



A new tree species of *Schinopsis* (Anacardiaceae) from Paraguay and Bolivia

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Abstract

The new tree species *Schinopsis boqueronensis*, endemic to the Bolivian-Paraguayan Chaco, is described, illustrated and compared to the related *Schinopsis heterophylla*. A distribution map and photographs of the new species are also provided.

Key words: Boquerón, Chaco, South America, taxonomy

Introduction

The genus *Schinopsis* Engl. (1876: 403) (Subfamily *Anacardioideae*, Family *Anacardiaceae*, Order *Sapindales*; Judd *et al.*, 1999; Pell, 2004) has a restricted geographical distribution in the Seasonally Dry Tropical Forests (SDTF, *sensu* Prado, 2000), but is also found in the subtropical Chaco forests (Prado 1993a, b) of South America. It is a small genus of very important cultural and economic influence in the continent, characterized by its timber of extreme durability and toughness (Barberis *et al.*, 2012). The species of *Schinopsis* are also of ecological importance because are usually dominant or co-dominant in the environments where they grow.

Meyer & Barkley (1973) included seven species in *Schinopsis* and placed *S. heterophylla* Ragonese & J. A. Castigl. (1947: 98) as a synonym of *S. quebracho-colorado* (Schltdl., 1861: 139) F.A. Barkley & T. Mey. (1950: 156), which in turn has been placed as a synonym of *S. lorentzii* (Griseb., 1874: 115) Engl. (1881: 46). *S. heterophylla* was originally described from the Argentinean Chaco. Recently, Muñoz (1990) reinstated *S. heterophylla* as a distinct species, and indicated the presence of newly collected specimens in Bolivia and Paraguay.

During the preparation of a revision of *Schinopsis*, the authors of the present contribution found a number of herbarium specimens collected in Bolivia and Paraguay that were identified as *S. heterophylla*, but have morphological characters that do not correspond to Ragonese & Castiglioni's (1947) original description of the species. A thorough morphological analysis of the specimens, together with the collection of fresh material in the field in the Paraguayan Chaco in 2011, led us to propose here a new arboreal species, *Schinopsis boqueronensis*. A key to distinguish the new species from *S. heterophylla*, together with illustrations, photographs and a distribution map of *S. boqueronensis* are provided.

Materials and methods

Herbarium specimens at CTES, FCQ, LIL, PY and SI (*Index Herbariorum*, Holmgren *et al.*, 1990) were studied. Additionally, new material collected in central-western Paraguayan Chaco in December 2011 (deposited in FCQ, Asunción) was also included in the analysis.

At present, the proper administrative processes are being followed in order to formally distribute duplicates of specimens from FCQ herbarium in the near future.

Morphological characters were studied using digital calliper and a stereoscopic microscope, and are here described using the terminology used by Ragonese & Castiglioni (1947), Barkley (1962), Meyer & Barkley (1973), and Muñoz (1990).

Taxonomy

Schinopsis boqueronensis V. Mogni & L. Oakley, *sp. nov.* (Fig. 1 & Fig. 2)

Species S. heterophylla similis sed foliis simplicibus oblongatis vel ovatis, rara oblongo-lanceolatis, nervis lateralibus foliorum numerosis atque densis, sub angulo 60–90° patentibus, parallelis, petala 5, interdum 6, samara breviter tricornuta, differt.

Type:—PARAGUAY. Presidente Hayes: Ruta trans-chaco, entre Pioneros y 25 Leguas, a la derecha del camino en dirección oeste-este, 22,73° S, 59,69° W, 16 December 2011, *M. Vera, V. Mogni & L. Oakley 4240* (holotype FCQ!).

Tree 12 to 15 m tall, dark bark fracturing into irregularly quadrangular plates. Reproductive short-shoots puberulent and spineless. Spines usually present in long-shoots, 0.37–7.35 × 0.14–0.63 cm. *Leaves* subcoriaceous, simple to imparipinnately compound; petioles sparsely puberulent on margins and sometimes narrowly winged, frequently longer in pinnate leaves (0.45–4.03 cm) than in simple ones (0.25–1.81 cm). Blades glabrate or sparsely puberulent on the margins and principal vein; margin entire to undulate; abundant secondary veins, considerably lighter coloured and almost parallel, with a divergence of 60° to 90° from the principal vein; upper surface shiny, with epicuticular wax-forming punctations, mainly concentrated on the main vein; lower surface grey to pale green, densely wax-dotted except for the veins. *Simple leaves* oblong, ovate, oblong-lanceolate, sometimes reniform, 1.20–6.26 × 0.63–2.20 cm; apex obtuse, to emarginate or obcordate, less commonly sub-acute, sometimes mucronate; base rounded, obtuse to gradually cuneate. *Compound leaves* imparipinnate, rarely paripinnate, 2.98–29.51 × 2.45–10.14 cm, 1–9 pairs of pinnae; rachis subquadrangular, pubescent; leaflets asymmetric, sessile to subsessile, generally oblong-lanceolate to lanceolate, ovate, at times obovate or reniform, 0.54–7.29 × 0.48–5.89 cm, the terminal leaflet frequently larger than the rest; apex subacute, obtuse, to emarginate, usually mucronulate; base cuneate to obtuse or rounded, very rarely lobate. *Inflorescence* a pubescent terminal panicle, very short-pedunculate; bracteoles lanceolate or ovate-lanceolate, concave, ciliate and caducous. *Imperfect flowers*, subsessile; sepals 5, imbricate, ovate to suborbiculate with obtuse to rounded apex, ciliate on the margins, 1.28–1.41 × 0.84–1.02 mm; petals 5, but occasionally 6, 1.89–2.29 × 0.77–1.20 mm, greenish-white to cream-coloured, concave, ovate-elliptic, apex rounded, principal vein prominent, exceptionally 2 principal veins and consequently a dentate apex. *Pistillate flowers* not seen. *Staminate flowers* with 5 stamens, approx. 3 mm long, anthers half the length of to equalling the filaments. *Fruit* a lustrous and cultriform samara, 2.5–3.25 cm long, with persistent calyx; seminiferous portion sub-ovoid to rhomboid, 1–1.33 × 0.8–1 cm, with evident and prominent lignified styles, persistent on the pericarp, wing 1–1.6 × 0.83–1 cm, apex obtuse; dorsal margin straight or slightly concave, the opposite margin convex.

Distribution and habitat:—Endemic to the Bolivian-Paraguayan Chaco; up to now it has been found only in central-west Paraguay in Presidente Hayes, Boquerón and Alto Paraguay departments, and in the south-east of Bolivia in the Santa Cruz department (Fig. 3). The species grows between 130–900 m a.s.l. in the drier Western Chaco phytogeographical region (*sensu* Prado, 1991; Prado 1993a), and it is also found in transitional areas with the more humid Eastern Chaco. It is often associated with sand dunes, and in savannas dominated by the grasses *Elyonurus muticus* (Spreng., 1827: 32) Kuntze (1898: 350) and *Aristida mendocina* Phil. (1870: 205), where it coexists with other species of the genus such as *S. cornuta* Loes. (in Loesener & Herzog, 1915: 86) and *S. lorentzii*. It is also associated with other arboreal elements (Spichiger *et al.* 2005), such as *Astronium fraxinifolium* Schott (1827: 404), *Jacaranda cuspidifolia* Mart. (1841: 51), *Aspidosperma pyrifolium* Mart. (1824: 60), *Tabebuia aurea* (Silva Manso, 1836: 40) Benth. & Hook. f. ex S. Moore (1895: 423) and *Pterogyne nitens* Tul. (1843: 140).

Schinopsis boqueronensis also grows in open forests together with the species of *Schinopsis* mentioned above and *Aspidosperma quebracho-blanco* Schlttdl. (1861: 137), *Ziziphus mistol* Griseb. (1874: 99), *Celtis ehrenbergiana* (Klotzsch, 1847: 538) Liebm. (1851: 339) var. *discolor* (Hunz. & Dottori, 1976: 130) L. Oakley & D. Prado (2013: 127), *Chloroleucon chacoense* (Burkart, 1947: 513) Barneby & Grimes (1996: 140), *Salta triflora* (Griseb., 1879: 89) A.D. Sánchez (2011: 708), *Mimosa castanoclada* Barneby & Fortunato (1987: 167), *Senegalia emilioana* (Fortunato & Ciald., 1996: 217) Seigler & Ebinger (2006: 51) and *Vachellia aroma* (Gillies ex Hook. & Arn., 1833: 206) Seigler & Ebinger (2005: 143).

Etymology:—The species epithet derives from ‘Boquerón’, a department of Paraguay where the species is particularly frequent.

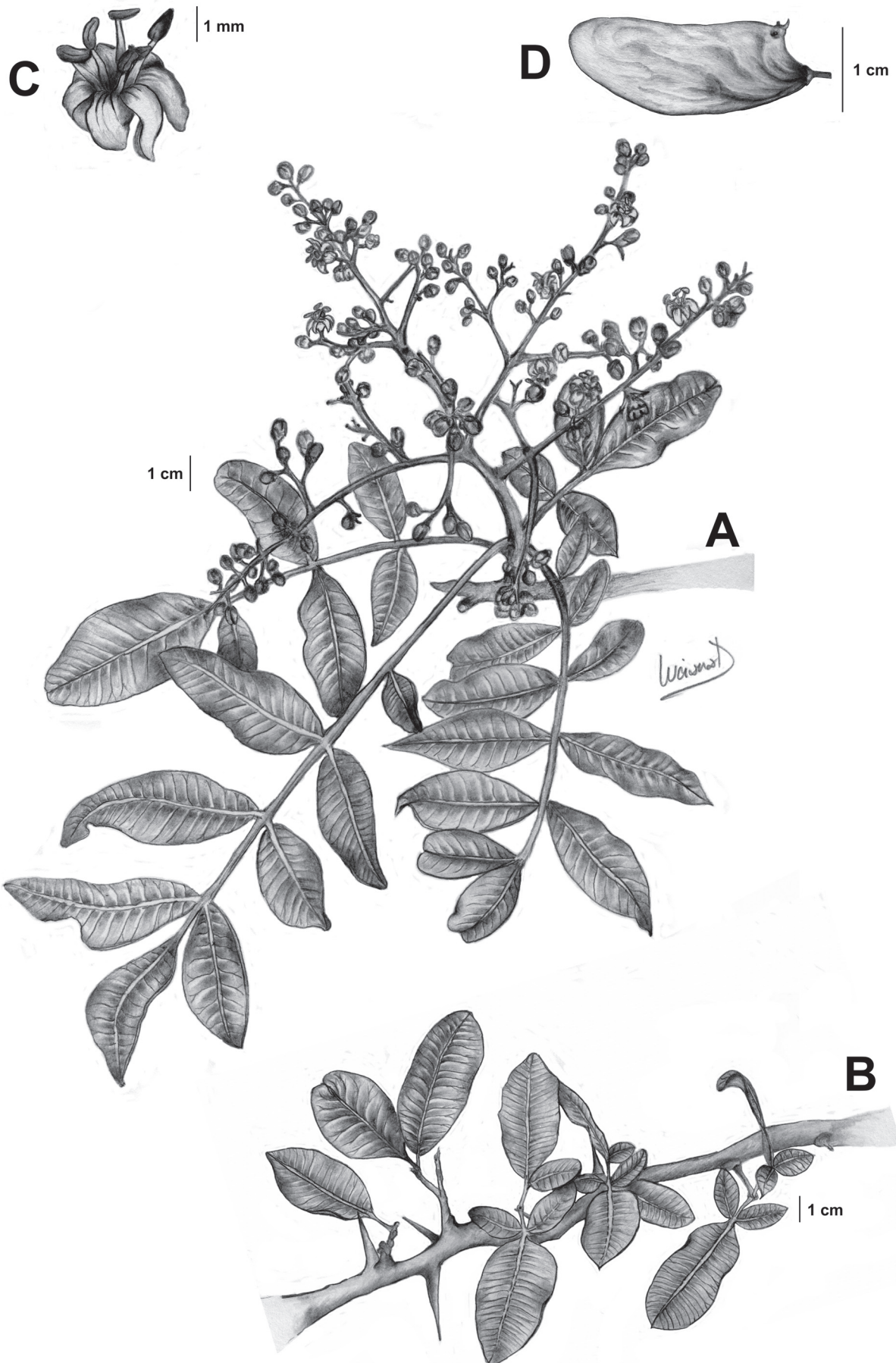


FIGURE 1. *Schinopsis boqueronensis*. A. Brachyblast with compound leaves and inflorescence. B. Macroblast fragment usually found in lower positions in the tree crown, showing leaf polymorphism and spines. C. Staminate flower. D. Samara.

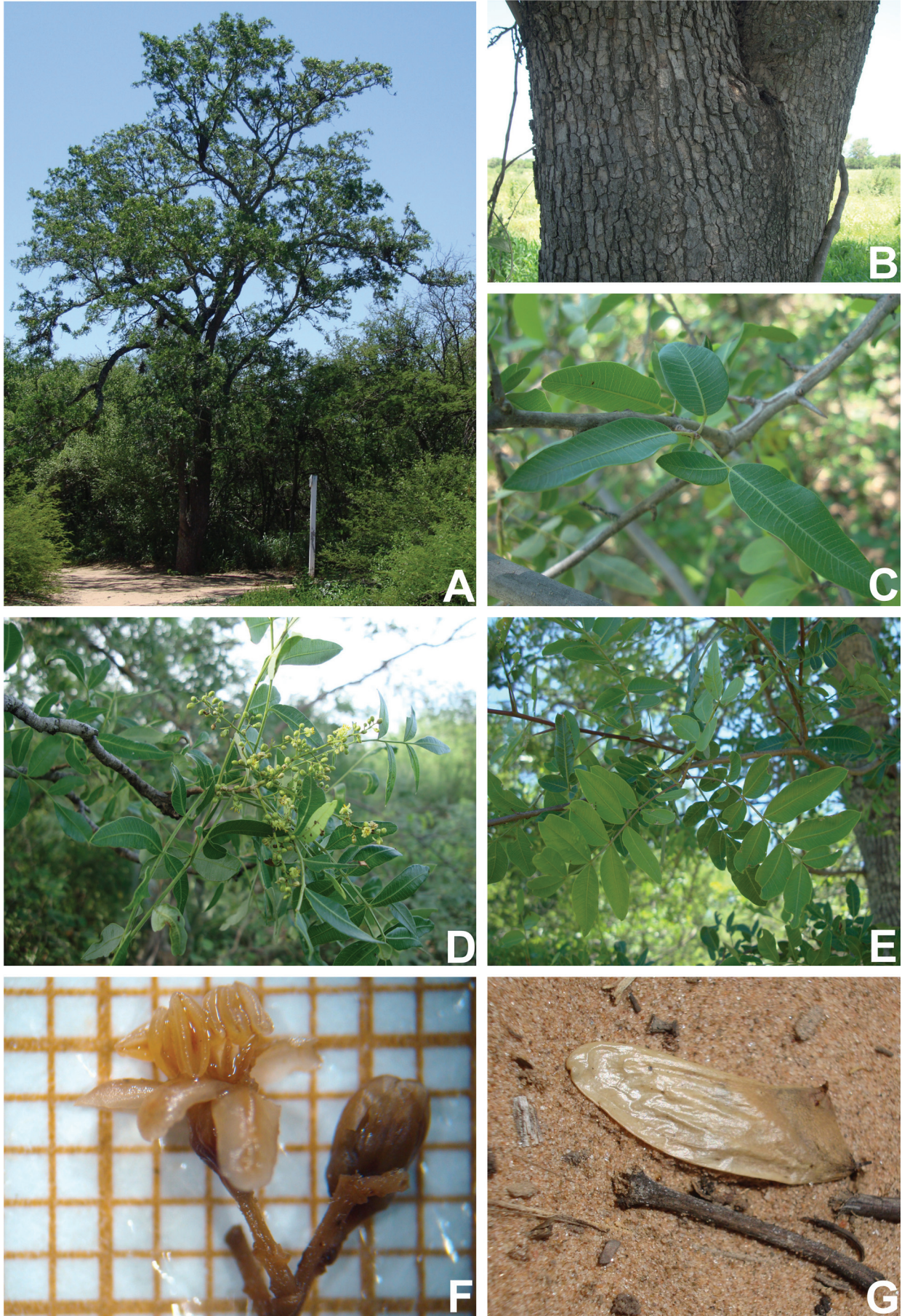


FIGURE 2. A. Individual of *S. boqueronensis*. B. Bark in detail. C, D, E. Leaf polymorphism. D. Inflorescence. F. Staminate flower. G. Samara.

Additional specimens examined (paratypes):—BOLIVIA. Santa Cruz: Prov. Cordillera, 27 de Noviembre y Parapetí, Chaco Boreal, March 1935, *T. Rojas* 7252 (LIL!)—cited in Muñoz (1990) as *S. heterophylla*; Parque Nacional Kaa Iya del Gran Chaco, Laguna Azul (puesto ganadero), 24 May 1998, *A. Fuentes* 2397 (CTES!, LPB, MO, USZ).—PARAGUAY. Alto Paraguay: Capitán Mayor Pablo Lagerenza, 20° S, 60° 45' W, 16 April 1978, *A. Schinini & E. Bordas* 15076 (CTES!); Boquerón: Filadelfia, 18 February 1987, *I. Basualdo* 840 (FCQ!, MO); 17 km al norte de Filadelfia en dirección a Montanía, 10 March 2005, *R. H. Fortunato* 8640 (CTES!, SI!); Ruta Transchaco a la derecha del camino dirección este-oeste, Parque Nacional Tte. Enciso, 20,92° S 61,83° W, 14 December 2011, *M. Vera, V. Mogni & L. Oakley* 4227 (FCQ!); Ruta Transchaco a la izquierda del camino dirección este-oeste, Parque Nacional Tte. Enciso, 20,90° S 61,84° W, 14 December 2011, *M. Vera, V. Mogni & L. Oakley* 4238 (FCQ!); a la derecha de camino en dirección norte-sur, a 25 km de Neuland, 22,78° S 59,94° W, 15 December 2011, *M. Vera, V. Mogni & L. Oakley* 4239 (FCQ!); Parque Enciso, Ruta Transchaco km 656, 600 km al noroeste de Asunción 21° 13' S 61° 30' W, 26 January 1984, *E. L. Little Jr.* 40070 (G, MO, PY!); km 412, ruta IX Carlos A. López, 2 km del cruce Loma Plata, 12 January 1990, *T. Florentín Peña, L. de Molas, A. Aguayo & M. Quintana* 650 (CTES!); Ruta Transchaco, 21° 26' S 61° 25' W, 7 March 1979, *A. Schinini* 16444 (BACP, CTES!, SI!)—cited in Muñoz (1990) as *S. heterophylla*.

There exists a chance that further specimens of this new species are stored in other herbaria, probably misidentified under *S. heterophylla* (Navarro 2004, Mereles 2005, Navarro *et al.* 2006). For example, additional specimens from Bolivia deposited in the LPB and HSB herbaria could potentially be attributed to *S. boqueronensis*.



FIGURE 3. Distribution map of *S. boqueronensis* in South America.

Discussion:—The newly described species, *S. boqueronensis*, closely resembles *S. heterophylla* which occurs in the Argentinean central Chaco. The two species may be readily distinguished, however, on leaf venation and morphology, staminate flowers and samara pericarp, as summarized below:

Identification key to distinguish *S. boqueronensis* from *S. heterophylla*:

1. Simple leaves glaucous, generally oblong-lanceolate; apex acute to gradually emarginate; base sometimes lobate; secondary veins prominent but inconspicuous in colour, with a divergence of 55° to 60° from the principal vein. Petals 5. Samara without lignified styles *S. heterophylla*
- Simple leaves green and shiny on the upper surface, lighter and grey below, generally oblong-ovate; apex emarginate, obtuse to sub-acute; base rarely lobate; secondary veins pallid, with a divergence of 60° to 90° from the principal vein. Petals 5, occasionally 6. Samara with noticeable lignified styles *S. boqueronensis*

Finally, it is worth noting that the new species described presents morphological characters intermediate between *S. cornuta* and *S. lorentzii*, with which it coexists in the field. A similar situation has been observed for *S. heterophylla*, considered a possible hybrid between *S. balansae* Engl. (1885: 286) and *S. lorentzii* (Ragonese & Castiglioni, 1947, Anzótégui, 1971, and Del Pero de Martínez, 1972).

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References

- Anzótégui, L.M. (1971) El polen de las Anacardiaceae del N.E. de la Argentina. *Ameghiniana* 8: 329–340.
- Barberis, I.M., Moggi, V.Y., Oakley, L.J., Alzugaray, C., Vesprini, J.L. & Prado, D.E. (2012) Biología de especies australes: *Schinopsis balansae* Engl. (Anacardiaceae). *Kurtziana* 37: 59–86.
- Barkley, F.A. & Meyer, T. (1950) El nombre botánico del “quebracho colorado santiagueño”. *Boletín de la Sociedad Argentina de Botánica* 3: 155–156.
- Barkley, F.A. (1962) Anacardiaceae: Rhoideae: *Schinopsis*. *Proceedings of the Iraqi Scientific Societies* 5: 44–69.
- Barneby, R.C. & Fortunato R.H. (1987) Four new diplostemonous species of *Mimosa* (Mimosaceae) from Paraguay and Eastern Bolivia. *Brittonia* 39: 165–174.
<http://dx.doi.org/10.2307/2807367>
- Barneby, R.C. & Grimes, J.W. (1996) Silk Tree, Guanacaste, Monkey’s Earring. *Memories of The New York Botanical Garden* 74(1): 1–292.
- Burkart, A. (1947) Leguminosas nuevas o críticas, II. *Darwiniana* 7: 504–540.
- Del Pero de Martínez, M.A. (1972) Hibridación en el género *Schinopsis*. *Resúmenes XII Jornadas Argentinas de Botánica*, 2–5 Noviembre 1972, Neuquén, Argentina.
- Engler, H.G.F. (1876) *Anacardiaceae*. In: Martius, C.F.P. von (Ed.) *Flora Brasiliensis*, vol. 12, part 2. F. Fleischer, Monachii & Lipsiae, pp. 367–418.
- Engler, H.G.F. (1881) Diagnosen neuer *Burseraceae* und *Anacardiaceae*. *Botanische Jahrbücher für Systematik* 1: 41–47.
- Engler, H.G.F. (1885) Eine neue *Schinopsis*. *Botanische Jahrbücher für Systematik* 6: 286.
- Fortunato, R.H. & Cialdella, A.M. (1996) Una especie nueva del género *Acacia* (Acaciae, Mimosoideae, Fabaceae) para el Chaco boliviano-paraguayo: *A. emilioana* Fortunato & Ciald. Discusión sobre su ubicación infragenérica. Contribución al estudio de la flora y vegetación del Chaco. X. *Candollea* 51: 215–224.
- Grisebach, A.H.R. (1874) *Plantae Lorentzianae*. *Abhandlungen der Königlichen Gesellschaft der Wissenschaften zu Göttingen* 19: 49–279.
- Grisebach, A.H.R. (1879) *Symbolae ad Floram Argentinam*. *Abhandlungen der Königlichen Gesellschaft der Wissenschaften zu Göttingen* 24: 1–346.
- Holmgren, P., Holmgren, B. & Barnett, L. (1990) *Index Herbariorum. Part I: The herbaria of the World*. 8th ed. Regnum Vegetabile, vol. 120. New York Botanical Garden, New York, USA, 693 pp.
- Hooker, W.J. & Arnott, G.A.W. (1833) Contributions towards a Flora of South America and the Island of the Pacific. *Botanical Miscellany* 3(8): 129–211.
- Hunziker, A. & Dottori, N. (1976) Contribución al conocimiento sobre los talas (*Celtis*, *Ulmaceae*) de Argentina, con especial referencia a la región mediterránea I. Sobre una especie Austrosudamericana y sobre otra de área disyunta. *Kurtziana* 9: 103–140.

- Judd, W.S., Campbell, C.S., Kellogg, E.A. & Teven, P.P. (1999) *Plant Systematics: A Phylogenetic Approach*. 2nd ed. Sinauer Associates, Sunderland, Mass., USA, 576 pp.
- Klotzsch, J.F. (1847) Beiträge zu einer Flora der Aequinoctial-Gegenden der Neuen Welt. *Linnaea* 20: 337–542.
<http://dx.doi.org/10.5962/bhl.title.6148>
- Kuntze, C.O. (1898) *Revisio Generum Plantarum* 3(3): 1–576. A. Felix, Leipzig.
- Liebmann, F.M. (1851) Mexico Halvgræs. *Kongelige Danske videnskabernes Selskabs Skrifter, Naturvidenskabeli Mathematisk Afdeling* ser. 5, vol. 2: 4–513.
- Loesener, L.E.T. & Herzog, T.C.J. (1915) Herzog's bolivianische Pflanzen II: *Anacardiaceae*. *Mededeelingen van 's Rijks-Herbarium* 27: 84–88.
- Martius, C.F.P. von (1824) *Nova Genera et Species Plantarum Brasiliensium*, vol.1. Typis Lindaueri, Munich, 158 pp.
- Martius, C.F.P. von (1841) Beiblätter zur Flora oder Allgemeinen Botanischen Zeitung. *Flora* 24 (2 Beibl.): 1–112.
- Mereles, M.F. (2005) Una aproximación al conocimiento de las formaciones vegetales del Chaco boreal, Paraguay. *Rojasiana* 6(2): 5–48.
- Meyer, T. & Barkley, F.A. (1973) Revisión del género *Schinopsis* (Anacardiaceae). *Lilloa* 33: 207–257.
- Moore, S.L.M. (1895) The Phanerogamic Botany of The Matto Grosso Expedition, 1891–92. *Transactions of the Linnean Society of London, Botany* 4: 265–516.
<http://dx.doi.org/10.1111/j.1095-8339.1895.tb00046.x>
- Muñoz, J.D. (1990) *Anacardiaceae*. In: Spichiger, R. & Ramella, L. (Eds.) *Flora del Paraguay*. Missouri Botanical Garden & Conservatoire & Jardin Botaniques de la Ville de Genève, Geneva, 5–84 pp.
- Navarro G. (2004) *Mapa de Vegetación del Parque Nacional y ANMI KAA-IYA del Gran Chaco*. WCS. FAN, Santa Cruz de la Sierra, Bolivia, 42 pp.
- Navarro, G., Molina, J. & Pérez de Molas, L. (2006) Classification of the forests of the northern Paraguayan Chaco. *Phytocoenologia* 36(4): 473–508.
<http://dx.doi.org/10.1127/0340-269x/2006/0036-0473>
- Oakley, L.J. & Prado, D.E. (2013) Nueva combinación en *Celtis ehrenbergiana* (Klotzsch) Liebm. *Rojasiana* 12: 125–129.
- Pell, S.K. (2004) *Molecular systematics of the cashew family (Anacardiaceae)*. PhD Dissertation, Louisiana State University, Baton Rouge, 193 pp.
- Philippi, R.A. (1870) Sertum mendocinum alterum, o sea, catálogo de las plantas recojidas cerca de Mendoza i en los caminos que conducen de Chile a esa ciudad. *Anales de la Universidad de Chile* 36: 159–212.
- Prado, D.E. (1991) *A critical evaluation of the floristic links between Chaco and Caatingas vegetation in South America*. PhD Dissertation, St. Andrews University, St. Andrews, 283 pp.
- Prado, D.E. (1993a) What is the Chaco vegetation in South America? I. A review. *Candollea* 48: 145–172.
- Prado, D.E. (1993b) What is the Chaco vegetation in South America? II. A redefinition. *Candollea* 48: 615–629.
- Prado, D.E. (2000) Seasonally dry forests of tropical South America: from forgotten ecosystems to a new phytogeographic unit. *Edinburgh Journal of Botany* 57: 437–461.
<http://dx.doi.org/10.1017/s096042860000041x>
- Ragonese, A. & Castiglioni, J. (1947) Nueva especie del género *Schinopsis* y área geográfica de las especies argentinas. *Revista de Investigaciones Agrarias* 1: 93–100.
- Sánchez, A. & Kron, K.A. (2011) Phylogenetic Relationships of *Triplaris* and *Ruprechtia*: Re-delimitation of the Recognized Genera and Two New Genera for Tribe Triplaridae (Polygonaceae). *Systematic Botany* 36: 702–710.
<http://dx.doi.org/10.1600/036364411x583664>
- Schlechtendal, D.F.L. von (1861) Ueber den Quebracho der argentinischen Staaten nach Prof. Burmeister's Mittheilungen. *Botanische Zeitung (Berlin)* 19: 137–140.
- Schott, H. (1827) Appendix: Fasciculus Plantarum Brasiliensium. In: Sprengel, K.P. (Ed.) *Systema Vegetabilium* 16. Sumtibus Librariae Dieterichianae, Göttingae, 403–410 pp.
- Seigler, D. & Ebinger, J. (2005) New combinations in the genus *Vachellia* (Fabaceae: Mimosoideae) from the New World. *Phytologia* 87(3): 139–178.
- Seigler, D. & Ebinger, J. (2006) The genus *Senegalia* (Fabaceae: Mimosoideae) from the New World. *Phytologia* 88(1): 38–93.
- Silva Manso, A.L.P. (1836) *Enumeração das Substancias Brasileiras que podem promover a catarze*. Imperial Academia de Medicina do Rio de Janeiro, Rio de Janeiro, 72 pp.
<http://dx.doi.org/10.5962/bhl.title.42855>
- Spichiger, R., Calenge, C & Bise, B. (2005) Discriminant analysis of the spatial distribution of plant species occurrences: II. Distribution of major tree communities in Paraguay. *Candollea* 60: 577–593.
- Sprengel, K.P. (1827) *Systema Vegetabilium* (Ed. 16) 4(2): 1–410. Sumtibus Librariae Dieterichianae. Göttingae.
<http://dx.doi.org/10.5962/bhl.title.822>
- Tulasne, L.R. (1843) Nova quaedam genera in Leguminosarum classe. *Annales des Sciences Naturelles; Botanique*, séries. 2 20: 136–144.