 layers of brownish cortical cells, thicker and smaller than medullary cells. Leaves succubous, ovate-orbicular, contiguous to imbricate; the margins finely dentate, teeth 1–3 cells long and 1–2 cells at base, sometimes lacking. Trigones triangular to cordate. Postical leaf margin not or little decurrent along stem, antical margin decurrent. Propagules lacking.

Specimens examined: Distrito Federal: Cuajimalpa de Morelos, Desierto de los Leones (19°19' N, 99°18.6' W), 3,078 m, F. Morales H. 13; 2958 m, C. Juárez-Martínez 98, 99b. Magdalena Contreras, Cuarto Dinamo (19°16' N, 99°17.7' W), 3,100 m, C. Juárez-Martínez 154, 156, 170, 171b, 172b. Tlalpan, Ajusco, cerca del albergue (19°13' N, 99°16' W), 3,305 m, C. Juárez-Martínez 230, 232, 233a, 246. Estado de México: Summit of Cerro Gordo, west of Santiago Tolman, immediately north of Teotihuacan (19°45' N, 98°49' W), 3,050 m, A. T. Whittemore 4090. Tlalmanalco, 12 km al NE de San Rafael (19°13' N, 98°44' W), 2,820 m, C. Juárez-Martínez 128. Hidalgo: El Chico, 5 km al W de Pueblo Nuevo, cerca del Parque Nacional El Chico (20°08' N, 98°41' W), 2,660 m, C. Juárez-Martínez 135. Villa del Carbón, 6 km al S de El Cerrito (19°37' N, 99°31' W), 3,030 m, C. Juárez-Martínez 206a, 207.

References: Fulford and Sharp (1990); Paton (1999).

#### 54. *Plagiochila bifaria* (Sw.) Lindenb. •

Branching irregular, intercalary. Stem cross section with 2–5 layers of cortical cells. Leaves postically secund, ovate to ovate-oblong, antical margin recurved or reflexed, antical base longly decurrent. Leaf apex broadly rounded or truncate, apical and ventral margins toothed. Unlike other species of *Plagiochila*, *P. bifaria* has a vitta formed by elongated cells from near leaf base to mid-leaf. Trigones of the vitta nodulose, or elongated and confluent. Asexual reproduction by fragmentation of leaves.

References: Fulford and Sharp (1990); Heinrichs, Gradstein, and Grolle (1998).

#### 55. *Plagiochila exigua* Taylor

Branching irregular, intercalary. Leaves very small, distant, ovate,  $1/2$ – $1/3$ -bifid, usually with 1 tooth on the postical leaf margin. Leaf apex acute. Antical leaf margin incurved, not or scarcely decurrent. Leaf cells smooth. Underleaves inconspicuous, formed by a few cells. Asexual reproduction through deciduous leaves; propagules lacking.

Specimens examined: Distrito Federal: Cuajimalpa de Morelos, Desierto de los Leones (19°19' N, 99°18.6' W), 2,958 m, C. Juárez-Martínez 89. Magdalena Contreras, Cuarto Dinamo (19°16' N, 99°17.7' W), 3,100 m, C. Juárez-Martínez 253.

References: Fulford and Sharp (1990); Inoue and Sharp (1976); Schuster (1980).

56. *Plagiochila diversifolia* Lindenb. & Gottsche •

Branching dichotomous, terminal. Leaves ovate-oblong; upper half of the postical margin and apex with teeth 1–5 cells wide and 1–4 cells at base; apical teeth slightly larger than others. Cells of the leaf base slightly elongate. Postical leaf base shortly decurrent. Underleaves present, very small and inconspicuous, margins usually with cilia. Propagules absent.

References: [Fulford and Sharp \(1990\)](#); [Heinrichs and Renker \(2001\)](#); [Heinrichs, Anton, Gradstein, and Mues \(2000\)](#).

57. *Plagiochila patula* (Sw.) Lindenb.

Branching dichotomous, terminal. Abaxial surface of the leaf with numerous propagules. Leaves widely spreading, oblong, apex and ventral margin toothed, ventral leaf base entire, not expanded, longly decurrent. This species may be confused with *P. xalapensis*, but its leaves are widespread and the teeth are at the apex and postical margin of the leaf.

Specimens examined: Distrito Federal: Magdalena Contreras, Cuarto Dinamo (19°16' N, 99°17.7' W), 3,100 m, C. Juárez-Martínez 177, 267, 271. Estado de México: Isidro Fabela, Presa Iturbide, (19°31' N, 99°28' W), 3,220 m, C. Juárez-Martínez 184. Huixquilucan, La Cañada, al SW de Huixquilucan (19°19' N, 99°22' W), 3,074 m, A. P. Peña R. 115. Tlalmanalco, 14 km al NE de San Rafael (19°12' N, 98°43' W), 2,650 m, A. Cárdenas S. 6768, 6770, 6772, 6773, C. Juárez-Martínez 131, 132, 133, 134. Tepotzotlán, Cima de la Sierra de Alcaparrosa (19°45' N, 99°16' W), 2,660 m, A. Cárdenas S. 6793. Hidalgo: Epazoyucan, Peñas Cargadas, cerca de Tezuantla (20°06' N, 98°38' W), 2,700 m, A. Cárdenas S. 6772, 6781. El Chico, 5 km al W de Pueblo Nuevo, cerca del Parque Nacional El Chico (20°08' N, 98°40' W), 2,660 m, C. Delgadillo M. 7257. Cerca de Peña del Cuervo, Parque Nacional EL Chico (20°11' N, 98°43' W), 2,740 m, A. Cárdenas S. 6780.

References: [Fulford and Sharp \(1990\)](#); [Gottsche \(1863\)](#); [Heinrichs et al. \(1998\)](#).

58. *Plagiochila xalapensis* Gottsche

As *P. patens* but leaves oblong, obliquely spreading and teeth present only at leaf apex. Abaxial surface of the leaf with numerous propagules.

Specimens examined: Distrito Federal: Cuajimalpa de Morelos, Desierto de los Leones (19°19' N, 99°18.6' W), 2,958 m, C. Juárez-Martínez 80, 81, 82, 83, 84, 86, 90, Ernest Lyonnet 1625. Magdalena Contreras, Cuarto Dinamo (19°16' N, 99°17.7' W), 3,100 m, C. Juárez-Martínez 69, 70, 160, 175; entre el Cuarto y el Tercer Dinamo (19°17' N, 99°16.5' W), 3,100 m, C. Juárez-Martínez 180. Estado de México: Huixquilucan, La Cañada, al SW de Huixquilucan (19°19' N, 99°21' W), 2,997 m, A. P. Peña R. 224, 228. Tepotzotlán, Cima de la Sierra de Alcaparrosa (19°45' N, 99°16' W), 2,680 m, C. Juárez-Martínez 221, 223, 226, 228.

References: [Fulford and Sharp \(1990\)](#); [Gottsche \(1863\)](#).

59. *Porella leiboldii* (Lehm. & Lindenb.) Trevis.

Leaves incubous, ovate-oblong, widespread; apex rounded, flat. Postical leaf margin plane to somewhat undulate. Underleaves wider than the stem, ovate. Leaf lobule oblong-ovate. Bases of the lobules and underleaves ciliate-laciniate. Perianth campanulate.

Specimens examined: Distrito Federal: Just SW of Mexico City, Contreras, near second Dinamo (19°16' N, 99°15' W), Vitt 17603. Estado de México: At 10,050 ft. on moist boulder above Río Frío. A. J. Sharp 302. Amecameca, Sacro Monte. C. G. Pringle 10673. Tepotzotlán, Cima de la Sierra de Alcaparrosa (19°45' N, 99°16' W), 2,660 m, C. Juárez-Martínez 222. Tlalmanalco, Parque Ecoturístico Dos Aguas (19°12.6' N, 98°44.2' W), 2,692 m, C. Juárez-Martínez 290; 14 km al NE de San Rafael (19°12' N, 98°43' W), 2,650 m, A. Cárdenas S. 6769. Hidalgo: El Chico, 5 km al W de Pueblo Nuevo, cerca del Parque Nacional El Chico (20°08' N, 98°41' W), 2,660 m, C. Juárez-Martínez 136.

References: [Fulford and Sharp \(1990\)](#); [So \(2005\)](#).

60. *Radula quadrata* Gottsche

Leaves broadly ovate to concave, imbricate; leaf margins weakly undulate. Leaf cells thin and smooth. Trigones small. Leaf lobules large, flattened, imbricate, quadrate to shortly rectangular, broadly attached to the stem. Underleaves lacking. Discoidal gemmae on the antical margin of the leaf.

Specimens examined: Estado de México: Tlalmanalco, Parque Ecoturístico Dos Aguas (19°12.6' N, 98°44.2' W), 2,692 m, C. Juárez-Martínez 294.

References: [Fulford and Sharp \(1990\)](#); [Yamada \(1982, 2003\)](#).

61. *Schistochilopsis incisa* (Schrad.) Konstant.

Leaves plicate, bifid to quadrifid; segments polymorphic, apex of the segments acute-apiculate, ending in 1 long tooth, some segments with obtuse apex. Underleaves lacking. Gemmae 1- or 2-celled, angled, green.

Specimens examined: Distrito Federal: Tlalpan, Ajusco, cerca del albergue (19°13' N, 99°16' W), 3,305 m, C. Juárez-Martínez 242a. Tlalpan, Ajusco, cerca del albergue (19°13' N, 99°16' W), 3,299 m, C. Juárez-Martínez 249. Estado de México: Volcán Popocatepetl, 4,000 m A. M. Cleef & C. Delgadillo M. 10237, 10241, 10244. Just above timberline, Popocatepetl, 500 m W of Tlamacas (19°04' N, 98°38' W), 3,900 m, J. J. den Held, F.A. van Rhijn, HH1. Tlaxcala: N facing slope of La Malinche (19°18' N, 98°01' W), C. Delgadillo M. 2461, 2494. La Joya, extremo SW del volcán Iztaccíhuatl (19°08' N, 98°39' W), 3,963 m, C. Juárez-Martínez 116.

References: [Fulford and Sharp \(1990\)](#); [Gradstein et al. \(2001\)](#).

62. *Solenostoma amplexifolia* (Hampe) Váña & Schäf.-Verw. •

This species and *Lethocolea glossophylla* have lingulate leaves and the cells along the postical leaf margin strongly elongated. However, *S. amplexifolia* has leaf cells smooth and the sporophyte is developed within a perianth. In contrast, *L. glossophylla* has a leaf cells strongly papillose and the sporophyte is developed within a marsupium. Moreover, *L. glossophylla* has brown oil bodies (colorless or gray in *S. amplexifolia*).

References: Fulford and Sharp (1990).

63. *Solenostoma callithrix* (Lindenb. & Gottsche) Steph.

Leaves ovate to orbicular, contiguous, distant toward the base. Trigones triangular, sometimes cordate. Leaf cells smooth to scarcely papillose. Rhizoids originating from the leaf base.

Specimens examined: Distrito Federal: Cuajimalpa de Morelos, Desierto de los Leones (19°19' N, 99°18.6' W), 2,958 m, C. Juárez-Martínez 91. Magdalena Contreras, Cuarto Dinamo (19°16' N, 99°17.7' W), 3,100 m, C. Juárez-Martínez 77, 159. Estado de México: Isidro Fabela, Presa Iturbide (19°31' N, 99°28' W), 3,220 m, C. Juárez-Martínez 190. La Joya, extremo NW del volcán Iztaccíhuatl, 8 km al N de Paso de Cortés (19°08' N, 98°39' W), 3,963 m, C. Juárez-Martínez 115. Tepotzotlán, Cima de la Sierra de Alcaparrosa (19°45' N, 99°16' W), 2,660 m, C. Juárez-Martínez 212. Villa del Carbón, 6 km al S de El Cerrito (19°37' N, 99°31' W), 3,030 m, C. Juárez-Martínez 209, 210.

Referencias: Fulford and Sharp (1990); Váña (1974a,b).

64. *Solenostoma decolor* (Schiffn.) R.M. Schust. ex Váña, Hentschel & Heinrichs

Leaves ovate to orbicular, distant to contiguous. Leaf cells smooth. This species may be confused with *J. callithrix*, but differs in rhizoids originating from the epidermal cells of the stem.

Specimens examined: Distrito Federal: Cuajimalpa de Morelos, Desierto de los Leones (19°19' N, 99°18.6' W), 2,958 m, C. Juárez-Martínez 93, 94. Estado de México: Huixquilucan, La Cañada, al SW de Huixquilucan (19°19' N, 99°19' W), 3,045 m, A. P. Peña R. 22. Villa del Carbón, 6 km al S de El Cerrito (19°37' N, 99°31' W), 3,030 m, C. Juárez-Martínez 201.

References: Fulford and Sharp (1990); Váña (1974a,b).

65. *Solenostoma sphaerocarpum* (Hook.) Steph. •

Leaves ovate to orbicular, spreading; leaf apex rounded, sometimes emarginate. Cells of the postical margin of the leaf slightly elongated. Leaf cells papillose. Rhizoids scattered, reddish. Plants parocious, usually fertile, perianth inflated, terminal on long stems. Antheridia in axils of leaves (with a strongly swollen base) just below the perianth.

Specimens examined: Distrito Federal: Summit Cerro Gordo, west of Santiago Tolman, immediately north of Teotihuacán (19°45' N, 98°49' W), 3,050 m, A. T. Whittemore 4092.

References: Fulford and Sharp (1990); Váña (1974a, b).

66. *Sphenolobus minutus* (Schreb. ex D. Crantz) Berggr. •

Leaves asymmetrically bifid up to  $\frac{1}{4}$ - $\frac{2}{5}$  their length, leaf segments triangular. Leaf cells papillose. Gemmae angled, 2–5-celled, red tinged, on the adaxial surface of the leaf.

Specimens examined: Estado de México: Volcán Popocatepetl, 3,900–4,000 m A. M. Cleef & C. Delgadillo M. 10253. Iztaccíhuatl (19°06' N, 98°39' W), 4,000 m, A. M. Cleef & C. Delgadillo M. 10276.

References: Váña (1984).

67. *Stephaniella paraphyllina* J.B. Jack

Plants strongly adhered to the substrate, with long ventral stolons. Leaves strongly imbricate, not longitudinally plicate, oblate to ovate, hyaline. Leaf apex obtuse, entire. Axillary paraphyllia usually filiform.

Specimens examined: Estado de México: Extremo NW del Iztaccíhuatl, Llano Grande (19°13' N, 98°41' W), 3,500 m, C. Juárez-Martínez 117, 118a. La Joya, extremo SW del Iztaccíhuatl, 8 km al N de Paso de Cortés (19°08' N, 98°39' W), 3,963 m, A. Cárdenas S. 6756, 6757. Municipio Toluca, Outer N slope of the cráter of Nevado de Toluca volcano (19°17' N, 99°46' W), 4,050 m, T. Pócs 9548 H.

References: Fulford and Sharp (1990); Juárez-Martínez and Delgadillo-Moya (2017); Schmitt and Winkler (1968); Schuster (2002).

68. *Stephaniella rostrata* U. Schmitt \*\*

Plants strongly adhered to the substrate, with long ventral stolons. Leaves loosely imbricate, not longitudinally plicate, ovate, hyaline. Leaf apex acute, slightly serrulate or prorulose. Axillary paraphyllia usually filiform.

Specimens examined: Estado de México: Volcán Nevado de Toluca, 4,180 m, C. Juárez-Martínez 296. Parque Nacional Iztaccíhuatl-Popocatepetl, 3,900 m, C. Juárez-Martínez 339 p.p., 341 p.p. Tlaxcala: Mpio. San José Teacalco, Volcán La Malinche, ~4,000 m, C. Juárez-Martínez 346.

References: Juárez-Martínez and Delgadillo-Moya (2017); Schmitt and Winkler (1968); Schuster (2002).

69. *Stephaniellidium sleumeri* (Müll. Frib.) S. Winkl. ex Grolle

Plants strongly adhered to the substrate, without long ventral stolons. Leaves strongly imbricate, longitudinally plicate, broadly ovate to reniform, green. Leaf apex rounded-obtuse to rounded, entire. Axillary paraphyllia always foliose.

Specimens examined: Distrito Federal: Cima, 10,000 ft. C. G. Pringle 10681. Estado de México: Llano Grande, extremo NW del Iztaccíhuatl (19°12' N, 98°42' W), 3,320 m, C. Juárez-Martínez 121; (19°13' N, 98°41' W), 3,470–3,500 m, A. Cárdenas S. 6759, 6760, C. Delgadillo M. 7252, C. Juárez-Martínez 120. Iztaccíhuatl (19°06' N, 98°39' W), 3,950 m, A.

M. Cleef 10265. La Joya, extremo SW del volcán Iztaccíhuatl, 8 km al N de Paso de Cortés (19°08' N, 98°39' W), 3,963 m, A. Cárdenas S. 6754, 6755, C. Juárez-Martínez 110, 112, 114. Tepotzotlán, Cima de la Sierra de Alcaparrosa (19°45' N, 99°16' W), 2,660 m, C. Juárez-Martínez 214. Tlaxcala: Volcán La Malinche, 4,000 m C. Juárez-Martínez 351.

References: Juárez-Martínez and Delgadillo-Moya (2017); Schmitt and Winkler (1968); Schuster (2002).

70. *Strepsilejeunea obtusistipula* Steph. ●

Leaves distant; leaf apex acute to obtuse. Leaf lobule oblique to oblong. Underleaves broadly obtuse, 3 times the width of the stem; apex emarginated, segments slightly divergent. Inner female bracts oblong-elliptic. Inner female bracteole obovate. Perianth pyriform.

Note: the taxonomic position of this species is uncertain. If *Strepsilejeunea* is a synonym of *Cheilolejeunea* the correct name is probably *Cheilolejeunea choachina* (Gottsche) Gradst. (Gradstein pers. com.).

References: Fulford and Sharp (1990); Herzog (1916).

71. *Syzygiella anomala* (Lindenb. & Gottsche) Steph. ●

Plants frequently reddish-purple in color. Leaves opposite, ovate-triangular, antical and postical margins of the leaves connate, antical base decurrent; antical margins revolute, postical margins slightly undulate; leaf apex subacute to slightly bifid. Trigones large with 3 convex sides, intermediate thickenings scarce. Leaf cells papillose. Underleaves very small or lacking.

References: Feldberg, Váña, Hentschel, and Heinrichs (2010); Fulford and Sharp (1990); Inoue (1966).

72. *Syzygiella autumnalis* (DC) K. Feldberg, Váña, Hentschel & Heinrichs. ●

Leaves alternate (bases free), ovate to orbicular, appressed or spreading, apex rounded to emarginated, margins plane. Cells of the leaf margin quadrate to shortly rectangular, forming a border. Trigones triangular. Leaf cells papillose. Underleaves very small, filiform.

References: Fulford and Sharp (1990); Gradstein et al. (2001).

73. *Triandrophyllum subtrifidum* (Hook. & Taylor) Fulford & Hatcher \*

Leaves incubous, ovate, concave; leaf apex trifid or bifid (to  $\frac{1}{3}$ - $\frac{2}{5}$ ), apex of the segments obtuse, sometimes acute; basal cells of the segments quadrate to shortly rectangular. Leaf base sometimes with short filiform appendages. Trigones small. Leaf cells thin and papillose. Vitta lacking. Underleaves similar to leaves or slightly smaller.

Specimens examined: Distrito Federal: Tlalpan, Ajusco, cerca del albergue (19°13' N, 99°16' W), 3,305 m, C. Juárez-Martínez 244a.

References: Fulford and Sharp (1990); Fulford (1963).

74. *Trichocolea floccosa* Herzog & Hatcher

Leaves bisbifid almost from the base, leaf segments narrowly triangular with numerous long cilia on the margins, opposite or verticillate. Leaf cells narrowly elongate, with uniformly thickened walls, striate-papillose. Underleaves smaller, quadrid to  $\frac{3}{4}$ -bisbifid.

References: Fulford and Sharp (1990); Fulford (1963); Hatcher (1957).

75. *Tritomaria exsecta* (Schmidel) Schiffn. ex Loeske \*

Leaves succubous, concave, asymmetrically bifid to trifid to  $\frac{1}{10}$  their length; antical segment smaller than postical segment. Leaf apex acute-acuminate. Trigones triangular, those of the base larger than those of the mid-leaf. Leaf cells strongly papillose. Rhizoids abundant, hyaline to brown. Underleaves lacking. This species is characterized by numerous reddish tinged, 2-celled gemmae, ovoid at apex of the leaf segments.

Specimens examined: Distrito Federal: Tlalpan, Ajusco, cerca del albergue (19°13' N, 99°16' W), 3,305 m, C. Juárez-Martínez 242b. Estado de México: Extremo NW del Iztaccíhuatl (19°12' N, 98°42' W), 3,320 m, A. Cárdenas S. 6762c. Hidalgo: cerca de Peña del Cuervo, Parque Nacional El Chico (20°11' N, 98°43' W), 2,740 m, A. Cárdenas S. 6775b.

References: Fulford and Sharp (1990); Schuster (1969).

*Excluded species.* *Cephaloziella dentata* (Raddi) Müll. Frib., *Cryptolophocolea connata* (Sw.) L. Söderstr. & Váña, *Jungermannia gracillima* Sm., and *Porella platyphylla* (L.) Pfeiff. are excluded because they were not collected in the Valley of Mexico or were not available at MEXU, and have doubtful historical records.

## Discussion

The number of leafy liverworts in the Valley of Mexico is low for the size of the area. In addition to the apparent paucity in exploration, other factors are worthy of consideration to explain current numbers in this flora. The following should be mentioned: 1, environmental degradation. The Valley of Mexico is one of the most populated and polluted regions of the world. Population growth has affected in several forms the biota of the region. Zambrano, Nash, and Herrera-Campos (2000) reported the local extinction and the decline in abundance of lichens in Desierto de los Leones, attributing it, partly, to the open structure of the forest and the air pollution. Also, Delgadillo and Cárdenas (2000) reported the presumed extinction of moss species in Mexico City. Durán D., Cisneros, and Vargas (1992) evaluated the effect of certain pollutants on epiphytic mosses in Mexico City; showing their decline in this urban area. In Canada and Europe, the effects of environmental degradation have been well documented (Davies, Bates, Bell, James, & Purbis, 2007; Gignac & Dale, 2005; Hodgetts, 1996; Larsen et al., 2007;

Nelson & Halpern, 2005). Adams and Preston (1992) indicated that the decline in abundance and extinction of some species of bryophytes (e.g., *Frullania dilatata*, *Radula complanata*, and *Porella platyphylla*) are the result of high concentrations of air pollutants, mostly, sulfur dioxide. Hence, the potential extinction of leafy liverwort due to various human activities in the Valley of Mexico may not be ignored; 2, inaccessible areas. Some historical records and species not found in this study (e.g., *Sphenolobus minutus*, *A. auritum* and *Frullania obscura*) were reported for Popocatepetl volcano, which remains closed to the public due to volcanic activity; 3, inaccurate or incorrect data collection. Authors unfamiliar with local geography have mistakenly cited localities for various specimens. For example, Gradstein (1994) recorded *Dicranolejeunea axillaris* (Nees & Mont.) Schiffn. from the Valley of Mexico with a specimen collected from Valle de Bravo; therefore, the species was not included in this study; 4, although the vascular flora of the Valley of Mexico is very diverse, the dryland scrubby vegetation of the lower elevations and the coniferous forests of the upper elevations are not expected to yield substantial increase in the number of leafy liverworts species. This is particularly true of the epiphytic taxa.

Despite the numbers cited, it is expected that further exploration in specific sites will add to our knowledge of this group of plants in the Valley of Mexico.

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