Revision of the native South American species of Linum (Linaceae)

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INTRODUCTION

Linum is a genus of perhaps 160 species, widely distributed throughout the world, principally in temperate and subtropical regions. Five sections, Linum, Cathartolinum, Syllinum, Dasylinum and Linastrum, are commonly recognized. A sixth, Cliococca, has been treated as a separate genus (Rogers and Mildner, 1972). Section Linum is almost entirely Old World (two of the twenty-five to thirty species are found in western North America); Cathartolinum is comprised of but a single species, essentially Old World, but probably introduced into northeastern North America; Syllinum and Dasylinum are entirely Old World; Linastrum, to which all of the native South American species belong, is found in both Old and New Worlds. These general distributions suggest that the genus may have had its origin or center of dispersal in the Old World, possibly in the eastern Mediterranean region, the only area where representatives of all five sections can be found.

Early publications dealing with the South American species (St. Hilaire, 1825; Schiede, 1826; Gay, 1865; Urban, 1877a,b; and Reiche, 1896) were more or less provincial in their treatments. Planchon's monumental study of the genus (1847, 1848) described and classified all of the known species while Winkler (1931) listed the South American species. A number of recent publications have all been more or less local in their scope. One of the aims of the present study has been to update our knowledge, utilizing collections which have accumulated, to try to assess the relationships on a continental basis for the first time and to clarify relationships of South American plants to those of the other parts of the world. Earlier studies of the North American flaxes of the section Linastrum (Rogers, 1963, 1968, 1969) revealed that the species considered on comparative morphological bases to be among the most primitive on that continent closely resemble some of the species of southern Africa. It has seemed worthwhile to study the several South American plants of this section, to try to place them in their proper position with respect to the North American and the Old World, particularly southern African, plants. This paper summarizes some of the results of this study.

With the help of a grant from the Penrose Fund of the American Philosophical Society to the senior author and a Sigma Xi Grant-in-Aid of Research to the junior author, it has been possible to observe in the field and to collect most of the South American species and to harvest cytological materials and seeds of a number of species. Material from 24 herbaria has been examined. The cooperation of the many curators is hereby gratefully acknowledged.

KEYS TO AND DESCRIPTIONS OF THE SOUTH AMERICAN SPECIES

Glabrous or puberulent perennial or rarely annual herbs; leaves simple, sessile, entire or rarely denticulate, opposite, alternate, glabrous or sometimes pilose near the base; stipular glands present or none; inflorescence a terminal scorpioid cyme, this sometimes much reduced; sepals five, imbricate, entire or denticulate; petals five, obovate, convolute, separate, fugacious, yellow, the buds often reddish without; stamens five, united basally, with or without diminutive intervening staminodia; ovary superior, five-carpelled, but becoming more or less ten-locular through the intrusion of incomplete false septa; styles five, separate or united; stigmas capitate; fruit ovate, obtuse to acute, dehiscing into ten one-seeded segments.

1. Styles free or nearly so.

2. Septa prominently ciliate. 1. L. burkartii

2. Septa not prominently ciliate.

3. Stem leafy to the summit. 2. L. organense

3. Stem not leafy to the summit.

4. Sepals thin-textured, conspicuously scarious-margined.

5. Leaves broadly lanceolate to ovate.

6. Stipular glands present. 3. L. smithii

6. Stipular glands absent. 4. L. littorale

5. Leaves linear or narrowly lanceolate.

7. Inflorescence open, branched. 4. L. littorale

7. Inflorescence not open, branched.

8. Flowers mostly subsessile on short, lateral bracteate branches. 5. L. brevifolium

8. Flowers solitary or paired at end of slender, sparsely-leaved stems. 6. L. palustre

4. Sepals thick-textured, margin not conspicuously scarious.

9. Stipular glands absent.

10. Petals ca 10 mm long; styles ca 5 mm long or less.

11. Stems long, slender; upper leaves closely appressed, inflorescence much reduced. 11. L. filiforme

11. Stems, leaves, inflorescence not as above.

12. Leaves persisting to summit of inflorescence; Galapagos Islands. 18. L. cratericola

12. Leaves not as above; locality other than Galapagos Islands.

13. Stems with few or no branches below the inflorescence.

14. Leaves thick-textured; inflorescence small and more or less compact; larger leaves mostly less than 2 cm long. 7. L. carneum

14. Leaves thin-textured; inflorescence open; larger leaves mostly more than 2 cm long. 8. L. erigeroides

13. Stems densely branched. 9. L. scoparium

10. Petals ca 15 mm long; styles ca 10 mm long. 16. L. chamissonis

9. Stipular glands present.

15. Stiffly upright, shrubby; Galapagos Islands. 19. L. harlingii

15. Not as above; locality other than Galapagos Islands.

16. Stems long, slender; upper leaves closely appressed; inflorescence much reduced. 11. L. filiforme

16. Stems, leaves, inflorescence not as above.

17. Styles more than 2.5 mm long; leaves linear to narrowly lanceolate. 10. L. oligophyllum

17. Styles less than 2.5 mm long; leaves lanceolate to ovate. 12. L. prostratum

1. Styles clearly united.

18. Styles united about one-half way or less.

19. Branches mostly spreading to divaricate; upper pedicels and leaf bases pilose. 13. L. polygaloides

19. Branches mostly rather stiffly spreading-ascending; upper pedicels and leaf bases glabrous. 14. L. ramosissimum

18. Styles united nearly to the summit.

20. Plants much branched, with spreading, procumbent branches; petals 10 mm long or less. 15. L. cremnophilum

20. Plants not as above; petals 15 mm long or longer. 17. L. macraei

1. LINUM BURKARTII Mildner, Phytologia 23:439. 1972. Type: Rosengurtt Gallinal 5755, Estancia Rincon de Santa Elena, Picada Castro, Arroyo Mansavilliagra, Dept. Florida, Uruguay, Nov. 1946 (holotype: SP; isotypes: MVM,US). (Fig. 1).

Perennial glabrous herb, 18-50 cm tall; stems one or several, branching near the base and in the inflorescence; leaves linear, 1-nerved, the larger 7.5-14.0 mm long, 0.8-1.4 mm wide, opposite near the base, alternate and reduced above, appressed; stipular glands absent; flowers in an open paniculate inflorescence, subsessile or on pedicels up to ca 1 cm long; sepals lance-ovate to ovate, sharply acuminate, mostly 1-nerved, the larger 3.7-4.4 mm long, margins scarious, prominently glandular-denticulate, inner tip glabrous; petals obovate, clawed, 7-9 mm long; stamens 3-4 mm long; staminodia small, deltoid; anthers broadly elliptical, 0.5-1.0 mm long; styles free, 3.5-4.5 mm long; fruit broadly ovate, sharply pointed, 2.2-2.5 mm high, 2.7-3.0 mm in diameter; false septa ca 3/4 completed, with margins conspicuously ciliate; seeds brown, elliptic, 1.7-1.9 mm long.

Linum burkartii is found in rocky or sandy places in southern Uruguay and eastern Argentina. Within its range are L. carneum, L. scoparium and L. littorale, from all of which it may be distinguished by the sharply pointed fruit and the prominently ciliate septa. Herbarium material of

L. burkartii has most commonly passed as L. littorale, but its relationship to that species or to any other South American species is not clear. As will be amplified later, the closest relatives of L. burkartii may well be species such as L. rupestre of Mexico and L. holstii of Africa, which it resembles closely.

In addition to the type specimen, twelve collections have been examined. Its distribution is shown in Fig. 24.

2. LINUM ORGANENSE Gardn., Hook. Lond. Jour. Bot. 4:100. 1845. Type: Gardner 5683, dry, bushy places, near the summit of the Organ Mts., Rio de Janeiro, Brazil (holotype: K; isotypes: BM, G). (Fig. 2).

Perennial glabrous herb, 21-85 cm tall, simple or branched at the base and much branched in or near the inflorescence, the lower stems becoming woody; leaves lanceolate to ovate or obovate, 1-nerved, mostly entire, rarely slightly denticulate, the larger 10-19 mm long, 4.0-9.0 mm wide, opposite below and alternate above, imbricate; stipular glands absent; flowers few on short pedicels in a very leafy inflorescence; sepals lanceolate to ovate, shortly acuminate, mostly 3-nerved, the larger 3.3-3.6 mm long, margins entire, thin or somewhat scarious, inner tip pilose; petals obovate, clawed, ca 9-12 mm long; stamens ca 3.5-3.7 mm long; staminodia small, filiform or narrowly deltoid; anthers narrowly elliptic, ca 1.0-1.3 mm long; styles free at the base, ca 4-6 mm long; fruit ovate, sharply pointed, ca 2.2-2.6 mm high, 2.2-2.5 mm in diameter; false septa ca ½ completed; seeds subelliptic, brown, ca 2.0-2.3 mm long.

Linum organense is restricted to the Organ Mts. near Rio de Janeiro, where it is found in fields and grassy places at elevations between 1400 and 2000 m. The broad leaves and few-flowered leafy inflorescence not only distinguish it from others in the area but make it one of the most easily recognized of all of the South American species.

In addition to the type specimen, 24 collections have been examined. Its distribution is shown in Figure 24.

3. LINUM SMITHII Mildner, Phytologia 23:439. 1972. Type: Reitz and Klein 7999, Serra do Oratorio, Bom Jardim, Sao Joaquin, Santa Catarina, Brazil, Dec. 15, 1958 (holotype: UC; isotypes: G,NY,US). (Fig. 3).

Perennial glabrous herb, 30-70 cm tall, simple or branched at the base and in or near the inflorescence; lower stems often becoming woody; leaves 1-nerved, entire or somewhat denticulate, the larger 12-19 mm long, 4.0-5.2 mm wide, reduced in the inflorescence, opposite below, alternate above, lanceolate to ovate or obovate; stipular glands present; inflorescence open, paniculate; flowers shortly pedicellate, scattered; sepals lanceolate to ovate, shortly acuminate, mostly 3-nerved, the larger 2.9-3.6 mm long, margins denticulate and more or less scarious, inner tip pilose; petals obovate, clawed, ca 7.5-10.0 mm long; stamens ca 3.8-4.5 mm long; staminodia small, filiform or narrowly deltoid; anthers narrowly elliptic, ca 0.7-1.2 mm long; styles free at the base, ca 3.3-4.0 mm long; fruit ovate, sharply pointed, ca 2.2 mm high, 2.3 mm in diameter; false septa ca ½ completed; seeds subelliptic, brown, ca 2 mm long.

Linum smithii is found in moist areas at elevations of 1400 to 1600 m in the eastern parts of Santa Catarina and Rio Grande do Sul provinces of southern Brazil. It is distinguished from other species in the area except L. littorale var. oblongifolium by its comparatively broad leaves and from that variety by the presence of stipular glands. Fruit, acute or sharp pointed at the summit, serve to help distinguish it from any other species in its range. Although it has in the past been considered a part of L. organense, and some specimens we have examined have been annotated "L. organense var. smithii", there are sufficient differences in flower and fruit morphology, as well as habit, to show that these two plants warrant separation at the species level. The ranges of the two are separated about 900 km. Both L. smithii and L. organense have certain attributes which are also found in some plants of South Africa and Mexico. Partly on these bases, these plants are thought to be among the most primitive of the genus in South America and, as will be discussed later, may serve as a theoretical starting point for evolutionary trends which have led ultimately to most other South American species.

In addition to the type specimen, only four other collections have been examined. The distribution is shown in Fig. 24.

4. LINUM LITTORALE St. Hil., Fl. Bras. Mer. 1: 133. 1825.

Perennial glabrous herb, 25-60 cm tall, branched at the base and in the inflorescence; leaves 1-nerved, the larger 6-17 mm long, 1.4-7.0 mm wide, opposite below, alternate above, appressed, linear to broadly lanceolate; stipular glands present or sometimes none; flowers shortly pedicellate in an open inflorescence, scattered or frequently solitary or in few flowered clusters at ends of inflorescence branches; sepals lance-ovate, acuminate, 3-5-nerved, thin with prominent nerves, the larger 2.9-4.0 mm long, margins scarious, often involute, glandular-denticulate; petals lemon yellow, obovate, clawed, 5.5-7.4 mm long; stamens 3.5-4.5 mm long; staminodia small, narrowly deltoid; anthers ca 0.9 mm long; styles free or very briefly connate at the base, ca 2.8-4.0 mm long; fruit broadly ovate, obtuse, 1.8-2.3 mm high, 2.5-2.9 mm in diameter; false septa ca ½ completed; inner margin of true septa sparsely ciliate; seeds brown, subelliptic, 1.8-2.0 mm long.

A conservative treatment of this, the most variable of the South American species, distinguishes two varieties:

Leaves linear to narrowly lanceolate
L. littorale var. littorale

Leaves broadly lanceolate to ovate
L. littorale var. oblongifolium

L. LITTORALE VAR. LITTORALE. Type: St. Hilaire 61, in arenosis maritimis prope lacum Araruama, Rio De Janeiro, Brazil (holotype: P). (Fig. 4).

Linum littorale var. glandulosum St. Hil., Fl. Bras. Mer. 1: 134. 1825. Type: St. Hilaire 1806, Ararangua, Santa Catarina, Brazil (holotype: P). Linum junceum St. Hil., Fl. Bras. Mer. 1: 134. 1825. Type: St. Hilaire 403, Sao Joao del Rey, Minas Gerais, Brazil (holotype: P).

Linum littorale forma glomeratum Urb., Mart., Fl. Bras. 12: 2: 463. 1877. Type: Sello s.n. (not seen).
Linum littorale St. Hil. var. panniculatum Urb., Mart. Fl. Bras. 12: 2: 464. 1877. Based on L. littorale St. Hil.
Linum littorale St. Hil. var. bahiense Urb., Mart. Fl. Bras. 12: 2: 464. 1877. Type: Schott 4582, Salvador (isotypes: F,US).

Linum littorale var. littorale is found in a variety of more or less open habitats along the eastern part of the continent, mostly near the coast from Salvador, Brazil, southward to southern Uruguay. It is an extremely variable taxon, especially in habit. Several of these variants have been named but, based on the material available at this time, they tend to merge with one another to such a degree that attempting to distinguish them formally seems impracticable. Our collection from the approximate type locality near Lake Araruama has been found to have a chromosome number of n=36, double the number of any of the other eastern South American species thus far counted. It also has pollen grains with six germ pores, rather than the usual three, a feature not uncommon in tetraploids in this genus. In Santa Catarina province there is a population characterized by the absence of stipular glands, while in the southernmost part of the range are found plants which tend toward L. scoparium and L. carneum in having sepals of thicker texture, less prominently toothed (compare insets in figs 4 and 8). Smith and Klein 13536 from near Horizonte, Paraná, is a compact plant with closely imbricate leaves which deserves further study, as does this whole complex, among the most troublesome to classify of any on the continent.

Approximately 56 collections have been examined. The distribution is shown in Fig. 25.

L. LITTORALE St. Hil. var. OBLONGIFOLIUM (Urb.) Rogers.
Phytologia 27: 440, 1974; Fl. Il. Catarinense. Lináceas: 22, 1975.
Type: Glaziou 8285, Prov. Rio de Janeiro, Brazil (isotype: K). (Fig. 5).

Linum junceum St. Hil. var. oblongifolium Urb., Mart. Fl. Bras. 12: 2: 467. Tab. 100, Fig. 2. 1877.

Differing from the typical variety principally by the key characters. Stipular glands, which are frequently but not consistently present in the typical variety, are lacking in the specimens of var. oblongifolium thus far examined.

Linum littorale var. oblongifolium is found in grassy fields and more or less boggy areas at about 1000 to 1500 m elevation, in the Organ Mountains near Rio de Janiero and also intermittently southward to the provinces of Santa Catarina and Rio Grande do Sul. It resembles L. smithii, but differs from that species by the absence of stipular glands, which are always present in L. smithii.

About 15 collections have been examined. The distribution is shown in Fig. 25.

5. LINUM BREVIFOLIUM St. Hil. & Naud., Ann. Sc. Nat., Ser. II, Bot. 18: 30. 1842. Type: Gaudichaud 1274, Rio Grande do Sul, Brazil, 1833 (holotype: P). St. Hilaire did not designate a specimen but this is the only

collection he annotated as L. brevifolium. (Fig. 6).

Linum oligophyllum Willd. var. squamifolium Schiede, Linnaea 1: 68: 1826. Type: Martius "Prov. of Bahia". The annotations on a Martius specimen of L. brevifolium at M indicate that it may be the basis for this variety. The original label does not give locality. L. brevifolium is not otherwise known from Bahia, however.
Linum brevifolium St. Hil. and Naud. f. majus Urb., Mart. Fl. Bras. 12: 2: 462. Tab. 98, Fig. 2, 1877. Both specimens cited by Urban for this form are L. brevifolium.
Linum brevifolium St. Hil. and Naud. f. oppositifolium Urb., Mart. Fl. Bras. 12: 2: 462. 1877. Sello collection cited by Urban has not been seen, but our interpretation of Linum brevifolium includes this form.
Linum brevifolium St. Hil. and Naud. f. rigidum Urb., Mart. Fl. Bras. 12: 2: 462. 1877. Sello specimen cited by Urban not seen, but almost certainly this form is part of L. brevifolium as we interpret it.
Linum brevifolium St. Hil. and Naud. f. squamifolium (Schiede) Urb., Mart. Fl. Bras. 12: 2: 462. 1877.

Perennial glabrous herb, 12-80 cm tall, simple or sparsely branched; stems strongly angled; leaves 1-nerved, the larger 3.5-9.0 mm long, 0.8-2.0 mm wide, the lower opposite, the upper alternate, appressed, linear to subulate; stipular glands inconspicuous or absent; inflorescence racemose or spicate; flowers subsessile, terminating densely bracteate, very reduced branches; sepals lanceolate, sharply acuminate, mostly 5-nerved, 3.1-4.0 mm long, glandular-denticulate, inner tip pilose; petals ca 8-10 mm long, obovate, sometimes retuse, clawed; stamens 3.5-4.3 mm long; staminodia small, deltoid or none; anthers narrowly elliptic, ca 0.7 mm long; styles separate, 3.6-5.1 mm long; fruit broadly ovate, obtuse, ca 1.5-2.0 mm high, 2.1-2.6 mm in diameter; false septa ca ½ completed; seeds brown, elliptic, ca 1.4-1.7 mm long.

The distinctive racemose inflorescence of this species easily distinguishes it from all others. Nevertheless, flower and fruit structure clearly relate it so closely to L. littorale that it could be considered a variety of that species. Dusen 2256 from Curitiba (S) clearly combines traits of the two. L. brevifolium is found along stream banks, grassy and rocky fields and in marshy areas. It is confined to Brazil, but ranges from Minas Gerais southwestward along the coast to the vicinity of Porto Alegre, Rio Grande do Sul.

In addition to the type specimen, approximately 25 additional specimens have been examined. The distribution is shown in Fig. 25.

6. LINUM PALUSTRE Gardn., Hook. Lond. Jour. Bot. 4: 99. 1845. Type: Gardner 5682, near the summit of the Organ Mts., Rio de Janeiro, Brazil, Mar., 1841 (holotype: K; isotype: BM). (Fig. 7).

Perennial glabrous herb, 35-40 cm tall; stems slender, much branched at the base, infrequently in the inflorescence; leaves very reduced, 1-nerved, ca 2 (rarely 5) mm long, 0.5-1.5 mm wide, alternate or occasionally opposite below, closely appressed, subulate to narrowly lanceolate; stipular glands absent or, sometimes present at the base of floral bracts; flowers

terminal and solitary or rarely on bracteate, reduced branches as well; sepals narrowly ovate, acuminate, 3-5 nerved, the larger ca 2.5 mm long, glandular-denticulate, inner tip pilose; petals deep yellow, obovate, clawed, 6 mm long or more; stamens ca 4 mm long; staminodia small, deltoid; anthers narrowly elliptic, ca 0.5 mm long; styles separate, ca 2.5 mm long; fruit obtuse, ca 2 mm high, 3 mm in diameter; false septa 1/3 completed; seeds light brown, elliptic, ca 2 mm long.

The terminal flowers, reduced leaves and slender upright stems distinguish this species but it is very close to L. brevifolium and, like it, is so closely related to L. littorale that it could be considered a depauperate form of that species. L. palustre is known only from the southern part of Minas Gerais and in the Organ Mts., near Rio de Janeiro, where it is found in moist grassy areas.

In addition to the type specimen, the following collections have been examined: Glaziou 14500, Morro do Carapuca, Caraça, Minas Gerais (G, P, R) and Ule 2450, Sierra de Caraça, Minas Gerais (R,US). The distribution is shown in Fig. 25.

7. LINUM CARNEUM St. Hil., Fl. Bras. Mer. 1: 132. 1825. Type: St. Hil., Estancia de Suarez near St. Joseph, Cisplatine Prov. (Brazil) Uruguay (holotype: P). (Fig. 8).

Linum formosum Urb., Mart. Fl. Bras. 12: 2: 460. Tab. 97. Fig. 2. 1877. Type: Sello 3122, Brasilia Meridonali (M).

Perennial herb, 20-40 cm tall, glabrous or essentially so, branching at the base and in the inflorescence; leaves lanceolate, mostly 1-nerved, the larger 8-22 mm long, 3.0-5.0 mm wide, opposite below, alternate above; stipular glands none; inflorescence more or less compact, paniculate, with rather stiffly ascending-spreading branches; flowers shortly pedicellate, scattered; sepals ovate, acuminate, mostly 1-nerved, but sometimes with an additional pair of lesser nerves, 3.4-4.0 mm long, the outer often slightly longer than the inner, thick-textured, the inner denticulate; petals obovate, occasionally obcordate, shortly clawed, 7-10 mm long; stamens 4.0-4.5 mm long; staminodia small, deltoid; anthers subelliptic, 0.5-0.8 mm long; styles separate or barely connate at the base, 3-4 mm long; fruit depressed spheroidal, the summit reddish, 2.2-2.5 mm high, 2.8-3.1 mm in diameter; false septa ca ½ developed; true septa with occasional cilia at the inner margin; seeds brown, elliptic, ca 2 mm long.

The scattered flowers and fruit, the rather stiffly ascending-spreading branches, the depressed globose capsules and especially the thick-textured sepals serve to distinguish this species from others of the genus in this area, except L. erigeroides (see inset in Fig. 8). These two species are closely allied and in some earlier examinations of specimens, they were combined under the name L. carneum. With the study of further material, it seems clear that the form with narrow, thin-textured, more or less spreading leaves and with open and ample inflorescence deserves species recognition as L. erigeroides, while the form with broad, more or less appressed, thick-textured leaves and reduced inflorescence, should continue to be called L. carneum. L. carneum and L. erigeroides are probably very closely related

to L. scoparium, a frequently smaller and much-branched plant with inflorescence more diffuse, which is found in Uruguay, eastern Argentina and Bolivia, but which apparently does not extend into southern Brazil.

Linum carneum is an uncommon plant of grassy fields in the Province of Rio Grande do Sul, Brazil, and adjacent Uruguay. Four collections, besides the type specimen, were examined. The distribution is shown in Fig. 26.

8. LINUM ERIGEROIDES St. Hil., Fl. Bras. Mer. 1: 132. 1825. Type: St. Hil. Estancia de Suarez near St. Joseph, Cisplatine Prov., (Brazil) Uruguay (holotype: P). (Fig. 9).

Linum littorale St. Hil. var. corymbosum Urb. Mart. Fl. Bras. 12: 2: 464. 1877. Isotype: Sello 363. Montevideo. (M).
Linum littorale St. Hil. var. cuspidatum Urb. Mart. Fl. Bras. 12: 2: 464. 1877. Type: (not seen). Urban cited a Sello collection without date or number. A Sello collection (M) annotated by Urban as this variety proves to be L. erigeroides.

Perennial herb, 30-60 cm tall, glabrous, simple, branching at the base and in the inflorescence; leaves linear, mostly 1-nerved, the larger 18-35 mm long, 0.5-4.0 mm wide, opposite near the base of the plant, alternate above; stipular glands none; inflorescence open, paniculate, with rather stiffly ascending-spreading branches; flowers on pedicels becoming as much as 1 cm or more long, scattered; sepals lanceolate-ovate, subacuminate, mostly 1-nerved, but sometimes with an additional pair of lesser nerves, 3.0-4.0 mm long, thick-textured, the inner denticulate; petals obovate, shortly clawed, 7-10 mm long; stamens 4.0-4.5 mm long; staminodia small, deltoid; anthers subelliptic, 0.6-1.0 mm long; styles separate or barely connate at the base, 3-4 mm long; fruit depressed spheroidal, the summit reddish, 2.2-2.5 mm high, 2.9-3.2 mm in diameter; false septa ca ½ developed; true septa with occasional cilia at the inner edge; seeds brownish, elliptic, ca 2 mm long.

Linum erigeroides grows in open, grassy, mostly moist or swampy areas, in the Rio Grande do Sul Prov. of Brazil, in Uruguay and in eastern Argentina. This species appears to be closely allied with L. carneum and L. scoparium. See L. carneum for a brief discussion of the differences.

About 45 collections have been examined. The distribution is shown in Fig. 26.

9. LINUM SCOPARIUM Griseb., Abh. Will. Gött. 19: 103. 1874. Type: Lorentz 149, in collibus rupestribus, Cordoba, Argentina (isotype: CORD). (Fig. 10).

Perennial glabrous herb, 12-35 cm tall, the slender stems with more or less spreading branches at the base and to a lesser extent along the stem and in the inflorescence; leaves 1-nerved, the larger 3.6-14.0 mm long, 0.5-4.0 mm wide, the lower opposite, the upper alternate, appressed, linear, somewhat pilose at the base; stipular glands mostly absent; inflorescences open, paniculate; sepals lanceolate to ovate, sharply acuminate, 3-4 mm long, 3-5-nerved, glandular-denticulate, the inner tip pilose; petals obovate,

clawed, ca 8-10 mm long; stamens ca 4-6 mm long; staminodia small, deltoid; anthers elliptic, 0.5-1.0 mm long; styles separate, ca 3-5 mm long; fruit obtuse to somewhat pointed, reddish on the upper surfaces, 2.2-2.6 mm high, 2.8-3.6 mm in diameter; false septa ca 1/3 completed; true septa with a few cilia at the inner margin; seeds brown, subelliptic, ca 1.8-2.3 mm long.

Widely ranging, L. scoparium has been collected from western Uruguay northwestward through Argentina to west central Bolivia within a few km of the Peruvian border near La Paz. It is found in grassy loamy fields, rocky areas and occasionally moist places between 1000 and 3000 m elevation. It is a variable species in habit with some Bolivian populations more leafy. The type specimen is a comparatively coarse plant with short pedicels. It and other collections from near the type locality may differ enough to warrant restricting the name to plants of that area. Additional material needs to be collected. Throughout much of its range, L. scoparium is the only representative of the genus. The southernmost part of the range is shared with the closely related L. carneum and L. erigeroides; the differences between the two were described under the former. In the northern part of the range, plants which closely resemble the Peruvian L. oligophyllum may be found. The most conspicuous difference is the absence of stipular glands in L. scoparium. The ranges of the two as presently known are disjunct, with L. oligophyllum not being found in Bolivia and L. scoparium not having been collected in Peru, but additional field work in that region may reveal that the two species merge in the border region of these two countries. A single broad leaved specimen (Castellanos 20108 BA) from Jujuy in northern Argentina, somewhat distinct from L. scoparium, indicates more collections from this area are needed.

About 35 collections have been examined. The distribution is shown in Fig. 26.

10. LINUM OLIGOPHYLLUM Willd. ex Schult., Syst. 6: 758. 1820. Type: Willdenow Herb. 6233 (holotype: B). (Fig. 11).

Linum oligophyllum Willd. var. glandulosum Schiede, Linnaea 1: 68. 1826. Based on L. oligophyllum Willd.
Linum bipunctatum Bartl. ex Steud., Nom. Ed. II, 2: 51, 1841, nom. illegit.

Perennial glabrous herb, 6-40 cm tall; stems mostly upright, occasionally decumbent, branched at the base, along the stem and in the inflorescence; leaves 1-nerved, the larger 3-15 mm long, 0.5-3.0 mm wide, opposite below, alternate above, more or less spreading or the upper sometimes appressed, linear to lanceolate, acute to acuminate; stipular glands present; flowers frequently solitary and terminal but sometimes scattered in a more or less leafy paniculate inflorescence; sepals ovate, acuminate, 3-5 nerved, 3.2-4.3 mm long, margins denticulate, rarely entire, inner tip mostly glabrous; petals yellow, obovate, clawed, ca 7-12 mm long, the buds reddish without; stamens 4.0-5.5 mm long; staminodia short, deltoid or filiform; anthers elliptic, 0.5-1.0 mm long; styles free or briefly united at the base, 2.5-4.5 mm long; fruit broadly ovate, obtuse, 2.4-2.7 mm high, 3.0-3.4 mm in diameter, reddish brown on the upper surfaces; false septa ca ½ completed; seeds brown, subelliptic, 2.1-2.5 mm long.

The type of L. oligophyllum consists of three rather scanty specimens. There is no indication on the sheet as to locality, collector or date. They appear to represent a mixed collection. The left hand and center specimens are here taken as the holotype of L. oligophyllum. They bear stipular glands and agree with what we interpret as L. oligophyllum. The third plant, a fragment, lacks stipular glands and more closely resembles the plant we recognize as L. polygaloides. We include here figure 12, which shows more representative examples.

L. oligophyllum consists of a variable series of populations, the differences being mostly in habit, leaf size and, to a certain extent, style union. A rather widely collected plant, its range extends along both sides of the Andes Mts. from near Cuzco, Peru, northward to near Quito, Ecuador. It is found on rocky slopes in more or less open areas at elevations between 1800 and 3500 m. In the northern part of the range it may be confused with L. filiforme. The latter is a more slender plant, usually lacking stipular glands and possessing entire sepals. More collections are needed, however, from this part of South America to resolve the disposition of these two species. L. oligophyllum is also often confused with L. polygaloides where their ranges coincide in central Peru. The latter tends to have somewhat larger floral parts, particularly the styles, which are more than 5 mm long and united about 1/3 of the way or more, while in L. oligophyllum they are generally less than 5 mm and are separate or nearly so. There is no question, however, but that the two species are closely allied. L. oligophyllum, in fact, seems to be a transitional species between L. scoparium in the east, L. filiforme in the north, and L. polygaloides in the west.

About 50 collections of L. oligophyllum have been examined. The distribution is shown in Fig. 27.

11. LINUM FILIFORME Urb., Linnaea 41: 643. 1877. Type: Ruiz?, Peru? (photo of holotype: F). (Fig. 13).

Perennial glabrous herb, 19-50 cm tall; stems long, slender, branched at the base and simple or sparsely branched in the inflorescence; leaves 1-nerved, the larger ca 2.4-6.0 mm long, 0.5-1.6 mm wide, opposite or alternate, the upper reduced, appressed, linear or subulate; stipular glands mostly absent; flowers few, scattered, or more frequently solitary and terminal on inflorescence branches; sepals ovate, acuminate, 3-5-nerved, the larger 3.4-4.2 mm long, margins entire, inner tips glabrous; petals obovate, clawed, ca 9-10 mm long; stamens ca 4-5 mm long; staminodia small, deltoid or none; anthers elliptic, ca 0.5-0.9 mm long; styles separate, 3.4-4.1 mm long; fruit ovate, obtuse, reddish on the upper surfaces, 2.0-2.5 mm high, 2.2-3.0 mm in diameter; false septa ca 1/3 completed; seeds brown, subelliptic, ca 1.7-2.3 mm long.

The collector and place of origin of the type specimen are not known with certainty, although it was believed to have come from Peru of Bolivia and the name of Ruiz as collector was added later. The specimen was described in some detail by Urban when he named this species and there appears to be no question as to its status as the type, although it is now represented only by a photograph. Specimens which we have assigned to this species have come mostly from Ecuador. As noted under the discussion of L. oligophyllum, more collections from this part of South America are needed. As

circumscribed here, L. filiforme can usually be distinguished from L. oligophyllum, the only species with which its range overlaps, by the long slender stems and reduced leaves. The absence of stipular glands serves further to distinguish this from L. oligophyllum. However, some Ecuadorian plants with the same habit have quite well developed glands. They are included here, but may warrant formal recognition with further study.

About ten collections have been examined. The distribution is shown in Fig. 27.

12. LINUM PROSTRATUM Domb. ex Lam., Encyc. 3: 525. 1791.

Perennial or sometimes annual herb, 6-30 cm tall; stems upright to nearly procumbent, branched at the base and in the inflorescence; leaves 1-nerved, the larger 6-17 mm long, 1.8-5.1 mm wide, opposite below, alternate above, lanceolate, oblanceolate to narrowly obovate; stipular glands present; flowers very shortly pedicellate along spreading-ascending branches; sepals ovate, shortly acuminate, 3-5-nerved, entire or sparsely denticulate, inner tip pilose; petals lemon yellow, obovate, clawed, ca 5 mm long; stamens ca 3-4 mm long; staminodia small, deltoid or none; anthers elliptic, ca 0.6 mm long; styles free or very briefly connate at the base, ca 1.6-2.4 mm long; fruit broadly ovate, obtuse, 1.5-2.2 mm high, 1.9-2.7 mm in diameter; false septa ca ½ completed; inner margins of true septa with some cilia; seeds brown, elliptic, 1.3-1.9 mm long.

L. prostratum is comprised of two varieties which may be distinguished as follows:

Perennial; ca 20-30 cm tall; leaves ca 11-17 mm long, ca 3-5 mm wide
L. prostratum var. prostratum

Predominantly annual; ca 6-10 cm tall;leaves ca 6-9 mm long, ca 2-3 mm wide
L. prostratum var. parvum

L. PROSTRATUM var. PROSTRATUM. Type: Dombey, in collibus siccis, Lima, Peru (holotype: P; probable isotypes: BM,K,P). (Fig. 14).

Linum paposanum Phil., Reise Wueste Atac. 13. 1860. Type: Philippi, Paposo, Chile (photo: F).

Var. prostratum has an intermittent range near the coast in southern Peru and northern Chile. Although several specimens have been examined from both Chile and Peru, definite localities have been identified only from near Paposo, Chile and Lima, Peru, separated by some 1500 km. The smaller floral parts distinguish this from L. oligophyllum and L. polygaloides, the ranges of which might overlap that of L. prostratum, while the separate styles additionally distinguish it from L. polygaloides. Near Paposo may also be found L. cremnophilum, but that species has a very different mat-like habit and styles which are united nearly to the summit.

L. prostratum var. prostratum is found in rocky, open areas mostly at elevations of less than 500 m. About 16 collections have been examined. The distribution is shown in Fig. 28.

L. PROSTRATUM var. PARVUM (Johnst.) Mildner. Type: Johnston 3549, hillside directly back of Mollendo, Dept. Arequipa, Peru, Oct. 16, 1925. (holotype: GH). (Fig. 15).

L. parvum Johnst., Contrib. Gray Herb. 85: 172. 1929.

Var. parvum is known from just two areas, near Lima and near Mollendo, Peru. Both are extremely dry places and the annual habit and small stature may both be related to the conditions imposed by this habitat. The variety is found at elevations of less than 300 m. In addition to the type specimen, four collections have been examined. The distribution is shown in Fig. 28.

13. LINUM POLYGALOIDES Planch., Hook. Lond. Jour. Bot. 7: 487. 1848. Type: Mathews 615, Cerro Pasco, Peru (lectotype: K). (Fig. 16). This collection has been generally considered to be the type. Three collections of this species on the sheet, a second of Mathews, from Purruchucha and another, Cuming 568, were all cited in the original description. The plant at lower left on the herbarium sheet is here interpreted to be the type.

Linum andicolum Krause Engl. Bot. Jahrb. 40: 278. 1908. Type. Weberbauer 2407, Tarma, Dept. Junin, Peru (photo: F).
Linum macraei Benth. f. peruviana Macbr., Field Mus. Pub. Bot. 13: 623. 1949. Type: Weberbauer 5812, Ocros, Ancash, Peru (F,GH,NY).

Perennial glabrous herb, 8-22 cm tall; stems with more or less spreading branches; leaves 1-nerved, the larger 11-17 mm long, 1.0-2.6 mm wide, opposite below but mostly alternate, sparsely pilose at the base, linear to lanceolate, acuminate; stipular glands present; flowers on pedicels up to ca 1 cm long, scattered in a more or less open leafy-bracted inflorescence; sepals ovate, acuminate, 3-5-nerved, the larger 3.8-4.2 mm long, margins denticulate or occasionally entire, inner tip glabrous or pilose; petals yellow, obovate, clawed, 10-14 mm long, buds reddish without; stamens ca 6.0-8.5 mm long; staminodia short, filiform; anthers narrowly elliptic, 0.7-1.4 mm long; styles united at least 1/3, 5.5-10.0 mm long; fruit broadly ovate, obtuse, 2.4-2.8 mm high, 2.9-3.5 mm in diameter, reddish brown on upper surfaces; false septa ca ½ completed; seeds brown, subelliptic, ca 2.0-2.6 mm long.

L. polygaloides may be found in open places, rocky slopes at elevations of 1800-3700 m from central Peru, southward along the western slope of the Andes Mts. to near Arequipa in southern Peru. It is most often confused with L. oligophyllum with which it is very closely allied, but may usually be distinguished from it by the larger floral parts and the partially united styles. L. andicolum has been identified by photograph only and is placed here principally on the basis of the united styles it is said to have.

L. polygaloides provides a transition from the comparatively small flowered, separate-styled L. oligophyllum of Peru to L. ramosissimum and L. macraei, with larger flowers and, in the latter, united styles. The whole complex is rather a puzzling one and additional collections would be highly desirable. Plants here placed in L. ramosissimum differ principally in habit from L. polygaloides and it may well be that the whole disjunct series of populations could better be called L. ramosissimum. A single collection from Peru, called L. macraei f. peruviana, included here, differs from other material of L. polygaloides principally in having styles united almost to the summit. In this regard it resembles L. macraei too closely, but is disjunct from that species by more than 2000 km.

In addition to the type specimen, 22 collections have been examined. The distribution is shown in Fig. 27.

14. LINUM RAMOSISSIMUM Gay Flor. Chil. 1:463. 1845. Type:Gay 67, Prov. Coquimbo, Chile (holotype: P; probable isotypes: s.n., K and photo, B). (Fig. 17).

Linum obtusifolium Phil., Anal. Univ. Chile 82: 1105. 1893. Type: Philippi, Fray Jorge, Chile (photo: F).
Linum chamissonis Schiede var. obtusifolium (Phil.) Reiche, Anal. Univ. Chile 93: 841. 1896.
Linum chamissonis Schiede var. ramosissimum (Gay) Reiche, Anal. Univ. Chile 93: 841. 1896.

Perennial glabrous herb, 10-30 cm tall; stems angled, sometimes somewhat spreading, generally much branched, the branches stiffly subascending; leaves 1-nerved, the larger ca 9-22 mm long, 1.0-3.2 mm wide, mostly alternate, linear to narrowly lanceolate, acuminate, sometimes extending into the inflorescence; stipular glands present; flowers scattered in a more or less open few-flowered panicle; sepals ovate, acuminate, lanceolate, margins scarious, entire or sparsely denticulate, 3-5, rarely 7-nerved, 4.0-5.5 mm long, inner tip pilose; petals obovate, clawed, ca 12-14 mm long, the buds reddish without; stamens ca 6-9 mm long; staminodia small, filiform to deltoid, or none; anthers narrowly elliptic, ca 1 mm long; styles sometimes nearly free but usually united to about ½ way, ca 4-6 mm long; fruit ovate, depressed, 2.3-2.5 mm high, 3.2-3.5 mm in diameter, reddish brown on the upper surfaces; false septa about 3/4 completed; true septa with inner margins sparsely ciliate; seeds brown, elliptic, 2.1-2.4 mm long.

Although Gay's original description of L. ramosissimum did not include a collection number or specific locality, his number 67 from Coquimbo has been accepted as the type. Interpreted as such, L. ramosissimum is known from only a relatively small coastal area of Chile, centering in the Fray Jorge area near the Limari River, about 250 km north of Valparaiso. The species is very similar to L. polygaloides, which otherwise is found about 1500 km northwest in Peru. L. ramosissimum is rather more amply and stiffly branched and there are minor differences in flower size, but there is little question but that the two are closely allied. Further study may show that the two populations should be combined, in which case L. ramosissimum would be the prior name. We are at this point reluctant to combine the two, since material of L. ramosissimum, especially the type collection, is not very adequate. Additional material is needed, particularly from the vegetational "island" known as the Fray Jorge area. L. macraei also ranges northward into the range of L. ramosissimum. It may ordinarily be distinguished by its larger flowers and styles united nearly to the summit, but some collections appear intermediate. This large complex, which includes L. polygaloides, L. ramosissimum and L. macraei, as well as L. oligophyllum, L. filiforme, L. prostratum and L. chamissonis, extends intermittently from Ecuador to central Chile and is probably the most challenging in terms of species circumscription. The original description of L. obtusifolium notes the absence of stipular glands. Since no specimens lacking stipular glands have been seen from near the type locality of L. obtusifolium and since the remainder of the description and the photograph of the type fits L. ramosissimum very well, it appears safe to include it here. L. obtusifolium has been compared with L. chamissonis, which does lack these glands, but that species differs in other ways and as

now known, has a well-defined range several hundred km to the south.

In addition to the type specimen, about 9 other collections have been examined. The distribution is shown in Fig. 28.

15. LINUM CREMNOPHILUM Johnst. Contrib. Gray Herb. 85:62. 1929. Type: Johnston 5707, crevices at head of fog-bathed sea-cliffs near Aguada Cachina, Dept. Taltal, Chile, Dec. 15, 1929 (holotype: GH; isotype: K). (Fig. 18).

Perennial glabrous herb, ca 10-17 cm tall; stems mostly low, with spreading branches; leaves 1-nerved, the larger 4.5-7.5 mm long, 1.4-2.2 mm wide, opposite or alternate, lanceolate to ovate or obovate; stipular glands present; flowers solitary and terminal or scattered in a few-flowered paniculate inflorescence; sepals ovate, shortly acuminate, the larger 3.0-3.6 mm long, 3-5-nerved, entire; petals obovate, clawed, 9.5-10.0 mm long; stamens 6.8-7.0 mm long; staminodia small, deltoid or filiform; anthers elliptic, ca 1 mm long; styles united nearly to the summit, ca 8.0 mm long; fruit obtuse, 2.2-2.9 mm high, 2.6-3.2 mm in diameter; false septa ca ¼ completed; seeds light brown, subelliptic, ca 2 mm long.

L. cremnophilum is a very localized species on cliffs overlooking the sea near the Antofagasta-Atacama provincial boundary. Its mat-like growth makes it one of the most easily recognized of the South American species. The only other species of Linum known to grow near is L. prostratum, which is further distinguished by the essentially separate styles.

In addition to the type specimen the following collection has been seen: Johnston 5781, near Aguada Grande, Dept. Taltal, Dec. 16, 1925. The distribution is shown in Fig. 28.

16. LINUM CHAMISSONIS Schiede, Linnaea 1: 69. 1826. Type: Chamisso, slope near Biobio R., Chile (not seen). (Fig. 19). Chamisso's collection has not been located but the original description clearly refers to this distinctive species

Linum aquilinum β grandiflorum Hook. & Arn., Hook. Bot. Misc. III: 140. Type: Cuming 127. Concepcion (CGE,K).
Linum oligophyllum Hook. & Arn. non Willd., Bot. Beech. Voy.:11. 1841. (type not seen).
Linum macraei Benth. var. cumingii Urb., Linnaea 41: 626. 1877. This variety was meant to be based upon L. cumingii of Loddiges. That species is, however, best assigned to L. macraei, while this variety, represented by Cuming 127 (CGE,K), is L. chamissonis.

Perennial glabrous herb, ca 6-50 cm tall, simple or branched from the woody base as well as in the inflorescence; leaves 1-nerved, the larger 8-25 mm long, 1.5-3.0 mm wide, opposite below alternate above, often imbricate, linear to lanceolate or the lower broader; stipular glands absent; inflorescence few-flowered, racemose or paniculate, flowers often clustered near ends of branches; sepals lanceolate to ovate, sharply acuminate, 3-5-nerved, 4.6-6.0 mm long, the margins glandular-denticulate, inner tip pilose; petals yellow-orange, broadly obovate, clawed, 14.0-15.8 mm long; buds reddish without; stamens 9.5-12.0 mm long; staminodia short, filiform to deltoid; anthers narrowly elliptic, 1.1-1.5 mm long; styles free or very briefly united, ca 11-13 mm long; fruit broadly ovate, obtuse, 2.6-3.0 mm high, 2.8-3.5 mm in diameter; false septa about ½ completed; true septa with inner margins sparsely ciliate; seeds brown, subelliptic, 2.2-2.8 mm long.

L. chamissonis is the southernmost species of Linum in South America, being restricted to the region about Concepción and southward to about the 39th parallel near Temuco in south-central Chile, where it is found in sandy to loamy soil on hills and slopes. The only species with which its range overlaps is L. macraei from which it is easily distinguished by the separate styles and absence of stipular glands. It is one of the most distinctive of South American species.

About 40 collections have been examined. The distribution is shown in Fig. 29.

17. LINUM MACRAEI Nenth. Edward's Bot. Reg. 16: sub t. 1326. 1830.

Perennial glabrous or puberulent herb, ca 7-60 cm tall; stems simple or mostly branched at the base, along the stems and in the inflorescence, often compact; leaves 1-nerved, the larger 5-20 mm long, 0.8-3.5 mm wide, opposite below, alternate above, often imbricate, linear to lanceolate; stipular glands present, sometimes on the sepals as well; flowers solitary and terminal or in few-flowered clusters, sometimes scattered; sepals lanceolate to ovate, sharply acuminate, 3-5-nerved, 4.5-7.0 mm long, entire or sparsely denticulate, inner tip mostly pilose; petals yellow, obovate, clawed, ca 15-21 mm long, buds orange-red without; stamens 10.0-13.5 mm long; staminodia narrowly deltoid or sometimes none; anthers narrowly elliptic, 1.1-2.2 mm long; styles united nearly to the summit in the southern part of range, somewhat less so in the northern part, ca 11-15 mm long; fruit broadly ovate, obtuse, 2.6-3.0 mm high, 3.3-3.7 mm in diameter, reddish brown on upper surfaces; false septa ca 1/3 completed; true septa with occasional cilia at the inner margins; seeds dark brown, narrowly elliptic, ca 2.5-3.0 mm long.

Two more or less intergrading varieties may be recognized.

Stems glabrous; sepals mostly without stipular glands; habit more or less open — L. macraei var. macraei

Stems puberulent; sepals with stipular glands; habit low and compact — L. macraei var. marticorenae

L. MACRAEI var. MACRAEI. Type: McRae, Valparaíso, Chile, 1825 (holotype: K; isotype: G). (Fig. 20). The original description is of a plant without data other than "gathered at Valparaíso by Mr. McRae, collector to the Horticultural Society". The 1825 McRae collection is accepted as the type.

Linum cumingii Lodd. Bot. Cab. 20: t. 1996. 1833.
No Cuming collection was cited but an illustration seems clearly to be this variety. See L. macraei var. marticorenae for further discussion of this name.
Mesynium chilense Raf., Fl. Tell. 3: 33. 1836. Based on L. macraei.
Linum chironioides Griseb., Abh. Wiss. Gött. 6: 118. 1854. Type: Philippi 398, Valparaíso, Chile (isotypes: BM,G,LE,P).
Linum macraei Benth. var. oligophyllum (Hook. and Arn. non Willd.) Reiche, Flora de Chile 1: 343. 1896 (type not seen). This is an example of how errors of interpretation can become compounded. L. oligophyllum Willd. is a Peruvian plant. Hooker and Arnott misassigned that name to L. chamissonis known only from Chile. Reiche used Hooker and Arnott's oligophyllum as the basis for his variety of macraei, but based on the localities cited for it, it must be L. macraei var. macraei.

Var. macraei is found on dry, rocky and sandy slopes near the coast from about 250 km north to about 250 km south of Valparaíso. In the northern part of the range some collections more or less merge with L. ramosissimum although it tends to have more nearly united styles and larger floral parts.

In the southern part its range overlaps that of L. chamissonis but is easily distinguished from that species by its united styles and the presence of stipular glands.

Partly because of its large, showy flowers, var. macraei is the most commonly collected taxon in the genus in South America. In addition to the type, ca 90 collections have been examined. The distribution is shown in Fig. 29.

L. MACRAEI var. MARTICORENAE Mildner, Phytologia 23: 439. 1972. Type: Mildner 15a, roadcut, ca 23 km from Concepción, near Curapalihue, Chile, Dec., 1969 (holotype: US; isotypes: CONC,K,UC,WUD). (Fig. 21).

The assignment of a new varietal name to this, a somewhat more compact, puberulent form of L. macraei, may clarify its nomenclatural status. From Urban's description of L. macraei var. cumingii (Linnaea 41: 626. 1877) it seems that he had this plant in mind. The principal and name giving collection which he cites, Cuming 127, is, however, uniformly L. chamissonis. Loddiges' original description of L. cumingii did not cite a collection number but merely said it was introduced in 1830 by Mr. Cuming. The illustration accompanying his original description appears to be L. macraei var. macraei and thus L. cumingii becomes a synonym for that species.

L. macraei var. marticorenae is found from the Valparaiso area southward to Concepción. It shares the upper half of its range with var. macraei and overlaps the northern part of the range of L. chamissonis. Often confused with the two, it can be separated by the puberulent stems, the low compact habit and imbricate leaves. The connate styles and stipular glands also distinguish it very readily from L. chamissonis,

Var. marticorenae is found on dry soil, on wooded slopes and open areas up to about 400 meters. About 25 collections have been examined. The distribution is shown in Fig. 29.

18. LINUM CRATERICOLA Elias., Bot. Notiser 121: 634. 1968. Type: Eliasson 905, small crater north-east of Floreana Peak, Floreana, Galapagos, Dec. 16, 1966 (holotype: S). (Fig. 22).

Glabrous perennial, semi-shrubby herb, 40-50 cm tall; branches numerous, ascending; leaves 1-nerved, 7.5-11 mm long, 1.0-1.3 mm wide, alternate, narrowly lanceolate; stipular glands none; inflorescence of rather stiffly ascending-spreading, few-flowered branches; sepals ovate, acuminate, with prominant midnerve, 3-3.5 mm long; petals obovate, 8 mm long, alternating with diminutive staminodia; styles separate, ca 3 mm long; fruit broadly ovate, ca 3 mm high, 2.5 mm in diameter; seeds brown, subelliptical, ca 1.6 mm long.

L. cratericola is clearly related to L. oligophyllum and L. filiforme of mainland South America. From the former it differs in the lack of stipular glands; from the latter it differs in the more ample inflorescence of stiffly spreading-ascending branches. It is easily distinguished from L. harlingii, the only other species of Linum in the Galapagos Islands,by its lack of stipular glands.

L. cratericola is known only from the type and two additional collections from crater margins on the same island.

19. LINUM HARLINGII Ellas., Bot. Notiser 121: 636. 1968. Type: Harling 5367, Volcan Darwin, Isabella, Galapagos, June 7, 1959 (holotype: S). (Fig. 23).

Glabrous semishrub, 30-60 cm tall, with numerous suberect branches; leaves 1-nerved, mostly 5-10 mm long, 1.0-1.2 mm wide, alternate, narrowly lanceolate, with prominent stipular glands; inflorescence much branched, flowers mostly terminal; sepals ovate, acute, with prominent midnerve, 2.9-3.3 mm long, with basal glands; petals obovate, ca 10 mm long; stamens 3-4 mm long, alternating with diminutive staminodia; styles separate, 5-6 mm long; fruit ovate, ca 3 mm high and 2.5 mm in diameter; seeds brown, elliptic, ca 1.7 mm long.

L. harlingii, like L. cratericola, is most closely related to L. oligophyllum and L. filiforme of the South American mainland. It is a larger shrubbier, more bushy branched plant than either, especially the latter. The strongly developed stipular and sepalar glands easily distinguish this from L. cratericola the only other species known from the Galapagos Islands.

L. harlingii is known only from the type collection and one other collection, both Volcán Darwin on Isabela Island.

Doubtful Taxa

1. Linum aquilinum Mol., Sagg. Chil. : 150. 1782. There are a number of peaks and mountains known as Aquila, from whence this was supposed to have come. The name has generally been applied to L. macraei, but the meager description could fit more than one species and it is necessary to relegate it to the doubtful taxa. If its identity should become known, the name has priority over all others in Chile.
2. Linum chilense Kostl., Allg. Med.-Pharm. Flora 5: 1912. 1836. This was cited without exact location from Chile. The extremely meager description suggests that this plant may not be Linum.
3. Linum erectum Larr., Escritos D. A. Larrañaga 2: 123. 1923. This plant is not sufficiently well described to identify which of several Uruguayan species it might be. It may well be the cultivated L. usitatissimum L.
4. Linum oligophyllum Willd. var. eglandulosum Schiede, Linnaea 1: 68. 1826. Based upon an unidentified Sello collection from Buenos Aires, this could be any one of several species.

DISCUSSION

While there almost certainly are too few good collections yet available and there is genetical and other experimentation which must be done before a complete assessment of relationships of the South American species to each other and to the species of section Linastrum elsewhere can be made, there is a general picture which has emerged.

Examination of the worldwide distribution of Linum reveals that the center of diversity and possible center of origin lie in the Mediterranean region, the only area in which representatives of all five of the commonly recognized sections may be found. This suggests that the Old World plants

of section Linastrum may be ancestral to the American plants. Studies of the North American species of section Linastrum (Rogers, 1963, 1968, 1969) have shown that the species on that continent which are thought to be the most primitive are located in east-central Mexico. They resemble closely certain plants of southern Africa. For example in both North America and southern Africa are found two types of plants, probably not too distantly related from one another, but differing rather strikingly in habit. There are those which have broad leaves, frequently in whorls, and with a more or less leafy inflorescence, and those with narrow opposite leaves with an open inflorescence. All are perennial, with ovate, pointed, freely dehiscing fruits which have only partially developed false septa, separate styles, stipular glands and yellow petals. In Africa the broad-leaved type is represented by L. quadrifolium, in Mexico by L. schiedeanum. The narrow-leaved type is represented by L. holstii in Africa, L. rupestre in Mexico.

In South America these same two types may be found. The broad-leaved L. smithii has opposite leaves only, but its habit and most other morphological traits resemble those of L. quadrifolium and L. schiedeanum. The narrow-leaved type is represented by L. burkartii which, while lacking stipular glands, is very similar to L. rupestre and L. holstii. So close in appearance is it to the former that the two might well be considered conspecific if they were geographically near. The chromosome complements of the two are known to be $2n=36$ as well.

The composite range of L. burkartii and L. smithii includes eastern Argentina, Uruguay and southern Brazil (Fig. 24). This Atlantic coastal region proves to be the center of greatest diversity of the genus in South America, with nine of the twenty-two taxa being found there. It may indicate that this is the area of introduction to the continent and is in support of the idea that the South American plants are closely allied to the plants of southern Africa.

The comparison of South American species for a series of characters including habit, longevity, sepal margin and texture, fruit shape, degree of development of the false septa, union of styles, petal pigmentation, pollen morphology and, in some species, chromosome number, reveals that L. smithii and L. burkartii are among the least specialized. These plants may serve as a reasonable starting point from which to advance a general theory about the course of evolutionary development and geographical migration among the South American species of the genus.

On the basis of general similarities, plus what appear to be transitional collections, all of the South American species seem to be more closely allied with L. smithii than with L. burkartii although it must be said that this assumption is not on the firmest of ground without support from many more collections. L. organense, from the Organ Mts. of eastern Brazil, is a more leafy plant than L. smithii, without stipular glands and with a reduced inflorescence, but the two, which in the past have not been separated taxonomically, are clearly closely related. L. littorale, L. brevifolium and L. palustre comprise a closely related complex, differing from one another mainly in habit, with the last two possessing specialized, reduced inflorescences. They have a number of features in common with L. smithii, with L. littorale var. oblongifolium being most similar in habit. The most widespread and diverse of the complex is L. littorale, which includes a tetraploid population in the northern part of the range and plants which tend

to merge with L. scoparium in the south. L. carneum and L. erigeroides of Uruguay, Argentina and southern Brazil are most similar to L. scoparium, from which they differ mainly in habit and fruit shape.

L. scoparium has a range which extends from Uruguay and eastern Argentina, where its similarity to L. carneum and L. littorale has been noted, northward to western Bolivia within a few kilometers of the Peruvian border. At that point the chief difference between it and collections of L. oligophyllum from eastern Peru is the absence of stipular glands. L. oligophyllum extends along both slopes of the Andes in Peru and marks the region, in terms of present day distributions, where the genus crosses this mountain range.

At the northeastern part of the range of L. oligophyllum, L. filiforme may be distinguished, which differs mainly in habit. More collections are clearly needed from that area in order to resolve the question as to whether more than one species exists there.

Southward from Peru as far as south-central Chile, is a principal migratory route. Plants with generally more of the brick-red pigments in the corolla, more nearly united styles and larger floral parts are found along this route, beginning in the north with plants such as L. prostratum and including L. polygaloides, L. cremnophilum, L. ramosissimum, L. chamissonis and culminating with L. macraei. Linum macraei and L. cremnophilum, on the western coast of Chile, must be considered the most highly evolved of the genus in South America. It must be emphasized, however, that, notwithstanding a considerable degree of total diversity among the South American species, they are as a whole very much more uniform than the North American segment of the section. Species differences in several instances are not very profound and what can be interpreted as plants intermediate between adjacent species are common.

LITERATURE CITED

Gay, C., 1865. Historia de Chile 1: 460-465. Museo de Historia Natural, Santiago.

Planchon, J. E., 1847. Sur la famille des Linees. Hook. Lond. J. Bot. 6: 588-603. 1848. 7: 165-186, 473-501, 507-528.

Reiche, C., 1896. Flora de Chile 1: 340-343.

Rogers, C. M., 1963. Yellow flowered species of Linum in eastern North America. Brittonia 15: 97-122.

_____, 1968. Yellow flowered species of Linum in Central America and western North America. Brittonia 20: 107-135.

_____, 1969. Relationships of the North American species of Linum. Bull. Torr. Bot. Club 96: 176-190.

_____ and R. Mildner, 1971. The re-evaluation of the genus Cliococca (Linaceae) of South America. Rhodora 73: 113-116.

_____ and L. B. Smith, 1975. Linaceae. In: Flora Illustrada Catarinense. 34 pp.

St. Hilaire, A., 1825. Fl. Bras. Mer. 1: 129-134.

Schiede, C. J. G., 1826. De Plantis in expeditione speculatoria Romanzoffiana observatis rationem dicunt Ad. de Chamisso et D. de Schlechtendal. Linnaea 1: 65-71.

Urban, I., 1877a. In Mart., Fl. Bras. 12: 457-470.

_____, 1877b. Die Linum Arten des westlichen Südamerika. Linnaea 41: 609-646.

Winkler, H., 1931. Linaceae. In Engler & Prantl, Die Naturlichen Pflanzenfamilien. ed. 2, 19a: 82-130.

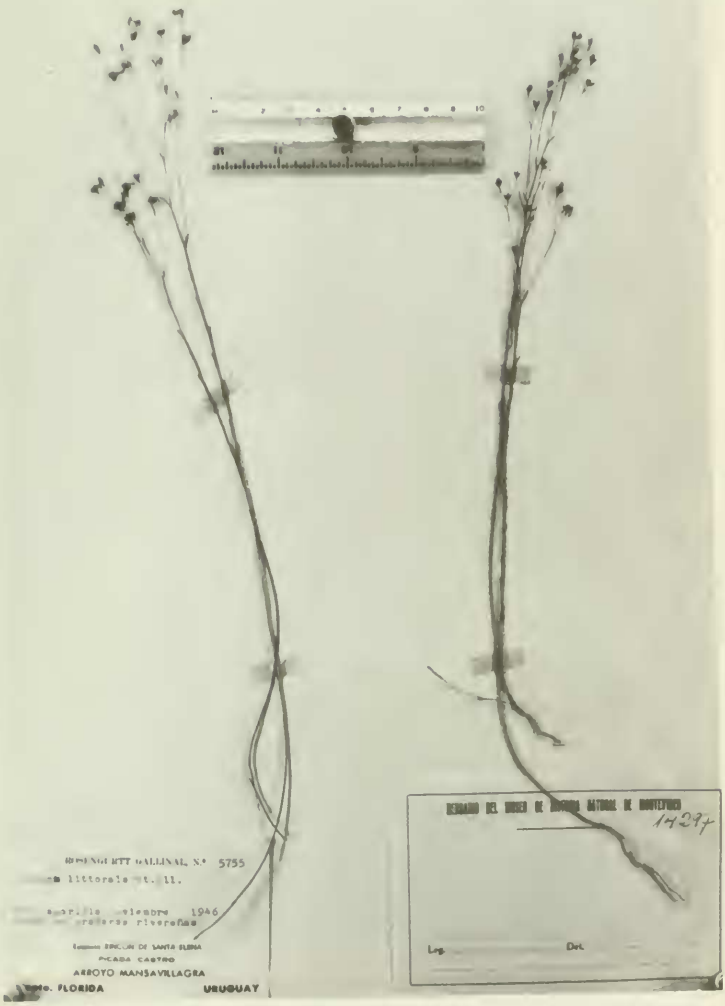


Figure 1. Linum burkartii Mildner. Isotype MVM.

Figure 2. Linum organense Gardn. Holotype K.

Figure 3. Linum smithii Mildner. Holotype UC.

Figure 4. Linum littorale St. Hil. var. littorale. Isotype P. Inset of a flower from a representative plant.

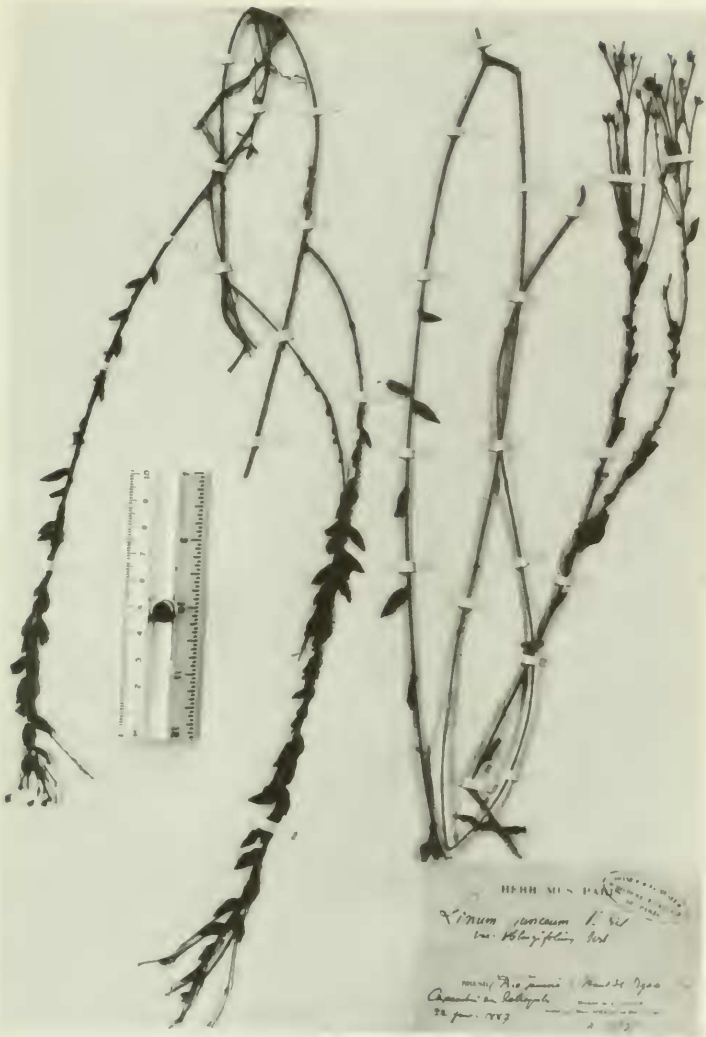


Figure 5. Linum littorale St. Hil. var. oblongifolium (Urb.) Rogers. Representative specimen.

Figure 6. Linum brevifolium St. Hil. Holotype P.

Figure 7. Linum palustre Gardn. Holotype K.

Figure 8. Linum carneum St. Hil. Isotype P. Typical fruit, enlarged.

Figure 9. Linum erigeroides St. Hil.
Representative specimen.

Figure 10. Linum scoparium Griseb. Isotype CORD.

Figure 11. Linum oligophyllum Willd. Holotype B.

Figure 12. Linum oligophyllum Willd. Representative specimen.

Figure 13. Linum filiforme Urb. Photo of holotype B.

Figure 14. Linum prostratum Dombey ex Lam. var. prostratum. Holotype P.

Figure 15. Linum prostratum Dombey ex Lam. var. parvum (Johnston) Mildner. Holotype GH.

Figure 16. Linum polygaloides Planch. Lectotype K.

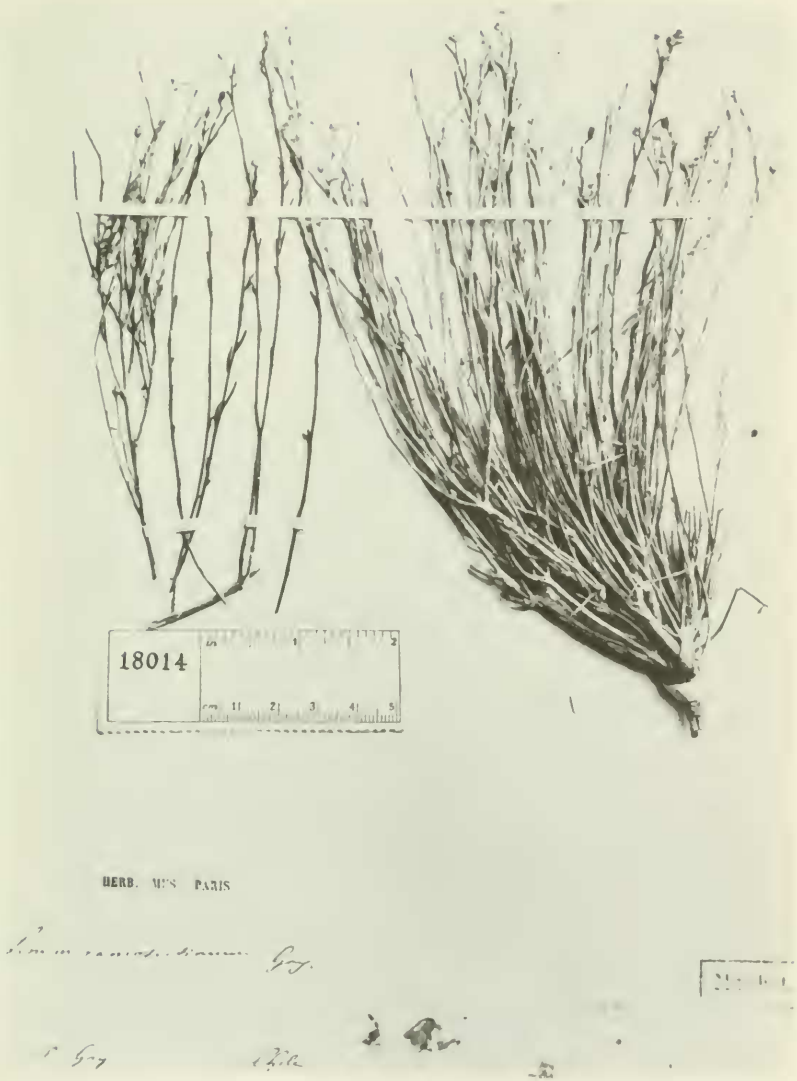


Figure 17. Linum ramosissimum Gay. Photo, probable isotype B.

Figure 18. Linum cremnophilum Johnston. Isotype K.

Figure 19. Linum chamissonis Schiede.
Representative specimen.

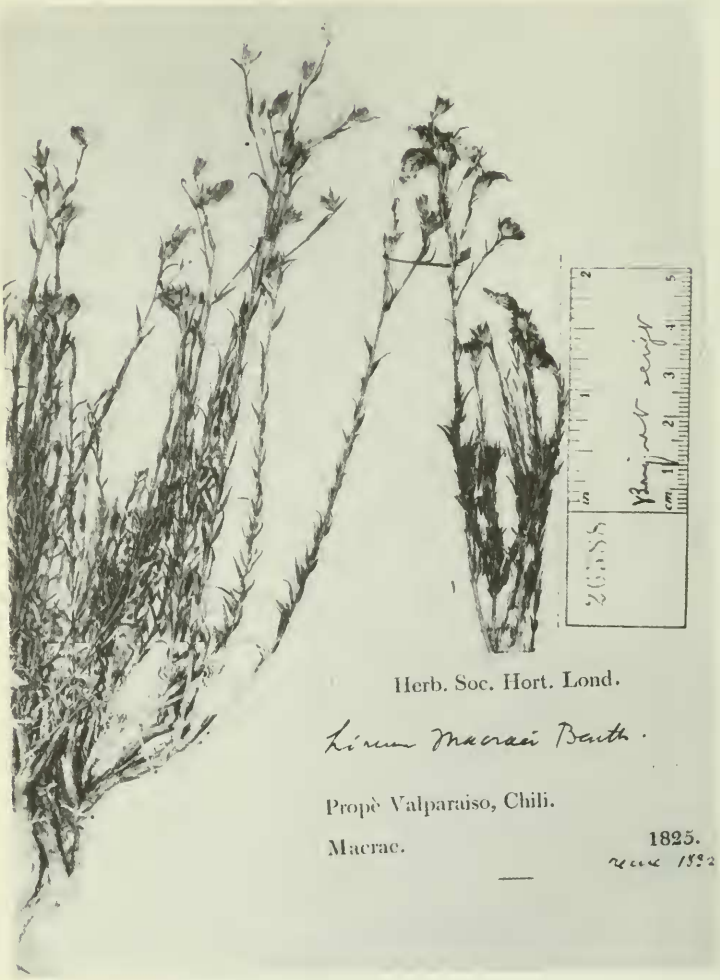
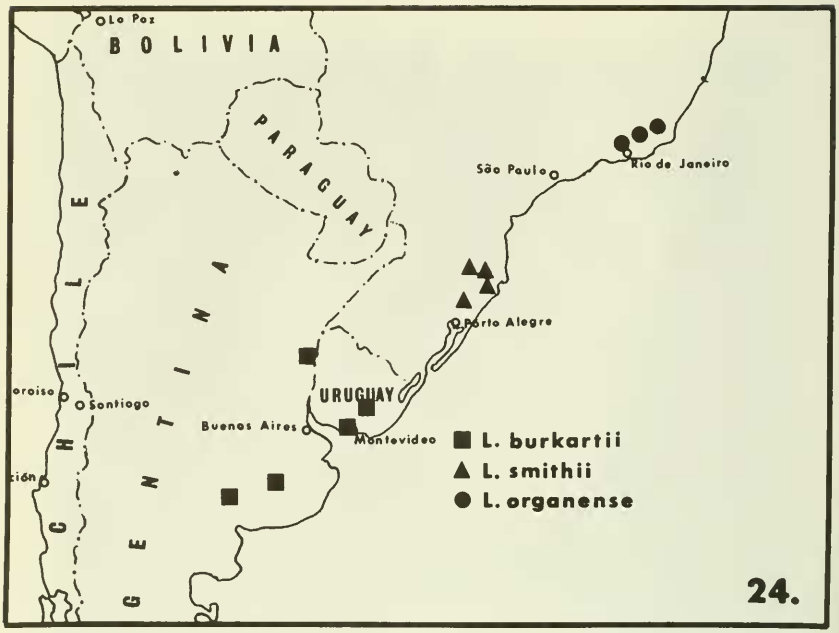


Figure 20. Linum macraei Benth. var. macraei Holotype K.

Figure 21. Linum macraei Benth. var. marticorenae Mildner. Holotype US.

Figure 22. Linum cratericola Elias. Holotype S.

Figure 23. Linum harlingii Elias. Holotype S.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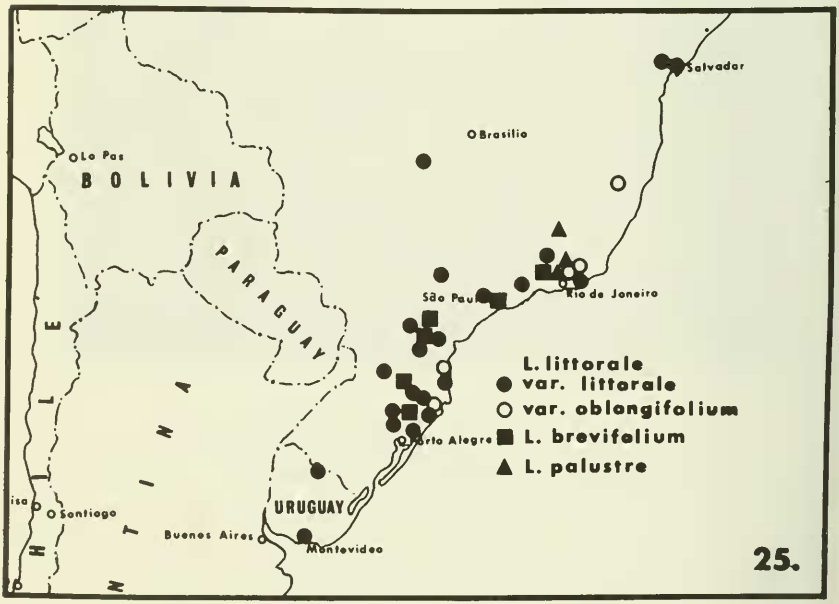
BOLIVIA
PARAGUAY
CHILE
ARGENTINA
São Paulo
Rio de Janeiro
Porto Alegre
URUGUAY
Santiago
Buenos Aires
Montevideo
L. burkartii
L. smithii
L. organense
24.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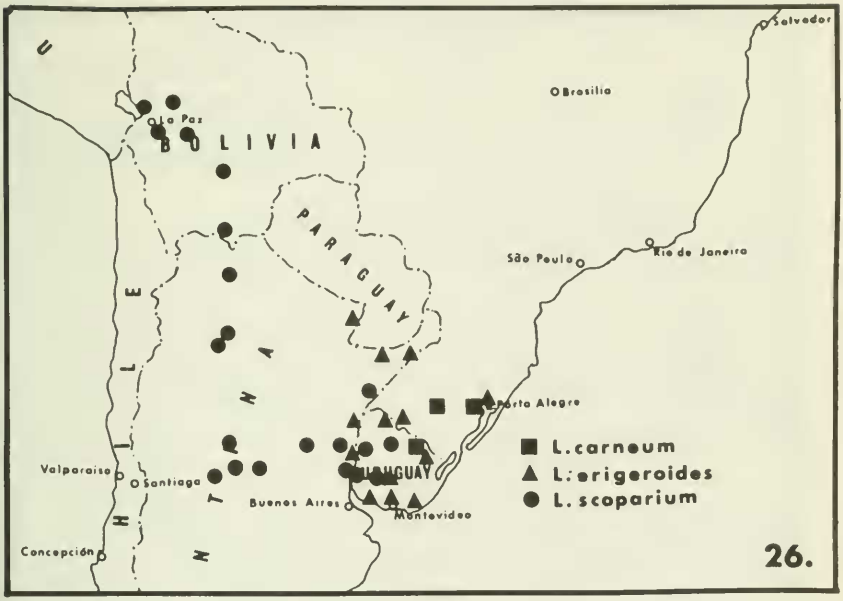
Montevideo
L. littorale
var. littorale
var. oblongifolium
L. brevifelium
L. palustre
25.


Salvador
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São Paulo
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Porto Alegre
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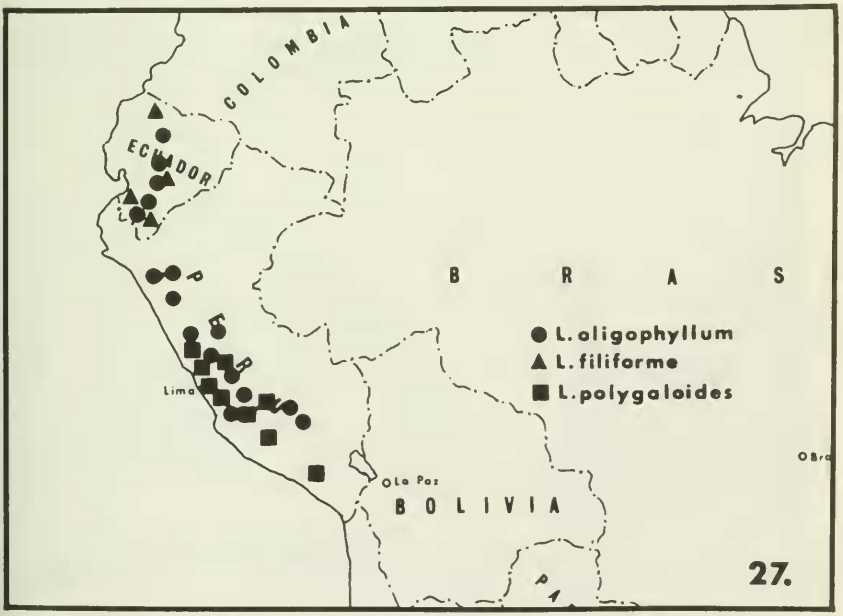
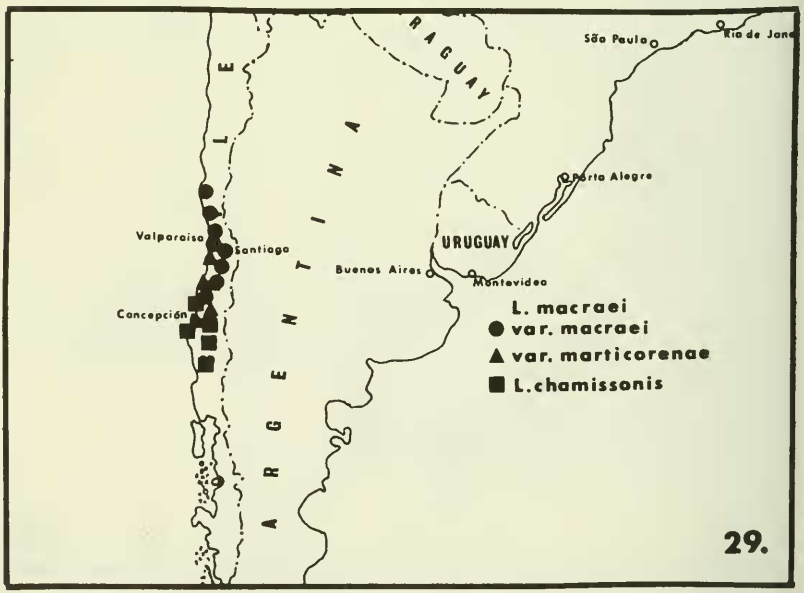
L. scoparium
Valparaiso
Santiago
URUGUAY
Buenos Aires
Montevideo
Concepción
26.


COLOMBIA
ECUADOR
B R A S
L. oligophyllum
L. filiforme
L. polygaloides
Lima
La Paz
BOLIVIA
27.


L. prostratum
var. prostratum
var. parvum
L. cremnophilum
L. ramosissimum
Lima
La Paz
Brasilia
BOLIVIA
PARAGUAY
São Paulo
Porto Alegre
Valparaiso
Santiago
Buenos Aires
URUGUAY
Montevideo
28.


São Paulo
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Valparaiso
Santiago
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Buenos Aires
Montevideo
Concepción
L. macraei
var. macraei
var. marticorenae
L. chamissonis
29.