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Taxonomy of Podostemaceae in Argentina

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Abstract

A taxonomic revision of Podostemaceae in the Republic of Argentina is presented with keys to genera and species, full descriptions, observations, geographic distributions and illustrations. Five genera and 13 species are recognized: *Apinagia* (*A. yguazuensis* Chodat et Vischer), *Mourera* (*Mourera aspera* (Bong.) Tul.), *Podostemum* (*P. aguirense* Chodat et Vischer, *P. atrichum* Chodat et Vischer, *P. comatum* Hicken, *P. mülleri* Warm., *P. ostenianum* Warm., *P. rutifolium* Warm., *P. schenckii* Warm., *P. undulatum* P. Royen var. *undulatum, P. uruguayense* Warm.). *Tristicha* (T. *trifaria* (Bory ex Willd.) Spreng.) and *Wettsteiniola* (W. *apipensis* Tur). © 1997 Elsevier Science B.V.

Keywords: Aquatic plants; Podostemaceae; Systematics; Geographical distribution; Argentina

1. Introduction

Podostemaceae are found in NE and E regions of the Republic of Argentina, in the Paraná and Uruguay River basins and their tributaries. This region is called 'Mesopotamia Argentina' (provinces of Corrientes, Entre Ríos and Misiones). The southern distribution of the family in the Paraná River extends to approximately 27°S latitude, and in the Uruguay River to about 31°S latitude. South of these latitudes both river basins lack the rocky substratum necessary for Podostemaceae.

Several papers have dealt with the taxonomy of Podostemaceae in Argentina. Hicken (1917) described two species, *Mourera pennicillata* Hicken and *Podostemum comatum* Hicken, from the country. It is evident that Van Royen (1951, 1953, 1954), in his monograph of the New World Podostemaceae, had access to only a few collections from Argentina as few are cited by him. A more thorough taxonomic treatment was provided by Pontiroli (1955), who recognized four genera and 10 species. Pontiroli's treatment, though valuable for the time, is badly outdated.

The present author has published several papers on the taxonomy of the family since Pontiroli's treatment (Tur, 1975, 1984, 1987). Tur (1975) described *W. apipensis* Tur,

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documenting the occurrence of *Wettsteiniola* in the country. Tur (1984) included five genera of the family in a taxonomic key to the phanerogamic genera of Argentina, and Tur (1987) considered the Podostemaceae in a regional floristic treatment of Entre Ríos province (two genera and seven species). The only other paper on Podostemaceae in Argentina has been by Ancibor (1990), who published an anatomical study of several species of *Podostemum*.

The taxonomy of Podostemaceae in Argentina remains problematic. Species distinctions are often unclear. Taxonomic difficulty stems in part from a paucity of herbarium collections. The available collections are often fragmentary or otherwise incomplete.

The purpose of this contribution is to provide a taxonomic treatment of Podostemaceae in Argentina that is based on herbarium collections as well as field observations and collections by the author over the last three decades. A secondary goal is to clarify the nature of the taxonomic problems in Argentina with the hope of stimulating further work.

2. Methods

Specimens in the following herbaria were examined (abbreviations according to Holmgren et al., 1990): BA, BAA, BAB, BAF, C, CORD, CTES, G, ICN, L, LIL, LP, MO, MU, MVM, NY, private herbarium PEDERSEN, SI and STL. The collections of the author are deposited in LP, SI and STL.

Collections from regions of Paraguay, Uruguay and Brasil that are adjacent to Argentina, or from the primary rivers in which Podostemaceae occur, were also examined during this study. These specimens are included in the list of specimens examined. Specimens denoted with * are from locations where dam building has lead to the extirpation of populations of Podostemaceae (see below). Many collections of Podostemaceae from Argentina cannot be identified to species because they are sterile or fragmentary. These specimens are listed as 'dubious specimens' in the list of specimens examined.

3. Human impacts on Podostemaceae

Human activities have a detrimental impact on populations of Podostemaceae in Argentina. Hydroelectric dams have led to the disappearance of Podostemaceae from the region of Salto Grande in the Uruguay River and Yaciretá in the Paraná River. A proposed hydroelectric dam in the Uruguay River near the juncture of Corrientes and Misiones provinces will also, predictably, be detrimental to Podostemaceae. Timber production is a major industry in the Paraná and Uruguay River basins. Although siltation from lumbering activities can have a detrimental impact on Podostemaceae, at present this does not seem to have happened.

4. Description of Podostemaceae in Argentina

Aquatic submersed herbs, highly variable in form and size. Roots present or absent. Prostrate axis dorsiventrally flattened, photosynthetic, attached to the rocks. Stems

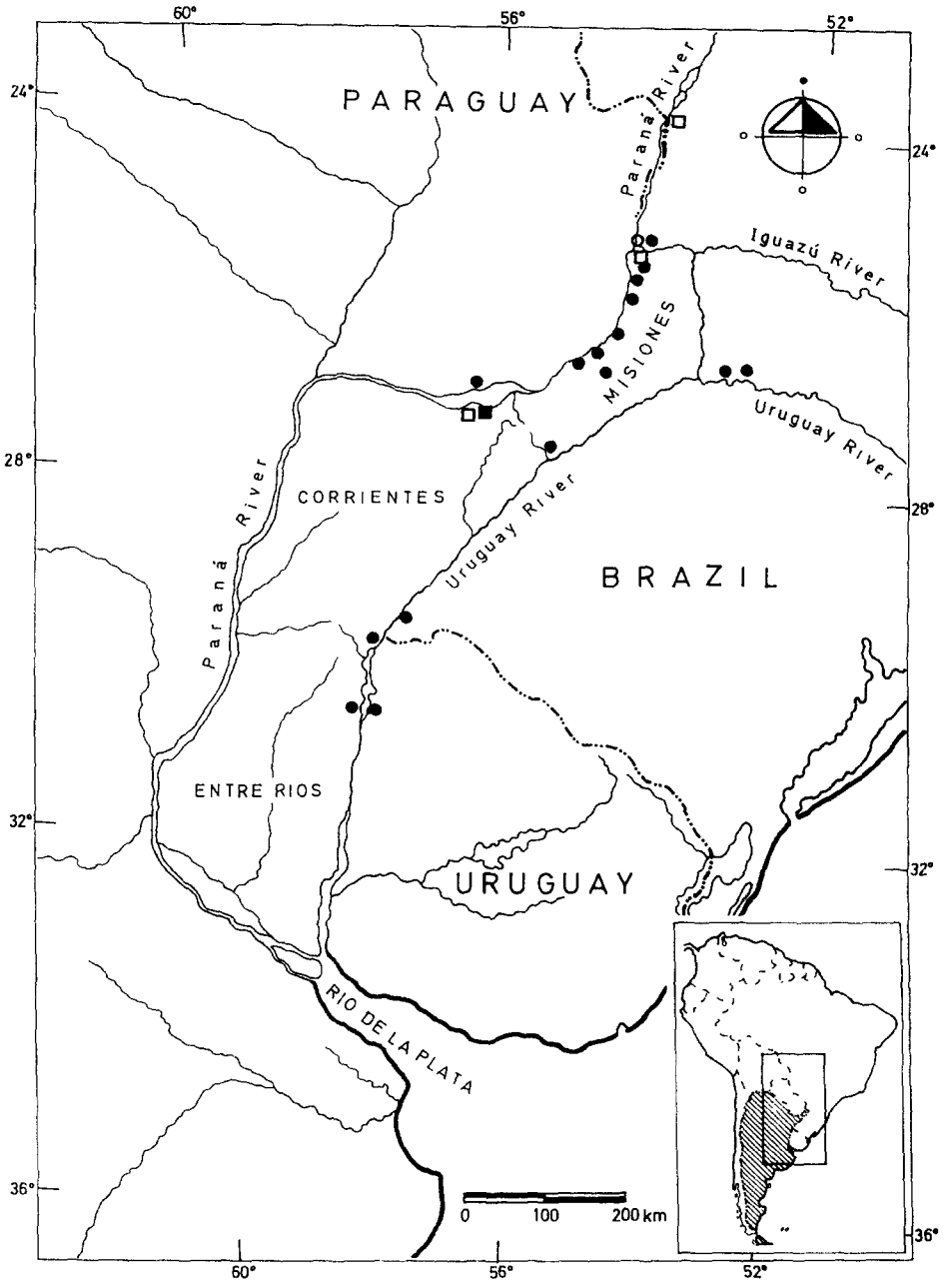

Fig. 1. Map showing the distribution of *Apinagia yguazuensis* (○), *Mourera aspera* (□), *Tristicha trifaria* (●) and *Wettsteiniola apipensis* (■).

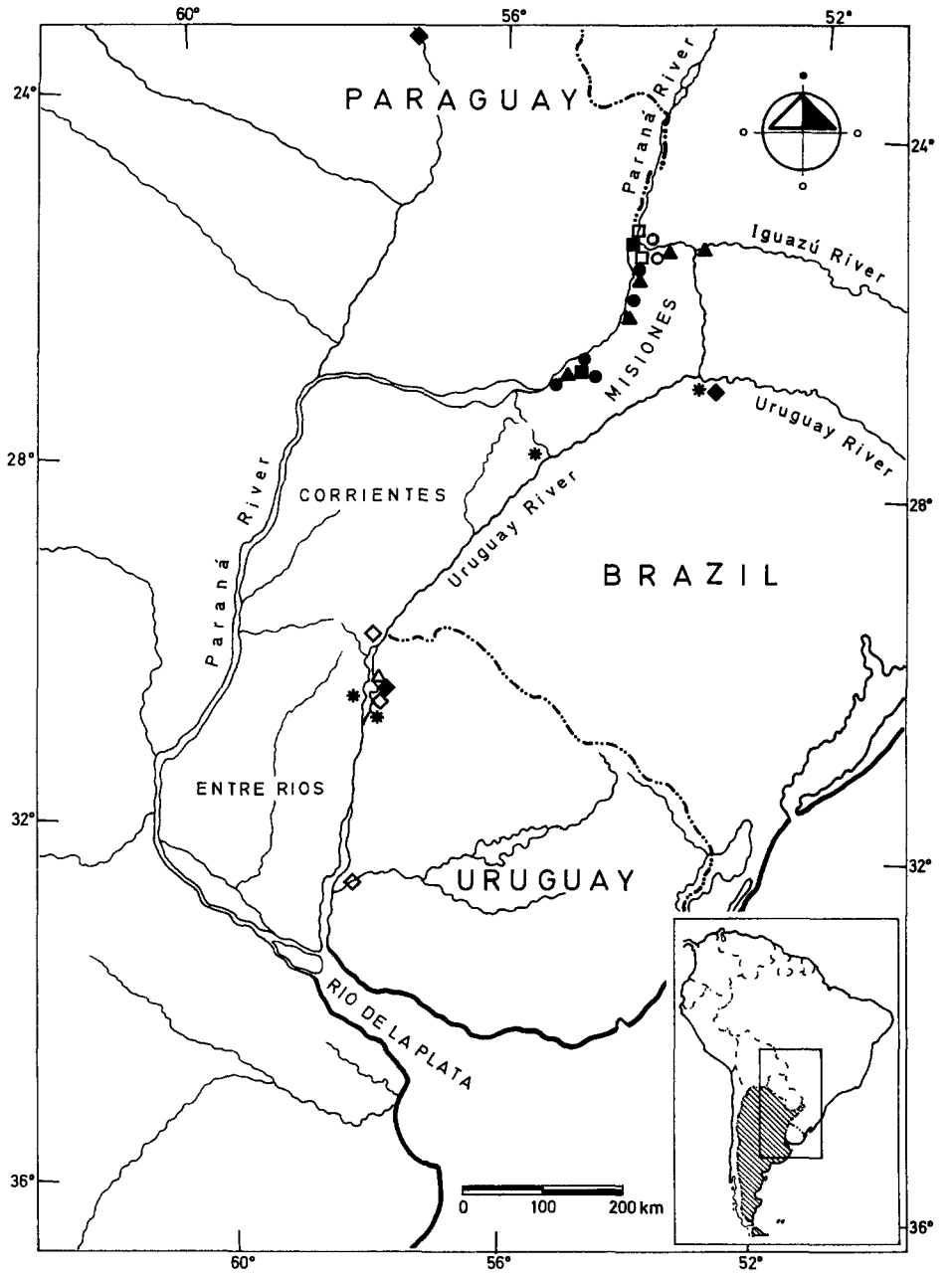

Fig. 2. Map showing the distribution of *Podostemum aguirense* (□), *P. atrichum* (■), *P. comatum* (○), *P. mülleri* (●), *P. ostenianum* (△), *P. rutifolium* (▲), *P. schenckii* (◇), *P. undulatum* (◆) and *P. uruguayense* (*).

present or absent, small or conspicuous, simple or divided. Leaves entire or divided, variable in size and shape. Flowers hermaphroditic; actinomorphic or zygomorphic; solitary, fascicled or 2-sided spiciform monochasial inflorescence; covered by a spathella or by few leaves. Tepals 2 to many; scale-like, free or united at the base. Stamens 1 to many, generally alternating with the tepals, in 1 or 2 complete whorls or on one side of the flower, filaments free or united by an andropodium; anthers dehiscing longitudinally, introrse or extrorse. Pollen in monads or dyads. Ovaries superior, 2–3 celled; carpels equal or unequal; styles 2–3, free or cohering at the base. Capsules 2–3 valved. Seeds numerous, without endosperm.

Family of five genera and 13 species in the subtropical NE region of Argentina. Plants grow in dense populations in areas of full sun in relatively shallow rivers where the current is swift (river-rapids and waterfalls) and solid substrata are abundant. Plants flower and set fruit when exposed by falling water levels.

Some species are restricted to the Paraná River basin (*Apinagia yguazuensis* Chodat et Vischer, *Mourera aspera* (Bong) Tul., *Podostemum aguirense* Chodat et Vischer, *P. atrichum* Chodat et Vischer, *P. comatum*, *P. rutifolium* Warm., *P. mülleri* Warm., *Wettsteiniola apipensis*) while others occur only in the Uruguay River basin (*P. schenckii* Warm., *P. ostenianum* Warm., *P. uruguayense* Warm.). *Tristicha trifaria* (Bory ex Willd.) Spreng. and *P. undulatum* P. Royen occur in both Paraná and Uruguay River basins (Figs. 1 and 2).

5. Key to genera of Podostemaceae in Argentina

(1A) Leaves tristichous. Flowers not enclosed by a spathella, ovary 3-celled, styles 3, capsule with 3 valves. 5.4. *Tristicha*

(1B) Leaves distichous. Flowers enclosed by a spathella, ovary 2-celled, styles 2, capsule with 2 valves.

(2A) Leaf blade entire, flat.

(3A) Leaf blade rough textured. Flowers in 2-sided spiciform monochasial inflorescence, branched or unbranched. 5.2. *Mourera*

(3B) Leaf blade smooth textured. Flowers solitary. 5.1. *Apinagia*

(2B). Leaf blade pinnatisect or dichotomously divided or entire with rigid base passing into an entire or forked blade.

(4A) Leaves pinnatisect. Flowers fascicled from the prostrate axis adhered to the rocks. 5.5. *Wettsteiniola*

(4B) Leaves dichotomously divided or entire with rigid base passing into an entire or forked blade. Flowers solitary from the erect stem. 5.3. *Podostemum*

5.1. Apinagia Tul.

Annual. Small to large herbs. Prostrate axes attached to the rocks. Stems unbranched. Leaves of variable forms and sizes (entire, subentire, elliptical, asymetric-rectangular to rhombiform, lanceolate, ovoid, forked, pinnate or palmate), pinnatinerved or palmatin-

erved, or without nervations, sometimes with tufts of filaments on the adaxial surface. Flowers hermaphroditic, actinomorphic or zygomorphic, solitary or fascicled, each enclosed by a spathella. Juvenile spathellae clavate to nippel-shaped, often papillate, when mature infundibuliform to tubuliform. Tepals 2 to many, free or united with the staminal column, in a complete or incomplete whorl, or on one side of the flower. Stamens 1 to many, in 1 or 2 whorls, an incomplete whorl, or confined to one side of the flower; filaments free, subulate; anthers sagittate at base, dehiscing introrsely or extrorsely. Pollen in monads, ellipsoidal, 3-sulcate. Ovaries 2-locular, ellipsoidal to ovoid or obovoid; stigmas 2, cylindrical to linear, free or cohering to half their length. Capsules 2-locular; with 2 equal or rarely unequal valves, 2–14 ribbed. Seeds numerous.

Apinagia is a South American genus with about 50 species. One species occurs in Argentina.

1. *Apinagia yguazuensis* Chodat et Vischer, Bull. Soc. Bot. Genève, Ser. 2, 9: 241, Fig. 176, 184–187, 197. 1917. Type: Paraguay, Alto Parana, 'Iguazu in rupibus inmersis, Oct. 1914, Hab. in aqua rapide fluente limpida Rio Yguazu ad confines Argentinae', *Chodat et Vischer 341* (Holotype G!, phototype LP! ex G).

Herbs, 2–4(5) cm high. Stems erect, attached to rocks by a irregular basal disk, 1.5–4 mm diam. Leaves 1–4 cm long, membranous, decurrent, cuneate at base, irregulary pinnately lobed, lobes dissected into dichotomous filaments, tuft of filaments on the adaxial surface near the margins, filaments 2 mm long. Flowers not seen. The following description based on Chodat and Vischer (1917) who did not see flowers at anthesis. Flowers solitary, axillary or terminal, enclosed before anthesis between the leaf sheaths. Tepals 3, acute, confined to one side of the flower, alternate with the stamens. Stamens 2; anther base sagittate. Ovaries oblong, indistinctly ribbed; stigmas linear. Capsules 2.5–3 mm long, 8 ribbed, each valve with 3 nonmarginal ribs (Fig. 3).

Additional comments: The type material lacks flowers and fruits. Plants occur in running waters, but not in cascades. This species does not possess an exterior layer of silica cells, but has collenchyma tissue around the central cylinder (Chodat and Vischer, 1917). The dubious specimens cited below are old plants represented by basal disks, dried stems, and remnants of capsules.

Distribution: Upper Paraná River basin in the area of Iguazú Falls (Fig. 1). Chodat and Vischer (1917) report their collection of this species as from Iguazú Falls, Paraguay. However, the Iguazú Falls occurs in the Iguazú River, which forms the political boundary between Argentina (Misiones) and Brazil (Paraná). As the photographs in their paper are clearly of the Iguazú Falls it is likely that they were in error in terms of the country from which the specimen was collected.

Dubious specimens. Argentina. Misiones: Dpto. Iguazú, Cataratas, Garganta del Diablo, 25 January 1922, *Parodi 4351* (BAA). Brasil. Paraná: Foz de Iguazú. 28 September 1967, *Fabris & Crisci 7146-C* (LP).

5.2. *Mourera* Aubl.

Perennial. Small to large herbs. Prostrate axes attached to the rocks. Stemless or with a short stem. Leaves distichous, cuneate, nerved, elliptical with fimbriate margins, or

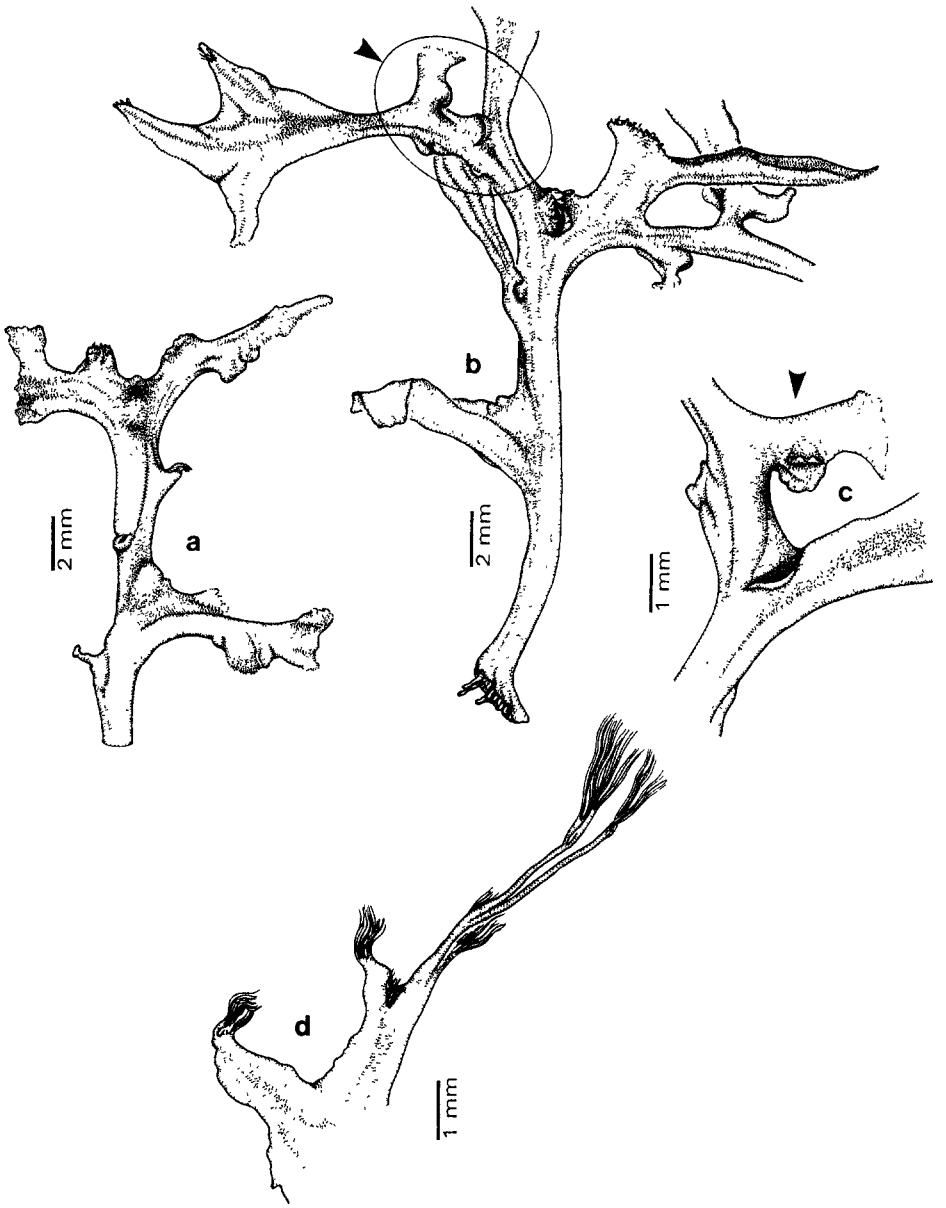

Fig. 3. *Apinagia yguazuensis* based on the type, *Chodat et Vischer 341* (G). (a) Stem showing the inclosed flower bud. (b) Sterile plant. (c) Detail of (b) (denoted by arrow and oval). (d) Detail of leaf

pinnately lobed or repeatedly forked, with the ultimate divisions filiform, sometimes the adaxial surface with many projecting papillae. Inflorescences 2-sided, spiciform monochasia, branched or unbranched. Flowers hermaphroditic, actinomorphic, 1 to many, alternating with decurrent bracts, each flower enclosed by a spathella. Juvenile

spathellae clavate, obtuse or acute, when mature infundibuliform, exceeding the bracts. Tepals 5–20, free, in a complete whorl. Stamens 5–35, in 1 or 2 whorls, or in an incomplete whorl, filaments free or united at the base, linear to subulate; anthers sagittate at the base, dehiscing introrsely, or when 2 whorls occur the inner whorl dehiscing extrorsely. Pollen in monads, ellipsoidal, 3-colpate. Ovaries 2-locular, ellipsoidal, attenuated at the base; stigmas 2, filiform, linear to spatulate, free or cohering at the base. Capsules 2-locular, ellipsoidal; valves 2, equal, 6–14 ribbed. Seeds numerous.

South American genus with six species. One species in Argentina.

1. *Mourera aspera* (Bong.) Tul., Ann. Sci. Nat. sér. 3, 11: 93. 1849. *Lacis aspera* Bong., Mem. Acad. Imp. St. Petersb., Ser. 6. t. 3, part 2, t. 1: 73, tab. 2. 1835. Type: Brazil, rio Tiéte, *Riedel 413* (LE). *Mourera pennicillata* Hicken, Revist. Chilena Hist. Nat. 21(6): 148. 1917. Type: Argentina, Misiones, Iguazú, Salto Iguazú, 7 April 1913, *Rodríguez 793* (hototype SI!, isotypes BA!, LIL!).

Prostrate axes 1–7 cm long, to 1.5 cm wide and to 1 cm high. Stems to 1 cm long. Leaves radical, 6–35 cm long, 3–17 cm wide, asymmetric at base; blade lanceolate to oval, margin pinnatilobed, lobes with filaments up to 10 mm long, adaxial surface with many outgrowths, rough textured and with grooves, abaxial surface with prominent nerves. Inflorescences 9–18 cm long. Flowers numerous. Spathellae 10 mm long. Tepals 5–10, subulate, 1–2.5 mm long. Stamens 6–10(14); filaments free, 4–7 mm long; anthers 1.5–2.5(3) mm long. Ovaries 2–5 mm long; stigmas linear to spatulate, 1.5–3 mm long. Capsules 4–7 mm long, 10–14 ribbed; pedicels to 3 cm long (Fig. 4).

Additional comments: The common name for this plant is 'lechuga de agua' (water lettuce). This species has only been collected four times in Argentina and only once in flower.

Distribution: Upper Paraná River basin (Fig. 1).

Specimens examined: ARGENTINA. Corrientes: Dpto. Ituzaingó, *Apipé Grande, 30 August 1944, *Umana 1* (LP). Misiones: Cataratas del Iguazú, 14 May 1951, *Cabrera et al. 189* (LP); Parque Nacional Iguazú, 21 February 1992, *Tur & Guaglianone 2036* (LP, SI). Brasil. Paraná: *Sete Quedas (Guaira), flor lilaz, 23 April, 1968, *Hatschbach & Guimaraes 19106* (LIL, NY); Municipio de Guaira, *around the Salto-Sete Queds, 290 Km Pedro Juan Caballero, 4 June 1981, *Y & T. Sano & T. Okuhara 62* (MO); *Sete Quedas, nas pedras dos saltos, flor rosada, 18 May, 1979, *Hatschbach 42235* (MU); rio Iguassú, 20 February 1949, *Schwarz 7554* (LIL). Minas Gerais: Nova Ponte, 18 October 1986, *Teixeira & Stehmann 94* (LP). Mato Grosso: Ituiutaba, Dorada, aquatica das Cachoeiras, flores lilazes, 16 June 1946, *Macedo 778* (MO).

5.3. Podostemum Michx.

Small to large herbs. Prostrate axes attached to the rocks. Stems simple, branched or absent, opposite or subopposite, arising laterally along the flanks of the photosynthetic prostrate axes. Leaves distichous, repeatedly forked or simple; stipules intrapetiolar, adnate, entire or forked. Flowers hermaphroditic, zygomorphic, axillary or terminal, solitary, enclosed by a spathella. Spathellae splitting irregularly from the top. Juvenile spathellae clavate, umbonate, when mature tubuliform to campanuliform. Tepals 3, free,

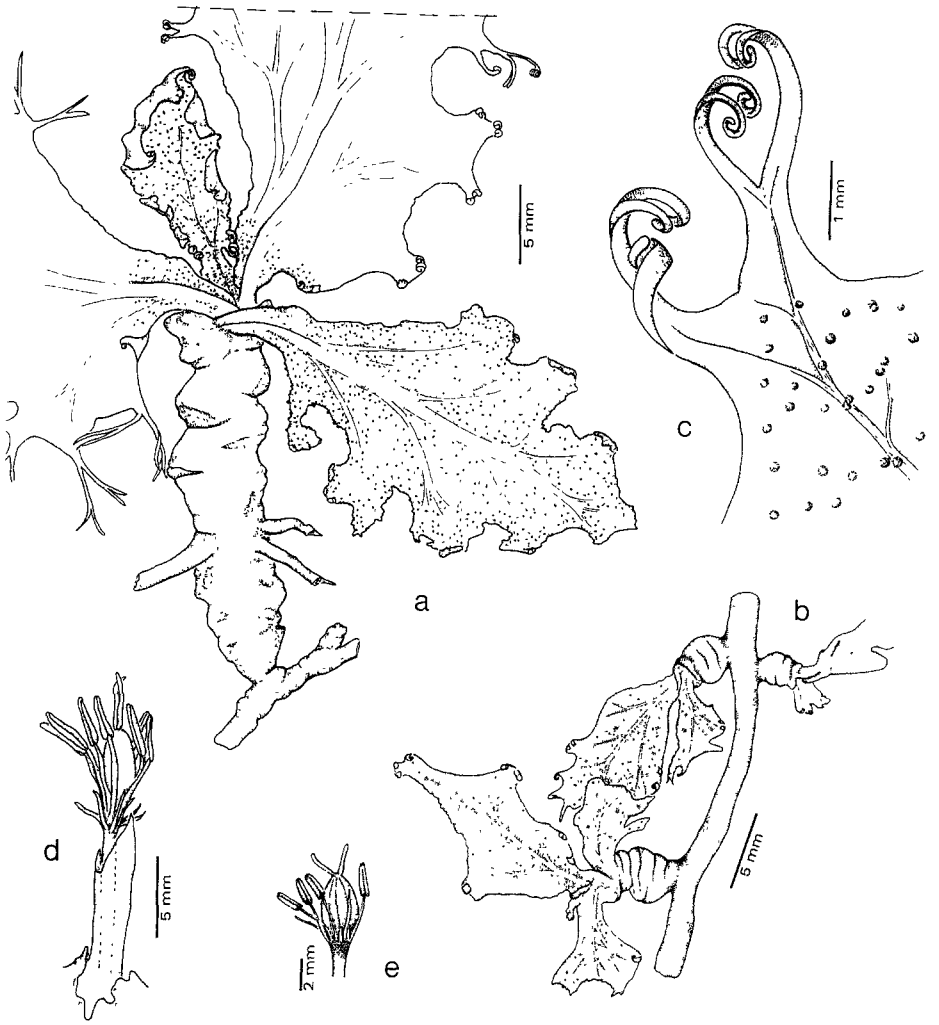

Fig. 4. *Mourera aspera*. (a–c) Based on lost material from Corrientes, Salto Apipe. (a and b) Sterile plants. (c) Detail of margin of young leaf. (d–e) Flowers, based on *Umana 1* (LP).

one on each side of the andropodium and a third (sometimes absent) in the fork between the 2 filaments. Stamens 2, borne on an andropodium, filaments linear, subulate or lanceolate; anthers sagittate at the base, dehiscing introrsely. Pollen in dyads. Ovaries 2–locular, ellipsoid to ovoid or subglobose; stigmas 2, free, filiform, pyramidal or conical. Capsules 2-locular; with 2 subequal valves, the smaller valve caducous, 6–8 ribbed. Seeds numerous.

Additional comments: The systematics of species of *Podostemum* in Argentina is complicated. Species are highly polymorphic. Protologs for many species are based on

incomplete material. Collections of many species are scarce. Additional collections are needed for a proper revision of the genus.

Podostemum is composed of about 18 species in America, India and Ceylon, the majority in South America. In Argentina nine species are described.

5.3.1. Key to species of Podostemum

(1A) Base of the leaves wide, flattened, rigid; blades entire or forked, caducous. Stipules inserted at one side of the leaf base, crest-like.

(2A) Base of the leaves 4–10 mm long; blades few times forked, up to 100 mm long. 9. *P. uruguayense*

(2B) Base of the leaves 1–4 mm long; blades entire, spatulate to linear up to 25 mm long. 4. *P. müulleri*

(1B) Base of the leaves terete; blades forked, persistent. Stipules amplexicaule or subamplexicaul, concave, boat-shaped.

(3A) Leaves at the apex of the stem with stipules divided into 2–3 subulate lobes.

(4A) Stipules with 2 subulate lobes on sterile plants, triangular on fertile ones. Ultimate divisions of the leaves filiform. 1. *P. aguirense*

(4B) Stipules with 2–3 subulate lobes on sterile plants, on fertile plants not known. Ultimate divisions of the leaves subulate. 2. *P. atrichum*

(3B) Leaves at the apex of the stem with stipules entire or with 2 triangular lobes.

(5A) Ultimate divisions of the leaves filiform. 3. *P. comatum*

(5B) Ultimate divisions of the leaves widened.

(6A) Leaves up to 10 mm long.

(7A) Ultimate divisions obovate to rhomboid. 6. *P. rutifolium*

(7B) Ultimate divisions lanceolate. 5. *P. ostenianum*

(6B) Leaves more than 10 mm long.

(8A) Leaves repeatedly forked, ultimate division lanceolate to linear. 7. *P. schenckii*

(8B) Leaves few times forked, ultimate division abruptly spatulate. 8. *P. undulatum*

1. *Podostemum aguirense* Chodat et Vischer, Bull. Soc. Bot. Genève, Ser. 2: 240, Fig. 195-196. 1917. Type: Paraguay, Alto Paraná, 'Iguazu', October 1914, *Chodat et Vischer 338* (holotype G!, phototype LP! ex G).

P. warmingii Chodat et Vischer, Bull. Soc. Bot. Genève, Ser. 2: 240, Fig. 176–180, 183, 188–192, 194. 1917. Type: Paraguay, Alto Paraná, 'Ad rupes inundatas in Salto Grande Yguazu ad confines Argentinae. Oct. 914'. *Chodat et Vischer 339* (holotype G!, phototype LP! ex G).

Herbs 0.1–8 cm high. Prostrate axes up to 2 mm wide. Stems simple or branched. Leaves 2–30 mm long, repeatedly forked; ultimate divisions filiform, 1–3 mm long; stipules on leaves of fertile stems coriaceous, with 2 short triangular lobes, to 0.5 mm long; stipules on leaves of sterile stems membranous, with 2(3) subulate lobes, 0.5–2 mm long. Flowers axillary. Spathellae coriaceous, 2–2.5 mm long. Tepals subulate, 1.5 mm long. Andropodia 1.5 mm long. Filaments 1 mm long; anthers 1 mm long. Ovaries 2 mm long; stigmas acute, 0.5–1 mm long. Capsules 2 mm long; each valve 5-ribbed; pedicels 2–5 mm long (Fig. 5).

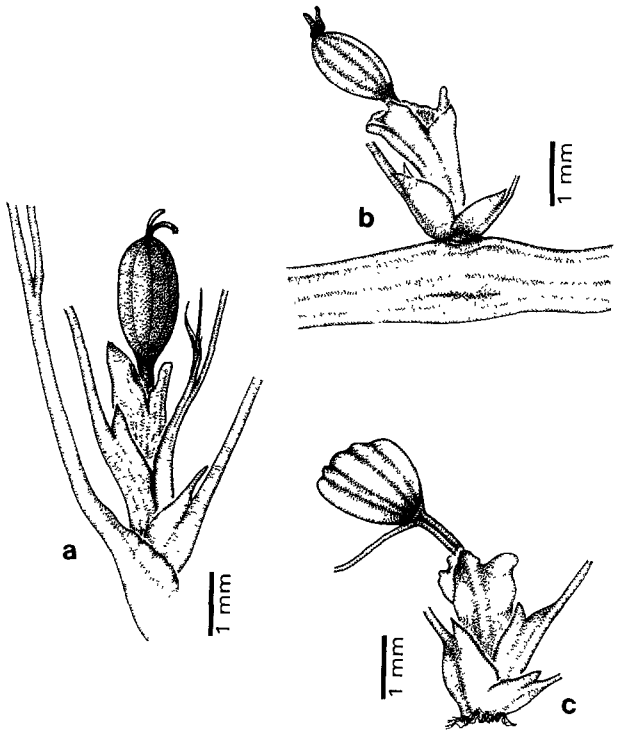

Fig. 5. *Podostemum aguirense*. (a) Fertile plant, based on the type, *Chodat et Vischer 338* (G); (b and c) Fertile plants, based on *Chodat et Vischer 339*, type of *P. warmingii* (G).

Additional comments: Tall sterile plants of *P. aguirense* have stipules similar to *P. atrichum*.

Distribution: Upper Paraná River basin in the area of Iguazú Falls (Fig. 2).

Specimens examined: ARGENTINA. Misiones: Dpto. Iguazú, Parque Nacional Iguazú, November 1948, *Meyer 17036* (LIL); Cataratas del Iguazú, 13 May 1951, *Cabrera et al. 88* (LP); ibid. 27 August 1969, *Tur 1869* (LP, STL in alcohol); ibid., Salto Bozzetti, 20 February 1970, *Tur 1316* (LP, SI, STL in alcohol); Parque Nacional Iguazú, Cataratas, Salto Dos Hermanas, 21 February 1992, *Tur & Guaglianone 2027* (LP, SI); Iguazú, 9 and 10 September 1915, *Osten & Rojas 8165, 8166* (BAF); Cataratas Iguazú, Puerto Aguirre, Cascada Bozzetti, 24 January 1922, *Parodi 4389* (BAA). BRASIL. Paraná: Cataratas del Iguazú, 28 September 1967, *Tur 1020, 1022* (STL); ibid., 27 September 1967, *Boelcke 13429* (BAA); ibid., 27 September 1967, *Fabris & Crisci 7146 B* (LP).

2. *Podostemum atrichum* Chodat et Vischer, Bull. Soc. Bot. Genève. Ser. 2: 241, Figs. 169–172, 181, 182, 187. 1917. Type: Paraguay, 'Paraguay, au dessous de la chube, dans l'eau tranquille, Yague,' *Chodat et Vischer 337* (holotype G!, phototype LP! ex G).

Herbs 0.1–4 cm high. Prostrate axes 1–3 mm wide. Stems simple. Leaves 3–30 mm long, repeatedly forked; ultimate divisions subulate, 1–1.5 mm long; stipules membranous, subamplexicaulous, to 3 mm long, with 2–3 subulate lobes, 1–1.5 mm long. Flowers and fruits not known (Fig. 6).

Additional comments: This species differs from *P. aguirense* by the narrowly subulate ultimate divisions of the leaves and the 3-divided stipules on the apical region of the stem.

Distribution: Upper Paraná River basin (Fig. 2).

Specimens examined: Argentina. Misiones: Dpto. Libertador General San Martín, Salto Encantado, arroyo Cuñapirú, 16 February 1992, *Tur & Guaglianone 1953* (LP, SI).

3. *Podostemum comatum* Hicken, Revista Chilena Hist. Nat. 21(6): 149. 1917. Type: Argentina, Misiones, Dpto. Iguazú, Salto Iguazú, 6 April 1913, *Rodríguez 791* (holotype SI!, isotype BA!).

Herbs, 6–50 cm high. Prostrate axes 1–2 mm wide. Stems simple. Sterile and fertile stems of different size. Sterile stems pendulous, furrowed, twisted, to 50 cm long; internodes 5–20 mm long. Leaves on sterile stems 50–80 mm long, repeatedly forked; ultimate divisions filiform, 2–3 mm long; petioles 5–20 mm long; stipules subamplexicaulous, membranous, 2–4 mm long, with 2 acute lobes. Fertile stems erect, 0.5–60 mm long, internodes short, crowded. Leaves 15–25 mm long, repeatedly forked (shortest stems leafless); ultimate divisions filiform, 1–2 mm long; petioles 2–5 mm long, stipules subamplexicaulous, coriaceous, 1.5 mm long, with 2(3) acute lobes. Flowers axillary. Spathallae umbonate, 2–3 mm long. Tepals subulate, 1 mm long. Andropodia 2 mm long. Filaments 1 mm long; anthers 1 mm long. Ovaries 1.5 mm long; stigmas 1 mm long. Capsules 2 mm long; each valve with 5 narrow ribs; pedicels 1.5–2 mm long (Fig. 7).

Additional comments: The ultimate divisions of the leaves of this species are often curled. Sometimes on the sterile branches the leaves arise only from one side of the stem because the stems are twisted. In *Schwarz 7553* there are branches with flowers at the base.

Distribution: Upper Paraná River basin in the area of Iguazú Falls (Fig. 2).

Specimens examined: Argentina. Misiones: Cataratas del Iguazú, 23 February 1952, *Capurro 1077* (BA); ibid. 12 May 1951, *Cabrera et al. 58* (CTES, LP); ibid., Salto San Martín, 20 September 1968, *Tur 1140* (LP, SI). Brasil. Paraná: rio Iguassú, 20 February 1949, *Schwarz 7553* (LIL).

4. *Podostemum mülleri* Warm., Kgl. Danske, Vidensk.-Selk, Skr., 6. Raekke 4 (8): 480, tab. XVI and XVII, Fig. 1–15. 1888. Type: Brazil, Santa Catarina, rio Itajahy, *Müller s.n.* (holotype B, isotype C!).

Small herbs. Prostrate axes 1–2 mm wide. Stems erect, 3.5 cm high, dorsiventral. Leaves with rigid base, ovate to elliptic, obliquely inserted, decurrent, 1–4 mm long, 1–2.5 mm wide, blade 8–25 mm long, entire, linear, apex spatulate; stipules triangular to trapezoid, acute. Flowers axillary. Spathellae umbonate, coriaceous, 3–3.5 mm long.

Fig. 6. *Podostemum atrichum*. Sterile plants. Based on the type, *Chodat et Vischer 337* (G). (a and b) General views. (c) Detail of apex of the plant and stipules.

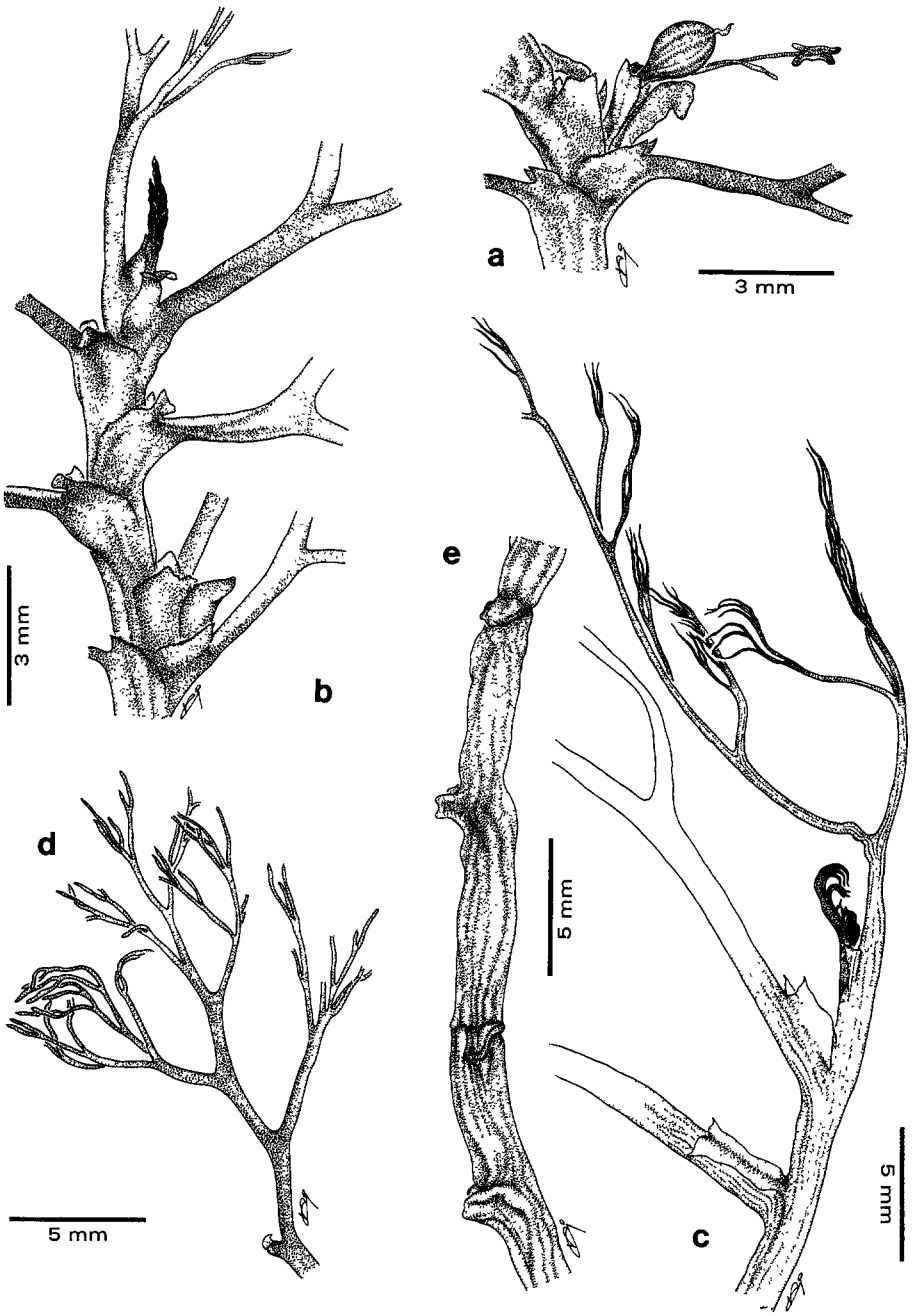

Fig. 7. *Podostemum comatum*. Sterile and fertile plants. Based on the type, *Rodríguez 791* (BA). (a) Dried specimen of fertile plant showing location of flower. (b–e) Moistened specimens. (b) Sterile stem. (c) Sterile 'twisted' stem showing stipules and leaf orientation along one side. (d) Leaf of fertile plant. (e) View of old stem on which leaves have dropped.

Tepals linear, acute, 1.5–2 mm long, the one between the filaments shorter or absent. Andropodia 1–2 mm long. Filaments 0.5–1 mm long; anthers 0.75–1.5 mm long. Ovaries ellipsoid, to 2 mm long; stigmas 0.5–1 mm long. Capsules 1.5–2.5 mm long; each valve 5 ribbed; pedicels 2–4 mm long (Fig. 83(a–h) and Fig. 9).

Additional comments: Normally the leaf blades are lost when pressed and mounted on herbarium sheets. Although Tur (1987) determined Argentinean specimens as *P. galvone*, subsequent study of the type materials indicates the species is *P. mülleri*. *Podostemum mülleri* has longer and wider leaf bases than *P. galvone*.

Distribution: The specimens collected in Argentina are from tributaries of the upper Paraná River (Fig. 2).

Specimens examined: ARGENTINA. Misiones: Dpto. Cainguás, Salto Las Golondrinas, 18 October 1975, *Zuloaga & Deginani 561* (LP); Aristóbulo del Valle, balneario del arroyo Cuñapirú, 15 February 1992, *Tur & Guaglianone 1948* (LP, SI). Dpto. El Dorado, arroyo Aguaray Miní, 20 February 1970, *Tur 1309* (LP, SI, STL); ibid. *Tur 1310* (SI, STL); arroyo Piray Guazú, 21 February 1970, *Tur 1317*, 1318a (LP, SI, STL in alcohol); arroyo Aguaray Guazú, 20 February 1970, *Tur 1313* (LP, SI, STL in alcohol); río Piray Guazú, 10 December 1943, *Burkart 14655* (SI) arroyo Piray Miní, 27 August 1969, *Margalef s.n.* (STL in alcohol). Dpto. Iguazú, *Salto grande del arroyo Uruguaí, 27 January 1983, *Guaglianone et al. 1058* (LP, SI); *arroyo Uruguaí, puente camino viejo, 26 January 1983, *Guaglianone et al. 998* (LP, SI); *arroyo Uruguaí, 19 September 1968, *Tur 1133* (LP, SI, STL in alcohol); ibid. 20 February 1970, *Tur 1308* (SI, STL). Dpto. Libertador General San Martín, Salto Encantado, arroyo Cuñapirú, 16 February 1992, *Tur & Guaglianone 1959* (LP, SI); arroyo Paranay Guazú, 19 September 1968, *Tur 1134* (LP, SI, STL in alcohol). Dpto. San Ignacio, Salto del Tabay, 14 October 1977, *Cabrera et al. 28795* (SI); arroyo Tabay 19 February 1970, *Tur 1305* (LP, STL); ibid., 18 September 1968, *Tur s.n.* (STL in alcohol); ibid., 23 February 1992, *Tur & Guaglianone 2046* (LP, SI). BRASIL. Santa Catarina: Blumenau, rio García, *Schwacke 5012* (C); rio Itajahy, *Schwacke 5010, 5055 (C)*; arriba de Blumenau, Salto rio Itajahy, September 1886, *Schenck 330, 331, 332* (C); Itajahy, Blumenau, August 1888, *Ule 862* (CORD).

5. *Podostemum ostenianum* Warm., Kgl. Danske Vidensk.-Selsk, Skr., 6. Raekke 9 (2): 127, Fig. 23. 1899. Type: Uruguay, *Salto, Salto Grande, río Uruguay, 15 December 1892, *Osten 2903* (holotype, C!, isotype MVM!).

Herbs, to 1 cm high. Prostrate axes 1–1.5 mm wide. Stems simple. Leaves 2–4 times forked, to 7 mm long; ultimate divisions lanceolate, apex acute; stipules 1 mm long, with 2 acute lateral lobes. Flowers axillary. Spathellae 2.5–3 mm long. Tepals linear, acute, half as long as the ovary. Andropodia 2–4 mm long. Filaments up to 1 mm long; anthers 1 mm long. Ovaries to 2 mm long; stigmas acute. Capsules 2–2.5 mm long; each valve 5 ribbed; pedicels 5 mm long (Fig. 10a and b).

Additional comments: Specimens from Salto Grande, Uruguay River, were determinated by Warming (1899) as *P. ostenianum* and *P. schenckii*, and by Van Royen (1954) as *P. galvone, P. ostenianum, P. schenckii, P. rutifolium* and *P. undulatum*. In some regions of the Uruguay River basin short plants occur with leaves that are few times

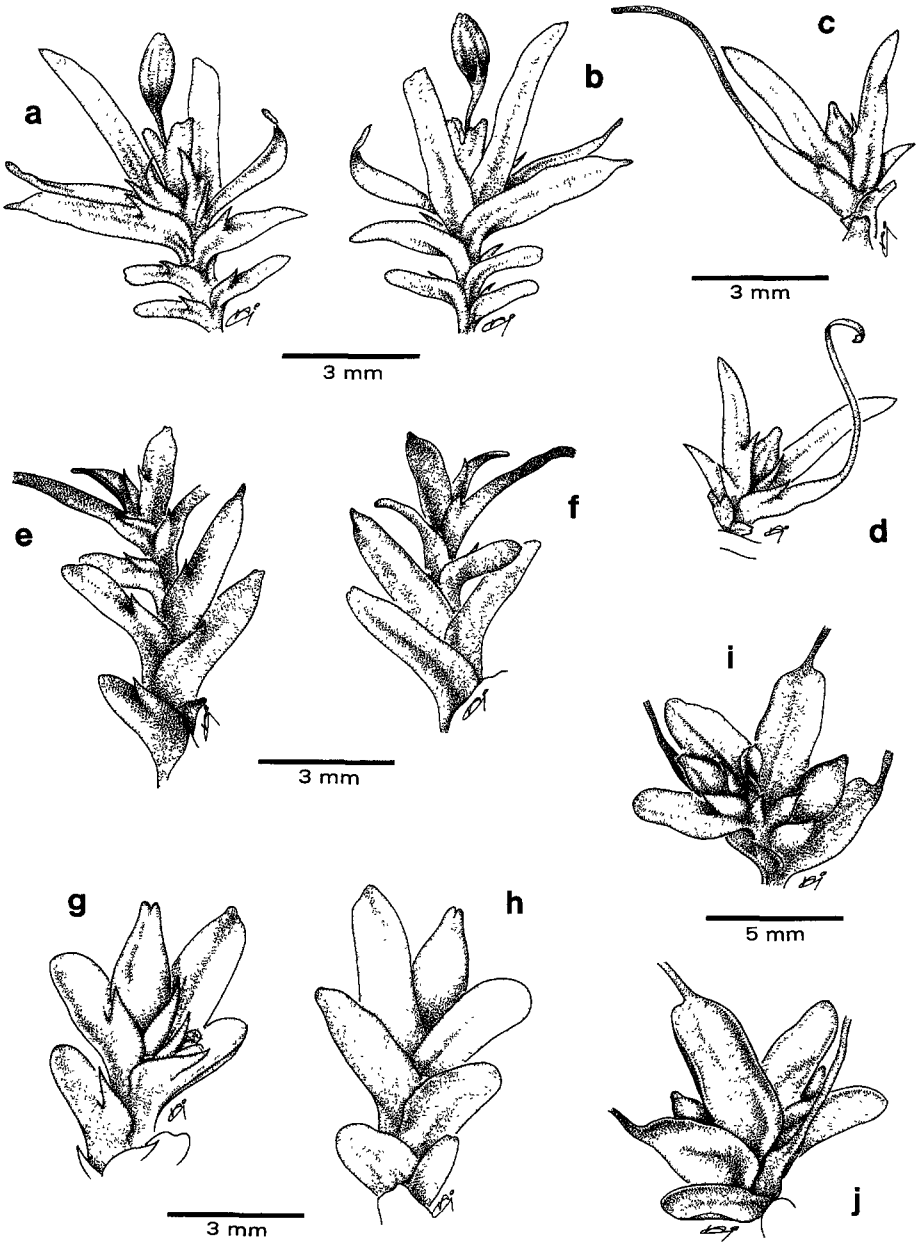

Fig. 8. *Podostemum mülleri* and *P. uruguayense*. (a–d) *P. mülleri*, based on the isotype, *Muller s.n.* (C). (a and c) Ventral view of stem. (b and d) Dorsal view of stem. (e and f) Based on *Tur 1317* (LP). (e) Ventral view of stem. (f) Dorsal view of stem. (g and h) Based on *Tur 1133* (LP). (g) Ventral view of stem. (h) Dorsal view of stem. (i and j) *P. uruguayense*. Based on the isotype, *Osten 2904* (SI). (i) Ventral view of stem. (j) Dorsal view of stem.

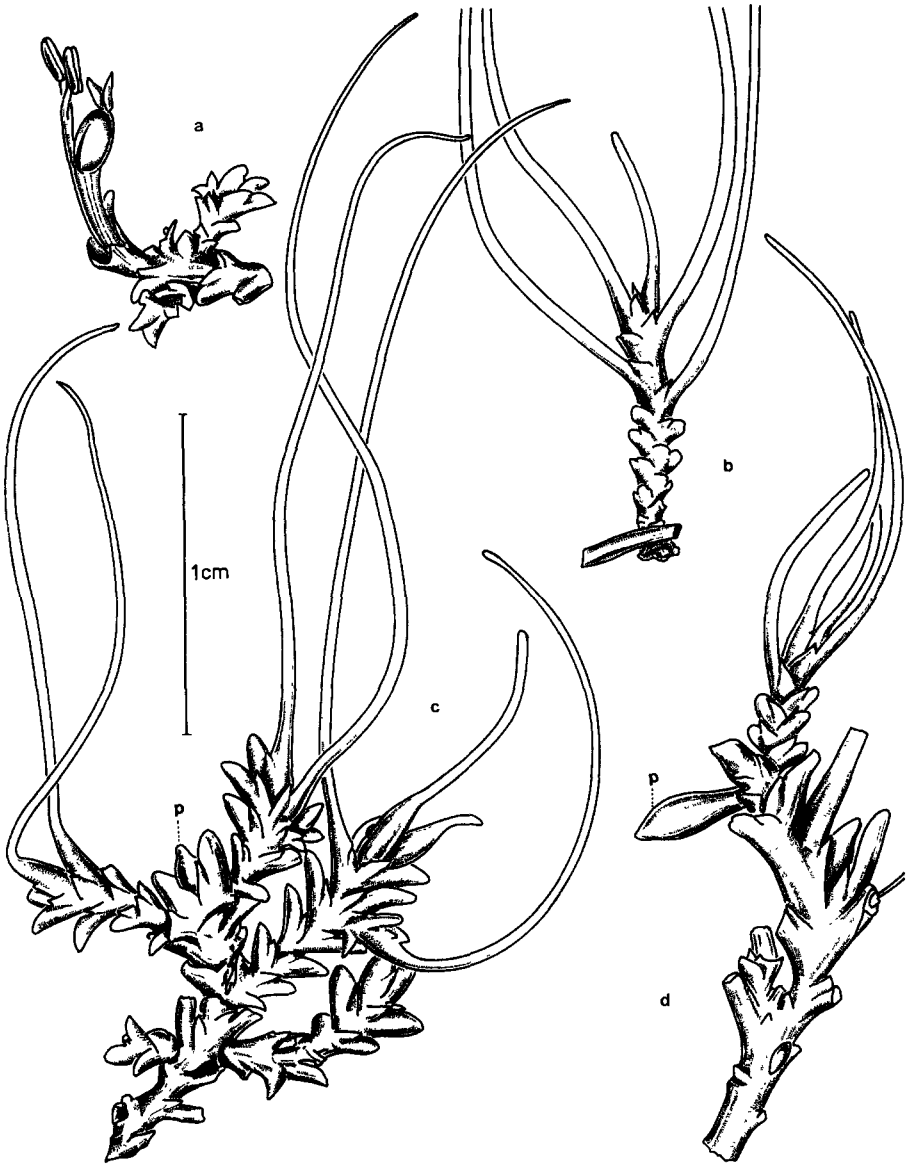

Fig. 9. *Podostemum mülleri*. (a and b) Based on *Tur 1309* (STL). (a) Fertile plant showing the flower. (b) Sterile plant. (c and d) Fertile plants showing flowers enclosed in the spathella (p), based on *Tur 1305* (STL). (From Tur, 1987).

forked and with wide ultimate divisions, while close by in deeper water, large plants occur that have longer leaves that are many times forked and with lanceolate ultimate divisions. These species may represent environmental forms of a single species. This problem needs additional study.

Distribution: In the Uruguay River basin (Fig. 2). Although only definitively known from the Uruguay side of the Uruguay River (cf., *Osten 2903*) this species predictably also occurs on the Argentina side of the river, and is thus included in this treatment.

Dubious material: ARGENTINA. Entre Ríos: Dpto. Concordia, *Salto Grande, 3 November 1921, *Parodi 3961* (BAA); ibid. 10 February 1967, *Tur 953*, (LP, SI, STL) (Fig. 10a–b).

6. *Podostemum rutifolium* Warm., Kgl. Danske Vidensk.-Selsk, Skr., 6. Raekke 9 (2): 129, Fig. 25. 1899. Type: Brazil, Santa Catarina, río Itajahy, *Schwacke 5053* (holotype C!).

Herbs, (0.5)1–4(7) cm high. Prostrate axes 1–1.5 mm wide. Stems compressed, (sometimes the lower part cylindrical), simple or few branched. Leaves (2)3–10(15) mm long, 2–3(5) times forked; ultimate divisions obovate to rhomboid, obtuse to subacute, 1–2(4) mm long, 0.5–1 mm wide; petioles 0.5–5(7) mm long; stipules amplexicaulous, coriaceous, concave, entire or with 2 short acute lobes. Flowers terminal, rarely axillary. Spathellae coriaceous, 2–3 mm long. Tepals linear, acute, 1 mm long. Andropodia 2–4 mm long. Filaments 1 mm long; anthers 1 mm long. Ovaries to 2 mm long; stigmas to 1 mm long. Capsules 2–2.5 mm long, each valve 5 ribbed; pedicels 3–5 mm long (Fig. 11).

Additional comments: The material of *Schinini 16249* is questionably *P. rutifolium*. Schinini's specimens are sterile plants with longer leaves that have lanceolate ultimate divisions, but they have truncated stem apices as in *P. rutifolium*.

Distribution: In the upper Paraná River basin (Fig. 2).

Specimens examined: ARGENTINA. Misiones: Dpto. Iguazú, *arroyo Uruguay, 26 January 1983, *Guaglianone et al. 997, 999* (LP, SI); ibid. 20 February 1970, *Tur 1307* (LP, SI); Parque Nacional Iguazú, Salto 2 Hermanas, 21 February 1992, *Tur & Guaglianone 2025* (LP, SI); ibid., río Iguazú, al S Puerto Canoas, 21 February 1992, *Tur & Guaglianone 2029* (LP, SI); ibid., R 101, arroyo Yacuy Grande, 22 February 1992, *Tur & Guaglianone 2043* (LP, SI); arroyo Aguaray Guazú, 20 February 1970, *Tur 1314* (LP, SI, STL in alcohol); arroyo Aguaray Miní, 20 February 1979, *Tur 1311* (SI, STL); Dpto. Libertador General San Martín, arroyo Paranay Guazú, 19 September 1968, *Tur s.n.* (STL in alcohol); Dpto. San Ignacio, Salto del Tabay, 14 October 1977, *Cabrera et al. 28796* (SI); ibid. 18 September 1968, *Tur s.n.* (STL in alcohol); ibid., 19 February 1970, *Tur s.n.* (STL in alcohol). BRASIL. Paraná: rio Iguassú, 20 February 1949, *Schwarz 7555* (LIL).

Dubious material: ARGENTINA. Misiones: Dpto Iguazú, cataratas del Iguazú, entre rocas en un curso rápido de agua, 23 January 1979, *Schinini 16249* (CTES, LP).

7. *Podostemum schenckii* Warm., Kgl. Danske Vidensk.-Selsk, Skr., 6 Raekke 4 (8): 480, Tab. 18-19, Fig. 1-4. 1888; idem, 9 (2): 128. 1899. Type: Brazil, Santa Catarina, Itajahy, Blumenau, 20 September 1886, *Schenck 328* (holotype C!).

Herbs (0.5)3–6 cm high. Prostrate axes 1–2 mm wide. Stems simple or branched. Leaves 3–30 mm long, repeatedly forked; ultimate divisions lanceolate to linear, 1–3 mm long, 0.3–0.5 mm wide; stipules subamplexicaulous, decurrent, to 2 mm long,

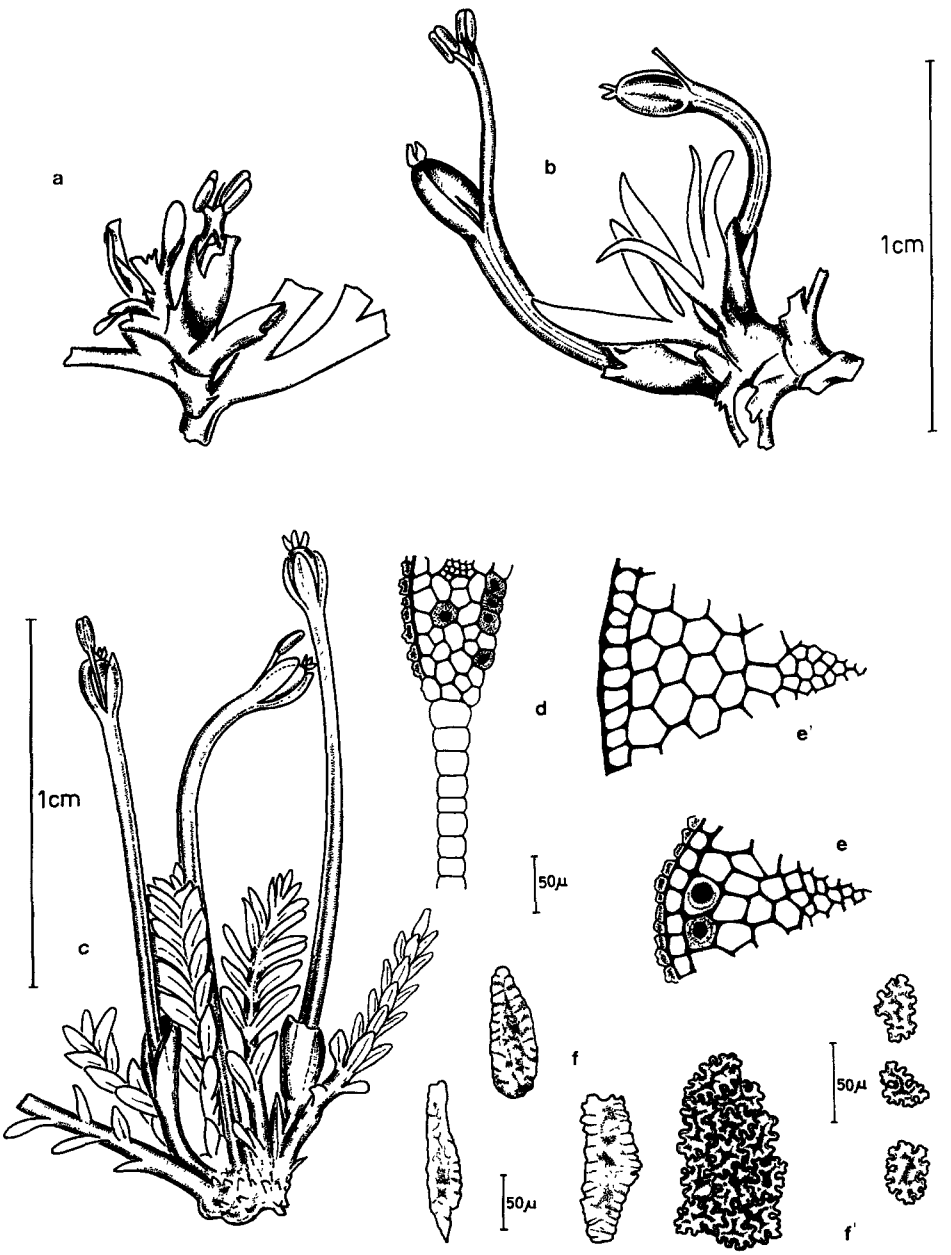

Fig. 10. *Podostemum ostenianum* and *Tristicha trifaria*: (a and b) Fertile plants of *P. ostenianum*, based on *Tur 953* (STL). (c–f′) *T. trifaria*, based on *Tur 1756* (STL). (c) Plant with flowers. (d) Tranverse section of leaf. (e–e′) Transverse section of an old (e) and young (e′) stems. (f) Three separate silica cells. (f′) A group of 12 silica cells (left) and three separate silica cells (right). (From Tur, 1987).

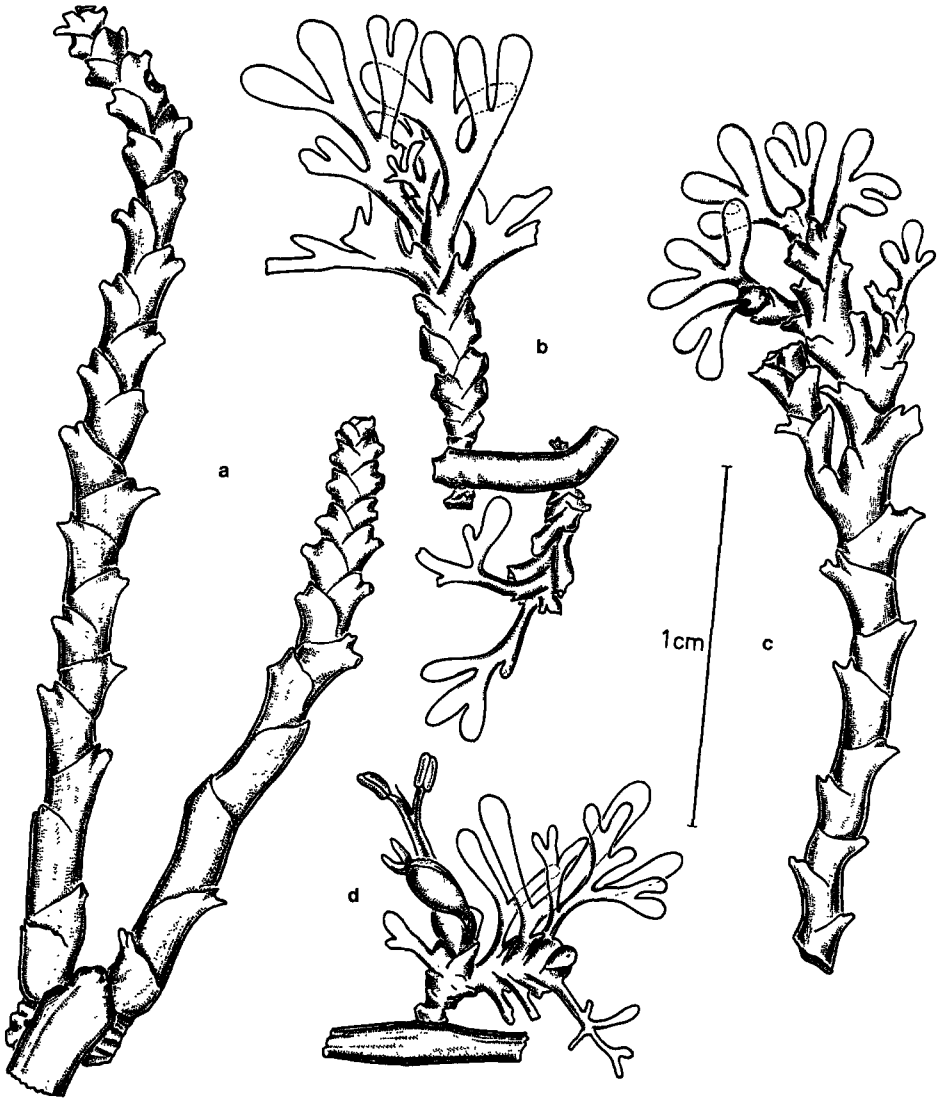

Fig. 11. *Podostemum rutifolium.* Based on material in alcohol. (a) Sterile plant without leaves, based on *Tur 1314* (STL). (b and c) Sterile plants with leaves, based on Paranay Guazú, *Tur s.n.* (STL). (d) Fertile plant, based on *Tur 1314* (STL). (From Tur, 1987).

entire or divided into 2 triangular lobes; petiole 1–7 mm long. Flowers axillary, or terminal on the upper part of the stem. Spathellae 2–3 mm long. Tepals 1 mm long. Andropodia 2 mm long. Filaments 1 mm long; anthers 1 mm long. Ovaries 1.5 mm long; stigmas acute, 0.5 mm long. Capsules 1.75 mm long; each valve 5 ribbed; pedicels to 4 mm long (Fig. 12).

Additional comments: The type material has filiform ultimate leaf divisions. The wide ultimate divisions of the leaves noted in the description here differs from the original description. The present description is based on material collected (during 1892) by Osten in the Uruguay River that was determinated and cited by Warming (1899) as P. *schenckii* (see additional comments of *P. ostenianum*).

Distribution: In the Uruguay River basin (Fig. 2).

Specimens examined: ARGENTINA. Corrientes: Dpto. Monte Caseros, La Cachuera, en el río Uruguay, 12 January 1953, *Nicora 6318* (SI). URUGUAY. Salto: * Salto Grande, 18 April 1905, *Berro 3228* (C); ibid., 15 December 1892, *Osten 2905* pro parte (MVM). Soriano: río Negro, 19 February 1906, *Berro s.n.* (MVM); ibid., March 1906, *Berro 3* (C, MVM); Barra de Vera, 16 February 1906, *Berro 5161 (C)*.

8. *Podostemum undulatum* P. Royen var. *undulatum*, Acta Bot. Neerl. 3 (2): 259, pl. 2, Fig. 20. 1954. Type: Brazil, Santa Catarina, rio Itayahy, near Blumenau, *Ule 804* (holotype P).

Herbs, 2–5 cm high. Prostrate axes 1 mm wide. Stems few times branched, internodes 1–10 mm long. Leaves 15–90 mm long, few times forked; ultimate divisions spatulate, subacuminate, membranous, 3–10(–12) mm long, 0.2–1 mm wide; petioles subterete, 1–30 mm long; stipules concave, subamplexicaulous, 1–2 mm long, entire or with 2 short lobes, 0.2–0.5(–0.8) mm long. Flowers not seen. The following description is from Van Royen (1954). Flowers 'few, terminal, tepals 3, filiform, 1 mm long. Andropodium membranaceus, 0.5 mm, filaments 0.5 mm long; anthers with unequal thecae, 1 mm long, top obtuse or emarginate. Ovary ellipsoid 0.5 mm × 0.5 mm, with 8 ribs, styles filiform?, cohering at the base. Fruit unknown' (Figs. 13 and 14).

Additional comments: It is probable that the material from the Uruguay River basin is another taxon (see additional comments of *P. ostenianum*).

Distribution: In the Paraná and Uruguay River basins (Fig. 2). This species is known from collections made on the Uruguay side of the Uruguay River (cf., *Herter 1708*) and likely also occurs on the Argentina side of the river, and is thus included in this treatment.

Specimens examined: PARAGUAY. Concepción: N. Paraguay, entre río Apa y río Aquidaban, Caballero-cué, verde oscuro, firmemente adherida sobre las piedras del fondo del río, 10 February 1908/09, *Fiebrig 4990* (G, L). URUGUAY. Salto: Salto Chico, 30 November 1934, *Herter 1708* (CTES, SI).

Dubious specimens: ARGENTINA. Entre Ríos: Dpto. Concordia, * Salto Grande, 10 February 1967, *Tur 955* (LP, SI). Brasil. Rio Grande do Sul: Parque Forestal do Turvo, Tenente Portela, hidrófito submerso no rio Uruguai, próximo ao Salto Yacumâ, 10 July 1980, *Waechter 1654* (CTES, ICN). URUGUAY. Salto: a la altura de Salto Chico. 24 January 1989, *Tur et al. 1885* (LP).

9. *Podostemum uruguayense* Warm., Vidensk.-Selsk., Skr., 6 Raekke 9 (2): 133, Fig. 29–30. 1899. Type: Uruguay, Salto, * Salto Grande, 15 December 1892, *Osten 2904* (holotype C!, isotype SI!).

Herbs. Prostrate axes to 3 mm wide. Stems erect, dorsiventral, branched, to 5 cm high. Leaves oblong to elliptic, obliquely inserted, decurrent, often keeled on the upper

Fig. 12. *Podostemum schenckii*. (a and b) Based on *Berro 3* (MVM). (a) Fertile plant with flower enclosed in a spathella at apex of stem. (b) Sterile plant. (c) Fertile plant with dehisced capsule, based on *Osten 2905* (MVM). (d and e) Based on *Berro 3* (MVM). (d) Fertile plant with flower enclosed in the spathella on the stem projecting to the upper right. (e) Prostrate axis with the base of two shoots. (From Tur, 1987).

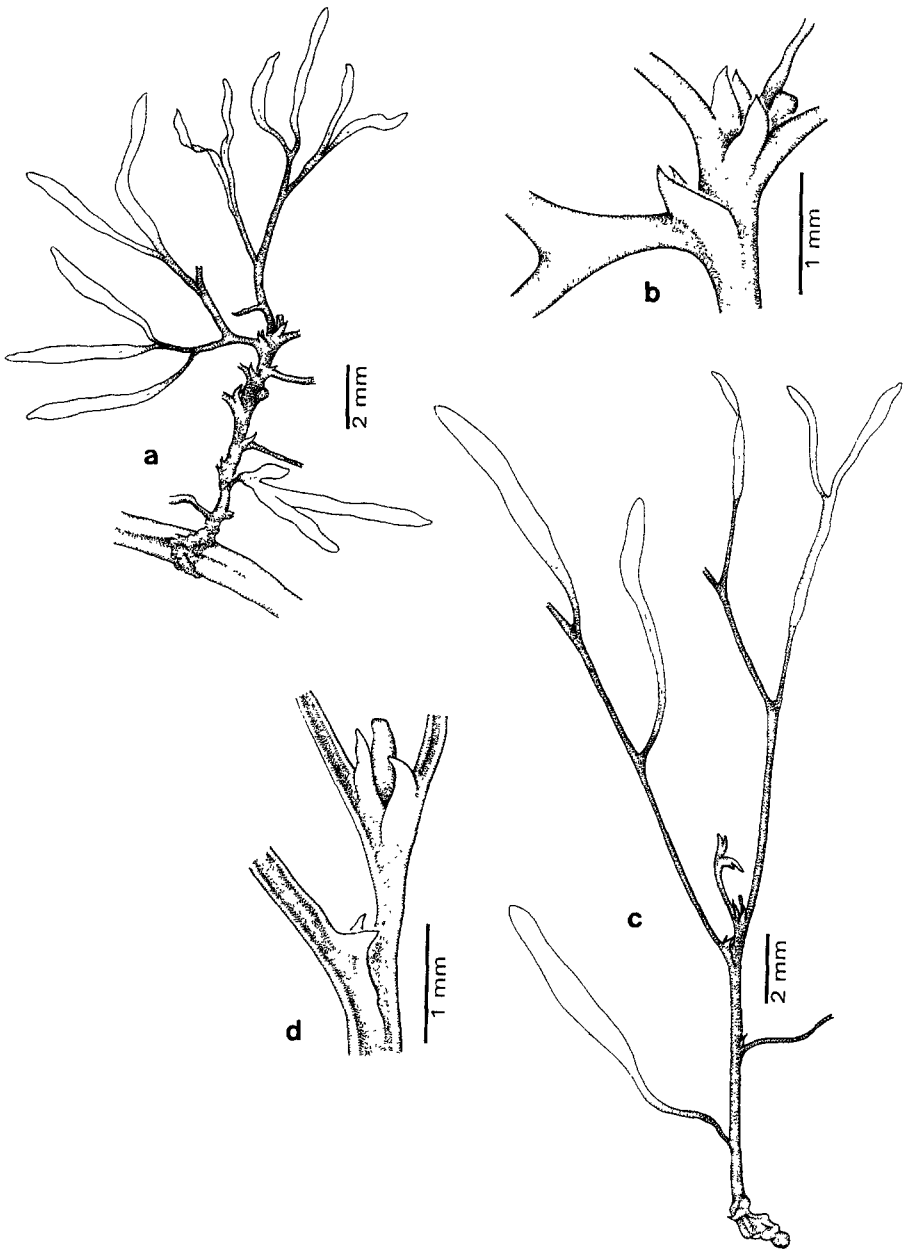

Fig. 13. *Podostemum undulatum*. (a–d) Based on *Fiebrig 4990* (g) (a and c) Sterile plants (b and d) Detail of stipules.

surface, to 10 mm long, (1)2–3 mm wide; blade few times forked or rarely entire, base rigid, apex linear or subterete, to 100 mm long, ultimate divisions membranous (5) 10–15 mm long; stipules adaxial, irregularly quadrangular to ovate, 2 mm long, 1 mm

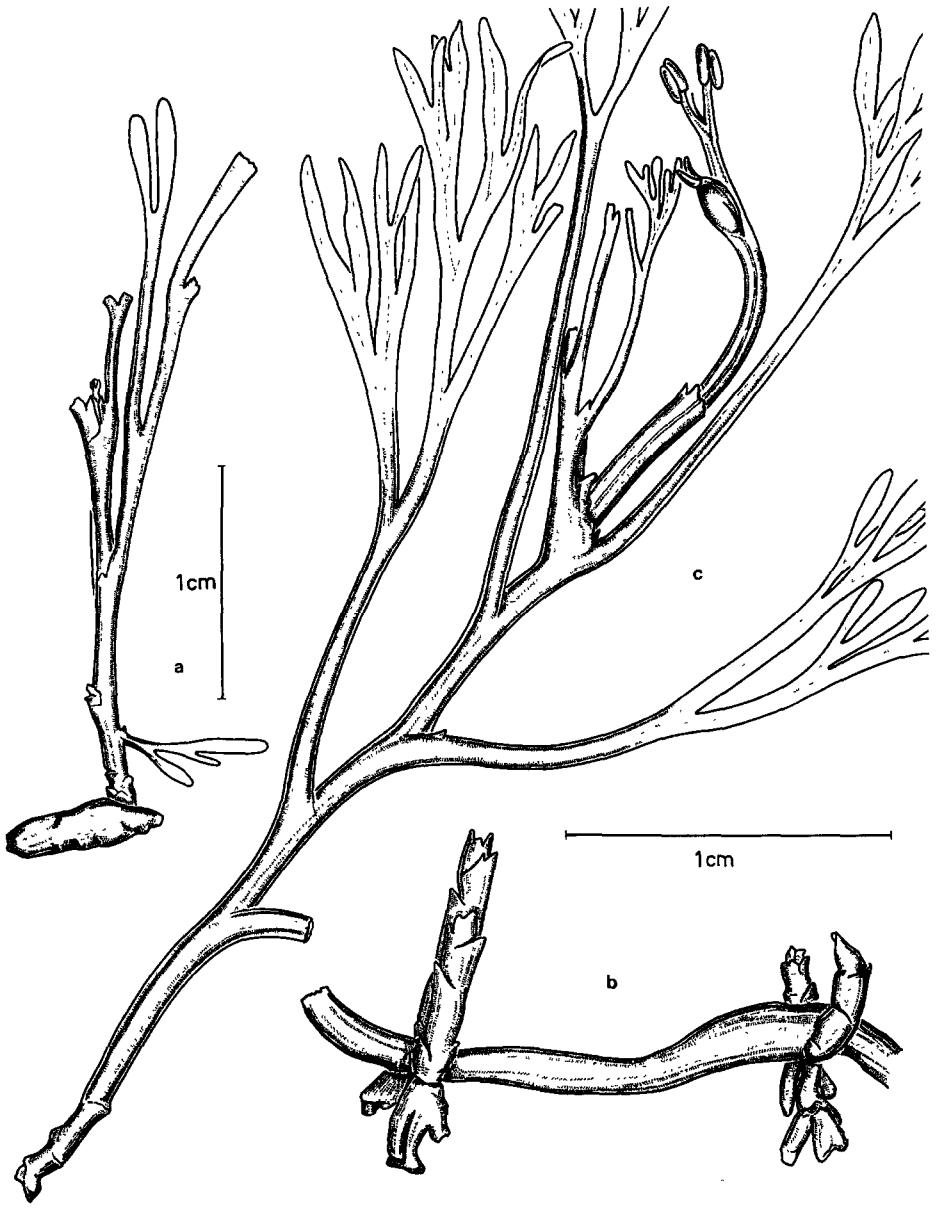

Fig. 14. *Podostemum undulatum.* (a) Sterile plant, based on *Herter 1708* (SI). (b and c) Based on *Tur 955* (STL). (b) Young stems projecting from a prostrate axis. (c) Fertile plant with flower near apex. (From Tur, 1987).

wide, apex acute, base narrow. Flowers axillary. Spathellae umbonate, coriaceous, to 4 mm long. Tepals subulate, 0.5–2 mm long, the one between the filaments filiform or absent. Andropodia 2 mm long. Filaments 0.2–1 mm long; anthers 0.5–1 mm long.

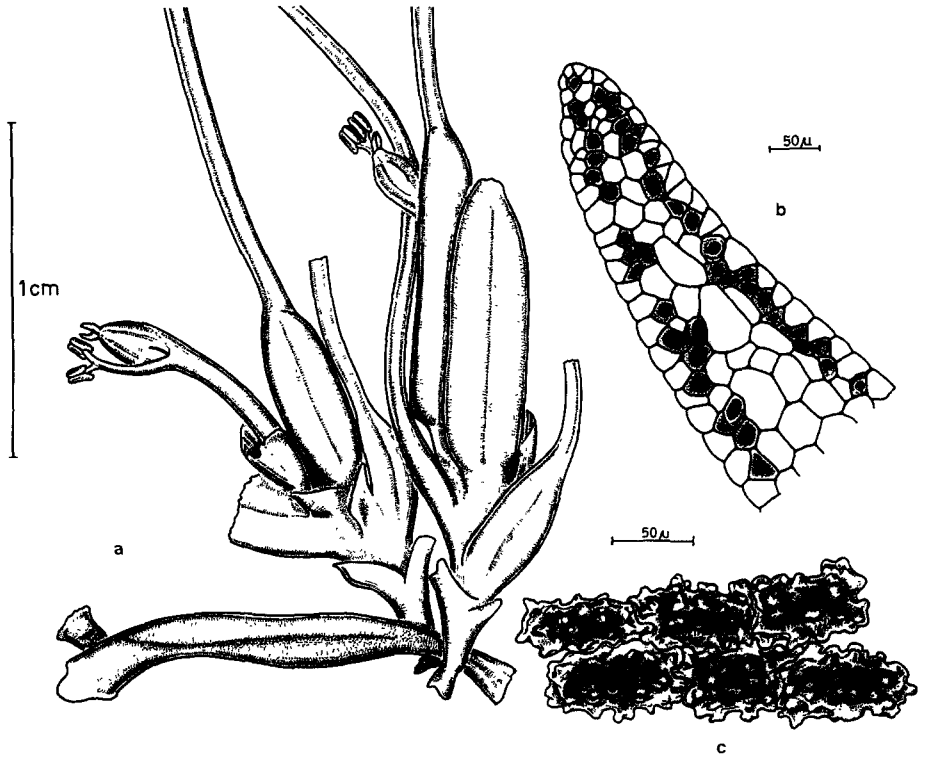

Fig. 15. *Podostemum uruguayense*. Based on *Tur 954* (STL). (a) Dorsal and ventral views of separate fertile stems projecting from a prostrate axis. (b) Tranverse section of leaf base showing the position of the silica cells. (c) Detail of a group of silica cells. (From Tur, 1987)

Ovaries 1.8–2 mm long, 1–1.5 mm wide; stigmas 0.5 mm long. Capsules 2–2.5 mm long; each valve with 5 broad ribs; pedicels to 9 mm long (Fig. 8(i–j)Fig. 15).

Additional comments: Normally the leaf blades are lost when specimens are pressed and mounted on herbarium sheets. The material of *Pedersen 9236* has small fertile plants. This species is threatened in Argentina. It seems to have been extirpated at Salto Grande after a dam was built. A dam is also planned for the region of the Garabí stream, the only other locality of the species in Argentina.

Distribution: In the Uruguay River basin (Fig. 2).

Specimens examined: ARGENTINA. Corrientes: Dpto. Santo Tomé, arroyo Garabí, 10 October 1969, *Pedersen 9236* (LP, Herb. Pedersen, C, NY). Entre Ríos: Dpto. Concordia, * Salto Grande, 10 February 1967, *Tur 954* (LP, SI, STL); ibid., 23 January 1967, *Tur 1867* (LP, STL); ibid., 7 December 1952, *Nicora 6292* (SI); ibid., 21 September 1951, *Cabrera 10854* (LP); río Uruguay, * Salto Grande, 21 September 1951, *Boelcke 4796, 4797, 4798* (BAB); ibid., January 1931, *Castellanos s.n.* (BA 31/1581). BRASIL. Rio Grande do Sul: Parque Florestal do Turvo, Tenente Portela, hidrófito sumerso no Rio Uruguai, próximo ao Salto Yucumã, 10 July 1980, *Waechter 1655*

(CTES, ICN); Vila Mendes, rio Uruguai, abaixo de V. Dutra, *Trevisan s.n.* (ICN 47744). Uruguay. Salto: * Salto Grande, 15 December 1892, *Osten 2905* (C); ibid., *Felippone 5255* (SI).

5.4. Tristicha Thouars

Small moss-like herbs, forming dense mats. Stems simple or branched. Roots without a calyptra. Leaves tristichous on the young stems and irregular on older stems, sessile, entire or 2–3 lobed. Flowers hermaphroditic, zygomorphic, solitary. Perianth trimerous; tepals free or united at the base, membranous, marcescent. Stamens 1–2, filaments free, narrowly deltoid; anthers dehiscing introrsely. Pollen in monads, globose. Ovaries 3-locular, ellipsoid; stigmas 3, filiform, slightly cohering at the base. Capsules 3-locular; with 3 subequel valves, each valve 3-ribbed. Seeds numerous.

According to Cusset and Cusset (1988) *Tristicha* is a genus with two species and two subspecies in the tropical and subtropical zones. One species occurs in America and Africa and another in Australia.

1. *Tristicha trifaria* (Bory ex Willd.) Spreng., Syst. Veg., Ed. 1: 22. 1825. *Dufourea trifaria* Bory ex Willd., Mag. Gresell. Nat. Freunde zu Berlin 5: 63. 1811. Type: Madagascar *Du Petit-Thouars s.n.* (holotype P).

Herbs, 0.2–20 cm high. Stems terete, erect. Leaves entire, 0.2–1.5 mm long, on the lower part of the stem irregularly distributed in whorls of up to 6, sometimes lobed. Flowers solitary; covered by 2 or 3 membranous bracteoles before anthesis, 1.5–2 mm long. Tepals cohering at the base, obtuse, with a central nerve, 1–2 mm long. Stamens 1(–2); filaments 1.5–2 mm long; anthers 0.5–0.8 mm long. Ovaries 1.5–1.8 mm long; stigmas 0.5 mm long. Capsules 2 mm long; pedicels 3–15 mm long. (Fig. 10(c–f')).

Additional comments: The species is very polymorphic and has the widest geographic distribution of any Podostemaceae.

Distribution: Africa, Australia, tropical and subtropical America, Mesopotamia Argentina in the Paraná and Uruguay River basins (Fig. 1).

Specimens examined: ARGENTINA. Corrientes: Dpto. Monte Caseros, Cachuera, 30 December 1952, *Nicora 6306* (Herb. Pedersen, SI). Entre Ríos: Dpto. Concordia, * Salto Grande, 10 February 1967, *Tur 1756* (LP, STL in alcohol). Misiones: Dpto. Apóstoles, Azara, balneario arroyo Chimiray, 23 January 1983, *Guaglianone et al. 910* (LP, SI); ibid., 10 Km al S de Azara. 25 January 1983, *Guaglianone et al. 966* (LP, SI); ibid., 16 February 1992, *Tur & Guaglianone 1929* (LP, SI); Dpto. Cainguás, Salto Las Golondrinas, 18 October 1975, *Zuloaga et al. 558* (LP); Aristóbulo del Valle, arroyo Cuñapirú, 15 February 1992, *Tur & Guaglianone 1947* (SI); Dpto. El Dorado, arroyo Piray Guazú, 21 February 1970, *Tur 1320* (STL); Dpto. Iguazú, Salto Iguazú, 7 April 1913, *Rodríguez 792* (BA, LIL, SI); Cataratas del Iguazú, 14 May 1951, *Cabrera et al. 167, 177* (LP); Cataratas del Iguazú, Salto 2 Hermanas, 20 September 1968, *Tur 1138* (LP, SI, STL); ibid., Salto Mbiguá, 21 September 1968, *Tur 1142* (LP, SI, STL); ibid., Salto Bozzetti, 20 February 1970, *Tur 1315* (LP, SI, STL); ibid., 20 February, 1992, *Tur & Guaglianone 2016* (LP, SI); ibid., Salto 2 Hermanas, 21 February 1992, *Tur & Guaglianone 2026* (SI); río Iguazú al S de Puerto Canoas, 21 February 1992, *Tur &*

Guaglianone 2030 (LP, SI); río Iguazú, arriba de Cataratas, 21 September 1968, *Tur 1143* (LP, SI, STL in alcohol); Parque Nacional Iguazú, R 101, arroyo Yacuy, 22 February 1992, *Tur & Guaglianone 2042* (LP, SI); * arroyo Uruguay, 19 September 1968, *Tur 1132* (LP, SI, STL in alcohol); ibid., 20 February 1970, *Tur 1306* (STL); * arroyo Uruguaí, 2 October 1986, *Neiff 1727* (CTES); Salto Misterioso, desembocadura arroyo Uruguay, 16 December 1971, *Neiff s.n.* (STL in alcohol); * río Uruguay, en las cascadas a 15 km de la desembocadura, 27 January 1952, *Castellanos s.n.* (416530 LIL); * Salto grande del arroyo Uruguay, 27 January 1983, *Guaglianone et al. 1059* (SI); arroyo Aguaray Guazú, 20 February 1970, *Tur 1312* (STL); Dpto. Libertador General San Martín, arroyo Garuhapé, 21 February 1970, *Tur s.n.* (STL in alcohol); Salto Encantado, 16 February 1992, *Tur & Guaglianone 1960* (LP, SI); ibid., 15 December 1971, *Neiff s.n.* (STL in alcohol); R 7 y 223, desvío a Cuñapirú, 16 February 1992, *Tur & Guaglianone 1961* (LP, SI); Salto Tabay, 23 February 1992, *Tur & Guaglianone 2045* (SI); Dpto. Montecarlo, Fracán, 25 February 1924, *Parodi 5686-B* (BAA); Dpto. San Ignacio, Salto Tabay. 14 October 1977, *Cabrera et al. 28795-b* (SI). Dpto. San Javier, arroyo Once Vueltas, paso Kalesplaner, 3 February 1995, *Tur & Guaglianone 2080* (LP, SI); [Without dpto.] río Francés Cue, Puerto Denis, July 1919, *Hauman s.n.* (BA 50789). Brasil. Paraná: rio Iguassú, 20 February 1949, *Schwarz 7546* (LIL); Foz de Iguazú, 28 September 1967, *Fabris & Crisci 7146-A* (LP); Cataratas del Iguazú, 28 September 1967, *Tur 1021* (STL). Rio Grande do Sul: Estrada Uruguaiana, Quaraí-Ric, Quaraí-Mirim, 21 November 1973, *Girardi & Irgang, ICN 22099* (CTES, ICN); Parque Est. Turvo, Tenente Portela, 30 November 1985, *Brack s.n.* (ICN 66487). Santa Catarina: rio Capinzal, in rupibus fluviatilis subaquaticis, 28 February 1916, *Dusen 17871* (NY); Mun. Abelardo Luz, on submerged ledges in rio Chapeco at Abelardo Luz, ca. 26° 35′ S 52° 20′ W, alt 900–1000 m, 23 October 1964, *Smith & Reitz 12873* (NY, SI); Mun. Concórdia, rocky banks and bed of rio Uruguai, Estreito do Uruguai, near Barra do Veado, alt. ca. 400 m, 4 Jan., 1957, *Smith & Reitz 9913* (NY). Para: in vicinibus Santarem, September 1850, *Spruce s.n.* (NY). s.d., *Glaziou 13137* (MO); *Glaziou 21996* (MO); *Glaziou 22007* (SI). PARAGUAY. Itapúa: Cap. Mesa, arroyo Yaguarazapa, May, 1994, *G. Rossi s.n.* (LP). URUGUAY. Salto: * Salto Grande, *Osten 2902* (MVM).

Excluded species: Tristicha phascoides Griseb. (in Goett. Abh. 24: 41. 1879) is *Crassula phascoides* (Griseb.) Bywater (Crassulaceae) (cf., Kew Bull. 40: 537–538. 1985). Type: Argentina, Tucumán, Chicligasta, Las Pavas, puerto El Bolsón. *Venturi 3373* (LIL). A complete enumeration of the synonyms of *T. trifaria* can be found in Van Royen (1953) and Cusset and Cusset (1988).

5.5. Wettsteiniola Suess.

Small to medium size herbs. Prostrate axes attached to the rocks. Leaves pinnatisect, with external stipel on one side of the base of the pinnae and pinnulae; ultimate divisions of tufts of filaments numerous, filiform. Flowers hermaphroditic, zygomorphic, 2–8 in fascicles arising from protuberances of the prostrate axis, each flower enclosed by a spathella. Tepals 3–6, in an incomplete whorl. Stamens 1–4, in an incomplete whorl, filaments free, subulate; anthers sagittate at base, dehiscing introrsely. Pollen in monads, ellipsoidal or globose. Ovaries 2-locular, ellipsoidal to ovoid, borne by a short

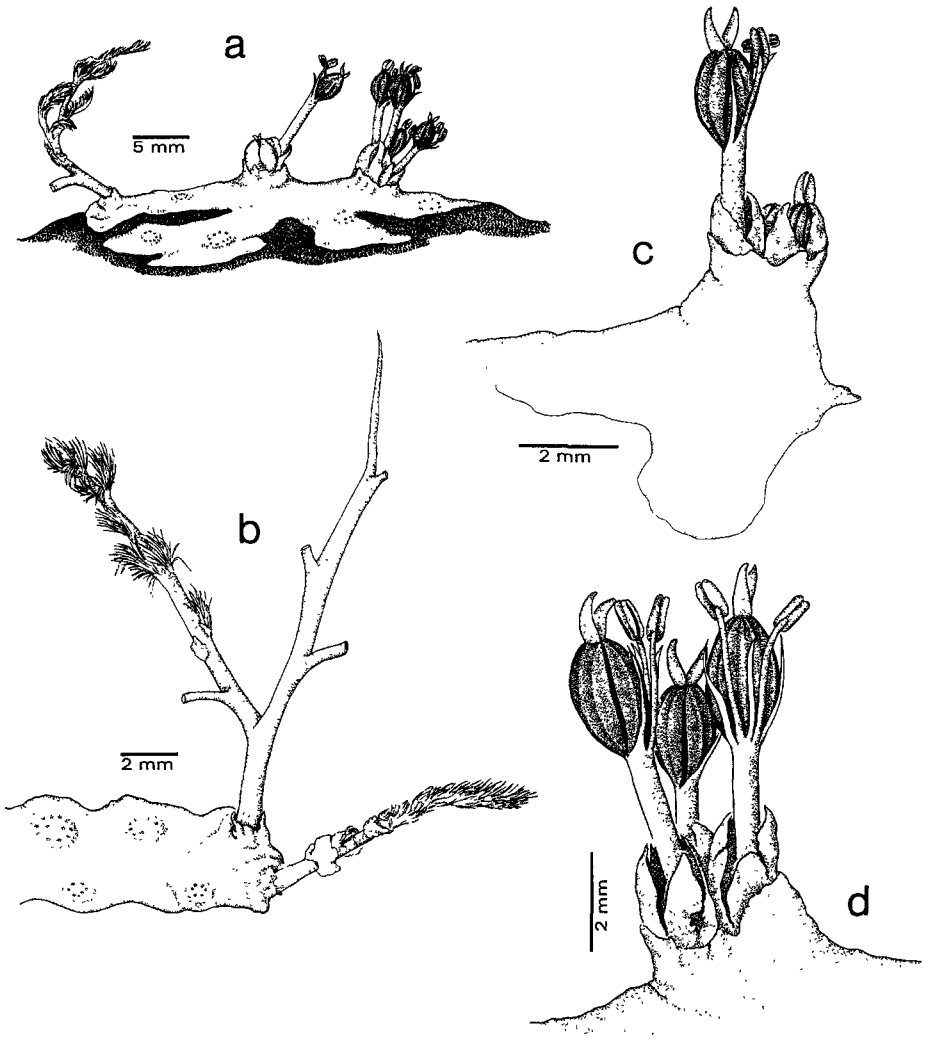

Fig. 16. *Wettsteiniola apipensis*. Based on the type material in alcohol *Tur 1520* (LP). (a) Plant with leaf and flowers projecting from the expanded basal prostrate axis. Based on a photograph. (b) Detail of prostrate axis with leaves and stipules. (c and d) Group of flowers arising from the axis. (a, b, and d from Tur, 1975).

gynophore; stigmas 2, linear or filiform, free or cohering at the base. Capsules 1.5–2 mm long, 2-locular; with 2 equal valves, 12–14 ribbed. Seeds numerous.

South American genus with three species, 2 in S Brazil and one in NE Argentina.

1. *Wettsteiniola apipensis* Tur, Bol. Soc. Argent. Bot. 16 (4): 321, Fig. 1. 1975. Type: Argentina, Corrientes, Dpto. Ituzaingó, * Salto Apipé, frente a la isla de Los Pájaros, 29 November 1971, *Tur 1520* (holotype LP!).

Herbs. Prostrate axes hepatic-like, to 1 mm high, 10 mm wide, 50 mm long. Leaves arising from the apex of the prostrate axis, to 20 mm long; irregularly pinnatisect, base

of the pinnae with a hyaline stipel, subcircular, to 1 mm long; petioles to 4 mm long; ultimate divisions to 1 mm long; leaf bases persistent. Flowers in groups of 2–4. Spathellae membranous, 2–3(4) mm long. Tepals (2)3(4), subulate, to 2.5 mm long. Stamens 2(3); filaments to 3 mm long; anthers 1 mm long. Pollen globose, 16.7 μ diam. Ovaries ellipsoidal, 1.5–2 mm long, 1–1.3 mm wide; gynophores to 0.25 mm long; stigmas filiform, 1 mm long. Capsules 1.5–2 mm long, with 12 ribs; pedicels to 11 mm long (Fig. 16).

Additional comments: This species seems to have been extirpated at the type locality after a dam was constructed. The species may occur in neighboring regions in the Republic of Paraguay and in the Paraná River basin north of the current dam. Collections in these regions are needed.

Distribution: Once collected (Fig. 1).

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