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CONTENTS

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FLORA
OF THE PRAIRIE PROVINCES

Bernard Boivin

Part IV -- MONOPSIDA

Class 7. MONOPSIDA   MONOPSIDS, MONOCOTS

Always herbs, always devoid of a taproot, without bark. Leaves nearly always simple, sessile, and entire with parallel nervation. Flowers mostly trimerous, but often much reduced.

The more obvious difference between the Dicopsids and Monopsids is in the basic leaf type. The normal leaf is made up of a blade and petiole; it is present is nearly all Dicopsids. The Monopsid leaf appears to have lost its blade and is reduced to a petiole. When this Monopsid petiole is flattened out into a blade, as frequently happens, it may take on the general appearance of a Dicopsid leaf, yet the nervation is still recognizably that of a petiole with its parallel and non branching nerves. The two types of leaves may be compared as follows.

Dicopsida. A typical leaf comprises 3 readily identifiable elements: a dilated blade, an elongated petiole, and a pair of stipules. The stipules are very variable in size, colour and shape; often they are absent; commonly they are borne at the base of the blade and have the aspect of a pair of small leaflets. The petiole is a thin elongated structure supporting a blade and it is prolonged into the blade in the form of a simple or branching midnerve. The blade is the flat and green terminal part of the structure. The central or main nerve of the leaf is termed the midnerve and the other nerves arise as branches of it. The branches arising directly from the midnerve are termed primary nerves, these in turn may also produce lesser branches which are termed secundary nerves. Commonly the midnerve and primary nerves will end in the marginal teeth or they may turn ± halfway around and connect with one another or they may merely fade out towards the margin. The midnerve may give rise to the primary nerves successively, in the manner of the barbs of a feather (i.e. pinnately). Or the midnerve may branch off at the base of the blade and produce a group of primary nerves diverging in the manner of the fingers of a spreadout hand (i.e. palmately). Less commonly two (sometimes more) of the primary nerves will arise from near the base of the blade and will be almost as long and almost as strong as the midnerve; often such a leaf will described as parallel-nerved if the stronger primary nerves run somewhat halfway between the midnerve and the margin, but this terminology is clearly an exageration although a convenient one. Dicopsids present numerous variations on their basic leaf pattern and some of them may resemble a Monopsid leaf: the leaf may be very narrow and its nervation may be reduced to the midnerve (e.g. Hippuris, Callitriche), or the nervation may be in the form of divergent rather than branching primary nerves (e.g. Plantago).

Monopsida. The leaf may be reduced to a filiform and elongated petiole with a single midnerve, as exemplified by the submersed leaves of many species of Potamogeton, but usually the petiole is broadened into a limb. The stipules are nearly always present and may be free or variously modified, but commonly they are very much elongated and fused to the edge or to the ventral face of the petiole; they are then distinguishable mainly as membranous marginal expansions which will often enclose the stem into a structure termed sheath. The tip of the stipules may remain free and form structures called auricles or a ligule. Commonly the petiole will not be readily recognized as such, but will be flattened out into a green expense similar to the leaf of the Dicopsids and similarly called a leaf despite its petiolar origin. The usual type of leaf as seen in the Grasses and Sedges, is a sessile and much elongated or ribbon-like structure with a few truly parallel nerves running the whole length of the limb. The central nerve is usually a bit stronger than the others and is termed the midnerve. The primary nerves do not branch off the midnerve, but are already distinct at the very base of the limb; they may converge at the tip of the limb without actually joining. Secondary nerves are sometimes sent in the form of finer nerves crossing the intervals between the primary nerves. All nerves are simple or they may be joined by fine interconnections. Broader leaves also occur (e.g. many Liliaceae); they still fit the description above except that their primary nerves are somewhat curved and not truly parallel, although they are still said to be parallel as a matter of convenience. More rarely (e.g.: Smilax or the floating leaves of Potamogeton) the petiole will remain narrow and petiole-like in the lower part, but will be dilated into a blade in the upper part. Only very exceptionally will a Monopsid leaf be atypical (e.g. Trillium, Arisaema) to be point of similarity to a Dicopsid leaf.

Two keys are provided for the Monopsids. The first is a natural key based primarily on floral characteristics.

A second and purely artificial key will be found at the end of the Monopsids,

a. Ovary of free and many-seeded carpels, or more commonly the carpels fused into a compound ovary, sometimes reduced to a single achene .... Folliculidae
aa. Carpels free and reduced to one-seeded achenes, sometimes reduced to a single carpel .... Achenidae p.

Sub-class 3. FOLLICULIDAE

Ovary of 3-6 carpels and compound, or the carpels free and many-seeded, maturing into a capsule, a group of follicles or a berry, etc., sometimes an achene-like fruit reduced from a compound ovary.

a. Perianth much reduced or absent.
  b. No spathe.
    c. Stem solid; each floret with only one bract or the bracts not opposite .... 71. Cyperales, p. 808
    cc. Stem hollow; each floret subtended by a pair of opposite bracts .... 72. Graminales, p. 879
  bb. Spathe present, subtending the inflorescence.
    d. Fruit a berry .... 73. Arales, p. 976
    dd. Fruit achene .... 74. Typhales, p. 980
aa. Perianth present and functional.
  e. Ovules scattered all over the wall of the carpel .... 61. Butomales, p. 758
  ee. Ovules borne along the edge only.
    f. Carpels free or nearly so.
      g. Carpels borne around a central column .... 64. Juncaginales, p. 762
      gg. No central column .... 62. Scheuchzeriales, p. 761
    ff. Carpels fused into a compound ovary...Group A

Group A

Perianth present; carpels fused.

a. Ovary superior.
  b. Flower plainly differentiated into sepals and petals .... 63. Commelinales, p. 761
  bb. Petals and sepals very similar or nearly identical and usually concolour.
    c. Perianth small and chaff-like .... 70. Juncales, p. 797
    cc. Perianth petaloid.
      d. Leaves normal; roots system herbaceous or fleshy .... 65. Liliales, p. 763
      dd. Leaves strongly fibrous, rigid, sharp-pointed; rhizome or stem ± woody ... . 67. Agavales, p. 782

aa. Ovary inferior.
  e. Flower zygomorphic .... 69. Orchidales, p. 783
  ee. Regular.
    f. Leaves equitant .... 66. Iridales, p. 780
    ff. Leaves normal ...... 68. Haemodorales, p. 783

Sub-class 3. FOLLICULIDAE

Order 61. BUTOMALES

Ovules borne all over the inner wall of the carpel.

a. Ovary superior .... 114. Butomaceae, p. 758
aa. Inferior .... 115. Hydrocharitaceae, p. 759

114. BUTOMACEAE FLOWERING RUSH FAMILY

A typical Monopsid, resembling the Liliaceae, but for the placentation and the carpels free or nearly so.

1. BUTOMUS L. FLOWERING RUSH

Flowers umbellate. Petals persistent.

1. B. UMBELLATUS L. -- Flowering Rush (Jonc fleuri, Flûteau) -- Flowers purplish pink in a showy umbel on a tall scape. Leaves all basal, ensiform and triangular in cross section, nearly as tall as the scape, the latter often 1 m high or more. Early to mid summer. Cultivated and rarely escaping or introduced to shores of receding waters: Netley Creek. -- NS-PEI, Q-Man, US, Eur.

Some gardeners, nature lovers or naturalists may attempt to introduce plants into native habitats; they rarely meet with success. Indeed the failure rate might be of the order of 99%, while most successful introductions seem to be essentially unpremeditated. Attempts at introductions in the wild are relatively uncommon in our area, yet not completely absent. The local history of Butomus offers interesting insights in the matter.

In 1948 a business firm in Chatham, Ontario, sent 11,000 corms to the Manitoba Government for trial plantings. There may have been also some later shipments to a few individuals. Most, if not all, corms must have died, since the first collection of Butomus in the wild was not made until 16 years later and, after such a long interval, one may wonder if the two are events are causally related.

We have tried in this flora to distinguish between deliberate introductions in the wild and actual naturalisations; the first are ignored, the others are keyed out and described. Unfortunately label data are often inadequate to our purposes and introduce a margin of error; no doubt some of our inclusions are not fully justified, some omissions were unwarranted. Time will tell: cultivated plants almost invariably regress and wither if they are denied the care and attention of an interested gardener, hence the lack of repeat collections over the long term for nearly all deliberate introductions.

115. HYDROCHARITACEAE FROG'S BIT FAMILY

Ovary inferior. Aquatic plants ± submerged.

a. Leaves opposite or in whorls .... 1. *Elodea*
aa. All basal .... 2. *Vallisneria*

1. ELODEA Richard WATERWEED

Flower arising singly from a long tubular sheath. Pistillate flower borne inside the sheath, but the perianth-tube elongating greatly and simulating a long, thin pedicel, and eventually reaching the surface of the water. Our species rarely seen in flower.

a. Middle and upper leaves in 3's ..... 1. *E. canadensis*
aa. Opposite .... 2. *E. longivaginata*

1. *E. canadensis* Mx. (*Anacharis canadensis* (Mx.) Planchon) -- Waterweed, Ditch-Moss (Peste des eaux) -- Submerged and nearly always sterile herb with numerous small leaves verticillate in 3's. Leaves ligulate, about 1 cm long, about 2 mm wide. Late summer. Shallows in slow flowing freshwater streams, from lake La Ronge eastward. -- NS, NB-S, BC, US, Eur.

2. *E. longivaginata* St. John (*E. canadensis* AA.; *E. laevivaginata* sphalm.; *Anacharis Nuttallii* AA.) -- Quite like the first, but all the leaves opposite and commonly about 2 cm long. Leaves very finely scabrous-serrulate towards the tip. Early summer. Alkaline sloughs, rare or overlooked. --swS-sAlta, US.

Not to be confused with the habitally similar *Callitriche*, the latter has entire leaves, or (*C. hermaphroditica*) shallowly emarginate and minutely bidentate at tip.

2. VALLISNERIA L. TAPEGRASS

Leaves all in a basal rosette. Perianth tube elongating as in *Elodea*, only more so. Male flowers not stipitate, but released from a basal spathe to become free floating on the surface of the stream.

1. *V. americana* Mx. (*V. spiralis* AA.) Wild Celery, Eelgrass (*Herbe à la barbotte*, *Herbe aux anguilles*) -- Tufted submerged herb with very long, narrow and ribbon-like leaves, very flaccid and their tip coming to float on the surface of the water. Leaves with transverse or diagonal lines of darker or purplish dots. Perianth tube becoming coiled after anthesis. Mid summer. Slow moving waters, usually less than 1 m deep. -- NS, NB-seMan, US.

When sterile likely to be confused with other ribbon-like aquatics such as Sparganium, but these lack the lines of purple dots and usually have much larger cells.

Order 62. SCHEUCHZERIALES

Carpels free or nearly so and maturing into many-seeded follicules. Similar to the Butomales, but the seeds borne along the carpel margin only.

116. SCHEUCHZERIACEAE

SCHEUCHZERIA FAMILY

Leaves sheathing and ligulate like a Grass.

1. SCHEUCHZERIA L.

Monotypic.

1. S. palustris L. -- (Petit jonc fleuri) -- Fruit of 3 horizontally spreading follicles. Habitally much like a Juncus but the 3 carpels nearly free. Flowers small and inconspicuous, the tepals only 2-3 mm long, the plant therefore nearly always collected in fruit. Early summer. Wetter parts of bogs and rare, or perhaps merely inaccessible. --Mack-Aka, L-NF, NS, NB-BC, US.

North American specimens are reported to have a slightly longer seed and the mature capsule should have a slightly higher beak, they have been accordingly segregated as var. americana Fern. But specimens at hand failed to conform to the expected morphological pattern.

Order 63. COMMELINALES

Perianth clearly differenciated into a corolla and a green calyx. Otherwise similar to the Liliaceae.

117. COMMELINACEAE SPIDERWORT FAMILY

Ovary 2-3 locular. Leaves sheating at base.

1. TRADESCANTIA L. SPIDERWORT

Corolla regular. Flowers in cymes.

1. T. occidentalis (Britton) Smyth -- Showy flower with 3 large blue petals and much smaller green sepals, the petals deliquescent and often leaving nothing but a blue smear on the herbarium sheet. Leaves broadly sheating at base, the limb very long and very narrow, falcate to somewhat coiled at tip. Glandular-pilose in the inflorescence; herbage otherwise glabrous. First half of summer. Light sands; local: Melita, Routledge. -- swMan, US, (CA).

Order 64. JUNCAGINALES

Flowers bractless as in the Achenidae, but the perianth normal, trimerous.

118. JUNCAGINACEAE ARROWGRASS FAMILY

Single family.

1. TRIGLOCHIN L. ARROWGRASS

Fruit a group of carpels attached to a central column.

a. Tepals broadly rounded at summit; fruit oblong .. .. 1. *T. maritimum*
aa. Sepals acuminate; fruit narrowly oblanceolate ... . 2. *T. palustre*

1. *T. maritimum* L. -- (Herbe soelting, Faux Jonc) -- Inflorescence a bractless raceme. Otherwise habitally similar to an Onion. Leaves all basal, narrow and elongate, sheating at base. Carpels and styles 6. Fruit 3-5 mm long. Early summer. Frequent in marshes and sloughs -- seK-Aka, L-SPM, NS-BC, US, (CA, SA), Eur, (Afr).

2. *T. palustre* L. -- (Faux Jonc) -- Closely similar but smaller and with much finer foliage. Carpels and styles 3. Fruit 6-9 mm long. First half of summer. Bogs, shores and sloughs. --G, K-Aka, L-SPM, NS-BC, US, (SA), Eur.

Order 65. LILIALES

The typical family of Monopsids with flowers regular, the floral parts in 3's and all free, except the carpels.

119. LILIACEAE LILY FAMILY

Ovary superior.

a. Climbing by tendrils .... 21. *Smilax*
aa. Non-climber.
  b. At least the upper leaves opposite or verticillate .... Group A
  bb. Alternate or all basal.
    c. Leaves all or mainly basal .... Group B
    cc. Stem leafy.
      d. Inflorescence terminal .... Group C
      dd. Flowers axillary .... Group D

Group A

At least some of the leaves opposite or verticillate.

a. Leaves numerous, the upper verticillate, the middle and lower ones alternate .... 8. *Lilium*
aa. Leaves (2)-3-(4).
  b. Leaves broadly ovate .... 20. *Trillium*
  bb. Lanceolate to long linear.

c. Leaves isomegueth, borne near the middle of the stem .... 9. Fritillaria
cc. Dimegueth, the basal one many times longer than the two opposite upper leaves .... 11. Calochortus

Group B

Leaves all or mainly basal.

a. Flower solitary or in an umbel.
  b. Flowers very numerous .... 7. Allium
  bb. Only 1-6 flowers; leaves large.
    c. Glabrous .... 10. Erythronium
    cc. Leaves ciliate or villous ..... 14. Clintonia
aa. Flowers in a raceme or panicle.
  d. Flowers small, sessile .... 1. Tofieldia
  dd. Much larger and on long peduncles.
    e. Leaves strongly scabrous above...... .... 2. Xerophyllum
    ee. Smooth.
      f. Flowers blue; bracts longer than the peduncles .... 12. Camassia
      ff. Flowers white or yellow to purplish; bracts mostly shorter.
        g. Flowers 1-4 ....10. Erythronium
        gg. Much more numerous.
          h. Flower tubular; leaves enlarging to 2-3 cm in fruit.. .... 3. Stenanthium
          hh. Tepals spreading; leaves less than 1 cm wide .... 4. Zygadenus

Group C

Leaves alternate; inflorescence terminal.

a. One-flowered.
  b. Flower or fruit longer than its peduncle .. .. 6. Uvularia
  bb. Peduncle many times longer .... 9. Fritillaria
aa. Flowers numerous.
  c. Leaves very narrow, ensiform, strongly scabrous above .... 2. Xerophyllum
  cc. Broader, ovate to lanceolate.
    d. Leaves cordate at base, the lower short petiolate .... 16. Maianthemum
    dd. Cuneate to broadly rounded at base and sessile to clasping.
      e. Flowers 1-3 at the end of each branch .. .. 17. Disporum
      ee. Flowers in a single terminal raceme or panicle.

f. Flowers greenish; herbage soft pubescent throughout..... 5. *Veratrum*
ff. Flowers whitish; herbage glabrous or nearly so .... 15. *Smilacina*

Group D

Stem leafy; flowers axillary.

a. Leaves filiform, borne in clusters .... 13. *Asparagus*
aa. Leaves alternate and much larger.
  b. Flowers in 2's .... 19. *Polygonatum*
  bb. Solitary.
    c. Single-flowered plant .... 6. *Uvularia*
    cc. Flowers many .... 18. *Streptopus*

1. TOFIELDIA Hudson FALSE ASPHODEL

Leaves equitant, that is folded longitudinally with the two halves of the upper face fused together, thus only the lower face is visible and the leaf appears to be inserted edgewise to the base of the stem. Leaves distichous. Flowers in a spiciform raceme.

a. Stem densely glandular .... 2. *T. glutinosa*
aa. Glabrous.
  b. Stem green, leafless .... 1. *T. pusilla*
  bb. Reddish purple and bearing a small leaf halfway up .... 3. *T. coccinea*

1. ***T. pusilla*** (Mx.) Pers. (*T. palustris* AA.) -- Scotch Asphodel -- Small scapose herb with a flabelliform rosette of equitant leaves. Glabrous, the stem 1-2 dm high. Inflorescence short and fairly dense, the flowers mostly only 5-7, nearly sessile and verticillate. About the middle of summer. Along subarctic and mountain creeks. -- G-Aka, L-NF, Q-nwS-BC, (US, Eur).

A report by Lowe 1943 of *T. palustris* from McCreary along the eastern edge of the Riding Mountain was repeated by Hultén 1962. But it was ignored by Scoggan and probably rightly so as the locality has never been confirmed and seems rather unlikely for a subarctic species.

2. ***T. glutinosa*** (Mx.) Pers. var. ***glutinosa*** -- Stem copiously dotted in red with sessile glands. A larger plant, 2-4 dm, with the longer basal leaves 1-2 dm long. Flowers, etc. larger. Pubescence dimorphic, the rachis and pedicells glandular-puberulent in yellow. Seed brown, the seed-coat tight. Early summer. Bogs and open, wet places. --K-Aka, (L)-NF-SPM, NS, NB-BC, US -- Var. ***intermedia*** (Rydb.) Boivin (ssp. *brevistyla* (Rydb.) C.L. Hitchc.) -- Seeds straw-coloured with the paler outer seed-coat loose and the brown seed free inside. Pu-

bescence as above. -- seAka, swAlta-BC, US -- Var. *montana* (C.L. Hitchc.) R.J. Davis -- Stem glandular-puberulent in the manner of the inflorescence. Seed type intermediate, brown with a partly loose seed-coat. Waterton--swAlta, wUS.

Tye type (NY) of *T. intermedia* Rydb. comes from southeastern Alaska an area where two varieties occur; as it is in flower it cannot be identified positively as to variety. However traditional usage, as pointed out by Hitchcock 1944, has more or less restricted this name to the pale-coloured seed type and we have felt justified to continue in the same vein as the name is not otherwise ambiguous.

3. *T. coccinea* Rich. var. *coccinea* -- Small and glandless like *T. pusilla*, but the stem deep purple and bearing 1-(2) leaves. Stem rarely over 1 dm high. Flowers becoming pedicellate, at least the lower ones alternate. Early summer. High alpine, usually in limestone areas. -- G-Aka, (Q, Alta)-BC, (Eur).

A number of other varieties (not studied) have been reported from Eastern Asia.

2. XEROPHYLLUM Mx. BEAR GRASS

Herbs with a woody rhizome and the general habit of a *Yucca* or *Agave*. Flowers unspecialized and typical of the family. Styles 3, free.

1. *X. tenax* (Pursh) Nutt. -- Bear-Grass -- Showy raceme of very numerous white flowers on a tall stem arising from the center of a dense clump of very long leaves. Leaves very rough, the basal ones 2-7 dm long, stiff and very narrow. Raceme large and dense. First half of summer. Locally abundant in open montane woods: Waterton. --swAlta-seBC, US.

3. STENANTHIUM Kunth

Closely similar to the next, but the glandless tepals adnate to the base of the ovary, the fruit therefore somewhat semi-inferior. Otherwise a typical Liliaceous plant.

1. *S. occidentale* Gray -- Mountain-Bells, Bronze Bells -- Flowers tubular and drooping in a more or less secund raceme. Rosette leaves linear-lanceolate, the stem leaves few and much smaller. Inflorescence sometimes slightly branched towards the base. Flowers mostly purplish green. Fruit erect. First half of summer. Moist, open montane woods. --swAlta-BC, US, (Eur).

4. ZYGADENUS Mx. CAMASS

Tepals with 1-2 glandular spots towards the base. Ovary superior to semi-inferior. Flower otherwise typical of the family.

Z. paniculatus (Nutt.) Watson has been reported repeatedly from Western Canada. An earlier report by Watson for Saskatchewan is repeated by Macoun 1888. Henry 1915 includes Alberta in its range and Eastham 1947 quotes some B.C. locations. None of these reports were ever confirmed and only one was eventually traced (and doubtfully at that) to an herbarium specimen (CAN, DAO). The latter has been revised to *Z. venenosus* and a similar disposition is presumably the correct one for the other reports.

a. Tepals 8-12 mm long .... 1. *Z. elegans*
aa. Tepals smaller, 4-7 mm long; inflorescence always a raceme .... 2. *Z. venenosus*

1. **Z. elegans** Pursh (*Z. chloranthus* Rich.; *Anticlea elegans* Rich.) -- White Camass, Alkali-Grass -- Ovary soon becoming semi-inferior. Onion-like in habit and arising from on onion. Stem leaves few and much reduced. Inflorescence a raceme or more commonly a panicle. Flowers yellow and greenish with large, darker, glandular patches towards the base. First half of summer. Common in prairies. --Mack-Aka, NB-BC, US.

2. **Z. venenosus** Watson (var. *gramineus* (Rydb.) Walsh; *Toxiscordion gramineum* Rydb.) -- Poison-Camass, Hog's Potato -- Tepals unguiculate, yellowish-white. Flowers smaller in a denser and simple raceme. Ovary and capsule superior. Late spring and early summer. Frequent in low spots in prairies and steppes. -- sS-BC, US.

5. VERATRUM L. FALSE HELLEBORE

Seeds winged, borne in a capsule. Styles 3 and free, the flowers otherwise typical of the family.

1. **V. Eschscholtzii** Gray var. **Eschscholtzii** -- A rather coarse herb with broad, ovate leaves 1-2 mm wide and short-sheating at base. Perennial 1-2 m high, the herbage puberulent to somewhat arachnoid. Inflorescence a narrow raceme of secund and recurved racemes. Tepals 8-11 mm long. Mid summer. Light and wet or marshy woods. --wMack-Aka, Alta-BC, (US) -- var. **incriminatum** Boivin -- Smaller, only 1 m high or less. Leaves narrower, only 5-8 cm wide. Tepals shorter, 5-8 mm long. Branches spreading rather than recurved. Low alpine -- swAlta-BC.

6. UVULARIA L. BELLWORT

Only 1 style, but trifid. Single-flowered herbs with alternate leaves and unusual branching arrangements.

1. *U. sessilifolia* L. (*Oakesia sessilifolia* (L.) Watson) -- Wild Oats -- At first simple and circinate with a single terminal flower, soon producing a single branch while the fertile one elongates and the single flower or fruit becomes borne opposite the lowermost leaf of the fertile branch. Fruit fairly-large, pedunculate and abruptly contracted into an obvious stipe. Late spring. Local in deciduous woods: Roseisle, Sandilands. -- NS, NB-sMan, US.

7. ALLIUM L. ONION

The Onion proper, that is an herb arising from a bulb of tubular sheaths, with a rosette of elongate leaves, a stem scapose or leafy towards the base only, and a terminal umbel of flowers. Flowers typical for the family.

a. Leaves 1-7 cm wide, absent at flowering time... .... 6. *A. tricoccum*
aa. Leaves narrower and present throughout the season.
  b. Most flowers changed to bulblets; stem leafy below the middle .... 1. *A. sativum*
  bb. Flowers normally present and bulblets absent.
    c. Leaves terete; perianth 10-12 mm high.. ....5. *A. Schoenoprasum*
    cc. Leaves flat; tepals 8 mm long or less.
      d. Outer bulb sheaths disintegrating to a fibrous reticulum; stamens included .... 4. *A. Geyeri*
      dd. Outer sheaths remaining membranous; stamens more or less exserted.
        e. Umbels usually nodding; sepals obtuse or rounded at summit .. .. 2. *A. cernuum*
        ee. Umbels typically erect; sepals short mucronate ...... 3. *A. stellatum*

1. A. SATIVUM L. -- Garlic (Ail) -- Umbell mostly of bulblets. Leaves flat, 5-10 mm wide, clothing the stem in the lower half. Umbel subtended by, and half enclosed into, a large bract prolonged into a beak up to 1 dm long. Early summer. Cultivated and rarely spreading to fencerows, wasteland or dumps: Otterburne. -- swO-seMan, (US, Eur).

2. *A. cernuum* Roth -- Wild Onion -- Inflorescence nodding, the scape being strongly recurved just below the

umbel. Scape 2-4 dm high and usually tinted pink towards the base. Main leaves 2-4 mm wide. Stamens 1½ times as long as the perianth. Mid summer; chernozems. --swO, S-BC, US.

Despite a variety of earlier reports from Manitoba, all specimens under this name at CAN, DAO, MT, MTMG, QK and TRT have erect inflorescences, mucronate sepals and barely exserted stamens. All have been revised accordingly to *A. stellatum*.

3. ***A. stellatum*** Fraser -- Wild Onion -- Like the last and the outer layers of the bulb similarly membranous, but the umbel typically erect. Scape 3-6 dm high, not red-tinted. Leaves not over 2 mm wide. Stamens barely exserted. Mid summer, chernozems. --wO-S, US.

The many reports for further west in Alberta (CAN, DAO) and B.C. (DAO, QK, V) were based on specimens since revised to *A. cernuum*.

4. ***A. Geyeri*** Watson var. *Geyeri* -- Wild Onion -- Outer bulb coats reduced to a gray, fibrous reticulum. Mostly 2-5 dm high. Flowers pink, fading white. Perianth 6-8 mm high. Sepals linear-lanceolate, largest towards the base, long attenuate. Late spring. Foothill prairies. --S-BC, US -- F. ***tenerum*** (M.E. Jones) Boivin (*A. rubrum* Osterh.) -- Flowers all or mostly replaced by bulblets. Rare: Waterton. --swAlta-(sBC), US -- Var. ***textile*** (Nelson & Macbr.) Boivin (*A. reticulatum* Fraser; *A. textile* Nelson & Macbr.)-- Generally smaller, with smaller and whitish flowers. Mostly 1-2 dm high. Perianth 4-6 mm high. Sepals lanceolate, broadest towards the middle, obtuse to subacute at summit. Late spring and early summer. Common in prairies. --Man-Alta, US.

5. ***A. Schoenoprasum*** L. (var. *sibiricum* (L.) Hartm.) -- *Chives* (*Ciboulette*, *Oignon sauvage*) -- Flowers largest, 1 cm long or more. Tufted. Stem with 1-2 leaves. Flowers commonly pink. First half of summer. Infrequent on shores; also cultivated and sometimes persistent. --Mack-Aka, L-NF, NS, NB-O-(Man)-S-BC, US, Eur.

Most current floras will distinguish between var. *Schoenoprasum*, native in the Old World but an occasional escape in North America, and one or more native variants. We have found the supposed diagnostic criteria to be neither realistic nor constant and we have been unable to distinguish clearly the introduced plant on criteria other than its habitat.

6. ***A. tricoccum*** Aiton -- Wild Leek, Ramp -- (*Ail des bois*, *Ail sauvage*) -- Leaves flat and quite lar-

ge, disappearing before anthesis. Flowers in an umbel on a leafless scape. Perianth short, whitish. Early summer. Deciduous woods: Morden. --(NS), NB-sMan, US.

8. LILIUM L. LILY

Basic type of the Family and of the Monopsids. A large flower with 6 petaloid tepals, 6 stamens and a 3-carpellate ovary. Stem leafy. Anthers attached dorsally, towards the middle. Bulb of fleshy scales. Fruit a 3-locular capsule.

1. L. philadelphicum L. var. philadelphicum -- Wood-Lily, Freckled Lily -- Flower very large and showy, of 6 red orange tepals, the latter unguiculate and coarsely punctate in deep purple. Leaves narrow, mostly verticillate. Flowers often 2 or 3, but more commonly only one. Typically the stem is 4-8 dm high; the leaves are 5-10 mm wide and about half of them are alternate, the others form two verticils, one median, one terminal; the tepals are about 7 cm long, the claws 1.5-2.0 cm long. First half of summer. Prairies and light woods. -- Q-Man, US -- Grades into the more common and mainly western var. andinum (Nutt.) Ker. (L. umbellatum Pursh) -- Prairie Lily -- Uppermost leaves forming a single verticil, the other leaves all or mostly alternate. Often a somewhat smaller plant. Typically 3-4 dm high; the leaves less than 5 mm wide; the tepals about 6 cm long, the claws 1.0-1.5 cm long. --O-CB -- F. immaculatum Raup -- Flowers yellow and spotless or the spots rather weak. -- (Man-S)--Alta.

Intermediates are frequent throughout the range of the species, more so in Ontario. In accordance with our general practice, we have placed all such intermediates with the locally prevalent type. On the basis of a sorting of some 200 sheets, the length of the claw would seem to be more clearly restricted geographically than most other characters.

9. FRITILLARIA L. FRITILLARY

Anthers attached at the end, otherwise as in Lilium.

1. F. pudica (Pursh) Sprengel -- Mission-Bell, Yellow Bell -- A single, showy, yellow, drooping flower of 6 oblanceolate tepals. 1-2-(4) dm high. Leaves 2-5, variously arranged, typically the upper 2 are opposite and the lower 3 alternate. Early to mid summer. Foothill prairies. --Alta-BC, US.

10. ERYTHRONIUM L. DOG-TOOTH-VIOLET

Leaves all basal, usually 2. Bulb solid. Otherwise like Fritillaria.

1. E. grandiflorum Pursh var. grandiflorum (var. pallidum St. John) -- Adam and Eve, Chamise-Lily -- Flowers 1-(3), large, showy, yellow, on a leafless scape. Leaves broadly lanceolate. Tepals lanceolate, recurved. Anthers purple or pale yellow. Mid spring to early summer. Montane to low alpine. --swAlta-BC, US.

In a more southern var. chrysandrum (Applegate) stat. n., ssp. chrysandrum Applegate, Contr. Dudley Herb. 1: 190. 1933, the anthers are golden yellow.

The related genus Lloydia occurs west of us and L. serotina (L.) Reich. var. serotina has been reported by Hultén 1943 and Hitchcock 1969 as occurring in Alberta, querried by Boivin 1967. We know of no justifying specimen; none could be located at S in 1968, or at WTU in 1969.

11. CALOCHORTUS Pursh MARIPOSA-LILY

Resembles the last 3, but the sepals are strongly differenciated although petaloid.

1. C. apiculatus Baker -- Three-Spot-Lily -- With 3 -(4) leaves, of which one is basal and nearly reaches the flower level, the other 2 are many times shorter, opposite, and borne in the upper part of the stem. Flowers 1-(3), yellow, large and showy. Petals unguiculate with a purple spot at the summit of the claw and a suborbicular blade. Sepals smaller, sessile, lanceolate. Early summer. Mountain slopes. --Alta-BC, US.

12. CAMASSIA Lindley BLUE CAMASS

As in Lilium, but the leaves all basal and the inflorescence a raceme.

1. C. Quamash (Pursh) Greene var. Quamash -- Quamash, Soap-Root-Plant (Camace, Quamash) -- A showy raceme of large blue flowers. Leaves linear. Tepals narrowly oblanceolate, 3-5 mm wide, with 3 nerves. Early summer. Foothill prairies, locally abundant. --swAlta-BC, US.

A more western var. maxima (Gould) Boivin has a more showy flower, the tepals being 5-10 mm wide and lined with 5-(9) nerves, although the sepals may rarely have only 3 nerves.

13. ASPARAGUS L. ASPARAGUS

Flowers all or mostly solitary, axillary. True leaves very small and inconspicuous, functionally replaced by ± filiform pseudo-leaves which represent reduced branches.

1. A. OFFICINALIS L. -- Asparagus (Asperge)-- Tall, feathery herb, over 1 m high, growing in loose

colonies. Pseudo-leaves filiform, borne in small fascicles. Flowers yellow. Fruit red, turning black. Early summer. Cultivated and long persisting or even spreading to ditches and river planes or bluffs. -- NS-(PEI)-NB-BC, US, Eur.

14. CLINTONIA Raf. CLINTONIA

Similar to *Lilium*, but the leaves all basal and the fruit a berry.

a. Flowers yellow, mostly 3-5 .... 1. *C. borealis*
aa. White and solitary .... 2. *C. uniflora*

1. *C. borealis* (Aiton) Raf. -- Poison-Berry, Blue-bead-Lily (*Lis sauvage de la vallée*) -- Herb with 2-3 large basal leaves and a few yellow flowers in an umbel. Inflorescence mostly of 3-5 flowers, sometimes with 1-2 additional flowers borne lower on the scape. Fruit blue. Late spring and early summer. Coniferous woods. --L-SPM, NS-seMan, US.

2. *C. uniflora* (Schultes) Kunth -- Queen's Cup -- Similar to the last, an herb with a single white flower on a scape shorter than the 2-3 large basal leaves. Herbage villous, especially the scape. Early summer. Coniferous woods: Waterton. --(Aka), swAlta-BC, US.

15. SMILACINA Desf. FALSE SOLOMON'S SEAL

Fruit a berry in a terminal raceme or panicle. Stem leafy, simple.

a. Inflorescence a panicle .... 1. *S. racemosa*
aa. Inflorescence simpler, a terminal raceme.
    b. With 5-10 stem leaves .... 2. *S. stellata*
    bb. Stem leaves fewer, usually only 3 .....
    .... 3. *S. trifolia*

1. *S. racemosa* (L.) Desf. var. *racemosa* -- Job's Tears (*Raisinette*) -- A simple herb with many large distichous leaves and a terminal panicle of white flowers or red berries. Leaves ± lanceolate, 3-4 times as long as wide and acuminate. Anthers 0.5-1.0 mm long, ovoid. Style 0.2-0.7 mm long, not elongating in fruit. Berry 5-7 mm across, solid red. Early summer. Woods, mainly Aspen groves; rare: Shoal Lake. -- (NF), NS-seMan -- Var. *amplexicaulis* (Nutt.) Watson (*S. amplexicaulis* Nutt.) -- Anthers smaller, 0.3-0.5 mm, globular. Style longer, 0.5-1.3 mm long, elongating to 1 mm or more in fruit. Berry smaller and paler, 4-5 mm across and punctate or pale red. -- (Aka), wAlta-BC, US -- Var. *Jenkinsii* Boivin (*S. amplexicaulis* Nutt. var. *ovata* Boivin) -- Leaves broader, suborbicular to narrowly elliptic, less than 3 times as long as wide; acutish to obtuse at tip. --swS-Alta.

2. S. stellata (L.) Desf. -- Wood-Lily -- Similar to the above, but the inflorescence simple and the larger fruit marked by 6 dark purple stripes. Late spring and early summer. Wet places and Aspen groves. --(seK)-Mack-Aka, sL-SPM, NS-BC, US, (Eur).

3. S. trifolia (L.) Desf. -- Tobacco-Berries, Scent-Bottle -- Leaves only (2)-3-(5) per plant. Flowers in a terminal spike. Fruit small, bright red. First half of summer. Frequent in bogs. --seK-Y, L-SPM, NS-BC, US, Eur.

16. MAIANTHEMUM Weber

WILD LILY-OF-THE-VALLEY

Floral parts in 2's. Otherwise similar to Smilacina.

1. M. canadense Desf. var. canadense -- Lily, Wild Lily-of-the-Valley (Muguet, Petit Muguet) -- A small stoloniferous herb with numerous solitary and sterile cordate leaves, and less numerous stems bearing 2 oblong leaves and a terminal raceme of small white flowers. Herbage glabrous. Early summer. Woods. --L-SPM, NS-seMan, US -- Var. interius Fern. -- Herbage pubescent. -- Mack, O-BC, US.

17. DISPORUM Sal.

Fruit a berry, etc., as in Smilacina, but the flower solitary and terminal, or in a small terminal cluster of 2-3 flowers.

a. Leaves glabrous above, acute to subacuminate .. .. 1. D. trachycarpum
aa. Scabrous-puberulent above, abruptly acuminate-caudate .... 2. D. Hookeri

1. D. trachycarpum (Watson) B.& A. -- Fairy-Bells -- A branched herb with 1-(2) flowers at the end of each branch. Leaves cordate, subsessile. Ovary and fruit densely papillose, the latter orange-red. Second half of spring. Woods. --nO-BC,US.

2. D. Hookeri (Torrey) Britton var. oreganum (Watson) Q. Jones (D. oreganum (Watson) B. & H.) -- Much like the first. Leaves narrower, mostly oblong. Ovary and fruit not papillose, but usually pubescent. Second half of spring. Mountain woods in Waterton. -- swAlta-BC, nwUS.

The anthers are clearly exserted in our var. oreganum and the style and ovary are commonly lanate. The stamens are included in the more southern typical phase and its style and ovary are usually glabrous.

18. STREPTOPUS Mx. TWISTED STALK

Flowers axillary and solitary or in 2's, but the peduncule twisted around the leaf-base, so that the flower appears to be borne under the leaf. Fruit a berry.

a. Flower rotate .... 1. S. streptopoides
aa. Campanulate; plants larger.
  b. Leaves sessile to subamplexicaul.... 2. S. roseus
  bb. Deeply cordate at base ..... 3. S. amplexifolius

1. S. streptopoides (Led.) Frye & Rigg var. brevipes (Baker) Fassett -- Flower small, greenish with a purple center and 6 large white stamens. Glabrous, (0.5) -1.0-(2.0) dm high. Leaves sessile to nearly clasping. Peduncle at first straight, becoming geniculate. All spring to mid summer. Dense and wettish coniferous woods; rare: Swan Hills. --Aka, wcAlta-BC, (US).

In the typical phase from eastern Eurasia the leaves are ciliate. In ours they are eciliate and seemingly entire, but under an enlargement of about x 30 they will prove to be minutely crenulate-serrate because the marginal cells are strongly convex on their outer face.

2. S. roseus Mx. var. perspectus Fassett -- Caribou-Berry, Wild Cucumber (Rognons de coq) -- Herb once or twice dichotomously divided and bearing its flowers hidden under the leaves. Herbage ± hirsute. Leaves ciliate, more or less clasping. Peduncles recurved and somewhat hirsute. Late spring. Wet woods. --Aka, L-SPM, NS-Man, wAlta(Kakwa R.)-BC,US.

The peduncles are glabrous in the more southern var. roseus.

3. S. amplexifolius (L.) DC, var. americanus Schultes (var. denticulatus Fassett) -- Like the last, but glabrous and the peduncles strongly geniculate. Stem sometimes coarsely pilose on the 3 lowermost internodes. Leaves entire or more or less denticulate, deeply clasping. Flowers longer. Early summer. Wet woods. -G, swMack-(Y)-Aka, L-NF-(SPM), NS-O, S-BC, US, (Eur).

In southern British Columbia southward one may find a var. chalazatus Fassett in which the leaves are minutely papillose beneath.

It was pointed out by N.C. Fassett, Rhodora 37: 98-99. 1935 the correct name for the plants coarsely pilose on the lower stem internodes below the first branch is var. papillatus Ohwi. He adds: "such plants may occur anywhere throughout the range." When the large supply of Ontario sheets at TRT was sorted out according to leaf ciliation, stem pubescence and their permutations, the four resulting piles were of about equal thickness. There was no evidence that either character could delimit a geographical variant. And obviously they were not linked.

Recently, Hitchcock 1969 has extended the range of *chalazatus* to Alberta and Alaska, but these extensions are discounted on the basis that var. *chalazatus* had been defined primarily in the sense of the earlier var. *papillatus*. There was no corresponding Alberta sheet at WTU and the two Alaska sheets (*Kincaid* on St. Paul and *Hardy* on Attu) have since been revised to var. *americanus*.

19. POLYGONATUM Miller SOLOMON'S SEAL

Tepals fused for over half their length. Plant otherwise typical of the family. Fruit a berry.

1. ***P. biflorum*** (Walter) Ell. (*P. canaliculatum* (Muhl.) Pursh; *P. commutatum* (R. & S.) Dietr.) -- Conquer-John -- Simple herb with broad leaves and drooping axillary umbels of (1)-2-(3) flowers. Flowers tubular, whitish, drooping, borne on a recurved peduncle. Early spring. Forests, usually Oak forests. --O-sMan-seS, US.

20. TRILLIUM L. WAKE-ROBIN

Leaves in a single verticil of 3. Flower single, typical of the family, but the sepals green. Fruit a berry.

1. ***T. cernuum*** L. (var. *macranthum* Eames & Wieg.) Sugarberry. -- Herb with a single verticil of 3 large squarrish-rhomboid leaves. Flower white, borne on a long deflexed peduncle and more or less hidden under the leaves. Berry red. Early summer. Low, deciduous woods. --NF-SPM, NS-ecS, US.

Because *Trillium* flowers keep on enlarging after opening, it has not been possible to delimit clearly and recognized readily a reputedly larger-flowered and more western var. *macranthum*.

Becomes quite rare in Saskatchewan where it is known from Hudson Bay Junction, Mistatim, Runnymede and Yorkton. A collection reported from further west at Fort Carlton (GH) has never been confirmed and is to be taken with a grain of salt. A *Richardson* collection labelled Mackenzie River (GH) is undoubtedly incorrect. Both of the latter were quoted by Macoun 1888 (as *T. erectum* var. *declinatum*) and in Rhodora **25**: 191. 1923. Repeated by Porsild 1968.

T. ovatum Pursh was reported by Moss 1959 for Waterton, querried by Boivin 1967, repeated by Hitchcock

1969. The basis for the report is a photograph (ALTA) labelled "Found by R.H. Riggall, 1915, in Watertown Lakes Park, a small colony in deep shade. Pine-willow-aspen association, never found since." This has never been confirmed either as to locality or as to spontaneousness of occurrence. There is no voucher to check. The label data is not inconsistent with a deliberate introduction into the wild.

It has been our experience with unusual records that start as photographic evidence only, that they generally failed to progress from an initial preliminary report to a fully confirmed report. Hence our continued spepticism in all such cases.

A series of specimens at MTMG, including one of Trillium undulatum W., was collected in 1871 by I.S. Hargrave, supposedly at "St. Remi, Man." But the Saint Remi series does not to-day carry Hargrave's original labels and it comprises a number of other unlikely records; we speculate that they more likely came from "Saint-Rémi, Québec" and that the abbreviation "Man." may have been a speculative editorial accretion. Other series of Hargrave collections from Manitoba seem reliable as to location.

21. SMILAX L. GREEN BRIER

Dioecious climber by means of stipules modified into tendrils.

1. S. herbacea L. var. herbacea -- Carrion-Flower, Jacob's Ladder (Raisin de Couleuvre) -- Climber, 1-2 dm high, with paired tendrils. Leaves broadly cordate, glabrous, glaucous below. Flowers green in a long-pedunculate umbel. Peduncle overtopping the subtending leaf. Fruit deep blue with a glaucous bloom. Early summer. Woods, rare: Tompkins, Hudson Bay Junction. --NB-sO, S, US -- Var. pulverulenta (Mx.) Gray -- Lower face of the leaves green and shiny, often pubescent. Peduncles elongate as above. Fruit black. Very local: Big Muddy Lake. --wO, scS, (US) -- Var. lasioneuron (Hooker) A. DC. (var. lasioneura sphalm.; S. lasioneuron Hooker; Nemexia lasioneuron (Hooker) Rydb.) -- Densely pubescent below on the nerves with thick whitish hairs. Peduncle not longer than the subtending leaf. Fruit glaucous. Frequent in deciduous woods. --O-S, US.

The common variety is var. lasioneuron. The latter is the original spelling of the name and apparently represents a name in apposition; many authors have altered it to the adjectival form lasioneura, but we are not convinced that such a correction was called for.

Of the other two varieties, var. *herbacea* is generally more eastern in its distribution, while var. *pulverulenta* is generally more southern. Both varieties are highly isolated in our area and both are associated with some of the more outstanding physiographic features (see Boivin 1953) within our area.

The two known localities for var. *herbacea*, Tompkins and Hudson Bay Junction, are located respectively on the Coteau Boisé and the Coteau de Prairie. Both Coteaus are not so well known as the Missouri Coteau, but both are similar and outstanding physiographic features of the Prairie. Undoubtedly all tree Coteaus have played an important role in the history of the development of the vegetation of our area in postglacial times.

The Boisé Coteau arises in northeastern Montana near Plentywood, follows the Big Muddy Valley along its western side, enters Canada at Big Muddy, veers West-North-West towards Swift Current, then West-South-West towards the Bullshead Butte in southeastern Alberta. From east to west this Coteau stands out gradually more and more above the surrounding country, being about 200 feet high at the eastern end and about 2000 at its western end. Various sectors of the Coteau Boisé have received individual names such as Little Woody, Wood Mountain, Pinto Butte, Cypress Hill and Bullshead Butte. The Coteau is well know for its fairly rich Rocky Mountain element and this aspect was the object of a special study by Breitung 1954. But it also harbors a more limited eastern flora that finds its western limit of range among the numerous wooded gullies that cut into this Coteau. Such as *Ulmus americana* and the typical variety of *Smilax herbacea*. These wooded gullies are like so many ecological islands in a otherwise steppic environment and their alighment along the Boisé Coteau offer a natural migration path for eastern forest types.

The Prairie Coteau runs almost parallel to the Red River and somewhat to the west of it. It is quite in evidence in the U.S.A. at least as far south as Big Stone Lake. Its various Canadian elements have received individual names such as the Pembina Hills, Agassiz Delta, Riding Mountain, Duck Mountain, Porcupine Mountain and Pasquia Hills. Its role as a south-north migration path is briefly mentioned under *Milium effusum*. If these two Coteaus have, as we postulate, played a role in the westward and northward expansion of var. *herbacea*, one can reasonably expect to find additional isolated colonies of this variety at other spots along either or both Coteaus.

Var. *pulverulenta* is known in our area only from two collections within the Big Muddy Valley, one at Big

Muddy itself, at the southern end of the Big Muddy Lake, the other due south of Bengough, at the western end of the lake. Both came from small wooded ravines, and it is not clear whether this variety belongs here phytogeographically with the Hudson Coulee or with the Coteau Boisé as in this sector the Coteau Boisé follows closely the coulée, merely adding an extra 200 feet or so to the height or the western (or southern) escarpment of the coulée. The Hudson Coulée is a glacial drainage system located between the crest of the Missouri Coteau and the foot of the Coteau Boisé. South of Big Muddy, the Hudson Coulée is a simple channel which coincides with the valley of the Big Muddy River. But north of Big Muddy it forms an interconnecting dendritic pattern of fossil valleys occupied by a series of saline lakes, each forming the heart of an inland drainage basin, with Lake Chaplin at the northermost end of the chain. The role of these fossil coulées in the history of our vegetegion is still to be worked out in detail, with Sarcobatus vermiculatus as perhaps the most obvious coincident botanical element.

Incidentally, each of the 3 known Canadian specimens of var. pulverulenta is sterile.

Also worth mentioning is an old collection from Dufferin (TRT) made during the boundary survey of 1873. One sheet is typical of var. lasioneuron, but a second sheet is in intermediate, the leaves being glabrous as in var. herbacea while the peduncles are short as in var. lasioneuron.

Order 66. IRIDALES

As in the Liliales, but the ovary inferior.

120. IRIDACEAE IRIS FAMILY

Single family. Leaves equitant, that is folded longitudinally and the 2 upper halves fused face to face. Thus only the lower leaf face is visible, the leaves appear inserted edgewise on the stem and the rosette is conspicuously fan-like.

a. Petaloid appendages 9; flowers very large.... 1. Iris
aa. Appendages a normal 6; flowers much smaller... .... 2. Sisyrinchium

1. IRIS L. IRIS

Flower with 9 petaloid appendages: 3 sepals, 3 petals and 3 enlarged styles.

a. Flowers yellow .... 3. I. pseudacorus
aa. Blue.
    b. Leaves over 1 cm wide .... 1. I. versicolor
    bb. Narrower .... 2. I. missouriensis

1. I. versicolor L. var. versicolor -- Flag, Boats (Clajeux, Glaïeul de marais) -- Herb with very large blue flowers and leaves inserted edgewise. Up to 1 m high. Leaves ensiform, 1-2 cm wide, up to 3-7 dm long. Tepals up to 5-6 cm long. Early summer. Very wet places. -- seK, L-SPM, NS-seMan, US.

The typical phase found in our area is segragated by its ovary 1-2 cm long, elongating to 3-6 cm in fruit and a yellowish and finely papillose patch on the sepals. Grades into the more southern var. Shrevei (Small) Boivin with a longer ovary, 1.8-3.5 cm long, elongating to 5-10 cm in fruit and the yellow patch pubescent and more vividly contrasted.

2. I. missouriensis Nutt. -- Like the last but the leaves stiffer and norrower, their bases deep brown, marcescent and very crowded. 3-6 dm high. Leaves 1-4 dm high, 3-8 mm wide. Inflorescence bracts pale, often whitish. Early summer. Marshes and shores, rare: Carway, Whiskey Gap. --sAlta-wBC, US.

Seems native with us, but more likely to be an introduction in B.C.

3. I. PSEUDACORUS L. -- Water-Flag, Yellow Flag (Fleur de Lis, Flambe d'eau) -- Flowers yellow and very showy. Leaves 1-3 cm wide. Fruits drooping, much tapered at both ends. Early summer. Cultivated and possibly escaped to ditches in Saint-François-Xavier. --(NF), NS-PEI, Q-Man, BC, (US), Eur.

The only Manitoba locality could not be confirmed as to occurrence.

2. SISYRINCHIUM L. BLUE-EYED GRASS

Like a diminutive version of Iris, but the corolla-like parts only 6 in number, the styles not being petaloid.

1. S. Bermudiana L. Var. Bermudiana (S. angustifolium AA.; S. campestre Bickn.; S. montanum Greene; S. mucronatum AA.; S. sarmentosum Suksd.; S. septentrionale Bickn.) -- Grass-Flower, Blue-eyed Grass (Bermudienne) -- A Grass-like herb with blue flowers. Tufted. Stems flattened and produced into a pair of opposite wings. Tepals blue, about 1 cm long, mucronate. Capsule light green to light brown or straw-coloured. Early summer. Wettish meadows. -- G, Mack-Y-(Aka), L-SPM, NS-BC, US-- F. albiflorum (J.W. Moore) Boivin -- Flowers white. -- (Man)-S-Alta, US.

Grades eastward into a var. crebrum (Fern.) Boivin, a more intensely coloured plant that tends to darken in drying; bracts and spathes commonly purplish, at least at margin; capsule green, often blackening in drying.

The rejection of Sisyrinchium Bermudiana by Bicknell in 1896 does not seem to conform to our current Rules of Botanical Nomenclature. The linnean type, an excellent Kalm collection (LINN), is inscribed "Bermudiana 1 K", and clearly represents the typical phase of the linnean concept of the species. It is a specimen of what current manuals call S. montanum.

There is also much confusion between S. Bermudiana (or S. montanum) and S. angustifolium Miller; the latter a larger plant frequent around the Gulf of St. Lawrence. Some authors will apply S. Bermudiana to S. angustifolium or even to either species indifferently. Other authors will use S. angustifolium to designate S. Bermudiana. Our usage is coherent with Fernald 1950.

Order 67. AGAVALES

Root (or stem) woody. Tepals partly fused. Leaves all basal, long and very stiff, bayonet-like. Otherwise much as in the Liliales.

121. AGAVACEAE AGAVE FAMILY

Tepals fleshy and petaloid.

1. YUCCA L. SPANISH BAYONET

Tepals free. Coarse herbs of a rather distinctive habit.

1. **Y. glauca** Nutt. var. **glauca** -- Yucca, Soapweed -- Numerous Bayonet-like leaves in a basal hemispheric tuft, overtopped by the tall stem bearing bract-like leaves and a raceme of large yellow flowers. Stem about 1 m high. Leaves about 4 dm long, very stiff and very sharp-pointed. Early summer. Eroded steppes, local: Lost River Canyon in Onefour. -- scAlta, US.

In a more southern var. mollis Eng. the leaves are not so stiff, but more pliable, less involute and often a bit broader.

Order 68. HAEMODORALES

Resembles Liliales and Iridales, but the ovary is ± inferior and the perianth is partly fused into a single tube which is more or less pubescent on the outside.

122. HYPOXIDACEAE STARGRASS FAMILY

Leaves all basal, pubescent.

1. HYPOXIS L. STARGRASS

Anthers attached dorsally.

1. **H. hirsuta** (L.) Cov. -- Stargrass -- Small grass-like herb, pubescent, the yellow flowers pubescent on the outside. Perennial from a corm. Flowers few, umbellate or racemose, overtopped by the leaves. Early summer. Low meadows. -- swO-S, US.

REVISION OF NOTOTRICHIUM SANDWICENSE (AMARANTHACEAE)
HAWAIIAN PLANT STUDIES 87

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One of the numerous monographs of Hawaiian plants made in Chicago by Sherff (1951) was of the genus *Nototrichium*. His treatment of the rare *N. humile* Hbd., and *N. viride* is considered satisfactory. However, the third species, *N. sandwicense* (Gray ex Mann) Hbd., is common and abundant on all the large Hawaiian Islands. Sherff recognized twenty varieties of it, mostly restricted to single islands. This sort of distribution is common among the denizens of the rain forest at medium or high levels on the island mountains. It is not usual among the plants of the lower, dry scrub zone below the forests. In separating his numerous varieties Sherff laid much weight upon the size and shape of the leaf blades. Vigorous young and the lower branches have leaves several times the size of the terminal, fruiting branches. Sherff's key distinctions between blades that are elliptic to lanceolate, versus broader; and broadly ovate, versus moderately ovate, are not easily applied. The writer, long dissatisfied with Sherff's treatment, has now revised the species, and here presents it as one species occurring on all seven large islands, and seven varieties, each found on a single island.

Key to Varieties

A. Blades obtuse,
  B. Petioles 1.5-3 cm long; blades chartaceous.
      e. Maui. var. *leptopodum*.
  B. Petioles 5-12 mm long; blades subcoriaceous.
      Molokai. var. *kolekolense.*
A. Blades acute,
  C. Spikes 1.5-6 cm long,
    D. Blades lanceolate; spikes 1.5-2.5 cm long.
        Molokai. var. *longespicatum.*
    D. Blades ovate to ovate lanceolate,
      E. Sepals 2-2.5 mm long; blades 2-5 cm long; spikes 2-6 cm long.
          Molokai. var. *Forbesii.*
      E. Sepals 3-3.5 mm long; blades 5.7-15 cm long; spikes 2-6 cm long.
          Niihau. var. *niihauense*.

  C. Spikes 0.6-2 (-3) cm long,

F. Peduncles 5-7.5 cm long; blades lanceolate. Kauai. var. olokeleanum.

F. Peduncles 6-30 mm long,

G. Blades obtuse, 1-3 cm long, elliptic. Kauai. var. decipiens.

G. Blades acute, 1.5-11 cm long. Kauai, Oahu, Molokai, Maui, Lanai, Hawaii. var. sandwicense.

Conspectus of Varieties

Nototrichium sandwicense (Gray ex Mann) Hbd., Fl. Haw. Is. 373, 1888; Sherff, Bot. Leafl. 4: 4-8, 1951.
Ptilotus sandwicensis Gray ex Mann, Am. Acad. Arts Sci., Proc. 7: 200, 1867.
Psilotum sandwicense Seem. ex Drake, Ill. Fl. Ins. Mar. Pacif. 270, 1886.
N. sandwicense,
var. dubium Sherff, Bot. Leafl. 2: 2, 1950.
var. Helleri Sherff, Bot. Leafl. 1: 3, 1950.
var. kavaiense (Gray) Hbd., Fl. Haw. Is. 373, 1888.
Ptilotus sandwicensis Gray, var. kavaiensis Gray in Mann, Am. Acad. Arts. Sci., Proc. 7: 200, 1867.
var. lanaiensis Sherff, Bot. Leafl. 1: 3, 1950.
var. lanceolatum Sherff, Bot. Leafl. 1: 3, 1950.
var. latifolium Sherff, Bot. Leafl. 1: 3, 1950.
var. macrophyllum Sherff, Bot. Leafl. 1: 2, 1950.
var. mauiense Deg. & Sherff in Sherff, Bot. Leafl. 2: 3, 1950.
var. pulchellum Sherff, Bot. Leafl. 2: 3, 1950.
var. pulchelloides Deg. & Sherff in Sherff, Bot. Leafl. 3: 2, 1951.
var. subcordatum Deg. & Sherff in Sherff, Bot. Leafl. 1: 3, 1950.
var. syringifolium Sherff, Bot. Leafl. 1: 2, 1950.

var. sandwicense
Lectotype: Iles Sandwich, Hawaii, 1851-1855, J. Remy 207 (GH). Lectotype chosen by Sherff, Bot. Leafl. 4: 7-8, 1951.
Distribution: Common on the drier lowlands of Kauai, Oahu, Molokai, Maui, Lanai, and Hawaii.

var. decipiens Sherff, Bot. Leafl. 2: 2, 1950; 4: 17, 1951; Degener, Fl. Haw. 112: 3/15/56.
Holotype: Kauai, Kaholuamanu, 2,500 ft alt.,

Sept. 24, 1895, A. A. Heller 2,831 (US). Isotype (BISH, MO, NY).

Distribution: Kauai, Kaholuamanu to Waimea Canyon, Halemanu, and Napali Coast from Hoolulu to Haena.

var. Forbesii Sherff, Bot. Leafl. 2: 2, 1950; 4: 9-10, 1951; Degener, Fl. Haw. 112: 3/15/56.

Holotype: Molokai, Mauna Loa, June 1912, C. N. Forbes3.Mo. (NY). Isotypes (BISH, MO). Forbes recorded this as a tree 10 ft high.

Distribution: Arid western Molokai. Besides the type collection, there was another in 1920 by Munro at Papohaku, on the west end of the island.

var. kolekolense Sherff, Bot. Leafl. 1: 3, 1950; Degener, Fl. Haw. 112: 3/15/56.

Holotype: Molokai, slopes of Puu Kolekole, July 1912, C. N. Forbes 179.Mo. (CHI). Isotypes (BISH, MO, NY).

Distribution: Known only from the type collection at Puu Kolekole, southeastern Molokai.

var. leptopodum Deg. & Sherff in Sherff, Bot. Leafl. 1: 2, 1950; 4: 15, 1951; Degener, Fl. Haw. 112: 3.15.56.

Holotype: Maui, Nakaohu, on aa lava waste, Dec. 23, 1948, O. Degener 19,341 (CHI). Isotype (BISH).

Distribution: Maui, Nakaohu, Kanoi, and Auwahi on arid southern slopes of Haleakala.

var. longespicatum Hbd., Fl. Haw. Is. 373, 1888; Sherff, Bot. Leafl. 4: 9, 1951; Degener, Fl. Haw. 112: 3/15/56.

Syntypes: West Maui; Molokai, Kalaupapa, W. Hillebrand (B). These were not seen by Sherff or by the writer, and they are now destroyed.

Neotype: Molokai: Settlement Trail (=Kalaupapa), June 1912, C. N. Forbes 43.Mo. (BISH), here designated. Isotypes (NY, US).

Distribution: Known from several localities in arid West Molokai, and from Wawaia in East Molokai.

Discussion: Hillebrand based his variety on two syntypes: West Maui, and Kalaupapa, Molokai. Both were destroyed in World War II, and had not been critically examined.

Sherff (1951: 9) chose as lectotype the unseen Hillebrand, West Maui (B). There are no known duplicates of this, and no subsequent collections from Maui. The plant is well knwon from Molokai. Consequently, Forbes 43.Mo. from Kalaupapa is here chosen as a neotype.

var. niihauense St. John, Pacif. Sci. 13: 166-168, fig. 9, 1959.
Holotype: Niihau, 1st valley w. of Kaali Cliff, 100 ft alt., Aug. 16, 1947, H. St. John 22,830 (BISH).
Distribution: Lower cliff slopes of Niihau.

var. olokeleanum Sherff, Bot. Leafl. 2: 3, 1950; 4: 12, 1951; Degener, Fl. Haw. 112: 3/15/56.
Holotype: Kauai, Olokele Canyon, Sept. 1909, J. F. Rock 5,422 (GH). Isotype (BISH), and 5,424 which is a duplicate.
Distribution: Known only from the lower Olokele Canyon collection by Rock in 1909, and by Degener in 1926.

Literature Cited

Sherff, Earl Edward, 1951. A revision of the Hawaiian Island genus Nototrichium Hillebr. (fam. Amaranthaceae). Bot. Leafl. 4: 2-21.

ADDITIONAL NOTES ON THE ERIOCAULACEAE. LXXXIII

Harold N. Moldenke

PAEPALANTHUS MUSCOSUS Körn.

Additional citations: Moldenke, Phytologia 41: 483 & 485. 1979.

The Pennell 2256, previously cited by me as P. karstenii var. minimus Moldenke, seems, on closer examination, to represent a form of P. muscosus. It was collected on wet open páramo at 3300 meters altitude, flowering in September, and is described by the collector as an herb with white flowers. Other recent collectors have found P. muscosus growing in marshy páramos, at 3845 m. altitude, fruiting in January, and describe the fruiting-heads as "greenish".

Additional & emended citations: COLOMBIA: Cauca: Cuatrecasas 19099 (W—2817410). Cundinamarca: Pennell 2256 (F—485508, N, W—1042205). ECUADOR: Carchi: Boeke 803 (N).

PAEPALANTHUS PARVUS Ruhl.

Additional bibliography: Moldenke, Phytologia 30: 109--110 (1975), 35: 36 (1976), and 35: 112, 332, & 333. 1977.

The Hatschbach collection cited below is placed here tentatively; it was collected in sunny sandy soil near rocky cliffs, flowering and fruiting in January.

Additional citations: BRAZIL: Minas Gerais: Hatschbach 40826 (Z).

PAEPALANTHUS PEDUNCULATUS (Bong.) Ruhl.

Additional bibliography: Moldenke, Phytologia 30: 114--115 (1975) and 35: 34. 1976.

Recent collectors have found this plant on "campo, solo arenoso junto a pequeño corrego", flowering in January.

Additional citations: BRAZIL: Minas Gerais: Hatschbach 40925 (Ld).

PAEPALANTHUS PERPUSILLUS Kunth

Additional bibliography: Moldenke, Phytologia 37: 50, 263, & 264. 1977.

Recent collectors have encountered this species on exposed river sand bars, at 35—65 m. altitude, flowering and fruiting in April and May.

Additional citations: VENEZUELA: Apure: Davidse & González 12254a (N), 12547 (Ld, Z).

PAEPALANTHUS PHAEOCEPHALUS Ruhl.

Additional bibliography: Moldenke, Phytologia 37: 50. 1977.

Additional citations: BRAZIL: Goiás: Irwin, Harley, & Smith 32154 (Ld).

PAEPALANTHUS PHELPSAE Moldenke

Additional bibliography: Moldenke in Steyerm. & Brewer-Carías, Bol. Soc. Venez. Cienc. Nat. 132/133: 286. 1976; Steyerm. & Brewer-Carías, Bol. Soc. Venez. Cienc. Nat. 132/133: 181. 1976; Moldenke, Phytologia 37: 50. 1977.

Steyermark and his associates describe this plant as growing in solitary clumps, the leaves membranous, rich-green on both surfaces, the heads sordid-white, and the involucre gray pale-brown. They found the plant at 1800 meters altitude, flowering in February and March, and distributedit as Syngonanthus sp.

Additional citations: VENEZUELA: Bolívar: Steyermark, Carreño Espinoza, & Brewer-Carías 109424 (W--2813880).

PAEPALANTHUS PILOSUS (H.B.K.) Kunth

Additional bibliography: Moldenke, Phytologia 37: 50. 1977.

Recent collectors have found this plant on páramos and Espeletia páramos, at 2980—3450 meters altitude, flowering in February, July, and October, fruiting in October, describe the species as a cushion plant, with white inflorescence-heads, the plants "easily separated" [as compared to those of P. karstenii var. corei], and record the vernacular name, "clavitos", for it.

Additional citations: COLOMBIA: Antioquia: Boeke & McElroy 265 (N); Fábrega 2198 (W--2771902). Cauca: Cuatrecasas 23654 (W--2816938).

PAEPALANTHUS PLANIFOLIUS (Bong.) Körn.

Additional bibliography: Hocking, Excerpt. Bot. A.25: 378 (1975) and A.28: 170. 1976; Moldenke, Phytologia 37: 50--51. 1977.

Hatschbach found this plant in sandy soil along roadsides in the cerrado zone, flowering in January.

Additional citations: BRAZIL: Minas Gerais: Hatschbach 40932 (Ld).

PAEPALANTHUS PLANIFOLIUS var. CONDUPLICATUS Ruhl.

Additional bibliography: Moldenke, Phytologia 35: 29. 1976.

Additional citations: BRAZIL: Paraná: Dusén 15650 (Ld).

PAEPALANTHUS PLANIFOLIUS var. GLOBULIFER (Alv. Silv.) Moldenke & Smith

Additional bibliography: Hocking, Excerpt. Bot. A.25: 378. 1975; Moldenke, Phytologia 37: 51. 1977.

Additional citations: MOUNTED CLIPPINGS: Silveira's original description & illustration (N, W, Z).

PAEPALANTHUS PLANIFOLIUS var. VILLOSUS Moldenke

Additional bibliography: Hocking, Excerpt. Bot. A.28: 170. 1976; Moldenke, Phytologia 33: 55. 1976.

PAEPALANTHUS POLYANTHUS (Bong.) Kunth

Additional bibliography: Moldenke, Phytologia 37: 51--52. 1977.

Recent collectors describe the "flowers" as white, and have found the plant in anthesis in March.

Additional citations: BRAZIL: Bahia: *Mori, Mattos Silva, Kallunki, Santos, & Santos 9682* (Ld). Santa Catarina: *Reitz 4687* (Ld).

PAEPALANTHUS POLYANTHUS f. **VILLOSUS** (Beauverd) Moldenke & Smith

Additional bibliography: Moldenke, Phytologia 37: 52. 1977.

Anderson encountered this plant in wet shaded places in cerrado, in an area of rocky cerrado and sparse woods, at 800 meters altitude, flowering in April, and describes it as an "herb to 1.1 m. tall, with many flowering stalks on one basal axis, heads white".

Additional citations: BRAZIL: Minas Gerais: *W. R. Anderson 8815* (Ld, N). MOUNTED CLIPPINGS: Beauverd's original description (N, W, Z).

PAEPALANTHUS POLYTRICHOIDES Kunth

Additional bibliography: Moldenke, Phytologia 37: 52 (1977) and 38: 46 & 47. 1977.

Recent collectors describe this plant as forming multi-headed clumps, with gray-green leaves, white or whitish capitate flowerheads, and have encountered it in wet sand on savannas, in sand along rivers, in damp white sand in scrub, and in open xeromorphic scrub, at 750 m. altitude, flowering and fruiting in January, March, and September. Davis refers to it as a "small forb".

Material of this species has been misidentified and distributed in some herbaria as *P. subtilis* Miq. — the two Guyana collections listed below were even so cited by me in a previous publication in this series. On the other hand, the *Bautista 68*, distributed as *P. polytrichoides* actually is *Syngonanthus umbellatus* (Lam.) Ruhl.

Additional citations: VENEZUELA: Bolívar: *Steyermark, Dunsterville, & Dunsterville 113283* (Ld), *113343* (Z). GUYANA: *D. H. Davis 156* (N); *Herb. Univ. Georgetown Bio. 106 no. 21* (N). SURINAM: *Mori, Bolten, & Jansma 8327* (Ld, N). MOUNTED CLIPPINGS: Huber's original description of *P. maracanus* (N, W).

PAEPALANTHUS POLYTRICHOIDES var. **GLABER** Moldenke

Additional bibliography: Moldenke, Phytologia 30: 319—320. 1975.

Irwin refers to this plant as "abundant in wet savannas among thickets on white wet quartz sand" and says that the flowers were "gray-white", blooming in April.

Additional citations: GUYANA: *Irwin 475* (Au—165651, Au—178024).

PAEPALANTHUS PULLUS Körn.

Additional bibliography: Moldenke, Phytologia 35: 30. 1976.

Additional citations: BRAZIL: Rio de Janeiro: *Gaudichaud s.n.*

[Rio Janeiro; U. S. Nat. Herb. photo 5887] (W).

PAEPALANTHUS PULVINATUS N. E. Br.

Additional bibliography: Hutchins. & Dalz., Fl. W. Trop. Afr., ed. 1, 2: 328. 1931; Meikle in Hutchins. & Dalz., Fl. W. Trop. Afr., ed. 2, 3: 65. 1968; Moldenke, Phytologia 33: 57. 1976.

Hutchinson & Dalziel (1931) refer to this species as "A small cushion-plant with several shortly pedunculate heads from around the sides of the cushion". Meikle (1968) says "Plants forming dense cushions; leaves greyish, strongly recurved; capitula greyish, pilose, hemispherical, about 5 mm. diam.; sepals of female flowers not recurving at maturity". He cites only Bockstatt s.n. from Sierra Leone and notes that it is "A very rare plant, only once collected, and unsatisfactorily localized; its rediscovery would be very welcome."

PAEPALANTHUS RAMOSUS (Wikstr.) Kunth

Additional bibliography: Moldenke, Phytologia 37: 52 & 273. 1977.

Recent collectors describe this plant as to 40 cm. tall, with white flowers, and have found it in flower and fruit in March.

Additional citations: BRAZIL: Bahia: Vinha & Santos 156 (Ld, N). Minas Gerais: P. Clausen 232 (Ld).

PAEPALANTHUS RAMOSUS var. AFFINIS (Bong.) Ruhl.

Additional bibliography: Moldenke, Phytologia 37: 52. 1977.

Additional citations: BRAZIL: Espírito Santo: Duarte 13978 (N).

PAEPALANTHUS REGALIS Mart.

Additional bibliography: Moldenke, Phytologia 37: 53. 1977.

Santos describes this plant as up to 40 cm. tall, the "flores secas, arroxeadas quando jovens", and encountered it in rocky soil at 1050 m. altitude, flowering in May.

Additional citations: BRAZIL: Bahia: T. S. Santos 3113 (Ld, N).

PAEPALANTHUS REPENS (Lam.) Körn.

Additional bibliography: Moldenke, Phytologia 37: 53. 1977.

Additional citations: HISPANIOLA: Dominican Republic: Ekman H. 13667 (Ld); Türckheim 3327 (Au--26802). Haiti: Ekman H.1385 (Ld).

PAEPALANTHUS SAXICOLA var. CONICUS Moldenke

Additional bibliography: Moldenke, Phytologia 35: 31 (1976), 35: 336 & 431 (1977), and 37: 84. 1977.

Additional citations: VENEZUELA: Amazonas: H. C. Clark 6638 (Ld).

PAEPALANTHUS SCANDENS Ruhl.

Additional bibliography: Moldenke, Phytologia 33: 138 & 140--141. 1976.

Shepherd and his associates refer to this plant as a "subarbusta até 70 cm., capítulos brancos" and found it growing in brejo (wet sedge meadow), flowering in November.

Additional citations: BRAZIL: Goiás: Shepherd, Andrade, Kinoshita & Tamashiro 3745 (N, N).

PAEPALANTHUS SELLOWIANUS Körn.

Additional bibliography: Moldenke, Phytologia 33: 150--151 & 191. 1976.

According to J. Angely, in a letter to me dated August 25, 1977, the type locality for this species is "inter Castro - Itararé, 10 December 1828, leg. Sellow 5149" and this locality lies in what is now the state of Paraná, Brazil, not in São Paulo as some writers have contended, because São Paulo state was split up in 1853 and this locality is in the part split off as Paraná.

PAEPALANTHUS SESSILIFLORUS Mart.

Additional bibliography: Hocking, Excerpt. Bot. A.25: 379. 1975; Moldenke, Phytologia 33: 185--187 (1976) and 35: 288. 1977.

PAEPALANTHUS SESSILIFLORUS var. VENEZUELENSIS Moldenke

Additional bibliography: Hocking, Excerpt. Bot. A.25: 379. 1975; Moldenke, Phytologia 33: 186--187 (1976) and 35: 288. 1977.

PAEPALANTHUS SPECIOSUS (Bong.) Körn.

Additional bibliography: Hocking, Excerpt. Bot. A.25: 379. 1975; Moldenke, Phytologia 37: 54. 1977.

Kirkbride & Lleras refer to this plant as an herb, 1.5 m. tall, and found it growing in "short scrubby forest over bare white sandstone rocks", in flower and fruit in February.

Additional citations: BRAZIL: Pará: Kirkbride & Lleras 2971 (W--2815577, W--2815578, W--2815579).

PAEPALANTHUS SPECIOSUS var. ATTENUATUS Moldenke

Additional bibliography: Hocking, Excerpt. Bot. A.25: 379. 1975; Moldenke, Phytologia 35: 33. 1976.

Additional citations: BRAZIL: Goiás: Irwin, Harley, & Smith 32935 (Ld--isotype).

PAEPALANTHUS SPECIOSUS f. CALVESCENS Moldenke

Additional bibliography: Hocking, Excerpt. Bot. A.25: 379. 1975; Moldenke, Phytologia 33: 192, 194, & 196. 1976.

PAEPALANTHUS STEYERMARKII Moldenke

Additional bibliography: Moldenke, Phytologia 37: 54 (1977) and 38: 36 & 45. 1977.

Steyermark describes this plant as forming large depressed-globose gray-green clumps 0.5--2 meters in diameter, the heads gray-white, flowering in December, and found it as 1300 meters altitude.

Additional citations: VENEZUELA: Bolívar: Davidse 4681 (N);

J. A. Steyermark 111284 (N).

PAEPALANTHUS STUEBELIANUS Ruhl.

Additional bibliography: Moldenke, Phytologia 37: 54. 1977.

Recent collectors have found this plant in boggy soil, *Sphagnum* bogs, and the "sub-jalca" formation, flowering in May and June, fruiting in May, describing the inflorescence-heads as "white" or "whitish".

Additional citations: PERU: Amazonas: *Boeke 1815* (N), *1826* (N), *2036* (N).

PAEPALANTHUS SUBTILIS Miq.

Additional bibliography: "M. P. B." [Moldenke], Biol. Abstr. 63: 6594. 1977; Moldenke, Biol. Abstr. 63: 3041. 1977; Moldenke, Phytologia 37: 54 (1977), 38: 41 (1977), and 41: 484. 1979.

The *Steyermark 58447*, distributed as and previously cited by me as *P. subtilis*, actually is the very similar *P. lamarckii* Kunth, while *D. H. Davis 156*, *Steyermark, Dunsterville, & Dunsterville 113283* & *113343*, and *Herb. Univ. Georgetown Bio. 106-21* are *P. polytrichoides* Kunth.

Additional citations: GUYANA: *Jenman 5770* (C).

PAEPALANTHUS SYCHNOPHYLLUS Ruhl.

Additional bibliography: "M. P. B." [Moldenke], Biol. Abstr. 63: 6594. 1977; Moldenke, Phytologia 35: 118. 1977.

Sucre and his associates found this plant growing in extensive colonies in clearings of "restinga contígua a mata alagadica, heliófila", along with sparse herbaceous vegetation "mais perto da área alagardica, flores branco-acinzentadas", flowering in June.

Additional citations: BRAZIL: Rio de Janeiro: *Sucre, Graziela Barroso, & Ichaso 5312* [Herb. Jard. Bot. Rio Jan. 175198] (N).

PAEPALANTHUS TATEI Moldenke

Additional bibliography: "M. P. B." [Moldenke], Biol. Abstr. 63: 6594. 1977; Moldenke, Phytologia 35: 119—121. 1977.

Steyermark and his associates describe this plant as having "heads depressed, gray-white, involucre dull green, leaves flaccid, rich green" and have encountered it at 750 m. altitude, flowering in January.

Additional citations: VENEZUELA: Bolívar: *Steyermark, Dunsterville, & Dunsterville 113274* (N, W--2813992).

PAEPALANTHUS TORTILIS (Bong.) Mart.

Additional bibliography: "M. P. B." [Moldenke], Biol. Abstr. 63: 6594. 1977; Moldenke, Biol. Abstr. 64: 4787. 1977; Moldenke, Phytologia 37: 36 & 55. 1977.

Recent collectors describe this plant as growing to 5 cm. tall, the scapes to 15 cm. tall, and the inflorescences "cinza" or "cor. verdes-sumo". They have found it growing in wet sandy soil, in flower in April, July, and August.

Additional citations: BRAZIL: Bahia: Santos & Mattos Silva 3255 (Ld); Vinha 34 [Pinheiro 182] (Ld, N). Minas Gerais: Hatschbach 41260 (Ld), 41304 (Ld).

PAEPALANTHUS ULEANUS Ruhl.

Additional bibliography: Moldenke, Biol. Abstr. 64: 686. 1977; Moldenke, Phytologia 35: 255. 1977.

Additional citations: BRAZIL: Rio de Janeiro: Glaziou 17304 [U. S. Nat. Herb. photo 5886] (W—photo).

PAEPALANTHUS URBANIANUS Ruhl.

Additional bibliography: Moldenke, Phytologia 35: 257—258. 1977; Anon., Roy. Bot. Gard. Kew. Lib. Curr. Aware. List 8: 33. 1978; Moldenke, Phytologia 41: 475. 1979.

Additional citations: BRAZIL: Goiás: Haas, Haas, & Belém 364 [Herb. Brad. 50408] (N).

PAEPALANTHUS URBANIANUS var. **ANGUSTIFOLIUS** Moldenke, Phytologia 39: 330. 1978.

Bibliography: Moldenke, Phytologia 39: 330 (1978) & 41: 475. 1979.

The type collection of this variety, cited below, was previously mistakenly distributed and cited as P. arenicola Alv. Silv.

Citations: BRAZIL: Goiás: Irwin, Reis dos Santos, Souza, & Fonsêca 24936 (N—type).

PAEPALANTHUS VENETIFOLIUS Moldenke & Steyerm. ex Moldenke, Phytologia 31: 383, nom. nud. 1975; in Steyerm. & Brewer-Carías, Bol. Soc. Venez. Cienc. Nat. 132/133: 284—286, fig. 4. 1976.

Additional bibliography: Moldenke in Steyerm. & Brewer-Carías, Bol. Soc. Venez. Cienc. Nat. 132/133: 284—286, fig. 4. 1976; Steyerm. & Brewer-Carías, Bol. Soc. Venez. Cienc. Nat. 132/133: 199. 1976; Moldenke, Biol. Abstr. 64: 686. 1977; Moldenke, Phytologia 35: 264. 1977.

Illustrations: Moldenke in Steyerm. & Brewer-Carías, Bol. Soc. Venez. Cienc. Nat. 132/133: [285], fig. 4. 1976.

PAEPALANTHUS VESTITUS Ruhl.

Additional bibliography: Hocking, Excerpt. Bot. A.28: 170. 1976; Moldenke, Biol. Abstr. 64: 1838. 1977; Moldenke, Phytologia 35: 278. 1977.

PAEPALANTHUS VESTITUS var. **CAULESCENS** Moldenke

Additional bibliography: Hocking, Excerpt. Bot. A.28: 170. 1976; Moldenke, Phytologia 35: 278. 1977.

PAEPALANTHUS VIRIDIS Körn.

Additional bibliography: Moldenke, Phytologia 35: 280—281. 1977.

Hatschbach has found this species growing in sandy soil of corregos, shady wet margins of corregos, and wet sandy soil on plains between a river and hills, flowering and fruiting in April.

Additional citations: BRAZIL: Minas Gerais: *Hatschbach* *41295* (Ld), *41325* (Ld), *41370* (N).

PAEPALANTHUS WEBERBAUERI Ruhl.

Additional bibliography: Moldenke, Phytologia 35: 283. 1977.

Additional citations: PERU: San Martín: *Weberbauer* *1152* [Macbride photos 10662] (Z--photo of cotype).

PAEPALANTHUS WILLIAMSII Moldenke

Additional bibliography: Moldenke, Phytologia 35: 284. 1977.

Recent collectors have encountered this plant in wet sandy areas on sandstone savannas, and report the flowers as "white". They have found it in anthesis in June.

Additional citations: COLOMBIA: Vaupés: *Zarucchi* & *Balick* *1792* (N). VENEZUELA: Amazonas: *H. C. Clark* *6859* (Ld).

PHILODICE Mart.

Additional bibliography: Moldenke, Biol. Abstr. 64: 1838. 1977; Moldenke, Phytologia 37: 56, 70, 87, 485, 488, & 510 (1977), 38: 50 (1977), 38: 509 (1978), and 41: 475 & 509. 1979.

PHILODICE HOFFMANNSEGGII Mart.

Additional bibliography: Moldenke, Biol. Abstr. 64: 1838. 1977; Moldenke, Phytologia 37: 56, 70, 87, 485, & 488 (1977) and 41: 475. 1979.

Recent collectors describe this plant as a "locally common" herb, to 10 cm. tall, the inflorescences "white", and have found it growing in moist or wet sandy soil, at 133 meters altitude, flowering and fruiting in May and October.

Material of this species has been misidentified and distributed in some herbaria as "*Paepacantus* *bifudos* (Schara) Kunth".

Additional citations: BRAZIL: Mato Grosso: *Rosa* & *Santos* *1973* (N). Roraima: *Coradin* & *Cordeiro* *803* (N).

RONDONANTHUS RORAIMAE (Oliv.) Herzog

Additional synonymy: *Rhondonanthus* *roraimae* (Oliv.) Herzog, in herb.

Additional bibliography: Moldenke, Biol. Abstr. 64: 1838. 1977; Moldenke, Phytologia 37: 56. 1977.

Steyermark and his associates describe this plant as having the "outer bracts blackish, rest of head bright white" or "heads white with black outer bracts" and found it growing in large or scattered clumps or "forming large tufts in spongy ground in open meadowy terrain among rock formations of 'morros' and on open slopes below bluffs", at 2750—2800 meters altitude, flowering in August and September. Irwin speaks of it as "occasional" at 9200 feet altitude, the flowers "gray-white".

Additional citations: VENEZUELA: Bolívar: Steyermark, Brewer-Carías, Dunsterville, & Dunsterville 112438 (N, W—2813991), 112608 (W—2813996). GUYANA: Irwin 704 (Au—173718).

SYNGONANTHUS Ruhl.

Additional synonymy: Mutia Mart. ex Moldenke, Phytologia 38: 127 & 128, in syn. 1977. Sygonanthus Ruhl., in herb.

Additional bibliography: Hutchins. & Dalz., Fl. W. Trop. Afr., ed. 1, 2: 324 & 328. 1931; Meikle in Hutchins. & Dalz., Fl. W. Trop. Afr., ed.2, 3: 57 & 67. 1968; Hocking, Excerpt. Bot. A.25: 378 & 379. 1975; Spellman, Dwyer, & Davidse, Rhodora 77: 124. 1975; Hocking, Excerpt. Bot. A.28: 170, 171, & 259. 1976; Moldenke, Biol. Abstr. 61: 4884. 1976; Moldenke in Steyerm. & Brewer-Carías, Bol. Soc. Venez. Cienc. Nat. 132/133: 286. 1976; Steyerm. & Brewer-Carías, Bol. Soc. Venez. Cienc. Nat. 132/133: 182 & 183. 1976; Batson, Gen. East. Pl. 40 & 201. 1977; Moldenke, Biol. Abstr. 64: 1838, 2445, 4787, 5384, & 6581. 1977; Poppeton, Shuey, & Sweet, Fla. Scient. 40: 372. 1977; Moldenke, Phytologia 37: 24, 54, 56—58, 252—275, 420—423, 485—499, 508. & 511 (1977), 38: 23—50 (1977), 38: 178—193, 199, & 511 (1978), 39: 161 & 512 (1978), and 40: 316 & 511. 1978; Anon., Biol. Abstr. 65 (8): C.22. 1978; Anon., Roy. Bot. Gard. Kew Lib. Curr. Aware. List 8: 33. 1978; Craig, Proc. Fla. State Hortic. Soc. 90: 110. 1978; Moldenke, Biol. Abstr. 65: 3117, 3719, & 4341. 1978; Moldenke, Phytologia 41: 10 (1978) and 41: 423, 464, 474, & 511. 1979.

SYNGONANTHUS ALLENI Moldenke

Additional bibliography: Moldenke, Phytologia 35: 311—312. 1977.

Prance and his associates encountered this species on open wet grassy savannas, fruiting in November.

Additional citations: BRAZIL: Pará: Prance, Silva, Berg, Henderson, Nelson, Balick, Bahia, & Reis dos Santos P.25250 (N, N).

SYNGONANTHUS ANDROSACEUS (Griseb.) Ruhl.

Additional bibliography: Moldenke, Phytologia 37: 56. 1977.

Additional citations: CUBA: Province undetermined: Herb. Bio. Dept. Va. Polytech. Inst. 11358 (Ld).

SYNGONANTHUS APPRESSUS (Körn.) Ruhl.

Additional bibliography: Hocking, Excerpt. Bot. A.25: 378. 1975; Moldenke, Phytologia 35: 321--322 (1977) and 37: 96. 1977.

SYNGONANTHUS APPRESSUS var. CHAPADENSIS Moldenke

Additional bibliography: Hocking, Excerpt. Bot. A.25: 378. 1975; Moldenke, Phytologia 35: 322. 1977.

SYNGONANTHUS AURIFIBRATUS Alv. Silv.

Additional bibliography: Moldenke, Phytologia 35: 366 & 349.

1977.

The Schultes & Cabrera 17564, distributed as S. aurifibratus in some herbaria, seems actually to represent the perplexing taxon at present known as Paepalanthus saxicola var. conicus Moldenke.

Additional citations: MOUNTED CLIPPINGS: Silveira's original description & illustrations (N, W, Z).

SYNGONANTHUS BAHIENSIS Moldenke

Additional bibliography: Hocking, Excerpt. Bot. A.25: 378. 1975; Moldenke, Phytologia 37: 57. 1977.

Additional citations: BRAZIL: Bahia: Davidse, Ramamoorthy, & Vital 11932 (N).

SYNGONANTHUS BELLUS Moldenke

Additional bibliography: Moldenke, Phytologia 37: 57. 1977.

Material of this species has been misidentified and distributed in some herbaria as Paepalanthus fertilis Körn.

Additional citations: BRAZIL: Pará: Bautista 69 (N).

SYNGONANTHUS BIFORMIS (N. E. Br.) Gleason

Additional bibliography: Moldenke, Biol. Abstr. 64: 1838. 1977; Moldenke, Phytologia 37: 57 (1977) and 38: 40 & 41. 1977.

The Steyermark, Dunsterville, & Dunsterville 112373, distributed as S. biformis, actually is S. glandulosus var. epapillosus Moldenke, while these same collectors' no. 113135b is S. simplex (Miq.) Ruhl.

SYNGONANTHUS BISULCATUS (Körn.) Ruhl.

Additional bibliography: Moldenke, Biol. Abstr. 64: 1838. 1977; Moldenke, Phytologia 35: 341--342. 1977.

Hatschbach encountered this species in wet sandy soil of a plain between a river and hills, flowering in April.

Additional citations: BRAZIL: Minas Gerais: Hatschbach 41319 (N).

SYNGONANTHUS BRACTEOSUS Moldenke

Additional bibliography: Hocking, Excerpt. Bot. A.25: 378. 1975; Moldenke, Phytologia 35: 344. 1977.

SYNGONANTHUS CANDIDUS Alv. Silv.

Additional bibliography: Hocking, Excerpt. Bot. A.25: 378. 1975; Moldenke, Phytologia 35: 348--349, 446, & 448 (1977), 37: 57--58 (1977), and 38: 27. 1977.

Additional citations: MOUNTED CLIPPINGS: Silveira's original description & illustration (N, W, Z).

SYNGONANTHUS CANDIDUS var. BAHIENSIS Moldenke

Additional bibliography: Hocking, Excerpt. Bot. A.25: 378. 1975; Moldenke, Phytologia 37: 57--58. 1977.

SYNGONANTHUS CAULESCENS (Poir.) Ruhl.

Additional & emended bibliography: Hocking, Excerpt. Bot. A.28: 170 & 259. 1976; Moldenke, Biol. Abstr. 61: 4884 (1976) and 64: 1838 & 2445. 1977; Moldenke, Phytologia 37: 58. 1977.

The *Reitz 5343*, distributed as typical *S. caulescens* in some herbaria, actually represents var. *angustifolius* Moldenke.

Additional citations: VENEZUELA: Guárico: *Davidse 3771* (N). FRENCH GUIANA: *Halle 2224* (N); *Jannoda 47* (N). BRAZIL: Minas Gerais: *Davidse, Ramamoorthy, & Vital 11590* (N). Paraná: *Dombrowski 9437* (Ld); *Dombrowski & Neto 9074* (Ld). Rio Grande do Sul: *Rambo 46178* (Au—26803, Au—26804). MOUNTED CLIPPINGS: Bongard's original description of *Eriocaulon splendens* (N, W, Z).

SYNGONANTHUS CAULESCENS var. **ANGUSTIFOLIUS** Moldenke

Additional bibliography: Moldenke, Phytologia 37: 58. 1977.

Recent collectors have found this plant growing on wet campos and in brejo (wet sedge meadows), at 750 meters altitude, flowering in January and fruiting in October, the flowers describes as "white".

Additional citations: BRAZIL: Minas Gerais: *Davidse & Ramamoorthy 10572* (N). Paraná: *Hatschbach 40434* (Ld). Santa Catarina: *Reitz 5343* [Herb. Barb. Rodr. 6346] (N, N).

SYNGONANTHUS CAULESCENS var. **HATSCHBACHII** Moldenke

Additional bibliography: Hocking, Excerpt. Bot. A.28: 170. 1976; Moldenke, Phytologia 35: 420. 1977.

SYNGONANTHUS CAULESCENS var. **PROLIFERUS** Moldenke

Additional bibliography: Moldenke & Sm. in Reitz, Fl. Ilust. Catar. I Erioc: 89, 93--94, & 103. 1976; Moldenke, Phytologia 35: 423. 1977.

The vernacular names reported for this variety are identical to those reported for the typical form of the species.

SYNGONANTHUS CHRYSANTHUS (Bong.) Ruhl.

Additional & emended synonymy: *Eriocaulon morulum* (Kunth) Steud. apud Moldenke & Sm. in Reitz, Fl. Ilus. Catar. I Erio: 84, in syn. 1976. *Eriocaulon morulum* "Kunth ex Moldenke" apud Moldenke & Sm. in Reitz, Fl. Ilus. Catar. I Erio: 99, in syn. 1976. *Syngonanthus chrysanthus* var. *chrysanthus* [(Bong.) Ruhl.] apud Moldenke & Sm. in Reitz, Fl. Ilust. Catar. I Erioc: 84. 1976.

Additional bibliography: Moldenke & Sm. in Reitz, Fl. Ilust. Catar. I Erio: 77, 83--88, 98--101, & 103, pl. 9, fig. 1--9. 1976; Moldenke, Phytologia 35: 425—428 (1977) and 36: 74. 1977.

Illustrations: Moldenke & Sm. in Reitz, Fl. Ilust. Catar. I Erio: 85, pl. 9, fig. 1—9. 1976.

Vernacular names recorded for this species are "capim-manso", "capipoatinga-dourada", "gravatá-manso", and "sempre-viva-do-campo" and it is said to flower from November to February in Santa Catarina, Brazil.

SYNGONANTHUS CHRYSANTHUS var. CASTRENSIS Moldenke
Additional bibliography: Moldenke & Sm. in Reitz, Fl. Ilust. Catar. I Erio: 83, 87—88, & 103. 1976; Moldenke, Phytologia 35: 428. 1977.

Vernacular names reported for this variety are "capim-manso", "capipoatinga-dourada-de-castro", "gravatá-manso", and "sempre-viva-do-campo" and it is said to flower in November.

SYNGONANTHUS COMOSUS Alv. Silv.
Additional bibliography: Hocking, Excerpt. Bot. A.28: 170. 1976; Moldenke, Phytologia 35: 430—431. 1977.

Additional citations: MOUNTED CLIPPINGS: Silveira's original description & illustration (N, W, Z).

SYNGONANTHUS DENSIFLORUS (Körn.) Ruhl.
Additional bibliography: Hocking, Excerpt. Bot. A.25: 378. 1975; Moldenke, Phytologia 35: 435—438. 1977.

SYNGONANTHUS DENSIFLORUS var. GLABRIFOLIUS Moldenke
Additional bibliography: Hocking, Excerpt. Bot. A.25: 378. 1975; Moldenke, Phytologia 35: 438. 1977.

SYNGONANTHUS DENSUS (Körn.) Ruhl.
Additional bibliography: Moldenke, Phytologia 37: 68. 1977.

Keel refers to this plant as an "herb with runners" and found it in fruit in October.

Additional citations: BRAZIL: Amazônas: _Keel 235_ (N).

SYNGONANTHUS DROUETII L. B. Sm.
Additional bibliography: Moldenke, Phytologia 37: 68 (1977) and 38: 48. 1977.

Additional citations: VENEZUELA: Amazonas: _H. C. Clark 6860_ (Ld).

SYNGONANTHUS ELEGANS (Bong.) Ruhl.
Additional bibliography: Moldenke, Phytologia 37: 68, 69, 85, & 486—488 (1977) and 38: 27. 1977.

Additional citations: BRAZIL: Minas Gerais: _Mexia 5735_ (Au—26806). MOUNTED CLIPPINGS: Bongard's original description (N, W, Z).

SYNGONANTHUS ELEGANTULUS Ruhl.
Additional bibliography: Moldenke, Biol. Abstr. 64: 5384. 1977; Moldenke, Phytologia 37: 68—69, 487, & 488 (1977) and 38: 48. 1977.

Hatschbach has found this species growing in "solo arenoso junto a corrego" and in sandy soil on plains between a river and hills, flowering and fruiting in April.

Additional citations: BRAZIL: Minas Gerais: Hatschbach 41283 (N), 41373 (N).

SYNGONANTHUS FERTILIS (Körn.) Ruhl.

Additional bibliography: Moldenke, Phytologia 37: 69, 90, & 91 (1977) and 41: 10. 1978.

Recent collectors describe the flower-heads of this species as "white", found it in fruit in August, and have misspelled the name of the parenthetical author as "Korne".

The Bautista 69, distributed as S. fertilis, actually is S. bellus Moldenke, while W. A. Anderson 8130, Murça Pires, Silva, & Souza 9843a, and Saint-Hilaire C^{1}.712 [U. S. Nat. Herb. photo 5901], previously regarded as and cited as the typical form of S. fertilis, are now thought to represent var. fuscus Moldenke.

Additional citations: BRAZIL: Rondonia: Rosa, Murça Pires, & Rodrigues 894 (N).

SYNGONANTHUS FERTILIS var. FUSCUS Moldenke, Phytologia 41: 10. 1978.

Bibliography: Moldenke, Phytologia 41:

Collectors have encountered this plant on grassy hillside campos, at 1250 meters altitude, flowering in April and July, and fruiting in July. The specimens cited below were previously cited by me as typical S. fertilis (Körn.) Ruhl. before the present taxon was recognized.

Citations: BRAZIL: Goiás: W. A. Anderson 8130 (Ld, N); Murça Pires, Silva, & Souza 9843a (N—type); A. Saint-Hilaire C^{1}.712 [U. S. Nat. Herb. photo 5901] (N--photo, P, P, W—photo).

SYNGONANTHUS FISCHERIANUS (Bong.) Ruhl.

Additional bibliography: Hocking, Excerpt. Bot. A.25: 379. 1975; Moldenke, Phytologia 37: 69 (1977) and 38: 178 & 179. 1978.

Additional citations: BRAZIL: Paraná: Dombrowski & Neto 9075 (Ld).

SYNGONANTHUS FLAVIDULUS (Michx.) Ruhl.

Additional bibliography: Batson, Gen. East. Pl. 40. 1977; Moldenke, Biol. Abstr. 64: 2445 & 6581. 1977; Moldenke, Phytologia 37: 69. 1977; Poppeton, Shuey, & Sweet, Fla. Scient. 40: 372. 1977; Craig, Proc. Fla. State Hortic. Soc. 90: 110. 1978; Moldenke, Phytologia 41: 464. 1979.

Additional illustrations: Batson, Gen. East. Pl. 40. 1977.

Craig (1978) reports this species growing on only 1 percent of the coastal sand dunes studied by him in southeastern and southwestern Florida.

The Halfert s.n. [3 Apr. 1934] collection, cited below, is a mixture with Lachnocaulon beyrichianum Sporleder.

Additional citations: NORTH CAROLINA: Brunswick Co.: Godfrey 48362 (Ld, Ld). GEORGIA: Berrien Co.: R. Kral 24254 (Au--245544). Clinch Co.: R. Kral 24288 (Au--245585). Effingham Co.: R. Kral 24103 (Au--245647). Lanier Co.: R. Kral 24265 (Au--245589). Liberty Co.: R. Kral 24217 (Au--245523). Pierce Co.: R. Kral 24149 (Au--245644). Screven Co.: R. Kral 24028 (Au--245594), 24051 (Au--245595, Ld). Ware Co.: R. Kral 25307 (Au--245543). Wayne Co.: R. Kral 24184 (Au--245596), 24198 (Au--245547, Ld). FLORIDA: Alachua Co.: W. V. Brown s.n. [June 22, 1940] (Au--217130). Highlands Co.: B. M. Davis s.n. [Mar. 8, 1933] (Mi). Hillsborough Co.: Patman 1052 (Ld). Leon Co.: Godfrey 62901 (Au--229685, Ld). Liberty Co.: Godfrey 57055 (Ld). Okaloosa Co.: Godfrey 56719 (Au--232210. Polk Co.: Taylor & Taylor 7540 (Ld). Seminole Co.: Foster, Smith, & Smith Pl. Exsicc. Gray. 1334 (Au--26807, Au--198889, Ld). Volusia Co.: Halfert s.n. [3 Apr. 1934] in part (Mi).

SYNGONANTHUS GLANDULOSUS Gleason

Additional bibliography: Moldenke, Biol. Abstr. 64: 6581. 1977; Moldenke, Phytologia 37: 69--70, 82, 87, 88, 91, & 270 (1977) and 38: 40 & 42. 1977.

Additional citations: GUYANA: Irwin 776 (Au--165662).

SYNGONANTHUS GLANDULOSUS var. EPAPILLOSUS Moldenke

Additional bibliography: Moldenke, Biol. Abstr. 64: 6581. 1977; Moldenke, Phytologia 36: 36 & 65--66 (1977) and 37: 87, 88, & 270. 1977.

Recent collectors describe the leaves of this plant as green and flat, the flowers "pale-white", and have found it growing in the wet margins of forested streambanks or in riverine forests, at 350--1200 m. altitude, flowering and fruiting in August.

Material of this plant has been misidentified and distributed in some herbaria as S. biformis (N. E. Br.) Gleason.

Additional citations: VENEZUELA: Bolívar: Cardona Puig 2886 (W--2815597); Steyermark, Dunsterville, & Dunsterville 112373 (Lc), 112379 (Ld).

SYNGONANTHUS GOYAZENSIS (Körn.) Ruhl.

Additional bibliography: Moldenke, Biol. Abstr. 64: 6581. 1977; Moldenke, Phytologia 36: 67 (1977), 38: 38 (1977), and 40: 316. 1978.

SYNGONANTHUS GOYAZENSIS var. HATSCHBACHII Moldenke, Phytologia 40: 316. 1978.

Bibliography: Moldenke, Phytologia 40: 316. 1978.

Citations: BRAZIL: Goiás: Hatschbach 40064 (Z--type).

SYNGONANTHUS GRACILIS (Bong.) Ruhl.

Additional synonymy: Syngonanthus gracwlis Moldenke, Biol. Abstr. 64: 6581, sphalm. 1977.

Additional bibliography: Spellman, Dwyer, & Davidse, Rhodora 77: 124. 1975; Moldenke, Biol. Abstr. 64: 6581. 1977; Moldenke, Phytologia 36: 63—66 & 68—85 (1977), 37: 70—77, 86, 257, 261, 269, 270, 274, 420, 421, 495, & 496 (1977), 38: 24, 40, 41, 47, & 48 (1977), 38: 193 (1978), and 41: 474. 1979.

Steyermark and his associates encountered this plant on dry, rocky, open, sandstone exposures, at 750 m. altitude, flowering and fruiting in January, and distributed it as "*S.* aff. *S. simplex* (Miq.) Ruhl. Tillett and his associates found it growing in white sand along riverbanks at 1350 m. altitude in an area of "las filas con 'crest slope vegetation' de *Brocchinia*, *Stegolepis pungens*, *Heliamphora*, etc., invadido por el bosque bajo (hasta 5 m) de los sitios con piedra expuesta y del borde de los riachuelos, 'valley forest' en las quebradas hondas; much evidencia de fuego, sobre todo las bases carbonizadas de *Vellozia*, *Stegolepis* y árboles muertos a pie". Goodland and Persaud found it in a white sand savanna, describe it as an "erect herb with white heads", and found it in fruit in October.

Spellman and his associates (1975) record *S. gracilis* from Belize, but this seems highly unlikely; re-examination of their material will probably show that it has been misidentified.

Additional citations: VENEZUELA: Amazonas: *Tillett, Ferrigni V., & Zorrilla F. 751-78* (N). Bolívar: *Steyermark, Dunsterville, & Dunsterville 113154* (Lc). GUYANA: *Goodland & Persaud 1097* (N). MOUNTED CLIPPINGS: Bongard's original description (N, W, Z).

SYNGONANTHUS GRACILIS var. **AMAZONICUS** Ruhl.

Additional synonymy: *Syngonanthus gracwlis* var. *amazonicus* Moldenke, Biol. Abstr. 64: 6581, sphalm. 1977.

Additional bibliography: Moldenke, Biol. Abstr. 64: 6581. 1977; Moldenke, Phytologia 36: 65, 76—77, & 83 (1977) and 37: 73. 1977.

SYNGONANTHUS GRACILIS var. **AUREUS** Ruhl.

Additional bibliography: Moldenke, Biol. Abstr. 64: 6581. 1977; Moldenke, Phytologia 36: 74, 77—79, 81, & 83 (1977) and 37: 420. 1977.

Recent collectors have encountered this plant among rocks and "locally common in moist sandy soil of savannas (campo)", describing it as a small herb, 15—20 cm. tall, with "cream"-colored inflorescence heads, and have found it in flower in July.

Additional citations: BRAZIL: Bahia: *Santos & Mattos Silva 3264* (Ld). Minas Gerais: *Windisch & Ghillány 345* [Herb. Brad. 54254] (N). Roraima: *Coradin & Cordeiro 851* (N).

SYNGONANTHUS GRACILIS var. **GLABRIUSCULUS** Ruhl.

Additional bibliography: Moldenke, Biol. Abstr. 64: 6581. 1977; Moldenke, Phytologia 36: 72, 73, 75, & 80—83. 1977.

Kirkbride & Lleras describe this as a plant to 8 cm. tall, with white heads (in February), and found it growing in artificially created wet areas. Their no. 2924 is a mixture with what may be S. minutulus (Steud.) Moldenke. Other recent collectors refer to the plant as a small herb, 10 cm. tall, and found it to be "common on savannas (campo) in moist sandy soil", at 107 m. altitude, flowering and fruiting in September and October.

Additional citations: BRAZIL: Bahia: Mori, Mattos Silva, & Santos 10615 (Ld). Pará: Kirkbride & Lleras 2924 in part (W—2815575). Roraima: Coradin & Cordeiro 530 (N).

SYNGONANTHUS GRACILIS var. HIRTELLUS (Steud.) Ruhl.

Additional bibliography: Moldenke, Biol. Abstr. 64: 2581. 1977; Moldenke, Phytologia 36: 72 & 82—84 (1977) and 37: 70, 74, & 76. 1977.

Recent collectors have found this plant growing on campos, flowering and fruiting in September. Mori and his associates note on the label of their no. 10613 that it is "like 10616 but the inflorescence shorter".

Additional citations: BRAZIL: Bahia: Mori, Mattos Silva, & Santos 10503 (Ld), 10613 (Ld), 10616 (Ld).

SYNGONANTHUS GRACILIS var. KOERNICKEANUS Ruhl.

Additional bibliography: Moldenke, Biol. Abstr. 64: 6581. 1977; Moldenke, Phytologia 37: 70—72 & 76 (1977), 38: 41 (1977), and 41: 474. 1979.

Recent collectors have found this plant in white sand of savannas and in damp brown sand of damp savanna sinks, at 750 m. altitude, flowering and fruiting in January and September. Steyermark and his associates describe it as having "leaf clusters gray-green with white centrally, heads creamy-white". Irwin calls the heads "grayish-white".

Material of this taxon has been misidentified and distributed in some herbaria as Paepalanthus sp.

Additional citations: VENEZUELA: Bolívar: Steyermark, Dunsterville, & Dunsterville 113362 (Z). GUYANA: Irwin 775 (Au—165358). SURINAM: Mori, Bolten, & Jansma 8326 (Ld, N).

SYNGONANTHUS GRACILIS f. PROLIFER Moldenke

Additional bibliography: Moldenke, Phytologia 37: 73. 1977.

Recent collectors have encountered this plant "in rocky terrain around waterfalls, growing on moist cliff in spray of fall", at 300 m. altitude, fruiting in May.

Additional citations: BRAZIL: Pará: Prance, Silva, Berg, Henderson, Nelson, Balick, Bahia, & Reis dos Santos P.24837 (N).

SYNGONANTHUS GRACILIS var. RECURVIFOLIUS Ruhl.

Additional bibliography: Moldenke, Phytologia 37: 74 & 77. 1977.

[to be continued]

Studies on Fungi Exposed to Space Irradiation

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Abstract. The cellulolytic fungus Chaetomium globosum Kunze et Fries was exposed to spaceflight parameters on board the Apollo 16 Command Module. Flight phenotypic isolates lost pigment forming capabilities. Ultraviolet light irradiation of C. globosum during deployment of the MEED hardware caused a reduction of perithecial development. In addition the returned spaceflight phenotypes demonstrated variation in α-amylase enzyme production.

Introduction

Selected fungal species were placed in the Microbial Ecology Evaluation Device (MEED) of Apollo 16 and were exposed to various quantitative and qualitative spaceflight parameters then returned to earth for various postflight analyses (Volz, 1972). The MEED hardware passed rigid weight and size requirements yet maintained full experimental capabilities (Taylor, 1970). Ascospores of C. globosum were housed in MEED cuvettes and maintained in a controlled state that prohibited spore germination yet maintained survival qualities until exposure to ultraviolet light irradiations in space. The passive life support system for the spores provided a stable environment before, during, and after deployment of the MEED package in space. Technical design requirements for the microbial cuvettes maintained a thermal environment of 20 C ± 3 C throughout the Apollo flight and during the 10 minute + 7 second MEED deployment on the transearth Extra Vehicular Activity (Volz, 1972).

Select MEED phenotypes of C. globosum from Apollo 16 were isolated for the current threefold postflight study. The first segment consisted of a growth dynamic study to identify changes in dry weight. The second segment consisted of a colony morphology investigation to qualitatively identify extracellular α-amylase of the select phenotypes.

Chaetomium globosum is a valuable organism for study in space related experiments. Both filamentous fungi C. globosum and T. terrestre provided an excellent model for studies in nutritional requirements (Volz, 1973b), chromosome configurations (Hsu et al., 1973a, 1973b; Jerger and Volz, 1977), cell growth dynamics (Volz and Dublin, 1973; Volz and Jerger, 1973) in addition to biochemical studies (Sawyer et al., 1975a, 1975b), radiation exposure (Volz et al., 1974), and medical studies (Hsu and Volz, 1975; Hiebel and Volz, 1977; Veselenak and Volz, 1977).

Chaetomium globosum is known to be a spaceship and spacesuit contaminant (Henney, 1971, 1972; Henney and Arredondo, 1973; Truby, 1968; Volz, 1973a), thus any change incurred by the organism during spaceflight may affect the well being of the astronauts in space. Prior to space studies C. globosum was considered of economic significance in military and industrial operations due to the ability to degrade cellulose material (Moore-Landecker, 1972).

Literature Review

α-Amylase is commonly found in most organisms of the plant and animal kingdoms. Microorganisms utilize amylases to hydrolyze carbohydrate substrates into oligosaccharides or sugars (Whitaker, 1972).

Chaetomium globosum is a cellulolytic ascomycete. Extracellular enzymes produced by this organism destroy fibers, paper, and other materials composed of cellulose. Damage caused by the Chaetomiales each year is extensive. The organisms are easily recognized by their characteristic perithecia produced superficially without a stroma that possess numerous long curly perithecial hairs. The gelatinous walls deliquesce before spore maturity. Ascospores formed in asci are lemon shaped and dark brown in color, thick walled, and contain oil droplets in the protoplasm (Hsu, 1973).

Chaetomium globosum has septate hyphae which with the MEED phenotypes have different growth patterns. Hyphal growth occurs expontentially during the early stages of colony development. During the latter stages of colony development, however, growth in the center of the colony declines while the marginal hyphae maintain their linear rate of growth (Plomley, 1959).

Chaetomium species have been used in experiments with radiation sources. Dickson (1932, 1933) exposed Chaetomium colonies growing on malt agar and ascospores of several species to X-rays for 50 minutes at a distance of 26 cm. Changes in color and amount of mycelium were induced in colonies arising from subcultures of irradiated species. Chaetomium globosum produced maximum mutations after irradiation at 280 nm (McAulay and Ford, 1947). Ultraviolet radiation at 254 nm has a marked lethal effect on C. globosum (Hsu, 1973). In the MEED spaceflight study it was found that high energy multicharged particles (HZE) in space caused breaks in chromosomes of living organisms (Benton and Henke, 1973). Studies on UV absorption of DNA indicated that DNA absorption peaks were at 240 nm. Absorption of UV light by proteins occurs at 275 nm, while the relative germacidal effectiveness of UV peaks is 260 nm (Taylor, 1970). Phenotype counts and viability rates of C. globosum exposed to spaceflight parameters including known levels of UV light were examined (Volz, 1973b). The organism degrades spacesuit material and Apollo Extravehicular Modular Unit (EMU) fabrics (Volz and Jerger, 1973). The material is utilized as a direct food source. A spacesuit degraded by the fungus has a direct effect on the health and safety of astronauts in space.

Materials and Methods

Chaetomium globosum perithecia were harvested 14 days before launch from colonies grown on corn meal agar. Ascospores were removed from the perithecia with a sterile glass rod and placed in quartz cuvettes for UV exposure in the MEED spaceflight hardware (Volz, 1972). After splashdown of Apollo 16 and the return of the MEED to the laboratory, postflight studies were initiated on the recovered ascospores and phenotype colonies (Volz, 1974). Phenotypes of C. globosum were selected by perimeter growth rates, colony pigmentation, reverse colony color, perithecial density, and genetic restriction of colony compatibility. Stock colonies were maintained on Sabouraud maltose agar.

Select phenotypes of C. globosum were grown in 250 ml Erlenmeyer shake culture flasks containing 75 ml of Omeliansky's medium. The cultures were harvested after one week growth. Known concentrations (2.5×10^5 hyphal units/ml) of blended phenotype mycelium were innoculated into new culture flasks and the culture procedure repeated. The cultures grew for one week at 25 C, harvested, and weighed using preweighed Whatman #1 filter paper. Select phenotype mycelial weights were then compared. Colony morphology was studied as cultures matured, and the distinctive features were noted.

Select phenotypes were grown 10 days in Omeliansky's liquid medium on shakers for the α-amylase studies. Harvested phenotypes were homogenized in a sterile blender one minute. A known concentration of fungal suspension of each phenotype was reinoculated in 50 ml Omeliansky's liquid medium in 250 ml shaker flasks in replicates of three. α-Amylase was analyzed using the RBB starch method (Hall et al., 1970). To each of 3 test tubes (two duplicate samples and a blank), 0.3 ml of the flask medium was pipetted. The medium contained select actively growing cultures of C. globosum. Just prior to use, the substrate suspension was prepared. The substrate was composed of 2.0 ml RBB starch, in 100 ml substrate buffer. The substrate buffer consisted of 2.76 g $NaH_2PO_3 \cdot H_2O$ and 2.93 g NaCl, adjusted for pH 7.0 with NaOH, and brought to a final volume of 1 liter. RBB starch used in this study was amylose asure B grade. The samples and substrate were preincubated in a 37 C water bath 15 min. The substrate was swirled to obtain a homogenous suspension while remaining in the water bath. Immediately, 2.7 ml of RBB starch substrate was added to the first sample tube, swirled to mix. The mixed substrate was pipetted into the remaining sample tubes. After 15 min the enzymatic activity of the first tube was terminated by the addition of 1.2 ml 18% aqueous acetic acid. Enzymatic activity in the remaining sample tubes was stopped with 18% acetic acid using the same sequence and time interval established when the substrate was added. The blank contained 0.3 ml sample, 2.7 ml substrate buffer without RBB starch, and 1.2 ml 18% acetic acid. After the enzymatic action was terminated, samples and blanks were well mixed and filtered through Whatman #1 filter paper. The supernatant was read at 595 nm in a Bauch & Lomb spectronic 20 spectrophotometer, using quartz cuvettes. The RBB starch filtrate was read, the absorbency relative to water of an aqueous solution of 0.1 M $CuSO_4$ was determined in duplicate.

Results

During the transearth Extra Vehicular Activity of Apollo 16 on April 25, 1972, the MEED hardware was deployed. The exposure levels received by each of the selected phenotypes for the current study are presented in Table I.

The wet flight cuvettes, housing cells in water, exposed the cells to full solar irradiation. Wet ascospores produced low viability rates for C. globosum. The dry cuvettes vented to space atmosphere and unvented cuvettes exposed the cells to full solar irradiation. Cell viabilities remained high in dry space flight cuvettes in addition to cells housed in the ground controls, vibration controls, and the flight control trays.

The colonies of C. globosum growing in shake cultures with Omeliansky's medium appeared diverse in growth patterns and pigmentation. All colonies grew as small (0.1-3.5 mm) spherical or oval pellets. Dry mycelial weight of each phenotype is presented in Table I. The growth rate variation is evident.

Select flight phenotypes exposed to solar irradiation had either no perithecia or immature perithecial development. Flight control isolates produced normal perithecial development.

Flight phenotypes displayed new agar colony morphology. Some grew as small dense colonies (Cg 6899-1) while others were large, flat colonies (Cg 7102-2). Select ground controls did not appear much different from the Chaetomium flight control in colony morphology. Ground control colonies were distinctive in colony appearance from flight phenotypic colonies.

Phenotypes of C. globosum and the control were cultured in 50 ml of Omeliansky's liquid medium one week for the starch studies. After 168 hours growth, the enzyme production stabilized. A total of 0.3 ml of the liquid medium was pipetted from each flask and analyzed by the RBB starch method. Absorbencies of the various select phenotypes were determined according to described techniques. The number of RBB starch units per 100 ml of the specimen was calculated by the equation: RBB starch units per 100 ml = $A_s/A_{cu} \times 100$. A_s is the average absorbency (sample 1 + 2) at 595 nm of the flask phenotype, and A_{cu} is the average absorbency (sample 1 + 2) at 595 nm of the $CuSO_4$ solution (0.1 M). Three replicates of the RBB starch units were averaged to yield the final results on the Chaetomium control and select phenotype (Table I).

Discussion

The select phenotypes of Chaetomium globosum through postflight experimentation exhibited changes in growth dynamics and microbial physiology. These select phenotypes did respond to the calculated flight parameters to provide a qualitative and quantitative exobiology experiment. Chaetomium globosum flight phenotypes did exhibit variation compared to select phenotypes in the ground control and vibration control.

All of the phenotypes isolated from the Apollo 16 MEED, except Cg 6899-1 and Cg 6904-2, lost pigment forming capability as expressed in the culture grown in the liquid medium. The flight phenotypes were exposed to full light, dark, unvented, and vented, yet they all expressed this pigment alteration greater than control isolates. The synergistic relationship of effects of weightlessness and radiation has been reported (Bender, 1967). The ground control and the vibration control of the select phenotypes expressed no pigmentation alteration when grown in the liquid shake cultures.

The select phenotypes revealed a variation in growth dynamics as expressed in the dry weight study. The flight phenotypes grew at a greater rate as indicated by the dry cell weight compared with the control or ground vibration control. No relationship could be found between the exposed flight phenotypes and the isolates unexposed to UV irradiation with respect to dry weight.

Perithecial development was somewhat lacking in the flight phenotypes. Flight phenotypes displayed different colony morphology as compared to ground control phenotypes.

The Omeliansky's liquid medium provided a good starch source and the source of Ca^{+2} and trace Na^{+} needed for α-amylase production. Starch in the medium was hydrolyzed and utilized by C. globosum.

The flight phenotypes expressed a slightly higher value in RBB starch units than the ground controls and vibration controls. These higher readings, correlated with the dry weight findings and the color alteration demonstrated that select flight phenotypes did undergo cellular change. The RBB starch units expressed among the flight phenotypes do not show any correlation between UV exposed cells and unexposed cells.

Summary

Microbial experimentation using Chaetomium globosum as a space test organism provided a test system to identify effects of space parameters on fungi. Isolated species have been causal agents of damage to space hardware during extended space missions. The microbial damage effects the safety and well being of human astronauts traveling in space.

The current study demonstrated that the MEED flight phenotypes possessed a greater mycelial growth rate than the ground control phenotypes. Flight phenotypes generally lost pigmentation as compared to ground control phenotypes. The MEED flight phenotypes exhibited higher α-amylase production compared to ground control phenotypes. Exposure to space flight environments does induce changes in biological systems as identified in Chaetomium globosum.

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Table I

<u>Chaetomium</u> <u>globosum</u> controls and phenotypes exposed to space irradiation, and postflight observations

Isolate	Ergs/cuvette/ 10 min	Cell housing	Pigmentation	Dry weight	RBB starch units
Cg 7102-2	1.4×10^8 *	dry vented	none	0.39 g	41.95
Cg 6899-1	0	wet flight control	brown	0.47	24.13
Cg 1349-1	1.5×10^5	wet unvented	none	0.42	24.71
Cg 7907-1	1.4×10^8	dry vented	none	0.40	28.73
Cg 6891-1	0	wet flight control	none	0.31	31.60
Cg 6416-1	0	dry vibration control	brown	0.38	18.38
Cg 6898-1	0	dry ground control	brown	0.44	38.50
Cg 1345-2	0	wet ground control	brown	0.30	5.17
Cg 6904-2	1.5×10^7	dry unvented	brown	0.37	27.58
Cg control	0	0	brown	0.33	16.66

* full light of space

BOOK REVIEWS

Alma L. Moldenke

"FLORA MALESIANA: LABIATAE & ANACARDIACEAE" former by H. Keng & latter by Ding Hou. Series I Spermatophyta Vol. 8, part 3, 577 pp., 101 b/w line draw. & photo. Sijthoff & Noordhoff International Publishers, 2400 MA Alphen aan den Rijn, The Netherlands. 1978. Paperbound.

Welcome to this fine new section of the growing Malesian flora under the general editorship of C. G. G. Jan van Steenis and the auspices of the Botanic Gardens of Indonesia/Bogor/Java and the Rijksherbarium in Leyden. This volume is dedicated to the Dutch botanist F. A. W. Miquel with an account of his professional life culminating at the Rijksherbarium and a pertinent bibliography by F. A. Stafleu. For each of the labiate and anacard families there are described diagnostic characteristics, distribution generally and specifically for the area treated, ecology, seed and/or fruit dispersal, pollen description and pollination mechanisms, chromosome numbers, phytochemistry and chemotaxonomy, taxonomic affiliations, and keys to genera. Under the genera there are the expected diagnostic descriptions, keys to species and then species descriptions with pertinent interesting ecological, economic and morphological notes and excellent illustrations. This is a needed study.

"HANDBOOK OF PHYCOLOGICAL METHODS — Culture Methods and Growth Measurements" edited by Janet R. Steen, xii & 448 pp., 49 b/w fig. & 45 tab. Cambridge University Press, London NW1 2DB & New York, N. Y. 10022. 1973. $29.50.

This publication is sponsored by the Phycological Society of America so as "to present a synthesis of experimental aspects of phycology in a single source book". There are 28 papers on isolation and purification techniques, general equipment and methods, special culture (continuous, mass, light-temperature gradient) methods, growth measurements (division rates, carbon and pigment analysis, Coulter counter) and bioassay (cyanobalamin, vitamins). There are author, taxonomic, and subject indexes for easy hunting of information. The editor herself proclaims truly that "this is a most useful tome" after stating that her "own laboratory has benefited greatly as many of our standard practices have undergone close scrutiny and revision in light of the methods presented in the Handbook".

"HANDBOOK OF PHYCOLOGICAL METHODS — Physiological and Biochemical Methods" edited by Johan A. Hellebust & James S. Craigie, xiv & 512 pp., 63 b/w fig. & 45 tab. Cambridge University Press, London NW1 2DB & New York, N. Y. 10022. 1978. $29.95.

This carefully executed methods source book, sponsored by the Phycological Society of America, consists of 46 papers with methods applicable to as wide a variety of algal types as possible under such topics as: Isolation of organelles and membranes, Analysis of chemical constituents, Enzymes, Physiological and biochemical processes, Nutrients, Ion content and transport, and Inhibitors.

"FENLAND: ITS ANCIENT PAST AND UNCERTAIN FUTURE" by Sir Harry Godwin, vii & 196 pp., 45 b/w fig. & 65 photo pl. Cambridge University Press, London NW1 2DB & New York, N. Y. 10022. 1978. $18.95.

This Fenland of East Anglia covers several hundred square miles north of Cambridge mainly in the drainage basin of the Ouse rivers and their tribularies and has been the research "pet" of the author, his research students and his group of interested amateur naturalists over his long professional career. This interesting non-technical account of changes in water levels and temperature, plants grown, seashells found, peat or turf over the past 10,000 years including evidence of Mesolithic, Neolithic, Bronze, Iron, Roman, Medieval and Modern age remains of man and his cultures as well as other animal and plant life. The author's wife has provided and/or verified much of this information through her studies of pollens and core samples. There is a careful, logical explanation of how the peat or turf has been drastically changed since the mid 17th century because of increased crop cultivation and drainage resulting in "contraction in volume", loss of anaerobic, acidic preservation of live or dead forms within rather than their being oxidized "virtually to disappear into thin air". This book is a plea for the preservation of this special ecological formation and for its decreasing wild life, especially the endemic endangered species.

"ISOLATION OF PLANT GROWTH SUBSTANCES" edited by J. R. Hillman, v & 157 pp., 45 b/w fig. & 19 tab. Cambridge University Press, London NW1 2DB & New York, N. Y. 10022. 1978. $23.50 clothbound & $8.95 paperbound.

These papers, composing important Seminar Series 4 for the Society of Experimental Biology, should provide "direct and useful application in research and advanced teaching laboratories" for their critical "analysis of the known endogenous plant growth substances". They cover effectively the appropriate gas and/or liquid chromatography, mass spectrometry, spectrophotofluorimetry, quantitative analysis and assay techniques for indole acetic acid, gibberellins, cytokinesis, abscisic acid and ethylene that seem to regulate all aspects of growth and development.

"THE SHOOT APEX AND LEAF GROWTH — A Study in Quantitative Biology" by R. F. Williams, vii & 256 pp., 114 b/w. fig. & 17 tab. Cambridge University Press, London NW1 2DB & New York, N. Y. 10022. 1975. $19.95.

This comprehensive study, reporting much research work for the first time, has proven and will prove of much value to developmental and theoretical biologists as well as to advanced students and researchers in plant physiology, crop sciences, etc., especially since the appendix is actually a full chapter explaining the "procedures which were developed for the quantitative studies of shoot apical systems [including] suggestions on data processing." For leafy shoot apical systems and for flowering ones in wheat, checked through serial reconstruction, their growth can be quantitatively expressed as an integration of physical constraint of neighboring parts leading internally to genesis of form and organization. Phyllotaxy and its parameters are developed through geometrical modelling. This is an important advanced text.

"BORN IN THE SPRING — A Collection of Spring Wildflowers" by June Carver Roberts, 159 pp., 46 color & 45 b/w plates. Ohio University Press, Athens, Ohio 45701. 1976. $15.00 clothbound & $8.50 paperbound.

At Winter's waning windy snow-laden days, there is often nothing as hopeful as the seed catalogues that stand out boldly almost daring you to deny that real life plants could be as big, as strong and as brilliantly colorful as their illustrations. But the illustrations in this book are even more assuring because the delicacy of beauty in their lines, their colors, and the accurately and exquisitely rendered details of structure, and in their easy recognition by so many people in much of the United States and southern Canada. They are arranged in order of blooming and opposite each plate is a text that is descriptive and informative. Naturally there is a plea for the protection of these plants and their habitats.

"ORCHIDS OF PAPUA NEW GUINEA — An Introduction" text by André Millar and photographs by Roy & Margaret Mackay, xi & 101 pp., 16 full color pl. & 206 color illus. & 6 b/w line draw. University of Washington Press, London & Seattle, Washington 98105 1978. $25.00.

This publication is indeed a beautiful introduction to over 200 orchids shown in clear, attractive color photographs accompanied by descriptive text for each on habitat, plant form and flowers. A 1972 list gives 134 genera and 2666 species which by now falls short of the ever increasing known total which is further augmented by much natural hybridization and continued plant exploration in "the dry savannah and grasslands to high mist and moss forest [and] from the lush wet coast to small islands encircled by reefs". For horticulturists, orchidophiles and orchidologists this book is a real treat.

"**PACIFIC SEASHORES** — A Guide to Intertidal Ecology" by Thomas Carefoot, 208 pp., 176 b/w draw., 30 b/w photos & 80 color photos. University of Washington Press, Seattle 98105. 1978. $12.95 paperbound only.

The author has been privileged to study the intertidal zone of rocky, sandy and muddy seashores of much of our world for the interactions of the plant and animal life among each other and within the various varying habitats involved. Some of the chapters describe water movements, distribution of organisms on the shore, causes of intertidal zonation, the economy of the shore with its highly efficient primary production starting with its phytoplankton and going through various food chains, sand dunes, and those items influenced by man — mariculture and pollution. This book makes an excellent text or interesting book to read. The line drawings of plants and animals are clearly represented but the printing of the color photographs in many cases unfortunately is somewhat blurred.

"**MAN, LAND, AND THE FOREST ENVIRONMENT**" by Marion Clawson, xi & 74 pp., 3 b/w fig. & 6 tab. University of Washington Press, London & Seattle, Washington 98105. 1977. $6.95.

This little book is composed of three important lectures presented by the author to the forestry school and additional audience at Washington University. They deal with the author's lifetime specialization: — land use planning and use control, general forest use and policy issues, and our national forests especially in the Pacific Northwest where they can be managed as greater economic assets.

"**ROADS AND TRAILS OF OLYMPIC NATIONAL PARK**" Third Revised Edition by Frederick Leissler, xii & 102 pp., 19 b/w photo plates and 16 trail maps. University of Washington Press, London & Seattle, Washington 98105. 1976. $3.95 paperbound.

"This guide to the park includes a map for each major watershed and Pacific Coast Area. The maps [16] show automobile roads, campgrounds, ranger stations, and trails [600 miles of these], as well as mountains, ridges, streams, and lakes". About four decades ago we enjoyed some of these lovely trails; about a decade ago we enjoyed the many roads that lead to these and to new trails. This essential guide to this beautiful part of the world slips easily into a jacket pocket.

"GARDEN DESIGN ILLUSTRATED" by John A. & Carol L. Grant, xii & 172 pp., 39 b/w line draw. & 64 b/w & 1 color photo. plates. University of Washington Press, London & Seattle, Washington 98105. 1978. $9.95 paperbound.

This material first appeared in book form in 1954 with its parentage set in a series of articles previously published in "House Beautiful". Its purpose "is to open up vistas of possibilities through the understanding of naturalistic principles and through a more vivid awareness of the design potential of plant material itself". Planting in drifts as God does, not rows; using rhythmic movement of curves and contours, not flat little box outlines; full ranging of warm colored flowers in a long graceful border, not in a small area, and other basic ideas are well developed in the text and effectively demonstrated in the excellent photographic illustrations and diagrams. This is a useful book for the individual gardener and the student horticulturist and landscape gardener.

"LEXICON ROSSICO-LATINUM IN USUM BOTANICORUM" by M. Kirpicznikov & N. Zabinkova, 857 pp. Nauka, official editor and publisher, Leningrad. 1977.

This detailed Russian-Latin botanical dictionary is published under the auspices of the well known Komarov Botanical Institute in Leningrad. There is an introduction, bibliography on botanical Latin, and charts on alphabet equivalents making this work more accessible to readers of only one of these languages. The Latin definitions are given in full explicative form, not as just single synonyms. Any botanical or botanically related institution anywhere in the world — as well as in Russia itself — that handles any foreign literature could use a copy of this lexicon for its library.

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CONTENTS

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OXALIDACEAE EXTRA-AUSTROAMERICANAE

II. *Oxalis* L. Sectio *Corniculatae* DC.

Alicia Lourteig

Muséum National d'Histoire Naturelle, Paris

Résumé. Les espèces du Genre *Oxalis* L. Sectio *Corniculatae* DC. ont été étudiées. Celles qui ne figurent pas dans cette publication sont exclusives de l'Amérique du Sud (petites Antilles comprises); les synonymes donnés pour cette région ne sont pas mentionnés.

Après avoir révisé des milliers de spécimens du monde entier j'ai pu conclure qu'il existe 19 espèces, 4 sous-espèces et 3 variétés. Les nouvelles combinaisons: *O. corniculata* L. ssp. *albicans* (H.B.K.); *O. c.* ssp. *pilosa* (Nuttall)et *O. florida* Salisbury ssp. *prostrata* (Haworth)ont été necéssaires, ainsi qu'un changement de status et nom nouveau: *O. novaeguineensis* Lourt. (= *O. corniculata* L. var. *papuana* Knuth).*O. chnoodes* Lourt. n. sp. et *O. procumbens* Steud. ex Rich. ssp. *Bathieana* Lourt. sont décrites.

Pour *O. corniculata* et sa variété *villosa*, *O. florida* et sa ssp. *prostrata*, *O. fontana*, *O. perennans*, *O. radicosa* et *O. stricta*, extremement abondantes, seulement une partie du matériel étudié est citée, néanmoins aucun pays où ces espèces vivent n'a été omis.

Il y a de nombreux spécimens hybrides, la plupart des Etats-Unis: ils sont fertiles et très souvent montrent différents états de régression. Ils ont été groupés d'après leur morphologie. La suggestion des parents possibles est indiquée. Une forme anomale (mutation, *O. stricta viridiflora*) assez repandue est considérée.

L'attaque fungique est courante pour les espèces de cette Section et produit des modifications des organes souvent importantes. Ces attaques se présentent davantage sur les hybrides; les spécimens de la mutation sont également attaqués.

Introduction

This Section the most intricate of the Genus *Oxalis*, includes weedy species with a large geographical distribution. Later monographers especially Knuth (1930), reduced many names to synonymy including even those less known for Europe that in some cases correspond to distinct species.

The Section appears quite homogeneous. Hybrid origin of some species is not impossible. Natural hybrids found in United States and in the Pacific Islands are indicated in this paper, but only from morphological evidence.

The difficulty of identification is increased when only parts of a hybrid collection show the hybrid characters, as well as when fragmentary collections do not permit the separation of subspecies (ex. *O. flori-*

Oxalidaceae Extra-Austroamericanae I . Phytologia 29 (6).1975.

da ssp. *prostrata*).

The purpose of this publication is the solution of the nomenclatural problem in order to get general understanding and hoping that some other kind of research would be inspired.

19 specific, 4 subspecific and 2 varietal names are retained.

O. fontana Bunge, is the most widely distributed and the most abundant species in the Northern Hemisphere. *O. stricta* L., a very abundant North-American species, is found very rarely introduced in Europe. *O. corniculata* L. seems to be a "complex" distributed in all the world. Several American taxa are herein combined as subspecies. In Europe, there are two varieties of *O. corniculata*, which are less frequently found in America: *O. c.* var. *villosa* (Marsch.-Bieberstein) Hohen. and *O. c. atropurpurea* Planchon, the latter seems to be originated from Horticulture; the American subspecies *O. c.* ssp. *albicans* (H.B.K.)Lourt. and *O. c.* ssp. *pilosa* (Nuttall ex Torrey ex Gray) Lourt. are common in South-Western United States and Central America. *O. radicosa* A. Richard also largely distributed and very frequent, occurs in Tropical Africa, India to the Far Orient and in some Pacific Islands. *O. filiformis* H.B.K. from the Andes of Colombia and Ecuador reaches Costa Rica in the North. Endemics are :

1) in the Great Antilles, *O. thelyoxys* Focke and *O. Rugeliana* Urban ;
2) in United States, *O. florida* Salisbury and its ssp. *prostrata* (Haworth) Lourt. in the East and the Center; *O. grandis* Small in the Appalachian region, and *O. macrantha* (Trel.) Small in woody zones of the East; *O. Suksdorfii* Trelease confined to the Oregon region, and *O. californica* (Abrams) Knuth to California and Baja California (Mexico); *O. Lyonii* Pursh to the South-Central part;
3) in the Old World, *O. perennans* Haworth abundant in all Australia, New Zealand and adjacent Islands; *O. procumbens* Steudel ex Richard and its ssp. *Bathieana* Lourt. occur in the forest belt of Tropical Africa and Madagascar; *O. rubens* Haworth, a rare species restricted to coastal localities in E Australia; *O. exilis* Cunningham in South Australia, New Zealand and adjacent Islands, and in New Caledonia (introduced in Great Britain and in Japan); *O. novae-guineensis* Lourt. and *O. chnoodes* in New Guinea region.

Difficulties in the research of this group are due to:

1. Large number of taxa described in different countries, which lead to the revision of many type-specimens.

2. The confusion of two Linnaean taxa for about two centuries.

3. The loss of a number of type-collections.

4. The fungical attack on the plants in nature which modifies important characters of systematic value. Pubescence becomes irregular, very dense in some parts, with fine viscous hairs on the fruits, inflorescences, etc. Some carpels do not develop normally giving a fruit bend and curve, the number of seeds diminishing in some carpels. White, or less frequently black spots are observed on fruits, stems, leaves, etc. Another attack shows yellow or orange spots distributed on all the plant. This Section is specifically attacked by Fungae. Much research has been carried on this fact for the damage that it can introduce in

field crops (many papers published ex.: on *Puccinia andropogonis*, Cummins 1973; on *Puccinia Ellisiana*, Overholts 1973; on *Phyllosticta guttulata*, Anderson 1919;Overholts 1940; on *Puccinia purpurea*, Gäumann 1959; on *Puccinia Sorghi*, Arthur 1921; Berry 1964; Brenckle 1918; Flangas 1958; Gilman & Porter 1926; Hooker & Le Roux 1957; Hooker & Yarwood 1966; Lele, Misra & Rao 1962; Mains 1934; Misra 1963; Misra & Sharma 1964; Pavgi, Cooper and Dickson 1960;on *Synchytrum oxalidis* Cook 1947, and on *Ustilago oxalidis*, Zundel 1930.

5. Natural hybridization is more frequent in United States. Regression is also observed. This phenomenon has added a number of names to the taxonomic literature.

Typification

I. HAWORTH type-specimens were destroyed by Fielding. Three species were described by this author in 1803. The descriptions made on living plants, cultivated by himself and of origin known are so accurate that, knowing the group, the species can be precisely recognized. Recently, H.Ch. Friedrich(Mitt. Bot. München *11*: 326-7.1974) explained the same experience working on *Crassula* : ..."*Crassula undulata* kein Herbarbeleg, der als Typus betrachtet werden könnte. Die Beschreibung ist jedoch so klar, dass die Sippe eindeutig zu identizieren ist...." I have, therefore, to establish 3 neotypes; for *O. prostrata* Haworth, *O. rubens* Haw. and *O. perennans* Haw.

II. The herbarium of John LYON has not been found and all my efforts to locate PURSH's types were unsuccessful. The results of the researches of Dr. Joseph Ewan confirm the non existance of any type collection and a neotype for *O. Lyonii* Pursh has been established.

III. *The Linnaean species*. Two species: *O. corniculata* and *O. stricta* L. have been misunderstood for a long time. Subsequent authors have added more confusion by creating new binomials.

1. In Sp. Pl. *1*: 435. 1753, Linnaeus'intention was to distinguish as species a low creeping plant (N° 11) which he named *O. corniculata* and an erect taller plant (N° 12) which he named *O. stricta* (W.STEARN, personnal communication). The protologues are from Cliffort *Hortus*, Linnaeus *Hortus Upsal*., van Royen *Roy. Lud*., Sauvage, *Monspel*., Görter *Gelr*., Clusius *Hist*., Bauhin *Pinax*, Linnaeus cites "Habitat in Italia, Sicilia" At the end under Confer., Feuillée, *peruv*.

The last reference corresponds to *O. tuberosa* Molina, that belongs in a different Section.

The first publication of *O. corniculata* by Linnaeus was in *Hortus Upsaliensis* exhibens Plantas exoticas, horto Upsaliensis Academiae a sese illatas ab anno 1742, in annum 1748.... He cites Cliff., Clus., Lobelius, Bauhin. The plant to which he refers "Habitat in Italia, Sicilia. Hospitantur sub dio, annua cicur. " was cultivated in Linnaeus' Garden in Upsala. This is the plant that Linnaeus saw in his garden and described, adding the protologues that seemed to match with it.

I have seen the specimens under *O. corniculata* in the Linnaean Herbarium of London. They are from Africa and Central Asia. None of the specimens corresponding to the protologues of other authors, used by

Linnaeus, came from Italy.
In THUNBERG's herbarium, under N° 11084 a specimen of *O. corniculata* L. "culta in horto Upsaliensi. Thunberg" with flowers and fruits exists and presents all the characters that correspond to that species. Even if it might not be the actual plant that Linnaeus saw, it is one of the plants descended from that open-air cultivated one that Linnaeus described, in Hortus Upsaliensis. Plants and clones derived from Linnaeus cultivated plants of other families are still living in the greenhouses of Upsala Botanical Garden (R. SANTESSON and O. HEDBERG, personnal communication). Upsala Thunberg's herbarium N° 11084 has been chosen as the lectotype of *O. corniculata* L.

2. Under *Oxalis stricta* L., Sp. Pl. 1: 435 N° 12. 1753 the author refers to Gronovius, to Tournefort and to Morison. The specimens corresponding to the two last authors as well as the one in the Herbarium of Hortus Cliffortianus, p. 175, 4, p 2 E, are the same species, different from that of Gronovius. Linnaeus worked with Gronovius and gave names to his plants (STEARN, Spec. Pl. facsim. ed. 118 &c. 1957) while it is unlikely he had in mind the specimens of Tournefort and of Morison; yet, these specimens are not from Virginia as Linnaeus stated. I have seen Gronovius specimen at the British Museum, from Virginia, leg. Clayton 474 that fits perfectly in the protologue Gron. virg. 161, Sp. Pl. 435, 12. This is the lectotype of *O. stricta* L.
The currently called *O. Dillenii* Jacquin is this species.
The remaining protologues (Tournefort, Morison, in spite of the inaccuracy of the t. 17, f. 3, and Clifford) belong to the species that was called currently *O. europaea* Jordan , this name is antedated by *O. fontana* Bunge, collected by its author in China.
ROBINSON (J. Bot. 44: 1906) has come to the same conclusion and left a note on the Clifford sheet refusing the name of *stricta* by "certainly not, B.L.R." and on the Clayton's sheet "This is the type of *O. stricta* L. (B.L.R.)".

IV. The name *O. florida* Salisbury, Prodr. Stirp. Horto Chapel Allerton 322. 1796 is a legitimate name obviously intended for and to be typified by the cultivated material introduced by John Fraser which Salisbury grew at Chapel Allerton and upon which he based his diagnosis. It cannot be rejected because Salisbury cited with this a pre-Linnaean synonym, namely Dillenius' *Oxys lutea americana*, etc. (that belongs to another species). The case is comparable with those of many Linnaean names, the protologues for which include pre-Linnaean synonyms relating to species other than the one upon which the diagnosis was primarily based. When Salisbury published his *O. florida*, the species with which he was primarily concerned possessed no legitimate name, unlike the other species of *Oxalis* for which he provided illegitimate names by rejecting the available names of Linnaeus and Jacquin. Salisbury's protologue covered two elements. Exclusion of the minor element, the Dillenian synonym, does not warrant a change in the name of the major element, the cultivated plant, which is the obligate lectotype of *O. florida* (STEARN, personnal communication). Relevant articles of the Int. Code are N° 51-53. See also Britten, J. Bot. 54: 57-65. 1916.

During my researchas of types I was particularly helped by some colleagues to which my deep gratitude is herein expressed.

Dr. William STEARN of London, BM. for the discussions on the pre-Linnaean and Linnaean research, and typification of *O. stricta* L. and *O. florida* Salisb.

Professors Rolf SANTESSON and O. HEDBERG of Uppsala for their cooperation in the searching of Linnaeus' and pre-Linnaean Swedish herbaria leading to the typification of *O. corniculata* L.

Dr. Frank WHITE of Oxford, provided detailed drawings and photographs of the type-specimen of *O. Dillenii* Jacquin in Dillenius Herbarium as well as information on Morison's specimens and Haworth's collections.

Dr. Fredrick MEYER of Washington, for his examination of the specimmens of *Oxalis* in Elliott's Herbarium at Charleston (U.S.A.) with photographs and accurate comments.

Dr. Joseph EWAN of Tulasne University for his research on Lyon's Herbarium and Pursh's types and other communications.

My recognition goes to all those who helped me with photocopies, information and photographs, as well as to all the friends and institutions that welcomed me during my visits and made my sojourns very agreeable.

Thousands of specimens were at my disposition in the herbaria visited or on loan to me. The specimens are all annotated. However, for some species (see *Résumé*) the lists of material are too long to be inserted in this paper. A selection of specimens with all the data, giving a correct idea of the geographical distribution as well as all the type-specimens has been made.

Sectio Corniculatae DC.

Candolle, Prodr. 1: 691 p.p. 1824(*incl. typus*). Eiten, Am. Midl. Nat. 69: 292-4 (incl. Subs. *Strictae* Eiten 294,304) 1961. Salter, J. S. Africa. Bot. 53,73. 1944.

Ceratoxys Endlicher, Gen. 1172.1840. Planchon, Fl. Serres 8: 231. 1853 p. p.

Trifoliastrum Progel in Martius, Fl. Bras. 12 (2): 477. 1877 p.p. Norlind, Ark. Bot. 14 (6): 12.1915 p.p.

Corniculatae (Reiche) Knuth, Bot. Jahrb. 50 Suppl.: 200.1914; Pflreich. 142 (Subsectio *Boreales* Knuth et Subs. *Australes* Knuth p.p.). Young, Watsonia 4 (2): 55. 1958.

Austro-americanae Knuth, Rep. Sp. Nov. 23: 278.1927 pr. max. parte.

Domingenses Knuth, Pflreich. 162.1930.

Antillanae Knuth, *Andicolae* Knuth, *l.c.* 164.

Ceratoxalis Dumortier, Florul. Belg. 111. 1827.

Div. *Trifoliatae* Subg. *Trifoliastrum* Sectio *Corniculatae* Reiche, Bot. Jahrb. 18: 300.1894.

Gen. *Xanthoxalis* Small, Fl. SE. U.S. 666. 1903; N. Am. Fl. 25 (1): 49-50. 1907 (excl. syn. *Pseudoxalis* Rose).

Gen. *Ceratoxalis* (Dum.) Lunell, Am. Midl. Nat. 4: 468. 1916.

Subgen. *Trifoliastrum* (Prog.) Reiche *l.c.* 281.

Hierbas reptantes a ± erguidas o con rizoma horizontal. Hojas alternas, a veces subopuestas o pseudoverticiladas. Estípulas soldadas, a veces ensanchadas hacia el ápice, otras, enangostadas, en algunos casos reducidas. Hojas 3-folioladas, palmadas. Peciolillos muy cortos. Folíolos obovado-cuneados, ± incisos. Cimas 2-fidas a umbeliformes, a veces flores solitarias. Sépalos verdosos o ± purpúreos. Pétalos amarillos o anaranjados, amarillo-salmón , a veces con estrías rojizas o purpúreas. Estambres soldados en la base en un tubo de altura variada, aligulados. Ovario oblongo a cilíndrico (raro subgloboso). Estilos filiformes. Estigmas 2-fidos. Cápsulas largamente cilíndricas, oblongas o globosas con carpelos interiormente ± pubescentes, pluri- (1-2-) multiseminados. Semillas pequeñas, aplanadas, transversalmente estríadas y costadas en zig-zag, con tubérculos ± notables en las intersecciones.

Tipo. *O. corniculata* L.

Las especies viven en los cinco continentes,siendo más frecuentes en las regiones templadas, en lugares húmedos, llegando a elevadas altitudes en las montañas. Algunas son invasoras, otras endémicas. Se hibridizan naturalmente dando descendientes fértiles.

Clave de las especies

A. Pedicelo pubescencia hirsuta, laxa

a. Cimas 2-cótomas, laxas. Pl. poco pilosa

b. Fl. pequeña. Cáps. cilíndrica, Ca. h. 1/5-1/4, pelos pluricelulares, largos, hirsutos........ 1. *fontana* v. *fontana*

Iguales caracteres, haz fol. pubescente....... 1a. *f.* v. *Bushii*

b' Fl. grande (12-16 mm). Cáps. oblonga, gruesa, Ca. h. ± ½, pelos cortos esparcidos, glandulosos.(Borde fol. purpúreo)...................... 2. *grandis*

a' Cimas umbeliformes o 1-floras por reducción.Pl. pilosa

b. Cáps. casi glabra o pelos largos,finos. Fl. grande (11-22 mm).Pl. hirsutísima............. 3. *macrantha*

b' Cáps. gruesa, retrorso-pubescente. Fol. ± hirsuto-pubescentes. Tallo retrorso-piloso....... 8c. *corniculata* ssp. *pilosa*

B. Pedicelo adpreso-pubescente o ± glabro

a. Cáps. uniformemente retrorso-pubescebte

b. Pét. amarillo-anaranjados exteriormente, rosados o estríados de purpúreo interiormente, pelos en el borde (a veces incospiacuos). Pl. erguidas o decumbentes. Rizoma y raíz tuberculada, lignificada

c. Pubescencia corta, fina, blanquecina, retrorsa (al menos en parte). Cáps. fusiforme, larga erecta ....6. *radicosa*

Ca =cáliz,Est.= estípula, Fl. = flor, Fol. = folíolo, gen. = generalmente, h. = hasta, Pét. = pétalo, Pl. = planta, Sép. = sépalo.

c'. Pubescencia adpreso-antrorsa o ± hirsuta. Cáps. cilíndrica, fina u oblonga

d. Fol. glaucos ± purpúreos, notablemente lobulados, lób. divergentes

e. Cimas mayores que el follaje. Sép. ápice ciliado. Cáps. cilíndrica, aguda, Ca. 1/6-1/3 (Viejo Mundo)................. 7. *perennans*

e'. Cimas ± largo del follaje. Sép. gen. bor de purpúreo. Cáps. gruesa oblonga a cidrica, aguda, Ca. $\frac{1}{4}$ - $\frac{1}{3}$ (América)...... 8d. *corniculata* ssp. *albicans*

d'. Fol. verdes anchamente obovados, incisos 1/5-1/4. Cáps. cilíndrica, gruesa, cortísimamente pubescente, abruptamente aguda, Ca. ± 1/3.................................. 5. *californica*

b'. Pét. amarillo-claros, translúcidos. Pl. erguida a rastrera. Rizoma delgado o raíces fibrosas, raro (8 y 8b) ráíz tuberculada. (Lóbulos fol. redondeados, ascendentes).

c. Pl. rastrera o prostrada, pubescencia hirsuta, laxa

d. Sép. pelos pluricelulares en la base. Rizoma largo a veces ramificado. Cáps. oblongo-cónica, pubescencia cortísima, subretrorsa, Ca. h. 1/3-1/2............................ 4. *Suksdorfii*

d'. Sép. adpreso-pubescentes. Tallos prostrados o reptantes, raro raíces engrosadas. Cáps. cilíndricas, pubescencia densa retrorsa, ± pelos pluricelulares, Ca. h. 1/5-1/4....... 8. *corniculata* ssp. *corniculata*

Iguales caracteres, haz fol. pubescente.... 8. *c.* ssp. *villosa*

Iguales caracteres, Pl. pequeña, radicante, rojiza.................................... 8a. *c.* v. *atropurpurea*

c'. Tallo erguido o surgiendo de un rizoma, adpreso-antrorso-pubescente. (Est. subescariosa, rojiza enangostada hacia el ápice)............. 9. *stricta*

a'. Cáps. no retrorso-pubescente

b. Fol. incisos más de $\frac{1}{2}$ h. ca. la base (incisión gen. angosta)................................ 14. *thelyoxys*

b'. Fol. enteros o apenas retusos. (Cáps. antrorso-pubescente).............................. 15. *Rugeliana*

b". Fol. incisos menos de $\frac{1}{2}$

c. Pl. rastrera, cespitosa. Est. conspicuas, gen. rojizas

d. Cáps. glabra o apenas pubescente. Pl. radicante, rojiza.............................. 8a. *corniculata* v. *atropurpurea*

d'. Cáps. pubescencia cortísima. Sép. borde gen. purpúreo

  e. Est. 1-2 mm. Cáps. h. ca. 5 mm, Ca. h. $\frac{1}{4}$ -$\frac{1}{3}$. Sép. linear-oblongos, raro elípticos (Oceanía).............................. 12. *exilis*

  e'. Est. 2-3 mm, anchas. Cáps. 5-12 mm, Ca. h. 2/3. Sép. oblongos (Andes tropicales).... 13. *filiformis*

d''. Cáps. densamente adpreso-antrorso-pubescente 17. *procumbens*

  Iguales caracteres, Pl. mayor (fol., cáps.), haz gen. pubescente......................... 17a. *pr.* ssp. *Bathieana*

c'. Tallos ramificados, largos o surgiendo de un rizoma horizontal

d. Tallos surgiendo de un rizoma horizontal

  e. Cáps. tomentosas, en parte antrorso-pubescente. Pl. adpreso-pubescente, Fl. grande (12-20 mm)............................ 10. *Lyonii*

  Iguales caracteres, haz pubescente, Fl. a veces menor............................ híbridos de *Lyonii*

  e'. Cáps. cilíndrica, fina, aguda con pelos adpresos, gen. antrorsos, sólo en el dorso carpelar............................ 11. *florida*

  Iguales caracteres, tallos prostrados, ramas acortadas, rígidas, densamente foliadas................................ 11a. *fl.* ssp. *prostrata*

d'. Tallos ramificados, subescandentes o prostrados

  e. Pl. poco pubescente, pelos esparcidos. Cáps. pelos cortísimos en el dorso o esparcidos. Est. reducidas, esclerificadas..... 16. *rubens*

  e'. Pl. pubescente y glandulosa. Cáps. tomentosa ± antrorso-pubescente

    f. Tallos hirsuto- y glanduloso-pubescente Fol. adpreso-pubescentes, incisión aguda................................ 18. *novae-guineensis*

    f'. Pl. toda velutino-tomentosa. Fol. anchamente obovado, lób. redondeados.. ..... 19. *chnoodes*

O. fontana Bunge var. *fontana* (1)

Fig. 1 B

Bunge, Mém. Sav. Etr. Petersb. 2: 87. 1833. Hara, J. Jap. Bot. 25: 105-6, f. 2A. 1949.

[*Oxys s. trifolium luteum corniculatum, virginianum rectum, majus*, Morison Pl. Umbellif. 184, tab. 17. 3. 1672, dibujo imperfecto,sugiere esta especie]

[*Oxalis lutea americana erectior* Tournefort, Inst. Rei Herb. 1: 88. 1700]

[*Oxys caule ramoso*... Hortus Cliffort. 175 (Cfr. p. 2 E) 1738]

O. europaea Jordan in Schultz, Arch. Fl. Fr. Allem. 1842-54: 309,311. 1854. Billot, Annot. Fl. Fr. Allem. 20.1855. Wiegand, Rhodora 27: 134-135.1925. Conard and Hubbard, Iowa Ac. Sci. 51: 179,182.1944. Fernald, Manual 945.1950. Rogers, Gray Bull. n.s. 2: 268,270.1953. Gleason, Ill. Fl. 2: 455 , fig. 1958.Butcher, New Ill. Brit. Fl. 1:546.1961. Lawalrée, Fl. Belgique 4: 232-235, f. 40. 1963. Scholz, Verh. Bot. Brandenb. 103: 51,52.1966. Young, Watsonia 4: 58, f. C.1958; in Fl. Europ. 2: 1921.1968. Jørgensen, Blyttia 33: 65-66, f. 4.1975.

O. diffusa Boreau, Fl. Centre Fr. ed. 2. 2: 111.1849 (Obs.). Rouy et Foucaud, Fl. Fr. 4: 126.1897. Tipo: Boureau ex herb. Rouy LY.

O. cymosa Small, Bull. Torr. Bot. Club 23: 267.1896. Britton & Brown,Ill. Fl. 2: 347, f. 2256.1897.Tipo: New York, Bicknell NY.

O. Lejeunei Rouy, l.c. (incl. *O. stricta* v. *diffusa* Lejeune et Courtois, Consp. Fl. Belg. 2: 112.1831).

O. coloradensis Rydberg, Bull. Torr. Bot. Club 29: 243.1902.Tipo: Colorado, Rydberg et Vreeland 5920 NY.

O. rufa Small in Britten, Man. 577. 1901. Tipo: New York, Cult. NY.

O. shinanoensis Ito, Encyc. Jap. 2: 818. 1909.Tipo:Japon, Ito TNS.

O. Boreaui Fournier, Quatre Fl. 616.1937.

O. stricta auct. mult. (Eiten, 1955, 1963; Long & Kalela, 1971, Ahles, 1974, Robertson, 1975) non L.!

O. fontana Bunge f. *cymosa* (Small)Hara; f. *pallidiflora* (Fernald)Hara, f. *pilosella* (Wiegand) Hara; f. *villicaulis* (Wiegand) Hara, J. Jap. Bot. 24: 106.1949.

O. europaea Jordan f. *cymosa* (Small) Wiegand, l.c. 135. Knuth, Pflreich. 130:435. 437.1930. Conard & Hubbard, l.c. Fernald, l.c. 945.

O. europaea Jord. f. *pilosella* Wiegand, l.c. Conard & Hubbard, l.c. Knuth, l.c. Fernald,l.c. Tipo: Missouri, Courtney 6701 GH.

O. europaea Jord. f. *villicaulis* Wiegand, l.c. Conard & Hubbard, l.c.180-182. Knuth,l.c.Tipo: Michigan, Dodge 41 GH.

O.europaea Jord. f. *pallidiflora* Fernald, Rhodora 44: 425.1942. Tipo:Virginia, Fernald and Bayard 13060 GH.

O. europaea Jord. v. *rufa* (Small) Young, l.c. 59.1958.

O. stricta L. v. *diffusa* Boenninghausen, Fl. Monast. 131.1824.Tipo: Westphalia, Boenninghausen OXF.

O. stricta L.v. *pseudocorniculata* Schultz, Verh. Bot. Ver. Brandenb. 46: 239. 1905. Murr, Allg. Bot. Zeitschr. 13: 24.1907.Knuth, l.c. 144.Tipo: Allemania, Thellung BAS.

?*O.stricta* L. v. *decumbens* Bitter, Abh. Nat. Bremen 19: 298-300,lám. 10 (2-3).1907-9 ex descr.! Knuth,l.c.

(1) el epíteto alude a la ecología en que se halló el tipo: cerca de una fuente de agua.

O. stricta L. v. *rufa* (Small) Farwell, Mich. Ac. Sci. Rep. *20*: 183.1918.
O. stricta L. v. *villicaulis* (Wieg.) Farwell, Am. Midl. Nat. *11*: 62. 1928.
O. stricta L. v. *europaea* (Jord.) Knuth, *l.c.* et v. *fontana* (Bunge)Knuth, *l.c.* 145 et v. *Lejeunii* (Rouy) Knuth,*l.c.*
?O. corniculata L. f. *erecta* Makino, in Iinuma, Somoku-Zusetu, ed. 3. *2*: 664.1910; Ill. Fl. Nipp.399, f.1197.1940 Tipo inexistente.
?O. chinensis Haworth ex G. Don in Loudon, Hort. Br. Suppl. *1*: 595.1832 nomen!

Acetosella fontana (Bunge) Kze.,Revisio *1*: 91.
Xanthoxalis cymosa (Small) Small, Fl. SE U.S. 668.1903; N. Am. Fl. *25*(1): 55.1907.
X. europaea (Jord.) Moldenke, Boissiera *7*: 5. 1943; Castanea *7*: 125.1943; f. *cymosa* (Small) Moldenke, *l.c.*; Castanea *9*: 42.1944.
X. rufa (Small) Small, *l.c.* 1903; *l.c.* 51.1907.
X. coloradensis (Rydberg) Rydberg, Fl. Col. 220.1906.
X. fontana (Bunge) Holub, Bot. Közlem. *59*: 37,43, f. 42 C. 1973.
Ceratoxalis cymosa (Small) Lunell, Am. Mid. Nat. *4*: 468.1916.
C. coloradensis (Rydberg) Lunell, *l.c.*

TIPO. China Borealis, Pan-Sham,hab. ad fontem, leg. Bunge a. 1831 P. Isótipos E, P.

Herbácea (h. 1 m). Pubescencia ± hirsuta y pluricelular glandulosa. Raíces fibrosas y ramificadas. Tallos generalmente ascendentes, raro procumbentes, a veces profusamente ramificados, glabros o con pocos pelos esparcidos; ramos jóvenes con pelos curvos ± hirsutos a subadpresos. Follaje a menudo frondosísimo, hojas pseudoverticiladas. Internodios h. 6 cm y muy corto hacia el ápice. Pecíolos largos (h. 9 cm) hirsuto- y glanduloso-pubescentes,articulados en la base sin estípulas desarrolladas. Folíolos anchamente obovados, cuneados (8-25 x 8-35 mm), incisos h. 1/10 -1/5, ciliados, pocos pelos sobre los nervios en el envés. Cimas mayores que el follaje, ascendentes (3-) 5-17-floras, dos veces 2-fidas, ramas h. 5 cm, a menudo una rama aborta en parte o completamente. Pedúnculos (h. 12 cm) finos, pubescencia como el pecíolo. Brácteas (1,5-2 mm) y bractéolas (½ - mm) lineares, acuminadas, glabras o con pocos pelos. Pedicelos largos (h. 6 mm), los terminales articulados ca. la mitad con 2 bractéolas, acrescidos en la fructificación h. 15 mm.

Sépalos hialinos, lineares o elípticos (2,5 - 3,5 x 5-10 mm) subagudos, pocos pelos esparcidos o glabros,cíliados, densamente en el ápice. Pétalos amarillo-claros, pequeños (ca. 2 veces el largo del Ca.)obovado-unguiculados (5-6 mm). Estambres filamentos ensanchados hacia la base, los largos cortamente pilosos (± 3,5 mm), los cortos (± 2,5 mm) glabros, soldados h. 2/3. Pistilos (± 4 mm); estilos finos, ± adpreso-pubescentes; estigmas pequeños capitados, papilosos.

Cápsulas cilíndricas, agudas (h. 15 mm), estilos ± mm; cáliz h. 1/4-1/5 , pubescencia hirsuto-glandulosa pluricelular,esparcida, a veces densísima y otras casi nula (frutos glabros excepcionalmente); carpelos 3-8-seminados, interiormente pocas setas esparcidas. Semillas pardas, elipsoideo-aplanadas, algo asimétricas, apiculadas (1-1,25 mm), 9-10-costadas con 12-14 estrías transversales, pequeñas protuberancias en las intersecciones.

OBS. La mayoría de las flores son mesostíleas. Se observan también verticilos mayores sensiblemente del mismo largo que el pistilo. Raramente flores longistíleas.

Distribución geográfica. Abundante en América del Norte y en Europa.Rara en Asia y más aún en Africa, introducida.

Material estudiado.
Herb. Lamarck P. Ex herb. Vaillant P. Ex herb. Korthals L. Nos haies, les lieux exposés au soleil du midi, Ex herb. Persoon (p.p. corniculata) L. Ex herb. Meerbury L. Ex herb. v. Royen (3) (s. Oxys trifolium) L. Ex herb. v. Royen (s. O. Dillenii) L. Ex herb. Gatterer (s. O. Dillenii) L. Ex herb. Trevirani, ex herb. Hasskarl (p.p.corniculata) L. Ex herb. Persoon (s. O.Dillenii) L. Ex herb. Schultes (s. corniculata) L. Ex herb. Forster L. Herb. Tournefort (152) P. Ex herb. Muhlenberg (380)PH.
America.
CANADA. Leg. Holmes Ex herb. Greville E. Leg. ipse a. 1830 ? Ex herb. Rouy LY. British Columbia. Vancouver, Crown / W 23 Av., leg. Bird 89 19 VIII 1954 BM. Spanish Banks, leg. Eastham16464 18 VIII 1950 NA. Tranquille, leg. Groh 240 III 1947 S. Manitoba. Winnipeg, Rivière Rouge, leg. Bourgeau 13 VII 1859 P. 1 mi. N of Elisabeth, leg. A.& D. Löve 5885 7 VII 1953 GH. Winnipeg, La Salle, leg. Denike 735 15 VI 1939 NY. Brandon, leg. Macoun 21 VII 1896 K. Red River, leg. Douglas a. 1827 BM. New Brunswick. Bass River, leg. Fowler 1175a 30 VII 1872 UC. Charlotte Co., Grand Maman road to Grand Harbor, leg. C.A.& U.F. Weatherby 3725 2 VIII 1927 GH,PR. Apalaches, leg. Rafinesque P. Green Riv. area, 1300 ft., leg. Harmsen 142 6 VII 1957 WAG. Campbelltown, leg. Chalmers 391 8 IX 1877 BM. St. Laurent, env. de Langueil, près Montreal, leg. M. Victorin 9604 XI 1919 P. Bathurst, leg. Malte 649 29 VI 1976 S. Nova Scotia. Windsor, leg. Macoun 391 20 VII 1883 BM. Rings Co., Fentville, leg. Fernald 22 VIII 1902 GH. Picton Co., Springfield, leg. Robinson 499 25 VIII 1906 NY. Halifax, leg. Gorham 45.1328 25 VIII 1945 BM,US. Point, leg. Adams 23 VIII 1938 K, S. Ontario .Near Lake Superior, leg. Bourgeau a. 1857 P. Bruce Co., Southampton, leg. Grassl 5103 9 VII 1932 MICH. Ridean Canal, leg. Ford 16 VII 1894 OXF.Elgin Co., St. Thomas, leg. James 2804 20 VII 1955 S. Hamilton, Roy. Bot. Gdns., leg. Walton IX 1949 E. Kenora, leg. Rendle and Good 31 VIII 1924 BM.Toronto, leg. Biltmore 2921 f 22 VII 1901 US.Kingston, leg. Fowler 16 IX 1898 F. Comté de Vaudreuil , leg. Roy 3755 13 VII 1935 WAG. Québec. Montréal, leg. Jacquemont 3 IX 1827 P. Comté d'Argenteuil, St. Adolphe, leg. Rolland-Germain 2521 12 VIII 1905 S,UPS. Hull, en face d'Ottawa, leg. M. Victorin 15658 5 VII 1921 NY,UC.Québec, leg. Whiteaver 244 1861 OXF. Comté de Chably, leg. Rolland-Germain 208 22 VI 1927 BR. Nappierville Co., 6 mi. SW of Nappierville, leg. W.T.Stearn 2422 22 VIII 1959 BM. Saskatchewan. Prince Albert, leg. Krivda (65-103) 12 VI 1965 BM. Leg. Bourgeau 1857-58 P. Leg. Richardson K.
ESTADOS UNIDOS.
Alabama. Tuscaloosa, Warrior Riv., leg. Harper 3367 10 V 1935 GH,NY,US. Arizona. Tucson, leg. Spofford GH. Arkansas. Mt. Magazine, near Havana, leg. Hass 2003 5 VI 1931 US. Arkansas, leg. Rafinesque G. California.Mariposa Co., Yosemite Nat. Park, Ahwahnee Hotel Grounds, 4000 ft., leg. Rose 54124 1 X 1954 NY. Colorado. Sangre de Cristo Creek, 2400-2700 m, leg. Rydberg et Vreeland 5920 2 VII 1900 Tipo de O. coloradensis NY.Denver, leg. Ehlers 8396 10 VII 1942 MICH. Connecticut. New Haven Co.(and

city), leg. Porter 823 18 VIII 1962 USF.Southington, leg. Bissell 133 2 VIII 1899 GH. Dakota .Leg. Merchant P. Delaware. Wilmington, leg. Canby VII 1888 NY,US. Greenbank, leg. Commons 8 VIII 1883 PH. District of Columbia. Washington, Capitol Hill, leg. Fosberg 54477 27 VII 1972 P, US. Glen Echo, leg. Burgess 10 VI 1893 NY. Georgia. Clarke Ruv., Oconee Riv., 600 ft., leg. Harper 5 18 VI 1900 BM,GH,NY,P. Fannin Co., Blue Ridge Mts. leg. H.H.Smith 2453 22 VII 1909 F. Idaho. Talladega creek, 1000 ft., leg. Mohr 6 VIII 1896 US. Illinois. Stark Co., near Wady Petra, Copse, leg. Chase 639 25 VI 1900 F,GH,LY,NY,US.Chicago, leg. Scammon 9 VI 1889 PR.Indiana. Howard Co., Purdum St., Kokomo, leg. Ek 7 VIII 1941 MVNF,NY,UC. Crown Point, leg. Baehni 54 4 VIII 1934 G. IowaPoweshiek Co., Grinnell, leg. Conard 6 VII 1965 BM,GH,NA,USF.Johnson Co., leg. Fitzpatrick 30 IV 1898 P. Kansas. Riley Co., leg. Norton 57 1895 GH,LY,NY,P,US. Davy Co., Baldwin City, leg. McGregor 727 21 VIII 1946 S. Kentucky.Cumberland et Kentucky, hautes montagnes à l'Ouest des Alleganys, leg. Michaux p.p. P. Nelson Co., SE of Balltown, leg. Wharton 4085 1 VI 1939 MICH. Louisiana. Jacksonville, leg. Drummond FI. Basse Louisiane, leg. Barbe 10 1839? P. Maine. Oldtown, leg. Fernald 227 14 VIII 1908 BM,F,GH,K,LE,OXF,P,PRC,S, US. Cumberland Co., Orrs Island, leg. True 15 VIII 1922 PENN. Maryland. Mont Co., Takoma Park, Meyer's Garden, leg. F. Meyer 9259 8 VIII 1965 NA, UC.Georgetown to Plummer's Isl., leg. Morris 98 3 VI 1899 F,US. Massachusetts. Cambridge, street, leg. Lourteig 3020 IX 1974 P. Nantucket Island, leg. Bicknell 5433 9 IX 1904 NY. Michigan. St. Clair Co., Port Huron, leg. Dodge 41 25 VII 1914 Tipo O. europaea f. villicaulis Wiegand GH. Isótipo MICH. Berrien Co., Lake side, leg. Millspaugh 3878 IX 1914 F. Minnesota. Ft., Snelling, leg. Sheldon VI 1895 US. Renville Co., 1 mil. E of Fairfax, leg. Moore 13210 22 VI 1940 GH,NY,UC. Mississippi. Fort Smith to the Río Grande, leg. Bigelow a. 1853-54 US. Bolivar Co., 6 mil. W Lobdell, leg. Ray Jr. 4975 16 VII 1955 GH,NY,USF. Missouri. Jackson Co., Courtney, leg. Bush 6701 20 V 1912 Tipo O. europaea f. pilosella Wiegand GH. Isótipos NY,US. Prés des montagnes, leg. Trécul 491 11 VII 1848 P. Nebraska. Calabran, leg. William 3 IX 1889 US. Minden, leg. Hapeman 4 VII 1938 NA, U, UC, UPS. New Hampshire. S of Armenia,leg. Blake 7 VIII 1877 BP. Coos Co., Jefferson, leg. Pease 39815 25 IX 1960 USF. New JerseyWatchung, leg. Moldenke 7404 19 VIII 1932 BM,P,PRC. Atlantic Co., Mayo Landing, leg. Fogg 2099 5 VI 1927 PENN. New Mexico. Socorro Co., Mogollon Mont., leg. Wooton 7 VIII 1900 US p.p. Between Coon Creek and Paronic Fork, leg. Fendler 7 IX 1847 BM. New York. Riverdale, leg. Bicknell 26 VIII 1894 Tipo O. cymosa Small NY. Tompkins Co. Ludlowville, leg. Munz 17379 13 VII 1945 S. North Carolina.Macon Co., van Hook Glade Rd., leg. Stewart & Hechenbleiner 25 VII 1938 PENN. Yadkin Riv., near Lenoir, leg. Small 25 VI 1891 K,US. North Dakota. Fargo, along Red Riv., leg. Rudd 616, 635 5 VI 1929 US. Washabaugh Co., leg. Visher 2279 VIII 1911 NY. Ohio. Clark Co., vic. Lawrenceville, leg.Leonard 19113 7 IX 1941 US. Mahoning Co., Youngstown, leg. Eiten 1030 9 V 1955 NY. Oklahoma. Near Miami, Neoslio Riv. bank, leg. Stevens 2273 26 VIII 1913 GH,K,NY,US. Choctaw Co., Near Fort Towson, leg.Houghton 3992 1 VI 1916 GH. Pennsylvania. In cultis Pennsylvania, leg. Hultgren,herb. Thunberg 11126 UPS. Chester Co., Westtown, leg. Pennell 11822 28-31 VIII 1923 NY,PENN. Rhode Island. Rocky Port, leg. Round VI 1905 LY. Providence Co., Yard, Providence, leg. Collins 9090 28 VI 1902 F, PENN.

South Carolina.Kershaw Co., Camden, leg. Biltmore 2291 i US. Santee Canal, leg. Ravenal 1 IX 1... GH. South Dakota. Black Hill Nat. Forest, Mounta in Meadow Ranch, 5400 ft., leg. Murdoch Jr. 3093 10 VII 1908 F,GH, NY. Medary, leg. Carter 10 VI 1896 NY. Black Hilles, Elk Canon, 4000-5000 ft., leg. Rydberg 586 29 VII 1892 K,NY,US. Tennessee. Cocke Co., Wolf Creek, leg. Kearney 629 27 VIII 1897 NY,US. Bedford Co., 2,5 mi. Shelbyville, leg. Godfrey 57530 30 VIII 1958 GH. Utah. Utah campus, leg. Howard 25 V 1881 GH. Vermont. Ripton, Bread Loaf Inn, leg. Williams 8 VII 1908 S. Burmington Co., E Woodford, leg. True 2385 8 VIII 1936 PENN.Virginia.Isl. of Wight Co., James River, W of Fort Boykin, leg. Fernald & Bayard Long 13060 14-16 VI 1941 Tipo O. europaea f. pallidiflora Fernald GH.Fauquier Co., Bull Run Mt., leg. Allard 1994 12 VII 1936 US. West Virginia. Shannadale, leg. Palmer 4 IX 1899 US.Upsher Co., N of Buchannon, 1300 ft., leg. Rossbach 2359 10 II 1960 USF. Washington.King Co., Seattle, leg. Neville Jones 22 VI 1936 BM p.p. Klickitat Co., leg. Suksdorf 3 VI-12 VII 1892 UPS. Wisconsin. Pierce Co. Prescott, shore of L. St. Croix,leg. Fassett 10153 31 VIII 1927 GH. Monroe Co., N of Tomah, leg. Iltis & Noamesi 7039 19 VIII 1956 NY. Wyoming. Crook Co., Bear Lodge Range, E of Hulett, 4200 ft., leg. Porter 7802 23 VI 1959 UC.

Europa - Asia

NORUEGA. En Fredrikstad, Onsøy, Moss, Oslo, Modum Borre, Erdanger, Brevik Kragerø,Holt Lillesand,Arendal, Kristiansand, Mandal Flekkefjord, Stavanger, Strandebarm, Fana, Sunudal (Cfr. Jørgensen, l.c.).

SUECIA

Blekinge.Sölverborg, leg. Holmgren 31 VI 1933 S. Bartasjo, leg. Hylander 25 VIII 1949 UPS. Bohuslän.Ljung, Åker, leg. H. Fries 29 VIII 1934 S. Strömstad, leg. Frisedahl 23 VII 1949 UPS. Göteborg. Nya Warfvet ad Gothosburgum, leg. Lübeck a. 1856 S,UPS. Lagklarsbock, leg. Ohlsén 21 VII 1926 S. Gotland. Hejde, leg. Ahlfvengren 15 IX 1883 S,UPS. Ib., leg. ipse 1 IX 1888 S. Gervall i Hejde, leg. ipse 7 IX 1882 S. Halland. Halmstad leg. Nordström 6 IX 1903 S. Okamps, Eskilstop, leg. Blom 22 VII 1929 S. Närke. Knista, Lekeberga, leg. Starbäck 26 VII 1954 S. Nercke, Kikis,leg. Geyerstam VIII 1861 S. Oland. Kogsby, leg. Kingström VII 1967 S. Vickleby, n. Resmo-grässens, leg. Asplund 27 VIII 1947 S. Skäne. Källstrop,leg. Tedin 1104 6 IX 1925 F,GH,K,NY.Drottninghol, leg. Lagerwall VIII 1909 UPS; VIII 1916 & VIII 1915 S. Södermahland.Eskilstuna. leg. Almquist 9 IX 1945 UPS. Säpstabolm, leg. Lundström 25 1884 LE. Stockholm. Hafnia a. 1709 S. In Herb. Thunberg 11081 UPS.Drottningatan, leg. Thedenius VIII 1840 S. Uppland. Pr. Uppsaliam, leg. Ahlberg VII 1867 OXF,US. Upsala, Bot. Trädgard, leg. Petré VIII 1902 S. Västergötland. Langared, Risvedens, leg. Hasselrot 15 VIII 1941 S. Silva Tweden, Finnerödja,leg. Neander 8 X 1931 S.

POLONIA.

Karpaty, Zach Myslenice, leg. Dyakowska 353b 5 VIII 1938 GH,K,NY,PRC, UPS,US. Nowa-Alexandria, Lublin, leg. Shmielewski 15 1897 BP,MPU,PRC. Krakau, leg. Herbich VI 1857 LY. Podkarpacie, Ogrodi, leg. Marcowna 353 17 VII 1938 NY,K,S. Wadowice, Bradej ad Kalwarja Zebrzydowska, leg. Trela 17 VIII 1932 US.

INGLATERRA

Waterloo, leg. Jacquemont IX 1820 P. Ex herb. Bishop Goodenough(Corporation Carlisle) VI 1880 K. Cornwall, Pezance, leg. Fraser IX 1875 LY. W. Sussex, Pulborough,leg. M.Hutchinson 712 15 VII 1960 U. Kent, Bromley, leg. Lowne 30 VIII 1919 K. N. Somerset, near Harters Hill, leg. Summerhayes 2919 17 VII 1956 K. Oxfordshire, Woodstock, leg. Turrill & Hubbard 12292 16 VIII 1944 K. Lancaster, Langcliffe Gardens, leg. Simpson 715 6 X 1835 OXF. Norfolk, leg. Druce 406 I 1919 BAS. Wales, Cardiff, Canton, leg. Davies 3 IX 1969 S. Isl. Wight, St. Johns Gard., near Ryde, pl. by Bromfield 244 10 IX 1867 OXF. Liverpool,Allerton, leg. Last 132/2 VIII 1906 K.

DINAMARCA

Fyn, D 41, near Sorø, leg. Young 4521 1 VIII 1952 BM,K. Frederisborg, leg. Rank Sür Elöver LY. I Have u. Thorvalsenvig, leg. Lange 30 VII 1896 S. Sjaelland, Brede, leg. Petersen 1 IX 1862 UC. Søllorød, leg. ipse 9 IX 1862 UC. Ljoll, Gurre, leg.Rasch 18 VII 1877 PR. Hillerød, leg. Lange VIII 1846 S. Kopenhavn, leg. Ringstrand a. 1849 UPS. Sjelland, Havalsted, leg. Wündsted, 20 IX 1936 USM.

ESTONIA

Parnut, leg. Kaarst 165 24 VIII 1937 LE.

HOLANDA

Hort. Leidensis, leg. Burmester 17.. SBT. Hortus Cliffort.(p 2E) BM. Doorn, leg. Koster 2 VIII 1936 GH,P. Vorsjaranag, leg. G. de Chalmot US. Bergen op Zoom, leg. Recâane VII 1899 US. Apeldoorn, leg. Anker Smit, a. 1880 F. Etten-Leur, near Breda, leg. Bakhuizen 6541 23 VI 1948 K. Baarn, leg. Vermeulen 10 VI 1927 NY. Bennekon,leg. ipse 20 VII 1927 NY. Wageningen, leg. Roosje 21 VII 1948 UC. Ib., leg. Roorda v. Esinga VIII 1949 UC. Prov. Noor Brabant, Sleeuwijk, leg.de Roon 695 21 VIII 1959 UC.

BELGICA

Royaume des Pays-Bas, leg. Lejeune 85 P. Hainaut, Papignies,(leg. Begl) leg. Fontaine 312 VII 1873 P. Anvers, Tongerloo, leg. Thielens VII 1870 FI. Bohan (Semois), leg. Schouwenburg-Mol & A. Mennega 31 VIII 1965 U. Peruwelz, Brasse,leg. G. de Contot 25 IX 1872 LY. Hainaut, Harvengt,leg Gandoger 22 VI 1882 LY. Laaken, near Brussels, leg. St. Mill IX 1851 K. Op-den-Berg, près de la Chapelle, leg. Quarré 11 2 X 1926 NY. Spa, leg. Wright 7 VIII 1897 K. Brabant, Berchem-Sainte Agathe, leg. Lambert 22 VI 1936 NY.Anderghem, leg. Lawalrée 8624 8 VIII 1957 UC. Ilny, leg. ipse 11367 22 VII 1961 UC. Leeuwarden, leg. Schierbeck 26 VIII 1903 GENT. Workum, leg. ipse VII 1906 GENT.

FRANCIA

Indigène de monjardin à Paris ou elle se multiplie en abondance sous les arbres Herb. Lamarck, P. Aisne. Vermabd,leg. Hibon 831 VIII 1903 P. Ebreuil, leg. Héribaud 19 VIII 1891 LY. Allier.Iseure, leg. Lassimonne 291 29 VI 1891 US.Bords du Cher, près Noirlac, leg. Lombard 18 VII 1842 P. Alsace.Strasbourg, leg. Fernald 7 VII 1903 GH. Barr, 200 m, leg. Hausser 20 VII 1885 PRC. Calvados. Villers, leg. Morion a. 1846 P. Caen, leg. Chauvin a. 1850 LY. Cantal. Pleaux, leg. Pomarat VIII 1904 LY. Tivoli, près Aurillac, leg. Héribaut VIII 1901 LY. Cher. St. Armand, bord du Cher, leg. Boureau Ex herb. Rouy Tipo O.diffusa LY. Quincy, bords du Cher, leg. Déseglise BR. Sables du Cher à Chaillot, leg. ipse 8 VIII 1854 LY. Côte-d'Or. Semior-en-Auxois, 380 m, leg. Desplantes 26 VIII 1924 PR. Deux-Sèvres. Les Aubiers, leg. Violleau 698 8 VIII 1891 GENT. Prailles, Mauley, leg. Sauzé 14 VII 1853 LY. Doubs. Fresnières à Rougemont, leg. Paillot 119ter 21 VII 1860 K,LY,OXF,P,PRC. Besançon, 245 m, leg. Durand et Paillot 36 18 VIII 1867 BP, LY. Essone. Morangis, route d'Athis, leg. Jovet 1 et 1bis 20 VII 1969 P. Parc de Fleury- Merogis, leg. ipse 3 18 VII 1969 P. Eure. Champs de Bois, leg. Toussaint 20 IX 1900 P,PR. Haute-Marne. Leg. Mugnier 7 VIII 1904 LY. Hautes-Pyrenées. St. Lary, 830 m, leg. MacKee 25705 6 IX 1967 P. Haute-Saone. Port-sur Saone, leg. Madiot 1054 1 X 1930 P. Ib., leg. ipse 6586 25 VIII 1931 P. Haute-Savoie. Pringy, leg. Puget 7 VI 1868 BR,LE,P. Aix, leg. J.Gay 23 VII 1812 K. Ib., Grand Port, leg. Erdmann 15 VII 1910 S. Hérault. Montpellier Ex herb. Sauvages MPU. Ille-et-Vilaine. Rennes, leg. MacKee 30167 2 IX 1975 K,P. Ib., leg. Parmentier a. 1842 P. Indre-et-Loire. Bords de la Loire, leg.Blanchet 72 20 VI - 12 VIII 1850 F,FI,K,LE,LY,OXF,P,PRC,S,US. Langeais, leg. Tourlet a. 1876 P. Isère. Gières, leg. Chaboisseau et Faure 2003bis 11 X 1881 FI,LY,MPU,P. St. Vérand, leg. Mercurin 699 29 VI 1945 P. Jura. St. Claude, leg. Paillot 36ter 16 VIII 1870 BP,LY. Loir-et-Cher. Chailles, leg. Franchet 3 VII 1881 P. Ile de Muide, leg. ipse 16 IX 1879 P. Vendôme, leg. Doumergguet 15 VIII 1885 LY. Loire. Bords de la Loire, leg. Legrand 23 12 VII 1869 LY. St. Chamond, leg. Gandoger 23 VIII 1895 LY. Loire-Inférieure. Le Cellier, St. Jules de Coucelles, leg. Violleau 696 18-21 VIII 1894 GENT. Cherbourg, Le Jolis, leg. Lloyd 29 VII 1867 LE. Loiret. Gien, Val de la Loire, Port Gallier, leg..... 11 VIII 1898 LY. Lot-et-Garonne. Aiguillon, leg.Granjean 10 IX 1915 UPS. Ib., le Passage, leg. Duffour 1621 12 IX 1915 P. Manche. Tamerville, près Valoquer, leg. Leber VI-X 1849 P. Mayenne. Aron, Etang de la Forge, leg. Savouré 1 VIII 1897 P. Fraimbault-de-Prières, leg. ipse 22 VIII 1897 P. Nièvre. Sables de la Loire entre Soulangy et Germigny, leg..... 79 15 VI 1871 LY. Bords de la Loire, leg. Boreau a. 1843 LY. Nord. Quarouble, leg. Martin 15 IX 1887 LY. Viesvigne, leg. Riomet IX 1892 LY. Oise. Litz, leg. Caron 237 9 VIII 1854 BP,GENT,GH,K,LY,MPU,OXF,P,PRC,S. Ib., leg. ipse 119bis 9,10 VIII 1854 BR,OXF,P,S. Orne. St. Front, Les Maisons-Neuves, leg. Savouré 962 5 VII 1900 P. Puy-de-Dôme. Bords de la Sioule, Chateauneuf-les-Bains, leg. Gatien 21 VIII 1879 K,LY,P. Puy-de-Dôme, leg. Brevière 21 VIII 1906 LE,PRC. Rhône. Lyon St. Clair, leg. Duffour 388bis VI 1847 LE,P,S. Corcelle, leg.Gillot 3 IX 1870 MPU. Sarthe. Cee, leg. Chevallier 1 VII 1886 P. Le Mans, leg. Thériot 1 VII 1888 LY. Seine. Cimetière Père Lachaise, leg. Jovet 29 VIII 1967 P. Hortus Paris., leg. Leman a. 1820 P. Orsay, leg. Bonnet et al 2003 28 VII 1878 BP,K,LY. Seine Inférieure. Rouelles, leg. Thériot 3621 17 IX 1894 GH,LY. Seine et Marne. Lagny, leg. Gaume 29 IV 1920 P. Liverdy, leg. ipse 27 VIII 1919 P. Seine et Oise. Entre le Déluge et la Graissée, près Bazemont, leg. Humbert 21 VII 1901 P. St. Brice sous forêt, leg. Mouillefarine 28 VII 1889 US. Somme. Les Allein-Deher, leg. E. de Vicq VIII 1857 P. Var. Vallée du Lot, Aveyron, leg. Bras 21 VI 1859 P. Vendée. St. Maurice-le-Girard, leg. Seyrat 15 VII 1914 P. Vosges. Rhenane, St. Louis, leg. Grosrenaud VIII 1864 LY. Dampierre, leg. Jeanpert 2 VIII 1891 F. Yvelines. St. Leger, leg. Luizet VII 1885 P. St. Cyr, leg. Belanger a. 1822 P. Versailles, leg. Gougerot-Nicot VII 1942 P.

ALEMANIA

Hanover, leg. Grisebach IV 1846 FI. Cologne, leg. Löhr 119 BAS,LY,OXF, P,S. Bei Leipzig, leg. Richter 379 BAS,BP,FI,K,OXF,P,PRC.Pr. Carlsruhe et Haidelberg, leg. Braun V 1834 K. Westphalia, Monasterium, leg. Boenninghausen a. 1824 Tipo O.stricta v. diffusa Boenning. OXF. Bavaria, Erlangen, leg. Reineck 12 VIII 1860 PRC. Bei Freiburg, leg. Thellung 460 15 VIII 1912 BAS. Storckow, leg. Chulz VIII 1901 Tipo O.stricta v. pseudocorniculata Schulz BP. Hannover, cottage Gard., a. 1779 LINN. Ehrl., Herb. 127, LINN. Berlin, Steglitz, leg. Hülphers 19 VII 1906 S. Kork, ex herb. Tuczkievicz 18 X 1857 MPU.

CHECOSLOVAQUIA

Slovenia Orient., Velká Lodiná, 260 m, leg. Dostál 9348 26 VII 1932 PRC. Kl. Karpaten, St. Georgen, leg. Ronniger 10 V. 1908 W. Presburg, Mühlthal, leg. Wiesbursy 3 IX 1874 BP. Valle Gründl,ad Dolsinom, leg. Lengyel 5 VIII 1924 BP. Nad Senickou u. Litovle, 280 m, leg. Hejný 498 8 IX 1941 PRC. Horazdovicko, Babiny,leg. Vanecek 565 12 VII 1947 PRC. Tabor, 400 m, leg. Hnifdor 2590 15 VIII 1927 PRC. Praga, leg. Sterneck a. 1884 PRC. Rankovcu u. Kosic, leg. Domin 24 23 VIII 1919 PRC. Bohemia. Pisek, 430 m, leg. Ambrož 2590 25 VI 1942 PRC. Veltrusy, leg. Hejný 380 VIII 1923 PRC. Moravia. Vysvov, leg. Skrivánek 16 VIII 1941 PRC. Yesenik, Mala Moravka,650 m, leg. Dostál 14 VII 1961 PRC. Drevnice, Provodov, 500 m leg.Romasek 15 VII 1944 PRC.

SUIZA

Berne, leg. Tieche VIII 1873 BP,F,FI,LY. Lausanne, bords du Leman, leg. Chevallier 31 VIII 1880 P. St. Legier, leg. Papon MPU. Genève, leg. Brown VIII 1872 UPS. Ib., Plan-les-Ouates, leg. Walsh 338 19 VI 1959 VAD Vevey, leg. Sommier 7 VI-7 VII 1917 FI.Fribour, de Vauderens a Uroy, 720 m, leg. Fr. Castella 8 IX 1902 US. Tessin, Lugano, leg. Roos IX 1929 S. Locarno,leg.Schleicher 1898 UC. Zurich, leg. Hexamer et Maier 29 VI 1850 GH. Aargau, Zofingen, leg. Siegfried a. 1869 FI,LY.

AUSTRIA

Vindobonae, leg. Schur 776b 4 VIII 1867 P.Tirol, pr. "Trident", 190 m, leg. Murr 4856 VI 1905 BP, E,G,LE,LY,OXF,P,PR,PRC,S. Coratia, Schlosser, leg. Calas a. 1881 LY. Oniponte, leg. Kerner BP,K. Bei Salzburg, leg. Hinterhofer OXF. Enzersdorf, leg. Keller 21 VI 1905 PR. Hallstadt, leg. Krebs VIII 1898 PRC. Lusmont, leg. Winkler VIII 1948 BP.Innsbruck, leg. Wall 1925 S. Bei Gloggenitz, leg. Kischfur 5 IX 1873 PRC. Caribthia Super., Mullstadt, in hortus,leg. Sonklar VIII 1880 LY.

HUNGRIA

Szigetszentmiklos, Ins. Csepel, leg. Filarszky et Kümmerl 231 18 IX 1913 BAS,F,FI,GH,K,LE,P,PR,PRC,R,S,UC,US. Nyitva, leg.Ginzery VI 1911 K. Commit Pest, Szigetszentmiklos, leg. Lengyel IX 1910 NY. Com. Zala, pr. Zalalövö, 230 m, leg. Pocs & Gelencser 26 VI 1953 BP. Borsodm, Diós Györ, leg. Budai 1340 19 VIII 1906 BP. Budapest, leg. Degen 29 VIII 1916 BP. Türje, Com. Szabolos, Zalam., Otvospursta, leg. Javorka et Islyomi 22 V 1938 BP. C. Pest, Monte Srechenyi-Pregy ad Budapestium, leg. Degen 12 VIII 1925 BP.

RUSIA

Lublin, pr. Nova Alexandria, leg. Chmielewski a. 1897 LY, K. Rossia Subcarpatica,fl. Tisa pr. Chust, leg. Zofak 24 VI 1932 PRC. Flora Volkynica Pl. Skitomir, leg. Golde VI 1872 LY.

ESPAÑA

In agro Malacitano, leg. Willkomm 216 15 V 1845 FI,P. Toledo, S. Bernado leg. Pomata V 1882 LY.

ITALIA

In satis Agri Pisani, leg. Savi VIII 1843 P. Venecia, Verona, leg. Rigo 26 VIII 1870 K,P,OXF. Marche, Pratis Maceratensib., leg. Narducci IV 1877 FI. Toscana, Corno alle Scale, 6000 ft., leg. Marchesetti 29 VI

1873 FI. Atte Coscine di Firenze, leg. Coldesi VI 1857 LY. Villa Albareto pr. Modena, leg. De Toni VII 1903 NY. Naples, leg. Gussone a. 1830 LY. Cuneo, leg. Gresino 21 IX 1920 BP. Vicenza, leg. Sadler BP. Verona, leg. Micheltti IX 1890 PRC. Piemonte, Casale Monferrato, leg. Bolós 25 VII 1957 BC. Lungo il Piave a Vedor, leg. Bolzon 31 VIII 1900 FI.

RUMANIA

Moldova, Neamt, Topolita pr. Ocea, 400 m, leg.Ravarest 2241 1 IX 1936 P. S. Josef, leg.Barth 23 VII 1900 BP. Transilvanie, Nagy-Suben, leg. Ornay IX 1852 BP. Araryosmarót, leg. Moczl 19 VIII 1930 BP. Eperyes, ex herb. Hazslinskyi BP. Lipotmeso pr. Budapestinum, leg. Thaisz 22 VIII 1898 BP.

YUGOSLAVIA

Crna Gova,Stari Bar, Mont. Rumija, leg. Deyl 22 VI 1974 PR.Miokoler, leg. Budai 7445 5 VIII 1916 BP.

CHINA

China Borealis, leg. Bunge 74 1835 G. Prov. Hopeh, Pan-Sham, leg. Bunge a. 1831 Tipo P. Isótipos E, G, LE. Chekian Prov., Tanmuschang, W Khandjou, leg. Takhtajan LE. Kiaoschan, Shanhaikwan, leg.Licent 1585 5,8 IX 1915 BM, K,P. Pekin, 500 Km S, leg. Chanet et Serre, a. 1930-35 P. Thowkowtien,Chichli, leg. Cowdry 1772 20-21 VII 1927 K. Near Peking, leg. Bushell, bef. 1874 K. Hupeh, leg. Wilson 907 VI 1900 K. Tient-sin, leg. Licent 8543 25 VII 1928 K. Chichli, Fungling, leg. Coudry 1257 18 V 1921 K. Penn Yan, leg. Sartwell K. Peking, Yushan, leg. Tatarinod 331 bef. 1856 LE., S. Yuan-shu Distr., Yecho-shan, Fuchian-ho, leg.Smith 6362 18 VII 1924 UPS. Yuan-chu Distr., Nsiungshan-ting, ca. 900 m, leg. ipse 6148 10 VII 1924 S, UPS. Hannan, leg. Kustropp 19 VII 1866 K. Huan, Yiyang, Taoluvalum, leg. Dahlström 132 15 IX 1947 S. Manchuria. Kuantung region, vic. Dalny, leg. Vassiliev LE. Imperial tombs near the town of Mukden, leg. Litvinow LE. Liaotung Pla., near RW Station Vangphangoo, s.c. LE. Kuantung Pla., Bay Dalanvan, leg. Gudzenko LE. Prov. Shin-King, Chien Shan, Liao-Nung, leg. Ross 564 15 VI 1876 K.

JAPON

Prov. Musaski, Hondo, near Asakawa machi, leg. Mizushima 3 VII 1947 GH, UC,US. Hakodate, Usignope, leg. Maximowicz 7-9 VIII 1861 LE,US. Tokyo, Tochigi Pref., Nikko City, Bot. Garden Kajoo Fall, leg. Kobayushi 3 VIII 1963 US. Mino Prov. Hondo, leg. Shiota 10 25 VIII 1922 GH. Tosa, Ochi, leg. Watanabe VI 1888 GH. Yushun, Kudo, Prov. Ugo, Yokote, leg. Masuda - machi 7 VI 1905 NY. S. Hokkaido, leg. Brroks 414 1884 UC. Sendai, leg. Iisiba 16 I 1925 et 30 VI 1927 (s. corniculata f.erecta Makino) G. Mt. Takao, Hachiogi City, leg. Makino a. 1926BR. Hondo, Prov. Musaski, leg. Kobayashi 13654 10 VI 1955 S. Prov. Shinano, in montanis Kiso inter Agématsu et Otaki, leg. Ito 8 VIII 1891 TNS. Tipo O. shinanoensis Ito

KOREA

Korea Septemtr., flum. Talu, leg. Komarow 1005 24 VIII 1897 BM,FI,GH,K, LE,NY. Pr. Tamunrana, leg. ipse 28 VIII 1897 LE. Seoul, leg. Kalinowsky VII 1886 LE. Pr. Kuncana, leg. Schmid 322 a. 1900 LE. Moexencan, in sylva, leg. Vorobjev et Grushevitерky 101 3 VI 1957 LE (s. corniculata f. erecta Makino). Prov. Fen Nian, Distr. Czashin ad Kenze, leg. Komarow 24 VIII 1897 LE. South Korea, Kwangnung, Kyongii-Do, leg. Chung In-Cho, 3138 15 X 1947 F. Chemulpo, leg. Carles 71 VI 1884 K.

Africa
EGIPTO
Delta, Bassa Tebaïde, leg. Figari III-IV 1867 FI. Abu el Numrus, leg. Simpson *90* 2 XII 1921 K.
ETIOPIA
(Abissinia) S.d. FI.
CANARIAS
S.d., Ex herb. Desfontaines FI.
Océania
NUEVA ZELANDIA
North Island, Wellington, leg. Travers IX 1908 G.

1a. *O. fontana* Bunge var. *Bushii* (Small) Hara (1)

Hara, J. Jap. Bot. *24*: 106. 1949.
O. Bushii Small, Bull. Torr. Bot. Club *25*: 611.1898. Knuth, *l.c.* 145.
O. interior (Small) Just, Bot. Jahrbber. *32*(1): 410.1905Knuth, Not. Bot. Gart. Berlin *7*: 300.1919; *l.c.* 153.
O. europaea Jord. v. *Bushii* (Small) Wiegand, *l.c.* 135. Fernald, Man. 945 1950. Young, l.c. 59. 1958.
O. europaea Jord. v. Bushii (Small) Wieg. f. *subglabrata* Wiegand; f. *vestita* Wiegand, *l.c.* 136. Fernald, *l.c.* 945-6. Rogers, Gray Bull, n.s. *2*(3) : 268,270.1953. Conard & Hubard, *l.c.* 180,181. Knuth, *l.c.* 435, 437.Tipos Iowa, Pammel & Ball *4* , GH; Massachussetts, Anderson GH, respect.
O. europaea Jord. v. *Bushii* (Small) Wieg. f. *lanulosa* Benke, Rhodora *31*: 149. 1929 Tipo: Illinois, Benke *4877*, F.
O. stricta L. v. *Bushii* (Small) Farwell, *l.c.* 183.1918. Knuth, *l.c.* 434.
Xanthoxalis Bushii Small, *l.c.* 668. 1903; *l.c.* 51. 1907.
X. interior Small, *l.c.* 668. 1903; *l.c.* 53. 1907 Tipo: Arkansas, Plank, NY.
O. fontana Bunge v.*Bushii* (Small) Hara f. *subglabra* (Wieg.) Hara; f. *vestita* (Wieg.) Hara *l.c.*
O. stricta L. v. *Bushii* (Small) Farwell,*l.c.* 1918.
Xanthoxalis europaea (jord.) Moldenke v. *Bushii* (Small) Moldenke,Castanea *7*: 125.1943; f. subglabrata (Wieg.) Mold.; f. vestita (Wieg.) Moldenke,*l.c.*
TIPO. Estados Unidos. Missouri, Jackson County, dry ground, leg. Bush *30* 28 V 1893 NY. Isótipos GH, NY.

Difiere de la variedad típica por el haz foliolar pubescente.

Distribución geográfica.Centro y Este de los Estados Unidos, China y Japón, rarísima en Europa.

Material estudiado. CANADA. Charlotte Co., Grand Manan, Whale Cove, leg. C.A. and U.F. Weatherby *7236* 29 VI 1944 GH,US.
ESTADOS UNIDOS
Alabama. Clay Co., Idaho, leg. Mohr 6 VIII 1896 US.
Arkansas. Benton Co., leg. Plank s. 1899 NY. Lectotipo *O. interior*. Isótipo NY. Pulaski Co., Pulaski Heights, Little Rock, leg. Demaree *8476* GH NY. Lawrence Co., Strawberry, 400 ft., leg. Demaree *26179* 12 VII 1947 NY, USF.

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(1) Dedicada a Benjamin Franklin Bush (1858 - 1937) botánico estado-unidense quien recogió el tipo.

Delaware. Nombay Hook, leg. Commons 10 VI 1880 PH. Georgia. Stone Mountain, 1600 ft., leg. Small VIII 1896 NY. Illinois. Johnson Co., Bloomfield, leg. Benke 4877 22 IX 1928 Tipo O. europaea v. Bushii f. lanulosa Benke F. Isótipos GH,US. Pike Co., Illinois River bluffs, leg. Pohl 1879 26 V 1940 PENN.Peoria Co., Peoria, leg. McDonald VI 1912UC.Indiana. Greene Co., S of Linton, leg. Friesner 22233 3 VII 1948 GH,NY,UC. Crown Point, leg. Baehni 149 22 IX 1934 G. Iowa.Ames, leg. Pammel and Ball 4 25 VII 1896 Tipo O.europaea v.Bushii f. subglabrata Wieg. GH. Isótipos F, US. Cherokee Co., Little Sioux Riv., leg. Hayden 7056 5 IX 1937 GH,NY. Kansas. Jefferson Co., N of Oskaloosa, leg. Horr 4220 3 IX 1952 GH,NY,US. Kentucky. Ouest des Alléganys, leg. Michaux P p.p. Marshall Co., Calvert City, leg. Eggleston 4845 16-19 VI 1909 NY. Maine. Portland, leg. Wall 26 V 1931 S. Maryland. Talbot Co., Near Easton, leg. Earle 2303 3 IX 1939 PENN.Michigan.Menominee Co., Sugar Beet Isl., leg.Grassl 2549 25 VII 1933 MICH, NY. Pike Co., Florence, leg. Pohl 1879 26 V 1940 PENN. Massachussetts. Waverly, leg. Robinson et al. 26 V 1895 GH. Cambridge, leg. I.W.Anderson 7 VII 1904 Tipo O. europaea v.Bushii f. vestita Wieg. GH. Minnesota. Vic. Minneapolis, Copsis, leg. Small V 1894 NY. Missouri. St. Louis, leg. Riehl 285 VIII 1841 EI,K,NY,P. Jackson Co.,leg. Bush 30 28 V 1893 Tipo O. Bushii NY. Isótipos GH, NY. Livingston Co., Clear Creek, WNW of Blue Mound, leg. Steyermark 73409 11 VI 1952 F. New Jersey. Delair,Pochack Creek, leg. Bayard Long 6309 26 VII 1911 PENN. Hunterdon Co., SW of Linvale, leg. Benner 7190 13 VI 1936 PENN. New York. New York, leg. Jacquemont a. 1827 P,p.p. Long Island, S St. Alban, leg. Bicknell 5406 24 VI 1905 NY. Ohio. Steubenville, leg. Jewet 15 VI 1836 P. Johnson's Island, leg. Moseley 28 VI 1894 F. Pennsylvania. Philadelphia, leg. Williamson VIII 1903 NY. Berks Co., Jacksonwald, leg. Brumbach 454 17 VII 1932 PH . Tennessee. Nashville, leg. Bicknell VI 1894 NY. Virginia. Nasemond Co., Adams Swamp, S Baines Hill School, leg. Fernald and Bayard Long 13061 20 VI 1941 GH. Fairfax Co., S of Alexandria,leg. Erlanson 284 1 VIII 1935 NA .Wisconsin. La Crosse Co., Bohemian Valley, leg. Hartley 825 24 VI 1956 US. Sauk Co., Sandstone Bluff, leg. Fassett 14453 28 VII 1932 GH.

Europa.

SUECIA.

Rydboholm, Kinnarumma, leg. Westfeldt 28 VI 1919 S.

INGLATERRA

Cornwall, Cult. near Penzance, leg. Lomax 244 VIII 1872 K. Ib.,leg. Gwatin 506 p.p. VIII 1857 OXF. Cornwall, Lands End, leg. ?Hooker K. Penzance, leg. Penneck IX 1838 K.

Asia.

CHINA. Nanking, Mo Kan Shan, leg.Cheo & Wilson 12652 19 VI 1926 GH. Cha-Tung, Che-Foo, leg. Fauvel P. Ib., leg. Cowdry 743 VI 1920 K. Schen-si, septentr. Ngo-san, leg.Giraldi 4464 VIII 1899 FI. Ib., leg. ipse 4465 IX 1899 FI. Monte Lun-san-huo, leg. ipse 4458 23 V 1892 FI. Ib., leg. ipse 4461 VI 1895 FI. Lu-tun, leg. ipse 4462 20 VII 1891 FI. Pei-su-sel-ti, leg. ipse 1651 VI 1896 FI. Ta-lien-Twan Yellow Sea, leg. Birmie a. 1861 K. Manchuria. Liao-tung, near Dalny, leg. Litvinov 1451 15 VII 1902 NY.

2.Oxalis grandis Small (1)

Fig. 1 A

Small, Bull. Torrey Bot. Club 21: 474.1894. Knuth, Pflreich. 157-158.

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(1) Así llamada por el tamaño mayor de todos sus órganos.

435,7. **Britton** & Brown, Ill. Fl. N. US & Canada 2: 347, f. 2257.1897. Fernald, Man. 944,946.1950. Eiten, Am. Midl. Nat. 69: 296. 305-6.1963. Gleason, Ill. Fl. 2: 456, fig. 1958. Robertson, J. Arn. Arb. 56: 231, f. 1,o-q.1975.

O. recurva Trelease, Mem. Boston Soc. Nat. Hist. 4: 89. 1888 not Elliot 1821!

Xanthoxalis grandis (Small) Small, Fl. SE. U.S. 668. 1903. N. Amer. Fl. 25: 55. 1907.

TIPO. Estados Unidos, Pennsylvania, Wysox, leg. Carey VII 1836 NY. Isótipo GH.

Herbácea, erguida (h. 50 cm). Raíces fibrosas, ramificadas. Tallos con pocos pelos esparcidos, cortos, curvos, mazclados con abundantes pelos 3-7-celulares, purpúreos, ± largos. Internodios casi nulos o h. 7 cm. Hojas pseudoverticiladas hacia el ápice. Estípulas reducidas, completa-

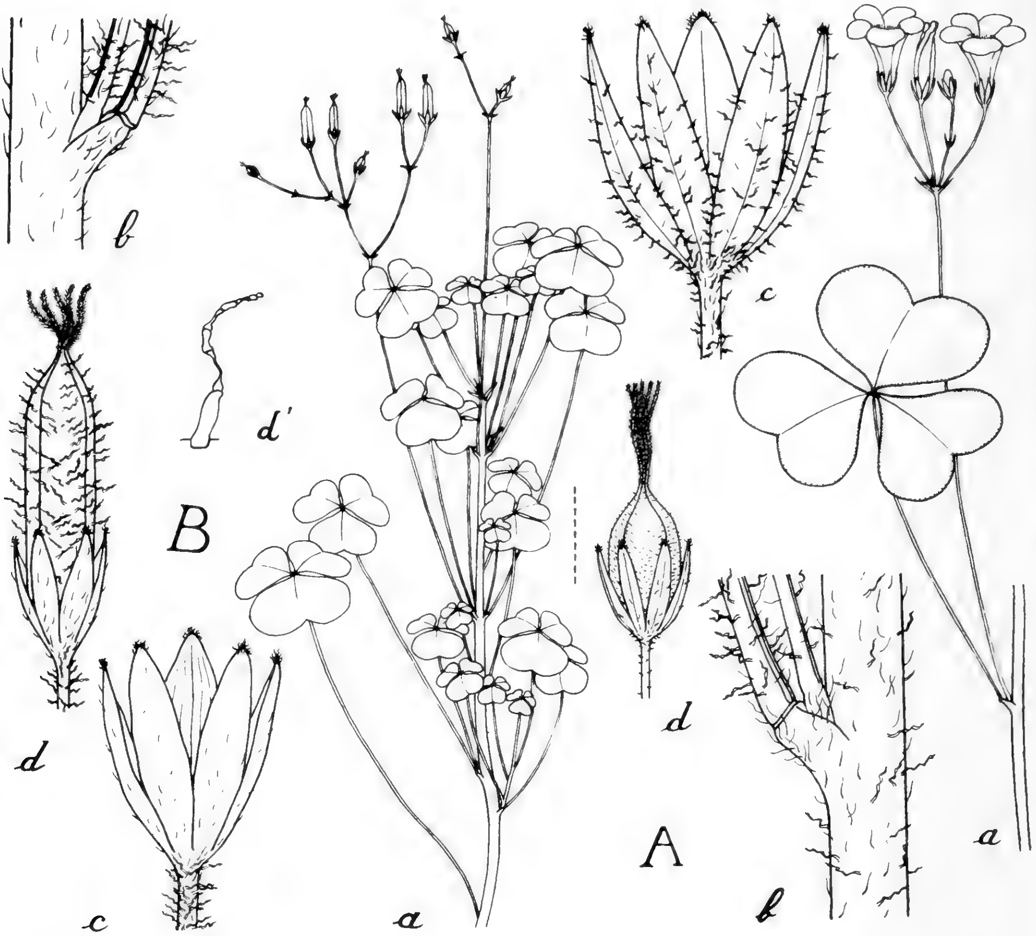

Fig.1.A, *O. grandis*: a, parte de planta x $\frac{1}{2}$; b, inserción peciolar x 4; c, cáliz x 5; d, fruto x 2.a-c Biltmore 1225 US, d,Eggleston 16661 US. B, *O. fontana*: a, planta x $\frac{1}{2}$; b, inserción peciolar x 4; b'pelo x 20,c, cáliz x 6;d, fruto x 3.a-c Hall,a.1866 P,d,d' Riga a. 1871 P.Guerber del.

mente soldadas (0,5-1 mm). Pecíolos 1½-2½ veces el diámetro de las hojas, pelos hirsutos y pluricelulares. Peciolillos 0,5-1 mm) carnosos, pilosos. Folíolos anchamente obovado-cuneados, borde pardo-violáceos (a menudo visibles en los especímenes de herbario), incisos 1/12-1/7, lóbulos redondeados, base 5-nervada, pocos pelos esparcidos sobre las nervaduras y en el envés, raro en el haz, borde ciliado (15-35 x 18-45 mm). Cimas largas sobrepasando el follaje, 2-fidas, 3-7-floras, compuestas, a veces asimétricas. Pedúnculo (8-15 cm) pubescencia semejante a la de los pecíolos pero más corta. Pedicelo(12-15 mm) articulado en la base o h. 5 mm, pubescencia adpresa ± densa y pelos pluricelulares cortos. Brácteas (3,5 - 4,5 mm) y bractéolas (1,5-2,5 mm) lineares, pilosas y glandulosas.

Sépalos elípticos (3,5-6,5 x 1- 2,5 mm) subagudos o obtusos, pocos pelos cortos y glandulosos esparcidos en la base y los bordes, ápices densamente ciliados. Pétalos amarillos con estrías violáceas en la mitad inferior, obovado-espatulados (12-16 mm), irregularmente crenados. Estambres largos (5-6 mm) densamente pilosos; los cortos (3-4 mm) glabros, soldados h. ½ . Pistilos (macro-, meso y microstíleos) 7,5-9 mm, estilos densamente hirsuto-pilosos, estigmas pequeños, papilosos.

Cápsulas cilíndrico-oblongas ± pelos glandulosos cortos, esparcidos; estilos persistentes, cáliz h. ca. 1/2; carpelos 3-5-seminados, interiormente pilosos.(El tamaño del fruto varía: ± 6 mm, carpelos 2-4-seminados, ± 10 mm, carpelos 5-seminados, según provengan de flores micro- o macrostíleas).

Semillas (1,5- 2 mm) pardas, elipsoideo-apiculadas, poco aplanadas, 8-9 costadas, estrías finas, transversales, uniformes 15-17.

Distribución geográfica. Centro y Este de los Estados Unidos.

Material estudiado. Amer. Sept., leg. Michaux P. Leg. Torrey, a. 1837 S. Alabama. Rocky Mountains, Sanel Mt., leg. Biltmore 1225c 6 VI 1901 US. Kalb Co., Mentone, leg. Morh 3 VI 1892 US. Jackson Co., Bryant, base of Porter's bluff, leg. Porter 9 VI 1939 GH. Ib., McGee Place, leg. ipse 5 VI 1934 GH. District of Columbia. Vic. Washington, leg. Kearney 22 VI 1897 NY,US. Great Falls, leg. Ward 3 VI 1877 US. Washington, leg. Brewer 22 VI 1860 MPU. Ib., Zoological Park, leg. Pollard 382 15 VI 1895 US. River Flat, leg. Steele 29 VI 1897 GH. Mercer Co., Burgin, leg. A.King 348 10 VI 1916 F. Illinois. Gordon Hills, near Mt. Carmel, leg. Schnek 7 VII 1888 GH. Indiana. Orange Co., ½ mi. W of Abby Dell, leg. Deam 25 V 1901 US. Hanover, leg. Coulter a. 1873 US. Martin Co., near Loogootee, leg. Palmer 39509 10 VI 1931 GH. Morgan Co., 3 mi. NE Hindoustan, leg. Deam 48360 22 V 1930 GH. Brown Co., 5 mi. NE of Nashville, leg. Friesner 16878 20 VI 1942 GH,UC. 2 mi. E Helmsburg, leg. Deam 48438 22 V 1930 PENN. Greencastle, leg. Ek 20 VI 1942 UC. Trevlac, leg. Friesner 14338 6 VIII 1940 NY. Ib., leg. Lewis & Brown 30 V 1905 et 30 V 1907 F. Jackson Co., Guthrie Creek, 1 mi. E Leesville, leg. Deam 48412 25 V 1930 GH. Dearbon Co., 3 mi. SE Dillsboro, leg. ipse 48493 29 V 1930 PENN. Lawrence Co., Spring Mill St. Park, leg. Een 24 VI 1950 D. Kentucky. Elk Lich Falls, leg. Farland 97 19 V 1923 S,US. Carter Co., W of Olive, leg. C.A. & U. Weatherby 6389 23 V 1933 GH,PENN,US. Olive Hill, leg. Braun 2446 20 V 1939 US. Near Irvine, leg. Biltmore 1225d 19 V 1903 US. Near Harlant Court House, leg. Kearney 11 VIII 1893 F,G,GH,NY,US. Mammoth Cave Nat. Park, Cedar Sink, leg. Lix 117 17 V 1947 US. Harlan Co., Big Black Mt., leg. Kearny 470 VIII 1893 NY,S. Salt Lick, leg. Biltmore 1225e 26 V 1909

US. Nelson Co., St. Thomas, leg. Agnes 1444 13 VI 1934 P. Mamoth Cave, Ex herb. Bureau P. Baltown, leg. Braun 2958 18 V 1941 US. Clinton Co., cliffs Cumberland Riv., leg. Jordal 3444 3 V 1950 MICH. Cymberland Falls leg. Braun 2592 6 IX 1939 US. Adams Co., Turkey Creek, leg. ipse 28 V 1927 US. Beaver Pond, leg. ipse 11 VI 1930 US. Hamilton Co., leg. ipse US. Ferris Woods, leg.ipse 12 VI 1909 US. College Hill, leg. ipse 16 V 1905 US. Red Bird Hollow, Terrace Park, leg.ipse 1 VI 1931 US. Fleming Co., leg. ipse 1865 7 V 1938 US. Harlan Co., Black Mt., 3900 ft., leg. ipse 266 VIII 1931 US. Big Black Mountain, leg.Kearney 280 VIII 1893 GH. Ib., leg. Camp 1516 17 VI 1936 NY. Martin Co., State Forest, leg. Tryon 3209 4 VII 1937 F. Crawfordsville, leg. Thomson 13 V 1896 F. Powell Co. SW Stauton, leg. Wharton 2223 17 V 1938 NY. Clark Co., Boone Creek, leg. Becket 496 17 VI 1955 GH. Jefferson Co., leg. Watson 135 VIII 1960 F. Kent, Lexington, leg. Peter V 1833 K. Woodford Co., Brusley Run, leg. Wharton 8961 15 VI 1955 USF. Maryland. Washington Co., Hancock, leg. Shreve and Jones 744 13 VII 1906 US. Glen Echo, leg. House 821 25 V 1905 US. Jefferson Co., 5 mi. W Worhville, leg. Wahl 2743 24 VI 1947 GH. Greene Co., leg. Dickey 31 5 VI 1922 GH. Plummer´s Isl., leg. Steele 6679 22 VI 1897 G,GH. Ib., leg. Morris 92 3 VI 1899 F. Ib., leg. Pollard 6 VI 1897 NY. Montgomery Co., leg. Hunnewell 5222 12 V - 30 VI 1918 GH. New Orleans. Pr. New Orleans, leg. Frank a. 1837 G,K,OXF,P. North Carolina. Caldwells Co., E of Blowing Rock, 8500 ft., leg. Heller 1349 24 VI 1893 NY,US. Biltmore, leg. Biltmore 1225a 2 VI 1897 BM,GH,L,LY,NY,PENN,UC,US. Eagles Nest, near Waynesville, 900-1500 m, leg. Standley 5653 8 IX 1910 US. Ravine riv. at near Plowing Rock, leg. Small 24 VI 1891 US. Ashe Co. near New Riv., at Fleetwood, leg.Radford 44885 7 VII 1966 BM,US,S. Polk Co., Lynn, leg. Churchill 20 V 1899 US,GH. Haywood Co., Sunburst, 3000 ft., leg. House 4610 6 VI 1911 US.Fines Creek, 7,5 mi. N Cove Creek, leg. Ahles & Duke 42226 5 VI 1958 GH. S of Marshall to Canto, leg. ipsi 42381 6 VI 1958 NY.Biltmore, banks of the Swannanoa riv., leg. Biltmore 11074a 21 VI 1904 P,S, US. Cherokee Reserve, Qualla, leg. Mooney a. 1888 US.Buncombe Co., N Black Mt., leg. Goodrich 31 V 1948 MICH. DcDowell Co., Little Swtizerland, leg. G. Miller 18 VI 1948 US. Haywood Co., Fines Creek, leg. Wilbur 7056 11 VI 1964 GH. Pigeon Riv.,2700 ft., leg. Wiegand 19 VI 1931 F,NY. Avery Co., Plumtree, leg. Hunnewell 14974 16 VI 1937 GH. Waynesville, Rocky Knob, leg. Magee 10 VI 1897 GH. Swain Co., Great Smocky Mts., 3800 ft., leg. Beardslee & Kofoid 5 VIII 1891 GH. Watanga Co., 5 mi. W of Blowing Rock, leg. Small and Heller 415 24 VI 1891 F,NY. Flat Rock, leg. Forster a. 1855 NY. Grahan Co., Ca. Graham-Swain Co.line,leg. Ahles & Radford 13192 29 V 1956 UC. Ohio. Cincinnati, leg. Morgan 31 V 1879 US. Near Cincinnati, leg. Lloyd 1 VI 1882 BP,US. Ohio, leg.Ridell a. 1838 US. Nead of Nixon Run, leg. Bartley 1262 12 V 1949 US. Columbus leg. Werner VI 1892 NY. Ib., leg. Kellerman VI 1896 NY. Hamilton Co., leg. Matthes 49 P. Oxford, Four Mile Creek, leg. Wehmayer & Waters 149 11 VII 1924 MICH. Coshocton Co., leg.Ganong 655 31 V 1903 GH. Scioto Co. Rocky Frok, near mouth of Big Run Otway, leg.Demaree 10691 6 VI 1934 GH Coshocton Co., Near Coshocton, leg. Moldenke 12856 18 VI 1942 PENN. Delaware Co., Welch´s Run, leg. Crane 2363 28 VI 1924 NY. Pike Co., leg. Crowl 28 VI 1938 NY. Byington, leg. Bartley and Pontius 190 14 VI 1936 NY. Preston Co., Muddy Creek, 1400 ft., leg. Core 6881 25 VI 1931 NY. Meigs Co., Lebanon Twp., leg. Jones 1 VI 1930 NY.Pennsylvania. Wysox, leg. Carey VII 1836 NY. Lectotipo NY. Isótipo GH. Great Falls of Potomac, leg. Williamson 29 V 1909 PENN.Allegheny Co., Hall, leg. Seal 10 VI 1891 F,GH,PENN. Wikinsburg, leg. Pearce 31 V 1890 BM. Pittsburg, leg. Britton 11 VII 1902 LY,NY. Fulton Co., Tonoloway Creek, 5,5 mi. S of Needmore, leg. Fogg 18561 8 IX 1940 PENN. Westmoreland Co., Trafford St., leg. Jennings 21 VI 1907 PENN. Westmoreland, leg. Pierron 15 VII 1878 LY. Franklin Co., Licking Creek, 2¼ mi. SW Sylivan,leg. Westerfiel 13153 7 VI 1955 PENN. Jefferson Co., 5 mi. W Worthville, leg. Wahl 2743 24 VII 1947 PENN,UC. Beaver Co., Patton's Point, Raccoon Creek, leg. Bright 5 VII 1924 PENN.Ib., leg. Bright 18642 6 VI 1942 UC. Bedford Co., 2¼ mi. WNW Clearville, leg. Berkheimer 7479 22 VI 1946 PENN. ENE Inglesmith, leg. ipse 8798 23 VI 1947 PENN. 2 mi. S Beans Cove Church, leg. ipse 9849 23 VII 1948 PENN. SSE Shelleburg, leg. ipse 11301 9 VI 1949 PENN. Butler Co., Buffalo Creek, near Monroe, leg. Bright 11443 26 VI 1938 PENN.Franklin Co., W branch Conococheague Creek, 1,5 mi. NNE Mercersburg, leg. Adams and Wherry 4709 14 V 1939 PENN. Fayette Co., Ohiopyle, leg. Brown 7690 3-8 VII 1905 PENN(grown in abnormal condition).Washington, leg. Breweer 22 VII 1860 F. Tennessee. Knowville, leg. Ruth 282 5 VI 1900 GH. Grundy Co., bel. Monteagle, 1300 ft., leg. Svenson 9914 12 V 1939 GH. Cheatam Co., Kingston Springs, leg. Palmer 35516 24 IV 1929 GH,NY. Montgomery Co., Yellow Creek, leg. Harger 7874 20 V 1934 GH. Nashville, leg. Gattinger p.p. NY. Jefferson Co., leg. Rugel 66a VI 1844 G,P. Virginia. Virginia, leg. Small 10 VI 1892 US. Ib., leg. Small & Heller a. 1891 US. Montgomery Co., Near East Radford, leg. Freeman 21 V 1938 NA. Wythe Co., Jackson's Ferry, leg. Hermann 10652 22 VI 1940 NA,NY. Fredrick Co., near Cedar Creek, leg. Hunnewell 11143 2 VI 1929 GH. Giles Co., New River Foodwin Ferry, leg. Fogg Jr. 17211 10 VII 1940 PENN.Near Glen Lyn, leg. Alexander 31 V 1938 NY. Smyth Co., Middle Fork Holston Riv. at Marion, 2100 ft., leg. Small 16 VI 1892 NY,UC. Vic. Marion, leg. Britton & Vail 6 VI 1892 G. Augusta Co., vic. of Fordwick and Craigsville, Allegheny Mts., 450 m, leg. Steele 26 22 VIII 1913 BM. West Virginia. Near Marion Middle Fork of Holston riv., 2100 ft., leg. Small 6 VI 1892 F,NA,PENN, US. Along Madam Creek, opp. Hinton, leg. Morris 956 9 VII 1900 F,US. Cheat riv., leg. Donnell-Smith 7 VII 1879 US. Barbour Co., leg. Pollock 18 VI 1897 US.Wayne Co., Cabwaylingo St. Park, leg. Gilbert 761 29 V 1939 F,GH,NY,NY,PENN,US. Giles Co., Narrov, 470 m, leg. Eggleston 16661 24 VI 1920 US. Allegheny Plateau, S of Rowlesburg, 420 m, leg. Steele 81 1 IX 1926 US. Allex Mts., Browns Ridge, 540 m, leg. ipse 26 22 VIII 1913 US. Fairfax Co., Langley, leg. Palmer 18 V 1902 US. Roanoke, leg. Brown et al. 29 V 1890 NY,US. Eggleston Spring, leg. ipsi 3 VI 1890 NY. North Fork of Holston riv., Beaver Creek, 2800 ft., leg. N.L. and E.G. Britton 21 VI 1892 NY. Vic. Marion, 2100 ft., leg. ipsi 6 VI 1892 GH,NY Mineral Co., 2 mi. SE of Fort Ashby, leg. Wilkens 5568 7 VII 1938 NA. Vic. Fordwick and Craigsville, Allegheny Mts., 540 m, leg. Steele 26 22 VIII 1913 US.Wirt Co., Reedy Creek, leg. Bartholomew 413 28 V 1944 GH, NY. Manitowoc Co., Mishicot, leg. Benke 6079 2 X 1939 F. St. Croix Falls leg. Schuette 11 VII 1888 F. Madison, Univ. Bay, leg. Heddle 9 VII 1909 F. Grant Co., Mt. Storm, leg. Core 31 VII 1931 NY. Preston Co., Three Forks Creek, leg. Davis 324 12 VI 1942 GH,PENN,UC. Muddy Creek, leg. Core 25 VI 1931 S. Hardy Co., Lost Riv.,leg. Hunnewell 19854 VI... GH.Raleigh Co., New Riv., at Terry, leg. Tosh 166 31 V 1941 UC. Greenbrier

Co., Shael White Sulphur Springs, leg. Hunnewell *19353* 5 VII 1933 GH. Ib. leg. Mackenzie *506* 7 IX 1903 NY. Smyth Co., S slope of White Rock Mt., 3500-4000 ft., leg. Small 21 VI 1892 F.S of Roanoke, leg. Small and Heller 414 2 VII 1891 F,NY,PENN. S of Union, leg. Alexander et al. 28 VIII 1933 NY. Tyler Co., Raven's Rock, leg. Moldenke *6754* 20 VI 1929 NY. Wetzal Co., Fish Creek, near Littleton, leg. Core *2629* 2 VI 1931 NY. Mineral Co., SE Fort Asby, leg. Wilkens *5568* 7 VII 1938 PENN. Wheeling Oglebay Park, leg. W.V. Univ. Bot. Exp. 11 VI 1929 S.

3. *Oxalis macrantha* (Trel.) Small (1)

Fig. 2 A

Small, Bull. Torrey Bot. Club *23*: 268-9. 1896. Knuth, *l.c.* 153. 1930.
O. cespitosa Rafinesque, New Fl. N. Amer. *2*: 27. 1836 non *O. caespitosa* St. Hil. 1825! Tipo: Kentucky, Rafinesque, P.
O. hirsuticaulis Small, *l.c.* *25*: 611. 1898. Tipo: Tennessee, Gattinger GH.
O. Priceae Small, *l.c.* 612. Knuth, *l.c.* 155. Eiten, Amer. Midl. Nat. *69*: 302. 1963. Tipo: Kentucky, Price, NY.
O. corniculata L. v.? *macrantha* Trelease, Mem. Boston Soc. N.H. *4*: 87,88 1888.
O. recurva Elliott v. *macrantha* (Trel.) Wiegand, Rhodora *27*: 138. 1925. Knuth, *l.c.* 437. Fernald, Man. 946. 1950.
O. recurva Elliott v. *macrantha* (Trel.) Wieg. f. *sericea* Wiegand, *l.c.* Knuth, *l.c.* Tipo: Alabama, Gates GH.
Xanthoxalis Priceae (Small) Small, Fl. SE U.S. 669. 1903; N. Amer. Fl. *25*: 54. 1907.
X. hirsuticaulis (Small) Small, *l.c.*; *l.c.* 54-55.
X. macrantha (Trel.) Small, *l.c.* 667. 1903. *l.c.* 52-3. 1907.

LECTOTIPO: Estados Unidos, Alabama, leg. Hatch GH.

Herbácea. Pubescencia hirsutísima, pelos finos, largos (1-1,5 mm) en toda la planta. Rizoma horizontal, largo (más de 20 cm). Tallos erguidos (h. 30 cm) a veces ramificados desde la base. Estípulas completamente soldadas (1-1,5 mm) rectas o algo ensanchadas. Pecíolos ascendentes muy largos (h. 12 cm). Peciolillos ± 0,5 mm. Folíolos a veces ± purpúreos, anchamente obovado-cuneados (4-18 x 4,5-20 mm), incisos h. 1/7 - 1/5, lóbulos redondeados, los laterales algo menores, ± asimétricos, ciliados, pubescencia laxa, haz ± glabro. Cimas 2-4- (1-)floras, umbeliformes, mayores que el follaje. Pedúnculos ascendentes muy largos (h. 15 cm) y pedicelos (h. 3 cm) hirsuto-pilosos. Brácteas (3-4 mm) y bractéolas (1-2 mm) lineares, agudas, hirsuto-pilosas. Flores amarillo-claras con estrías rojizas en la fauce de la corola.

Sépalos elípticos o lineares, agudos (4,5-7,5 x 1-2 mm) a veces uno más ancho, oblongo, subagudo; pubescencia laxa, a veces casi glabros ápices a veces mucronados, ciliados. Pétalos 2½ - 3 veces el largo del cáliz (h. 22 mm), pocos pelos finos esparcidos exteriormente e interiormente en la fauce; bordes irregulares, subcrenados, pilosos. Estambres largos con algunos pelos (4,5-5,5 mm), los cortos glabros (3,5-4,5 mm), soldados h. ca. ¼ . Pistilos (micro- meso y macrostíleos) (8,5-9,5 mm), ovarios casi glabros o pilosos sobre el dorso de los carpelos; estilos

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(1) el epíteto recuerda el gran tamaño de las flores.

finísima y densamente hirsuto-pilosos; estigma bífido pequeño.

Cápsulas cilíndricas (12-20 mm) agudas, cáliz ca. ⅓, acompañadas de los estilos largos, casi glabras o con ± pelos sobre el dorso carpelar, a veces sobre toda la superficie pelos largos, muy finos, retrorsos que dan un aspecto tomentoso.

Semillas purpúreas, oscuras (± 1,5 mm) ovoideo-aplanadas, apiculadas 8-9-costadas, estrías horizontales muy finas (ca. 15).

Distribución geográfica. Endémica de lugares abiertos, rocosos y pendientes calcáreas de bosques del Este de los Estados Unidos.

Material estudiado.

Alabama. Leg. H. Gates (1) Tipo *O. recurva* v. *macrantha* f. *sericea* Wiegand GH. Alabama, leg. Hatch Tipo GH. Franklin Co., Newburg, leg. Churchill 734161 16 IV 1973 NA. Russellville, leg. Terrell & Barclay 3369 25 IV 1961 et 3381 26 IV 1961 US. Colbert Co., E Littleville, leg. Harper 4361 3 V 1956 GH. Hale Co., NW Rosemary, leg. ipse 3203 2 V 1934 GH,NY,US. SW Livingston, leg. Reed 1457 7 IV 1935 NA,US. Lee Co., Auburn, leg. Earle & Baker 414 p.p. 1897 F et 25 IV 1898 US. Ib., leg. Earle 11 IV 1896 US. Tuscaloosa Co., near Peterson, leg. Chercmock 43 23 III 1955 GH,NY,USF. Citronelle,Dry Pine woods, leg. Mohr 2 p.p. 3 IV 1896 NY. Mobile Co., Mt. Vernon, leg. ipse b IV 189? US. Pinebarrens, Springhill, leg. ipse 5 IV 1895 US. *Florida*. Ex herb. Chapman G. Near Mariana, leg. Small & Wherry 11691 et 11708 6 IV 1925 NY. SW Gainesville, leg. Cooley 1473 25 II 1952 USF. *Georgia*. Near Augusta, leg. Cuthbert V 1900 NY. Georgia, leg. Nuttall BM. Woods in Americus, leg. Huger IV 1897 NY. *Kentucky*. Warren Co. Bowling Green, leg. Price 6 XI 1898 Lectotype *O. Priceae* NY. Ib., leg. ipse V-VI 19... US et 16 X 1898 p.p. NY; 17 V 1899 GH,NY,US; 4 V 1899 GH; 20 V 1897 GH. Glades of West Kentucky and Tennessee, leg. Rafinesque V-VI 1823 Lectotipo *O. cespitosa* Raf. P. *Mississippi*. Forrest Co., W Perry Forest Co. line, St. Hattiesburg, leg. Ray 6067 14 IV 1952 GH,USF. Stone Co., De Sota Nat. Forest, leg. Cooley 3977 13 III 1955 USF. *North Carolina*. Stanly Co., Steep moist blank ab. Yadkin Riv. ab. E Badin, leg. Wilbur 6826 10 V 1963 NY. *Tennessee*. Wilson Co., Lebanon, leg. Braun 28 IV 1944 NA. Betw. Cedar Forest and Lebanon, leg. Wilson 317 7 V 1939 PENN. Cedars of Lebanon, St. Park, leg. Shanks 1572 18 V 1941 PENN. Rutherford Co., N Lavergne, leg. Channell 7256 19 V 1958 NY. Murfresboro, 600 ft., leg. Demaree 47561 10 V 1963 UC. S Murfreesboro, Cedar Glades, leg. Svenson 10257 18 V 1939 GH,NY,UC,US. Ib., Fosterville, leg. ipse 9468 5 V 1939 et 16 VI 1938 UC. SW Murfreesboro, leg. ipse 8999 27 VI 1938 UC. Cedar Glades, leg. Mortimer 213 11 V 1940 US. Nashville, leg. Gattinger Tipo *O. hirsuticaulis* Small NY. Isótipo PENN. Bedford Co., Duck Riv., leg. Sudworth 22 V 1897 US.

OBS. A pesar de los comentarios publicados sobre la identidad de esta especie (Wiegand, Eiten) considero que Trelease tenía una idea clara de lo que representaba su variedad (en tanto que planta) dado que hallé 3 especímenes en el herbario Gray y uno en el Museo Británico que son esta especie y están determinados por Trelease. Uno de ellos ha sido seleccionado como tipo en este trabajo.

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(1) Según las investigaciones históricas de Joseph EWAN, Tulane University, ese especimen habría sido recogido por el Hezakiah Gates (1850?) en Alabama. (Comunicación personal).

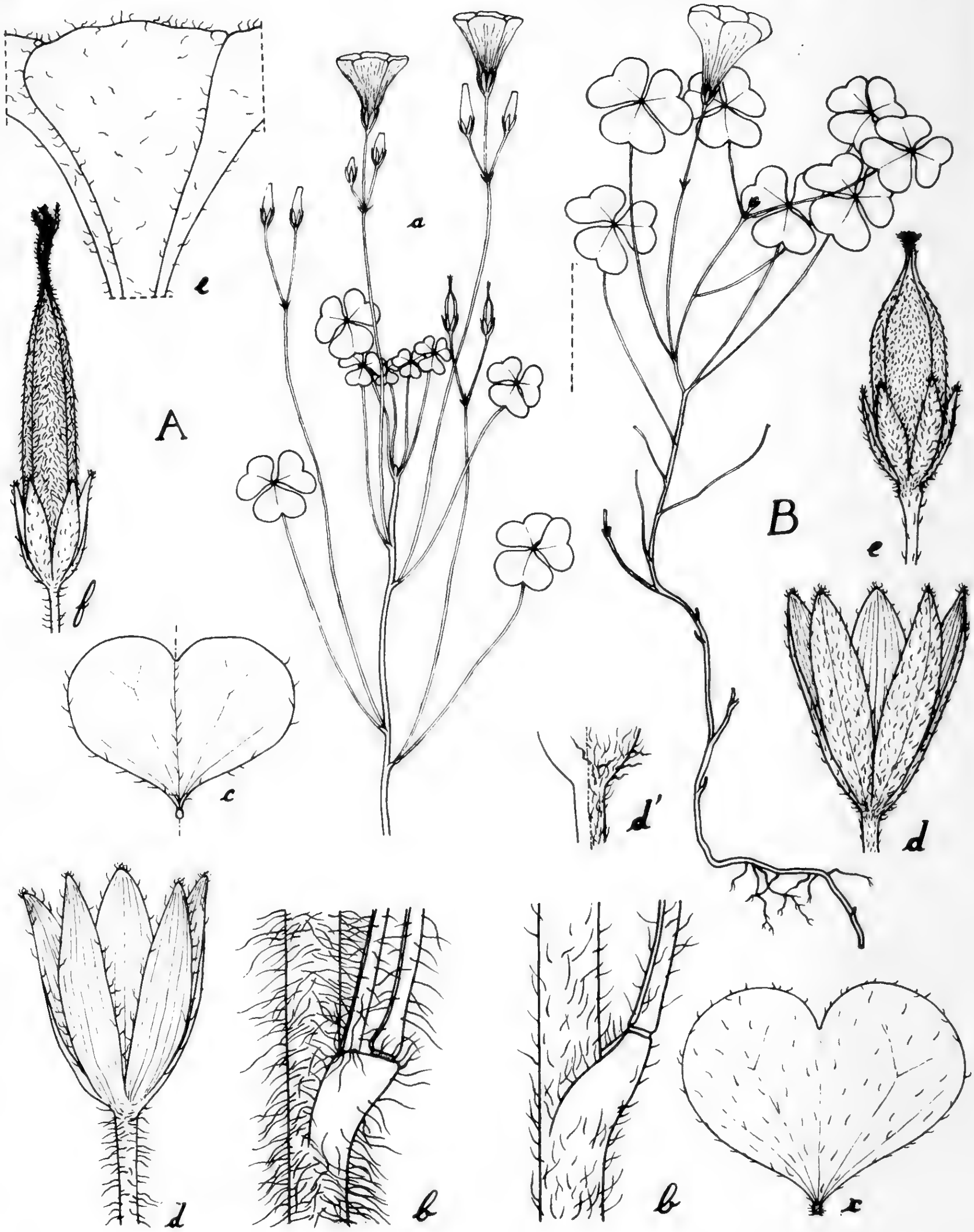

Fig. 2. A, O. macrantha: 2, rama x ½; b, inserción peciolar x 6; c, folíolo x 2; d, cáliz x 4; e, pétalos x 2; f, fruto x 4, a–e, Terrell & Baclay 3381 US, f, Svenson 10257 GH,US. B, O. Suksdorfii: parte de planta x ½; b, inserción peciolar x 6; c, folíolo x 2; d, cáliz x 4; d'base del cáliz x 8; e, fruto x 2, a–d, Constance & Rollins 2961 GH, e, Tracy 15479 US. Guerber del.

4. *Oxalis Suksdorfii* Trelease(1)

Fig. 2 B

Trelease, Mem. Boston Soc. Nat. Hist. 4: 87,89.1888 Small, Bull. Torrey Bot. Club 23: 456. 1896 et Contr. Bot. Dep. Columbia Univ. 107:456.1896. Wiegand, l.c. 137.Knuth, l.c. 154. Eiten,l.c. 305. Munz & Keck, Calif.Fl. 148. 1959.

O. pumila Nuttall in Torrey and Gray,Fl. N. Amer. 1: 212. 1838.Piper,Fl. Washington 330. 1906 non *O. pumila* D'Urville 1829 nec Philippi 1893!Tipo: Oregon, Nuttall NY.

Xanthoxalis Suksdorfii (Trel.) Small, North Am. Fl. 25(1): 53.1907.

TIPO: Estados Unidos, Oregon, in woods near Portland, leg. Suksdorff 1 VI 1882 MO. Isótipo GH.

Rizomas largos (más de 50 cm) a veces ramificados profusamente, radicantes, Ráices muy finas ramificadas. Tallos erguidos o decumbentes (h.40 cm) generalmente ramificados, pelos hirsutos desiguales,± esparcidosmezclados con pocso pelos pluricelulares más abundantes en la base de los pecíolos. Internodios h. 7 cm y muy reducidos en los pseduoverticilos foliares. Estípulas soldadas (± 1 mm), inconspicuas, pilosas.Pecíolos erguidos (1-9 cm), pilosos. Lámina verde-brillante, membranácea (4,5-22 x 6-30 mm)anchamente obovada a transoblonga, incisa h. 1/4-1/5, lóbulos anchos redondeados, base cuneada; pubescencia esparcida sobre ambas faces o haz glabro, ciliados. Cimas 1-2- (3-)floras, menores o poco mayores que el follaje, acrescidas en la fructificación. Brácteas (1-4 mm) y bractéolas (1-2 mm) lineares, agudas, pubescencia simple y pelos pluricelulares. Pedúnculos (2 - 8 cm) adpreso o subhirsuto-pubescentes, a veces con pelos pluricelulares. Pedicelos (0,8-2,5 cm) adpreso-pubescentes, reflexos en el fruto.

Sépalos lineares u oblongo-lineares (3-6,5 x 0,7-2 mm),verdosos, adpreso-pubescentes, pelos pluricelulares en la base, ápice ciliado. Pétalos amarillo-brillantes 2½ - 3½ veces el largo del cáliz, obovado-oblongos, cuneados, estrías rojizas en la fauce. Estambres largos 4-7 mm los cortos (3-5 mm) soldados h. ½, filamentos pilosos. Pistilos (micro- macro y mesostíleos) 8 - 8½ mm; estilos con pelos ascendentes subhirsutos; estigmas bífidos con papilas largas.

Cápsula oblongo-cónica (10-14 mm) cáliz ⅓ - ½, pubescencia cortísidensa, subretrorsa (raros pelos pluricelulares mezclados), estilos largos o cortos según el tipo de flor del cual proceden. Carpelos interiormente pilosos, 2-5-seminados, raro 1-seminados.

Semillas negro-purpúreas (± 2 mm), ovoideo-aplanadas, apiculadas,9-costadas, sólo las de los "bordes" visibles, 12-14 estrías horizontales.

Distribución geográfica. Endémica del Norte de la región Pacífica de los Estados Unidos; vive en bosques.

Material estudiado.

Washington. Sparm, leg. Grant a. 1915 K. Vancouver, leg. Piper 4939 8 VI 1904 GH,US. Oregon. Leg. Nuttall Tipo *O. pumila* NY. Isótipos GH,K,P,PH. Leg. Howell VI 1877 K. Leg. Kellog & Harford 119a 1868-9 US. Leg. Revius o Nevius? a. 1882 US. Columbia and Northern Mountains, leg. Nuttall (sub *O. pumila*) BM.Coast Range & Willamette Vall., leg. Moseley VII 1877 K. Gold Beach, leg. Peck 8673 7 VII 1919 GH,NY. Confluence of the Columbia,

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(1) Dedicada a Wilhelm Nikolaus SUKSDORF (1850-1933) botánico estadounidense quien recogió la especie abundantemente.

leg. Douglas a. 1825 BM, GH. ? Farmington, leg. Kirwood 1818 VII-VIII 1901 NY. Berton Co. E of Alsea Mt., leg. Powell 27 V 1939 UC. Clackamas Co., Elk Rock, near Oswego, leg. Heller 10061 20 V 1910 F,G,US. Near Oregon City, leg. Thompson 885 5 VI 1926 K. Coos Co., leg. Carpenter 69 1882 US. Head of Coos River, leg. House 4807 3 IX 1911 US. Near Slough Bridge,leg. Haydon 72 25 VI 1911 F. Curry Co., Chetco Riv. vall., ab. 300 ft., leg. Tracy 5897 9 VIII 1921 UC. Douglas Co. Cow Creek at Nichols St., leg.Ward 98 16 IX 1899 NY,US. ½ mi. SSW Glide, leg. Earle 4458 12 VII 1950 PENN. Little Riv., ab. Bridge at Glide, leg. ipse 4676 25 VII 1950 PENN. Umpqua Riv., 2 mi. W Glide, leg. ipse 4693 26 VII 1950 PENN. Umpqua Riv., 10-12 mi. of Peel, 1300 ft., leg. Applegate 2710 14 VII 1898 US. Humboldt Co. Redwood Creek at Berry's, 1500 ft., leg. Tracy 8796 22 VI 1930 UC. Ib., leg. ipse 4375 20 VII 1913 UC. Josephine Co. Lower Grave Creek, 6 mi.W Leland, leg. Constance & Rollins 2961 17 V 1942 GH,K,NA,NY,UC,US. Lane Co. Eugene, along Wilamette Riv., leg. Constance 22 V 1924 UC. Siuslaw River, near Linslaw, 300 ft., leg. Detling 20 V 1938 UC. Near Swiss Home, leg. Eastwood & Howell 1556 15 IV 1934 F,NY. Open hills, leg. Patterson UC.Marion Co. Leg. H.G.Nelson a. 186? NY. Salem, leg. J.C.Nelson 1163 20 V 1917 GH. Multuomah Co. Albina, leg. Suksdorff 6 VIII 1902 LY. Near Albina leg. ipse 961 6 VIII 1890 F,G,LY,NY,P,UC,US. Ib., leg. Dickson & Drake 20 V 1889 NY. Portland, leg. Henderson VI 1896 F,NY. Ib., leg. Thompson 253 19 VI 1925 K. Ib., leg. Lunell 20 VI 1903 US,W. Ib., leg. Sheldon 9333 6 VII 1902 UC. Ib., Connell Rd., leg. ipse 10334 6 VII 1902 F,GH,NY,US.Near Portland, leg. Suksdorff 1 VI 1882 Tipo MO. Isótipo GH. Ib., leg. ipse 19 VI 1905 S. Ib., leg. ipse 676 2 VI 1906 L,UPS. Ib., leg. ipse 2 VI 1906 L. Ib., leg. Lyon 17 7 V 1905 US. Ib., leg. Palmer 1453 10 V 1902 US. Ib., leg. Howell 1494 15 VI 1891 K,NY,UC,US. Ib., hillsides, leg. Henderson 162 20 V 1887 F,US. Portland, Reed College, leg. French 2205C 19 X 1963 UC. Portland Zoo, leg. ipse 2206B 5 X 1963 UC. South Portland, Sharapta, leg. Thompson 5173 11 VII 1929 K. Silver Creek, leg. Hall 75 1871 BM,F,GH,NY. Marshfield, leg. Hayden VI 1911 NY. Portland, Council Crest, leg. Collins 29 V 1918 GH. Ib., leg. Drake & Dickson 20 V 1887 F. Dalles, leg. Edwards VII 1873 NY. Portland, leg. Savage et al. VIII 1898 F. Washington Co. Forest Grove, leg. Lloyd 9 VII 1894 NY. Hillsbors, leg. ipse 12 V 1894 NY. Near Tonquin, leg. Thompson 2402 10 V 1927 K. *California*. Leg. Kellog & Hartford 119b 1868-9 BM,US. Leg. Fitch NY. Leg. Parry (Mex. Boundary Exp.) Canyon Hollywood, leg. Wÿtman-Steelink V 1952 L. Sauvié's Island, leg.Howell VI 1875 F. Inolume Co., Lake Eleanor, leg. Brandegee 8 VII 1888 UC. Del Norte Co. Smith Riv. ab. Crescent City, leg. Applegate 4727 19 VI 1926 F. Gasquet Golf Links, leg. Brown 108 18 IV 1934 US. Requa, leg.Day & Blasdale 5903B V-VIII 1809 UC. Crescent City, leg. Parks 8363 20 VI 1925 UC. E Crescent City, Elk Vall., 50 ft., leg. Tracy 15479 22 VII 1937 BM,GH,NY,UC,US.

5. *Oxalis californica* (Abrams) Knuth(1)

Fig. 3 B

Knuth, Not. Bot. Gart. Berlin 7: 300.1919; *l.c.* 156,434,436.1930. Wiegand *l.c.* 116,118-9. Munz & Keck, Calif. Fl. 148.1959. Suppl. 13.1968.
Xanthoxalis californica Abrams, Bull. Torrey Bot. Club 34: 264.1907.Small, N. Am. Fl. 25(1): 54.1907.
O. albicans H.B.K. ssp. *californica* (Abrams) Eiten,*l.c.* 303.

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(1) el epíteto recuerda la región en donde vive la especie.

TIPO. California, San Diego Co., Onofre Mountains, leg. Leroy Abrams 3274 19 IV 1903 DS.

Herbácea (h. 40 cm). Pubescencia finísima, corta, curva, subadpresa, esparcida, raras veces densa y más raro plantas casi glabras. Raíz lignificada, larga, tortuosa, gruesa (± 1 cm diám) ramificada. Tallos sublenosos en la base, profusamente ramificados, decumbentes, luego erguidos, verdes o rojizos, pubescencia esparcida, ascendente. Hojas subopuestas. Estípulas completamente soldadas, inconspicuas, bordes ciliados. Pecíolos ascendentes largos (h. 9,5 cm) finísimos. Peciolillos gruesos, purpúreos, pilosos. Folíolos membranosos, verde-claros, anchamente obovado-subcuneados (4-14 x 5-18 mm) incisos h. 1/5-1/4, lóbulos redondeados, pubescencia esparcida sobre ambas faces, bordes finamente subadpreso-ciliados. Cimas 2-(1-)floras, pubescentes, entre el follaje, largamente pedunculadas (h. 8,5 cm). Pedicelos ± 3 cm. Brácteas (h. 5 x $\frac{1}{3}$ mm) y bractéolas (menores) lineares, pubescentes.

Sépalos verde-purpúreos, marginados, desiguales, elípticos a ovado-elípticos y linear-oblongos, pubescentes, ápice desamente ciliado (3-7x $\frac{1}{4}$- 2 mm), agudos, obtusos, raro retusos. Pétalos amarillo-anaranjado o rosados o estríados de rojo, 2 - $2\frac{1}{2}$ veces el largo del cáliz, anchamente obovados, pelos cortísimos en el borde, algunos en el exterior, subretusos o borde irregularmente ondulado. Estambres largos (± 5,5 mm), cortos (± 4,25 mm) soldados h. 2/3, glabros. Pistilos (macrostíleos) ± 6,5 mm; estigmas bífidos, subcapitados, papilosos, estilos adpreso-pubescentes.

Cápsula cilíndrica, gruesa, aguda (h. 17 mm), cáliz ± $\frac{1}{3}$; estilos erguidos o cruvos (2-3 mm); pubescencia cortísima apenas retrorsa y pelos pluricelulares muy cortos mezclados. Pedicelos erguidos o subhorizontales, mayores que la cápsula, a madurez. Carpelos 6-10-seminados, interiormente transverso-pilosos. Semillas pardas (± 1,5 mm), ovoideo-aplanadas, apiculadas, 8-9-costadas, estrías horizontales ± 12 notables.

Distribución geográfica. Endémica del Sur de California y Baja California (México), en las montañas. Un sólo especimen hallado en el SW de Arizona.

Material estudiado.

California. San Diego Co. Onofre Mts., leg. Leroy Abrams 3274 19 IV 1903 Tipo DS. Isótipos BM,F,GH,NY,P,UC,US. Forsters, leg. Brandegee III 1906 NY. San Diego, leg. Cummings 8 IV 1896 UC. Ib., leg. Fernald 8 IV 1896 GH. Oceanside, San Luis Rey River, leg. Glowenke 4645 3 IV 1945 PENN. W Jamul, leg. Wiggins 1903 7 III 1926 UC. Ib., leg. Wiegand & Upton 3705 30 III 1922 F. Escondido, leg. Meyer 107 IV 1927 UC. San Diego, leg. Hall 3930 IV 1903 F,NY,P,UC,US. Oceanside, leg. Parish 4442 11-16 VI 1897 BM, F,GH,NY,US. San Diego, leg. Orcutt 15 V 1885 BM. Ib., Chollas, leg. ipse 4 IV 1884 F. San Diego, Los Paredes Ranch, leg. Deane 26 II 1888 GH. La Jolla, leg. Parks 336 25 I 1920 UC. San Diego, leg. Spencer 24 II 1915 UC. Orange Co. Mt. Santiago, leg. Leroy Abrams 1806 VI 1901 NY. Silverado Canyon at Mouth of Ray Canyon, leg. Fosberg 1582 27 III 1930 NA,PENN. Sta. Ana Mts., Santiago Canyon, leg. ipse 2872 15 VI 1930 PENN. Ib., Silverado Canyon, leg. ipse 5091 21 VI 1931 PENN,S. Ib., leg. ipse 5097 21 VI 1931 GH,NY. Sta. Ana Cañón, Cleveland Forest, 500 ft., leg. Lewis II 1934 NA ,UC. S Laguna, leg. Mason 2927 25 IV 1926 GH,UC. Los Angeles Co. Elysian Hills, leg. Braunton 168 30 III 1907 US. N Pomona, leg. ipse 468 IV 1902 UC,US. San Rafael Hills, leg. Crandall 29 III 1902 LY.

Los Angeles, leg. Gambee GH,Near Los Angeles, Hollywood, leg. Greene 31 III 1905 Los Angeles, leg. Hasse 18 III 1892 GH. Ib., leg. Barber 67 16 III 1897 UC. Sta. Monica, leg. Hasse 5678 V-VI 1892 NY. Dimas Canyon, 1400 ft., leg. Horton 586 4 IV 1941 NA.Rock Spring Canyon, leg. L.W.Nuttall 127 6 V 1920 F. Ca. Azuca, leg. H.H.Smith 4937 3 V 1912 P. Los Angeles Golf Links, leg. Nuttall 745 23 V 1920 F. San Gabriel Wash near Azusa, leg. Grinnell 29 III 1906 NY,US. Near Los Angeles, Laurel Cañón, leg. Piper 6354 16 V 1904 GH,US. San Gabriel, leg. Braunton 164 II 1861 UC,US. Cahuenga Pass, leg. Brewer 179 UC,US.Los Felis Rd., leg. Farr 20 III 1911 PENN.W Pomona, leg. Jones 16 III 1926 GH. Fall Brook leg. ipse 2652 24 III 1882 BM,NY,P,UC. San Gabriel, leg. Brewer 164GH.Santa Catalina Island, leg. Fosberg 4586 13 IV 1931 F,NY,NA,UC,US. Leg. Knopf 91 F,K,BM. Ib., Avalon, leg. Trask V 1900 K. Ib.,leg. ipse 302 IV 1902 F,NY, US. Ib.,leg. ipse 301 III 1901 F,NY. Santa Barbara Co. Leg. Fosberg 7672 25 III 1932 NA ,PENN.Santa Cruz Island,leg. Brandegee IV 1888 p.p. UC.Ibid., Prisoner's Harbor, leg. Clokey 4990 9 VI 1930 NY,UC. Ib.,leg. Wolf 2726 19 III 1932 US. Ib.,leg. Hoffmann 5 III 1932 UC. Carpintería, leg. Hall 3173 V 1902 NY,UC. Near Lompoc, leg. Suksdorf 221 16 VI 1913 GH. Sta. Catalina Island, Sliver Canyon, leg. Millspaugh 4879 27 III 1920 F. Santa Bárbara Nat. Forest, leg. Detmers 4 V 1929 MICH. Ventura Co., Ojai, leg. Fosberg 1910 5 IV 1931 PENN. Santa Cruz Island, Cañada Puerto, ca. Prisoner's Harbor, 250 ft., leg. Thorne & Everett 36841 18 IV 1967 GH. Los Angeles, leg. Nuttall P. Matilija Cañón, 500 ft., leg. Peckham 7 II 1866 US. San Bernardino Hills, leg. Parish 293 1880 F. Mt. Springs Grade, leg.Orcutt 190 17 IV... UC. Santa Monica Mts., Los Alisos Canyon, leg. Dunn 30 V 1931 UC. Ventuta River, 600 m, leg. Clokey 6723 2 V 1935 UC. Riverside Temescal Cañón, 1200 ft., leg. Johnston 1998 30 V 1918 UC. Topango Canyon, leg. Epling & Ellison 30 III 1929 UC. Santa Monica, leg. Hasse 6 III 1892 NY. Santa Ana River Cañón, 800 ft., leg. Hall 3286 V 1902 NY,UC. Monrovia, leg. Baker 4175 22 IV 1903 F,GH,K,NY,UC. Oceanside, leg. Black 4758 6 III 1946 IAN,B. NW Pala, leg. Munz 15578 18 III 1940 UC. San Diego, leg. Cleveland a. 1875 UPS.San Diego Co., Mission Hills 200 ft., leg. Chandler 5049 10 IV 1904 NY,UC. San Dimas Cañón, 2000 ft., leg. ipse 14 III 1897 UC. Topango Canyon, leg. Crawford-Hiatte 29 III 1906 US. El Rancho Viejo, leg. Brandegee 30 IV 1889 UC p.p. Los Alisos Canyon, leg. Epling & Dunn 30 V 1931 K,US. Southern California, Mexican Boundary, leg. Parry NY.Arizona. Maricopa Co., Mesquite Creek ca. 1 mile E of Tortilla Flat, ca. 1500 ft., leg. Halverson 54 31 III 1963 BM.

MEXICO.

Baja California. Ensenada, leg. Anthony 184 III-VI 1897 F,UC,US,GH. Ib., leg. Black 4139 11 II 1949 IAN. Ib., leg. Wiggins 5148 4 IV 1931 GH,NY, UC,US. Ib.,leg. ipse 7539C 1 II 1935 F,UC,US. 5 Km N of Ensenada, leg. Johnston 21 9 IV 1937 F. Ensenada, Tiajuana Rd., leg. Ferris 8477 28 II 1934 US. Mun. Ensenada, NE Santa Catarina, 4100 ft., leg. Broder 721 22 IV 1962 US. Cariso Ck., leg. Brandegee 20 IV 1893 UC. All Saints Bay, leg. Fish V 1882 GH. S Ensenada, leg. Purer 7123 24 III 1937 US. Sierra San Borja, Cerro Santa Marta, 1600 m, leg. Moran 13101 1 V 1966 UC. Picachos de Santa Clara, 450 m, leg. Moran y Reveal 19684 3 II 1973 US.Ab. Río San Miguel, leg. Moran 16002 31 V 1969 UC. Sauzal, leg. Orcutt 23 II 1883 US. Northern Lower California, leg. Orcutt 23 II 1883 US. Ib.,leg. ipse 17 IV 1886 F,NY. Santo Tomás, leg. Wiggins 4251 25 II 1930 GH,US. S Sierra San

Pedro Mártir, Los Emes, 3500 ft., leg. ipse *9907* 12 V 1941 US. Desierto Viscaíno region, Picachos de Santa Clara, 500-2000 ft., leg. Scott Gentry *7700* 5-10 XI 1947 UC,US. Sierra San Pedro Mártir, Rancho San Martín, ca. 1200 m, leg. Morán *10869* 6 V 1963 UC. Sierra de Francisquito, leg. Brandegee *86* 18 X 1890 UC. Ejido Mexico, 300 m, leg. Raven, Lewis & Thompson *12238* 4 IV 1958 UC.

OBS. I. La pubescencia muy fina y curva, el largo de los pecíolos y sobre todo de los pedicelos en el fruto, el largo relativo cáliz/cápsula ($\frac{1}{3}$),el porte de la planta y el verdor del follaje diferencian bien esta especie de sus vecinas.

II. Todas las flores vistas con macrostíleas pero se presentan casos en que los estambres mayores son casi tan largos como los pistilos.

6. *Oxalis radicosa* A. Richard (1)

Fig. 3 A

Richard, Tent. Fl. Abyss. *1*:123. 1847. Kabuye in Fl. Tr. East Afr. 5-6. 1971.

O. micrantha Bojer ex Progel in Martius, Fl. Bras. *12*(2): 493.1877 non Bert. ex Colla, 1832! Tipo: Madagascar, Bojer M.

O. simulans Baker, J. Linn. Soc. *20*: 112. 1883.Tipo: Madagascar, Baron *2110* K.

O. corniculata L. v. *sericea* Knuth, Not. Bot. Gart. Berlin *7*: 300.1919; l.c. 151. 1930. Lectotipo: Nueva Guinea, Hellwig *49* K.

O. stricta auct. (Australia, *p.p.*, Allan, Fl. N. Z. 228.1961) non L.!

Acetosella simulans (Bak.) Kze., Revisio, Rev. *1*: 91. 1891.

O. corniculata L. v. *radicosa* (Rich.) Michelozzi, Adumb. Fl. Aeth. *29*: 428-9, fig. 2 B-C. 1978.

TIPO.Abisinia, Oudodgerate, leg. Quartin-Dillon et Petit VI 1838-40 P.

Herbácea, finamente pubescente (5-40 cm). Raíces profundas, largas (h. 20 cm) lignificadas, tuberculadas, negruzcas, (h. 1,5 cm diám.), a veces ramificadas. Tallos subleñosos en la base o herbáceos, profusamente ramificados, ramas largas ± procumbentes o erguidas, generalmente densamente foliadas, retrorso-pubescentes (por lo menos en parte), pelos desiguales. Internodios de largo muy variado (0 - 5 cm). Estípulas completamente soldadas (1,5 - 3 mm), rojizas, escariosas, dorso ± carenado, enangostadas hacia el ápice, pubescentes, borde hirsuto-ciliado. Pecíolos ascendentes (h. 6 cm). Folíolos anchamente obovados (2-17 x 2,5-20 mm), incisos h. ± $\frac{1}{2}$, lóbulos suborbiculares, pubescencia fina, variable, sobre ambas faces, densa, haz menos pubescente, hasta glabro, borde ciliado. Cimas umbeliformes, mayores que el follaje 2- (3-5-)floras y solitarias, erectas. Pedúnculos pubescentes 1,5-8 cm), pelos finos generalmente retrorsos. Brácteas (h. 4 mm) y bractéolas (1,5-2mm) lanceolado- o linear-acuminadas. Pedicelos (5-20 mm) acrescidos en el fruto.

Sépalos lineares o elíptico-lineares (3,5-5 x 0,7-1,5 mm), obtusos mucronados, fina y cortamente tomentosos (a veces pocos pelos esparcidos) Pétalos obovado-oblongos, interiormente amarillo-anaranjado exteriormente rosados o estriados de rojo, "pink outside"(los botones florales se ven rosados en los herbarios),pelos cortos en los bordes tempranamente caducos (se observan en los botones) y en la fauce de la corola. Estambres largos (± 3,5 mm) filamentos aplanados con ppcos pelos glandulares o simples; los cortos (± 2,5 mm) glabros, soldados h. $\frac{1}{2}$. Pistilos (micro-

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(1) El epíteto alude a la raíz gruesa, larga, lignificada.

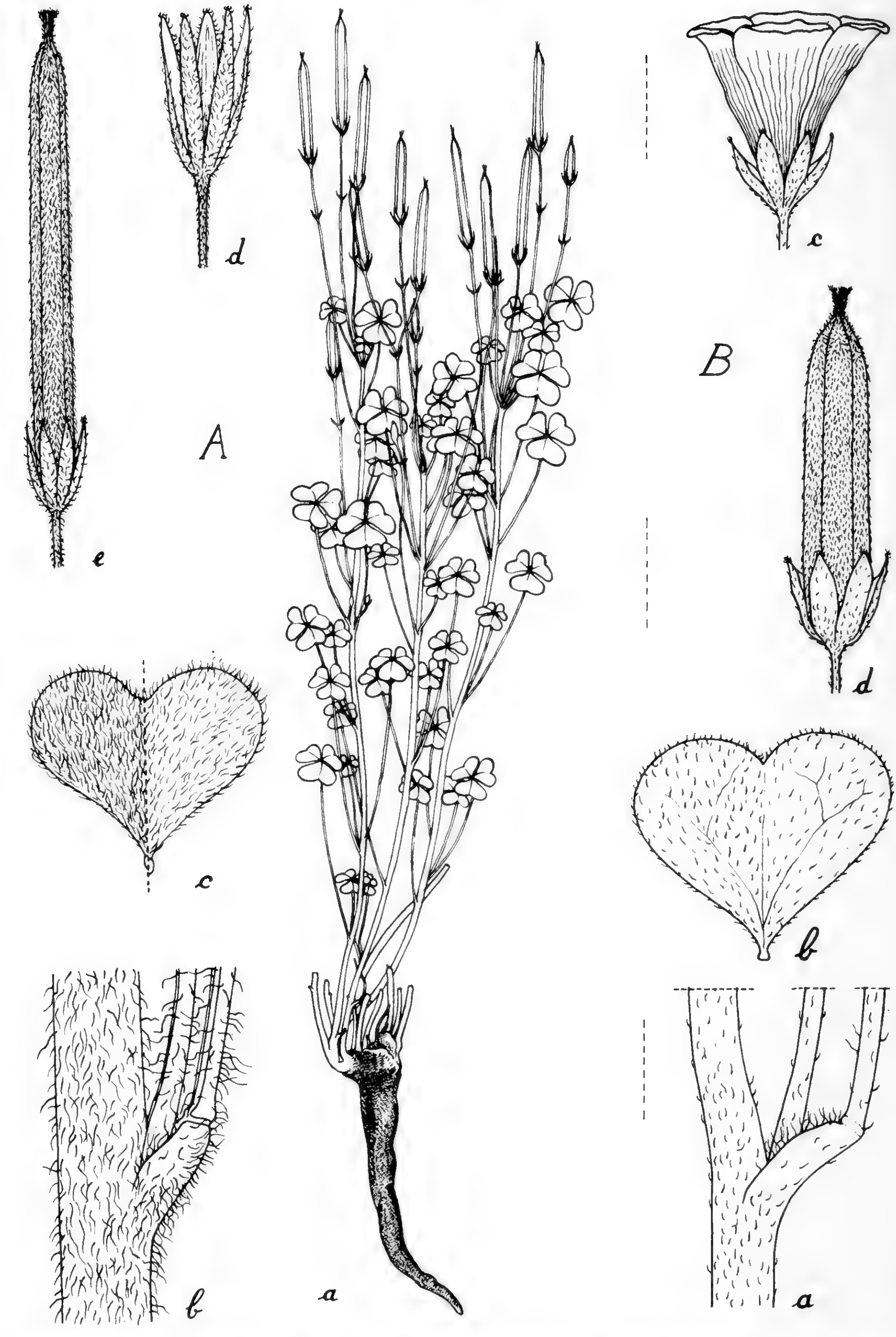

Fig. 3. A, O. radicosa: a, parte de planta x ½; b, inserción peciolar x 6; c, folíolo x 4; d, cáliz x 4; e, fruto x 2, Perrier de la Bâthie 1456, P. B, O. californica: a, inserción peciolar x 6; b, folíolo x 2; c, flor x 2; d, fruto x 2, c, Price 7123, resto Dunin US. Guerber del.

meso- y macrostíleas)en algunos casos ± de igual largo que los estambres mayores (± 5 mm), ovario fusiforme, piloso, estilo piloso, estigma 2-lobulado, notable, papiloso; carpelos 10-15-ovulados (raro menos).

Cápsula erecta a madurez, rígida, grande (h. 3 x 0,5 cm diám.), cáliz h. 1/6, densamente retrorso-pubescente, pelos blancos o amarillentos; estilos cortos, rectos, pilosos; carpelos 10-15-seminados (raro pauciseminados), interiormente pilosos.

Semillas pardo-purpúreas (± 1,5 mm), ovoideo-aplanadas, agudas, costas poco prominentes, salvo las "laterales", 10-12 estrías transversales, profundas.

Distribución geográfica. Africa Tropical, Madagascar e islas vecinas, India hasta China, Indochina, Australia e islas del Pacífico.

Material estudiado.

Africa.

EGIPTO. Campagne dell´intiero Corso della Valle Nilotica, leg. Fiagari, a. 1867 FI p.p.

SUDAN. Yei Distr., near Khor Abba, leg. Andrews 1220 14 V 1939 K. Amadi Distr., Lanya Rest House, leg. ipse 834 27 IV 1939 K. Zande, Kitika, leg. Myers 6762 29 V 1937 K. Wanlitary, Erkowit Gard., leg. ipse A 3622 K. Omochakara, Didinga Mts., Betw. Iwowa and Nagichot, 6300 ft., leg. Myers 11089 24 IV 1939 K. Ib., bank Riv. Poone, leg. ipse A 1551 30 V 1939 A. Yei Riv., Lado, leg. Sillitoe 395 23 X 1919 K. Jebel Marra, 6500 ft., leg. Wickens 1455 6 IV 1964 K; 1486 9 IV 1964 K; 2422 8 IX 1964 K; 2880 12 III 1965 K. Ib., leg. Robertson 150 20 XII 1957 K. Ib., Darfuz 7000 ft., leg. Lynes 37f II 1921 K. Ib., leg. Aglen 59 18 VII 1947 K. Ib., Noringa, leg. Mackintosh 5 III 1930 K. Jabel Marra, Nimbilbif, 8300 ft., leg. Steele 18 2 V 1932 K. Bank of Meridi, leg. Andrews 1416 23 V 1939 K. Zande, R. Napere, leg. Wyld 318 27 X 1938 BM. Kitika, leg. ipse 503 16 IV 1939 BM. Mamenze, leg. ipse 156 V 1937 BM.

ETIOPIA. Pr. Dscheladscheranne, leg. Schimper 2034 1852 BP,LY,P,PR,UPS,S Environs d´Adowa, leg. Quartin-Dillon P. Adowa et environs, leg. Petit 80 1 VI-23 VII 1841 P. Vallée d´Adoa, leg. Quartin-Dillon 9 P. Ouodgerate, leg. Quartin-Dillon et Petit 1838-40 Tipo P. Isótipos P. Addi Duhoa leg. Schimper 827 p.p. 10 X 1862 BM,S,US. Abba Gerima 6800´, leg. ipse 829 22 VIII 1862 BM.Mont Alam Kalé, NW d´Aideresó, leg. Schweinfurth et Riva 1645 10 IV 1892 G,K.Lake Tana reg. Dangila, 6000´ leg. Cheesman a. 1926 BM. Prov. Borana, Konso, 500 ft., leg. Thesiger 1923 27 VI 1953 BM. Road to Agaro, 30 Km NW Jimma, ± 1900 m, leg. de Wilde 6921 3 VI 1965 K, P,WAG. Ab. 5 Km W Lekemti, ± 2200 m, leg. ipse 6301 18 IV 1965 K,WAG.Bonga, ± 1800 m,leg. ipse 9354 21 XII 1965 K,P,WAG. Vallée Mogod, 1400 m, leg. Schweinfurth et Riva 1604 8 IV 1892 G. Gojjam, near Ejubi, 15 mi.S Debra Marcos, 7000 ft., leg. Hillier 914 8 IX 1957 K. Harar to Jijiga,± 1900 m, leg. de Wilde 4236 18 XII 1968 WAG. 15 Km E Asmara, ± 3100 m,leg. ipse 4464 1 II 1969 WAG. Tigre Prov. 19 Km S Maichew, ± 2650 m, leg. ipse 6950 3 IX 1970 WAG. Betw. Mattu and Agaro, 5000 ft., leg. Piffard 108 6 IV 1953 K. Ab. Guder, 2300m,leg. Mooney 8921 19 VI 1962 K. Addis Ababa, leg. ipse 4713 V 1953 K. Ib., 8000 ft., leg. Curle 37 20 IV 1951 BM. Alia Auiba, leg. Roth 212 X 1842 L. Jibat Forest, near Tabu, 7500 ft., leg. Mooney 6674 9 III 1956 K.Harar, 6300 ft., leg. Gillet 5016 17 II 1933 K. Wallaga, Prov. Anfilo, near Dembidollo, 6300 ft., leg. ipse 6888 5 III

1957 K. Mara River 6220 ft., leg. Copley 628 I 1940 K. Mega, leg. Gillet 14221 13 XI 1952 K. Ab. 15 Km S of Shashemene, ± 1800 m, leg. de Wilde 7084 15 VI 1965 P,WAG. Ab. 60 Km SW of Awash St., ± 900 m, leg. ipse 10614 5 IV 1966 WAG. Exp. Sources Nile, leg. Cap. Speke and Grant 189 XI 1861 K. Illubabor, 1200 m, leg. Freis et al 1757 15 XII 1972 K. Prov. Gojjan, betw. Debre Markos and Bahar Dar, leg. Gilbert 482A 9 VII 1967 K. Kaffa Prov, Gimira, 6000 ft., leg. ipse 246 28 I 1967 K; 546 10 II 1968 K.

SOMALIA. Wagga Mt., leg. Lort Phillips a. 1897 BM,K. Dobo Pass, 4000 ft., leg. Gillett 4949 5 II 1933 K,P,S. Golis Range, leg. Drake Brochman 326 K. Waggu, 4-8000 ft., leg. Burne 31 15 III 1929 K. Berbera, leg. Bury 23 1905 BM. Meid Serrulget, 15-1800 m,leg. Hildebrandt 1380 IV 1875 LE,BM. Mt. Wargale & Sheikh Pass, 4500-6000 ft., leg. Godman 172 24 III 1920 BM. Between Dobar & Hasnmar, leg. Phillip a. 1897 BM. Upper Sheikh, leg. ipse a. 1897 BM. Isla Socotra leg. Balfour 608 VIII 1880 BM,K,LE,OXF.

NIGERIA. Banchi Plateau, 3000-4500 ft., leg. Young 24 1922 K. Jos Plateau, leg. Hepper 1115 23 X 1957 K. Randa Mada Hill, 2000-3000 ft., leg. Hepbrun 86 1927 K. Plains betw. Hepham and Ropp, 4600 ft., leg. Lely 354 23 VIII 1921 K. Ndop Plain-Babungo Agr. Dep. Farm, 3800 ft., leg. Brunt 432 17 V 1962 K.

CAMEROUN. Batouri, leg. Ladurantie 39 1946 P. Monts Mandara, Hossere OUpay, 15 Km NNO de Mokolo, 1250 m, leg. Letouzey 6889 15 IX 1964 P,K,WAG. Moleré à Meigomga, 6370 ped., leg. Jacques-Félix 4141 VI 1939 P. Haut Logone, Cap Periquet, leg. Pellegrin 24 II 1910 P. Ab. 5 Km E of Mogodé, ± 900 m, leg. de Wilde 3448 19 IX 1964 WAG. Plateau of the Adamaora, 10 Km S of Ngaounderé, leg. Breteler 464 11 X 1960 WAG. Wakwa, leg. Inst. Elévage 160 II 1958 P. Mogodé, Gomtemale Mt., 1100 m, leg. Leeuwenberg 10452 9 X 1972 WAG.

REPUBLICA CENTRO-AFRICANA. ? Central Africa, Niamniam, leg. SSchweinfurth 3708 6 V 1860 K. Haut Oubangui, Yalinga, leg. Le Testu 2930 30 VI 1921 BM P. Krébidje, leg. Chevalier 5484 21 IX 1902 P. Région de Bambari, Waka, près Ippy, leg. Tisserant 2482 V 1928 BM,P. Oubangui, Lac Tchad, Fort Trompel à Fort Simot, leg. Chevalier 10617 10 XII 1903 P. Oubangui-Chari, Bocaranga, leg. Le Teste 113 27 X 1936 P. Chari, Krébidjé, leg. Chevalier 5484 p.p. 21 IX 1902 P. Oubangui-Chari, Haute-Kotto, Yalinga, leg. Le Testu 2555 18 III 1921 BM. Ib., Gréganza, leg. ipse 2930 30 IV 1921 BM.

CONGO BRAZZAVILLE. Prov. Katanga, Albertville, ferme Bertrand a Nuhila, 1550 m, leg. Quarré 7118 X 1945 K,P. Mitivaba, Parc Nat. de l'Upemba, 1250 m, leg. de Witte 6385 V 1949 K,WAG. Kafubu, Ferme Don Bosco, leg. Quarré 253 IV 1927 GH.

CONGO KINSHASA. Kivu, Lula, leg. Lebron 8201 X 1937 K,P,WAG. Kivu,Rutahuru, leg. ipse 8985 p.p. XII 1937 K,WAG.Kivu, SW Lac Edouard, Monts Kisale, 1200-2000 m, leg. Humbert 8243bis V-VI 1929 P. Plaine S du Lac Edouard, ± 1100 m,leg. ipse 8697 V-VI 1929 P.S Volcán Karisimbi, 2400 m, leg. de Witte 2060 1934 K,P. Kisozi, leg. Lejeune 53 1 VII 1933 P. Entre Isoai et Nyanza, leg. Robyns 2423 1926 K. Kibali-Ituri, Irumu, 1250 m , leg. Lebrun 4219 1931 NY,P; 3593 VIII 1931 GH,K. Volcans du Kivu, 1500 m, leg. Gromier-Le Petit 11 IV 1911 P. Lac Kivou, Kadjudju, leg. Babault 159 1934 P. Elizabethville, leg. Rogers 10885 K. Parc Nod de la Garamba, 700-800 m, leg. Sueger 1519 12 XI 1951 K. Kivu, Lubero, Luifu, leg. Léonard 5294 VIII 1959 K, UC. Kasindi, pr. Lacum Albert Edward, leg. R.E. Fries 1806 1912 UPS.Yangambi, plateau Isalowe, leg.Bo'Yanguma 59 26 VIII

1976 P.
UGANDA. Kipayo, Elephant grassland 4000 ft., leg. Dümmer 1037 VIII 1914 BM,P.US. Vic. Kikondo on trail fr. Entebbe to Albert Nyanza, 1118-650 m, leg. Mearns 2650 1 I 1910 BM,US. West Prov., Toro Distr., Namwauela vall. bel. Kilembe, 4000 ft., leg. Taylor 2686 28 XII 1934 BM,G,S; 1508 1891 K. Mt. Moroto, 9600 ft., leg. Eggeling 2893 II 1936 K. Moroto township, 4500 ft., leg. Wilson 544 X 1958 K. Moroto Mt.,, Karamosa, 9500 ft., leg. A.S. T. 2148 3 I 1937 K. Rokosa rock, N Maracha, 4600 ft., leg. Chancellor 74 30 VII 1953 K.Moroto Mt., Karamdja, 9500 ft., leg. Thomas 2148 3 I 1937 K. Nyass., Misuku hills, 5-6800', leg. Williamson 220 13 III 1953 BM. Kagara vall., near Malema, leg. Bagshawe 297 22 V 1904 BM. Near Rufuda, leg. ipse 512 11 XII 1903 BM.
KENYA. Near Kaposoret, Eldoret Distr., forest reserve, leg. Williams 169 8 V 1951 FI,P. Nairobi, Ainsworth Hill, leg. Fosberg 49961 24 III 1968 US. Kilimanjaro, Kibiköln, 1100-1200 m, leg. Endlich 330 IV 1909 M. Nyanza Prov., Londiani Distr., Tinderet Forest, 2400 m, leg. Maas 5047 20 VI 1949 K,L. Bura, leg. Sacleux a. 1892 P. Coles Mill, 2000 m, leg. R. & Th. Fries 1097 18 I 1922 S,UPS. Chevanzani, 6500', leg. Wilkes 114 12 VIII 1927 BM. Suam River, 6000', leg. Traill 30 XII 1937 BM. Machakos Distr., Kimunyu, 1890 m, leg. Mwangangi 819 6 V 1968 K.Kasawasawa, leg. Haerdi 364/0 16 XI 1959 K. Prov. Nairobi, Kirichiva Kubiva, 5400 ft., leg. Bally 12435 1957 G. Sambuan Distr., Varagess, 7000 ft., leg. Newbould 3104 XI 1958-I 1959 K.
RUANDA.Biumba, Mutara env. Mimuli, Coll. Rutengula, 1400-1450 m,leg. Troupin 11804 8 X 1959 F,US; 5216 14 XII 1957 K. Entre Astrida et riv. Akanyane, env. Gisagara, 1750 m, leg. Bazarusanga 33 17 I 1957 K. Pref. Kibungo, Nyakarambi-Nyarubuya Km 12, 1700 m, leg. Bamps 2776 9 XII 1971 GENT.Butare à Kigali, 18 Km Kalagayi, 1600 m, leg. v.d.Veken 9105 18 I 1972 GENT. Gitega, 1700 m, leg. Baudet 213 15 I 1972 K.
TANZANIA.
Mufindi, prati e campi, leg. Balbo 885 2 VII 1934 FI,P.Twambo, S of Lake, 5250 ft., leg. Nutt a. 1896 K. Tukuyu Distr., near Rinyve Miss., 4600-5500 ft., leg. Thompson 1882 23 III 1932 K. West Lake Prov., Ngara Distr., Keza, Bushubi, 5000 ft., leg. Tanner 4503 18 XI 1959 K,UC.; 4982 15 V 1960 K,UC. Moshi Distr., Moshi-Himo Rd., leg. Huxley 44 11 II 1955 K. Maranga, 5000 ft., leg. Archebold 341 K. Ruwenzori,Ukambane, 5-6000 ft.,leg. Scott Elliott 6433 1893-94 BM,K.Iringa Distr., Kidatu, leg. Mhoro 431 4 II 1971 K, UPS.Distr. Korogwe, Kwalukonge, 1000 ft., leg. Faulkner 4201 14 III 1969 K.Matengo, leg. Zimmer 5 25 VIII 1936 BM. Isla Pemba, 100 ft., leg. Kaisner 394 20 III 1902 BM.
ANGOLA. Cuanza Norte, N Dalatando, fl. Lucala, 750 m, leg. Gossweiler 13 V 1922 P. Colungo Alto, in arvis relictis, 100-2400 ped., leg. Welwitsch 1610 VII-IX 1835 BM,G,K,P. Duque de Braganca, Malange, leg. Castro 253 COI Huila, Humpata, 1800 m, leg. Exell e Mendonça 2590 5 VI 1937 COI. Ib.,leg. Meiotou III 1893 COI. Huila Tehivinguiro, leg. Barbosa e Morán 10073 22 I 1962 COI. Hochland v. Quela, leg. Nolde 461 BM. ? Bulawayo, leg. Rand 296 V 1898 BM.
ZAMBIA. 9 mi. Lusaka, 4000 ft., leg. Kusaka Nat. H. Cl. 66 24 XI 1961 K. Near Mumbwa, leg. Macaulay 378 1911 K;1064 VII 1912 K. East Prov., Jameson Distr., Kachabere, 1000 m, leg. Robson 1065 7 I 1959 K. Liamba vill., 5000 ft., leg. Richards 4463 11 II 1955 K. Mesetter, Lusilu/Haroni, Ngosima Res. leg. Ngoni 21 22 XI 1967 K. Lusaka Distr., Great E Rd., 14 mi.fr. Lusaka,

ca. 1250 m, leg. Strid 2879 20 I 1973 K. Mbala Distr., Saisi vall., 5000 ft., leg. Sanane 1051 22 I 1970 K.

MALAWI. Nyassaland, leg. Buchanan 868 1891 BM,G,GH,US; 1508 US.Masuku Plateau, 6500-7000 ft., leg. Whyte a. 1897 K. Leg. ipse a. 1898 P. Zomba, leg. Whyte & Mc Clounie a. 1897 G. Suigo, Butemba, Kiboga Gambdola, 3620 ft.leg. Langdale-Brown 2011 K. S of Nakasongola, 3570 ft., leg. ipse 1964 29 II 1956 K. Teitaa, Mt. Boura, leg. Sacleux 2482 VIII 1897 P. NE Elgon, 7500 ft., leg. Tweedie 2675 VIII 1963 K. Distr. Kipkarren, leg. Brodhurst-Hill 233a K. Saui, 4000 ft., leg. Kaessner 759 19 V 1902 BM,K. Uniba, leg.Smith XII 1892 K. Nyassa Hochland, Stat. Kyimbila, 1350 m, leg. Stolz 1550 16 IX 1912 G,K,L,P,PR,S,UPS. Mts. E of Lake Nyassa, leg. Johnson IV 1884 K. Entebbe, 3200 ft., leg. Brown 29 1904 K. Nyassaland, Maperi House, 3300 ft., leg. Lawrence 587 24 XII 1937 K. Likwena,leg. Seddon 11 I 1947 K. Teso,3600 ft., leg. Chancellor 291 XII 1931 K. Nyassaland, Zomba township, leg. Banda 193 22 II 1956 BM.

MOZAMBIQUE. Morrumbala, 3000 ft., leg. Kirk 20 XII 1858 K p.p. Manica e Sofala, Chimoio, Bandula, leg. Barbosa 1154 3 IX 1948 K. Morrumbala Mt., Shive Riv., ± 500 m, leg. Pope & Müller 573 10 XII 1971 K. Ichanna(sea coast), leg. Kirk VIII 1962 K. Lupaha, Mt. Makulu, leg. Rensburg 3092 23 XII 1965 BM,K.

AFRICA DEL SUR. Transvaal. Bei Pretoria, leg. Wilms 199a XI 1883 PRC. Witbank, leg.Rand 36 XII 1919 BM.Lydenburg, leg. Wilms 199 I 1893 Matebe Valley, leg. Holub 20 IX 1876 PRC.Somersetland, leg. MacOwan 2096 XI 1873 BM.

RHODESIA. Inyanga, pr. pagum, leg. Norlindh et Weimarck 4200 11 I 1931 M,S. Ib., leg. Fries, Norlindh & Weimarck 2443 30 X 1930 F,K,US,WAG. Salisbury, leg. Walters 2749 1 X 1919 K. East Prov., Jameson Distr., Kachabere, 1000 m, leg. Robson 1065 7 I 1959 BM. Malunge, leg. Young 863 22 IX 1932 BM.Miami, leg. Rand 4 IV 1926 BM.

Islas CABO VERDE. Ins. Promont. Viridis, Bocandé, leg. Bolle S. Santiago de Praia a Ribeira da Barca, leg. Chevalier 44541 13 VII 1934 COI,P p.p.

MADAGASCAR. Leg. Dr. Lyall 302 K. Leg. Le Myre de Villers, a. 1887 P. Leg. Parker FI. Leg. Shufeldt 125 188? US. Leg. Deams Cowan a. 1880 BM. Leg.Justice Blackburn ca. 1863 GH. Tananrive, leg. Goudot ca. 1840 G. Pr. Tananarive, leg. Hilsenberg & Bojer BM. Pr. Tananrive, Ambohipotsy, leg. Hildebrandt 3490 18 VI 1880 BM,G,K,LE,P,PR,PRC,U,US. Massif de l'Andringitra(Iratsy), vallées de la **Riambava** et de l'Antsifotra, 1600-2000 m, leg. Humbert 3673 27 XI-8 XII 1924 P. Maitso-Kely, Haut Bemarivo, ca. 300 m, leg. Perrier de la Bâthie 5794 VIII 1907 P. Pr. Ermina, leg. Stokes 601 K. Angovo, 1600 m, leg. ipse 5760 VII 1914 P. In monte prov. Emirna, leg. Bojer P. Prov. d'Andovoranto, Distr.d'Anivorano, SE de Lohariandava, 250-300 m, Viguier et Humbert 662 12 X 1912 P. Lieux cultivés, aux abords du lac Alaotra, 750 m, leg. Humbert et Cours 17557 X 1937 P. Itasy, leg. Frappa I 1941 Ib., leg. Catat 123 17 IV 1889 P. Ankaizinnana,1200 m, leg. Decary 1847 15 IV 1923 P. Bords rivière Anony, leg. ipse 598 5 VIII 1921 P. Imerimandroso, leg. ipse 750 27 VI 1921 P. Befandriana Nord, (J. Bot. Tananarive 5355)1942 P. Analavory(J. Bot. Tananarive 3114) 26 I 1938 P. ManakanbahinyEst, Distr. Ambatondrazaka, leg.Saboureau 6035 29 I 1953 P. Mozy, près Miarinarivo,leg. Perrier de la Bâthie 5774 VIII 1902 P. Bassin de l'Isandrana, leg. ipse 1486 XI 1902 P. Antsihanaka, 56 Km E of Mandritsara, 800 m,leg. Schofield 29 6 IX 1968 K. Manakambahiny-Est, Ounbatoudrazaka, leg. Rakotovao 12372 24 XII 1962 P.

Central Madagascar.Leg. Baron 864 et 4391 K,P. Leg ipse 2110 comm. 1880

Tipo O. simulans Baker K. Ib., leg. Parker 132 K. Ib., leg. Baron 3936 K. Ib., leg. ipse 6300 K. Inter. of Madagascar, leg. Bojer P. In humidis Ins. Madagascar, leg. Bojer Tipo O. micrantha Boj. M. Central Plateau, leg. Hopkins & Stansfield 18 et 158 K.

Islas COMORES. Ins. Juanna, leg. Blackburn (Pt. Adm. Bowles) ca. 1863 K. Johanns, culturfelder, leg. Hildebrandt 1574 VI-VIII 1875 BM,K,LE,L,P. Leg. Humblot 370 a. 1884 BM,K,P. Leg. Bojer (Bouton 1837) K. Angazija or Grand Comoro, leg. Kirk XII 1878 K. Anjouan, leg. Boivin I 1850 P. Pamonzi, Mayotte, leg. ipse 3402 VII 1850 P. Grande Comore, leg. ipse V 1850 P p.p. SEYCHELLES. Leg. Horne 438 1874 K.

Asia.

ARABIA. In humid. reg. Mascate, leg. Aucher-Eloy 4304 1837 FI,K,P. Semail, leg. Pilgrim a. 1906 K. Oman, Lislat, leg. Fernández 1615 21 XI 1925 K. Gebel Soda, 920 ft., leg. Tothill 124 5 VIII 1952 BM. Yemen, leg. Botta a. 1837 LE,P. Ib., 1300 m, leg. Deflers 219 6 V 1887 P. Taifa, leg. Botta a. 1838 P. Al Hajar, leg. Mandeville 3411 14 III 1972 BM. Wadi al Ma'aqil, 5800 ft., leg. ipse 3477 et 3485 16 III 1972 BM. NW Tayif, 6450 ft., leg. ipse 2993 20 II 1971 BM. Taif, 5500 ft., leg. Simonds 1 III 1949 K. Asir, ab. Abha, leg. Thesiger VI 1946 BM. Baihan, 9000 ft., leg. ipse BM. Abha, leg. ipse 7 V 1946 BM. S Hejaz, Azzafir, 6000', leg. Pronside Wooa 97 7 II 1971 BM. Yemen, Manakka, Gebel Kahil, 2400 m, leg. Deflers 336 10 V 1887 P. Mont Maamara, leg. Botta X 1837 L,P. Mt. Saber, leg. ipse XI 1837 P. Thogaif, Highlands, leg. Fitzgerald 16592/3 11 XII 1946 BM. Abha area, 7-9000 ft., leg. Kercher 165 8 IX 1950 BM. Taif Highlands, leg. Fitzgerald 17058/5 11 V 1947 BM. Saig, leg. Smiley 18 V 1959 BM. Saudi Arabia, Jebel Shada az Zahram, W Biljurshi, 7500 ft., leg. Collenette 279 7 IV 1977 K.

IRAN. (Persia) Caspian, Palevy (Pahlevi) river near Chalous, leg. Godman 67 17 IV 1960 BM.

PAKISTAN Baluchista, Wam Tangi, 4000 ft., leg. Lace 5 IV 1889 K.

INDIA. Leg. Jacquemont 1513 = 572 K. Leg. ipse 272 P. Himalaya 1-6000 ped., leg. Hooker & Thomson K. Bengel Inf., leg. ipsi FI,K,L,US. Simla, leg. ipsi VI 1849 K p.p. Mausor & Carnatic, leg. Thomson a. 18.. FI,K. Madras, Pulney Mts., leg. Wight 301 p.p. 1866-7 FI,K,L,LE,NY,P,S. Saran Range, Hilkote, leg. Duthie 2 IX 1899 K. Marara, leg. Jacquemont 572 P. Ootacamund, Nilgiris 7000 ft., leg. Koelz 19882 2 III 1948 NA. Chamba et Kilel, 4000 ft., leg. Harsukh 20 VI 1899 A. Near Shulaghat, 3000 ft., leg. Tyson 147 30 VII 1953 BM. E Baitadi, 4000', leg. ipse 129 28 I 1953 BM. Nepal, Para (Jibrihot) 9500', leg. Polunin, Sykes & Williams 2493 18 VII 1952 BM. Atjeh, Boer in Fellong, leg. Jeswiet 1868 2 VIII 1929 WAG. Dera Dun Prov. Tons Vall., leg. Darham Mari VII 1950 NY. Punjab, Kangra Bhadwar, 2000 ft., leg. Koelz 4233 p.p. 23 IV 1933 NY,US. Kalabagh, W side of Indus via Lakki to Dera Ismael Khan, leg. Schlagintweit 10985 15-22 II 1857 P. Sirahan, Bushahr, Simla, leg. Negi Parmananad 369 5 VI 1934 NA.

CHINA. Leg. Osbeck 1757 SBT. Hong-Kong. East Point, leg. Poli 38 16 III 1880 P. Leg. Wright 33 U. S. N. Pacific Expl. Exp. 1853-56 K,P,US. Prov Fukien. Foochow, leg. Carles 608 V 1897 BP,K. Island of Taitan, leg. Price 1327 VIII 1912 K. Prov. Che Kiang. Leg. Maries a. 1880 K. Chenfeng Nakan, leg. Tsiang 4735 19 X 1930 NY. Hainan. Tan Distr., I Kap Shan and vic. Leg. Lau 1043 12-24 II 1933 BM,GH,LE,NY,P. Lin Fa Shan, leg. Tsang

334 9 VI 1928 GH,NA,LE,US. Prόv. Hunan. Yiyang, Taoluvalum, leg. Dahlström 382 1 VI 1948 S. Prov. Hupeh. Wuchang, Lobiaschan, leg. Sun 971 IV 1933 NY. Prov. Kiangsi. Tung Lei Village, leg. Lau 4134 1-29 VIII 1934 BM,GH,S, US.Canton et Macao, leg.Gaudichaud, Voy. La Bonite,309 1835-37 P. Prov. Kwangtung. Sui Luk Distr., SW of Nanning, leg. Tsang 21900 1-18 III 1933 A,GH,LE,P,S. Lung T'au Shan, near Iu, leg. To and Tsang 12004 22 V-5 VII 1924 BM,NA,P,S. Prov. Kweichow. Ching Chao Ping, Fan Ching Shan, leg. Steward et al. 699 23 X 1931 GH,K,LE,NY,S,US. Nakan, Chengfeng, leg. Tsian 4735 19 X 1930 S. Prov. Yunnan. Van Chiao, 1350 m, leg. Wang 75015 VI 1936 A. Yunnan Fu, 1900 m, leg. Schoch 113 20 V 1916 K,LE,US. Prov. Kuangtung. Pakhoi, leg. Playfair 6 IV 1883 K. Swatow, leg. Perry a. 1883 p.p. NY. Prov. Hupeh. Ichang, leg. Henry a. 1886 K,LE. Taiwan. Tamsuy, leg. Oldham a. 1864 BM,p.p. Bunkiko, leg. Faurie 1614 XII 1914 P.

KOREA.

Leg. Schmidt 273 27 VI 1900 LE.

BIRMANIA. Maymyo Plateau, 3500 ft., leg. Lace 3190 15 V 1908 K. Southern Shan States, Taunggyi,c. 1500 m, leg. Malaise 329 22 VIII 1934 S.

JAPON.

Yakusima,leg. Masamune 7 VII 1928 NY.

THAILANDIA. Bo Luang, 1000 m, leg. Larsen et al. 1925 1 VI 1968 K,P. Chiang Mai, ob Luang, table-land, leg. Bausekom & Phengkhlai 1140 11 VI

INDOCHINA.

Tonkin Mér., leg. Bon 28 1883-91 P. Ib., Camp des Tigres,leg. Balansa 1129 16 I 1886 P. Ib., Cho Ganh, leg. Pételot 1255 XI 1923 P. Pro. Annam. Fimnon, leg. Lichy 22 VI-X 1929 P. Langbian, des Planches à Dran, leg.Evrard 1444 14 X 1924 P. Prov. Dran, Lang Bian, 1000 m, leg. Poilane 2952 20 VI 1922 P. Massif Su Langbian Dran, 1000-1200 m, leg. Chevalier 40460 1 V 1919 P. Kouan, Tchéon Wan, Sam Ka Vo, leg. Poilane (on Rothe) 132 XII 1932 P.

Oceanía.

PHILIPPINAS. Prov. Luzon, Benguet, Baguin, high sunny bank, leg. Leroy Topping 81 19 I-26 II 1903 US. Benguet, leg. Loher 1642 US. Luzon, Iloecos, Burgos, leg. Ramos 32806 VII 1918 US. Benguet, leg. Mearns 3472 VII 1907 US. Ib., leg. ipse 3540 VII 1907 LY,NY. Mindanao, Cotabato, Nutol, leg. Ramos y Edaño 84960 III-IV 1932 GH.

CELEBES. Loka, leg. Sarasin 1295 11 X 1895 K. Selebes Exp., Kawsi, leg. Kjellberg 3814 16 V 1929 S.

SUMATRA. Exp. Gajoe, Landen van Daalen: Gajo Loeas, Dag, leg. Pringo Atnodjo 115 24 II 1921 K.

JAVA. Djember, leg. Franck 177 p.p. 5 XII 1934 P.

NUEVA GUINEA.

Dutch Guinea. Balim Riv., 1600 m, leg. Brass 11729 XII 1968 A,L. Nieud Guinea, West, Kebar Vall., 600 m, leg. Versteegh 10358 25 XI 1960 L,LAE. East. Highlands, Goroka Subdistr., leg. Robbins 860 17 IX 1957 A,CANB;L, LAE. Kaiser Wihelmsland, leg. Hellwig 49 15 VII 1888 Lectotipo O. corniculata v. sericea Knuth K. Neu-Pommern. Herbertshöhe, leg. Nyman 920 20 IX 1899 UPS. Finschkafen, leg. ipse 1109 13 IX 1899 UPS.Papua. Milne Bay Distr., N slopes Mt. Dayman Maneau Range, 2230 m, leg. Brass 22884 12 VI 1953 A,CANBp.p., G,L,LAE,US. Central Distr., Port Noresby, Lake Myola, 1800 m, leg. Croff & Lelean 34646 18 IX 1973 LAE. Ib.,leg. Gillison 384 5 XI 1964 LAE. East. Highlands, Kainantu, 10 mi. SE Obura, 6400 ft., leg.

Hays 99 20 XI 1972 LAE. Kokoda Distr., E side Lake Myola, 2000 m, leg. Croft et al. 61944 22 VII 1974 K.

AUSTRALIA

Leg. R. Brown 5226 p.p. BM,K.Nova Hollandiae, leg. Mitchell a. 1846 K. Austral. Boreal., fr. the Lynd, leg. Leichardt P. Leg. Labillardière G. Gundabooka Mts., leg. Andrae 146 1890 M p.p. Mt. Sonder, ca. 130 Km W lice Springs, leg. Tielkens 12 IV 1889 AD. Port Jackson, leg. Dumont D'Urville 350 P.Moreton Bay, leg. Verreaux a. 1844 P. All colonies of Australia, lef. F.v.Müller... FI. Sydney Nat. Park, leg. Hochreutiner 3140 4 III 1905 G. Canberra City Distr., O'Connor, 600 m, leg. Hoogland 3110 10 I 1953 CANB,L. Murrumbidgee Riv., 9 Km S of Canberra, leg. Hartley 76 26 IX 1943 CANB. *New South Wales*. Sydney, leg. Cap. Wilkes Exp. US p.p. Foothills of Mt. Oxley, ca. 20 mi. ESE of Bourke, leg. Constable 4492 12 X 1963 K,G. Mt. Fenandra, Gulargambana, leg. McPherson 9973 VII 1933 M. Armidale, Bollon, Cunnamulla Rd., leg. S.W.Q.S. 193 2 V 1953 CANB. *South Australia*. E of Mortlo, leg. Symon 3926 16 XII 1965 K.*Queensland*. Guthalungra, leg. Michael 1341... GH.Queensland, 900 m, leg. Kuntze 20175 III 1904 NY. Warrego Distr., Charleville, leg. Clemens 26 XI 1945 K. Port Curtis, leg. I.M.Gillivray B.77 XI 1847 K.Cape Grafton,leg. Cap. Cook, 1st. Voy. 8 VI 1770 BM. Dunk Isl., leg. MacGillivray 272B 5 VI 1848 (Voy. Rattlesnake) K. *Victoria*. Leg. Williamson XII 1910 LE. *Norfolk Isl*. Anson Bay, leg. Comish 122 p.p. 8 I 1939 K. Ducombe, slopes of Malabar (low forest),leg.Green 1559 11 XI 1963 A. *Philip Isl*.300 ft., leg. Hoogland 11330 31 XII 1967 CANB.

SUMBA. Leg. de Googd 1869 5 XII 1934 L.

TIMOR. Soë, leg. Walsh 139 1 III 1929 BM. Leg. Forbes 3507 BM. Leg. ipse 4027 1882-3 BM.

7. *Oxalis perennans* Haw. (1)

Fig. 4

Haworth, Miscel. 181-182.1803. Candolle, Prodr. 1: 691.1824.

O. ambigua A.Richard, Voy. Astrolabe 1: 296.1832 non Jacquin, 1794! Tipo: N. Zelandia, Rivière Tamise, leg. D'Urville, Voy. Astrolabe P.

O. Urvillei Cunningham, Ann. Nat. Hist. 3: 315.1839 Tipo: el de *O.ambigua*.

O. lacicola Cunningham,l.c. 316. Tipo: N. Zelandia, Cunningham 590 K.

O. divergens Cunningham,l.c. Tipo: N. Zelandia, Cunningham 235 K.

O. crassifolia Cunningham, l.c. 317. Tipo: N. Zelandia, Cunningham 592 K.

O. Richardiana Steudel, Nom. ed. 2.2:241.1841 Tipo: el de *O. ambigua*.

O. Preissiana Steudel in Lehmann, Pl. Preiss. 1: 160.1844. Tipo:Australia, Preiss 1915 P.

O. cognata Steudel in Lehmann, l.c. 1616-162. 1845. Tipo: Australia, Preiss 1916 P.

O. corniculata L. v. *Preissiana* (Steud.) Knuth, Pflreich.152. 1930.

O. corniculata L. v. *crassifolia* (Cunn.)Hooker f., Fl. N. Zeal. 1: 42. Allan, Fl. N. Zeal. 1: 230.1961.

O. corniculata auct. (ex. Symon, Tr. Roy. So. Austr. 84; 74. 1961 p.p.)

O. stricta auct. (Allan, l.c.238) non L.!

TIPO. Australia, cult. en Inglaterra. Destruído. NEOTIPO: Camberra, SE base Black Mt., 600 m, leg. McKee 11678 14 X 1964 P. Isótipo CANB.

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(1) Así llamada para distinguirla de especies consideradas anuales.

Hierba (1-25 cm) cespitosa (a veces en conjines flojos). Pubescencia corta adpresa o subadpresa blanca o amarillenta, raro ± hirsuta(raramente pelos pluricelulares finos, cortos) en todas sus partes. Raíces fibrosas en general muy ramificadas y largas (h. más de 20 cm)rígidas (1,5 cm diám) también tubérculos fusiformes o napiformes. Tallos erguidos subleñosos en la base, profusamente ramificados ± pubescentes, ramas rojizas, estoloníferas y radicantes o largas, flexibles, procumbentes(h. 50 cm). Internodios,casi nulos en las plantas nanas y ramas cortas, h. 8 cm.Estípulas escariosas, ± rojizas, angostas, soldadas completamente, bordes paralelos o ensanchadas en la base, 3-nervadas, fuertemente carenadas, generalmente pubescentes, a veces adpreso-pubescentes, o bien ciliadas (0,7- 3 x 0,7-2,5 mm)esclerificadas a la caída de las hojas. Pecíolos filiformes, ascendentes ± adpreso-pubescentes, largo muy variable. Peciolillos carnosos, cortísimos, pilosos. Folíolos glaucos, discolores, a veces ± purpúreos, anchamente obovados, profundamente incisos 1/3-2/3, cuneados (2,5-20 x 4-25 mm), lóbulos (a veces sublineares) divergentes, los laterales asimétricos, glabros o haz generalmente glabro, o ± cortamente pubescentes (raro subtomentosos), cilias subadpresas o hirsutas. Cimas netamente mayores que el follaje (excepto en los especímenes nanos), a veces larguísimas(h. 18 cm), umbeliformes 1-2- (5-)floras. Brácteas lineares o elíptico-lineares (1-3,5 mm), acuminadas, pubescentes. Pedúnculos h. 15 cm, acrescidos

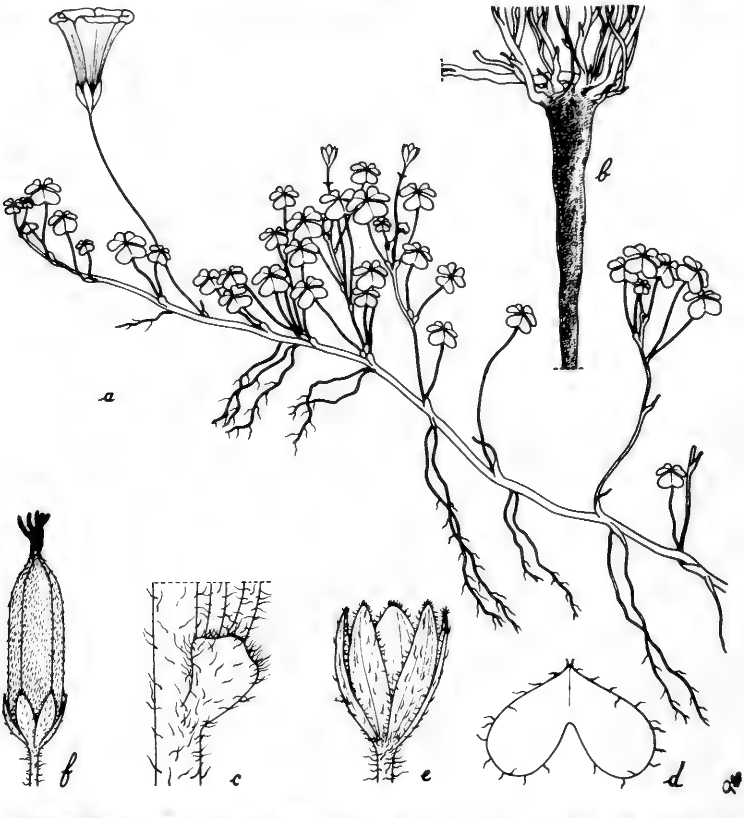

Fig. 4. *O. perennans*: a, parte de planta x 1; b, parte de raíz x ½; c, inserción peciolar x 6; d, folíolo x 4; e, cáliz x 5; f, fruto x 4.a-e del tipo, f, Sommerville P. Guerber del.

en el fruto h. 20 cm. Pedicelos h. 5 cm.

Sépalos desiguales (2) o 3 lineares u oblongos, subobtusos (2,5 - 4,5 x 0,5 -1,5 mm), 2 o (3) elípticos u ovado-elípticos (2,5-4,5 x 1 -2,5 mm), obtusos, emarginados; todos 5-nervados, fina y cortamente ciliados, pocos pelos en la base; ápices rojizos, densamente ciliados. Pétalos exteriormente rosados, "salmón", "brownish" o estríados de rojo, interiormente amarillos o amarillo anaranjado brillante, 2½ - 4 veces el largo del cáliz, obovado-oblongos, unguiculados, pelos muy cortos en los bordes, caducos, irregularmente crenados. Estambres glabros, los largos (3,5 - 5 mm), los cortos(2½ - 4 mm) soldados h. 1/2. Pistilos (micro, macro- algunos mesostíleos, otros ± mismo largo que los estambres); estilos densamente pilosos; estigmas 2-fidos, papilosos.

Cápsulas erguidas a madurez, cilíndricas muy largas delgadas (h. ca. 30 mm) cáliz 1/6-1/8, u oblongas, más gruesas y sólo 4-7 mm, cáliz h. ± ⅓; densa y uniformemente retrorso-pubescentes; estilos muy cortos, rígidos, o mayores según el tipo de flor del que procedan, carpelos 4-14-seminados.

Semillas purpúreo-negruzcas, elipsoideas, apiculadas (± 15, mm), aplanadas, 8-costadas, 9-10 estrías transversales notables con finas púas en las intersecciones.

Distribución geográfica. Australia y Nueva Zelandia en situaciones ecológicas diversas lo que confiere diferencias notables en el porte y tamaño de la planta. Soporta los suelos áridos (dunas, etc.) y climas bastante secos. Parece ser invasora en los terrenos de cultivos, en donde adquiere su desarrollo máximo.

Material estudiado.

AUSTRALIA.

New Holland, leg. Clowes K. New England, comm. Beckler a. 1884 M. Leg. Cunningham, 2nd. Voy. Mermaid a. 1819 BM. Leg. Bignoc K. Nouvelle Hollande, leg. Lhotsky 303 18...P. Ib., leg. Verreaux a. 1844-49 P. Miss. Astrolabe G. Île Stérile, leg... P. Leg. Müller VII 18.. FI,P. Austr. Merid., leg. Emmeric 18... P. Côte Est, leg. Mossmand FI. All colonies of Australia, leg. Müller FI. Waruauma, leg. Busseuil, Voy. Thétis, Cap. Bougainville C,P. Oneehcow, leg. Beechey K. Côte Orientale, leg. Verreaux 105 et 899 X 1845 P. Eastern Australia, leg. Statter a. 1865-83 BM. Western Australia. Swan Riv., leg. Drummond 736 1843 BM,G,K,LE,P. In calcareis umbrosis prope Paintwater ditionis Perth, leg. Preiss 1915 18 VII 1839 Tipo O. Preissiana P. Isótipos G,L,LE,P,S. In arenosis conchyliopsis humidis prope lacum insulae Rotenest, leg. ipse 1916 22 VIII 1839 Tipo O. cognata P. Isótipos C,L,LE. Northern Terr. Macdonell Range, Painter Spring ca. 35 Km Alice Spring, leg. Strelow, a. 1932-33 AD. 6 mi. W Alice Springs leg. Nelson 9 18 IX 1967 NY. Acacia Well, 25 mi. NE Undoolya Station, leg. Perry 3294 6 III 1953 CANB,K. Queensland. Leg. R. Brown 5226 p.p. VIII-X 1802 BM. Burnett Distr. Kingaroy, leg. Smith 3064 16 IV 1947 CANB,GH,K,NY, Darling Downs Distr., S Inverai School, leg. Johnson 443 30 III 1958 CANB. Northumberland Islands. Part I Keppel Bay, Part II Short Bay, Thirsty Bay Broadsoun, leg. Brown 5226 15 XI 1802, varios especímenes sin que se pueda atribuir la localidad precisa a ninguno, uno de ellos no pertenece a esta especie, BM. South Australia. Mt. Loft, Torrens Gorge, leg. Jackson 489 12 VI 1963 G,P,S. Northern Flinders Range, Gammon Rangers, leg. Eichler 12602 15 IX 1956 AD,P. Mount Lofty Range, near Mt. Jagged, leg. ipse 14273 13 X 1957 AD,P. New South Wales. Botany Bay, leg. Cap. Cook's First

Voy. 26 IV- 6 V 1770 BM. Sydney, Bondi Bay, leg. Tilden 542 IX 1912 BM, F,G,GH,K. Wilson's Promontory, leg. Meebold 2313 I 1929 M. Alentours de Sydney, leg. Verreaux 1844-1846 P. Capital Terr. SE base Black Mt., 600 m leg. McKee 11678 14 X 1964 Neótipo P. Isótipo CANB. Canberra, Ginninderra leg. Michael 2 17 III 1960 CANB. Narrabundah, leg. Michael 10 et 11 19 III 1960 CANB. Victoria. Port Philip, leg. Müller 268 K. Ib.,leg. Gunn 56 K. Melbourne, Riversdale, leg. Valentin 24 III 1928 S. Victoria Desert, Fraser Range, leg. Helms 12 X 1891 AD,K. Grampian Mts., Hall's Gap, leg. Tilden 827 1 XII 1912 G,GH,K. Tasmania. Van Diemen's Land, leg. Hügel M, W. Ib.,leg. Hooker 1084 K,P,UPS. Georgetown, leg. Gunn 94 a. 1842 v. 1844 BM,K,LY. Hobart, leg. Le Guillou, Voy. "La Zélée" a. 1839-41 P. Norfolk Islands. Anson Bay, leg. Comish 122 p.p. 8 I 1939 K.

NUEVA ZELANDIA.

Leg. Hooker BM,K. Ib., a. 1852 p.p. FI,K,LY,P,S. Leg. Cap. Cook's First Voy. 1768-71 Ex herb. Banks & Solander S,US. Pr. Teoneroa, Tizadu, Tolaga, Opuragi, Motuaro, leg. Banks & Solander 1769 BM. Leg. Kirk GH. North Isl. Rivière Tamise, leg. D'Urville, Voy. Astrolabe, Tipo O. ambigua Rich. P. Leg.D'Urville 322,228,698,235 K. Margins lake near Waimaté Bay,Islands, leg. Cunningham 590 1834 Tipo O. lacicola Cunn. K. Near Matauri opp. Cavallos, leg. Cunningham 236 1833 Tipo O.divergens K. Near Waimaté, among Ferns, leg. ipse 235 1834 K. Worxer Bay, leg. Kirk F. Leg. Cunningham 591 p.p. 1838 K. South Isl. Awatere, 4000 ft., leg. Travers II 1909 M. Bay of Islands, S shore, leg. Cunningham 592 1834 Tipo O. crassifolia Cunn. K.Isótipos GH,NY. Canterbury, Mt. Peel, leg. Lester-Garland VIII 1924 K.Baie des Isles, leg. Thorouds a. 1840 P. Auckland Islands. Leg. Hombron, Voy. Astrolabe et Zélée a. 1838-40 P. Kermadec Islands. Sunday Island, leg. Cheeseman 6 VIII 1887 K.

Lord Howe Island. Ned's Beach alt. 5 m, leg. Balgooy 1054 20 VII 1965 CANB,L. Leg. Gillivray 719 Voy. Herald IX 1853 K. Ned's beach, leg. Hoogland 8748 XI 1963 CANB.

OBS. Especie sinonimizada,por muchos autores, a O. corniculata L. Los autores antiguos conocían mejor esta especie. Se diferencian entre sí por el color de la flor, el porte de la planta, las cápsulas, el sistema radicular tamaño y esculturas de las semillas.

8. Oxalis corniculata L. ssp. corniculata(1)

Fig. 5

Linnaeus, Sp. Pl. ed. 1. 1: 435. 1753; ed. 2. 1: 623. 1762 excl. var.α Thunberg, Oxalis 22.1781.Jacquin, Oxal. 30 f. 5.1794 excl. villosa. Lamarck et Candolle, Fl. Fr. 5: 856.1805.Ib., 1815. Roxburgh, Fl. Ind. 2: 457. 1832; ed. 2. 384.1874. Candolle, Prodr. 1: 693. 1824. Billot, Ann. Fl. Fr. All. 20. 1855. Le Maout et Decaisne, Fl. Sard. Champs 2: 528-9. 1855. Cosson et Germain St. Pierre, Fl. Env. Paris 56-7.1861. Oliver,in Fl. Trop. Afr. 1: 296-297.1868. Parlatore, Fl. Ital. 5: 270. 1872. Battandier, Fl. Algérie 173. 1888. Trelease, Mem. Boston Soc. N. Hist. 4:87 88.1888. Goiran, Bull. Soc. Bot. It. 1896: 97.1896. Britton & Brown, Ill. Fl. 2: 346, f. 2252. 1897. Rouy et Fpucaud, Fl. Fr. 4: 124. 1897 (incl. v. genuina et minor). Coste Fl. Fr. 1: 267.1906. MOschler, Fl. Egypt 1: 564-565.1912.Oliver, Tr. Proc. N. Zeal. Inst. 49: 140. 1917. Schinz u. Guillaumin in Sarasin u. Roux, Nov. Caled. 1(2): 159.1920. Wiegand, Rhodora 27: 117,120-121.1925.Knuth, Pflreich. 146-8.1930. Jahandiez et Mai-

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(1) El epíteto alude a la forma y disposición de los frutos.

re, Cat. Pl. Maroc 2: 448.1932. Masamune,Tr.N.H.Soc. Formosa 28: 431.1938. Fournier, Quatre Fl. 616, f. 2647.1946. Hara, J. Jap. Bot. 24: 103, f. 28 1949. Fernald, Gray's Man. Fl. 944. 1261. 1950. Exell e Mendonça, Consp. Fl. Angola 1: 261 p.p., excl. syn. 1951.León y Alain, Fl. Cuba 2: 368,f. 150. 1951. Rogers, Gray Bull. n.s. 2: 268, 269. 1953.Eiten, Taxon 4: 99, 104, 1955. Sealy, Kew Bull. 11: 365.1957. Young, Watsonia 4:55.1958; Fl. Eur. 2: 192. 1968. Wilczek, Fl. Congo Belge 7: 7. 1958. Tutin & Warburg, Pl. Brit. Isl. 396. 1958. Owi, Fl. Jap. 580.1960. Butcher, New Ill. Brit. Fl. 1: 545, f. 1961. Allan, Fl. N. Zeal. 1: 239.1961. Symon, Tr. Roy. Soc. S.Austr. 84: 74.1961 p.p.Munz & Keck, Calif. Fl. 148.1959. Eiten, Am. Mid. Nat. 69: 294-295,299.1963. Exell in Fl. Zambes. 2: 150-151.1963.Lawalrée, Fl. Belgique 4: 235-236.1963. Backer and Brink, Fl. Java 1: 245.1963. Issler, Loyssonet, Walter, Fl. Alsace 328.1965. Scholz, Verh. Ver. Bot. Brandenburg 106: 51-53.1966. Wildenauer u. Schreiber, Prodr. Fl. SW Afr. 63(4) 3,5.1966. Schreiber, Bot. Jahrb. 86: 297.1967. Rechinger, Fl. Iran. 40:3-4.1966.Munz, Suppl. Calif. Fl. 13.1968. Exell e Gonçalves, in Fl. Moçambique 35: 3. 1969. Burbidge and Gray, Fl. Austr. Cap. Ter. 237. 1970. Green, J. Arn. Arb. 51: 207. 1970. Kabuye in Fl. Trop. E. Afr. 3, f. 5. 1971.Long and Lakela, Fl. Trop. Florida 503.1971. Veldkamp in Steenis, Fl. Males. 7 (1): 155-156. 1971. Lourteig, in Jovet et Vilmorin, Suppl. Coste, Fl. Fr. 1: 69. 1972. Adams, Fl. Pl. Jamaica 376.1972. Delanghe et coll.,Nouv. Fl. Belgique 332. 1973. Ahles, Man. Fl. Carol. 647,648, f. 1974.Michelozzi, Webbia 32: 423-428.1978 exl. synonym.[Linnaeus,Hort. Upsal.1:116.1748.

O. repens Thunberg, Oxalis 16. 1781; Fl. Capensis 538.1823. Jacquin,l.c. 32, lám. 78, f. 1.Gleason, Ill. Fl. 2: 45, fig. 1958. Candolle, l.c. Ecklon et Zeyher, Enum. 1: 83.1836. Lawalrée, l.c. 236-7. Tipo Africa, Thunberg 11118 UPS.

? O. pubescens Stokes, Bot. Mat. Med. 2: 558.1872. Tipo: no existe.

O. Acetosella Blanco, Fl. Filip. ed. 1: 388. 1837 non L.! Tipo Manila, Blanco 226 GH.

O. herpestica Schlechtendal, Linnaea 27: 525. 1856 Tipo: Cult. Halle, orig. Guatemala, no existe.

? O. taiwanensis (Masam.)Masamune, Tr. N.H.Soc. Formosa 30: 339-340.1940.

O. corniculata L.ssp. repens (Thunb.) Masamune, Mem.Fac. Sci. Agr. Taihoku Univ. 11: 257-258 excl. synon. 1934.

O. c. L. v. minor Ecklon et Zeyher, Enum. 1: 83 N° 648β 1836. Tipo: Africa, Cap, Ecklon & Zeyher 648 L.

O.c. L. v. repens (Thunb.) Zuccarini, Denkschr. Ak. München ser. 2. 1:230 1831. Masamune,l.c. 28: 432.1938. Young, l.c. 55-6; in l.c. 1968.

O. c. v. pusilla (Salisb.) Petermann, Fl. Lipsiae 507.1838 n. illeg.!

O. c. v. minor Lange in Willkomm et Lange, Prodr. Fl. Hispan. 3: 520. 1880 non Ecklon et Zeyher! Tipo: España, San Sebastián,leg. Lange.

?O. c. v. f. uniflora Szyszyl, Pl. Rehmann. 2: 21. 1888 Tipo: no hallado.

O. c. v. microphylla Gómez Maza, An. Soc. Esp. H. Nat. 19: 225. 1890 non Poiret! Tipo: CUBA.

? O. c. f. erecta Makino in Iinuma, Somoku-Dzusetsu ed. 3. 2: 664. 1910: Ill. Fl. Nippon 399, f. 1197.1940. J. Japan. Bot. 18: 40.1942.S. descr. lat.! s. tipo!

O. c. v. reptans Laing, Tr. Pr. N. Zeal. Inst. 47: 28.1915 pr. max. part. Tipo: Norfolk Isl., Laing 113 CANTY.

O. c. v. macrophylla Arsène ex Knuth, Not. Berlin 7: 500.1919; l.c. 151 1930. Tipo: no indicado; todos los especímenes de Arsène determinados por él mismo pertenecen a esta especie.

O. c. v. *taiwanensis* Masamune Tr. N.H.Soc. Formosa *28*: 431-432.1938.Tipo perdido.

O. c. v. *subglabra* (Kuntze) Masam., *l.c.* 432.

O. c. v. *repens* (Thunb.) Zucc. f. *speciosa* Masamune, J. Trop. Agr. Formosa *2*: 132. 1930. Hosokawa in Masamune, Short Fl. Formosa 109. 1936. Masamune, *l.c.* 432-433.1938. Tipo perdido.

O. ceratilis Meyer in Drège, Zwei Pfl. Docum. 72.1844 n.n.!

O. reptans Sol. ex Forster f., Prodr. 90. 1786 Nº 519 n.n.! Endlicher, Prodr. Fl. Norfolk 72.1833 n.n.!

O. pusilla Salisbury, Tr. Linn. Soc. *2*: 343, pl. 23, f. 5. 1792 n. illeg. Roxburgh, *ll.cc.* Sealy,*l.c.*

O. minima Steudel, Nom. ed. 1. 579. 1821 n. illeg.!

? O. monadelpha Roxburgh, East Ind. Co. Mus., lám. 1433. 18... inéd. Sealy,*l.c.*

Acetosella corniculata (L.) Kuntze, Rev. *1*: 90.1891.

A. corniculata L. v. *subglabra* Kze., *l.c.* Tipo: no indicado.

A. herpestica (Schlecht.) Kze., *l.c.* 92

Xanthoxalis corniculata (L.)Small, *l.c.* 667.1903; *l.c.* 52.1907. Holub, Bot. Közlem, *59*: 39, f. A.1972.

X. repens (Thunberg) Moldenke, Castanea *9*: 42. 1944.

NEOTIPO. Spec. cult. Horto Upsaliensi Herb. Thunberg Nº 11084, UPS.

Hierba prostrada, pluricaule ± hirsuta. Raíces fibrosas. Tallos h. 50 cm, ramificados, ascendentes en los ápices. Internodios de largo variable. Hojas a veces fasciculadas, largamente pecioladas (h. 7 veces el largo de la lámina). Estípulas soldadas (0,8-30 x 1- 30 mm) ápice truncado, hirsuto-ciliadas y pubescentes. Láminas obovadas, cuneadas (4-20 x 5 - 20 mm) incisión poco profunda ± abierta; lóbulos obtusos, redondeados, haz glabro, envés (a veces sólo la mitad) ± pubescente, borde adpreso-ciliado. Cimas umbeliformes 2-7-floras. Pedúnculos laxamente pilosos, ascendentes (h. 21 cm). Brácteas linear-triangulares (0,5-3mm), bractéolas lineares menores, ciliadas. Pedicelos(4-15 mm) acrescidos en el fruto,± deflexos.

Sépalos lineares o angostamente ovados, agudos (2,5- 5,5 x 0,5 -1,5 mm) verdosos, a veces ± purpúreos, poco pubescentes. Pétalos amarillos, oblongo-subespatulados, ± dos veces el largo del cáliz (5-11 x 1-2,5 mm). Estambres glabros, los largos ca. 6 mm, los cortos ± 4 mm, soldados h. ± 1/3. Pistilos (macro-, meso y microstíleos) h. 8 mm; ovario oblongo-agudo, retrorso-pubescente, estilos adpreso-~~antrorso~~-pubescentes, estigmas 2-lobulados, papilosos; carpelos 4-15-ovulados.

Cápsula cilíndrica, aguda, larga (5-20 x 1- 3 mm diám.) retrorso-pubescente con ± pelos pluricelulares, glandulosos, de lumen ancho, mezclados; lóculos generalmente 8-10-(14-)seminados, interiormente pubescentes; cáliz h. 1/5 - 1/4, estilos generalmente casi totalmente soldados, rectos.

Semillas pardo-rojizas, pequeñas (ca. 1 mm), ovado-apiculadas, aplanadas, 6-costadas, estrías transversales tuberculadas en las intersecciones.

Distribución geográfica. Especie cosmopolita de origen probablemente mediterráneo-europeo, conocida desde tiempo inmemorial y citada en las obras clásicas más antiguas. Se adapta a todos los climas a condición de

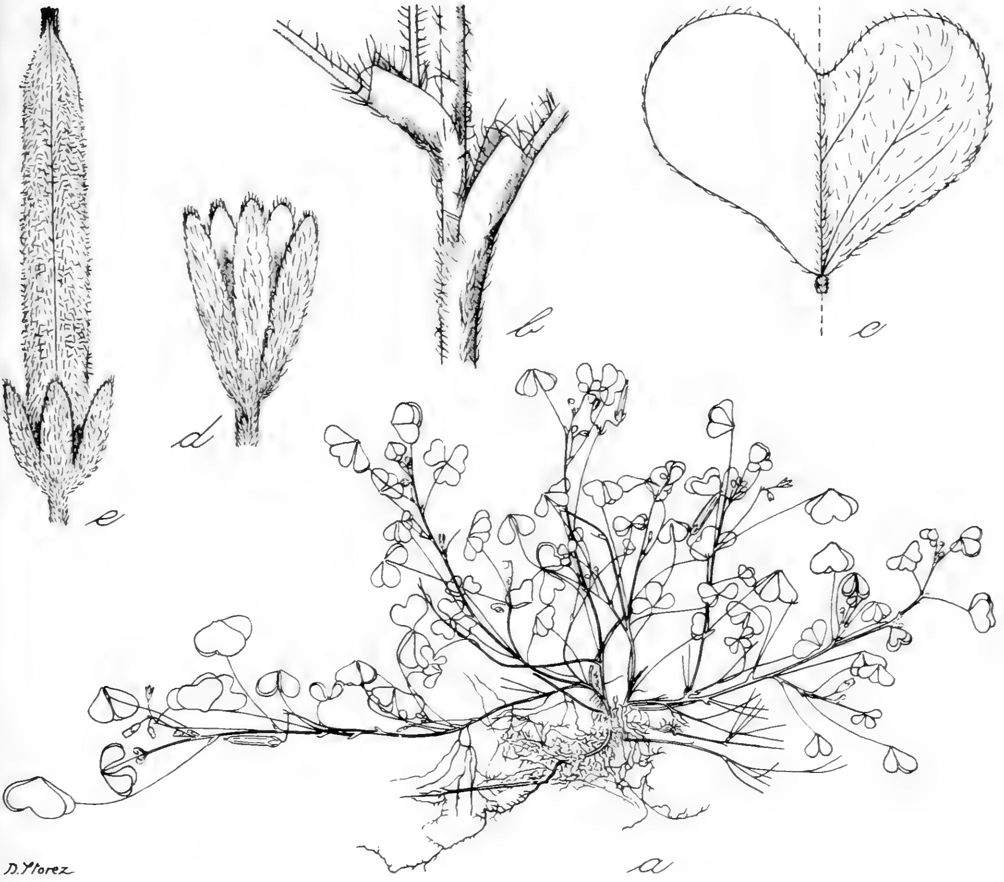

Fig. 5. *O. corniculata* ssp. *corniculata*: a, planta x ½; b, inserción peciolar x 5; c, folíolo x 3; d, cáliz x 5; e, fruto x 3. a-c, Jovet 1968, d,e, Jovet 1969 P. Storez del.

de hallar suficiente humedad. Los especímenes más desarrolados provienen, en general de terrenos de labranza. La cápsula raras veces es casi glabra por razones ecológicas muy especiales. A la madurez los pedicelos son horizontales y las cápsulas se dirigen hacia arriba o bien son reflexas sobre el pedicelo.

Material estudiado. Herb. van Royen, Burman pag. 107 L. Herb. Liefe C. Glasgow Bot. Gard., Cult. Bot. G. Cambridge, cult. leg. Marks 1 18 III 1955 CGE. Leg. Colla a. 1824 BR. Herb. Linneano 600. 43 LINN. Leg. Osbeck S.

CANADA. Ontario, cult. 3 mi. SE St. Thomas Elgin Co., leg. James 2521 18 IX 1954 US. SE Newfoundland, St. John, leg. Ayre III 1932 GH.Prince Albert, Saskatchewa, leg. Krívda 13 12 VI 1965 OXF.Ib., leg. ipse 65-103 12 VI 1965 BM.

ESTADOS UNIDOS.

Alaska. Juneau, leg. Anderson 533 25 VI 1917 NY.

Arkansas. Garland Co., Hot Springs, leg. Mŏldenke 1412 15 II 1931 NY.

California. San Francisco, leg. Eisen 18 IV 1875 UPS. San Diego Co., 2 mi. S Vista, leg. Kurtz 6 VIII 1937 PENN. Los Angeles, leg. Thackery 357 5 XII 1923 NA. District of Columbia. Ca. greenhouse, leg. Batchelder 4714 21 IV 1917 GH. W of National Museum, leg. Killip 44964, 44963 et 44965 20 VI 1955 NY. Florida. Leg. Rugel 1842-49 BM. Polk Co., Lake Hamilton, Main St., lèg. Conard 4 III 1963 GH, NY. Illinois. Rock Co., leg. Haynie 3583 X 1938 F. Chicago, leg. Nelson IX 1898 LY. Indiana. West Lafayette, Station Greenhouse, leg. Sturat 28 IX 1910 NA. Louisiana. Port Tads., leg. Tracy & Lloyd 268 8 IV 1900 US. Massachusetts. Prince Edward´s Island, Charlettetown, leg. Fernald & St. John 226 1914 BM,F,GH,K,LE,NY,OXF,L,P,PRC,S,US. Northampton, leg. Winslow 29 X 1880 US. Maryland. Prince Co., Beltsville in garden, leg. Lourteig 2466 X 1969 P. Michigan. Ab. Alma, leg. Davis 22 IX 1893 UC. City of Port Huron, Dodge´s Yard, leg. Dodge 31 VII 1916 MICH. Maine. Lawrence, 830 ft., leg. Horr E 467 10 VIII 1942 UC. Mississippi. Biloxi, leg. Tracy 5000 18 III 1898 US. Catalina Isl., leg. Lloyd & Tracy 261 28 VIII 1900 NY. Missouri. Jackson Co., Independence, leg. Bush 106 23 III 1894 GH,NY,US. Ib., leg. Mackenzie a 10 IV 1898 S. Nebraska. Red Cloud, leg. Bates 4711 14 IX 1908 GH. New Haven. Yale, leg. Desvaux P. New Jersey Cape May, leg. Brown 20 VIII 1904 PH. Atlantic Co., Margate, leg. Benner 10424 29 IV 1948 PH. New Mexico. San Miguel Co., Las Vegas, N. Mex. Highlands Univ., leg. Eiten 1192, 1194 et 1195 I 1958 NY. New York. Syracusis, leg. Wibbe s. 1877 NA. Kings Co., Brooklyn Bot. Gard., leg. Monachino 23 V 1959 NY. North Carolina. Wake Co., Raleigh, campus, leg. Godfrey 4 II 1937 GH. Orange Co., Chapel Hill, leg. Ahles 53973 13 V 1961 USF. Oregon Waverly St Salem, leg. Nelson 3321 24 VIII 1920 GH. Near Portland, Linnton, leg. Suksdorf 1621 28 IX 1910 GH. Pennsylvania Ballast, near Communnipaw Ferry, leg. Addison Brown X 1880 GH,NY. Berks Co., near Oley Furnace, 1,5 mi. N Friedensburg, leg. Wilkens 7272 26 IX 1943 PH. South Carolina. Berkley, leg. Porcher F. Beaufort Co., Beaufort, leg. Ahles 15590 27 VI 1956 US. South Dakota. Brookings, greenhouse, leg. Thornber 10 VII 1892 GH, UC,US. Ib., leg. T.A. Williams IV 1892 US. Texas. Bejar, leg. Berlandier 152, 1810 FI, LD. Hidalgo Co., N of Mc Allen, leg. Painter & Barkley 14470 29 II 1944 S. Virginia. Nausemond Co., Harrell Sideing, leg. Fernald & Bayard 7085 9 IV 1937 GH,PENN. Craig Co., Craig´s 600 m, leg. Steele 1 29 VIII 1903 NY. Wisconsin. Univ. greenhouse, leg. Williams III 1958 NY.

MEXICO.

Chiapas. Pueblo Nuevo Solistahuacán, 6500 ft., leg. Ton 2868 15 VIII 1967 WIS. Chihuahua. Base Mt., Mohinora, 8 mi. fr. Guadalupe & Calvo, leg. Nelson 4851 23-31 VIII 1898 GH. Coahuila. Galeana Canyon, 6 mi. bel. Iturbide, 3650 ft., leg. Tinkharn 9781 30 VIII 1940 GH. Guadalajara, 1580 m, garden, leg. Gregory & Eiten 145 22 II 1956 MICH. Hidalgo. Real del Monte, 8000 p., leg. Galeotti 3987 VIII 1840 BR. SW side Cerro San Andrés, 3100 m, leg. Beaman 4363 6 IX 1960 GH. Mexico. Zaladingo, leg. Schiede XI 1828 P. Near Tlalnepantla, leg. Rose et al. 8402 6 VII 1905 US. Jalisco. NW of S. Sebastián, leg. Mexia 1888a 16 III 1927 UC. Guzmán, 1460 m, leg. Gregory & Eiten 336 16 VII 1956 MICH,NY,S. Michoacán. Morelia, jardin du collège, leg. Arsène 30 IV 1909 K,US. Oaxaca. Oaxaca, leg. Conzatti y González 1194 IX 1901 GH. Chiltepec, Acahual, 120 m, leg. Martínez Calderón 1386 8 V 1967 F,MICH,UC. Puebla. Puebla, azotea del Colegio, leg. Arsène 1934 VI 1908 (s. macrophylla, det Arsène) LY. Puebla, archevâché, 2165 m, leg. ipse 1953 14 VII 1907 (s. macrophylla Arsène) LY,US. San Luis de Potosí. Route to Valles, garden, leg. Gregory & Eiten 35 10 VI 1956 NY. Sinaloa. Ocurahui, Sierra Surobato, leg. Scott Gentry 6292 1-10 IX 1941 GH, MICH,NY. Sonora. Santa Cruz Valley, leg. Thurber VII 1852 GH. Tamaulipas. Mun. Gómez Farías, Rancho del Cielo, 3700 ft., leg. Sullivan 316 5 VI 1971 NY. Tepic. Tepic, sur la route de Jalisco..... FI. Veracruz. Orizaba, leg. Botteri 781 VIII 1854 BM,K,LISU,OXF. Mirador, leg. Linden 812 II 1838 FI, GENT,K. Zacatecas. Tabasco, Mayito, leg. Rovirosa 348 10 II 1889 NY,US. Guerrero. Pungarabato, Coyuca, in ripa flum. Cutzamala, leg. Hinton 5880 5 IV 1934 GH,NY,US.

GUATEMALA.

Alta Verapaz. Coban, 4300 p., leg. v. Tuerckheim 302 II 1896 F,G,GH,NY,P, US. Near Cobán, 1260-1440 m,leg. Standley 69304 et 71857 26 III - 15 IV 1929 F. Chimaltenango. Barranco de la Sierra, SE of Patzún,ab. 2100 m,leg. Standley 61507 31 XII 1938 F. Chiquimula. Socorro Mts., betw. Finca San José and Montaña Nube, 1200-1700 m, leg. Steyermark 30983 1 XI 1939 F. Guatemala. Campo de Marte, près Guatemala, 1450 m, leg. Rodríguez 1924 25 II Guatemala Stadt, leg. Seler 2498 19 V 1896 GH,US. Huehuetenango. E of San Rafael Petzal, near crossing of Rio San Juan Ixtan, 1730 m, leg. Standley 83004 9 I 1941 F. Cuchumatane Mts., Huehuetenango to Concepción, 3350-3450 m, leg. Boeke 89 27 VIII 1976 NY,P. Izábal. Vic. Los Amates, Río Motagua, 85 m, leg. Standley 24360 24 V 1922 US. Jalapa. Jalapa, 1300 m,leg. Steyermark 32115,32157 et 32158 28 XI 1939 F. Potrero Carrillo, Hierba Buena, 1500-1900 m, leg. ipse 33052 11 XI 1939 F. Jutiapa. Jutiapa. Volcán Suchitán, NW Asunción Mita, 600-2050 m, leg. Steyermark 31948 18 XI 1939 F. Matitlán. Volcán de Pacaya, 1752 m, leg. Tonduz 442 6 IV 1921 US. Petén Leg. Bernouilli & Cario 70-3032 1866-67 BAS. Quezaltenango. Aguas Calientes, leg. Seler 3147 14 VI 1896 GH. Mts. ab.Zunil,Volcán Zunil, road to Fuentes Georginas, 2200-2350 m, leg. Standley 85768 3 II 1941 F. Retalhuleu. Finca Helvetia,leg. Muenscher 12465 6 V 1937 F. Sacatepéquez. Baños de San Lorenzo, near Tejar, 1650 m, leg. Standley 59867 14 XII 1938 F,G. Antigua 5000 pp., leg. Donnell Smith 2180 III-IV 1890 US. San Marcos. 6 mi. SW of Tajunmulu, 2300-2800 m, leg. Steyermark 36643 26 II 1940 F,US. Santa Rosa. La Joya de Limón, E of Cuillapa, ab. 900 m, leg. Standley 78301 25 XI 1940 F. SE of Barberena, 1100-1180 m,leg. ipse 77818 21 XI 1940 F. Sololá. Panajachel ab. Atitlán, 2100 m, leg. Gentry 6522 14 X 1972 MO,P. Betw. slopes Volcán Santa Clara and San Pedro, 1900-2100 m, leg. Steyermark 47110 6 VI 1942 F,MO.

COSTA RICA.

Cartago. N Cartago, along Río Reventado, 1460-1650 m,leg. Standley & Valerio 49405 26 II 1926 US. San José. Gazons des parcs de l'Observatoire à San José, leg. Tonduz 8047 VI 1893 BR,G. Vic. El General, 640 m, leg. Skutch 3848 I 1939 GH,K,MO,NY,S,US. San Josecito de Alajuelita, 1800 m, leg. Sastre 4853 et 4854 8 V 1976 P.

EL SALVADOR.

Ahuachapán. Vic. Apanea, 1400-1600 m, leg. Standley & Padilla 2995 24 I 1947 F. La Libertad. Vic. Santa Tecla, 790-950 m, leg. Standley 23060 10 IV 1922 GH,NY,US. Santa Tecla, leg. Villacorta 8137 I 1905 US. Chalatenango. E slope of Los Escaniles, 1160 m, leg. Tucker 1084 p.p. 18 III 1941 F,US. San Salvador. Vic. S. Salvador, 650-950 m, leg. Standley 19625 20 XII 1921 - 4 I 1922 GH,S,US. San Salvador, leg. Calderón 265 XI

1921 NY,US. San Vicente. Vic. San Vicente, 350-500 m, leg. Standley 21198 2-11 III 1922 US. Vic. Ixtepeque, ab. 400 m, leg. ipse 21459 6 III 1922 GH. Sonsonate. Vic. Armenia, leg. Standley 23503 28 IV 1922 GH,US. Vic. Sonsonata, 220-300 m, leg. ipse 18-27 III 1922 GH,NY,US.

HONDURAS.

Atlántido. Lancetilla Valley, near Tela, 20-600 m, leg. Standley 53414 6 XII - 20 III 1928 F,US. Comaguaya. Vic. Siguatepeque, ab. 1050 m, leg. Standley & Chacón 6727 25 III - 5 IV 1947 F. Vic. Comaguaya, leg. ipsi 5670 12-23 III 1947 F. Intibuca. Vic. La Esperanza, 1500-1600 m, leg. Standley 25603 31 I- 12 II 1950 F. Morazán. Mt. Uyuca, entre Quebrada Granadillo y Labranza, 2000 m, leg. Molina 2771 27 VII 1950 F,GH,US. Vic. El Zamorano, 800-850 m, leg. Standley 16092 2 II 1949 F,P. Olancho. Vic. Juticalpa, 380-480 m, leg. Standley 18066 5-16 III 1949 F.

NICARAGUA.

Chontales. Chontales, leg. Tate 146 1867 BM,K. Jinotega. Vic. Jinotega, 1030-1300 m, leg. Standley 9884 19 VI - 9 VII 1947 F. Managua. Vic. Casa Colorada near El Crucero, 800-900 m, leg. Standley 8177 14-25 V 1947 F. Sierra de Managua, 850 m, leg. Garnier A972 IV 1932 US. Matagalpa. Santa María de Ostuma, 1300-1500 m, leg. Williams et al. 23610 8-15 I 1963 F,G. Zelaya. Vic. La Luz-Sirena, 150-200 m, leg. Bunting & Licht 685, 14 III 1961 F,NY.

BAHAMAS. New Providence, in fruticetis, leg. Eggers 4414 7 III 1888 BM,K, MO,US. Bimini,Cat Cay, leg. Correll 45661 11 VII 1975 F,NY.

BERMUDA. Leg. Mosely, Challenger Exp. BM,MO. Grassmere, leg. Collins 413 2 XII 1915 F,GH,K,LE,NY,P,US. Devonshire, Middle Rd., leg. Manuel 326 29 XI 1963 A.

CUBA. Prov. Habana. Morro, in rupibus, leg. Ekman 1162 27 VI 1919 BM,F,LD, S,US. Streets of Marianao, leg. León 7081 1 III 1917 NY. Prov. Matanzas. Matanzas, S. Savarino Str., leg. Eiten 1012 II 1955 NY: Prov. Oriente. Loma del Gato (Sierra Maestra) 750 m, leg. Ekman 15691 9 XI 1922 F,G,K,P,S, UC. Arroyo Grande, 600 m, leg. Eggers 5133 IV 1889 P. Vic. El Cuero, leg. Britton & Lowell 12791 18,19 III 1912 NY. Prov. Pinar del Río. Valley of Jauco Riv., S of Baraco, leg. León 11721 GH. Sierra del Rosario, Rangel, 600 m, leg. Alain 765 IV 1949 GH.

JAMAICA. Castleton, 500 ft., leg. Harris 12384 25 VI 1916 F,K,MO,NY,P,S, US. St. Andrews, near Bellevue, 4000 ft., leg. Yuncker 17430 17 XI 1957 F,MICH,S.

HAITI. Vic. of St. Louis du Nord, leg. Leonard 14265 3 IV 1929 GH,NY,US. Dep. du Nord., Oriani, 1500 m, leg. Holdridge 905 20 XII 1941 GH,MO,NY, US. Isle de la Tortue, Nan-Jacques, leg. Ekman 9783 24 III 1928 S.

SANTO DOMINGO. Prov. Azua, San José de Ocoa, 1500 m, leg. Ekman 11770 4 III 1929 GH,S,US. Prov. Barahona, leg. Howard 8319 18 VIII 1946 BM,GH,NY US. Sommet du Col de l'Escalier, leg. Jacquemont 23 III 1827 LE,P. La Cumbre, leg. Raunkiaer 1138 8 IV 1906 C.

PORTO RICO. Adjuntas, ad vias, leg. Sintenis 4003 20 III 1886 BM,G,LD,M, P,PR,S. Rio de Maricao, 500-600 m, leg. Britton,Stevens, Hess 2411 2 IV 1913 F,MO,NY. Caguas, leg. Heller 924 24 III 1899 F,K,NY,US.

SANTO TOMAS. Leg. Hjalmarson a. 1850 S. Crown, leg. Raunkiaer 9 V 1906 BR,C. St. Peter, leg. Krebs 27 II 1848 C,NY. Denmark Hill, leg. Laub, a. 1932 C.

SANTA CRUZ. Two Friends, leg. Thompson 516 28 X 1923 NY. Leg. Benzon 6058

C. Leg. Eggers 1 VI 1871 C. Wells Nursey, Fountain Valley, 30 m, leg. Fosberg 54075 20 I 1972 US.

Europa – Asia.

SUECIA.

Bohusläu. Marstrand, leg. Eliasson 22 VIII 1879 S. Tanums Socken, leg. Thedenius VIII 1882 UPS. Götsborg. Moludal, Papyrus, leg. Hjärne 3 X 1940 Jonköping, leg. Andersson VIII 1869 UPS. Medelpad. Söråker, leg. Westerberg VIII 1872 S,UPS. Medelpad, vid Sudnsvall, leg. Hjort 1908 UPS. Oland. Lilla slottsvillan, leg. Wison Munthe 20 VIII 1898 S. Ib., leg. Wall VII 1935 S Ostergotland. Norrköping, leg. Engstedt 13 X 1931 S. Skåne. Bilinge, leg. Lönnegren VIII 1867 F,S. Nortibus ad Rynga, leg. Kurck 1 IX 1898 S,UPS. Eslöf, leg. Birger IX 1899 UPS. Småland. Gambby, leg. Plejel VIII 1900 S. Otcarsham, leg. Kohler 11 VIII 1913 S. Ljungby, leg. Ljünggren VIII 1880 S. Kalmar, leg. Lindström 1 IX 1884 GH. Södermanland. Gryts, leg. Ljungman 2 VIII 1889 S. Strengnass, leg. Samuelsson VII 1901 UPS. Falkenå, Kracklinge, leg. Ringselle VIII 1889 UPS. Stockholm. Stockholm, leg. Lagerwall VIII 1892 S. Ib., trädgården, leg. Bovallius VIII 1864 UPS. Uppland. Uppsala, Bot. Trädg., leg. A. Friss IX 1889 S. Hässelby, leg. Valentin 1 VII 1930 S. Cult. hort. Uppsal. Herb. Thunberg 11084 UPS. Neótipo. Västmanland. Arboga, leg. Kjellmert 29 VIII 1951 UC. Allhelgona s. Söra, leg. Schotte 25 VIII 1890 LE. Arboga Stad, leg. Starbäck 7 IX 1952 S.

INGLATERRA.

Ins. Malden, leg. Macrae a. 1825 P. Chelsea Gardens, a. 1788 Ex herb. J. E. Smith LINN. Channel Islands, leg. Doubleday NY. Somerset, Minehad, leg. Gifford 244 1866 OXF. Dorset, Chenole, leg. Moyle Rogers 327 VIII 1875 K. Cornwall, Par, leg. Graham 9 VI 1908 K. Warwick, Westam House, leg. Young 4417 28 VI 1952 K. Bristol, near King's Weston, leg. Salisbury Ex herb. J. E. Smith LINN. Devonshire, Lynston, leg. W.J. Hooker VII 1806 Ex herb. J. E. Smith LINN. Cheltenham, Cult. Rokery, leg. Milne Redhead 11 VIII 1929 K. Sark, near Vicarage, leg. Edmonds 3 30 III 1930 K. ersey. St. Aubins, leg. Christy VIII 1837 GH. Guernsey, leg. Fox VII 1867 OXF. Scotland, Roy. Bot. Gard., VII 1846 P.

DINAMARCA.

In haven ved Jonstrup, leg. Mortensen 4 IX 1881 LCU,LY. Ib., leg. ipse 9 X 1891 PR. Hauniae, horto infestans, leg. Lange 12 VIII 1893 L. Sjelland Kjobenhavn, leg. Gabrielsson VII 1881 UPS. Geltingen f. Slevigan, leg. Jessen VII 1872. S. Sjoll, Jonstrup, leg. Mortensen 12 IX 1879 S.

HOLANDA.

Nieuw St. Joosland, eiland Walcheren, leg. Ankersmit VIII 1879 F,L. Zuid Beveland, leg. Bosch VII 1840 L. Dordrecht, leg. Visyek 15 VIII 1884 L. Heerenveen, leg. v. Claervergen 134 17 IX 1931 UC. Schiedam, leg. Kern 12631 23 X 1930 L. Moeslanden by Amsterdam, leg. Doornib VII 1848 L. Texel, leg. Groll I 1881 L. Rotterdam, leg. Risch VII 1898 L. Neuzen, leg. Loos 21 VIII 1937 L.

BELGICA.

Tongerloo, leg. Hoosendock VIII 1971 BP,FI,P. Seminaire de St. Trond (serres chaudes), leg. Vandenborn 202 15 IV- 3 V 1866 K,L. Env. Louvain, leg. Dieudonné VII 1870 LY. Anvers, Tongerloo, leg. Thielens VII 1872 BP. Verberto pr. Anvers, Ex herb. Wahlsted F. Eola, leg. Lebrun 863 VIII 1930 F. Près Gand, leg. Vandasyken 17 X 1876 LY.

FRANCIA. Ex herb. Vaillant 4 P. Hort. Paris. 20 V 1835 FI.

Alpes Maritimes. Cannes, leg. Müller 81 22 V 1851 FI. Castellar, leg. Williams 1 29 III 1899 GH. Menton, leg. Gandoger 3 XII 1882 LY. Alsace. Strasbourg, leg. Schimper X 1872 F. Ariège. Foix, jardin, leg. Sudre 13 VI 1891 FI. Ib., leg. Giraudias IX 1889 BR,P,UPS. Bouches-du-Rhône. Marseille, leg. Hervier VI 1880 K,P. Les Miramas, leg. Eugène 795 7 IX 1859 P. Calvados. Lisieux, herb. Germain et Cosson 3 VIII 1846 P. Monceaux, leg. Bonnechasse VIII 1882 LY. Cantal. Cros-de-Montver, Laroquebrou, leg. Héribaud 1172 VIII 1898 FI,LY,P. Charente. Lavalett, leg. Rocherbrune VI 1843 P. St. Germain sur Vienne, leg. Duffort VI 1887 LY p.p. Rupella, leg. Rallet VII 1947 S. Corrèze. Brive, 120 m, leg. Dumas V 1877 LY p.p. Ussel, leg. Gonod d' Artemare VIII 1897 LY. Corse. Corte, leg. Kralik 8 VIII 1849 P. N Solenzara, leg. Aellen 1832 18 VII 1933 LCU,LE. Bastia, leg. Debeaux 25 III 1865 LY. Côte-d'Or. Flavigny, 400 m, leg. Desplantes VIII 1925 S. Côtes-du-Nord Perros Guirec, leg. Rodríguez 832 IX 1917 P. Treglamus, leg. Guerniou 24 XII 1972 P. Deux-Sèvres. Nazières-en-Gâtine, à la Gagnerie, cult., leg. Litardière 1257 10 IX 1946 L. Doubs. Besançon, leg. Bickart VII 1888 P. Nans, leg. Billot 120bis 29 VII 1861 LE,LY,NY, Eure. Bois-Jerôme, leg. Toussaint 8 X 1897 P. Jardins des Andelys, leg. ipse 20 IX 1899 LY. Finistère. Brest, leg. Thiébaut I 1868 P. Gard. Vigan, leg. Abthouard 7 IX 1879 LY. Gironde. Arcachon, Av. Rapp, leg. Jovet 8 IX 1968 P. Jardin Botanique de Bordeaux, leg. Jovet 11 VII 1967 P. De Bordeaux à Bouseat, leg. Pancher 20 V 1849 LY Haute-Garonne. Cour de l'Arsenal, leg. Loret 12 XI 1857 P. Hautes-Pyrenées. Lourdes, leg. L. Chevallier 1 VIII 1874 P. Bagnères de Bigorre, leg. Lartigue IX 1847 P. Hérault. Montpellier, leg. de Montesquieu IV 1853 LY. Béziers, Crouzette, leg. Renaud 832 20 VI 1926 MPU. Après la Merdanson, leg. A. de St. Hilaires IV 1846 MPU. Hyères. Island of Porquerolles, leg. Garland 26 IV 1901 K. Ille-et-Vilaine. St. Servan, leg. Jeanpert 16 X 1892 F, P. Rennes, leg. Humbert VI 1904 P. Indre-et-Loire. Lariche, leg. Blanchet P. Tours, coll. Bezançon VII 1864 LY. Isère. La Tronche, près Grenoble, leg. Verlot 336 18 VI, 2 IX 1874 LY,P. Ste. Pezenne, près St. Martin d'Hères, leg. Duret VI 1893 P. Landes. Vieux Boucau, leg. Jovet 23 X 1969 P. Saubusse, Prorpieté Betbeder, leg. ipse 23 X 1969 P. Loire-Atlantique. Nantes, leg. Lloyd a. 1852 MPU. Chapelle des Marais, leg. Augé de Lassus X 1847 S. Lot-et-Garonne. Autour d'Agen, leg. Carroute 12 III 1864 LY. Aiguillon, Le Passage, leg. Coste et Jeanjean 1621 12 IX 1915 P. Maine-et-Loire. Angers, leg. Le Chatellier 881 1852 P. Saumur, leg. Puel 10 VIII 1845 P. Manche. Cherbour, leg. Corbières 3 VIII 1883 US. Beauficel, leg. Tobard 25 X 1869 P. Mayenne. Port de la Grande Traverse, près du lavoir, leg. Savouré 16 VIII 1894 P. Morbihan. Vannes, leg. Pontarlier VII 1846 P p.p. Oise. Compiègne, leg. Grave 18... P. Paris. Jardin des Plantes, leg. Jovet 14 VI 1975 P. Env. Parc de Neuilly, leg. Jacques a. 1848 P. Puy-de Dôme. Confluence de l'Allier et de la Dore, aux Baraques, leg. Chassagne 15 IX 1929 P. Pyrenées Atlantiques. Talus du lac Marion, leg. Jovet 4 XII 1966 P. Pau, leg. Brutelett XI 1865 P. Borda, leg. Bancroft IV 1928 OXF. St. Jean-de-Luz, leg. Gandoger 15 IV 1895 LY. Montant Betharrham, leg. Guyon 3806 4 VIII 1876 GENT. Rhône. Lyon, leg. Timeroy, a. 1840 P. La Mouche, leg. Annier 23 X 1839 LY. Seine. La Garenne, Colombes, leg. Engel 778 9 VI 1942 P. Seine-Maritime. Bonsecours, near Rouen, leg. Tidestrom 13445 19 IX 1934 LCU. Entre Bouvreil et Cauchorse, leg. Toussaint vers. 1780 P. Var. Hyères, old walls, leg. Raine 3 IV 1905 GH. St. Tropez, leg. Camus a. 1910 P. Toulon, La Calade, leg. Arènes 5264 XII 1918 P. Vauclu-

se.Avignon, leg. Requien, 1834 P. Ib., leg. Thos IX 1871 BP. *Vendée*. Luçon, leg. Seyrat X 1923 P. Le Bourg-sur-la-Roche, à Beautour, leg. Durand X 1953 UPS. Vienne. Env. Chauvigny, leg. Boutron *702* VIII 1893 GENT. *Yvelines*. Versailles, leg. Jeanpert 21 X 1894 F,P. Trianon, leg. Cosson 3 VI 1846 P.

ALEMANIA.Leipzig auf Gartenland, leg. Richter *380* BP,FI,GH,K,OXF,P,PRC, UPS. Autour de Carlsruhe, leg. Döll *120* 17 VII 1840 L,LE,LY,MPU,p.p.P,S. Harz, Blakenburg, leg. Klingermann VII 1889 NY. Waldenburg, Sachs, leg. Rabder 3 IX 1882 GH. Pette, leg. Nördike *424* X 1879 US. Hamburg, leg. Chamisso a. 1830 LE. Hanover, leg. Roemer PRC.München-graetz, leg. Sckera IV 1869 BP.Jena, leg. Röll 15 VIII 1872 BP.Batavia, Teenvosch-Vlanderen, leg Walraven 13 VII 1859 PRC.Brunschweig, leg. Koch 621 IX 1884 BP.Görlitz, leg. Peck VIII 1869 BP,OXF.

CHECOSLOVAQUIA.

Bohemia vor., distr. Loberac, in hortis vic. Habartica, leg. Jehlik 6 X 1964 P,PR. Sloupnice, leg. Fleischer 8 X 1908 PR,PRC. Hortus Presl., PR. Bohemia Hlubosky, leg. Domin VII 1899 PRC. Libomyski, leg.Oborzalek X 1907 PRC. Podebrady, leg.Sechl 28 VIII 1943 PRC. Bohemia, vic. Hrusona, leg. Kroulik 2591 7 VIII 1939 PRC. Böhmen, Olleschau, leg.Stelzhamer 22 VIII 1925 S.

SUIZA.

Genève, Jardin Botanique, leg. Reuter 28 VIII 1863 P. Lugano, Castagnola, Ticino, 950 m, leg. Lousley 5 V 1930 K. Tessin, Lugano, 300 m, leg. Wistrand 19 VI 1954 S. Ib., leg. Roos IV 1923 S.

AUSTRIA.

Tirol, Lodrone, 300 m, leg. Cimarolli VI 1893 LY. Trient, San Marco, leg. Valdé lièvre PR. Brizia, leg. Bracht a. 1838 PR. Heimburg, Donau, leg. Aust IX 1889 PR. Styria, Gratz, leg. Prokopp *318* BP. Tirolds Kaltern, leg. Beck 9 X 1875 PRC. Horenhut, leg. Hrb IX 1867 BP. Bei N Radagund, leg. Aust 12 VIII 1874 BP.

HUNGRIA

Orawieza, leg. Wierzbicki 189... FI. Erlau, leg. Vrabélyi *777* 11 X 1869 P. Posoni, leg. Sadler a. 18... LY. Zemple, leg. Suiltinge VIII 1875 BP p.p. Ganovszky, leg. Vágner VIII 1885 BP. Varpalota, leg. [illegible] VIII 1919 BP. Munkrais, leg. Margittai V 1899 BP. Györ, leg. Polgár *1069* 20 VII 1909 BP.

RUSIA.

Rus. merid. Tauria leg. Kowalewsky a. 1899 LY. Caucaso, leg. Hohenacker 21 I 1838 BP? Caucasus, leg. Ledebour K. Srenna, leg. Dietrich 28 VIII 1881 BP. Ung Var, leg. ipse VIII 1878 BP.

ESPAÑA

Iberia, leg. Wilhems VIII 1824 LE. Valence, Segorbe, leg. Pau ex herb.Sennen *4162* 25 X 1920 FI. Guipuzcóa, Irún, leg. Rouy 31 V 1891 LY. Oviedo, leg. Gandoger 5 VI 1910 LY. Près Mucria, leg. Bourgeau *1714* 17 IV 1852 FI, K,LE,LY. Gibraltar, leg. Bouchet a. 1822 MPU. Argentona, NW v. Mataro, leg. Colaris *1354* 13 IV 1867 U. Barcelona, leg. ipse *1006* 15 III 1967 U. Puerto Real, leg. Arozarena *51* XI 1880 P. Penticours, leg. Francaville VII 1828 P. Sevilla, Alcázar, leg. Jovet 21 V 1967 P. Asturias, Grado,leg Rodríguez Suárez 23 III 1958 NY. Pilotuerto, vers Cangas, leg. Laínz 24 V 1958 NY. *Islas Baleares*. Majorca, Valldemosa, leg. Edmonds *144* 31 III 1931 K. Palma de Mallorca, Son Espanyolet, leg. Marcos 25 II 1970 BC.Man norca, La Cellera pr. St. Pelegrí, leg. Codina 1 V 1920 BC.

ITALIA

Abruzzo. Terama, leg. Zodda V 1942 FI. Basilicata. Patenza, Montereale, leg. Gavioli 12 VIII 1936 FI. Campania. Napoli al Vomero, leg. Francaville 27 III 1846 P. Capri, Monte Tiberio, leg. Agostini 14 20 V 1954 FI. Pompei, leg. Brumer 30 III 1913 U. Istria. Trieste, St. Andraea, leg. Beck 22 V 1880 PRC. Pola, Medolino, leg. Freyn 4 VI 1874 BP. Lazio. Palazzo Quirinale leg. Haynard 4896 9 II 1866 BP. Roma, leg. Parmentier P. Liguria. Valle di Polcenera, leg. Carrega VII 1842 FI. Genova, Portofino, leg. Brummitt 648 16 V 1968 K. Lombardia. Grumone, leg. Parlatore 30 VIII 1866 FI. Milano a Monlué, leg. Mazzuchelli e Corti 2 IV 1877 FI. Marche. San Pellegrin Ripe, leg. Bettini 21 V 1937 FI. Arezzo, leg. Savelli 14 IX 1908 FI. Piemonte. Aosta, leg. Bolzon 10 V 1913 FI. San Martino, leg. Carestia 212 27 V 1856 FI. Puglie. Vic. ad Otranto, leg. Groves V 1883 FI. Gravina di Laterza (Taranto), 100 m, leg. Nardi e Bavezzano 13 VI 1968 FI. Sicilia e Malta. Sicilia, leg. Tineo ant. 1828 S. Messina, leg. Nicotra a. 1881 LY. Palermo, leg. Todaro a. 1868 LY,P. Ins. Pianosa, leg. Sommier 11 V 1901 FI. Ins. Giglio, Porto Cannelle, leg. ipse 17-20 V 1884 FI. Ticino. Val Vigezzo, leg. Craveggia 882 30 V 1885 FI. Parma, leg. Jan 416 IV 1825 LE. Toscana. Sterrati del Pisano, leg. Savi a. 1863 F,P. Lucca, leg. Corradi 5 VI 1935 FI. Venezia. Verona, leg. Pringsheim 2 VI 1903 PRC. Padova, leg. Beguinot 1323a V-VI 1910 BP,GH,K,OXF. Sardinia. Lassari, leg. Nicolson a. 1898 LY.

RUMANIA

Moldovia, Univ. Jasiensis, 100 m, leg. Ravarut 2240 22 V 1939 BP. Ib. Hort. Univ., ca. 100 m, leg. Ravarut 22 V 1939 P. Pl. Bucharica, Kabadian, leg. Roshewitz 320 16 IV 1906 BP.

YUGOSLAVIA

Dalmacia, Ins. Unie, leg. Marchesetti III 1882 FI. Fiume, leg. Kammerer PR.

BULGARIA

Varna, leg. G. Smith 968 20 IX 1924 K.

ALBANIA

Corfou, leg. Bally 12473 VIII 1962 K.

GRECIA

Thenalia, Kato Zehonia, leg. Topali IV 1934 G. Athos Penins. (S. Macedonia) betw. Vatopedi and Karaia, leg. Vine 19 XII 1946 K.

MALTA

Inquisitor's Palace, leg. Wright 124 24 XI 1865 K. Melitae, leg. Delicata IV 1847 S.

CHIPRE.

Larnaca, nursery gardens, 50 ft., leg. Syngranides 1828 6 V 1938 K. Ayos Epektitos, leg. Atherton 236 20 IV 1955 K.

PORTUGAL.

Coimbra, Santo Antonio dos Olivaes, leg. Moller 766 VI 1889 COI,P. Lordello, près de Porto, leg. Sequeira VI 1882 LY. Caldas do Jerez, leg. Murray VI 1887 K. Santa Catarina, Caldas da Rainha, leg. Pinto IX 1943 COI. Amares, leg. Azambuja IV 1906 COI. Bussaco, leg. Loureiro VI 1883 COI. Arred. de Vizella, leg. Velloso VII 1887 COI. Lisboa, Pedrouços, leg. Lemos 22 VI 1947 K. Odemira, leg. Sampaio VI 1894 COI. Evora, leg. Costa II 1931 COI

SIRIA

Tripoli, leg. Peyron a. 1879 LY. Leg. Gandoger K.

LIBANO

Byblos, leg. Stuts 2961 27 XII 1967 NY.

ARABIA

Yemen, leg. Botta a. 1837 P. San'a Distr., Beit-el-Ghofa N of Haz, 9200 ft., leg. Scott et Britton 490 4 II 1938 BM. Jebel Jihaf, Dhalá Highlands c. 7000 ft., leg. ipsi 94 19 IX 1937 BM. Yemen, Tha'Sad, Jebel Sabir,Taiz, 1900 m, leg. Wood 115 20 X 1974 BM.

IRAK

Rawa, 150 m, leg. Gillet & Ravi 7031 28 III 1947 US. Baghdad, leg. Rogers 114 III 1929 BM. Ib., leg. Hauschnecht V 1868 BM. Ib., leg. Barkley & Brahim 5 IV 1962 K,NY.

IRAN.

Teherán, leg. Parsa 43 1938 P. Mamoudabad, sand dunes, 100 ft., leg. Furse 9031 21 VIII 1966 K. Malsuch, 50 mi. SSW R^sht, Elburz Mts., 6500 ft., leg. Zagras Exp. 466 26 VIII 1966 K.3 Km S of Chalus, to Karaj, 180 m,leg Danin et Plitmann 3137 et 3157 20 VII 1965 HUS.

AFGANISTAN.

Kurrum vall., leg. Aitchison 909 XII 1879 BM,FI,GH,K,LE,P. Taif, 5500 ft. leg. Simonos 15 I III 1949 K. Riyaedh, 3000 ft., leg. Trott 88 X-XI 1939 K. Prov. Nuristan, Pashager vall., 6500 ft., leg. Thesiger 1694 1 IX 1956 BM.

PAKISTAN

Karachi, 4 mi. fr. Peshawag to Mardan, leg. Ghafoor & Quiser 1668 18 VI 1970 NA. Prov. de la Frontière, N-O Mahandri, 1620 m, leg. Schmid 219 26 VI 1953 C. Karakoraru, Gilgit, 4770 ft., leg. Polunin 6040 15 VII 1960 BM. Upper Topa, Murree, ca. 7000 ft., leg. Rodin 5365 19 VI 1952 K,UC.

INDIA

Bengalia, ca. Calcuttam, leg. Helfer 93 1836-38 (s. *O. monadelpha* Roxburgh) BM,LCU,NY,PR. Ex India, leg. Osbeck (40:13) herb. L.f., S. E India leg. Kinderleya a. 1793 Herb. J.E.Smith LINN.Ib.,leg. ipse Herb. J.E.Smith a. 1804 LINN. Pondichéry, leg. Leveillé 874 1891 LY.Sikkim, 3-9000 ft., leg. Hooker & Thomson K,OXF,S.Maisor and Carnatic, leg. Thomson BM,GH,K,P. Benares, leg. Millspaugh 3355 22 I 1918 P. New Delhi, Talkatora Gardens, leg. Mathur VI 1957 U.Nilagiri, leg. Hohenacker 1143 p.p. 1851 GH,L,S. Rampur, leg. Malik 46 3 I 1956 F.*Punjab*.Lahore, leg. Chandhuri III 1938 GH.Dalousie, leg. Drummond 23659 1879-80 K. *Nepal*. Kusma, 3000 ft., leg. Stainton et al. 21 p.p. 18 IV 1964 BM. Kakani, 7-8000 ft., leg. Polunin 199 1-8 IX 1962 BM. Dingla, ± 3000 ft., leg. Banerji 1558 22 IV 1965 GH, USF.Chitral, Drosch, 4500 ft., leg. Stainton 2387 10 V 1958 BM.

CEYLAN

Leg. Burman 24 (Herb.Zeylan. 499) M. E Ceilona, Herb. Thunberg 11119 UPS. Thotula, ab. Haputale, 1700 m, leg. Kosterman 23209 18 IV 1969 G,K. Badulla District, Ohiya, 2200 m, leg. Jayasuriya et al. 1372 11 II 1973 US.

CHINA

Leg. Incarville 143 p.p.,a. 1740 P. Macao, leg. Bladh, Herb. Thunberg 11125 UPS. *Ankwei* Chin Hua Shan, 2000 ft., leg. Ching 8487 28 VI 1925 GH US.Mountains W Peking, leg. Bretchneides 63 sum. 1881 BM,GH.*Chekiang*.Mokanshan, leg.Read 1214 15 IX 1934 BM. Sze-ton, S Sie Chu, 150-600 m,leg. Ching 1699 30 V - 1 VI 1924 NA,US. *Fukien*.Foochow, leg.Tang Siu King 5258 27 X 1926 LE. Quang Tau, on Min riv., leg. Tang Siu King 13783 28 IV 1927 A. Hainan. Yai-hsien Distr., Nam Shan Leng, leg.Lau,S.K. 6016 7-30 IV 1935 GH. Ka Chik Shan, leg. ipse 2941 24.XII 1933 P. *Honan*. Ho-Kien Tchenn, leg. Licent 1147 18 VI 1915 P. Shao Lin Sau, Tan Fong, 700 m,leg.

Schindler 170 VIII 1907 BM,K. Hong-Kong. Leg. Tate VI 1862 K. Sur les routes, leg. Bodinier 1065 23 III 1895 P. Hopeh. Tche Ly Kia Chan, leg. Chanet VIII 1910 WRSL. Peking, Peiping-Prince Park, leg. Liou 2 V 1930 NY. Hunan. Yi Chang Distr., Ping T'ou Shan, T'anh Wan village, Put Kow Suen, leg. Tsang 23635 17-30 IV 1934 GH,US. Yiyan, Taoluvaban, leg. Dahlström 350 15 V 1948 S.Hupeh. Hu-peh sept., leg. Silvestri 4834 p.p. 1912 FI.Siang-yong, 100 m, leg. ipse 1209 19-30 VIII 1905 FI.Nanking, leg.Chan & Teng 107 16 IV 1931 GH.Li Shan, NW Cheonen, leg. Ching 8759 4 VIII 1925 UC,US.Kwantung. Tsengshing Distr., Naam Kwan Shan,leg. Tsang 20247 15 IV 1932 F,K,NA,NY. Young Kong, leg. Whiting & Stewart 113,117 et 121 29 I 1935 K. Kweichow. Tchson, leg. Perny a. 1858 P.Shantung. Fei Shien, Meng Shan, leg.Cheo and Yen 276 1 VIII 1936 BM,GH,P.Tsingtao, Sung, leg. Univ. Shantung 22 V 1927 US.Shen-Si. Pres. Huo Kio Zaez, leg. Giraldi (Biondi 4456) 3 VIII 1897 FI,K. Yunchang, 1250 ft., leg. Sandberg 5 25 III 1923 S. Shi Kong. Bao Hsiu (Moupiu), Lung-Tung, 4000 ft., leg. Hu 1506 VII-VIII 1939 A. Si Kang. Setchuen Ta Tsien, leg. Soulié a. 1891? P. Szechwan Chengtu, leg. Fang 12071 III-IV 1938 BM,F. Drogochi, 2800,,leg. H. Smith 4551 25 IX 1922 UPS. Taiwan. Vic. Taikoka, leg. Tanaka 1750 6 IV 1930 GH, L,P. Leg. Faurie 198 1903 P. Yunnan. Long Tcheou, au pied du K'eeoumei ling (frontière sino-annamite), leg. Beauvais 319 17 IV 1895 P. Pint-ta, leg.Cavalerie 7446 1906 K. Manchuria. Liaotung Penins., near town of Dalmy, leg. Litvinow LE. Ib., near RW Station Vanphangso, leg. ipse LE.

JAPON.

Hondo.Prov. Miho, leg. Kenzo Shiota 7574 5 VI 1934 GH. Tokyo, Asamayama bo Nikko, leg. Milne IV-V 1877 BM. To Kujo, leg.Faurie 2326 6 VI 1888 G, K.Kiu Siu, leg. Wright 1853-56 GH,NY,P. Nagasaki, leg. Oldman a. 1862 GH, K,P,S. Kanagawa Pref., Yokohama City, leg. Makino a. 1914 (s. f. erecta) MAK. Near Tokyo, Mt. Takao, leg. ipse 15 VII 1890 (s. f. erecta) MAK.Hakodate, leg. Maximovicz 13 I 1861 BM,K,LE,P.Liu Kiu Isl., Okinawa, leg. Broehmer 127 17 V 1904 NY. Isl. Amami-Oshima, env. de Naze, leg. Ferrié 61 III-IV 1897 G,NA.Ryukyu Isl., Kunigami, leg. Walker et al. 2652 12 VI 1951 US. Ikema Shima, 5-20 m, leg.Fosberg 38515 27 VIII 1956 US.

KOREA.

Korea Septentr., Flum. Talu, leg. Komarov 1005 24 VIII 1897 P.Quelpaert, leg. Taquet 1765 VII 1907 BM,G. Pgengyang, leg. R.K.Smith 15 VII 1938 US. Ullung Isl., Kyongsang-Pukto, leg. Oyongsok 6165 3 VI 1949 F. South Kyongsang, Kumnyon-San, Nammyon, Tongnae-up, leg. Chandler 23 13 IV 1954 BM.

BIRMANIA

Kachin St. Sumprabum, N of Hpuginhku, 4000 ft., leg. Keenan et al. 3766a 1 III 1962 USF. Pyinmana, leg. Dickason 6997 III 1938 GH,L.Haka, leg.ipse 7456 GH,L.

TAILANDIA

Shiengmai, Doi Sutep, 1100 m, leg. Sörensen et al. 3673 21 VI 1958 P.Bankok,leg. Weiss 1184 BP. Chiang-mai, Chiang Dao, leg. Suvarnakoses 930 5 XII 1955 K,L,P. Chiengmai, leg. Groff 5989 23 VI 1920 NA.

VIET NAM.

Tonkin, Jonai, Bot. Gard., leg. Maclure 7389 24 IX 1921 NA. Hanoi, leg. Lemarie 76 XI 1911 P. Ib., leg. Chevalier 29072 22 XI 1918 P. Hué and vic., leg. Squires 257 1 V 1927 LE. Cochinchine, Chole, leg. Talmy XI 1867 P. Prov. Annam. Hoa Cat près Nhatrang, leg. Poilane 4732 27 IX 1922 P. Baïka, leg.Lecomte et Finet 1240 XI 1911 P.

Africa.

MAROC. Taner, leg. Pitard 883 II 1911 P. Massif des Beni-Snassen, Berkane, jardin, leg. Faure 16 V 1928 K. Marrakech, 1200 ft., leg. Trettewy 160 III 1930 K. South Morocco, hortus, leg. Hooker IV-V 1871 K.

ALGERIA

Bône, leg. Meyer 13 I 1875 FI. Alger, leg. Lefebvre 186...P. Ib.,leg.Luitfroy 20 8 III 1890 P. Cherchel, leg. Goutan 20 IV 1890 P. Mostaganem, leg. Lalandy 15 IX 1848 P. Numidia, ex herb. Poiret P. Philippeville, leg.Murbeck & Olin 8 III 1896 S.

LIBIA.

Gargaresh, garden. leg.Ascherson 311 31 VI 1873 P. Ib., Marcella, 10 m, leg. Keith 1134 8 XI 1962 K. Farapech, gärte, leg. Aschersob 312 2 I 1874 K. Lybian Desert, Dakhla Oasis, leg. Meinertzhagen III 1928 BM.Lybian Desert, Rashida, leg. Harding King 26 IV 1909 BM.

Rép. ARABICA REUNIDA

Kairo, leg. Kneucher 13 III 1904 GH. Environs Caire, leg. Bové 313 1834 GH,K,P. Alexandire, Jardin de M.Calvert, leg.Calvert? 14 VIII 1868 P. Canal bank betw. Mahmodia and Melaha canals, leg. Mustafa & Sabet 28 VIII 1928 S. Egypte Infér., leg. Kotschy 624 vere 1836 K,LE,P,PRC.

SENEGAL

Dakar, Niayes, Hann, Mbao,leg. Berhaut 658 VII 1950 P. Sor près St. Louis leg. Chevalier II 1945 P. Jardin de Hayn, leg.ipse 45102 29 III 1932 P.

SUDAN

Jabel Marra, Golol, leg. Wiekens 1934 14 VII 1964 K. Red Sea Hills, Diris Pass, 1700 m, leg. Jackson 2884 10 IV 1953 K. Jebel Marra, Golol, leg. Wiekêns 2806 12 IV 1961 K. Jebel Marra, Kizinbani, leg. Oxtoby 13 3 I 1951 K.

ETIOPIA

Adowa, leg. Quartin Dillon et Petit 8 et s.n. 3 X 1839 P. Jimma, Coll. campus, leg. Agr. School S 10 II 1957 K. Arussi Prov. Kulumsa Farm near Asella, Chilabo awraja, leg. Svenson X 1968 S.

Isla SOCOTRA

Kishen vall., 2080 ft., leg. Guyune 44 18 VIII 1956 BM.

GUINEA

Fa, leg. Guerra 3979 18 I 1963 K.

SIERRA LEONE

Hill St., leg. Deighton 3969 23 V 1941 K.

COTE D'IVOIRE

Tohzoni, leg. Guillaumet 54 P. Tianalé, leg. Chevalier 34201 IX-X 1930 P.

GHANA

Mampong scarp, leg. Dalziel 53 26 IV 1920 K. Coomassie, leg. ipse 63 2 I 1920 K. Aburu, leg. Deighton 615 22 III 1927 K. Aburi gard., leg. Irwini 848 VIII 1927 K.

NIGERIA

Leg. Barter 1938 1857-9 (Baikie's Exp.) P. Plateau Jos, Naraguta, forest reserve, leg. Olorunfemi 8 IX 1964 K. Ondon, Akure, 3 mi. fr. Osagie Camp leg. Obomanu 26919 4 XI 1950 K. NE State, Sardauma Prov., Mambila Plateau near Maya Ndaga, leg. Bowden 67 4 IV 1970 K. Jos, leg. Marchal 8 X 1944 P. Jos Plateau escarpment near Shendam Rd., leg. Oche & Tuley 1644 20 IX 1969 K. NE, Sardauna Prov. Mambilla Plateau, 5000 ft., leg. Chapman 3065 20 IV 1973 K,WAG. Prov. Thosbadan, Forest Hill,leg. Jones 10 XI 1945 BM. Oban, leg. Talbot 44 1911 BM.

CAMEROUN

Yaoundé, leg. Jacques Félix 2255 X 1938 P. Plateau Adamaoua, Wakwa, 10 Km S of Ngaoundéré, leg. Breteler 464 11 X 1960 K,P. Près Serere (35 Km NNE de Bafia), leg.Letouzey 7798 8 IX 1966 P,WAG. Dschang Djuttitsa, 1950 m, leg. Stauffer 205 19 VII 1955 K. Bertoua-Doumé, 5 Km W Dimako, 650 m,leg Leeuwenberg 5821 10 VI 1965 K,P,WAG.Mts. Rumpi, près Lokando, 900 m,leg Letouzey 14518 23 III 1976 P. Bambui, leg. Botté 311 et 387 1971 P.Buea, 3000 ft., leg. Migeod 4 4 XI 1927 BM. Ib., leg. ipse 219 18 XI 1927 K.Bamenda, leg. Daramola 40586 10 I 1959 P. Cameroon Mt., Jongo,leg. Maitland 1012 K.

CONGO BRAZZAVILLE

Leg. Cooman 2954 XI 1903 WAG. Lékana, route de Nikena, village de Bélé, 3 Km de S/P, leg. Bouquet 2482 27 II 1968 P.

CONGO KINSHASA

Camp Kabara, S slope Mt. Mikaro, 10615 ft., leg. Linder 2342 17 III 1927 GH. Jard. Bot. Eala,leg. Léonard 102 19 X 1945 K,P. Kindamba, leg. de Nerè 786 21 I 1963 P.Sougoloto, Leopoldville, Riv. Malanga, leg. Compère 975 XII 1959 K. Yambuya, leg. Louis 26216 1936 K. Kimpese, leg. Stenström 6 IV 1946 S. Eala, leg. Lebrun 563 VIII 1930 NY,P.Kivu, leg. ipse 8985p.p. XII 1937 K,WAG.Ib., leg. ipse 8272 p.p. XI 1937 K. Ib., Rutshuru, leg Ghesquière 4301 1937 K. Isangi, Yangambi, leg. Léonard 109 30 X 1937 K.

UGANDA

Bumyumyambuzi, leg. Eggeling 1573 XII 1934 K. Mengo, Entebbe, 3880 ft., leg. Harker 144 28 I 1956 K. Kigesi Distr., SE of Lake Albert Edward, leg. Godman 220 10 I 1924 BM.Nyassaland, Masuku Plateau, 6800-7000 ft., leg. Whyte VII 1896 K. Glatyre Distr., 3300 ft., leg. Lawrence 660 10 III 1938 K. Entebbe, 3863 ft., leg. Maitland 37 2 VII 1922 K.

KENYA

Uhiguru Mts., 4500 ft., leg. Carmichael 75 2 VIII 1951 K. Elgon, 7500 ft., leg. Tweedie 2674 VIII 1938 K. Nairobi, Ainswoorth Hill, leg. Fosberg 49960 24 III 1968 US. Nombasa Shanzu, 50 ft., leg. Polhill 388 2 XII 1972 K.

RUANDA URUNDI

Kitega, Urundi, Kinyota, ± 1650 m, leg. v.d.Ben 1886 5 II 1958 K.

TANZANIA

Zanzibar, Naegaa, leg. Faulkner 3421 27 VIII 1964 K,P,WAG. Ruhudje,Landschaft Lupembe, leg. Schlieben 423 III 1931 BMp.p. K,SLushoto Dist.,Vugiri, leg. Archbold 230 13 VI 1963 K. Isla Pemba. Chake-Chake, leg. Vaugham 573 24 VIII 1929 K.

ANGOLA

Loanda, leg. Gossweiler 458 1903 BM,K,P.Cazengo, Granja S.Luiz, leg.Welwitsch 5188 COI.Huila, Humpata, ca. 1800 m, leg. Teixeira e Almeida 7321 11 XII 1969 COI. Ilha do Principe. Pico do Papagaio, 3000-4000 ped. leg. Welwitsch 1608 IX 1853 BM.

ZAMBIA.

Ndola, 1220 m, leg. Wilberforce A97 V 1961 K. Mbala Dist., Township Brewery, 1590 m, leg. Richards 22952 21 I 1968 K. Kalabo, near resthouse, leg. Drummond & Cookson 6417 13 XI 1959 K.

MALAWI

Dist. Mzimba, Marymount, Mzuzu, 4500 ft., leg. Pawek 4314 14 I 1971 K. 3 mi. W of Mzuzu, Katoto, 4500 ft., leg. ipse 8324 14 IV 1974 WAG.

RODESIA

Dist. Umtali, Staphford For. Res. 5000 ft., leg. Chase 4270 28 XI 1951 BM,K. Pretoria, leg. Eyles 1785 IX 1919 K. Wolwerand, leg. Hanekom 1827 2 IX 1972 P.

MOZAMBIQUE

Morrumbala, 3000 ft., leg. Kirk 30 XII 1858 K p.p. Namaacha, Mts. Poduini, leg. Moure 138 20 XI 1966 COI. Manhiça, leg. Gomes e Sousa 609 IV 1931 COI. Lourenço Marques, leg. Pereira e Marques 397 26 IV 1965 COI, WAG.

REPUBLICA SUDAFRICANA

Transvaal. Hekpoort, ca. Pretoria, leg. Lindberg 16 VIII 1936 S. Pretoria, leg. Hanekom 1827 2 IX 1972 K,WAG.Distr. Wakkestroom, Oshock, 6400 ft., leg. Devenish 907 12 X 1962 K. Natal. Hasts Hill, near Colenso, leg Strey 9951 18 X 1970 K.Durban, Beven, leg.Wood 2954 C 1909 WAG.SW Africa Komas Hochland, Farm Friadenau, ca. 2000 m, leg. Gassner 184 14 V 1939 M. Basouto-Land.Léribé, leg. Dieterlen 171 P, US. Hermon, leg. Christol 1907-8 P. Cap. Cap Bonae Spei, 600.32 LINN. Ib., herb. Thunberg 11118 Tipo O. repens Thunb. UPS.Ib.Herb. Thunberg 11117 et 11082 UPS.Pr. Cap - stadt, leg. Ecklon 595 1843 (s. ceratilis E. & Z.) BP,K,LE,LY,P p.p.,NY, PR,PRC.Kaehu u. Zandplaat, 1500-2500 ft., leg. Drège 5253 16 I 1832 (s. ceratilis E.&Z.) P. In hortis Capprorum vetsustis laterum montis "Winterberg", alt. IV (eeded Territory), leg. Ecklon & Zeyher 648 X 18.. Lectotipo L. Isótipos LE,LY,S.

SEYCHELLES

Mahe, reservoir, 1000 ft., leg. Osborne-Day 222 30 X 1936 BM.

RODRIGUEZ

Haute vallée de la Baie aux Huitres, leg. Cadet 2788 VII 1970 P. Leg. Balfour VIII-XII 1874 E p.p.,K.

MADAGASCAR

Leg. Hildebrant a. 1890 LY. Leg Pervillé, Ex herb. Fée FI. Ivoloine,leg. Martine 816 VII 1931 P. Leg. Baron 3586 K,P. Ambatobevandza, leg. Decary 2 II 1917 K,P. Ambatodrazaka, 78 m, leg. Cours 1273 XI 1938 K,P. Leg.Le Myre de Villers a. 1887 P. Kodiadiamborona(Jard. Bot. Tananarive 243, 129-2) P. Ambatondrazaba, Manakambahiny, Est, leg. Rasanuson 12311 21 XI 1962 P. Central Madagascar, leg. Baron 6283 K. Marovato, S/P. d'Andapa, leg. J. de Dieu Rabe 7315 5 XI 1967 P.

LA REUNION

Bourbon, leg. Richard 192 1837 K,P. Ib., leg. Cordemoy MAR.Ib., Ex herb. Fischer LE. Près de Cilaos, Bras Sec,leg. Lourteig 2453 19 III 1969 P. Reserve Matambou, au-dessus de Cilaos, leg. ipse 2456 19 III 1960 P.Le Brûlé, ca. St. Denis, Pente des Palmiers, leg. ipse 2452 15 III 1969 P. Vers Takamaka, 600 m, leg. Friedmann 549 12 XI 1970 P. Haute de la rivière des Remparts, 1700 m, leg. ipse 1644 II 1972 P. Plaine de Makes, 900 m, leg. Cadet 4369 27 VIII 1973 P,REU.

MAURICIO

Leg. Sieber II 216 p.p. P. Leg. Perrotet P. Leg. Orian 68 MAU. Le Reduit, leg. Rochecouste 11 IX 1959 MAU. Jardin des Plamplemousses leg. Bojer 247 MAU p.p. Chateau d'Eau, leg. Ayre VI 1860 K.

Islas Atlánticas

AZORES

São Miguel, Ponta Delgada, 50 m, leg. Gonçalves 2512 16 V 1971 BM.Faial, Santo Amaro, 10 m, leg. ipse 144 15 XI 1961 BM.

MADEIRAS

Orang a. 1796, Ex herb. Forström, Herb. Linnaeus fil. 40: 13A S. Leg. Andersson a. 1857 S. Leg. Mason 65 1857 P.Funchal, leg. Druce II 1909 OXF. São Miguel, 810 ft., leg. Dodman 334 26 VII 1970 BM. Ile Graciosa, leg. Carreiro 858 VIII 1903 LY. Madeira Hage, leg. Schumann LE. São Miguel,leg Trelease 7616 F. Mell. São Vicente o. Ponta Delgada, leg. Een 145 8 V 1952 S.

CANARIAS

Palma, leg. Blauner VI 1851 FI. Tafira, leg. Murray 30 IV 1894 K. Santa Cruz de Tenerife, leg. Weiss 112 BP. Ib., Barranco Cabezas juxta Orotava leg. Ball II 1888 US.Guimar, leg. Pitard 1276 II 1905 P.

CABO VERDE

Santiago de Praia à Ribeira da Barca, leg. Chevalier 44541 13 VII 1934 COI; 44553 bis 13 VII 1934? P.

SANTO TOME

Uba, Budo, leg. Monod 12029 23 VIII 1956 BM,COI. Monte Café et pic de S. Tomé, leg. Chevalier 14576 VIII-IX 1905 LY,P. São Antao, Fontainhas, leg. Cardoso V 1887 COI.

ANNOBON

S of Crater Lake, leg. Wrigely & Melville 146 14 VII 1959 BM,F,K.

ASCENSION

Reise der K.K.Corvette Carolina 1857-8, leg.Wawra 374 et 377 1857-8 LE, W. Leg. Loomis, U.S.Eclipse Exp. III 1889 GH p.p. Leg. Moseley 3 IV 1876 K.

FERNANDO PO

Moka, Plateau Area, 3500-4000 ft., leg. Boughey 84 9 XII 1951 K. Ib., leg. Melville 481 13 IX 1959 BM,K.Ib., 4000-5000 ft., leg. Exell 766 29 I 1933 BM.

SANTA HELENA

Leg. Burchell a. 1867 P. Leg. Lind BM. By Major Pierrie's, leg. Burchell 106-1 p.p. 11 VI 1808 K.

TRISTAN DA CUNHA

Leg. Milne 12 XI 1852 GH,K. Inaccessible Island, leg. Moseley (Challenger Exp.) X 1873 BM,GH,K,LE,P,W. Round Settlement, leg. Keytel 1795 K. Ib., leg. Christophersen 1248 22 XII 1937 BM.

Oceanía

MALASIA

Biserat in Jalor, leg. Gwyne-Vaughan 520 30 V 1899 K,UC. Singapore Bot. Garden 9 IX 1937 UC,US. Ib., leg. Purseglove 4001 26 IX 1954 A,K,LAE. Pennang, Waterfall Rd., leg. Ridley 29 I 1921 K.

PHILIPINAS

Leg. Cuming 1214 1841 BM,FI,G,K,LE,P, 705 BM,G,K,L,LE,P,PR,PRC. Manila, leg. Blanco 226 XII 1913 Lectotipo O.Acetosella NY. Isótipos F,GH,L,P,US. Luzon, Pampanga, Camp Stotsenburg, leg. Elmer 22299 V 1927 BM,G,GH,K,L, NY,P,US. Batan Isl., Prov. Batanes Mt. Iraya, leg. Ramos 468 8 VI 1930 NY.Balest Isl.,leg. Mearns 23 I 1906 US.

BORNEO

Mt. Kinabalu, Lobang to Kiau, leg. LeRoy Topping 1801 19 XI 1915 US.Bangamassing, leg. Motley 939 1857-8 K. Kaehing, Rest House, leg. Clemens 7927 XI 1929 K.

MOLUCAS.

Kei Eilanden, leg. Jensen 346 11 I 1922 L. Halmaheira, Djailolo Kap Djawa, leg. Nedi 177 28 IX 1937 L. Amboyna, La Billardière 6I. Ib., leg. Robinson 216 VII-XI 1913 US.

SUMATRA

Leg. Forbes 2075 et 2075c 1880 BM. Laboehan Batoe, Dist. Kota, Pinang, Goenoeng Si Papan, leg. Toroes 3779 7-14 IV 1933 NY,US. Medan, 15-20 m, leg. Lörzing 13756 3 IX 1928 P. Totoepan, leg. Boeea 5987 2-11 XI 1933 GH,L.

JAVA

Ex herb. Ventenat G. Ex herb. Winterbotton VI 1846 K. Ex herb. Burmann 29 1757 G. East Java, leg. Forbes 677 1880 BM. Leg. Blume Tipo *O. javanica* L. Isótipos L,NY. Mt. Tengger, ± 7000 ft., leg. Zollinger 1584 p.p. 2-3 VII 1858 BM,G,L,P. Entrée de la Vallée du Tiran, près de Likupang, leg. de la Savinièrre 342 24 XII 1876, 16 VIII 1876 G,LE,P. Leg. Commerson a. 1767 P. Tosari, leg. Ridley 27 I 1915 K. Bogor, leg. Kjellberg 2911 et 1527 1929 S.

NUEVA GUINEA

Sepik Dist., Lumi, near Miwante vill. (Torricelli Mts.) ca. 2900 ft., leg. Dabyshire 305 30 VIII 1961 CANB,L,LAE. Papua, Milne Bay Dist., Mokoma, 8500 ft., leg. Cruttwell 132 11 VIII 1962 K,LAE.

SOLOMON

Skolotan, Bukar, leg. Waterhouse 168 IV 1930 CANB,K,L. Bougainville Isl. Near Aku vill., ca. 10 mi. W Buin, 100 ft., leg. Craven & Schodde 536 24 IX 1964 A,CANB,G,K.

AUSTRALIA

Van Diemen's Land, leg. Hooker K. Adelaide Plains, Kent Town, leg. Pearce IX 1948 AD. Queensland. Bellenden, leg. Kaspiev 1189 8 VIII 1958 G. Sydney, leg. Bynoe K. New S. Wales. Mc Intyre Riv., leg. Pamplin a. 1915? K. Southgate, 8 mi. NE Grafton, leg. Macdonald 163 2 IV 1963 K. Victoria Melbourne, leg. Edwards IX 1959 UC. Ib., leg. Willis 1 II 1960 K. Lord Howe Isl. W Stevens Point, leg. Beauglehole 5562 17 II 1962 CANB. Norfolk Isl. Near sea shore, on rocks, leg. Laing 113 p.p. 1912 Tipo *O. corniculata* v. *reptans* Laing CANTY.

TIMOR

800 m, leg. Driedberg P. Leg. Forbes 3958a 1882-3 BM. Tatunaba, 2000 ft. leg. Forbes 3448 19 II 1883 BM.

NUEVA ZELANDIA

Leg. Forster 10 (s. *O. reptans*) S. Leg. Raoul G. Mt. Cook region, Hermitage, leg. Sehtuel 4 III 1927 UC. Wellington, Levin, leg. Cheeseman 5010/2 US. Ooampo, leg. Heusler a. 1897 G,S. Pukekone, N. Isl., leg. Woods 71 IV 1962 K. Near Auckland, leg. Cheeseman NA. Cook Isl., Rarotonga 0-1800 ft., leg. Cheeseman 526 VI 1899 K.

HAWAIAN ISL.

Leg. Beechey K. Leg. Ballieu P. Leg. Seemann 1730 1849 G,GH,K. Port Byron leg. Deell, Voy. La Bonite IX-X 1836 P. Honolulu, leg. Du Petit Thouars P. Oahu, leg. Remy 631 p.p. 1851-1855 GH,P. Ib., leg. Heller 2159 19 IV 1895 BM,F,K,LE,P. Ins. Maui, Haleakala ab. Auahi Forest, 1380 m, leg. Fosberg 48355 28 III 1967 BM,GH,K,NY,P,US. Kanai, Waimea Cott., leg. Hochrreutiner 18 IV 1905 G.

MARIANAS

Tinian Isl., NE Carolinas (Lalo) Point, 60-80 m, leg. Fosberg 24845 1 VI 1946 P,US. Sariguan, 250-300 m, leg. Evans 2387 22 VI 1966 US.

CHRISTMAS.

50-1000 ft., leg. Powell 12 27 V 1968 K.

WALLIS

Leg. Oédel, Voy. du Berarel, a. 1847 P.

CAROLINES

Ponape, Vic. Colonia, leg. Glassman 2840 14 VIII 1949 US. Kolonia, leg. Sachet 1835 11 VI 1973 US. Yap, leg. Ryozo et al. 4368 29 III 1938 F.

MARQUESAS

Leg. Du Petit Thouars 73 1843 P. Noukahiva, leg. Le Batard (Exp. Reine Blanche) 36 1844 P. Hiva´va Isl., Eiaone vall. floor, 3-6 m, leg. Decker 700 20 X 1963 US.

SAMOA

Ipolu, Apia, leg. Reinecke 17 IX 1893 BM,G,K,US. Tau, Luma, 150 ft., leg Harris 34 24 VI 1938 K. Ofu, Near Ofu vill., leg. Yuncker 9482 25 XI 1939 K,UC.

NUEVAS HEBRIDAS

Hog Harbour, leg. Baker 175 13 I 1934 BM. Malekula N., Tuptil, 1500 ft., leg. Cheeseman 11K VI 1929 K. Espíritu Santo, Nokowoula, 1130 m, leg. Mc Kee 5 IX 1971 K,P.

FIDJI

Leg. Seeman 89 BM,G,GH,P. Viti Levu, Tailevu, vic. Ndakuivuna, 100-200 m leg. A.C.Smith 7087 14-26 IV 1953 GH,K,P,S,UC,US. Rewa, Ram Das´Farm, Nasinu, leg. Ledua 11108 12 XII 1957 LAE. Naisai, leg. Milne (Herald Exp) 160 XI 1855 K.

TONGA

Leg. Moseley (Challenger Exp.) IX 1875 K. Leg. Cook´s 3rd. Voy. BM. Leg. Lépine 65 1847 P. Leg. Vesco a. 1847 P. Nieu Isl., Lakepa vill., 65 m, leg. Yuncker 9925 27 I 1940 K,UC,US. Premières collines de Mara, leg. Savatier 857 2 IX 1877 P.

SOCIEDAD

Tahiti, leg. Cook (s. reptans) BM. Tahiti, Tatuahua, leg. Andersson a.1852 S. Tahiti Fare Rau Ape ab. Papaete, 650 m, leg. Fosberg and Sachet 54562 18 III 1973 K,P,US.

NUEVA CALEDONIA

Lifu, leg. Deplanche a. 1865 P. Ib., leg. Whitmee 8 BM. Summit of Dome de Tiébagui, N o Tiébagui Mine, 1800 ft., leg. McMillan 5068 13 IV 1952 GH,L,P. Nouméa, leg. Barrau 57 1948 P. Lacome, leg. McKee 5 I 1965 P.

PITCAIRN

Flatlands, 110 m, leg. Fosberg & Christian 11233 13 VI 1934 P,UC.

GAMBIER

Leg. Beechey G,K.

AUSTRAL

Rimatara, Auapoto, 3 m, leg. St. John & Fosberg 16780 4 IX 1934 P.

LOO-CHOO

Leg. Wright 36 U.S.N.Pacif. Expl. Exp. 1853-6 GH,K,P.

SUNDA

Lombok, Rindjani-Vulkangebirge, N seite, Putihtal, Barranco du Rindjani-Caldrea, 2100-2500 m, leg. Elbert 1232 11 V 1909 L.

8a. Oxalis corniculata L. ssp. corniculata
v. atropurpurea Planchon (1)

Planchon in v. Houtte, Fl. Serres 12: 47-48, lám. 205. 1857. Bailey, Cycl. Amer. Hortic. 3: 1182.1910. Young, Watsonia 4: 56-57.1958. Lawalrée, Fl. Belgique 4: 236.1963. Munz & Keck, l.c. 148.1959.

O. grenadensis Urban, Symb. Antill. 7:233.1912. Knuth, Pflreich. Tipo: Grenade, Eggers 219 b.

O.trinidadensis Knuth, Rep. Sp. No. 23: 276.1927; l.c. 163. Tipo: Trinidad, Britton et al. 3126 GH.

O. corniculata L. v. purpurea Parlatore, Fl. Ital. 5: 271. 1872. Goiran, Bull. Soc. Bot. It. 1896: 97. 1896. Jabandiez et Maire, Cat. Pl. Maroc 2: 448. 1932. Tipo: Napoli, Parlatore, FI.

?O. corniculata L. v. rubra Nichols, Ill. Dict. Gard. 2:540.1886. Makino, Sômoku-Dzusetsu 1: 664. 1910. Knuth, Pflreich. 149-150 (sub forma).Tipo: no hallado.

O. corniculata L. v. tropaeoloides (Schlachter) Cannarella, Bull. Soc. Bot. It. 1909: 78.1909. Makino, Bot. Mag. Tokyo 27: 112. 1913.

O. corniculata L. v. viscidula Wiegand,l.c. 117,121.Knuth, Pflreich.434 436.Tipo: Estados Unidos, Massachussetts, Terry GH.

O. corniculata L. v. rubrifolia Makino, J. Japan. Bot. 3: 2.1923.Tipo: No existe. Tres colecciones, así nombradas, de Japón, pertenecen a esta variedad.

XO. Uittienii Jansen, Ned. Kruidk. Arch. 54: 246.1947. Tipo: Holanda, Jensen 4617 L.

O. corniculata L.ssp. repens (Thunberg) Masamune v. atropurpurea (Pl.) Masamune, Mem. Fac. Sc. Agr. Taihoku Univ. 11: 258.1934.

O. corniculata L. f. purpurea (Parlat.) Knuth; f. tropaeoloides (Schlachter) Knuth,l.c. 149-150.

O. tropaeoloides Schlachter ex Planchon, l.c. 47,48 nomen! Vilmorin,Fl. Pleine Terre ed 1: 584.1865.

Xanthoxalis corniculata (L.)Small v. atropurpurea (Pl.) Moldenke, Phytologia 2: 324.1947.

X. trinidadensis (Knuth) Holub, Fol. Geob. Phyt. 8: 176.1973.

TIPO. La lámina de van Houtte, l.c.

Plantas generalmente pequeñas, radicantes, bien arraigadas. Raíces con abundantes ramificaciones fibrosas. Tallos,estípulas y hojas ± purpúreos. Sépalos verdes o ± purpúreos. Fruto poco pubescente hasta glabro. Fácil de reconocer in vivo.

Distribución geográfica. Variedad de origen hortícola europeo; se la halla en jardines, invernáculos o lugares de cultivos de jardinería. No es invasora.

Material estudiado.

CANADA

SE Newfoundland, St. John's greenhouse, leg. Ayre 3 III 1932 GH.

ESTADOS UNIDOS

California. Cult. Bot. Gard. Univ., leg.Walker 3458 12 IV 1914 NA. Berkeley, Univ. Campus, leg. Hall 3 II 1900 NY. Santa Clara, leg. Leeds,winter 1890-91 F. Connetticut. New London, Spalding'greenhouse, leg. Graves 268 2 VIII 1902 GH. Fairfield 8149 10 IX 1908 GH. Colorado. Routt Co.,

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(1) El epíteto alude al color de la planta.

Near Hayden, leg. Porter 3948 26 VI 1946 S.Delaware. New Castle Co., Smyrna Landing (wood side N), leg. Bayard Long 13 VIII 1908 PH. Middleton,leg. ipse PH.Distr. Columbia. Nat. Arboretum, Gotelli Conifer. Gard., leg.Lourteig 2463 10 X 1969 A,NA,P,US. Dep. Agr. Grounds, leg. Wheeler 23 X 1906 US. Florida. Riv. Suwannee & Tallahassee, leg. de Castelnau P. Pinewoods along King Rd., mosses creek, leg. Small et al. 11124 31 III 1924 P,US. Georgia. Chatham Co., Mts. of Georgia, leg. Cronquist 4277 12 IV 1947 GH. Illinois. Chicago, Eggleston, in garden, leg. A. Chase 1226 16 IX 1899 F. Garfield Park Conserv., leg. Steyermark 19 IV 1939 F. Iowa. City campus Univ. (cult. pot), leg. Thorne 17 XII 1954 UC.Louisiana. Rapides, vic. Martin Springs, ca. 7 mi. W Lecompte, leg. Reese 1930 26 1959 GH. Ascension Parish, 5 mi. E González, leg. Lowe 37 12 III 1955 GH. Maine. Orono greenhouse, leg. Morse II 1919 GH. Maryland. Prince Co., Beltsville, garden, leg. Lourteig 2466 X 1969 P. Talbot Co., 3,5 mi. WNW Easton, garden, leg.Earle 3192 25 IX 1940 PEN. Massachusettes. Northampton, leg. Terry VI 1902 Tipo O. c. v. viscidula Wieg. GH. Easton, greenhouse, leg. Fernald 8 I 1905 GH. Michigan. Ab. Alma, leg. Davis 20 VIII 1892 NY,UC.Missouri. St. Louis, Miss. Bot. Gard., leg. Eiten 1072,1074,1075,1076 4 I 1956 NY. St. Louis, cult., leg. Sherff 145 30 VI 1910 F. New Jersey.Somerset Co., Watchung, leg. Moldenke 8099 25 VII 1934 BR,L,NY,S.Cape May Co.,Cape May, leg. Williamson 2 VII 1911 PENN.New YorkBrooklyn Bot. Gard. leg. Svenson 10707 14 IX 1939 UC,S.Long Isl., Cottage Gard., leg. Bicknell 5438 31 X 1912 NY. Pennsylvania. Philadelphia Co., Morris Arboretum leg. Wherry 17 IX 1954 PENN.Montgomery Co., Elkins Park, leg. Long 26092 3 IX 1944 PH.Texas. Grayson Co., Denison, leg. Centr. High. School X 1918 GH,UC. Polk Co., Indian Reserve, leg. Birvin 130 15 III 1940 GH. Virginia. Nonongalia Co. Morgantown, Davis Gard., leg. Davis 4292 25 VIII 1941 GH,NA,NY.Arlington Co., Arlington Farm, greenhouse, leg. Allard 8240 24 IX 1940 GH,PEN,US.West Virginia. Clifton Forge, 400 m, leg. Steele 1 18 VIII 1903 GH.

MEXICO.

Distrito Federal. In pineto circunv. ad Cuernavacam, Km 44, 3000-3100 m, leg. Frödeström et Hultén 596 3 II 1939 S.Oaxaca. Dist. Pochutla, vic. Concordia, 630 m, leg. Markinius 820 15 III 1937 US. Orizaba. Orizaba, leg. Müller 622 1855 NY.

COSTA RICA.

Alrededores de San José, leg. Orozco, 108 6 VI 1938 F. Barrio González Lehmann ca. Nat. Mus., 3870 ft., leg. Rossbach 3386 26 VII 1961 GH.

BERMUDAS

Isl. St. David's, leg. Brown 612 10 II - 9 III 1908 F,GH,NY,US. Paynter's Vale, leg. ipse 462 10 II - 9 III 1908 F.

CUBA

Leg. Alain 765 GH.

Europa Asia

SUECIA.

Bohmslän. Tanums socken, prestgården, leg. Thedenius VIII 1882;VII 1881; IX 1880 S. Dalarna. Falun, leg. Jonson VIII 1929 S. Göteborg. Mosaiska begr. platzen, Ohlsén 29 IX 1926 S. Sanviken, leg. Wihslow s. 1873 NY. Östergötland. Marmobruket, leg. Linde IX 1896 S. Kvarsebo, leg. Svensson VIII 1903 S. Skåne. Malmö, leg. Larsson VIII 1903 S. Estóf, leg. Andersson 14 VIII 1889 S. Småland. Alvesta, leg. Pleijel VII 1916 S. Södermanland. Botkyrka, leg. Ridderstolpe 4 VIII 1900 S. Allhelgona s. Söra,leg.

Schotte 25 VIII 1890 S. Stockholm. Trädgård, leg. Thedenius VII 1884 S. Stockholm, leg. Sondén 1 X 1901 S. Uppland. Solna, Nya Huvudsta, leg. Almquist 16 IX 1929 S. Vaxholm, leg. Krok VIII 1909 S. Vastergötland. Elgaras leg. Lundberg VIII 1892 S. Stenum, leg. Westerlund IX 1884 S. Värmland. Kartstad, leg. Hielphers 18 VII 1897 S. Västmanland. Ekebyhammar, leg.Larsson VIII 1870 S.

DINAMARCA

Vid Fredericksborg, leg. Lange VIII 1875 UPS. Sjoelland,, Kjobenhavn, leg. Gabrielsson VII 1881 NY,S. Pr. Hauniae, in hort., leg. Lange II 1874 PR. Ib., leg. ipse 10 VIII 1893 S. Ukand, Thorvaldsenvij, leg. ipse 1 IX 1895 S. Forvildst, Frederiksberg, leg. ipse 22 IX 1879 S. Jylland, leg. Bronderslevkaad VII 1934 S.

POLONIA

Krakow, Hort. Bot., leg. Djakowska et Sródón 354 IX 1938 BP,GH,FI,K,NY,P, PRC,S,UPS.

HOLANDA

Cult. Jansen te Wychen, leg. Jensen 4617 4 IX 1943 Tipo XO. Uitienii L. Cult. Hort. Bot., leg. Abeleven 231 VI 1887 L. Aan Angelo, leg. Brand a. 1932 L. Doesburg, leg. ipse a. 1943 L. Rotterdam, Trapenburg, leg.Boom 3048 IX 1950 L. Sordrecht, leg. Kloos IX 1937 L. Wijchen, leg. Jansen 12630 3 X 1943 L. Voorschtoen, Papenloon, leg. Bakhuizen 12 X 1953 L. Heemstede, leg. ipse 6604 18 IX 1948 L. Leiden leg. ipse 5874 24 VIII 1946 L. Husk, leg. Posthumus P. Nieuw-en-St. Joosland, leg. Lako VII 1878 L. Woerden Nieuwedijk 2, leg. Voo 1987 13 VIII 1953 L. Den Haag, leg. Bolten L. Ter neuzen, leg. Siutseme 1911 23 VIII 1937 L. Engbergenby, leg. Rust L. Rysswyk, leg. Wagensveld a. 1898 L. Utrecht, Maiebaam, leg.Steenis IX 1918 L. Verwerspad, Olifantspad, leg.Sande Lacoste, ex herb. Rombouts L. Apeldoorn, leg. K.A.Smit 20 VIII 1898 L.

BELGICA.

Brabant, Saintes, leg. André 24 VIII 1952 K,US.

INGLATERRA

Essex Coggleshall, on old wall, leg. Jermyn 779 16 VII 1961 US.Ramsey Church wall, leg. ipse 779 21 V 1961 US. Redhill, leg. Crossfield 20 VII 1884 K. Surrey, Sanderstead, leg. Young 5323 3 X 1954 NY. Upminster, leg. Adam 23 VIII 1963 US.

FRANCIA

Allier. Moulins, leg. Bourdot IX 1891 BP,BR. Calvados. Env. Caen, leg. Duhamel IX 1858 P. Corse. Ajaccio, leg. Bubani a. 1834 FI. Bastia, leg. Martelli 8 III 1896 FI.Côte d'Or. Flavigny, 420 m, leg. Desplantes X 1936 S. Doubs. Nans, jardin, leg. Paillot 120bis 28 VII 1861 P. Eure. Jardin des Andelys, leg. Toussaint 17 VII 1899 P. Giverny, jardin, leg. Butler 173bis 24 X 1939 NY. Eure-et-Loire. Chartres, rue de Varize, leg. Savouré 22 IX 1898 P. Gironde.St. Emilion, vieux murs, leg. Hibon 21 IV 1922 P. Cavignac, leg. Bouchon 2749 14 IX 1934 FI,MPU. Arcachon, Boulev. de la Plage, leg. Jovet 5 IX 1968 P. Hérault. Montpellier, Herb. Fac. Méd. 25 IV 1826 MPU. Béziers, Feuillée, jardin, leg.Renaud 832 V - X 1920 MPU p.p. Isère. Grenoble, leg. Jacquemont V 1823 P. Landes. Cimetière de Moustey, parois, leg. Jovet 25 X 1969 P. Dax, rive dr. Adour, face aux Beignots, leg. ipse 13 IX 1966 P. Loir-et-Cher. St. Aignan,sur la place, leg. Jovet 13 VII 1967 P. Lot-et-Garonne. Aiguillon Tourrasse leg. Duffour 1620 15 IX 1915 P. Mayenne. Mayenne, leg.Rocher 21 VII 1919 P. Pont de la Grande Traverse, leg. Savouré 23 VI 1897 P. Paris.

Jardin des Plantes, leg. Jovet a. 1966 P. Bagatelle, leg. Lourteig 2653 VI 1973 P. Pyrenées-Atlantiques. Vid Biarritz, Bois de Boulogne, leg. Birger 26 III 1921 S. Itxassou, entre Nive et route, leg. Jovet 22 III 1966 P. Pyrenées-Orientales. Banyuls-s-Mer, leg. Hibon V 1913 P. Seine-et-Loire. Macon, jardin, leg. Bec X 1908 P. Seine-et-Marne. Haut, Samois, rue, leg. Buchet 30 VI 1914 P. Var. St. Tropez, leg. A. et E.G.Camus III 1918 P.

ALEMANIA

Leg. Kummer (s. tropaeoloides) IX 1863 M. Dortman, leg. Suffrian 25 L. Bei Karlsruh, leg. Alex. Braun L. Saxonia, Nossen, leg. Lernhardt IX 1889 FI. Berlin, Bot. Gart., leg. Magano 31 VII 1868 FI. Sachsen, in gärten Derenburg, leg. Lohmeyer VIII 1896 PRC.Braunschweig Gärten bei Schladen, leg. Krummel IX 1884 BP. Hamburg, gartenland, leg. Aust IX 1888 BP.

CHECOSLOVAQUIA

Hort. Bot. Univ. Carolinas Praha, leg. Dostál 853 25 IV 1950 PRC. Josefora, leg. Traxler 20 VI 1931 PRC. Olenici, leg. Clupek a. 1883 PRC.Mithreit, Znorin, leg. Oborny 20 IX 1879 PRC. Moravia, Olomouc, 220 m, leg. Otrube VII 1943 PRC. Slovenia, Rimavza Sobota, leg. Novák 483 IX 1925 PRC.

SUIZA

Tessin, leg. Simonet 20 V 1946 G. Ib., Orselina, leg. Beauverd 30 IX 1930 G. Ib., leg. ipse 9 IX 1929 G. Locarno, leg. S. Vautier 6 IV 1946 G.

AUSTRIA

Tirol, Riva, leg. Sterneck V 1917 PRC. ?Leitmeritzer, leg. Preis 15 IX 1934 PRC. Klooterneuburg an d. Gartensmauer, ex herb. O. Wittmer 8 VIII 1935 W.

HUNGRIA

Budapest, Diósárok, 200 m, leg..... 17 VII 1944 BP. Nagylsanirsán,150 m, leg. Jávorka 2203 24 VII 1948 BP. Pecs, leg. Karoli 21 VI 1946; 24 VIII 1948 BP. Eperpy, leg. Hazslinky, BP.Budapest, Gellésthegy, leg. Jávorka 19 IX 1934 BP. Mankreis, leg. Margittai 79 19-27 IX 1915 BP. Györ, leg. Polgár 1 VIII 1932 BP.

ESPAÑA

Mallorca, Palma, La Bona Nova, fente de mur, leg. Stehlé 31 III 1978 P.

ITALIA

Campania. Isla de Capri, valle Tiberio, leg. Groves VII 1889 FI. Emilia Modena, ca. Sassuolo, leg. Fiori 6 IV 1882 FI. Bologna, Monte Donato, leg. ipse 30 V 1886 FI.Lazio. Tivoli, via Capparini, leg. Vaccari 22 IV 1903 FI. Monte Ripoli, via del Cimetero, leg. ipse 2 VI 1914 FI.Roma,ad vias, leg. Cacciato 20 VI 1956 S. Liguria. Sta. Margherita, leg. Birger 8 V 1907 S. Savona, valleta di S. Lorenzo, leg. Mazzana 12 IV 1899 FI. Lombardia. Malgrate, leg. Camperio 29 VIII 1894 FI. Como, Bellano, leg. Lenander V 1937 S. Marche. Castello a Monterado, leg... 30 V 1933 FI. Piemonte. Torino, via Magenda, leg. Zola 17 X 1923 FI. Ib., via Sebastiano Volpi, leg. ipse 17 VII 1922 FI.Sicilia. Trapani, Erice, leg.Brummit 4675 2 VI 1964 K. Toscana. Florence, sidewalk, leg. Pease 8683 26 XI 1905 GH. Sarteano, via di Fuori, leg. Bergagli 30 IV 1891 FI.Venezia Negli salini della stufa del Giard. Bot. di Napoli, leg. Parlatore,Tipo O. corniculata L. v. purpurea Parl. FI. Verona, in hortis, leg. Goiran

4bis et 4 31 X 1887 FI. Padova, Hort. Bot., leg. Béguinot 1323b V-VI

YUGOSLAVIA

Cavtat, 20 Km v. Dubrovnik, leg. Mennega et Baretts 69a 10 V 1967 U. Buccari, Quarnero, leg. Jávorka 12 VII 1939 BP.

CHIPRE

Larnaca, nursery garden, 100 ft., leg. Syngranides 1825 6 V 1938 K.

TURQUIA

Constantinopla, entre Ostalouy et Kourotahaschau, leg. Aznavour 7 XI 1911 G. Istambul, Prinkipo, leg. v. Post 26 V 1916 G. Constantinopla, Sultan Ahmelds Moskés gärd, leg. Hummel 19 IX 1957 S.

IRAN

Persia, Shimran, 1200 m, leg. Cedergren 68 5 VIII 1914 S. Mazandaran, 7 Km E of Babolser, in pasture, leg. Grant 130 30 III 1965 NA.

INDIA

Nepal. Pokuara, 3500 ft., leg. Stainton et al. 5 16 IV 1954 BM.

CEYLAN

Peradeniya, Bot. Gard., 480 m, leg. Dassanayake 159 22 VII 1970 US.

CHINA

Shanghai, in gard. Friends Hotel, leg. Beach S 9 28-30 IV 1949 US. Fukien Amoy, Univ. Campus, leg. Chung 5472 p.p. IV 1927 A. Shen-Si. Chich-hsiu Dist., Sung-lin-miao, pr. Templum, ca. 900 ft., leg. Smith 7889 22 IX 1924 UPS.

JAPON

Yokohama, leg. Tanaka 59 16 IV 1961 (s.v. rubrifolia Makino) AD. Hondo, Prov. Musashi, leg. Mizushima 11791 14 V 19... Kôbe, Settsu, leg. Makino 2 XII 1929 (s. v. rubrifolia) MAK. Kanagawa Pref., Manazuru, leg. ipse III 1962(s. v. rubrifolia) MAK. Ashiga, leg. ipse III 1937 (s. v. rubrifolia) LE. Kyushu Isl., Kojyo Mt., gard. plots, leg. Carette 1071 3 V 1953 NY.

COREA

Quelpaert, leg. Farie 921 IX 1906 E. Ib., Mokpo, leg. Taquet 614 10 VI 1908 E,K. Ca. Quelpaert, Honguo, leg. Taquet 4805 12 IV 1911 G.

Africa

MAROC

Marrakech-Queliz, 1200 ft., leg. Frethewy III 1930 BM.

NIGERIA

Busa, garden, 3000 ft., leg. Migeod 4 4 XI 1927 K.

CAMEROUN

Yaoundé, garden, 700 m, leg. Leeuwenberg 6803 22 IX 1965 P,WAG. Manengouba Mts., bas, Nkongsamba, 1000 m, leg. ipse 9862 15 V 1972 WAG.

CONGO BRAZZAVILLE

Brazzaville, Jardin d'essais, leg. Attirns 214 2 IX 1969 P.

UGANDA

Seme Tead, 3600 ft., leg. Chandler 783 VI 1932 K.

KENYA

Njoro Dist., 7200 ft., leg. Polhill 128 24 VIII 1965 K. Mt. Elgon, E slope ab. Japata Estate, 3150 m, leg. Hedberg 1953 9 V 1948 S.

ZAMBIA

Mufulira, in short cut grass, 4000 ft., leg. Cruse 343 16 V 1948 K. Ndoba, 220 m, leg. Wilberforce A60 IV 1961 K. Mbala township IRLCS head quarters, 5300 ft., leg. Sanane 864 3 IX 1969 K.

SW AFRICA
Dist. Windhosk, Nachtingalstrasse, leg. P.G.Meyer 1087 13 II 1968 M.
S AFRICA
Cape Town, Gard., Bv. Res. Univ., 400 ft., leg. Boucher 1558 12 VIII 1971 K.

Islas Atlánticas

CANARIAS
Palma, 400 m, leg. Dinklage 3128 13 X 1934 GH. *Tenerife*, Las Mercedes, Las Mercedes, 1000 m, leg. Hummel 3 III 1961 S.
AZORES.
Pico, leg. C.S. Brown 36 2 VIII 1894 GH,US. Saint Michel, Furnas, leg. Persson VI 1937 S.
ASCENSION.
Leg. Duffey 108 1958 P. Leg. ipse 177 1958 K.

Oceania

FILIPINAS
Luzon, Baguio, 250 m, leg. Wöhler 83 I 1949 S.
JAVA.
G. Lawge, leg. Jacobson XII 1916 L. Bogor, Tjomas, leg. Soegandiredja 97 1900 L. Panguango, c. 3000 m, leg. Möller 26 IV 1897 S.
NUEVA GUINEA
Morobe Dist., Wan Subdist., Bulolo, forest school nursery, 2500 ft.,leg Kairo & Emos 35781 23 I 1968 CANB,GH,K,LAE.
NUEVA ZELANDIA
Christchurch Garden, Avonhead, Harrowdale Dr., leg. Edgar 236561 15 IV 1973 P.
HAWAI
Volcanoes Nat. Park, Kilauea Volcano NW rim of Caldera, 1235 m, leg.Fosberg 47725 20 IX 1965 US. Punu Huluhulu, Mumunla Saddle, 2100 m,leg.ipse 42150 11 IX 1961 US. Kuhaian ranch, ravine, leg. Hitchcock 14268 20 VIII 1916 US.
SAMOA
Upolu, Apia, leg. Reinecke 17 IX 1893 WRSL. Savai'i, Forest Exp. plot, leg. Whistler 80 3 VII 1972 US.
NUEVA CALEDONIA
Noumea, jardin, leg. McKee 27560 5 X 1973 P.

OBS.
O. corniculata L. v. *variegata* Goiran,l.c., Young, l.c. 57, *O. corniculata* (Goiran)Knuth, l.c.149, basada sobre *O. corniculata foliis rosso- et nigro-variegatis*, descrita por van Houtten, Fl. des Serres 19: 59, lám. 1968.1873 debe haber sido una variedad hortícola que no perduró. Ni Young ni yo pudimos hallarla.

8 b. *Oxalis corniculata* L. ssp. *corniculata* v. *villosa* (Marsch. Bieb.) Hohen.(1)

Hohenacker, Enum. Talysch. 395.1837. Bull. Soc. Imp. Nat. Moscou 11: 395 1838.
{Morison, Pl. Umbelliferarum Hist. 185, f. 17,2. 1672.]Tipo:Morison, OXF.
{*Oxys caule ramoso, pedunculis multifloris* Clifford, Hortus 175 (cf. p. 3) 1737.]Tipo: Herb. Cliford BM.

(1) El epíteto recuerda la pubescencia abundante especialmente sobre el haz foliar.

[Oxys lutea J. Bauhin, Pinax 330. 1623. Tournefort, Inst. Rei Herb. 1: 88. 1700.] Tipo: ? (In herb. Tourn. 154 P.)
[Oxalis scapo unifloro..... Sauvages, Fl. Monspel. 173 1751] Tipo: Francia, Sauvages, MPU.
Oxys corniculata Scopoli, Fl. Carn. ed. 2. 1: 326. 1772. Tipo: Yugoslavia, no visto.
O. villosa Marschall v. Bieberstein, Fl. Taur. Cauc. 1: 355. 1808. Lamarck, Encyc. 4. Suppl. 251-2.1816. Candolle, l.c. 692. Badaro in Moretti, Bot.It. 27. 1826. Reichenbach, Fl. Germ. 781. 1830-32. Ib. 5: lám. 4897.1841. Avé-Lallemant, Pl. It. Bor. 13. 1829. Rouy et Foucaud, l.c. 125. Non villosa Baker .833!
?O. jamaicensis Macfadyen, Fl. Jam. 182. 18 . Tipo: Jamaica. No existe.
O. Thunbergiana Montrousier, Mem. Ac. Imp. Sc. Arts Lyon 10: 192. 1860. Lectotipo: Nueva Caledonia, Montrousier P.
O. Langloisii(Small) Fedde, Bot. Jahresb. 32: 410. 1905. Smith, Mitchell Ser. Bot. 62: 82. 1946. Lectotipo: Estados Unidos, Louisiana, Langlois NY.
O. corniculata L. v. trichocaulon Leveillé, Rep. Sp. Nov. 8: 284. 1910. Knuth, Pflreich. 151. Tipo: Corea, Quelpaert 612 E.
O. corniculata L. v. pubescens Battandier, Fl. Algérie 173. 1888 ex descript. Jahandiez et Maire, Fl. Algérie 2: 448. 1932.
O. corniculata L. v. Langloisii (Small) Wiegand, l.c. Knuth, Pflreich. 434,436.
O. corniculata L. v. longepedunculata Sennen ex Knuth, Pflreich. 434. Tipo: Barcelona, Sennen 4725 BC.
O. corniculata L. f. villosa (M. Bieb.) Goiran, Bull. Soc. Bot. It. 1896: 97. 1896. Knuth, Pflreich. 150.
?O. corniculata L. v. repens (Thunb.)Zucc. f. maritima Masamune, Tr. N.H. Soc. Formosa 28: 433. 1938 Tipo no hallado.
Oxys lutea Tourn. ex Lamarck, Fl. Fr. 3: 60-1.1778. nom. illeg.!
Oxalis lutea Lamarck ex Steudel, Nom. ed. 1. 579. 1821;ed. 2. 240.1841 nom. illeg.!
Acetosella corniculata (L.) Kze.; v. villosa (Marsch. Bieb.)Kuntze, Rev. 1: 90. 1891
Xanthoxalis Langloisii Small, Fl. SE. U.S. 667.1903; N. Am. Fl. 25(1):52

TIPO. Albaniae Ibericae lapidosis inumbratis. D. Teuen. Iberia occid.,ex herb. Marschall Bieberstein LE.

Difiere de la variedad típica por poseer pelos en la faz superior de los folíolos.

En materiales de ciertas regiones alejadas y de islas del Pacífico la pubescencia en la faz superior de los folíolos es muy escasa o es glabrescente. Por el contrario, en especímenes de regiones euro-asiáticas y mediterráneas es densa y permanente como la del especímen-tipo. Estos, indudablemente aparecen distintos de O. corniculata var. corniculata y por esa razón se han creado nombres distintos. Entre ambos casos se observan estados de transición. Me parece útil conservar esta variedad.

Distribución geográfica. En todos los continentes, siendo en algunas regiones más frecuente que la variedad típica.

Material estudiado.

Ex herb. van Royen s. "Luzula 24", varios especímenes L. Ex herb. van Royen "G 4" L. Ex herb. Pittoni OXF.

ESTADOS UNIDOS:

N. America, leg. Menzies BM.

California. Berkeley, leg. Blankinship 28 III 1892 LY.

Florida. Sarasota, leg. Perking 20 I 1943 GH. Polk Co., S of Lake May, Winter Haven, leg. Mazzeo 1134 31 XII 1965 NA. Lake Hamilton, 433 Main St., leg. Conard & Ward 7 III 1963 NY,P,USF. Lower Captiva, leg. Brumbach 8629 10 X 1974 GH,NY. Middle Captiva Isl., leg. ipse 6628 25 II 1969 GH, NY. Louisiana. Near St. Martinsville, leg. Langlois 15 III 1897 Lectotipo X. Langloisii NY. Texas. Cameron Co., Santa Rosa, leg. Cannon 4 II 1927 MICH p.p.

MEXICO

Puebla. Chinantla, 7000 ft., leg. Liebman 53 V 1841 US. Moulin de Huexotitla, 2155 m, leg. Arsène 319 23 IX 1906 US. Veracruz. Jalapa, leg. Barkley et al. 2513 3 VIII 1947 F. Mun. Alto Lucero, Cerro del Sombrero Ca. plan de las playas, 1050 m, leg. Hernández 1633 23 VI 1972 F.

GUATEMALA

Guatemala. Capital, leg. Wall 2 21 IV 1928 S. Las Vacas, leg. Rodríguez 1465 23 XII 1929 P. Sacatepéquez. Ciudad Vieja, 1550 m, leg. Rodríguez 2089 31 III 1930 P. Antigua, 2000 m, leg. Williams y Molina 11803 19 I 1927 F,GH. Escuintla. 2000–2500 m, leg. Steyermark 32681 5 XII 1939 F. Quezaltenango. Near Río Samala, betw. Zunil and Cantel, 2150–2300 m, leg. Standley 83906 et 83935 18 I 1941 F. San Marcos. Ab. Río Tacaná, near S. Antonio, ab. 2700 m, leg. Standley 66179 22 II 1939 F. Amatitlán. Volcán Pacaya, 9000 p., leg. Shannon 3640 VI 1892 US.

COSTA RICA

San José, 900 m, leg. Rodríguez 97 6 I 1929 P. Vic. Palmira, 1900 m, leg. Jiménez 2555 13 XI 1964 F.

BAHAMAS.

Great Abaco, Marsh Harbour, leg. Correll & F. Meyer 44691 16 III 1975 NA, P.

CUBA

Oriente, leg. Wright 56 p.p. 1860–64 G,S. Vedado Habana, Rancho Pilila Garden, Soroa, leg. Alain 1758 I 1951 GH. Habana, pelouse Ac. Sci., leg. Sastre 424 7 I 1969 P. Santiago, Jardín Bot., Gran Piedra, leg. Boiteau 2606 VIII 1972 P. Habana, Marianao, jardin, leg. ipse 2609 18 VIII 1972 P.

PORTO RICO

Near Ciales, roadside, leg. Britton 8961 27 II 1927 NY,S. Betw. Aibonite and Copey, leg. Baker 29 II 1920 NY. Tortola. Road Town to High Bush, 3 300 m, leg. Britton & Shaper 745 13–17 1913 K,NY. Sage Mountain, 435 m, leg. D'Arcy 207 4 IX 1965 GH.

JAMAICA

Arntully, leg. Orcutt 2725 25 VIII 1927 UC. Gordon town to Cinchona, leg. Britton 36 1 IX 1906 NY. Blue Mts., Chester Vale, 3200 ft., leg. Philipson 691 14 VIII 1939 BM. Bethany, leg. Wolle X 1847 P,USF. Bog Walk, leg. Hitchcock 17 XII 1890 MO.

ANTIGUA

H.i. in umbrosis, rarius 90 Ex herb. Wullschlaegel M, W (Sería de la colección original de O. jamaicensis Macfadyen que lleva el N° 90 de la especie en la publicación? Boggy peak, leg. Rose et al. 3428 12 II 1913

NY,US. Near Fig Tree Hill, leg. Bos *909* 24 VII 1937 BM,UC.

Europa - Asia

Herb. Tournefort *154* P. Hort. Cliffort. *p.3* BM. Herb. v. Haller *27:4*(s. *O. flore luteo*) P.

INGLATERRA

Cult. Chelsea Physic Gard., *885* 1739 BM. Hereford, Sedbury, leg. Bickham *326* 17 VII 1917 K. Ipswick (Fl. Serres, lám. 1205) comm. Thompson K. Guernsey, near Rocquaine Bay, leg. Metcalfe IX 1840 K.

POLONIA

Podkarpacie, leg. Marcowa a. 1938 BP.

BELGICA

Ex herb. Merat.... P.

FRANCIA

Alpes-Maritimes. Nice, rive droite du Paglione, leg. Jacquemont V 1821 P. Presqu'île de St. Jean, Villefranche-s-Mer, leg. Marcilly *I 326* p.p. 21 IV 1874 P. *Ardèche*. Pradelles, leg. Pourret 18... P. *Ariège*. Jouola, leg. Guillol 25 V 1898 P. *Aveyron*. Lincou, leg.Bec VI 1904 P. Entrayques et Couesques, leg. Puyfol 18 V- 18 X 1967 P. *Cantal*.St. Santin-de-Maurs,leg. Héribaud 3 IV 1874 P; *1373* 18 IX 1903 P. *Dordogne*. Payzac, leg. Gandoger 2 IX 1890 LY. *Côtes-du-Nord*. St. Jean du Doigt, leg. Butler *173* 29 VII 1938 NY. *Deux-Sèvres*. St. André-s-Sèvre, leg. Regnier *701* VIII 1890 GENT *Gironde*. Lormont, fossés, leg. B. Martin 10 IV 1861 MPU p.p. Beaurech à Cambes, leg. Jallu 20 V 1928 P. *Haute-Garonne*. Pyrenai, Cazaril, leg. Franqueville XII 1845 FI. Ib., leg. Aunier 8 VII 1843 LY. *Hautes-Pyrenées*. St. Sauveur, 3000 ft., leg. Meinerthazen 3 X 1932 BM. *Hauts-de-Seine*. Bois-Colombes, leg. Chevallier 2 IX 1886 P. *Hérault*. Montpellier leg. Horry *113* 1766 P. Ex herb. Sauvages MPU.*Ile-et-Vilaine*. Bourg des Comtes, leg. Puiseaux 24 V 1843 P. *Landes*. Adour, en amont du Pont de Lamarquèze, leg. Jovet 13 X 1967 P. *Loire-Atlantique*. La Contrie, près Nantes, leg. A. Camus 22 VII 1875 P.Château de la Maillene, leg. Bureau 9 IX 1869 LE. *Lot-et-Garonne*. Villeneuve, leg. Guillon 5 VI 1856 P. Agen, leg. Chabert, ex herb. Persoon L. *Lozère*. Ex herb. Persoon L. Lozère, leg. Boivin a. 1835 LY. *Maine-et-Loire*. Angers, Chalonnes, leg. Bastard a. 1845 P. Eglise de Vazay, ex Allard V 1858 P.*Manche*. Beauficel, près Sourdeval, leg. Tobard X 1870 P. Vire, leg. Disigny a. 1827 P.*Morbihan*. Vannes, leg. Pontalier a. 1846 P. *Pyrenées-Atlantiques*. Orthez, leg. J. Gay 3 IX 1813 K. Puyoo, leg. Copineau 9 IX 1889 US.Pau, leg. Forestier VI 1847 P.Biriatou, Rochers des Perdrix, leg. Jovet 23 IX 1965 P. *Pyrenées-Orientales*. Pr. Catllar, leg. Franqueville 22 VI 1847 P.Banyuls, leg. Colàon V 1865 P. Perpignan, leg. Adanson 1 VII 1779 GH,US. *Sarthe*. Près le Gué de Maulny, leg... P. *Tarn.* Durfort, rochers, leg. Chevallier 21 V 1885 P. Jouffray, leg. Grenier ? III 1878 P p.p. *Var*. Hyères ad marg. fossarum, leg. Sonder VI 1838 BM,UPS. Env. de Toulon, leg. Robert, ex herb. Mérat a. 1851 P. *Corse*. Calvi, leg. Soleirol *5226* FI,P. Bastia, leg. ipse *805* 20 V 1827 FI,LE,P,WAG. Bonifacio, leg. Serafino III 1828 K.

ALEMANIA

In cald. Blankenb. et Brunswigae, ex herb. Mercier FI.Görlitz, in gärten leg. Peck VIII 1869 K.

CHECOSLOVAQUIA

Bar, Montenegro, leg. Rohlena V 1900 et IV 1903 PRC. Montenegro, Rijeka, leg. ipse V 1900 PRC.

SUIZA

Leg. Gale OXF. Ticino, Locarno, leg. Wyatt 16 10 V 1938 K. Ib., leg. Schleicher UC p.p. Monte Pilato (Capell) 600-40 LINN. Ib., leg. Keller VII 1888 UPS. Tessin, Ronco, leg. Muret IV-VI 1870-1871 K.

AUSTRIA

Tirol, pr. Botzen, leg. Haussman 1249 1885 LE,LY,P. Tirol, leg. Waldmüller V 1855 BP. Ib., pr. Darzo, 3-4000 m, leg. Porta IX 1889 FI. Castagnola, muri, leg. Lenticcia 1 IV 1890 FI. Euganeis Interhinat, leg. Meyer (herb. Zahlbruckner) PRC.

RUSIA

Caucasus, Lenkoran, leg. Radde 230 25 X 1870 GH,LE,P. Ib., leg. Hohenacker 2086 1836 BM,K,LE,P. Ib., Cever, 61 Km Alekseevna, leg. Matveeva 44 20 VI 1931 NY. Entre Lenkoran et Galouchivan, leg. Chipeginski 63 6 VI 1931 NY. In aridis Georgia, leg. Hohenacker s. 1838 BM,BP,FI,OXF,P,PRC. Adzharistan, Kobuleti pr. Batum, leg. Woronov 518 29 VII 1917 K,NY. Dist. Nucha, Elizabethpol. pr. Kutkaskin, 2800', leg. Alexeenko 29 30 VII 1899 LE. Imeretia, leg. Brotherus VI 1877 LE. Armenia. Guriel, leg. Szovits 99 I- V00 1830 FI, LE,P. Transcaucasia. Abkhasia, Suchun-Kale ad viam Monasterium N. Athonense, leg. Bordzitowski 5 V 1906 LE. Batum, leg. Holmberg 1922 26 VI 1912 UPS.

PORTUGAL

Oporto, leg. Sjogren VII 1855 GH,US.UPS. Serra da Louza, leg. Henriques VI 1883 COI. Valença do Minho, leg. Gandoger 16 VI 1898 LY. Lisbon Dist., leg Scarlett 63 1935 K. Concelho de Cerveira, Carvalha, leg. Silva 165 1 VIII 1945 S. Caldas de S. Gemil, leg. Moller VII 1886 COI. Buarcos, leg. Goetz de Carvalho 1330a XI 1895 COI. Figueiro dos Vinhos, leg. Freitos IV 1888 COI. Entre Abrantes e Mourisea, rib. do David, leg. Fernandes, Matos e Santos 5815 17 VI 1956 COI.

ESPAÑA

Murcia, leg. Gueras IV 1852 ex herb. Willkomm. Barcelona, Rubí, leg. Sennen 4725 25 V 1923 Tipo O. corniculata L. v. longepedunculata LE. Isótipo BC. Env. de Barcelona, leg. Tremols VI 1873 LY. Vizcaya, Lequeitio, 300 p. leg. Gandoger VII 1908 LY. Asturias, Puente de los Fierros, leg. Laínz 10 VI 1958 NY. Catalonia, Pr. Tarragona, La Riba, 300 m, leg. Font i Quer 23 III 1921 BC. Granada, Almuriécat, leg. Roivainen 23 IV 1952 UPS. Majorca. Betw. Soller et Daya, 500 ft., leg. Martindale 22 4 X 1934 K. Pollensa, 200 ft., leg. ipse 52 21 X 1934 K.

ITALIA

Ex herb. Linnaeus F. 40- 13 B,S.

Calabria. Latanzaro, Simigliano, leg. Fiori 4 V 1884 FI. Campania. Napoli a Pozzuolo, leg. Parlatore 6 X 1868 FI. Pontamare, leg. Tenore X 1821 FI. Etrusca. Altopascio, leg. Savi V 1863 P. Lombardia. Boix ad Benacum, leg. Porta 14 V 1865 K. Pr. Grosio, Castello, leg. Longe 17 VI 1892 FI. Marche. Monte Fortino al Campo di Marte, leg. Marzialetti IV 1836 FI. Piemonte. Turin, leg. Chabeert 2 VI 1860 FI. Verris lungo la strada di Brusson, leg. Bolzon 6 V 1911 FI. Sardegna. Monte Narba (Sarrabus) ad vias, leg. Sommier 20 IV 1872 FI. Prov. Iglesias, Rio de Bau, pr. Ingurtosa, leg. Ascherson 9 VI 1863 FI. Sicilia e Malta. Messanam, ad vias, leg. Sommier 30 III 1873 FI. Margino dei campi e giardini, leg. Parlatore X 1868 FI. Toscana. Florentia, ex herb. Burser 18:2, 60 UPS. Pisa, leg. Savelli 6

IX 1914 FI. Firenze, Isolotto, leg. Bargagli I 1875 FI. Chianti, leg. Ricasoli I 1843 FI. Monsumano, leg. Sommier 28 VI 1871 FI. Ins. Capraria, leg. ipse a. 1910 FI. Umbria. Nei muri, leg. Mari 15 VIII 1896 FI. Roma, Cimet. St. Laurentii, leg. Haynard 4896 30 V 1862 BP. Venezia. Pr. Verona, leg. Rigo XI 1872 FI. Istria. Ex Arena palent. Ex herb. Sadler 15 V 1825 BP.

YUGOSLAVIA

Ex herb. Pittoni OXF. Dalmatia, leg. Prior K. Croatia, Fiume, leg. Noë 338 IX 1883 BP,NY. Ragasa, leg. Prior IV 1843 K. Orna Gova, Pistula pr. Ulcinij, leg. Deyl 11 V 1974 PR. Dalmatia, Monjsliveck, leg. Rohler a. 1908 PRC. Velebit, supra Starigrad, leg. Lengyel 14 V 1909 BP. Com. Modrus-Fiume, ad port. Cirkvenica, leg. Filarsky, Kümmerle et Moesz 9 3 V 1909 BP.

BULGARIA

Constantinopla, Istanbul, leg. Aucher-Eloy 2112 1837 FI,K,P. Ib., leg. Murmann 21 V 1876 G. Env. Constantinopla, Dere, leg. Nemetz 3 XI 1895 LY Pr. Rodosto, leg. Nikoloff 12 V 1913 S.

ALBANIA

Albaniae Ibericae lapidosis inumbratis, leg. Steuen, ex herb. Bieberstein Tipo LE. Dist. Sarandë, near Cuké, leg. Alston & Sandwith 1312 2 VI 1933 K. Elbassan, leg. Stöhr a. 1917 PR.

GRECIA

Xanthie-Shahin Rd., Km 7, 600 ft., leg. Tedd 1335 6 IV 1934 K. Anatolia, Pamphylia, Antalya, 30 m, leg. Tengwall 243 9 IV 1936 K,P. Helos Crete, 1200 ft., leg. Atchley 1703 VII 1932 K. Pelion, Thessalie, 500 m, leg. Topali G.

CHIPRE

Nicosia, Kambos, leg. Lindberg 15 VII 1939 K,S. Paphos, leg. Kotschy a. 1840 UPS. Palechovi, 3000 ft., leg. Conomidos 1332 8 V 1970 K. Agros, leg. Davis 3057 9 IV 1940 K.

TURQUIA

Prov. Adana, Dist. Bahce, Dildil dag, ab. Harunive, 1000 m, leg. Polunin 18 IV 1956 BM. Prov. Coruh, Borcha-Hopa, 200 m, leg. Davis & Hedge 29831 21 VI 1957 BM. Gakakoy, Black Sea coast, betw. Gatsa and Persembe, 20 ft. leg. Watson 194 6 V 1964 K. Turcomania, leg. Kareline 1724 1839 S.

SIRIA

Plantae Byzanthi-Scutari, leg. Parsons 11 VI 1877 NA. Saïda, leg. Blanche 78 26 XI 1852 P. Mt. Nusairy, Bahma, 15 mi. E Ladikie, 1000 ft., leg. Haradjan 2837 IV 1909 K,S. Phoenizische Küste XII 1899 LE. Nahr el Kelb, leg. Wall 21 IV 1932 S.

LIBANO

Batroum, leg. Bombault 1173 11 I 1931 P. Damour, leg. ipse 1174 19 III 1931 P. Beirut, leg. Wood 21 V 1971 NY. Ib., Ragusa, leg. Adamovic 2 IX 1906 PRC. Abudiye, leg. Trench 4 IV 1945 BM. Alexandrett, leg. Fr. Louis 30 VI 1931 P.

JORDANIA

American Colony, Banias, 330 m, leg. Meyers and Dinsmore 1815 11 V 1911 G,K. Near Tripoli, leg. Post 28 IV 1865 K.

ARABIA

Ca. Haïfan, leg. Deflee 551 17 IV 1890 P. Oman, Exp. Farm Nizwa, 600 m, leg. Parker 11 II 1973 BM. Haddah, 2280 m, leg. Hepper 6302 7 XI 1975 K.

IRAK

Mesopotamia, Biredijik, leg. Sintenis 486 30 IV 1888 K,LE,P.Babylonia Australis, Basra, leg. Bornmüller 121 23 III 1893 BM,K,P,PRC. Zalum near Khormal, 100-110 m, leg. Raioi et al. 29492 22 VI 1960 K. Baquba Luva, Raaya, vill., leg. Alizzi & Hazim 33694 10 IV 1965 K.

IRAN.

Prov. Asterabad, Bender Gas., leg. Sintenis 1354 7 III 1901 BM,BP,FI,K,LE, P,PR,PRC,US. Ib., leg. ipse 1354b LE,S,UPS. Astrabadensi, leg. Bunge IV-V 1858 P. Ghilan, leg. Aucher-Eloy 477 ... P. W of Astara, Baharastan,3000 ft., leg. Cowan & Darlington 2517 et 2664 16VI 1929 K. Mozanderan, Chalus, leg. Oosten 240 X 1958 WAG.

AFGANISTAN

Prov. Mangahar, Qasemabad, ca. Jalalabad, 570 m, leg. Podlech 17337 3 IV 1970 p.p. G.

PAKISTAN

Chitral vill., 5000 ft., leg. Stainton 2153 10 IV 1958 US. Kagan vall. betw. Balakot and Babusar,Pass, leg. Abel 32 VII-IX 1954 BM.Punjab, Prov. Murree, upper Topa, ca. 7000 ft., leg. Rodin 5365 19 VII 1952 F,US.Rawalpindi, ± 1500 ft., leg. Nassir 2462 20 IV 1964 NA. Khaipur, leg. Jafri 1244 12 III 1956 K. Karachi, 9 mi. fr. Nathiagali to Abbottabad, leg. Farvogi & Quiser 3457 4 X 1970 NA.

INDIA

Himalaya. 1-6000 ped., leg. Thomson P,S. Kumaon, Almora, 5700 ft., leg. Strachey & Winterbotton 1 GM,GH,K,P. Near Nilagiri, leg. Hohenacker 1143 p.p. 1851 BM,FI,K,L,LE,P,PR,PRC,S,UPS,US. Sikkim, 6-1000 ft., leg. Hooker P.NW Himalaya, Bashahr, Kotgarh to Twit, leg. Lace 820 24 IV 1891 OXF. Prov. Tsamba, Kali Pass, leg. Hogs 3188 28 VI-8 VIII 1856 GH. Simla, Nahau via Degshai to Solen, 2800-6500 ft., leg. Schlagihtweit 7724 17-24 III 1856 P. Sairag, 8000 ft., leg. Koelz 20195 1 V 1948 NA,NY.Nepal. Bel.Manche Bazav, Khunnbu Dist., 9200 ft., leg. Onyon 9 7 IV 1966 BM. Monjo, 2550 m, leg. Zimmermann 1842 26 X 1954 K. Birathager, Dharan Bazar, 1250 ft., leg. Stainton 35 16 IV 1956 A,BM. Tarakot, 2800 m, leg. Einarasson et al. 12 VI 1973 BM.

CHINA

Leg. Incarville 143 p.p. 1740 P. Leg. Osbeck S. China Boreal, Tschili, Schansi, leg. Potanin 17 VIII 1885 LE. Anhwei. Chiu Hua Shan, leg.Ching 8487 28 VI 1925 UC,US. Chekiang. Shihpu, leg. Chiao 14092 11 VII 1927 US Mo Kan Shan, leg. Cheo & Wilson 12652 19 VI 1926 K,UC. Hainan. Yaichow, leg. How & Chun 70017 I 1933 E,GH,LE,NY,P.Tan Dist., Ikap Shan, leg. Lau S.K. 1030 12-24 II 1933 BM,GH,LE,NY,P. Hopeh. Tch'eng Chan Tao, vers le Miao-tao, leg. Licent 6439 29 VIII 1921 P. HunanYi Chang Dist. P'ing T' ou Shan, Pai Mu vill., leg. Tsang 23635 17-30 IV 1934 BM,P. Hong-Kong. Leg. Coert 1225 9 VI 1936 L. Ib., leg. Kuntze II 1875 NY. Macao, leg. Shiu 7035 19 IV 1969 A,K,US. Honan. Kreose, Tengfong, 760 m,leg. Schindler 170 VIII 1907 LE. Hupeh. Ichang, leg. Henry 741 1886 K,P. Du pan chan, 600 m, leg. Silvestri 3065 14-23 III 1910 FI.Fukien. Diong Loh, Muoi Hua, leg. Tang Siu Ging 13632 22 IV 1927 GH. Amoy, leg. Chung 5610 9 V 1923 GH. Kan Su. Lung Chow, leg. Morse 111 1 V 1907 FI. Inter Kan Su et Thian Schan, leg. Piasezky 24 1875 LE. Kiang Su. Nanking, leg.Zee 480 10 VI 1920 UC. Ib., leg. Macklin 69 1906 F. Kwangtung. Canton Campus, leg. To Kang Ping 10972 24 III 1923 BM,US.Wung Yuen Dist., Wong

Chuk, Tsing Wan Shan, leg. Lau S.K. 2039 16-31 VIII 1933 GH.. Keichow. Tsunyi Haien, Liang Fang Yah, leg. Steward et al. 219 6 VIII 1931 LE,NY,S, US. Tien chu tze, Tungtze, leg. Tsien 4876 20 V 1930 GH. Shantung. Yangschau (Fei), leg. Licent 213 3 VII 1926 GH. Tsingtao, First Park, leg. Chiao 2404 7 VI 1930 GH,F,GH,K,US. Shen Si. Leg. Père David VIII 1876 P. Entre Sin Tsa Ling et Yu Men Tcheun 3004 29 IX 1916 BM,K,P. Shi kang. Ta Hsiang Ling, Han Yuen Hsien, 2600 m, leg. Chiao 1903 19 VIII 1939 GH. Shi Kong. Tchenton et Vallé du Ming, 500 m, leg. Lagendre 86 15 V 1908 P. Szechwan. Kiating, leg. Chow 8835 20 XI 1938 GH. Cheng Tu, leg. Fang 12058 III-IV 1938 BM,GH. Tsin Shai. Leg. Leclandher a. 1844 P. Yunnan. Pl. du Yunnan et du Mékong, leg. Prince H. de Orléans 12 II et 12 III 1893 P. Tong Tchouang, leg. Maire 3188 III 1910 LE,UC,US,W. Kun Ming, 2000 m, leg. Wang 62835 IV 1935 GH.

JAPON

Leg. Wright 1853-6 K. Leg. Challenger Exp. IV-V 1875 BM. Hakone, leg. Bisset 62 29 V 1876 BM. Yokohama, leg. Maximovicz 23 VI-3 VI 1862 BM,LE. Nagasaki, leg. Oldham a. 1862 L. Fukukoa, Kasuya Tatara, leg. Tanaka 150 4 VII 1925 UC. Prov. Ohsumi, Kyunsyu, leg. Nasu 1 XI 1950 US. Kamakura, leg. Faurie 6444 X 1890 FI,G. Yokoska, leg. Savatier 165 p.p. BP,K,P. Tohtohmi, Misakubomachi, Mukoichiba, 300 m, leg. Koyama 7209 4 V 1957 AD. Dogo Isl., N of Nishimura, path tow. Shirashima, leg. Walker 8503 8 VIII 1906 US. Ryukyu Isl. Ishigaki Shima, 0,5 Km fr., Nusukun Muru, 50 m, leg. Fosberg 37074 22 V 1956 US.

COREA

Quelpaert, Syeteni, orizetarum, leg. Taquet 612 IV 1908 Tipo O. trichocaulon E. Isótipos G,K. Ib., inter rupes, leg. ipse 5441 V 1911 E. Quelpaert insula Saiseum, leg. Tawuet 4615 16 IV 1908 E,G. Ib., leg. Taquet 4614 15 III 1911 G. Quelpaert, in agris Honguo, leg. Taquet 12 IV 1911 p.p. Ib., leg. Ohiwi 9185 V 1935 UPS.

BIRMANIA

Kambaiti, 73 Km E of Myitkyina, 2100 m, leg. Malaise 187 26 III 1934 S.

TAILANDIA

Loei, Pha Nok Kao, leg. Suvarnakoses 1353 2 III 1958 L. 15 Km E Mae Sariang, 1000 m, leg. Larsen et al. 2399 12 VII 1968 K,P. Wang Tao, 700 m leg. Larsen 1061 13 II 1958 A, USF.

LAOS

Hung-Kouang, leg. Spire 1501 1903 ? P. Muong Ngoi, Prabang, leg. Poilane 20625 2 IV 1932 P.

VIET-NAM

Annam, Massif du Langhian, 1000-1200 m, leg. Chevalier 40367 29 IV 1919 P. Tonkin, Phuong, leg. Bon 2203 19 VII 1883 P. Près Langson, Forts de Kilua, leg. Balansa 1128 27 II 1886 P. Bentram, Prov. Quang-tri, leg. Poilane 1139 19 III 1920 P. Baie d'Along, La Surprise, leg. Lecomte et Finet 778 7 XI 1911 P. Env. Saïgon, leg. Lefèvre 95 26 X 1864 P. Hanoi, leg. Demange 1007 24 I 1908 P.

CAMBODGE

Exped. Mékong, Lacone, leg. Thorel a. 1866-68 P. Samabury, leg. ipse 3250 1866-68 K,P.

MALASIA

Singapore, 100 ft., leg. Purseglove 4001 26 IX 1954 L. Malacca, leg. Burkill 1498 8 VII 1916 K. Penang, propagation yard, leg. McHoor? 24 IX 1918 UC. Pulau Penang, leg. Burkill 10 xi 1917 K.

Oceania

FILIPINAS

Prov. Benguet, Baguio, leg. Elmer 8623 III 1907 BP,FI,G,GH,L,LE,LY,NY,P, PRC,US.Manila, leg. Merrill 88 19 V 1902 K,NY,US. Luzon Central,Parang, leg. Loher 1641 K. Manila, leg. Barthe (Frégate La Sybille) 1857 P. Lepanto,leg. Bona VIII 1912 US. Luzon, Bayninan, Banane, Ifugao, leg. Conklin & Buwaya 80396 30 III 1963 A.

SUMATRA

Rabasi, Pad Bovenl., ± 1000 m, leg. Bünnemeyer 3871 23 VII 1918 K,L,P. Gajo Loeas, Kota Lintang, leg. Pringo 263(Exp. Gagoe Alas)14 IV 1904 L. Karo Haighlands, Berastagi, leg. C. Hamel 439 5 VI 1928 NY.

JAVA

Ex herb. Burman G. Pr. Jebok, Klakko, leg. Zollinger 2543 9 XI 1844 P. Plateau de Pengalengan, 1400 m, leg. Hochreutiner 1335 21 VII 1904 G. Oost Java, Hjang Plateau, 2000 m, leg. Coert 3531 12 V 1935 L. Cult. Tjipanas, ca. 1060 m, leg. v. Ooststroom 12974 16 III 1950 L.

NUEVA GUINEA

Mafulu, leg. Brass 5528 IX-XI 1933 GH,K,NY,UC,US.W Highlands, Sirunki NE slopes of Puridi Hill, 8500 ft., leg. Walker 464 VIII 1969 CANB,GH,K, L,LAE. Star Mts., Sibil vall., 1200-1300 m, leg. Kalkman 4253 11 VI 1959 CANB,GH,L,LAE.Kaiser Wilhemsland, leg. Weinland 29 1889-91 L,M,US, WRC. Morobe, Lal, Kupandu, Waritoat, leg. Millar 12195 9 VIII 1968 K,LAE. Papua. East Papua, Milne Bay Dist., Bauiara, Boneanu vill., ca. 1000 m, leg.Pullen 8086 19 VIII 1969 CANB,LAE.

AUSTRALIA

Newcastle, leg. A. Valentin 17 XI 1927 S. New S. Wales,Peel River,betw. Piallamore & Dungowan Tamworth, leg. Goode 73 6 XI 1954 K. Queensland, Lawes, leg. Shaw 485 7 IX 1945 CANB. Norfolk Isl. Near sea shore, on rocks, leg. Laing 113 pr. max. p.,a.1912 Tipo O. c. v. reptans Laing CANTY.Anson Bay, leg. McComish 122 p.p. 6 I 1939 K.

NUEVA ZELANDIA

Leg. Védel a. 1847 P. Ocampo, leg. Heusler a. 1897 G, PRC. Baie des Iles, leg. Raoul a. 1843 P. Raoul Isl., Farm Area, leg. Sykes 371 10 XII 1966 K. Ins. Boreal, Ohaeawai, leg. Berggren X 1874 UPS. Auckland, Mt. Eden, leg. Hochreutiner 3177 10 III 1905 G.

Islas Pacíficas.

HAWAI

Oahu, leg. Rémy 631 p.p. 1851-55 L,P. Ib., Nuuanu Pali, leg. Hitchcock 13781 17 VI 1916 US. Raiatea, 60 m, leg. Moore 52 14 IX 1926 L,LAE.Honolulu, leg. Du Petit Thouars P. Emoloa, leg. Gaudichaud G,P. Along Tantalus, leg. Heller 2159 19 IV 1895 G,GH,NY,US. Maui, Kula, near foot of Haleakala, 1000 m, leg. Fosberg 55669 14 III 1975 US.

MARIANAS

Leg. Gaudichaud a. 1830 G. Guam, leg. Thompson 164 17 XI 1913 K,US. Track fr. Cetti Bay to top of Mt. Lamlam, 200-405 m, leg. Evans 1719 1 IV 1966 US.Rota, near Poniya Point, 350-500 m, leg. ipse 2204 26 V 1966 P, US.Vavao, leg. Leguillou 26 P.Uahuka Isl., N of Vaipae's 550-600 m, leg. Decker 1840 16 III 1964 US.

FIDJI

Viti Levu, Vic. Nalotawa, E Base of Evans Range, 550-600 m, leg. Smith 4326 28 IV - 17 V 1947 GH,US.Tonga Isl., Isl. Eua,ab. Riechelmann's Plantation, 250 m, leg. Yuncker 15647 5 IV 1953 BM,US. Vavau, 200 ft., leg. Yuncker 1011 29 IX 1959 K.

MARQUESAS.

Hiva'oa Isl., Puman along Puamau-Atuona trail, 500-680 m, leg. Decker 1209 14 XII 1963 P,US. Nuhiva, leg. Hombron (Voy. Astrolabe et Zélée)1838-40 P. Fatu Hiva, hills of Hana Vavé, 800 ft., leg. Chapin 780 21 X 1934 NY.Tahuata Isl., Vaihatu, crête d'Amatea, 550 m, leg. Schäfer 5506 10 IV 1975 US.Fatuhiva Isl., ab. M'a vall., 400 m, leg. Decker 2601 22 X 1974 US.

SOLOMON

New Georgia, leg. Waterhouse 304 26 VIII 1929 A.

NUEVA CALEDONIA

Ny, Port-de-France, leg. Gillivray 5 VII 1858 BM,G,K,S. Plaine de Cohala leg. Delacour VIII 1869 P. Paila, leg. Le Rat 693 1909 P. Leg. Montrouzier Lectotipo O. Thunbergiana Mont. P. Nouméa, leg. Balansa 526 X 1868 P. Prouy, leg. Franc 1540 IX 1913 G. Ib., leg. ipse 1986 V 1915 G, NY. Ile des Pins, leg. Pancher a. 1870 P. Ile Hugon, leg. Denizot 19 V 1961 P.

POLINESIA

Observatory Isl., Isle of Pines, leg. Gillivray (Voy. Herald) 813 IX 1853 K. Ib., leg. ipse 793 X 1853 K. Ib., leg. Milne (Voy. Herald) 117 X 1853 K.

GAMBIER

Mangareva, leg. Hombron (Voy. Astrolabe et Zélée) 1838-40 P.

Africa

MAROC

Taroudant, leg. Ibrahim 11 VI 1888 BM,FI,G,LE,LY,P. Oum Djerid, leg. ipse 20 VI 1888 FI,G,MPU,P.Tetuan, leg. Pitard 882 10 IV 1911 P. Aga Dir, 10 Km SE, leg. De Wilde et Dorgelo 1897 28 IV 1961 WAG.Amigmig, 4300 ft., leg. Balls 2465 30 V 1936 BM,K,S. Greater Atlas, leg. Hooker V 1871 K. Dakar Riffien (Averyhera), leg. López y Vidal 280 4 IV 1925 BC.

ALGERIA

Blidah, leg. Meyer 1 VII 1881 FI.Orán, leg. Durien 18 VI 1842 P. La Calle au pied du Rotondo, leg. ipse 1840-44 P. Aid Ouabou, leg. Letourneux 27 VIII 1869 P. Pointe Pescado, leg. Janin a. 1850 P. Env. d'Alger, leg. Durando a. 185.. P.

TUNISIA

Bargou, leg. Letourneux 2 VI 1887 P. Kroumirie Orient., Col d'Argoub-el-Ahman, leg. Cosson, Barrette et Duval 26 VI 1888 P.

LIBIA

Gärten von El Basar, leg. Ascherson 88 2 V 1876 P.

REPUBLICA ARABE

Leg. Delile P. Valle Nilotica, leg. Figari V 1867 FI. Cairo, leg. Schweinfurth 981 1866 P. Horto pr. Cahiram, leg. Ehrenberg IV 1820-26 P,UC. Aegypti Inf., leg. Wiest 558 1835 M.Giza, leg. Sisi 21 VI 1959 K. Dimanche, leg. Samaritain 18 X 1858 S.Entre Alexandrie et Rauleh, leg. Du Parquet a. 1872 BM.

SAHARA ESPAÑOL

Pr. Mahzen, Iter Maroccanum, ad agrorum margines, 900 m, leg. Font i Quer 289 30 VI 1939 BC,BM,FI,S,UC.

COTE D'IVOIRE

Entre Tabou et Bériby, leg. Chevalier 19179 16-18 VIII 1907 P. Mont Tonkoni, leg. Schnell 6357 VIII 1954 K. Toumode, Boca de Titickro, leg. Roberty 13949 21 I 1951 G.

CHANA

Lagon Campus, leg. Enti 114 20 VIII 1971 US.

NIGERIA

Nkama Dist., Ndu, 600 m, leg. Hepper 1870 1958 K,P. Sapobe, via Sapel, leg. Kennedy 2368 K.

CAMEROUN

Leg. Periquet 209 1912-14 P. Env. Vouca, 1000 m, leg. Annet 31 II 1918 P. Ambari, pelouses, leg. J. et A. Raynal 10004 22 II 1963 P. Mfoulekok, 10 Km WSW d'Ambam, leg. Letouzey 10056 9 II 1970 P. Yaoundé, 700 m, leg. Leeuwenberg 6808 22 IX 1965 WAG.

REPUBLICA CENTRO-AFRICANA

Krébidjé, leg. Chevalier 5484 p.p. V 1906 P.

SUDAN

Jebel Marra, Golol 5000 ft., leg. Wickeys 2869 III 1965 K,M,P. Nyertele, 3800 ft., leg. ipse 1013 20 I 1964 K. Prov. Equatoria, Dist. Torit, Ngairigi R., Imatong, leg. Jackson 1041 8 I 1950 BM.

ETIOPIA

Plaine de Dergow?, Expl. Mer Rouge, leg. Courbon 254 12 I 1860 P. Addi Duhoa, leg. Schimper 827 p.p. 10 X 1862 S,US.

GUINEA

Nimba, leg. Schnell 3476 VIII 1947 P. Cercle du Kissi, entre Koundiani et Ouria, leg. Chevalier 20762 20 II 1909 P.

GABON

Niari, Coruba à Bonanza, leg. Thollon 1035 VI 1888 P.

CONGO- BRAZZAVILLE

Village de M'Pengui, route de Mouyounzia Makala, Km 26, leg. Bauquet 698 11 XI 1964 P. Kindamba, leg. de Nere 786 21 I 1963 P. Kimboto, leg. Babet X 1930 P. Près Ndjolé, leg. Hallé 1905 28 IV 1963 P.

CONGO KINSHASA

Entre Amateat Doruma-Ucle-Nepoho, leg. Lebrun 3127 VI 1931 UC. Buronga W du Volcan Mikeno, leg. J. Louis 5133 P. Rutshuru (Kivu), leg. Lebrun 8985 XII 1937 BM,P. Irumu (Kibali-Ituri), leg. ipse 4219 1931 F. Mulungu, leg. Hendriehz 1348 3 XI 1940 K. Yamboa, NW de Yangambi, leg. J. Louis 11262 11 IX 1938 NY. Kivu Prov., Ruwenzori Mts., Butahu vall., Kalonge, 2000 m, leg. Osmaston 3366 15 VII 1954 BM.

UGANDA

Nyassaland, Nyankhava, Mt. Zomba, 1500-1800 m, leg. Humbert 16973 IX 1937 K,P. Nyandiduma, Morogor, leg. Mgaza 14 p.p. III 1956 K. W Prov. Mobuhu Riv., near Mihunga, 1800 m, leg. Osmaston 1565 16 VII 1952 BM.

KENYA

Karen Mong, 200 m, leg. Babault s. 1937 P. Nyanza Prov., Londiani Dist. Tinderet forest reserve, Timboroa Stat., leg. Maas 5482 12 VII 1949 F,L, UC.

TANZANIA

Ngorongoro Nat. Park, 7000 ft., leg. Tanner 3815 22 XI 1957 UC. Ruhudje, Landschaft Lupembe, leg. Schlieben 423 III 1931 BM,G,M,P. Misambaras Lushote, Mkuzi, 1600 m, leg. Drummond and Hemsley 2893 11 VI 1953 K, S. Kungwe, N of Lake Nyassa, leg. Geilinger 2480 19 IX 1932 K. Mbeya Dist., Mbeya, leg. Milne-Redhead and P. Taylor 10309 15 III 1956 BM,K.

ANGOLA

Dist. Huilla, Momos, 5500 ped., leg. Welwitsch 1611 IV 1860 G,K. Ib.,leg. ipse 1610 p.p. P.

SIERRA LEONE

Ex herb. Afzelius UPS.

SOMALIA

Near Sheikh, ca. 6000 ft., leg. Ironside 112 1 VI 1973 K.

RODESIA

Umtali, Stapleford Forest, 5000 ft., leg. Chase 4270 28 XI 1951 NY.

TRANSVAAL

Lydenburg, leg. Wilms 199 I 1893 G,K,L,P. Shilouvane, termitière, leg. Junod 591 IX 1889 K.Bechuanaland,Prov. Batharos near Kuruman, leg. Silk 23817 F. Rustenburg, 4500 ft., leg. Nation 27 2 I 1904 K. Letaba, 3425 ft., leg. Scheepens 543 6 I 1959 NY.

SUDAFRICA

Natal. Margate, leg. Theron 853 23 VIII 1950 K. Natal, leg. Byrne 3174 17 III 1885 K. Pr. Durban, leg. Wood 46 1 IX 1883 BM,LE.Pieter Mantzburg leg. Wihins 1909 X 1883 BM,K. Cap. Cap Bona Spei, leg. Tuhnberg 11119 UPS. Caplandet, ex herb. Sonder S. Ex herb. Drège 114.10 FI.

COMORES

Grande Comore, leg. Boivin a. 1859 P p.p.

RODRIGUEZ

Leg. Balfour, Trans. Venus Exp. VIII-XII 1874 E p.p. Cascade Victoire, leg. Bosser 22004 15 V 1974 P. Près Grande Montagne, leg. Guého 3 VIII 1876 MAU.

MADAGASCAR

Montagnes N de Mangindrana (Haute Maevarana) clairières aux bords de la Haute Bemafo, 1800 m, leg. Humbert et Capuron 25158 19 I - 12 II 1951 P. Dist. Ambalavae, Sandrisoa, leg. Razafindrakoto 3606 10 V 1952 P. Central Plateau, leg. Hodgkin & Stausfield 122 K. Antananarive, leg. Parker K. Tananarive, vieux murs, leg. Decary 6771 16 IX 1928 P. Prov. Imerina Antananarivo, leg. Hildebrandt 4059 VII 1880 BM,G,K,LE,LY,M,P. Antsirabe, 1600 m, leg. P. de la Bâthie 5701 X 1918 P. Bassin Matitana, rivière Rihenana, leg. ipse 5781 X 1911 P. Ambalavao, Antanifotsy, leg. Rakotovao 696 11 XII 1954 P.

LA REUNION

Terr. cult., leg. Richard Hortul. 155 p.p. P. (Ile Bourbon) leg. Richard P. St. Denis, leg. Boivin 1418 1847-52 P. Salazie, Roche Ecrite, 2000 m, leg. Rivals VII 1945 P. Bois de Nefles, St. Paul, ca. 1400 m, leg. Cadet 4782 P,REU. Avirons, leg. ipse 79 23 VII 1962 REU. Cirque de Salazie,Col de Fourche, sentier du Belier, leg. Bosser 22176 16 V 1976 P.

MAURICIO

(Ile de France) leg. Sonnerat a. 1776 P. Leg. Commerson a. 1767 P.Leg. Bojer 247 p.p. MAU.Port Louis, leg. Balfour IV 1857 K. Leg. Sierber II 216 E, LE,P,PRC. Vacoas, 1600 ft., leg. Lorence 183 8 IX 1973 P. Curepipe, 1800 ft., leg. Johnston VII et XI 1888 E.

AZORES

Sao Miguel, Sete Cidades Lagoa Verde, 810 ft., leg. Dolman 469 23 VIII 1970 BM. St. Michel, leg. Drouet V 1857 BM. Santa María, leg.ipse V 1857 BM.

MADEIRAS

Cap. Cook's First Voy. 13-18 IX 1768 BM.Leg. Mason, a. 1856 BM. Leg. Mun-by NA. Saint Amaro, leg. Vahl VII 1901 US. San Vicente, leg. Löwe *166* K. Ib., Monte Verde, leg. Vogel *35* VI 1841 K. Funchal, leg. Webb 3 VII 1827 LE.

CANARIAS

Gran Canaria, near Guia, leg. Carter Cook 42 II 1897 GH,NY,UC,US. Near Galder, leg. Carter Cook *47* XII 1893 US. La Palina, leg. Pérez 15 [illegible] 1849 FI. Arive Gomera, 1000 m, leg. Andres *96* 14 VIII 1960 K.

CABO VERDE

Santiago, Ferme Pico d'Antonia, leg. Chevalier *44673* 24 VIII 1934 P. Ins. Prom. Ver., leg. Bocandé a. 1847 FI. Fogo, Espia près Monteiros, leg. Chevalier *45139* 1 VIII 1934 P. Santiago de Praia a Ribeira da Barca, leg. ipse *44541* 13 VII 1934 P p.p. São Nicolas, leg. Thorne Pires *81* 21 II 1864 BM,NY.

SANTO TOME

Café et Pic S. Thomé, leg. Chevalier *14576* VIII-IX 1905 P. Roca Rio d'Ouro, 150 m, leg. Quintas *1256* IV 1888 COI. Bom Successo, 1100 m, leg. Moller *799* IX 1885 COI. Agua Izé, leg. Mendonça 4 10 III 1937 BM,COI.

ASCENCION

Leg. Ecklon a. 1828 BR. Leg. Loomis (US Eclipse Exp.) III 1889 GH p.p. Leg. Lesson I 1829 P. Leg. Gordon a. 1889 P. Leg. Duffey *137* 1958 K. Leg. Reise Corvette Carolina, Dr. Wawra *377* 1857 -8 LE.

SANTA ELENA

Leg. Hombron (Voy. Astrolabe et Zélée) 1838-40 P. Cap. Cook's First Voy. 1-2 V 1771 BM. "Scotland", leg. Leask *5* X 1971 K. Major Pierries, leg. Burchell *106-1* p.p. 11 VI 1808 GH,K.

ANNO BOM

S. Antonio de Mau, lac du cratère, 100-200 m, leg. Descoings *12828* 25 II 1964 P. S of Crater Lake, 1600 ft., leg. Wrigely & Melville *146* p. p. 1959 BM,K.

8c. *Oxalis corniculata* L. ssp. *pilosa* (1)
(Nuttall ex Torrey et Gray) Lourt. n. c.

Fig. 6 B

O. pilosa Nuttal ex Torrey et Gray, Fl. N. Amer. *1*: 212.1838. Small, Bull. Torr. Bot. Club *23*: 457.1896. Contr. Columbia Univ. *107*: 457.1896 (reimpr.). Knuth, Pflreich 156. Munz & Keck, Calif. Fl.148.1959. Munz, Suppl. Calif. Fl. 13. 1968. Non *O. pilosa* Pohl ex Progel nomen, 1877!

O. Wrightii Gray v. *pilosa* (Nutt. ex Torr. et Gray) Wiegand, *l.c.*117, 120. 1925. Knuth, *l.c.* 434,436.

O. Wrightii Gray v. *subpilosa* Wiegand, *l.c.* 117,119. Knuth, *l.c.* 434. Tipo: California, Suksdorf *768* GH.

O. pilosa Nutt. ex Torr. et Gray v. *subpilosa* (Wiegand) Wiegand, *l.c.* *28*: 67. 1926.

O. albicans H.B.K. ssp. *pilosa* (Nutt. ex Torr. et Gray) Eiten, *l.c.*303. 1963.

Xanthoxalis pilosa (Nutt. ex Torr. et Gray) Small, N.Am.Fl. *25*(1):54. 1907.

TIPO. Estados Unidos, California, Santa Bárbara, leg. Nuttall NY. Isótipos BM p.p.,PH.

Herbácea (h. 40 cm). Pubescencia hirsuta, retrorsa, generalmente

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(1) El epíteto alude a la pubescencia hirsuta, especialmente de los tallos.

larga. Raíz gruesa, lignificada, profunda. Tallo sublеñoso en la base, ramificado, ramas ascendentes o decumbentes. Estípulas completamente soldadas, pequeñas, de forma variada, a veces inconspicuas, ciliadas. Folíolos ± glaucos, forma y tamaño variados, incisión ± profunda, lóbulos redondeados, erguidos o divergentes, pubescencia hirsuta en ambas faces o sólo en el envés. Cimas 2- (1-3-)floras, pedúnculos largos, ascendentes, pedicelos de largo variado. Flores a menudo grandes (h. 13 mm).

Sépalos desiguales. Corolas amarillas, a menudo pilosas en el borde y en el exterior, generalmente con estrías rojizas (los pelos son diminutos). Pistilos en general con estilos del mismo largo que los estambres mayores, raro mesostíleos, un caso de microstíleos del largo de los estambres menores.

Cápsula erguida (12-18 mm), pedicelos erguidos o subhorizontales;pubescencia densa retrorsa, cáliz h. ± 1/4; estilos cortos erguidos.

Los demás caracteres son los de la subespecie *corniculata*.

Distribución geográfica.Oeste de los Estados Unidos, Vancouver, Guatemala, El Salvador (1 solo especímen visto).

Material estudiado.

CANADA

Vancouver Island, vic. Nanaimo, leg. Macoun 54 13 VI 1893 GH.

ESTADOS UNIDOS

Arizona. Reed's Ranch, Cave Creek, 5500 ft., leg. Blumer 1547 28 VI 1907 L,W p.p. Fort Grant, leg. Goodding 1056 17 VI 1912 NY,US. Chirihuaca Mts., leg.ipse 2382 10 VIII 1907 GH,NY,UC. Univ. Arizona Campus, leg. Griffiths 2168 21 XI 1900 NY. Tumacacori, leg. ipse 3957 8-9 IV 1903 US SW Fort Verde, leg. Mearns 19 IV 1888 NY. Mazatazal Mts., Collom's camp, leg. Nelson 1940 16 V 1935 K,NY. Prescott, leg. Palmer 54 20 IV 1876 GH. Lowell, leg. Parish 32 IV-V 1884 GH. Huachuca Mts., leg. Toumey 15 IV 1894 NY. Fort Huachuca, leg. Wilcox V 1898 NY. Coconico Co., Havasupai Canyon, Mooney Falls, leg. Glover 8065 26 IV 1945 MICH. Havasy Creek, Canyon Colorado Riv., to Mooney Falls, leg. Holmgren et al. 15650 13 V 1971 NY.Pima Co.Santa Catalina Mts., Esperero Cañón, leg. Foster 579 17 III 1938 GH. Santa Catalina Mts., leg. Toumey 17 VII 1896 NY. Gila Co. Sierra Ancha Mts., Parker Creek Canyon, leg. Gould 3641 10 VIII 1946 UC. Maricopa Co., Ashdale, 3350 ft., leg. Peebles 11627 18 V 1935 US.Pinal Co., Picket Post Mt., leg. Smith 12997 10 V 1936 US. Santa Cruz Co. W Nogales, leg. Wiegand 1278 14 IV 1935 GH. Pinal Co., Mt. Lemmon Rd. Pepper Sauce Canyon, 4500 ft., leg. Wiegand and Upton 3707 27 IV 1922 F. *California*. N Claremont, Rancho Santa Ana Bot. Gard. 1300 ft., leg. Balls 12041 14 IV 1960 BM,S. San Luis Obipso, S Los Osos vall., Forks, Cayucos, 1000 ft., leg. Balshaw 1719A 25 III 1936 UC. San Gabriel, leg. Bigelow (Whipple's Expl.)1853-54 K,NY,P,US.San Francisco,leg.Blankinship 5 III 1892 GH. Ib., Cap. Wilkes Exp. US.Ib., leg. Redfield 44 9 VIII 1872 NY. Ib., Lake Merced, leg. Howell 11423 9 VII 1933 F,GH,K,US. Ib., leg. Rose 33281 14 VII 1933 BM,K. San Francisco, Laguna Honda, leg. ipse 38246 4 IX 1938 UC. Los Angeles Co.Oak Knoll, 800 ft.,leg. H.H.Smith 4368 7 III 1912 F. Centinella Ranche, leg. Parish X 1882 NY,US.Santa Barbara, leg. Nuttall Tipo NY. Isótipos BM p.p. PH. Mountains Drive, Santa Bárbara, leg. Leroy Abrams 4110 22 VIII 1904 GH,NY. Betw. Ottello and Gaviota Pass, leg. ipse 6547 11 VI 1917 NY. Near Santa Barbara, Carpentería in cañón, leg. Brewer 267 III 1861 GH,US. Ellwood, leg. Eastwood 180 16

V 1908 F,GH,K,NY,UC,US. Santa Bárbara, leg. Elmer 2925 V 1902G,K,NY,P,UC, US,W. Butte Co., Butte Creek, leg. Austin 108 V 1896 US.Ib., leg. ipse 1852 25 IV 1897 US. Ib., leg. Bruce 1852 V 1894 NY. Humboldt Co., Vic. Eureka, Bucksport, leg. Tracy 1149 16 VI 1901 F,UC. Alton, leg. ipse 3682 9 VI 1912 UC,US. Eureka, Elk Riv., Corners leg. ipse 5119 17 XI 1918 UC.Phillipsville, 400 ft., leg. ipse 7872 2 IV 1927 UC. Garberville 500 ft., leg. ipse 17336 16 V 1942 UC.Marin Co., Sausalito Hills, leg. Howell 11458 23 VII 1933 NY. Mill vall., Blythedale Canyon, leg. ipse 14607 23 IV 1939 NY, Tomales Bay, Heart's Desire Beach, legl Schreiber 688 27 VII 1932 UC. Mendocino Co., Fort Bragg, leg. Eastwood 1610 8-16 VIII 1912 GH,UC. Ib., leg. Hitchcock 14-16 VII 1915 US. Monterey Co., Point Lobos State Park, leg. Lee & Mason 9385 15 VI 1935 UC. Carmel Highlands, opp. Yankee Point, 500 ft., leg. Balls 11386 6 III 1958 BM,NY,S. Monterrey, leg. Brandegee VI 1889 UC. Pájaro Hills, leg. Chandler 451 VI-VII 1899 UC.Pacific Grove,leg. Heller 3 VI 1903 GH,NY. Alameda Co. Redwood Ridge, leg. Constance 341 22 II 1932 UC. Berkeley, leg. Jepson s. 1887 UC. Near Oackland, leg. Palmer 7397 22 VI 1892 UC,US.Napa Co. E Napa, leg. Suksdorf 768 30 VII 1913 Tipo O. Wrightii v. subpilosa Wieg. GH.Oakland leg. Brewer 2767 21 III 1864 K,UC,US. Santa Cruz Co., Santa Cruz, leg. Baker 1968 14 IV 1903 G,GH,K,LY, NY,UC,US. NW Hazelbrook School, 500 ft., leg. Belshaw 2228 25 V1936 UC. Island Santa Cruz, leg. Brandegee IV 1888 UC p.p.San Mateo Co.Pescadero, Swanton House, leg. Dudley 9 II 1895 NY. Near San Bruno, leg. Suksdorf 356 28 VI 1913 GH,W Crystal, Spring Lake, leg. ipse 395 30 VI 1913 GH. Sonoma Co., Salmon Creek on Bodega Bay, leg. Ferris 9371 18 VIII 1937 GH NY. S Healdsburg, leg. Heller & Brown 5237 9 IV 1902 F,GH,NY,L,P,US.Bodega, leg. Chandler 668D26cWn1880lUC.200 ft., leg. Yates 3825 21 IV 1934 San Diego Co. San Diego, leg. Mc Clatchie 28 VI 1896 NY. San Luis Rey riv., leg. Parish 1 VI 1897 NY. Ib., near Pala, leg. ipse 4397 31 V 1897 BM,GH,NY,US. Ib., W Pala, leg. Wiggins 3063 13 VI 1928 UC.

Reg. S. Francisco Bay, Mill vall., Tamalpais, leg. Chandler 531 26 II 1900 UC. Ib., Exp. Cap. Wilkes 1880 US. Santa Isabel, leg. Henshaw 204 et 224 15 IV 1893 US.Garvanza, leg. Hunnewell 22 I 1895 GH.Cañón near Monrovia, 1500 ft., leg. Johnson 8 III 1910 NY, Inglewood, leg. Phillips 22 III 1899 PENN.Valley Sacramento, leg. Stillman NY, Diamond Cañón,leg. Walker 683 7 VII 1907 UC. Tumacacori, leg. Griffiths 3957 8-9 IV 1903 UC Louisiana. Gretna, opp. New Orleans, leg. Ball 352 6 V 1899 GH,NY,UC,US. New Mexico. Animas vall., Cloverdale, leg. Mearns 481 15 VII 1892 US.

MEXICO

Baja California. Cape Region, Cañón San Pedro, Potrero de Almenta, 1000 m, leg. Moran 7400 10 V 1959 GH,US. Chihuahua. Sierra Charuco, Rancho Byerly, 5000-5800 ft., leg. Scott Gentry 8095 17-25 IV 1948 UC,US. Cañón Huahuatan Temosachic, SE Madera, leg. Muller 3484 24 IX 1939 GH,MA,UC. Coahuila. Saltillo, Soledad, leg. Palmer 134 1-15 IV 1880 GH 9-19 IX 1880 GH,K,NA,NY,UC,US. Ib.,leg. Arsène 3433 V 1909 US. Ib.,leg. Palmer 134 21 IV- 18 V 1906 F, NY,UC,US. Ib.,leg. Gregg 29 III 18.. NY. Müzquiz La Mariposa, leg. Marsh 1033 5 XII 1936 F. Ib.,leg. ipse 2113 12 IV 1936 F,GH. Jardin del Sur, leg. ipse 775 3 IX 1936 F,GH.Durango, leg. Palmer 5 p.p. IV-XI 1896 GH. San Ramón, leg. ipse 134 21 IV-18 V 1906 GH. S of Jalaca, leg. Manning 53606 25 VII 1953 GH. Hidalgo. La Placita, betw.Zimapán and Jacala 1600-1700 m,leg. Moore & Wood 3910 11 VII 1948 GH,UC, US. Zacualtipán, leg. Berlandier 508 20 V 1827 FI p.p. Nuevo León. Ga -

leana Canyon, bel. Iturbide, 3650 ft., leg. Shreve & Tinkham *9781* 30 VIII 1940 NA. Mirador, 2000 ft., leg. Calás *294* 31 III 1947 F. Santa Catarina, leg. Hinton et al. *16941* 10 II 1950 GH. Sierra Madre, Cañón di dente, near Monterrey, leg. Canby 54 19 III 1900 GH (atípica). *Sonora*. Oputo, 3450 ft. leg. Hartman *200* 3 XI 1890 F,GH,K,PENN,NY,UC,US. Sonora, leg. Thurber *1679* 1851 NY. Cañón de la Petaquilla, leg. White *3330* 15 VIII 1940 GH. *Tamaulipas*. Mt. Victoria, 1000 m, leg. Runyon *872* 8 IV 1926 US.

GUATEMALA

Quezaltenango. Zunil, 2500 m, leg. Steyermark *34440* 20 I 1940 F. Cerro La Pedrera, S of Quezaltenango, a. 2400 m, leg. ipse *65532* 18 II 1939 F. *Sacatepéquez* Vol. Agua, 9000 ft., leg. Kellerman *4768* 15 II 1905 US.

EL SALVADOR

Chalatenango. E of Los Esesmiles, 2160 m, leg. Tucker 1084 p.p. 18 III 1942 F,US.

8d. **Oxalis corniculata** L. ssp. **albicans** (H.B.K.) Lourt. n.c.(1)

Fig. 6 A

O. albicans H.B.K. Nov. Gen. Sp. Pl. *5*: 189.1821 Candolle, Prodr. *1*: 692. 1824. Sprengel, Syst. *2*: 430. 1825. Zuccarini, Denks. Ak. Muench. *9*: 160 1825; *l.c.* ser. 2. *1*: 231-2.1831. Don, Gen Syst. *1*: 758. 1831. Knuth, Pflreich. 155. Eiten, *l.c.* 303.

[Hernández, Rerum Medic. 440 (*Xoxocoyol hoihoilan*). 1651.]

O. verticillata De Candolle, *l.c.* 691. Mociño et Sessé , Ic. Ined. *1*: lám. 151. 1824. Zuccarini, *l.c.* 167; *l.c.* 246 respect.

O. Wrightii Gray, Pl. Wrightianae *1*: 27. 1852. Trelease, Mem. Boston Soc. N.H. *4*:86,88.1888. Wiegand, *l.c.* 117,119.1925. Tipo: Estados Unidos, Texas, Wright *907* GH.

? *O. stricta* auct. (Sessé et Mociño, Fl. Mex. ed. 2. 70. 1893; 118.1894) non L.!

O. californica (Abrams) Knuth v. *subglabra* Wiegand, *l.c.* 116,118-119 Tipo: Pringle 1204 GH.

O. pilosa Nuttall ex Torr. et Gray v. *Wrightii* (Gray) Wiegand, *l.c.* *28*:67 1926.

O. marginata Willd. ex Zucc. *l.c.* 160.1825 nomen! excl. mat. sudamericano

Xanthoxalis Wrightii (Gray) Abrams, Bull. Torr. Bot. Club *34*: 264.1907.

X. albicans (H.B.K.) Small, N. Am. Fl. *25*(1): 54.1907.

TIPO. México, Morán, leg. Humboldt et Bonpland *4071* P.

Herbácea muy pequeña hasta 40 cm, procumbente o rastrera. Raíz lignificada, napiforme, gruesa, larga (h. más de 30 cm) ramificada. Tallos ramificados en la base, prostrados o procumbentes, raro erguidos. Pubescencia blanquecina, amarillenta a ferrugínea, ascendente, ± adpresa h. subhirsuta, ± curva, a veces densa. Hojas pseudoverticiladas, subopuestas o alternas. Pecíolos ascendentes pilosos. Peciolillos carnosos purpúreos. Folíolos glauco-verdosos, anchamente obovado-cuneados (en general más anchos que largos), incisos h. 1/5- 1/3 (raro más de la mitad), lóbulos divergentes, los laterales asimétricos, generalmente bordes purpúreos (muchas veces visibles en los especímenes de herbario), adpreso- a hirsuto-ciliados, pubescencia variada, haz generalmente glabro. Cimas ascendentes generalmente menores que el follaje, 1-2-(3-)floras, adpreso-pubescentes. Pedún-

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(1) Así llamada, según los autores, por el aspecto glauco-grisáceo de la planta.

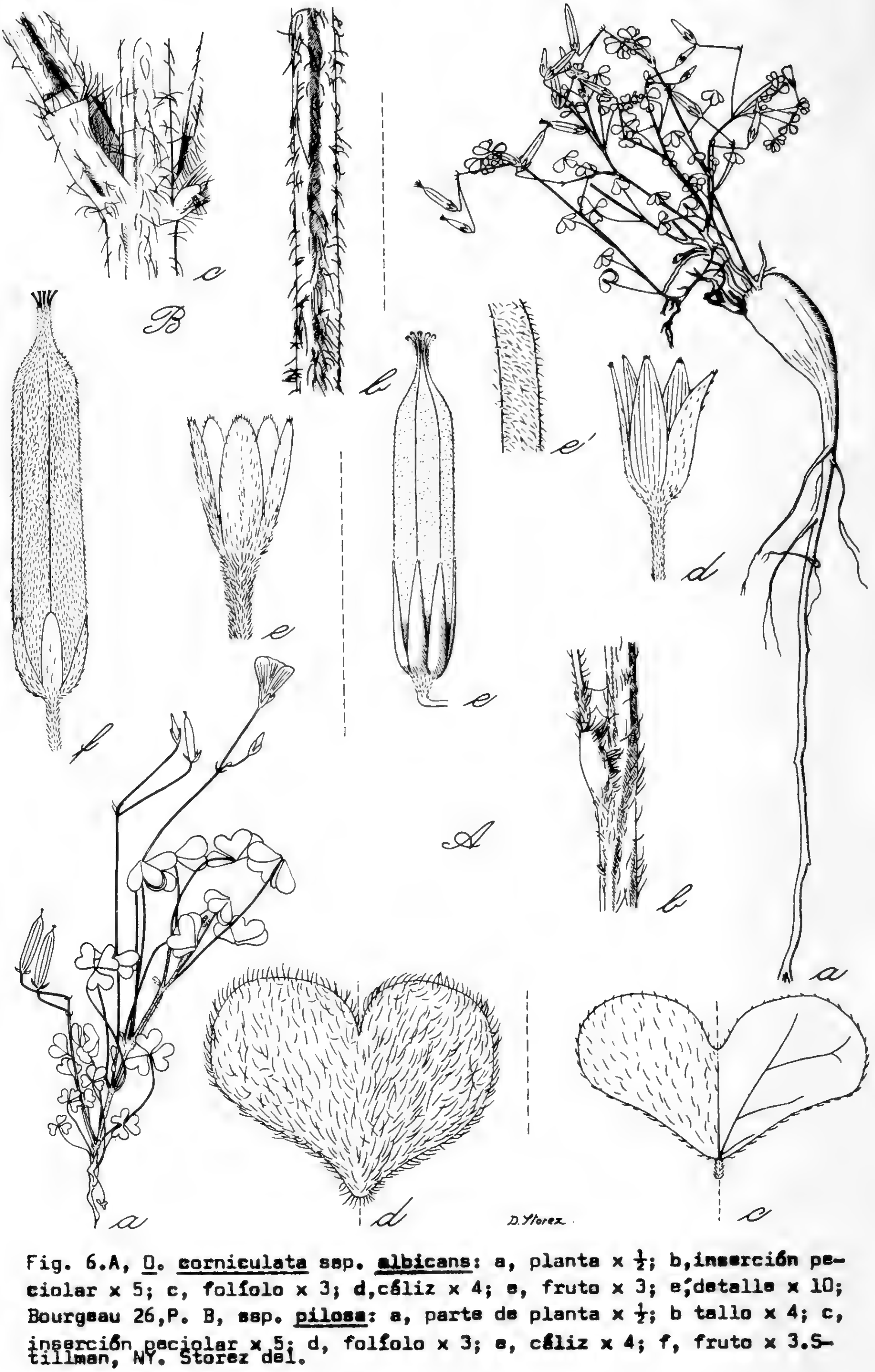

Fig. 6.A, *O. corniculata* ssp. *albicans*: a, planta x ½; b, inserción peciolar x 5; c, folíolo x 3; d, cáliz x 4; e, fruto x 3; e', detalle x 10; Bourgeau 26, P. B, ssp. *pilosa*: a, parte de planta x ½; b tallo x 4; c, inserción peciolar x 5; d, folíolo x 3; e, cáliz x 4; f, fruto x 3. Stillman, NY. Storez del.

culos pilosos (h. 5 cm) Pedicelos adpreso-pubescentes acrescidos en el fruto, generalmente menores o de igual largo que la cápsula.

Sépalos elíptico-oblongos, geñeralmente verdoso-purpúreo, desiguales, los exteriores pubescentes, los ± glabros. Pétalos amarillos estríados de rojo exteriormente, rosados o "salmón"(fide coll.)interiormente, a menudo con pelos desiguales en el borde; suelen verse en el material de herbario en los botones florales, coloreados. Flores en su mayoría mesostíleas,algunas con estambres de igual largo que los pistilos, pocas microstíleas.

Cápsulas cilíndrico-agudas, estilos cortos, cáliz h. $\frac{1}{4}$ - $\frac{1}{3}$.

En los demás detalles es igual a *O. corniculata* ssp. *corniculata*.

OBS I. La estípula puede ser ancha y obovada como en el tipo: ..."obovatae basi petioli adnatae"... Cf. H. B. diagn. orig., pero ofrece muchas variaciones.

II. Hay algunos especímenes con pubescencia hirsuta que se asemejan a la ssp. pilosa, pero en ésta la pubescencia es retrorsa en los tallos y aun en los ápices es hirsuta, no adpresa como en la ssp. *albicans*.

Distribución geográfica. Sud-Oeste de los Estados Unidos, México y Guatemala siguiendo las montañas hasta más de 3.000 m; rara en Honduras, hallada en Panamá. Es posible que viva en todos los países de América Central, siguiendo la Cordillera.

Material estudiado.

ESTADOS UNIDOS

Arizona. Tempe, Campus,leg. Russell 11527 28 IC 1960 USF. Bavoquivari Mt. Canyon, leg. Gilman 17 4 IX 1931 NA. Sta. Rita Mts., leg. Griffiths & Thorder 49 20 IX- 4 X 1902 NY,US. Castle Rock near Tucson, leg. Griffiths 2116 17 XI 1900 NY. Camp Creek, leg. Peebles, Harrison & Kearney 5142 25 III 1928 US. Prescott, leg. ipsi 2676 8 VIII 1926 S. Santa Rita Mts., Roleg. Thornber 4143 2 IX 1905 UC. Tucson, leg. Wilcox 15 IV 1905 US. San Pedro River, Mexican boundary line, leg. Mearns 1112 12 X 1892 US. Tucson to Nogales, leg. Peebles, Harrison & Loomis 6971 6 V 1930 NA,NY,US. Cochise Co., Chiricahua Mts., Cave Creek, 4800 ft., leg. Darrow, Phillips & Puitz 1302 6 IX 1944 UC. Ib., Reed's Ranch, 5500 ft., leg. Blumer 1547 28 VI 1907 p.p. E,GH, K, L, NY,US,W. Chiricahua Nt. Park, leg. Ferris 9997 8-12 VII 1940 GH,NA,UC. S. Oracle, leg. Gould & Macbride 3433 19 X 1945 GH,UC. Maricopa Co., Beeline Highway, leg. Russell 11364 2 IV 1960 USF.

California

Alameda Co., Nobel, near Berkeley, leg. Suksdorf 406 4 VII 1913 GH. San Miguel Hills, près S. Francisco, leg. Monet 462 II 1913 P. Ib., leg. Behr p.p. W. Pasadena, leg. Grant 10 I 1906 UC. Ib.,leg. Barclay K. El Rancho Viejo, leg. Brandegee 30 IV 1889 UC p.p. San Mateo Co., Bellmont leg. Elmer 2269 IV 1910 NY.

New Mexico

As Canyon, leg. Wooton 13 VIII 1902 NY,UC,US. Río Grande, Doña Ana vall. leg. Parry et al. 3 VII 1852 K,NY,P,US. Eddy Co., Guadalupe Mts., SW of Carlsbad at Sitting Bull Falls, leg. R.and M Spellenberg 4203 21 VI 1976 NY.

Texas

Bejar, Austin, leg. Berlandier 1732 V... BM,FI,P. Near Brownsville,leg. Tyler Townsen 7 1895 US. Belknap, leg. Sutton Hayes 97 10 III 1858 F. Peña Colorada SO of Marathoh, 3880 ft., leg. Steiger 587 V 1934 NY. Weste tern Texas, Musquez Canyon, leg. Havard VII 1883 F,US. Western Texas,near the head of the Limpio, leg. Wright 907 Tipo O. Wrightii GH. Isótipos BM, GH,K,L,NY,P,PH,UC,US. Brewer Co. Chisos Mts., Boot Springs, leg. Cory 1169 9 IX 1933 GH. Toronto, leg. Palmer 34454 10 VI 1928 GH,NY,US.Marfa, leg. Plank 9 VI 1895 NY. Chisos Mts., Big Ben Nat. Park, Boot Springs, 7600 ft. leg. Kruckeberg 4756 1 VIII 1959 UC. N Alpine, leg. Sperry 1410 19 VI 1946 US; 1182 16 VII 1935 NY. Chisos Mts., Upper Green Gulch, leg. ipse 1506 29 X 1939 US; 447 7 IX 1936 US; 1969 14 IX 1941 US.Chisos Mts., Oak Creek Canyon, leg. ipse 1192 18 VI 1937 GH. Alpine, leg. Warnock 450 25 IV 1937 US. Ib., Golf Course, leg. ipse 21455 7 VI 1940 NA.Chisos Mts., leg. Mueller 8287 20 VI 1931 GH,NY,US. Ib., leg. ipse 29 VI 1932 GH,NY. Ib., Canyon,leg. ipse 6 VII 1932 F,NY. Jeff Davis Co., 15 mi. Ft. Davis, near McDonald Obser vat., leg. Correll 33716 20 IX 1966 GH,NA. Fort Davis, leg. Dunn 16090 3 IV 1969 NY. Upper Madera, NW Fort Davis, leg. Cory 34837 26 VI 1940 GH. Davis Mts., beh.Fort Davis, leg. Ferris & Duncan 2709 9-12 VII 1921 NY. Fort Davis, leg. Girard a. 1880 GH. Limpio, leg. Hayes 95 GH,NY.SSE Kent, leg.Waterfall 5418 31 VII 1943 GH. Limpio Canyon, leg. Correll and Johnston 18388 23 VII 1957 GH. Kinney Co., Leg. Cory 486 17 IV 1929 GH. Mitchell Co., SEE Colorado City, Seven Wells, leg. Pohl 5109 29 VII 1945 PENN. Presido Co., Trans-Pecos Davis Mts., 1750 m,Morley's Ranch, leg. Hinckley VIII 1937 NY. Trans-Pecos, Goat Canyon, leg. ipse 20 31 VII 1935 F,NY.Ib., Henry E, NY. Ib., Henry Fletcher Ranch, leg. ipse 2599 20 VIII 1942 GH,NY. SE Russell, 4700 ft., leg. Hinckley and Warnock 3682 9 XI 1946 NY. Pecos Mts., Mt. Locke, leg. Tharp 642 25 VII 1943 GH,NY,UC,US. Pinto Co., Leg. Ruth 1463 8 V 1927 US. Uvalde Co., Uvalde, leg. Palmer 13326 10 IV 1918 US. Zavella Co., Nueces Riv., 11½ mi. S of Uvalde, leg. Cory 11909 24 X 1934 GH.

MEXICO

Leg. Sessé et Mociño, Castillo et Maldonado 1003 1787-1795-1804 F probable fragmento del tipo de O. verticillata DC. Leg. Coulter 774 GH. Chiapas.Comitan,leg. Goldman 809 1 IV 1904 US. San Cristóbal de las Casas leg. Merrill King 2809 11 VI 1960 MICH,NY,UC,US. Ib., 700 ft., leg. Breedlove 5980 5 VII 1964 F. Chihuahua. Sierra Canelo, Río Mayo, leg. Scott Gentry 2511 30 VIII 1936 F,GH, Ib., 2200 m, leg. Wall 16 IX 1930 S. Río Mayo, Memelichi, 7500 ft., leg. Scott Gentry 2746 16 IX 1936 F,GH,K, NA,UC,US. Mojarachic, leg. Knobloch 5244 21 VII 1938 F. Ib., leg. ipse 5583 1 X 1938 F. Majalca, leg. LeSueur 152 20 VIII 1935 F,GH,UC,US.Ib., leg. ipse 139 20 VIII 1935 F. Ib., leg. ipse 15 VI 1936 GH,UC. Dist. Querrero, Rancho Colorado, 2200 m, leg. Mexia 2566a 27 V 1929 F,UC. Mt. Morinora, leg. Nelson 4851 13-31 VIII 1898 GH,US. Vic. Chihuahua, 1300 m, leg. Palmer 100 8-27 IV 1908 F,GH,NY,US. Vic. Madera, 2250 m, leg. ipse 319 27 V - VI 1908 GH,NY,US. Dist. Bocoyna, N San Juanito, 7800 ft.,leg. leg. Schreve 8025 26 VII 1937 F,US. Dist. Cushuiriachic, 7000 ft., leg. ipse 8043 27 VII 1937 F,GH,US. 45 mi. S Mineca, 2200 m, leg. Straw & Forman 1702 23 VII 1959 MICH.Majalca, 40 mi. NW Chihuahua, 6800 ft.,leg. White 2377 11 VIII 1939 GH,NA. Mun. Janos, Carretas border Chihuahua and Sonora, 4800 ft., leg. ipse 3545 26-28 VIII 1939 NA. Ib., leg. ipse 2544 GH. Base of Sierra Madre, leg. Pringle 1204 27 IX 1887 Tipo O. californica v. subglabra GH.Isótipos BM,F,NA,NY,UC,US. Río Gavilán, SW Pacheco, 1800 m, leg. McCabe 76 26 VII 1948 WIS. 14 Km S of Escobillas, leg. Stewart 2358 22 IX 1942 GH. Vic. Rancho El Pino, ca. 10 Km SE Sierra Chica, leg. ipse 2402 23 IX 1942 GH. Mun.Janos,Sierra, SE flanck,Cañón de la Madera, leg. ipse 2469 24 IX 1942 GH. Vic. of Pirákide, leg. Johnston 8142 11-12 VIII 1941 GH. E of Madera, leg. Walker 7632 6 VIII 1976 M. Coahuila. S Saltillo S San Roberto Junction, leg. Boke & Massey 234 31 III 1967 MICH. Buenos Aires, Mts. E Saltillo, leg. Kenoyer & Crum 4116 17 VIII 1948 A. Saltillo, leg. Palmer 234 VI 1898 GH,US. Ib., leg. ipse 525 11 IV 1905 F, GH, NY, US. Quebrada Lerios, E Saltillo, 10000 ft. leg. ipse 133 10-13 VII 1880 GH,K,NA,NY,P. Saltillo, Fraile, 1967 M,leg. Retherford and Northcraft 293 10 VII 1941 GH,NY,UC. Summit of Mt.Jimulco 1730 m, leg. ipsi 119 29 VI 1941 GH,NY. Fraile, 2900 m, leg. ipsi 395 15 VII 1941 GH,NY,UC. Mun.Villa Acuña,Canyon de Sentinela on Hacienda Piedra Blanca, leg. Wynd and Mueller 603 8 VII 1936 GH,NY,US,S. Sierra de Hechiceros, vic. Rancho El Tule, near Chihuahua border, leg. Johnston and Muller 1324 17-19 IX 1940 GH.Durango. Durango, 2288 m, leg. Detling 8413 8 VII 1961 NA,US. Coyotes, W Durango, 2400-2500 m, leg.Maysilles 7144 28 VI 1950 MICH. Ib.,leg. ipse 8090 1 VIII 1955 MICH. Otinapa, leg. Palmer 419 25 VIII - 5 VIII 1906 F,GH,K,NY,IC,US. SE Victoria (E Tapona) 6900 ft., leg. Shreve 9174 26 VIII 1939 GH,NA,UC. W Durango, leg. Waterfall 12655 11 VIII 1956 MICH. Ib., leg. Waterfall & Wallis 13378 9 VIII 1957 US.Vic. Durango, leg. Palmer 5 IV-XI 1896 BM,F,GH,K,NY,UC,US. Tepehuanes, leg. ipse 21 25 III - 16 IV 1906 F,GH,K,NY,US. San Ramón, leg. ipse 125 21 IV - 18 V 1906 US. SW Durango, leg. Mick & Roe 143 24 VI 1964 WIS. S of Chihuahua state line, S of Parral, 5800 ft., leg.Yorke, Ellis and Dunn 102 21 VII 1975 NY. Guanajato. Mun. Celaya, Centro Inv. Agríc. 1700 m, leg. Villegas 702 12 II 1968 MICH. Guanajato, leg. Dugés... US. Betw. S.Miguel de Allende & Queretaro, 2600 m, leg. Genelle et Fleming 860 29 VI 1971 USF. Ib., leg. Kenoyer 1904 9 VIII 1947 GH.Guerrero. Morán, leg. Humboldt et Bonpland 4071.Tipo P. Isótipo B.Hidalgo. Dist.Pachuca, betw. Tizayuca & Tolcayuca, leg. Moore & Wood 4125 30 VII 1948 GH,UC. Mun.Jacala, Mt.side, 4500 ft., leg. Chase 7125 25 VI 1939 F,GH. W Atotonilco to Pachuca, 2100 m, leg. Moore 1362 4 X 1946 GH. Betw. Pachuca and Real del Monte,leg. Rose & Painter 6704 31 VIII 1903 NY,US. Near Salto, leg. ipsi 7062 16 IX 1903 NY,US. Near Real del Monte, leg. ipsi 4955 2 VI 1899 US. Near Tula, leg. Rose et al. 8326 3,4 VII 1905 US. Zimapán, leg. Schbooberger 7861 10 VII 1948 MICH. Cerro San Isidro, betw. Hac. S. Isidro and Tetlapayac, 2650 m, leg. West J.21 1 VII 1966 MICH,WIS. Real del Monte, leg. Berlandier 394 26 V 1827 BM,FI. Sierra de Pachuca, leg. Rose & Hay 5550 21,22 VII 1901 NY,US.Zacualtipán, leg. Berlandier 508 20 IV 1827 BM,FI,P. S of Huichapan, 2000-2800 m, leg. Schiefer 7 28 VI 1943 GH.Jalisco. S of Mascota, 1250 m, leg. González 189 20 III 1971 MICH. El terrero,leg. Gregory & Eiten 97 18 VI 1956 NY. Ib., leg. ipsi 101 18 VI 1956 MICH,NY. Ib. leg.ipsi 105 18 VI 1956 NY. Cerro Viejo 1840 m, leg. ipsi 182 25 VI 1956 NY. Sierra Tapalpa, Talcozagua, 2000 m, leg. Koeppen & Iltis 803 5-7 VIII 1960 MICH. W San Sebastián, Hac. Ototal, 1500 m, leg. Mexia 1849a 9 III 1927 UC,US. Guadalajara, 5000 ft., leg. Pringle 11323 12 VII 1902 F, GH,UC,US. S Ojuelos, to Lagos de Moreno, leg. Weintraub & Roller 58 19 VII 1955 MICH.Mexico. Mexico, leg. Graham 121 1827-9 BM. Pedregal, 8000 ft., leg. Balls 4139 10 IV 1938 BM,K,UC,US. Mexico, leg. Berlandier 702 22 VIII 1827 BM,FI,G,L,LE,P,W.Près Mexico, 7500 ft., leg. Galeotti 3986 VIII 1840 BR,P. SW México, 10000 ft., leg. Barkley et al. 593 10 VIII 1947 F. México, University, leg. Gregory & Eiten 59 14 VI 1956 MICH NY.Vallée de Mexico, près Tacubaya, leg. Bourgeau 26 20 VII 1865 FI,GH, L,LE,P,S. Ib., leg. Pringle 7090 21 VIII 1896 L,M,W. Mexico City, (Boul. Zola and Mier y Pasado), leg. Née 179 1 VII 1967 WIS.Tlalnepantla, leg. Langman 2448 17 VII 1940 NA. N Atizapán, 2350 m, leg. López 64 11 VI 1967 MICH. Nat. Park Lagunas de Zempoala, 9812 ft., leg. McAdams 93 4 VIII 1949 MICH. Near Tlalpam, 7300 ft., leg. Pringle 8523 15 VII 1901 BM,F,GH, K,LE,M,NY,P,PR,PRC.S,UC,US,W. Ib., leg. Rose and Hay 5493 15 VII 1901 F, K,NY,US. N of M éxico, leg. Barkley 17207 13 IV 1947 F. E Toluca, leg. Barkley et al.639 10 VIII 1947 F. Vallée de Mexico, près México, leg. Bourgeau 24 11 V 1865 FI,K,LE,UC. Toluca, leg.Frye 2622 18 V 1939 GH,NA, NY,UC,US. Ib., leg. Gregory & Eiten 69 15 VI 1956 NY. S. Miguel de Toluca, 10000 ft., leg. Heller 278 P. Mexico, leg. Ortenburger et al. 16750 1 IX 1946 F. E of Mexico City, W of Río Frío, 10300 ft., leg. Manning 53674 1 VIII 1953 GH.Cañada de Contreras, leg. García 66 25 VI 1967 MICH. Foot Popocatepetl, W Amecameca, 8000 ft., leg. Gree 717 8 VI 1954 PENN. El Pedregal,leg. Gregory & Eiten 49 13 VI 1956 NY.Salazar, Sierra de las Cruces, leg. Harshberger 18 13 VIII 1896 PENN. Xochimilco, 2240 m, leg. Hernández 12 25 IV 1965 MICH. Mun. Tepozotlán, Sierra de Alcaparrosa,leg. Hilario 209 6 VIII 1967 MICH. Temascaltepec, Tequesquipán, 2480 m, leg. Hinton 4185 30 VI 1933 UC,US. Dist. Temascaltepec, San Miguel, 2740 m, leg. Hinton 622 12 V 1932 GH,K.Sultepec, Almoloya, leg. Hinton et al. 7462 p.p.28 III 1935 GH,NY,US,p.p. Ajusco, 2900 m, leg. Rzedowski 260 p. p. 8 VII 1951 MICH. Pedregal, near Ajusco, 2500 m, leg. Matuda 19109 16 VII 1950 F. C. de León, 2600 m, leg. ipse 19129 14 V 1950 F. Tres Cumbres, 2600 m, leg. ipse 18854 28 V 1950 F. Parres, leg. Orcutt 30 VIII 1910 F. Tenango del Aire, 2350 m, leg. Pineda 336 14 VII 1968 MICH.Eslava, leg. ipse 11942 6 VI 1904 BP,F,GH,K,L,US. Near Tlalnepantla, leg. Rose & Hay 5270 30 VI 1901 NY,US. Tultenango, leg. ipsi 5438 13 VII 1901 US. Amecameca, leg. ipsi 5502 16 VII 1901 NY,US.San Angel, leg. ipsi 5507 17 VII 1901 NY,US. Ib., leg. Rose & Painter 6477 21 VIII 1903 NY US. Michoacán. Coalcomán, 1000 m, leg. Hinton 13631 24 III 1939 GH,K,NY, US. S Pátzcuaro to Opopeo, 2400 m, leg. Ugent and Flores 2164 16 IX 1962 WIS. W Santa Clara del Cobre, betw. Villa Escalante and Zirahuén 2700 m, leg. ipsi 2220 17 IX 1962 WIS. Zitacuaro, Barranca, 1800 m, leg. Hinton 11850 5 IX 1938 P. Angahuám, near Paricutín, leg. Hest 32 21 VII 1944 F. Taucilaro, 4 mi. E. 6200 ft., leg. Leavenworth and Hoogstraal 1051 et 1052. 20 VII 1941 F.Vic. Morelia, leg. Arsène 3309 30 IV 1909 US. SW Cerro San Andrés, 3100 m, leg. Beaman 4364 6 IX 1960 US. Atzimba Nat.Park 2800 m, leg. Gregory & Eiten 71 15 VI 1956 NY, MICH.Coalcomán,2250 m, leg. Hinton et al. 15001 25 VII 1939 GH,NY,US,W. San Juan de la Viña, Patzcuaro to Tacambaro, leg. Moore & Wood 4006 20 VII 1948 GH,UC,US.Morelos.Near Cuernavaca, leg. Rose & Hough 4426 27-30 V 1899 NY,US. Ib. leg. ipsi 4437 27-30 V 1899 US. Tres Cumbres, 2100-2400 m, leg. Gregory & Eiten 60 14 VI 1956 GH,NY. Ib., leg. ipsi 61 MICH, NY. Tres Marías, leg. Rose 11105 17 VIII 1906 NY,US. Nuevo León. Sierra Madre Oriental, Mt. El Infiernillo, Pablillo, 2750-2900 m, leg. Pennell 17140 29 VI 1934 US. Ib., Cieneguillas, 2450-2550 m, leg. ipse 17082 28-30 VI 1934 US. Sierra Madre slopes, ab. Monterey, 8000 ft., leg. Pringle 8738 29 VIII 1903 F,GH,LE,NY,PR,S,US. Hac. Pablillo,Galeana, leg. Taylor 61 5 VIII 1936 BM,F,GH,K,NY,P,S,UC,US,W.Monterrey, leg. Orcutt 1244 1924 US. Sierra Madre Oriental. Dulces Nombres, leg. F.G.Meyer & Rogers 2743 12 VII 1948 U. El Mirador, 1900 ft., leg. Lacás 243 3 IV 1947 F. Sierra

Madre Oriental, Cieneguillas to Puesto Santa Ana, ab. 15 mi. SW of Galeana leg. Mueller 906 28 VI 1934 F,GH, Near Monterrey, Diente Canyon, leg. ipse 478 VII 1933 F,GH(atípico). Oaxaca. Monte Albán, leg. Carlson 1405 11 III 1949 F. Ib., near Mitla,leg. Ernst 2268 21 I 1966 US. Vic. Cafetal Concordia, 400-650 m, leg. Morton & Makrinius 2587 1-15 IV 1933 US. Mt. Zempoaltepec, 7700-8000 ft., leg. Nelson 574 et 556 5-13 VII 1894 US. Telixlahuaca, 6000 ft., leg. Smith 514 5 VII 1895 GH, US. SE Miahuatlan to Puerto Angel, 2400 m, leg. Marks 1054 6 VII 1969 WIS. La Cima, to Guelatao, leg. Vilas 328 13 II 1972 WIS. Puebla. Puebla Highway, Km 55, leg. Langman 2574 4 VIII 1940 NA.Pont de México, leg. Arsène 913 14 III 1907 US. Bord de l'Alseseca, leg. ipse 1083 1 VI 1907 P,US. Ib., leg. ipse 1169 17 IV 1907 P,US. Tranvía de Manzanilla, leg. ipse 45 14 IV 1909 P,US.Laguna de San Baltasar, 2135 m, leg. ipse 1099 9 V 1907 US. Ib., leg. ipse 1111 9 V 1907 US. Ib., leg. ipse 277 20 IX 1906 US. Puebla, 2200 m, leg. ipse 437 15 VIII 1906 US. Ib., jardín del Arzobispado, 2165 m, leg. ipse 384 7 X 1906 US. Puebla au Mayorazgo, sur l'Atoyac, 2120 m, leg. ipse 1134 20 VI 1907 P,US. Puebla a Acatzinco, ca. 1900 m, leg. Arsène et Amable, 1916 VII 1907 US. NW San Martín Texmelucán, leg. Merrill King 2622 4 VI 1960 MICH,NY,UC,US. Cerro San Juan, leg. Nicolas 14 IV 1909 LE,MICH,P, US. Ib., leg. ipse 1 VII 1909 P. Rancho de las Posadas, leg. ipse 191 1 VII 1909 BR,P,US. Vic. San Luis Tultilanapa, leg. Purpus 3519 VIII 1908 GH,NY,UC. Tlacuisloltepec, leg. ipse 3945 V-VI 1909 UC. NE Atlixco, leg. Roe et al. 370 20 VII 1965 F,WIS. Near Calchicomula, leg. Rose & Hay 5811 24 VI 1901 US. Cabecero, ab. Serdan, 8500 ft., leg. Sharp 44106 26 IX 1944 GH,NY. Barranca del Alsesera, près Sta. Bárbara, 2150 m, leg. Arsène 7 VI 1907 US. SSW Puerto del Aire, Betw. Chapulco and Acultzingo 2210 m, leg. Ugent and Flores 2527 28 IX 1962 WIS. San Luis Potosi. Charcas, leg. Lundell 5117 VII-VIII 1934 GH,S,US,UC. San Luis de Potosí leg. Palmer 651 1898 GH,NA, Ib., leg. Schaffner 391 1879M,NY,P. Ib.,leg. ipse 761 VIII 1876 GH,K.Ib., leg. Virlet d'Aoust 1253 1851 P. Ib., leg. ipse 1255 1851 P. Ib., leg.Ward IX 1891 US. Ib., leg. ipse 5810 6 VII 1966 MICH. Ib., 1100m, leg. Rose & Mori 110 10 VII 1965 WIS.Ib., Puerta de la Huerta, 2000 m, leg. ipsi 120 10 VII 1965 MICH.Valles, leg. Gregory & Eiten 36 10 VI 1956 NY. Sinaloa. San Blas, leg. Rose, Standley & Russell 13425 24 III 191.. NY,US. Mazatlan, leg. ipsi 14144 7 IV 1910 NY,US. Vic. Rosario, leg. ipsi 14582 14 IV 1910 US. Vic. Culiacan, leg. ipsi 14868 21 IV 1910 US. Sonora.Cero Saguarivo, E San Bernardo, 1500 m, leg. Pennell 19613 7-8 VIII 1935 US. El Tajo, Río Fronteras, 4200 ft. leg. White 4058 20 VIII 1941 MICH. Sonora, leg. Thurber 1079 IX 18.. GH Tamaulipas. N Miquihuana, leg. Stanford et al. 2468 15 VII 1949 NY,UC, U,US. W Miquihuana, 3000 m, leg. Stanford et al. 935 7 VIII 1941 GH.Ib., Rutherford and Northcraft 935 7 VIII 1941 NY.Tepic. Sierra Madre,near Santa Teresa, leg.Rose 3410 9 VIII 1897 US. Tlaxcala. Tlaxcala,6800 ft., leg. Balls 4907 24 VI 1938 BM,K,UC,US. Contadero, leg. Rose & Hay 5963 3 VIII 1901 US. Veracruz. Lomagrande, leg. Balls 4407 29 IV 1938 BM,UC, US. Ib., leg. ipse 5386 28 VIII 1938 BM,K,NY,UC,US. Fortín, leg. Kerber 384 III 1883 BR,F,PR,US. Orizaba, leg.Müller 87 1855 LE,NY. Ib., leg. Bmy P. Ib., leg. Nelson 25 28 I 1894 US. Ib., leg. Seaton 90 1891 NY.Ibid., leg. Mohr IX 1857 US. Ib.,leg. Bilimek 72 V 1865 P. Ib.,leg. Rose & Hay 5670 25,26 VII 1901 US. Córdoba, leg. Orcutt 3141 6 IV 1910 F,GH, US. Ab. Perote, 8500 ft., leg. Sharp 45485 24 V 1945 GH. Jalapa, 4400 ft., leg. Smith 1750 1894 NY. Banderilla, Piletas, 2 Km Banderilla, 1580 m, leg. Báez 313 10 IV 1976 F. Zacatecas. Ojo Caliente, leg. Jones 113 9 V 1892 US. Near Concepción del Oro, leg. Palmer 292 11-14 VIII 1904 GH, US. Ojuelos, close Jalisco, leg. Weintraub & Roller 17 19 VII 1955 MICH. SE of Pinos, leg. I.M.JOhnston 7497 6-8 IX 1938 GH. Zacatecas, leg. Coulter 773 GH. N of Zacatecas, 8300-8600 ft., leg. Ripley and Barneby 13446 6 XI 1963 NY.

GATEMALA

Sierra Madre Mts. where dep. Huehuetenango, Totonicapán and Quezaltenango join, 2400-2600 m, leg. Williams et al. 22593 8-9 XII 1962 F,G,NY. Chimaltenango. Tres Cruces, N Volcán Acatenango, W San Miguel Dueñas, leg. Beaman 3992 5 VIII 1960 GH,NA,US. Santa Elena, 2400-2700 m, leg. Skutch 285 25 II 1933 US. Cerro de Tecpám, reg. Sta. Elena, 2400-2700 m, leg. Standley 60977 26 XII 1938 F. Near Chimaltenango, near Finca Alameda, ab. 1830 m, leg. Standley 59041 7 XII 1938 F,NY. Zaragoza, leg. Donnell-Smith 2927 2 VI 1896 GH. Guatemala . Finca La Aurora, 1480 m, leg. Ruano 349 14 VI 1923 US. Huehuetenango. Near Chiantla, 1930 m, leg. Standley 82514 6 I 1941 F. Ib., Aldea San Nicolás, Estación Ovino, 3150 m, leg. Smith 467 X 1976 F. Sierra de los Cuchumatanes, ab. Chiantla, 1950-2550 m, leg. ipse 65617 19 II 1939 F. Sierra de los Cuchumatanes, bel. Calaveras, 3000 m, leg. Williams et al. 22001 29 XI 1962 F. Jalapa. Mts. betw. Jalapa and Paraíso, 1400-1700 m, leg. Standley 77276 14 XI 1940 F. Quezaltenango. Zunil, 2500 m, leg. Steyermark 34473 20 I 1940 F. Near Cantel, 2250-2365 m, leg. Standley 83853 18 I 1941 F. Slope of Volcán Santa María ca. 10 mi. bel. Quezaltenango, 5750 ft., leg. Bunting 3468 27 II 1961 F. Betw. Fuentes Georginas and Zunil, ab. 2500 m, leg. Standley 67307 4 III 1939 F. Volcán Santa María, betw. Sta. María de Jesús, Los Mojadas and Summit of Volcano, 1500-3000 m, leg. Steyermark 33993 12 I 1940 F. Road to San Cristóbal, Totonicapán, 7000 ft., leg. Breedlove 11454 4 VIII 1965 F. Near Cantel, 2250-2365 m, leg. Standley 83860 et 83853 18 I 1941 F. Near Quezaltenango; 2280-2400 m, leg. ipse 66419 18 II - 3 III 1939 F. Quiché. San Miguel de Uspatán, 7000 ped., leg. Heyde & Lux 2994 IV 1892 GH, M,MO,NY,US. San Marcos. Cerro Tumbador, 15 Km W San Marcos, 2600 m, leg. Williams et al. 23047 15 XII 1962 F. Garden of Señora Dolores Arriaga, 1 Km SE San Sebastian, 3900 m, leg. Steyermark 35937 16 II 1940 F. Betw. Tajumulco and Tecutla, 9 mi. S and W Tajumulco, NW slopes Volcán Tajumulco, 1800-2500 m, leg. ipse 36805 27 II 1940 F. Sololá. Cerro María Tecúm, NW Los Encuentros, 2800-3400 m, leg. Williams et al. 25415 7 XII 1963. Volcán Atitlán, leg. Kellerman 5843 16 II 1906 US. Totonicapán. San Cristóbal, 2340 m, leg. Standley 83153 12 I 1941 F. Salvachán, Mt. ab. Totonicapán, ca. Desconseulo, 3100 m, leg. Standley 84499 23 I 1941 F. Sierra Madre, Mts. near villa Las Cruces, 8 Km SW Totonicapán, 2800 m, leg. Williams et a. 22981 13 XII 1936 F.

HONDURAS

El Paraíso. in pine oak woods, 1200 m, leg. Morton 7077 15 III 1951 US.

9. *Oxalis stricta* L. (1)

Fig. 7 B

Linnaeus, Sp. Pl. 1: 435. 1753 (excl. protol. Tournefort et f. 2 Morison) Thunberg, Oxalis 22. 1781.Michaux, Fl. Bor. Amer. 2: 38. 1803.Elliot, Skecht Bot. 1: 526-7.1821 *ex descr*.Le Maout et Decaisne, Fl. Jard. Champs 2: 528.1855. Rouy et Foucaud, *l.c.* 126. Britton & Brown, Ill. Fl. 346,f. 2254. 1897. Coste, Fl. France 1: 267.1906. Wiegand, *l.c.* 122-123.1925. Rogers, Gray Bull. n.s. 2:268,269. 1953.Conard & Hubbard, Iowa Ac. Sci. 51: 180,182.1944. Fernald, Man. 944, 945.1950. Gleason, Ill. Fl. 2: 455, f. 1958. Chapman, Tutin & Warburg, Fl. Br. Isl. 396.1958. Young, Watsonia 4: 57-58, f. B. 1958; in Fl. Europ. 2: 192. 1968. Isler, Loyson et Walter, Fl. Alsace 328.1965. Lourteig in Jovet et Vilmorin,Suppl. Coste, Fl. Fr. 1: 67. 1972.

[*Oxys lutea americana humilior et annua* Dillenius, Hort. Eltham. tom. alt. lám. 121, f. 288.1732.]

[*Caule ramoso erecto, pedunculis umbelliferis* Gronovius, Virg. 161.1739.]

[*Trifolium acetosum corniculatum, luteum, erectum, Indicum seu virginianum* Morison Hist. 2 : 184, f. 17, 3. 1680.]

O. Dillenii Jacquin, Oxal. 28. 1794. Candolle *l.c.* 691. Eiten, Taxon 4: 99-105.1955; *l.c.* 301.Scholz, Verh. Bot. Ver. Brandenburg 106: 50,53. 1966. Ahles in Man. Fl. Carol. 647-8, f. 1974.Tipo:América, Hort. Elth. OXF.

?O. furcata Elliott,*l.c.* 527. Tipo: perdido.

O. Navieri Jordan in Schultz, Arch. Fl. Fr. All. 1: 311-312. 1854.Billot, Ann. Fl. Fr. All. 20. 1855. Rouy et Foucaud, *l.c.* 125. Coste,*l.c.* Lourteig, in *l.c.* Tipo: no hallado.

?O. arborea hort., Brown, Garden. Chron. 16 (2): 183. 1881.

O. oneidica House, Bull. N.Y. State Mus. 243-244: 43,44. 1923 Tipo:Estados Unidos, N. York, House 6140 NYS.

O. lutea Lamarck ex Steudel, Nom. ed. 1. 579. 1821; ed. 2. 240. 1841 n. illeg.!

O. stricta L. v. *Navieri* (Jord.) Knuth, *l.c.* 195.

O. stricta L. v. *piletocarpa* Wiegand, *l.c.* 123-4. Knuth, *l.c.* 435,436. Conard & Hubbard, *l.c.* Tipo: Estados Unidos, New Hampshire, Williams GH

O. stricta L. f. *condensata* Domin, Preslia 11: 28. 1932 Tipo: Slovenia, no indicado.

O. Dillenii Jacq. v. *radicans* Shinners, Field & Lab. 24: 39. 1956.Tipo: Estados Unidos, Texas, Shinners 23872, SMU.

O. corniculata L. v. *adscendens* Moris, Fl. Sardoa 1: 363. 1837 Tipo:Sardegna, no indicado.

O. corniculata L. v. *stricta* (Sav.) Trelease, *l.c.* 88.

O. corniculata L. v. *Dillenii* (Jacq.) Trelease in Gray, Syn. Fl. N. Am. 1: 365. 1897. Farwell, Rep. Mich. Ac.Sci. 20: 183. 1918. Knuth, *l.c.*434

O. corniculata L. v. *Dillenii* (Jacq.) Trel. subvar. *piletocarpa* (Wieg.) Farwell, Am. Mid. Nat. 10: 36. 1926.

O. fontana Bunge f. *stricta* (L.) Hara, *l.c.* 101.

O. corniculata auct. (Elliott, etc.) non L.!

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(1) El epíteto recuerda la posición erguida de la planta, por oposición a *O. corniculata* de la cual Linneo quiso así diferenciarla.

Oxys lutea Moench, Meth. 48.1794 nom. illeg.!
Xanthoxalis stricta (L.) Small, *l.c.* 667.1903; *l.c.* 51.1907.
X.stricta (L.)Small v. *piletocarpa* (Wieg.) Moldenke, Boissiera *7*:6.1943.
X. Dillenii (Jacq.) Holub v. *piletocum* (sphalm.) (Wieg.) Holub, Bot. Közlem. *59*: 41, f.B.1972.
Ceratoxalis stricta (L.) Lunell, Am. Mid. Nat.*4*: 468.1916.Domin,*l.c.*

TIPO.Estados Unidos, Virginia, leg. Clayton *474*, Fl. Virg. pr. *51* BM.

Herbácea (h. 45 cm) pubescente, erguida o los tallos, ramificados desde la base, decumbentes; a veces largos rizomas (h. más 25 cm),gruesos (h. 3 mm diám.), radicosos. Raíces principales profundas, tortuosas, gruesas;las secundarias finas, fibrosas abundantemente ramificadas. Tallos densamente adpreso-antrorso-pubescentes, raro laxamente pubescentes y aun casi glabros. Pelos blancos y amarillentos. Internodios de largo muy variado (h. 14 cm) y casi nulos en los pseudoverticilos. Pecíolos ascendentes (½-10 cm), pubescencia adpresa y subhirsuta. Folíolos anchamente obovados, cuneados (el mediano mayor, los laterales algo asimétricos),incisos h. 1/5 - 1/4, lóbulos redondeados, etguidos (3,5 - 21 x 5 - 25 mm), haz glabro, envés pubescencia laxa, corta a veces sobre una mitad solamente o sobre el nervio medio, cilias finas, cortas. Peciolillos (± 1 mm) gruesos, carnosos, pubescentes. Cimas umbeliformes, ascendentes mayores que el follaje, largamente pedunculadas, adpreso-pubescentes (h. 15 cm) 1-5-floras, brácteas (h. 4 x 1 mm) lineares, agudas, adpreso-pubescentes, bractéolas (2,5 x 0,5 mm). Flores erguidas.

Sépalos oblongos a oblongo-lineares o elípticos (2,5 - 5,5 x ½ - 1½ mm), obtusos o retusos, desiguales, verdes o con bordes rojizos, adpreso-pubescentes o pelos incurvados, ápice finamente ciliado. Pétalos amarillos 1½ vez el largo del cáliz, obovado-espatulados, unguiculados, borde irregularmente subcrenado, a veces estrías rojizas en la mitad, interiormente. Estambres con filamentos planos, los mayores 2½ - 4 mm) glabros o con pelos cortísimos viscosos en flores macrostíleas; los cortos 1½ - 2½ mm. Pistilos(macrostíleos, meso-y micro?,casi iguales a los estambres cortos; existen casos de estambres mayores casi iguales a los pistilos) 2½ - 6 mm;estilos densamente adpreso-antrorso-pilosos; estigmas 2-fidos, papilosos.

Cápsula cilíndrica, larga (4-25 mm) retrorso-pubescente y pelos pluricelulares finos, mezclados, cáliz ± 1/5 - 1/4; carpelos interiormente con pelos horizontales rígidos, 3-15-seminados.

Semillas paradas (0,9-1,2 mm), suborbicular-aplanadas, apiculadas; 8-9-costadas, estrías horizontales 10-12, notables.

OBS. La abundancia de pelos pluricelulares que puede observarse en los frutos, parece estar en relación con el ataque fúngico.

Distribución geográfica.Especie norteamericana, rara en Europa, introducida, en jardines o en cultivos. Es posible que se halle accidentalmente introducida en otros continentes.

Material estudiado.

América. Ex herb. Kalm, 600.34 LINN. Americ. Septentrionale, leg. Plée *199* P.British North America, leg. Richardson a. 1819-22 BM,B.p.

CANADA

Ontario.Munster, leg. Dore 169 19 VI 1947 PENN. Comté de Norfolk, Saint Williams, leg. Marie-Victorin et al. 46466 3 VII 1936 GH. Peterborough

Co., Mount Otonabee Riv., leg. Soper and Dale 3905 12 VI 1948 GH. Bruce Co.,Tobermory, leg. Krotkov 7571 26 VIII 1933 GH,US. British Columbia.Vancouver Isl., Vic. Nanaimo, leg. Macoun 54 13 VII 1893 GH. Manitoba. Dist. Neepawa, Carberry NW Fossé, leg. Boivin et Perron 12865 12 VIII 1958 GH. Newfoundland. Red Deer Riv., leg. Macoun 391 20 VIII 1879 BM;102 20 VIII 1879 GH.

ESTADOS UNIDOS

Ex America, ex herb. Dillenius, Hort. Eltham. 925 Tipo O. Dillenii Jacq. OXF.

Alabama. Tuscaloosa Co., Univ. Alabama, leg.Deramus 49 19 III 1963 GH. Cherokee Co., S Centre, leg. Kral 34484 25 IV 1969 USF.Orange Co., W of Bithlo, leg. Blanton 6546 19 III 1930 UPS. Arkansas. Izard Co., Penters Bluff, Croker Springs,800 ft., leg. Demaree 17000 7 IV 1938 F,NY,UC. Franklin Co., Mulberry Riv., E of Mulberry, leg. Stephens 10578 23 IV 1967 GH. Arizona.Head of White Riv., leg. Gooding 665 23 VI 1910 GH,NY, US. Apache Co., Tonto Lake, S of Maverick, 7500 ft., leg. Gould & Robinson 5081 3 IX 1948 UC. Colorado. Pagosa Springs, 7100 ft., leg. Baker 450 VII 1899 G,GH,K,NY,US. Boulder, 5000 ft., leg. Penard 96 VII 1891 G NY. Connecticut. Southinton Co., leg. Bissell 26 VI 1903. Norwich, leg. Setchell 3 VI 1883 UC. Delaware. New Castle Co., Vandyke, leg. Bayard Long 24 V 1909 PH. Wilmington, leg. Leeds 17 V 1886 F. Dist. of Columbia Washington, Nat. Arboretum, Gotelli Conifer Garden, leg. Lourteig 2462 10 X 1969 K,NA,P. N East Pines, leg. Leonard 21585 25 VII 1961 US. Flori- Putnam Co., Johnston, leg. Barnhard 2064 28 IV - 3 V 1897 NY. E Crestview, leg. Godfrey & Lindsey 56733 17 V 1958 GH,S,USF.Georgia. Ex Muhlenberg Herb. 683 PH. Rennesaw Mt., 1200 ft., leg. Harper 214 12 VII 1900 BM,GH,K,NY p.p.,P,US.Bulloch Co., GSC campus, leg. Trapnell 94 17 IV 1964 WAG.Idaho. Nez Perce Co., Potlatch Riv., leg. Christ 18234 2 VI 1949 NY. Kootenai Co., Hauser Lake, leg. ipse 10255 10 VI 1939 NY.Illinois.Morgan Park Ridge, leg. Dixon & Gage 664 1-15 V 1907 F,US.Stark Co. Wady Pedra, leg. V. Chase 462 6 VI 1899 F,LY,PENN,UC.Cook Co., Chicago, Lake Michigan, leg. Reich 263 21 VI 1960 F. Indiana . Jackson Co., Muscatatuck Riv.vall., E Chestnut, leg. Friesner 16756 24 V 1942 GH,NY,UC. Hamilton Co., S of Noblesville, leg. Friesner 17633 6 V 1943 S.Iowa. Davis Co., W Floris, Lick Creek Twp., leg. Hayden 9115 1 X 1938 GH,NY.Poweshеik, 2 mi. W Grinnell, leg. Fleming 34 29 IV 1955 USF.Kansas. Riley Co., leg. Norton 56 1895 GH,LY,NY,P,US. McPherson Co., Lindsborg, leg. Bodin VII 1884 UPS. Kentucky. Kenton Co., Near Independende, leg. Braun 4720 18 X 1942 GH,NA. Edmonson Co., Vic. Mammoth Cave, leg. Palmer V 1899 NY,US. Louisiana. Vic. Alexandria, leg. Ball 418 20 V 1899 GH,UC,NY US. New Orleans, leg. Teinturier a. 1826 P. Ib., leg. Hooker K. Maine. Cumberland Co., Pine Point, Scarboro, leg. Fernald 1979 30 VI 1909 GH. Albion, leg. Parlin 3551 23 VI 1916 GH.Maryland. Charles Co., Allens Fresh, leg. L.B.Smith 5001 14 V 1950 US.Chesapeake City, Pivot Bridge, leg. Bayard Long 41139 15 VII 1933 PH. Massachusetts. Barnstable Co., Harwich, leg. Fernald 464 26 VII 1927 BM,F,G,GH,K,LE,NA;NY,P,PRC,US,UPS. Isl. Penikese, leg. Fogg 1439 24 VII 1923 PENN.Michigan. Oakland Co., Addison, leg. Billington 19 VII 1924 MICH. Stevensville, leg. Lansing 3209 3 VII 1911 F,GH,US.Minnesota.Duluth, leg. Lakela 2567 15 VII 1938 GH.Dakota Co., S St Paul, leg. Moore 10237 4 VII 1938 F,S,UC. Mississippi. Panola Co., SW Batesville, leg. Hardin & Duncan 15415 13 IV 1953 GH, MICH,US,USF.Mississippi Riv., leg. v. Heerdt 195 18 III 1948 L.Missouri. McDonald Co., Noel, Butler Creek, leg. Palmer 4074 2 IX 1913 LE,P.St. Louis, leg. Engelmann VIII 1839 K,LE,P. Nebraska. Alma, leg. Pammel 21 VI 1897 GH. Thomas Co., Middle Loup Riv., near Thedford, leg. Rydberg 1348 17 VI 1893 NY,US. New Hampshire. Alstead, leg. Fernald & Noyes 4 VIII 1901 GI, NA,NY,UC,US. Ib., leg. Williams 27 VII 1901 Tipo O. stricta v. piletocarpa Wieg. GH. New Jersey. Atlantic Co., Hammonton, leg. Bassett 4 VII 1923 GH,PH. Somerset Co., Watchung, leg. Moldenke 8037 26 VI 1934 G, LE,S. New Mexico. Las Vegas, Cañón, leg. Arsène 18287 10 VIII 1926 P; 18479 8 IX 1927 P. Socorro Co., Near W Fork of Gila Riv., ca. 6500 ft., leg. Metcalfe 613 28 1903 GH,K,NY,P,US.New Orleans. Lake Pont Chartrain, leg. Hummel 30 III 1958 S. New York. Oneida Co., Taberg, leg. House 6140 6 VI 1919 Tipo O. oneidica House NYS. Canton, leg. Phelps 626 11 VI 1914 GH,NY,UC. Long Isl., leg. Ferguson 8 VIII 1919; 14 IX 1899 NY. North Carolina. Biltmore, leg. Biltmore 1249a BM,GH,L,MUP,NY,PENN,UC,US. Near Hot Springs, leg. Wehmeyer 518 9 VIII 1924 MICH.North Dakota. Benson Co., Leeds, leg. Lunell 18 VII 1909 US. Fargo, leg. Stevens 280 16 VIII 1937 F, UC. Ohio. Scioto Co., Portsmouth, leg. Hicks & Bartley 2287 6 V 1956 NY,US. Western Reserve, leg. Farwell 8709 2 VII 1930 MICH. Oklahoma.Love Co., Thackerville, leg. Clemens 67 16 IV 1913 GH,P.Woods Co., Near Alva, leg. Stevens 666 GH,K,P,US.Oregon. Oregon, leg. Nuttall P. Clackamas Co., Jennings Lodge, leg. Ornduff 6319 19 V 1961 UC. Pennsylvania. Lebanon Co. NNW Annville, leg. Berkheimer PENN.Delaware Co., Swarthmore, E Crum Creek NE of Baltimore Pike, leg. Hermann 3096 29 V 1932 NA.Rhode Island. New Port, leg. Robinson 19 VI 1903 GH. E Providence, leg. Whitney Phoenix 16 VI 1871 NY p.p. South Carolina. Horry Co., Mirtle Beach, leg. Weatherby & Griscom 16568 2 V 1932 GH,US.Charleston Co., Magnolia Gardens,leg. Mazzeo and Dudley 1909 27 IV 1967 NA. South Dakota. Rosebud Creek, leg. Wallace 106 2 VII 1896 NY.Boulder Creek, E Deadwood, leg. Hayward 1008 1927 F. Tennessee. Natchez Trace Parkway, Lewis Nat. Monument, leg. King 386 13 VII 1946 US.Shelby Co., President's Isl., 200 ft., leg. Demaree 21366 14 VII 1940 F. Texas. Houston, leg. Bush 5 1 IV 1899 GH,NY,UC. Freestone Co.,SE Streetman, leg. Shinners 23872 28 IV 1956 Tipo O. Dillenii v. radicans Shinners SMU. Isótipos GH,USF. Dallas, leg. Reverchon 1923 10 V 1900 P. Austin, leg. Rugel a. 1878 NA.Vermont. Brazos Co., College St., leg. Gully 23 19 IV 1975 NY. Townshend, leg. Blanchard 17 25 VII 1903 GH. Virginia. Leg. Clayton 474, Fl. Virg. pr. 51. Tipo BM. Leg. Michaux P. Arlington Co., Clarendon, leg. Allard 11345 25 VI 1945 GH,PEN,US. Fairfax Co., Great Falls, leg. Lourteig and F. Mayer 2652 11 VI 1972 K, NA,P. SW Williamsburg, leg. Grimes 2573 11 V 1920 GH,NY. Washington.Stevens Co., Columbia Riv., N Northport, leg. Bonner & Weldert 207 7 VII 1939 GH,NY,UC.King Co., Seattle, leg. Jones 22 VI 1936 BM p.p. West Virginia. Hardy Co., Betw. Moorfield and Rommey,leg. Allard 8753 1 VI 1941 GH,US. Cabell Co., Huntington, leg. Gillespie 18 V 1936 PENN. Wisconsin. Dane Co., Mt. Horeb, leg. Heddle 2762 22 IX 1920 F. Whitewater, Bass Lake, leg. Abbott 45 10 VI 1893 NY. Wyoming. Whalen Canon, leg. Nelson 522 18 VII 1895 F,GH,NY,US. Crook Co., Bear Lodge Range, 10 mi. N Sundance, 6000 ft., leg. Porter 9105 10 VII 1962 GH,S,UC,US.

BERMUDAS

Smith's Parish, garden Hotel,Frascati 24 13 VII 1905 GH. Roadside, leg. Collins 210 p.p. 1 VII 1913 F,NY,P. Paynter's Vale, leg. Brown 462 10 II

– 9 III 1908 GH,US. Leg. Kemp 16 III 1884 NY. Leg.Flynn 40 23 III 1910 NY.

Europa

SUECIA

Oland, Skogsby, leg. Ingström VII1867 S. Scania, Saxtorp, leg. Blixt 8 IX 1967 NY.

INGLATERRA

Wiggonholt near Pulborough, leg. Buckle & Young 4591 6 IX 1952 K. Sussex, Wickford Bridge, W Chiltington, leg. Lowne 15 IX 1957 K. Sark, near Vicarage, leg. Horlock 493 22 VII 1930 K. Surrey, Cult. Sanderstead, fr. Pulborough (W Sussex), leg. Buckle 4893 1951 BM,L. Warleyen, leg. Willmott 25 IX 1858 K. Hort. Chelsea VIII 1851 K. Chelsea VII 1849 K.

POLONIA

Ucrainia, Pliskow, Dist. Lipowiee, leg. Blónski 154 12 lipca 1893 S.

FRANCIA

Culta comm. Jordan, leg. Grenier 8 VIII 1856 P (s. O. Navieri). Du jardin de Mr. Lloyd, leg. Foucaud VIII 1883 LY.

Charente. St. Germain sur Vienne, leg. Duffort 9 V 1887 LY. Corrèze.Poulviré près Tulles, leg. Delboneau 2 VII 1848 P. Meynac, jardins du presbitère, leg. Gonod d'Artemare 5 X 1894 LY. Doubs. Besançon, leg. Grenier 2645 25 VIII 1858 F,G,LE,LY,OXF,P,PRC. Ib., leg. Grenier a. 1861 UPS. Eure. Corrèze, Ussel, leg. d'Artemare 30 VIII 1894 LY.Haute-Vienne. Pont de-Lussac-les-Chateau, leg. Chaboisseau 841 p.p. 11-20 VI 1863 BP,G,OXF, P, PR,PRC. Bords de la Vienne a Gouet, ?leg. Jousset 7 VII 1873 LY. Ib., près Senou, leg. B^{on}. de Contes 26 V 1872 LY. Indre-et-Loire. Lariche,leg. Blanchet P. Isère. Grenoble, Ile-Verte, leg. Verlot 337 18 VI 1874 BP, LY, P. Loiret. St. Benôit-sur-Loire, leg. Schotsman 5 XII 1969 P.Paris. Jardin des Plantes, leg. Guerniou VI 1973 P. Ib., leg. Hariot 1483 IX 1904 P. Terrain vague à Paris, leg. Hariot 1483 IX 1904 LE,LY,P. Saint-Maur, leg.Arènes 650 VI 1941 P. Seine-et-Marne. Seine-Port, entre la côte 51,2 et la Seine, leg. Jovet 23 XI 1977 P.Vienne. Limoges, leg. Lamy 841bis 20,25 VIII 1868 BP,GH,FI p.p. LE, LY,P,S. Env. Limoges, leg. Duffour 805 28 VII 1913 P. Pindray, leg. Jordan 8 VI 1855 LY. Ib., Violleau 700 28 IV 1892 GENT.Montmorillon, leg. Rouy 20 XII 1862 LY. Lussac, leg. Chaboisseau VI-X 1861 BR,P,UC. Saulgé, Les Plobins, leg. Violleau 703 18 X 1890 GENT. Châtellerault, bords de la Vienne, leg. Grelet 8 VII 1875 P.

ALEMANIA

Grand Duché de Bade, Carlsruhe, leg. Doell 120 p.p. 17 VII 1840 MUP.

CHECOSLOVAQUIA

Praga, leg. Schiffner PRC. Bot. Gart., leg. Hora 4 VII 1816 PRC. Karl.Varech, leg. Güttley a. 1929 PRC. Karlovy Bot. Gart., leg. Domin X 1933 PRC Spisská St. Ves: pr. Haligovce,ca. 480 m,leg. Chrtek et Krisa 8 VII 1965 PRC p.p.Böhmen Prag, leg. Senujcer 16 VI 1879 UPS.

SUIZA

Cult. Jard. Bot. Genève, leg. Ducommun 13 X 1860 BM.

AUSTRIA

Viena, Karlsplatz, leg. Rechinger 8 VI 1925 BM.

HUNGRIA

Bakony, leg. Karolyi-Tallós 15 VI 1965 BP. Szegad, leg. Kováts 4 VI 1934 BP. Com. Somozy, Pr. Szödkedenes, leg. Keller et Egyed 27 V 1943 BP. Budapest, Mülgysten, leg... 17 VI 1943 BP. Zala pr. Bagola 200m, leg. Károlyi 2203a 26 VI 1965 BP. Comves, pr. Sárvar, 1250 m, leg. Pénzes 2203a

28 V 1965 BP. Budapest-Lörim, 120 m, leg. Pois 15 X 1950 BP.

ITALIA

Toscana. Palermo, leg. Hofmann a. 1847 PR. *Venezia*. Padova, Bacchiglione fl. pr. Bassanello, leg. Fiori et Béguinot *1324bis* VI 1912 BM,BP,GH,K,p. p. OXF. Ib., leg. ipse *1324* 16 V 1909 GH,K,LY,OXF.

10. *Oxalis Lyonii* Pursh (1)

Fig. 7 A

Pursh, Fl. Amer. Sept. *1*: 322. 1813. Elliott, Sketch *1*: 527-8.1816-21. Candolle, *l.c.* 692. Zuccarini, *l.c.* 159. 1825. Sprengel, Syst. *2*: 429. 1825. Poiret in Lamarck, Encyc. Suppl. *4*: 754. 1816.

O. texana (Small) Fedde, Bot. Jahresb. *32*: 410.1905. Knuth, Notizbl. *7*: 299. 1919; Pflreich. 145.

O. corniculata L. v. *Lyonii* (Pursh) Zucc., *l.c.* 230.1831.Knuth, Pflreich. 151.

O. recurva Ell. v. *texana* (Small) Wiegand, *l.c.* 137. Knuth, *l.c.* 437.

O. recurva Ell. v. *floridana* Wiegand, *l.c.* 138. Knuth, *l.c.* Tipo:Estados Unidos, Florida, Eaton GH.

O. Priceae Small ssp. *texana* (Small) Eiten, *l.c.* 301-302.

Xanthoxalis texana Small, Fl. SE U.S. 667.1903; N. Am. Fl. *25*: 51. 1907. Tipo: Estados Unidos, Texas, Plack NY.

X. Lyonii (Pursh) Holub, Fol. Geob. Phytot. *8*: 175. 1973.

TIPO. Estados Unidos, Georgia, Cumberland Island, leg. Lyon VI in herb. Lyon, no hallado.

NEOTIPO. Estados Unidos, Mississippi, Harrison Co., Henderson Point, leg. Demaree *34767* 18 III 1954 GH.

Herbácea sericeo-pubescente (h. 25 cm). Rizomas horizontales (más de 10 cm), radicantes. Raíces fibrosas ramificadas, la principal profunda, gruesas (h. 0,5 cm diám.). Tallos poco decumbentes, luego erguidos, ramificados desde la base, densamente adpreso-seríceo-pubescentes(o subadpreso±), pelos ascendentes. Internodios h. 7 cm, casi nulos en los pseudoverticilos. Follaje denso en la base. Estípulas comoletamente soldadas, obtusas en el ápice (15,- 2,5 x 1- 2 mm). Pecíolos largos ascendentes(h. 8,5 cm), pubescencia corta, ± curva densa a esparcida, ascendente. Folíolos verdes o ± purpúreos, obovados, cuneados,(3,5 - 12 x 3,5 - 14 mm), los laterales asimétricos; pubescencia adpresa en ambas faces, densa hasta esparcida y nula en el haz, ciliados, anchamente incisos h. 1/5. Peciolillos rojizos, gruesos, muy cortos. Pedúnculos sobrepasando netamente el follaje (h.20 cm long.), pubescencia como en los pecíolos. Cimas umbeliformes o con una rama muy desarrollada (o dos, una muy corta), 2-fida, 2-7-(1-)floras, más frecuentemente 2-5-floras. Brácteas lineares, agudas (2- 3,5 mm), pilosas; bractéolas(1-2,5 mm) en la base de los pedicelos. Pedicelos (15-30 mm) pubescencia semejante a la de los pedúnculos generalmente más densa.

Sépalos verdes (4-6 x 1 - 1,5 mm) oblongos o elípticos, obtusos, los exteriores subagudos, pubescencia adpresa o subadpresa a veces muy densa. Pétalos amarillo-brillantes (*luteo*) anchamente obovado-cuneados(12-20 mm) borde ± retuso, algunos pelos finísimos en el borde a menudo inconspicuos. *Estambres* filamentos ensanchados en la base, los largos (5 -6,5 mm) con

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(1) Dedicada a John Lyon (ca. 1765-1814) horticultor de Georgia quien recogió el tipo.

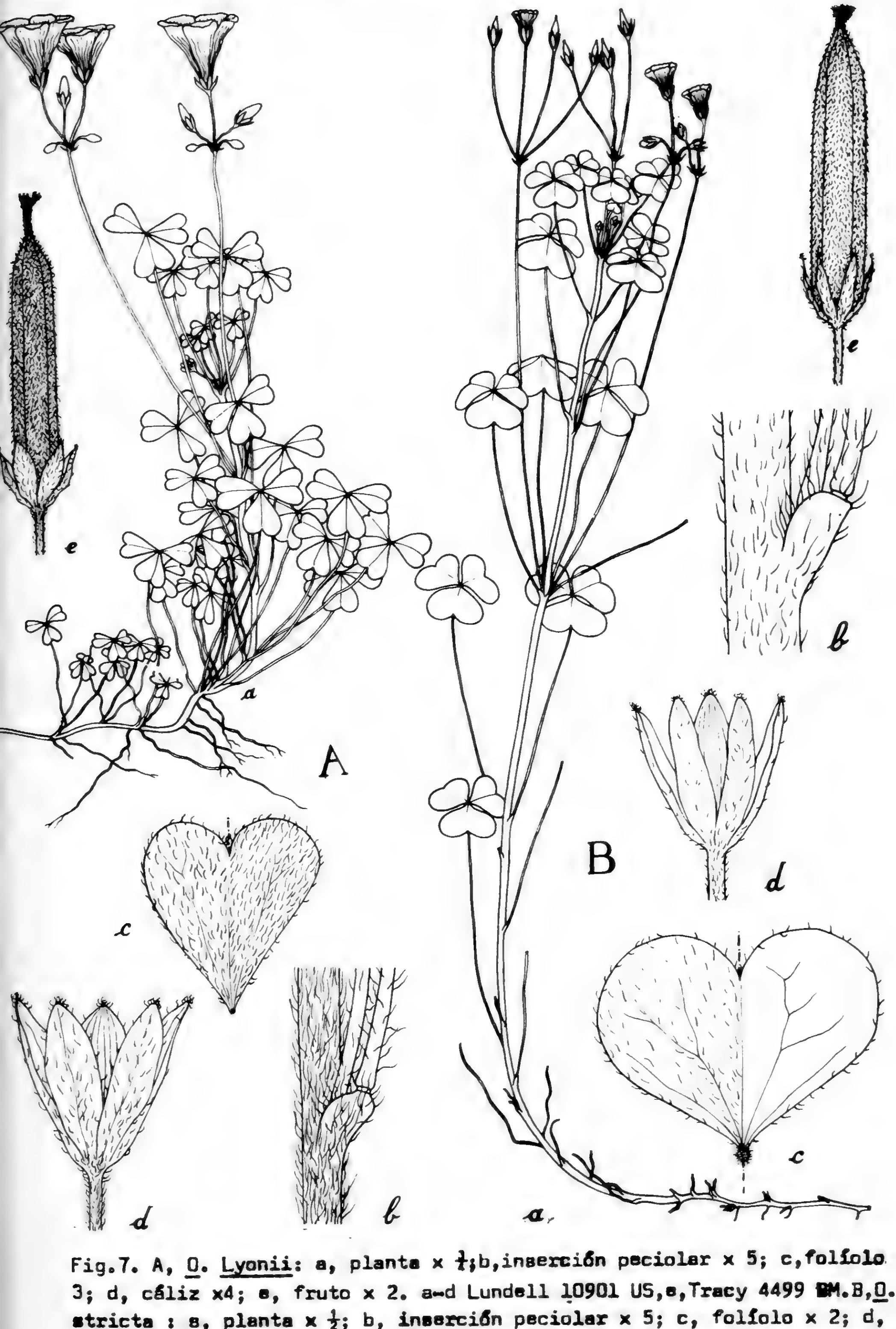

Fig.7. A, *O. Lyonii*: a, planta x $\frac{1}{2}$;b,inserción peciolar x 5; c,folíolo x 3; d, cáliz x4; e, fruto x 2. a-d Lundell 10901 US,e,Tracy 4499 BM.B,*O. stricta* : a, planta x $\frac{1}{2}$; b, inserción peciolar x 5; c, folíolo x 2; d, cáliz x 4;e, fruto x 2.a-d,Biltmore 1249d US, e, Short P. Guerber del.

pelos muy cortos; los cortos (2,5 - 3 mm) glabros, soldados hasta 2/3, generalmente todos pubescentes en las microstíleas. Pistilos (macro- y microstíleos) 7,5 - 10 mm, estilo piloso (en las flores macrostíleas tan largos como el ovario), estigmas 2-fidos, pequeños, papilosos.

Cápsula (10-20 mm) gruesa, oblonga, aguda, tomentosa, pelos glandulares a menudo mezclados, muchos retrorsos, cáliz hasta ± 1/2, estilos largos encorvados, pilosos (flores macrostíleas); cápsula cilíndrica, cáliz hasta 1/3 raro 1/4, estilos erguidos, cortos (flores microstíleas. Pedicelos erectos u horizontales.

Semillas pardas (ca. 1,5 mm), elipsoideo-aplanadas, agudas, costas poco conspicuas, a excepción de las "laterales", estrías horizontales 11 - 12 notables, ± onduladas.

OBS. La identidad de la especie *Lyonii* es clara conociendo las especies de *Oxalis* que habitan en Georgia y siguiendo los detalles de la descripción de Pursh: ....."siliquis tomentosis calyce lanceolato duplo longioribus".... ...."foliis ternatis bilobo- obcordatis, laciniis rotundatis divaricatis,".. .... "caule ramoso decumbente, pedunculis bifloris petiolis longioribus", lo que se observa en el material corrientemente determinado como *texana*. Las inflorescencias bifloras se hallan especialmente en especímenes de Georgia. La diagnosis original comienza "*O. tota sericeo-pilosa* " lo que la distingue de las otras especies del grupo.

El neotipo conviene con la descripción, los cálices son proporcionalmente más largos que en *O. stricta* en la fructificación y llegan ± a la mitad en los frutos de pistilos longistíleos.

Distribución geográfica. Sudeste de los Estados Unidos, lugares húmedos o abiertos de bosques de pinos, suelos arenosos. La pubescencia varía según los factores ecológicos.

Material estudiado.

ESTADOS UNIDOS

Americae Septentrionalis, leg. Fraser FI.

Arkansas. Faulkner Co., leg. Demaree 5652 NY. *Florida*. Apalachicola, leg. Drummond 3 XII 1835 GH. Ib., leg. ipse K. Ib., leg. ipse 2 OXF. East Florida, ex herb. Eaton Tipo *O. recurva* Ell. var. *floridana* Wieg. GH. *Georgia*. Augusta, leg. Cuthbert 207 16 IV - 20 V 1900 NY. Ib., leg. ipse 208 18 IV - 3 V 1900 NY. Wayne Co., Altamaha, leg. Eyles 6868 21 IV 1940 NA. Baker Co., Gulf Coastal Plain, Mossy Pond, leg. Thorne & Muenscher 9043 21 III 1949 GH. Dougherty Co., Flint Riv., Albany, leg. Small 24-28 V 1895 NY. Screven Co., Altamaha Grit reg., Coastal Plain, leg. Harper 2082 1 IV 1904 F,GH,NY,US. Glynn Co., St. Simons Isl., Fort Frederica, leg. Meyer and Mazzeo 13604 7 IV 1973 NA,P. *Ohio*. Jackson Co., S of Limerick, Liberty Twp., leg. Barkley 1263 15 V 1949 US. *Louisiana*. Natchitoches, leg. Palmer 7367 24 IV 1915 US. Sabine Parish S May, leg. Shinners 22779 23 IV 1956 GH. Minden, leg. Trelease 14 IV 1901 L. Vernon Parish, Kisatchie Nat. Forest in pine wood, leg. Cooley & Brass 4007 29 IV 1955 USF. *Mississippi*. Harrison Co., Henderson Point, leg. Demaree 34767 18 III 1954 Neótipo GH. Isótipo USF. *New York*. Long Island, Lawrence, leg. Bicknell 5424 18 V 1902 NY. *New Hampshire*. Leg. Wood.... NY. *Texas*. Brazoria Co., Alvin, leg. Plank 20 IV 1894 Tipo *O. texana* NY. Trinity, 300 ft., leg. Brock 2 IV 1933 US. Houston, leg. Canby et al. 52 23 III 1900 US. Titus Co., SE Mt. Pleasant, leg. Correll 16119 1 I 1957 GH. Tyler Co., W Airport, leg. Correll 32404 5 IV 1966 GH,NA,UC. Angelina Co., Lufkin, leg. Cory 8019 13 IV 1934 GH. Jasper Co., SE Buna, leg. ipse 52738 8 IV 1947 GH,NA,NY,US. Hardin Co., W Silsbee, leg. ipse 52780 9 IV 1947 NA. Houston, leg. Fisher 26 17 III 1918 UC,US. Ib.,leg. ipse 50 17 III 1912 US. Hemphill, 200 ft., leg. ipse 34123 21 IV 1934 GH,US. Hardin Co., SW Kountze, leg. Lundell 10901 24 III 1942 NY,UC,US. Cerokee Co., betw. Alto and Lufkin, leg. ipsi 12715 25 III 1944 UC. Fayette Co., leg. Matthes 169 .... W. Smith Co., NE Tyler, leg. Moore 685 26 III 1944 GH.Tyler Co., Colesmeid, leg. Nealey 27 21 IV 1892 US. Montgomery Co., Monroe, leg. ipse 33327 15 IV 1928 GH.NY. Houston Co., Grapeland, leg.Wiegand 1283 28 III 1935 GH. Ib., leg. Palmer 13186 p.p. 26 III 1918 US. Texas, leg. Wright GH,K. W Jasper, leg. Innes & Warnock 761 13 IV 1941 GH. Titus Co., SE Mt.Pleasant, leg. Correll 16119 1 V 1957 GH. Tyler Co., Airport, leg. Correll 32404 5 IV 1966 GH,UC. San Felipe, leg. Drummond FI. Hudson Highlands, Mearns House, leg. Mearns 93 15 VI 1882 US. Hockley, leg. Thurrow a. 1890 F. Austin, leg. Bray 41 25 III 1898 NY. Houston Co., Betw. Ratcliff and Kennard,Dary Crockett Nat. Forest, leg. Correll 15842 12 IV 1957 NA.

11. *Oxalis florida* Salisb. ssp. *florida* (1)

Fig. 8 A

Salisbury, Prodr. 322. 1796 excl. syn. Dillenii. Wiegand, l.c. 124. Knuth, l.c. 436. Fernald, Man. 944,945.1950.

?O. *recurva* Elliot, Sketch 1: 526. 1821. Britton and Brown, Ill. Fl. 2: 347, lám. 2255. 1897. Wiegand, l.c. 127. Knuth, l.c. 437. Trelease, Mem. Boston Soc. N.H. 4: 87,89.1888. Weatherby, Contr. Gray Herb. 141: 257. Fernald, l.c. 944,946. Tipo: imposible de reconocer.

O. *rupestris* Rafinesque, New Fl. Bot. Am. 2: 26. 1836. Tipo: Estados Unidos, Kentucky, Rafinesque P.

O. *Brittoniae* Small, in Britton Man. Fl. US Canada 577.1901. Knuth, l. c. 152. Tipo:Estados Unidos, New York, Britton NY.

O. *colorea* (Small) Fedde, Bot. Jahresber. 23: 410. 1905.

Xanthoxalis recurva (Ell.) Small, Fl. SE U.S. 668. 1903; N. Am. Fl. 53. 1907. Gleason, l.c. 45, fig.

X. *Brittoniae* (Small) Small, l.c.; l.c. 52. 1907.

X. *colorea* Small, l.c.; l.c. 53. Tipo: Estados Unidos, Georgia, Small, NY.

X. *florida* (Salisb.) Moldenke, Boissiera 7: 5. 1943.

O. *Dillenii* Jacq. v. *florida* (Salisb.) DC., l.c. 692.

O. *Pricea* Small ssp. *colorea* (Small) Eiten, l.c. 302.

?O. *florida* Salisb. v. *recurva* (Ell.) Ahles,J. Elisha Mitchell Sc. Soc. 80: 173. 1964.

TIPO. Cult. Hortus Chapel Allerton (Inglaterra), leg. Salisbury (de semillas provenientes de Saouth Carolina, comm. Fraser) 1789 BM.

El especimen del herbario del Obispo Goodenough, Presidente de la Corporación de Carlisle (herbario formado ca. 1780-1800),en Kew y el del Jardín de Edward Forster (1763-1793) de Londres, en el herbario J.E. Smith, LINN, contemporáneos del especimen de Salisbury,probablemente resultan del cultivo de otras semillas traídas por John Fraser.

Herbácea rizomatosa, ± hirsuto- y adpreso-pubescente. Raíces abun-

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(1) El epíteto alude quizás, a la profusión de flores.

dantes, fibrosas, ramificadas. Rizomas horizontales (h. 25 cm), delgados, rojizos, de donde surgen varios tallos erectos, generalmente rojizos (10 –25 cm) o decumbentes en la base. Pubescencia amarillenta, hirsuta esparcida ± abundante en la base, generalmente adpresa en los ácpies. Internodios largos (h. 10 cm) y casi nulos en los pseudoverticilos foliares.Pe-

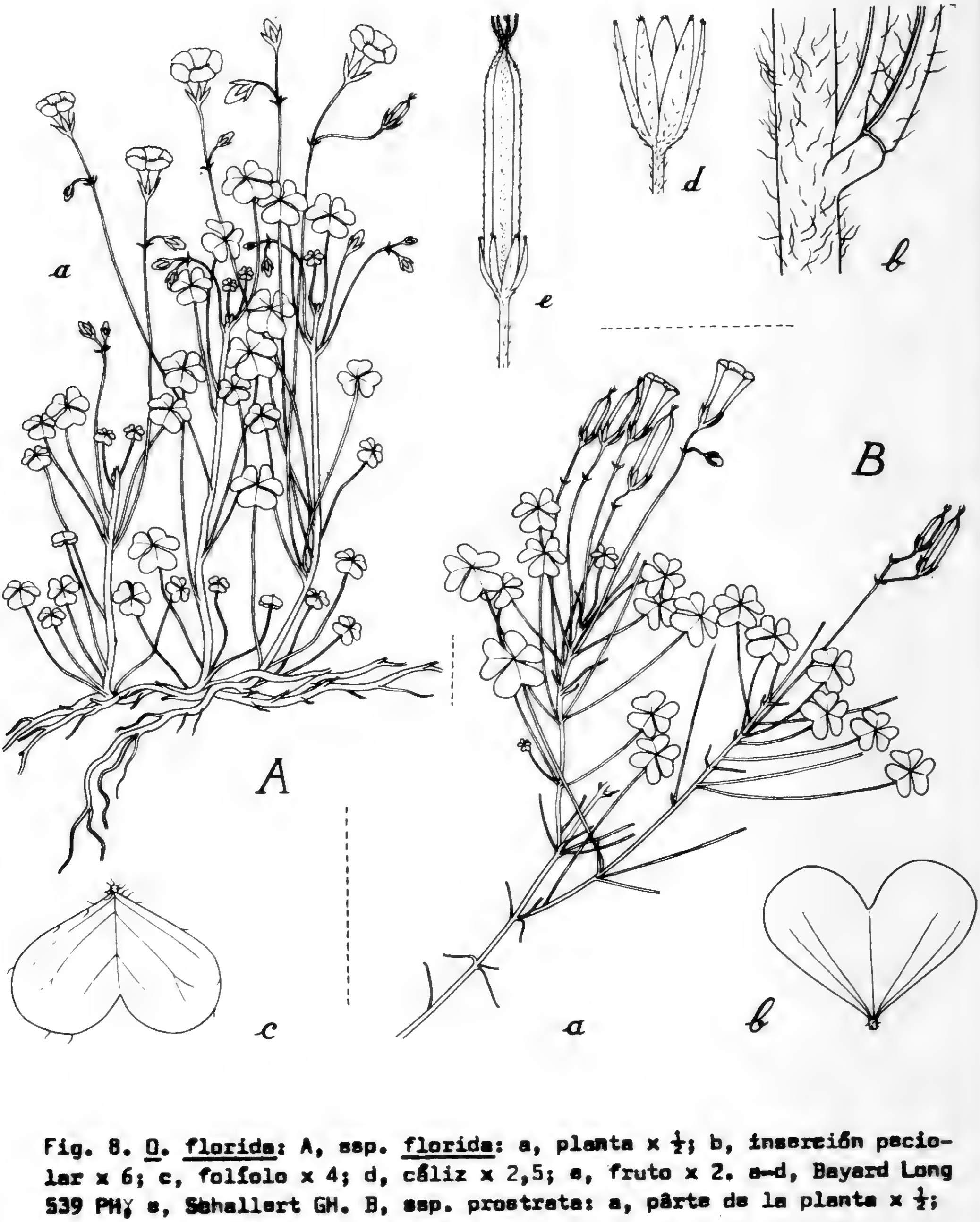

Fig. 8. *O. florida*: A, ssp. *florida*: a, planta x ½; b, inserción peciolar x 6; c, folíolo x 4; d, cáliz x 2,5; e, fruto x 2. a–d, Bayard Long 539 PH; e, Schallert GH. B, ssp. prostrata: a, pârte de la planta x ½; b, folíolo x 4. Lang 343 GH. Guerber del.

cíolos ascendentes ± pubescentes articulados ca. la base. Estípulas soldadas, reducidas, pilosas. Peciolillos gruesos, purpúreos, hirsuto-pilosos. Folíolos generalmente glaucos, ambas faces ± purpúreas o sólo el envés; anchamente obovados, cuneados (1,5 - 10 x 2-15 mm), haz raramente pubescente, envés pocos pelos sobre las nervaduras hasta glabros, incisos hasta 1/5 - 1/4, lóbulos redondeados, Pedúnculos erectos, depasando notablemente el follaje (h. 10 cm), pubescencia hirsuta e adpresa, laxa. Cimas úmbeliformes 2-(5-)(1-)floras. Brácteas (1,5 - 2,5 mm) y bractéolas (1-2 mm) lineares, agudas, angostísimas, hirsuto-pubescentes. Pedicelos (7-15 mm), pubescencia o subhirsuta, acrescidos en el fruto. Flores grandes, interiormente de color amarillo más intenso y rojizo-purpúreo en las fauces de la corola.

Sépalos elípticos a oblongos, algunos lineares, desiguales, angostos, obtusos o subagudos, verdosos, raro ± purpúreos (3-5 x 2/3 - 2 ½ mm) pubescencia adpresa en la base, a veces también en la superficie, cilias cortas en el ápice. Pétalos 2-3 veces el largo del cáliz, obovado-subespatulados, retusos. Estambres largos (4,5-7,5 mm) irregularmente pilosos; los cortos (3-5 mm) soldados h. 1/2 - 2/3. Pistilos(microstíleos de la altura de los estambres cortos, meso- y macrostíleos) 6-10 mm. Ovarios cortísimamente pubescentes en el ápice y a lo largo de la sutura carpelar (dorso); éstigmas pequeños, capitados; éstilos pubescencia desigual ± ascendente.

Cápsula cilíndrica (7,5 - 15 mm) delgadas (muy raro en algunos especímenes gruesas), agudas, erectas o pedicelos horizontales, pubescencia adpresa, antrorsa, muy fina, o cortísima, paralela a las suturas carpelares (dorso) sobre todo hacia el ápice, raramente glabras.

OBS. Los especímenes de herbario no son siempre adecuados (ramas separadas de los rizomas) para poder separar las spp.

Distribución geográfica. Endémica del Este de los Estados Unidos.

Material estudiado.

ESTADOS UNIDOS

Amer. Sept., leg. Michaux P. Ex herb. Swartzii UPS. Leg. Rafinesque 10573 NY.

Alabama. Autanga Co., betw. Autangaville and Booth, leg. Harper 3029 3 IV 1933 GH,NY. Abbeville, leg. Biltmore 5383d 10 IV 1901 NY,US. Connecticut. Fairfield, leg. Eames 8840 13 V 1910 GH. Tolland Co., Willemantic, leg. Eiten 1208 30 V 1958 NY. Delaware.New Castle Co., N New Castle leg. Benner 8123 11 VI 1938 PH. Delaware, leg. Canby a. 1866 p.p. FI. District of Columbia. Canal Road, leg. Steele 21 V 1916 BM,NY,US. Washington, leg. Pieter a. 1899 MICH. Florida.Leon Co., near Tallahassee, leg. Godfrey 52994 14 III 1955 GH,NY,S,USF. Apalachicola & Chattaboutchi leg. Castelnau P. Walton Co., Crestview, leg. Biltmore 5383c 10 IV 1899 PRC,S,US. Georgia. Dekalb Co., Stone Mountain, leg. Small 1-18 V 1895 Tipo O. colorea NY.Isótipo NY. Kenesan Mt., leg. Perry & Myers 935 12 V GH,NY,PENN,PH,US. Kentucky. Carter Co., Flat Fork, leg. Braun 325 8 V 1932 US. Kentucky, leg. Rafinesque a. 1823? Lectotipo O. rupestris,P. Louisiana. Evangeline Parish, Chocot St. Park, leg. Ewan 19970 28 IV 1968 UC.Natchitoches, leg. Palmer 7213 15 IV 1915 K. Maine. Falmouth, Presemepscot Riv., leg. Collins 597 13 VIII 1903 GH. Maryland. Montgomery Co., Cropley, leg. Blake 10845 17 V 1929 GH,P,S. Cecil Co., SE Cecilton, leg. Long 48826 16 V 1936 PH. Massachussetts.Nantucket, Polpis, leg. Day 66 1 VI 1900 F. Milton, leg. Kennedy 9 VI 1902 GH.*Mississippi*. Lamar Co., WHattiesburg, leg. Jones *2670* 5 IV 1965 MICH. Carrollton, leg. Cluts *2* 17 IV 1899 LY,NY p.p. *Missouri*. Doniphan, leg. Bush *277* 16 V 1900 K,NY,GH,US. Scott Co., Benton, leg.Bauer 2305 5 V 1940 F. *New Hampshire*. Connecticut Riv., Walpole, leg. Eggleston 17 V 1903 GH. *New Jersey*. Monmouth Co.,Farmingdale, leg. Long & Brown *3677* 28-30 V 1910 PENN,PH. Hunterdon Co., Lamertville, leg. Dreisbach *4295* 20 VI 1926 MICH,PH.*New York*. Staten Island, leg. Jacquemont 12 VI 1827 P p.p. Ib., Giffords, leg. Britton 19 V 1889 Tipo *O. Brittoniae* NY. Tompkins Co., Ithaca, New Field leg. Eames & Wiegand *10201* 6 VI 1918 F,GH. *New Orleans*.?Leg. Drummond a. 1832 UPS.Silver Bay, Lake George, leg. Kemp 29 V - 20 VI 1901 NY. *North Carolina*.Biltmore, leg. Biltmore *5383a* 27 V 1898 GH,NY,PRC,S,US. Stanley Co., Charlotte, leg. Palmer *39985* 20 IV 1932 GH,NY,US. *Ohio*. Pittsburg, leg. Holg 1831 P,S. *Pennsylvania*.Huntingdon Co., SW Madensville, leg. Wahl *2103* 1 VI 1947 GH,PENN.Haines Sta., leg. Carter 16 V 1909 et 21 V 1907 NY,PH. *South Carolina*. Leg. Fraser, Cult. Chapel and Allerton,leg. Salisbury 1789 Tipo BM. Isótipo G (DC). Charleston, leg. de Castelnau P. Ib., leg. Elliot Tipo *O. recurva* (v. photogr. et descrip.) CHARL.*Tennessee*. Nashville, leg. Gattinger PENN p.p.*Virginia*. Norfolk Co., Near Benefit, leg. Fernald and Griscom *4444* 7 V 1935 GH,K,PEN,USF. Virginia, leg. Dupuis, ex herb. Poiret P. Pony, near Culpepper, leg. Allard *2730* 16 VI 1937 GH,US. *Western Virginia*. Roanoke Riv., leg. Small and Heller *415* 2 VI 1891 BM,F,NY,P,US.Apalachian Mts., Nonongalia,leg. Zinn 25 V 1936 PR.

11a. *Oxalis florida* Salisb. ssp. *prostrata* (Haw.) Lourt. n.c.(1)

Fig. 8 B

O. prostrata Haworth, Miscell. 183. 1803.

O. filipes Small, in Britton et Brown, Ill. Fl. ed. 1.*2*: 346, f. 2253. 1897. Wiegand, *l.c.* 124. Knuth,Pflreich. 152. Fernald, Man. 944,945. 1950. Tipo: Estados Unidos, North Carolina, Small, NY.

O. corniculata L.v.*minima* Poiret in Lamarck, Encycl. Suppl. *4*: 251. 1816. Tipo: Estados Unidos, North Carolina, Bosc P.

O. Dillenii Jacq. ssp. *filipes* (Small) Eiten, *l.c.* 301.Robertson, *l.c.* 231,f. m-n.

O. florida Salisb. v. filipes (Small) Ahles, J. E. Mitchell Sc. Soc.*80*: [172]. 1964.

Xanthoxalis filipes(Small) Small, *l.c.* 667.1903; *l.c.* 52. 1907.

TIPO. Estados Unidos,cult. en Inglaterra, Haworth, destruído.NEOTIPO. Estados Unidos, Virginia, Henrico Co., dray cinders of railroad embankment West of Elk Station, leg. Fernald and Bayard Long 9355 21 IX 1928 US.

Raíces fibrosas, a veces apenas fusiformes, delgadas. Tallos decumbentes o prostrados profusamente ramificados desde la base. Ramas numerosas, alternas, delgadas, rígidas ascendentes, a menudo acortadas mostrando las hojas abundantes, aglomeradas. Pecíolos como los tallos, más delgados, ascendentes. Pubescencia fina, hirsuta, a menudo adpresa en la parte inferior del tallo. Folíolos desiguales, asimétricos, cuneados,incisión hasta 1/4. Cimas comúnmente 1-floras, ascendentes, a veces 2- 3-

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(1) Así llamada por el hábito de la planta.

(5-)floras, laxifloras, asimétricas. Flores en general más pequeñas que en la ssp. *florida*.

OBS. La característica de la subespecie es la ramificación abundante de los tallos (Haworth, comparándola con *Dillenii*, dice "caulibus numerosioribus, magis effusis, prostrata.... ramis alternis patulis, numerosis, valde pilosi") y la delgadez y rigidez de los tallos, ramas y pecíolos (*usually very slender and wiry*, cfr. Small, *l.c.* p. 25).

Distribución geográfica. Endémica del Este de los Estados Unidos.

Material estudiado.

ESTADOS UNIDOS.

Ex Amer. Sept., leg. Koch (ex herb. Zuccarini) M.

Alabama. Ex herb. Mühlenberg *681* PH. Mobile, ex herb. Maille, leg. Mohr 17 IV 1895 FI,NY. Cullman, leg. ipse *5* 20 IV 1892 US. *Arkansas*. Montgomery Co., Ouachita Nat. Park, Camp Albert Pike, Hopper, 940 ft., leg. Demaree *36685* 6 V 1955 NY. Dierks Forests, 700 ft., leg. ipse *42861* 17 VI 1960 GH. Connecticut. Orange, leg. Eames *60* 28 VIII 1898 GH,NY. *Delaware* Greenbank, leg. Commons 18 VI 1883 PH p.p. Bombay Hook, leg. ipse 10 VI 1880 PH p.p. *District of Columbia*. Nat. Arboretum Area, leg. Freeman 21 V 1936 NA. Rock Creek, leg. Pollard 10 VI 1897 NY,US. *Florida*. Manatu, leg. Tracy *6880* 8 V 1900 BM,F,LY p.p.,NY,US. Hendry Co., Labelle, leg. Moldenke *1020* 19 IV 1930 BM,K,NY,PENN,S,US. *Georgia*. McIntosh Co., Sapelo Isl., leg. Duncan *20238* 9 VII 1956 F,GH,US,USF. Apalachicola & Chattahouchu, leg. Castelnau P. *Kentucky*. Rowan Co., White Pine Branch, leg. Braun *4811* 5 VI 1945 US. Lyon Co., Kuttawa, leg. Eggleston *4594* 2-18 VI 1909 NY p.p. *Louisiana*. Vernon Co., leg. Cooley & Brass *3916* 28 IV 1955 NY,USF. Jacksonville, leg. Drummond K,LD,P. *Maryland*. Betsville, Little Paint Branch, leg. Leonard *651* 9 VIII 1919 PRC,US. Forest Glen, leg. Steele 18 VI 1899 BP,S,US. *Massachussetts*. Berkshire Co., Vic. Tyringham, 1000 ft., leg. A. Murray Vail 18 VII 1897 NY. *Mississippi*. Choctaw Co., Ruff's Pl., 7 mi. NW Chester, leg. Ray *4780* 6 VII 1955 GH. N of Bay St. Louis, leg. Small Mosier and Matthaus *12795* 30 IV 1926 NY. *Missouri*. Pleasant Grove, leg. Bush *306* 18 V 1900 K,NY,US. *New Jersey*. Camden Co. Delair, Pochack Creek, leg. Long *6309* 26 VII 1911 PENN. Milford, leg. Mackenzie 6470 19 VI 1915 NY. *New York*. Ithaca, North Spencer, leg. Muenscher & Bechetel *523* 11 VIII 1920 UC,US. Long Island, Hempstead, leg. Churchill 11 IX 1901 GH. *North Carolina*. Leg. Bosc Tipo *O. corniculata* v. *minima* Poiret P. Isótipo FI. Stanley Co., Falls of Yadkin Riv., 100 -200 ft., leg. Small 23 VIII 1894 Tipo *O. filipes* Small NY. Isótipos F, NY. Northampton Co., Junction 258 & 158 Rd., leg. Ahles & Duke *41755* 31 V 1958 GH,NY. *Ohio*. Jefferson Co., Wells Twp., leg. Cusick *1551* 14 IX 1965 NA. Pickaway Co., Main St., leg. Bartley *1261* 24 V 1949 NY,US. *Pennsylvania*. Lehigh Co., Allentown, leg. Schaeffer *53366* 28 VIII 1956 PH. Northumberland Co., NW Trevorton, leg. Wherry 12 VII 1961 PENN. *South Carolina*. Horry Co., Longwood Landing, leg. Weatherby & Griscom *16567* 2 V 1932 GH,NY,US,USF. Charleston, leg. de Castelnau . Florence Co., Pee Dee Riv., Mars Bluff Bridge, leg. Wiegand and Manning *1701* 8 VII 1927 GH. *Tennessee*. Wolf Creek, leg. Kearney 28 VII 1894 E, GH,NY,US. Ib., leg. Ruth VII 1894 MICH,NY,UC,US. *Texas*. San Felipe, leg. Drummond FI. Angelina Co., W Lufkin, leg. Cory *10614* 1 X 1934 GH. Polk Co., leg Thrap 12 IV 1941 GH. *Virginia*. Henrico Co., Elko Station, leg. Fernald and Long *9355* 21 IX 1938 Neótipo US. Isótipos GH,UC,US. Fauquier Co., Bull Run Mts., Pond Mt., leg. Allard 10488 20 IX 1942 GH,NY,US. West Virginia. Shenandoah Riv., Shannonfale, leg. Palmer 138 4 IX 1809 US. Pocahontas Co., Onoto, leg. Core 5 VIII 1931 NY.

12. Oxalis exilis Cunningham (1)

Fig. 9 B

Cunningham, Ann. Nat. Hist. 3: 316. 1839.
O. ciliifera Cunningham, l.c. Tipo: Nueva Zelandia, Cunningham 591 K.
O. propinqua Cunningham, l.c. non Knuth! Tipo: Nueva Zelandia, Cunningham K
O. tenuicaulis Cunningham, l.c. Tipo: Nueva Zelandia, Cunningham 589 K
O. amaniana Hatusima, J. Geobot. 13: 50-51, f. 1964. Tipo: Japon, Sako 4999 KAG.
O. corniculata L. v. ciliifera (Cunn.) Hooker f., Fl. N. Z. 1: 42.1852. Allan, Fl. N. Z. 1: 239. 1961.
O. corniculata L. v. microphylla Hooker f., l.c.; Handbook N.Z.Fl.38. 1867; Fl. Tasmania 1: 59. 1855 (excl. syn. Poiret). Young, l.c. 56. 1958; l.c. 192. 1968. Allan, l.c. Green, J. Arn. Arb. 51: 207-208. 1970. Non O. corniculata L. v. microphylla (Cunn.) Griseb.! Tipo: el de O. exilis Cunn.
O. microphylla Cunningham ex Hooker f., l.c. nomen in syn.!

TIPO. Nueva Zelandia, Waapu, Bay of Islands, leg. Cunningham 587 1833 K

Cespitosa o procumbente. Raíces fibrosas, ramíficadas (hasta + 10 cm), a veces gruesas (½ cm diám.). Tallos largos (h. 35 cm), finos, radicantes y con fascículos paucifolios; corteza rojiza que se exfolia. Internodios diminutos hasta 3 cm. Pubescencia muy fina, cortísima, con pelos más largos mezclados en las partes jóvenes. Estípulas verde-rojizas, soldadas, muy pequeñas de forma variada más anchas o más angostas hacia el ápice (1-2 x 0,75 - 1,5 mm) ± pubescentes y ciliadas. Pecíolos filiformes, erguidos ± pubescentes (0,5 - 3 cm, raro h. 10 cm). Folíolos tenues ± purpúreos, obovados, cuneados o transoblongos (1,5 - 7,5 x 1,5 - 10 mm), inciso 1/6-1/4-(1/3), lóbulos obtusos ascendentes, haz glabro raro algún pelo, envés pocos pelos esparcidos, borde irregularmente ciliado. Peciolillos carnosos, cortísimo, pilosos. Flores solitarias, sobrepasando el follaje. Pedúnculos filiformes (4-25 mm, excepcionalmente h. 8 cm). Brácteas lineares (h. 2 mm) angostísimas, pilosas. Pedicelos 0,25 - 7 mm, excepcionalmente h. 25 mm.

Sépalos lineares a oblongos, raro elípticos (1,5 - 3,5 x 0,6 - 1 mm), obtusos o subagudos, ± pubescentes, bordes frecuentemente violáceos, cilias finas en el ápice. Pétalos amarillos, obovado-oblongos (4,5-7, raro 9 mm), cortísimamente pubescentes o sólo en el borde. Estambres soldados en la base, glabros, filamentos filiformes, los largos 2,25 - 3,5 mm, los cortos 1,5 -2 mm. Pistilos (meso- y macrostílos, ± iguales a los estambres largos), 5,5 mm; estilos pilosos; estigmas 2-fidos, papilosos.

Cápsula erecta o reflexa sobre el pedicelo, en general muy pequeña, oblonga (5,5-9 mm) o subcónica o cilindroide, aguda (h. 9 mm) finísima y cortísimamente hirsuto- y glanduloso-pubescente hasta glabra; cáliz 1/4-1/3; estilos rectos, cortos (o,5-1 mm); carpelos interiormente pilosos, 2-5-(6-)seminados.

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(1) El epíteto alude al porte frágil de la planta.

Semillas pardo-purpúreas, pequeñas (1-1,2 mm) ovoideo- a suborbicular-aplanadas, subapiculadas, 8 costas poco notables, 12 estrías transversales nítidas.

Distribución geográfica. Nueva Zelandia, Este de Australia, Norfolk y Nueva Caledonia. Introducida,con plantas cultivadas, en Inglaterra,Japón hallándosela en jardines o en sus proximidades.

Material estudiado.

NUEVA ZELANDIA

Teoneroa, Tolaga, Opuragi, leg. Banks & Solander (B) 1769 BM.

Northern Island. Hokianga, in boggy situations, leg. Cunningham 1833 Tipo *O. propinqua* Cunn. K. Ib., 231 K. Bay of Islands, Waapu, leg. ipse 587 1833 Tipo K. Ib., leg. ipse 234 K. Ib., leg. Hooker 388 FI p.p. Ib., leg. Raoul, 1843 P. Waimate, Keri-Keri, leg.Cunningham 591 1834 Tipo O. ciliifera Cunn. K. Isótipo LE. S.l., leg. ipse 591 1838 K. Hawke's Bay, Tongoio Reserv., 100 m, leg. v. Zanten 1561 27 XI 1959 L.Keri-Keri, Matim, amongst ferns, leg. Cunningham 589 Tipo *O. tenuicaulis* Cunn. K. East Cape, leg. Sinclair K. Wahoke, leg. ipse K. Mouth of Thames, leg. ipse K. S. l., leg. Colenso 5,296,1083,1126,1620,1932,1962, 1985 L. Leg. Hooker 187. FI,K p.p. Makara-Bucht, leg. Meebold 18241 X 1932 M. Leg. Cap . Wilkes, Pacif. Exp. a. 1838-42 GH. Paha, leg. Meebold 5375 IX 1929 M. Hunterville, leg. Burgess a. 1905 K.

Southern Island. South Camterbury, Fairlie township, leg. Collett 6 II 1970 CHR. Canterbury, Barr Hill, leg. Allan 6 II 1970 CHR. Awatere, 4000 ft., leg. Travers II 1909 L,P,PRC,WRSL. Ib., leg. Kirk 315 BM,GH, OXF. Mackenzie Country, Lake Pukaki, 1700 m, leg. Collett 25 V 1969 P. Beneath Matagouri, edge of airstrip, leg. ipse 22 V 1969 P. South Canterbury, Waimate Park, "in sandwust", leg. Laplanche et Parnham 11773 13 III 1969 P. Mackenzie Country, Ohau Riv., leg.Collett 17 V 1969 K. Timaru, S of City public gardens, leg. Healy 25 I 1970 P. Banks Peninsula Little Pigeon Bay, leg. Collett & Moss 13 V 1969 P. Canterbury, Port Hill Christchurch, leg. Lothian I 1937 GH. Sugarloof Porthills,leg ipse 53-1-1 XI 1936 et XII 1936 AD. Taylor 's Mulake, leg. ipse I 1937 AD,K. Canterbury, leg. Sinclair et Haast 303 1860-61 G p.p., K. Presqu'île de Banks, leg. Raoul, a. 1843 L,P. S.l., leg. ipse a. 1843 G,GH.Hermitage, base of Mt. cook, ex herb. Cartwright a. 1889 OXF. Akaroa, leg. Croix de Belligny LE,P. Waimea Riv., leg. Mouro 74 1850 K. Waimea S near Wakefield, leg. ipse 12 1850 K. Otago, leg. Hector & Buchanan a. 1864-5 K. Canterbury, Halkett, Intake Rd., leg. Edgar 236560 11 IV 1973 P. Ib., Salt ponds near Intake Rd., leg. ipse 236559 11 IV 1973 P.Greymouth, leg. Helms VIII 1888 G. Christchurch, leg. Lester-Garland III 1922 K. Canterbury, leg. Berggren II 1974 S,UPS. Mt. Peel, 3000 ft.,leg. Anderson I 1933 NY p.p. Near Nelson, leg. Travers a. 1860 K.

AUSTRALIA

New South Wales. Sydney, leg. Capt. Wilkes Exp. US. Glen Elgin, leg. White-Haney 16 II 1930 CANB. Robertson, leg. Carnaham 5 29 III 1960 CANB Meyer's Hill, Boolambayte, E of Bulahdelah, leg. Constable 19181 22 I 1952 K. *Camberra Terr.*, Molonglo Riv., leg. Gray 4844 31 III 1960 CANB. Canberra, Acton, leg. Pullen 2189 7 IX 1960 CANB. *South Australia.* Kangaroo Isl. leg. Rogers AD. Mt. Lofty Range, low slopes Mt. Kitchener, leg. Kraehenbuehl 1805 3 IX 1966 AD. Wheogo, 12 mi. S of Dunedoo, 1600 ft., leg. Macdonald 109 26 III 1963 K.*Victoria*. Danderong Ranges, leg.

Guérard W. *Tasmania*. Florentine Vall., Frodsham's Gap, leg. Carolin 1654 2 II 1960 K.

NORFOLK ISLAND.

Cascade, roadside, Harpers Rd., leg. Ralston 52 VII 1965 A. Near Kingston, leg.McComish 122A 28 I 1939 K. Kingston, ruins of old prison,leg. Green 1434 30 X 1963 A. Near Rocky Point, leg. ipse 1461 30 X 1963 A. Philip Island, leg. ipse 1502 31 X 1963 A.

INGLATERRA

Introducida. Algunos especímenes presentan la pubescencia de los pecíolos y pedúnculos algo hirsuta y más larga, seguramente por adaptación ecológica.

Hereford, Sedbury, leg. Britton 18 VII 1917 K. Beaulieu Abby Hants., walls, leg. Findlay 7 VIII 1926 K. Newquay, St. Michael House, leg. Vigurs 5 X 1913 K. West Kent, Tunbridge, Wells,leg. Bull and Young 4886 15 VIII 1953 K. Somerset, Bruton, foot of wall, 200 ft., leg. Makins 359 15 IX 1937 K. E. Glos., Cheltenham, Park Pl.,leg. Sprague IX 1948 K Warwick, Mt. Rever, 900 ft., leg. Jermyn 779a 31 VIII 1953 US. Thetford ex horto Catford, leg. Hewitt 10 X 1909 K. Catford ex greenhouse, leg. Lowne 15 VI 1913 K. Bedford, near Flitwick, leg. McCallum Webster 7025 30 IX 1961 K. Hortus Kew., VII 1923 K; 5 VI 1921 K; Spring 1875 K. Mumby's Herb. IV 1876 K. Guernsey, St. Peter Port, Hantville House, leg. Ballard 541 25 VII 1930 K.

NUEVA CALEDONIA. Noumea, jardin, leg. McKee 23929 9 VII 1971 P; 27559 5 X 1973 P; 30200 et 30201 2 XI 1975 P; 34080 20 X 1977 M,P.

JAPON

Introducida. *Ryukyus*. Amami-Ohshima Isl., on the mossy rock at the upper stream of the Sumiyo Electric Dam, 100 m, leg. Sako 4999 19-24 XII 1963 Tipo *O. amamiana* Hatusima KAG. Transplanted fr. Amami-Ohshima to Kagoshima City, leg. Sako et Gato 10 IV 1964 KAG.

13. *Oxalis filiformis* H.B.K.(1)

Fig. 9 A

Humboldt, Bonpland et Kunth, Nov. Gen. Sp. Pl. 5: 190, lám. 460. 1821.

Non *O. filiformis* Steudel, Nom. ed.2. 239.1841 Cfr. Sprengel, Sphalm. *Ononis filiformis* L.=*Indigofera sarmentosa* L.

O. Bradei Knuth, Rep. Sp. Nov. 23: 276. 1927; Pflreich. 167 ex descr.Tipo: Costa Rica, Irazu, 2100 m, leg. Brade 2017 1908.Destruído en B.

O. nematodes Sprengel, Syst. 2: 29. 1825(Nomen nov. para *Ononis filiformis* Steud, v. supra.

O. hirtella Willdenow ex Knuth, Pflreich. 167 nomen!

Acetosella filiformis (H.B.K.)Kze., Revisio 1: 92.1891.

Xanthoxalis filiformis (DC.) Holub, l.c. 175.

TIPO. Colombia, Guaduas, Santa Ana, leg. Bonpland P. Isótipos B,P.

Reptante(h. 10 cm alt.), pubescente; pelos simples finos y blanquecinos o rojizos, pluricelulares (1,5 - 2 mm mezclados). Raíces fibrosas, ramificadas. Rizomas y tallos filiformes (h. 50 cm o más), radicantes, rojizos que se exfolian, hirsuto-pubescentes. Internodios 1-5 cm con fascículos de hojas,u hojas solitarias,y floríferos. Estípulas soldadas,rojizas, ensanchadas en el ápice (2-3 x ½ - 1½ mm), setoso-ciliadas, cóncavas. Folíolos cordiformes o transoblongos, cuneados (2 - 15 x 3- 20 mm)

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(1) Así llamada por el aspecto de sus tallos y rizomas.

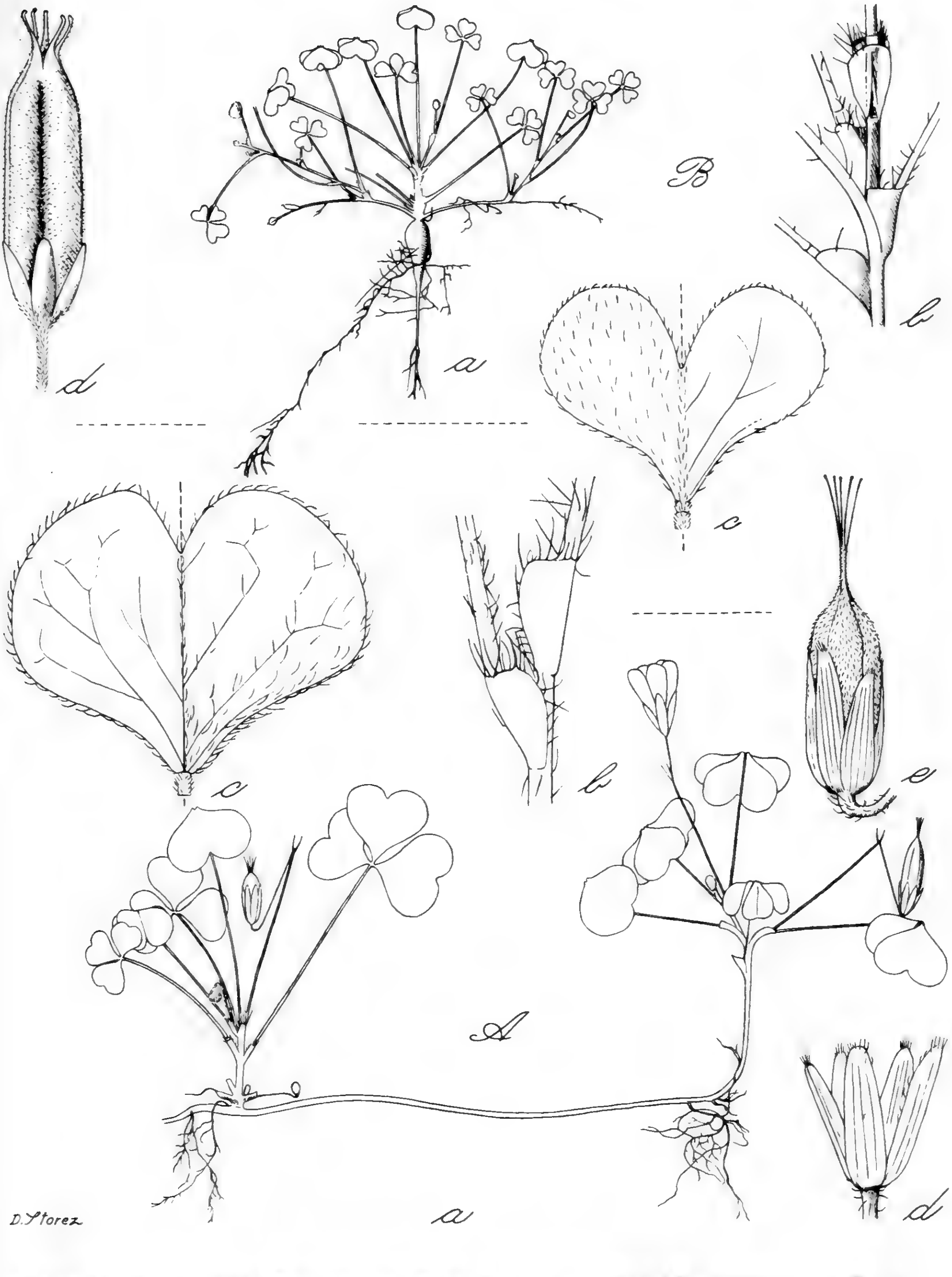

Fig. 9. A, *O. filiformis*: a, planta x 1; b, inserción peciolar x 5; c, folíolo x 3; d, cáliz x 4; e, fruto x 3; Skutch 3472 K. B, *O. exilis*: a, planta x 1; b, inserción peciolar x 5; c, folíolo x 4; d, fruto x 4. a, Parham 12160 P, b-d, Parham 11773 P. Storez del.

incisos hasta 1/4, pubescenciaen ambas faces o haz glabro, ± glabrescentes, ciliados. Inflorescencias mayores que el follaje, solitarias. Pedúnculos (1-7 mm) filiformes, bractéolas lineares, pilosas (1,5-3 mm). Pedicelos 0,5- 2,4 cm.

Sépalos verdosos generalmente purpúreos en los bordes, oblongos (3-5 x 1 - 2 mm), obtusos, densamente ciliados en el ápice, ± pubescentes. Pétalos obovados, cuneados ± 2 - 3½ veces el largo de los sépalos, raro con pequeñísimos pelos glandulares, aislados, en el borde y en el dorso. Estambres cortísimamente pubescentes, los largos h. 5,5 mm, los cortos h. 4 mm, soldados h. 3/4. Pistilos (todos macrostíleos) 6,5 - 7,5 mm. Ovario rojizo, carpelos interiormente con raros pelos cortísimos, 3-6-ovulados, Estilos densamente pilosos (± 5 mm), apenas soldados en la base. Estigmas bífidos, laciniados, papilosos.

Cápsula gruesa, oblonga (5-12 mm) cáliz h. 2/3-1/2, aguda, finamente pubescente, pubescencia cortísima, estilos largos, libres, lóculos 3-6-seminados.

Semillas pardo-rojizas, pequeñas (ca. 1 mm) elipsoideo-aplanadas, agudas, 6-costadas, estrías transversales notables.

OBS. Aunque muy parecida a *O. exilis* se distingue de ella por sus sépalos obtusos, ciliados con el borde generalmente intensamente purpúreo (se observa en los materiales de herbario), cápsulas con pubescencia cortísima, a veces esparcida y el cáliz hasta 1/2 - 2/3 de su altura, las incisiones de los folíolos poco profundas. Algunos especímenes (ej. Standley 32838) pueden tener la pubescencia del fruto algo más larga y subretrorsa.

Distribución geográfica. Costa Rica, entre pastos en prados y sabanas altas (Colombia y Ecuador).

Material estudiado.

COSTA RICA

Prov. San José. San Josecito de Alajuelita, 1800 m, leg. Sastre *4839* 8 V 1976 P. Copey, pâturages et forêts, leg. Tonduz *11879* II 1898 US. Las Nubes, 1500-1900 m, leg. Standley *38752* 20-21 III 1924 US. Betw. San Pedro de Montes de Oca and Curridabat, 1200 m, leg. ipse *32828* 2 II 1924 US. Vara Blanca de Sarapiquí, N slope of Central Cordillera betw. Poás anda Barba, volcanoes, 1950 m, leg. Skutch *3472* I 1938 GH,K,MO,NY, S,US. Santa María de Dota, 1500-1800 m, leg. Standley *42434* 14-26 XII 1925 US. East of San José, leg. Greeman 25 I 1922 MO. *Prov. Cartago.* Cordillera de Talamanca, near La Sierra, 25 Km S of Cartago, 2000 m, leg. Williams et al. *28051* 23 I 1965 F. Vic. Cartago, 1425 m, leg. Standley 33371 II 1924 US. Prov. Alajuela. Vic. Fraijanes, 1500-1700 m, leg. Standley & Torres *47612* 13 XII 1926 US. San Pedro de San Ramón, leg. Brenes *3402* IV 1921 NY.

14. *Oxalis thelyoxys* Focke (1)

Fig. 10 A

Focke, Abhand. Nat. Ver. Bremen *10*: 516. 1889. León et Alain, Fl. Cuba *2*: 370. 1951. Eiten, *l.c.* 300.

O. hemitoma Urban, Symb. Antill. *7*: 235. 1912. Knuth, *l.c.* 162-3. Tipo: Santo Domingo, v. Türckheim *3540* M.

O. oligosperma Urban, *l.c.* 236. Knuth, *l.c.* 164. Tipo: Santo Domingo,

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(1) Derivado de thely = femenino; oxys = Oxalis. Quizás alude a la delicadeza de la planta.

v. Türckheim 2951. No hallado.
O. corniculata L. v. *pygmaea* Grisebach, Cat. Pl. Cub. 47. 1866.Tipo: el de *O. thelyoxys*.
O. corniculata L. v. *microphylla* Grisebach, l.c., p.p.
X. pygmaea (Gris.) Small N. Amer. Fl. 25 (1): 55. 1907. Non A. Gray nec Philippi!
X. thelyoxys (Focke) Holub, Fol. Geol. phyt. 8: 176. 1973.

TIPO. Cuba, leg. Wright 2178 Lectotipo US.

Rastrera, cespitosa (h. ± 5 cm alt.) tenue. Pubescencia escasa, muy fina, blanquecina, hirsuta. Raíces finas, fibrosas (h. ± 5 cm). Tallos a veces rojizos, filiformis, radicantes, largos (más de 15 cm),ramificados Internodios 0,5 - 3 cm. Estípulas pequeñas (1-2 x 0,5 - 1 mm) soldadas, más anchas en la base o en la parte media, cóncavas, ± pilosas, a veces angostísimas. Pecíolos largos, finos (h. 6 cm). Peciolilllos h. 0,5 mm. Folíolos obovados, cuneados (0,7 - 10 x 1 - 11 mm) profundamente incisión ½ hasta ca. la base, a menudo angostísima, variable en la misma planta; lóbulos obtusos o subtruncados, a menudos desiguales, especialmente los laterales; pocos pelos esparcidos en el haz, cortos y sobre las nervaduras en el envés, cilias ± hirsutas en el borde (a veces casi glabros). Cimas 1-floras. Pedúnculos h. 4,5 cm. Brácteas lineares, pilosas (0,7 - 1,5 mm). Pedicelos largos (h. 13 mm) adpreso-pubescentes, deflexos en el fruto.

Séaplos elípticos o lineares (2-3 x 0,5 - 1 mm) irregularmente pubescentes, agudos poco acrescentes en el fruto. Pétalos amarillo-claros, 2½ - 3 veces el largo del cáliz, obovados, oblongos, subespatulados. Estambres filamentos finos, los largos 5,5 mm poco pilosos; los cortos glabros (3,5 mm) soldados 1/2. Pistilos (micro- y macrostíleos ± 7 mm. Estilos pilosos. Estigmas 2-fidos, papilosos. Ovarios 2-4-ovulados.

Cápsulas subovoideas o elipsoideas, delgadas (± 4,5 x 2 mm diám.), cáliz más corto, pistilos largos (h. 1,5 mm), pubescencia fina corta y pelos pluricelulares más largos, ondulados; carpelos 2-4-seminados, interiormente glabros o diminutos pelos cerca de los bordes.

Semillas pequeñas pardas (1¼ mm) ovoideo-comprimidas, apiculadas, costadas difusamente, estrías transversales suaves (± 10), prominencias en las intersecciones.

Distribución geográfica. Endémica de las Grandes Antillas. Halladas en Cuba, Santo Domingo, Haiti.

Material estudiado.

CUBA.

Leg. Wright 2178 Tipo de la especie y de *corniculata* L. v. *pygmaea* Lectotipo US. Isótipos G,GH,K,NY. Cuba Orientali, leg. Wright a. 1856-57 G. Leg. Wright 56 1860-64 p.p.G,GH,K,LE,MO. Bainos, leg. Nyst 3 IV 1837 BR. San Blas, 300 m, leg. Rutten-Pekelharing 116 8 III 1946 U. Prov. Pinar del Río.San Vicente, Viñales, leg. Alain et al. 5264 4 II 1956 GH. Viñales, Sierra de la Guasasa, beneath overhanging on rocks, in moist laces, leg. Ekman 18685 10 III 1924 G,S. Prov. Las Villas, San Juan Mts. El Junco ab. Siguanea, leg. Howard et al. 190 1-20 VII 1950 GH,UC,US. Prov. Sta. Clara. Mountains of the Siguanea-Trinidad group, in forest, edge of Rio Habanilla, creeping on rocks, leg. Ekman 18453 13 II 1924 S Prov. Oriente. Sierra Maestra inter Rio Oro et Rio Bayamo, leg. Ekman 7268 6 V 1916 S. Sierra Maestra, Alcarraza Arriba, leg. Clemente 5091

18 VII 1946 GH. Along río Peladero, bel. Aserradero, S. Antonio de los Cobres, crest of Sierra Maestra,ca. 1300 m, leg. Morton 9540 23 I 1956 US. Prov. Macariges, in sylva humid. obscuris, leg. Poeppig III 1824 W.

HAITI

Vic. of Furcy, 1300 m, leg. Leonard 4647 26 V - 15 VI 1929 US. Massif de la Selle, Morne Tranchant, 1650 m, leg. Ekman 1262 2 VIII 1924 S,US.

SANTO DOMINGO

Sierra de Ocoa, San José de Ocoa, 1300 m, leg. Ekman 11800 6 III 1929 G, GH,K,S,US. Prov. de la Vega, Valle Nuevo, ab. Río Nizao, 2300 m, leg. ipse 13870 20 X 1929 S. Prov. de Azua, San Juan Lomas de la Medianía,2500 m, leg. ipse 13560 15 IX 1929 S. Pr. Constanza in Valle Nuevo, 2200 m, leg. v. Türckheim 3540 VIII 1910 Tipo de O. hemitoma M. Isótipo NY. Prov. La Vega, Vic. of Constanza, 1000-1600 m, leg. Allard 17424 4 XII 1947 US Prov. San Juan, Río Sabana Nueva, N of San Juan, leg. Howard 9011 17 IX 1946 GH,US. Valle Nuevo, pine forest, 2100-2300 m, leg. Liogier 12205 17 VIII 1968 NY,P. Jarabacoa, ciénaga de Nianabao, 1000-1130 m, leg. ipse 12103 14 VIII 1968 NY,P. Roadside dr. La Culata to Ciénaga, 1400 m, leg. ipse 15963 22-23 IX 1969 NY,P. Jarabacoa, Los Guanos ciénaga de Manabao, 1000 m, leg. ipse 17167 9 XII 1969 NY,P. Prov. San Juan, Near Piedra del Aguacate on Río de Oro, leg. Howard 9341 9 X 1945 BM,GH,US.

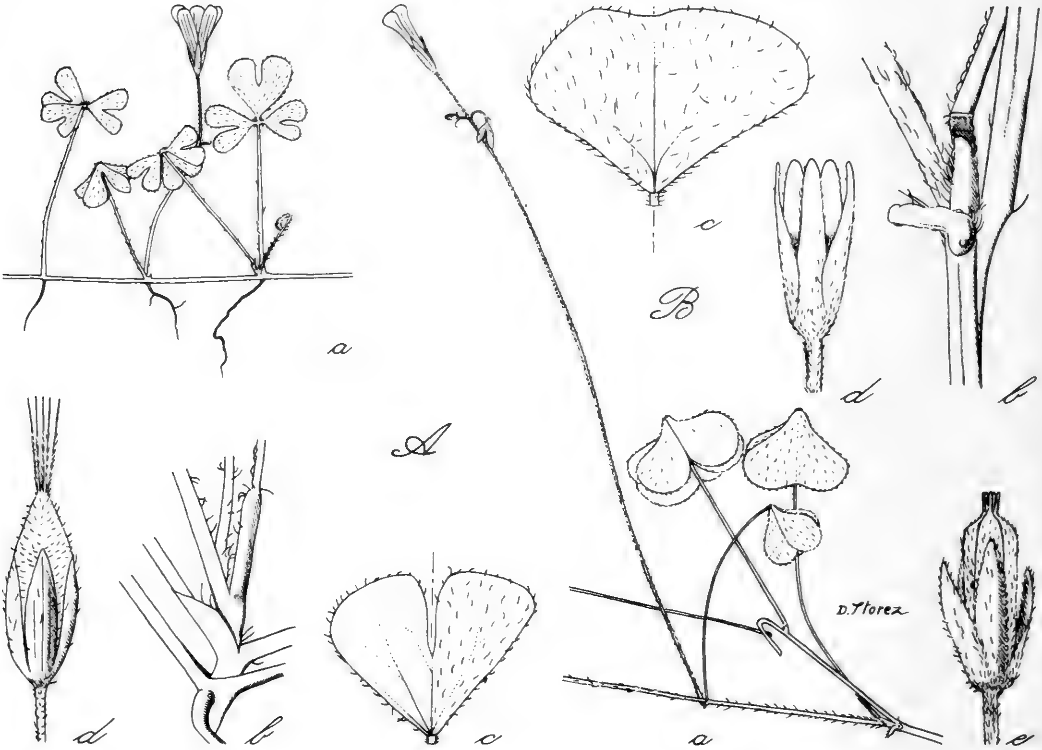

Fig. 10. A, O. thelyoxys: a, parte de planta x 1; b, inserción peciolar x 5;c, folíolo x 2; d, fruto x 4.Liogier 12103 P. B, O. Rugeliana: a, parte de planta x 1; b, inserción peciolar x 5; c, folíolo x 2; d, cáliz x 4; e,fruto x 4. a-c, Liogier 15269 P, d,e, Canela 126 P.Storez del.

15. *Oxalis Rugeliana* Urban (1)

Fig. 10 B

Urban, Symb. Antill. 7: 234. 1921. Knuth, *l.c.* 164. Léon y Alain, Fl.Cuba 370. 1951. Eiten, *l.c.* 300.

O. domingensis Urban, *l.c.* Knuth, *l.c.* 162. Lectótipo: Santo Domingo,Raunkiaer 898 S.

O. corniculata L. v.*domingensis* (Urb.) Moscoso, Cat. Fl. Doming. 273.1943

TIPO. Santo Domingo, St. Johns V., leg. Rugel 388 1849 L.

Rastrera,cespitosa, a veces densa. Pubescencia muy fina, ± hirsuta (0,3-0,6 mm). Raíces finas, fibrosas (± 5 cm), ramificadas. Tallos finos largos (h. más de 30 cm), radicantes, laxamente adpreso-pilosos. Internodios 1- 3 cm. Pecíolos finos (h. 5 cm) pilosos. Pciolillos (± 0,5 mm) gruesos. Estípulas (¾ - 1,5 x ¼ - ½ mm) soldadas, pilosas, cóncavas, apenas más anchas en la base. Folíolos anchamente obovados, apenas retusos (5- 12 x 7 - 17 mm), pubescencia esparcida en ambas faces, corta, curva, base obtusa a subcuneadas, bordes ciliados. Cimas 2-3-floras, que sobrepasan el follaje. Pedúnculos filiformes (3 - 6 cm). Brácteas (1,5 - 2,5 mm) y bractéolas (¾ - 1 mm) filiformes, pilosas. Pedicelos 6- 10 mm.

Sépalos lineares o elípticos, agudos (3- 5 x 1 - 2 mm),poco ensanchados en el fruto, adpreso-pubescentes. Pétalos amarillo-brillantes (7-8 mm), obovado-subespatudlados. Estambres mayores pilosos, los menores glabros (fide Knuth). Pistilos microstíleos (2).

Cápsulas elipsoideas (± 4 x 2,5 mm) cáliz ± del mismo largo, adpreso-antrorso-pubescentes, pelos largos; estilos cortos; carpelos 2-3-seminados, interiormente glabros o con pocos pelos cortísimos.

Semillas pardas, oblongo-apiculadas (± 1,5 x ca. 0,7 mm), poco aplanadas, 9-costadas, estrías transversales 12, notables, protuberancias agudas en las intersecciones.

Distribución geográfica. Endémica de lugares húmedos, valles de ríos,rocas húmedas, declives, entre 200 y 800 m de altitud de las Grandes Antillas.

Material estudiado.

CUBA

Leg. Wright 56 1860-64 p.p. NY,MO,S. Ib., leg. ipse 56 1856-57 GH. Santiago, Mont Liban, leg. Linden 1849 V 1844 FI,G. Pinar del Río, Río San Miguel fr. Volador to Mal Paso, leg. Wilson 9377 17 XII 1910 GH,NY,US. Matanzas, Valle of the San Juan, leg. N. & E. Britton & Shafer 300 14 III 1903 NY.

PORTO RICO

Cuyon Riv. valley, Coamo, leg. Britton & Bron 6156 22 II 1922 NY.

HAITI

Baie des Moustiques, Vic. of Cabaret, Jean Rabel Rd., leg. Leonard 12080 16 I 1929 MO,UC,US. Vic. Jean Rabel, leg. Leonard 12629 29 I 1929 GH,MO,NY,US. Massif du Nord, Le Borgne,S slope of Morne Darras, 800 m, leg. Ekamn 4784 3 IX 1925 S. Presqu'île du NW, road Port-de-Paix to Jean Rabel, in Morne Palmiste, leg. Ekman 3559 23 III 1925 G,GH,S,US.

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(1)Dedicada a Ferdinand Ignatius Xavier Rügel (1806-1879) botánico alemán quien recogió el tipo

(2) Ni Knuth ni yo hallamos otros especímenes que microstíleos.

SANTO DOMINGO

Prov. Santiago. Santiago, leg. Raunkiaer 898 14 V 1906 Lectotipo O. domingensis S. Dist. San José de las Matas, 200 m, leg. Valeur 747 14 III 1931 F,G,MO,K,S,UC,US. Ib., leg. ipse 366 18 I 1930 S,UC,US. Dicayagua, 200 m, leg. Jiménez 1630 30 V 1948 US. Valle del Cibao, Hato del Yaque ab Río Yaque, in thickets, leg. Ekamn 16051 15 X 1930 K,S. Jaiquí Picado, 20 mi. W of Santiago, 300–400 m, leg. Liogier 15269 19 V 1969 NY,P. Prov. Azua. San Juan tow. Loma de Jayaco, 500 m, leg. Ekman 13465 2 IX 1929 GH,S,US. Azua, leg. Rose & Russell 3897 III 1913 NY,US. Prov. Seibo. Road to Gato leg. Taylor 451 6 XII 1909 F,NY.

Cabimal, cuenca Río Magua, leg. Canela 126 25–31 VII 1937 P. Llanos de San Rafael, 200 m, leg. Eggers 1908 12 V 1887 US.

ANTIGUA

St. Johns. St. Johns v., leg. Rügel 388 1849 Tipo L. Isótipos BM,L,NY,MO.

16. Oxalis rubens Haworth (1)

Fig.11

Haworth, Miscel. 182–183. 1803

O. microphylla Poiret, Encyc. Suppl. 4, 248. 1816, non H.B.K., Nec Martius, Philippi, Cunningham ex Hooker, Schlechter! Candolle, l.c. 692. Tipo: Australia, Marie, JUSS.-P.

TIPO. Australia, Nova Hollandia, cult. Haworth. Destruído. Neótipo: Australia, Campden Haven, leg. Verreaux, a. 1844 P.

Hierba erguida, decumbente, purpúrea casi glabra. Raíces fibrosas, ramificadas. Tallos (h. 35 cm) profusamente ramificados, ramas largas, gráciles (a veces acortadas), glabros o, hacia el ápice, con raros pelos cortos, finos, adpresos. Internodios cortísimos h. 6 cm. Estípulas completamente soldadas (0,5 – 1 x 0,5 – 1 mm) angostas o ensanchadas hacia la base que se esclerifican haciéndose inconspicuas, borde notablemente ciliado, cilias rígidas, largas (± 0,5 mm). Hojas a veces subopuestas o fasciuladas. Pecíolos filiformes, erguidos, pocos pelos cortos ± hirsutos, largo variado. Peciolillos cortísimos, pelos hirsutos. Folíolos purpúreos, subglaucos (2– 7 x 2– 10 mm), anchamente oboavdos, cuneados, envés glabro o pocos pelos cortísimos esparcidos y sobre la nervadura media, haz glabro, borde adpreso-ciliado, incisión $\frac{1}{4}$ – $\frac{1}{2}$, lóbulos anchamente obtusos, divergentes, a veces asimétricos. Cimas 1-2-floras, largamente pedunculadas (h. 2,5 cm). Brácteas setiformes (0,5 – 2 mm) poco pilosas, bractéolas iguales, menores. Pedicelos (7–8 mm) acrescidos en el fruto (h. 15 mm).

Sépalos lineares a oblongos o elípticos, obtusos (2 – 3,5 x 0,5–1 mm), los externos pubescentes, partes no cubiertas de los internos pubescentes, pelos adpresos, cortísimos, borde finísimamente ciliado. Pétalos amarillos 2–3 veces el largo del cáliz, obovado-oblongos. Estambres filiformes, los largos (2–2,5 mm), los cortos (1,5 – 2 mm) glabros soldados ± 1/5. Pistilos (macro-, meso y microstíleos, algunos casos estambres largos de igual largo que los pistilos) 3– 4,5 mm; estilos filiformes pelos cortísimos adpresos; estigmas pequeños 2-fidos.

Cápsula erguida, pequeña, aguda globosa, cáliz h. 3/4 (± 4 mm) o cilíndricas (4,5– 6 mm) cáliz h. 1/3 – 1/2, pelos cortísimos a veces sé-

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El epíteto alude al color de la planta.

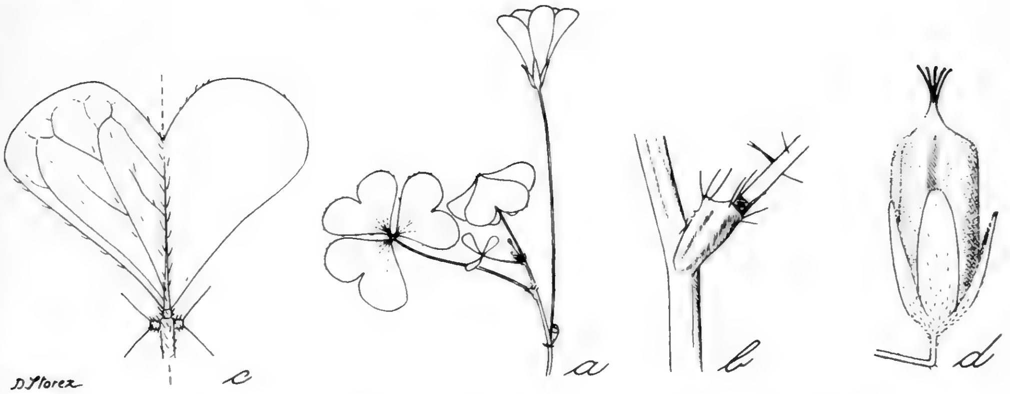

Fig. 11. *O. rubens*; a, ápice de planta x 1; inserción peciolar x 5; c, folíolo x 4; d, fruto x 4. a-c, Mueller, P. d, Verreau, P. Storez del.

lo en el dorso de los carpelos y en los surcos, pocos pelos cortísimos glandulosos, raro glabras; estilos erguidos; carpelos 2-4-seminados, interiormente pelos ± transversales.

Semillas pardo-purpúreas, elipsoideo-aplanadas (1,5- 1,8 mm) subapiculadas, 8-costadas, 9 estrías transversales notables, protuberancias en las intersecciones.

OBS.I. La especie está bien caracterizadas, aunque las colecciones sean pocas. Quizás sea una planta rara, o bien, pasa desapercibida por su morfología. Faltan datos ecológicos.

II. Has especímenes atacados por hongos, al parecer, entonces proliferan los pelos simples y aparecen finísimos pelos largos, viscosos, anormales.

Distribución geográfica. Endémica del Este de Australia.

Material estudiado.

AUSTRALIA

25° L S, leg. Hogdson P. Leg. Sieber *236* 1823 FI,P. Leg. Labillardière M. Leg. Marie, comm. Guichard Tipo *O. microphylla* Poiret JUSS,P. Isótipos FI,P. Campden Haven, leg. Verreaux a. 1844 Neótipo P. Ib., leg. ipse *61* 1844 P. Sydney, leg. ipse a. 1844 P p.p. *Queensland*. Trinity Bay, leg. Müller BM,LY,P. E Nova Hollandia... ex herb. Schwaegrichen, ded. Fliendlmayr M. Moreton Dist., Mount Coolum, leg. Clemens 2 IV 1945 BM,L. Myola-Cairus, leg. Podenzana 4 II 1892 BM p.p. Cardwell, leg. Fristedt VII 1889 S.

17. *Oxalis procumbens* Steudel ex Richard ssp. *procumbens* (1)

Fig.12 A

Richard, Tent. Fl. Abyss. *1*: 123. 1847. Michelozzi, Webbia *32*: 430-435 f. 3. 1978.

O. corniculata L. v. *procumbens* (Steud. ex Rich.)Engler, Bot. Jahrb. *19* Beibl. *47*: 33. 1894.

O. corniculata L. v. *repens* auct.Floras Africanas(incl. Kabuye, Fl.Tr. E. Afr. 5. 1971) non v. *repens* (Thunberg) Zucc.!

TIPO. Abbisinia, Pr. Enschecap, leg. Schimper *1165* 5 I 1838 P.

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(1) El epíteto alude al hábito de la planta.

Herbácea, pequeña, cespitosa (1 - 10 cm alt.). Raíces fibrosas, ramificadas. Tallos largos (h. más de 30 cm) ± purpúreos, rastreros, radicantes, profusamente ramificados, casi glabros, que se exfolian; los jóvenes corta y finamente pubescentes. Internodios h. 5 cm, casi nulos en los fascículos foliares. Estípulas purpúreas, ± hialinas, soldadas, bordes paralelos o enangostándose hacia el ápice (1 - 1,5 x 0,5 - 2 mm) hirsuto-ciliadas. Pecíolos finos, ascendentes, pilosos, largos. Peciolillos purpúreos, canosos, cortísimos, pilosos. Folíolos anchamente obovados, subcuneados(1 - 7 x 2 - 10 mm, los laterales algo menores) incisión 1/4 - 1/3, lóbulos redondeados, pubescencia sobre las nervaduras y esparcida en el envés, raro en el haz, ciliados. Cimas solitarias, rarísimo 2-floras, mayores que el follaje. Pedúnculos (0,3 - 3,5 cm) pubescentes, pedicelos 1,5- 10 mm. Brácteas (1,5 - 3 mm) y bractéolas lineares, angostas, largas, pilosas.

Sépalos verdosos, ápice purpúreo,lineares, oblongos o elípticos (2-3 x ¾ - 1¼ mm) obtusos, pubescentes, cilias finas y cortas. Pétalos amarillos 2 - 2½ veces el largo de los sépalos, muy poco soldados, obovado-oblongos, unguiculados, obtusos, pelos finos en el borde e interior, a veces inconspicuos. Estambres largos (3,5 - 4 mm), los cortos (2,5 - 3 mm) glabros, soldados h. ± la mitad. Pistilos (meso- y macrostíleos) 4 mm; estilos densamente antrorso-pilosos; estigmas bífidos, papilosos.

Cápsula ovoidea a oblonga (± 4 mm,rarísimo h. 8 mm) pubescencia cortísima, antrorsa, cáliz h. ± ½; estilos cortos, rectos (1 - 1,5 mm); carpelos interiormente pilosos 2-4-seminados.

Semillas pardas (± 1,25 mm), elipsoideo-aplanadas, agudas, 8-9-costadas, estrías transversales ± 10, notables.

OBS.I. Las semillas son más gruesas que las de *O. corniculata*, las estrías más marcadas.

II. La especie ha sido sinonimizada y confundida con *O. corniculata*,pero se diferencia fácilmente por la pubescencia antrorsa del fruto, las inflorescencias solitarias, la escultura de las semillas y el aspecto morfológico de las plantas nanas.

Distribución geográfica. En lugares húmedos del borde de selvas ecuatoriales del Este de Africa, entre 2500 y 3500 m.

Material estudiado.

Africa.

Tropical E Africa, leg. Whyte a. 1898 K.

ETHIOPIA

Debra Tabor, leg. Schimper 1140 1863 BM,K. Demerki, 10500 ft., leg. ipse324 15 XI 1851 P. Prope Enschecap, leg. ipse 1165 5 I 1838 Tipo P.Isótipos BM,BP,K,L,LE,LY,P,PRC,G,S,UPS,US. Ouodgerate, leg. Quartin Dillon et Petit... P. Kafta Prov. Dekano, Omo-Nadda Rd., leg. Mooney 6190 26 X 1954 K. Choké Mts., Gojam, vic. upper Ghiedeb vall., 500 ft., leg. Flenley 207 2 VIII 1957 K. Ib., leg. Evans 352 4 XI 1957 K. Bale Prov. Goba, 9100 ft., leg. Mooney 7130 10 IX 1938 K. In agris novalidus, pr. Enschecap, leg. Alexandre Prior 5 I 1888 K. Addis Abbeba, Entoto hills, leg. H. Scott 19 16 IX 1948 K. SE Hagere Selam, SE of Wondo, ± 3000 m, leg. De Wilde 10322 13 III 1966 WAG. Bagemeder vall. Jinbar Wanz, 3465 m, leg. Verfaillee 234 10 IX 1974 WAG.

CONGO KINSHASA

Kivu. Volcan Mikeno, col entre le Mikeno et le Karisimbi, 3200 m, leg.

Humbert 8072 IV 1929 P. Camp Kabara, S slope of Mt. Mikeno, 10615 ft., leg. Linder 2342 17 III 1927 GH.

UGANDA

Kigezi, Mt. Mukavuro, 6500-8000 ft., leg. Snowden 1525 17 X 1929 K.Frontière Uganda-Ruanda, volcan Nuhavura, 3450 m, leg. Humbert 8535 VI 1929 P. Western Prov., Virunga Vulkane, zw. Muhavura u. Mgahinga, ca. 3000 m, leg. Stauffer 769 14 XI 1954 K,P,UPS, WAG. Mt. Elgon,Bamboo Zone, clearings, 8500 ft.,leg. Dummer 3628 I 1918 K. Ib., heath zone, 12000 ft.,leg. ipse 3517 1918 K. Prov. Bugishu, Mt. Elgon, ab. Mudange, rocky ground 12000 ft., leg. Synge 942 VIII 1934 BM.Kigezi, Mt. Mukavuro, 6500-8000 ft. leg. Taylor 2125 14 X 1929 BM.

KENYA

Thomson's Falls, leg. Meinertzhagen 23 III 1936 BM. Naivaska Prov. Aberdare Mts., Kinangop, 10200 ft., leg. Taylor 1272 26 X 1934 BM. Timboroa, Mau Escarpment, Elgeyo, 3000 m, leg. Arambourg, Jeannel et Chapuis 26 1932-33 P. Meru Dist., Mt. Kenya NE slope Ithanguni, volc. Kirui, 2530 m, leg. Faden & Evans 112 28 II 1970 K.Pr.Forest Stat. in silva montana pendora ad rivulum, 2350 m, leg. Fries 761 11 I 1922 K,S,UPS. SW May Forest, Farm1645, 8000 ft., leg. Whitall 85 IX-XI 1956 K. Kinangop, 10600 ft., leg. E.R.N. 713 21 XII 1930 K.Mt. Kenya, 9000 ft., leg. Bally 3498 18 VIII 1944 G,K. Kilimandscharo, Obe halb Marungu, 2700 m, leg.Volkens 1138 X 1893 BM,G,K.Mt. Elgon, 13600 ft., leg. Ingard 331 XII 1930 K. Ib. slope ab. Japata, 3150 m, leg. Hedberg 842 9 V 1948 K,UPS. Narok Dist., Enesambulai vall., E side 8800 ft., leg. Greenway & Kanuri 13587 5 III 1969 K. Kilimandjaro, Shira Plateau S ngare Nairobi Riv., 11400 ft.,leg. Bigger 2264 6 XI 1968 K. Trans. Nzoia Dist. Mt. Elgon, 11200 ft., leg. Taylor 3694 24 II 1935 BM,S. Mt. Aberdare, ca. 3000 m, leg. Fries 2409 15 III 1922 UPS. S Kinangop plateau, 2200 ft., leg. Verdcourt 1767 31 III 1957 K. Ib., 8000 ft., leg. Maclures 11 1 I 1938 BM.

TANZANIA

Ngorongoro Conservation, Empakaai Crater, 2900 m, leg. Frame P8 28 II 1973 K. Mbeya, 8000 ft., leg. Bullock 3987 1 VII 1951 K.

17a. Oxalis procumbens Steud. ex Richard
ssp. Bathiaea Lourt. n. ssp. (1)

Fig.12 A'

Ab O. procumbenti differt pubescentia foliolorum facie superiore; fructibus majoribus, conicis, pubescentia longiore; sepalis acutis vel subacutis et habitu majore cum caulibus plerumque decumbentibus.

TYPUS:KENYA. Rift valley Prov., Nakum Distr., Eastern Mau Forest Reserve, leg. Maas Gesteranus 6160 7 IX 1949 K. Isótipos G,UC.

Rastrera, cespitosa o decumbente. Tallos con pubescencia esparcida ± hirsuta, corta. Internodios h. 7 cm. Pecíolos a veces muy largos (h. 14 cm),ascendentes. Folíolos (h. 17 x 22 mm) haz y envés con pelos esparcidos, raro haz glabro.

Sépalos elípticos desiguales, angostos, dos más anchos. Flores meso y macrostíleas con poca diferencia de largo entre los estambres y los pistilos.

Cápsula cilindro-cónica (h. 12 mm); estilos restos (h. 2 mm);

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(1) Dedicada al botánico francés Joseph Marie Henri Perrier de la Bâthie,(1873-1958),investigador de la Flora de Madagascar,quien recogió el tipo.

pubescencia más larga que en la ssp. procumbens, no siempre uniformemente dispuesta, o velutina.
Distribución geográfica. En borde de selva ecuatorial de Africa y de Madagascar, entre 1000 y 2500 m de altitud.
Material estudiado.
ETIOPIA
Wollo Prov., Dessie, 2600 ft., leg. Hall 48 15 VIII 1946 BM. Jimma Area, J.A.T.S. Compound, leg. Siegenthaler 1521 13 II 1961 K. Sidamo, Manafisha, near Irgallem, 6800 ft., leg. Mooney 5374 31 XII 1953 K.Belita, Abetu vall., Kaffa, 6500 ft., leg. ipse 6059 18 X 1954 K.
NIGERIA
Prov. Cameroons, Distr. Victoria, Ab.Buea, 4-4500 ft., leg. Dundas 20386 14 IV 1947 K. Bamenda, Forestry Nursery, leg.Daramola 40586 10 I 1959 K. Cameroon Mts., Tongo, 7600 ft., leg. Mattland 1012 II 1930 K. West. Cameroons,Bambui Exp. Station, 5000 ft., leg. Brunt 498 15 VI 1962 K. Bamenda, Forestry Plantation, leg. Ujor 30071 20 IV 1951 K.Forest Station,leg. R. o. Th. Fries 761 11 I 1932 UPS. Buea, leg.Deistel 88 26 XII 1905 BM.
CAMEROUN
Leg. Preuss 706 BM,M. Nkambé, Okov, 3008 m, leg. Letouzey 8934 14 VII 1967 P. Mts. Bameoutos, 25 Km Mbouda, 2150 m, leg. Satabie 158 XI 1974 P.
CONGO KINSHASA
Buronga, W du Volcan Mikeno, leg. Jean Luis 5133 12 VIII 1937 K,NY.Dist. Kivu Nord, Virunga-Kette, Nyamuragira Nordhang, ca. 2700 m, leg. Stauffer 328 2 IX 1954 K,UPS. Kibira, Mukarumbi, leg. Robyns 2366 29 V 1926 K. Lake Kivu, Mts. W of Katana, 6500'Cambridge Congo Exp. 17 6 VII 1959 BM.
UGANDA
Budadirs Bugishu, 4360 ft., leg. Chandler 428 I 1932 K. Kampala, Fort Portal, Toro, leg. Hazel 1 20 XI 1931 K. Kigezi, Kachwekano Farm, 7000 ft., leg. Purseglove 2795 V 1949 K. Nyakasura School, 5300 ft., leg. Shillito 94 15 V 1932 K. West. Prov., Virunga Mts., Mobungo, 8000 ft., leg. Taylor 2125 26 XI 1934 BM. West. Porv., Lume vall. 7150'leg. Ross 997 28 VIII 1952 BM. West.Prov., Toro Dist., Kibale Forest, leg. Longfield 93 27 XII 1937 BM.
KENYA
Rift valley Prov., Nakuru Dist., E Mau Forest Reserve, 2300 m, leg. Maas Geest. 6160 7 IX 1949 Tipo K. Isótipos G,S,UC. Nyanza Prov., Londiani Dist., Tinderet Forest Reserve, Timboroa Station, 2800 m, leg.ipse 5482 2 VII 1949 G,K,S,UC. Nuanza Prov., Londiani Dist., Tinderet Forest Reserv. 2200 m, leg. ipse 5396 7 VII 1949 G,K. Mau Forest, Endabarra, 7400 ft., leg. Bally 4992 19 I 1946 K. Ib., leg. ipse 4892 19 I 1946 G. Chyulus, 4000 ft., leg. ipse 7981 17 V 1938 K. Ngong Hills,7600 ft., leg. ipse 8455 26 XII 1953 K. Cherangani Hills, NW Kaibibich, 7850 ft., leg. Mabberley & McCall 44 18 VII 1969 K.Mau Range, 5000-7000 ft., leg. Grosvernor Curtis 829 26 VII 1923 GH. Kabete Grassland, 6200 ft., leg. Mettam 160 1930 K.Myerrebarri, 5700 ft., leg. Speranger 5 25 V 1925 Kabete 6000 ft., leg. Bogdan 1067 13 VIII 1947 K. Mau Forest, Kericho, leg. Kerfoot 2776 III 1961 K. Ngona Range, 4 mi. Ngong, 6800 ft., leg. Rogers 245 29 XII 1932 BM,K. Mt. Elgon, 6500-7500 ft., leg. Ingard 254

X- XI 1930 K. Aberdare Mt., ca. 2600 m, leg. Fries 1213 27 I 1922 UPS. Coles Mill, ca. 1800 m, leg. ipsi 1042 17 I 1922 UPS. Mua Hills, leg. Benson X 1929 BM.

RUANDA

Gisenyi- Kibuye, Gishwati, 2100 m, leg. v.d.Veken 9245 6 II 1972 GENT. Burundi, Hayanza (Gatabo), leg. Mtirurikamwe 18..... GENT.

TANZANIA

Ngorongoro crater, 5000 ft., leg. Bally 2338 IV 1941 G,K. Olmotonyi, 5500 ft., leg. Carmichael 40 K. Near Arusha, Berguren, 2400 m, leg. Geilinger 3852 26 XI 1932 K. Unteren Meru, leg. ipse 3758 18 XI 1932 K. Arusha Dist., Sokon, 1470 m, leg. Milne-Redhead & Taylor 11401 23 VII 1956 K. Arunsha Dist., Mt. Meru, 1500 m, leg. Richards 23128 4 III 1968 K,UPS. Njombe Dist., Mkenja villa., 2100 m, leg. ipse 7791 15 I 1957 K. Meru Mt., Jakumia Camp, Ngari Nanyuli Stream, 2100 m, leg. ipse 23087 18 II 1968 K. Kilimandscharo, Wiss. Station, 1550 m, leg. Volkens 685 VIII 1893 G,K. Masai Dist., Embagai Crater Rim, c. 9.900 ft., leg. Greenway 9132 7 XII 1956 K. Kilimanjaro Dist., Lyamungo, 4250-4400 ft., leg. ipse 3058 20 VIII 1932 K. Ngorongoro, 7000 ft., leg. Tanner 3815 22 XI 1957 K. Jaegertal hushoto, 5000 ft., leg. Archbold 629 14 I 1966 K. Rungwe Dist., Shariya Mbola forest, 2200 m, leg. Gillett 17724 9 XI 1966 K. Simuru, leg. Snowden 567 5 VI 1918 K. Arusha Dist., Mt. Meru, Arusha Nat. Park, 6300 ft., leg. Greenway & Kanuri 13385 14 III 1968 K,M. Plateau Kikuyu, 2500 m, leg. Mission Gomier 15 VIII 1911 P. Minga Dist., leg. Geilinger 1907 6 IX 1932 K. Nluguen Mts., Bunduki, 4000 ft., leg. Vaugham 2613 26 XII 1938 BM.

RODESIA

Stapleford Forest Reserve, Central Patrol, 5500-5900 ft., leg. Gilliland 339 15 VI 1934 BM,K.

SUDAFRICA

Natal nára Pieter Montzburg, leg. Haström o. Lindberg 22 VIII 1936 S.RH. Londiani-Eldorea, leg. Lindblom V 1920 S.

MADAGASCAR.

Prov. Emyrne, Ilafy, leg... 1 XII 1888 P. Massif du Kalambatitra, Mt. Kalambatitra, 1500-1600 m, leg. Humbert 11847 XI 1933 P. Toit d'Analamahitso, Bemarido, 8-900 m, leg. de la Bâthie 5795 VIII 1932 P. Massif de l'Andrangovalo, SE Lac Alaotra, Reserve Zakamena, bassin de l'Onibe, ca. 1000 m, leg. Humbert et Cours 17694 X 1937 P. Canton Manakambahing Est, Dist. Ambatondrazaka, Jofika, leg. Botoalina 4455 17 VIII 1952 P.

18. Oxalis novae-guineensis Lourt.(1)

nom. nov., st. nov.

Fig. 12 B

Oxalis corniculata L. v. papuana Knuth, Rep. Sp. Nov. 48: 3. 1940. Non O. papuana F. Muell.!

TIPO. Nueva Guinea, Morobe Dist., Sarawaket, 6-8000 ft., leg. Clemens 6335 1937 (Isótipo O. corniculata v. papuana). Lectótipo A.

Herbácea. Pubescencia hirsuta desigual y pluricelular, larga ± amarilla-anaranjado, a menudo retrorsa. Raíces fibrosas. Tallos largos (h. más de 1 m), prostrados, ascendentes , a veces en parte radicantes. Ramitas abortadas con pseudoverticilos foliares. Internodios h. 10 cm.

(1) El nombre recuerda el territorio en donde habita la especie y el origen del tipo.

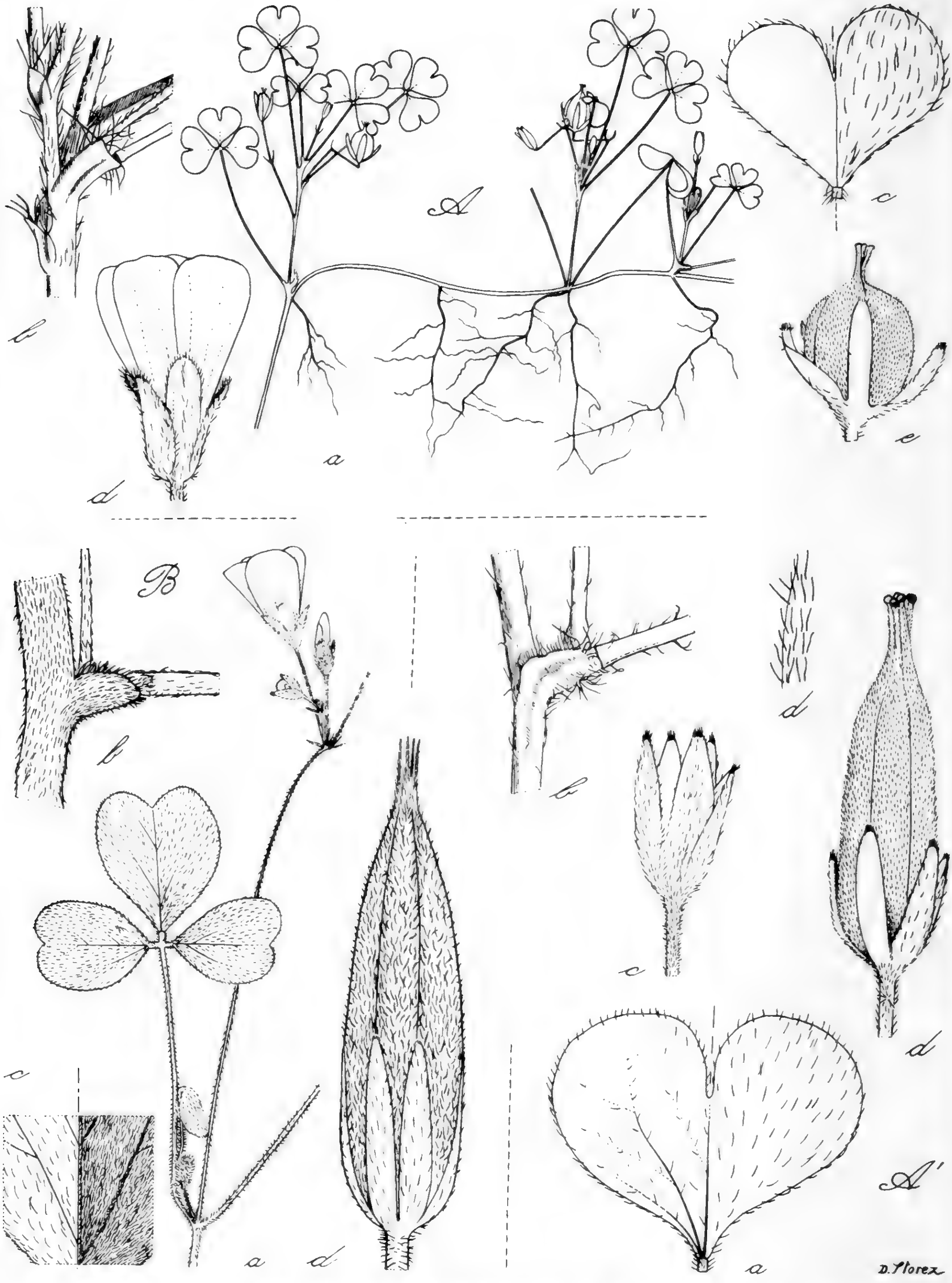

Fig.12.A,O.procumbens ssp. procumbens:a,parte de planta x 1;b,inserción peciolar x 5;c,folíolo x 4;d,flor x 4;e,fruto x 4.d,Arambourg 26 P,resto Schimper 324,P.A', ssp. Bathieana:a,folíolo x 2;b,inserción peciolar x 5; c,cáliz x 4;d,fruto x 4;d',detalle x 16;c,Humbert 11487 P,resto Maas 6160 UC.B, O.novae-guineensis:a, parte de planta x 1;b,inserción peciolar x 5 c,folíolo x 2;d, fruto x 4;d,Street 164 LAE,a-c Brass 32620 L.Storez del.

Estípulas completamente soldadas, inconspicuas, seteso-ciliadas. Pecíolos 1,5-7 cm hirsuto-pubescentes. Folíolos discolores, haz ± rojizo, obovados cuneados, los laterales asimétricos (6 -30 x 6-30 mm) anchamente incisos (h. 1/5 - 1/4), lóbulos obtusos, densamente adpreso-pubescentes en ambas faces, más en el envés, pelos más cortos en el haz, rarísimo ± glabro.Cimas 2-7-floras o compuestas, laxifloras, asimétricas que sobrepasan largamente el follaje; pubescencia hirsuta y pluricelular. Pedúnculos h. 7 cm, acrescidos en el fruto. Brácteas ± 3 mm y bractéolas (1-1,5 mm) lineares, agudas, en la base del pedicelo. Pedicelos 7-20 mm.

Sépalos verdosos (3,5 - 5,5 x 1-2,5 mm), desiguales, linear-oblongos, elípticos, pilosos, ciliados, los interiores casi glabros o sólo la parte central dorsal pilosa, subagudos y obtusos. Pétalos amarillos, más intenso interiormente, 2 - 2½ veces el largo del cáliz, obovado-cuneados, bordes irregularmente ciliados. Estambres largos ± 5,5 mm, los cortos 4 - 4,5 mm, casi libres, glabros. Pistilo (± 6,5 mm),macro- y mesostíleos, también estambres largos y pistilos del mismo largo; estilos pilosos, estigmas bífidos, pequeños.

Cápsulas gruesas, ovoideo-oblongas, agudas (8 - 13,5 mm); estilos 2-4 mm, cáliz h. ½ (o ⅓), tomentosas, pelos pluricelulares e hirsutos antrorsos; carpelos 4-8-seminados, pilosos interiormente, a veces pelos inconspicuos.

Semillas (± 2 mm) pardo-oscuras, ovoideo-aplanadas, cortamente apiculadas, 8-9-costadas, 9-12 estrías transversales, profundas.

OBS. Los estambres, virtualmente soldados en un verticilo, aparecen como libres; no hay un tubo.

Distribución geográfica. Nueva Guinea, rara en Australia. Vive en lugares muy húmedos, borde de selva, sobre pendientes o lugares rocosos o entre pastos a la sombra de Casuarina o de helechos arborescentes.

Material estudiado.

NUEVA GUINEA

Sputhern Highlands, Mt., Giluwe, 10500 ft., leg. Wade and McVean 7787 17 VII 1967 CANB.S.l., leg. Lauterbach 290 1896 WRCL. Morobe Dist., Siyugei, c. 1200 m, leg. Argent 1028 26 VII 1970 GH,K,LAE,CANB. Eastern Higlands Dist., Kassam, 1370 m, leg. Brass 32466 8 XI 1959 A,CAB,K,L,LAE,US. Morobe Dist., Umi Riv., Markham vall., 480 m,leg. ipse 32620 20 XI 1959 A, CANB,K,L,LAE,US. Morobe Dist., Sarawaket, 6-8000 ft., leg. Clemens 6335 12 V 1937 Tipo A (tipo de O. corniculata L. v. papuana).Morobe Dist., Matap, 5000-6000 ft., leg. ipse 11227 6 II - 6 IV 1940 A. West. Highlands Wabag, Parwas, 6500 ft., leg. Flenley 2011 17 VII 1964 A,CANB,L,LAE. Morobe Dist., Tewep-Kiakum vill., c. 4500 ft., leg. Gillison 8 16 II - 9 III 1960 LAE. Morobe Dist., S Wau Kuali Creek, 4000 ft., leg. Hartley 11531 2 IV 1963 CANB,GH,LAE. Eastern Highland, Kainantu Subdist., SE Obura, leg. Hays 51 23 IX 1971 LAE. Ib., leg. ipse 243 21 III 1972 LAE. Morobe Dist., Lae-Wau Rd., Snake Riv., leg. Henty 29160 13 I 1967 GH,L, LAE.CANB. Chimbu Dist. Kundiana Subdist., Sinasina, SW Koge, 2200 m,leg. Hide 324 15 XII 1972 LAE. Western Highlands, S Mt. Hagen Range, Tomba vil., ca. 2550 m, leg. Hoogland & Pullen 6170 7 IX 1956 A,BM,CANB,L,LAE, Morobe Dist., Wau Subdist., Inakanda Creek, Bulolo, 2500 ft., leg. Kairo & Encos35791 30 I 1968 A,CANB,K,LAE. Kaiser-Wilhelmsland, Saruwaged-Gebirge, 1500 m, leg. Keysser III-IV 1913 BM. Dist. Morobe, Kalapit, Umi Riv., 1400 ft., leg. Miller & v. Royen 15651 10 I 1963 CANB,L,LAE.

West. Highlands, Hagen Subdist., Kaugel vall., Tambil, 7500 ft., leg. Hobbins 385 11 VII 1957 CANB,LAE. East. Highlands Dist., Cimbu Subdist., Mingende Miss. St., 7800 ft.,leg. Simonett 95 20 VI 1962 LAE. Jimi vall.,Kwima, 4500 ft., leg. Street 118 19 X 1964 LAE. Jimi vall., Koinambe, 3300 ft leg. ipse 164 12 XI 1964 LAE. West. Highlands, Kaiamanda near Sirunki,8300 ft., leg. Walker 436 28 VII 1962 A,CANB,K,L,LAE. Morobe Dist., Bulolo,ca. 3000 ft., leg. Wells 7568 I 1957 CANB,K,L,LAE. West. Highlands, Mt. Kum, near Mt. Hagen, c. 6500 ft., leg. Womersley 9501 19 V 1957 A,K,LAE. Morobe Dist., Finisterre Mts., vic. Kikiepa vill., near Wantoat Patrol Post, ca. 5000 ft., leg. Womersley and Thorne 11869 VI 1960 LAE. West. Highlands Wahgi vall., Nondugl, 1600 m, leg. Gyldenstolpe VIII-XI 1951 S.

PAPUA

Central Div. Laloki Riv., Rouna Falls, leg. Womersley & v. Royen 5804 21 VI 1954 L,LAE. Papua, Bulolo, c. 870 m,leg. v. Royen 4294 29 VI 1954 CANB L,LAE. Southern Highlands, Dist. Tari Subdist., Ibiwara, 2700 m, leg.Kalkman4631 10 VI 1966 CANB,LAE. North. Dist. Tufi Subdist., Mafo Barracks, 1900 ft., leg. Darbyshire 1143 18 VII 1963 A,CANB,L,LAE. N.E. Dist., Bonenau, 4000 ft., leg. Crutwell 219 31 X 1950 K. Milne Bay Dist., Gwariu Riv.,Biniguni Camp, 200 m, leg. Brass 23699 30 VII 1953 CANB,A,L,LAE,US. Milne Bay Dust. Mt. Dayman, Maneau Range, 2200 m, leg. ipse 22684 30 V 1953 A.

AUSTRALIA

New South Wales, Five Isl., leg. Cunningham 105 1818 BM (atacado por Hongos). Bulli-Pass, leg. Meebold 13937 V1933 M. Port Jackson (Port of Colony), leg. Cunningham K p.p. Illawara, leg. Andersson X 1852 S.

LOMBOK

Rindjani-Vulkangebirge, NNO-Seite, 1250-1350 m, leg. Elbert 1443 19 V 1909 L.

19. Oxalis chnoodes Lourt. n. sp. (1)

Fig. 13

Herba (usque 40 cm alta), pubescentia densa et durta, tomentosa.Caulis decumbens diffuso ramosus. Internodia usque 4 cm,versus apicem brevissima. Folia alterna et fasciculata. Stiulae(1 - 1,5 mm) omnino adnatae,raro versus apicem latiores, adpresso-pubescentes, confertim ciliatae. Petioli 2 - 2½ plo longiora quam foliola. Petiolulum (½ mm) adpresso vel retrorso-pubescens. Lamina obovato-cuneata (7 - 14 x 5 - 15 mm) utraque pagina pubescens, incisa usque 1/8-1/5, raro usque 1/4, lobulis rotundatis. Cimae ascendentes, longe pedunculatae (usque 8 cm) foliis majores, 2-3-florae, pubescentes, subumbelliformes vel irregulariter 2-fidae, 1 vel 2 ramis evolutis 1-2-pluriflorae vel partim umbelliformes et uno ramo evoluto paucifloro. Bracteae (2,5 - 3 mm) et bracteolae (1 - 2 mm)lineares, acutae. Pedicelli(usque 20 mm) articulatione ca. dimidium longitudine, pubescentia densa (adpressa ad retrorsa).

Sepala elliptica (3-4½ x 1½ - 1¼ mm), obtusa, rarissimo subacuta confertim adpresso-pubescens, pilis pluricellularibus tenuissimis intermixtis; interdum facie interiora pilis versus apicem ornata. Petala lutea, 2 - 2½ plo calycem longitudine, oblongo-suspatulata, interdum margine et apice exteriore pilis minutissimis instructa. Stamina filamento tenui versus basim aucta; stamina majora (5,5 mm) pubescentia diminuta dimidio superiore; minora (4,5 mm) glabra, connata usque 1/5 - 1/4. Pis-

(1)Así llamada por su pubescencia(χνοωδης=velutina)en todos sus órganos

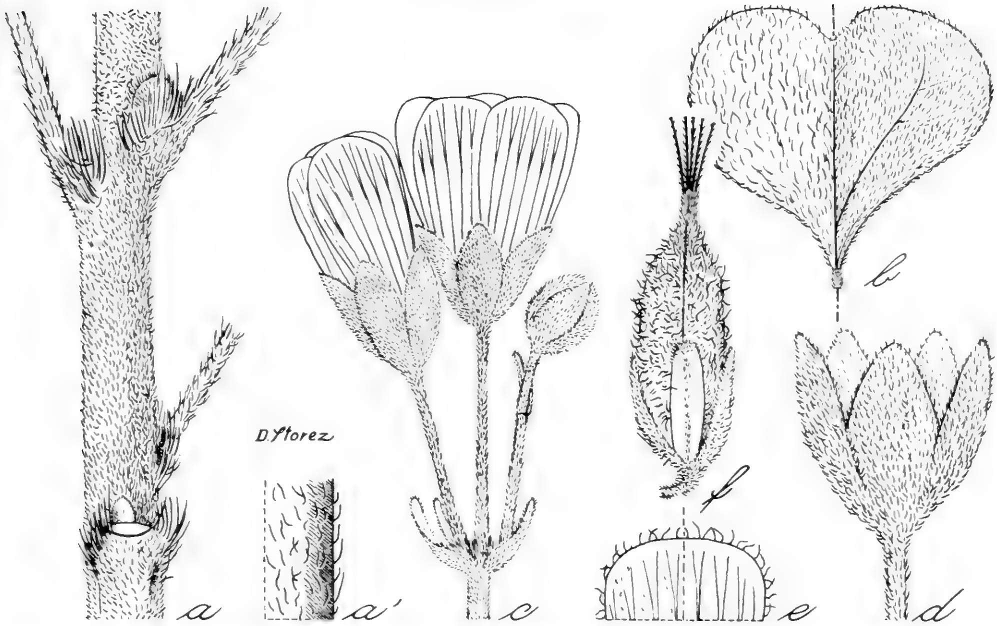

Fig. 13. *O. chnoodes*: a, inserción peciolar x 5; a', detalle x 10; b, folíolo x 2; c, inflorescencia x 3; d, cáliz x 6; e, detalle de pétalo x 6, f, fruto x 3. a-e v. Royen 3932. f, Gillivray 272B, K.Storez del.

tillum (longistileum) 6,5 mm; stylis confertim adpresso pubescentes; stigmata minutissima 2-fida, papillosa, ovarium tomentosum.

Capsula (immatura) quando carpelli 1-seminati, subglobosa calycem minora, quando carpelli 2-4-seminati, ellipsoidea (± 9 mm), calyce paulo dimidium capsulae minor, tomentosa cum pilis pluricellularibus intermixtis, styli ± 1,5 mm, interiore paucis pilis transversaliter dispositis.

Semina fere nigra, ovoideo-complanata, 7-8-costata et transversaliter striata, intersetionibus prominentibus in zig-zag modo dicto gallice et anglice.

TYPUS. New Guinea, Khebar Valley, c. 100 Km West of Manokwari, in grass plains along Anjai Airstrip, c. 550 m, leg. P. van Royen 3932 30 X 1954 L. Isótipos A, CANB.

OBS. Se distingue de todas las especies del grupo por su pubescencia cortísima, fina y tomentosa. Parecida en su aspecto a *O. radicosa* de la cual se diferencia bien, además de su pubescencia característica, por sus folíolos menos incisos, redondeados, los sépalos elípticos, anchos (que en *O. radicosa* son linear-elípticos a lineares), las flores amarillo-claras con corolas translúcidas y las inflorescencias en cimas alargadas.

Distribución geográfica. Nueva Guinea, Archipiélago Bismarck, E de Australia

Material estudiado.

NUEVA GUINEA

Kebar vall., ca. 100 Km W of Manokwari, 550 m, leg. v. Royen 3932 30 X 1954 Tipo L. Isótipos A, CANB.

ARCHIPIELAGO BISMARCK
Neu-Britannien, Balun, leg. Lauterbach 130 WRCL.
AUSTRALIA
Queensland. Fitzroy Isl., leg. Gillivray 272 B VI 1848, Voy. Rattlesnake K. New South Wales. Doyles River State Forest, 30 mi. NW pf Taree, leg. Constable 6311 16 XI 1965 K.Comboyne, Wingham, descent, in brush patch by rock wall, leg. Phillips 15337 24 II 1961 CBG.

Mutación

Una colección anómala (mutación) fué descrita por Hus(Rep. Missouri Bot. Garden 18: 99-107,f. 10-11.1907)como *O.stricta* L. *viridiflora*: "Missouri, Vic. St. Louis, Bellefontaine Cemetery not far from Florissant Av., Sept. 1907". Este material muy bien ilustrado por fotografías no fué conservado (comm. MO).

Fernald basándose en ese estudio estableció una forma: *O. stricta* L. f. viridiflora (Hus)Fernald, Rhodora 38: 425.1936. Tipo: Northampton Co., Savage Neck, border of roadside ditch, leg. Fernald, Long and Fogg 5341 11 X 1935 GH, en Viriginia.

Actualmente esta forma anómala se halla en varios Estados de Norte América. No puede reternerse ese nombre como taxon.

Todos los especímenes que estudié están atacados por Hongos, se observan manchas en los frutos (blancas) y en las hojas (a veces negras), las cápsulas se presentan a menudo curvas. La mutación hace que los pétalos se tornen verdosos pero en algunos casos conservan el color amarillo con el verde y también el color rosado (de las estrías ?).

Material estudiado.
ESTADOS UNIDOS
Arkansas. Faulkner Co., leg. Demaree 5831 NY. Georgia. Charleston, leg. ... NY. Illinois. Mt. Carmel, leg. Schneck 28 V 1898 NY. Michigan. Washtenaw Co., Ann Arbor Arboretum, leg. Ehlers 22 1 X 1916 MICH. New Jersey Cape May Co., Cape May, leg. Long 5185 21 IX 1910 PH. Texas. Austin,leg. Bogusch 5 IV 1918 GH,UC. Victoria Co., leg. Palmer 9063 4 III 1916 US(sólo parte de las flores verdes). Virginia.Northampton Co., Savage Neck, leg. Fernald, Long and Fogg 5341 11 X 1935 Tipo:*O. stricta* L.f. *viridiflora* Lectótipo GH, Isótipos K,NY,PENN,US. Southampton Co., Applewhite Church, leg. Fernald and Long 10309 20 VI 1939 F,GH,US.

Especie desconocida

O. ambigua Salisbury, Trans. Linn. Soc. 2: 242-3, f. 23,4.1794 nom. superfluo (*O. stricta* L. o *O.fontana* Bunge ?).

Material no identificado

El especimen de Mexico, Nuevo León, mountains, 15 mi. W of Icamole, leg. Safford 1269 3 II 1907 n.v. "chancaquilla" US, no se parece a ninguna de las especies conocidas de México. Las flores,con la pubescencia de la base del cáliz característica de *O. macrantha*, no poseen de esa especie ni la pubescencia de la inflorescencia, ni la incisión profunda de los folíolos ni su pubescencia ni la forma de los sépalos. Además está en un área muy alejada.Una sola planta que posee un rizoma tortuoso, sin frutos no es suficiente para tomar una decisión. En esa región han aparecido elementos que no se hallan en ninguna otra del país.

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HIBRIDOS

Many specimens show hybrid characters. The observation of all the morphological characters permits grouping the plants following their analogies with non hybrid species, suggesting the parents. However, states of introgression or regression are common and in some cases it is almost impossible to differentiate one of the parents, but differences exis in some of the individuals of the same community that have been gathered under one collection number. Therefore, the number of the hybrid collections is probably higher.

The examples may be placed in two groups:

I. Hybrids resulting from two spontaneous species living in a country, under the same ecological conditions:
In United States:
Frequently: 1. O. stricta ⟷ O. florida ssp. prostrata; 2. O. stricta ⟷ O. Lyonii.
Rare: 3. O. florida ssp. prostrata ⟷ O. fontana.
In Australia:
Rare: 4. O. rubens ⟷ O. novae-guineensis.

II. Hybrids where O. corniculata, weed invading the territories or the islands; intervenes hybridizing with a commun spontaneous species well established: in the Southern Hemisphere
Frequently: 5. O. novae-guineensis ⟷ O. corniculata
Relatively frequent: 6. O. radicosa ⟷ O. corniculata; 7. O. perennans ⟷ O. corniculata.
Rarely (only 1 case observed in herbarium): 8. O. procumbens ⟷ O. corniculata.

An exceptionnal example is perhaps:
9. ? O. fontana v. Bushii ⟷ O. corniculata, found in Japan and in Manchuria, both species being possibly introduced in those regions.

Since my observations are based solely on herbarium material the real frequency of hybridization and the series of regression in the nature can provide a quite different pattern.

Esta Sección del Género *Oxalis* presenta muchos especímenes híbridos. La hibridación ha sido observada hace largo tiempo sobre todo en los Estados Unidos donde se produce en la naturaleza dando productos fértiles que a su vez se reproducen e hibridizan dando individuos que muestran caracteres regresivos.También se han hallado, aunque raramente, casos de híbridos en el viejo mundo.

Mis observaciones se basan en los caracteres morfológicos observados en los numerosos especímenes de herbario. Observaciones en la naturaleza y quizás trabajo experimental sería necesario para llegar a conclusiones precisas.

Tratando de preparar el camino, he reunido esos materiales, por los caracteres observados después de haber establecido las especies según mis investigaciones taxonómicas indicando la intervención de los "posibles padres".

En consecuencia puedo decir que las especies norteamericanas de área de distribución grande,y que son frecuentes,se hibridizan mientras que las endémicas con áreas limitadas no parecen hacerlo.

En el viejo mundo, por el contrario, parece que la especie *O. corniculata* L. introduciéndose en una isla o región en donde vive una especie propia a la flora de ese territorio, se hibridiza produciendo también híbridos fértiles. En todos los especímenes que parecen ser híbridos, se observan los caracteres de *O. corniculata* L.

I.Grupo de especies norteamericanas, híbridos de especies que cohabitan.

1. *Oxalis stricta* L. x *O.florida* Salisb. ssp. *prostrata* (Haw.) Lourt. Syn. *O. florida* Salisb. v. *strigosifolia* Wiegand, Rhodora 27: 134. 1925. Knuth, Pflreich. 436.Tipo Estados Unidos, New York, Wiegand 14811 CU.

El porte, la ramificación, el follaje son generalmente los de *O. florida* ssp. *prostrata*. La pubescencia, en general, es la de este taxón pero en algunos casos es la de *O. stricta*. Los frutos aunque son por lo general delgados como en *O. florida* están totalmente cubiertos de pelos, lo que no ocurre en ninguna de las dos ssp.de *florida*. Es en los frutos donde se observa mejor la hibridación: la pubescencia que es adpresa y antrorsa y que existe sólo en líneas dorsales de los carpelos, tampoco es (salvo en algunos casos) netamente retrorsa como en *O. stricta* ni tiene el mismo aspecto; muchas veces se observan pelos ascendentes en una cierts proporción o bien quedan ciertas zonas, aunque muy angostas, glabras como en *O. florida*. Estas variaciones fueron halladas en una misma colección que presenta frutos típicos de *O. florida* y de *stricta*.Las flores en algunos casos son grandes como en *O. florida*, en otros como en *O. stricta*; son heterostíleas como en todas las especies del género.

Distribución geográfica. Sur y Este de los Estados Unidos.

Material estudiado.

Alabama. Mobile, leg. Mohr, US. *Arkansas*. Montgomery Co., Ouachita Riv., 700 ft., leg. Demaree 37935 16 VIII 1955 GH,NY. Ouachita Co., Camden, 180 ft., leg. ipse 16789 1 IV 1938 F,NY. Ib., leg. Fendler 12 V 1850 GH. Hot Springs Nat. Park (Mountains), leg. Adams 6 V 1960 US. Little Riv. Co., Foreman, 400 ft., leg. Demaree 63173 21 X 1970 BM.Pulaski Co., Levy by R.R. Bridge, leg. ipse 8862 4 XI 1931 F,GH,NY,UC,US.Little Rock near Five Mile Creek, leg. Merrill 1136 29 IX 1938 NA. Randolph Co.,Pocahontas, 300 ft., leg. Demaree 23701 12 VIII 1942 NY. Arkansas Riv.

bluff, 220 ft., leg. ipse 16429A 9 X 1937 NY. Delaware. New Castle Co., Middletown, leg. Bartram 16 VIII 1908 PH. District of Columbia. Washington City, private garden, leg. Lourteig 2470 IX 1969 P. Florida. Near Tallahassee, leg. Berg NY. Lafayette Co., E Mayo, leg. Godfrey & Kral 56283 25 III 1958 GH, UC. Hillsboro Co., Tampa, Sans Barrens, leg. Churchill 21 III 1923 GH. Walton Co., near Bearhud, leg. Small et al. 12773 28 IV 1920 NY. Pineland E of Gainesville, leg. Small et al. 10021 23 XI 1921 NY. Hâmmond Turtle Mound, leg. ipsi 11136 2 IV 1924 NY. Pinelands, near Higa Alum Bluff on Apalachicola Riv. N of Bristol, leg. ipsi 11266 26 IV 1924 NY. Wakulla Co., St. Mark's Wildlife Refuge, leg. Trott 147 7 IV 1958 GH, UC, US. E. Hillsborough Co., Tampa, leg. Reed S.748 USF. Manatee Co., E Bradenton, leg. Genelle & Fleming 2034 27 IV 1975 USF. Alachua Co., SE Gaineville, leg. Cooley 2594 29 III 1954 USF. Escambia Co., Pensacola, leg. Freeman 26 XII 1939 NA. Georgia. Oomulgee Riv., bel. Macon, leg. Small 8–9 VII 1895 F. Thomas Co., Thomasville, leg. Fosberg 20 X 1945 US Augusta, leg. Cuthbert 209 5 V 1900 NY. Oak woods, leg. ipse 206 VIII 1898 NY. Louisiana. Evangeline Parish, Chicot St. Park, leg. Ewan 19957 29 IV 1960 UC. Natchitoches, Parish, N Gorum, leg. ipse 20280 6 V 1961 UC Alexandria, leg. Hale a. 1839 F, K, US. East E Baton Rouge Parish, Near Leland Coll., leg. Richardson 507 19 VI 1958 US. St. John Parish, Laplace Plantation, leg. Ashbey 9 13 X 1956 GH. New Orleans à Baton Rouge, leg. Douflou 70 1831 P. Rapides Parish, N edge of Pineville, leg. Correll 9938 30 VII 1938 NY. Wis, leg. Parker 13 VI 1962 NY. Maryland. Prince Georges Co., Beltsville, leg. Lourteig 2468 X 1969 P. Ib., leg. ipse 2467 X 1969 P. Takoma Park Area, private garden, leg. ipse 2465 X 1969 P. Massachussetts. Chesterfield, garden, leg. Lourteig 3019 22 IX 1974 P. Cambridge, leg. ipse 3018 IX 1974 P. Dukes Co., Uncatena, leg. Fogg 3096 1 X 1927 PENN. Michigan. Leg. Pitcher Ex herb. Martindale, NA. Mississippi. North Carrollton, leg. Clute 2 p.p. 17 IV 1899 NY. Missouri Dunklin Co., Kennett, leg. Demaree 41850 13 X 1959 GH. Jackson Co., Courtney, leg. Bush 277 3 X 1896 NY, US. New Hampshire. N Walpole, leg. Blanchard 10 VII 1903 GH. Ib., leg. ipse 2 11 VII 1903 NY. New Jersey. Canberry Lake, leg. Mackenzie 2196 15 VII 1906 NY. Cumberland Co., Deerfield, leg. Dreisbach 1925 6 X 1923 MICH. Heislerville, East Point, leg. Long 41943 10 IX 1933 PH. New York. Tioga Co., Spencer Lake, Spencer, leg. Wiegand 14811 7 VI 1922 Tipo O. florida v. strigosifolia Wieg.!CU. Bronx Park, leg. Nash 303 7 VI 1896 NY. New York B.G., leg. Eiten 319 30 VIII 1951 NY. Sussex, along railway, leg. Mackenzie 7756 1 VII 1917 NY. Long Isl., W Sodmere, leg. Bicknell 5408 11 X 1908 NY. Ib., garden ground, leg. ipse 5401 8 VIII 1897 NY. Ib., Plattsdale, leg. Ferguson 18 VII 1919 NY. North Carolina. Orange Co., Couch Mt., Duke forest, leg. Elder 32 21 VI 1940 NA. Chapel Hill, leg. Ashe 2054 US. Ib., leg. ipse NY. Oklahoma. Logan Co., 2 mi. S of Guthrie leg. Gephardt 893 13 VIII 1941 US. E edge of Enid, leg. ipse 981 20 VIII 1941 US. Brechinridge, leg. ipse 1136 21 X 1941 US. La Flore Co., Stapp, leg. Demaree 16044 25 VIII 1937 NY. Mc Curtain Co., N Broken Bow, leg. Nichols 1052 8 X 1971 USF. Pennsylvania. Northampton Co., Raubeville, Isl. in Delaware Riv., leg. Long 35749 18 X 1931 PH. Mifflin Co., 3 mi Wagner, leg. Fogg 16636 11 VI 1940 PENN. Bucks Co., NW Brownsburg, leg. Wherry 17 IX 1937 PENN. Philadelphia Co., Schuykill vall., Nature Center, NW Shawmont, leg. Wherry 17 IX 1937 PENN. Lackawanna Co., Ca. Madisonville, leg. Glowende

1226 12 IX 1937 PENN. South Carolina. Colleton Co., Ashepoo riv., S of Ritter, leg. Ahles & Bell 12193 8 V 1956 USF. Tennessee. Maryville, leg. Wehmeyer 302 24 VII 1924 MICH. Texas. West Texas, leg.Schott p.p. F. Gregg Co., Near Kilgore, leg. Barkley 13611 29 VII 1943 NY. Walker Co., S of Untersville, leg. Albers & Warnock 79 31 X 1945 NY. Ib.,leg. Cory 10407 29 IX 1934 GH. Angelina Co., W Diboll, leg. Hamby 1583 9 VIII 1940 Bowie Co., Ca Texarkana, 300 ft., leg. Heller 4241 14 IX 1898 F,G,GH,L, LE,NY,P,UC,US. Travis Co., Onion Creek at Old Lockhardt Rd., leg. Rowell & Webster 21 4 X 1946 UC,S. Chillicota,leg. Ball 1008 1 IX 1906 US.San Diego, leg. Croft 10 1884 NY,US. Virginia. Rockingham Co., Hone Quarry Camp, leg. Allard 2109 16 VIII 1936 US. Arlington Co., Nat. Cemetery, leg. ipse 8006 22 VIII 1940 GH,US. Arlington Farm, leg. ipse 8216 17 IX 1940 US. Prince William Co., E slope of Bull Run Mts., Beverly Hill, leg. ipse 7359 3 VIII 1939 GH,US. Loudoun Co., E Goose Creek, leg. ipse 21807 11 X 1953 US. Lancaster Co., Kates Creek, leg. ipse 21836 bis 18 VII 1954 US. Charles City Co., James Riv., "Four Oaks" bel. Harrison Point, leg. Fernald & Long 1826 23 V 1940 PENN. Clifton Forge, 400 m, leg. Steele 1 18 VIII 1903 US. Clarke Co., Near Boyce, leg. Eiten 541 13 VI 1952 NY,P, US.

2. *Oxalis stricta* L. x *O. Lyonii* Pursh

Especímenes que presentan características de las dos especies. Aunque presenten el porte de una o de la otra especie, los frutos son tomentosos, con pelos más largos que en *O. stricta* y la pubescencia del tallo no es adpresa como en esta especie sino ascendente o subadpresa más parecida a la de *O. Lyonii*. Los folíolos son glabros a densamente pubescentes (a veces difieren en la misma colección). Se pueden reunir en dos grupos:
a. Porte más parecido a *O. Lyonii*, la inflorescencia que se destaca bien del follaje, en general con pelos y flores grandes (10-12 mm, raro menos)
b. Porte más parecido a *O. stricta* L. en general profusamente ramificados con folíolos a menudo grandes (h. 22 x 22 mm), inflorescencias por lo común menores que el follaje y flores menores (del tamaño de las de *O.stricta*) no mayores de 8 mm.

Evidentemente hay algunos especímenes intermedios; el tamaño de las flores, el color amarillo pálido, no "dorado" intenso como en *O. Lyonii* y el hábito de la planta en ambos grupos, los diferencian de esta especie.

Material estudiado.

Grupo a.

Arkansas. Drew Co., Monticello, leg. Demaree 14374 10 IV 1899 US. Florida. Pensacola, Escambia Bay, leg. Bitmore 11074 13 IV 1899 US. Lynn Haven Hotel Plot, leg. Banker 3531 8 IV 1926 NY. Anderson Bayou, leg. ipse 3538 30 V 1926 NY. Florida Citrus Co., betw. Floral City and Bushnell, leg. Cooley and Monachino 5705 25 III 1953 USF. Georgia. McIntosh Co., Coastal Plain, Altamaha Riv., betw. Brunswick and Darien, leg. Cronquist 4925 21 III 1948 NY,US. Illinois. Champaign Co., Urbana, leg. Pease 11887 20 V 1909 GH. Iowa. Appanoose Co., E Centerville, leg. Hayden 9653 13 V 1939 UC,US. Kansas. Lawrence, 830 ft., leg. Horr E 467 10 VIII 1942 F. Mississippi. Biloxi, leg. Tracy 4999 22 IV 1898 BM,F,GH,LY,MICH,NY,US.Ib.,leg. ipse 4499 NY. Nebraska. Halsey, leg. Krauter VI 1903 PENN. South Carolina. Anderson, leg. Davis 1314 20 V 1920 GH,MICH. Texas.West Texas, leg. Schott p.p. F. Travis Co., Austin, leg. Biltmore 14794 18 IV 1903 GH.Edwards Co., Pullian creek, bel. Blue Hole, leg. Cory 43774 24 III 1944 GH

Newton Co., S Newton, Nogle Camp, leg. ipse 52594 4 IV 1947 GH,NY,US. Newton Co., S Newton, leg. ipse 52618 5 IV 1947 NA. Jasper Co., S Jasper, leg. ipse 52861 10 IV 1947 GH,NY. Walker Co., Vic. Huntersville, leg. Dixon 570 6-12 V 1918 F,NY,US. San Augustine, leg. Crocket US. Rusk Co., leg. Henderson High School 5739 IX 1929 US. Kinney Co., Fort Clark, leg. Mearns 1261 10 III 1893 US. Kerr Co., leg. Orr IV 1932 GH. Frio Co., Río Frío, N Dilley, leg. Painter et al. 14210 26 II 1944 GH,S. Houston Co., Grapeland leg. Palmer 13186 p.p. 26 III 1918 US. Texas, leg. Pope... F. San Antonio leg. Schulz 2235 17 III 1926 F. San Saba Riv., Brady, leg. Studhalter 1107 16 IV 1926 US. Port O'Connor, leg. Tharp 29 III 1930 UC. Galveston Co., W Galveston, Eight Mil. Rd., leg. Waller 3437 25 III 1975 GH. Gordy Rd., betw. Houston Drive and Chanter St., leg. ipse 2543 14 III 1974 GH. Harris Co.., Todville Rd., near Bayport, Taylor Bayou, N of Seabrook, leg. Waller & Baunel 3552 11 IV 1975 GH.

Grupo b.

Alabama. Mobile, leg. M$_o$hr IV... NA. Arkansas. Lincoln Co., Star City, 200 ft., leg. Demaree 19160 14 V 1939 F. Florida, Leg. Chapman K. Mississippi. Harrison Co., Handsboro, leg. Demaree 35002 27 IV 1954 GH. New York. Bronx Co., van Cortland, leg. Pollard V 1893 US. Ib., leg. Monachino 24 V 1953 NY,PH. Ib., leg. Eiten 909 1 VI 1954 NY. Farryton, leg. Barnhart 1431 9 VI 1896 NY. State Isl., leg. Bodin V 1884 UPS. Pennsylvania. Northampton Co., SW Slateford, leg. Scheffer 46779a 6 VIII 1854 PH. Texas. West Texas, leg. Schott p.p. F. Waller Co., Near Austin, leg. Armer 5360 1 XII 1928 US. Ib., leg. Tharp 43058 11 XI 1942 NY. Austin, leg. Young 29 III 1915 UC. Ib., leg. Tharp 2830 1921 US. Ib., leg. ipse 27 V 1920 NY. Colorado Riv., Austin, leg. ipse 16 V 1939 GH,UC. Travis Co., Woods Park, Austin, leg. ipse 44088 15 IV 1944 GH,K,NA,NY,PENN,S. Ib., leg. Painter 9 V 1923 GH. Kebberville Rd., near Hornaby's Monument, leg. Lundell 10312 24 IV 1941 US. González Co., Ottine, leg. Bogusch 2342 11 IV 1926 GH,UC. Ib., leg. Warnock 20657 12 IV 1940 UC. Palmetto State Park, leg. Tharp 430019 15 IV 1943 F,NY,UC. Kleberg Co., Kingsville, leg. Bogusch S 99 1 IV 1949 US. Kendell Co., Bel. Edge Falls, leg. Tharp et al. 17T141 3 V 1947 GH. Conco Co., leg. Tharp 25 IV 1943 UC. Bidalgo Co. Mt. Allen, leg. Cameron 12 II 1937 F. Bentsen Río Grande vall., St. Park leg. Correll 32350 18 III 1966 GH. Bexar Co., Bejar, leg. Jermy VI 1904 NY. S San Antonio, Shady Oak Silica, leg. Correll 29190 15 IV 1964 GH,NA. Gilliespie Co., Pedernales Ruv.m SE Harper, leg. Correll & Johnston 19560 10 VII 1958 GH. Cameroon Co., 4 mi. SE Bronsville, leg. Correll & Rollins 20945 20 IV 1959 GH,NA,UC. Edwards Co., Paint Rock Springs, leg. Cory 483 1 IV 1929 GH. NW of Comfort, leg. ipse 14002 24 V 1935 GH. Painted Cave, banks of the río Grande, leg. Davy 38 12 III 1893 UC. Harrison Co., Caddo Lake States Park, NE Marshall, leg. Gregory & Eiten 3b 3 VI 1956 NY. Del Río, leg. Jones 26300 19 IV 1930 BM. Caldwell Co., Lockhart, leg. Lundell 8924 16 V 1940 GH. Uvalde Co., Uvalde, leg. Palmer 13326 10 IV 1918 US. Vic. Bronwsville, leg. Shiller 321 1941 US. Vall. Río Grande bel. Doñana, leg. Parry (Mex. Found. Survey) p.p. K,P. Palestine, leg. Tharp 5424 14 IV 1929 US. Chambers Co., leg. ipse 7-10 IV 1936 GH,NY,UC. Bastrop, leg. ipse 21 III 1921 NY. Deep Eddy, Colorado Riv., leg. ipse 21 IV 1936 GH,UC. Wise Co., Post Oak Belt, SE Bidgeport, leg. Whitehouse 15237 13 IV 1946 NY,UC. Texas, leg. Vist p.p. W. Central Texas, Bell Co., Near Belton, leg. Woldd 604 US. Bell Co., Cowhouse Creek, near Sparta, leg. ipse *2861* 18 IV 1931 US. Brewster Co., Mt. Emory, leg. Woldd *4661a* 9 IX 1933 S. Medina Co., Woodland Ranch Lane, leg. Hamby *641* 22 III 1940 NA. Valverde Co., Beaver Lake, leg. Cory *31682* 6 IV 1939 GH. Valverde Co., San Felipe Springs, leg. ipse *21026* 16 II 1937 GH. Weatheford, leg. Tracy *8066* 26 V 1902 BM,F,NY,US. Chisos Mts., leg. Marsh *48* VIII 1935 F. San Antonio, leg. Jermy NY. Floresville, leg. Metz *117* 7 III 1932 NY. San Marcos leg. Stanfield, VI 1897 M. Blanco Co., near Blanco, leg. Palmer *33953* 12 V 1928 NY.

3. *O. fontana* Bunge x *O. florida* Salisb. ssp. *prostrata* (Haw.)Lourt.

El porte es erguido como en *O. fontana* pero el tallo puede ser ramificado como en *O. florida* ssp. *prostrata*, los frutos en parte como en cada una de las especies padres.

Material estudiado.

New Jersey. Burlington Co., Catskin Camp, Hedford, leg. W. Stone *5016* 30 1903 PENN. *New York.* Long Island, Kew Gardens, leg. Fergusson 28 VIII 1919 NY. *Pennsylvania.* Montgomery Co., Belfry, leg. Benner *10094* 30 VIII 1945 PH.

II.Grupo de especies del Viejo Mundo,h-ibridos con O.corniculata,invasora.

4. *O. corniculata* L. x *O. novae-guineensis* Lourt.

En este caso se observan,con frecuencia, estados regresivos. El porte es en general el de *O. corniculata* pero algunos presentan el de *O. novae-guineensis*, las estípulas conspicuas, soldadas, la forma de los folíolos y las cápsulas más delgadas, cilíndricas, pubescentes como en *O. corniculata*. Pero aunque la pubescencia de los tallos sea ± adpresa o subhirsuta ascendente asemejándose a *O. corniculata*, es densa y presenta pelos rojizos pluricelulares de largo variado mezclados como en *O. novae-guineensis*. La pubescencia de las cápsulas varía, en egneral no es estrictamente retrorsa(como en *O. corniculata*) y puede aún ser antrorsa (ex. van Royen *18206*, Borgmann *235*). Los estambres son casi libres en los especímenes más semejantes a *O. novae-guineensis*, soldados ca. 1/2 en los otros A veces esta condición puede variar en la misma planta.Las colecciones Vink *16308* y van Royen *18206* son las más parecidas a *O. novae-guineensis*

Material estudiado.

NUEVA GUINEA. E Highlands Dist., Mt. Wilhelm, 2600 m, leg. Brass *30728* 26 VII 1939 CANB,GH,K,LAE,US. Bele Riv., 18 Km NE of Lake Habbema, 2200 m, leg. ipse *11467* XI 1938 BM,GH,K,LAE. Komanemambrino, ca. 2800 m, leg. Borgmann *235* 7 X 1966 L,LAE. Upper Kaugel vall, Alip, Kebaka, 7620 ft., leg. Bowers *24* 29 III 1962 CANB,LAE,US. Daulo, 8100 ft., leg. MacKee *1209* 16 XI 1954 K,L. Central Highlands, Aiyura, 6000 ft., leg.L.S.Smith *1117* X 1944 LA E,L. E Highlands Goroka, upper Omahaiga vall., Collins Bros timber base, 7400 ft., leg. Pullen *584* 13 IX 1957 CANB,LAE,L. E. Highlands Minj sub-dist., Warapuri river, S of conf. with Kori Riv., Wahgi-Jimmy Divide, 6500 ft., leg. v. Royen *18206* 5 IX 1963 L,LA E. W. Highlands ½ mi. SE Tomba, 8000 ft., leg. Saunders *657* 1 VII 1957 BM,CANB,GH, L,LA E. W. Highlands, Kubior Range, Uinba, Nona-Minj Divide, 1950 m,leg. Vink *16308* 20 VIII 1963 A,CANB,GH,K,LAE,L,P. Irian Jaya , Wamena, vallée de la Balim, 1600 m, leg. Raynal 16932 5 IV 1973 P. East Highlands- Daule, Chimbu Divide, 8100 ft., leg. McKee *1209* 16 XI 1954 K,L,LAE.

NUEVA CALEDONIA.
Leg. Deplanche 499 1861 P. Port de France,Nu, leg. Gillivray 6 VII 1858 P. Île Yandé, Homone, 0-20 m, leg. McKee 22646 7 X 1970 P. Kuóbini, Cap Coronation, 0-3 m, leg. ipse 22479 15 IX 1970 P.
AUSTRALIA
Queensland. Roehampton, leg. Thozet 538 1870 P. Ib., leg. Kalle Russell 7 XI 1943 US.

5. *O. corniculata* L. x *O. radicosa* A. Richard
Syn. *O. boridiensis* Knuth,Rep. Sp. Nov. 48: 3. 1940 Tipo:Papua, Carr 14778.

El porte y la forma de los folíolos pueden ser de lasdos especies y aun de tipo intermedio; las estípulas pueden presentarse ensanchadas hacia el ápice, como en *O. corniculata* así como la pubescencia del tallo puede ser irregular. Es común que la forma de los frutos sea delgada, que sean erguidos, largos fusiformes como en *O. radicosa*, pero su pubescencia es ± irregular acercándose a la de *O. corniculata* y presentando más pelos pluricelulares.

En muchos casos se observan diferentes estados regresivos.

Material estudiado.
NIGERIA
Bamenda, 5000 ft., leg. Migeod 292 14 I 1928 K,NY. Cam. Mt. Vidona Mann's Springs, 7150 ft., leg. Brenan 9376 25 III 1948 K. Kumba, leg. ipse 9460 17 III 1948 BM,K. Kumba-Mombo, Beach-Bakosi, leg. Olorunferni 30571 14 V 1951 K.
UGANDA
Kinalsa gap, Kigazi, 7820 ft., leg. Chandler Hamock 2645 XII 1938 K. Kilimanjaro, Kilema, leg. Sacleux 1930 1892 K,P.
TANZANIA
Durham, Usangim 4500 ft., leg. Haarer 905 X 1927 K. Nandwa, Marakwet, leg. Brodhurst Hill 233 K. Rungwe Mission, leg. Sem Sei 1557 I 1854 K. Moshi region, Rd. Sanya junc. Engaro-Nanyuk, 1350 m, leg. Richards 20126 9 IV 1965 K. Moshi, leg. Durham 9 XII 1925 K.
PRETORIA.
Maquassie, Tussenvier, leg. Morris & Engelbrecht 1147 12 II 1970 K.
RHODESIA
Dist. Umtali, Benti Forest Res., leg. Mavi 560 9 XI 1967 K.
ETHIOPIA
Addis Ababa, leg. Mooney 7082 5 V 1957 K. Upper Godeb Gorde, 9500 ft., leg. Evans 358 4 IX 1957 K. Agrima, 6000-7000 ft., leg. Schimper 318 13 VII 1852 LE,P.
INDIA
Nepal, Chitral, leg. Stainton 2153 10 IV 1958 BM,GH,K. Jaschichodjong Timpu, 8000 ft., leg. Cooper & Bulley 3155 11 VIII 1914 BM. Himalaya, leg. Walker K p.p.
CEYLAN
Anniewatte, Kandy,500 ft., leg. Comanor 344 6 VI 1967 K,US. Leg. Walker 371 X 1845 K.
NORTH CENTRAL CHINA
Chi-Fung Hiu, leg. Hugh 111 3 VI 1891 BM. *Formosa*, Tamany, leg. Oldham a. 1864.BM.
JAVA
Buitenzorg, Bot. Gart., leg. Zollinger 1584 3 X 1843 BM,BP,C,FI,K,LE,P.

AUSTRALIA
Queensland, N of Glenmorgan, Myall Park, leg. Johnson 621 8 XI 1958 K,NY.
NUEVA GUINEA
Papua, Boridi, ca. 4700 ft., leg. Carr 14778 5 II 1935 Tipo O. boridiensis Knuth K. Isótipos BM,GH,CANB,L. Arfak gebergte, 1900 m, leg. Gjellerup 1189 30 IV 1912 GH,K,NY,W. Dekano, 6600 ft., leg. Mooney 6138 23 X 1954 K.
NUEVAS HEBRIDAS. Santo Nokowoula, 1130 m, leg. McKee 24216 5 IX 1971 K.
NUEVA CALEDONIA
Ile des Pins, leg. Germain 1874 - 75 K.

6. O. corniculata L. x O. perennans Haw.

Los caracteres son mezcla de las dos especies en grados variables, la pubescencia se presenta desordenada como en O. corniculata, los frutos con pelos pluricelulares finos mezclados a la pubescencia retrorsa, etc.

Material estudiado.
AUSTRALIA
Queensland, Brisbano, the gap, leg. Blake 20560 3 V 1959 CANB,K. W Homebusch Bay, ca. 3 mi. Parramatta, Armament Depot, leg. Constable 5506 17 X 1964 K. Nowra, leg. Rodway 529 27 IX 1931 K. Fike Riv. Dist., leg. Basedow (Austr. Med. Relief Exp.) a. 1919 K.
NUEVA GUINEA
E Highlands Dist. Kassam, 1370 m, leg. Brass 32465 8 XI 1959 CANB,GH, LAE,US.
NUEVAS HEBRIDAS
Erromanga, 300 ft., leg. Cheeseman 64 14 VIII 1930 K.

7. O. corniculata L. x. O. procumbens Steud. ex Rich.

Material estudiado.
NUEVAS HEBRIDAS, Espíritu Santo, Talwernassan, 4000 ft., leg. Oxford Exp. 33 29 X 1933 BM.

8. O. corniculata L. x O. fontana Bunge v. Bushii (Small)Hara
Material estudiado.
JAPON. Spporo, leg. Tokobuchi 1 VIII 1880 K. Manchuria, Dairen, leg. Stuart a. 1910 BM.

9. O. rubens Haw. x O. novae-guineensis Lourt.

El hábito de la planta es el de O. rubens, la pubescencia de los folíolos (más corta) y de los tallos (esparcida) aunque no sea idéntica, es la de O. novae-guineensis. Especialmente los pelos pluricelulares el número de flores por inflorescencia y su grosor son los de O. novae-guineensis. La descripción del especimen Johnson & Pedley 459 hecha por los colectores corresponde a O. rubens y la planta es esa especie. Sin embargo, la pubescencia y los frutos corresponden a los de O. novae-guineensis. El especimen está atacado por Hongos.

Material estudiado.
AUSTRALIA.
Queensland. Brisbane Riv., forest rivulets, leg. F. v. Mueller XII 1856 K. Percy Island N°2, leg. Mc Gillivray 169 XII 1847 K. Darling Downs Dist, in open Eucalyptus forest, on edge ofrain forest Bunya Mt. Bell

road ab. 3 mi. S of Mt. Mowbullan Guest House, leg. Johnson & Pedley 459 3 V 1958 K.

NOTA. En todos los taxones, las medidas indicadas para los pistilos corresponden a flores longistíleas.

Advertencia

Terminado este trabajo recibí la publicación de G.R. Michelozzi Clavarino (v. Bibliografía) quien describe (p. 429-30, f. 2 D,E) O. corniculata L. v. glabrocapsula Rot. Mich. var. nov. Tipo: Etiopia, Addis Abeba, Ruderati a N.O. della Città, m 2400, 22 Apr. 1909, leg. Negri 185 FI. No habiendo podido ver el material no emito opinión por el momento.

INDICE

NOMBRES LATINOS

NOTES ON NEW AND NOTEWORTHY PLANTS. CXXII

Harold N. Moldenke

LIPPIA BOLIVIANA var. **INTEGRIFOLIA** Mold., var. nov.

Haec varietas a forma typica speciei foliorum laminis marginaliter integris recedit.

This variety differs from the typical form of the species in having the margins of its leaf-blades entire.

The type of the variety was collected by Adolfo M. Jiménez (no. 188) at Jatumpata, 25 km. from the city of Cochabamba, Prov. Tarata, Cochabamba, Bolivia, at 2590 meters altitude, on November 18, 1978, and is deposited in my personal herbarium. The collector comments: "Planta lenosa, 1—1.5 m. de altura, flor blanca".

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ADDITIONAL NOTES ON THE ERIOCAULACEAE. LXXXIV

Harold N. Moldenke

SYNGONANTHUS GRACILIS var. **RECURVIFOLIUS** Ruhl.

Additional bibliography: Moldenke, Phytologia 42: 44. 1979.

Santos describes this plant as 15 cm. tall, with "white" flowers, and found it growing on "original campo", flowering in August.

Additional citations: BRAZIL: Bahia: Santos 2365 (Z).

SYNGONANTHUS GRACILIS var. **TENUISSIMUS** Ruhl.

Additional bibliography: Moldenke, Phytologia 37: 76—77. 1977.

Hatschbach has found this plant growing in wet sandy soil near roadsides, flowering and fruiting in April.

Additional citations: BRAZIL: Minas Gerais: Hatschbach 41254 (Z).

SYNGONANTHUS HATSCHBACHII Moldenke

Additional bibliography: Moldenke, Phytologia 37: 79. 1977.

This species is obviously very closely related to S. harleyi Moldenke and may eventually prove to be only a form or variety of it.

Recent collectors describe the species as "crescendo em espaços abertos, folhas com linhas brancas nas margens" and have found it growing in restinga, flowering and fruiting in September.

Additional citations: BRAZIL: Bahia: Hatschbach 39668 (N—isotype); Mori, Mattos Silva, & Santos 10471 (Ld). MOUNTED ILLUSTRATIONS: Moldenke, Phytologia 39: 237 & 238. 1978 (Z).

SYNGONANTHUS HETEROPEPLOIDES Herzog

Additional bibliography: Moldenke, Phytologia 27: 84. 1977.

Recent collectors refer to what may be this species as "occasional" in wet sandy soil, flowering in November, and describe the inflorescences as "cream-color".

Additional citations: BRAZIL: Roraima: Coradin & Cordeiro 973 (N).

SYNGONANTHUS HETEROPHYLLUS Alv. Silv.

Additional bibliography: Moldenke, Phytologia 37: 85 (1977) and 38: 42. 1977.

Hatschbach has encountered this species in wet sandy soil at the base of a mountain, flowering and fruiting in April.

Additional citations: BRAZIL: Minas Gerais: Hatschbach 41323 (Z). MOUNTED CLIPPINGS: Silveira's original description & illustration (N, W, Z).

SYNGONANTHUS HONDURENSIS Moldenke

Additional bibliography: Spellman, Dwyer, & Davidse, Rhodora 77: 124. 1975; Moldenke, Phytologia 37: 86. 1977.

SYNGONANTHUS HUBERI Ruhl.

Additional bibliography: Hocking, Excerpt. Bot. A.28: 171. 1976; Moldenke, Phytologia 37: 84, 86—88, & 261 (1977) and 38: 23. 1977.

SYNGONANTHUS HUBERI f. **VIVIPARUS** Moldenke

Additional bibliography: Hocking, Excerpt. Bot. A.28: 171. 1976; Moldenke, Phytologia 37: 87 & 88. 1977.

SYNGONANTHUS HUMBOLDTII (Kunth) Ruhl.

Additional bibliography: Moldenke, Phytologia 37: 81 & 88--93 (1977) and 38: 118 & 120. 1977.

Recent collectors have found this plant growing in wet sandy areas of savannas near rapids, in open grassy seepage areas, and in open wet grassy savannas on sandstone, flowering in September, fruiting in November, and speak of the flowers as "white".

The Cardona Puig 2849, cited below, is a mixture of this species and something cyperaceous and was collected at 350 m. altitude.

Additional citations: COLOMBIA: Vaupés: Zarucchi 1998 (N). VENEZUELA: Amazonas: Davidse 2752 (N). Bolívar: Cardona Puig 2849 in part (W--2815611). BRAZIL: Pará: Prance, Silva, Berg, Henderson, Nelson, Balick, Bahia, & Reis dos Santos P.25188 (N, N), P.25247 (N, N).

SYNGONANTHUS HUMBOLDTII var. **GLANDULOSUS** Gleason

Additional bibliography: Moldenke, Phytologia 37: 90--92. 1977.

Recent collectors have found this plant growing on dry sand savannas, in temporarily dry creekbeds, in marshy seepage areas, "in dry seep among quartzite rock outcrops and sandy soil with cerrado", and in "solo arenoso junta afloramento de arenito", at 38—1000 meters altitude, flowering and fruiting in February, April, May, July, and December, and refer to it as an herb, to 20 cm. tall.

Material has been misidentified and distributed in at least one herbarium as "Pontederiaceae"!

Additional citations: VENEZUELA: Amazonas: Steyermark & Redmond 112801a (N). Apure: Davidse & González 12336 (Ld). Bolívar: Agostini 256 (Ut—332854b), 348 (Ut—332856b). BRAZIL: Goiás: W. R. Anderson 10018 (N); Haas, Haas, & Belém 303 [Herb. Brad. 50344] (N); Hatschbach 40136 (Ld).

SYNGONANTHUS ITAMBEENSIS Alv. Silv.

Additional synonymy: Syngonanthus itambéensis Alv. Silv., Fl. Mont. 1: pl. 211. 1928.

Additional bibliography: Moldenke, Phytologia 37: 96—97. 1977.

The label accompanying Silveira's illustration in the United States National Herbarium at Washington is erroneously inscribed "pl. 221".

Additional citations: MOUNTED CLIPPINGS: Silveira's original description & illustrations (N, W, Z).

SYNGONANTHUS LAGOPODIOIDES (Griseb.) Ruhl.

Additional bibliography: Moldenke, Phytologia 37: 252. 1977.

Additional citations: CUBA: Pinar del Río: Ekman 11035a (Ld).

SYNGONANTHUS LANATUS Moldenke

Additional bibliography: Moldenke in Steyerm. & Brewer-Carías, Bol. Soc. Venez. Cienc. Nat. 132/133: 286. 1976; Steyerm. & Brewer-Carías, Bol. Soc. Venez. Cienc. Nat. 132/133: 182. 1976; Moldenke, Phytologia 37: 252—253. 1977.

SYNGONANTHUS LEPRIEURI (Körn.) Ruhl.

Additional bibliography: Moldenke, Phytologia 37: 255—256 (1977) and 41: 10. 1978.

Additional citations: FRENCH GUIANA: Halle 2223 (N, Z); Jannoda 46 (N); Leprieur 557 [U. S. Nat. Herb. photo 5885] (W--photo).

SYNGONANTHUS LEPRIEURI f. VIVIPARUS Moldenke, Phytologia 41: 10. 1978.

Bibliography: Moldenke, Phytologia 41:

Citations: BRAZIL: Pará: Prance, Silva, Berg, Henderson, Nelson, Balick, Bahia, & Reis dos Santos P.24837 (N—type).

SYNGONANTHUS LLANORUM Ruhl.

Additional bibliography: Moldenke, Phytologia 37: 256—257 &

495 (1977) and 38: 24. 1977.

Recent collectors have found this plant growing in "open areas along small low-forested stream through Trachypogon-Byrsonima savanna", at 55 m. altitude, flowering and fruiting in May.

Additional citations: VENEZUELA: Apure: Davidse & González 13096 (Z).

SYNGONANTHUS LONGIPES Gleason

Additional bibliography: Hocking, Excerpt. Bot. A.28: 170. 1976; Moldenke, Phytologia 37: 257—259. 1977.

Recent collectors have found this plant on sandstone savannas near rapids, in "thin woodland adjacent to rocky sandstone exposures", and on artificially created wet areas at 750 meters altitude, flowering in January and June, fruiting in May. They refer to it as an herb, 50—70 cm. tall, stoloniferous, the heads "white", "pale white", or "whitish".

Additional citations: COLOMBIA: Vaupés: Zarucchi 1341 (N). VENEZUELA: Bolívar: Steyermark, Dunsterville, & Dunsterville 113130a (N, W—2813993). BRAZIL: Mato Grosso: Rosa & Santos 1977 (N). Pará: Kirkbride & Lleras 2923 (W—2815574).

SYNGONANTHUS LONGIPES var. PILOSUS Moldenke

Additional bibliography: Hocking, Excerpt. Bot. A.28: 170. 1976; Moldenke, Phytologia 37: 259. 1977.

SYNGONANTHUS LUNDELLIANUS Moldenke

Additional bibliography: Spellman, Dwyer, & Davidse, Rhodora 77: 124. 1975; Moldenke, Phytologia 37: 259. 1977.

SYNGONANTHUS MACROCAULON Ruhl.

Additional bibliography: Moldenke, Phytologia 37: 260—261 (1977), 38: 23 (1977), and 38: 199. 1978.

Recent collectors describe this species as a floating aquatic plant, the "flowers on erect stems [peduncles] above [the] water, white", and found it in flower in September.

Additional citations: COLOMBIA: Vaupés: Zarucchi 1934 (N).

SYNGONANTHUS MINUTULUS (Steud.) Moldenke

Additional bibliography: Moldenke, Phytologia 37: 263—264 (1977) and 42: 44. 1979.

The Kirkbride & Lleras 2924, cited below, is placed here very tentatively; it is a mixture with S. gracilis var. glabriusculus Ruhl.

Additional citations: BRAZIL: Pará: Kirkbride & Lleras 2924 in part (W—2815575).

SYNGONANTHUS NGOWEENSIS H. Lecomte

Additional bibliography: Moldenke, Phytologia 37: 266—267 (1977) and 38: 26 & 132. 1977.

Additional citations: ZAIRE: Devred 1872 (Ba, Ca—55599).

SYNGONANTHUS NITENS (Bong.) Ruhl.

Additional bibliography: Moldenke, Phytologia 37: 267--275 & 420--422. 1977.

Recent collectors report finding this plant in peaty bogs, at 1100 m. altitude, flowering in July.

Additional citations: BRAZIL: Distrito Federal: *Davis* & *Shepherd* *D.60037* (N). Paraná: *Hatschbach* *19963* (N).

SYNGONANTHUS NITENS var. HIRTULUS Ruhl.

Additional bibliography: Moldenke, Phytologia 37: 270, 273, 274, & 420. 1977.

Recent collectors have found this plant in open wet grassy savannas on sandstone, fruiting in November.

The *Irwin* & *Soderstrom* *6981*, distributed as this variety and so cited in a previous installment of these notes, seems better placed as var. *koernickei* Ruhl.

Additional citations: BRAZIL: Pará: *Prance*, *Silva*, *Berg*, *Henderson*, *Nelson*, *Balick*, *Bahia*, & *Reis dos Santos* *P.25246* (N, N).

SYNGONANTHUS NITENS var. KOERNICKEI Ruhl.

Additional bibliography: Moldenke, Phytologia 37: 420. 1977.

Recent collectors have found this plant growing in brejo (wet sedge meadows), on sandstone savannas near rapids, and forming dense stands among grasses, at 700--1000 m. altitude, describing it as an herb, 25 cm. tall, with "white" or "gray-white" heads. They have found it flowering in June, July, and September.

The *Irwin* & *Soderstrom* *6981*, cited below, was previously erroneously cited as var. *hirtulus* Ruhl.

Additional citations: COLOMBIA: Vaupés: *Zarucchi* *1355* (Z). BRAZIL: Distrito Federal: *Irwin* & *Soderstrom* *6981* (Ac, N). Goiás: *Hatschbach* *40087* (Ld).

SYNGONANTHUS NITIDUS (Bong.) Ruhl.

Additional bibliography: Moldenke, Phytologia 37: 422--423. 1977.

Additional citations: BRAZIL: Rio de Janeiro: *Segadas-Vianna*, *Lau*, *Ormond*, *Machline*, & *Loredo* *I.940* (Au--210065).

SYNGONANTHUS NIVEUS var. ROSULATUS (Körn.) Moldenke

Additional bibliography: Moldenke, Phytologia 37: 488. 1977.

Additional citations: BRAZIL: Minas Gerais: *Mexia* *5734* (Au--26809).

SYNGONANTHUS NIVEUS var. STRIGOSUS Moldenke

Additional bibliography: Moldenke, Phytologia 37: 489. 1977.

Recent collectors describe this plant as 20 cm. tall, with "white" flowers, and encountered it on "original campo", flowering in March and August, fruiting in March.

Additional citations: BRAZIL: Bahia: *Mori*, *Mattos Silva*, *Kal-*

lunki, Santos & Santos 9701 (Ld); Santos 2363 (Ld, N).

SYNGONANTHUS OBLONGUS (Körn.) Ruhl.
Additional bibliography: Moldenke, Phytologia 37: 489--492 (1977) and 38: 121. 1977.

Tillett describes this plant as having the "leaves satiny light yellow-green, bracts [same] as leaves, flower heads white, the phyllaries lustrous tan-white" and encountered it on white sand at 1200 m. altitude, flowering in February.

Additional citations: VENEZUELA: Amazonas: Tillett 752-151 (N).

SYNGONANTHUS OBLONGUS var. **AEQUINOCTIALIS** Ruhl.
Additional bibliography: Moldenke, Phytologia 37: 490--492. 1977.

Additional citations: BRAZIL: Amazônas: Spruce 2578 [U. S. Nat. Herb. photo 5884] (W--photo of isotype).

SYNGONANTHUS ONEILLII Moldenke
Emended synonymy: Syngonanthus o'neillii Moldenke, Known Geogr. Distrib. Erioc. 59, in syn. 1946; Spellman, Dwyer, & Davidse, Rhodora 77: 124. 1975.

Additional bibliography: Spellman, Dwyer, & Davidse, Rhodora 77: 124. 1975; Moldenke, Phytologia 37: 492. 1977.

SYNGONANTHUS PERUVIANUS Ruhl.
Additional bibliography: Moldenke, Phytologia 37: 496--497. 1977.

Recent collectors have found this species growing in boggy areas of "sub-jalca" and boggy soil in general, flowering in May and June, fruiting in May, and describe the inflorescence heads as "white" or "white, centrally yellow".

Additional citations: PERU: Amazonas: Boeke 1813 (N), 1825 (N), 2034 (N).

SYNGONANTHUS PHELPSAE Moldenke
Additional bibliography: Moldenke in Steyerm. & Brewer-Carías, Bol. Soc. Venez. Cienc. Nat. 132/133: 286. 1976; Steyerm. & Brewer-Carías, Bol. Soc. Venez. Cienc. Nat. 132/133: 183. 1976; Moldenke, Phytologia 37: 497--499. 1977.

SYNGONANTHUS PHELPSAE var. **ELONGATUS** Moldenke
Additional bibliography: Moldenke in Steyerm. & Brewer-Carías, Bol. Soc. Venez. Cienc. Nat. 132/133: 286. 1976; Moldenke, Phytologia 37: 498--499. 1977.

SYNGONANTHUS PULCHELLUS Moldenke
Additional bibliography: Hocking, Excerpt. Bot. A.25: 378. 1975; Moldenke, Phytologia 38: 28. 1977.

SYNGONANTHUS REFLEXUS Gleason
Additional bibliography: Moldenke, Phytologia 38: 30--31.

1977; Moldenke, Biol. Abstr. 65: 3719. 1978.

Additional citations: VENEZUELA: Amazonas: *H. C. Clark 6857* (Ld).

SYNGONANTHUS TENUIS (H.B.K.) Ruhl.

Additional synonymy: *Sygonanthus tenuis* (T.B.K.) Kuhl, in herb.

Additional bibliography: Moldenke, Phytologia 38: 33 & 46--48. 1977; Moldenke, Biol. Abstr. 65: 3719. 1978.

Recent collectors describe this species as a terrestrial herb, to 15 cm. tall, the "inflorescencia esbranquisenta", the flowers "white", and have found it growing in sandy areas on savannas and among sandstone rocks with typical cerrado vegetation, flowering in September.

Additional citations: COLOMBIA: Vaupés: *Zarucchi 2135* (N). BRAZIL: Mato Grosso: *Rosa & Santos 1962* (N). MOUNTED CLIPPINGS: Huber's original description of *Paepalanthus bulbifer* (N, W).

SYNGONANTHUS UMBELLATUS (Lam.) Ruhl.

Additional bibliography: Moldenke, Phytologia 38: 118--125 (1977) and 39: 161. 1978; Anon., Biol. Abstr. 65 (8): C.22. 1978; Moldenke, Biol. Abstr. 65: 3719 & 4341. 1978; Moldenke, Phytologia 42: 31. 1979.

Recent collectors have found this plant growing in sandy soil, fruiting in August.

Material of *S. umbellatus* has been misidentified and distributed in some herbaria as the totally different *Paepalanthus polytrichoides* Kunth (perhaps due to mixed labels). On the other hand, *Cowan & Soderstrom 1713*, *Maguire, Murça Pires, & Maguire 47130*, and *Maguire, Steyermark, & Maguire 53542*, distributed as and previously cited as typical *S. umbellatus*, are (in part, at least) f. *proliferans* Moldenke.

Additional citations: SURINAM: *Irwin, Prance, Soderstrom, & Holmgren 57536* (Au--250307). BRAZIL: Pará: *Bautista 68* (N).

SYNGONANTHUS UMBELLATUS f. PROLIFERANS Moldenke, Phytologia 39: 161. 1978.

Bibliography: Moldenke, Phytologia 39: 161. 1978.

Collectors report this plant as a "frequent herb on wet white sand" and "frequent on campo", at 1400 m. altitude, and found it in flower and fruit in February and July. The collections cited below were previously cited as and were distributed as typical *S. umbellatus* (Lam.) Ruhl. and are in most cases mixtures with it.

Citations: VENEZUELA: Bolívar: *Maguire, Steyermark, & Maguire 53542* (N--type). GUYANA: *Cowan & Soderstrom 1713* (Fg, N). BRAZIL: Amapá: *Maguire, Murça Pires, & Maguire 47130* (N).

SYNGONANTHUS UMBELLATUS f. STELLARIS Moldenke, Phytologia 39: 161. 1978.

Bibliography: Moldenke, Phytologia 39: 161. 1978.
Citations: COLOMBIA: Vaupés: Zarucchi 2048 (Z--type).

SYNGONANTHUS VERTICILLATUS (Bong.) Ruhl.

Additional bibliography: Moldenke, Phytologia 38: 126--128. 1977; Anon., Biol. Abstr. 65 (8): C.22. 1978; Moldenke, Biol. Abstr. 65: 4341. 1978.

Hatschbach found this species on sandy campo and in wet sandy soil at the base of hills, flowering and fruiting in April.

Additional citations: BRAZIL: Minas Gerais: Hatschbach 40812 (N), 41321 (Ld).

SYNGONANTHUS XERANTHEMOIDES (Bong.) Ruhl.

Additional bibliography: Hocking, Excerpt. Bot. A.28: 170. 1976; Moldenke, Phytologia 38: 180--192 (1978) and 41: 474. 1979.

Recent collectors have encountered this plant in wet areas of scrubby forests, in wet grassy seepage areas, and along very small streamlets, at 38 m. altitude, flowering in April and November, fruiting in April, and refer to the flowers as "white".

The Eiten & Eiten 2349, Irwin, Souza, & Reis dos Santos 9971, Irwin, Maxwell, & Wasshausen 20078 & 21358, Mattos & Mattos 8563, distributed as and previously cited by me as typical S. xeranthemoides, actually seem to be f. brevifolius Moldenke, while D. H. Davis 340 and Hatschbach 27286 are var. tricostatus (Gleason) Moldenke.

Additional citations: VENEZUELA: Apure: Davidse & González 12279a (Ld). BRAZIL: Pará: Kirkbride & Lleras 2975 (N, W--2826921); Prance, Silva, Berg, Henderson, Nelson, Balick, Bahia, & Reis dos Santos P.25314 (N, N). Rio de Janeiro: Segadas-Vianna, Lau, Ormond, Machline, & Laredo I.380 (Au--210063).

SYNGONANTHUS XERANTHEMOIDES f. BREVIFOLIUS Moldenke

Additional bibliography: Moldenke, Phytologia 38: 184--185 & 190. 1978.

Recent collectors have found this plant growing in white sand along riverbanks, in wet ground in cerrado, in cerrado seeps in areas of gallery forest and adjacent cerrado, on sandy slopes of sandy campo with outcrops, in marshy black organic soil in open sedge meadows on slight slopes, and in "terreno brejoso na baixada, solo prêto, orgânica", at altitudes of 550--1350 meters, flowering & fruiting from January to March and September to November. They describe the plant as a rosette herb, 15--50 cm. tall, the leaves very stiff and sublustrous, the inflorescence heads "white", "gray", or "light-brown". Tillett and his associates encountered it in "las filas con 'crest slope vegetation' de Brocchinia, Stegolepis pungens, Heliamphora, etc., invadido por el bosque bajo (hasta 5 m) de los sitios con piedra expuesta y del borde de los riachuelos, 'valley forest' en las quebradas hondas, mucha evidencia de fuego, sobre todo las bases carbonizadas de *Vellozia*, *Stegolepis* y árboles muertos a pie".

Most of the collections cited below were previously cited erroneously as typical S. xeranthemoides before the present taxon was recognized, or were distributed as *S. tricostatus* Gleason.

Additional citations: VENEZUELA: Amazonas: *Tillett*, *Ferrigni V.*, & Zorilla F. 751-79 (N). Bolívar: *J. A. Steyermark* *111303* (N); *Steyermark*, *Dunsterville*, *&* *Dunsterville* *113238* (W—2813997). BRAZIL: Distrito Federal: *Irwin*, *Souza*, *&* *Reis dos Santos* *8871* (Ld, N, W—2759058). Goiás: *Irwin*, *Maxwell*, *&* *Wasshausen* *21358* (Ld, N). Minas Gerais: *Irwin*, *Maxwell*, *&* *Wasshausen* *20078* (Ac, N). São Paulo: *Eiten* *&* *Eiten* *2349* (N); *Mattos* *&* *Mattos* *8563* (N).

SYNGONANTHUS XERANTHEMOIDES var. GRAHAMAE Moldenke

Additional bibliography: Moldenke, Phytologia 38: 186—187 (1978) and 41: 474. 1979.

Irwin reports the flowers of this plant as "grayish-white" and encountered the plant "occasional in savannas on fine brown sand", flowering in January. Material has been misdentified and distributed in some herbaria as *Paepalanthus* sp.

Additional citations: GUYANA: *Irwin* *774* (Au—165254).

SYNGONANTHUS XERANTHEMOIDES var. HIRSUTUS Moldenke

Additional bibliography: Hocking, Excerpt. Bot. A.28: 170. 1976; Moldenke, Phytologia 38: 186 & 187. 1978.

SYNGONANTHUS XERANTHEMOIDES var. TRICOSTATUS (Gleason) Moldenke

Additional bibliography: Moldenke, Phytologia 38: 185 & 188—190. 1978.

Tillett and his associates describe this plant as having the "leaves very stiff, sublustrous, medium-green above, light-green beneath, peduncles light yellow-green slightly flushed with brown, phyllaries light-tan, flowers dirty-white" and encountered it in white sand along riverbanks in an area of "las filas con 'crest slope vegetation' de *Brocchinia*, *Stegolepis pungens*, *Heliamphora*, etc., invadido por el bosque bajo (hasta 5 m) de los sitios con piedra expuesta y del borde de los riachuelos, 'valley forest' en las quebrados hondas, mucha evidencia de fuego, sobre todo las bases carbonizadas de *Vellozia*, *Stegolepis* y árboles muertos a pie". Davis described the inflorescence heads as white and encountered the plant in white sand in a small ford, flowering in August.

The *Hatschbach* *27286*, cited below, was previously erroneously regarded as typical *S. xeranthemoides* (Bong.) Ruhl.

Additional citations: VENEZUELA: Amazonas: *Tillett*, *Ferrigni V.*, *&* *Zorrilla F.* *751-76* (N). GUYANA: *D. H. Davis* *340* (N). BRAZIL: Minas Gerais: *Hatschbach* *27286* (Ld).

SYNGONANTHUS YACUAMBENSIS Moldenke

Additional bibliography: Moldenke, Phytologia 38: 192--193. 1978.

Additional citations: ECUADOR: Loja: *Asplund 17993* (Ld).

TONINA Aubl.

Additional bibliography: Spellman, Dwyer, & Davidse, Rhodora 77: 124. 1975; Moldenke, Phytologia 38: 193--202, 507, & 511. 1978.

TONINA FLUVIATILIS Aubl.

Additional bibliography: Meisn., Pl. Vasc. Gen. 2: 312. 1843; Spellman, Dwyer, & Davidse, Rhodora 77: 124. 1975; Moldenke, Phytologia 38: 196--202. 1978.

Recent collectors refer to this plant as "an abundant erect weed" in roadside ditches and in wet soil under cultivation, flowering and fruiting in May, at 20--420 meters altitude.

Additional citations: COSTA RICA: Puntarenas: *Wilbur, Almeda, & Daniel 23621* (N). TRINIDAD AND TOBAGO: Trinidad: *Hekking 1352* (Au--245932). COLOMBIA: Chocó: *Cuatrecasas 21430* (W--2817463); *Sneidern 4984* (Ld). Nariño: *Sneidern A.510* (Ld). Valle del Cauca: *Cuatrecasas 21039* (W--2817467). VENEZUELA: Amazonas: *H. C. Clark 6566* (Ld), *6874* (Ld). FRENCH GUIANA: *Granville 1821* (N); *Lescure 69* (N). BRAZIL: Bahia: *Duarte 6070* [Herb. Jard. Bot. Rio Jan. 113027] (N); *T. S. Santos 2348* (Ld). Mato Grosso: *Harley 11219* (N). Roraima: *Coradin & Cordeiro 976* (N).

WURDACKIA Moldenke

Additional bibliography: J. Hutchins., Fam. Flow. Pl., ed. 3, 710 & 967. 1973; Cárdenas de Guevara, Act. Bot. Venez. 10: 35. 1975; Moldenke, Phytologia 38: 202 & 511. 1978.

This is a monotypic genus of which the type species is *W. flabelliformis* Moldenke. Hutchinson (1973) feels that it *is* not sufficiently different from *Paepalanthus* Mart. to warrant segregation. Taylor (1966) erroneously classifies it in the *Compositae*.

WURDACKIA FLABELLIFORMIS Moldenke in Maguire, Steyerm., & Wurdack, Mem. N. Y. Bot. Gard. 9: 413--414. 1957.

Bibliography: See the bibliography of the genus as a whole.

Thus far this species is known only from the original collection

Citations: VENEZUELA: Bolívar: *Steyermark & Wurdack 671* (N--type).

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CONTENTS

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NEW SPECIES OF PICRIS (ASTERACEAE, LACTUCEAE) FROM AUSTRALIA

H. Walter Lack
Botanischer Garten und Botanisches Museum Berlin-Dahlem
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During preparatory work for a revision of the genus Picris L. (Asteraceae, Lactuceae) in Australasia a number of new species have been recognized. Two of them, both from the tropical southeastern part of Queensland in Australia, are described here.

PICRIS CAROLORUM-HENRICORUM LACK, SP.NOVA

Planta perennis 20-50 cm alta, lactifera; caudex 1-2 cm longus, lignosus, superne foliatus in radice palari perlonga, lignea, crassa elongata; caulis gracilis, erectus, pauciramosus, tota longitudine sparse pilis bihamatis ancoriformibus obtectus, apicem versus saepe nudus. Folia basalia et caulina 3-10 (25) cm longa, 0,2 - 0,6 (2,5) cm lata, angustissime obovata, lanceolata ad spathulata, denticulata vel mucronulata, utrinque sparse - imprimis secundum nervum medium - pilis bihamatis ancoriformibus obsita vel nudiuscula. Pedunculi graciles, erecti, semper fere nudi, interdum paucis squamulis 3-4 mm longis, c. 0,5 mm latis, anguste lanceolatis integris obsiti. Capitula pauca, gracilia, ramos terminantia, 30 - 40 - flora, fructifera c. 10 mm diametro. Involucrum e squamis anguste lanceolatis, supra nudis, inferne nudis vel minute canescente puberulis, raro perpaucis pilis brevibus simplicibus vel bihamatis ancoriformibus obsitis. Squamae exteriores 2-3 mm longae, ad 0,5 mm latae, interiores 8 - 10 mm longae, c. 1 mm latae margine late hyalinae. Corollae 12-14 mm longae, in vivo luteae, ligulae 6-8 mm longae, ad 2 mm latae, quinquedentatae, tubo apice et ligula basi et dorsaliter pilis simplicibus obtecto. Stamina c.3 mm longa, antherae c.2mm longae. Achenia conformia, brunnea ad atrobrunnea, 4-5 mm longa, c.1 mm diametro, fusiformia, utrinque attenuata, longitudinaliter quinquecostata, transverse rugosa et pappo 5-6 mm longo facile deciduo coronato. Radii papporum multi, fragiles, numerosis pinnulis longis obsiti (plumosi). Receptaculum nudum, alveolatum, squamae post dehiscentiam acheniorum reflexae. Numerus chromosomatum 2n = 10.

Duobus Carolis Henricis in studiis Lactucearum meritissimis hanc speciem dicavi - Carolo Henrico Schultz Bipontino (1805-1867) medico hospitii deideshemiensis et

Carolo Henrico Rechinger vindobonensi (1907-) aulae consuli, musei vindobonensis historiae naturalis rectori emerito et florae iranicae editori.

Type: Australia, Queensland, Point Cartwright, 80 km N of Brisbane, 6.XII.1976, L.PEDLEY 4402 (Holotype, B, fig.1). Achenes taken from this specimen have been germinated, cultivated in the Botanical Garden at Berlin-Dahlem (Lack Acc. No.234) and used for determination of the chromosome number; flowering and fruiting material of this progeny has been distributed widely (A,AD,AK,B, BM,BP,BR,BRI,C,CANB,COI,E,F,FI,FR,G,GB,GH,GOET,GZU,H,HAL, HBG,HO,JE,K,L,LD,LE,M,MA,MEL,MO,MPU,NSW,NY,O,P,PERTH,PR, PRC,S,U,UC,US,W,WAG,WU,Z).

Other specimens: Fraser Island, 15.-16.X. 1930, C.E. HUBBARD 4415 (BRI,K); about 15 miles SSW of Double Island Point and 27 miles E of Gympie, 21.X.1964, S.L.EVERIST 7728 (BRI,K); Point Halloran, X.1930, F. KUNZE 5457 (K).

Ecology: The new species has been collected so far in mixed forests (Eucalyptus, Casuarina, Banksia etc.) and on sandy slopes, in particular on the coastal dunes in S Queensland.

PICRIS EVAE LACK, SP. NOVA

Herba annua (vel biennis ?) 50 - 170 cm alta, lactifera, caulis crassus (basi ad 2 cm diametro) erectus ad ascendens, ramosus saepe ramosissimus (apice interdum irregulariter umbellatim), obtusangulus, tota longitudine pilis bihamatis ancoriformibus rigidis obtectus. Folia basalia et caulina bene evoluta, (5) 10-15 cm longa, 1-2 cm lata, anguste obovata ad lanceolata, denticulata vel mucronulata, sessilia, nervo medio crasso instructa, utrinque pilis bihamatis ancoriformibus rigidis obtecta. Pedunculi erecti, pilis bihamatis ancoriformibus obtecti, paucis squamis 5-6 mm longis, 0,7-1 mm latis, integris, anguste lanceolatis obsiti. Capitula numerosa (saepe numerosissima), ramos terminantia, (50) 60-80 flora, fructifera 15-20 mm diametro. Involucrum polyphyllum e squamis anguste-lanceolatis, supra nudis, inferne multis pilis crassis 1-3 (11) mm longis tortuosissimis simplicibus, rarissime apice bifurcatis vel bihamatis intertextis in vivo viridibus obtectis. Squamae exteriores 4-6 mm longae, ad 1 mm latae, inferne tota longitudine secundum nervum medium pilis perlongis densissime obtectae, squamae interiores 9 - 12 mm longae, ad 1 mm latae, naviculiformes, margine late hyalino, inferne basi nudae vel paucis pilis perlongis obtectae, secundum nervum medium - imprimis apice - dense pilis perlongis obtectae. Corollae 10-12 mm longae, in vivo luteae, ligulae 6-8 mm longae, 0,5 - 0,8 (1) mm latae, saepe involutae, quinquedentatae, tubo apice sparse pilis tenuibus simplicibus obsito. Stamina c.3 mm longa, antherae c.2 mm longae. Achenia conformia, brunnea vel rufa, 7-8 mm longa, 0,5 mm diametro, anguste et longe fusiformia, ad apicem gradatim in cuspide longa attenuata, longitudinaliter quinquecostata, transverse rugosa ad transverse costata et pappo 7-8 mm longo facile deciduo coronata. Radii papporum multi, fragiles, multis pinnulis longis dense obsiti (plumosi). Receptaculum nudum, alveolatum. Squamae post dehiscentiam acheniorum reflexae. Numerus chromosomatum 2n = 1o.

Amatae uxori meae Evae hanc plantam dicavi.

Type: Australia, Queensland, about 1 km S of Oakey on main road to Toowoomba, 27.XI.1975, T.STANLEY & J.CLARKSON 66 (Holotype, B; upper part of specimen fig.2). Achenes taken from this specimen have been germinated, cultivated in the Botanical Garden at Berlin-Dahlem (Lack Acc. 110, 298) and used for determination of the chromosome number; flowering and fruiting material of this progeny has been widely distributed (A,AD,AK, BM,BP,BR,BRI,C,CANB,COI,E,F,FI,FR,G,GB,GH,GOET,GZU,H, HAL,HBG,HO,JE,K,L,LD,LE,M,MA,MEL,MO,MPU,NSW,NY,O,P, PERTH,PR,PRC,S,U,UC,US,W,WAG,WU,Z).

Other specimens: Ma-Ma Creek road, 4.XII.1962, W.T.JONES 2335 (CANB); W Haldon, 29.XII.1962, L.PEDLEY 1151 (BRI,CANB,K); Hendon, XII.1912, C.T. WHITE (BRI); Warwick, XII.1875, F.M. BAILEY (BRI p.p.); Warwick, III.1911, J.L. BOORMAN (NSW); Warwick road, 19.XII.1960, W.T. JONES (CANB); Freestone, II.1959, G.R.LEE (BRI); Southbrook, 4.XII.1969, L.PEDLEY 3060 (BRI).

Ecology: From the scanty label annotations available at present it is evident that P.evae grows in Eucalyptus forests and on roadsides in tropical SE Queensland.

Material of the two new species has been determined by the collectors as Picris hieracioides L., a widespread eurasian perennial which does not occur in Australasia.

Ripe achenes from the progeny of both type specimens have been offered for exchange in the Index Seminum 1978 of the Botanical Garden at Berlin-Dahlem and are currently available.

Acknowledgements: Thanks are due to the members of staff at BRI for kindly providing me with recently collected *Picris* specimens from Queensland; J.R.Edmondson corrected the style of the text, G.Wagenitz kindly went over the manuscript and made valuable suggestions.

Fig.1 Picris carolorum-henricorum Lack, Holotype. Botanisches Museum Berlin-Dahlem.

1978 det., rev., app. H. W. LACK

QUEENSLAND HERBA
FLORA OF QUEENSLAND
DARLING DOWN
27 26 S 151 14 E
coll T. Stanley
J. Clarkson
66
27 Nov 1975
Picris
hieracioides
acc.

About 1 km south of Oakey on main road to Toowoomba. Growing by the roadside in black soil.
Erect herb to ca 1 m tall. Flowers orange-yellow. Scattered plants seen throughout the area.
Voucher for chromosome material sent to Dr. H. Lack, Berlin.

Fig.2 *Picris evae* Lack, Holotype, upper part of the specimen. Botanisches Museum Berlin-Dahlem.

METROSIDEROS POLYMORPHA (MYRTACEAE) AND ITS VARIATIONS
HAWAIIAN PLANT STUDIES 88

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How to classify the common Hawaiian species of *Metrosideros* is a problem that confronts the botanists today. It is not a new problem, as every close student of the Hawaiian flora has been confronted by it. It is noteworthy that the first botanist to collect and publish on them, Charles Gaudichaud, named the species *Metrosideros polymorpha* (1829: 482), and described three varieties. In his discussion of the vegetation (p. 99) he wrote, "Rien au monde, en effet, n'est plus remarquable que le *metrosideros polymorpha*, a feuilles lineaires vers le sommet de la montagne, successivement lineaires-lancéolées, lancéolées, ovales, obovales, elliptiques, arrondies, même cordiformes, à mesure qu'on descend, en qui, de glabres et luisantes qu'elles étoient primitivement, deviennent pubescentes, velues, et de plus en plus tomenteuses." In 1819 on the voyage of the Uranie, Gaudichaud botanized on Hawaii, Maui, and Oahu for a total of seven days. In this short time he made large collections, and from 1826-1830 published on his discoveries on this world voyage. One after another, Gray, Mann and Brigham, Wawra, Hillebrand, Heller, Hochreutiner, Rock, and Skottsberg studied the Hawaiian flora, and published on the classification of *Metrosideros*. The most elaborate, and the standard, treatment was by Rock (1917). He considered the Hawaiian trees conspecific with *M. collina* (J. R. & G. Forst.) Gray, of Tahiti. Under this he grouped the Hawaiian ones in subspecies *polymorpha* (Gaud.) Rock, and under it recognized ten varieties. This classification was generally accepted, but Skottsberg (1944: 402-409) reestablished *M. polymorpha* as the common Hawaiian species, and described several new taxa. Also he raised Rock's varieties to subspecies, but then in his discussion, disclaimed them as new combinations. Consequently, by the provisions of ICBN, Article 34, his new combinations are invalid.

Subsequently, the monographer, J. W. Dawson (1970: 445), restricted *M. collina* to its type locality, Tahiti, and to Rarotonga. The Hawaiian one which is dominant in the forests, he reestablished as the species *M. polymorpha* Gaud.

When the writer published his List of Flowering Plants in Hawaii (1973) the local *Metrosideros* problem had not been resolved, so the two alternative arrangements were printed (pp. 253-254), without indicating a choice between them.

Now, on accepting Dawson's treatment, aside from *M. macropus*, *M. rugosa*, *M. tremuloides*, and

M. waialealae, all the remaining local variants of *Metrosideros* are to be placed under *M. polymorpha*. To make them available, the following transfers are here proposed:

M. polymorpha Gaud., Bot. Voy. Uranie 482, 1829; Atlas Pl. 108, 1826.
var. polymorpha, Hawaiian Islands.

var. glaberrima (Lévl.) comb. nov.
Nania polymorpha (Gaud.) Lévl., var. *glaberrima* Lévl., Fedde Repert. 10: 149, 1911.
M. collina (J. R. & G. Forst.) Gray, subsp. *polymorpha* (Gaud.) Rock, var. *glaberrima* (Lévl.) Rock, Hawaii Bd. Agric. & For., Bot. Bull. 4: 69, pl. XXIX, 1917.
Holotype: Oahu, Punaluu, maio 1910, *Faurie 35*.

var. glabrifolia (Heller) comb. nov.
Nani(a) *glabrifolia* Heller, Minn. Bot. Stud. 1: 866, 1897.
Holotype: Kauai, above Waimea, 4,000 ft. elev., Sept. 10-11, 1895, *Heller 2,821*.

forma obovate (Skottsb.) comb. nov.
M. polymorpha Gaud., var. *glabrifolia* (Heller) St. John, forma *obovata* Skottsb., Goteb. Bot. Trädg., Meddel. 15: 404, 1944.
Holotype: West Maui, Honokahua-Amalu ridge, above Haelaau, 1/8/38, *C. Skottsberg 2,748* (GOTH).

var. haleakalensis (Rock) comb. nov.
M. collina (J. R. & G. Forst.) Gray, subsp. *polymorpha* (Gaud.) Rock, var. *haleakalensis* Rock, Hawaii. Bd. Agric. & For., Bot. Bull. 4: 56, pl. XXI, 1917.
Holotype: Maui, Haleakala, gulches back of Puunianiau Crater, 6,500-7,000 ft elev., Oct. 1910, *J. F. Rock 8,593* (BISH).

var. hemilanata (Hochr.) comb. nov.
M. collina (J. R. & G. Forst.) Gray, var. *hemilanata* Hochr., Candollea 2: 456, 1925.
Syntypes: Kauai, Rock, var. ζ and Gray var. φ.

var. imbricata (Rock) comb. nov.
M. collina (J. R. & G. Forst.) Gray, subsp. *polymorpha* (Gaud.) Rock, var. *imbricata* Rock, Hawaii Bd. Agric. & For., Bot. Bull. 4: 49, pl. XVII, 1917.
Syntypes: Sandwich or Hawaiian Islands, Gaudichaud,

Seemann, U. S. Exploring Expedition (GH).

var. incana (Lévl.) Rock,

forma lurida (Rock) comb. nov.

M. collina (J. R. & G. Forst.) Gray, subsp. *polymorpha* (Gaud.) Rock, var. *incana* (Lévl.) Rock, forma *lurida* Rock, Hawaii Bd. Agric. & For., Bot. Bull. 4: 54, pl. XX, 1917.

Holotype: Molokai, above Kamolo, April 1910, *J. F. Rock 7,021* (BISH).

forma psilophylla (Skottsb.) comb. nov.

M. polymorpha Gaud., subsp. *incana* (Lévl.) Skottsb. (invalid), forma *psilophylla* Skottsb., Goteb. Bot. Tradg., Meddel. 15: 406, 1944.

Holotype: West Maui, Puu Kukui, 1,750 m alt., 9/10/22, *Skottsberg 767* (GOTH).

var. macrophylla (Rock) comb. nov.

M. collina, subsp. *polymorpha* (Gaud.) Rock, var. *macrophylla* Rock, Hawaii Bd. Agric. & For., Bot. Bull. 4: 58, pl. XXII, 1917.

Holotype: Hawaii, Volcano Road, Olaa-Mountain View, 1,200-1,500 ft elev., April 20-24, 1916, *J. F. Rock 12,630* (BISH).

var. micrantha var. nov.

M. polymorpha Gaud. subsp. *micrantha* Skottsb., Goteb. Bot. Trädg., Meddel. 15: 407, 1944, this epithet invalid since it was not accepted by its author.

Syntypes: Hawaii Island, Skottsberg 1977; 451; 452; 453; and 430 (GOTH).

var. Newellii (Rock) comb. nov.

M. collina (J. R. & G. Forst.) Gray, subsp. *polymorpha* (Gaud.) Rock, var. *Newellii* Rock, Hawaii. Bd. Agric. & For., Bot. Bull. 4: 58, pl. XXIII, 1917.

Lectotype: Hawaii, Hilo, Feb. 1916, *J. F. Rock 12,627* (BISH), here chosen, being the sheet illustrated by Rock, as a photo, (pl. XXIII).

var. prostrata (Rock) comb. nov.

M. collina (J. R. & G. Forst.) Gray, subsp. *polymorpha* (Gaud.) Rock, var. *prostrata* Rock, forma *prostrata*, Hawaii Bd. Agric. & For., Bot. Bull. 4: 61, 64, pl. XXV, 1917.

Lectotype: Molokai, Kawela swamp, March 17, 1910, *J. F. Rock 6,097* (BISH), here chosen, since it was the one illustrated by Rock (pl. XXV).

forma strigosa (Rock) comb. nov.

M. collina (J. R. & G. Forst.) Gray, subsp. *polymorpha* (Gaud.) Rock, var. *prostrata*, forma *strigosa* Rock, Hawaii Bd. Agric. & For., Bot. Bull 4: 64, pl. XXVI, 1917.

Holotype: Hawaii, Kohala Mts., June 1910, *J. F. Rock 8,414* (BISH).

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Rock, Joseph F. 1917. The Ohia Lehua Trees of Hawaii. Hawaii Bd. Agric. & For., Bot. Bull. 4: 1-76, pl. I-XXXI.

St. John, Harold, 1973. List and Summary of the Flowering Plants in the Hawaiian Islands. Pacif. Trop. Bot. Gard., Mem. 1: 1-519.

FOUR VARIETAL TRANSFERS OF UNITED STATES TREES

ELBERT L. LITTLE, JR.

Nomenclatural transfers for four varieties of United States trees in the genera *Persea, Populus, Quercus,* and *Pinus* are made here. They are desired for this publication now in press: Checklist of United States Trees (Native and Naturalized), (U.S. Dep. Agric., Agric. Handb. 541. 1979).

Variations below the rank of species are called varieties in Forest Service checklists. Historically, the rank variety has been widely adopted for names of United States trees. Some modern workers have substituted the rank subspecies for geographical variations, while others distinguish both ranks. Originally, the subspecies was an intermediate rank for optional use if needed, such as in a species with many varieties. The later usage of subspecies has confused the nomenclature and would require numerous name changes or transfers.

PERSEA BORBONIA var. PUBESCENS (Pursh) Little, comb. nov.
swampbay

Laurus carolinensis var. β *pubescens* Pursh, Fl. Am. Sept. 1: 276. 1814.
Tamala palustris Raf., Sylva Tellur. 137. 1838.
Persea carolinensis var. *palustris* (Raf.) Chapm., Fl. South. U.S. 393. 1860.
Persea carolinensis var. β *pubescens* (Pursh) Meissn. in DC., Prodr. 15(1): 51. 1864.
Persea carolinensis f. *pubescens* (Pursh) Mez, Jahrb. Bot. Gart. Berl. 5: 176. 1889.
Persea palustris Sarg., Silva No. Am. 7: pl. 302. 1895; *nom.*
Persea pubescens (Pursh) Sarg., Silva No. Am. 7: 7 [pl.302] . 1895.
Tamala pubescens (Pursh) Small, Fl. Southeast. U.S. ed. 2, 822, 1375. 1913.
Persea palustris (Raf.) Sarg., Bot. Gaz. 67: 229. 1919.
Persea borbonia f. *pubescens* (Pursh) Fern., Rhodora 47: 149. 1945.

Apparently the desired varietal combination has not been published. However, one collection was distributed with a printed label bearing the same trinomial without rank or author: Geo V. Nash 435, Eustis, Lake County, Fla., April 15-30, 1894 (US).

Swampbay was first distinguished as a variety in 1814, as a species in 1838, and as a form in 1889. Fernald (Rhodora 47:

149. 1945) concluded: ". . . I have abandoned the futile attempt to see two species or two varieties in the glabrous-leaved material and that with leaves densely pubescent beneath, and I cannot look upon them as anything but glabrous and pubescent forms of one species *P. Borbonia* (L.) Spreng."

The 1953 checklist, which omitted forms, mentioned swampbay in a note as a synonym (Little, U.S. Dep. Agric., Agric. Handb. 41: 253. 1953). However, this variation was treated as a species in the 1927 checklist by George B. Sudworth (U.S. Dep. Agric. Misc. Circ. 92: 124. 1927).

In her monograph, Lucille E. Kopp (Mem. N.Y. Bot. Gard. 14(1): 45-46. 1966) accepted swampbay, *Persea palustris* (Raf.) Sarg., as a species, stating: "The kind of pubescence on vegetative parts, erect and crisped, and the length of the peduncle are the main differences discernible from herbarium material which separate *P. palustris* from *P. borbonia* . . . ." Charles Sprague Sargent (Man. Trees North Am. ed. 2, corr. 357-359. 1926) accepted both species. Earlier (Silva North Am. 7: 7-8. 1895), he noted that swampbay has thin bark and is found on wet thin soil of swamps near the coast (thus, in a different vegetation type and narrow zone).

The differences in leaf pubescence, visible with a hand lens, are well illustrated in photographs taken with the scanning electron microscope by B. Eugene Wofford and Ronald W. Pearman (An SEM study of leaf surface pubescence in the southeastern taxa of Persea. Sida 6: 19-23, illus. 1975). They accepted *Persea palustris* as a species also.

POPULUS FREMONTII var. MESETAE (Eckenwalder) Little, comb. nov.
meseta cottonwood

Populus fremontii ssp. *mesetae* Eckenwalder, J. Arnold. Arbor. 58: 201, fig. 1977.

This cottonwood was included under *Populus fremontii* Wats. (Proc. Am. Acad. Arts Sci. 10: 350. 1875), Fremont cottonwood, in the 1953 checklist (p. 285). It has been accepted as a species, *Populus arizonica,* Arizona cottonwood, for example, in the 1927 checklist (p. 64). Also by Charles Sprague Sargent (Man. Trees North Am. ed. 2, corr. 131. 1926), Donovan S. Correll (Fl. Tex. 3: 397-399, pl. 58. 1961), and Little (Atlas U.S. Trees 3: map 115. 1976).

James E. Eckenwalder (J. Arnold Arbor. 58: 201-203. 1977) proposed a new epithet with rank of subspecies for this cottonwood that has been called *Populus mexicana* auct. non Wesm. as well as *P. arizonica* auct. non Sarg. He concluded that none of the five epithets applied to this tree could be used. Apparently no epithet with rank of variety is available.

QUERCUS TURBINELLA var. AJOENSIS (C. H. Muller) Little, comb. nov.
Ajo oak

Quercus ajoensis C. H. Muller, Madroño 12: 140, fig. 1. 1954.
Quercus turbinella ssp. *ajoensis* (C. H. Muller) Felger & Lowe, J. Ariz. Acad. Sci. 6: 83. 1970.

Shortly after publication of the 1953 checklist, this oak was named as a new species by Cornelius H. Muller (A new species of Quercus in Arizona. Madroño 12: 140-145, fig. 1. 1954; Muller and Tucker 9519, isotype at US). It was related to *Quercus turbinella* Greene (in Kellogg & Greene, Illus. West Am. Oaks 37. 1889; 59, pl. 27. 1890), turbinella oak (shrub live oak).

The original author noted the occurrence of intermediates (presumably of hybrid origin) and concluded that the new species was nearing extinction. The range extends from southwestern Arizona to Baja California (Little, Atlas U.S. Trees 3: map 130. 1976). This oak has been reduced to a subspecies.

PINUS ARISTATA var. LONGAEVA (D. K. Bailey) Little, comb. nov.
Intermountain bristlecone pine

Pinus longaeva D. K. Bailey, Ann. Mo. Bot. Gard. 57: 243, fig. 23. 1970.

This pine has attracted attention because of the great age of certain individuals, confirmed by counts of annual growth rings in the wood. The Ancient Bristlecone Pine Forest Botanical Area within Inyo National Forest near Bishop, California, contains many trees more than 4,000 years old, one more than 4,600 (Schulman, Edmund. Bristlecone pine, oldest known living thing. Natl. Geogr. Mag. 113: 355-372, illus. 1958). Another grove in the Wheeler Peak Scenic Area, Humboldt National Forest, southeast of Ely, Nevada, had a tree about 4,900 years old (Currey, Donald R. An ancient bristlecone pine stand in eastern Nevada. Ecology 46: 564-566, illus. 1965). Thus, these pine trees are the world's oldest known dated living trees.

Less than a decade ago, this pine was segregated as a species by D. K. Bailey (Phytogeography and taxonomy of Pinus subsection Balfourianae. Ann. Mo. Bot. Gard. 57: 210-249, illus. 1970). (Isotype at US: D. K. Bailey & J. E. Whitson 7001, Wheeler Peak Scenic Area, White Pine Co., Nevada.)

Earlier this variation had been included almost universally in *Pinus aristata* Engelm. (in Parry & Engelm., Am. J. Sci. Arts, Ser. 2, 34: 331. 1862), bristlecone pine. Also, that species had been reduced by its author to a variety of a related species, *Pinus balfouriana* Grev. & Balf., foxtail pine: *Pinus balfouriana* var. *aristata* (Engelm.) Engelm. (in Rothr., Wheeler Rep. U.S. Geogr. Surv. 6: 375. 1878).

A photograph of an ancient tree, as *Pinus longaeva*, Intermountain bristlecone pine, was featured on the cover and frontispiece of Intermountain Flora: Vascular Plants of the Intermountain West, U.S.A. (vol. 1, 1972) by Arthur Cronquist, Arthur H. Holmgren, Noel H. Holmgren, and James L. Reveal. They summarized the distinguishing characters (p. 231-232): needles with 2 resin ducts (instead of 1, often with whitish dot of exuded resin, beneath a prominent groove) and cones with rounded bases and fine bristles (instead of truncate bases and stout bristles).

Variations in the essential oils of wood and foliage were found by Eugene Zavarin and Karel Snajberk (Variability of the wood monoterpenoids from Pinus aristata. Biochem. Syst. 1: 39-44, illus. 1973; also with Dana Bailey. Variability in the essential oils of wood and foliage of Pinus aristata and Pinus longaeva. Biochem. Syst. 4: 81-92, illus. 1976). Those authors accepted two species but observed geographical intermediates.

Cross pollination tests of these related pines were made by William B. Critchfield (Hybridization of foxtail and bristlecone pines. Madroño 24: 193-212. 1977). He noted that crosses between the bristlecone pines from California and Colorado were relatively unsuccessful.

The genus *Pinus* is ancient geologically and appeared in the fossil record as early as the Jurassic period. Minor geographic variations, races, provenances, etc., some unworthy of taxonomic rank, have been noted in many species. Careful studies in other species doubtless will reveal additional minor differences.

Under a conservative classification of the genus *Pinus*, the variation cited above is transferred here to rank of variety. The natural range of var. *longaeva* is local in high mountains near timberline in Utah, Nevada, and eastern California. The typical variety, *Pinus aristata* Engelm. var. *aristata*, Colorado bristlecone pine, is local in high mountains near timberline in Colorado, northern New Mexico, and northern Arizona (San Francisco Mt.).

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POLLINATION ECOLOGY WITHIN THE SIERRA NEVADA

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Little published information is available on the intricacies of the pollination ecology of the Sierra Nevada. My own synecological studies of the basic descriptive features and driving variables of pollination ecology (Moldenke 1975, 1976) throughout western North America can be supplemented with few specific studies actually carried out within the Sierra Nevada. In this paper I will very briefly describe some overall descriptive features and present an approach for testing the selective mechanisms responsible for producing the observable patterns.

Two of the research methodologies that I, and my associates John Neff, Pat Lincoln and Ray Heithaus, have employed over the past 10 years or so, have been the following:

A) In order to establish what actually does happen pollination-wise within a community of plants, we have employed as thoroughly as possible what we call "the perfect observant vacuum cleaner approach". We establish a 0.5 km^2 research site in as undisturbed a natural community as possible. Within each site: we census all the plant species present; we transplant to the greenhouse or bag each species to determine whether it is genetically compatible or genetically incompatible and incapable of setting selfed seed; we collect every insect we observe visiting every flower in the community, determining whether it actually serves as a pollinator or merely acts as an herbivore exploiting the community floral resource without any substantial indirect pollination benefit; and we determine finally which species of pollinators visit which plants in what relative abundances.

We sample each site two to three times a week for two consecutive years for: 1) completeness; 2) to answer the inevitable questions remaining from the first year; and most importantly, 3) to try to average out (to some extent) variability in abundance patterns from year to year. We have done this now in 18 different communities in California and about 18 more in tropical Costa Rica, the Mediterranean climates of Chile, the deserts of Arizona and Argentina and the subalpine and alpine Rocky Mountains of Colorado. The data I will draw upon for this address is based on work done in the years 1969-1973 at Mather 1500-1800 meters in Tuolumne and Mariposa Counties, Tioga Pass Hall Natural Area 3300-3500 meters in Mono County, Dore Crest 4000-4200 meters in Mono County, and as representative

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This paper was originally prepared as a chapter in Vegetation of the Sierra Nevada by the Southern California Botanical Club; publication of the book has since been cancelled.

of the low-elevation Sierra Nevada grasslands data are also cited from the Stanford University Campus at sea level.

What, then, is the basic idea behind working at the community level, rather than studying the autecology of a particular plant species? The answer involves the issue of repeatibility and generalization, particularly to distinguish the basic features of the interaction patterns and hence the primary driving variables of the system, from the secondary variables involving only several constituent species. All too often pollination studies are based on one particular species (usually only a single population!) during only a single blooming season.

If there is one predominant feature of all pollination ecology, it is that most phenomena are extremely localized and that there is great variability in the abundance, specific identity and flight patterns of pollinators within as little a distance as 100 meters or between the same geographical location during subsequent years. This is the case, of course, because each species of plant and each pollinator is responding to its own set of environmental variables and predation, and because pollinator flight patterns are determined competitively by the conditions existing within extremely circumscribed areas. A plant species at a particular density growing with three other blooming plants is treated differently when growing at a different density with the same plants or at the same density with three other species of plants.

	pollinator species	total pollinator abundance	habitual + obligately selfing species
Dore Crest 4100m	78	1,182	47
Timberline 3400m	350	27,045	30
Mather 1700m	630	340,837	22

TABLE 1. Pollinator species richness and abundance along transect. Habitually selfing species indicates that class of species so infrequently visited by pollinators that cross-pollination cannot be considered the usual method of reproduction in the sites studied.

TABLE 2: FLOWER VISITORS

		Stanford -	Mather		-	Tioga Pass			- Dana Crest
		Grassland	Grassland	Forest	Chaparral	Meadow	Forest	Talus	Alpine
Bees	species	163	146	165	141	36	72	91	36
	individuals	19,602	38,716	33,122	26,400	1,060	1,291	4,176	716
Beetles	species	47	37	36	63	10	16	27	2
	individuals	57,161	51,039	27,063	09,116	74	4,131	1,634	26
Butterflies	species	35	24	26	13	19	15	60	19
	individuals	3,801	2,767	1,837	3,710	37	68	664	200
Muscoids	species	24	19	9	16	45	44	53	5
	individuals	3,345	525	86	321	1,416	1,588	3,985	94
Syrphids	species	22	18	21	23	7	16	21	4
	individuals	925	682	69	927	17	23	132	15
Beeflies	species	31	24	26	10	1	5	9	4
	individuals	6,699	4,842	4,493	26,438	2	12	48	48
Wasps	species	26	30	23	22	0	4	21	6
	individuals	448	1,100	811	874	0	11	191	7
Hummingbirds + Sphingid Moths	species	1	1	3	2	2	4	4	2
	individuals	31	20	14	87	6	52	196	22
total species		386	326	327	316	158	202	337	77
total individuals		98,452	100,827	68,640	170,375	5,101	10,263	13,681	1,182

However, with these caveats in mind, there are indeed certain useful, predictable and generalizable features about pollination systems that can be distinguished by studying the sum total of species under a rather variable set of environmental conditions (such as those met with in 0.5 km^2).

1. Some types of plants are always preferred to others (under widely different density conditions) by the majority of pollinator species.
2. Some types of plants are faithfully visited by a specific pollinator, which visits only that single species regardless of its density or what other plants are blooming contemporaneously.
3. Certain environments favor insect activity in terms of temperature and illumination, others are favorable in providing unlimited nesting sites, others favor the activity of a certain type of pollinator while hindering other types.
4. Pollinators are generally limiting in certain environments, floral resources are limiting in others.

Having observed nearly 1½ million insects in our experimental sites, we are able to make the following sorts of general statements about the pollination ecology of the Sierra Nevada.

1. With increasing altitude (or more appropriately, increasing severity of the environment for poikilotherms) the species richness of potential pollinator species drops dramatically from 737 at Stanford, to 1/10 that at alpine altitudes (Table 1). Along with species richness, total pollinator abundance drops even more dramatically to 0.3% that at mid-elevation. Correlated to decreasing pollinator abundance and diversity at higher altitudes, the number of habitual and obligately selfing species increases (Table 1).
2. A closer look at the types of flower-visitors at each site shows that these trends hold for all of the different pollinator types individually except for the muscoid flies, which are extremely abundant flower visitors at subalpine altitudes (Table 2).
3. If one examines only the efficiency of different types of breeding systems and the importance of only those flower visitors which function as significant pollinators, one sees the complex pattern presented in Table 3. Disproportionately important modes are: solitary bees (including specialist-feeding species) at low and mid-elevation grassland and chaparral; bumblebees in mid- and high-elevation scrub; muscoids at subalpine sites; wind-pollination in high-elevation sites; and selfing in grassland communities and high elevations.

TABLE 2. Species richness and abundance of different classes of flower-visiting animals. See Moldenke (1975) for methods of obtaining data.

		Stanford -	Mather		-	Tioga Pass		-	Dore Crest
POLLINATOR	range in California	Grass-land	Grass-land	Forest	Chaparral	Meadow	Forest	Talus	Alpine
Solitary Bee	9-62	41 ↑	40 ⇑	30	62 ⇑	9 ⇓	19	20	27
(Specialists)	(2-37)	(20) ⇑	(28) ⇑	(13)	(37) ⇑	(6) ⇓	(10) ⇓	(15)	(15)
Bumblebee	0-47	10	12	21	47 ⇑	15	19	22 ⇑	24 ⇑
Beefly	0-23	20	16	17	23	0 ⇓	2 ⇓	5 ⇓	0 ⇓
Beetle	0-20	16	13	5	15	0	5	6	0
Wasp	0-7	1	2	3	7	0	0	0	1
Butterfly	1-20	7	13 ⇑	4	20 ⇑	2	4	8	8
Moth	0-3	1	2	0	0	1	0	1	2
Muscoid fly	1-16	3	3	2	1	16 ⇑	16 ⇑	8 ⇑	5
Syrphid fly	0-18	4	4	3	1	2	0	2	1
hummingbird & sphingid moth	0-14	3	1	3	12 ⇑	2	5	6	4
wind	9-35	16	31 ⇑	12	12	35 ⇑	29 ⇑	20	25 ⇑
± habitual selfer	7-42(m)	41 ⇑	42 ⇑	25	7 ⇓	19	22	35 ⇑	39 ⇑
(obligate selfer)	[1-11(m)]	(18) ⇑	(4)	(4)	(1)	(5)	(2)	(3)	(2)
vegetative reprod.	0-8	1	0	1	0	8 ⇑	6 ⇑	7 ⇑	3 ⇑

TABLE 3. Breeding systems and actual agents of pollination. Specialist-feeding bees are a subclass of solitary bees; obligate selfer is a subclass of habitual selfer. Vegetative reproduction includes only the most extensive and successful forms of apomixis.

What causes the complex pattern revealed in Table 3? The majority of community pollination phenomena are caused by the interplay of two variables, which do not always result in the expected manner. The two variables are: 1) decreasing pollinator abundance with increasing severity of climate; and 2) the fact that a particular community type is often more similar between differing altitudinal replicates, than any two physiognomically different sites at the same geographical and altitudinal location are to one another.

Three examples of this very significant variable are plant diversity, genetic self-compatibility and pollinator food-utilization patterns (Moldenke 1975). Table 4 quantifies measures of plant diversity along the altitudinal transect. "Diversity" measures both the total number of species and their respective relative abundances. As such, diversity is an excellent indicator of the resource base available to the potential pollinators of a community, rather than measures such as total species count. Notice in Table 4 how similar community types cluster around similar diversity values.

H Diversity	Community Type	Total Species
3.90	Mather Forest	182
3.74	Subalpine Forest	126
3.58	Stanford Oak-Madrone Forest	104
3.30	Dore Crest Alpine Tundra	79
3.07	Stanford Chaparral Scrub	90
3.02	Subalpine Talus Scrub	181
2.77	Coastal Sage Scrub	191
2.70	Mather Grassland	103
2.70	Subalpine Marsh-Meadow	137
2.20	Stanford Serpentine Grassland	150
1.81	Mather Chaparral Scrub	62

TABLE 4. Species richness and diversity of the flora at the experimental sites.

Table 5 analyses the emphasis on genetic self-compatibility as a breeding strategy in the different experimental sites. The most significant measure in this context is the percentage of the total floral biomass of the community.

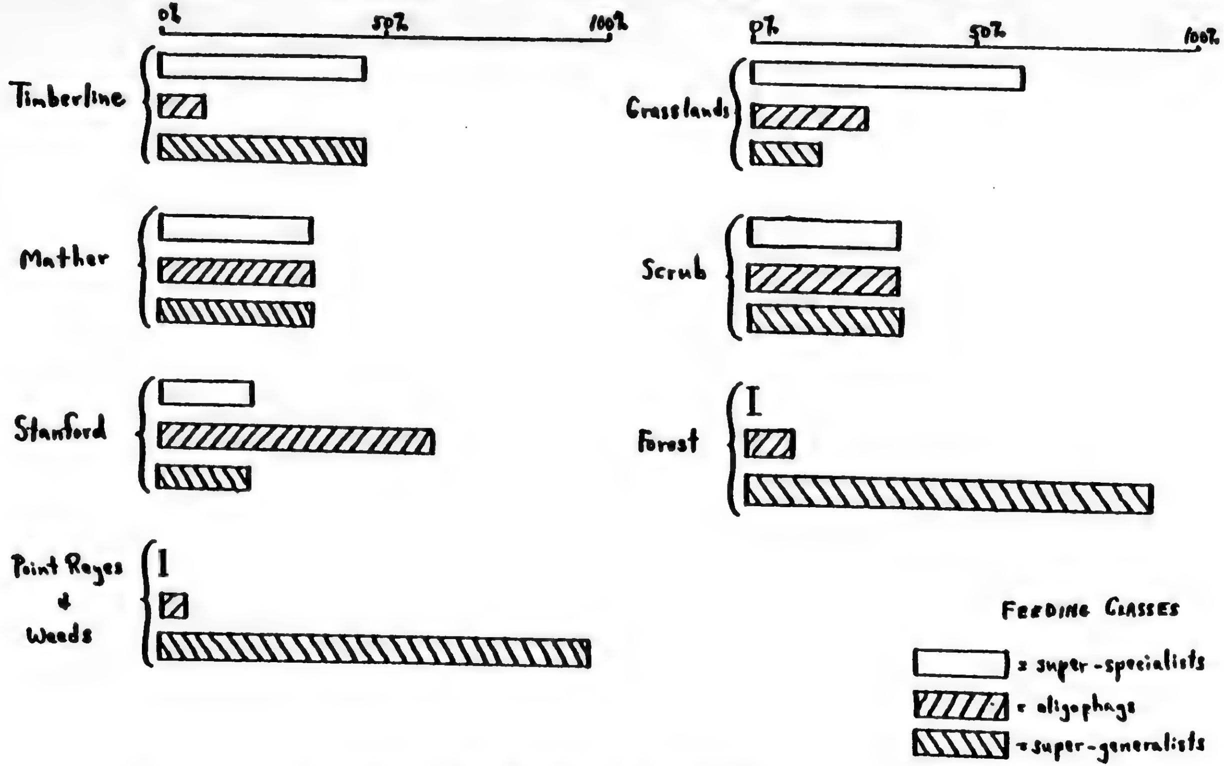
Figure 1 may be used to illustrate the importance of both variables. The extremes (both specialization and super-generalization of food selection patterns increase in importance with increasing altitude and climatic severity. However, regardless of altitude, specialist feeding patterns are important in grasslands and super-generalists are important in forests. Since the ranges of the values (not shown on the figure) averaged for each statistic on the left-hand column are in all cases much greater than for the right-hand column, this signifies that the primary variable determining pollinator feeding strategies is community physiognomy, rather than pollinator diversity or abundance!

	% species	% individuals	% biomass (floral)
Tioga Pass Meadow	74	97	55
Mather Grassland	87	97	90
Stanford Serpentine Grassland	79	85	70
Tioga Pass Forest	61	90	<0.01
Mather Forest	49	75	<0.01
Stanford Oak-Madrone Forest	44	48	<0.01
Tioga Pass Scrub	65	85	49
Mather Chaparral Scrub	31	81	<1
Stanford Chaparral Scrub	46	60	<1

TABLE 5. Measures of genetic self-compatibility in different community types. Compatibility is especiallly important in grasslands by all measures, but least so in terms of biomass. In forest communities all the large or common plants are heavily outcrossed and incompatible; pollinators are very infrequent, but nearly all species are perennial. The lack of potential pollen vectors at the high altitudes is reflected by a noticeable increase of compatible plants in all community types.

FIGURE 1

RELATIVE EMPHASIS ON NICHE FEEDING STRATEGIES



$$\% \text{ emphasis} = \frac{\% \text{ species} + \% \text{ individuals} + \% \text{ biomass}}{3}$$

In a very generalized fashion, the preeminent features of the pollination ecology of the Sierra Nevada are summarized in Table 6. These statements represent the general trends evidenced at specific point sites; they should not be taken to imply that they will hold for much more than a majority of the plant species in any as yet unstudied particular location.

B) The second major emphasis of our laboratory has centered on bees. Since bees are the most important pollinator type (Moldenke 1976) in California, we have made a special effort to understand their distributions, relative abundances and floral visitation patterns. Several years ago we catalogued all of the published information available as well as all the information on all the specimen labels of all the bees in the major collections in California, together with our own data as well. There are about 2,500 species of bees in the arid southwestern United States and the catalogued information (incomplete and sketchy as it is) was rather voluminous (Moldenke & Neff 1974). This information was not published, since four of the largest bee genera are still in the process of taxonomic revision, but it is available to interested researchers from me personally.

This project was remarkably fruitful to my mind, for it allowed for the first time:

1) relatively accurate estimates of the total bee species richness in the different regions of California (Table 7). Note particularly the intermediate values pertinent to the different regions of the Sierra Nevada.

2) relatively sound decisions on the flower-visiting behaviors of about 80% of the species of bees in the western United States, for instance: generalist feeders on anything; specialist feeders on one particular plant family; or specialist feeders on one particular genus over a very broad geographic expanse. In making these general statements about bee feeding habits, I fully realize that there is no such thing as a true theoretical generalist feeder or theoretical specialist. No generalist feeder visits all the resources in the exact proportions of their density; and only, probably, at most 99% of the females of any specialist-feeding bee, in nearly all of its populations exploit the appointed flower -- and of course they may visit a wide variety of flowers for nectar, sometimes effectively pollinating them too.

3) an idea of which plant genera are associated consistently with specialist pollinators only; which ones are serviced by generalist pollinators; and which ones by both.

	Mature Chaparral	Grassland	Forest
wind pollination	nearly absent	prominent, but never more than ⅔ of most abundant species	nearly all dominants
pollinator abundance	very high	high	low
pollinator diversity	very high	high	very low
abundant pollinator groups	all high	all high except hummingbirds	bumblebees ont. important butterflies ± absent
nocturnal pollination	yes	occassionally	rarely
limiting resource (in general)	insects compete for plants	dominants: insects compete for plants non-dominants: plants compete for pollinators	plants compete for pollinators
specialist pollinators	assoc. w̄ all dominants	many dominants assoc. w̄ specialists	very rare
breeding system	all dominants and rare annuals heavily outcrossed	many dominants are habitual inbreeders	dominants monoecious and heavily outcrossed herb layer mostly perennial and genetically self-incompatible
special features	recolonization problems after burns	extreme annual weather-correllated variability	Sundappling

TABLE 6. General features of the pollination dynamics of plant communities within the Sierra Nevada.

TABLE 7. Distribution of bee groups in Biotic Regions of California (Moldenke, 1976)

	Bee Families										
	Colletidae	Andreninae	Panurginae	Melittidae	Halictidae	Megachilidae	Anthophoridae	Apidae	Total bee species	Plant Genera with specialist pollinators	Total specialist bee pollinators
TRANSMONTANE											
No. Great Basin	13	30	12	0	21	72	50	15	213	17	118
Great Basin	12	18	12	0	19	66	47	5	179	14	98
Owens Valley	21	22	86	6	48	120	84	7	394	33	253
DESERT											
Mojave Desert	29	29	101	9	80	105	103	1	456	33	271
Colorado Desert	27	22	137	14	86	92	104	0	482	35	299
MONTANE											
Trinities + Siskiyous	17	43	0	0	21	80	46	13	220	11	86
Alpine Sierras	15	18	4	0	25	87	20	14	183	13	89
Northern Sierras	23	70	15	0	62	137	81	10	398	28	170
Southern Sierras	20	80	25	2	96	170	116	7	516	38	219
Montane + Alpine so. Calif.	12	53	20	3	95	146	85	8	422	30	186
COASTAL											
Dunes and Sage	10	30	3	1	43	24	41	10	172	12	52
MEDITERRANEAN											
No. Coast Ranges	16	60	9	0	61	114	106	11	377	33	152
So. Coast Ranges	21	96	40	2	89	132	132	8	520	44	262
Cismontane so. Calif.	22	98	43	7	122	119	138	7	555	47	253
No. Central Grassland	13	48	9	0	41	45	72	10	238	29	108
So. Central Grassland	19	34	30	1	57	54	80	7	282	36	161

4) by applying subsequent studies on bee phylogeny and biogeography, it allows us for the first time to estimate the number of independent events during the coevolution of bees and plants in which specialist-bees have become tied to a particular group of plants.

5) the realization that nearly three-quarters of the non-anemophilous California plant genera are actually pollinated by at least two very different types of pollinators, and that nearly one-half of the genera are serviced by at least three distinct types. This means that the often-cited generalizations about 1:1, pollinator:plant, tightly coupled systems is scarcely relevant to California (Table 8).

We will utilize the results of this research later on in this presentation in specific ways pertinent to an analysis of the pollination ecology of the Sierra Nevada. I would like to pass on now to an analysis of the mechanisms responsible for producing many of the patterns heretofore described in my previous papers. Wind-pollinated plants will be excluded from this discussion.

. . . . . .

From the botanical point of view, one of the basic pieces of data emerging from our community pollination studies is a chart of when each species blooms and the relative contribution of each species to the total floral biomass resource of the community (Figure 2). The entry representing each species is determined by the behavior of the sum of all populations in the study site. In the field, anthesis was judged on a scale of+1 to +5 to -1, with +1 signifying that a few flowers have appeared on a very small fraction of the population, +5 signifying full-bloom of nearly all individuals, -1 signifying only a few scattered flowers remaining on a few scattered individuals; the charts and analyses include only the period +3, +4, +5, -4, -3 for each species of non-anemophilous plants.

TABLE 8. Pollination Syndromes of the California Flora. Vector categories represent the most efficient modes of pollination for a particular plant genus rather than simply the total flower visitors. A: Only categories with listings more than 5 included in the table; B: Indicates pollination by indicated mode and at least two others; C: Indicates pollination by indicated mode and at least one other; D: Obligate selfing is a subset of habitual selfing; E: Difficult to delineate between modes without further investigation (57 taxa cited jointly). From Moldenke (1976).

Table 8.

POLLINATION MODE																
Water Pollination	Wind Pollination	Obligate Selfer Ⓓ	Habitual Selfer Ⓓ	Generalist Bees Ⓔ	Specialist Bees	Hummingbird	Sphinx Moth	Moths (nocturnal)	Butterflies	Wasps	Beetles	Muscoid Flies	Beeflies	Syrphids	Primitive Flies	# California Genera Possessing Stated Mode of Pollination Ⓐ
X																5
	X															136
		X														76
			X	(x)												246
			(x)	X												56
				X	X											27
					X											9
						X										10
				X		X										22
							X									3
								X								4
									X							2
										X						0
				X						X						5
											X					1
				X							X					9
												X				5
				X								X				4
													X			5
				X									X			15
				X	X								x			7
														X		0
				X										X	X	18
															X	6
				X		(← 2 x →)										49 Ⓑ
				X	X	(← 1 x →)										20 Ⓒ
				X	X	(← 2 x →)										70 Ⓑ
	x			(← 2 x →)												5 Ⓑ
						(← 2-5 x →)										27

FIGURE 2. Anthesis timing in the Dore Crest alpine community. Thick lines indicate major contributants to the community floral biomass resource. Tanacetum, a dominant community feature, which blooms during the period indicated for Solidago was accidently omitted from the figure during preparation.

ANTHESIS INITIATION

Since the anthesis period of each plant species is subject to a large number of independent variables, we might expect to find (examining floral initiation time alone) that the distribution of all species within a community would follow a bell-shaped or normal distribution as a result of the Central Limit Theorem. The Central Limit Theorem states that the total distribution of a population of independent random events is normally distributed, or "bell-shaped". In a temperate climate, we would expect the peak to be slightly to the left of the middle of the total growing season, in order for seed maturation to ensue, and we might additionally expect the left tail to be somewhat truncated by the spring frosts. However, if the initiation of flowering by each species was not a randomized event relative to the other species in the community, then the time at which irregular pulses occurred should reveal the nature of the driving variable(s).

The pattern of floral initiation of the mid-elevation communities is basically normally distributed, as expected (Fig.3). This data was not compared directly to any particular simulated curve because of the reasons presented in the Discussion. The approximation to a normal curve is best in the Mather grassland and forest communities, which have the largest total number of species and therefore would be expected to show the least irregular bias due to small sample size. The center of the main peak is at May 15th in all three Mather communities, even though the flowering season in the snow-covered grassland starts a full month after that in the neighboring chaparral and forest communities. As the total blooming season increases at Mather from 6 to 7 months in the three communities, the peak of the floral initiation curve broadens from two weeks in the grassland to seven weeks in the chaparral.

At the Tioga Pass and Dore Crest sites the pattern of floral initiation is distinctly bimodal throughout (Figure 3). The major peak occurs about May 15th, which is the beginning of the total growing season, regardless of the length of each of the growing seasons in the four respective communities. In the subalpine forest, subalpine meadow and Dore Crest alpine communities there is a subsidiary peak at July 15th during basically a total 2½ month blooming season. In the subalpine talus-fell community, the total blooming season extends for 3½ months and the subsidiary peak occurs two weeks later than in the other communities and is noticeably broader. The entire growing season is so foreshortened at these high-elevation sites that in the face of severely limiting pollinators 43-60% of the resident plant species initiate anthesis as soon as physiologically possible; this trend is facilitated by the presence of perennials as 96% of the flora (Moldenke 1975).

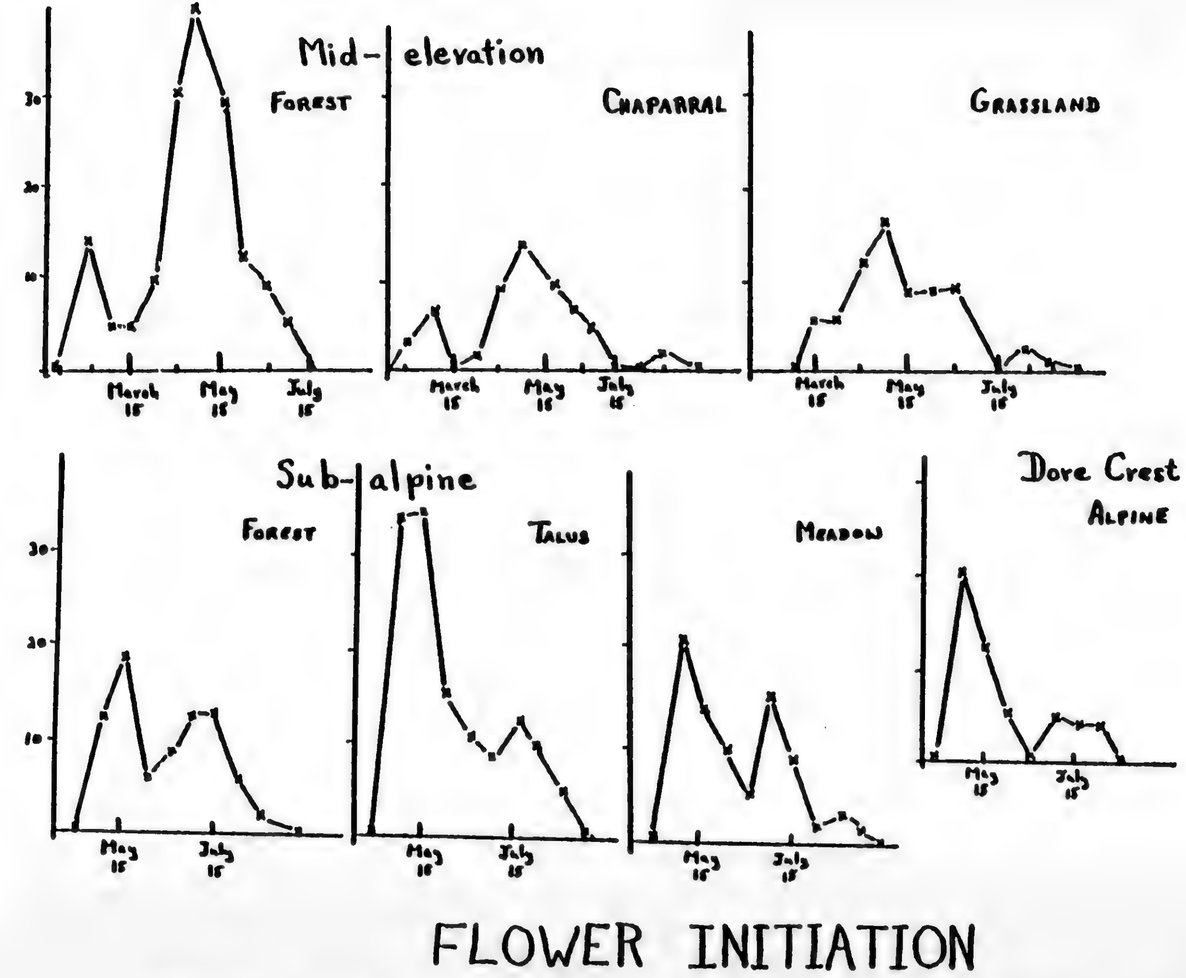


FIGURE 3. Number of species of resident plants initiating anthesis during the weeks indicated at the experimental sites.

Not all species initiate bloom abnormally early, the second peak clearly indicates that about 30-40% of the species still initiate blooming at what would be considered the normal time based on the results at mid-elevation.

SYNCHRONOUS BLOOM

Since the total length of time each species spends blooming is presumably under independent control as well for each of the species, we should expect a normal distribution through time for the total plant species in bloom during each week. Since this distribution is a cumulative result of the initiation times, it should and does peak at or shortly after the initiation curves. The distributions for all seven communities are indeed apparently normal; Mather communities have narrow peaks at May 1 - June 15 with distinct tails, while Timberline communities are very broad and without distinct tails (Figure 4). The peak in the total number of simultaneously blooming plants in the Mather chaparral is delayed about two weeks compared to forest and grassland communities; this delay is correlated to a 2-4 week longer total blooming season.

The total number of simultaneously blooming species in all of the subalpine and alpine communities yeilds too broad a curve for meaningful distinctions. The precise peak occurs on July 1 for alpine and talus-fell communities, whereas in the meadow and forest communities it does not occur until a full month later. I presume that this correlates with the considerably more stressful evapotranspiratory difficulties in the former as the season progresses and snow melt is concluded. Undoubtedly there is significant variability from year to year in the precise length and initiation of blooming seasons depending upon amount of snow pack. When summing the behavior of all populations within 0.5 km^2, as was done throughout these studies, significant microenvironmental gradients are not distinguished (see Discussion).

TOTAL FLORAL BIOMASS

Though total community floral biomass might be expected to follow a simple and repeatable pattern, the extreme disparity in the relative abundances of the dominant plants in most communities seem to preclude anything approaching smooth curves. Floral biomass is estimated not in nutritional terms but is calculated by the product of the two largest linear dimensions of the flower (inflorescence), times the number of flowers (inflorescences) per plant, times the number of individuals in the census (see Methods: Moldenke 1975). As such, this is not a direct measure of floral reward though it probably does approximate it in relative terms.

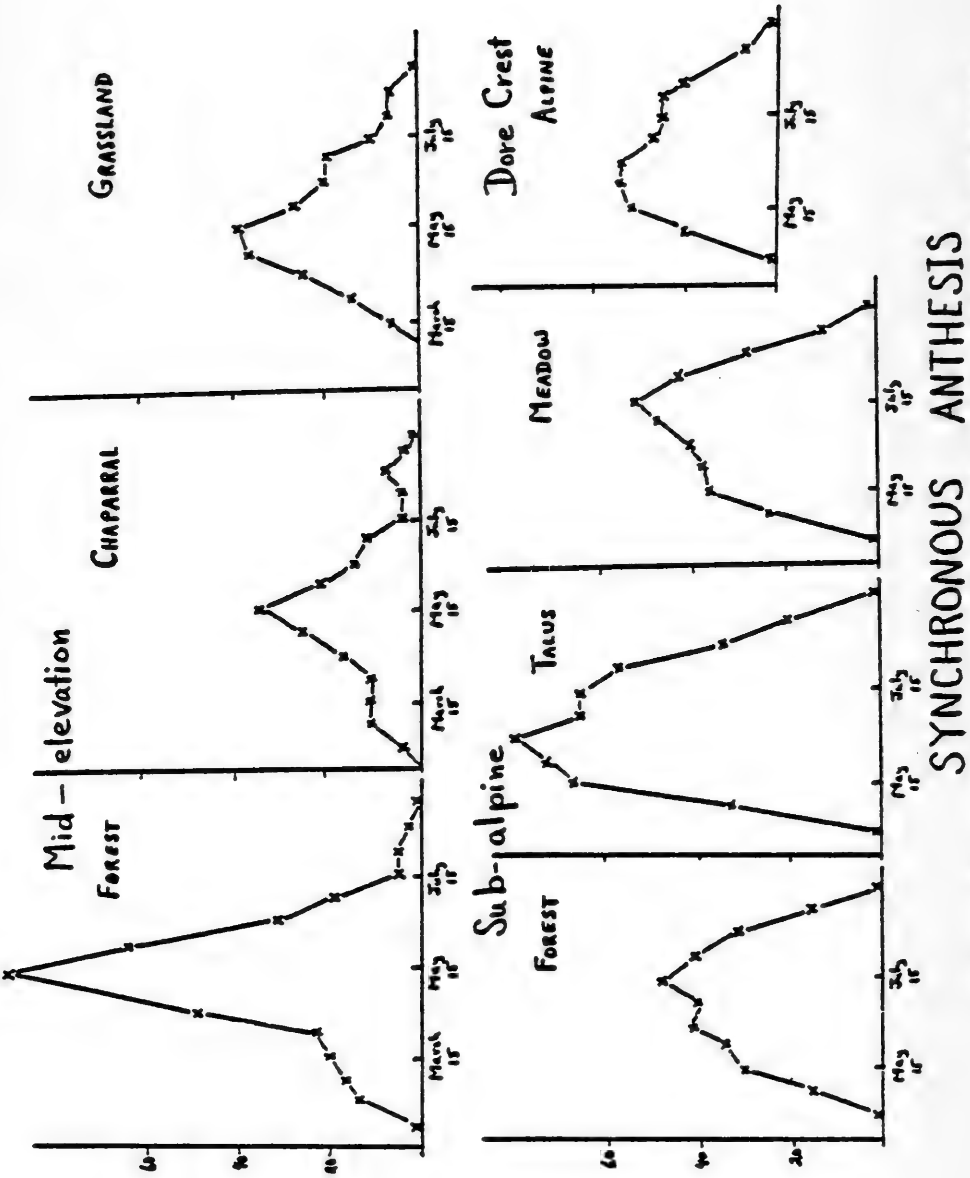


FIGURE 4. Number of plant species in bloom during the weeks indicated within the experimental sites.

Several conclusions are apparent from an analysis of the biomass data (Figure 5):

1) The peak biomass is not necessarily correlated with the peak number of flowering species. In Dore Crest and Mather chaparral communities the biomass peak occurs respectively several weeks after and before the peak of simultaneously blooming species (Figure 5).

2) The Mather grassland and Tioga Pass meadow communities demonstrate clear bimodal biomass availability patterns (Figure 5).

3) Many of the most heavily visited plant species seem to produce very minor amounts of floral biomass (e.g., *Haplopappus* spp., *Achillea lanulosa*, *Ranunculus californicus*, *Ceanothus integerrimus*, *Eriogonum latifolium* ssp. *nudum*, *Rhamnus crocea*, *Lotus scoparius*, *Grindelia camporum*, *Phacelia* spp., *Gilia capitata*, *Eriodictyon californicum*, *Potentilla glandulosa*, *Hackelia* sp., *Horkelia fusca*, *Ligusticum* sp., *Sphenosciadium capitellatum*). In my experience most of these species are aggressive early colonists of disturbed areas and would normally be widely scattered and unpredictable in distribution. It is interesting that many generations of selection under such conditions has indeed somehow produced plant species with especially attractive flowers to a wide spectrum of possible pollinators.

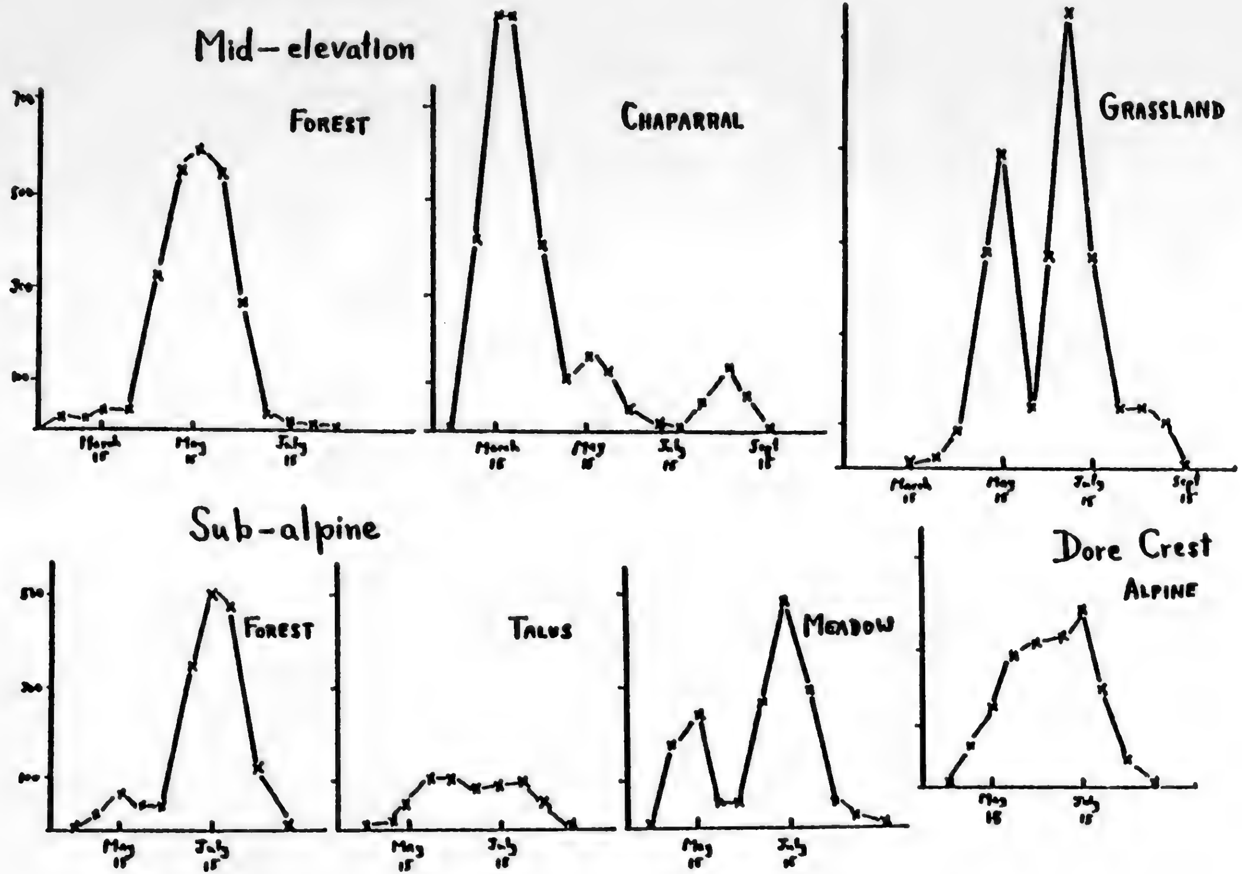
4) Many of the most heavy contributants to community floral biomass resource are very poorly visited by potential pollinators (e.g., *Adenostoma fasciculatum*, *Nemophila spatulata*, *Boisduvallia densiflora*, *Trichostema rubisepalum*, *Amelanchier* spp., *Phlox* spp., *Mimulus primuloides*, *Ledum glandulosum*, *Ranunculus alismellus*, *Holodiscus* spp.).

5) In all communities except the chaparral, anemophilous flower types usually account for 10-1000 times the floral biomass produced by entomophilous and ornithophilous plants (data not presented here; Moldenke 1975, 1976). This is generally true throughout the temperate and arctic regions of the world.

I think that it is unwise to draw more specific conclusions from this type of data. The biomass curve is determined in general outline by only 3-10% of the resident species; slight changes in their blooming seasons or amount of bloom from year to year could and probably does alter the shape of the curve significantly.

ANNUAL VERSUS PERENNIAL

Intuitively, one might expect that annual plant species would differ significantly from perennials in terms of their flowering phenology, since many of the options available to perennials are not open for annuals. However, such is not the



COMMUNITY FLORAL BIOMASS

FIGURE 5. Total community floral biomass during the weeks indicated. Biomass units in cm^2.

case. The respective phenological behavior of annuals and perennials in the four communities with a significant number of species of annuals, is basically the same whether one plots floral initiation (Figure 6), synchronously blooming species or floral biomass.

COMPETITION FOR POLLINATORS: BETWEEN COMMUNITY COMPARISONS

a) Overlap of anthesis periods

If pollinators are a resource that is ever competed for by plants within a community, then there should be a tendency for plants to bloom asynchronously. In particular, there should be a limit on the largest total number of plants blooming at the peak of the season. As the growing season increases in length, the ease of blooming asynchronously should increase and a smaller percentage of the flora should be blooming at the peak. In the Mather communities (total blooming season = ca. 26 weeks), 52-58% of the flora is blooming at the peak, whereas at Tioga Pass (total blooming season =

COMMUNITY	TOTAL SPECIES in bloom at peak week	TOTAL SPECIES in community	% TOTAL SPECIES in bloom at peak week
Dore Crest alpine	35	59	65%
Subalpine talus	79	127	62%
forest	51	78	65%
meadow	52	86	60%
Midelevation chaparral	31	57	55%
forest	91	152	58%
meadow	37	71	52%

TABLE 9. Characteristics of the non-anemophilous flora at the peak week of bloom during the year.

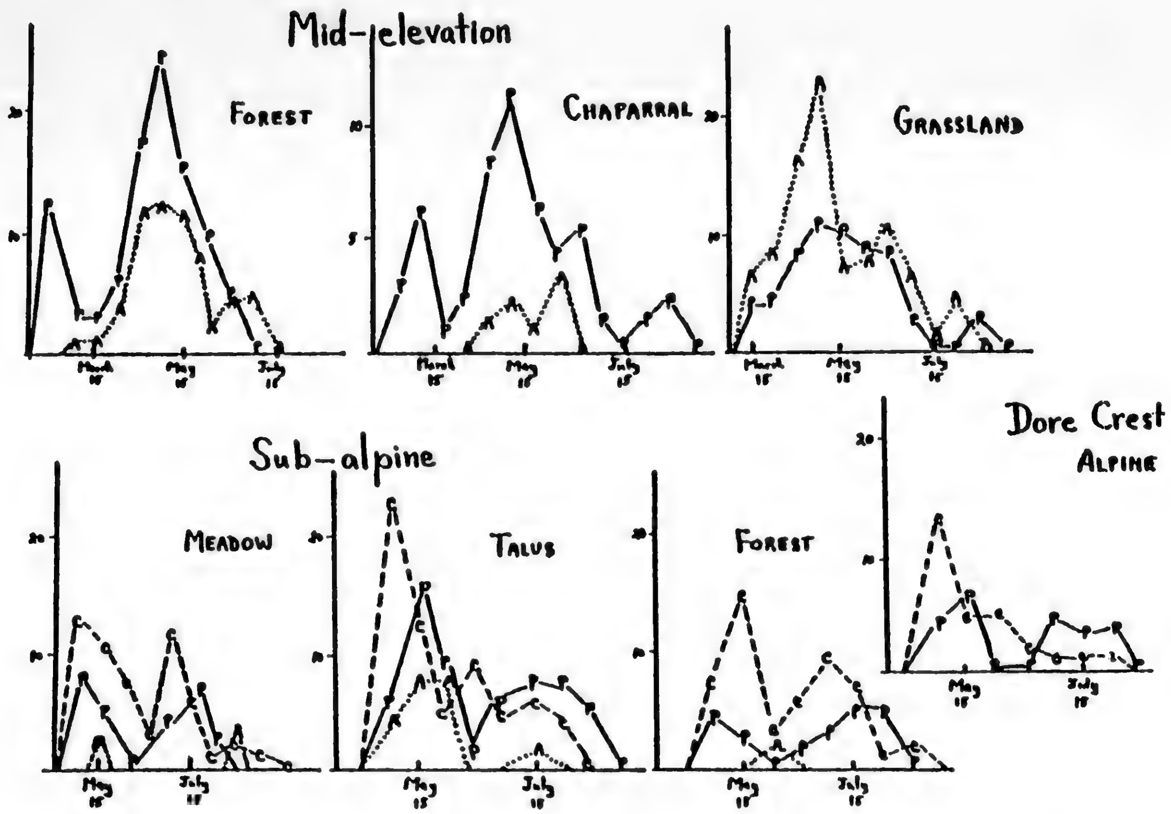


FIGURE 6. Timing of floral initiation by annual plants (A), incompatible perennial plants (P) and genetically compatible perennial plants (C) during the weeks indicated at the subalpine sites; all perennials are lumped (P) at the mid-elevation sites.

ca. 19 weeks) 60-65% of the flora is blooming at the peak (Table 9).

In the most species-rich community studied (Mather forest = 152 spp./0.5 km^2) the total number of synchronously blooming species is 91, whereas in nearly the least species-rich community (Mather chaparral = 57 spp./0.5 km^2) the number is only 31 (Table 9). Now, if plants must compete for pollinators (as we assume), we would expect that in the Mather forest there would be a larger percentage of the flora forced to rely upon genetic self-compatibility at the peak of the bloom and we would also expect that at the peak there would be more floral morphologies adapted to a particular type of pollinator class. Such species, by excluding all classes of pollinators save one, greatly increase the relative worth of the floral reward and in so doing facilitate the specificity of intraspecific pollen transfer.

COMMUNITY	total length of blooming season (weeks)	number self-compatible species in bloom at peak week	% self-compatible species in bloom at peak week
Dore Crest alpine	18	25	70%
Subalpine talus	22	60	76%
forest	18	37	72%
meadow	18	37	71%
Midelevation chaparral	28	11	36%
forest	26	45	50%
meadow	24	22	60%

TABLE 10. Abundance of genetically self-compatible species during the week of peak bloom as related to the length of the blooming season.

b) Escape through Self-Compatibility

In the Mather Forest at the peak of the bloom 50% (45 species) are genetically capable of selfing in the event pollinators are not attracted to the flowers, while 36% (11 species) are self-compatible in the chaparral (Table 10). This conforms to prediction, as does the rank order of all seven communities except for the exceptionally low figure of the Mather forest in comparison with the high altitude communities. In this one exception, the low percentage of self-compatible plants in the Mather forest is especially peculiar though, since the total species in bloom and the floral biomass peaks coincide in the forest.

c) Exclusionary Syndrome Insurance

The morphology of certain flowers when compared to the span of morphological types represented by the pollinators within an entire community, often clearly excludes certain types of pollinators. Other features of flowers, such as nocturnal anthesis, differentially poisonous nectar and particularly aberrant scents and nectar compositions, also function to attract pollinators of certain types exclusively. Generally only one pollinator type visits flowers of these species, one distinctly morphologically and behaviorly adapted to a particular syndrome. However, many other plant species (not specialized in any noticeable manner) are visited by only one pollinator type. Usually these are species which happen to be low on the general rank preference order of the community; the pollinator type which visits them in any one locality is not particularly adapted to that particular plant species, and in fact the pollinator type of these infrequent visitors would be expected to vary between locations as conditions of local competition change. Hence "exclusionary flower" is defined primarily on the basis of morphology, rather than localized results of flower visitation observations, although such a deliniation must in fact be somewhat circular.

In the Mather forest there are six distinct exclusionary syndromes (flowers adapted for pollination by: bumblebee (12), small bee (8), beefly (7), mosquito/gnat (4), moth (2), hummingbird (2)) at the blooming peak, whereas in the chaparral there are only four (adapted for: hummingbird (4), small bee (4), bumblebee (2), moth (1)). Throughout the year, there are a total of 48 species with ± exclusionary flowers in the forest, 16 in the chaparral (Table 11). However, since there are three times the number of entomophilous and ornithophilous species resident in the forest as the chaparral (Table 9), the percentages of exclusionary flower types are not significantly different (Mather chaparral 28%; forest 31%). The community with the largest percentage of exclusionary-flowered species (42%) is the Mather grassland,

COMMUNITY	Total Species with Exclusionary Morphologies		% Species with Exclusionary Morphologies	Different Syndromes at peak week	Most important exclusionary morphologies	
	at peak week	through year	through year	(+ polyphilic)	through year	at peak week
Dore Crest alpine	8	10	18%	1	SB≫ BB, BT	BB
Subalpine talus	25	37	30%	3	SB≫BT, BB	BB>SB>MT
forest	23	27	34%	1	SB>BB, HB	BB
meadow	18	22	25%	1	BB>SB>M	BB
Midelevation chaparral	11	16	28%	4	SB>BB>BM	SB>BB, HB
forest	25	48	31%	6	BM≫SB≫BB	SB>BB>BM
meadow	15	30	42%	5	SB≫BB, BM	SB>BB>BM

TABLE 11. Plant species with exclusionary floral morphologies at the different experimental sites. Classes of morphological syndromes: BB=bumblebee, SB=small bee, BT=butterfly, MT=moth, HB=hummingbird, M=muscoid fly.

which possesses an intermediate number of total species in the community and an intermediate number of total species in bloom at the flowering peak.

Therefore, in a cross-community comparison these measures are either inappropriate or they imply that plants in these California communities are not responding phenologically to competition for pollinators. However, it should be noted at this point that Moldenke (1975) has pointed out that the percentage of self-compatible species within the total flora is a relatively constant characteristic of community physiognomy and is independent of total number of species and length of blooming season.

COMMUNITY	GENETICALLY INCOMPATIBLE SPECIES	GENETICALLY SELF-COMPATIBLE SPECIES		% GENETICALLY SELF-COMPATIBLE SPECIES		% COMPATIBLE SPECIES which HABITUALLY SELF	
	that bloom off peak	blooming off peak	blooming at peak	blooming off peak	blooming at peak	blooming off peak	blooming at peak
Dore Crest alpine	13	25	25	62%	70%	80%	72%
Subalpine talus	20	34	60	63%	76%	64%	64%
forest	13	20	37	61%	72%	50%	53%
meadow	12	20	37	64%	71%	55%	48%
Midelevation chaparral	9	2	11	22%	36%	0%	28%
forest	10	26	45	72%	50%	20%	27%
meadow	5	15	22	75%	60%	33%	80%

TABLE 12. Breeding system of plants which are in bloom during the peak week of bloom relative to the systems employed by all species in bloom at least two weeks earlier or later throughout the year.

COMPETITION FOR POLLINATORS: WITHIN COMMUNITY COMPARISONS

a) Selfing

Within any community, the predicted effects of competition for pollinators can be tested for by observing the relative frequency of genetic self-compatibility, frequency of selfing and bee feeding habits as the season progresses. Table 12 demonstrates that the species richness of genetically self-compatible plants is greatest at the peak in all communities. At Mather the percentage of plants that are self-compatible is usually greatest flanking the peak, but even more significantly however, the percentage of those plants that are both self-compatible and that habitually or obligately self is much greater at the peak (Table 12). At subalpine and alpine localities there is no significant difference in the habitual selfers on- and off-peak; an artifact due to the extremely long individual blooming seasons and the broad community peak, even though the proportions of self-compatibility are about 10% greater at the peak. At the mid-elevation sites, then, 27-80% of the self-compatible plants at the peak of the bloom are forced to self habitually. These species are the losers in the face of superior competition for pollinators.

b) Overlap of Anthesis Periods

If plants are indeed generally competing for pollinators, then in a community characterized by generalist pollinators the peak number of synchronously blooming plants should be lessened. All plant communities at subalpine and alpine regions in California are severely pollinator-limited (Moldenke 1975, 1976), mid-elevation grassland and chaparral being pollinator-rich. However, the Mather grassland and chaparral support respectively 37 and 31 synchronously flowering species whereas the average for Tioga Pass and Dore Crest is 51, even though total plant species richness is much lower (Table 4). Within the Mather communities, the forest relies heaviest on generalist-feeding bumblebees and beefly pollinators. It is the forest which demonstrates the highest number of synchronously blooming plant species, two to three times the number in adjacent communities characterized by many specialist-feeding pollinators within the total resident fauna.

c) Specialist-Feeding Pollinators & Exclusionary Syndromes

Discrepancies from our predictions, however, could be permissable if species of plants at the peak of the bloom are efficiently serviced by specialists. In the Mather forest community, during the peak of the bloom 4-8 times as many plant species are visited by specialist-feeding bees than during the periods March 1 - April 30 and July 1 - September 1. In addition, during the peak from May 1 - June 30 there are 5-6 (+ polyphilic) different specialized exclusion floral morphologies in use, a number which decreases precipitously towards either tail (Table 13). If we assume that the selective advantage which produces specialized floral morphologies is the efficient exclusion of many potentially inefficient pollinators, with the net result of protecting a large reward for the selected pollinator, then the selective advantage of such exclusion-flowers should have been greatest precisely when there was the highest level of synchrony from competitor flower species. The lower values of synchronous species blooming in the Mather grassland and chaparral are correlated, of course, with a much smaller total entomophilous and ornithophilous flora; however, the same trends in exclusionary-flowered species and specialist bee pollinators are present (Table 13).

In all the Sierra Nevada communities studied, flowers which bloom at the beginning or end of the season very seldom

COMMUNITY	Peak weeks of specialist-feeding bee activity	Percentage of blooming species serviced
Dore Crest alpine	—	—
Subalpine talus	6/7 - 6/30	22-25%
forest	6/28 - 7/15	25%
meadow	5/21 - 5/28 + 6/15 - 6/28	18-20%
Midelevation chaparral	{3/7 - 4/7 + 5/30 + 7/15 - 7/28}	50-100%
forest	5/15 - 6/15	20-25%
meadow	4/7 + 5/28 - 6/15	25-33%

TABLE 13. Dates (month/day) encompassing periods of highest specialist-feeding bee activity relative to the percentages of the non-anemophilous flora actually serviced during that specific period.

TABLE 14: Exclusionary Flowers

	Mar 1		Apr 1		May 1		June 1		July 1		Aug 1		Sept 1		
DORE CREST															
#specialist-visited species						5	7	11	11	7	4	5	4	2	
#exclusionary syndromes						1	2	2	2	2	2	2	1		
#exclusionary species						4	7	7	8	7	7	6	1		
exclusionary species/total spp.									+	+	+				
TIMBERLINE TALUS															
#specialist-visited species						4	14	17	14	15	14	12	10	3	2
#exclusionary syndromes						3	5	5	5	5	5	5	4	3	2
#exclusionary species						9	27	27	24	25	26	27	10	7	2
exclusionary species/total spp.							+	+	+	+	+	+			•
TIMBERLINE FOREST															
#specialist-visited species							4	5	6	7	10	11	8		
#exclusionary syndromes						2	3	4	5	5	5	4	3	2	
#exclusionary species						2	9	12	15	17	23	22	14	6	
exclusionary species/total spp.											+	+	+		
TIMBERLINE MEADOW															
#specialist-visited species						3	5	7	8	6	8	7	4	2	
#exclusionary syndromes						2	3	3	3	4	4	4	2	3	1
#exclusionary species						3	9	9	13	15	18	16	6	5	1
exclusionary species/total spp.								+	+						
MATHER CHAPARRAL															
#specialist-visited species	3	6	6	8	6	8	11	9	3	2	1	1	3	2	1
#exclusionary syndromes				2	2	3	4	4	4	4	1	1	1		
#exclusionary species				3	3	6	11	6	7	5	1	1	1		
exclusionary species/total spp.	•	✱	✱	✱	✱	✱	✱	✱	✱				•	•	•
MATHER FOREST															
#specialist-visited species	1	2	2	2	9	11	17	14	7	3	2	2			
#exclusionary syndromes		1	3	4	5	6	6	5	5	4	1	1	1		
#exclusionary species		1	3	5	12	25	35	31	11	6	1	1	1		
exclusionary species/total spp.						✱	✱	✱	✱		•	•			
MATHER MEADOW															
#specialist-visited species			1	3	5	6	6	6	5	5	2	2	1		
#exclusionary syndromes				2	4	5	5	4	3	3	2	1	1	1	
#exclusionary species				2	9	11	15	14	9	11	2	1	1	1	
exclusionary species/total spp.				✱	+			+	+	✱	+	✱			

possess exclusionary morphologies (Table 14). The ratio of exclusionary species to total entomophilous and ornithophilous species at the week of peak bloom is approximately 26% in all communities (range = 19-41%; Table 14). In four of these communities this ratio is nearly equal to the ratio of total exclusionary species to total species for the entire year; in the subalpine forest, Mather forest and Mather grassland the ratio at the peak week is considerably less. In all communities, however, the total number of different exclusionary syndrome types is disproportionately highest at the peak weeks of synchronous bloom.

d) Modification of Compatibility Strategies

Perennial plants throughout most regions of California are generally genetically incapable of setting selfed seed. If it is true that competition for pollinators is important in determining the reproductive strategies of plants, then at the peak of the bloom there should be a selective advantage accruing to perennial species which can evolve the ability to set selfed seed if competitors induce all of the available pollinators away. (There are, of course, long-term costs involving reduced population polymorphism or individual heterozygosity which will usually counter such a shift on the part of the entire community.)

In all three Mather communities the incidence of genetically self-compatible perennials coincides with the blooming peak (Figure 7). At the Tioga Pass and Dore Crest sites, most perennials are genetically self-compatible or apomictic (Moldenke 1975) and hence determine the shape of the anthesis curve. In the subalpine meadow and talus-scree the incidence of genetically incompatible perennials is highest in the time periods immediately flanking the blooming peak; in the subalpine forest the incidence curve of incompatible perennials is broad and flat, overlapping the peak but also disproportionately prominent after the peak (Figure 7). In the alpine community, the incidence of incompatible perennials is evidently equivalent to the periodicity of self-compatible perennials, but the very low total species richness and long average blooming season per species obscure resolution.

TABLE 14. Relative abundances of exclusionary-flowered species during the week of peak bloom and percentage of the total non-anemophilous flora of the experimental sites. Total number of plant species visited by specialist-feeding bees during the week in question. *= greater than 33%; += greater than 20%; ·= greater than 33%, but total number of species less than 2.

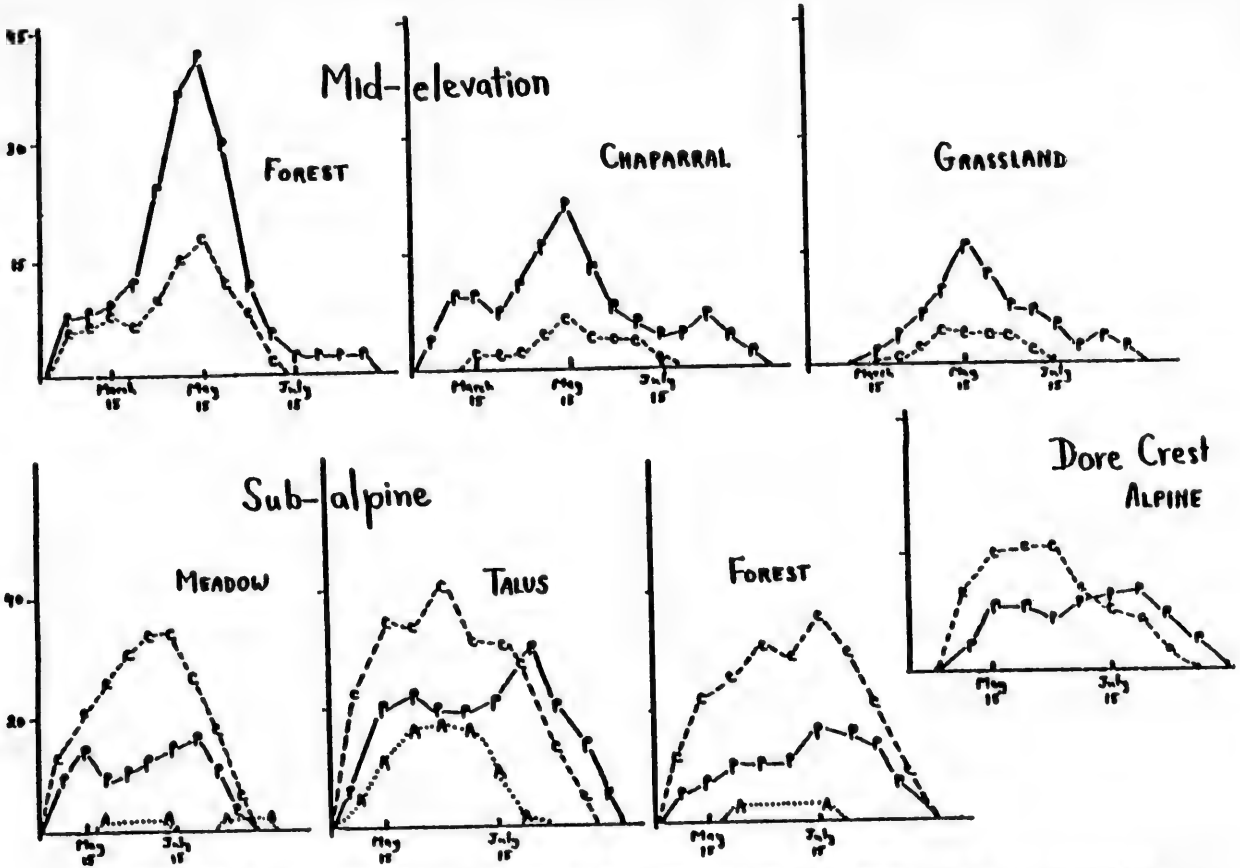


FIGURE 7. Total species of genetically self-compatible perennials (C), self-incompatible perennials (P) and annuals (A) in bloom throughout the weeks of the blooming season in subalpine and alpine localities; at mid-elevation only all genetically incompatible (P) and all genetically self-compatible (C) plant species are indicated.

On the other hand, annual plants are usually genetically self-compatible in California. Though there are too few annual plants at subalpine and alpine localities for analysis, annual plants are abundant in the Mather forest and grassland. For annual plant species which possess a genetically self-incompatible breeding system, little advantage would accrue in blooming during the peak of competition from synchronously blooming species. If annuals bloom "too early" or "too late" in the season relative to general pollinator abundance, they likewise would suffer reduced seed set unless they had coevolved with a particular specialist-feeding pollinator. Reduced seed set has much greater consequences for annuals than for perennials. Hence the observation that genetically incompatible annuals are disproportionately abundant during the flanks rather than the peaks of blooms in Mather forest and grassland supports the hypothesis that flowering phenology is in large part determined by the availability of pollinators (Figure 8); there are too few genetically incompatible plants in these sites for a firm conclusion though.

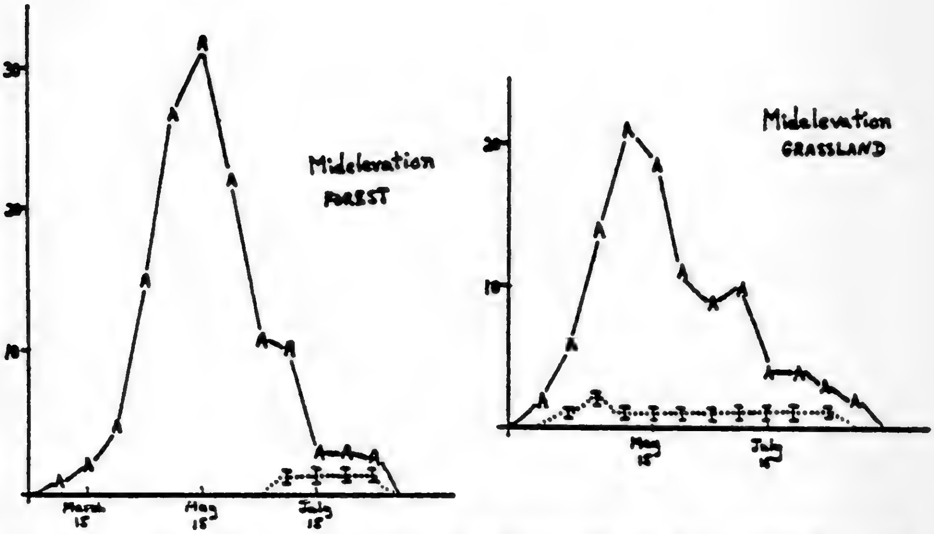


FIGURE 8. Temporal occurrence of genetically self-compatible (A) and genetically self-incompatible (I) annual plants during the year.

e) Length of Blooming Period

If there is a maximum theoretical value of niche overlap (anthesis synchrony), then in communities with short blooming seasons, the blooming period of each species should be correspondingly reduced if species richness remains the same. High relative abundance or exceptional floral attractivity might counter this trend in instances of specific species.

The alpine, mid-elevation chaparral and mid-elevation grassland communities each contain about 35 species in bloom at the peak week of anthesis; the total blooming season at the alpine site is two months less than that at Mather but the average length of individual anthesis times is nearly two weeks longer than that of the mid-elevation chaparral or grassland (Table 15). Likewise, a similar lengthening of the blooming period in species-rich communities with short total blooming seasons is apparent in the subalpine forest and subalpine meadow versus the mid-elevation forest comparisons. Hence, the trend observed runs counter to the one expected.

Blooming Season per Species
(weeks)

COMMUNITY	compatible species	incompatible species	total length of season
Midelevation			
chaparral	2.6	3.0	28
forest	2.6	2.8	26
meadow	2.7	2.7	24

COMMUNITY	compatible perennials	incompatible perennials	annuals	total length of season
Dore Crest alpine	4.0	4.2	—	18
Subalpine				
talus	4.1	3.9	4.0	22
forest	4.1	3.5	4.5	18
meadow	4.1	3.5	3.3	18

TABLE 15. Average length of blooming season for an individual plant species in each of the experimental regions.

However, another contrasting possibility conforming to predictions would be for selective advantage to accrue to genetically compatible plants under the conditions of the shorter blooming season. This alternative apparently is the more usual happening, since the shortening of the blooming season is indeed correlated at all seven sites with an increasing total percentage of self-compatible species.

In carrying this line of reasoning one step further, we would hypothesize that in pollinator-poor communities the length of blooming period for each pollinator-limited (genetically incompatible) species should increase relative to species capable of selfing. We observe, in fact, the opposite tendency in all the alpine and subalpine communities. The mean length of anthesis period for incompatible plants in all high-elevation communities is 3.8 (range = 3.5-4.2) weeks, whereas it is 4.1 (range = 4.0-4.1) for the compatible perennials (Table 15).

POLLINATOR BEE DISTRIBUTION & COEVOLUTION OF SPECIALIST FEEDING HABITS

Bees are the effective pollinators of an average of 52% of the Timberline and 66% of the Mather plant species (including anemophilous species). Not only do they account for the pollination of more species of plants than any other group, they are also, by far, the most species-rich assemblage of floral visitors (Moldenke 1976). In addition, since many species will consistently visit the flowers of only one species or genus of plants, regardless of density or the abundance of competing flowers, many bee species assume a unique pollinator role, far out of proportion to their often small sizes and limited numbers.

There are approximately 520 species of pollen-collecting bees resident in the Sierra Nevada. The southern half of the mountain chain is the most species rich, supporting 1.25x the number of species in the northern region (ca. 350), while the alpine regions support only about 0.5x the number of the northern forested and scrub regions (Moldenke 1976). The bee fauna of the Sierra Nevada demonstrates a very low degree of endemicity (ca. 6%; Table 16). Within the Sierra Nevada the range of most species includes the entire length of the mountain chain, with 5% distributed additionally throughout only the coastal mountains of California as well. Thirteen percent have ranges including all the mountainous regions along the Pacific Coast north into Canada; 29% are distributed throughout all the mountains of western USA and Canada; and 8% are distributed transcontinentally through Canada and the northern United States to the Appalachians and the East Coast. Nearly all of the Sierran bees with ranges that basically

DISTRIBUTION OF SIERRAN BEES

	transcontinental n.N.Am	montane w US & Canada	high alpine w US & Canada	Great Basin N.Am.	southern California	arid southwest USA	Pacific Coast mts. only	all California -deserts, alpine	endemic Sierran
COLLETIDAE									
Colletinae (12)	5	4	0	2	1	0	0	0	0
Hylaeinae (18)	4	5	2	3	0	1	1	1	1
MELITTIDAE (2)	0	0	0	0	2	0	0	0	0
ANDRENIDAE									
Andreninae (106)	12	34	6	12	13	4	16	16	4
Panurginae (53)	0	1	0	8	22	2	5	4	13
HALICTIDAE									
Halictinae (26)	2	8	0	7	13	7	4	0	0
Dufoureinae (27)	0	2	1	1	11	0	6	0	6
MEGACHILIDAE									
Anthidiini (34)	1	11	1	12	0	4	2	3	0
Megachilini (154)	13	59	7	23	21	7	28	2	10
ANTHOPHORIDAE									
Anthophorinae (68)	4	18	0	21	19	9	12	1	1
Xylocopinae (9)	4	0	0	0	0	1	3	2	0
APIDAE									
Bombini (23)	8	7	1	2	0	0	5	0	0
519	47	153	18	91	100	35	81	30	39

TABLE 16. Distributional ranges (inclusive) of bee species inhabiting the Sierra Nevada. Cleptoparasitic bees excluded from analysis.

which patterns of floral dependencies have evolved within the Sierra Nevada. The floral choice preferences of many bees are reasonably well-known within California, but since there has been relatively less work done in other regions of the American West, one cannot determine with assurance whether the flowers utilized in regions outside of California are the same or not. Bees with apparent generalized feeding habits over broad geographic expanses may be specific to single species locally; and vice-versa. When it is well-established that certain widespread bees are indeed specialized feeders on the same plant genus throughout all of western United States, for instance, I know of no way to distinguish the area where the floral dependence first evolved and the areas to which it subsequently spread. Presumably such species may belong to alliances that originated in the montane Rocky Mountains and subsequently spread westward to occupy the Sierra Nevada.

However, the segment of the bee fauna of the Sierra Nevada which is either strictly endemic or confined to California and immediately adjacent regions and has phylogenetic origins traceable either within California itself or to the southwestern deserts, provides a partial explanation of the pattern of coevolutionary inter-relationships and how they evolved. Approximately 33% of the total bee fauna of the Sierra appears to be generalized feeders; only 5% of the locally evolved and endemic species seem to be generalized feeders. Most of the Sierran bee species with generalized feeding tendencies are apparently part of transcontinentally or Holarctically distributed genera (e.g., *Bombus*, *Evylaeus*, *Dialictus*, *Hylaeus*, *Ceratina*); since they demonstrate generalized feeding traits one might expect that their distributions would be less constrained and that their ancestries would be less easily traceable to a particular include the entire Great Basin vegetation, are restricted in large part to the alpine and high-elevation east-facing slopes. Seventeen percent are distributed primarily in the montane chaparral and grasslands of southern California; within the Sierra Nevada these species are largely confined to the chaparral regions of Kern and Tulare Counties. Very few resident species are primarily distributed throughout the arid southwestern United States, though a large percentage of the Sierran bees have evolutionary ancestries clearly traceable to these southern arid regions of the United States and northern Mexico (about 40 resident genera and subgenera: Moldenke 1976b).

The wide distributions of most bees inhabiting the Sierra Nevada, renders difficult the task of determining precisely

TABLE 17

SIERRAN POLLEN-COLLECTING BEES

feeding specialization	#species	#independently evolved groups
— polyleges —	170 (6?)	47
— unknown —	55	—
summer/fall composites	75	21
Lasthenia	1 (1?)	2
Stephanomeria	2	2
Spring dandelions	4	1
Sunflowers	4	4
Lupinus/Lotus/Astragalus	25 (2?)	8
Trifolium	7	4
Psoralea	1	1
Clarkia	9 ([illegible])	3
Cayophytum	5 (1?)	2
Camissonia	3 (1?)	3
Phacelia	19	9
Eriodictyon	2	2
Cryptantha	10	3
Salix	12 (2?)	8
Ceanothus	7 (2?)	7
Lomatium/Sanicula	3	2
Cruciferae	2	2

feeding specialization	#species	#independently evolved groups
Mimulus	2 (1?)	2
Salvia/Lepechinia/Trichostema	1	1
Penstemon	9	3
Campanula	2	2
Limnanthes	2	2
Gilia/Linanthus	6 (1?)	5
Navarretia	1	1
Arenaria	1	1
Ribes	1	1
Symphoricarpos	1	1
Zygadenus	9	3
Eschscholzia	2	2
Monardella	1	1
Eriogonum	3	2
Perideridia	(1?)	1
Potentilla	6	5
Adenostoma	1	1
Calystegia	1	1
Malacothamnus	1	1
Sidalcea	2	1
Mertensia	2	1
Arctostaphylos	2	2
Ranunculus	5	3

source area. The widespread genus *Dianthidium*, is comprised in large part of specialized feeders; however, *D. dubium* of the Sierra Nevada belongs to a complex of closely related (and probably primitive) group of species which are all generalized feeders.

As Table 17 reveals, there are specialist-feeding bees associated with at least 48 plant genera throughout the Sierra Nevada (57% specialists, 10% feeding preference unknown -- of total bee fauna). Of the bees whose origins we can trace with some degree of accuracy, there are four basic patterns to their coevolutionary lineages of host associations. One large group of species (28) represents Sierran-endemic specialists which feed on the same group of plants as their closest relatives do elsewhere; the effected plant genera are widespread (e.g., *Calochortus*, *Camissonia*, spring dandelions, *Eriogonum*, *Eschscholzia*, fall & summer composites, *Lupinus*/*Astragalus*, *Penstemon*, *Phacelia*). Another group (at least 9) of these specialist bees are quite probably derived directly from ancestors with broadly generalized feeding tendencies; with the exception of *Centris rhodomelas* on *Psoralea* and *Ashmeadiella salviae* on *Salvia*/*Lepechinia*/*Trichostema*, the plant genera concerned have been the realized objective of coevolutionary feeding switches on many occasions (e.g., *Clarkia*, *Eriogonum*, *Eschscholzia*, *Gilia*, *Lasthenia*). The third group (27 species) embraces host switches between genera within the same family (Compositae, Hydrophyllaceae/Boraginaceae, Malvaceae, Onagraceae, Polemoniaceae). With the exception of the shifts from *Eriastrum* and *Sphaeralcea*, most involve radical changes in the timing or emergence dates to be synchronous with the new host (Table 18). Another clearly defined class (15 species) of host-plant switches involves radical taxonomic changes but little if any temporal displacement (Table 19). In only two cases (*Camissonia* to *Ranunculus*; *Sidalcea* to *Clarkia*) do the old and the new hosts look strikingly similar to the human eye. There are 18 other instances of circumstantial host-switches involving a new host very dissimilar from whatever the ancestor is likely to have specialized upon (host ancestry unknown, presumably a specialist but no relatives feeding on anything at all related) and additionally within the genera *Andrena* (9 species), *Panurginus* (1 species) and *Micralictoides* (2 species) there are specialized feeders whose ancestry is obscure (the ancestors may have been generalized feeders or perhaps specialists on very unrelated plant groups).

TABLE 17. Total number of species and total number of different phyletic lineages of specialist-feeding bees associated with indicated plant genera within the Sierra Nevada. Grasslands within the Central Valley proper excluded from analysis.

Though such studies on a wider geographic scale have not been undertaken, presumably these same four classes of coevolutionary relations with host plants are encountered in all regions that support specialist-feeding bees. A full listing of the pollen-collecting bees resident in the Sierran region is given in the Appendix; plant host data are supplied wherever known. The large genera *Dialictus*, *Andrena*, *Panurginus*, and *Osmia* are currently under taxonomic revision; *Evylaeus* and *Emphoropsis* are in need of revision still.

OCCURRENCE OF CORNUCOPIA SPECIES

As pointed out in previous publications (Moldenke 1975, 1976), in all communities the distribution of pollinator species per plant is log-normal, that is there are very large numbers of plants serviced by 0-2 pollinator species, much fewer by several pollinator species and extremely few species of plants serviced by disproportionately large numbers of pollinator species. "Cornucopia species", defined as species supporting 5x the average number of pollinators per species for the entire community (Moldenke & Lincoln 1979), are basically the result of the differential success of the different species in competing for pollinators.

Coevolutionary Host-Plant Switches

I range extension associated with same/similar plant genus in ancestral area (29)

II polylectic generalized-feeding ancestor gives rise to specialized-feeding descendent (9)

III range extension associated with a switch to a different (but confamiliar) genus
—usually involving a shift in seasonal emergance time

IV a shift of hosts to a taxonomically unrelated genus
—usually not involving a temporal switch
—often between visually very distinct groups

TABLE 18. The four types of coevolutionary host association demonstrated by bees within the Sierra Nevada.

GROUP III HOST-SWITCHES:

Camissonia → Clarkia	Andrena (Onagandrena)
Camissonia → Gayophytum	Dufourea (4)
Camissonia → Clarkia	Andrena (Diandrena)
Camissonia → Gayophytum	Andrena (Onagandrena)
Oenothera → Clarkia	Megachile (Derotropis) (2)
Sphaeralcea → Malacothamnus	Diadasia
Sphaeralcea → Sidalcea	Diadasia (2)
Eriastrum → Gilia	Perdita (Glossoperdita)
Eriastrum → Navarretia	Perdita (Glossoperdita)
Summer composites → Stephanomeria	Melissodes (Callimelissodes)
summer composites → Lasthenia	Andrena (Stenandrena)
Phacelia ←?→ Nemophila	Dufourea (2)
Phacelia → Cryptantha	Proteriades (7)
Eriodictyon ←?→ Phacelia	Nomadopsis (Micronomadopsis) (2

GROUP IV HOST-SWITCHES:

Larrea ?→ Adenostoma	Hesperapis (Amblyapis)
Camissonia ?→ Arenaria	Andrena (Diandrena)
Camissonia → Ranunculus	Andrena (Diandrena)
Lasthenia → Linanthus	Andrena (Callandrena)
Ranunculus → Limnanthes	Panurginus
Ranunculus → Nemophila	Panurginus (2)
Calochortus ?→ Potentilla	Nomadopsis (Nomadopsis) (2)
Potentilla → Monardella	Nomadopsis (Nomadopsis)
Calochortus ?⇄ Eriodictyon	Nomadopsis (Nomadopsis)
Campanula ←?→ Calochortus	Dufourea (2)
Sphaeralcea → Clarkia	Diadasia
Summer composites → Clarkia	Melissodes (Callimelissodes)
Lasthenia → Limnanthes	Andrena (Hesperandrena)

TABLE 19. Examples of coevolutionary host association switches hypothesized, corresponding to the latter two categories in Table 18. Numbers in parenthesis indicate the total number of species within the group endemic to the Sierra Nevada. Many of these examples must be regarded as tentative in the light of present knowledge of the recent phylogeny of bees within California.

Since all of the species (Table 20) have generally open polyphilic flowers that can be utilized by any available flower-feeder, their temporal occurrence during the season is a clear clue to the strength of competition for pollinators. Polyphilic flowers could not be cornucopias if they bloomed at the peak of synchronous bloom unless they were the overwhelming contributant to the floral biomass as long as pollinators were abundant and diverse and utilizing most of the plant species present. Cornucopias are very seldom the dominant plants in the communities studied, hence the fact that all cornucopia species (14) at Mather occur primarily during the late summer and not during the peak follows expectation (Table 20). At

CORNUCOPIA SPECIES

	minimum number of species defining a cornucopia	# Cornucopia species	temporal occurrence of Cornucopia anthesis periods
DORE CREST	16	1	peak
SUBALPINE			
TALUS	37	7	peak
FOREST	32	2	peak
MEADOW	14	4	peak
MID-ELEVATION			
CHAPARRAL	55	3	2 at peak 1 later than peak
FOREST	20	8	late skew
GRASSLAND	43	3	bimodal around peak

TABLE 20. Abundance and temporal occurrence of cornucopia species at the experimental sites. Cornucopia species are defined as species visited by five times the average number of flower-visiting species characteristic of that community. Species are: Erigeron sp.; Eriogonum spp. (2), Sphenosciadium, Ligusticum, Potentilla, Senecio, Solidago; Ligusticum, Potentilla glandulosa; Veratrum, Polygonum bistortoides, Potentilla, Salix, Ranunculus californicus, Perideridia, Solidago; Clarkia spp. (2), Chamaebatia, Monardella, Gilia capitata, Eriogonum nudum, Thysanocarpus, Horkelia; Eriodictyon, Ceanothus integerrimus, Haplopappus. (in order indicated on Table)

Tioga Pass and Dore Crest the cornucopia species occur temporally during the peak of synchronous bloom. These high altitude localities are so pollinator-limited, 1/14 to 1/100 respectively the number of pollinators at Mather communities (Moldenke 1975), that they represent basically the only species which have successfully attracted any pollinators at all; the average number of pollinator species per cornucopia species must be at least 40 at Mather but is only 24 at these high-altitude sites.

DISCUSSION

The data cited in this analysis were not collected specifically for the approach taken herein. I am of the firm conviction that any such studies must quantify micro-environmental and year-to-year variability in order to be sufficiently rigorous to purport to be more than introductory hypotheses. Specifically, such a study must quantify the initiation of anthesis by a species within an area, the initiation and cessation by each component population thereof, and the average length of anthesis (and variance thereof) by individual plants. Since this type of information is not available to my knowledge, I have utilized data from my own field studies to outline what I hope to be interesting approaches that subsequent researchers may test. Likewise, I have not employed statistical tests in this approach, lest they impart the impression of rigor that the data base does not warrant.

SUMMARY

Competition between plants for pollinators increases the blooming season of plant species in pollinator-limited environments, thus increasing the percentage of the flora that is blooming during any given week. Perennials, then, have a premium on blooming immediately following the dormant season. In communities that are not seriously pollinator-limited, floral initiation time is not pulsed and rather conforms to the Central Limit Theorem, implying independent control on the flowering phenology of each species. As the total length of permissible blooming season lengthens, the peak of maximum synchronous bloom is delayed. The peak in total available community floral biomass is not always correlated to maximum number of species in bloom; additionally, some of the least important contributants to community floral biomass are the most heavily visited by pollinators and vice-versa. Though annual plants as a group might be expected to differ significantly from perennial plants in the timing of their blooming season, in fact they do not.

Though competition for pollinators in communities with progressively more total species would be expected to produce a larger percentage of self-compatible species (the "losers") at the peak of the bloom and a larger emphasis on exclusion floral morphologies (the winners, or the ones that can "afford an insurance policy"), this in fact does not take place. The total percentage of self-compatible species in a community is determined by community type. The percentage of species with exclusion flowers of the total species is apparently consistent in all Sierra Nevada communities.

Within all communities the proportion of genetically self-compatible species that is in fact unvisited by pollinators and therefore has to habitually self is highest at the peak of synchronously blooming species. Additionally, this competition for pollinators is revealed in the disproportionate occurrence of genetically incompatible annual species flanking the anthesis peak, while the disproportionate abundance of self-compatible perennial species occurs at the anthesis peak.

Plant communities which are pollinator-limited have much fewer total entomophilous and ornithophilous species at the peak of anthesis, since a larger percentage of the community species total is wind-pollinated; the precise number of successfully animal-vectored species in a community varies widely and does not cluster about a particular limit independent of community type. A mechanism which permits the successful synchronous outcrossing at the peak of bloom is the disproportionate number of plants serviced by specialist-feeding bees; this allows efficient pollination even when in low density or when competing species may have successfully usurped all the generalist pollinators. Specialized-feeding habits of course would not evolve in bees, if it were not competitively forced upon them by competition for their floral resources as well; more species of specialist-feeding bees are in fact active during the peak synchrony of anthesis than at any other period.

Most of the bees native to the Sierra Nevada are rather widespread throughout mountainous western United States, and endemicity is very low. Bee species endemic to montane California and with phylogenetic lineages traceable to California itself or desert southwestern U.S.A. are largely specialized in their feeding habits. They demonstrate four patterns of coevolutionary host-specialization and switching: specialist-feeding species on hosts with relatives on congeneric hosts in adjacent areas; specialist-feeders on plant genera commonly associated with many specialist-feeding groups, evolved directly from generalist feeders; specialist-feeders on different genera with different anthesis times within the same plant family; and specialists on species of plants blooming synchronously with the original hosts, but taxonomically and morphologically distinct.

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APPENDIX: Bee fauna of the Sierra Nevada, pollen-plant sources given where known. Due tb the very preliminary state of knowledge of the biology of these many species, an indication of the relative degree of assurance about their pollen-gathering habits is noted: F= established fact; IV= data insufficient, needs verification but quite probably correct; ZV= extremely little direct evidence, definitely needs verification, conclusion based on indirect evidence; R=indirect evidence based on the clearly established bahavior of closely related species. Cleptoparasitic bees not included in table. *=species not clearly established as living within the Sierra *per se*. VR=very rare; R=rare; IF=infrequent, but locally abundant; FR=frequent; EA=extremely abundant.

Colletes californicus* - Phacelia,F - AB
Colletes compactus* - Compositae,IV R - R
Colletes consors pascoensis - Phacelia,
Mertensia?,ZV - AB
Colletes fulgidus fulgidus - Compositae,F
- VA
Colletes hyalinus* - polylectic,IV - VR
Colletes kincaidii - polylectic,IV - AB
Colletes lutzi monticola - Compositae +?,
IV - FR
Colletes nigrifrons - Potentilla,IV - R
Colletes paniscus mertensiae - Mertensia,
F - VR
Colletes phaceliae - polylectic?,ZV - VR
Colletes simulans simulans - Compositae,
F - VA
Colletes slevini - polylectic.IV - VA
Hylaeus basalis - polylectic(Rosaceae),IV
- VA
Hylaeus calvus - polylectic,F - VA
Hylaeus coloradensis - polylectic,F - FR
Hylaeus cressoni cressoni - polylectic,F
- EA
Hylaeus ellipticus - polylectic,F - OC
Hylaeus episcopalis coquilleti - polylectic
F - VA
Hylaeus episcopalis episcopalis -
polylectic,F - VA
Hylaeus modestus citrinifrons - polylectic
F - VA
Hylaeus nevadensis - polylectic,F - VA
Hylaeus nunnenmacheri - polylectic,F - VA
Hylaeus personatellus - polylectic,F - OC
Hylaeus rudbeckiae - polylectic, F - VA
Hylaeus timberlakei - polylectic,F - OC
Hylaeus verticalis - polylectic,F - VA
Hylaeus wootoni - polylectic,F - VA
Hesperapis ilicifoliae - Adenostoma,F-LA
Hesperapis regularis - Clarkia,F - LA
Andrena ablegata - Agoseris,F - R
Andrena albihirta - Salix,IV - OC
Andrena amphibola - polylectic?,IV - AB
Andrena angustitarsata - polylectic,IV-AB
Andrena arctostaphyllae - Arctostaphylos,
IV - OC
Andrena astragali - Zigadenus,F - R
Andrena auricoma - polylectic,IV - AB
Andrena birtwelli - Potentilla,F - LF
Andrena candida - polylectic(Ceanothus),
IV - AB

Andrena candidiformis - Ceanothus +?,IV - AB
Andrena carliniformis - polylectic?,IV-EA
Andrena ceanothifloris - Ceanothus,IV -FR
Andrena cercocarpi - unknown,ZV - OC
Andrena chalybioides - Agoseris,F R - LA
Andrena chapmanae - unknown,ZV - AB
Andrena chlorogaster - polylectic,F - VA
Andrena chlorura - unknown,ZV - IF
Andrena cleodora melanodora - Ceanothus, IV - VA
Andrena cleodora cleodora - Ceanothus,IV -VA
Andrena chylismiae - Camissonia,F - R
Andrena citrinihirta - Compositae,F - R
Andrena coerulea - Ranunculus,F - EA
Andrena colletina* - Compositae,F - IF
Andrena columbiana - Compositae,F - AB
Andrena concinnula - Salix,F - VA
Andrena congrua - unknown,ZV - OC
Andrena costillensis - Compositae?,R-R
Andrena crataegi - polylectic (Rosaceae) F - AB
Andrena cressoni cressoni - unknown,ZV R
Andrena cressoni infasciata - Salix?,ZV R
Andrena cristata - Arctostaphylos,IV-R
Andrena crudeni - Nemophila,F - AB
Andrena cryptanthae - Cryptantha,F - VR
Andrena cuneilabris - Ranunculus,F - VA
Andrena cupreotincta - polylectic?,IV - VA
Andrena cyanophila - Potentilla, Ranunculus,IV - FR
Andrena duboisi - Lasthenia,Layia,F-LF
Andrena eothina - Camissonia,F - LA
Andrena erecta - unknown,IV - FR
Andrena errans - Salix,IV - AB
Andrena evoluta - Agoseris+,F - LA
Andrena flocculosa - Cornus?,ZV R - VR
Andrena forbesii - Rosaceae +?,IV - R
Andrena foxii - Camissonia,F - LA
Andrena helianthi* - Compositae,F - VR
Andrena fuscicauda - polylectic (Ceanothus),IV R - AB
Andrena gibberis - Salix,IV R - R
Andrena hippotes*- polylectic,IV - IF
Andrena huardi - Salix?,IV - FR
Andrena knuthiana - polylectic??,IV-FR

Andrena latifrons - unknown,IV - OC
Andrena limnanthis - Limnanthes,F - LF
Andrena lawrenci* - Compositae,IV - R
Andrena levipes - Linanthus?,IV - AB
Andrena lewisorum - Clarkia,F - LF
Andrena livida - polylectic,IV - OC
Andrena lupini - Ceanothus (+Eschscholzia?),IV - LF
Andrena lomatii - Lomatium,Sanicula F-AB
Andrena mackiae - Ceanothus??,IV - AB
Andrena macrocephala* - Nemophila,F-AB
Andrena medionitens - polylectic,IV - R
Andrena melanochroa - Potentilla,IV - IF
Andrena mesoleuca - unknown,ZV - VR
Andrena microchlora - Lomatium,Sanicula F - VA
Andrena miranda* - polylectic,IV - R
Andrena miserabilis - polylectic,F - FR
Andrena nemophilae* - Nemophila, Pholistoma,F - R
Andrena nevadensis - Salix,F - FR
Andrena nigrocaerulea - polylectic,F-VA
Andrena nudiscopa - unknown,ZV - R
Andrena nivalis* - unknown,ZV - R
Andrena nothocalaidis - dandelions,F-IF
Andrena obscuripostica - Arctostaphylos? IV - OC
Andrena orthocarpi - Lasthenia,Orthocarpus IV R - IF
Andrena osmioides osmioides - Cryptantha,F - FR
Andrena pallidifovea - Compositae,IV R - R
Andrena perplexa - polylectic?,IV - R
Andrena perarmata - Salix?,IV - LF
Andrena perimelas - polylectic?,IV - AB
Andrena pertristis - polylectic?,IV - OC
Andrena plana - Trifolium,F - OC
Andrena porterae - unknown Ribes?,ZV - R
Andrena prunorum prunorum - polylectic,F -EA
Andrena puthua - Lasthenia,F - LA
Andrena quintiliformis - polylectic (Ceanothus),IV - AB
Andrena ribblei - unknown,ZV - R
Andrena saccata - unknown,ZV - IF
Andrena salicifloris - polylectic (Salix) F - VA
Andrena sigmundi*- Salix,F - VR
Andrena scurra scurra - Ceanothus?,IV-IF

Andrena scutellinitens - Compositae,F-FR
Andrena semipunctata - Salix,F - EA
Andrena sola - polylectic?,IV - VA
Andrena subaustralis - Salix,F - FR
Andrena striatifrons - Salix,F - EA
Andrena suavis - Ranunculus,F - EA
Andrena submoesta - Lasthenia +?,F - AB
Andrena subtilis - polylectic?,IV - AB
Andrena surda - Compositae,F - IF
Andrena torulosa - Nemophila,F - LA
Andrena timberlakei - Cryptantha,F - FR
Andrena transnigra - unknown,ZV - EA
Andrena trevoris - unknown,ZV - OC
Andrena trizonata - Salix,IV - OC
Andrena vanduzeei - Gayophytum,IV - R
Andrena vandykei - polylectic (Ceanothus), IV - FR
Andrena vierecki - unknown,ZV - OC
Andrena vexabilis - Lasthenia,F - R
Andrena vulpicolor* - Compositae,F - VR
Andrena w-scripta - polylectic,F - FR
Panurginus atriceps - Nemophila,Ceanothus, IV R - LF
Panurginus ceanothi - Ceanothus?,ZV R-VR
Panurginus nigrellus - Nemophila?,IV - LF
Panurginus nigrihirtus - Ranunculus,IV-LF
Panurginus occidentalis - Limnanthes,F-LF
Nomadopsis anthidia anthidia - Trifolium F - EA
Nomadopsis boharti - unknown,ZV - R
Nomadopsis cincta cincta*- Calochortus,F - IF
Nomadopsis comptula - Potentilla,F - LF
Nomadopsis edwardsii - Potentilla, (Calochortus),F - VA
Nomadopsis filiorum*- Trifolium,ZV R-VR
Nomadopsis fracta - Eriodictyon,F - LA
Nomadopsis linsleyi - Eriodictyon,F - AB
Nomadopsis micheneri - Trifolium,F - FR
Nomadopsis obscurella - Eschscholzia, IV - VA
Nomadopsis phaceliae* - Phacelia?,IV - R
Nomadopsis scutellaris - polylectic,IV-VA
Nomadopsis solitaria*- unknown,ZV - VR
Nomadopsis trifolii - Trifolium,Mimulus IV R - R
Nomadopsis xenus - Phacelia?,IV - VR
Nomadopsis zonalis sierrae - Monardella, F - VR

Perdita adjuncta* - Compositae,F R - R
Perdita aemula* - Compositae,ZV R - VR
Perdita bilobata*- Calochortus,IV R - OC
Perdita blaisdelli - Polemoniaceae,ZV R-R
Perdita bohartorum - unknown,ZV - VR
Perdita calochorti*- Calochortus, F R - R
Perdita ciliata - Compositae,F R - FR
Perdita claypolei limulata - Eriogonum, F R - VA
Perdita digna - unknown,ZV - VR
Perdita foleyi - Compositae,F R - VR
Perdita hirticeps* - Stephanomeria,F - VR
Perdita imberbis - unknown,ZV - VR
Perdita lepidosparti* - Compositae,ZV R-R
Perdita leucostoma - Calochortus,F R - AB
Perdita melanogastra - unknown,ZV - VR
Perdita navarretiae angusticeps - Polemoniaceae,ZV R - VR
Perdita navarretiae navarretiae - Polemoniaceae,F R - R
Perdita navarretiae powelli - Polemoniaceae,ZV R - VR
Perdita nevadensis culbertsoni - Perideridia,IV-LA
Perdita nevadensis nevadensis - unknown (Eriogonum?),IV - LA
Perdita nigrocincta*- Compositae,ZV R -VR
Perdita obtusa - Eschscholzia,Calochortus ?,ZV R - VR
Perdita oregonensis expleta - Compositae, ZV R - VR
Perdita oreophila - unknown,ZV - VR
Perdita panocheana* - unknown,ZV - VR
Perdita placida* - Compositae,ZV R - VR
Perdita pulliventris - Calochortus?,ZV R - VR
Perdita rivalis - Aster,Erigeron F R - FR
Perdita salicis tristis - Salix,F R - LA
Perdita scotti - Compositae,F R - IF
Perdita stottleri* - Compositae,F R - R.
Perdita subfasciata* - Compositae,F R-VR
Perdita sweezyi - Compositae(Erigeron), F R - IF
Perdita trisignata ornata - Lotus,F - AB
Perdita tularensis - Calochortus,F R - LF
Perdita yosemitensis - Eriogonum,F R - IF
Perdita zonalis monticola - Compositae, F R - VR
Halictus farinosus - polylectic,F - EA
Halictus ligatus - polylectic,F - EA

Halictus rubicundus - polylectic,F - AB
Halictus tripartitus - polylectic,F - EA
Dialictus -- unmonographed genus--
numerous species, all polylectic
in Sierra Nevada despite published
reports to contrary (Eickwort,
pers. comm.)

Lasioglossum mellipes - polylectic,F - AB
Lasioglossum olympiae - polylectic,F - AB
Lasioglossum sisymbrii - polylectic,F- VA
Lasioglossum titusi - polylectic,F - AB
Lasioglossum trizonatum - polylectic,F-AB
Evylaeus aberrans - Oenothera,IV - OC
Evylaeus allonotum - polylectic,F - FR
Evylaeus aspilurum - polylectic,F - IF
Evylaeus avalonense - polylectic,F - IF
Evylaeus cooleyi - polylectic (Clarkia),
F - AB
Evylaeus dasiphorae - polylectic? - VR
Evylaeus glabriventre - polylectic,F -FR
Evylaeus kincaidii - polylectic,F - AB
Evylaeus miguelense - polylectic,F - FR
Evylaeus nigrescens - polylectic,F - EA
Evylaeus orthocarpi - polylectic,F - FR
Evylaeus ovaliceps - polylectic,F - AB
Evylaeus pullilabre - polylectic(Clarkia)
IV - AB
Evylaeus sequoiae - polylectic? - IF
Evylaeus tracyi - polylectic,F - IF
Augochlorella pomoniella - polylectic,
F - VA
Agapostemon femoratus - polylectic,F-EA
Agapostemon texanus angelicus - polylectic
F - EA
Nomia melandri - polylectic(Medicago),
F - EA
Micralictoides ruficaudis - Eschscholzia
F - R
Micralictoides sp. #1 - Gilia capitata,F
- VR
Micralictoides sp. #2 - Campanula,IV - VR
Dufourea leechi - unknown,IV - R
Dufourea afasciata - Trifolium,F R - IF
Dufourea australis* - Compositae,F - IF
Dufourea bernardina - unknown,IV - IF
Dufourea brevicornis - Gilia,Linanthus,
F R - OC
Dufourea calientensis - unknown,IV - IF
Dufourea calochorti - Calochortus,F R-VR

Dufourea cuprea - Nemophila,F R - R
Dufourea davidsoni - Gayophytum,F R - IF
Dufourea dentipes - Calochortus,F R - IF
Dufourea femorata - Gilia capitata,F - FR
Dufourea fimbriata fimbriata - Potentilla F - R
Dufourea fimbriata sierrae - Potentilla, F - R
Dufourea holocyanea - Symphoricarpos,F-R
Dufourea macswainii - Clarkia,F - R
Dufourea nemophilae - Phacelia,Nemophila F R - IF
Dufourea neocalifornica - Linanthus,F-VR
Dufourea pectinipes - Gilia,Mimulus?,IV R - VR
Dufourea sandhouseae sandhouseae - polylectic (Eschscholzia),F - VA
Dufourea scabricornis - Gayophytum,F R -LF
Dufourea spilura - Gayophytum,F R - LF
Dufourea spinifera - Trifolium,F R - R
Dufourea subdavidsoni - Gayophytum,F R -FR
Dufourea trochantera - Phacelia,F R - LA
Dufourea tularensis - unknown,ZV - VR
Dufourea tuolumne - Gilia,F R - R
Dufourea versatilis rubriventris - Mimulus,F - AB
Dufourea versatilis versatilis - Gilia, Mimulus?, IV R - IF
Dufourea virgata - unknown(polylectic?), IV - VA
Heteranthidium timberlakei - polylectic, IV R - FR
Anthidium atripes* - Lotus,Astragalus, IV R - AB
Anthidium banningense - Phacelia,IV R -AB
Anthidium clypeodentatum - Lotus,Lupinus, Astragalus,IV - OC
Anthidium collectum - Lotus,Phacelia, IV R - EA
Anthidium edwardsii - polylectic,F - VA
Anthidium emarginatum - Phacelia,legumes, IV R - VA
Anthidium jocosum - polylectic (Lotus), IV R - AB
Anthidium maculosum - polylectic,IV - VA
Anthidium mormonum - Phacelia,legumes IV R - EA
Anthidium placitum - polylectic,IV R - AB
Anthidium tenuiflorae - Phacelia,legumes IV R - AB

Anthidium utahense - legumes,IV R - EA
Callanthidium formosum - polylectic?, IV - FR
Callanthidium illustre - polylectic (Phacelia,legumes)IV R - VA
Dianthidium dubium dubium - polylectic, IV R - VA
Dianthidium heterulkei heterulkei* - Compositae,F R - IF
Dianthidium platyurum mohavense*- Compositae,F R - VR
Dianthidium plenum - polylectic,IV R-OC
Dianthidium pudicum consimile - Compositae,F R - AB
Dianthidium pudicum pudicum - Compositae,F R - AB
Dianthidium singulare - Compositae,F R-OC
Dianthidium subparvum - Compositae,F R-AB
Dianthidium ulkei - Compositae,F R - EA
Anthidiellum ehrhorni - polylectic,F - FR
Anthidiellum notatum robertsonii - polylectic,F - EA
Chelostoma californicum - Phacelia +?, IV R - AB
Chelostoma incisulum - Phacelia,IV R - OC
Chelostoma marginatum incisuloides - Phacelia, IV R - R
Chelostoma marginatum marginatum - Phacelia, IV R - OC
Chelostoma minutum - Phacelia,F R - LA
Chelostoma phaceliae - Phacelia,F R - LA
Chelostoma tetramerum - unknown,ZV - VR
Chelostomopsis rubifloris - polylectic,F - EA
Ashmeadiella aridula astragali - polylectic(Lotus),IV - VA
Ashmeadiella bucconis denticulata - Compositae,IV - VA
Ashmeadiella cactorum basalis - polylectic(Lotus,Cordylanthus),IV-AB
Ashmeadiella californica californica - polylectic?(Compositae),IV - EA
Ashmeadiella californica sierrensis - Compositae?,IV - R
Ashmeadiella cubiceps cubiceps - Compositae?,ZV R - R
Ashmeadiella difugita emarginata - Compositae?,IV - R
Ashmeadiella foveata - polylectic?,IV-OC
Ashmeadiella rufitarsis*- Eriogonum,IV-R

Ashmeadiella australis - Penstemon,IV-AB
Ashmeadiella erema - Dalea +?,ZV R - VR
Ashmeadiella foxiella - unknown,ZV - VR
Ashmeadiella salviae - Salvia,Lepechinia Trichostemma,IV - OC
Ashmeadiella stenognatha - unknown,ZV-R
Ashmeadiella timberlakei solida - Lotus, Phacelia?,IV - FR
Ashmeadiella timberlakei timberlakei - Lotus, Phacelia, IV - AB
Heriades cressoni - Compositae,IV - VA
Heriades occidentalis - polylectic,IV-LA
Hoplitis clypeata* - unknown,ZV - VR
Hoplitis colei - Eriodictyon,IV - IF
Hoplitis grinnelli grinnelli - polylectic, IV - AB
Hoplitis producta gracilis - polylectic, IV - VA
Hoplitis sambuci - polylectic,IV - VF
Hoplitis uvulalis* - unknown,ZV - R
Hoplitis hypocrita - polylectic (Lotus, Astragalus),IV - AB
Hoplitis albifrons argentifrons - polylectic(Phacelia),F - VA
Hoplitis albifrons maura - polylectic (Phacelia),F - EA
Hoplitis fulgida platyura - Phacelia, IV R - EA
Hoplitis louisae - Phacelia,IV R - R
Hoplitis viridimicans - unknown,ZV-VR
Proteriades laevibullata - Phacelia, Nemophila?,IV R - R
Proteriades plagiostoma - unknown,ZV-VR
Proteriades rufina - unknown,ZV - VR
Proteriades bullifacies* - Phacelia?, IV R - IF
Proteriades bunocephala - Lotus?,IV - R
Proteriades howardi - Lotus,IV R - FR
Proteriades mazourka* - unknown,ZV - R
Proteriades jacintana - Cryptantha,F-FR
Proteriades boharti* - Cryptantha,ZV R-R
Proteriades evansi - Cryptantha,F R - R
Proteriades incanescens tota - Cryptantha,IV R - VR
Proteriades nanula sparsa - Cryptantha, F R - R
Proteriades seminigra yosemitensis - Cryptantha,F R - R

Proteriades remotula - Cryptantha,F R - IF
Anthocopa abjecta abjecta - Penstemon, ZV R - VR
Anthocopa abjecta alta - Penstemon,F R- IF
Anthocopa anthodyta anthodyta - Penstemon,Collinsia,F R - IF
Anthocopa elongata - Penstemon,F R - R
Anthocopa hebitis - Collinsia,Penstemon F R - VR
Anthocopa oregona - Penstemon?,ZV R - R
Anthocopa pycnognatha pycnognatha - Penstemon,F R - VR
Anthocopa pycnognatha solatus - Penstemon,F R - R
Anthocopa triodonta shastensis - Penstemon,F R - R
Anthocopa triodonta triodonta - Penstemon,F R - R
Anthocopa copelandica albomarginata - Phacelia, Nemophila F R - FR
Anthocopa copelandica copelandica - Phacelia,F R - VR
Osmia lignaria propinqua - polylectic,F-EA
Osmia ribifloris biedermannii - polylectic,F - VA
Osmia coloradensis - Compositae,F - EA
Osmia texana - Compositae(Cirsium),F - VA
Osmia californica - Compositae,F - EA
Osmia grinnelli* - Compositae,F - AB
Osmia montana quadriceps - Compositae,F-EA
Osmia subaustralis - Compositae,F - VA
Osmia austromaritima - unknown,ZV - VR
Osmia bakeri - unknown,ZV - R
Osmia bucephala* - unknown,ZV - VR
Osmia pikei - unknown,ZV - R
Osmia thysanica - unknown,ZV - VR
Osmia calcarata - legumes,IV R - R
Osmia giffardi - unknown,ZV - FR
Osmia hurdi - unknown,ZV - R
Osmia integra - legumes,IV - IF
Osmia kenoyeri - unknown,ZV - VR
Osmia lanei - unknown,ZV - R
Osmia longula - legumes,IV R - R
Osmia nifoata - legumes,IV R -FR
Osmia nigrifrons - legumes,IV R - IF
Osmia nigrobarbata - legumes,IV R - VA
Osmia obliqua - legumes,IV R - R

Osmia odontogaster - unknown,ZV - VR
Osmia physariae - legumes,IV R - FR
Osmia sedula - legumes,IV R - R
Osmia melanopleura - unknown,ZV - R
Osmia claremontensis - unknown,ZV - R
Osmia nemoris - polylectic (legumes),IV R, - AB
Osmia latisulcata - legumes,IV R - IF
Osmia aglaia - Lotus?(+Penstemon?),IV R-OC
Osmia bruneri - polylectic?,IV - AB
Osmia calla - legumes,IV R - AB
Osmia cobaltina - polylectic?,IV R - AB
Osmia cyanopoda* - legumes?,IV - VR
Osmia dolerosa - unknown,ZV - R
Osmia exigua - polylectic (Labiatae). IV-OC
Osmia gaudiosa - Lotus,IV R - FR
Osmia inermis - Ericaceae?,IV R - VR
Osmia indeprensa - unknown,ZV - IF
Osmia inurbana - unknown?,ZV - IF
Osmia kincaidii - legumes,IV R - AB
Osmia laeta - polylectic,IV R - AB
Osmia malina - legumes,IV R - IF
Osmia mertensiae - unknown,ZV - VR
Osmia nanula - unknown,ZV - R
Osmia pagosa - unknown,ZV - VR
Osmia penstemonis - Penstemon,F - IF
Osmia potentillae - unknown,ZV - R
Osmia pulsatillae - unknown,ZV - R
Osmia pusilla - unknown,ZV - IF
Osmia regulina - legumes,IV R - FR
Osmia trevoris - unknown,ZV - IF
Osmia tristella cyanosoma - unknown,ZV - IF
Osmia tristella tristella - unknown,ZV - IF
Osmia zephyros - unknown,ZV - R
Osmia albolateralis - polylectic (legumes),IV R - IF
Osmia atrocyanea atrocyanea - polylectic(legumes),IV R - AB
Osmia brevis - polylectic(Penstemon, Collinsia),IV - AB
Osmia bridwelli - polylectic?,IV - LF
Osmia cara - unknown,ZV - FR
Osmia cyanella - unknown,ZV - AB
Osmia densa densa - legumes?,IV R - VA
Osmia gabrielis - legumes?,IV R - FR
Osmia hendersoni - unknown,ZV - VR
Osmia hesperos - unknown,ZV - VR

Osmia iridis - unknown,ZV - VR
Osmia juxta subpurpurea - unknown,ZV-AB
Osmia paradisica - unknown,ZV - R
Osmia rostrata - unknown,ZV - LA
Osmia sculleni - Hackelia?,IV - LA
Osmia seclusa - unknown,ZV - FR
Megachile brevis brevis - polylectic,F - VA
Megachile brevis onobrychidis - polylectic,F - EA
Megachile coquilletti - polylectic,F-VA
Megachile gentilis - polylectic,F - EA
Megachile texana cleomis - polylectic,F - AB
Megachile texana texana - polylectic,F - AB
Megachile montivaga - polylectic (Compositae),F - EA
Megachile relativa - polylectic (Compositae),F - AB
Megachile rotundata - polylectic (Legumes),F - EA
Megachile frigida frigida - polylectic, F - OC
Megachile gemula - polylectic,F - OC
Megachile melanophaea calogaster - legumes,F - LA
Megachile melanophaea melanophaea - legumes,IV - AB
Megachile melanophaea submelanophaea - legumes,F - OC
Megachile gravita - Clarkia,F - OC
Megachile pascoensis - Clarkia,F - LA
Megachile hilata* - unknown,ZV - VR
Megachile manifesta* - unknown,ZV - R
Megachile nevadensis - Compositae,IV - EA
Megachile pseudonigra - unknown,ZV - IF
Megachile seducta - unknown, ZV - VR
Megachile subnigra angelica - Compositae (Chaenactis),IV - AB
Megachile subnigra subnigra - unknown,ZV - IF
Megachile wheeleri - Compositae,IV - AB
Megachile parallela facunda - Compositae, F R - R
Megachile tulariana - unknown,ZV - VR
Megachile cochisiana*- unknown,ZV - OC
Megachile comata* - unknown,ZV - VR
Megachile perihirta - Compositae (+?),IV-EA
Megachile fidelis - Compositae,F - EA

Megachile frugalis frugalis - unknown,ZV-R
Megachile frugalis pseudofrugalis - polylectic,F - EA
Megachile inimica sayi - Compositae,IV R-OC
Megachile mellitarsis - Compositae?,ZV R-VR
Megachile pugnata pomonae - Compositae, IV R - FR
Megachile pugnata pugnata - Compositae, IV R - FR
Chelostomoides angelarum - polylectic(Lotus, Cordylanthus),IV - EA
Exomalopsis chionura - Grindelia,IV R - AB
Diadasia angusticeps - Clarkia,F - AB
Diadasia bituberculata - Calystegia,F - VA
Diadasia enavata - Helianthus,F - EA
Diadasia laticauda - Malacothamnus,F R-AB
Diadasia nigrifrons - Sidalcea,F R - EA
Diadasia nitidifrons - mallows,F R - AB
Melissodes communis alopex* - polylectic (Legumes),F - AB
Melissodes tepida timberlakei - polylectic (Legumes),F - EA
Melissodes dagosa*- polylectic,IV - OC
Melissodes lupina - Compositae,F R - EA
Melissodes plumosa*- Compositae(sunflowers), F R - R
Melissodes metenua* - Composites?,ZV R - OC
Melissodes clarkiae - Clarkia,F - R
Melissodes nigricauda - Stephanomeria?,IV-R
Melissodes lustra - Compositae,F R - VA
Melissodes glenwoodensis* - Compositae,F R-R
Melissodes stearnsi*- Compositae(+poly?), IV - VA
Melissodes menuachus*- Compositae,F R - R
Melissodes bimatris - Compositae,F R - VR
Melissodes bicolorata - Compositae,F R - R
Melissodes expolita* - Compositae,F R - OC
Melissodes robustior - Compositae,F R - EA
Melissodes pallidisignata - Compositae,F -VA
Melissodes hymenoxidis* - Compositae,F R -OC
Melissodes lutulenta - Compositae,F R - IF
Melissodes velutina - Compositae (+ Eriastrum?),IV R - AB
Melissodes microsticta - Compositae,F R-VA
Melissodes melanura - Compositae,F R - OC
Melissodes moorei - Compositae,F R - IF
Melissodes confusa - Compositae,F R - R
Melissodes micheneri - Compositae,F R-LA
Melissodes monoensis* - Compositae,F R-R
Svastra sabinensis nubila - Compositae, F R - IF

Tetralonia acerba - Arctostaphylos?,IV R - AB
Tetralonia actuosa - polylectic (legumes),F R - EA
Tetralonia angustifrons - polylectic IV - AB
Tetralonia cordleyi - polylectic,F -VA
Tetralonia delphinii - polylectic (Delphinium?),IV - OC
Tetralonia dorsata - polylectic (legumes),IV - AB
Tetralonia edwardsii - polylectic (legumes),IV R - EA
Tetralonia frater albopilosa - polylectic(legumes),IV R - VA
Tetralonia frater lata - polylectic?,IV R - OC
Tetralonia hurdi - polylectic,IV - OC
Tetralonia lunata - polylectic (legumes,Arctostaphylos),IV - VA
Tetralonia monozona - unknown,ZV - VR
Tetralonia stretchii - polylectic?,IV R - FR
Tetralonia venusta carinata - Clarkia, IV R - VR
Tetralonia virgata - polylectic?,IV -OC
Tetralonia zonata - unknown,ZV - R
Anthophora bomboides stanfordiana - polylectic,F - AB
Anthophora californica californica - polylectic,F - VA
Anthophora centrifirmis centriformis - polylectic,ZV R - VR
Anthophora centroformis vierecki - polylectic,ZV R - IF
Anthophora crotchii - polylectic,F - AB
Anthophora edwardsii edwardsii - polylectic?,IV R - VA
Anthophora neglecta - polylectic,IV -AB
Anthophora pacifica - polylectic;F - VA
Anthophora urbana - polylectic,F - EA
Anthophora ursina simillima - unknown, ZV - R
Anthophora furcata - polylectic,F - FR
Anthophora curta - polylectic (Composites),IV - EA
Anthophora exigua - Compositae,IV AB
Anthophora flavocincta - Composites,IV -AB
Anthophora flexipes - unknown,ZV - AB
Anthophora maculifrons* - Compositae, IV - OC

Emphoropsis rugosissima - unknown,ZV -OC
Emphoropsis tristissima - unknown,ZV -R
Centris rhodomelas - Psoralea?,IV - R
Ceratina arizonensis - polylectic,F - VA
Ceratina nanula - polylectic,F - EA
Ceratina pacifica - polylectic,F - AB
Ceratina micheneri - polylectic,F - OC
Ceratina tejonensis - polylectic,F - OC
Ceratina acantha - polylectic, F - EA
Ceratina sequoiae - Clarkia,F - OC
Ceratina timberlakei - polylectic,F - OC
Xylocopa brasilianorum varipuncta - polylectic, F - VA
Xylocopa californica californica - polylectic, F - VA
Xylocopa californica diamesia - polylectic, F - VA
Xylocopa tabaniformis orpifex - polylectic, F - EA
Bombus appositus - polylectic,F - R
Bombus balteatus - polylectic,F - VR
Bombus californicus - polylectic, F - EA
Bombus nevadensis nevadensis - polylectic, F - R
Bombus sonorus - polylectic,F - VA
Bombus occidentalis occidentalis - polylectic, F - AB
Bombus bifarius - polylectic, F - AB
Bombus centralis - polylectic,F - EA
Bombus edwardsii - polylectic,F - EA
Bombus flavifrons dimidiatus - polylectic, F - AB
Bombus griseocollis* - polylectic,F - VR
Bombus huntii* - polylectic,F - VR
Bombus melanopygus - polylectic,F - R
Bombus mixtus - polylectic,F - AB
Bombus morrissoni - polylectic,F - OC
Bombus rufocinctus - polylectic,F - R
Bombus sylvicola - polylectic,F - OC
Bombus vandykei - polylectic,F - AB
Bombus vosnesenskii - polylectic,F - EA

Anthophora rhodothorax - unknown, ZV-OC
Emphoropsis cineraria - Arctostaphylos?
IV - OC
Emphoropsis dammersi - Arctostaphylos?,
IV - R
Emphoropsis depressa - polylectic?, IV-AB
Emphoropsis excellens - unknown, ZV - VR

BOOK REVIEWS

Alma L. Moldenke

"EXTINCTION IS FOREVER — Threatened and Endangered Species of Plants in the Americas and Their Significance in Ecosystems Today and in the Future" edited by Ghillean T. Prance & Thomas S. Elias, vi & 437 pp., 33 b/w photo plates, 69 fig. & 14 tab. New York Botanical Garden, Bronx Park, New York 10458. 1978. $20.00 in U.S.A. & $22.00 foreign, paperbound.

These are the important and interesting Proceedings of the International Symposium on Threatened and Endangered Species of Plants and Ecosystems in the Americas held in commemoration of the bicentennial of the U.S.A. at the New York Botanical Garden. There are 10 papers regionally limited on North America, 3 on Mexico, Central America and the Caribbean, and 11 on South America, including an appreciation of Carlos Muñoz Pizarro who collapsed and died while delivering his paper. This volume is dedicated to him and includes his list of threatened and endangered plants of his Chile. The next 6 papers are on plant groups especially prone to endangerment as orchids, palms, ferns and carnivorous plants. The following 7 papers are on such special topics as aid from computers, Brazilian humid tropics program. All these papers are well worth reading. In the closing address Gerardo Budowski gives concrete suggestions — and the valid reasoning behind them — for saving wild plants. "The present destructive trends can only be stopped if an imaginative concerted approach replaces the presently ineffective and negative method of merely complaining and denouncing. Such change of strategy demands sensitivity and appreciation of the poor peasant's problems, influencing land use policies, and carrying out assistance programs by strengthening the position of local conservation leaders."

"NEW ZEALAND FLOWERS AND PLANTS IN COLOUR" Enlarged and Revised Edition by J. T. Salmon, 235 pp., 630 color photo plates, A. H. & A. W. Reed, Australia & New Zealand and Charles E. Tuttle Company, Rutland, Vermont 05701 for U.S.A. distribution. 1974. $22.95.

In this beautifully and copiously illustrated book plants are grouped according to habitat, as coastal, forest, bogs and swamps, outlying islands, alpine and subalpine herb fields, etc. with separate chapters describing them and their plant life. Even some of these plants are being shown in print for the first time. For each the common English name, Maori name, scientific name and plant family are given and the accompanying legend gives blooming time, size and other pertinent data not obvious from the illustration. The author is a professional photographer, a national leader in conservation, a professional entomologist for years, but nominally — and only that — not a botanist. This book should appeal to many folks besides the New Zealanders. It is good to have easy access to it in the U.S.A.

"FLOWERS AND PLANTS OF VICTORIA — Australian Flora in Colour" Revised Edition edited by E. R. Rotherham (Chairman), E. R. Cochrane, B. A. Fuhrer & J. H. Willis, 216 pp. & 543 color photo plates. A. H. & A. W. Reed, Australia & New Zealand & Charles E. Tuttle, Rutland, Vermont 05701 for U.S.A. distribution. 1974. $37.35.

This gorgeously illustrated publication is sponsored by the Field Naturalists Club of Victoria with Rotherham and Fuhrer providing most of the photographs and with Cochrane and Willis supplying most of the text. It is altogether a beautiful accurate book not only for the people, schools and libraries of Victoria but also for the many visitors from other parts of the world. Those residing in the U.S.A. can get their copies before or after their trips from Tuttle and so avoid carrying them in their luggage. The same is true for armchair travelers and American botanical and horticultural institutions. The disseminating of Salmon's "New Zealand Florers and Plants in Colour" instigated the present book which is similarly arranged by habitats, such as grampians, fern gullies, gippsland, etc. with full cross-referencing and descriptions. Each illustration has common, scientific and family names given and descriptive legend.

"FLOWERS AND PLANTS OF NEW SOUTH WALES AND SOUTHERN QUEENSLAND — Australian Flora in Colour" edited by E. R. Rotherham (chairman), D. F. Blaxell, Barbara G. Briggs & R. C. Carolin, 191 pp. & 556 color photograph plates. A. H. & A. W. Reed, Australia & New Zealand, & Charles E. Tuttle Company, Rutland, Vermont 05701 for U.S.A. distribution. 1975. $40.50.

Like its predecessors on New Zealand and on Victoria this book provides (1) superb lifelike photographs of many of the flowering plants and a few ferns of this area which claims the richest flora, (2) common, scientific and family names, (3) legends with descriptive details and geographic range, (4) organization by habitats such as rainforests, saltbush plains, mallee that are described in separate chapters, and (5) blooming and/or fruiting time. Most of the photographs are the work of Rotherham. When a plant is pictorially presented in more than one book in this series a different view of it is used. What an inspiration for learning and enjoying and conserving such wonderful wild life!

"BIOCHEMICAL ASPECTS OF PLANT-PARASITE RELATIONSHIPS" edited by J. Friend & D. R. Threlfall, xiv & 354 pp,m 68 b/w fig. & 35 tab. Academic Press, New York & London NW1 7DX.[1976] 1977. £10.80 or $23.50.

This book is composed of the author- and subject-indexed 15 papers of the Proceedings of the Phytochemical Society Symposium at the University of Hull, England in 1975. Since "it is often through an understanding of the structural and genetical basis of the plant-parasite interaction that a sensible biochemical explanation can be given" these reports stress the morphological, genetic and biochemical research efforts as in Structural Aspects of Infection by Biotrophic Fungi illustrated by excellent electron micrographs, Development and Use of Some Genetically Controlled Lines for Studies of Host-Parasite Interactions, and Terpenoid Phytoalexins which concludes with "The primary event determining a compatible or incompatible interaction of potato to P[hytophthora] infestans depends upon an interaction (recognition) which occurs within hours and perhaps seconds after penetration. All the profound alterations, including the accumulation of phytoalexins, are the result of this initial interaction." Advanced students, researchers and faculty in parasitology, biochemistry, physiology, etc. will find reading and/or studying this work highly profitable.

"THE CULTIVATION OF NEW ZEALAND TREES AND SHRUBS" Second Edition by L. J. Metcalf, xviii & 292 pp., 48 color photos & 74 b/w photos and line draw. A. H. & A. W. Reed, Australia & New Zealand and Charles E. Tuttle Company, Rutland, Vermont 05701. 1975. $22.95.

"Amongst botanists and horticulturalists the New Zealand flora is world famous and this is not to be wondered at when it is considered that approximately 80 percent of our plants are found growing wild in no other land". This flora includes the ancient New Zealand, palaeotropic Malaysian-Polynesian, Subantarctic, Australian and Cosmopolitan elements. After an interesting introduction to the history of this flora, to botanical and horticultural nomenclature, there are chapters on garden landscaping, propagation, cultivation of trees and shrubs, recognition and control of plant pests and diseases, and New Zealand's and Christchurch's climate as a cultivation guide. The second part of the book describes over 450 plants — usually directly from living specimens. Well over one quarter of them are illustrated. All the illustrations are excellent. This book will be highly valued by all in many different parts of the world who grow or study New Zealand woody plants.

"HOUSE PLANTS, CACTI AND SUCCULENTS" by Anthony Huxley, 133 pp., 101 color & 63 b/w photo plates & 42 line draw. Hamlyn Publishing Group Ltd., London, Toronto, New York, N. Y. 10016. Eighth printing, 1977.

The author is a well known writer and lecturer in the field of horticulture especially in the British Isles. House plants and succulents have long been his special delights. About 75 of them are described with their growing needs mentioned. The photographs - black-and-white and colored - are beautifully printed as single plants or in arrangements.

"BOTANICAL MICROTECHNIQUE AND CYTOCHEMISTRY" by Graemé P. Berlyn & Jerome P. Miksche, viii & 326 pp., 127 b/w fig. & photos & 19 tab. Iowa State University Press, Ames, Iowa 50010. 1976. $13.50.

"The goal of the present book is to serve as a training manual .....to introduce future teachers and researchers in plant science to the basic principles [and skills].....Each topic begins at an elementary level and proceeds to more advanced considerations" with considerable quantitative and graphic interpretations so that "cytochemistry becomes an activity that uses microtechnical methods to gain an understanding of cellular chemistry and thereby cellular functions". Expectedly the text deals with microscope optics, construction and use, electron and other types of microscopes, photomicrography, full details with reasons for various preparations of plant material slides, etc. This text is excellent.

"CURRENT TOPICS IN PLANT PATHOLOGY" edited by Z. Király, 443 pp., 32 b/w photo plates, 97 fig. & 72 tab. Akadémiai Kiadó Publishing House of the Hungarian Academy of Sciences, Budapest V, Alkotmány U 21. 1977. $28.00.

These 49-papered Proceedings honored the sesquicentennial of the Hungarian Academy of Sciences. All are written in the English language and therefore are accessible to a large reading audience. The articles cover resistance, epidemiology, biochemistry and physiology of fungal, bacterial, viral and mycoplasmic diseases mainly of fruit, tobacco, potato and grain crops with the studies far from limited to old style crop pathology. Király's concluding remarks emphasized this new orientation by summarizing the new questions raised by new research results presented as to whether factors are causes or consequences, etc. Congratulations to the Akadémiai Kiadó for its 150th birthday and for this fine book!

"ECOLOGY OF HALOPHYTES" edited by Robert J. Reimold & William H. Queen, xiv & 605 pp., 70 b/w photo., 59 fig. & 106 tab. Academic Press Inc., London NW1 7DX & New York, N. Y. 10003. £9.35 or $19.50.

A symposium on this topic was sponsored by the Physiological Ecology Section of the Ecology Society of America and commenced with an overview or stage-setting report on the Salt Marshes and Salt Deserts of the World by V. J. Chapman who believes that because of human overpopulation and food shortages many will be reclaimed for arable purposes, inevitably greatly reducing these natural phenomena. There follow eight papers on halophytes of the United States including the mangroves on our southern borders in reference to their distribution, ecology, anatomy and physiology especially salt tolerance. Seven papers are directed to plant and animal associates in halophytic habitats with Reinold's mathematic modeling of Spartina. The last section of six papers is devoted to applied research for using remote sensing, stabilizing coastal dredge spoil, herbicides, economic uses, etc. Much valuable material for many kinds of scientists, students and researchers is presented. The subject index suffers from severe anemia.

"BIOCHEMISTRY OF INSECTS" edited by Morris Rockstein, xiv & 649 pp., 115 b/w fig., 11 Photo. & 61 tab. Academic Press Inc., London NW1 7DX & New York, N. Y. 10003. 1978. $29.50.

"Designed to serve as a basic textbook in [the] field, this volume should be equally useful as an auxiliary text for most relevant courses in insect biology, particularly insect physiology, insect ecology, insect control and economic entomology..... The book should also serve as an important reference source for the advanced student, the research scientist, and the professional entomologist seeking authoritative details of relevant areas of subject matter." All this it does admirably with very recent and advanced information and reasonable cautions. Most chapters include both a list of general references for students and another citing original publications for advanced students and research scientists. Among the topics treated so well are the functions of carbohydrates, lipids and proteins, the chemistry of cuticle, biochromes, hormones and detoxication mechanisms, the chemical control of intra- and inter-specific behavior and biochemical defenses, and chemical genetics and evolution.

The ability to use many of the details reported in this book would enrich and make more interesting the teaching of almost all kinds of biology courses.

"THE U. S. FOREST SERVICE: A History" by Harold K. Steen, xvi & 356 pp., 1 b/w fig., 37 photo & 9 tab. University of Washington Press, London & Seattle, Washington 98105. 1976. $15.00.

It is good to have an historically accurate century-long account of the leaders, aims, achievements of the Forest Service both because of and in spite of political and vested interests in American timber and other forest resources. It whittles down into reasonable size the flagrant arguments about personalities, research, range use, fire use and abuse and ultimately the most recently accepted multiple use concept. Appendix I gives a detailed chronological summary of events important to the history of the U. S. Forest Service. Appendix II gives a tabular chronology of administrations. The text fleshes out this information with fairly interesting accounts.

"NORTH AMERICAN TREES — Exclusive of Mexico and Tropical United States", Third Edition by Richard J. Preston Jr., xxx & 399 pp. & 5 b/w fig. & 161 plates with diagnostic structures and geographic distribution maps. Iowa State University Press, Ames, Iowa 50010. 1976. $7.50.

For three decades earlier editions and printings of this pocket-sized book have served amateurs, students, teachers and scientists with facile and accurate access through workable keys, accurate illustrations and helpful text to the identification of our local trees. Second generations are starting to find this study even more useful especially since the nomenclature, maps and drawings have been brought up-to-date and corrected.

"EXPLORING THE OLYMPIC PENINSULA" Second Revised Edition by Ruth Kirk, vii & 120 pp., 78 b/w photo. & 6 maps, 10 color photo on cover. University of Washington Press, London & Seattle, Washington 98105. 1976. $4.95 paperbound.

With inviting photographs and text this descriptive guide relates some of the history, natural features and creatures, trail and road notes and informational directory to this temperate zone cloud forest with its "wholly distinctive realms: the bare rock and ice of the mountaintops; the flower meadows and tarns of the ridges; the lichen-upholstered trees in the rain forest; the quiet waterways inland; and the wild outer coast."

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CONTENTS

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Price of this number $3.00; for this volume $10.00 in advance or $11.00 after close of the volume; $2.00 extra to all foreign addresses; 512 pages constitute a full volume; claims for numbers lost in the mails must be made immediately following receipt of the next following number.

QUERCUS DELIQUESCENS, A NEW SPECIES FROM CHIHUAHUA, MEXICO

Cornelius H. Muller

Department of Biological Sciences
University of California, Santa Barbara

and

Department of Botany, University of
Texas, Austin

Recent heavy concentration of collecting efforts in the Chihuahuan Desert region of Mexico and adjacent Texas and New Mexico have yielded much new information on the flora and its distribution. Among the novelties is a striking species of Quercus here described as new.

QUERCUS DELIQUESCENS C.H. Mull., sp. nov. Frutex ad 1.5 m. altus, intricato-ramosus; folia sempervirentia, 12—25 (35) mm. longa, 10—15 (25) mm. lata, ovata, apiculato-dentata vel lobata, crispata, coriacea, supra puberulenta, subtus persistente cinereo-stellato-tomentosa vel lanata; venis utrinque 5—7, supra impressis; petioli 2—4 mm. longi, canescenti; fructus annuus, brevi-pedunculatus; cupula hemispherica, 10—15 mm. lata; squamae, praeter apicem, incrassatae, cinereo-tomentulosae, apicibus strictis adpressis fuscis; glans ignota.

TYPE. MEXICO: Chihuahua: south slope and top of Sierra del Roque, NNE of Julimes, approached from Mina Las Playas via Rancho El Saucito (28° 39'—28° 40' N; 105° 18'—105° 19' W), 1500—2000 m., June 19, 1973, M.C. Johnston, T.L. Wendt, & F. Chiang C. 11388 (holotype, TEX).

Rhizomatous shrubs to 1.5 m. tall, intricately and diffusively branched throughout; twigs 1—2 mm. in diameter, densely white- or pale gray-tomentulose, graying and persisting tomentulose the second year; buds narrowly ovoid, scarcely 2 mm. long, commonly hidden in the pubescence of the crowded petioles; stipules subulate, pubescent, quickly deciduous. Leaves evergreen, coriaceous, 12—25 (35) mm. long, 10—15 (25) mm. broad, ovate, 2—3 apiculate teeth or small lobes on each side, crispate, apiculately acute at apex, rounded or cordate at base; upper surface green, minutely stellate-pubescent, the scattered hairs finally deciduous; lower surface densely and persistently pale gray-tomentulose or lanate, darkening slightly the second year; veins 5—7 on each side, the principal ones passing into the teeth, somewhat impressed on the upper surface, prominent even through the tomentulum beneath; petioles 2—4 mm. long, tomentulose or lanate as the lower leaf surfaces. Staminate catkins about 10 mm. long, the filiform white-lanate rachis densely flowered, the glabrous anthers barely exserted from the fimbriate calyces. Pistillate catkins 1- or 2-flowered on a canescent peduncle about 3 mm. long. Fruit annual, solitary or paired on a persistently pubescent peduncle 3—5 mm. long; cups hemispheric, 10—15 mm. broad, the scales moderately thickened and gray-tomentulose except for the thin, brown, closely appressed, glabrous apices; acorns unknown.

ADDITIONAL SPECIMENS EXAMINED. MEXICO: Chihuahua: canyon above Rancho El Recuerdo in Sierra de Carrasco, ca. 31 (air) miles NW of Julimes, 6200 ft., September 15, 1973, *James Henrickson 12977* (TEX); Sierra Chorreras: W slopes of side canyon of Cañon Pedregosa that drains N side of 2150 m. SW peak of range; ca. 6 1/2 (air) miles ESE of Chorreras (28° 48' 30" N; 105° 09' 30" W), March 20, 1975, 1700 m., *T. Wendt & E.J. Lott 705* (TEX); ca. 7 (air) miles ESE of Chorreras (28° 48' N; 105° 09' W), 1800 m., *T. Wendt & E.J. Lott 712, 712A* (TEX); 1900 m., *T. Wendt & E.J. Lott 712B, 712C* (TEX); 2000 m. *T. Wendt & E.J. Lott 712D, 712E* (TEX); Sierra Grande, ca. 3 km. E. of Rancho El Murcielago (29° 52' N; 104° 50' W), 1550—1750 m., June 12, 1973, *M.C. Johnston, T.L. Wendt, & F. Chiang C. 11288B* (TEX); Sierra de la Parra, across Rio Grande from Sierra Vieja (30° 00' 30"—30° 02' 30" N; 104° 52' 30"—104° 53' W), 1450—2158 m., June 13, 1973, *M.C. Johnston, T.L. Wendt, & F. Chiang C. 11306A* (TEX).

HABITAT. Limestone slopes and tops of desert mountains in chaparral or thorn-shrub vegetation. At the higher elevations it forms extensive and dense thickets.

Quercus deliquescens is named to reflect the excessively intricate branching which obscures the principal axes of this rhizomatous shrub. The several collections exhibit a marked morphological constancy over a wide environmental range. The species is related to *Q. intricata* Trel. of nearby Texas, Coahuila, and southward to Zacatecas and Durango. Both species are obligate inhabitants of limestone and function as major constituents of well-developed chaparral (*sensu Californico*). The two species are distinguished by several characters as follows:

A. Leaf blades ovate in outline, coarsely 2—3 toothed or lobed on each side, the margins almost always coarsely crisped but never ultimately revolute, the white or light gray tomentum fully covering the midribs and principal veins beneath, veins 5—7 on each side . . . . *Q. deliquescens*.

B. Leaf blades oblong or rarely ovate in outline, usually entire or rarely 3—5 teeth or lobes on each side of a few leaves, the margins commonly moderately crisped or plane but always ultimately revolute, the midribs and principal veins glabrous and brown against the buff tomentum beneath, veins 8—9 on each side . . . . *Q. intricata*.

The purely irrelevant deviations of *Q. intricata* in which toothing of the leaves suggests *Q. deliquescens* all occurred in southern Coahuila, far distant from any genetic contact with the latter species. While the two species are nowhere sympatric, the great similarity of their habitat requirements and their close relationship would make hybridization very likely if they were to occur on the same mountain. The distribution of *Q. deliquescens* is unique in the genus. It occupies a rectilinear range incorporating generally untimbered mountains paralleling the courses of the Rio Grande and Rio Conchos in Chihuahua (Fig. 1).

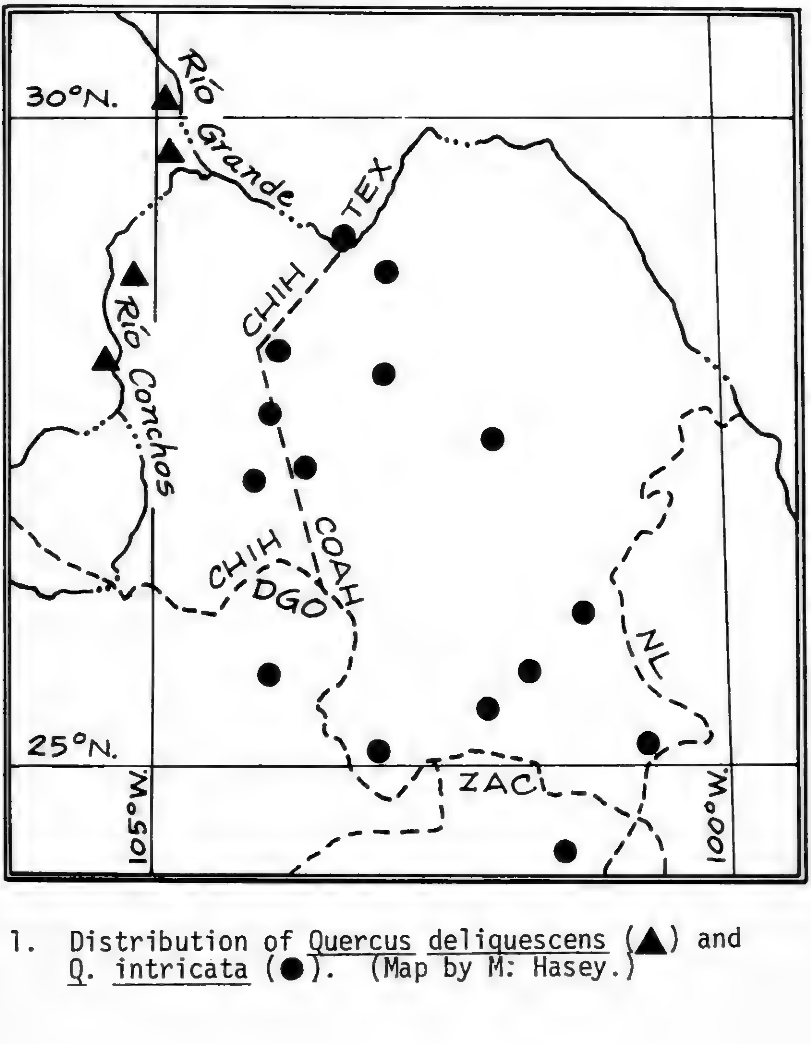

Fig. 1. Distribution of *Quercus deliquescens* (▲) and *Q. intricata* (●). (Map by M. Hasey.)

ADDITIONAL NOTES ON THE GENUS *PETREA*. VII

Harold N. Moldenke

Since the publication of my monograph of this genus in 1938 and its subsequent six supplements much additional information has come to light and many additional specimens have been examined, necessitating the present seventh supplement. Explanation of the herbarium acronyms employed will be found in my Fifth Summ. 2: 795—801 (1971).

PETREA Houst. ex L., Hort. Cliff. 319. 1739; Sp. Pl., ed. 1, imp. 1, 2: 626. 1753; Gen. Pl., ed. 5, 275. 1754.

Additional & emended synonymy: *Petraea* L. ex B. Juss. in A. L. Juss., Gen. Pl., ed. 1, 108. 1789. *Petraea* Houst. ex Meisn., Pl. Vasc. Gen. 2: 199. 1840. *Petrea* Auct. ex Meisn., Pl. Vasc. Gen. 2: 199, in syn. 1840. *Petraea* B. Juss. apud Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 477, in syn. 1894. *Petra* Cooke ex Woodr., Gard. Trop., ed. 6, imp. 8, 442. 1910. *Petraca* Mold. ex F. C. Hoehne, Resen. Hist. Secc. Bot. Agron. Inst. Biol. S. Paulo 153, sphalm. 1937. *Petraes* Vell. ex Sampaio, Bol. Mus. Nac. Rio Jan. 13: 287, sphalm. 1937. "*Petrea* (*Petraea*) Houst. ex Linn." ex Bor & Raizada, Some Beaut. Indian Climb. 141. 1954. *Petrae* Barroso, Rodriguésia 32: [69], sphalm. 1957. *Petroea* Grindal, Everyd. Gard. India, ed. 16, 40 & 81. 1960. *Petrea* (Houst.) L. ex Soukup, Biota 5: 14. 1964. *Petraea* Haust. ex Datta & Majumdar, Bull. Bot. Soc. Bengal 20: 102, sphalm. 1966.

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119—125, fig. 1—7. 1978; R. F. Sm., Act. Bot. Venez. 13: 182, 193, 207, & 262. 1978; Steyerm. & Huber, Fl. Avila 44, [66], 100, 112, 861, [866]—868, & fig. 302 & 303. 1978; Tlamsa in Minkus New World Wide Stamp Cat. 1977-1978 1 (1): 104. 1978; Mold., Phytologia 41: 450 & 509. 1979; Anon., Guide Some East Afr. Flow. Trees 3. n.d.

Bor & Raizada (1954) remind us that "This genus was named in honor of Lord Petre, (1713—1743), Thorndon, Essex, [England], who in his short life had managed to put together the finest collection of exotic plants then existing in Europe". He is said, according to Macbride (1960), to have been the first to grow *Camellia japonica* in Europe.

Bernardi & Robert (1966) comment that "other authors write [the generic name as] *Petraea*, but William Houstoun (1695-1733) who discovered the type species in Mexico near Vera Cruz in 1732 wanted to dedicate the name to Lord Robert Petre (1713-1743" and so the spelling should be *Petrea*. This and other species of the genus are commonly called "chapeau de veuve" or "viuvinha"; in Venezuela the genus is commonly called "chaparrillo", "Marie penitente", "Nazareno", and "penitente". Aristeguieta (1973) comments that "Son plantas muy ornamentales por su floración morada hasta blanca, siendo plantas muy resistentes como ornamentales de parques y jardines". J. G. Agardh actually proposed a separate family, the *Petreaceae*, for the genus. Soukup (1964) lists "sanango sacha" as the popular name for the genus in Peru. López-Palacios (1975) rightly notes that "Indiscutiblemente el género es uno de las más ornamentales de la familia".

Melchior (1964) reports that in this genus the "Blätter [sind] mit Lichtsinneorganen (Ozellen)". Mitchelmore (1967) notes that the fruit is wind-dispersed, the 5 elongated sepals acting as propellers. He provides a line-drawing illustrating the flowers and fruit of an unidentified species. Van der Pijl (1969) adds that the colored calyx-wings "develop from the bracts [which is not true]" and first "collaborate" with the corolla in attracting "animals for pollination" and then "help in dispersal".

Goyena (1911) pllaces the genus *Petrea* in a Subtribe "*Petreas* Schau., obviously a misspelling of the *Petreae* of Schauer (the *Petraeeae* of Briquet). Gallandat in Bull. Soc. Neuchatel Sci. Nat. 95: 97—111 (1972) refers to a "Quercidion pubescenti-Petraeae" in his study of the vegetation skirting the oak crop in three localities at the foot of the Swiss Jura", but just what he means by this is unclear since *Petrea* does not occur wild in Europe at the present time. Probably he is referring, instead, to *Quercus petraea* (Mattuschka) Lieblein, a European species of oak.

It is to be noted that the Endlisher (1838) reference cited in the bibliography above is often cited as "1836-1856", but the page involved with *Petrea* was actually issued in 1838. The revised dates for the Humboldt, Bonpland, & Kunth works are in accordance with Barnhart (1902). The index in Esteva's work (1969) indicates that the genus is discussed on page "159", but this seems to be an error for p. 355 as corrected in the Addenda.

Additions to the list of taxa excluded from the genus as previously published by me are

Petraea bignonioides H.B.K. ex Pittier, Supl. Pl. Usual. Venez. 55. 1939 = *Vitex capitata* Vahl.

Petraea violacea Angely, Fl. Anal. Fitogeogr. Est. S. Paulo, ed. 1, 4: xiv. 1970 = *Petunia violacea* Lindl., *Solanaceae*.

Petrea bignonioides H.B.K. ex López-Palacios, Fl. Venez. Verb. 589 & 651, in syn. 1977 = *Vitex capitata* Vahl.

The Mrs. D. J. Collins 1969, distributed as a species of *Petrea*, actually is *Sphenodesme pentandra* in the *Symphoremaceae*, while *Duke 9868* is not verbenaceous, *McGregor*, *Harms*, *Robinson*, *Rosario*, *&* *Segal* *884* is *Agdestis clematidea* Moc. & Sessé (*Agdestidaceae*), *Pfeiffer 1739* is *Congea tomentosa* Roxb. (*Symphoremaceae*), and *Tyson*, *Dwyer*, *&* *Blum* *3157* is *Triplaris gardenianus* Wedd. (*Polygonaceae*).

PETREA AMAZONICA Mold., Feddes Repert. Spec. Nov. 43: 173—174. 1938.

Additional bibliography: Mold., Biol. Abstr. 36: 3141. 1961; Mold., Phytologia 7: 409. 1961; Hocking, Excerpt. Bot. A.6: 533. 1963; Mold., Fifth Summ. 1: 168 & 366 (1971) and 2: 897. 1971.

Recent collectors describe this species as a vine and have encountered it along roadsides, on "terra firme", and in "mata" [= unflooded land and woodland]. The corollas are said to have been "blue" on *Krukoff 4694* and *Santos 1580*, "violet" on *Duke 212*, and "rôxo-oscuras sem perfume" on *Guedes 496*. The plant has been collected in anthesis by recent collectors in January, May, and June. The common name, "viuvinha", is reported for it by Guedes.

Material of *P. amazonica* has been misidentified and distributed in some herbaria as *P. aspera* Turcz.

Additional citations: BRAZIL: Amazônas: *Krukoff 4694* (A). Bahia: *Santos 1580* (Z). Ceará: *Guedes 496* (N). CULTIVATED: Brazil: *Ducke 212* (N, N).

PETREA ANDREI Mold., Feddes Repert. Spec. Nov. 43: 188—190. 1938.

Additional bibliography: Mold., Biol. Abstr. 36: 3141. 1961; Mold., Phytologia 7: 409. 1961; Hocking, Excerpt. Bot. A.6: 533. 1963; Mold., Fifth Summ. 1: 137 (1971) and 2: 897. 1971.

PETREA ARBOREA H.B.K., Nov. Gen. Sp. Pl., ed. folio, 2: 228 [as *Petraea*]. 1817; Spreng. in L., Syst. Veg., ed. 16, 2: 761. 1825.

Additional synonymy: *Petrea splendes* López-Palacios, Revist. Fac. Farm. Univ. Andes 15: 66, sphalm. 1975. *Petrea arborea* Turcz. ex López-Palacios, Revist. Fac. Farm. Univ. Andes 15: fig. [13]. 1975. *Petrea vicentina* Turcz. apud Mold., Fifth Summ. 2:

599, in syn. 1971. Verbena arborea Gibbs, Chemotax. Flow. Pl. 3: 1753. 1974.

Additional & emended bibliography: H.B.K., Nov. Gen. Sp. Pl., ed. folio, 2: 228 (1817) and ed. quart., 2: 282—283. 1818; Sweet, Hort. Brit., ed. 1, 1: 490. 1826; G. Don in Loud., Hort. Brit., ed. 1, 247. 1830; Sweet, Hort. Brit., ed. 2, 417. 1830; Cham., Linnaea 7: 367—368. 1832; G. Don in Loud., Hort. Brit., ed. 2, 247 & 551 (1832) and ed. 3, 247 & 551. 1839; Sweet, Hort. Brit., ed. 3, 551. 1839; Schau., Linnaea 20: 482. 1847; Buek, Gen. Spec. Syn. Candoll. 3: 338. 1858; Edgeworth, Pollen, ed. 1, 76 & 96, pl. 6, fig. 107. 1877; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 478. 1894; Solered., Syst. Anat. Dicot. 712 & 716. 1899; Barnhart, Bull. Torrey Bot. Club 29: 590. 1902; D. H. Scott in Solered., Syst. Anat. Dicot. [transl. Boodle & Fritsch] 1: 631 & 634. 1908; Goyena, Fl. Nicarag. 1: 566. 1911; M. Kunz, Anatom. Untersuch. Verb. 64. 1911; Loes., Verh. Bot. Ver. Brand. 53: 80 [Abhandl. 245]. 1912; Roys, Ethno-bot. Maya [Tulane Univ. Midd. Am. Res. Ser, Publ. 2:] 272 & 324. 1931; Schipp, 1933-34 Price-list 39 & 50. 1934; Matschat, Mex. Pl. Am. Gard. 234. 1935; H. B. Davis, Life Works Pringle 173. 1936; M. Martínez, Cat. Nomb. Vulg. Cientif. Pl. Mex., ed. 2, 339. 1937; Pittier, Supl. Pl. Usual. Venez. 55. 1939; Robledo, Lecc. Bot. 2: 499. 1940; Perez-Arbelaez, Pl. Util. Colomb., ed. 1, 443. 1947; R. O. Williams, Usef. Ornam. Pl. Zanzib. 9, 57, & 71. 1949; Metcalfe & Chalk, Anat. Dicot. 1033 & 1038. 1950; Bravo Hollis & Ramírez Cantú, Anal. Inst. Biol. Mex. 22: 421. 1951; Chittenden, Dict. Gard. 1534. 1956; Perez-Arbelaez, Pl. Util. Colomb., ed. 2, 733. 1956; B. & B. Hargreaves, Trop. Bloss. 31. 1960; J. F. Macbr., Field Mus. Publ. Bot. 13 (5): 662. 1960; Mold., Phytologia 7: 431—432. 1961; O'Gorman, Mex. Flow. Trees 92 & [93]. 1961; Menninger, Flow. Trees World 284, pl. 413. 1962; Pesman, Meet Fl. Mex. 226 & 276. 1962; R. Good, Geogr. Flow. Pl. 188. 1964; Bose, Handb. Shrubs 10—11, 16, 77, 115, & 122. 1965; Kundu & De, Bull. Bot. Surv. India 10: 406. 1968; Esteva, Arb. Ornament. Trop. 355—357. 1969; Lasser, Act. Bot. Venez. 4: 48. 1969; El-Gazzar & Wats., New Phytol. 69: 462, 483, & 485. 1970; Gibson, Fieldiana Bot. 24 (9): 218. 1970; Lowden, Taxon 19: 845. 1970; Mold., Fifth Summ. 1: 112, 119, 126, 130, & 366 (1971) and 2: 595, 597—600, 603, 652, & 897. 1971; Farnsworth, Pharmacog. Titles 7 (10): xii. 1972; Fong, Trojánkova, Trojánek, & Farnsworth, Lloydia 35: 147. 1972; Rouleau, Taxon Index Vols. 1-20 part 1: 280. 1972; Mold., Phytologia 23: 426 & 434 (1972) and 25: 242. 1973; El-Gazzar, Egypt. Journ. Bot. 17: 75 & 78. 1974; Gibbs, Chemotax. Flow. Pl. 3: 1753 & 1754. 1974; Alain in León & Alain, Fl. Cuba, imp. 2, 2: 298. 1974; Mold., Phytologia 28: 450. 1974; [Farnsworth], Pharmacog. Titles 7, Cum. Gen. Ind. [87]. 1975; López-Palacios, Revist. Fac. Farm. Univ. Andes 15: 64—66, fig. [13]. 1975; Mold., Phytologia 31: 392 & 406. 1975; Molina R., Ceiba 19: 96. 1975; J. A. Steyerm., Act. Bot. Venez. 10: 184. 1975; Laurence & Mohammed, Journ. Agr. Soc. Trin. & Tob. 76: 345. 1976; Mold., Phytologia 34: 257 & 270. 1976; López-Palacios, Fl. Venez. Verb. 454—462, 638, 651, & 652, fig. 108. 1977; Mold., Phytologia 41:

132. 1978; Mound & Halsey, Whitefly World 67 & 213. 1978; R. F. Sm., Act. Bot. Venez. 13: 193, 207, & 262. 1978; Steyerm. & Huber, Fl. Avila 864, [867], & 868, fig. 303 C. 1978; Mold., Phytologia 41: 450. 1979.

Additional illustrations: Menninger, Flow. Trees World pl. 413 (in color). 1962; Bose, Handb. Shrubs opp. 73. 1965; Esteva, Arb. Ornament. Trop. 356 & 357 (in color). 1969; López-Palacios, Revist. Fac. Farm. Univ. Andes 15: fig. [13]. 1975; López-Palacios, Fl. Venez. Verb. [457], fig. 108. 1977; R. F. Sm., Act. Bot. Venez. 13: 262. 1978.

Vernacular names for P. arborea reported by recent collectors and authors are "arquaco", "azulina", "bejuco", "bejuco de caballo", "blue petrea", "cucharo", "flor de viuda", "fruto de paloma", "jazmín azul", "liane de St. Jean", "María", "Maria penitente", "Nazareno", "opptizimin", "palo de la cruz", "penitente", "pluma de la reina", "tostadito", "totopostillo", "tree petrea", and "upright petrea".

Sweet (1826) gives the date of the introduction of this species into cultivation in England as 1824, but Chittenden (1956) asserts that it was in gardens there in 1823. Alain (1974) records it from cultivation in Cuba, saying "Se ha citado también de Cuba P. arborea HBK., aunque probablemente sólo esté en cultivo". Molina (1975) avers that it occurs in gardens in Honduras, while Goyena (1911) records it from Nicaragua. It is most probable, however, that both these Central American "records" apply instead to P. volubilis L.

Petrea vincentina Turcz. is based on a Caley collection from the island of St. Vincent. Smith (1978) lists P. arborea from Lara, Venezuela. Standley & Record call it a large woody vine, "One of the handsomest of all Central American plants because of the abundance of blue flowers, the color depending chiefly on the calyx lobes which retain their color for a long time." What they refer to, however, is P. volubilis L., the common Mexican and Central American species.

Marshall says of P. arborea: "A small evergreen tree only reaching a girth of a foot or so....The flowers are bluish-mauve borne profusely in long sprays and the tree is highly ornamental. Its natural occurrence is extremely rare, but it has been planted in gardens to a fair extent....It tends to occur in the drier areas" of Trinidad. Bose (1965) tells us that it does not root easily from layers, but when grafted on to P. volubilis will unite in about one month. It does not respond favorably to pruning. It is a tall slow-growing shrub, thriving in sun and rich soil, and with blue flowers, "blues and violet not [being] common in perennial plants".

Marshall's statement that P. arborea is "one of the handsomest of all Central American trees, blooming 3 times a year" is certainly erroneous, probably having been copied from Standley & Record (above) since it does not occur in Central America and the species there, P. volubilis, is usually a vine.

Recent collectors describe P. arborea as a shrub or tree, 2--6.5 m. tall, or an "arbusto recostadizo", the leaves very harsh to touch, the inflorescences showy, the bracts lilac, and the calyx pilose with a few glandular hairs. They have encountered it in dry hillside pastures and at the fringes of forests, at 600--700 m. altitude, flowering in January and February. The corolla is said to have been "blue" on López-Palacios 3589, Mills 147, and Pittier & Curran 15306, "blue-purple" on Howard 10401, "purple" on Haught 4046, "violet" on Alston 5976, and "pale-mauve" on Mills 196. Pittier & Curran refer to the plant as "occasional". According to Laurence & Mohammed (1974) it is used as a bee plant in Trinidad. The pollen is described by Edgeworth (1877) as "oblong, flat, a pore at the ends, in water 3-cornered". Gibbs (1974) reports syringin absent from the stems and cyanogenesis absent from the leaves.

Mound & Halsey (1978) list P. arborea as one of the host plants for the whiteflies, Aleurotrachelus sp. (in Trinidad) and Trialeurodes mirissimus Samps. & Drews.

As is apparent from what has been said above, P. arborea has been confused widely in literature and herbaria with P. volubilis L. The P. arborea of Loesener (1912), based on Seler 1777 from Oaxaca, Mexico, is certainly P. volubilis.

López-Palacios (1977) cites as true P. arborea from Venezuela the following collections: Aragua: Badillo 3081; Delgado 101, 135; Fendler 867; Holt 326; Humboldt & Bonpland s.n. [Herb. Willd. 11489, Guacara, Hacienda de Cura, & Villa de Cura, Feb. 1800] type collection; Montaldo 4006; Pittier 6063, 15237, 15306; Vogl 298, 1178. Bolívar: Trujillo 2422; Wurdack & Monachino 41293. Carabobo: Alston 5976; Fernandez-Yépez F.662, Pittier 8774; Saer 831; Stauden 24; Trejos V.91. Cojedes: Burkart 16222; Chardon 20. Falcón: Christ 45; Lasser 4318; Madriz 31; Steyermark 99055. Federal District: Herb. Jacquin s.n.; Manara s.n.; Moritz 191; Otto 570; Pittier 7786, 7853, 9449, 12525, 13573; Trujillo 999, 1421; Wagener 293; Ll. Williams 10061. Guarico: Aristeguieta 4674; Tamayo 4626. Lara: Cardona 4187; Ewel 14; Ferrari & al. 311; Saer 393; R. T. Smith V.3058; Steyermark 55546; Tamayo 3332, 3383; Trujillo 2551. Portuguesa: Pittier 11749. Yaracuy: Burkart 16485; Steyermark & Carreño 106799. State undetermined: Curran 577. Of Saer 831 he says "Este ejemplar, lo mismo que Pittier 8774, han sido determinados por el Dr. Moldenke y citados en su monografía como P. pubescens; pero después de un estudio cuidadoso de los especímenes y las poblaciones, los retrotraigo a este lugar. Dudo mucho también de Saer 393." He also says that I identified as P. pubescens Chardon 20, Aristeguieta 4674, Saer 393, Tamayo 3332 & 3383, and Burkart 16485, but all of which he feels are P. arborea.

Gibbs (1974) erroneously lists P. arborea as "Verbena arborea", a synonym of V. litoralis H.B.K.

The revised Humboldt, Bonpland, and Kunth references given in the heading and bibliography of this species (above) are in accordance with Barnhart (1902). The reference by Roys (1931) to P. arborea obviously applies, instead, to P. volubilis.

The Peele 798, distributed as P. arborea, actually is P. aspera Turcz., while Ruiz-Terán & López-Palacios 10871 is P. kohautiana Presl, Little 15567 and H. H. Smith 1521 are P. pubescens Turcz., Conzatti, Reko, & Makrinius 3001, Creighton 724, Dilmy s.n. [Herb. Bogor. Bot. Gard. XI.C.29], Gilly, Simpson, & Dodds 57, Janzen s. n. [6 February 1964], T. MacDougall 5985, C. D. Mell s.n. [near Campeche, Feb. 1945], Pringle 5003 & 8004, C. L. Smith 1017 & s.n. [San Francisco, 1894], and Smith & Barkley 17M174 are P. volubilis L., F. Chiang 343, Cox 850 [Herb. Cox 641], Crisman & Willis 200, C. C. Deam 6092, and Linden 18 (in part) are P. volubilis var. pubescens Mold., and Gilly, Simpson, & Dodds 136 is Agdestis clematidea Moç. & Sessé in the Agdestidaceae.

Additional & emended citations: TRINIDAD & TOBAGO: Trinidad: Britton, Freeman & Watts 2689 (W—1194474); W. E. Broadway 5271 (Ca—363897, E—914392, F—549648), 7568 (F—699673), s.n. [May 22, 1911] (D—583015, E—862830, F—492743, W—1047650), s.n. [Sept. 6, 1913] (W—1194670), s.n. [June 12, 1920] (E—939917); Field Mus. Econ. Pl. 611126 (Oa). MONOS: R. A. Howard 10401 (Mi, N). COLOMBIA: Magdalena: Haught 4046 (W—1708852). VENEZUELA: Aragua: Delgado 101 (F—1003977), 135 (F—925664); Pittier 6063 (W—601791); Pittier & Curran 15306 (Ve—25087, W—1901137); Ll. Williams 10035 (F—940746, F—946517). Carabobo: Alston 5976 (N); Pittier 8774 (W—1065338). Cojedes: Burkart 16222 (Ve). Falcón: Lasser 4318 (Ve); J. A. Steyermark 99055 (Z). Federal District: Pittier 7786 (W—987883), 7853 (W—987951), 9449 (W—1068303), 13573 (E—110741); Ll. Williams 10061 (F—940722). Portuguesa: Pittier 11749 (Mu—4362, W—1232655, Y—7744). CULTIVATED: South Africa: A. P. Mills 147 (Ba), 196 (Ba). Sri Lanka: Collector undetermined s.n. [Royal Bot. Gard. Peradeniya, Sect. R, July 1895] (Pd). Tobago: W. E. Broadway 4769 (E—741211, W—759638). Venezuela: López-Palacios 3589 (Ld, N). MOUNTED ILLUSTRATIONS: H. N. Moldenke color slide 304 (Z).

PETREA ARBOREA f. **BROADWAYI** (Mold.) Mold., Phytologia 41: 450. 1979.

Synonymy: Petrea arborea var. broadway Chittenden, Dict. Gard. 1534. 1956.

Additional bibliography: Schipp, 1933-34 Pricelist 39 & 50. 1934; Mold., Verb. 19. 1955; Chittenden, Dict. Gard. 1534. 1956; Mold., Phytologia 7: 432—433. 1965; Lowden, Taxon 19: 845. 1970; Mold., Fifth Summ. 1: 366 (1971) and 2: 897. 1971; Mold., Phytologia 23: 426 & 434 (1972) and 41: 450. 1979.

Emended citations: CULTIVATED: Trinidad: W. E. Broadway s.n. [1908] (Ca—416296—type, E—926018—isotype).

PETREA ASPERA Turcz., Bull. Soc. Imp. Nat. Mosc. 36 (2): 211. 1863.

Synonymy: Petraea aspera Turcz. ex Pittier, Supl. Pl. Usual. Venez. 55. 1939. Petraea pauciflora (Benth.) Duke ex Mold., Résumé Suppl. 16: 25, in syn. 1968. Petrea aspera L. ex Gibson, Fieldiana Bot. 24 (9): 218, sphalm. 1970. Petraea volubilis Schau. ex Braga, Fl. Nordest., ed. 2, 479, in syn. 1960 [not P. volubilis Gaertn., 1791, nor Jack, 1947, nor Jacq., 1832, nor L., 1763 & 1919, nor Willd., 1940].

Additional & emended bibliography: Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 478 (1894), imp. 2, 2: 478 (1946), and imp. 3, 2: 478. 1960; Braga, Pl. Nordest., ed. 2, 479. 1960; Mold., Phytologia 7: 433. 1961; Mold., Résumé Suppl. 16: 4 & 25. 1968; Rollet, Adansonia, ser. 2, 8: 543 & 549. 1968; J. A. Steyerm., Act. Bot. Venez. 3: 156. 1968; Mold., Phytologia 18: 421. 1969; Anon., Biol. Abstr. 51 (1): B.A.S.I.C. S.159, S.169, & S.226. 1970; Gibson, Fieldiana Bot. 24 (9): 218. 1970; Mold., Biol. Abstr. 51: 460. 1970; Hocking, Excerpt. Bot. A.18: 444. 1971; Mold., Fifth Summ. 1: 91, 119, 126, 134, 168, & 366 (1971) and 2: 595, 596, & 897. 1971; Mold., Phytologia 23: 434. 1972; Mold. in Woodson, Schery, & al., Ann. Mo. Bot. Gard. 60: 83—86 & 147, fig. 7. 1973; Mold., Phytologia 28: 461. 1974; Troncoso, Darwiniana 18: 41 & 369. 1974; López-Palacios, Revist. Fac. Farm. Univ. Andes 15: 64 & 66. 1975; Mold., Phytologia 31: 379. 1975; Molina R., Ceiba 19: 96. 1975; Mold., Phytologia 34: 252. 1976; López-Palacios, Fl. Venez. Verb. 452, 454, 462—468, & 637—638, fig. 109. 1977; Steyerm. & Huber, Fl. Avila 44, [66], 861, 864, [866], & 868, fig. 302A. 1978.

Additional illustrations: Mold. in Woodson, Schery, & al., Ann. Mo. Bot. Gard. 60: 84. 1973; López-Palacios, Fl. Venez. Verb. [463], fig. 109. 1977; Steyerm. & Huber, Fl. Avila [66] (in color) & [866] fig. 302 A. 1978.

Recent collectors describe this plant as an ornamental, woody, high-climbing vine or liana, 4—15 m. long, or a shrub or small tree, 2—4 m. tall, erect, unarmed, the bark smooth, the stems to 2.5 cm. in diameter at the base, the foliage stiff and papery, crackling when broken, medium- to pale-green or else medium-green above and paler beneath, slightly glossy, scabrid, the flowers slightly or very fragrant, the calyx petaloid, blue or bluish to lavender or purple, the lobes approximately "RHS Wistaria Blue 640/2", the corollas early deciduous. They have found it growing in woods, primary forests, deep or marshy rainforests, rocky upland chaparral, on savannas, often by native plantations, and "on cliffs in forest along quebradas and adjacent pastures", at altitudes of sealevel to 1800 meters, flowering from November to May and in September, in fruit in September and November.

López-Palacios describes it as an "arbolito de ramos reclinados sobre la vegetación adyacente, ca. 5 m. de alto. Hojas lisas por la haz, algo ásperas y con muchos puntos glandulosos por el envés. Flores longipedunculadas, de cáliz costado y lóbulos ca. 1.5 cm. de largo, en racimos hasta de 40 cm. de largo. Corola violácea;

cáliz azul-violáceo."

The corollas are described as having been "blue" on Duke 8079, 9303, & 10071, Maguire & al. 56867, Skog 1205, and Tyson 3747, "violet" on López-Palacios 2586, "purple-violet" on Lewis & al. 195, "purple" on Blanco 499, Breteler 4572 & 5149, Ruiz-Terán & López-Palacios 9784, and Tyson & Blum 3892, "deep-purple" on Lewis & al. 5317, "dark-purple" on Lewis & al. 5427, "lavender" on Kennedy & al. 3110 and Tyson & Loftin 3849, "dark-purple with white at the throat" on Nee & Dressler 9380, and "corolla-lobes from RHS Mineral Violet 635/1 and 635/2, the throat white" on Peele 798.

The species is cultivated as an ornamental in Venezuela; Molina (1975) records it from Honduras. Breteler 4572 & 5149 are accompanied by wood samples from the base of the main stem. López-Palacios & Bautista 3549 is a possible topotype collection.

Vernacular names for P. aspera recorded by recent authors and/or collectors are "bejuco de Mayo", "bejuco de palo", "capela de viúva", "chaparrito", "chorão de viúva", "cipó azul", "coroa de viúva", "flor azul", "flor de la cruz", "flor de niño", "flor de mayo", "flor de S. Miguel", "flor de viúva", "grinalde de viúva", "guamo macho", "Nazareno", "penitente", "pluma de la reina", "primavera", "San José", "San José de palo", "Santa Lucía", "tostadito", "toucado", and "toucado de viúva".

Steyermark (1968) cites Blanco 145 & 499 from Venezuela, while López-Palacios (1977) cites the following from the same country: Anzoategui: Chaper s.n. [Barcelona 1885]. Aragua: Oberwinkler s.n. [9-II-1969]; Pittier & Nakichenovich 15430; Vogl 299, 939; Ll. Williams 10077, 10160. Bolívar: Bernardi 3053; Delascio 2302; Ll. Williams 11475; Wurdack & Monachino 39641. Carabobo: Funck & Schlim 507; Schnee 1194; Tamayo 2223; Trujillo 6101; Wetzel & Muller 746. Delta Amacuro: Blanco 499; Wurdack & Monachino 39641. Federal District: Aristeguieta 6646; Benítez 150; Jahn 343; Landsbergen 228; Manara s.n. [14-V-1976]; Stauden 111; Vogl 1182. Mérida: Bernardi 1913; Breteler 4572; López-Palacios 87, 2549, 2586; López-Palacios & Bautista 3549; Ruiz-Terán & López-Palacios 6169. Miranda: Aristeguieta 2868; Steyermark & Carreño 106909. Monagas: Breteler 5149; Ruiz-Terán & López-Palacios 9784. Sucre: Ruiz-Terán 2885; Steyermark 62638, 62801. Yaracuy: Aristeguieta & Foldats 1370; Killip 37068; Pittier 11769; Trujillo & Fernández 794.

Additional & emended citations: PANAMA: Canal Zone: Bangham 601 (F—711017); Blum 2232 (E—1836108); Epplesheimer s.n. [1910] (F—285371); Frost 196 (F—589207); Goldman 1868 (W—690324); Lewis, Porter, Durkee, & Baker 5317 (Ac), 5427 (Z); Maggs II.48 (F—960502); Pittier 2275 (W—676531); Shattuck 412 (F—649968); P. C. Standley 27609 (W—1217662); Tyson & Blum 3892 (E—1832145); Tyson & Loftin 3849 (E—1832090); Wetmore & Abbe 162 (F—650425); Woodworth & Vestal 385 (F—650668). Chiriquí: Liesner 369 (W—2745303).

Colón: Pittier 3895 (W--678972). Darién: P. H. Allen 4293 (E--1597146); Duke 8079 (E--1833530, Oh), 9303 (W--2547337), 10071 (E--1890777). Panamá: Kennedy, Dressler, & Wilder 3110 (W--2788968); Nee & Dressler 9380 (W--2780668); Paul 281 (W--1589470); Pittier 6531 (W--716597); R. S. Williams 702 (W--678227, W--678228). San Blas: Lewis, Dwyer, Elias, & Solís 195 (E--1881636, W--2545818). Veraguas: Powell s.n. [San Francisco, Febr. 1924] (W--1206763); Tyson 3747 (E--1835336). Barro Colorado Island: Aviles 14 (E--1953168); Croat 4858 (N); Shattuck 412 (E--1953167). COLOMBIA: Bolívar: Sneidern 5765 (Ld, Mi). Santander: Haught 1568 (W--1592086). VENEZUELA: Amazonas: Foldats 130a (N). Aragua: Pittier & Nakichenovich 15430 (W--1909991); Ll. Williams 10077 (F--940716), 10160 (F--946488). Bolívar: Couret 236 (W--2710441); Ll. Williams 11475 (F--997170, F--1000632, F--1010177, W--1775290). Carabobo: Funck & Schlim 507 [Macbride photos 34293] (F--976303--isotype); Pittier 8855 (W--1065366); Whetzel & Müller s.n. [Herb. Estac. Exp. Agric. 746] (W--1778128). Delta Amacuro: C. Blanco 499 (N, N, W--2557710). Federal District: Jahn 343 (W--6945321). Mérida: Breteler 4572 (N, N, W--2582983A); López-Palacios 87 (Ft), 2586 (Mu, N); López-Palacios & Bautista 3549 (N). Monagas: Breteler 5149 (N, N, W--2583422A). Sucre: J. A. Steyermark 62368 (Ve--25624). Yaracuy: Curran 203 (Ld, N), 203m (Ac, Ld, N); Killip 37068 (W--1855273); Pittier 11769 (Mu--4361, Ve--12742, W--1232674). BRAZIL: Mato Grosso: Maguire, Murça Pires, Maguire, & Silva 56867 (N). CULTIVATED: Pennsylvania: Peele 798 (Ba). Venezuela: Ruiz-Terán & López-Palacios 6169 (N), 9784 (Ld); Skog 1205 (W--2705165). MOUNTED ILLUSTRATIONS: Mold. in Woodson, Schery, & al., Ann. Mo. Bot. Gard. 60: 84. 1973 (Z).

PETREA ASPERA f. **ALBIFLORA** Mold., Phytologia 18: 421. 1969.

Bibliography: Mold., Phytologia 18: 421. 1969; Anon., Biol. Abstr. 51 (1): B.A.S.I.C. S.159, S.169, & S.226. 1970; Mold., Biol. Abstr. 51: 460. 1970; Hocking, Excerpt. Bot. A.18: 444. 1971; Mold., Fifth Summ. 1: 191 (1971) and 2: 897. 1971; Mold. in Woodson, Schery, & al., Ann. Mo. Bot. Gard. 60: 82, 86, & 147. 1973.

This form differs from the typical form only in having its calyx and corolla white. It has been described as a "vine with showy white flowers" and is known thus far only from the original collection, but probably occurs sporadically through the range of the species. Collectors report the vernacular name, "bejuco de hajo" and have found the plant in flower in April. Material has been distributed and has been previously cited by me as typical P. aspera Turcz.

Citations: PANAMA: San Blas: G. P. Cooper III.234 (F--771402--isotype, N--type).

PETREA ATROCOERULEA Mold., Feddes Repert. Spec. Nov. 43: 195-197. 1938.

Synonymy: *Petrea atrocerulea* Mold. ex López-Palacios, Revist. Fac. Farm. Univ. Andes 17: 48. 1976.

Additional bibliography: J. F. Macbr., Field Mus. Publ. Bot. 13 (5): 663—664. 1960; Mold., Phytologia 7: 433—434. 1961; Mold., Fifth Summ. 1: 119, 142, & 168 (1971) and 2: 897. 1971; López-Palacios, Revist. Fac. Farm. Univ. Andes 17: 48. 1976; Soukup, Biota 11: 14. 1976.

López-Palacios (1976) comments regarding *Karlbreyer 1634* that "En ninguna parte el Río Porce corre a esta altura [3000 metros]. Quizás hay un error y la altitura deba considerarse en pies. Las otras dos citas que para la especie existen (*Schultes 6063* y *Duque Jaramillo 2426*) corresponden a la Comisaría del Amazonas, de alturas aproximadas de unos 100 m., en piso térmico caliente".

Macbride (1960) cites only *Ruíz & Pavon s.n.* from Peru.

PETREA BLANCHETIANA Schau. in A. DC., Prodr. 11: 617—618. 1847.

Additional synonymy: *Petrea blanchettiana* Schau. ex Bonstedt, Pareys Blumengärtn., ed. 1, 277. 1932. *Petraea latifolia* P. DC. ex Mold., Feddes Repert. Spec. Nov. 43: 166, in syn. 1938.

Additional & emended bibliography: Buek, Gen. Spec. Syn. Candoll. 3: 338. 1858; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 478. 1894; M. Kunz, Anatom. Untersuch. Verb. 64. 1911; Bonstedt, Pareys Blumengärtn., ed. 1, 277. 1932; Jacks, in Hook. f. & Jacks., Ind. Kew., imp. 2, 2: 478 (1946) and imp. 3, 2: 478. 1960; Mold., Phytologia 7: 434. 1961; Mold., Résumé Suppl. 16: 25. 1968; Mold., Fifth Summ. 1: 168 & 366 (1971) and 2: 595—598 & 897. 1971.

Recent collectors describe this plant as a vine and as an "arbusto de galhos tortuosos e emaranhados, flores e cálice arroxeados", and have encountered it in capoeira, flowering in November. The corollas are said to have been "blue" on *Santos 2158*. The vernacular name, "jasmin roxo", has been recorded for it. Material has been misidentified and distributed in some herbaria as *P. racemosa* Nees.

Additional & emended citations: BRAZIL: Bahia: *Blanchet s.n.* (F—521070, Sp—8600); *Martius 1029* (E—118720—cotype, Mu—896—cotype, Mu—1420—cotype); *Santos 2158* (Z). Pernambuco: *Pickel 2974* (W—1571559). CULTIVATED: Brazil: *Teixeira 2559* [Herb. Serg. Tavares 1513] (W—2541814). MOUNTED ILLUSTRATIONS: Schau. in Mart., Fl. Bras. 9: pl. 45 I. 1851 (N, Z).

PETREA BOREALIS Ettingsh., Denkschr. Akad. Wiss. Wien [Foss. Fl. Bilin. 2: 31] 28: 219, pl. 37, fig. 18 [as "*Petraea*"]. 1868; Potbury, Carnegie Inst. Wash. Publ. 465: 79. 1935.

Synonymy: *Petraea borealis* Ettingsh., Denkschr. Akad. Wiss. Wien 28: 219 [Foss. Fl. Bilin. 2: 31], pl. 37, fig. 18. 1868.

Bibliography: Ettingsh., Denkschr. Akad. Wiss. Wien 28: 219

[Foss. Fl. Bilin. 2: 31], pl. 37, fig. 18. 1868; Potbury, Carnegie Inst. Wash. Publ. 465: 79. 1935; Mold., Geogr. Distrib. Avicen. 41. 1939; Mold., Prelim, Alph. List Inv. Names 34. 1940; Mold., Alph. List Inv. Names 34. 1942; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 75 & 97 (1942) and ed. 2, 166 & 192. 1949; Mold., Résumé 226, 330, & 464. 1959; Mold., Fifth Summ. 1: 376 (1971) and 2: 595 & 897. 1971.

Illustrations: Ettingsh., Denkschr. Akad. Wiss. Wien 28: pl. 37, fig. 18. 1868; Ettingsh., Foss. Fl. Bilin. 2: pl. 37, fig. 18. 1868.

PETREA BRACTEATA Steud., Flora 26: 764 [as "*Petraea*"]. 1843.

Additional & emended synonymy: *Petraea bracteata* Steud., Flora 26: 764. 1843. *Petrea schomburgkiana* Schau., Linnaea 20: 482. 1847. *Aegiphila bracteata* Steud. ex Mold., Alph. List Cit. 2: 445, sphalm. 1948. *Petrea macrophylla* Splitgerber ex López-Palacios, Revist. Fac. Farm. Univ. Andes 15: 67, in syn. 1975.

Additional & emended bibliography: Schau., Linnaea 20: 482. 1847; Schau. in A. DC., Prodr. 11: 616—620. 1847; Buek, Gen. Spec. Syn. Candoll. 3: 338. 1858; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 478. 1894; H. H. Rusby, Mem. Torrey Bot. Club 6: 106. 1896; M. Kunz, Anatom. Untersuch. Verb. 64. 1911; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 2: 478. 1946; Mold., Alph. List Cit. 2: 445. 1948; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 2: 478. 1960; Mold., Phytologia 7: 434—435. 1961; Mold. in Menninger, Flow. Vines 338. 1970; Mold., Fifth Summ. 1: 126, 130, 132, 134, & 169 (1971) and 2: 595—598, 792, & 897. 1971; López-Palacios, Revist. Fac. Farm. Univ. Andes 15: 66-67. 1975; Mold., Phytologia 31: 406. 1975; López-Palacios, Fl. Venez. Verb. 452—454, 468—471, & 650—653, fig. 110. 1977.

Additional illustrations: López-Palacios, Fl. Venez. Verb. [469], fig. 110. 1977.

Recent collectors have encountered this species on riverbanks, along roadsides, in secondary swamp forests and periodically inundated forests (varzea) and in low forests on non-inundated land (terra firme), at 50—140 m. altitudes, flowering in January, April to September, and November, fruiting in April and May. They describe the plant as a climbing woody vine, liana, or bush-rope, often hanging over water, 4—10 m. long, the bark light-brown, the young leaves purplish-green, the "bracts single, basal, green" or blue, the inflorescences pendent, blue or dark-violet, their stems purple, the flowers soon falling, and the calyx blue or pale-blue to dark purplish-blue or violet, often the tube deep-violet and the limb violet. The corollas are said to have been "blue" on *Mori & al. 8160*, *Prance & al. 3302* & *11454*, *Schulz 10330*, and *Silva & al. AS.240*, "pale-blue" on *Atkinson 4*, "dark-blue" on *Prance & al. 14620*, "bluish" on *Maguire & al. 56613*, "purple" on *Tutin 110*, "lilac" on *Ramsammy 23*, and "violet" on *Donselaar 3217*, *Ducke 872*, *Hallé 516* & *585*, and *Irwin & al. 54511*.

Schulz speaks of this plant as a "liana on thick branches at base of crown of big 'rode sali' tree, locally very common" in Surinam. Irwin and his associates also foun it "common in trees" in that country. Maguire and his associates report it "frequent" in Rondônia, Brazil, and Tutin says of it "common on banks of creeks" in Guyana. Hallé describes it as a "liane a superbe grappes pendentes". A wood sample accompanies Donselaar 3217. The vernacular name, "sandpaper vine", is reported from Guyana.

The type of P. candolleana (presently tentatively regarded as a synonym of P. bracteata) was photographed by Macbride at Geneva as his type photograph number 7875 and that of P. schomburgkiana at Berlin as his type photograph number 17574. I am still not convinced that these two taxa are really exactly the same a P. bracteata — more careful field and herbarium study is called for here. It is worth noting here that the name, P. schomburgkiana, regardless of what is said by Jackson (1894), was first published by Schauer in Linnaea, vol. 20, in August 1847 — considerably before it appeared in DeCandolle's Prodromus, volume 11, on November 26, 1847.

López-Palacios (1975) says of P. bracteata: "Es posible que tambien lleque a encontrarse en la Amazonia o en la Orinoquia colombiana". He also comments that "Los ejemplares del Amazonas son de jojas muy grandes y hacen honor al nombre de Petrea macrophylla, dado a la especie por Splitgerber". He cites (1977) from Venezuela the following collections: Amazonas: Cardona 1444, Level 5, Maguire, Cowan, & Wurdack 30444, Wurdack & Adderley 43583. Miranda: Steyermark & Carreño 106953. Concerning the last of these he notes "Ejemplar dudoso, que puede pertenecer a P. kohautiana Presl".

Material of P. bracteata has been misidentified and distributed in some herbaria as P. aspera Turcz. On the other hand, the Steyermark & Espinoza 106953, distributed as P. bracteata, actually is P. kohautiana Presl (as suspected by López-Palacios, above), while Ducke 872 & 1133 and Fróes 22628 are P. martiana Schau.

Additional & emended citations: VENEZUELA: Amazonas: Cardona 1444 (Ve). GUYANA: Appun s.n. (Pd); Atkinson 4 (Mi); E. H. Graham 254 (W--1444092); A. S. Hitchcock 17249 (W—1056369); Jenman 5125 (W—1323179), 5456 (W--58250, W--1323178); Lang & Persaud 87 (F—559014); Ramsammy 19 (W—2212562), 23 (W—2212565); M. R. Schomburgk 108 [Macbride photos 17574] (F—663053--photo, N--photo, W—photo), 173 (F—876664); A. C. Smith 2626 (F—1023803); Tutin 110 (W—1743410). GUYANAN ISLANDS: Moorie: Mori, Bolten, Persaud, Boyan, Roberts, Jugernauth, & Dwarka 8160 (N). SURINAM: Cowan & Lindeman 39221 (B); Donselaar 3217 (Oa, Oa); Fairchild s.n. [March 3, 1932] (W—1626075); Hostmann & Kappler 39 [Macbride photos 22776] (E—118718—isotype, F—687345--photo of isotype, F—976304 --photo of isotype); Irwin, Prance, Soderstrom, & Holmgren 54511 (N); J. P. Schulz 10330 (W—2691317). FRENCH GUIANA: Hallé 516 (N, P), 585 (P); Wachenheim 5 (F—540793, W—1185297). BRAZIL:

Amazônas: Ducke 872 (W--2592937); Prance, Maas, Atchley, Steward, Woolcott, Coêlho, Monteiro, Pinheiro, & Ramos 14620 (Ld, N); Prance, Pena, & Ramos 3302 (Ld, N); Prance, Ramos, Steward, & Pinheiro 11454 (Ld, N). Pará: Campbell, Ongley, Ramos, Monteiro, & Nelson P.22570 (Ld, N); Murça Pires 3622 (W--2222488); Silva, Prance, Balick, Berg, Henderson, Nelson, Bahia, & Reis dos Santos AS.240 (N). Rondônia: Maguire, Murça Pires, Maguire, & Silva 56613 (Ld, N). LOCALITY OF COLLECTION UNDETERMINED: Herb. De Candolle s.n. [Macbride photos 7875] (F--645723--photo, N--photo, W--photo).

PETREA BREVICALYX Ducke, Bull. Mus. Hist. Nat. Paris, ser. 2, 4: 748--749 [as "Petraea"]. 1932; J. A. Clark, Card-Ind. Gen. Sp. & Var. Pl. 1933.

Additional synonymy: Petraea brevicalyx Ducke, Bull. Mus. Hist. Nat. Paris, ser. 2, 4: 748. 1932. Petraca kuhlmannii Mold. ex F. C. Hoehne, Resen. Hist. Secc. Bot. Agron. Inst. Biol. S. Paulo 153, sphalm. & hyponym. April 1937.

Additional bibliography: Fedde & Schust., Justs Bot. Jahresber. 60 (2): 574. 1941; Mold., Phytologia 7: 435--436. 1961; Mold., Fifth Summ. 1: 169 (1971) and 2: 595, 596, 598, 788, & 897. 1971.

Prance and his associates refer to this plant as a liana, the inflorescence, calyx, and corolla blue, and found it growing in a forest beside a small stream, flowering in January.

Additional & emended citations: BRAZIL: Amazônas: Ducke 140 (F--901758, W--1693149, W--1875310), s.n. [Herb. Rio Jan. 22544] (W--1518519--cotype); Fróes 20501 (W--2439285); Prance, Pena, & Ramos 3912 (Ld, N, S).

PETREA COLOMBIANA Mold., Feddes Repert. Spec. Nov. 43: 174--176. 1938.

Additional bibliography: Mold., Phytologia 7: 436. 1961; Mold., Fifth Summ. 1: 119 & 366 (1971) and 2: 897. 1971.

López-Palacios describes this plant as an "arbolito de unos 3 m., flores azulvioláceas" and encountered it at 1600 m. altitude, flowering in August.

Additional & emended citations: COLOMBIA: Magdalena: Seifritz 123 (W--1572424). Santander: López-Palacios 3620 (N, Z); López R. s.n. [Bucaramango, 12/19/1918] (Ar--1782, Ar--1782a). CULTIVATED: Colombia: Killip & Smith 19067 (W--1354374--isotype).

PETREA DUCKEI Mold., Phytologia 1: 469--470. 1940.

Synonymy: Petraea duckei Mold., in herb.

Additional bibliography: Mold., Phytologia 7: 436--437. 1961; Mold., Fifth Summ. 1: 169 (1971) and 2: 897. 1971.

Additional citations: BRAZIL: Amapá: Fróes 25774 (W--2248456).

PETREA FRAGRANTISSIMA Rusby, Mem. N. Y. Bot. Gard. 7: 338. 1927.

Synonymy: Petraea fragrantissima Rsuby ex Mold., Feddes Repert.

Spec. Nov. 43: 190, in syn. 1938.

Bibliography: Rusby, Mem. N. Y. Bot. Gard. 7: 338. 1927; A. W. Hill, Ind. Kew. Suppl. 8: 178. 1929; Mold., Feddes Repert. Spec. Nov. 43: 190—191. 1938; Mold., Geogr. Distrib. Avicen. 28. 1939; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 40 & 97 (1942) and ed. 2, 97: 192. 1949; R. C. Foster, Contrib. Gray Herb. 184: 170. 1958; Mold., Résumé 114, 331, & 464. 1959; Mold., Fifth Summ. 1: 183 (1971) and 2: 595 & 898. 1971; Troncoso, Darwiniana 18: 366, 367, & 411. 1974.

PETREA GLANDULOSA Pittier, Bol. Cienc. Tecn. Mus. Com. Venez. 1: 70 [as "Petraea"]. 1925; Hill, Ind. Kew. Suppl. 7: 183. 1929.

Synonymy: Petraea glandulosa Pittier, Bol. Cienc. Tecn. Mus. Com. Venez. 1: 70. 1925. Petrea pubescens f. albicalyx Mold., Phytologia 18: 72. 1969.

Additional bibliography: J. A. Clark, Card-Ind. Gen. Sp. Var. Pl. issue 116. 1926; Fedde & Schust., Justs Bot. Jahresber. 58 (2): 329. 1938; Pittier, Supl. Pl. Usual. Venez. 55. 1939; Mold., Phytologia 7: 437. 1961; Mold., Résumé Suppl. 17: 347. 1968; Anon., Biol. Abstr. 50 (12): B.A.S.I.C. S.154. 1969; Mold., Biol. Abstr. 50: 6338. 1969; Mold., Phytologia 18: 72. 1969; Hocking, Excerpt. Bot. A.15: 422. 1970; Lasser, Act. Bot. Venez. 4: 48. 1970; Oberwinkler, Pterid. & Sperm. Venez. 78. 1970; Mold., Fifth Summ. 1: 126 (1971) and 2: 596 & 898. 1971; Mold., Phytologia 25: 228, 234, & 242. 1973; Lasser, Braun, & Steyerm., Act. Bot. Venez. 9: 36. 1974; López-Palacios, Revist. Fac. Farm. Univ. Andes 14: 22. 1974; Mold., Phytologia 28: 436. 1974; López-Palacios, Revist. Fac. Farm. Univ. Andes 15: 66—67. 1975; López-Palacios, Fl. Venez. Verb. 453, 454, [469], 472—476, 480, & 652, fig. 111. 1977.

Illustrations: López-Palacios, Fl. Venez. Verb. [473], fig. 111. 1977.

López-Palacios (1975) comments that "Bernardi 1224, por la zona de colección y por su forma parece pertenecer a esta taxon, y creoque el Dr. Moldenke lo haya colocado aquí. Sin embargo, el rótula dice: 'Floración muy vistosa por sus cálices corolinos violados'. Puede ser una equivocación y tratarse de cálices 'blancos con tintes violados'. Aunque mi opinión es que se trata de una P. glandulosa, la he conservado en P. pubescens en atención a la nota citada. De ser ésta última sería, la más baja (300 m) y la más oriental de los Andes venezolanos. Tengo una vaga idea de que el Dr. Moldenke la haya citado, como de Mérida, pero es de Barinas; tambien pertenece aquí Aristeguieta 4113."

Recent collectors describe P. glandulosa as a tree, 6--15 m. tall, unarmed, erect, and handsome, the trunk elongate, cylindric, erect, 10—12 cm. in diameter, the crown more or less narrow and open, the leaves very asperous, elliptic, to 27 cm. long and 12 cm. wide, and the calyx white and glandulose. They have found it growing in areas disturbed by cultivation, at 200—850 m. altitude, flowering from December to February, April, and September. Lasser reports it cultivated in Venezuela. López-Palacios speaks of the calyx as "blanco al principio, luego amarillento verdosulo" and the corolla as "blanca lila al principio, virando paulatinamente hacia al morado intenso". On *Aristeguieta 1602* the label informs us that the "flores blancas, con el centro debilmente moradas, muy ornamentales". The corollas are said to have been "pale-blue" on *Bunting 2369* and "pale-purple" on *Aristeguieta 3864* and *López-Palacios 2664*.

Vernacular names reported for this species are "guamo macho", "palo santo", "penitente", "tostadito", and "totumito".

Material of *P. glandulosa* has been misidentified and distributed in some herbaria as *P. aspera* Turcz. and *P. pubescens* Turcz. In fact, the *Aristeguieta 3864* and the *Aristeguieta & Agostini 4113*, cited below, were previously erroneously cited by me as *P. pubescens*.

López-Palacios (1977) cites the following collections from Venezuela: Barinas: *Aristeguieta 1602*, *3854*; *Bernardi 1224*, *3331*, *6520*; *Ruiz-Terán 1331*, *1504*. Federal District: *Aristeguieta 6600*; *López-Palacios 2553*. Portuguesa: *López-Palacios 2664*; *Peraza s.n.* [Pittier 11532]. Táchira: *Aristeguieta 4113*; *Bunting 2369*; *L. Cárdenas 1276*; *López-Palacios 2757*; *López-Palacios & Bautista 3238*; *Ruiz-Terán 3561*. Trujillo: *Ruiz-Terán & López-Palacios 10421*.

Additional & emended citations: VENEZUELA: Barinas: *Aristeguieta 1602* (N), *3864* (N); *Bernardi 1224* (N). Portuguesa: *López-Palacios 2664* (N, Z); *Peraza s.n.* [Pittier 11532] (W—1197958—isotype). Táchira: *Aristeguieta & Agostini 4113* (Ac); *López-Palacios & Bautista 3238* (Ld). Trujillo: *Ruiz-Terán & López-Palacios 10421* (Ld). CULTIVATED: Venezuela: *Bunting 2369* (Ld, Z).

PETREA INSIGNIS Schau. in A. DC., Prodr. 11: 620. 1847.

Additional synonymy: *Petraea insignis* Schau. ex Mold., Feddes Repert. Sp. Nov. 43: 20, in syn. 1938. *Petrea insigis* López-Palacios, Revist. Fac. Farm. Univ. Andes 15: 66, sphalm. 1975.

Additional & emended bibliography: Buek, Gen. Spec. Syn. Candoll. 3: 338. 1858; Bocq., Adansonia, ser. 1, 3: [Rev. Verbenac.] 251. 1863; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 478. 1894; Peckolt, Bericht. Deutsch. Pharm. Gesell. 14: 478. 1904; M. Kunz, Anat. Untersuch. Verb. 65. 1911; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 2: 478. 1946; LeCointe, Amaz. Bras. III Arv. & Pl. Uteis, ed. 2, 198 & 494. 1947; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 2: 478. 1960; Mold., Phytologia 7: 437. 1961; Mold., Fifth Summ. 1: 169 & 366 (1971) and 2: 596, 598, & 898. 1971; López-Palacios, Revist. Fac. Farm. Univ. Andes 15: 64 & 66. 1975; Mold., Phytologia 31: 406. 1975.

Recent collectors refer to this plant as a vine or liana, the calyx blue, and have found it growing along roadsides, on "blackwater flooded riverbanks" (varzea), and growing "on submerged trees", flowering in April, October, and November. The corolla is said to have been "blue" on *Prance & al. 15117* & *P.25462* and "violet" on Prance & al. 11768. The vernacular names, "flor de São Miguel", "viuvinha", and "touca de viuva" -- the last translated as "Witwenhaube" by Peckolt (1904) -- have been recorded for the species.

Macbride has photographed the type of this taxon in the Munich herbarium as his type photograph number 20348.

Additional & emended citations: BRAZIL: Amazônas: Murça Pires, Cavalcante, Magnago, & Silva s.n. [Herb. IPEAN 13884b] (Ld, N); Prance, Coêlho, Kubitzki, & Steward 11768 (Ld, N); Prance, Maas, Woolcott, Coêlho, Monteiro, & Ramos 15117 (Ld, N); Spruce s.n. [in vicinibus Barra, Dec.-Mart. 1850-51] (F—876692). Pará: Martius s.n. [Pará; Macbride photos 20348] (F--684155—photo of type, Mu—904—type, N—photo of type); Prance, Silva, Balick, Berg, Henderson, Nelson, Bahia, & Reis dos Santos P.25462 (N). MOUNTED ILLUSTRATIONS: Schau. in Mart., Fl. Bras. 9: pl. 46, fig. 2. 1851 (N, Z).

PETREA KOHAUTIANA Presl, Bot. Bemerk. 99. 1844.

Additional synonymy: Petraea volubilis Jacq. ex Cham., Linnaea 7: 366. 1832 [not Petraea volubilis Gaertn., 1791, nor Haust., 1966, nor Jack, 1947, nor Jacq., 1938, nor L., 1919, nor Willd., 1838 & 1940, nor Woodr., 1906]. Petrea kohantiana Presl ex Crevost & Pételot, Bull. Econ. Indochin. 37: 1289, in syn. 1934. Petrea kobautiana Presl ex Macbr., Field Mus. Publ. Bot. 13 (5): 663, sphalm. 1960. Petraea kohautiana Presl ex Mold., Résumé Suppl. 13: 7, in syn. 1966. Petrea volbilis Jacq. ex Jiménez, Cat. Fl. Doming. Supl. 1: 218, sphalm. 1966. Petrea konuatiana Mold. ex López-Palacios, Revist. Fac. Farm. Univ. Andes 18: 71, sphalm. 1976. Petrea kohautiana Mold. ex López-Palacios, Fl. Venez. Verb. [456], fig. 107. 1977.

Additional & emended bibliography: Buek, Gen. Spec. Syn. Candoll. 3: 338. 1858; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 478. 1894; Crevost & Pételot, Bull. Econ. Indochin. 37: 1289. 1934; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 2: 478. 1946; Mold., Phytologia 2: 178—179 (1946) and 2: 501. 1948; Pételot, Pl. Méd. Cambod. Laos Viet-Nam 2 [Archiv. Recherch. Agron. Past. Viet-Nam 18]: 258 (1953) and 4: 145. 1954; Mold., Verb. [Trin. Tob.] 19. 1955; Chittenden, Dict. Gard. 1534. 1956; D. & B. Hargreaves, Trop. Bloss. 31. 1960; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 2: 478. 1960; Macbr., Field Mus. Publ. Bot. 13 (5): 663. 1960; Mold., Phytologia 7: 437—438. 1961; Liogier, Rhodora 67: 350. 1965; Jiménez, Cat. Dl. Doming. Supl. 1: 218. 1966; D'Arcy, Rhodora 69: 439. 1967; Mold., Résumé Suppl. 15: 21. 1967; Uphof, Dict. Econ. Pl., ed. 2, 398. 1968; Corner & Watanabe, Illustr. Guide Trop. Pl. 76. 1969; Esteva, Arb. Ornament. Trop. 355. 1969; Menninger, Flow. Vines 61. 1970; Mold. in Menninger, Flow. Vines 338, pl. 193. 1970; Mold., Fifth Summ. 1: 103, 107, 109, 110, 366, & 390 (1971) and 2: 595, 596, 598, 599, 898, & 968. 1971; Mold., Phytologia 23: 416, 426, & 434. 1972; F. Perry, Flow. World 304 & 318. 1972; Chantry, Alive 1: 27. 1973; Mold., Phytologia 29: 76 (1974) and 31: 383 & 392. 1975; López-Palacios, Revist. Fac. Farm. Univ. Andes 15: 64, 66, & 67 (1975) and 18: 71. 1976; Mold., Phytologia 34: 257. 1976; Lewis & Elvin-Lewis, Med. Bot. 324. 1977; López-Palacios, Fl. Venez. Verb. 454—[456], 471, 638, & 651. 1977; Mold., Phytologia 41: 450. 1979.

Additional illustrations: D. & B. Hargreaves, Trop. Bloss. 31 (in color). 1960; Mold. in Menninger, Flow. Vines pl. 193 (in color). 1970; F. Perry, Flow. World 304 (in color). 1972; López-Palacios, Fl. Venez. Verb. [456], fig. 107. 1977.

Recent collectors describe this plant as a high-climbing woody vine, to 7 m. long, or as an erect branched shrub, 2 m. tall, the leaves very scabrous-asperous above, deep-green, and the calyx lavender or violet. They have encountered it at the edge of forests, on rock walls, along roadsides, and in low windswept woods on headlands, at 50 to 700 m. altitude, flowering from March to July, fruiting in May. The corollas are said to have been "purple" on Gillis 8177, Howard 11303, and Ruiz-Terán & López-Palacios 10871, "blue-purple" on Steyermark & Espinoza 106953, "lavender" on Wasshausen & Ayensu 357 and Webster & al. 9086, and "deep-violet" on Proctor 17943.

Howard reports the species "common" on St. Lucia and Degelius found it "abundant" on Martinique. Vernacular names reported for it are "liane à la veuve", "liane rude", "liane St. Jean", and "liane violette", as well as "queen's wreath". Chittenden (1956) reports it cultivated in England, while Esteva (1969) reports it both cultivated and escaped in Venezuela. Menninger (1970) speaks of it as "among the finest of the Queen's-Wreath climbers".

Uphof (1968), as well as Lewis & Elvin-Lewis (1977) report that a tea is brewed from the flowers of this species and Chiococca alba and that this tea is used as an abortive on Dominica.

Crevost & Pételot (1934) reduce P. kohautiana, along with P. retusa Presl, P. serrata Presl, and P. volubilis Vell., so synonymy under P. subserrata Cham. [now known as P. racemosa Nees].

Material of P. kohautiana has been misidentified and distributed in some herbaria as P. aspera Turcz. and P. bracteata Steud. On the other hand, the López-Palacios 3589, distributed as P. kohautiana, actually is P. arborea H.B.K.

Additional & emended citations: LEEWARD ISLANDS: Antigua: Rose, Fitch, & Russell 3479 (W—639622); Wullschlägel 428 (Mu—921). Dominica: Eggers 576 (Mu—1706), s.n. [Wallhouse, Oct. 1881] (W—1323171); Gillis 8177 (Ft—9520); Wasshausen & Ayensu 357 [wood 36929] (W—2536353). Guadeloupe: Duss 2390 (W—849818); Herb. Short s.n. (D—611740); Stehlé & Stehlé 6967 (W—2453655); Webster, Ellis, & Miller 9086 (Mi). Marie Galante: Proctor 20980 (W—2613803). WINDWARD ISLANDS: Grenada: W. E. Broadway s.n. [Presbytery, June 6, 1906] (F—192600). Martinique: Degelius s.n. [22/V/ç958] (Go); Duss 1979 (F—20541); Hahn 270 (D—618885, Mu—1422, W—58254); *Kohaut s.n.* [Sieber Fl. Mart. 157 in part] (Mu—920—isotype); *H. Stehlé 5754* (Mi); *Stehlé & Stehlé 6890* (W—2453661), *6921* (W—2453656). St. Lucia: *Herb. Schreber s.n.* (Mu—919); *Herb. Schwägrichen s.n.* (Mu—1421); *R. A. Howard 11303* (N); *Proctor 17943* (W—2585076). VENEZUELA: Aragua: *Overwinkler & Oberwinkler 14704* (Mu). Miranda: *Steyermark & Espinoza 106953* (W—2747231). CULTIVATED: Guyana: *Warren s.n.* [1924] (W—1280088). St. Croix: *L. A. Ricksecker 239* (E—118722, F—71050). Venezuela: *Ruiz-Terán & López-Palacios 10871* (Z).

PETREA KOHAUTIANA f. **ALBA** (Freeman & Williams) Mold., Phytologia 41: 450. 1979.

Additional synonymy: *Petrea volubilis* "white variety" Cove, Gard. Chron., ser. 3, 39: 25, fig. 15. 1906. *Petrea kohautiana* var. *alba* (Freeman & Williams) Mold., Phytologia 2: 108, nom. nud. (1945); 2: 179. 1946. *Petrea kohautiana* var. *anomolo* Chittenden, Dict. Gard. 1534. 1956. *Petrea volubilis* var. white-flowered MacM., Prop. Plant. Gard., ed. 5, 122. 1962. *Petrea volubilis* var. *albiflora* López-Palacios, in herb.

Additional bibliography: Cove, Gard. Chron., ser. 3, 39: 25, fig. 15. 1906; R. W. R. Mill., Gard. Book Barbados 87 & vii. 1935; Mold., Phytologia 2: 108. 1945; Mold., Verb. [Trin. Tob.] 19. 1955; Chittenden, Dict. Gard. 1534. 1956; D. & B. Hargreaves, Trop. Bloss. 31. 1960; Mold., Phytologia 7: 438. 1961; MacM., Trop. Plant. Gard., ed. 5, 122. 1962; Mold. in Menninger, Flow. Vines 338. 1970; Mold., Fifth Summ. 1: 366 (1971) and 2: 595, 598, 599, & 898. 1971; Mold., Phytologia 23: 426 & 434 (1972) and 31: 392. 1975; López-Palacios, Fl. Venez. Verb. 455 & 651. 1977; Mold., Phytologia 41: 450. 1979.

Illustrations: Cove, Gard. Chron., ser. 3, 39: 25, fig. 15. 1906; D. & B. Hargreaves, Trop. Bloss. 31 (in color). 1960.

Ruiz-Terán & López-Palacios refer to this plant as an "arbusto muy ramificado, 1.8 m. alto" and have encountered it in cultivation in Venezuela at 50 m. altitude, flowering in July. Cove (1906) reports the form cultivated in the Barbados islands. It is known commonly as "white petrea" or "white-wreath". It was originally described [as var. *anomala* Mold.] as having both white calyx and white corolla and is so pictured by Hargreaves (1960). It is most probable that not only the "*P. volubilis* white variety" of Cove (1906), but also the "*P. volubilis* var. white-flowered" of MacMillan (1962) and the *P. volubilis* var. *alba* of Miller (1935) actually are the taxon under discussion here and not the true *P. volubilis* f. *albiflora* (Standl.) Standl.

Additional citations: CULTIVATED: Venezuela: *Ruiz-Terán & López-Palacios 10870* (Z). MOUNTED ILLUSTRATIONS: H. N. Moldenke color slide 303 (Ld).

PETREA KOHAUTIANA var. **PILOSULA** Mold., Phytologia 29: 76. 1974.

Bibliography: Mold., Phytologia 29: 76 (1974) and 31: 392. 1975.

This variety differs from the typical form of the species in having is leaf-blades normally very distinctly rounded-emarginate apically, sometimes with the 2 lobe-like portions of the blade apex cordately overlapping, and with a sharp and firm, projecting, erect or divergent arista about 3 mm. long arising from the termination of the midrib and with the calyx and receptacle sparsely or densely whitish-pilosulous throughout.

Ruiz-Terán & López-Palacios describe the plant as an "arbusto erecto, 2 m., cultivado como ornamental, flores moradas" and collected it in anthesis in September, distributing their material as *P. aspera* Turcz. They record the vernacular name, "viuda".

Citations: CULTIVATED: Venezuela: *Ruiz-Terán & López-Palacios 7641* (Z--type).

PETREA LONGIFOLIA Mold., Feddes Repert. Spec. Nov. 43: 197--199. 1938.

Additional bibliography: Macbr., Field Mus. Publ. Bot. 13 (5): 665. 1960; Mold., Phytologia 7: 439. 1961; Mold., Fifth Summ. 1: 375 (1971) and 2: 596 & 898. 1971.

Emended citations: LOCALITY OF COLLECTION UNDETERMINED: *Herb. Mus. Paris s.n.* (F--976499--isotype).

PETREA MACROSTACHYA Benth., Ann. Nat. Hist., ser. 1, 2: 448 [as "*Petraea*"]. 1839; Schau. in A. DC., Prodr. 11: 617. 1847.

Additional & emended synonymy: *Petraea (volubilis?) guianensis* Kunth ex Cham., Linnaea 7: 367. 1832. *Petraea macrostachya* Benth., Ann. Nat. Hist., ser. 1, 2: 448. 1839. *Petraea (volubilis?) guianensis* Cham. apud Mold., Feddes Repert. Spec. Nov. 43: 204, in syn. 1938. *Petrea maritima* Schau. ex Mold., Résumé Suppl. 12: 12, in syn. 1965.

Additional & emended bibliography: Buek, Gen. Spec. Syn. Candoll. 3: 338. 1858; Turcz., Bull. Soc. Imp. Nat. Mosc. 36 (2): 211. 1863; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 478. 1894; M. Kunz, Anatom. Versuch. Verb. 65. 1911; Mold., Phytologia 2: 108. 1945; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 2: 478 (1946) and imp. 3, 2: 478. 1960; Macbr., Field Mus. Publ. Bot. 13 (5): 663 & 664. 1960; Mold., Phytologia 7: 439. 1961; Mold., Résumé Suppl. 12: 12. 1965; Mold. in Menninger, Flow. Vines 338. 1970; Mold., Fifth Summ. 1: 130, 134, 142, & 169 (1971) and 2: 596--599 & 898. 1971; López-Palacios, Revist. Fac. Farm. Univ. Andes 15: 66 & 67. 1975; Soukup, Biota 11: 14. 1976.

Recent collectors describe this plant as a woody vine or liana, climbing into trees, the inflorescences pendent, the calyx blue or blue-lilac to lavender, and the stamens purple. They have encountered it in low forests near fields, in partially inundated and in true varzea forests, in secondary forests, and in terra firme forests, flowering in February, June, August, and September, fruiting in September. Macbride (1960) records it from Loreto, Peru, but cites no substantiating specimens. The corollas are said to have been "blue" on *Bisby & al. P.18063*, "blue, interior of tube cream" on *Prance & al. 2585*, "blue-lilac" on *Prance & al. 5236*, "lavender" on *Bolten & al. 8136*, "violet" on *Ducke 1982* and *Hallé 747*, "purple" on *Lleras & al. P.17213* and *Prance & al. 10236*, and "roxa" on *Ribeiro 15287*. In situ photographs accompany *Mori & al. 8136*.

Material of this species has been misidentified and distributed in some herbaria as *P. martiana* Schau. On the other hand, the *Mathias & Taylor 5093*, distributed as *P. macrostachya*, actually is *P. martiana* var. *glabrescens* Mold.

Additional & emended citations: GUYANA: *Jenman 4905* (W--58249); *M. R. Schomburgk 158* [Macbride photos 34292] (F--976312--photo of isotype); *A. C. Smith 3401* (F--1023581). GUYANAN ISLANDS: Thomas: *Mori, Bolten, Persaud, Boyan, Roberts, Jugernauth, & Dwarka 8136* (N). FRENCH GUIANA: *Collector undetermined s.n.* (Pd); *Hallé 747* (N, P). BRAZIL: Amapá: *Irwin, Egler, & Murça Pires 47158* (N). Amazônas: *Bisby, Steward, & Ramos P.18063* (N); *Ducke 1982* (W--1901377, W--1901407); *Lanna 338* [Castellanos 23658; Herb. Cent. Pesq. Florest. 1971] (Z); *Lleras, Steward, Ongley, Coêlho, Ramos & Lima P.17213* (N); *Prance, Pena, Ramos, & Videcki 2585* (Ld, N, S); *Prance, Steward, Ramos, & Farias 10236* (Ld, N); *Ribeiro 15287* [714] (Ld). Rondônia: *Prance, Philcox, Forero, Coêlho, Ramos, & Farias 5236* (Ac, N).

PETREA MARTIANA Schau. in A. DC., Prodr. 11: 620. 1847.

Additional & emended bibliography: Buek, Gen. Spec. Syn. Candoll. 3: 338. 1858; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 478. 1894; M. Kunz, Anatom. Untersuch. Verb. 65. 1911; LeCointe, Amaz. Bras. III Arv. Pl. Uteis, ed. 1, 470. 1934; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 2: 478. 1946; LeCointe, Amaz. Bras. III Arv. Pl. Uteis, ed. 2, 495. 1947; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 2: 478. 1960; Macbr., Field Mus. Publ. Bot. 13 (5): 663--666. 1960; Mold., Phytologia 7: 439--440. 1961; Mold., Fifth Summ. 1: 142, 169, & 381 (1971) and 2: 596, 598, 599, & 898. 1971; López-Palacios, Revist. Fac. Farm. Univ. Andes 15: 67. 1975; Mold., Phytologia 32: 458 (1975) and 34: 257 & 259. 1976; Hocking, Excerpt. Bot. A.28: 259. 1976; Soukup, Biota 11: 14. 1976; López-Palacios, Fl. Venez. Verb. 468 & 652. 1977.

Recent collectors describe this plant as a liana, to "over 10 m. tall in trees", the pedicels and calyx blue, and have encountered it in forests and forest edges, on terra firme, and on low land at the borders of rivers of whitish water, flowering in February and from October to December. LeCointe (1947) reports that it is found "Na mata de terra firme argilosa. E' a especie mais frequente no Estado do Pará, [Brazil]". The corollas are said to have been "blue" on *Prance & al. 3793* & *8256* and "violet" on *Ducke 872* & *1133* and *Fróes 22628*.

[to be continued]

THE SEXUALITY OF THE BARRO COLORADO ISLAND FLORA (PANAMA)

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The sexual expression of species making up a flora have frequently been analyzed, but as yet no enumeration has been given for any entire neotropical flora. Probably the most thorough survey of the distribution of sexual expression was that made by Yampolsky and Yampolsky (1922), but that now much out of date survey was made on a worldwide phyllogenetic basis rather than on a geographical basis. The recent completion of the Flora of Barro Colorado Island (Croat, 1978) affords the opportunity to report on the sexual behavior of a species-rich tropical forest in the isthmus of Panama. Barro Colorado Island, which lies in Gatun Lake midway between the Atlantic and Pacific Oceans, has a flora of 1,369 species of vascular plants. Although the area is small in size (ca 6 square miles), it is representative of tropical moist forest, which makes up approximately 50% of the total area of Panama. Moreover, it occupies a central position between North and South America and apparently has acquired nearly equal numbers of species from the Central and South American floras (Croat and Busey, 1975).

Of the 1,212 species of native phanerogams in the flora, 286 (24%) have unisexual flowers. Of these, 106 (9%) are dioecious, 132 (11%) are monoecious,(4 are monoecious or dioecious and are included in both categories), and 52 (4%) are polygamous.

On BCI there are 481 arborescent species (39.7% of the native vascular flora) (See Table 1). Of this number, 34 (6.4%) are trees which may be larger than 30 m and are possible emergents, while 177 (37%) are trees 10-30 m tall. The two groups inclusively are referred to here as medium to large trees. There are 265 climbing plants making up 20% of the flora and 466 herbaceous plants (not counting herbaceous vines). accounting for 35.5% of the phanerogamic flora.

METHODS

Field work was carried out on Barro Colorado Island during the years 1967 through 1975. Plants were observed for obvious signs of sexual dimorphism and were designated as dioecious, monoecious and polygamous on this basis. Species in certain families, such as Meliaceae and Burseraceae where others have reported dioecism, were examined in greater detail but no controlled experiments were carried out. Though no apparent sexual dimorphism was observed in the flowers of some members of these families, they were presumed dioecious because during a normal flowering season some individuals set abundant fruit while others did not set fruit. Examples of such species are Protium panamense (Burseraceae) and Guarea glabra (Meliaceae). All other members of the Burseraceae and Meliaceae which are considered dioecious here are the result of reports by other workers (Styles, 1972; Bawa & Opler, 1975). With these exceptions all dioecious species reported here are based on obvious and conspicuous sexual dimorphism in the flowers.

Monoecious species and polygamous species are all reported on the basis of obvious sexual dimorphism in the flowers. Flowers of the Sapindaceae are however suspect owing to studies by Bawa (1977) (See the discussion under polygamous species). All Cucurbitaceae, though initially believed to be dioecious, are placed among the monoecious species based on observations by Bawa (personal communication).

MONOECISM (Tables 1 and 5)

A total of 132 (11%) of the native species on Barro Colorado Island are monoecious (Table 5). This compares very closely to the 10% reported by Bawa and Opler (1975) for the Comelco area of Guanacaste, Costa Rica. However, their study was limited to tree species while this study has dealt with the entire phanerogamic flora.

Monoecious species are most common percentage-wise among medium to large trees but a smaller percentage of these trees are monoecious (15%)

than are dioecious (21%). The same is true of climbing plants, 12% are monoecious versus 8% dioecious, but the differences are not significant. A significantly higher percentage of herbaceous species are monoecious, however, with 11% monoecious herbs versus only 2% dioecious herbs. Of the small trees and shrubs, 7% are monoecious and 12% are dioecious.

POLYGAMOUS SPECIES (Table 1 and 6)

The polygamous conditions of sexuality where both unisexual (usually staminate) and hermaphroditic flowers are present on the same or different individuals of a species is the most difficult sexual condition to classify, owing to the variety of sexual states which may be present and the difficulty of ascertaining whether certain sexual structures are functional. For example, while Sapindaceae usually are polygamous and their bisexual flowers appear to have both sexes functional, Bawa (1977) has shown the anthers of bisexual flowers of Cupania guatemalensis to be nonfunctional, apparently never opening. He concludes that perhaps this is true of other polygamous species in the family as well. Lacking more evidence to indicate that such is true for all polygamous species, I am including here as polygamous all species which have both functional hermaphroditic flowers as well as unisexual flowers.

Polygamous species (52) are found in relatively few (9) families and are most abundant in Compositae and Sapindaceae, the latter being a family principally of lianas.

DIOECISM (Tables 1 and 7)

Arborescent Species

The medium to large trees on BCI are 21% dioecious. The dioecious condition of a number of BCI species has not been verified, and their presence on the list of dioecious species is based on studies by other workers (Styles, 1972; Bawa and Opler, 1975). These include most species of Burseraceae, Polygonaceae, and Meliaceae which occur on the list though observation on

Guarea glabra Vahl (Meliaceae) and Protium panamense (Rose) I.M. Johnston (Burseraceae) indicate that they are dioecious. (See comments about these species under Methods). On the other hand, a number of additional species may ultimately be added to the list, such as other poorly known species of Pouteria (Sapotaceae).

Bawa and Opler (1975) reported that 22% of the trees from the Comelco study area in Guanacaste, Costa Rica, were dioecious while only 11% of the shrubs were dioecious. Comparable figures for BCI are 21% dioecious species for trees and 12% dioecious species for shrubs and small trees. Bawa and Opler's list of dioecious species (p.168) agrees in general with my size class of medium to large trees (trees more than 10 m tall) but some of these taxa fall into my small tree and shrub category (K. Bawa, pers. comm.). These include 2 species of Randia, Allophylus occidentalis, Xylosma sp. and Margaritaria nobilis. If only trees more than 10 m tall are considered, the percentage of dioecious species is 19% in the Comelco region, slightly lower than on BCI.

The category small trees and shrubs on BCI is much larger than the category medium to large trees, but contains proportionally fewer dioecious species. For example, on BCI, there are 270 species of shrubs or small trees (less than 10 m tall). This includes the 16 hemiepiphytic shrubs and the 7 parasitic shrubs (3 of which have unisexual flowers). If the shrubs or small trees category is considered alone, 12% of their species are dioecious while shrubs considered alone have 4% (4 of 93) of their species dioecious.

The more restricted category for trees (i.e., those more than 10 m tall) yielding 21% dioecious species also corresponds rather well to reports for tropical floras elsewhere, e.g., 27% for South Florida (Tomlinson, 1974) and 26%* for a dipterocarp forest of Sarawak (Ashton, 1969), but falls

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* Ashton (1969) included in his count some protandrous and some protogynous, hermaphroditic species.

far short of the percentages of dioecious species of trees calculated by Bawa and Opler (1975) for species reported by Jones (1955) for a rain forest in Nigeria (38-40%).

It would be interesting to make direct comparisons between the sexual expression of the tropical dry forest of Costa Rica and that of the tropical moist forest area of Panama. However, no such comparisons can be made, owing in part to the reasons discussed above. In addition to possible differences in our respective classification of trees, there are actual differences in which species I have considered dioecious. For example, I have considered as hermaphroditic, monoecious or polygamous, some taxa which Bawa and Opler have considered dioecious, e.g., _Spondias_, _Genipa_, and most Sapindaceae (Tables 5-7). Actually it is very difficult to clearly separate species into distinct classes based on their sexual expression since the degree to which a species is hermaphroditic or unisexual is variable. For example, some families with polygamous flowers, such as the Sapindaceae, have bisexual and pistillate flowers in varying proportions. Some polygamous species have such a preponderance of pistillate flowers that they can be said to be functionally pistillate. While most _Serjania_ species are polygamous, one species, _S. cornigera_, may be found to vary from year to year or even during the course of a single growing season. Lee (1967) has found that tendencies for maleness or femaleness in _Swietenia_ (Meliaceae) may vary from year to year. Bawa (1977) indicates the same tendency in _Cupania_ (Sapindaceae). In this case trees which produced only staminate flowers one year still bore fruits from the previous year. Other species reported by Bawa (1974) to be variable in their sexual expression in a local area include _Simaruba glauca_, _Allophylus occidentalis_ and _Coccoloba_ spp. Klaehn (1961), working with temperate trees, cites examples of similar differences in sexual tendencies from tree to tree in the same population. Styles (1972) states that in Meliaceae the proportion of staminate to pistillate or hermaphroditic to unisexual flowers is phenologically variable within a single flowering season. I have observed the same phenomenon on other taxa, such as _Trichospermum_

(Tiliaceae). Even completely hermaphroditic species may be so prominently protogynous or protandrous as to be functionally unisexual at any point in time. Bawa (1977) has found sexual expression in Cupania (Sapindaceae) to shift from staminate to pistillate and back to staminate in a single flowering season. The occurences of such sexual intergradations increases the complexity of studying sexual expression in the tropics.

As Bawa and Opler (1975) pointed out, it is often very difficult to distinguish dioecious species from hermaphroditic species. This is particularly true in such families as Meliaceae, Burseraceae, Sapindaceae, and Anacardiaceae. Many dioecious members of these families can only be distinguished as dioecious by repeated observation of flowering and degree of fruit set or alternatively by pollination experimentation. Styles (1972) found minute but consistent differences in some genera of Meliaceae but no differences whatever in other genera even though experimentation has shown them to be dioecious or monoecious. In addition to the variation in sexual expression at the populational level, there is the possibility of a clinal variation in sexual expression over the extent of the species' range.

I suspect that within some species there is intraspecific variation extending from individuals which are functionally hermaphroditic to those which are functionally staminate or pistillate. For example, while Spondias radlkoferi Donn. Sm. (S. nigrescens Pittier) (Anacardiaceae) is dioecious in Guanacaste, it is preponderately hermaphroditic in central Panama. All plants have very large numbers of hermaphroditic flowers and a small number of pistillate flowers and all individuals observed set fruit after flowering.

Scandent and Herbaceous Species

More interesting than the comparison of percentages of dioecious trees and shrubs is the percentage of scandent dioecious species for BCI as compared to the Comelco study site. Bawa and Opler (1975) emphasized forest trees as being characteristic of dioecism and reported that there were no dioecious vines or lianas in the Guanacaste study site. Despite the fact that larger trees remain the most important for dioecism, 20% of the dioecious species on BCI are vines or lianas. Representatives include Gnetaceae (1 sp.), Dioscoreaceae (5 spp.), Menispermaceae (7 spp.) Polygonaceae (1 sp.), Smilacaceae (5 spp.), Urticaceae (1 sp.), and Nyctaginaceae (1 sp., _Pisonia_, considered a tree by Bawa and Opler).

While there are no herbaceous plants in Guanacaste which were reported to be dioecious, there are 8 herbaceous species on BCI which are dioecious. (Subsequent to publication of these figures for Guanacaste, the authors have discovered 6 or 7 species of _Dioscorea_ at the Comelco study sites (Paul Opler, pers. comm.).)

MORPHOLOGICAL FEATURES OF DIOECIOUS SPECIES

The dioecious species on Barro Colorado Island were studied to test the statements made by Bawa and Opler (1975) concerning the morphology of dioecious species. These were the following:

1. That dioecious species often display sexual dimorphism in flower size with the pistillate flowers being larger than their staminate counterparts.

2. That flowers of dioecious species are generally not colorful or showy, usually being white to yellow or pale green.

3. That dioecious species often have flowers substantially smaller than congeneric hermaphroditic species.

1. Of the 106 dioecious species on BCI, 97 were studied for length of staminate flowers (Table 2; Figures 1 and 2). Flower measurements are those presented in the Flora of Barro Colorado Island (Croat, 1978). Only the length of the flower is considered except where the width was noticeably greater than the length. In such cases, the width of the flower was used. The measurement used was the upper limit of normal variation, but not the

unusual higher variant appearing in parenthesis, e.g., 10-12(15) mm, the parenthesized measurement referring to fewer than 5% of the cases or to reports of lengths for the same species growing elsewhere. The structures measured were the tepals, petals or sepals (depending on which were longer) except for flowers without petals or with a very reduced perianth. In such cases, the length of the sexual parts, i.e., stamens or pistil, was used. The average length of staminate flowers was 7.6 mm (Table 2). The standard error, however, of 20.1 is large because of a few species with large and very large flowers. If flowers 1 cm or more long are excluded from consideration, the average flower size for dioecious staminate flowers is 3.16 mm. Dioecious species with flowers 1 cm or more long had an average staminate flower size of 30.1 mm. There are 16 species in this latter category: *Carica*, *Jacaratia* (Caricaceae), *Diospyros* (Ebenaceae), *Clusia*, *Tovomita* (2 spp.)(Guttiferae), *Hampea* (Malvaceae), *Guarea* (2 spp.) (Meliaceae), *Neea* (Nyctaginaceae), *Mormodes* (Orchidaceae), *Scheelea* (Palmae), *Alibertia*, *Amaouia* and *Randia* (2 spp.) (Rubiaceae).

Fewer pistillate flowers were studied as they are less frequent. A total of 76 dioecious species with pistillate flowers were studied. The average flower length for these was 6.76 mm. However, again, if all flowers more than 1 cm long are excluded, the average length is only 3.1 mm. For the 19 species with normal maximum flower length of 1 cm or more, the average is 17.7 mm. In addition to the genera listed for staminate flowers with flowers more than 1 cm long, the following species have pistillate flowers more than 1 cm long: *Acalypha macrostachya*, *Alchornea latifolia* (only if styles are included) (Euphorbiaceae), *Gynerium sagittatum* (Graminae) and *Triplaris cumingiana* (Polygonaceae).

Though this study did show sexual dimorphism in flower size, it is not believed to be as important on BCI as was shown by Bawa and Opler (1975) in Guanacaste (Table 3). Only 29 species (27%) showed any noticeable sexual dimorphism in flower size, though pistillate flowers of an additional 6 species were not studied owing to inavailability of flowers. Thirteen species showed pistillate flowers to be smaller than their staminate counterpart rather than larger (16 species). However, the mean percentage difference in flower size was 60% for the group with pistillate flowers larger than staminate, and only 26% for the group with pistillate flowers smaller than staminate (see Table 3). In comparison Bawa and Opler (1975) found 14 of 20 species (70%) measured, with staminate flowers smaller than pistillate.

Perhaps more important than perianth size is the size and coloration of the sexual parts. For example, on many species the perianth is inconspicuous in comparison to the cluster of numerous stamens. Thus, in Xylosma (Flacourtiaceae) the staminate flower with its large cluster of stamens is showier than the pistillate flower with its inconspicuous stigma. On the other hand, the showy, much-divided style of such species as Acalypha macrostachya (Euphorbiaceae) make the pistillate flowers more conspicuous than the staminate flowers.

Also important yet difficult to compare is the shape, disposition and density of the inflorescence, which may replace the individual flowers as the pollinating unit, such as in the Moraceae. In that family individual flowers are inconspicuous and perhaps individually unimportant but the shape, size and coloration of the inflorescence are no doubt significant in attracting pollinators. While it is certainly true that most dioecious species have small flowers, relatively few dioecious species also have solitary flowers or otherwise have their flowers arranged in inconspicuous clusters. Thus insects are probably not attracted to individually inconspicuous dioecious flowers but rather to clusters of flowers which form attractive pollination units. Many dioecious species in the BCI flora have flowers which are so aggregated that the functional attraction unit must be the flower aggregate or inflorescence rather than individual flowers. These include Iresine celosia, Struthanthus orbicularis, Chamaedorea wendlandii, and Scheelea zonensis, as well as a large percentage of the Moraceae including Cecropia spp., Coussapoa Spp., Maquira costaricana, Perebea xanthochyma, Pourouma aspera and Pseudolmedia spuria. Also included here is one gymnosperm, Gnetum leyboldii var. woodsoniana, whose microsporangia are densely aggregated.

2. The inconspicuous nature of flowers of dioecious species is partly due to their usually pale color. Bawa and Opler (1975) have indicated that most have colors ranging from white to yellow or pale green. Added to this on the basis of my studies would be brownish flowers, Virola (Myristicaceae) (2 species), the brownish-purple flowers of Coccoloba acapulcensis (Polygonaceae), the violet-purple flowers of Dioscorea haenkeana and D. macrostachya (Dioscoreaceae), and the reddish flowers of Neea amplifolia (Nyctaginaceae), Coccoloba acuminata, (Polygonaceae) and Trattinnickia aspera (Burseraceae). The remainder of the dioecious species on BCI are the colors mentioned by Bawa and Opler (see Table 4).

3. In comparing dioecious and hermaphroditic species or genera, no general statement about flower size can be made. Some families, such as Anacardiaceae, Amaranthaceae, Compositae, Boraginaceae, Flacourtiaceae, Sapindaceae, Sapotaceae, Simaroubaceae and Lauraceae, have dioecious species with flowers averaging smaller than their hermaphroditic sibling genera but the degree of difference is not always significant. Some families have dioecious species with flowers averaging as large as or larger than their cogeners. Bawa and Opler have already noted this in the Rubiaceae. Other families which show this include the Guttiferae, Loranthaceae and Myrsinaceae. Still other families had no hermaphroditic species in Panama with which they could be compared and thus were not considered. These include such families as Burseraceae, Smilacaceae, Caricaceae, Euphorbiaceae, Meliaceae, Monimiaceae, Dioscoreaceae, Hydrocharitaceae, Gnetaceae, Myristicaceae, Nyctaginaceae, Rafflesiaceae, Palmae, Rutaceae, Urticaceae, Moraceae and Menispermaceae.

The only dioecious representative of the Gramineae on BCI has staminate flowers which are smaller (less than 3 mm) than the flowers of the average hermaphroditic grass species, but has pistillate flowers which are up to 12 mm long, longer than the flowers of the average hermaphroditic grass species. Dioecious representatives of the Polygonaceae also show an inconsistent pattern. Coccoloba coronata has flowers smaller than the average hermaphroditic polygonaceous species. Triplaris cumingiana has staminate flowers smaller than average but pistillate flowers larger than the average hermaphroditic polygonaceous flower.

SUMMARY

The breeding systems of the Barro Colorado Island flora in the isthmus of Panama were analyzed. Of the 1,212 native species in the flora, 286 (24%) have unisexual flowers. Of these, 106 (9%) are dioecious, 132 (11%) are monoecious (4 are monoecious or dioecious and are included in both categories), and 52 (4%) are polygamous. Fifteen percent of the medium to large sized trees are monoecious, while 21% are dioecious. Eleven percent of the herbs are monoecious, and only 2% are dioecious. Small trees and shrubs are 7% monoecious and 12% dioecious. These figures compare favorably with studies by Bawa and Opler (1975) in the Comelco region of Guanacaste in Costa Rica. However, they reported no scandent dioecious species, whereas by contrast, 20% of the dioecious species in the BCI flora are scandent (8% of all scandent species).

The average size of staminate and pistillate flowers for all species is 7.6 mm and 6.8 mm respectively. If all flowers more than 1 cm long are excluded from consideration, the average size for staminate and pistillate flowers is 3.16 mm and 3.12 mm respectively. Only 29 species (27%) of all dioecious species show any noticeable sexual dimorphism in flower size. Thirteen of these had staminate flowers larger than pistillate. Bawa and Opler reported 14 of 20 species measured in Costa Rica with pistillate flowers larger than staminate ones. The differences in staminate and pistillate flower size for dioecious species are thus less significant than the differences in the flora of the Comelco region of Costa Rica reported by Bawa and Opler.

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TABLE 1

Habit Type	Total Native Species	Hermaphroditic	Monoecious	Dioecious	Polygamous
Medium to Large Trees (more than 10 m)	211	133	32** 15%	45** 21%	3 1%
Small Trees and/or Shrubs (including hemiepiphytic and parasitic shrubs)	270	212	19* 7%	32* 12%	9 3%
Scandent Plants	265	189	31 12%	21 8%	23 9%
Herbs (including aquatic, epiphytic and parasitic herbs and palmettoes)	466	392	50* 11%	8* 2%	17 4%
TOTAL NATIVE PHANEROGAMS	1,212	926	132 11%	106 9%	52 4%
TOTAL SPECIES WITH UNISEXUAL FLOWERS 286 (24%)					

** Two species considered both monoecious and dioecious

* One species considered both monoecious and dioecious

TABLE 2 Flower length of dioecious species on Barro Colorado Island

Total dioecious species on BCI = 106	No. of Flowers studies	All dioecious species		Largest Flowers less than 1 cm			Largest Flowers 1 cm or more		
	n	Aver. Lgth.	Stand. Error	n	Aver. Lgth.	Stand. Error	n	Aver. Lgth.	Stand. Error
Staminate	97	7.61mm	20.12	81	3.16mm	1.75	16	30.1mm	42.58
Pistillate	76	6.76mm	8.41	57	3.12mm	1.62	19	17.7mm	10.78

TABLE 3 Sexual Dimorphism on BCI

	Number of Species	Average Normal Maximum size of staminate flowers	Average Normal Maximum size of pistillate flowers	Difference ♂ - ♀		Percentage Difference $\frac{♂ - ♀}{♂}$ $\frac{♀ - ♂}{♀}$	
				Aver.	Stand. error	Aver.	Stand. error
Staminate fls. larger than pistillate	13	3.8 mm	2.7 mm	1.45 mm	1.5 mm	26%	11.8%
Pistillate fls. larger than staminate	16	2.5 mm	8.0 mm	5.51 mm	4.7 mm	60%	21.5%

TABLE 4 Flower Color of Dioecious Species

Color	No. of Species	
Yellow	2	
Yellow-green or Greenish-yellow	7	
Green	33**	
Pale Green or Greenish-white	20	
White	36*	
Subtotal		98
Brown	2	
Reddish, Purplish or marked with reddish	6***	
TOTAL		106

* Includes	Catopsis sessiliflora	Greenish-yellow and white
	Cecropia insignis	Whitish-green and whitish-yellow
	Clusia odorata	White to pink
** Includes	Mormodes powellii	Green, yellow-brown or cream
*** Includes	Trattinnickia aspera	Dull red tinged with green
	Dioscorea macrophylla	Violet-purple with green edges
	Coccoloba acapulcensis	Brownish-purple

TABLE 5 Monoecious species in the BCI Flora

Family	Species	Habit*
Alismataceae	Sagittaria lancifolia L.	H
Amaranthaceae	Amaranthus viridis L.	H
Araceae	Dieffenbachia longispatha Engler & Krause	H
	D. oerstedii Schott	H
	D. pittieri Engler & Krause	H
	Homalomena wendlandii Schott	H
	Montrichardia arborescens (L.) Schott	H
	Philodendron fragrantissimum (Hook.) Kunth	H
	P. grandipes Krause	H
	P. guttiferum Kunth	V
	P. hederaceum (Jacq.) Schott	V
	P. inaequilaterum Liebm.	V
	P. inconcinnum Schott	V
	P. nervosum (Schultes & Schultes) Kunth	H
	P. panamense Krause	H
	P. pterotum C. Koch & Aug.	H
	P. radiatum Schott	H
	P. sagittifolium Liebm.	H
	P. scandens C. Koch & Sellow	V
	P. tripartitum (Jacq.) Schott	V
	Pistia stratiotes L.	H
	Syngonium erythrophyllum Birdsey ex Bunting	V
	S. podophyllum Schott	V
	Xanthosoma helleborifolium (Jacq.) Schott	H
	X. nigrum (Vell.) Stellfeld	H
	X. pilosum C. Koch & Aug.	H
Begoniaceae	Begonia filipes Benth.	H
	B. guaduensis H.B.K.	H
	B. patula Haw.	H
Bromeliaceae	**Catopsis sessiliflora (R. & P.) Mez	H

TABLE 5 continued

Ceratophyllaceae	Ceratophyllum demersum L.	H
Compositae	Clibadium surinamense L.	S
Cucurbitaceae	Cayaponia glandulosa (P. & E.) Cogn.	L
	C. granatensis Cogn.	V
	C. racemosa (Sw.) Cogn.	V
	Fevillea cordifolia L.	V
	***Gurania coccinea Cogn.	V
	G. makoyana (Lem.) Cogn.	V
	G. megistantha Donn. Sm.	V
	Melothria pendula L.	V
	M. trilobata Cogn.	V
	Momordica charantia L.	V
	Posadaea sphaerocarpa Cogn.	V
	***Psiguria bignoniacea (P. & E.) Wunderlin	V
	P. warscewiczii (Hook.f.) Wunderlin	V
	Sicydium coriaceum Cogn.	V
Cyclanthaceae	Asplundia alata Harling	H
	Carludovica drudei Mast.	H
	C. palmata Ruiz & Pavon	H
	Cyclanthus bipartitus Poit.	H
	Ludovia integrifolia (Woods.) Harling	V
Cyperaceae	Calyptrocarya glomerulata (Brongn.) Urban	H
	Scleria eggersiana Boeckl.	H
	S. macrophylla Presl	H
	S. mitis Bergius	H
	S. pterota Presl	H
	S. secans (L.) Urban	V
Euphorbiaceae	Acalypha arvensis Poepp.	H
	A. diversifolia Jacq.	S
	**A. macrostachya Jacq.	ST
	Chamaesyce hirta (L.) Millsp.	H
	C. hypericifolia (L.) Millsp.	H
	C. hyssopifolia (L.) Small	H
	C. thymifolia (L.) Millsp.	H
	Croton billbergianus Muell.-Arg.	ST
	C. hirtus L'Her.	H
	C. panamensis (Klotzsch) Muell.-Arg.	T

*** Gurania and Psiguria are usually functionally dioecious with long lapses between staminate and pistillate sexual states.

TABLE 5. continued

Euphorbiaceae	Dalechampia cissifolia Poepp. subsp. panamensis (Pax & Hoffm.) Webster	V
	D. dioscoreifolia Poepp.	V
	D. tiliifolia Lam.	V
	Garcia nutans Vahl	T
	Hura crepitans L.	T
	Mabea occidentalis Benth.	ST
	Omphalea diandra L.	L
	Phyllanthus acuminatus Vahl	S
	P. amarus Schum.	H
	P. urinaria L.	H
	Poinsettia heterophylla (L.) Klotzsch & Gke.	H
	Sapium aucuparium Jacq.	T
	S. caudatum Pittier	T
Graminae	Lithachne pauciflora (Sw.) Beauv. ex Poir.	H
	Olyra latifolia L.	H
	Pharus latifolius L.	H
	P. parvifolius Nash	H
Loranthaceae	Phorandendron piperoides (H.B.K.) Trel.	S
	P. quadrangule (H.B.K.) Krug & Urb.	S
Meliaceae	Cedrela odorata L.	T
Monimiaceae	Siparuna guianensis Aubl.	S
Moraceae	Brosimum alicastrum (Pitt.) C.C. Berg ssp. bolivarense (Pitt.) C.C. Berg	T
	**Castilla elastica Sessé	T
	Ficus bullenei I.M. Johnston	T
	F. citrifolia P. Mill.	T
	F. colubrinae Standley	T
	F. costaricana (Liebm.) Miq.	T
	F. dugandii Standley	T
	F. insipida Willd.	T
	F. maxima P. Mill.	T
	F. nymphiifolia P. Mill.	T
	F. obtusifolia H.B.K.	T
	F. paraensis (Miq.) Miq.	T
	F. perforata L.	T
	F. pertusa L.f.	T
	F. popenoei Standley	T
	F. tonduzii Standley	T

TABLE 5 continued

Moraceae	F. trigonata L.	T
	F. yoponensis Desv.	T
	Poulsenia armata (Miq.) Standley	T
Orchidaceae	Catesetum bicolor Klotzsch	H
	C. viridiflavum Hook.	H
Palmae	Astrocaryum standleyanum Bailey	T
	Bactris barronis Bailey	ST
	B. coloniata Bailey	ST
	B. coloradonis Bailey	ST
	B. major Jacq.	ST
	Desmoncus isthmius Bailey	V
	Elaeis oleifera (H.B.K.) Cortes	ST
	Geonoma cuneata Wendl. ex Spruce	S
	G. interrupta (R. & P.) Mart.	S
	G. procumbens Wendl. ex Spruce	S
	Oenocarpus panamanus Bailey	T
	**Scheelea zonensis Bailey	T
	Socratea durissima (Oerst.) Wendl.	T
	Synechanthus warscewiczianus Wendl.	ST
Sterculiaceae	Sterculia apetala (Jacq.) Karst.	T
Tiliaceae	Trichospermum mexicanum (L.) Baill.	T
Typhaceae	Typha domingensis Persoon	H
Ulmaceae	Celtis iguanaeus (Jacq.) Sarg.	L
	Trema micrantha (L.) Blume	T
Urticaceae	Boehmeria cylindrica (L.) Sw.	H
	Myriocarpa yzabalensis (Donn. Sm.) Killip	ST
	Pilea microphylla (L.) Liebm.	H
	Pouzolzia obliqua (Poepp.) Wedd.	L

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* H=Herb; V=Vine; L=Liana; S=Shrub; ST=Small Tree T=Tree

** May be either monoecious or dioecious.

TABLE 6 Polygamous species in the BCI Flora

Family	Species	Habit*
Araliaceae	Oreopanax capitatus (Jacq.) Dec. & Planch	T
Celastraceae	Maytenus schippii Lundell	ST
Compositae	Baltimora recta L.	H
	Chaptalia nutans (L.) Polak.	H
	Conyza apurensis Kunth	H
	C. bonariensis (L.) Cronq.	H
	Eclipta alba (L.) Hassk.	H
	Erechtites hieracifolia (L.) Raf. var. cacalioides (Fischer ex Spreng.) Griseb.	H
	Melampodium divaricatum (L.C. Rich.) DC.	H
	Pluchea odorata (L.) Cass.	H
	Schistocarpha oppositifolia (O. Ktze.) Rydb.	H
	Synedrella nodiflora (L.) Gaertn.	H
	Tridax procumbens L.	H
	Verbesina gigantea Jacq.	H
	Wedelia trilobata (L.) Hitchc.	H
Cyperaceae	Cladium jamaicense Crantz	H
	Rhynchospora cephalotes (L.) Vahl	H
	R. corymbosa (L.) Britt.	H
	R. micrantha Vahl	H
Dilleniaceae	Tetracera hydrophila Tr.&Pl.	L
	T. portobellensis Beurl.	L
	T. volubilis L.	L
Guttiferae	**Tovomitopsis nicaraguensis (Oerst.) Tr.&Pl.	ST
	Vismia billbergiana Beurl.	ST
Sapindaceae	Allophylus psilospermus Radlk.	ST
	Cupania cinerea Poepp. & Endl.	ST
	C. latifolia Kunth	T
	C. rufescens Tr. & Pl.	T
	C. sylvatica Seem.	ST

* H=Herb; V=Vine; L=Liana; S=Shrub; ST=Small Tree T=Tree

**Based on flower morphology only; fruit set not observed.

TABLE 6. continued

Sapindaceae	Paullinia baileyi Standley	L
	P. bracteosa Radlk.	L
	P. fibrigera Radlk.	L
	P. fuscescens H.B.K. var. glabrata Croat	L
	P. glomerulosa Radlk.	L
	P. pinnata L.	L
	P. pterocarpa Tr. & Pl.	L
	P. rugosa Benth. ex Radlk.	L
	P. turbacensis H.B.K.	L
	Serjania atrolineata Suav. & Wright	L
	S. circumvallata Radlk.	L
	S. cornigera Turcz.	L
	S. decapleuria Croat	L
	S. paucidentata DC.	L
	S. mexicana (L.) Willd.	L
	S. pluvialiflorens Croat	L
	S. rhombea Radlk.	L
	S. trachygona Radlk.	L
	Talisia nervosa Radlk.	ST
	T. princeps Oliver	ST
	Thinouia myriantha Tr. & Pl.	L
Tiliaceae	***Heliocarpus popayanensis H.B.K.	ST
Vitaceae	Vitis tiliifolia H. & B. ex R. & S.	L

***Based on flower morphology on only 2 individuals.

TABLE 7 Dioecious species in the BCI Flora

Family	Species	Habit*
Amaranthaceae	Iresine celosia L.	H
Anacardiaceae	Astronium graveolens Jacq.	T
Boraginaceae	Cordia panamensis Riley	ST
Bromeliaceae	**Catopsis sessiliflora (R.& P.) Mez.	H
Burseraceae	***Bursera simaruba (L.) Sarg.	T
	Protium costaricense (Rose) Engler	T
	P. panamense (Rose) I.M. Johnston	T
	P. tenuifolium var. sessiliflorum (Rose) Porter	T
	Tetragastris panamensis (Engler) O. Kuntze	T
	Trattinnickia aspera (Standley) Swart	T
Caricaceae	Carica cauliflora Jacq.	ST
	Jacaratia spinosa (Aubl.) A. DC.	T
Compositae	Baccharis trinervis Persoon	S
Dioscoreaceae	Dioscorea haenkeana Presl	V
	D. macrostachya Benth.	V
	D. polygonoides H. & B. ex Willd.	V
	D. sapindoides Presl	V
	D. urophylla Hemsl.	V
Ebenaceae	Diospyros arthanthifolia Mart.	T
Euphorbiaceae	**Acalypha macrostachya (Jacq.)	ST
	Adelia triloba (Muell.-Arg.) Hemsl.	S
	Alchornea costaricensis Pax & Hoffm.	T
	A. latifolia Sw.	T
	Drypetes standleyi Webster	T
	Hyeronima laxiflora (Tul.) Muell.-Arg.	T
	Margaritaria nobilis L.f.	ST
Flacourtiaceae	Xylosma chloranthum Donn.Sm.	ST
	X. oligandrum Donn.Sm.	ST
Gnetaceae	Gnetum leyboldii Tul. var. woodsonianum Markgr.	L
Graminae	Gynerium sagittatum (Aubl.) Beauv.	H
Guttiferae	Clusia odorata Seem.	ST

TABLE 7 continued

Guttiferae	Havetiopsis flexilis Pl.&Tr.	ST
	***Rheedia acuminata Pl.&Tr.	ST
	***R. edulis Tr. & Pl.	ST
	Tovomita longifolia (L.C.Rich.) Hochr.	ST
	T. stylosa Hemsl.	ST
Hydrocharitaceae	Hydrilla verticillata (L.f.) Royle	H
	Limnobium stoloniferum (F. Meyer) Griseb.	H
Lauraceae	Ocotea cernua (Nees) Mez	T
	O. oblonga (Meisn.) Mez	T
	O. pyramidata Blake ex T. S. Brandegee	T
	O. skutchii C. K. Allen	T
Loranthaceae	Struthanthus orbicularis (H.B.K.) Blume	S
Malvaceae	Hampea appendiculata(J.D.Sm.) Standley var. longicalyx Fryxell	T
Meliaceae	Guarea glabra Vahl	T
	G. multiflora Juss.	T
	Trichilia cipo (A.Juss.) C. DC.	T
	T. hirta L.	ST
	T. montana H.B.K.	ST
	T. verrucosa C. DC.	T
Menispermaceae	Abuta panamensis (Standley) Krukoff & Barneby	L
	A. racemosa (Thunb.) Tr.&Pl.	L
	Chondrodendron tomentosum R. & P.	L
	Cissampelos pareira L.	V
	C. tropaeolifolia DC.	V
	Odontocarya tamoides (DC.) Miers var. canescens (Miers) Barneby	V
	O. truncata Standley	V
Monimiaceae	Siparuna pauciflora (Beurl.) A. DC.	ST
Moraceae	**Castilla elastica Sessé	T
	Cecropia insignis Liebm.	T
	C. longipes Pittier	T
	C. obtusifolia Bertol.	ST
	C. peltata L.	T

TABLE 7 continued

Moraceae	Coussapoa magnifolia Trec.	ST
	C. panamensis Pitt.	T
	Dorstenia contrajerva L.	H
	Maquira costaricana (Standley) C.C.Berg	T
	Olmedia aspera R. & P.	ST
	Perebea xanthochyma Karst.	ST
	Pourouma guianensis Aubl.	T
	Pseudolmedia spuria (Sw.) Griseb.	T
	Sorocea affinis Hemsl.	ST
	Trophis racemosa (L.) Urban	T
Myristicaceae	Virola sebifera Aubl.	T
	V. surinamensis (Rol.) Warb.	T
Myrsinaceae	Stylogyne standleyi Lundell	ST
Nyctaginaceae	Guapira standleyanum Woodson	T
	Neea amplifolia Donn. Sm.	S
	Pisonia aculeata L.	L
Orchidaceae	Mormodes powellii Schlechter	H
Palmae	Chamaedorea wendlandiana (Oerst.) Hemsl.	S
	**Scheelea zonensis Bailey	T
Polygonaceae	Coccoloba acapulcensis Standley	ST
	C. acuminata H.B.K.	ST
	C. coronata Jacq.	T
	C. manzanillensis Beurl.	T
	C. parimensis Benth.	L
	Triplaris cumingiana Fischer & Meyer	T
Rafflesiaceae	Apodanthes caseariae Poit.	H
Rubiaceae	Alibertia edulis A. Rich.	ST
	Amaioua corymbosa H.B.K.	T
	Randia armata (Sw.) DC.	ST
	R. formosa (Jacq.) K. Schum.	ST
Rutaceae	Zanthoxylum belizense Lundell	T
	Z. panamense P. Wilson	T
	Z. procerum Donn. Sm.	T
	Z. setulosum P. Wilson	T
Sapotaceae	****Pouteria stipitata Cronq.	T
Simaroubaceae	Picramnia latifolia Tul.	ST
	Simarouba amara Aubl.	T
Smilacaceae	Smilax lanceolata L.	V
	S. mollis H. & B. ex Willd.	V
	S. panamensis Morong.	V
	S. spinosa Mill.	V

TABLE 7 continued

Smilacaceae	S. spissa Killip & Morton	V
Urticaceae	Urera eggersii Hieron.	V

* H=Herb; V=Vine; L=Liana; S=Shrub; ST=Small Tree T=Tree

** May be either monoecious or dioecious

*** Polygamodioecious

**** This species is doubtfully dioecious. The 3 other Pouteria species on BCI are thus also suspect.

Figure 1a. Distribution of species based on maximum normal length of staminate flowers

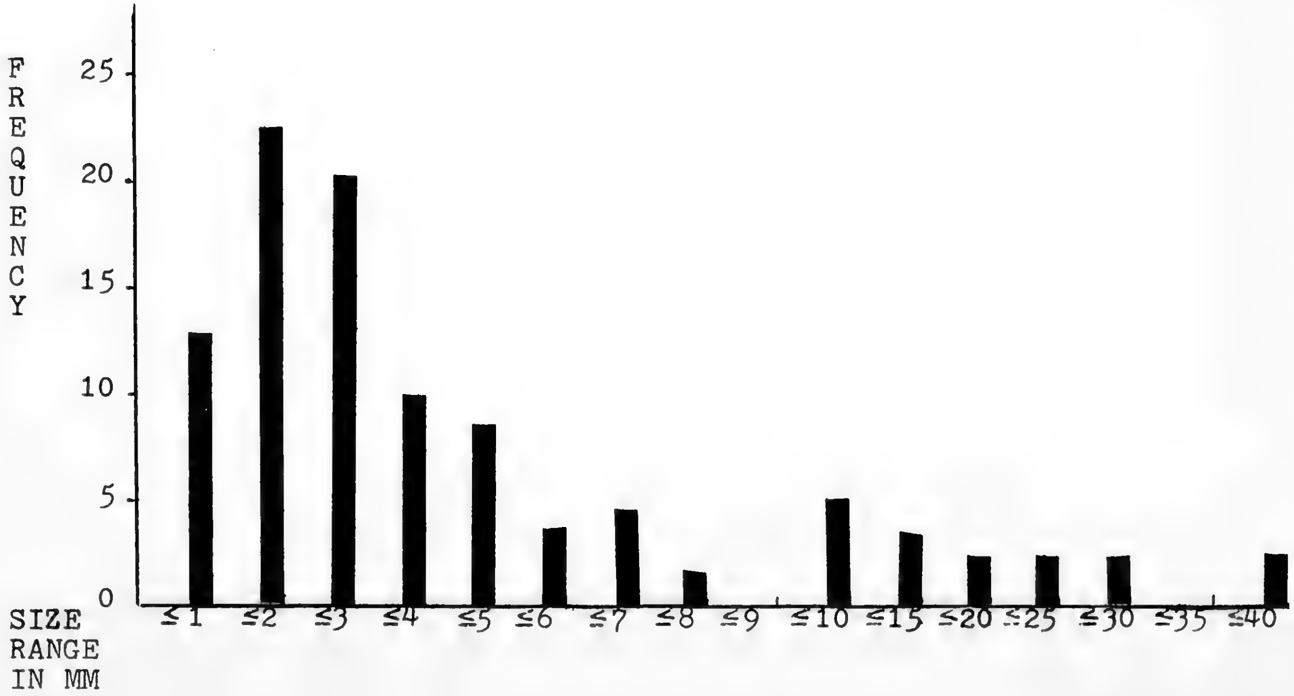
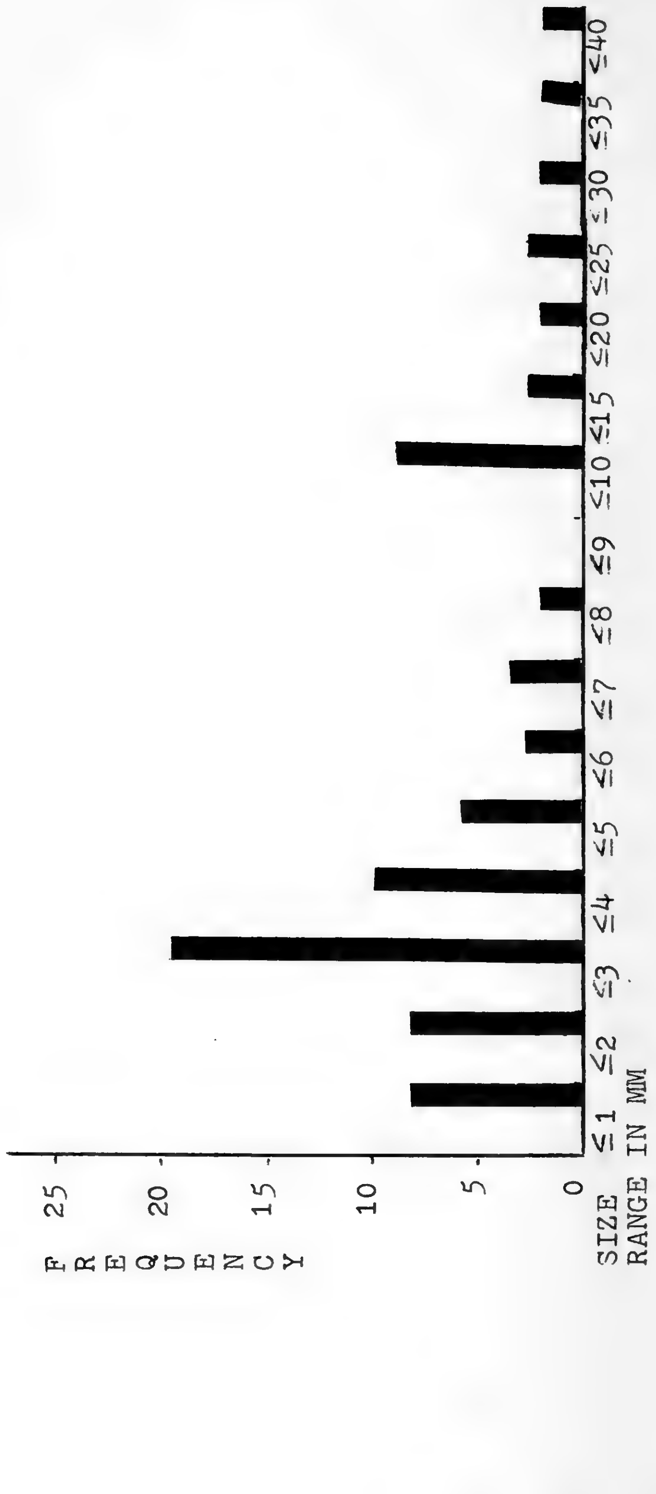


Figure 1b. Distribution of species based on maximum normal length of pistillate flowers.



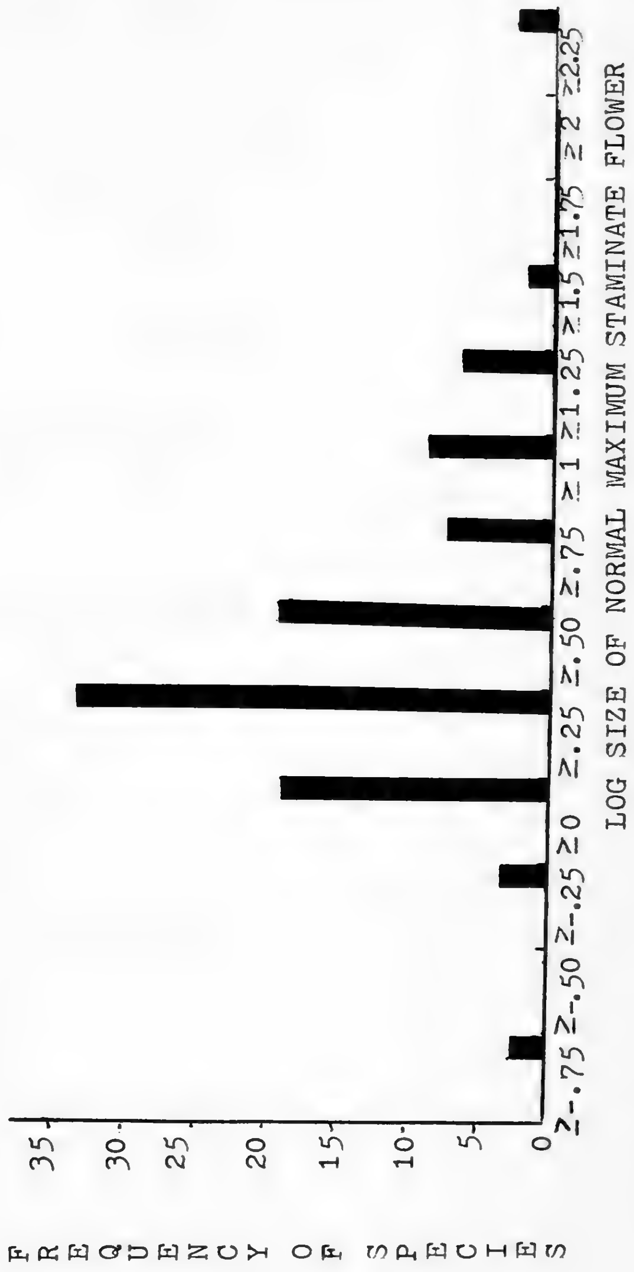
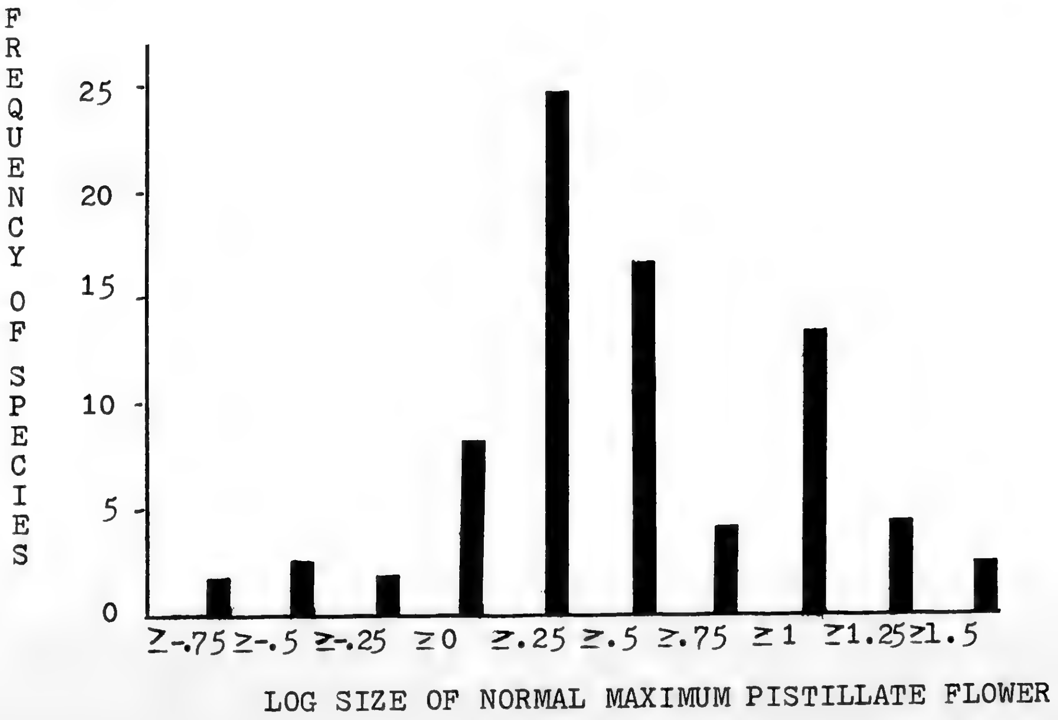


Figure 2a. Distribution of normal maximum staminate flower lengths.

Figure 2b. Distribution of normal maximum pistillate flower lengths



POLLINATION ECOLOGY IN MONTANE COLORADO:

A COMMUNITY ANALYSIS

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&
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ABSTRACT:

Synecological pollination studies of communities in montane Colorado revealed very low species richness of all types of pollinators although flowers were abundant. In every community less than 8% of the non wind-pollinated plant species attract more than 60% of the resident vector species. A large majority of the pollinator species and nearly all the pollinator individuals in each of the five communities are generalist feeders; bumblebees are preeminent in all environments and muscoid flies are prominent in the alpine tundra and forests. In all communities selfing as the habitual mode of reproduction is very frequent (20% of the total flora), and increases to 48% of the flora in the alpine tundra. Pollinators are most abundant in the physiognomically open fescue grassland, sage and alpine tundra communities, but are most diverse in the lower altitude grassland and sage. Pollinators are least abundant and diverse in the aspen and spruce-fir forest communities. Specialist pollinators comprise 8% to 22% of the total resident pollinators; specialist species are two to five times richer in the open communities than in the forests. Pollination characteristics of the five communities parallel results obtained in subalpine and alpine California.

INTRODUCTION

Pollination systems comprise the direct or indirect interactions of two trophic levels, forming a dynamic, yet somewhat cohesive, ecological subunit of a community. This plant/herbivore interface can be readily studied in terms of species diversity and distribution, resource utilization and niche packing. Analysis of pollination syndromes in different community types provides a means to compare the operation of these systems under a variety of environmental regimes. Community-wide studies also place the examination of specific plant/pollinator relationships in a broad ecological context. The necessity of viewing the coadaptations of pollinators and their plant hosts as components of the systems in which they operate and not simply as the results of reciprocal

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effects on a one-to-one basis has been pointed out by many authors (Heinrich and Raven, 1972; Macior, 1971; Baker, 1963).

Previous analyses of pollination systems by our group have indicated that over-all physical environment has a preeminent role in determining which adaptive strategies are viable and, in turn, the manner in which these systems must function (Moldenke, 1975, 1977, 1979; Cody et al., 1977; Simpson et al., 1977). However, for any one particular species, the success of any foraging strategy by pollinators or any means of outbreeding by plants is highly dependent upon the spatial arrangement and competitive interactions within the community in which they operate. Therefore, predictions about the specific composition and functioning of these strategies in individual community types cannot be made with precision for each species.

Our investigations were conducted near the Rocky Mountain Biological Laboratory in Gothic, Colorado, with study sites ranging from 3,800 m to 4,300 m in altitude. According to our basic null hypothesis that the over-all climate determines the possible outcomes of niche structuring to a very great extent, the pollination systems in the component community types should be very similar to those previously delineated in communities in the Sierra Nevada of California (Moldenke, 1975, 1977), despite the differences in the floristic and faunistic elements of the two areas. The present study was designed to test predictions generated from results in California and a general knowledge of the major groups of pollinators. Our predictions based on theory presented in Moldenke (1975) about the over-all diversity and adaptive strategies to be found under the general environmental regime in Colorado are as follows:

1. Total pollinator diversity and biomass should be low relative to previously documented communities at much lower altitudes; both measures should increase in Colorado at lower altitudes and in physiognomically more open habitats where the microclimate would favor insect activity.

2. There should be many more generalist pollinators than specialists, unlike the regions of warm Mediterranean climate on the West Coast of the United States. The ratio of generalists to specialists should be particularly high in physiognomically closed forest habitats where shade places a premium on poikilotherm energy conservation and should preclude the option of treating resource presentation in a "coarse-grained" (Levins, 1968) fashion. This ratio should increase with altitude as the severe unpredictable climate would favor a resource utilization strategy that takes advantage of whatever is available to an even greater extent.

3. Many plants should be autogamous and not visited by pollinators; their number should increase at higher altitudes.

4. A few species of plants should be heavily visited by many different pollinators in all vegetation types and altitudes, since the pollinators will concentrate upon whichever species offer the best reward as the season progresses, regardless of the relative total pollinator abundance.

METHODS

Research was conducted at five sites within a 100 mile radius of the Rocky Mountain Biological Laboratory in Gothic, Colorado. We selected one to two study sites in each of the following community types recognized by Langenheim (1962). In none of the areas studied was the introduced honeybee, *Apis mellifera*, a resident species. A 0.5 km^2 plot was studied intensively in each community type. Research sites were visited on a rotating basis whenever weather permitted from the third week in June through the last week in August, 1974.

a) Alpine Tundra: Cumberland Pass, Gunnison County, 4,000-4,100 m; and Mesa Seco near Slumgullion Pass, Hinesdale County, 3,900-4,100 m. Communities of caespitose perennials dominated by *Festuca brachyphylla*, *Poa alpina*, *Carex engelmannii*, *Trifolium dasyphyllum*, *Potentilla diversifolia*, *Erigeron leiomerus*, *Achillea lanulosa*, *Phlox caespitosa* and *Oreoxis alpina*.

b) Mature Aspen Forest: Rocky Mountain Biological Laboratory, Gunnison County, 3,200-3,500 m; and Spring Creek Road, near Almont, Gunnison County, 3,000-3,300 m. Closed canopy *Populus* forest with understory dominated by *Thalictrum fendleri*, *Ligusticum porteri*, *Agopyron trachycaulon*, *Bromus richardsonii*, *Lathyrus leucanthus*, *Festuca thurberi*, *Aster occidentalis*, *Pedicularis grayi*, *Calochortus gunnisoni* and *Senecio serra*.

c) Sagebrush: Jack's Cabin Cutoff Road, 15 miles southeast of Crested Butte, Gunnison County, 3,130-3,230 m. Open range with *Artemisia tridentata*, *Lupinus floribundus*, *Castilleja linearifolia*, *Chrysothamnus viscidiflorus*, *Achillea lanulosa*, *Arenaria congesta*, *Muhlenbergia montana*, *Eriogonum racemosum*, *Stipa lettermannii* and *Wyethia arizonica* dominant.

d) Fescue Grassland: Gothic, Gunnison County, 3,125-3,275 m; and Washington Gulch, near Crested Butte, Gunnison County, 3,150-3,300 m. Dominant plants are *Festuca thurberi*, *Potentilla gracilis*, *Achillea lanulosa*, *Taraxacum officinale*, *Erigeron speciosus*, *Muhlenbergia filiformis*, *Helianthella* *quinquenervis*, *Bromus polyanthus* and *Linum perenne*.

e) Spruce-fir Forest: Lake Irwin, Gunnison County, 3,380-3,485 m; and Washington Gulch, Gunnison County, 2,900-3,200 m. *Picea pungens* forest with *P. engelmannii* and *Abies lasiocarpa* and understory of *Lupinus argenteus*, *Vaccinium myrtillus*, *Bromus richardsonii*, *Agropyron trachycaulon*, *Agrostis scabra*, *Carex geyeri*, *Pedicularis racemosa*, *Achillea lanulosa*, *Polemonium delicatum*, *Mertensia ciliata*, *Arnica cordifolia* and *Haplopappus parryi*.

Censusing techniques employed for both plant and pollinator abundance are described in Moldenke (1975). Relative abundance of plant species was determined by censusing ten replicate 10 x 10 m random plots in each community; an additional list of all species present but not encountered in the census was also kept. Measurements on floral size and number of flowers per plant were made with the aid of the reference herbarium at the laboratory and a series of at least five randomly selected field individuals. All insects encountered visiting flowers during the course of the research were collected and their floral host recorded. Collection technique never entailed remaining at one particular plant or subarea, but rather took the form of a continuously moving search throughout the region under study. Paths were not chosen under a statistical format that completely assures that all portions of the study areas were visited with equal frequency; hence, if plant species are not randomly distributed, the results may not be unbiased. Plant self-compatibility studies carried out by Constance Rutherford (pers. comm.) entailing bagging with 0.4 mm mesh and known compatibility data from former studies (Moldenke, 1971) were used to supplement field observations on the percentage of successful seed set. Determinations of compatibility could be made for approximately 60% of the flora.

Not every insect which visits a flower is an effective pollinator nor is the relative abundance of all species of floral herbivores an index of their relative contribution to outcrossing. In the absence of autecological studies with marked pollen grains on each species of insect observed to utilize flowers as a food resource, our own subjective judgment based on field observation of intrafloral behavior, insect morphology and fidelity to a particular plant species by individuals for short extents of time are the basis of our judgment as to whether any significant pollination may be attributable to a particular species. In this paper no judgments are made as to the relative efficiency of different species of vectors servicing the same species; all species that on the above grounds are deemed potentially significant vectors are so treated in Table 2, for instance. Infrequent but consistent visitation by a bumblebee to a flower in which it usually contacts the reproductive structures weighs equivalently with an abundant syrphid species which feeds heavily upon one particular plant species, but seldom contacts the stigma. Since insect vectors are generally infrequent in the areas under study, if any bias exists it emphasizes the role of infrequent vector species at the expense of the "habitual selfer" category.

Collected insect specimens were identified whenever possible by taxonomic experts. Special thanks are due to David Inouye, Robbin Thorp, Roy Snelling, Url Lanham and P. Timberlake for their determinations. Additional determinations were made in the reference collection at the University of Colorado. Plant species were identified with reference to the herbarium of the Rocky Mountain Biological Laboratory, Barrell (1969) and Weber (1972).

RESULTS

I. POLLINATOR DIVERSITY AND FREQUENCY OF POLLINATION MODE

A. Total Floral-herbivore Diversity

Flower visitor diversity is highest within the unshaded sage and fescue grassland communities (mean species count=152; Table 1). Total species count of flower herbivores decreases by 29% in alpine communities and by 46%-51% in the aspen and spruce-fir forest communities compared to the levels supported in unshaded sites. The total number of individual floral-herbivores of all types was highest in the grassland communities, total floral-herbivore individuals decreasing by 45% in the alpine and by 71%-78% in the forest communities (Table 1). The count of individual insect flower feeders may be a misleading assay of trophic energetic relations, since different species may differ widely in their body size and energetic requirements. Relative biomass measurements were approximated by the product of linear dimensions of the bodies (appendages excluded)(Moldenke, 1975). Insect biomass, indeed, followed a similar pattern; biomass of floral-herbivores in fescue grassland was approximately three times that in the alpine and forest communities.

The most important floral-herbivore as well as pollinator group in all of the communities studied is the Apoidea (bees), in terms of diversity, number of individuals feeding upon flowers, and the percentage of the flora relying upon them for pollen transfer. Direct comparison of bee diversity patterns may be a better indicator of long-term species packing phenomena than comparisons between other groups of flower-visitors, since we know much more about the behavior and distribution of bee species than other insect floral-herbivore groups and since the entire life cycle of all bee

TABLE 1.

	ALPINE		ASPEN		SAGE		FESCUE		SPRUCE-FIR	
	Total Spec.	Total Indiv.	Total Spec.	Total Indiv.	Total Spec.	Total Indiv.	Total Scec.	Total Indiv.	Total Spec.	Total Indiv.
Solitary Bees	21	130	17	29	50	150	51	240	13	30
Halictine Bees	5	7	5	14	5	17	8	96	5	23
Bumblebees	5	110	7	36	10	105	11	306	7	97
Hover Flies	28	81	10	26	9	21	30	120	14	44
Beeflies	3	5	0	0	11	38	6	13	3	4
Beetles	3	3	5	22	7	41	10	23	9	27
Hummingbirds & Sphinx Moths	2	3	1	14	1	11	2	28	1	4
Butterflies & Moths	21	55	4	7	17	29	11	26	8	12
Wasps	1	1	4	4	15	31	6	6	6	7
Sawflies	5	7	3	10	3	4	4	14	1	1
Primitive Flies	2	11	4	8	3	4	4	8	3	10
Muscoid Flies	10	118	8	37	9	16	12	68	5	19
Other Groups	3	6	2	5	5	14	5	12	2	2
Total	109	537	70	212	145	481	160	960	77	280

TABLE 1. Flower-herbivore Diversity and Abundance

Hummingbirds are not distinguished to species; their abundance is the estimated total number of territorial birds working the region and relative floral resource use, rather than total number of floral visitations observed.

TABLE 2.

POLLINATION MODE	ALPINE	ASPEN	SAGE	FESCUE GRASSLAND	SPRUCE-FIR
WIND	16 (17%)	16 (21%)	9 (12%)	20 (17%)	14 (19%)
SELF	43 (48%)	19 (25%)	19 (24%)	35 (21%)	19 (25%)
Obligate Self & Apomictic	10 (11%)	10 (13%)	8 (11%)	6 (5%)	7 (9%)
BUMBLEBEE	29 (31%)	19 (25%)	22 (31%)	41 (35%)	18 (24%)
SOLITARY BEE	15 (16%)	12 (16%)	19 (27%)	31 (26%)	9 (12%)
Specialist Solitary Bee	10 (11%)	5 (6%)	13 (19%)	16 (13%)	3 (4%)
HALICTID BEE	4 (4%)	6 (8%)	1 (1%)	25 (21%)	4 (5%)
SYRPHID	19 (21%)	6 (8%)	1 (1%)	21 (18%)	11 (15%)
MUSCOID	9 (10%)	8 (10%)	0 (0%)	8 (7%)	4 (5%)
BUTTERFLY	11 (12%)	1 (1%)	5 (7%)	6 (5%)	5 (6%)
HUMMINGBIRD & SPHINX MOTH	3 (3%)	5 (6%)	4 (5%)	8 (7%)	3 (4%)
BEEFLY	0 (0%)	0 (0%)	6 (8%)	3 (3%)	2 (2%)
WASP	0 (0%)	1 (1%)	4 (5%)	1 (1%)	3 (4%)
OTHER GROUPS		beetle-1 sawfly-1	beetle-1	beetle-3 sawfly-1	beetle-1

species is obligately dependent upon flowers; whereas that of most other flower eating groups is not. The pattern of reduced species richness in alpine and subalpine regions, relative to lower altitudes is evident when examining only bees as well.

In Colorado, both Forest and alpine communities support roughly equivalent numbers of bee species, approximately one-half the number in the open sage and grassland communities (28:67; Table 1). Our results indicate that syrphid and muscoid flies are the exclusive pollinators of ten percent of the alpine flora in Colorado. A larger sample size and investigations during subsequent years are certain to reduce the number of plants serviced exclusively by these fly groups, but we are confident that it will not significantly alter the percentage crosspollinated most frequently by these groups.

Wind pollination is the rule for the dominant plants in all communities (e.g., Abies, Agopyron, Artemisia, Bromus, Carex, Festuca, Muhlenbergia, Picea, Poa, Populus, Thalictrum). On a species-by-species basis wind pollination is least frequent in the physiognomically open tundra, fescue and sage communities (Table 2). In the latter two communities the decrease in relative frequency of wind-pollinated species correlates with a significant increase in the presence of potential pollinator insect taxa. In the tundra community of California, studies have shown (Moldenke, 1975) that most of the "wind-pollinated species" reproduce in fact by selfing or apomixis; we did not undertake parallel breeding studies in Colorado tundra.

B. Community Pollination Modes and Relative Pollinator Group Frequency

The alpine tundra communities are characterized by relatively low diversities of solitary bees, bumblebees and muscoid flies and high diversities of syrphid flies and

TABLE 2. Pollination Syndromes of the Alpine and Subalpine Colorado Flora

The number represents the total number of resident species utilizing a particular mode; the figure in parentheses is the percentage of the total species in the community utilizing a particular mode. Percentages total to more than 100% because some plant species are characterized by more than one mode. Obligate selfing and specialist bee are subsets of the more inclusive categories. Many species which probably habitually self nearly all their seeds in most areas are also included under the category of their infrequent vectors, under the assumption that such outcrossed seed that is produced may occasionally possess competitive advantages.

butterflies. All other groups essentially are absent (Table1). The percentage of the total pollinator individuals which are solitary bees is high (24%), due to the extreme abundance of a single species, Panurginus bakeri, a Potentilla specialist. Although there are only two common bumblebees in the alpine tundra communities studied, they comprise more than one-fifth of the total pollinator biomass. The individuals of these species are relatively large and colony sizes are apparently small. Queens are encountered as frequently as workers on the flowers and may be encountered throughout the growing season. Anthomyiid flies account for one-quarter of the biomass of pollinators in these communities; none are suspected of specialized feeding habits. While syrphid flies and butterflies are diverse in total number of species, together they comprise only a quarter of the biomass.

From the standpoint of effectiveness as pollinators, high percentages of the alpine flora use bumblebee, syrphid fly, muscoid fly and butterfly pollination modes; beefly pollination is absent (Table 2). The occurrence of high winds and localized clouds over the high peaks in the afternoon restricts most pollinator activity in alpine tundra environments to the late morning hours after the ground temperature has risen, but before shading by the clouds. Even during these favorable periods, pollinator flight activity is generally limited to very short flights. Bumblebees are at a special advantage in these conditions, since their very low surface to volume ratio, pronounced insulatory properties and physiological capability to thermoregulate permit them to exploit floral resources during periods when other pollinators are inactive because of thermal stress. The alpine flora benefits directly from this increased level of activity, for even during extremely cool and windy periods, bumblebees frequently walk between the flowers of caespitose species. The cost of thermoregulatory floral visitation under cool ambient temperatures and the added cost of brooding within the nest requires more floral visitation for nectar than required by solitary non-thermoregulatory bees of equivalent body proportions (Heinrich, 1975), thereby further enhancing the crosspollination of the resident flora.

Both forest communities are characterized by very low levels of flower feeding individuals and total species diversity (Table 1). Pollination in the spruce-fir forests is largely restricted to that carried out by bumblebees and syrphid flies; jointly they visit 39% of the insect pollinated species (Table 2). Solitary bees, halictids, beeflies and wasps are infrequent and collectively pollinate less than 15% of the flora. Most pollinator activity is confined to small forest glades where understory bloom is profuse and sunlight is not intercepted by the forest canopy.

The understory in the aspen forest is much more dense, usually 100% cover. Most of the plants in the somewhat disturbed regions of the aspen understory that we studied flower profusely, even in the shade of the canopy, which is not as dense as that of even an immature spruce-fir forest. Hummingbirds are frequent, though not as abundant as in the glades or the meadows. Muscoid flies, solitary bees, bumblebees, syrphids and beetles are all abundant flower visitors, but none of the groups are species rich. Beeflies and wasps are absent from the aspen forest, except for the specialist-feeding pollen-collecting masarid wasp, _Pseudomasaris marginalis_, which occasionally strays into the forest edge in search of _Phacelia_. Unlike all other communities which have their own characteristic pollinator fauna, the aspen forest shares the fauna, as well as a large percentage of the flora, of other communities. Only 5% of the pollinator species encountered in the aspen forest were not found in greater abundance in other community types. Most of the pollinators collected in the aspen forest were found near to the forest edge; whether this represents the existence of a permanent ecotonal element within the pollinator fauna or simply the presence of higher levels of insolation, and consequently insect abundance, is not known. The solitary bees (_Osmia_ spp.), the muscoid fly _Lasiops septentrionalis_ and the syrphid _Cartosyrphus tarda_ are the most abundant aspen forest pollinators; they frequent legumes, composites and umbellifers, respectively.

Sagebrush communities at subalpine elevations have the high pollinator abundances and diversities characteristic of fescue grassland, but are noticeably depauperate in comparison to sage at only 2,000 m in the vicinity of Gunnison, Colorado. Bumblebees are abundant and diverse in the sage community; they account for the pollination of 48% of the insect pollinated flora. Solitary bees are more diverse in the sage than in any other community type; they comprise more than one-third of the total flower-feeding species (Table 1) and visit 42% of the insect pollinated flora (Table 2). The most diverse group of solitary bees are the _Osmia_ species, which frequent _Penstemon_, _Lupinus_ and composites. Specialist solitary bees visit nearly 20% of the total plant species present. Beefly and wasp pollination are both important elements within the sage community. Muscoid and syrphid flies are conspicuous by their absence.

The fescue grassland communities are characterized by the highest diversity and abundance of insect pollinators, as well as the greatest frequency of hummingbirds (Table 1). Grassland supports the highest diversities of all individual flower feeding groups, except butterflies, wasps and beeflies. As in the sage community, more than 40% of the total pollinator species are bees. Solitary, halictid and bumblebees are all very diverse relative to neighboring communities. Halictid bees are significant pollinators of more than 25% of the total resident flora (Table 2) and comprise 10% of the total pollinator abundance. The most abundant solitary bees are members of the genera Osmia and Panurginus. Beeflies are present, but not abundant. Muscoid and syrphid flies are abundant (about 20% of the total pollinator individuals) and figure significantly in the pollination of 20% of the insect pollinated flora (Tables 1 & 2). They are conspicuously more abundant in more mesic grasslands, where they heavily visit umbellifers and, to a lesser degree, composites. As in California marsh/meadow communities, muscoid flies reach their highest diversity in the "hydric" (Langenheim, 1962) communities; in this particular region of Colorado this plant association was too limited in width wherever it occurred to permit direct comparison to the plant communities of wider geographic extent. There are no tachinid muscoid pollinators at these elevations, again paralleling subalpine studies in California.

II. RESOURCE UTILIZATION STRATEGIES

A. Generalist vs. Specialist Feeders

Table 3 lists the most abundant pollinator species which have specialized feeding habits in the areas studied. We define "specialist feeder" as those species of pollinators which confine their feeding to only one species, to a series of congeneric species of plants or occasionally to morphologically similar non-congeneric Compositae and Leguminosae. We have designated species as specialists or generalists on the basis of feeding habits observed under localized conditions; thus, while generalist feeders at these sites are probably catholic in their preferences throughout their range, "specialists" may or may not be restricted to the same plant resource in adjacent regions. Rare species have been excluded from this analysis since the distinction between a rare generalist and a specialist is moot.

The percentage of the total pollinator species which are specialist feeders ranges from 8%-13% in the forest communities to 17%-21% in the alpine tundra and fescue grassland communities and to a high of 22% in the sage. Diversity measures (i.e., H; Margalef, 1957), in which both total species count and relative abundance are considered,

TABLE 3. Specialist Pollinators

Specialist is defined solely in terms of the manifest behavior of each insect taxon at each particular research site. These plant listings should not be interpreted necessarily as genetically determined host preferences, although some may well be.

TABLE 3.

		COMMUNITY TYPE(S) IN WHICH COLLECTED				
POLLINATOR SPECIES	PLANT(S) VISITED	ALPINE	SPRUCE	ASPEN	FESCUE	SAGE
BEES						
Andrena birtwellae	*Potentilla*	X			X	X
A. cyanophila	*Potentilla*				X	
A. n. sp.	*Erigeron*, *Aster*			X	X	
A. n. sp.	*Erythronium*		X		X	
A. n. sp.	*Salix*	X				
Anthidium maculosum	*Phacelia*				X	
A. emarginata	*Phacelia*				X	
A. emarginata	*Trifolium*	X				
A. tenuiflorae	*Trifolium*	X				X
A. sp.	*Trifolium*	X				
Anthocopa abjecta	*Penstemon*					X
Anthophora sp.	Compositae					X
Ashmeadiella sp.	Compositae					X
Colletes consors	*Mertensia*	X	X			X
C. nigrifrons	*Potentilla*	X		X	X	X
C. phaceliae	Compositae					X
C. wootonae	*Lupinus*					X
Dufourea fimbriata	*Potentilla*			X		X
D. maura	*Campanula*			X	X	
Formicapis clypeata	*Potentilla*				X	
Heterosarus bakeri	Compositae				X	
Megachile melanophaea	*Lupinus*, *Trifolium*	X		X	X	X
Megachile sp.	*Chaenactis*					X
M. sp.	Compositae				X	X
M. sp.	Compositae				X	X
M. sp.	Compositae				X	
Melissodes hymenoxidis	*Chrysothamnus*					X
M. sp.	Compositae					X
Osmia bucephala	*Lathyrus*			X		X
O. montana	Compositae			X	X	X
O. sp.	*Penstemon*		X			X
O. sp.	*Lupinus*			X		X
O. sp.	Compositae				X	X
O. sp.	Leguminosae					X
O. sp.	*Penstemon*	X				
O. sp.	*Penstemon*	X				X
O. sp.	Compositae	X				X
O. sp.	Leguminosae	X				

TABLE 3 (cont.)

		COMMUNITY TYPE(S) IN WHICH COLLECTED				
POLLINATOR SPECIES	PLANT(S) VISITED	ALPINE	SPRUCE	ASPEN	FESCUE	SAGE
BEES						
Osmia sculleni	*Cryptantha*					X
O. sp.	Leguminosae		X			
O. subaustralis	Compositae	X			X	
O. sp.	*Penstemon*	X				
O. sp.	*Penstemon*	X			X	X
Panurginus bakeri	*Potentilla*	X			X	X
P. cressoniellus	*Potentilla*				X	
P. n. sp.	*Potentilla*				X	
Pterosarus albitarsis	Compositae				X	
P. n. sp.	Compositae				X	
WASPS						
Pseudomasaris marginalis	*Phacelia*			X		
P. vespoides	*Penstemon*					X
BEETLE						
Coscinoptera vittigera	*Potentilla*				X	X
BUTTERFLIES						
Boloria helena	Compositae	X				
Nymphalis milberti	Compositae	X			X	
Euphydryas anicia	Compositae	X				
Speyeria hesperis	Compositae		X		X	X
BEEFLIES						
Villa harveyi	Compositae	X			X	X
Anastoechus melanohalteralis	Compositae					X
Conophorus painteri	Compositae					X
Poecilanthrax alpha	Compositae		X		X	X
P. signatipennis	Compositae					X
P. willistoni	Compositae					X
Villa eumenes	Compositae				X	X
SYRPHID						
Vollucella bombylans	Compositae				X	

TABLE 4.

	(BASED ON ABUNDANCE)			(BASED ON BIOMASS)			Plant Biomass Resource Diversity H
	Diversity H	% H Specialists	% H Generalists	Diversity H	% H Specialists	% H Generalists	
SAGE	4.3	8%	70%	2.8	4%	70%	2.3
FESCUE	4.2	2%	76%	2.7	1%	88%	2.3
ALPINE	3.7	0%	78%	2.7	0%	91%	1.5
SPRUCE	3.5	0%	88%	2.3	0%	96%	1.8
ASPEN	3.7	6%	91%	1.7	0%	94%	0.2

TABLE 4. Diversity of Specialist versus Generalist Bees

Diversity is measured by $H = -\sum(p_i)(\ln p_i)$; where p_i is the proportion p of the ith species in the sample. Diversity measured with respect to biomass is less than that measured with respect to individual abundance because the most abundant insects are disproportionately larger than the rest of the fauna. %H is the ratio formed by the specialist or generalist H value (each a subset) divided by the total H diversity for the entire community. The percent specialist plus the percent generalist does not sum to 100% since there is an entire spectrum of feeding types intermediate between these two extremes.

follow a similar pattern. An average of 82% of the diversity of all pollinators is composed of extremely generalized feeders (Table 4). This proportion increases to over 90% in each of the forest communities and drops to 70% in the sage. "Generalist" is defined in this context as those species which visit more than 7 plant species in only one community. Diversity measured with respect to biomass is less than that measured with respect to individual abundance because the most abundant generalists are disproportionately larger than the rest of the fauna.

Observations in adjacent regions indicate that none of the specialist species cited above consistently use a single plant species, with the exception of an undescribed species of *Andrena* associated with *Erythronium grandiflorum*. Many of the resident specialists are restricted in their feeding habits to the tribal level only. The groups most commonly involved in this type of herbivore/plant coevolution are the Leguminosae: Papilionoideae; Compositae: Astereae and the Senecioneae. *Potentilla* and *Penstemon* are associated with several specialist taxa and *Mertensia*, *Erythronium*, *Phacelia*, *Campanula*, and *Lupinus* are each visited by a specialist solitary bee. With the exception of *Erythronium*, however, nearly all of the genera pollinated by specialists are heavily visited by generalist foragers as well.

The only plant that we observed to be pollinated exclusively by specialist pollinators is *Erythronium grandiflorum*, the first flower to bloom each year in the grassland community. (D. Inouye has observed that hummingbirds occasionally frequent it as well in this locality -- pers. comm.) It is visited by an undescribed species of *Andrena* which is presumably physiologically adapted to the earliest spring in subalpine Colorado. The bee is relatively large, completely black, and very hairy; such adaptations provide maximal solar heating and maximum conservation of heat. *Campanula rotundifolia* is primarily dependent upon a specialist solitary bee for pollination. Its pendent, bell-shaped flowers apparently interfere with visitation by generalist pollinators which cannot, or do not attempt to, locate the pollen and/or nectar rewards. *Dufourea maura*, the *Campanula* specialist, possesses an array of morphological adaptations similar to the *Andrena* which forages on *Erythronium*.

Ipomopsis aggregata, *Collomia linearis* and *Androsace septentrionalis* are the only other plants which generally are visited by only one species of pollinator. *Ipomopsis* excludes all pollinators except hummingbirds by means of its extremely long, narrow, tubular corolla. (Visitation by *Papilio gothica* [Watt, *et al.*, 1974], an endemic swallowtail butterfly, and *Hyles lineata* [D. Inouye, pers.

comm.], a sphinx moth, have been recorded in the research area, but was not observed by the authors at our particular study plots.) Although they are generalist foragers, the hummingbirds which visit Ipomopsis are nevertheless very efficient pollinators. Through their territorial behavior, the birds themselves regulate the number of competing hummingbirds, assuring a cornucopia of nectar. Pollen remaining in the flowers after the heavy visitation by hummingbirds is harvested by the bee, Lasioglossum trizonatum, even though it cannot penetrate to the base of the corolla to obtain any remaining nectar. This visitation contributes nothing to the pollination of the plant. This pollen-gleaning foraging pattern on post-receptive flowers is similar to that observed on evening primroses in the Sonoran Desert (Linsley et al., 1963). Ipomopsis is also "nectar-robbed" by Bombus occidentalis on occasion; this species does not serve as a pollinator.

Collomia linearis and Androsace septentrionalis are genetically self-compatible and in many regions reproduce by habitual selfing. As the two most common and widely distributed annual plants in an area dominated overwhelmingly by long-lived perennial plants, they allocate little energy to floral production (flowers are 2-4 mm in diameter), while diverting most energy to the production of numerous tiny seeds easily dispersed short distances by wind and water. Both species are very abundant in the disturbed soil of frost heaves and the tumulus of rodent burrows. Bombylius aurifer, a parasite of bee species which nest in disturbed, bare soil, searches for bee nests by hovering at the level of the flowers, 20-40 mm above the ground. As a result, Bombylius frequently encounters both plant species and may visit many flowers in rapid succession, transferring pollen with considerable efficiency.

B. Pattern of Resource Allocation by Bumblebees.

Of all the generalist feeding pollinators, none are more abundant or more important to the greatest percentage of plants in the community than the bumblebees. Though they vary markedly in total and relative abundance from year to year, they still are the major pollinators in all communities even when there are relatively few bumblebees as in 1974. The social habits of bumblebees entail a long colony life-cycle and necessarily intense resource utilization; bumblebees must necessarily be opportunistic feeders. Indeed, of all the bumblebees that have been studied (Free and Butler, 1959; R. Thorp, pers. comm.), there is no indication that any American species is genetically specialized upon a given plant species or group (but see Løken, 1961). Any restriction in diet breadth that might occur is a function of local patterns of resource presentation and competition.

Since bumblebees are the most important pollinator group and since they are capable of utilizing nearly any resource present, the key to understanding the pollination dynamics of alpine and subalpine ecosystems revolves around the precise mechanisms which determine bumblebee host choice, population size and distribution.

The resident bumblebee fauna is quite diverse, consisting of at least 11 species. These species divide the available habitats to a considerable degree. *Bombus kirbyellus* and *B. frigidus* are usually restricted to alpine tundra; *B. frigidus* has been found by other workers at lower altitudes in the Gothic vicinity. *Bombus mixtus*, *B. appositus*, *B. occidentalis*, *B. rufocinctus*, *B. nevadensis*, and *B. californicus* are found primarily in the open, subalpine communities. *Bombus flavifrons* is primarily a forest dwelling and grassland species. *Bombus bifarius* and *B. sylvicola* are eurytopic; they are the only other species to be found in abundance within the forests, but never as frequently as *B. flavifrons*. There are few other studies available in other regions of Colorado to enable us to evaluate the generalizability of these observations. Macior (1970) reports on the distribution of bumblebee species along the Front Range of the Rocky Mountains near Boulder. He found that *B. kirbyellus* (=*B. balteatus*) and *B. frigidus* were alpine species ranging to over 4,700 m; that *B. bifarius* and *B. sylvicola* were distributed throughout all communities between 2,700-4,000 m; and that *B. flavifrons* and *B. mixtus* were generally distributed, but most common in the forests and absent in the alpine. *Bombus occidentalis* occasionally is encountered in alpine regions, spanning the altitudinal range from 1,700-4,700 m.

Habitat division in bumblebees is to a certain extent physiologically based. The two true alpine species are considerably larger and bulkier ($\bar{x}$ length = 19.8 mm [♀♀], 12.7 mm [☿☿] ; $\bar{x}$ body size = 0.99 cm^3 [♀♀] , 0.30 cm^3 [☿☿]) than many of those found at lower altitudes ($\bar{x}$ length = 16.1 mm [♀♀], 11.5 mm [☿☿]; x body size = 0.61 cm^3 [♀♀], 0.23 cm^3 [☿☿]). Since the larger body size with its diminished surface/volume ratio is such a clear competitive advantage in harsh environmental situations, it is unclear why the alpine species do not invade lower elevations and outcompete the smaller *Bombus* in these communities. The reproductives produced later in the year are highly mobile and they do descend to lower altitudes. In 1974 this descent may have been atypical, since the alpine habitats had suffered severe drought stress and the reproductives may have descended in response to a resource gradient. Perhaps the selective factor which does not permit permanent colonization by alpine species at lower altitudes is the apparent tendency of alpine species to produce much smaller colony sizes than the lower altitude species. If the subalpine species are genetically determined to produce large numbers of small-sized workers in regions under which they can physiologically exist, then they would hold a competitive advantage over the alpine species in subalpine environments. The queen to worker ratio we encountered in the alpine B. frigidus and B. kirbyellus (mean = 1:1.3) is strikingly less than the eurytopic B. occidentalis (1:5.6) or any of the subalpine species (mean = 1:9.6; range 1:6.6 - 1:14.0); we have no direct measurements of the relative colony size.[1]

There is a remarkable degree of diet specialization by Bombus in this region. If, as we have implied in Section I, pollinators are generally so infrequent that competition by most plant species for vectors usually is stronger than competition among bees for limited resources, then optimal foraging theory reviewed by Cody (1974) would predict that during periods of unlimited resource a bee individual may specialize upon the best possible resources while ignoring the majority of blooming plants. The males of most resident species adhere to these predictions closely. They are generally produced late in the summer when the diversity of plant flowers is quite high, yet confine their floral visitation to only the most prolific floral rewards. They forage primarily upon Chamaenerion, Frasera and late summer composites, with B. bifarius, B. flavifrons and B. frigidus confined nearly exclusively to the latter category.

Throughout the growing season, however, an average of only 29% of the flora is heavily dependent upon bumblebees for regular pollination. Instances of individual bumblebees foraging upon nearly every chasmogamous plant species are observed, implying that these bees are sampling the entire community but restricting their prime activity to only those plant species which are providing the most suitable rewards (Figure 1).

The foraging behavior of three Bombus species is notable in this regard. Bombus occidentalis is the only species which "robs" flowers by cutting through the perianth of flowers with nectaries that it is unable to reach with its relatively short mouthparts (Table 5). It does not exhibit any preference for pollen plants, which it exploits in the conventional way, but exhibits a strong nectar preference for Delphinium and Aconitum (also substantiated by D. Inouye, pers. comm.). These flowers not only provide

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[1] These ratios are probably highly dependent upon local conditions and should not be taken as characteristic of the species in other regions or even of the same population during years of differing resource availability; rare species were excluded from consideration. These ratios are biased in that many queens probably never found successful colonies and that once a colony is successfully started the queen has a much lower likelihood of being captured on flowers than her workers.

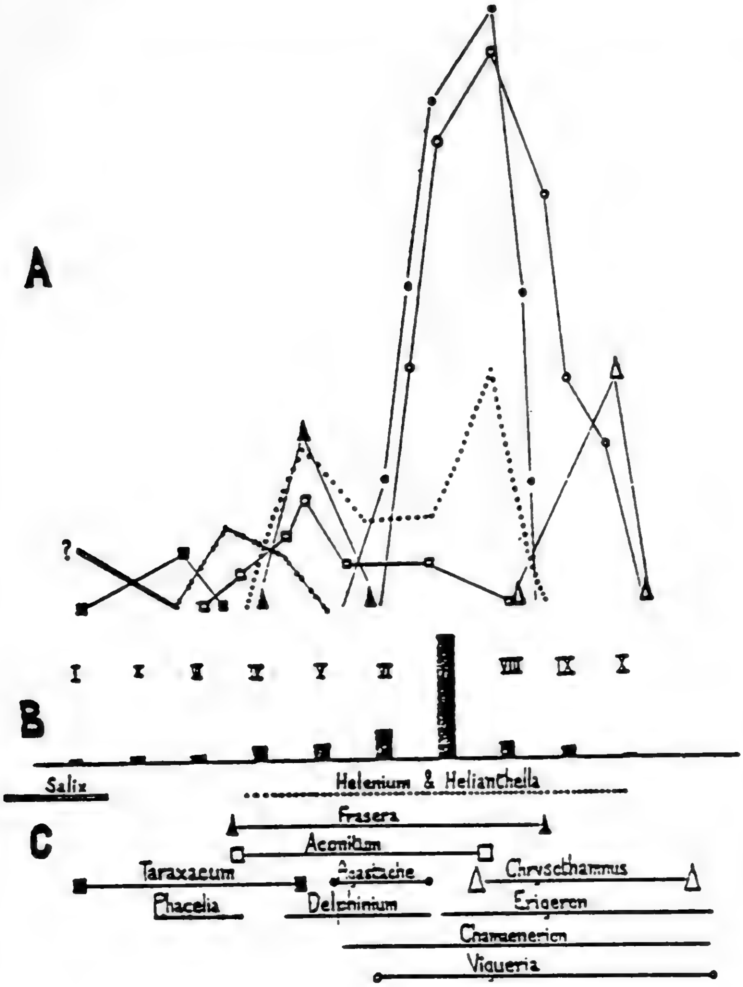

FIGURE 1. Seasonal Resource Utilization by Bumblebees in the Fescue Grassland.

A) Relative abundances of all bumblebee species on the preferred resources from weeks I to X of study. For the sake of clarity, the curves of bees utilizing Erigeron, Delphinium and Chamaenerion are omitted; they peak precisely over the center of the anthesis times.
B) Relative abundance of bumblebee workers and queens on all resources of the fescue grassland during period.
C) Periods of peak anthesis of the most frequently used bumblebee resources; periods of scattered blooming are not included. Note that the bees utilize Taraxacum, Aconitum, Helenium, Helianthella and Frasera during only a short portion of their peak blooming season and that Agastache and Phacelia are the preferred resources even after they have passed their major blooming season.

TABLE 5.

species	total length of head with mouthparts	length/width facial dimensions	length of glossa
B. occidentalis	7.7	1.08	4.2
B. bifarius	5.9	1.13	4.4
B. sylvicola	7.0	1.15	4.4
B. flavifrons	8.9	1.50	5.8
B. appositus	10.3	1.24	6.8

TABLE 5. Facial Morphology of Dominant Bumblebee (*Bombus*) species.

Measurements represent average values (mm) from five randomly selected workers of each species.

quantitatively some of the largest nectar resources available in the region, but as shown by Watt *et al.* (1974) produce nectar rich in dimer and trimer sugars which more efficiently fuel bumblebee and hummingbird flight than the usual glucose, fructose and sucrose nectars (Percival, 1961).

Bombus appositus possesses the longest and most slender mouthparts of all the resident bumblebees and therefore is capable of extracting some nectar from spurs without the necessity of robbing the flower (Table 5). This species restricts much of its foraging to *Delphinium* and *Aconitum*. *Bombus flavifrons*, another rather long-tongued species, emphasizes *Delphinium* and *Aconitum* in its diet also. Unlike *B. occidentalis*, both species collect the pollen as well as the nectar of these ranunculaceous plants. Macior (1970) reports that *B. appositus* also visits *Pedicularis crenulata* along the Front Range, another plant which produces voluminous nectar with unusual dissolved sugars (Moldenke, unpub. data).

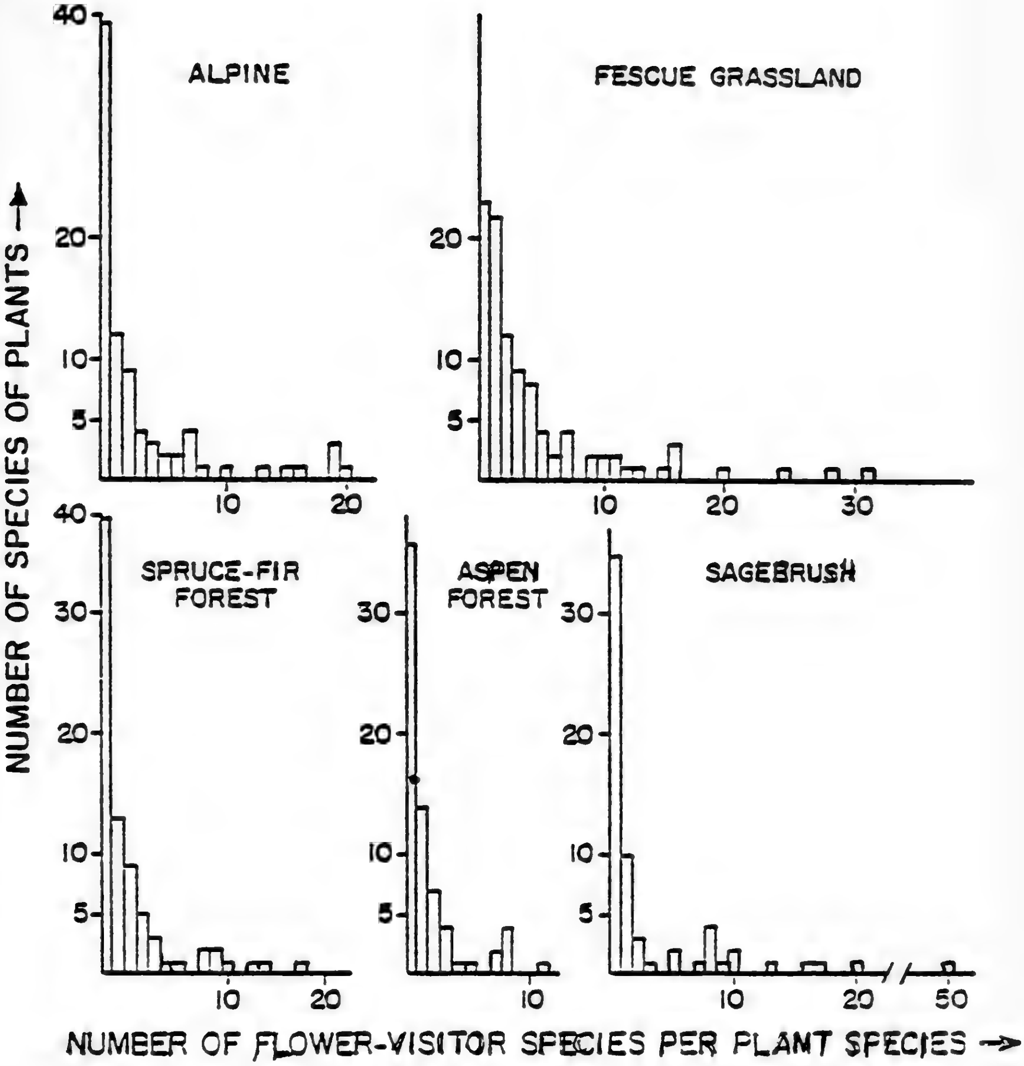

FIGURE 2. Distribution of Total Flower Visitors in Each Community.

Anemophilous plant species are not included. In all communities there are many species visited by 0-2 pollinators and very few species which are visited by large numbers of insect species.

C. Overlap in Res~~r~~ource Utilization Modes

All communities studied manifest a pattern of food resource division in which many plants are visited by 0-2 pollinator species, much fewer by 3-7 species, and a very few plant species attract large numbers of vector species (Figure 2). This pattern is consistent with observations made in eleven communities in California (Moldenke, 1975). Cornucopia plant species which attract a disproportionate percentage of the pollinator fauna (Mosquin, 1971) are present in all communities examined.

Our operational definition of cornucopia is a plant species which attracts a percentage of the available pollinator species greater than five times the mean number of pollinator species per plant species in the community. This definition is generalizable because it permits comparisons among communities with strikingly different levels of pollinator diversity and is unambiguous. The mean percentage of available pollinator species that the"average" nonwind-pollinated plant species attracts ranges from only 2.2% to 3.3%, while the "average" cornucopia species attracts a disproportionate 12.3% to 20.0% (Table 6). Such cornucopia species are visited by more pollinator species than 92% to 96% of the plant species in each community.

The demarcation for cornucopia species was estimated simply by inspection of the distribution of pollinator species on plant species from our Colorado study (Figure 2). When the same definition of cornucopia species is applied to eight low- and high-altitude California communities, the percentage of cornucopia plant species in each community ranges from 1.0% to 4.6%. The average percentage of the pollinator species attracted to such cornucopia species is also similar to the Colorado results, ranging from 13% to 30%, with an average of 18.8% at high altitudes and a closely approximating 16.0% at sea level. The cornucopia plants from comparable high altitude California study sites are in many cases congeners of those from Colorado communities. Cornucopia species in alpine and subalpine Colorado are *Astragalus molybdenus*, *Aster* spp., *Chrysopsis villosa*, *Chrysothamnus* spp., *Erigeron* spp., *Geranium richardsonii*, *Geum rossi*, *Hymenoxys grandiflora*, *Ligusticum porteri*, *Potentilla fruticosa*, *Potentilla gracilis*, *Senecio* spp. and *Taraxacum officinale*. With the exception of the first species. all of these plants have a polyphilic floral

TABLE 6. Community Pollination Characteristics and Cornucopia Plants.

Cornucopia species is operationally defined as a plant species which is visited by more than five times the mean percentage of pollinator species per plant species in the community.

TABLE 6.

COMMUNITY TYPE	Number of Pollinator Species	Number of Cornucopia Species	Percentage of Nonwind-Pollinated Plant Spp. Which Are Cornucopia	Mean % of Pollinator Species Visiting Cornucopia Species	Number of Specialist Pollinator Species
FESCUE GRASSLAND	160	4	4.0%	16.6%	34
SAGE	145	3	4.7%	20.0%	32
ALPINE TUNDRA	109	6	7.2%	16.5%	18
SPRUCE-FIR FOREST	77	4	5.1%	16.6%	6
ASPEN FOREST	70	5	7.1%	12.3%	9

morphology which allows exploitation by a wide range of floral herbivores.

Cornucopia species are most numerous in the alpine tundra and aspen forest communities, both in terms of their absolute numbers and in their percentage of the total number of plant species per community (Table 6). However, the alpine tundra has some of the most effective cornucopia plants, based upon the average percentage of total pollinator species attracted to them, while the aspen forest has the least effective. The single most effective cornucopia species in our research sites is found in the sage: Chrysothamnus viscidiflorus is visited by 34% of the resident pollinator species. Not surprisingly, there are few other cornucopia in the sage; the sage community has the fewest cornucopia species. Fescue grassland is the only community having a lower percentage of its plant species which act as cornucopia than the sage. Spruce-fir forest has the same number of cornucopia species as the fescue grassland, but they comprise a larger percentage of the community's total plant species than those of the sage.

Seventy-four percent of all specialist pollinators utilize the cornucopia plant species (Table 3) and hence overlap entirely in their diet breadths with a maximum number of other species. The number of specialist pollinator species increases from 8% to a high of 22% in the most diverse pollinator faunas (Table 6). While this might imply an increase in niche overlap of pollinators in regions of high pollinator diversity, the small relative contribution of specialists to over-all pollinator diversity in all communities (Table 4) makes the true degree of niche overlap difficult to discern in this manner. Niche overlap values calculated directly by the method proposed by Hendrickson and Ehrlich (1971) and adapted by Moldenke (1975) in fact reveal an inverse correlation between total number of pollinator species and degree of niche overlap (Table 7). Despite the distinctly overlapping food utilization strategies of specialists in association with cornucopia plants, their contribution to overlap values calculated on the basis of relative abundance must be minimal. Therefore, decreasing overlap values in pollinator rich communities must be due to a more equitable distribution of generalist feeding species upon available resources.

This inverse correlation cannot be used to determine the nature of niche packing in more diverse communities, since either the narrowing of diet breadths by generalists or simply their diffusion upon more resource states (without a change in the number of resources utilized) could be responsible for decreasing overlap. Changes in niche structuring in species-rich communities are indicated, however, by the positive correlation between diversity of pollinator biomass and degree of niche overlap (Table 7). This tendency for an increasingly disproportionate biomass concentration upon few resources implies an actual narrowing of diet breadth by those pollinators which comprise the greatest relative amount of biomass in all communities, i.e., Bombus species and hummingbirds. Therefore, it appears that in communities with more pollinator species, the additional species exist by a progressive increase in specialized feeding habits commensurate with a decrease in the tendency of the total fauna to utilize resources in common. This conclusion is supported by the lower number and percentages of cornucopia plant species in communities with the greatest pollinator diversity (Table 6), which must reflect at least indirectly a reduced amount of resource utilization overlap of all pollinators in these communities.

III. AUTOGAMOUS PLANTS AND VECTOR LIMITATION

Autogamous selfing occurs to some extent in all communities we have studied to date (Moldenke, 1975, 1977, 1979). Generally, selfing is used by annual plants in the understory of a community. Even though some dominant plants may be capable of self-pollination, they seldom have to rely upon it because they are efficiently cross-pollinated. Since the reproductive strategy of selfing is usually confined to annual plants, the occurrence of only nine species of annual plants in all communities studied in Colorado would indicate a weak incidence of selfing in this habitat. All of the resident annual plants are indeed habitual selfers under most conditions. In addition, many of the perennial plant species in the alpine tundra are self-pollinated in the apparent absence of sufficient vectors as reported above. Within the alpine tundra community, eleven (55%) of the twenty most abundant plants are genetically capable of selfing and presumably frequently do so. Higher levels of habitual selfing have been encountered previously only in offshore island and subalpine marsh communities (Moldenke, 1977).

Ten percent of the flora of all the Colorado communities reproduce either by obligate selfing or apomixis. Comparable emphasis on obligate selfing and apomixis is encountered in alpine and subalpine California. The only other systems known to support levels of more than six percent obligate selfing and apomixis are the coastal dunes and bluffs, weedy community and serpentine grasslands (Moldenke, 1977).

Fewer than 2,500 flower-visiting insects were collected in all the research areas during the four person-months of study. While collection techniques are not completely

	VECTOR ABUNDANCE						VECTOR BIOMASS			
	Total Species		M		M$_H$-M			M		M$_H$-M
FESCUE	160	↑	.029		.037	FESCUE	↑	.141	↑	.518
SAGE	145		.026		.531	SAGE		.153		.448
ALPINE	109	diversity	.049	overlap	.616	ALPINE	diversity	.165	overlap	.271
SPRUCE-FIR	77		.071		.622	SPRUCE-FIR		.208		.433
ASPEN	70		.037	↓	.670	ASPEN		.403		.200

Table 7: Diversity and Niche Overlap of Pollinators

Increasing tendency of the indices is indicated by the direction of the arrows.

Simpson's "M": $$M = 1 - \left[\frac{\sum_{i=1}^{s} \left[n_i \sum_{j=1 \neq i} (n_j) \right]}{N^2 - N} \right]$$

Hendrickson's "M$_H$": $$M_H = 1 - \left[\frac{\sum_{i=1}^{s} \left\{ n_i \left[\sum_{j=1 \neq i}^{s} (d_{ij})(n_j) \right] \right\}}{N^2 - N} \right]$$

where:

N = total number of individuals

s = number of species

n_i = number of individuals in the ith species

$(d_{ij}) = \frac{\text{number of food sources utilized by i not also by j}}{\text{total number of food sources of i}}$

comparable with the California studies and direct comparison is not possible, Colorado studies yielded at most only 1/10 to 1/25 the number of pollinators that previous studies have documented in low- to middle-altitude regions. Since a large proportion of the pollinators within any community use the same resource plant, communities with more available pollinators may on occasion consequently exhibit higher percentages of the flora relegated to selfing. For example, the sage has nearly the same pollinator abundance as is characteristic of the alpine tundra, but the percentage of the resident plant species that are habitual selfers is half that characteristic of alpine regions.

DISCUSSION

Communities in subalpine and alpine Colorado support only one-third to one-half of the total number of species in the more propitious climatic regimes previously studied in California. The mean number of pollinator species per community in these Colorado sites is 113 (Table 1). Studies of three community types (chaparral, oak woodland, grassland) on the Stanford University campus (sea level) in California revealed an average of 377 pollinator species per 0.5 km^2 community sample site (Moldenke, 1975). Another transect including three community types (chaparral, ephemeral community following a chaparral burn, montane oak woodland) in southern California revealed a similarly high level of pollinator diversity with an average of 257 species per community (Moldenke, 1979).

Comparing directly the alpine and subalpine regions of California and Colorado, we expected to find comparable reductions in diversity as a result of the similarly harsh and unpredictable climates at altitudes in excess of 3,300 meters. Alpine tundra in California had 24% fewer pollinator species than Colorado, while subalpine communities in California had twice the number of species found at comparable altitudes in Colorado (California $\bar{x}$ = 232, Colorado $\bar{x}$ = 113; comparable areas and analagous community types studied). The relatively greater number of species in alpine Colorado correlates with the larger expanses of true alpine tundra in the Rocky Mountains and may reflect the general species/area relationship (MacArthur and Wilson, 1967) which has never been precisely quantified for any group of pollinating insects. Alpine tundra in the Sierra Nevada of California is restricted to extremely narrow, discontinuous bands of isolated habitats. The numbers of total plant species censused in the alpine communities of both regions are somewhat comparable (California = 78; Colorado = 100), but again reflect the lower species count of California alpine communities.

The total number of pollinator species in subalpine regions of Colorado is only 62% of the number in climatically harsh Colorado Desert of California and is very similar to the very low pollinator diversities of the maritimal bluffs and dunes along the California coast (Moldenke, 1975,1979). There are no comparable studies for lower altitudes in Colorado, but on the basis of observations made while commuting between our research sites and consultation with Prof. Lanham (Natural History Museum, University of Colorado), we believe that local pollinator diversity increases markedly below 2,750 meters, but never reaches the high levels characteristic of low- or mid-elevation California.

In regards to only bee species, the aforementioned total Stanford University site has 276 bee species (sum of five 0.5 km^2 areas) and the cumulative southern California research sites (sum of four 0.5 km^2 areas, excluding the faunistically unique desert) by 264 total bee species (Moldenke, 1975, 1977, 1979), while only 157 bee species are found within the sum of four 0.5 km^2 sites in subalpine and alpine California. A sum total of 108 different bee species in the comparable five sites in Colorado demonstrates both the tendency for decreased species richness at high altitudes and the decreased richness of the total bee fauna in Colorado relative to California.

All of the results presented confirm the principle that the physiognomy of the community is correlated with, and perhaps exerts a major effect upon, the abundance and diversity of pollinators. Therefore, physiognomically distinct but adjacent community types may support radically different numbers and species richness of vectors. Since the diversity of pollinators is related in part to the breadth of their diet and overlap upon resources utilized in common, the relative emphasis upon different breeding systems within any community is therefore indirectly determined by community physiognomy.

It might be argued that the similarity observed between California and Colorado subalpine pollination systems represents the outcome of parallel evolutionary selective factors acting on separate components of the continuous Arcto-Tertiary Geoflora and Nearctic insect fauna. Though less than 5% of the pollinator species and less than 10% of the plant species is shared at the specific level between the two regions, the majority of the organisms are very closely related (i.e. congeneric) and little more than allopatrically distinct. However, the similarity of trophic relations and diversity patterns between similar community types in the disjunct areas cannot be ascribed to taxonomic similarity alone. The overlap of species within the four high altitude California communities is much stronger than any overlap between the two mountain ranges, and vice versa. When the same species of plant occurs in more than one community, in no instance is its breeding system identical; even if the same major pollinator occurs in both situations, its abundance and often its fidelity to the plant in question is altered. Self-compatible plant species may rely upon inbreeding more frequently in shaded or climatically more severe environments.

That herbivore dependencies upon the flora assume similar patterns in such widely separated research sites implies that optimal foraging theory (Cody, 1974) applies to assemblages of hundreds of sympatric species as well, so long as the resource bases are comparable. Resource division by bumblebees has been shown to result in similar outcomes of the competitive exclusion principle in Colorado.

The same plant groups in both high altitude Colorado and California have coevolved with specialist pollinators. Seventy-five percent of the plant genera in Table 3 support oligoleges in the California sites as well; only one of the cases of noncorrespondence involves a plant genus not native to the California research sites as well.

Despite the very close over-all similarity demonstrated between these regions, we cannot conclude that the precise pattern of feeding specialization and overlap observed in one season's collecting characterizes these communities on a long term basis. In fact, it is probable that the exact pattern of which species feeds on which plant resources varies greatly, since most of the potential pollen vectors are generalist feeders and the most common species (i.e., Bombus spp.) are liable to very large changes in relative abundance from year to year (D. Inouye, pers. comm.). In addition, there may be large annual fluctuations both quantitative and qualitative in floral resource presentation (e.g., Frasera; Beattie, et al., 1973).

June is typically a period of drought in the study area, but the melting of accumulated snow usually provides a persistent source of water until the onset of thermal storms in July (Langenheim, 1962; D. Inouye, pers. comm.). In the summer of 1974, however, snow melt-water virtually disappeared in the period prior to the first thundershowers; many species of fescue grassland, sage and alpine tundra plants showed signs of drought stress. Veratrum and the late summer composites bloomed exceptionally heavily after the initiation of the rainy season (D. Inouye, pers. comm.). Frasera, which is not controlled by the summer rains (Beattie et al., 1972), also bloomed very heavily in 1974. Another unusual occurrence was that only two individual plants of the extremely abundant Vaccinium species were observed in flower throughout the entire region. In view of the large variations in the pattern of floral presentation from year to year, it might be expected that the degree of facultative specialization exhibited by potentially generalized feeders would be altered in subsequent years.

Despite potentially broad adaptive responses by certain generalist feeders to changes in resource presentation, there are features of relative species packing in differing community types which remain distinctive. These characteristics involve the relative abundance and diversity of major pollinator groups and the relative emphases upon divergent foraging strategies.

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NOTES ON TRADESCANTIA III

TRADESCANTIA OHIENSIS RAFINESQUE VAR. PALUDOSA (ANDERSON & WOODSON) MACROBERTS, COMB. NOV.

D. T. MacRoberts
Louisiana State University in Shreveport

Anderson & Woodson (1935) described a new species from the vicinity of New Orleans, Louisiana, as *Tradescantia paludosa* Anderson & Woodson. This species has not met with general acceptance. Thieret (1970) placed it in synonomy with *T. ohiensis*. Correll & Johnston (1970) did not include it in the Texas flora although it had reportedly been collected by Hubricht in Freestone Co., Texas some time before 1967. (Sinclair, 1967).

Anderson & Woodson commented on the resemblance of the species to *T. ohiensis*: "Planta habitu *T. canaliculatum* Rafinesque simulans . . . . At first glance the only character which distinguishes this species from *T. canaliculata* may appear to be its somewhat lower and more diffuse habit." However, their collection of *T. ohiensis* from Louisiana, where it is the most common species, was far too exiguous, consisting of only two specimens, for them to draw such conclusions.

Although Anderson & Woodson collected eight specimens of *T. paludosa* from the vicinity of New Orleans their description does not adequately cover the deviations of this taxon from *T. ohiensis*. *T. paludosa* grows in dense stands in roadside ditches north of Baton Rouge and is sometimes cultivated in the old homes near St. Francisville. It is about as tall as *T. ohiensis* but with dark green (not "dilute viridibus" as Anderson & Woodson have it) foliage. The plant is either sub-glaucus or not glaucus at all. There is a slight tendency to root at the lowest node although this characteristic has not been observed on plants in northern Louisiana. The leaves, unlike those of *T. ohiensis* which are long, arcuate, and which leave the stem at an acute angle, are relatively short, straight, and leave the stem at nearly a right angle. The slight constriction emphasized by Anderson & Woodson is scarcely perceptible. A more pronounced idiosyncracy of *T. paludosa* is its tendency to throw out dense, sterile, foliaceous shoots from the upper nodes and the frequent suppression of the uppermost node making the inflorescences appear tri-bracteate. The plants are essentially glabrous throughout except for the typical *T. ohiensis* brabate sepal and bract tips.

In the course of a study of the Louisiana *Tradescantias* I examined all the specimens of that genus in the five major herbaria of the state as well as those in our own collection. There were 228 specimens of *T. ohiensis* and 16 attributed to *T. paludosa*. It was apparent that many of the T. ohiensis specimens showed some or all of the *T. paludosa* diagnostics: leaf-shape, axillary growth and suppression of the upper node. Whether the plants were glaucus or not could not be determined from herbarium specimens but some were noted as "slightly glaucus," "sub-glaucus," etc.

Although the *T. paludosa* characteristics were concentrated in the plants around Baton Rouge and south along the Mississippi River, they were also found in specimens throughout Louisiana - in half the parishes - and into central Mississippi, Arkansas and east Texas. Intergradation was of all degree, diminishing as one moved from the center in southeast Louisiana.

Considering the reputation of *Tradescantia* for ubiquitous hybridization, the obvious explanation is that these intermediate plants represent crosses between *T. paludosa* and *T. ohiensis*. However, the more I study *Tradescantia* the less am I inclined toward characterizing the aberrant specimen as a hybrid. In this case, *T. paludosa* apparently fails to hybridize with the other common species, *T. hirsutiflora* Bush since little or no sign of *T. paludosa* characteristics could be found in specimens of that taxon.

Anderson (1954) suggested that *T. paludosa* might have arisen from a cross between some tropical creeping species and *T. ohiensis*. This is an intriguing suggestion and the extreme form of the taxon, as exemplified by a specimen in LSU (Baton Rouge) Bougere 2119, St. Tammany Parish, 1952, does remind one strongly, in leaf shape and growth characteristics, of some of the erect, not creeping, Mexican species.

T. paludosa is a diploid form of *T. ohiensis* centered in southeastern Louisiana. It appears to deserve more than simple synonomy with *T. ohiensis* yet the diffusion of its characteristics throughout the *T. ohiensis* population throughout the state militates against granting it specific status. It appears best to retain the entity as a variety of *T. ohiensis* with the obligate observation that, like most other matters connected with this genus, it needs further study.

Tradescantia ohiensis Rafinesque, var. *paludosa* (Anderson & Woodson) MacRoberts, comb. nov. Based on *Tradescantia paludosa* Anderson & Woodson, Contr. Arn. Arb. 9:1-132, 1935.

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BOOK REVIEWS

Alma L. Moldenke

"FLORA OF BARRO COLORADO ISLAND" by Thomas B. Croat, ix & 943 pp., ca. 600 b/w photographs, 4 tab., 9 graphs, & 6 maps. Stanford University Press, Stanford, California 94305. 1978. $55.00.

Barro Colorado Island projecting out of Gatun Lake in the Panama Canal and its research set-up used to be a "tropical Elysian fields" dream of young biology students. Is it still so? I hope so. Reading the excellent, detailed introduction recalled our own short but wonderful visit there in '48 and appraised us of how much more is known today about this most thoroughly studied of tropical islands. Standley's fine study of the same title listed 1,058 species of vascular plants in 1933. This more detailed concentrated 10-year Croat's study describes 1,369 taxa of which 25.8 percent are monocots and 66.5 percent are dicots with the following genera having the largest number of species: Piper, Psychotria, Inga, Ficus and Miconia. There are carefully worked out keys to groups, to families, to genera and to species. There is also a "Key to Sterile Woody Plants" for about 700 species. Along with the plant descriptions there are often notes on flower and fruit timings as well as agents of pollination and dispersal. The many fine photographs are also the author's work and are chosen to show definite characteristics. This is an excellent study!

"NATIVE ORCHIDS OF NORTH AMERICA — North of Mexico" by Donovan Stewart Correll, xvi & 400 pp., 146 b/w photos, 10 text figs. Reissued by Stanford University Press, Stanford, California 94305. 1978. $28.50.

Now new and younger avid orchidophiles and orchidologists, as well as prosaic horticulture and botany libraries, can readily acquire this classic yet still modern study at a reasonable price in this unabridged printing. Besides the excellent introduction, keys, descriptions, derivation of names and synonymy provided by the author, there are many exquisitely accurate plates by Blanche Ames and Winston Dillon and the cultural notes of Edgar T. Wherry and John V. Watkins. The original printing was done in 1950 by Chronica Botanica. The work covers 46 genera with 157 species, 16 varieties and 3 hybrids. Two publications more recent by more than a score of years — C. A. Luer's "The Native Orchids of Florida" and "The Native Orchids of the United States and Canada Excluding Florida" add only 4 genera and 13 species but have hundreds of gorgeous color photographs. Of course, the classic line drawings reveal more technical details. As Correll explains in his new preface these works are not competitive; they supplement each other very effectively.

"**FLORA MALESIANA**" Series 1 Volume 8 Part 1 "CYCLOPAEDIA OF COLLECTORS", Supplement 2 by M. J. Steenis-Kruseman, 115 pp. & 52 b/w photographs and "HYPERICACEAE" by N. K. B. Robson, 29 pp., 18 b/w fig. & 3 photographs. Sept. 1974.

The first part of this publication gives additional botanically oriented biographical details to supplement those in Fl. Mal. I, 1 (1950) and Fl. Mal. I, 5 (1958) to help track down collection sites, dates and herbaria of deposition.

The second part is a taxonomic treatment of the involved 6 species of Cratoxylum and 15 species of Hypericum in the Hypericaceae. Despite the use of this term in the title, the author's footnote claims that it does "not deserve family rank and should be viewed as a subfamily of Guttiferae. It is merely for convenience that this name is maintained here". Then why not use the correct title Guttiferae - Hypericoideae, or some such designation, in this technical journal? The drawings are excellent.

"**FLORA MALESIANA**" Series 1 Volume 8 Part 2 "REVISIONS" by E. Soepadmo, D. J. L. Geerinck, K. M. Matthew, P. H. Raven, C. G. G. J. van Steenis, R. J. van Beuskom-Osinga, H. P. Nooteboom & P. Taylor, 269 pp., 24 b/w photos & 119 line draw. Dec. 1977.

The above-named authors, in the order given, have written taxonomic treatments for Ulmaceae, Iridaceae, Cornaceae, Onagraceae, Bignoniaceae, Crypteroniaceae, Symplocaceae and Lentibulariaceae. The excellent line drawings show key characteristics and geographic distribution. Each family is treated carefully for the area in a similar format. "Revisions" must refer to much earlier treatments in other publications.

"DIE HÖLZER MITTELEUROPAS — Ein Mikrophotographischer Lehratlas" by Dietger Grosser, ix & 208 pp., 64 b/w photog. plates, 87 fig. & folded charts in back cover. Springer-Verlag, New York, Heidelberg & D-1000 Berlin 33. 1977. DM.98 or $43.20.

For over 70 trees and shrubs of Central Europe the most consistently excellent photomicrographs, usually 4 to a plate, are clearly and cleanly reproduced. Populus tremula L., for example, on Plate 54 shows an annual xylem strand and adjacent xylem from the previous and from the succeeding year at 25x, a part of two bands at 75x, parenchyma at 95x and a tangential ray at 120x. The opposing page provides common names, family and notes on general height and type of tree, geographic distribution, microscope-camera directions, nature of fibers and other comments. A fine treatment indeed.

PHYTOLOGIA

Designed to expedite botanical publication

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CONTENTS

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FLORA
OF THE PRAIRIE PROVINCES

Bernard Boivin

Part IV -- MONOPSIDA

(continued)

ORCHIDACEAE-JUNCACEAE

Order 69. ORCHIDALES

Flower strongly zygomorphic. Ovary inferior. Stamens only 1-2. Pollen aggregated in pollinia.

123. ORCHIDACEAE ORCHID FAMILY

Single family. Style and anthers fused into a complex organ termed gynostegium. Stamen(s) usually not obvious.

a. Flower single, or exceptional individuals with 2-(3) flowers.

b. Leaves 2 or more and in most cases caulinary............................ 1. Cypripedium

bb. Only one leaf.

c. Leaf long linear and developing tardily.............................. 4. Arethusa

cc. Leaf ovate .... 12. Calypso

aa. Inflorescence a raceme.

d. Leaves 2, opposite.................... 6. Listera

dd. Alternate or all basal.

e. Lower petal spurred.

f. Flower cruciform, the upper 3 appendages overlapping; leaf only one, basal, ± obovate .... 2. Orchis

ff. Flower stelliform, the appendages divergent .... 3. Habenaria

ee. No spur. Sometimes obscurely spurred in Corallorhiza.

g. Leaves numerous.

h. No rosette, all leaves cauline and bract-like ...... 9. Corallorhiza

hh. Leaves dimegueth, the main ones basal and large, the cauline much reduced and bract-like.

i. Lip flattish; rosette leaves lanceolate to linear...... .... 5. Spiranthes

ii. Lip becoming ± hemispheric towards the base; rosette leaves ± ovate...
.... 7. *Goodyera*

gg. Leaves only 1-2. Scape bractless.

j. Flowers 4-5 mm wide and greennish .... 10. *Malaxis*

jj. Larger, 1-4 cm across.

k. Leaves 2 .... 11. *Liparis*

kk. Only 1 ....8. *Calopogon*

1. CYPRIPEDIUM L. LADY'S SLIPPER

Flowers large and very showy with the lip inflated and mostly egg-shaped. Stamens 2 (only 1 in our other genera).

a. Leaves only 2, basal.................... 3. *C. acaule*

aa. Stem leafy.

b. Flower with a lip and 5 other appendages; lip odd-shaped.................. 1. *C. arietinum*

bb. Only 4 other appendages due to the fusion of the lower 2 sepals; lip ± egg-shaped.

c. Lip white or yellow.

d. Lip white, 1.8-2.5 cm long.......
.... 5. *C. candidum*

dd. Yellow, 2-5 cm long.......4. *C. Calceolus*

cc. Pink or purple or at least spotted or striped in pink or purple.

e. Lip ± 18 mm long, the other appendages shorter........ 6. *C. passerinum*

ee. Flower larger, the lip 2-5 cm long, the other appendages 2.5-7.0 cm.

f. Other appendages white, flat ..
.... 2. *C. reginae*

ff. Deep green to purple brown and twisted .... 7. *C. montanum*

1. *C. arietinum* Br. (*Criosanthes arietina* (Br.) House) -- Ram's Head -- Lip whitish, heavily veined in purple, mostly 1.5 cm long and ± conical or pyramidal. Leaves 3-4-(5), borne in the upper half of the plant, lanceolate to broadly linear. Herbage thinly pubescent, eglandular. Early summer. Woods; rare and highly localized from Prince Albert eastward. --NS, Q-cS, US, (Eur).

2. *C. reginae* Walter (*C. hirsutum* AA.) -- *Lady's Slipper*, *Showy Lady's Slipper* -- A large and most handsome white flower with a pink, egg-shaped lip. Leaves 5-10, elliptic. Herbage soft hirsute. Lip 2.5-5.0 cm long, with pink-red dots and wide stripes on a whitish base. Other appendages not twisted. Early summer. Wooded bogs. --NF, NS-Man, US.

3. **C. acaule** Aiton (*Fissipes acaulis* (Aiton) Small) -- *Lady's Slipper*, Mocassin-Flower (*Sabot de la Vierge*) -- Herb with two large basal leaves and a single, large, reddish flower. Lip 4-6 cm long, irregularly egg-shaped, with a closed cleft along the upper side. Other appendages not twisted. Early summer. Sandy Coniferous woods. --NF-SPM, NS-Alta, US.

It is customary to extend the range north to Mackenzie on the basis of a Richardson collection labelled Great Bear Lake (GH). But this has never been confirmed and it now looks like the locality could have been in error.

4. **C. Calceolus** L. var. **parviflorum** (Sal.) Fern. (*C. parviflorum* *Sal.*) -- *Lady's Slipper*, *Yellow Lady's Slipper* (*Sabot de la Vierge*) -- Lip yellow, the other appendages brownish and twisted. Stem leaves 3-6, ovate. Herbage glandular-pubescent. Lip 2-3 cm long. Upper sepal 2.5-4.0 cm long. Twisted petals 3-5 cm long. Fruit on a stipe 0.7-0.8 cm long. Early summer. Moist woods or prairies. --Mack-(Y), NF-SPM, NS, NB-BC, US -- Var. **pubescens** (W.) Correll -- Larger throughout. Lip 3-5 cm long. Upper sepal 4-7 cm long. Twisted petals 5-9 cm long. --NS-sMan, US.

Despite a number of reports to the contrary, var. *pubescens* does not seem to extend west of Manitoba and all more western specimens examined proved to belong to var. *parviflorum*.

4X. **C. Andrewsii** A.M. Fuller -- Hybrid with the next. Lip yellowish. Floral appendages intermediate in size, mostly around 3 cm long. Rare: Brandon. --swO-swMan.

5. **C. candidum** Muhl. -- Lip white to lightly mauve-tinged, 2 cm long. Herb 2-4 dm high and glandular-pubescent. Other appendages green, ± brown-tinged. Upper sepal 2-3 cm long, lanceolate. Twisted petals 2.5-3.5 cm long. Fruit on a stipe 1.5-2.0 cm long. Early summer. Wet prairies, very rare: Woodlands, Brandon, Aweme, Indian Head. --swO-seS, US.

6. **C. passerinum** Rich. var. **passerinum** -- Lip creamy-white with large magenta dots. Herbage villous-pubescent, not glandular. Upper sepal 1.5-2.0 cm long, ovate, pale green; lower sepals slightly shorter and nearly completely fused. Lateral petals 1.0-1.5 cm long, flat, whitish. Fruit on a stipe 1.5-2.0 cm long. First half of summer. Wet places, especially flood-plain forests, in northern and low arctic woods. -- (K)-Mack-Aka, O-BC.

In an eastern endemic of Mingania, var. *minganense* Vict., the calyx is shorter, the upper sepal only 9-13 mm long and the lower appendage (or fused sepals) 7-10 mm long.

7. ***C. montanum*** Douglas -- Much like *C. Calceolus*, but the lip white with purple veins. Herbage glandular-pubescent. Flowers (1)-2-(3). Lip ± 2.5 cm long. Other appendages 3.5-7.0 cm long. Terminal fruit on a stipe usually less than 1 cm long. Late spring to early summer. Wet mountain woods: Waterton. --(Aka, swAlta)-BC, US.

2. ORCHIS L. ORCHIS

Like the next, with a spurred lip, but the upper appendages connivent or connate, the flower thus cruciform. Translators hidden in a small receptacle.

1. ***O. rotundifolia*** Banks -- Flower cruciform, mauve in bud, becoming white, with the lip dotted in purple. Leaf only one, orbicular to elliptic. Lip 8-11 mm long, emarginate to bilobed at tip, with a pair of small lobes near the base; other appendages white. First half of summer. Wet woods. --(G, K)-Mack-Aka, NF, NB-BC, US -- F. *lineata* (H. Mousley) E.G. Voss -- Dots on the lip much larger and confluent into a pair of longitudinal lines. Local: Cypress Hills. --wO, seAlta -- F. ***Beckettiae*** Boivin -- Lip white and dotless. Local: Churchill. --Man.

F. *Beckettiae* was also reported for Jasper by Moss 1959, querried by Boivin 1967. In 1971 there was no such albino on file at ALTA.

3. HABENARIA W. FRINGED ORCHIS

Lip prolonged at base into a spur. Perianth parts 6, mostly radially disposed.

a. Leaves all basal.
b. Only one leaf. (See also *Orchis*)...8. *H. obtusata*
bb. 2 or more leaves.
c. Leaves linear-spatulate to oblanceolate......................5. *H. unalascensis*
cc. Broader, orbicular to broadly oblong.
d. Scape bearing many bracts .... 7. *H. orbiculata*
dd. With only 1 bract or none.................................. 6. *H. Hookeri*
aa. At least 1 stem-leaf present.
e. Spur short; lip bidentate at tip... 1. *H. viridis*
ee. Spur nearly as long as the lip, the latter entire at tip.
f. Flowers white; lip abruptly broadened at base........................... 4. *H. dilatata*

ff. Flower greenish; lip linear or gradually tapered at base.
  g. Spur of uniform thickness..... .... 2. *H. hyperborea*
  gg. Spur 2-3 times thicker toward the tip than at base........... 3. *H. saccata*

1. *H. viridis* (L.) Br. var. *bracteata* (Muhl.) Gray (*H. bracteata* (Muhl.) Br.; *Coeloglossum bracteatum* (Muhl.) Parl.) -- Frog-Orchid -- Flowers all or mostly overtopped by a subtending bract. Stem leafy, the leaves ± lanceolate. Flower greenish, the lip darker. Spur 2-3 mm long, somewhat less than half as long as the ligulate lip. Early summer. Wettish woods. --seK-Mack-(Y)-Aka, NF, NS, NB-BC, US, (Eur).

Also the lower bracts are 2-6 times longer the flowers and the lip is bidentate at tip. By way of contrast, the alaskan and paleogean typical var. *viridis* has a tridentate lip and shorter bracts, the upper and middle bracts being shorter than the flowers while the lower bracts are less than twice as long as the flowers.

There is no morphological gap between these two varieties and intermediates will turn up here and there throughout the range. Such intermediates are often called var. *interjecta* Fern. if neogean, or var. *Vaillantii* (Ten.) Fern. if paleogean.

2. *H. hyperborea* (L.) Br. (var. *huronensis* (Nutt.) Farw.; *Limnorchis viridiflora* AA.) -- Marsh-Lily, Smelling Bottles -- Similar to the first, but the bracts shorter and the spur longer. Bracts overtopped by the flowers, or the lower slightly longer. Flower greenish, including the lip, the latter lanceolate, entire, somewhat longer than the curved spur. Early summer. Very wet places. --G,K-Aka, L-SPM, NS-BC, US, Eur.

3. *H. saccata* Greene var. *saccata* -- Spur much thicker towards the tip. Otherwise quite similar to the last. Perianth two-toned or bicolour, the sepals light green, the petals paler or purplish. Lip linear, entire. Spike usually laxer than in the first two species. First half of summer. Boggy places and subalpine meadows in Waterton and Carbondale River --Aka, swAlta-BC, US.

The alaskan var. *gracilis* (Lindley) Boivin has a thinner spur, almost filiform, and not thickened toward the tip.

4. *H. dilatata* (Pursh) Hooker var. *dilatata* (var. *albiflora* (Cham.) Correll; *Limnorchis dilatata* (Pursh) Rydb.) -- Bog-Lily, Perfume-Willow (Vanille) --

Flower white, otherwise similar to the first 3. Spur filiform, 4-10 mm long, commonly about as long as the lip, the latter lanceolate from a broad base. Mid summer. Wet meadows and bogs. --(G), seK-(Mack)-Y-Aka, L-SPM, NS-BC, US, (Eur).

Commonly subdivided into three varieties, mainly on a size basis, and especially of the length of the spur. The typical phase is average and its spur is about as long as the lip. Var. albiflora is a smaller plant, smaller flowered, the spur only 5 mm long or less. In the other extreme, var. leucostachys (Lindley) Ames, the spur is 1-2 cm long and 1½-2 times longer than the lip. All three varieties have been reported to range from western U.S.A. north to Alaska.

Var. albiflora is an uncommon type of sporadic occurence and appears to be of no particular significance; we have submerged it.

Var. leucostachys appears to be better defined and is probably restricted geographically to the western U.S.A. and adjacent B.C. Alaskan reports were discounted by Hultén 1943 and with this we concur as all specimens at DAO, CAN (in 1966) and WTU (in 1969) were revised to var. dilatata. Similarly most B.C. reports are to be discounted, but three (V) of the numerous collections examined did prove referable to var. leucostachys. In many of the specimens examined the lip was quite short, 5-6 mm only and the spur much longer, 8-11 mm long; we have placed all such specimen in dilatata despite the relative proportions of the spur and the lip. We have restricted the use of var. leucostachys to those specimens where the spur not only averaged clearly over 1 cm, but also was much longer than the lip. It is only when both criteria are applied together that var. leucostachys becomes a significant segregate of limited range.

5. H. unalascensis (Sprengel) Watson var. unalascensis -- Like the previous 4 but the leaves all basal and the stem merely bracteolate. Flowers small. Perianth segments 2-4 mm long. Spur from nearly as long to almost twice as long as the lip. Mid summer. Mountain woods. -- Aka, (Q)-O, (Alta)-BC, US, (CA).

In the more western var. elata (Jepson) Correll the spur is commonly 1.0-1.5 cm long and at least twice as long as the lip.

6. H. Hookeri Torrey var. Hookeri -- Solomon's Plaster -- With two large suborbicular basal leaves. Scape naked or nearly so. Basal leaves 5-10 cm long.

Spur 1.5-2.5 cm long and longer than the ovary. Lip 8-12 mm long. Ovary and fruit short stipitate. Sepals glabrous, the upper ovate-lanceolate, somewhat attenuate at tip. Early summer. Wettish woods. --SPM, NS-seMan, US.

The newfoundlander var. *abbreviata* Fern. is a generally smaller plant, its spur only 0.9-1.5 cm long.

7. *H.* **orbiculata** (Pursh) Torrey var. **orbiculata** (*Plantanthera orbiculata* (Pursh) Lindley) -- Heal-all -- Quite similar to the last but larger throughout and the upper sepal deltoid-ovate. Basal leaves usually 10-15 cm long, suborbicular, lying flat on the ground. Spur 1.5-3.0 cm long. Ovary and fruit on a stipe at least 5 mm long. Lip 10-15 mm long. Lateral sepals densely papillose or puberulent on the inner side. Early summer. Coniferous woods; uncommon.--Mack, (Aka, L)-NF-SPM, NS-nS-nAlta-BC, US.

The three known Alberta collections are from Faust and Whitecourt (ALTA). These specimens are somewhat smaller than the average for the species and thus somewhat intermediate to the eastern var. *Lehorsii* Fern. The latter, a Newfoundland and Saint-Pierre & Miquelon endemic, is a generally smaller plant, the stipe shorter, 2-4 mm in flower, spur only 0.8-1.5 cm long. In another eastern variant, var. *macrophylla* (Goldie) Boivin, the plant is generally larger and the spur 3-5 cm long.

The range of var. *orbiculata* was extended to Yukon by Correll 1950, repeated by Szczawinski 1959, Hitchcock 1969, querried by Boivin 1967, ignored by Hultén 1943 and 1968. No justifying sheet could be located in the Ames herbarium or at V, UBC, WTU or elsewhere.

8. *H.* **obtusata** (Banks) Rich. var. **obtusata** (var. *collecteana* Fern.; *Lysiella obtusata* (Pursh) Rydb.) -- With a single leaf, basal and broadly oblanceolate. Scape 1-3 dm high, bractless. Floral bracts shorter than the flowers. First half of summer. Mossy woods and bogs. --sK-Aka, L-SPM, NS-(PEI)-NB-BC, US.

The eurasian vicariant, var. **oligantha** (Turcz.) stat. n., *Platanthera oligantha* Turcz., Fl. Baic, Dah. **2,2**: 182. 1856, is usually a smaller plant with a shorter lip, only 3.0-3.5 mm long.

Previous reports of *H. psychodes* in southeastern Manitoba were discounted by Scoggan 1957. We have also seen a photograph (DAO), reportedly from the Whiteshell Forest Reverve, of what might be the white form of *H. psychodes*. However the photo does not lend itself to positive identification and we consider the occurrence of this species in our area is not yet conclusively demonstrated. See also our comment about photographs under *Trillium ovatum*.

4. ARETHUSA L. ARETHUSA

Lip partly adnate to the petaloid column. Sepals petaloid and quite similar to the lateral petals.

1. *A. bulbosa* L. -- *Snakehead*, Swamp-Pink -- A small herb almost reduced to its single, large showy, deep pink flower. Stem 1-4 dm high, bearing 2-4 bladeless sheaths, at first leafless, later developing a single grass-like leaf. Flower 4-6 cm long, zygomorphic, arched to one side. Lip spotted in purple. First half of summer. Bogs; rare. --L-SPM, NS-S, US.

5. SPIRANTHES Richard LADIES'TRESSES

Resembles *Goodyera*, but the lip flat and entire. Flowers borne in vertical rows, the inflorescence a ± twisted spiciform raceme.

a. Flowers in a single vertical row........ 1. *S. lacera*
aa. Flowers larger and in 3 rows......2. *S. Romanzoffiana*

1. *S. lacera* Raf. var. *lacera* (*S. gracilis* (Big.) Beck) -- Twisted Stalk -- Flowers spreading horizontally and conspicuously disposed in a single, twisted, vertical row. Herbage glabrous or nearly so. Leaves all basal, ± ovate. A very gracile herb. Stem thin and elongate, merely bracted. Perianth about 4 mm long, white but with a green stripe down, the center of the lip. Mid summer. Uncommon in sandy places. --NS-cS, US.

Two other varieties occur further south. Var. *brevilabris* (Lindley) stat. n., *Spiranthes brevilabris* Lindley, Gen. Sp. Orch. Pl. 471, 1840, is quite pubescent, especially so in the inflorescence, the rachis withish pubescent. And in var. *floridana* (Wherry) stat. n., *Ibidium floridanum* Wherry, Journ. Wash. Ac. Sc. 21: 49. 1931, the raceme is not twisted or only slightly so, and the stripe on the lip is yellow.

2. *S. Romanzoffiana* Cham. var. *Romanzoffiana* -- (Réséda sauvage) -- A conspicuously twisted spike of white flowers. Much coarser than the first. Basal leaves narrowly lanceolate to linear. Stem leaves similar but smaller. Flowers crowded. Perianth 8-12 mm long. Mid summer. Bogs and sandy places. --Mack-Aka, L-SPM, NS-BC, (US, Eur).

The typical phase is glandular-pubescent at least in the inflorescence, as contrasted with var. *porrifolia*

(Lindley) Ames & Correll of western U.S.A., a glabrous plant with a more clearly panduriform lip, the terminal segment being about as large as the basal ones.

6. LISTERA Br. TWAYBLADE

Leaves 2, opposite. Lip bifid at tip.

a. Plant glabrous at least in the inflorescence ..
.... 1. *L. cordata*
aa. Glandular-pubescent, at least above.
b. Lip entire or barely emarginate at tip ...
.... 4. *L. caurina*
bb. Obviously bilobed to bifid.
c. Lip narrowed to a sessile base ....
.... 3. *L. convallarioides*
cc. Cordate-clasping at base ..... 2. *L. borealis*

1. **L. cordata** (L.) Br. var. **cordata** -- Tway-Blade -- Flower smallest, the lip 3-5 mm long and bifid for about half its length. Leaves deltoid-ovate, often subcordate. Flower greenish and more or less purplish-tinged, especially the lip, the latter with narrowly lanceolate terminal lobes. Early summer. Boggy woods. --G, seK-swMack-Aka, L-SPM, NS-BC, US, Eur.

In a more western variant the flower is merely pale green, not at all tinged in red: var. *nephrophylla* (Rydb.) Hultén.

2. **L. borealis** Morong -- A delicate herb with a pair of opposite leaves and a terminal raceme of greenish flowers. Leaves ovate to narrowly elliptic. Rechis glandular-pubescent; pedicels and ovaries glabrous or nearly so. Lip 8-12 mm long, with a pair of terminal lobes about as wide as long. Early summer. Moist Spruce forests. --(K)-Mack-Y-(Aka, NF), seQ-neO-nMan-BC, wUS.

3. **L. convallarioides** (Sw.) Torrey -- Much like the last, but the lip long cuneate at base. Leaves orbicular to broadly ovate. Rachis pedicels and ovaries densely glandular-puberulent. Lip 8-12 mm long, with a pair of terminal lobes about as long as wide. First half of summer. Boggy coniferous woods. --(Aka), NF-SPM, NS-O, (Alta)-CB, US, (Eur).

The correct bibliographic reference for this name is Torrey, Comp. Fl. N. Midl. States 320. 1826. In an earlier usage by Nuttall, Gen. N. Am. Pl. **2**: 191. 1818, it was only a nomen nudum.

4. **L. caurina** Piper -- Resembles the last two, but the lip shorter. Leaves ± ovate. Rachis and pedicels glandular-puberulent; ovary glabrous or nearly so. Lip 5-6 mm long, dilated above the middle into a ± obo-

vate or flabellate upper half. First half of summer. Shaded coniferous woods in Waterton --seAka, swAlta-BC, US.

7. GOODYERA Br. RATTLESNAKE-PLANTAIN

Lip deeply concave in the lower half.

a. Perianth 3.5-4.0 mm long................ 1. *G. repens*
aa. Herb larger throughout, the perianth 6.5-8.0 mm long............................. 2. *G. oblongifolia*

1. *G. repens* (L.) Br. var. *repens* (*Epipactis repens* (L.) Crantz) -- Adder's Tongue (*Herbe écartante*)-- Small herb with a basal rosette, a bracteate scape and a secund spike of white flowers. 1-3 dm high. Leaves ovate, 1-3 cm long, without white markings. Mid summer. Spruce woods. --Mack-Aka, Man-BC, Eur -- Var. *ophioides* Fern. (*G. ophioides*(Fern.) Rydb.) -- Lateral nerves outlined with a double white line. --Aka, L-SPM, NS-ne Alta-BC, US.

Most Alberta specimens are clearly var. *repens*; a few transitional collections also come from the northeast section. One collection, *Dumais & Anderson 3833*, Ft. McMurray (ALTA), is clearly referable to var. *ophioides* and is the only one of its kind that we have seen from Alberta. We have been unable to confirm any of the earlier Alberta reports of var. *ophioides*.

From *repens* to *ophioides* the transition is gradual and occurs over a rather wide area. Ours is the area of transition. East of us the white lines are obvious and all specimens are referable to var. *ophioides*. West and north of us, nearly all specimens have solid green leaves. But a few collections from B.C. and Alaska are just as strongly lined in white as the average eastern plant and are indubitably to be filed with var. *ophioides*. The Mackenzie collections are essentially referably to var. *repens*, but in the more southern reaches (such as Fort Smith or Le Grand Détour) one may find the odd individuals or single leaves weakly lined in white; these could justifiably be regarded as transitional to var. *ophioides*.

Despite a number of reports, it seems doubtful that var. *ophioides* occurs in Yukon as all specimens seen belonged to var. *repens*. At S five sheets turned up under var. *ophioides*, but were all revised to var. *repens*. Two of the five sheets were duplicates distributed from Harvard, which may account for the report by Correll 1950, while the other three were among the specimens cited by Porsild 1951, which may account for the latter's report.

G. tesselata Lodd. as reported for Manitoba by Dugle 1969 was based on a collection of *G. repens* var. *repens* from Pine Point (PINAWA).

Repeated reports of *G. tesselata* from our area are no doubt partly related to the poor quality of the morphological discontinuity between *G. repens* and *G. tesselata*. This was briefly commented upon by Correll 1950, who noted the existence of intermediates in the Great Lakes area. Case 1964 regarded these as hybrids and remarked "numerous intermediate forms were present in nearly every station where I have found the two together". Returning from an expedition to the Tusket islands, J.S. Erskine (in litt.) reported that "a large patch of *Goodyera* will yield specimens that vary from *repens* to *tesselata*".

Reviewing the material at hand, quite a few specimens cannot be assigned clearly to either taxon and the odd sheet will bear a mixture of both taxa, confirming the observations of Case and Erskine. Checking each diagnostic character, all fail equally. Therefore a realistic reappraisal of their taxonomy calls for the following subordination of *G. tesselata* to *G. repens*.

Var. *repens*. 1-2 dm high. Rosette leaves typically ovate or broadly ovate, (1)-2-(3) cm long, (0.7)-1.2-(1.8) cm wide, the midnerve not outlined in white. Raceme strongly secund. Perianth 3.5-4.0 mm long, the tepals becoming more or less squarrose at tip. Lip strongly gibbose at base, the gibbosity tending to be deeper than wide, abruptly contracted into a point which at first is spreading horizontally, soon becoming strongly reflexed. Ovary somewhat longer than the perianth in flower, elongating to 5-7 mm in fruit. -- From Labrador west to Alaska, south to North Carolina, regularly intergrading with the next in their area of sympatry.

Var. **tesselata** (Lodd.) stat.n., *G. tesselata* Lodd., Bot. Cab. **10**: pl. 952, 1824. Averaging larger throught, 1.5-3.5 dm high. Leaves typically ovate-lanceolate, 2.0-4.5 cm long, 1-2 cm wide, the midnerve weakly and interruptedly outlined in white. Raceme varying from barely secund to strongly so. Perianth 4-5 mm long, the tips of the tepals remaining parallel, or the lateral sepals becoming sometimes squarrose. Lip less strongly gibbose, the gibbosity mostly somewhat longer than deep, the acumen straight and remaining so. Ovary 7-10 mm long in flower or in fruit. -- From Newfoundland to Ingolf in Western Ontario, south to New York State and, interruptedly, to Maryland.

Var. *tesselata* being known from Ingolf (DAO) just across from our borders, it is to be expected in adjacent Manitoba.

2. ***G. oblongifolia*** Raf. var. ***oblongifolia*** (*G. decipiens* (Hooker) Hubbard; *Epipactis decipiens* (Hooker) Ames) -- Rosette leaves with a heavy, double white line along the midnerve. Stem 2-4 dm high. Leaves 3.5-7.0 cm long, oblong to oblong-lanceolate, without white markings along the lateral nerves. Raceme less secund. Mid summer. Montane Pine woods: Cypress Hills and Rockies. -- (Aka), NS, (NB)-Q-O, swS-BC, US.

A remarquably disjunct species.

On Vancouver Island and adjacent Oregon one may find var. *reticulata* Boivin, a generally taller plant, 3.5-6.5 dm high, its basal leaves decorated with a fine reticulum in white.

8. CALOPOGON Br.

Lip borne uppermost, as if the flower was inverted.

1. ***C. tuberosus*** (L.) BSP. var. ***tuberosus*** (*C. pulchellus* (Sal.) Br.) -- Grass-Pink, Swamp-Pink -- Scapose herb with about 3 large, showy, red flowers and a single, grass-like, basal leaf. 2-5 dm high. Perianth parts 1.5-2.0 cm long. Lip with a conspicuous yellow beard. First half of summer. Wet bogs: Vivian. -- NF-SPM, NS-seMan, US.

In our typical phase the leaf is ± linear and overtopped by the stem. Var. *latifolius* (St. John) Boivin is a somewhat smaller plant, not over 2 dm high, bearing a relatively larger leaf, the latter rather lanceolate and equalling or overtopping the stem. It is a highly restricted costal plain variant barely surviving on two insular emergences, Sable Is. and Magdalen Is., of the largely submerged northern costal plain.

Current fashion favors *Calopogon pulchellus* as the scientific name of the "Grass-Pink", apparently in disregard of the International Code of Botanical Nomenclature. This was clearly pointed out by K.K. Mackenzie in Rhodora **27**: 193-6. 1925. Briefly, the synonymy and argument are as follows.

Calopogon pulchellus Br. 1813 is based on *Cymbidium pulchellum* W. 1805, which is based on *Limodorum pulchellum* Sal. 1796, which is based on *Limodorum tuberosum* L. 1753.

Because Salisbury changed the epithet from *tuberosum* to *pulchellum* without valid reason, *Limodorum pulchellum* is an illegitimate name (Art. 63). By the same article *Cymbidium pulchellum* and *Calopogon pulchellus* are also illegitimate because their authors failed to adopt the earlier epithet of which they were obviously aware. Being illegitimate, neither of these three names can be used as the correct name of the "Grass-Pink" or anything else. Having now eliminated *Calopogon pulchellus*, what is the correct name of the "Grass-Pink"?

The synonymy given by Correll 1950 and many others implies that *Limodorum tuberosum* does not refer to the "Grass-Pink". If this were true then neither would *Calopogon pulchellus* refer to the "Grass-Pink", since the one name is ultimately based on the other. Article 7 covers this case: "an epithet which was nomenclaturally superfluous when published is automatically typified by the type of the epithet which ought to have been adopted". Hence Correll's synonymy is not tenable in any case. The two other names involved are mere transfers.

And what about this apparently prevailing view that *Limodorum tuberosum* does not refer to the "Grass-Pink"? Is it justified?

The linnean protologue of *L. tuberosum* encompasses two taxa; namely the "Grass-Pink" and a West Indian species of *Bletia*. Such heterogeneity is not in itself grounds for rejecting a name. The Code provides criteria and procedures by which the application of such names can be restricted to a single element and a proper type selected. And the present case is a relatively simple one.

Mackenzie demonstrated conclusively that the main element of the linnean protologue is obviously the "Grass-Pink". The other element is out of range, contributed little if anything to the linnean descriptions, and is only superficially similar to the "Grass-Pink". This is unambiguously corroborated by the Linnean herbarium where only two sheets are to be found under *Limodorum*. A photograph of the first one, number 1058.1, is before me. It is a Kalm specimen inscribed "*tuberosum I*" in Linné's script; it is a characteristic specimen of the "Grass-Pink" in flower.

The other specimen, number 1058.2, is inscribed *Limodorum altum* in Linné's script and is referable to a species published in 1767 in the 12th edition of the Systema. It is a species of *Bletia* and not obviously relevant to the typification of the "Grass-Pink".

Since only sheet 1058.1 fits the linnaean protologue, it should undoubtedly be regarded as the type of the species and tuberosus is the correct epithet to use for the "Grass-Pink".

We are not aware that Mackenzie's paper provoked any kind of reaction, except perhaps a faintly disparaging comment by Weatherby in Rhodora 28: 139. 1926. After discussing the typification of some Solidago Weatherby added: "In the similar case of Limodorum tuberosum Mr. Mackenzie chooses what corresponds to the former alternative; in this instance he adopts the latter -- without, as it appeared to me, arriving at any conclusive results." But Weatherby did not actually try to counter Mackenzie's argument or find fault with his premisses. Nor has anybody else tried to do so, to our knowledge. Mackenzie's argument seems quite sound and in accord with our present Code; we know of no valid reason not to accept his conclusions.

9. CORALLORHIZA Châtelain CORAL-ROOT

Parasitic herbs with the leaves reduced to bladeless sheaths.

a. Tepals heavily lined in purple......... 3. C. striata
aa. Flowers smaller and merely spotted in purple.
  b. Plant and flowers greenish......... 1. C. trifida
  bb. Purplish......................... 2. C. maculata

1. C. trifida Châtelain -- Coral-Root -- Greenish and smaller-flowered than the next two. Sometimes somewhat tinged in purple. Lip 4-5 mm long, white, usually dotted in purple, not spurred. Capsule 8-12 mm long, drooping. Early summer. Parasitic on roots of woody plants. --G, K-Aka, L-NF-(SPM), NS-BC, US, Eur.

2. C. maculata Raf. -- Dragon's Claws -- A simple purplish herb, leafless, with a raceme of purplish flowers. Lip 6-8 mm long, white, punctate in purple, with an inconspicuous spur 1-3 mm long, partly adnate to the ovary. Capsule 15-25 mm long. Early summer. Aspen and Pine Woods. --NF-(SPM), NS-BC, US, (CA).

Near the Pacific coast it is largely replaced by var. occidentalis (Lindley) Cockerell, a variant with a more open flower, ± rotate, the lower tepals descending or reflexed; the column longer, barely shorter than the lip; the spur more obvious being only partly imbedded in the ovary tisue and proeminent by ± 1 mm.

3. C. striata Lindley -- All perianth parts heavily lined longitudinally in purple. Tepals 10-14 mm long, the lip more deeply coloured. No spur. Capsule 12-20 mm long. Early summer. Rich woods. --Q-BC, US -- F. fulva Fern. (C. ochroleuca AA.) -- Herbage and perianth yellowish. Cypress Hills. -- (seQ, swS)-seAlta.

The albino f. fulva may be identical with Rydberg's C. ochroleuca, but this point needs a close check as Rydberg's description indicates a plant rather similar to the more southern C. Wisteriana Conrad. However, conflicting opinions on the subject do not affect the correct name of our plant; only its geographical range remains in doubt.

10. MALAXIS Sw. ADDER'S MOUTH

Lateral petals narrow, nearly filiform. Habitally similar to Listera, but glabrous and the leaves all basal or only one. Lip elongate.

a. Leaves 2 or 3, all basal.............. 1. M. paludosa
aa. Leaf solitary, cauline.
  b. Lip acute, entire.............. 2. M. monophyllos
  bb. Deeply bifid at tip............... 3. M. unifolia

1. M. paludosa (L.) Sw. -- Bog-Orchid -- Small herb with 2-3 basal leaves and a scape bearing a raceme of greenish and erect flowers. Flowers small. Sepals 2-3 mm long, lanceolate. Lip 1.5 mm long, entire. Mid summer. Rare in Black Spruce bogs: McKague, Glenevis. -- Mack, Aka, wO, cS-cBC, (ncUS), Eur.

2. M. monophyllos (L.) Sw. var. brachypoda (Gray) F. Morris (M. brachypoda (Gray) Fern.) -- Similar to the first, the leaf solitary and appearing cauline because of a long sheathing base. Pedicels nearly erect. Lip 2-3 mm long, entire, deltoid-orbicular and contracted into a long, lanceolate tip. First half of summer. Boggy woods, rare or overlooked. --(Aka, NF), NS, (NB)-Q-wBC, US, (Eur).

The first known Saskatchewan sheet comes from Lake Waskesiu (SASK). It was originally identified as M. unifolia and was the source of the incorrect entries under this name in the earlier provincial lists.

In the Orchids the larger petal, termed lip, arises uppermost but is normally borne lowermost as a result of a half twist of the ovary and pedicel. Our var. brachypoda exhibits this normal torsion, but the alaskan and typical phase of the species lacks any such twist and the lip is then borne uppermost.

3. M. unifolia Mx. (Microstylis unifolia (Mx.) BSP.) -- Raceme lax below, becoming very dense at the tip. Pedicels widely spreading. Lip about 2 mm long, nearly squarrish, deeply bifid. Mid summer. Wet woods, rare. --L-NF-(SPM), NS-O-(Man), US.

11. LIPARIS Richard TWAYBLADE

Similar to *Malaxis*, lateral petals narrow, etc., but the lip broad, squarrish to oblong. Leaves 2, basal.

1. **L. Loesellii** (L.) Richard -- Fen-Orchid -- Small herb with 2 basal leaves and a raceme on a short scape. Leaves broadly lanceolate. Flower pale green. Early summer. Springy places and bogs, uncommon. --NS-O-(Man)-cS, US, Eur.

12. CALYPSO Sal. CALYPSO

Lip very strongly differentiated, the other appendages petaloid and not obviously differentiated into sepals and petals. Flower solitary.

1. **C. bulbosa** (L.) Oakes var. **bulbosa** (*Cytherea bulbosa* (L.) House) -- Venus' Slipper -- Single-leaved herb with a single, large and very showy red flower. Leaf ovate. Lip about 2 cm long, vaguely shoe-shaped, whitish with abundant purple veining, yellowish at tip and with 3 rows of yellow hairs. Other appendages 1.5-2.0 cm long, pink, lanceolate. Late spring and early summer. Bogs and wet coniferous woods, infrequent. -K-Aka,(NF, NS), NB-BC, US, Eur.

In the more western var. *occidentalis* (Holz.) Boivin the lip is bearded in white.

Aplectrum hyemale (Muhl.) Torrey was reported (as *A. spicatum* BSP.) from Norway House to Cumberland House by Hooker 1839, repeated by various later authors, but discounted by Scoggan 1957 and Breitung 1957. The justifying sheet (K) is labelled: Dr[ummond], between N [ew] Y [ork] and C [umberland] H[ouse]. In all likelihood this specimen came from the more eastern part of the stated region of collection, and Norway House may be a misreading of the abbreviation NY.

Order 70. JUNCALES

Basically as in the *Liliales*, but the perianth reduced to chaff-like bracts. Flowers 3-merous. Grass-like in habit.

124. JUNCACEAE RUSH FAMILY

The basic and unreduced type of the order.

a. Seeds numerous; plants glabrous........... 1. *Juncus*
aa. Seeds 3; plants mostly pubescent.......... 2. *Luzula*

1. JUNCUS L. RUSH

Grass-like plants with bract-like floral parts; otherwise as in the *Liliaceae*, with 6 perianth parts, 3/6 stamens and a single 3-carpellate ovary. Each carpel with many seeds. Stamens marcescent and available even when in fruit.

a. Flower subtended by a pair of bractlets besides the usual bract at the base of the pedicel.
  b. Inflorescence terminal.................... Group A
  bb. Inflorescence lateral .... Group B
aa. Flowers without accessory bractlets, only the usual bract at the base of each pedicel.
  c. Leaves not septate........................ Group C
  cc. Leaves hollow and clearly septate with transversal plates.......................... Group D

Group A

Flower subtended by 3 bracts, one of which is at the base of the pedicel, the other two at the base of the perianth and are much shorter than the parianth parts. Inflorescence terminal, lax or diffuse, subtended by leafy bracts that are obviously distinct from the stem. Leaves not septate-nodulose.

a. Annual; inflorescence tending to be half the height of the plant .... 1. _J. bufonius_
aa. Perennial; stem many times the length of the inflorescence.
  b. Stem leafy, with at least one leaf borne at or above the middle................ 2. _J. compressus_
  bb. Stem leafless; all leaves basal or involucral.
    c. Leaves terete; capsule exserted....... .... 4. _J. Greenei_
    cc. Leaves flattened but usually involute.. .... 3. _J. tenuis_

Group B

As in group A, but the inflorescence lateral, the stem being prolonged by one of the bracts which quite simulates the upper part of a stem.

a. Flowers few, 1-3, the perianth mostly over 6 mm long; densely tufted herbs.
  b. Capsule light brown, acute at tip... 7. _J. Parryi_
  bb. Dark purple and ± retuse........ 6. _J. Drummondii_
aa. Flowers many; perianth shorter; rhizomatous.
  c. Inflorescence borne towards the middle of the stem........................ 5. _J. filiformis_
  cc. Inflorescence borne in the upper quarter.. .... 8. _J. arcticus_

Group C

Flowers lacking the accessory pair of bractlets. Leaves not septate-nodulose, mostly flat.

a. Glomerules of 3 or more flowers.
  b. Capsule 7-9 mm long..............12. *J. castaneus*
  bb. Shorter 4-5 mm long........... 13. *J. longistylis*
aa. Flowers less numerous, 1-3-(4) per glomerule.
  c. Leaves all basal; stem with a single terminal glomerule.
    d. Glomerule 2-flowered, purple-black.....................................11. *J. biglumis*
    dd. Glomerule 3-(4)-flowered, pale couloured .... 10. *J. albescens*
  cc. Stem with 1-2 leaves and mostly 2 glomerules.
    e. Tufted; glomerules of 1-2 flowers .... 9. *J. stygius*
    ee. Stoloniferous, glomerules of (2)-3-(4) flowers................ 12. *J. castaneus*

Group D

Flowers lacking the accessory pair of bractlets. Leaves hollow, cylindric, nodulose with regularly spaced cross-partitions, somewhat in the manner of a stem of Grass or *Equisetum*; the cross-partitions becoming slightly proeminent in drying.

a. Flowers in small and few-flowered glomerules, these less than hemispheric.
  b. Sepals somewhat shorter than the petals; tufted plants.....................19. *J. brachycephalus*
  bb. Sepals obviously longer and narrower than the petals; stems borne singly along the rhizome.
    c. Anthers 0.3-0.5 mm long. Perianth 2.0-2.5 mm high..........20. *J. alpinoarticulatus*
    cc. Anthers about 1.0 mm long; perianth 3-4 mm high.
      d. Leaves equitant and mostly 3-4 mm wide.................. 16. *J. ensifolius*
      dd. Leaves roundish to somewhat flattened and norrower, usually less than 2 mm wide.................. 17. *J. nevadensis*
aa. Glomerules dense, hemispheric to globose.
  e. Heads purple-black.
    f. Head usually solitary.....18. *J. Mertensianus*
    ff. Heads typically 3, leaves wider................................ 16. *J. ensifolius*
  ee. Heads greenish brown to reddish brown.
    g. Heads 1 cm wide or less....... 14. *J. nodosus*
    gg. Heads wider, mostly 1.5 cm wide................................ 15. *J. Torreyi*

1. *J. bufonius* L. (var. *halophilus* Buch. & Fern.) -- Toad-Rush (Herbe à Crapauds) -- Annual, tufted, the flowers mostly solitary and scattered on the branches.

Up to 2 dm high. Tepals rather variable in length and shape, pale green, with wide membranous margins. Mid to late summer. Shores, sometimes weedy. --G, seK-Aka, L-SPM, NS-BC, US, Eur.

2. J. COMPRESSUS Jacq. -- Like the following, but the stem leafy and the flowers smaller. Forming a dense carpet. Perianth 2 mm long or less, shorter than the capsule, the sepals cucullate at tip. Early summer. Rare introduction of grassy places: Brandon, Duck Bay. --NF, (NS-PEI), Q-Man, US, Eur.

There is a dot at the mouth of the Nelson River on a distribution map of J. Gerardii Lois. by Hultén 1958. We are not aware of any corresponding herbarium specimen.

3. J. tenuis W. var. tenuis (J. confusus Coville; J. macer S.F. Gay; J. oronensis AA.) -- Path-Rush, Poverty-Grass (Herbe de misère) -- Inflorescence terminal, subtended by long leafy bracts, the flowers scattered on the branches, not clustered. Stiffly erect, wiry stems mostly 3-5 dm high. Sheaths of the basal leaves ending in thin, membranous and usually triangular to lanceolate auricles. Sepals 3-4 mm long, as long as, or longer than, the capsule. Early summer. Common in wet places. --(Aka), L-SPM, NS-BC, US, (SA), Eur, (Afr, Oc) -- Var. uniflorus Farw. (J. Dudleyi Wieg.) -- Auricles thick, hard, opaque, straw-coloured, rounded. Perianth often somewhat longer. --Y, (NF), NS-BC, US, (CA).

The more eastern plants are often subdivided into three varieties, with the taller and more loosely flowered plants being placed in var. anthelatus Wieg., while the smaller plants with crowded flowers on more widely divergent branches are placed in var. Williamsii Fern. Similar phenotypes occur in our area, but they do not seem to have ever been varietally distinguished, nor do they seem to be in any way significant.

The capsule may be completely (=J. confusus) or incompletely (=J. tenuis) divided in three locules by the placentae more or less projecting inward. The variation is continuous and not clearly linked to any other character; the distinction, when implemented taxonomically, seems arbitrary.

J. tenuis W. var. secundus (Beauv.) Eng. was reported as "occasionally met with between Edmonton and Little Slave Lake". The corresponding specimen (CAN) was long ago revised by F.V. Coville to the next species.

4. J. Greenei Oakes & Tuck. var. Vaseyi (Eng.) Boivin (J. Vaseyi Eng.) -- Similar but the fruit exceeding

the tepals. Perianth 3-4 mm long, the capsule 5-6 mm long. Inflorescence more congested, the flowers more crowded. Leaves quite terete, slightly channeled on the ventral side. Early summer. Wet open places. -Mack, L, NS, NB-BC, US.

The floral parts are smaller in the more eastern var. Greenei: perianth 2.5-3.0 mm, capsule, 3-4 mm long and the seeds also only half as long, mostly ± 0.5 mm.

5. J. filiformis L. -- Seemingly leafless herb, reduced to a wiry stem, 2-4 dm high, and bearing a small inflorescence halfway up. Basal leaves reduced to a sheath ending in a vestigial blade, filiform, not over 1 mm long. What appears to be the upper half of the stem is actually a long involucral leaf. Flowers greenish. Early summer. Wet places northward, apparently rare. -- G, K-Aka, L-SPM, NS-nS-BC, US, (SA), Eur.

6. J. Drummondii E. Meyer (var. subtriflorus (E. Meyer) Hitchc.) -- Smaller than the similar J. balticus and the inflorescence reduced to (1)-2-3 pedicellate flowers, usually dark purple. In compact tufts only 1-2-(4) dm high. Involucral bract merely 1-2 cm long. Early summer. Moraines and alpine prairies. -- swMack-Aka, swAlta-BC, US.

The tepals vary in length from 4 to 7 mm and the capsule from 4 to 7.5 mm. The amplitude of variation is apparently the same throughout the range, but the frequency is not. Most plants from the Rockies (var. subtriflorus) have tepals and capsule 6-7 mm long. Further west most plants have the tepals 4-6 mm long and the capsule will most often overtop the perianth. But if those criteria are applied coldly, both phenotypes will prove to have essentially the same range. Hence we contend var. subtriflorus does not denote a particular population, it merely designates a statistical concentration of particular individuals exhibiting a certain arbitrarily delimited morphology. At most, var. subtriflorus could refer to a frequency pattern of a certain morphological type.

Throughout this flora we have refrained from naming or recognizing variations justified statistically. But we are fully aware that many other biologists, especially zoologists, have a different philosophy and will recognize statistically definable populations as varieties or subspecies or even species. The recognition of statistical variants requires the support of a large collection. Amateurs, ecologists and others who do not normally have access to representation in depth cannot be convinced and recognize such variants, they can only name them on the basis of the locality, or ignore them, or accept the work of the specialist on faith. The latter is not particularly commendable as a scientific attitude and we are not inclined to impose such a choice upon our readers.

7. **J. Parryi** Eng. -- Flowers typically 3, large, straw-coloured to pale reddish-brown. Resembles the preceeding, but the involucral bract about twice the length of the inflorescence. Capsule narrowly acute at tip. Mid summer. Open montane and alpine slopes. -- swAlta-BC, US.

8. **J. arcticus** W. var. **arcticus**--Like *J. filiformis*, a wiry and seemingly scapose herb with a secund inflorescence borne toward the upper fifth. Mostly 2-4 dm high and growing in conspicuous lines of stiff stems strung along the nearly simple rhizome. Inflorescence purple black, short, and few-flowered, usually around 1 cm long, and of (1)-3-5-(8) flowers. Outer tegules acute to acuminate, the inner ones less sharply so or ± rounded at tip. Filament 1-2 times as long as the anther. Capsule ellipsoid, varying from included to exserted by 1-(2) mm. Early summer. Shores and wet tundra. --G-Aka, L, Q-nMan, Eur -- Var. **littoralis** (Eng.) Boivin (*J. ater* Rydb.; *J. balticus* W. var. *littoralis* Eng., var. *montanus* Eng., var. *vallicola* Rydb.) -- Inflorescence not so dark-coloured, more open and more heavily flowered, the branches very uneven, the longer ones mostly up to 2-3 cm long. Tegules 4-6 mm long, typically bicolour and mainly purplish, but with a broad median green zone, acute to acuminate at tip. Filament commonly only half as long as the anther. Capsule ellipsoid, ± included. First half of summer. Shores and wet ground; common and often pioneering. -- (G), seK-(Mack)-Y-(Aka), L-(NF-SPM, NS-PEI)-NB-BC, US.

Var. **littoralis** (Eng.) stat. n., *J. balticus* W. var. *littoralis* Eng., Trans. Ac. Sc. St. Louis **2**: 433. 1866.

Many botanist have experienced difficulties in distinguishing *J. arcticus* and *J. balticus*. In the southern Mackenzie basin Raup 1947 found all his material to be intermediate and he placed it under *J. balticus* sensu amplo, although *J. arcticus* was an earlier name. We have similarly been unable to establish a clear discontinuity between these two taxa and consequently we regard them as geographical variants of a single species. Phenotypes with petals a bit shorter, broader, less acute and more widely margined (= var. *montanus*, var. *vallicola*) will be found to occur here and there as far as the the east coast and do not seem to be in any way restricted geographically.

9. J. stygius L. var. americanus Buch. -- Generally quite similar to J. Drummondii, but the stem bearing 1 leaf and the flowers sessile. Usually around 2 dm high. Flowers greenish with strong red lines, in 1-(2) glomerules of 1-3 flowers each, their perianth 4.5-5.5 mm high. Capsule (5.0)-6.0-(7.5) mm long, at first green, turning ± purple or brownish, especially on the angles. Mid summer. Bogs, rare. --(Mack)-Y-Aka, L-NF-(SPM), NS, NB-O, nS-nBC, (US, Eur).

The eurasian var. stygius has a smaller perianth, 3.4-4.5 mm high, and an often shorter fruit, 5-6 mm long.

10. J. triglumis L. var. albescens Lange -- (J. albescens (Lange) Fern.) -- The single glomerule terminal and bicolour or whitish, the tepals being almost entirely membranous but the bracts mostly reddish brown. Stem leafless, mostly 1-2 dm high. Glomerule becoming darker and often ± brown at maturity. Involucral bract small and inconspicuous, often no longer than the glomerule, more commonly overtopping it briefly. Often resembling the last, but the capsule smaller, only 3-4 mm long, turning brown to purple black. Perianth 3-4 mm high, the tepals broadly lanceolate, acute or acutish. Stamens included, usually about 3/4 as long as the tepals. Early summer. Shores and calcareous bogs in mountains and arctic or subarctic regions, often pioneering. -- G-Aka, L-NF, Q-nMan-nS-BC, US, (Eur).

A circumpolar species readily divisible into three geographical varieties. There is a fair amount of variation in any area and a certain degree of intergradation in criteria, yet nearly all specimens examined were readily referable to the expected local variation. Thus we would refer all neogean specimens to var. albescens as described above. The european material is referable to the typical var. triglumis with bracts usually of a deeper brown, becoming dark brown, and the exserted capsule becoming deep purple brown, hence the fruiting head much darker; lowest bract nearly always shorter than the glomerule; tepals 3-4 mm long, acute to rounded (especially the petals) at summit, usually turning rusty brown; stamens about as long as the perianth or more often slightly exserted; capsule usually exserted by 1-2 mm.

Asiatic material is referable partly to var. triglumis, partly to var. fuscatus Regel (=J. Schischkinii Krylov & Sumn.). At flowering time the latter resembles var. albicans by its paler and strongly bicolour inflorescence. Also var. fuscatus has a slightly larger perianth, 4-5 mm high, its tepals narrowly triangular lanceolate and narrowly acute, its stamens and mature capsule about reaching the top of the perianth; the lowest bract shorter than the inflorescence.

There has been much confusion about the proper taxonomic disposal of the North American plants; some authors have called them J. triglumis, others J. albescens, others still (e.g. Hultén 1962) have detected both entities on our continent. But, using the criteria above, we would place all neogean specimens examined into var. albescens.

11. J. biglumis L. -- Pretty much as above, but the glomerule only 2-flowered and deep red-purple. Capsule purple black throughout or more commonly pale green with the sutures outlined heavily in dark purple. Mid summer. Rare on wet cliffs and wet alpine slopes. -- G-Aka, L, Q, nMan, swAlta-BC, US, Eur.

12. J. castaneus Sm. -- Similar to the last three, but stoloniferous, the stolons ending in a small bulb. Mostly 2-4 dm high. Glomerules red-brown, the lowest subtended by a bract overtopping the inflorescence. Capsule largest, 7-9 mm long. First half of summer. Wet peaty soils; subalpine or subarctic to arctic. -- G- Aka, L, Q--nMan-(nS)-swAlta-BC, US, Eur -- F. pallidus (Hooker) Boivin -- Glomerules of a lighter colour, yellowish to pale green: Churchill. --nMan, (Eur).

13. J. longistylis Torrey -- Tepals largely membranous and somewhat longer than the capsule. About twice taller than the preceeding, which it resembles. Stoloniferous. Stem leaves 2-3. Capsule 4-5 mm long. Mid summer. Wet meadows. --NF, Q-BC, US.

14. J. nodosus L. -- Typically the flowers are in a few, reddish-brown, globular glomerules. Stoloniferous and forming dense colonies, the stem and leaves thin and wiry. Tepals 3-4 mm long, overtopped by the bright, brown, acuminate capsule. First half of summer. Wet meadows, especially along shores, common. --Mack, (Aka), NF, NS-BC, US.

15. J. Torreyi Coville -- Resembling the preceeding but coarser, the heads nearly twice bigger and the leaves stiffly arching. Stoloniferous and forming numerous bulbs. Mid summer. Infrequent at the edge of sloughs and along slightly alkaline watercourses. --swQ--BC, US.

Two Manitoba collections were reported as J. canadensis J. Gay by Scoggan 1957. The first, Macoun, Manitoba 1872, (MTMG) is too immature for positive identification. Tentatively we have refered it to J. brachycephalus. It may result from a label mixture since Macoun makes no mention of it in his Catalogue, and we have not noticed a corresponding collection at CAN.

The second collection, Denike, Birds Hill, 1942 (DAO), has been revised tentatively to J. Torreyi, being also too immature for positive identification.

16. J. ensifolius Wilkstr. var. ensifolius -- Leaves flat, largest, 3-5 mm wide, and equitant, that is conduplicate and the two halves fused face to face, like an Iris leaf. Mostly 3-5 dm high. Sheaths not auriculate, or rarely subauriculate. Heads (2)-3-5-(8), subglobular, dark brown to purple black. Tepals subequal. Stamens 3, opposite the sepals, the anthers shorter than the filaments. Early summer. Wet spots in the mountains. --Aka, Q-O, swS-BC, US, (Eur) -- Var. montanus (Eng.) Hitchc. (var. major AA.; J. saximontanus Nelson; J. Tracyi Rydb.) -- Stamens 6, the anthers about as long as the filaments. Sheaths more or less auriculate. Heads often more numerous, up to 10-12. Petals usually somewhat shorter than the sepals. Boisé Coteau, and westward. Often at lower altitudes. --swS-BC, wUS.

Var. montanus has often been called var. major Hooker 1838 (see Boivin 1967, etc.), but there is an earlier var. major Meyer 1828 which is probably nomenclaturally identical to var. major Hooker and in any case precludes the use of a later homonym. Since the type of Meyer's name came from Unalaska, well outside the range of var. montanus, the two cannot be taxonomically identical. The latter name appears to be the correct one for our geographical variation.

The distinction between J. ensifolius (=broad-leaved, 3 stamens), J. saximontanus (=broad-leaved, 6 stamens), J. mertensianus (=narrow-leaved, monocephalous), and J. nevadensis (=narrow-leaved, many heads) is not as sharp as might be desirable, although nearly all specimens examined could be readily assigned to one or the other species. Reducing them to a set of varieties was considered, but it did not seem that the resultant classification would be clearly more satisfactory. The separation is weakest between J. ensifolius and J. saximontanus and we have finally rallied with some diffidence to the solution recently proposed by Hitchcock 1969 of reducing J. saximontanus to varietal rank while retaining the other taxa as species.

17. J. nevadensis Watson var. nevadensis -- Heads small and many, as the last, but the leaves narrow and roundish like the next. Mostly (3)-4-(5) dm high. Leaves weakly septate, roundish to somewhat flattened, (0.5)-

1.0-(2.0)mm wide,one of them (as in *J. ensifolius* and *J. Mertensianus*) borne near the middle of the stem. Auricles 1-4 mm long, 0.5-1.5 mm wide, rounded at tip. Mostly with 5-12 heads, these mostly less than hemispheric. Sepals short caudate, longer than the petals by 0.5-1.0 mm. Stamens 6, the anthers ± 1.0 mm long and slightly longer than the filaments. Early summer. Springy meadows; local: Hoosier and Cypress Hills. -- swS-Alta, US.

Often transitional to *J. ensifolius* var. *montanus*. A number of more southern varieties are reported of which var. *badius* (Suksd.) Hitchc. has somewhat smaller flowers in fewer heads.

18. ***J. Mertensianus*** Bong. -- Resembles *J. ensifolius*, but the leaves narrower and rather terete. Smaller and commonly only 1-3 dm high. Heads 1-(2), mostly broadly hemispherical. Perianth purple black. Stamens 6. Mid summer. Springy places, alpine or subalpine, often near glaciers: Rockies. --Y-Aka, swAlta-BC, US, (Eur).

Larger plants may have wider leaves, thus grading into *J. ensifolius*, or more numerous heads and grading into *J. nevadensis*.

19. ***J. brachycephalus*** (Eng.) Buch. (*J. brevicaudatus* (Eng.) Fern.) -- Inflorescence lax, with numerous small glomerules; leaves strongly cross-septate. Tufted. Sepals 2.5-3.0 mm long, the petals similar and slightly longer. Capsule 3.0-4.0 mm long, acute. Seeds ± 1 mm long. Mid summer. Occasional pioneer on wet ground. -- seK, L-SPM, NS-Alta, US.

Usually treated as two species, the name *J. brachycephalus* being restricted to plants with more open inflorescences and nearly ecaudate seeds, while in *J. brevicaudatus* the branches of the inflorescence are nearly erect and the seeds end in whitish appendages half as long as the body. True, there is a tendency for more northern plants to have a narrower panicle, but the tendency is hardly strong enough to justify a taxonomic distinction. The length of the appendages of the seeds is an important taxonomic character with many a species of *Juncus*, but there is no reason to suppose that it should be regarded as important in every case, and in the present case it seems to be a random variation of no obvious import.

20. ***J. alpinoarticulatus*** Chaix (*J. alpinus* Vill., var. *fuscescens* Fern., var. *rariflorus* Hartman; *J. Richardsonianus* Schultes) -- Similar, the flowers smaller and on less divergent branches. Stems closely lined up along the rhizome. Sepals 1.5-2.5 mm long, the

petals shorter and rounder. Capsule 2.0-3.0 mm long, obtuse at tip. Seeds ± 0.5 mm long. Just before mid summer. Shores. --G, (K)-Mack-Aka, L-NF, (NS)-PEI-BC, US, Eur.

Many segregates have been proposed, based mainly on the colour of the perianth, or on the florets being all sessile or partly pedicellate. The latter type has been variously called var. *rariflorus*, *J. nodulosus* Wahl., or *J. Marshallii* Pugsley. Such taxonomic refinements are of no obvious significance within our area.

J. alpinoarticulatus forms an obvious pair with the generally more southern *J. articulatus* L.; the morphological basis of their distinction is minimal. Of the many reported differences, the most reliable proved to be anthers length: (0.3)-0.4-(0.5) mm in our *J. alpinoarticulatus*, but (0.5)-0.6-0.7-(0.9) in *J. articulatus*. When specimens are sorted out on anther length, it turns out to be reasonably well correlated with the shape of the inflorescence; at least twice longer than wide in *J. alpinoarticulatus*, the main branches usually diverging at an angle of 15-30°, but ovoid to ellipsoid in *J. articulatus* and the main branches diverging at 30-60°. Others differences are usually mentioned, but their value is at best no more than statistical. Which means that the area of morphological overlap is so broad, these other characters are usually not discriminant; their significance cannot be assessed until the identity of a specimen has been ascertained from some other angle.

The use of *J. alpinoarticulatus* Chaix 1786 versus *J. alpinus* Villars 1787 was discussed in Journ. Bot. **66**: 210. 1928 and Rhodora **35**: 234-5. 1933. Both names were obviously intended by Villars for the same species and the protologue of the second name repeats the prelinnean synonym and place of collection given in the protologue of the first; hence it seems difficult to treat the two names as anything but synonymous, in which case the earliest name has precedence. One may speculate from prima facie evidence that Villars intended *J. alpinus* to be merely a shortened form of the more than sequipedalian *J. alpinoarticulatus*, but this is only a speculation and has no bearing on the typification of either name.

Juncus effusus L. was mentioned for Saskatchewan by Groh 1950, but we failed to locate any justifying collection. Manitoba reports, repeated by Hitchcock 1969, were discounted by Scoggan 1957.

2. LUZULA WOODRUSH

Ovary 1-celled and only 3-seeded. Otherwise as in *Juncus*, but the herbage commonly pilose or ciliate.

a. Flowers all or mostly single at the end of obvious pedicels.

b. Inflorescence simple or nearly so....1. *L. pilosa*

bb. Inflorescence compound.

c. Anthers 0.7-1.4 mm long; tepals about 3 mm long.................... 4. *L. glabrata*

cc. Anthers 0.3-0.5 mm long, tepals about 2 mm long.

d. Leaves 5-12 mm wide..... 2. *L. parviflora*

dd. Smaller, the leaves about 3 mm wide................ 3. *L. Wahlenbergii*

aa. Flowers in glomerules.

e. Leaves thickened and rounded at tip.

f. Glomerules many and mostly shorter than their peduncle......... 8. *L. campestris*

ff. Glomerules mostly 3 and subsessile in a capitate inflorescence.... 9. *L. hyperborea*

ee. Leaves acute at tip.

g. Inflorescence compact and conspicuously nodding.................... 5. *L. spicata*

gg. Inflorescence open or erect.

h. Glomerules (1)-3.......... 6. *L. confusa*

hh. More numerous and on recurved pedicels...................... 7. *L. arcuata*

1. *L. pilosa* (L.) W. var. *americana* R. & S. -- (*L. acuminata* AA.; *L. saltuensis* Fern.) -- Leaves very long-ciliate up to the callous tip. Leaves strongly dimegueth, the basal ones 3-10 mm wide. Inflorescence a subglobose umbel of long-pedicelled flowers. Flowers solitary or a few of them 2 to a pedicel. Late spring. Rare or overlooked herb of light woods. --NF-SPM, NS-cAlta, US.

The more western var. *macrocarpa* (Buch.) stat. n. *L. rufescens* Meyer var. *macrocarpa* Buch., Pflanzenreich 4, 36 (25): 47. 1906, has smaller leaves, the basal ones 1 dm long or less, 2-4 mm wide, the caulinary one smaller still by half.

The more southern var. *carolinae* (Watson) stat. n., *L. carolinae* Watson, Proc. Am. Ac. 14: 302. 1879, has partly compound umbels and its leaves are often larger, up to 15 mm wide.

L. acuminata Raf., a name often used for our plant, is now considered to be a nomen dubium.

2. ***L. parviflora*** (Ehrh.) Desv. -- Very open inflorescence, a compound (or twice compound) raceme. Glabrous or nearly so; 4-10 dm high. Typically with 5 stem leaves, the latter usually very long ciliate at the junction of the limb and sheath. Racemes somewhat congested. All pedicels subtended by a bract reduced to its sheath. Early summer. Infrequent native, mostly of disturbed places in woods. --G, (K)-Mack-Aka, L-SPM, NS, NB-BC, US, Eur.

The darker and more compact plants from more open habitats are often named var. *melanocarpa* (Mx.) Buch. Some B.C. and Alaska specimens with a more open panicle and paler perianth have been differenciated as var. *divaricata* (Watson) Boivin (=*L. divaricata* Watson), but such specimens occur throughout the range and further they are a misidentification since true *L. divaricata* does not extend that far north, being primarily a California species with eciliate leaves, more stiffly divergent pedicels and acuminate (but not noticeably paler) tepals.

3. ***L. Wahlenbergii*** Rupr. -- As above, but the leaves narrower and the whole plant generally smaller. All or most leaves less than 1 dm long and 5 mm wide or less. Stem 1-4 dm high and bearing only 1-3 leaves. Bracteoles strongly fimbriate. Tepals often somewhat fimbriate. Early summer. Wet places and shores in subarctic to arctic or subalpine to alpine situations. --(G)-F-Aka, L, Q, nMan-(S)-Alta-BC, (US), Eur.

Some specimens, especially from the western part of the range, may be somewhat more glaucous and somewhat more sturdier plants, and on that basis are sometimes identified as *L. Piperi*. However the latter name properly belongs to the synonymy of *L. parviflora*.

4. ***L. glabrata*** (Hoppe) Desv. -- Resembles the previous two, but the flowers larger and purple black. Capsule also purple black. Mostly 3-4 dm high. Inflorescence often somewhat nodding. Early summer. Disturbed or rocky places, alpine to subalpine. Rockies. --swAlta-BC, US.

5. ***L. spicata*** (L.) DC. -- The whole inflorescence conspicuously nodding. Densely tufted. Inflorescence congested, of a single glomerule or of a few closely set glomerules. Lowest bract usually equalling the inflorescence. The main bract under each flower as long as, or longer than, its flower. Early summer. Alpine slopes and mountain tops; also dry tundra at Lake Nueltin. -- G-(F)-K-Aka, L-SPM, (NS), Q, nMan, swAlta-BC, US, Eur.

6. *L. confusa* Lindeberg -- Densely tufted like the preceeding, but the inflorescence stiffly erect. Glomerules smaller, 1-(3), the lower one, when present, on an elongate and stiffly erect peduncle. Lowest bract short, merely reaching the base of the glomerule, or even shorter. Late spring. Forming large tussocks on the tundra. --G-Aka, L, Q, nMan-neS, BC, (US), Eur.

A Drummond collection (GH) originally identified as *L. hyperborea* and later filed under *L. confusa* may have been the basis for extending the range of the latter to Alberta by Fernald 1950, repeated by Moss 1959, querried by Boivin 1967. This same collection may also be the source of an isolated Alberta dot on distribution maps by Raup 1947, Porsild 1957 and 1964, and Hultén 1962. Also an earlier report by Buchenau in the Pflanzenreich *4, 36(25)*: 71. 1906 for the "Felsengebirge". Still earlier, this same Drummond Rocky Mountains collection was reported by Hooker 1838 and Macoun 1888 as *L. hyperborea* var. *minor*. The latter varietal name is a synonym of *L. confusa*. But Drummond's specimen belongs with *L. campestris*, hence we are discounting all Alberta reports.

7. *L. arcuata* Wahl. (var. *unalaschkensis* Buch.) -- Branches of the inflorescence, and also, usually, the stems, arching. Only 1-3 dm high and growing in dense tufts. Inflorescence often branching in the manner of *L. parviflora*, the flowers in small glomerules. Early summer. Alpine slopes. -- Mack-Aka, swAlta-BC, (US, Eur) . Our plants are not consistently different from those of the Old World.

8. *L. campestris* (L.) DC. var. *campestris* (*L. groenlandica* Böcher; *L. multiflora* (Retz.) Lej., var. *contracta* Sam., var. *frigida* (Buch.) Sam., ssp. *comosa* (E. Meyer) Hultén; *L. sudetica* (W.) DC., var. *frigida* (Buch.) Fern.) -- Blackcaps, Chimney-Sweeps -- Leaf gradually attenuate into a callous tip. Very variable. Leaves very long-ciliate, the cilia usually sparse, exceptionally deciduous. Stem leaves many and somewhat larger than the basal ones. Inflorescence subtended and overtopped by a leafy bract. Glomerules dark brown to purple black, small and tending to be spiciform. Tepals and capsule 2-3 mm long. Late spring. River shores and bogs. --G-K-(Mack-Y)-Aka, L-SPM, NS-BC, US, Eur -- Var. *pallescens* Wahl. (*L. pallescens* (L.) Besser) -- Inflorescence lighter in colour, pale brown to yellowish green. Plants often taller. Of more southerly distribution. --(NF), NB-S, US, (Eur).

9. *L. hyperborea* Br. var. *hyperborea* (*L. arctica* Blytt; *L. nivalis* (Laest.) Berl.) -- Leaves eciliate

or essentially so, not quite so clearly callous at tip as the last. Foliage mainly basal, the stem leaf slightly smaller and usually only one. Bract shorter than the inflorescence, the latter pyramidal and mostly ± 1 cm long. Flowers smaller, the tepals and capsule ± 1.5 mm long. (Summer?). Wettish toundra: Churchill, Lake Paterson. --G-Aka, L, nQ, nMan-(nS), neBC, Eur.

L. hyperborea has been applied now to *L. confusa*, now to *L. nivalis*. We contend that such conflicting usage is not ground enough to discard a name, otherwise many, if not most, of the older names would have to be replaced. Conflicting usage normally calls only for restriction through typification. In his original description Robert Brown described clearly *L. hyperborea* as a plant with flat leaves and foliaceous bracts: within the general area of the type collection only *L. nivalis* fits this description, hence we hold *L. hyperborea* and *L. nivalis* to be synonymous.

Grades to the northwest into var. *latifolia* (Kjellm.) Boivin, with somewhat larger leaves, the main ones up to 3-4 mm wide, the younger ones irregularly ciliolate. Also the inflorescence is laxer, the longest peduncle 1-5 cm long.

POLLINATION ECOLOGY AS AN ASSAY FOR ECOSYSTEMIC ORGANIZATION: CONVERGENT EVOLUTION IN CHILE AND CALIFORNIA

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SUMMARY

Diversity and feeding specialization (with/without niche overlap) of pollinating insects was examined at 0.5 km^2 sites along transects including analagous physiognomic plant communities in California and Chile. Though climates at the analogous community sites are similar, plant diversity ($\underline{H}$ and species count) patterns differ due to the prevalence of fire in the California sclerophyll scrub. Treating the distinct floras of the fire cycle additively, plant diversities of similar communities compared intercontinentally are more similar than within-country diversity comparisons of adjacent communities. The diversity of all taxonomic groups of pollinators manifests consistently greater intercontinental analogue similarity than compared to different physiognomic communities within the same country. All pollinator groups are more diverse in California due to the larger area and the presence of more diverse refugia from Pleistocene glaciation. Similar percentages of the resident flora of analogue communities rely upon wind, insect and self-pollination, whereas adjacent but different communities may differ markedly; the same analogous relations hold for the component pollinator groups with the exception of syrphid flies. Utilization strategies exhibit emphasis on generalists (by species) in maritimal and Mediterranean scrub environments; emphasis on generalists (by individuals) in the Mediterranean scrub; emphasis on feeding specialists (by species and individuals) in the desert; and emphasis on very few species of abundant generalist feeders in the cool forest and maritime environments of both countries. Results are commensurate with the hypothesis that climate controls the phenological presentation of floral resources and that these in turn determine the abundance and diversity of floral herbivores in optimized patterns irrespective of a completely distinct evolutionary heritage within the two continents.

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INTRODUCTION

As many plant ecologists (most notably Holdridge in 1947) have demonstrated, the physiognomy of any climax biome is determined in large measure by a few preeminent features of the climatic regime: rainfall, temperature and evapotranspiration. In regions with a Mediterranean climate, plants are especially affected by such climatic features, in particular by the water stress imposed by high temperatures and lack of appreciable summer precipitation. More than a century and a half ago, Alexander von Humboldt was impressed by the similarity of vegetation types in widely separated regions of the world, but only recently has convergent evolution in regions of Mediterranean climates been investigated in a holistic manner.

The investigations reported in this paper, which were conducted under the auspices of the International Biological Program, are an analysis of species packing at the interface between flowering plants and the flower-feeding herbivores which often act as the agents of cross-pollination. These studies were designed to distinguish between the physiological effects of climate and the historical influence of the taxonomic composition of the flora and fauna in determining the structure of an ecosystem. Ecosystem structure is assessed in terms of the species diversity of component guilds and the patterns of their competitive interactions.

In order to distinguish between the variables of taxonomic composition and climatic similarity, an Analysis of Variance design was employed utilizing two parallel transects of research sites under very similar climatic conditions but 7,500 km apart and comprised of very different faunistic and floristic lineages (Thrower and Kummerow, 1977). With the exception of a few pest and weedy species associated with commerce, there is little taxonomic similarity between the two regions in question below the family level (Raven, 1963; Mooney, 1975, 1977; Moldenke, 1976). Within the transect in each country on the other hand, the sites subject to differing climatic regimens share the same taxonomic lineages.

If the effects of climate significantly outweigh the taxonomic component within a community and if convergent evolution has been occurring, the well-documented similarity of community physiognomy should be indicative of pervasive similarities extending through the phenology, physiology and diversity patterns of resident floras; it should be reflected indirectly as well in the totality of resource utilization strategies of animal groups. Convergence at the physiological level within the Mediterranean floras of Chile and California has been shown to be the result of selection for similar physiological strategies (Mooney and Dunn, 1970; Mooney et al., 1970; Mooney, 1972, 1977). This observation signifies that the resource base is sufficiently similar in the two hemispheres to provide a basis for comparative analysis of food web relations.

If climate acts additionally to limit the total amount and the temporal presentation of floral resources in arid and Mediterranean regions, then optimization theory (Schoener, 1971; Cody, 1974) would predict strong convergence in the total biomass, the diversity and the structure of the flower-feeders' food web. Such convergence should be evident in a pattern of similarity between analogous intercontinental sites which must exceed the levels of similarity within the transect design of each continent. If similar patterns of species packing of flower herbivores which function as pollinators are achieved in intercontinental analogous sites, then presumably a similar percentage of the floras would be relegated to genetically compatible selfing or to wind pollination.

These testable hypotheses necessarily assume a similar duration of evolutionary development in the two hemispheres and a similar pattern of recent resource utilization by man. Although the situations in Chile and California do differ in some details, most of the null assumptions are in fact fulfilled or at least the situations are closely parallel. The discrepancies which do exist will be discussed as they become pertinent.

METHODS

a) Site Selection

Site selection for this integrated research project was established with the aid of a number of investigators having a wide variety of expertise. Great care was exercised to match the sites as closely as possible on the basis of the available climatic, topographic and land-use information. Perfect climatic matches, considering the number of pertinent variables, clearly would be statistically highly improbable. The sites chosen, described briefly below and in considerable detail in Thrower and Bradbury (1977) and Mooney (1977) are remarkably similar. All share "mediterranean" climatic regimes in that precipitation falls almost exclusively during the relatively cool seasons.

Mediterranean Sclerophyll Scrub

California, San Diego County, Echo Valley near Descanso: altitude ca. 1,000 m; annual precipitation 32 cm; mature chaparral with little understory, last recorded fire in 1950 (25,600 hectares); no grazing and little human disturbance; dominant cover Ceanothus, Arctostaphylos, Adenostoma and Quercus.

California, San Diego County, Japatul Valley near Descanso: altitude ca. 1,000 m; annual precipitation 32 cm; chaparral burned severely in 1970, investigations carried out during two years subsequent to fire; burn the largest (total 70,000 hectares; Phillips, 1971) in recent history of the region, nearest source area nearly 7 km distant; site located in close proximity to Echo Valley; entire cover fire-sprouted annuals and geophytes.

Chile, Santiago/Valparaíso Provinces, Fundo Santa Laura on the Cuesta la Dormida: altitude ca. 900 m; annual precipitation ca. 52 cm; the least disturbed extensive region of mature matorral with any sort of access to electricity and automobile in central Chile; light to moderate grazing by llama, burro and cattle; patrolled for 10 years to prohibit charcoal gathering and goat grazing; dominant cover Lithraea, Quillaja, Trevoa, Retanilla, Cereus, Cryptocarya and Satureja; investigations mostly completed before central laboratory was established and hence areas studied extensively were directly accessible from the main Cuesta and hence a bit more disturbed than regions studied by other workers.

Coastal Scrub

California, San Diego County, Torrey Pines State Park: altitude sea level to 100 m; annual precipitation 27 cm (Felton, 1965); the only region available for 50-150 km in either direction with a semblance of native flora and fauna; region honeycombed with footpaths, annual visitation rate is 700,000 people; remarkably undisturbed portions studied; local excellent botanical society floral listing available; island-like isolation of present system and extreme abundance of Apis mellifera are differences between the California and Chile sites; fauna and flora assumed to be depauperate representation of pre-colonial condition; dominant plants Rhus, Dudleya, Cneoridium, Eriophyllum and Mesembryanthemum.

Chile, Valparaíso/Aconcagua Provinces, Papudo: altitude sea level to 100 m; annual precipitation 30 cm; localized regions of relatively undisturbed community between the resort towns of Papudo, Zapallar and Maitencillo; though portions of region are severely overgrazed and extensively developed, regions furthermost from settlements appear undisturbed, with only occasional sightings of *Apis*; dominant plants *Baccharis*, *Puya*, *Bahia*, *Fuchsia*, *Lobelia*, *Cereus*, *Calandrinia* and *Mesembryanthemum*.

Montane Forest Community

California, San Diego County, Mount Laguna: altitude 1,700-1,900 m; annual precipitation ca. 60 cm; freezing temperatures and snow in winter; extensive stand of *Quercus*-*Pinus* woodland with little shrub cover but a well-developed understory; rather undisturbed, but grazed by cattle.

Chile, Santiago/Valparaíso Provinces, approaching cima Cerro El Roble: altitude 1,700-2,000 m; annual precipitation ca. 70 cm; freezing temperatures and snow in winter; mountaintop island *Nothofagus* forest; heavily grazed and timbered; though an official IBP site, the region was regarded as too disturbed to directly compare resource allocation patterns; observed and censused nevertheless.

Chile, Angol Province, Parque Nacional Nahuelbuta (37° S): well-preserved and extensive remnant of *Nothofagus* and *Araucaria* rain forest; analogous to Big Basin State Park (38° N), Santa Cruz County, California, a *Sequoia* rain forest community type. (quantitative sampling not undertaken)

Desert Scrub Community

California, Imperial County, Ocotillo: altitude 100-200 m; annual precipitation "average" less than 10 cm; studied in year of extensive spring rain and subsequent two years when there was virtually none, though supposedly characterized by occasional summer rains as well, only one storm left any noticeable moisture over a circular area with radius of 75 m (*Pectis papposa* and its pollinator *Perdita albovittata* were the only signs of life) during these three years; surrounding slopes with succulent vegetation observed wherever rainfall pattern permitted; extensive flat lower bajadas of *Larrea*, *Franseria*, *Fouquieria*, *Agave* and *Opuntia*.

Chile, Coquimbo Province, vicinity of Miña El Tofo:

altitude 750 m; annual precipitation less than 10 cm; partially, though not completely, sheltered from effects of coastal fog by seaward ridge of transverse mountains; studied during one year of exceptional rainfall and one year of minimal rain; though not as extensively studied as other sites, large data base available from local bee biologist, R. Wagenknecht; dominant plants Cereus, Eulychnia, Opuntia, Proustia, Balbisia and Aristolochia.

Coastal Community

Chile, Coquimbo Province, Cerro Potrerillo near Cd. Coquimbo: succulent desert community; altitude sea level to 100 m; coastal thick fog every day throughout October and November; ground cover both years of study exceptionally diverse and lush; both years with plagues of larval Sphyngidae; dominant plants Cereus, Eulychnia, Oxalis gigantea, Heliotropium and Bahia.

California, Marin County, Point Reyes: fog shrouded coastal dunes, strand and scrub vegetation at 38° N latitude; dominant plants Mesembryanthemum, Lupinus, Cakile and Ammophila (Moldenke, 1975, 1976b).

Alpine Community

Frequent research excursions were made to the vicinity of Farellones and Portillo in the high Cordillera (3,000-4,000 m) in central Chile for the purposes of comparing the communities with high altitude central Sierra Nevada, California (see Moldenke, 1971, 1975, 1976b). Quantitative censusing was not undertaken in the Chilean sites.

b) Censusing and Resource Allocation

Methods employed in plant censusing, herbivore censusing, and determining the relative resource utilization of the herbivores are described in detail in Moldenke (1971, 1975). The raw data from all sites are available from the author in complete form in Moldenke and Neff (1974b).

It should be noted that for purposes of this study, biomass is not measured directly but is assumed to be proportional to an estimate based on the volume of floral and insect tissue of each species censused. Floral "biomass" is thus not equivalent to animal "biomass" nor is it likely that single biomass "units" of different taxa measured in this way would be exactly equivalent if translated to grams, calories or more typical conventional currency. Despite such obvious shortcomings, I feel the method is justified both by its simplicity and by the striking differences in amounts of "biomass" involved. More precise estimations of "biomass" are not likely to change the general patterns observed.

RESULTS AND DISCUSSION

a) Diversity of the Flora

The similarity evident in the over-all pattern of the broad-leaved sclerophyll evergreen scrub vegetation and emphasis on annual plant speciation in Chile and California is discernable as well in the pattern of occurrence of the different physiological strategies within the environmental mosaic (Mooney, 1972, 1977). For example, similar sets of growth patterns, leaf size and shape, succulence and therophyte drought avoidance strategies tend to be characteristic of certain slope faces (Parsons, 1973, 1976). These correlations or morphological characteristics of the disjunct resident floras consistently evidence greater similarity between analogous community types in opposing hemispheres than between any two adjacent community types within either hemisphere (Parsons and Moldenke, 1975).

Since the climatic parameters and the adaptations of the flora of Chile and California are similar, species diversity of the dominant plants in the broad-leaved evergreen sclerophyll communities should approximate the same values in regions of similar extent chosen for their similar geologic heterogeneity (MacArthur and Wilson, 1967). However, three environmental and historical dissimilarities between the two regions indicate that within the framework of predicted similarity (when compared to physiognomically distinct neighboring community types), species diversity values would be lower in Chile _in toto_, but higher per unit area than in California.

1) The size of the land mass subject to a Mediterranean climate in Chile is less than that of California (California = ca. 240,000 km^2; Chile = ca. 100,000 km^2). Since the geographical heterogeneity of the two regions is remarkably comparable, the direct proportionality between species number and area would predict a more diverse California flora (MacArthur and Wilson, 1967).

2) The refugia available for the flora during the recurrent pluvial and interpluvial climatic fluctuations of the Quaternary were much more restricted in

Table 1. Plant abundance and diversity

	Censused Individuals $1000m^2$	Censused Species $1000m^2$	Total Species Count $(0.5 km^2)$	$\underline{H}$ Diversity of Abundance	Floral Biomass	$\underline{H}$ Diversity of Floral Biomass
California						
Coastal Scrub	79,899	83	140	2.15	2,755	2.82
Mediterranean Scrub Burn	43,236	85) 103*	157) 205*	2.89	2,625	2.46
Mediterranean Scrub	2,636	44)	72)	2.79	8,969	2.11
Deciduous Forest	85,713	55	84	2.44	49,337	0.65
Desert Scrub	41,110	39	140	1.66	2,220	1.53
Chile						
Coastal Scrub	110,055	131	154	2.46	16,508	2.71
Mediterranean Scrub	270,853	108	158	1.12	10,302	2.84
Coastal Succulent Scrub	20,388	94	105	3.40	45,423	1.66
Desert Scrub	79,019	76	80	1.03	2,508	2.71

South America (Vuilleumier, 1971). Each subsequent climatic reversal should therefore have had a resultant progressive decrease in the species diversity of Chile.

3) The California chaparral is a fire-adapted ecosystem. It cycles, with a natural pre-colonial periodicity of about eight years (Aschmann, 1959), between a dominant shrub community with essentially no understory and a dense cover of fire-sprouted annual and geophyte species with little photosynthetic shrub cover. There does not appear to be a similarly intense fire-associated evolutionary phenomenon in Chile (Parsons and Moldenke, 1975; Mooney, 1977). Since these pre-colonial fires were presumably very limited in geographic extent (compared to present fires), a mosaic of differing successional seres apparently existed within very close proximity facilitating refuging for both floral and faunistic elements, allowing all elements to persist within a relatively circumscribed region. These seral elements are sometimes combined where appropriate in the analysis which follows.

The Chilean matorral site with 108 species censused is very similar to the combined censuses of mature and burned California chaparral with a total of 103 species (Table 1). The Chilean matorral with the tremendous inequality of numbers between shrubs and annual plants is, however, much less diverse in terms of the information measure H (Lloyd and Ghelardi, 1964) than is the mature California chaparral even though in terms of the absolute number of species it encompasses, the Chilean site is slightly richer than the combined burned and mature sites of California.

Although the total extent of matorral vegetation in Chile contains as many woody Mediterranean scrub species as the total chaparral of California (Chile = 246: 217 trees and shrubs, 29 succulents[1]; California = 249: 217 shrubs and trees, 32 succulents[2]), thirty species of shrubs occur in the 1,000 m^2 censused in Chile, whereas only nineteen occur within the California census. The

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[1] Data supplied by Prof. Otto Zöllner, Universidad Catolica, Valparaíso, Chile.

[2] Data collated from Munz, 1955.

TABLE 1. Total species count within total extent of community (less than 1 km^2) of Chilean deciduous forest is 23. Personal data supplemented by Carter (1973); this low value is undoubtedly a result of present overgrazing and recent intense lumbering.

*Summation of total species count in either burned or unburned Mediterranean scrub vegetation.

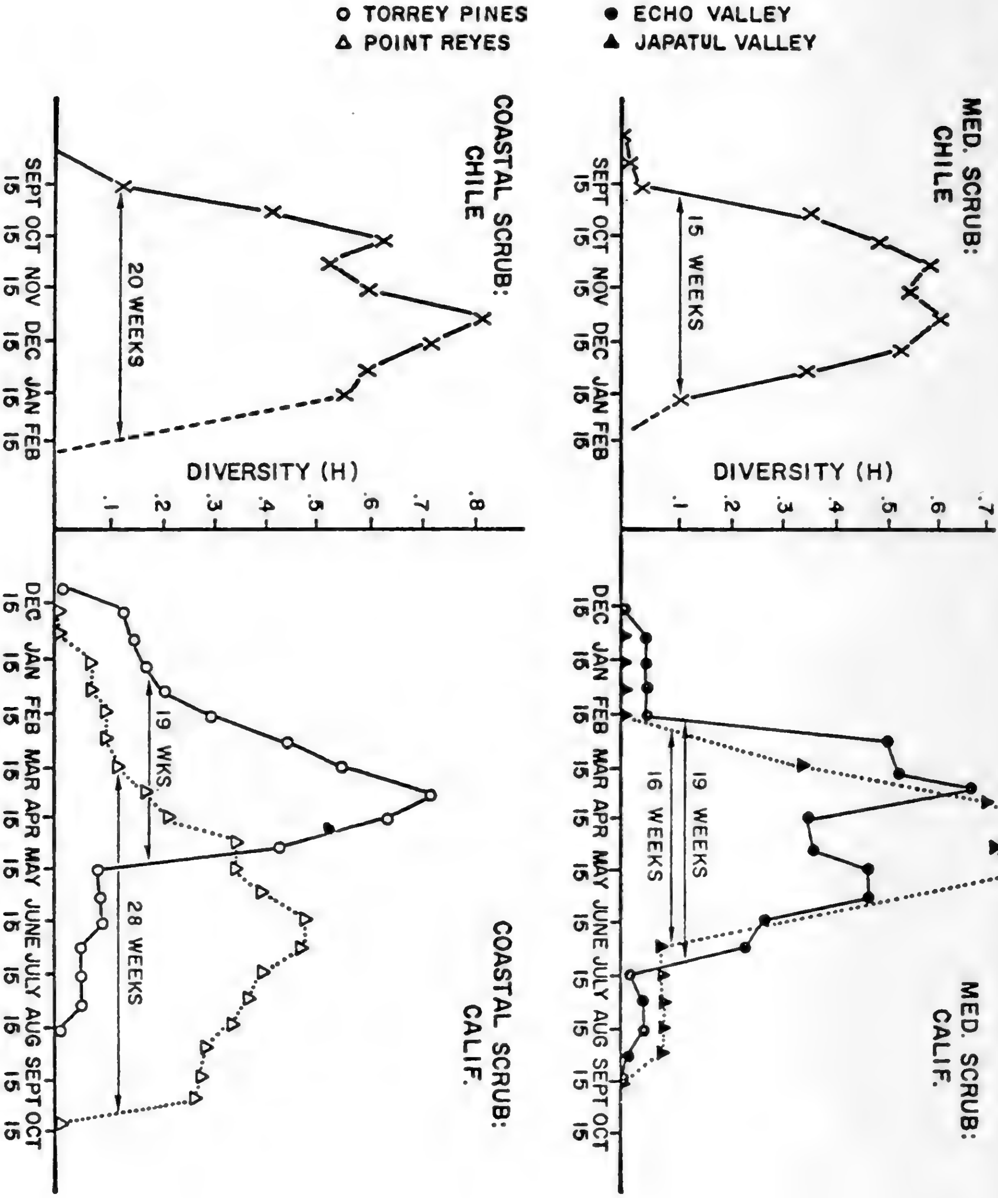
Table 2. Pollinator vs. Floral Biomass.

	Pollinator Biomass	Floral Biomass	Ratio P/F Biomass
California			
Coastal Scrub	664	2,725	.24
Mediterranean Scrub	3,012	8,969	.33
Desert Scrub	1,530	2,220	.70
Chile			
Coastal Scrub	946	16,508	.06
Mediterranean Scrub	2,549	10,302	.24
Desert Scrub	700	2,508	.28
Coastal Desert	370	45,423	< .01
Northern California			
Coastal Scrub	2,531	10,628	.23

decreased local species count of dominant shrub species within a small region (1-2 km^2) in California may reflect the rapid response by r-strategist shrubs to the periodic catastrophic destruction of the climax canopy caused by fires in California. Total species count (including ephemeral therophytes and geophytes) is high in these mosaics of continual reinvasion; once the shrub cover reestablishes, a monoculture of the original or most aggressive shrub colonist often results. This low diversity is probably characteristic of the California community in its pre-colonial state (DiCastri and Mooney, 1973). In Chile, the few remaining regions of relatively undisturbed natural scrub are characterized by the relatively high diversity levels censused in this study. In contrast, the majority of the matorral scrub vegetation type in Chile is presently heavily exploited by man, particularly by heavy selective cutting for firewood and intense overgrazing by goats (Parsons, 1973). As documented by Harper (1969), continued application of such selective pressures results in a community dominated by very few species of plants (in Chile: Acacia caven, Satureja gilliesii and Lithraea caustica).

Total species count of censused plant taxa is high in Mediterranean scrub ($\bar{x} = 105$) and coastal scrub ($\bar{x} = 107$) and drops off noticeably in forest ($\bar{x} = 39$) and desert ($\bar{x} = 57$) of both continents (Table 1). The noticeable discrepancy between desert censuses may be due to the maritimal location of the Chilean site with a more predictable incidence of precipitation and fog condensation. The species counts of the mature California montane forest community and the deserts of both hemispheres are conspicuously less rich than other California communities censused by the same method ($\bar{x} = 87$; Moldenke 1975). Measures of structural diversity have not been utilized in this study because pollinators do not respond to the same cues utilized by other groups (e.g. Cody, 1974). As a general phenomenon, total plant diversity (both species count and information indices) and floral-herbivore diversity have been shown not to be correlated (Moldenke, 1976, 1979). Though conclusive studies are lacking, it appears that pollinator diversity is usually highest in warm arid ecosystems characterized by an abundance of bare ground and little wind regardless of resident plant diversity.

The respective paired sites of Mediterranean scrub and desert scrub show close correspondence (Tables 1 and 2), both in species number and amount of floral biomass. The coastal scrub of Chile provides noticeably more floral biomass than that of California, primarily due to the contributions of three common mass-blooming species, Puya chilensis, Baccharis linearis and B.


○ TORREY PINES
△ POINT REYES
● ECHO VALLEY
▲ JAPATUL VALLEY
MED. SCRUB: CHILE
15 WEEKS
SEPT 15 OCT 15 NOV 15 DEC 15 JAN 15 FEB
DIVERSITY (H)
.1 .2 .3 .4 .5 .6 .7
MED. SCRUB: CALIF.
19 WEEKS
16 WEEKS
DEC 15 JAN 15 FEB 15 MAR 15 APR 15 MAY 15 JUNE 15 JULY 15 AUG 15 SEPT 15 OCT 15
COASTAL SCRUB: CHILE
20 WEEKS
SEPT 15 OCT 15 NOV 15 DEC 15 JAN 15 FEB 15
DIVERSITY (H)
.1 .2 .3 .4 .5 .6 .7 .8
COASTAL SCRUB: CALIF.
19 WKS.
28 WEEKS
DEC 15 JAN 15 FEB 15 MAR 15 APR 15 MAY 15 JUNE 15 JULY 15 AUG 15 SEPT 15 OCT 15

concava. The Puya is pollinated by the giant hummingbird (Patagonia gigas) and is structurally analogous to the Agave species of the coast of southern California and Baja California. The Baccharis spp. bloom so very late in the year that I have not had the opportunity of observing their pollinators, but collections by H. Toro (pers. comm.) reveal that they are heavily frequented by halictine bees and various groups of flies; they are the only flower resource available during the very late Chilean summer.

A significant lack of climatic correspondence between the Mediterranean scrub and coastal scrub community comparisons can be seen in Figure 1. While the blooming season in coastal Chile is significantly longer than that of the corresponding Mediterranean scrub (by 4-5 weeks), the blooming season in Torrey Pines is equal to that of the corresponding dominant Echo Valley community. The blooming season further to the north in California is more than twice as long as that of the scrub communities at the same latitude due to the earlier and warmer spring on the coast and to increased precipitation during late spring[3]. This ameliorating influence is not pronounced in southern California since there is not enough moisture during the summer months to permit extensive flowering except at elevations over 1,500 m; rainfall at 38° N is double that at coastal 33° N.[4] The

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[3] Blooming period at Point Reyes is 30 weeks long, that at Stanford is only 12 (Moldenke, 1971, 1974).

[4] Mean annual rainfall: Point Reyes (38° N) = 49 cm; Torrey Pines (33° N) = 27 cm (Felton, 1965).

FIGURE 1. Blooming seasons at Mediterranean and Coastal Scrub sites in Chile and California. Blooming seasons at Torrey Pines, Echo Valley and Papudo are equivalent whereas the blooming season is significantly decreased at Cuesta la Dormida and increased at Point Reyes. The length of the blooming peak is measured by:

$$H = -\sum_{s=1}^{n}(p_s)(l_n\, p_s)$$

N is the total number of plant species (s) in the community; p is the proportion of each species of the total community floral biomass resource. Diversity is used to measure the floral peak rather than species count or simply total flowers available due to the disproportionately large number of species with very few flowers in the earliest spring and the long-lasting mass blooms of one or two species in the fall. Peak blooming season is defined at the 0.1 level of diversity, except for Torrey Pines where inspection reveals that 0.18 is the preferable delimitation.

TABLE 3. Relative abundance of flower-herbivores along Chile/California transects.

	Torrey Pines	Burned Chaparral	Chaparral	Mt. Laguna Forest	Ocotillo Desert	Papudo	Matorral	Potrerillo	Desert
Bees (species)	80	151	171	135	87	64	116	22	29
(individuals)	3,108	6,297	55,749	11,032	9,905	2,918	28,815	475	4,824
($\underline{H}$ individuals)	2.82	1.55	2.37	2.01	2.15	1.69	1.79	0.87	1.23
($\underline{H}$ relative biomass)	2.13	1.11	2.09	1.59	1.84	1.67	2.12	0.95	0.82
Beetles "	7	16	41	17	24	20	34	11	20
	133	4,024	4,925	3,195	570	2,394	711	869	1,480
	0.18	0.60	0.38	0.58	0.23	1.00	0.11	0.77	0.65
	0.02	-	-	-	-	-	-	0.28	0.48
Lepidoptera "	3	13	15	13	4	4	13	3	3
	68	2,732	2,750	78	14	8	615	7	8
	-	0.40	-	-	-	-	0.10	-	-
	-	-	-	-	-	-	0.16	-	-
Muscoid Flies "	10	11	19	8	5	12	23	6	4
	55	417	140	196	755	48	261	22	9
	-	-	-	-	-	-	-	-	-
	-	0.39	0.40	0.37	-	-	-	-	-
Syrphid Flies "	4	1	6	3	3	12	27	7	3
	15	80	79	180	240	118	15,529	95	115
	-	-	-	-	-	0.11	0.95	0.24	-
	-	-	-	-	-	-	0.77	0.10	-
Wasps "	7	38	31	13	36	3	39	5	29
	69	335	804	63	453	4	505	15	297
	0.10	0.13	-	0.26	0.21	-	-	-	0.19
	-	-	-	-	0.14	-	-	-	0.09
Bee Flies "	7	22	24	16	22	14	28	5	12
	261	4,200	4,989	1,470	640	423	1,865	89	144
	0.30	0.71	0.34	0.34	0.22	0.30	0.20	0.23	0.12
	0.18	0.58	0.44	0.32	-	0.24	0.20	0.16	0.12
Hummingbirds* "	1	2	2	2	1	1	1	1	0
	73	133	187	73	44	55	46	18	0
	-	-	-	-	-	-	-	-	-
	0.36	0.30	0.31	0.30	0.22	0.37	0.22	0.34	-
Total spp.	119	254	309	207	182	130	281	59	100

length of the entire growing season is correspondingly reduced in southern California although this U.S. Weather Bureau statistic does not reflect the summer drought as strikingly as does the observed blooming season.[5] The decreased length of the blooming period is reflected in the reduced quantity of total floral biomass and the diminished abundance of the flower herbivore fauna resident in the Torrey Pines research site (Table 2).

b) Flower-Herbivore Abundance

Significantly larger numbers of species, individuals and biomass of flower-herbivores occur in the Mediterranean scrub (Tables 1 and 3) than in any other community type. Flower-herbivore species count of Mediterranean scrub is three times that of desert in both continents, twice that of coastal scrub in Chile, and four times that of coastal scrub in California. Flower visitor biomass follows a similar pattern to that of species diversity within both continents. Viewed in terms of flower-herbivore individuals, the richness of the chaparral in both countries (particularly California) is greatly augmented by the occurrence of enormous numbers of minute individuals of several flower-visiting species (e.g. Perdita, Panurginus, Bibio and Geron). Although they may facultatively specialize on one species or a related group of plant species, these species are probably inefficient pollen vectors. Their small size, low mobility and habit of visiting flowers in close proximity (usually on the same plant) may render them functional pollen and nectar robbers, since the plants they frequent are genetically self-incompatible.

In the coastal scrub community the flower-herbivore biomass (Table 2) decreases significantly since the maritimal climate decreases flight time for poikilothermous insects by at least two hours a day and commonly prohibits flight for the entire day when fog settles along the coast. The depressing effect of the fog on insect activity relevant to potential pollination is much more severe in Chile, where fog is a much more frequent and prolonged occurrence, than in California. The Humboldt Current, which parallels the Chilean coast

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[5] Growing season: Point Reyes = 361 days; Stanford (37° N) = 307 days; Torrey Pines = 336 days; Echo Valley (33° N) = 216 days (Felton, 1965).

TABLE 3. Flower-Herbivore Abundance.
*Based on individual sightings; all other abundances represent sampling without replacement.

$H = -\sum_{s=1}^{N}(p_i)\ (l_n\ p_i)$ where: N = total species (s) in community; (p_i) = relative abundance of species_i in census.

(colder and closer than the California Current of western North America), exerts its influence along the entire coast. Cerro Potrerillo is almost a true fog desert. Temperatures are so lowered and fog so common that the time favorable for poikilotherm activity is limited to only one hour per day (ca. 2:30-3:30 PM) for the extent of the peak blooming season (1 October to 1 December). The only pollinator activity possible at other times is by large relatively heavy-bodied facultatively homeothermic ("heterothermic"; Heinrich, 1974) hummingbirds, large bees (e.g. Caupolicana, Trichothurgus) and nemestrinid flies. Though minimal rainfall did not permit study of the climatically analogous Baja California coastal succulent sites, the same limitation of activity periods and relative importance of heterothermic flower-herbivores occurs along the coast of northern California.

The efficiency at which floral biomass is utilized within the trophic levels of the community may be approached by the ratio of total flower-visitor biomass supported divided by the total community floral biomass (Table 2). This ratio can only be used to show the general pattern of resource availability, since precise nutritional aspects are not known; there is no real evidence that more pollen or nectar is "wasted" in communities with high floral/animal biomass ratios. This ratio is lowest for the succulent fog desert and reaches a maximal value for the desert communities of both hemispheres. Similar to the situation encountered at Cerro Potrerillo, flower-herbivore activity at Point Reyes is virtually restricted (99 percent of community pollinator biomass) to thermoregulatory heavy-bodied insects. An analogous phenomenon occurs at a similar latitude in Chile, where the single species Bombus dahlboml assumes the role of the diverse Bombus fauna in California (7 species at Point Reyes). At high latitudes in both continents nearly all the bee pollination occurs through the agency of Bombus in all community types.

In desert communities, the ratios in Table 2 are maximized. In these communities more than half of all species of flower visitors (e.g. beetles, wasps, leps, beeflies) are not bees. Though evidence is growing that these groups are consumers of pollen as adults (Gilbert, 1972; Jack Hall, pers. comm.), it is probable that their increased frequency of floral utilization in deserts reflects more accurately the increasing relative value of nectar in an environment in which moisture is otherwise unavailable to many insect groups. In all other communities studied by the author, by far the largest percentage of visitors to flowers consists of bees which are utilizing pollen as a major food source for themselves and their larvae.

c) Flower-Herbivore Diversity

With the exception of Torrey Pines (see site selection), it is immediately apparent that the California sites are much richer in total flower visitors than their Chilean counterparts (Table 3). This pattern of α-diversity is reflected best within the bees (Apoidea) and in varying degrees in other groups as well. Bees are the group expected to show closest correspondence to floral abundance and diversity patterns.

An analysis of the bee diversity of all Chile (in contrast to only the local diversity of the research sites) and the corresponding region of North America (Baja California to southern Alaska) reveals a total of four times as many species of bees in the Northern Hemisphere (Moldenke, 1976). In the absence of any comprehensive botanical treatment of the Chilean flora, it is not possible to distinguish between the presumed lower total diversity of Chilean plants and the smaller total area as causes of this observed decrease in Chilean bee species.

A similar gradient of bee species diversity exists throughout the diverse biotic realms within each continent, both on the level of point sites and comparisons of the species inhabiting the total expanse of analogous community types. Therefore the flora of the corresponding climatic regions of the opposing hemispheres are faced with similar exigencies in attracting vectors to their flowers. Depending upon altitude and distance from the arid subtropics, a flora may have either a very rich potential vector fauna of both specialists and generalists or only 1/7-1/8 as many taxa, nearly all of which are generalists (Moldenke, 1976).

A significant ratio of potential significance in any community is the number of flower-visiting axa relative to the number of non-anemophilous flowering plant species. This number is, of course, not an absolute indicator of pollinator availability since one "facultative specialist" such as Apis can presumably perform the pollination function of a large number of specialist species. The ratio of bee species[6] to ento-

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[6] With their characteristic morphology and behavior patterns which usually bring them in contact with anthers and stigmata, their high rate of flower visitation per unit time and their densely furry bodies, nonparasitic

mophilous plant species resident within localized regions of Mediterranean scrub, desert and grassland communities is likely to exceed 2.0 (Moldenke, unpublished data); however, in coastal, alpine and boreal forest communities, the ratio may drop to 0.6-0.3 and the flora is generally faced with a severe competition for vectors. The competition between plants for pollinators is especially intense in these latter communities since these regions of low bee diversity are characterized by generalist-feeding opportunist bee species which visit most frequently those plants which offer them the greatest reward per effort expended (Moldenke & Lincoln, 1979). In the Mediterranean and desert scrub communities more than half of the bee taxa are coevolutionarily associated with only one plant taxon. These specialist-feeding bees may afford a predictable source of outcrossing regardless of the identity of sympatric plant species or the fact that many plant taxa serviced by specialist bees are visited under most circumstances by more efficiently pollinating generalist bees.

In contrasting the evolutionary history of the bees of Chile and Pacific North America (Moldenke, 1976), it is clear that both faunas possess relict species of ancient groups of long-standing distribution patterns as well as relatively recent taxonomic groupings actively adapting and speciating in new environments. However, whereas the Pacific North American fauna has received novel evolutionary stocks very frequently from the Neotropics, Nearctic and Palaearctic, the Chilean region has been relatively isolated. Though the species count of Chile is distinctly less than that of Pacific North America, it must be borne in mind that with respect to area, Chile does itself possess one of the most diverse bee faunas in the world. The Pacific North American bee fauna is clearly larger in total species and in the number of distinct genera that seem to have evolved *in situ* or in the closely associated Madro-Tertiary Geoflora region. Sixty-six genera and subgenera inhabiting semi-arid Pacific North America appear to have had an endemic origin; the corresponding number for Chile is only 22. The number of endemic bee genera (33% of the total Chilean bee genera) in Chile is larger than the comparable number in Pacific North America (9%). This higher level of endemicity in Chile is partially attributable to the isolation of Chile by the Atacama Desert

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bees represent the most important pollinator group; in the virtual absence of quantified studies on the vectoring efficiency of groups other than bees, it is impossible to estimate the number that are truly important as pollinators.

and the Andean Cordillera (Moldenke, 1976).

d) Pollination of the Flora

The relative abundances of different groups of flower-visitors is shown in Table 3. Not every insect which visits a flower is an effective pollinator nor is the relative abundance of all species of floral herbivores an index of their relative contribution to outcrossing. In the absence of autecological studies with marked pollen grains on each species of insect observed to utilize flowers as a food resource, my own subjective judgment based on field observation of intrafloral behavior, insect morphology and fidelity to a particular plant species by individuals for short extents of time are the basis of my judgment as to whether any significant pollination may be attributable to a particular species. In this paper no judgments are made as to the quantitative relative efficiency of different species of vectors servicing the same species; all species that on the above grounds are deemed potentially significant vectors are so treated in Tables 4 & 5, for instance. Infrequent but consistent visitation by a bumblebee to a flower in which it usually contacts the reproductive structures weighs equivalently with an abundant syrphid species which feeds heavily upon one particular plant species, but seldom contacts the stigma.

The species count of butterflies and skippers in Chile (ca. 75, pers. comm. H. Toro) is much less than it is in Pacific North America (238; Ehrlich and Ehrlich, 1961; D. MacNeill, pers. comm.), though comparable species diversities are maintained at each of the research sites. In both continents the preferred floral resource of butterflies is the Compositae; on these plants butterflies are often efficient vectors of pollen.

Wasps are abundant in the Mediterranean scrub and desert scrub ecosystems of both hemispheres; along with bees and beeflies (Bombyliidae), they form one of the most diverse floral-herbivore groups. In California the odd "vespoid bees," Pseudomasaris spp. pollen and nectar collecting wasps (Evans, 1966; Malyshev, 1968), are conspicuous elements of the flower visitor community, frequenting flowers of Phacelia (Hydrophyllaceae) and Penstemon (Scrophulariaceae). Gayella, a poorly known genus of this group, is found throughout central Chile; if they have specific floral preferences, they are unknown. The masarid wasps are efficient pollinators, but their more diverse sphecoid and vespoid relatives are significant vectors of pollen only in the desert where they may visit some plant species ignored by other flower visiting groups.

Diverse families of beetles (particularly the Mordellidae, Cerambycidae, Chrysomelidae, Dermestidae, Scarabaeidae, Buprestidae and Melyridae) are frequent visitors of flowers in both continents; however, for both morphological and behavioral reasons they seldom are effective as vectors of the pollen of the plants concerned. The Compositae are a favored resource. A remarkable example of convergent evolution is seen in the case of two abundant beetle pollinators, _Nemognatha_ (Meloidae -- California) and _Lichnia_ (Scarabaeidae -- Chile). Both are equipped with elongate labial palps, which in certain species are considerably longer than the length of their bodies. These probosces appear to be uniquely suited for extracting nectar from the long tubular disc flowers of the Compositae they visit.

Flies, as pollinators, must be subdivided into at least three groups: feeble-flighted Nematocerans, hovering beeflies, short-tongued syrphid and muscoid flies. Each of these groups generally visits a different set of flowers, apparently transfers pollen with widely differing efficiencies, and occurs in different preferred habitat types. The primitive Nematoceran flies appear to be extremely inefficient as vectors of pollen and are typically most abundant in communities characterized by large amounts of shade. Their activity is restricted to moist microhabitats during the early spring of typically more arid associations. Their effect in the regions of this study is expressed as the occasional outcrossing of taxa that normally self-pollinate; this is in contrast to their role in arctic communities, where their relative abundance coupled with the paucity of other pollinator types renders them significant elements in the pollination of the resident floras (Faegri and van der Pijl, 1966; Kevin, 1970). Beeflies (Bombyliidae and the Nemestrinidae [Chile only]) are a diverse and efficient group of pollinators at each of the research sites. Unlike research sites at higher latitudes in each country (Moldenke, 1971, 1975) where only one or two beefly species assume a major role in the pollination ecology of forest communities, along the more arid

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TABLE 4. Categories represent actual pollinators documented in study, rather than floral syndromes (i.e. perching short-tongued insect class) à la Knuth and subsequent authors (Faegri and van der Pijl, 1966). % flora = Number of species pollinated by particular mode divided by total species in region. Columns may total to more than 100% since taxa may be efficiently pollinated by more than one pollinator class.

Table 4. Plant pollination syndromes along California transect.

	Torrey Pines Coastal Scrub	Japatul Valley Chaparral Burned	Echo Valley Chaparral	Mount Laguna Oak-Pine Forest	Ocotillo Desert Scrub
Solitary Bees					
# species	37	35	32	33	34
% flora	27%	24%	41%	41%	29%
Specialist Pollen Vectors (bee subset)					
# species	24	18	20	16	24
% flora	18%	12%	29%	20%	21%
Halictine Generalist Bees					
# species	10	8	5	1	2
% flora	7%	5%	7%	1%	2%
Beeflies					
# species	3	11	4	7	2
% flora	2%	7%	6%	9%	2%
Beetles					
# species	4	3	0	3	3
% flora	3%	2%	-	4%	3%
Wasps					
# species	1	8	2	2	5
% flora	1%	5%	3%	3%	4%
Butterflies and Moths					
# species	3	4	1	1	2
% flora	2%	3%	1%	1%	2%
Hoverflies					
# species	3	3	0	0	4
% flora	2%	2%	-	-	4%
Muscoid Flies					
# species	1	1	2	1	3
% flora	1%	1%	3%	1%	3%
Hummingbird					
# species	4	8	10	6	3
% flora	3%	5%	14%	8%	3%
Water					
# species	4	6	0	0	0
% flora	3%	4%	-	-	-
Wind					
# species	21	16	7	16	13
% flora	15%	11%	10%	20%	11%
Selfers (predominantly)					
# species	45	35	6	10	44
% flora	33%	24%	9%	13%	38%
(Obligate Selfers)(subset)					
# species	12	9	1	3	7
% flora	9%	6%	1%	4%	6%

Table 5 Plant pollination syndromes along Chile transect.

	Papudo Coastal Scrub	Fundo Santa Laura Matorral	Cerro Potrerillo Succulent Desert	El Tofo Desert Scrub
Solitary Bees				
# species	33	48	16	27
% flora	22%	53%	16%	36%
Specialist pollen vectors (bee subset)				
# species	7	21	5	17
% flora	5%	23%	5%	23%
Halictine Generalist Bees				
# species	7	13	0	0
% flora	5%	14%	-	-
Beeflies				
# species	7	1	6	7
% flora	5%	1%	6%	9%
Beetles				
# species	6	1	5	3
% flora	5%	1%	5%	4%
Wasps				
# species	1	2	2	4
% flora	1%	2%	2%	5%
Butterflies				
# species	2	3	1	0
% flora	2%	3%	1%	-
Hoverflies				
# species	5	11	4	1
% flora	4%	12%	4%	1%
Muscoid Flies				
# species	6	2	3	3
% flora	5%	2%	3%	4%
Hummingbird				
# species	7	7	4	0
% flora	5%	8%	4%	-
Water				
# species	1	1	2	1
% flora	1%	1%	2%	1%
Wind				
# species	25	19	10	5
% flora	17%	21%	10%	7%
Selfers (predominantly)				
# species	47	27	48	23
% flora	32%	30%	48%	32%
(Obligate selfers) (subset)				
# species	13	3	9	2
% flora	9%	3%	9%	2%

community transects (Table 4) beeflies are diverse and very abundant in all communities.

Although the short-tongued muscoid flies are often more likely to contact anthers and stigmas than the long-tongued beeflies, simple abundance counts commonly overestimate their importance as pollinators due to their low floral visitation rate per unit time. While active foragers such as bees, beeflies or hummingbirds normally spend far less than 30 seconds visiting a particular flower, muscoids commonly spend from 5-10 minutes per flower, but even more extensive periods of time are spent resting on leaves, twigs or stones between subsequent visits. In both countries muscoid flies (particularly the Anthomyiidae in California) are extremely abundant on flowers in high latitudes or high altitudes (Moldenke, 1971, 1975), whereas they are an inconspicuous element in the transects reported herein (Table 3). Along these two transects more than 90 percent of the muscoid diversity is accountable to the Tachinidae, abundant flower visitors parasitic during their larval phase upon diverse insect groups. Tachinids are particularly prevalent as a flower visiting group in the Chilean desert, but scarce in the California deserts where they appear to have been replaced by other parasitic insects (e.g., Bombyliidae, Meloidae); their pronounced vestiture of extremely long setae may act to transfer pollen rather efficiently, but such analytic studies remain to be undertaken.

The hoverflies (Syrphidae) represent the sole noticeable lack of correspondence between the null hypotheses of convergence and actual field conditions. Hoverflies are faunistically diverse in California (E. Schlinger, pers. comm.) but neither abundant nor well-represented at the particular southern California transect sites. Except for the unique situation where one species, Eupeodes volucris, is abundant and a major source of outcrossing for numerous early spring desert annual species (at least during the years of this study), they exert little effect as pollinators within the community. This one species seems to be about the only flower-herbivore able to fly in the very cool and very windy conditions so typical of many of the days in the early spring in the Colorado Desert. In Chile, on the other hand, Syrphidae are very abundant in the Mediterranean scrub, and even more pronouncedly so in the forests and highest altitude matorral of the Cordillera de la Costa and at 3,000-4,000 m in the Andean Cordillera of central Chile. Nowhere in Chile is the syrphid fauna diverse, even though they are oftentimes very conspicuous elements of the flower visitor fauna.

Nearly all of the abundant syrphid species are predators upon the Aphidae as larvae; this facet of pollination ecology apparently is a function of an abundant aphid resource resulting from low levels of aphid predation by groups other than the Syrphidae. In central Chile, there are many species of introduced gregarious aphids which provide a large resource for predators; coccinellid beetles are uncommon in Chile and apparently the syrphid flies have responded to these introduced pest species with noticeably increased abundance (E. Schlinger, pers. comm.). In California, and western North America in general (Moldenke, 1971, 1976b), the primary flower visiting syrphids occur at high elevations and are large-bodied primarily Holarctic groups (e.g. Volucella, Eristalis) that are detritivores and herbivores as larvae, a faunal element conspicuously reduced in central Chile.

The most important single group of pollinators in all sites are the solitary bees. Forty percent of the flora rely upon solitary bees for the movement of pollen in the Mediterranean scrub and forest communities, whereas 25 percent and 27 percent of the flora, respectively, in the coastal and desert communities rely upon this group. The only significant differences between the community analogue comparisons are an increased percentage of the flora utilizing solitary bees and hoverflies in the Chilean matorral and a smaller percentage of obligate selfing and a compensatory increase in the reliance upon beeflies in the Chilean desert scrub.

The diversity and abundance of classes of pollinating agents is not only being monitored by ecologists, it is also being monitored through evolutionary time by the resident floras of California and Chile. The coevolutionary patterns of reliance upon certain insect groups as pollinating agents and the percentage of the flora reduced to genetic self-compatibility and habitual selfing are additional gauges of the relative success of pollinators. The relative percentages of the flora at each research site associated with a particular mode of pollination is shown in Tables 4 and 5. In every case (considering Cerro Potrerillo as a derivative desert community) there is much greater similarity between the analogous community sites in opposing hemispheres than between sites in different communities located along the same transect. The importance of selfing increases from a low level in the forested and chaparral community to a high in the deserts and coastal scrub (see also Moldenke, 1971, 1976b, 1979b). Increased incidence of the annual habit is the primary correlate of selfing as a reproductive strategy. All annual plants are to some extent r-strategists, usually finding existence too tenuous when genetically self-incompatible. Thus the vast majority of annuals in both California and Chile (even if locally efficiently pollinated and not scored as selfers in Tables 4 and 5), have evolved the ability to set seed facultatively in the absence of pollinators.

A paucity of all types of floral visitors, let alone the more efficient types of pollinators per se, is a chronic feature of maritime environments, where the coolness of the weather markedly decreases the abundance of floral-herbivores. In the desert where pollinators are usually limiting to all but the dominant plants, even during years of large amounts of rainfall and a peak emergence of pollinators, the total extent of the blooming season for annual plants will still be very restricted. An escape from pollinator limitation unavailable to desert annuals is to extend the blooming period of the species. Annual plants along the coast (e.g. Lasthenia spp.) may bloom for a period half again that of the same species in the desert and chaparral (6:4 weeks) (Moldenke and Neff, 1974b). Though an equivalently high percentage of the plant species along the coast and in the desert are genetically self-compatible, the most telling characteristic of their pollination ecologies is the observation that more than twice as many species along the coast are obligate selfers (Moldenke, 1976b). Many of the self-compatible species in the desert undoubtedly receive considerable outcrossing during a year of appreciable rainfall.

e) Resource Utilization Strategies

As in all other communities studied, the preponderance of species of flower-herbivores are found in association with 1-3 plant species (Moldenke 1971, 1975, 1979c; Heithaus, 1974). This trend is apparently always true on a local sample basis (Figure 2), even if the rare species are excluded from the tabulation; faunistic lists that deal only with preferred resources across wide geographic extents are however very different in divergent community types (Moldenke, 1976b, 1979).

The most difficult and time-consuming aspect of this study has been the determination of the relative degrees of feeding specialization exhibited by solitary bees along the two transects. Host preference among species of bees ranges from the extreme generalist with virtually catholic tastes to the extreme specialist which restricts its pollen collection to a single plant species; examples of all possible intermediates between these extremes are known. Host specialization among

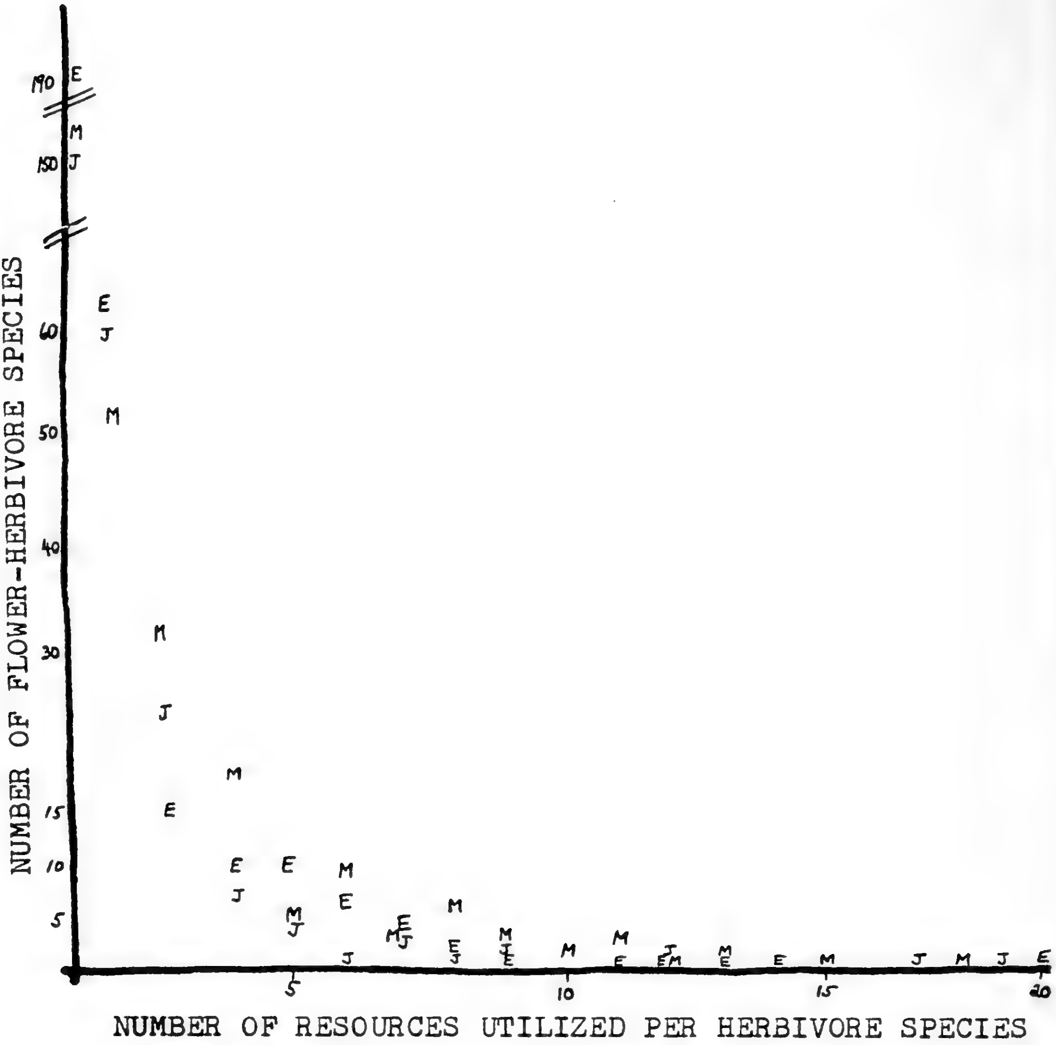


FIGURE 2. Number of resource plants utilized by Mediterranean scrub flower-herbivores.

E = Echo Valley mature chaparral
J = Japatul Valley burned chaparral
M = matorral of Fundo Santa Laura

bees is typically a relative phenomenon and thus the complete host range of a given bee species is essential for a knowledge of its degree of specialization. The degree of specificity observed at any point site may simply reflect the absence of certain plant taxa within the acceptable host range of the bee species or may be the outcome of competitive exclusion by sympatric nectar and pollen feeding species. In an attempt to deal with this problem, this study has entailed the observation of bee feeding habits at localities other than the established transect sites as well as extensive museum reference and correspondence with bee biologists (Moldenke and Neff, 1974a, 1974b).

Preliminary findings from these ongoing studies make it clear that the majority of the bee species of both Chile and California are indeed specialist feeders upon a particular genus, family, or similar limited array of closely related plant taxa. In the Pacific Coast and Sonoran Desert of the United States, there are nearly 2,000 species of bees, of which nearly 60 percent or 1,200 species are specialized feeders. However, of these 1,200 specialists at least 950 frequent taxa of only about 45 plant genera (Moldenke, 1979).

In other words, a one-to-one bee/plant relationship is rarely observed in nature. Rather there is tremendous overlap in the host preferences of specialist bees. It is pertinent to note that, while in many cases the relationship between floral host and specialist bee is indeed that of plant/primary pollinator (Hurd et al., 1971; MacSwain et al., 1973), this does not hold true in all cases. A plant which has "coevolved" with one specialist flower visitor commonly has not just one, but many species of specialist bees associated with it and is normally visited by numerous generalist taxa as well. Furthermore, in many instances, particularly those involving the numerous small specialist bees (3-6 mm body length), the bees are highly host specific and yet appear to be largely ineffective as agents of cross-pollination of their host plant due to such reasons as failure to contact the stigma, limited flight range and paucity of movements between individual plants (as opposed to intra-plant movement). While the factors which permit and maintain host specificity in bees are as yet poorly understood, a primary factor may possibly be the differing compositions of pollen (Vivino and Palmer, 1944), their relative nutritional values for solitary bees (Levin and Haydak, 1958) and the morphological specializations of the bees which presumably increase foraging efficiency (Linsley and MacSwain, 1958).

The majority of the flora must therefore rely on generalist bees or other flower frequenting groups for cross-pollination. This same phenomenon is apparent in Chile where we estimate that about 50 percent of the specialist bee taxa are primarily associated with about a dozen genera of plants.

In both countries both the number of specialist bee taxa and the percentage of specialist feeders in the total bee fauna increases with aridity (Moldenke, 1979). In the desert scrub communities 62 percent of the plant taxa that rely upon bee pollination have coevolved with specialist taxa, whereas 50 percent of the Mediterranean scrub and deciduous forest flora relying on bee pollination have specialists and a mere 25 percent of the coastal bee-pollinated flora possesses specialist vectors (Tables 4 and 5).

Resource utilization patterns of halictine bees in analogous communities provides another instance of convergent evolution of bees in the two continents. The halictines, a cosmopolitan group comprised of numerous small-to-medium sized species, are noted for their wide range of steps of social organization and the virtual absence of oligolecty or floral host specialization. The halictines in our study sites are generalists; while at any point in time individuals of a given species may show a marked preference for some particular plant species (commonly the plant producing the most abundant floral resources available in the community at the time), these preferences may change rapidly through the flowering season as different taxa come into bloom and other floral herbivore groups initiate or cease activity. As one might expect for such a generalist forager, these halictines generally lack the complex specializations of the feeding and pollen collection and transport systems so typical of specialist bees (Linsley, 1958). The generalist strategy the halictines pursue would appear to be most advantageous in situations where there is a rapid turnover of dominant flowering taxa through the flowering season.

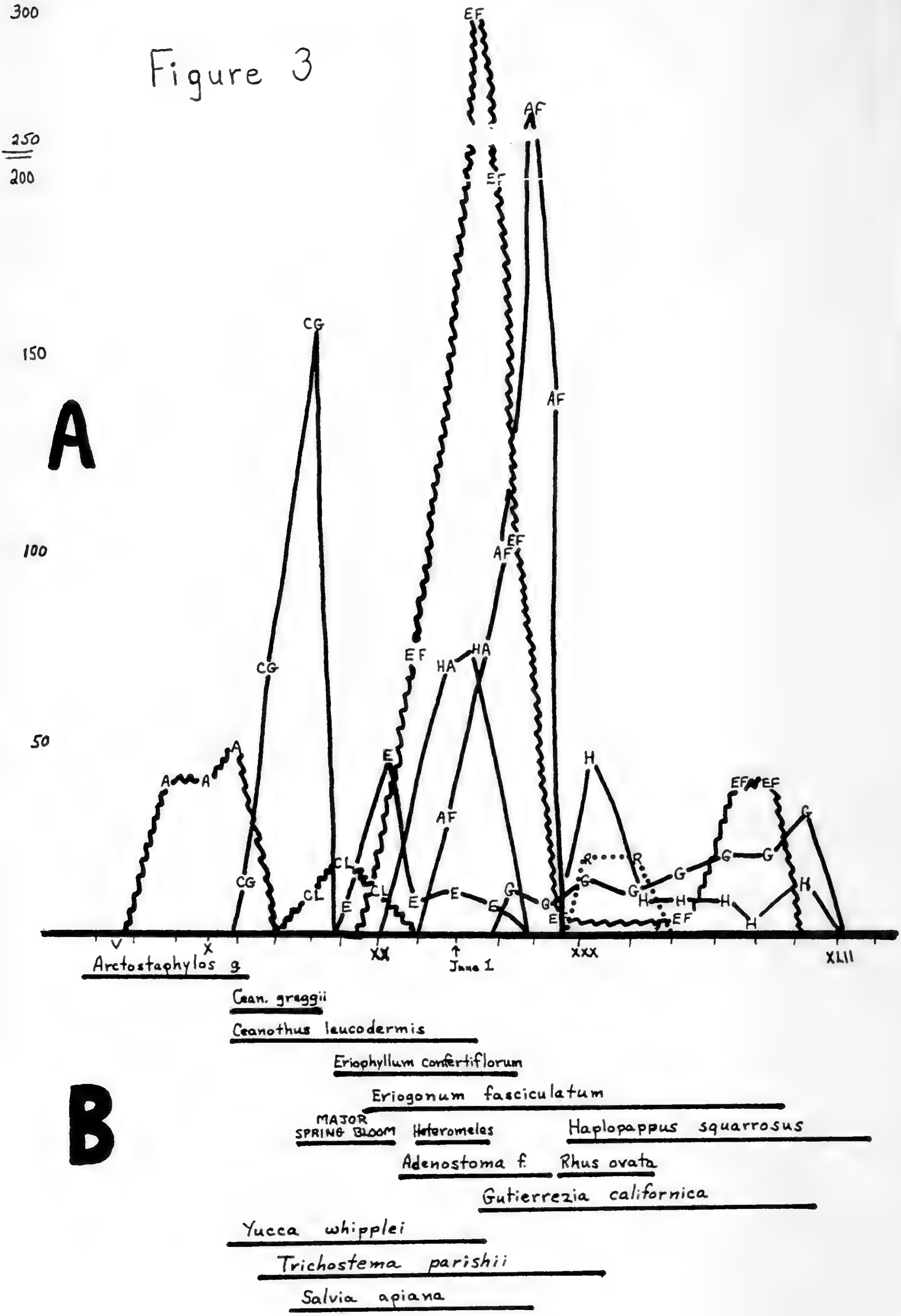
The Mediterranean scrub floras of both hemispheres have to a certain extent evolved the characteristic of non-overlapping flowering periods to insure minimum levels of pollen miscegenation (Mooney, 1972); only deep-rooted woody species capable of utilizing sufficient water throughout the dry summer can successfully compete by this mode. Figure 3 shows that all of the dominant perennials in the California site bloom at least in part either before or after the general blooming peak of all species and eight are capable of blooming after June 15th, by which time drought conditions are pronounced. Three of the four dominant species which do overlap the blooming peak to the greatest extent are not primarily bee-pollinated, possessing exclusionary morphologies adapted to moth(2) and hummingbird(1) pollination and are unavailable to halictine bees in general. All of the other dominant plant species (with the possible exception of Arctostaphylos) are conspicuously mass flowering taxa with inforescences of small specialized flowers, unlike most temperate North American communities where anemophily dominates. Semisocial halictine bees are very efficient pollinators in this habitat (especially in Chile) because they are able to utilize each of the shrub bloomers in succession throughout the blooming season (Figure 3). The flowers of the dominant species of the Mediterranean scrub community are structurally relatively similar and thus do not require morphological specialization as a prerequisite for efficient foraging on any particular species. In the compressed blooming season of the desert, on the other hand, competition among both annual and perennial plants for specificity of pollen transfer has led to a contemporaneous array of dissimilar floral morphologies (Simpson 1977; Simpson *et al*, 1977).

In the coastal scrub, where floral herbivores of all types are scarce, the halictines are not particularly diverse; yet they are the dominant pollinators for twenty-five percent of the bee-pollinated flora. A similar percentage (22%) of the bee-pollinated flora of the Mediterranean scrub relies upon halictines for pollination. In contrast, only two to three percent of the bee-pollinated flora relies upon the halictines as their primary pollinators in the temperate forests, where flowers tend to be widely scattered and the dominant mass bloomers are anemophilous, and in the desert, with its unpredictable yet strongly weather

FIGURE 3. Seasonal resource utilization by halictine bees in the mature chaparral at Echo Valley. (excludes the very poorly known Halictus harmonius found on Adenostoma and Eriogonum in large numbers at this site)

A) Relative abundances of all halictines on the dominant resources from weeks VI to XLII of study. Note that three dominant species are unvisited by halictines.
B) Periods of peak anthesis of the dominant shrub species; periods of scattered blooming are not included. Note that Eriogonum is not a preferred resource for much of its period of anthesis. The period of the major spring bloom, from April 1 to May 15, is also indicated.

Figure 3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Cean. greggii
Ceanothus leucodermis
Eriophyllum confertiflorum
Eriogonum fasciculatum
MAJOR SPRING BLOOM
Heteromeles
Haplopappus squarrosus
Adenostoma f.
Rhus ovata
Gutierrezia californica
Yucca whipplei
Trichostema parishii
Salvia apiana

controlled patterns of alternating dearth and abundance of flowers (Tables 4 and 5).

Feeding specialization is especially pronounced in the desert regions of both continents. Sixty-three percent of the total bee fauna in the California deserts are probable or apparent specialist feeders (Moldenke, 1976). In Chile feeding specialization information is more imprecise, but 59 percent of the presently recognized desert taxa are apparently specialist feeders. The Chilean deserts have not been extensively collected for insects, and the species still to be described will probably increase this percentage still further. Generalist-feeding desert bees which are abundant in the deserts of Catamarca, Argentina (e.g. Centris spp; Neff unpub. data) are not present in significant numbers in either Chile or California. In the western extremes of the deserts of the two continents, rainfall is lowest and least predictable, a situation which favors the specialist flower visitors which are utilizing precise environmental cues to emerge synchronously with their particular host plant.

In the cooler and moister temperate forests and immediate coastal environments, the blooming period of individual plants as well as the whole blooming season is protracted and less selective advantage rests with precise synchronous emergence times. Flower-herbivores of all types decrease as the temperature drops and generalist feeding heterothermic bumblebees become the major flower visitors and pollinators in all but the densest forest types. On the transects reported herein, bumblebees are nearly absent (one rare species observed in both continents), but 500 miles poleward in each continent they comprise more than 50 percent of the flower visitor individuals and more than 95 percent of the total flower-herbivore biomass. Specialist solitary bees are nearly absent in these climates, and the bulk of other vectors are generalist-feeding muscoid flies and halictine bees.

f) Feeding Overlap of Sympatric Specialists

A discussion of the species diversity and resource utilization patterns of flower-herbivores in Chile and California must analyze distributional patterns and niche overlap. Studies in California (Moldenke and Neff, 1974a, 1974b; Moldenke, 1971, 1976) have shown that bee species usually show a remarkable degree of fidelity to habitat type, the exception being high altitude Sierra Nevada communities where β-diversity is extremely low. Although data for other groups is not as good, this fidelity apparently is characteristic of pollinating taxa in general. The most obvious feature of bee distribution in Chile (Moldenke and Toro, in prep. is the exceedingly wide habitat and altitudinal tolerances exhibited by most Chilean bees. Frequently the same species occurs in a coastal region, a matorral locality and at 3,000-4,000 m in the Andean Cordillera. Often species are distributed from the secondary growth in the temperate forests of southern Chile (Valdivia, latitude 40° S) throughout all altitudes and most intervening community types to the edges of the Atacama Desert (latitude 29° S). Rather than a habitat or altitudinal replacement of species, which is the general rule in California, the general pattern in Chile is replacement with large changes in latitude.

This observation sheds considerable light on the pattern of resource utilization and sympatry of closely related competitors between the two regions. In California large numbers of congeneric, sympatric, specialist-feeding taxa are often found on the same host plant. For example, ten very closely related species of *Perdita* (*Heteroperdita*) are specific to *Coldenia* at the Ocotillo desert scrub site (Timberlake, 1954 and unpub. obs.) and nearly all the described species (18) of *Proteriades*, a specialist on *Cryptantha*, occur on the same species at Riverside, California (Timberlake and Michener, 1950). Our studies (Moldenke and Neff, 1974b) at the California sites frequently documented instances of 4-10 congeneric specialists utilizing the same host plant. In Chile, however, even though there are many specialist-feeding taxa and many have coevolved with the same resource genus, our studies (Moldenke and Neff, 1974b) show very few examples of sympatric congeneric specialists within any localized research site. (Two instances of three congeneric specialists on the same Chilean pollen plant are the only notable examples.) The factors controlling the distribution and co-occurrence of Chilean bees are even less well-delineated than the corresponding ones for California bees. However, in this regard the differing effects of Pleistocene glaciation in the two regions play a significant role. The lack of large refugia for the Chilean fauna and the considerable contraction of an already geographically limited inhabitable region must have led to widespread faunal extinction Competition during pluvial periods must have been most severe between congeneric specialists since they presumably differed less in their requirements than did specialist competitors in differing genera. The present interpluvial pattern of species distributions reflects the recolonization of large regions of expanding semiarid vegetation (as the forests recede to the south) by the depauperate fauna that survived the intense competition. In the arid portions of North America, pluvial periods had the effect of fractionating continuous distribution patterns. Though the total arid and semiarid area may have shrunk, it never decreased to the proportions that must have occurred in Chile. The imposed patchiness of distribution patterns presumably has led to the rate of speciation evidenced in California. Present patterns of sympatry may represent subsequent reinvasion of the now continuous widespread semiarid conditions.

CONCLUSIONS

The basic thrust of my recent research has been to determine the variety of interactions in the interface between flowering plants and flower-feeding herbivores. In all, five series of clinally related community analogues have been studied in order to elucidate the patterns at a community level (Moldenke, 1975; Moldenke and Lincoln, 1979; Neff, unpub.). The methodology has been designed to analyze both the manner in which diverse taxonomic groups of herbivores utilize the available floral resources in the different communities and the manner in which the flowering plants partition the potential pollen vectors. The parameters such research has begun to quantify are: the degree of specialization of interacting plant and animal species; the relative importance of buffered interactions within trophic pyramids in terms of the number of generalist flower feeders and the number of plant species pollinated by many vector taxa; and the degree of redundancy built into the food web by the interactions of taxonomically different but energetically or ecologically equivalent species.

Studies along an altitudinal transect of fifteen community types across central California (Moldenke, 1971, 1975), have demonstrated that:

1) Total species number of flower herbivores increases with stability and predictability of the climate.

2) Niche-specialization as a strategy is progressively more successful in terms of total number of species and total individuals of both plants and flower visitors as the climate ameliorates.

3) The percentage (by species count) of highly specialized species of both plants and flower-feeding herbivores increases in the most severe environments at the expense of the more moderately specialized species; however, the vast bulk of the individuals and trophic energy flow are attributable to a few extremely

abundant supergeneralist species.

4) Energetic flow chart redundancy attributable to distinct species of herbivores which feed on overlapping food resources increases in extreme environments. This increase in generalists is especially noticeable in terms of relative biomass and abundance of individuals and occurs most notably at the expense of moderately but not highly specialized species.

5) Similar physiognomic communities at widely different geographical localities are in most cases much more similar in terms of their pollination systems and the feeding habits of their respective pollinators than different community types at a given geographical site.

All of these results are commensurate with the hypothesis that, while there is a tendency towards specialization in most environments, it is only in the most predictable or stable environments that the loss of both behavioral and genetic flexibility resulting from specialization is a viable strategy. However, in the most extreme environments (alpine and desert), behavioral feeding specialization may occur and be a necessary prerequisite permitting the existence of ephemeral populations which thrive briefly but frequently must recolonize following local extinctions brought about by the severe unpredictability of these environments.

Results cited in this report not only substantiate the pattern previously recorded in California but further demonstrate that:

1) Total species number and diversity trends are directly correlated to similar climatic conditions in both continents;

2) Emphasis is on niche-generalists in maritimal and Mediterranean scrub environments in terms of relative species numbers;

3) Emphasis is on niche-generalists in terms of total number of individuals in the Mediterranean scrub environment;

4) Feeding specialists are the major adaptive life-style in the desert;

5) As one travels poleward along the Pacific coasts of both continents, flower-feeding generalists represent nearly all the biomass and virtually all the significant energy flow in both the maritime and forest environments.

The basic components of competitive species interactions have indeed resulted, at the local level in both continents, in the convergent evolution of similar species diversity, similar gross efficiency (relative biomass of flower-eating herbivores supported) and cross-link patterning of this section of the community food web.

Two further basic tendencies in convergent evolution which are manifest in this intercontinental site comparison indicate the possibility of generalizing the results to other sections of the world:

1) On a world-wide scale bee speciation has occurred at an extremely high frequency under certain climatic regimes (Linsley, 1958). The semiarid/arid regions of the southwestern United States, central Chile, South Africa, northern coast of Africa and parts of Australia support very rich bee faunas (Linsley, 1958). (California = nearly 2,000 species; Chile = 500, probably 700 when northern regions are fully explored -- contrast these figures to 65 species for southern Florida (Graenicher, 1930) and only 356 for Panama and adjacent Central America (Michener, 1954) -- two regions with non-anemophilous floras more diverse than those under consideration in this report even though they are smaller in area and contain less topographic heterogeneity.)

2) The floras of Chile and California are well known to be quite diverse, considering latitude and geographical extent. Geographically, both regions contain a remarkable amount of varied relief, which has facilitated rapid evolution of a relatively large flora, characterized in both instances by a heavy emphasis on annual species (about 50 percent of total, or at least three times the world average; P. Raven, pers. comm.). Annual plants are often characterized by synchronized blooming, short life cycles, emphasis on evolved genetic self-compatibility and facultative inbreeding. Therefore the diversity and distribution of resources through space and time are roughly equivalent in the opposing continental sites.

The conclusions drawn from the California/Chile research corroborate in general that it is the over-all climatic characteristics which determine plant phenology and structure, which in turn limit and define the emphases of different strategies of resource utilization (Cody, 1974; Schoener, 1972). Equally important, however, are the observations of non-correspondence. Most importantly though, other ecological subunits of the community may show one-for-one or two-for-one species correspondence in the two hemispheres (Mooney, 1977), whereas the species-rich nature of appropriate pollinator guilds (not defined in the present paper in other than the broadest taxonomic terms) precludes this type of comparison or species-for-species analysis. That a significant difference in such species packing phenomena does occur, is seen in the near absence of congeneric bee species utilizing the same resource in common in Chile, as is the distinctly higher values of species richness found throughout all the North American sites relative to their Chilean analogues.

Procedurally paramount is the role exerted by the fire in chaparral/matorral. Even though on a total floristic basis both Mediterranean regions are characterized by very diverse annual floras, in Chile the annual and shrub floras are apparently synchronous, whereas in California annual plants are nearly absent from mature chaparral. Because the fire succession is a very short one in California and the extent of precolonial natural fires was supposedly very limited, I feel that it is procedurally more equitable to combine both parts of the California cycle for comparison with the matorral. The presence of a cycle in California is a distinct lack of convergence, however, and for some aspects of the communities which are not suitably additive in this manner analysis of convergence becomes moot. An additional important lack of convergence in evergreen sclerophyll scrub is the pronounced diversity of the dominant shrubs of Chilean matorral.

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MISCELLANEOUS NEW SPECIES OF MASDEVALLIA (ORCHIDACEAE) FROM BOLIVIA, ECUADOR, PERU AND VENEZUELA

Carlyle A. Luer
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Masdevallia agaster Luer, sp. nov.

Planta parva caespitosa, foliis coriaceis anguste ellipticis, flore solitario horizontali flavescenti, tubo sepalorum cylindrico leviter arcuato non ventriculoso intus pubescenti partibus libris obtusis caulis recurvatis, pedunculo abbreviato, petalis albis supra basin unguiculatam uncinatis, labello ligulato obtuso.

Plant small, epiphytic, caespitose; roots slender, flexuous. Secondary stems slender, unifoliate, 1.5-2 cm long, enclosed by 2-3 loose, tubular sheaths. Leaf erect, coriaceous, narrowly elliptical, 7-9 cm long, 1.3-1.6 cm wide, the acute apex tridenticulate, narrowly cuneate below into an indistinct petiole 1-2.5 cm long. Inflorescence a solitary flower borne by a suberect to ascending, slender peduncle 1.5-2.5 cm long, with a bract near the base, from a node low on the secondary stem; floral bract tubular, 8-9 mm long; pedicel 9-10 mm long; ovary green, pitted, 6 mm long; sepals deeply connate to form a horizontal, dorsally curved, cylindrical tube without a ventricose dilatation, with only a small mentum below the column-foot, yellow, becoming whitish above the middle, glabrous without, glandular pubescent within on the free surfaces, the 3 tails terete, yellow, recurved, the dorsal sepal narrowly oblong-obovate, 25 mm long, 11 mm wide at the widest, connate to the lateral sepals for 21 mm, the free portion rounded, the obtuse apex contracted into the tail, the lateral sepals 23 mm long, connate for 18 mm, 18 mm across spread out above the sepaline tube, the free portions broadly ovate, oblique, each 10 mm wide, the subacute apices contracted into the tails; petals white, oblong, 7 mm long, 2.75 mm wide, the obtuse apex bilobed-apiculate, with a longitudinal callus along the lower margin ending in an incurved, hook-like appendage just above the shortly unguiculate base; lip white, suffused with purple along the margins, oblong-ligulate, 7 mm long, 2.75 mm wide, the apex obtusely rounded, the disc with a pair of low, longitudinal calli near the middle, the truncate base hinged beneath; column white with purple margins, semiterete, 5 mm long, the foot 3 mm long with an incurved extension.

ETYMOLOGY: From the Greek *a-*, "without," and *gaster*, "belly," in reference to the sepaline tube free of any ventricose swelling.

TYPE: *ECUADOR*: ZAMORA-CHINCHIPE: epiphytic in cloud forest between Loja and Zamora, alt. ca. 1500 m, collected by Walter Teague s.n. cultivated in San Francisco, Calif., flowered in cult. 12 Dec. 1978, *C. Luer 3644* (Holotype: SEL).

DISTRIBUTION: Southeastern Ecuador.

This species is readily recognized by the more or less horizontal, arcuate, tubular flowers without a ventricosity. The free portions of the sepals are glandular pubescent within and provided with recurving tails.

Masdevallia ampullacea Luer & Andreetta, sp. nov.

Planta parva caespitosa, pedunculo foliis breviore, flore solitario tubuloso ventricoso intus pubescenti albido flavo-suffuso caudis aureis, petalis oblongis carinatis, labello tricolorato oblongo marginibus revolutis prope medium angulatis.

Plant small to medium in size, epiphytic, caespitose; roots slender, flexuous. Secondary stems slender, blackish, unifoliate, 10-23 mm long, enclosed by 2-3 close, tubular sheaths. Leaf erect, coriaceous, narrowly elliptical, shortly petiolate, 4-10 cm long including the 1-3 cm long petiole, 1.5-2 cm wide, the subacute apex tridenticulate, the base narrowly cuneate into the petiole. Inflorescence a solitary flower borne more or less transversely by a slender, suberect peduncle 3-4 cm long, with a bract near the base, from a node low on the secondary stem; floral bract tubular, 5-9 mm long; pedicel 8-13 mm long; ovary 4-6 mm long, green; sepals white to light yellow, suffused and veined in yellow to orange, connate into a ventricose tube, the dorsal sepal connate 15-18 mm, the blade 23 mm long, 10-11 mm wide at the widest, pubescent within above the middle, the free portion suborbicular, the rounded apex produced abruptly into an orange, erect, filiform tail ca. 3.5 cm long, the lateral sepals connate 18 mm into a ventricoae lamina 21 mm long, 13-15 mm wide above the sepaline tube, pubescent within above the middle, the free portions broadly ovate, the obtuse apices produced into spreading tails similar to that of the dorsal sepal; petals yellow-orange, oblong, 7 mm long, 2.5-3 mm wide, the subtruncate apex more or less twisted with cellular erose margins, with a longitudinal carina above the lower margin ending in an obtuse angle above the base; lip oblong-ligulate, 6 mm long, 2 mm wide, with acute lateral angles near the middle formed by revolute margins, the rounded apex orange, purple around the angled middle, the truncate base white, hinged beneath; column white with purple margins, semiterete, 6 mm long, the foot 3 mm long with a short extension.

ETYMOLOGY: From the Latin *ampulla*, "a flask or bottle," in allusion to the shape of the sepaline tube.

TYPE: *ECUADOR*: MORONA-SANTIAGO: epiphytic in cloud forest near Bomboiza, alt. 1500 m, A. Andreetta 16, cultivated in Cuenca, flowered in cult. 18 Aug. 1978, *C. Luer 3319* (Holotype: SEL).

DISTRIBUTION: Southeastern Ecuador.

This species is most similar to the Peruvian *M. fuchsii* Luer. Both are characterized by the yellowish sepaline tubes, but the former is distinguished by the much longer sepaline tails and a narrower lip sharply angled near the middle.

Masdevallia aops Luer & Malo, sp. nov.

Species haec Masdevalliae pallidae (Woolward) Luer persimilis, sed sepalis lateralibus sine maculis et carina petalorum cum ala supra medium et unco crasso supra basin differt.

Plant small, epiphytic, caespitose; roots slender, flexuous. Secondary stems blackish, unifoliate, 8-15 mm long, enclosed by 2-3 loose, tubular sheaths. Leaf erect to suberect, coriaceous, elliptical-spatulate, petiolate, 4-6 cm long including the 1.5-2.5 cm long petiole, 2-2.5 cm wide, the apex obtuse to rounded, tridenticulate, cuneate below into the channeled petiole. Inflorescence a solitary flower borne by an erect, slender, 4-4.5 cm long peduncle, with a bract near the base, from a node low on the secondary stem; floral bract tubular, 10 mm long; pedicel 10 mm long; ovary 7 mm long; sepals glabrous, white, suffused and veined in pale yellow, the dorsal sepal erect, obovate, concave above the middle, 21 mm long, 15 mm wide, connate to the lateral sepals for 4 mm, the rounded apex abruptly produced into an erect, filiform, yellow tail 3.5-4 cm long, the lateral sepals elliptical, oblique, wide-spread, connate 4 mm over a transverse fold beneath the column-foot, 18 mm long, 13 mm wide, the obtuse apices contracted into tails similar to that of the dorsal sepal; petals white, oblong, 6 mm long, 2-2.5 mm wide, the truncate apex tridentate, with a callus along the lower margin, produced into an obtuse wing above the middle and terminating in a thick, incurved, uncinate process above the unguiculate base; lip erect, white with purple flecks, oblong, 5.5 mm long, 3 mm wide, the rounded apex provided with a purple, central callus protruding beyond the margin, the rounded base hinged beneath; column white marked with purple, semiterete, 5 mm long, the apex toothed, the foot 4 mm long with an incurved extension.

ETYMOLOGY: From the Greek a-, "without," and ops, "eye, or eyed," in reference to the absent "eye-spots" of the lateral sepals.

TYPE: ECUADOR: MORONA-SANTIAGO: epiphytic in cloud forest of the Cordillera Oriental, alt. 1700 m, Apr. 1975, B. Malo s.n., cultivated near Cuenca, flowered in cult. 9 July 1977, C. Luer 1657 (Holotype: SEL).

DISTRIBUTION: Southeastern Ecuador.

Masdevallia aops was included in the distribution and discussion of M. pallida (Selbyana 2:377) because of the similarity of these two species. Recent examination of more living material leads me to the conclusion that the southeastern Ecuadorian population without the dark "eye-spots" on the bases of the lateral sepals is specifically distinct. In addition to the absence of the spots the carina of the petals is produced into a distinct wing above the middle in addition to the thick, incurved, uncinate pro-process above the base.

Masdevallia dispar Luer, sp. nov.

Inter species sectionis Alaticaulium Krzl. planta mediocri, pedunculo foliis aequilongo, racemo congesto paucifloro floribus successivis, cupula sepalorum non profunda cum synsepalo expanso, petalis oblongis cum carina in callum rotundatum terminata et labello subpandurato antice verrucoso denticulato distinguitur.

Plant medium in size, epiphytic, caespitose; roots slender, flexuous. Secondary stems unifoliate, short, 1-2 cm long, enclosed by 2-3 loose, brown sheaths. Leaf erect, dark green, coriaceous, narrowly obovate, 6-10 cm long, 1.0-1.6 cm wide, the subacute apex tridenticulate, gradually narrowed below into an ill-defined, channeled petiole 1-2.5 cm long. Inflorescence a 3- to 5-flowered, congested raceme of successive, single (occasionally 2) flowers borne by an erect to suberect, slender, triquetrous peduncle 6-8 cm long, with a bract at the base, from a node near the base of the secondary stem; floral bracts close, tubular, imbricating, 8-10 mm long; pedicel 13-16 mm long; ovary 5 mm long; dorsal sepal yellow-green, obovate, subverrucose within, 7 mm long, 4 mm wide, connate to the lateral sepals for 5 mm, the triangular free portion acuminate into a slender, erect tail to 3 cm in length; lateral sepals dark purple, more or less spread before the shallow sepaline cup, microscopicallu verrucose, obovate, oblique, connate 15 mm into a broad lamina 20 mm long, 15 mm wide, forming a shallow mentum, the subacute apices contracted into slender tails up to 12 mm long; petals white, oblong, 5 mm long, 1.5 mm wide, the obtuse apex bilobed, edged in purple, with a longitudinal callus along the lower margin ending in a low, rounded swelling; lip cream dotted with red purple, oblong-subpandurate, 5 mm long, 1.5 mm wide, with obtuse marginal folds above the middle, the suborbicular apical portion revolute, verrucose, denticulate, oblong below the middle, the truncate base hinged beneath; column pale green suffused with rose, semiterete, 5 mm long, the foot 3 mm long with a short extension.

ETYMOLOGY: From the Latin dispar, "different," in allusion to the dissimilarities of the species as compared to others.

TYPE: VENEZUELA: TACHIRA: Quebradas Los Canitos, road to Fundación, alt. 900 m, 1972, collected by R. Mejia s.n., cultivated by O. Arango at Estrella, Colombia, flowered in cult. 2 Oct. 1977, C. Luer 1887 (Holotype: SEL).

DISTRIBUTION: Venezuela.

This species was identified as the Costa Rican Masdevallia lata Rchb. f. in Venezuelan Orchids Illustrated 6:230, 1976, and M. sanctae-fidei Krzl. was erroneously included in the synonymy. The peduncle of M. lata is ascending, thin, round in cross-section, and provided with a bract below the middle. The peduncle of M. dispar is sharply triquetrous with a bract only at the base.

Masdevallia dynastes Luer, sp. nov.

Planta mediocris caespitosa, pedunculo foliis anguste obovatis aequilongo, bractea florali inflata, pedicello cum filamento prominenti, ovario crasso alte cristato, flore solitario carnoso virescenti myriostictato caudis clavellatis aureis, sepalis in cupulam suborbicularem connatis, petalis pentangulatis, labello obtuso subtriangulari ad pedem columnae longissimum curvatum articulato.

Plant medium in size, epiphytic, caespitose; roots slender, flexuous. Secondary stems slender, unifoliate, 1.5-2.5 cm long, clothed by 2-3 close, ribbed sheaths. Leaf erect, coriaceous, narrowly obovate, petiolate, 7-10.5 cm long including the 2-3.5 cm long petiole, 1.0-1.3 cm wide, the subacute apex tridenticulate, the base gradually narrowed into the channeled petiole, the petiole and secondary stem green with purple dots. Inflorescence a solitary flower borne by an erect, slender peduncle 6.5-10.5 cm long with a bract below the middle, from a node low on the secondary stem; floral bract inflated, 6 mm long; pedicel 6 mm long with a filament ca. 4 mm long; ovary 3 mm long, 3 mm wide, with 6 overlapping, undulating crests, green intensely spotted with dark purple; sepals glabrous, fleshy, light green diffusely covered by small dots and dashes of purple-brown, the dorsal sepal concave, subquadrate, 10 mm long, 10 mm wide, connate to the lateral sepals for 7 mm, the free part transversely ovate, the obtuse apex produced into a thick, orange, clavate tail 7 mm long, the lateral sepals more or less oblong, 20 mm long, each 4 mm wide, connate to the column-foot for 7 mm and to each other for 2 mm to form with the dorsal sepal a globose sepaline cup, the subacute apices contracted into tails similar to that of the dorsal sepal; petals greenish white, pentangular, 5 mm long, 1.5-2.5 mm wide, the yellow apex acute, the lower margin with a thickened, obtuse angle above the middle and a larger, acute angle below the middle, the unguiculate base inserted obliquely on the lower portion of the column; lip yellow marked with red-brown, ovate-triangular, 6 mm long, 4.5 mm wide, with marginal folds above the middle forming a suborbicular anterior lobe with revolute margins, the broadly truncate base thickened, deflexed, hinged below to the column-foot; column white, semiterete, 6 mm long, with a curved foot 7 mm long with a short extension.

ETYMOLOGY: Named for the coleopteran genus Dynastes in allusion to the rhinoceros beetle-like appearance of the flowers. Dynastes from the Greek, "a ruler."

TYPE: ECUADOR: BOLIVAR: epiphytic in cloud forest between Guaranda and Balzapamba, alt. ca. 2500 m, Aug. 1978, C. Luer, J. Luer, A. Hirtz & A. Andreetta 3846, cultivated by Hirtz in Quito, flowered in cult. 5 Feb. 1979 (Holotype: SEL; Isotype: JAUM).

ADDITIONAL MATERIAL EXAMINED: ECUADOR: IMBABURA: epiphytic in cloud forest between Otavalo and Apuela, alt. 2250 m, 8 Feb. 1979, C. Luer, J. Luer, R. Escobar & A. Hirtz 3940 (SEL, JAUM).

DISTRIBUTION: Western Ecuador.

The flower of this species appears similar to that of Masdevallia pachyura Rchb. f., but M. dynastes is easily distinguished by the single-flowered inflorescence and the multi-angled petals. The thick, rounded, sepaline cup terminated by three short, thick, protruding tails reminds one of a horned beetle.

Masdevallia graminea Luer, sp. nov.

Inter species sectionis Polystictarum Krzl. pedunculo foliis subduplo longiore, recemo congesto, floribus glabris albis caudis viridibus, ovario non-alato, tubo sepalorum supra mentum profunde angulato et labello trilobato dignoscenda.

Plant small to medium in size, epiphytic, the rhizome ascending or shortly repent to caespitose; roots slender, flexuous. Secondstems slender, channeled, unifoliate, 1.5-2.5 cm long, sheathed by 2-3 close, thin, tubular sheaths. Leaf erect to suberect, coriaceous, long-petiolate, the blade elliptical, 6-12 cm long including the 2.5-5 cm long petiole, 1.5-2 cm wide, the obtuse apex tridenticulate, the base cuneate into the slender petiole. Inflorescence a short, 1.5-2.5 cm long, erect, congested, several-flowered (4-8), distichous raceme borne by an erect to suberect, slender peduncle 12-20 cm long, with 2-3 close, tubular bracts, from a node low on the secondary stem; floral bract translucent, cucullate, acute, ca. 2 mm long; pedicel 1.5-2 mm long; ovary non-winged, green with purple dots, 1.5 mm long; sepals white with infrequent, pale purple dots, the triangular free portions terminated by slender, terete, green tails dotted with purple and 5 mm long, the dorsal sepal oblong, 10 mm long, 3.5 mm wide, connate to the lateral sepals for 7 mm to form a sepaline tube with a sharp, deep, transverse, ventral fold before a rounded mentum, the lateral sepals obovate, 9 mm long 3 mm wide, connate for 5 mm over the transverse fold; petals translucent white marked with purple, oblong-cuneate, 2.75 mm long, 1 mm wide, the truncate apex irregularly toothed, with a longitudinal carina along the lower margin, more pronounced toward the base; lip white marked with purple, rigidly arcuate, ovate-ligulate, 3.25 mm long, 1.5 mm long spread out, 3-lobed, the lateral lobes marginal, erect, ending in acute angles above the middle, the middle lobe rounded; column red-purple, semiterete, 2.5 mm long, with a foot equally long plus a thick, incurved extension.

ETYMOLOGY: From the Latin gramineus, "grass-like," in allusion to the habit of the plant with the grain- or cereal-like head terminating the slender stem.

TYPE: ECUADOR: CHIMBORAZO: epiphytic in cloud forest near Pagma, alt. 2800-3000 m, June 1977, W. Teague s.n., cultivated in San Francisco, Calif., flowered in cult. 15 Dec. 1978, C. Luer 3645 (Holotype: SEL).

ADDITIONAL MATERIAL EXAMINED: ECUADOR: BOLIVAR: epiphytic in cloud forest between Guaranda and Balzapamba, alt. ca. 2500 m, Aug. 1978, C. Luer, J. Luer, A. Andreetta & A. Hirtz 3962, cultivated by A. Andreetta in Cuenca, flowered in cult. 11 Feb. 1979 (SEL).

DISTRIBUTION: Western Ecuador.

This little species of the "polysticta" group may be characterized by the medium-sized, petiolate leaves, the nearly twice-longer erect, slender peduncle bearing a short, distichous raceme of glabrous, white, tubular flowers with green tails shorter than the sepaline tubes. The truncate petals are irregularly toothed, and the lip is rigidly arched with erect, marginal, lateral lobes.

Masdevallia gutierrezii Luer, sp. nov.

Planta parva caespitosa, pedunculo foliis anguste obovatis longiore, flore solitario omnino candido, sepalis in tubum cylindricum connatis caudis aequilongis, petalis ellipticis apiculatis cum callo supra marginem infernum in dentem acutum terminato, labello ligulato bicalloso apice obtuso subverrucoso.

Plant small, epiphytic, caespitose; roots fine, flexuous. Secondary stems slender, unifoliate, 1-1.5 cm long, enclosed by 2 thin tubular sheaths. Leaf erect, coriaceous, narrowly obovate, 4.5-6.5 cm long, 7-8 mm wide, the apex obtuse, tridenticulate, gradually tapered below to a narrowly cuneate, channeled, subpetiolate base. Inflorescence a single, white, glabrous flower borne by an erect to suberect, slender peduncle 7.5-8.5 cm long, with a bract below the middle and another at the base, from a node low on the secondary stem; floral bract tubular, 5-6 mm long; pedicel 8 mm long; ovary greenish white, 2 mm long; sepals connate 5 mm into a cylindrical tube, the free portions gradually narrowed into reflexed, semiterete, white tails, the dorsal sepal narrowly ovate, 20 mm long, 3 mm wide, the lateral sepals connate into a shallowly gibbous lamina 6 mm wide, each lateral sepal 19 mm long, 3 mm wide; petals white, elliptical, 3.5 mm long, 1.5 mm wide, the truncate apex obtusely 2- to 3-dentate, with a low, longitudinal callus along the lower margin ending between the middle and lower thirds in a short point; lip white, yellow above the middle, oblong-ligulate, 4 mm long, 1.5 mm wide, with a pair of low, marginal folds near the middle, subverrucose above the middle, the apex rounded, the base cordate, hinged beneath; column white, semiterete, 3.5 mm long, with a 2 mm long foot ending with a very short extension.

ETYMOLOGY: Named in honor of Jorge Gutierrez of Santa Cruz, Bolivia, co-discoverer of this species.

TYPE: BOLIVIA: SANTA CRUZ: epiphytic near Caranda, 50 km northwest of Santa Cruz, alt. 500 m, L. Moreno and J. Gutierrez s.n., cultivated by J & L Orchids, Easton, Ct., flowered in cult. 25 Nov. 1978, *C. Luer 3623* (Holotype: SEL).

DISTRIBUTION: Northeastern lowlands of Bolivia.

This little species may be recognized by the solitary, all-white flowers borne by peduncles a little longer than the leaves. The cylindrical sepaline tube produces three equally long white tails. The apiculate petals bear a small tooth near the lower third. The ligulate lip bears a pair of angles near the middle.

Masdevallia hepatica Luer, sp. nov.

A speciebus ceteris sectionis Alaticaulium Krzl. statura parva, pedunculo foliis aequilongo, racemo congesto paucifloro floribus hepaticis successivis, caule sepali dorsalis crasso, sepalis lateralibus ecuadatis, petalis oblongis apiculatis et labello ligulato apice subverrucoso tricalloso acuto decurvato dignoscenda.

Plant small, epiphytic, caespitose; roots slender, flexuous. Secondary stems abbreviated, 1-1.5 cm long, unifoliate, enclosed by 2 loose, basal sheaths. Leaf erect, coriaceous, narrowly elliptical, 5-8.5 cm long, 1.0-1.4 cm wide, the subacute apex tridenticulate, narrowly cuneate below into an indistinct, channeled petiole 1-2.5 cm long. Inflorescence a few-flowered (3-4), congested raceme of successive flowers borne by a slender, triquetrous peduncle 7-11 cm long, with a bract at the base, from a node near the base of the secondary stem; floral bracts tubular, imbricating, 5-7 mm long; pedicel 7-8 mm long; ovary 4-5 mm long; sepals glabrous externally, minutely pubescent within, dull reddish brown, yellowish toward the apices, the dorsal sepal oblong, connate to the lateral sepals for 6-7 mm to form a short, cylindrical tube, the free portion triangular, the broad, acuminate apex produced into a thick, forwardly directed tail ca. 1 cm long, the total length of the dorsal sepal 20 mm, 5 mm wide at the widest, the lateral sepals connate 11 mm into a broadly ovate, bifid lamina 18 mm long, 13 mm wide, forming a mentum below the column-foot, the free apices 5 mm long, triangular, subacute; petals yellow, suffused and marked in red-purple, oblong, 6 mm long, 2 mm wide, the apex subacute, apiculate, with a low, longitudinal callus above the lower margin terminating in a low, rounded elevation at the base; lip diffusely covered with red-purple dots, oblong-ligulate, 6 mm long to 7 mm long spread out, 2.25 mm wide, the margins decurved above the middle, the apex lightly verrucose, more or less thickened with 3 parallel calli, acute, revolute, the subcordate base hinged beneath; column yellow, marked with red, semiterete, 5 mm long, the foot 3 mm long with a minute extension.

ETYMOLOGY: From the Latin hepaticus, "liver-colored" (from hepar, "liver"), in reference to the unusual color of the flower.

TYPE: ECUADOR: PASTAZA: epiphytic in felled rain forest trees ca. 20 km east of Puyo, alt. 1000 m, 1977, A. Hirtz s.n., cultivated in Quito, flowered in cult. 16 Feb. 1978, C. Luer 2888 (Holotype: SEL).

DISTRIBUTION: Eastern Ecuador.

Among the "winged-stemmed" species of the genus, Masdevallia hepatica is notable in the small stature and a reddish brown flower with yellow-tipped sepals. Instead of tails the lateral sepals end in subacute angles similar to those of M. brenneri Luer which occurs in the same general vicinity. The subverrucose apex of the lip is acute and revolute.

Masdevallia isos Luer, sp. nov.

Inter species sectionis Alaticaulium Krzl. planta mediocri, pedunculo foliis subaequilongo, racemo congesto paucifloro floribus successivis singularibus, tubo sepalorum mediocri, sepalo dorsali flavo in caudam gracilem acuminato, sepalis lateralibus virescentibus roseo-suffusis in laminam latam connatis caudis viridibus brevioribus, petalis oblongis cum dente crasso obtuso basali, labello subpandurato apice leviter papilloso.

Plant medium in size, epiphytic, caespitose; roots slender, flexuous. Secondary stems unifoliate, 1-2 cm long, mostly concealed by 2 tubular sheaths. Leaf erect to suberect, thickly coriaceous, shiny, narrowly obovate, 8-11 mm long, 1.5-1.7 cm wide, the obtuse apex tridenticulate, gradually narrowed below into an ill-defined, sulcate petiole 1-2 cm long. Inflorescence a 2- to 3-flowered, contracted raceme of successive, single flowers borne by an erect to suberect, triquetrous peduncle 6.5-7.5 cm long, with a bract at the base, from a node near the base of a secondary stem; floral bracts close, tubular, imbricating, 10-13 mm long; pedicel 15-18 mm long; ovary stoutly 3-winged, 3 mm long; dorsal sepal light yellow, obovate, carinate, lightly pusticular within, the total length 25 mm, the width 6 mm, connate to the lateral sepals for 8 mm, the triangular free portion acuminate into a slender, erect tail ca. 1 cm long; lateral sepals green, suffused with rose, obovate, oblique, bicarinate, pusticulate within, connate 13 mm into a broad lamina 17 mm long, 15 mm wide spread out, forming a shallow mentum, the obtuse apices contracted into slender, green tails 7 mm long; petals white, oblong-cuneate, 6.5 mm long, 2 mm wide, the truncate apex obscurely lobed, with a longitudinal callus along both margins, the lower callus ending in a thick, obtuse tooth at the base; lip ivory marked with red-purple, oblong-subpandurate, 7 mm long, 3 mm wide, with obtuse marginal folds above the middle, the apical portion suborbicular, lightly papillose, the margin microscopically irregular, oblong below the middle, the truncate base notched, hinged beneath; column green, suffused with purple, semiterete, 6.5 mm long, the foot 3 mm long with an incurved extension.

ETYMOLOGY: From the Greek isos, "equal, similar," in allusion to the similarity of this species to many others in the section.

TYPE: BOLIVIA: SANTA CRUZ: epiphytic in trees being logged between Samaipata and Vera Cruz, alt. ca. 1000 m, Aug. 1977, Helen Kuhn s.n., cultivated by J & L Orchids, Easton, Ct., flowered in cult. 11 March 1978, C. Luer 2793 (Holotype: SEL).

DISTRIBUTION: Eastern Bolivia.

This species is closely allied to several species of the "winged stem" section (e.g. Masdevallia auropurpurea Rchb. f. & Warsc.), but M. isos may be distinguished by the pastel colors (the lateral sepals are light green suffused with rose instead of mostly dark purple), the proportionately shorter tails of the lateral sepals, and the petals with a longitudinal callus along both margins, the lower one ending in a thick, basal tooth.

Masdevallia jubar Luer & Malo, sp. nov.

Ab Masdevallia lehmannii Rchb. f. species haec inflorescentia congesta, floribus grandioribus glabris non-maculatisque et ab M. ova-avis Luer habitu minore floribus auranticis distinguitur.

Plant medium in size, epiphytic, shortly repent to caespitose, the rhizome more or less ascending; roots slender, flexuous. Secondary stems slender, unifoliate, 2-3.5 cm long, enclosed by 2-3 loose, tubular sheaths. Leaf erect, coriaceous, long-petiolate, the blade elliptical, 8-15 cm long including the 3-8 cm long petiole, 2.5-3.3 cm wide, obtuse and tridenticulate at the apex, cuneate below into the slender, channeled petiole. Inflorescence a congester, 2-3 cm long, several-flowered (6-8), horizontal raceme borne by an erect to suberect, slender peduncle 15-18 cm long, with 3-4 short, evenly spaced, tubular bracts, from a node low on the secondary stem; floral bracts thin, oblique, acute, cucullate, 5 mm long, enclosing the pedicel and ovary; pedicel thick, 2 mm long; ovary 2 mm long, with tall, markedly undulating crests; sepals yellow-orange, unspotted, glabrous except for the minutely erose, free margins, the dorsal sepal suborbicular, deeply concave, 9 mm long, 8 mm wide, connate to the lateral sepals for 4 mm to form a shallow gaping, sepaline cup, the rounded apex contracted into an orange, filiform tail ca. 2 cm long, the lateral sepals elliptical, 9 mm long, 4.5 mm wide, connate basally ca. 3 mm across a transverse fold forming a rounded mentum below the column-foot, the subacute apices contracted into tails similar to that of the dorsal sepal; petals translucent greenish white, oblong, 4 mm long, 1.5 mm wide, the upper margin minutely serrate, the apex tridentate, the middle tooth the longest, with a low, slender, longitudinal keel along the lower margin; lip red-brown, oblong-subpandurate, 5 mm long, 2 mm wide, with lateral folds above the middle, shallowly channeled centrally, the apex convex, obtuse to rounded, the base cordate, hinged beneath; column yellowish white, semiterete, 5 mm long, with a curved foot nearly equally long.

ETYMOLOGY: From the Latin jubar, "sunbeams, splendor," in allusion to the impression of a yellow radiance produced by the compact inflorescence.

TYPE: ECUADOR: PICHINCHA: epiphytic in cloud forest above Chiriboga, alt. 2000 m, 1974, B. Malo s.n., cultivated near Cuenca, flowered in cult. 20 July 1977, C. Luer 1752 (Holotype: SEL).

DISTRIBUTION: Western Ecuador.

This species grows sympatrically with M. ova-avis and is perhaps most closely allied to that species. Although M. jubar is easily recognized by the yellow-orange, unspotted flowers, both species are characterized by short, horizontal, congested racemes. The sepaline tails of M. ova-avis decurve while those of M. jubar spread more or less horizontally in a semicircle. From M. lehmannii, another orange-flowered member of the "polysticta" group, M. jubar may be distinguished by the congested inflorescence of larger, glabrous, unspotted flowers.

Masdevallia nebulina Luer, sp. nov.

Planta parva caespitosa, pedunculo unifloro foliis longipetiolatis aequilongo, flore albido glabro, sepalis in tubum campanulatum cum mentum prominenti connatis caudis flavis aequilongis, petalis unguiculatis cum dente basali grandi retrorso et labello ligulato roseo-stictato.

Plant small, epiphytic, caespitose; roots fine, flexuous. Secondary stems blackish, slender, unifoliate, 1-2 cm long, enclosed by 2-3 close, tubular sheaths. Leaf erect to suberect, coriaceous, long-petiolate, the blade elliptical, 3-5 cm long including the 1.5 to 2 cm long petiole, 9-11 mm wide, the subacute apex tridenticulate, the base cuneate into the slender petiole. Inflorescence a solitary flower borne by a slender, suberect peduncle 5.5-6 cm long with a thin bract below the middle, from a node low on the secondary stem; floral bract white, tubular, 6 mm long; pedicel 7-9 mm long; ovary 3.5 mm long; sepals white, glabrous, the dorsal sepal obovate, carinate, 9 mm long, 4 mm wide, connate to the lateral sepals for 6 mm to form a broad sepaline tube, the rounded, free portion contracted into an erect, slender, yellow tail 9 mm long, the lateral sepals more or less oblong, oblique, 8 mm long, 4.5 mm wide, connate ca. 2.5 mm above a conspicuous mentum formed with the column-foot, the obtuse to rounded apices contracted into tails similar to that of the dorsal sepal; petals white, oblong, 4 mm long, 1.75 mm wide, the truncate apex irregularly and bluntly toothed, the base shortly and narrowly unguiculate below a broad, acute, retrorse tooth from a low, longitudinal callus above the labellar margin; lip white, suffused and flecked with rose, oblong-ligulate, 4.5 mm long, 1.75 mm wide, the margins lightly infolded above the middle, the rose apex more or less rounded, the base subcordate, hinged beneath; column white, semiterete, 3.5 mm long, the foot 2.5 mm long with an incurved extension.

ETYMOLOGY: From the Latin nebula, "mist, or fog," and -inus, "belonging to," in allusion to the cold, misty habitat.

TYPE: BOLIVIA: COCHABAMBA: epiphytic in mossy trees of cloud forest northeast of Cochabamba toward Villa Tunari, alt. 2600 m, 26 Nov. 1978, C. Luer, J. Luer, L. Kuhn & J. Kuhn et al. 3472 (Holotype: SEL).

DISTRIBUTION: Bolivia.

This little species, discovered by Lee Kuhn, was found growing on wet, mossy branches of a montane cloud forest in company with M. hajekii Luer. Masdevallia nebulina was rare in comparison to the abundance of the latter. Masdevallia nebulina is apparently related to M. strumifera Rchb. f., but the former is smaller vegetatively; the mentum of the flower is less conspicuous, the column-foot being shorter than the column itself; and the petals bear a large, basal tooth.

Masdevallia rimarima-alba Luer, sp. nov.

Masdevalliae uniflorae Ruiz & Pavon affinis sed foliis angustioribus, caudis sepalorum crassioribus, petalis late oblongis cum dente basali minimo et labello coccineo differt.

Plant medium in size, presumably epiphytic, caespitose; roots coarse, flexuous. Secondary stems terete, unifoliate, 2-3 cm long, enclosed by 2-3 tubular sheaths. Leaf erect to suberect, coriaceous, narrowly obovate, indistinctly petiolate, 7-11 cm long, 9-10 mm wide, the subacute apex tridenticulate, gradually narrowed below to the slender, channeled base. Inflorescence a solitary flower borne by a slender, erect peduncle 14-16 cm long, with a bract below the middle, from a node low on the secondary stem; floral bract 11-14 mm long; pedicel 20-23 mm long; ovary green, 8-10 mm long; sepals glabrous, white, faintly suffused with yellow toward the bases, lightly veined with rose within, the dorsal sepal ovate-oblong, 17 mm long, 11 mm wide, connate to the lateral sepals for 10 mm into a broad, cylindrical tube, the free portion semi-orbicular, the rounded apex produced into a lore or less erect, thickened, green tail 10 mm long, the lateral sepals ovate, oblique, connate 10 mm to form a mentum with the column-foot, each 18 mm long, 20 mm wide together, the broadly triangular free portions contracted into thick, deflexed, green tails 8 mm long; petals white, oblong, 8 mm long, 3 mm wide, the apex broadly obtuse to rounded, minutely irregular, with a low, longitudinal callus along the labellar margin ending in a short, subacute tooth at the base; lip pink marked with crimsom, oblong, 7 mm long, 3.75 mm wide, the margins reflexed in the upper third to the rounded apex with a small, central, marginal callus, the disc broadly and shallowly sulcate between low, longitudinal calli, the truncate base hinged beneath; column greenish white suffused with rose, semiterete, 6.5 mm long, the foot 4.5 mm long with an incurved foot.

ETYMOLOGY: Named for the local Indian name, rima-rima, applied to M. uniflora plus the Latin albus, "white," in allusion to "the white uniflora."

TYPE: PERU: without locality, imported by J & L Orchids, Easton, Ct., from R. Stumpfle of Lima, flowered in cult. 17 Nov. 1977, C. Luer 2210 (Holotype: SEL).

DISTRIBUTION: Peru.

For the past several years this species has been in cultivation under the name of "the white uniflora." The species known in cultivation as "the pink uniflora" is the Masdevallia uniflora of Ruiz and Pavon which we saw recently in flower at the original locality above Huasahuasi, Peru. White color forms of M. uniflora were observed. The local name for M. uniflora today is still rima-rima as it was two hundred years ago, and as it must have been for untold generations before. The "white uniflora" may be distinguished by narrow, indistinctly petiolate leaves, the yellowish white flowers with thick, green tails, broadly oblong petals with only a minute, basal tooth, and a crimson lip.

Masdevallia syringodes Luer & Andreetta, sp. nov.

Species haec Masdevalliae tubulosae Lindl. persimilis, sed foliis angustioribus, flore minore et labello oblongo-cuneato apice truncato cum carina bifurcata differt.

Plant small, epiphytic, caespitose; roots slender, flexuous. Secondary stems slender, unifoliate, 1-2.5 cm long, clothed by 2-3 loose, tubular sheaths. Leaf erect to suberect, coriaceous, very narrowly obovate, 4-9 cm long, 7-8 mm wide, the acute apex tridenticulate, gradually narrowed below into an indistinct petiole 1.5-3 cm long. Inflorescence a solitary flower borne by an erect, slender peduncle 5-7 cm long, with a bract below the middle, from a node low on the secondary stem; floral bract 6 mm long; pedicel 12 mm long, ovary green, 7 mm long; sepals glabrous, white, connate 11-12 mm into a slender, gently curved, cylindrical tube, the free portions triangular, acute, acuminate into thickened, yellow tails 10-15 mm long, the dorsal sepal oblong, the total length 26 mm, 3 mm wide, the lateral sepals connate into an oblong lamina 8 mm wide, the free portions oblique, the total length 27 mm; petals white, oblong, 4.5 mm long, 1.25 mm wide, the truncate apex tridentate, with a low, longitudinal callus along the labellar margin ending a short distance above the unguiculate base; lip light yellow, oblong-cuneate, 5.5 mm long, 2.5 mm wide at the apex, the disc with a low, longitudinal, central carina bifurcated on the broadly truncate apex, the cordate base hinged beneath; column white, semiterete, 4 mm long, the foot 1.5 mm long with a short, incurved extension.

ETYMOLOGY: From the Greek syringodes, "like a pipe" (from syrinx, "a pipe"), in reference to the slender cylindrical tube.

TYPE: ECUADOR: MORONA-SANTIAGO: epiphytic in cloud forest near Cuyes, alt. 1500-1800 m, March 1978, A. Andreetta & M. Portilla 1704, cultivated in Cuenca, flowered in cult. Feb. 1979, C. Luer 3968 (Holotype: SEL).

DISTRIBUTION: Southeastern Ecuador.

So far, this little species has been discovered but once. It was found without flowers by Mario Portilla at the same time he found Masdevallia portillae Luer. Masdevallia syringodes is allied to the Venezuelan M. tubulosa and the Colombian M. stenantha Lehm. & Krzl., but from both it differs in the smaller flowers with shorter tails and a lip with a bifurcated callus on a broadly truncate apex.

Masdevallia urosalpinx Luer, sp. nov.

Planta mediocris caespitosa, pedunculo foliis ellipticis petiolatis breviore, flore solitario suberecto, tubo sepalorum longissimo ventricoso supra medium valde constricto albido aureo-suffuso intus pubescenti caudis gracilibus longissimis flavis, petalis oblongis carinatis callo basali crasso, labello albo oblongo subacuto supra medium obtusangulato.

Plant medium in size, epiphytic, caespitose; roots slender, flexuous. Secondary stems slender, unifoliate, 1.5-2.5 cm long, enclosed by 2-3 close, tubular sheaths. Leaf erect, coriaceous, petiolate, 6-10 cm long including the 2-3.5 cm long petiole, 14-18 mm wide, the apex subacute, tridenticulate, narrowly cuneate below into the slender, channeled petiole. Inflorescence a solitary, suberect flower borne by a slender, suberect peduncle 4-5 cm long, with a bract near the base, from a node low on the secondary stem; floral bract tubular, 10 mm long; pedicel 10-12 mm long; ovary green, 7-8 mm long; sepals white, suffused and veined in orange, glabrous externally, pubescent within above the middle, connate into a ventricose tube 11 mm deep, markedly constricted to 5 mm above the middle before the free portions spread, the dorsal sepal connate to the lateral sepals for 30 mm, narrowly oblong, 37 mm long, 5 mm wide to 14 mm wide at the stoma, the free portion semiorbicular, the rounded apex abruptly produced into a straight, filiform, reflexed, yellow tail 3.5-4.5 cm long, the lateral sepals connate 35 mm, 37 mm long, 5-6 mm wide below the constriction and 22 mm wide above, the deflexed, free lamina 14 mm long, the obtuse apices contracted into tails similar to that of the dorsal sepal; petals yellowish white, oblong, 8 mm long, 2.5 mm wide, the subacute apex more or less twisted, the lower margin more or less narrowed near the middle, broadly rounded above, with a longitudinal carina along the margin ending in a thick, rounded callus at the base; lip white, oblong-ligulate, 6 mm long, 2-2.5 mm wide, the apex narrowly rounded, with obtuse, marginal angles above the middle, the disc with a low pair of longitudinal calli, the base truncate, hinged beneath; column white with a purple margin, semiterete, 6 mm long, the short foot with an incurved extension.

ETYMOLOGY: From the Greek oura, "tail," and salpinx, "trumpet," in allusion to the trumpet-like sepaline tube with three tails.

TYPE: PERU: HUANUCO: epiphytic in cloud forest between Tingo Maria and Pucallpa, alt. 1700 m, Mar. 1975, J. Kuhn, F. Fuchs et al. s.n., cultivated by J & L Orchids, Easton, Ct., flowered in cult. 7 Nov. 1977, C. Luer 1847 (Holotype: SEL).

DISTRIBUTION: Peru.

This species was first thought by us to be Masdevallia constricta Poepp. & Endl., but M. urosalpinx may be distinguished by the longer sepaline tube suffused and veined in orange, and pubescent within the broadly flared opening. The tube is remarkably constricted above the ventricosity. The lip is obtusely angled above the middle.

Masdevallia verecunda Luer, sp. nov.

Planta mediocris caespitosa, foliis coriaceis obovatis petiolatis, pedunculo ascendenti vel horizontali, flore solitario nutanti, tubo sepalorum campanulato albovirescenti nervatura purpurea, caudis gracilibus deflexis marrononis, petalis oblongis apice tridenticulatis basi cum cornu retrorso, labello cuneato trilobato.

Plant medium in size, epiphytic, caespitose; roots slender, flexuous. Secondary stems slender, channeled, unifoliate, 1.5-2 cm long, enclosed by 2-3 loose, tubular sheaths. Leaf suberect, coriaceous, narrowly obovate, 5-8.5 cm long, 16-22 mm wide, the rounded apex notched and apiculate, gradually narrowed below into a sulcate petiole 2-3 cm long. Inflorescence a solitary, nutant flower borne by an ascending to sub-horizontal, slender peduncle 4.5-7.5 cm long, with a bract below the middle, from a node low on the secondary stem; floral bract tubular, 6 mm long; pedicel 6 mm long; ovary 6 mm long; sepals glabrous, greenish white, the mid-veins purple, the dorsal sepal obovate, 20 mm long, 11 mm wide, connate to the lateral sepals for 12 mm into a campanulate tube, the free portion triangular, forwardly directed, the subacute apex acuminate into a slender, gently deflexed, maroon tail 3 cm long, the lateral sepals oblong, oblique, connate ca. 9 mm into a broadly cuneate lamina 15 mm long, 22 mm wide spread out, shallowly ventricose, the free portions triangular, subacute, contracted into straight, acutely reflexed tails similar to that of the dorsal sepal; petals white, oblong, 5.5 mm long, 2 mm wide, the apex tridentate, with a longitudinal callus along the lower margin ending in a prominent, retrorse horn just above the shortly unguiculate base; lip white, flecked with rose, cuneate, 6 mm long, 4 mm wide, 3-lobed above the middle, the middle lobe more or less ovate, deflexed, with irregular margins and a longitudinal, purple callus ending at the margin, the lateral lobes triangular, obtuse, the forward margins irregular, the disc with a pair of low, longitudinal calli, the truncate base hinged beneath; column white, suffused with rose, semiterete, 4.5 mm long, the foot 2.5 mm long with an incurved extension 1 mm long.

ETYMOLOGY: From the Latin verecundus, "bashful," in allusion to the nutant flowers.

TYPE: VENEZUELA: ARAGUA: near Choroni, received by Don Richardson 2851 from G. C. K. Dunsterville, cultivated by J & L Orchids, Easton, Ct., flowered in cult. 21 Apr. 1978, C. Luer 2920 (Holotype: SEL).

DISTRIBUTION: Venezuela.

Masdevallia verecunda is characterized by the nodding, bell-shaped, greenish white flowers with a drooping tail from the dorsal sepal. The petals, tridenticulate at the apex, are provided with a retrorse, basal tooth. The wedge-shaped lip is three-lobed above the middle with minutely irregular margins.

ADDITIONAL NOTES ON THE GENUS PETREA. VIII

Harold N. Moldenke

PETREA MARTIANA Schau.

Additional bibliography: Mold., Phytologia 42: 310 & 318. 1979.

The flowers on Prance & al. P.25519 are said to have had the "outer petals light-purple, inner petals dark-purple; inner petals missing from most" -- by "outer petals" they probably are referring to the calyx-lobes.

Macbride (1960) cites Fox 96 from Loreto, Peru. The Ducke 872 & 1133 and Frôes 22628, cited below, were previously incorrectly reported by me as P. bracteata Steud. On the other hand, the Ducke 14291 and Sampaio 5092 [Herb. Nac. Rio Jan. 19128] previously reported by me as P. martiana prove to be the more recently described P. martiana var. glabrescens Mold.

Additional & emended citations: BRAZIL: Amazônas: Ducke 872 (N), 1133 (N); Frôes 22628 (N); Prance, Pena, Ramos, & Monteiro 3793 (N). Pará: Cavalcante 2392 (Ld, N); Prance, Silva, Balick, Henderson, Nelson, Bahia, & Reis dos Santos P.25519 (N). Rondônia: Prance, Rodrigues, Ramos, & Farias 8256 (Ld, N, Z). MOUNTED ILLUSTRATIONS: Schau. in Mart., Fl. Bras. 9: pl. 46, fig. 1. 1851 (N, Z).

PETREA MARTIANA var. **GLABRESCENS** Mold., Phytologia 32: 458. 1975.

Bibliography; Mold., Phytologia 32: 458 (1975) and 34: 257 & 259. 1976; Hocking, Excerpt. Bot. A.28: 259. 1976; Mold., Phytologia 42: 318. 1979.

This variety differs from the typical form of the species in having at least its mature leaf-blades glabrous or glabrescent and not at all scabrous or even scabrellous above.

Collectors describe this plant as a scandent woody vine, the calyx light-blue or lavender, enlarged in fruit, and have found it growing at the edges of woods, in whitewater varzea forests, and on terra firme at the edges of partial clearings, flowering in February and from May to July. The corollas are said to have been "violet" on Ducke 14291, "purplish" on Mathias & Taylor 5093, "purple" on Campbell & al. P.22257, and "purple with a white spot at the base of one lobe" on Mori & al. 9131.

Material has been misidentified and distributed (and even erroneously cited by me in a previous work) as P. macrostachya Benth. and as typical P. martiana Schau.

Citations: PERU: San Martín or Loreto: Mathias & Taylor 5093 [Aguaytía] (W--2653024). BRAZIL: Amazônas: Mori, Prance, Hill, Bernardi, & Shimabukuru 9131 (Ld, N). Pará: Campbell, Ongley, Ramos, Monteiro, & Nelson P.22257 (N, Z); Ducke 14291 (N--type); Sam-

paio 5092 [Herb. Rio Jan. 19128] (N).

PETREA MAYNENSIS Huber, Bol. Mus. Para. 4: 602. 1906.

Additional synonymy: *Petrea mayensis* Huber ex Dwyer, Raymondiana 4: 71, sphalm. 1971.

Additional & emended bibliography: Prain, Ind. Kew. Suppl. 4, imp. 1, 177 (1913) and imp. 2, 177. 1958; R. C. Foster, Contrib. Gray Herb. 184: 170. 1958; J. F. Macbr., Field Mus. Publ. Bot. 13 (5): 663, 665, & 666. 1960; Mold., Résumé Suppl. 12: 5. 1965; Mold., Phytologia 7: 440. 1961; A. María, Pl. Vall. Cochab. 2: 42. 1966; Dwyer, Raymondiana 4: 71. 1971; Mold., Fifth Summ. 1: 119, 142, 169, 183, & 366 (1971) and 2: 598 & 898. 1971; Mold., Phytologia 25: 242. 1973; Troncoso, Darwiniana 18: 366, 367, 369, & 411. 1974; Soukup, Biota 11: 14. 1976.

Recent collectors refer to this plant as a climbing shrub, 2--3 m. tall, or as a vine or liana, 6--9 m. tall [long], climbing over shrubs, or even as a small tree, 2--5 m. tall, the leaves coriaceous, rough or even very rough and sandpaper-like, deep- or olive-green, brilliantly shimmering, the flowers fragrant or slightly so, and the calyx ["bracts"] pale-violet 2.5 P 8/4 or pale-blue to "pale whitish-cream". They have found it growing in cerrado as well as in low or high forests, secondary and disturbed forests on terra firme, and clearings in forests, at 400--950 m. altitude, flowering in January, April, May, and July to October, fruiting in July and August.

The corollas are said to have been "blue" on *Maguire & al. 56867*, "pale-blue" on *Forero & Wrigley 7106*, "deep-blue" on *Prance & al. 6224*, "purple" on *Schunke 2131*, "pale-purple" on *Woytkowski 7246*, "violet 2.5 P 4/9" on *Schunke 4978*, "moderate violet 2.5 P 3/8" on *Mathias & Taylor 3682 & 6088*, "blue tinted violet and yellow" on *Forero & al. 6344*, "lilaz até violaceo-clara" on *Ducke s.n.*, "white with green hue" on *Woytkowski 7640*, and "gray-green" on *Forero & Wrigley 7134*. It is suspected that the last two mentioned color descriptions refer to fruiting-calyxes rather than to corollas.

Ducke reports the species frequent in Pará, Brazil. The vernacular name, "yahua-piri-piri", is recorded for it. Dwyer (1971) cites *Woytkowski 5471 & 7246* from San Martín and *7640* from Huánuco, Peru. Troncoso (1974) cites *Steinbach 3470* from Santa Cruz, Bolivia. Macbride (1960) cites *Poeppig 1970* from San Martín and *Huber 1489* and *Tessman 3960* from Loreto, Peru.

Material of *P. maynensis* has been misidentified and distributed in some herbaria as *P. peruviana* Mold.

Additional citations: PERU: Huánuco: *Schunke Vigo 2131* (N); *Woytkowski 7640* (W--2452961). Loreto: *Mathias & Taylor 6088* (W--2704060). Madre de Díos: *Soukup & López G. 4621* (Ld). San Martín: *Schunke Vigo 3682* (N), *4978* (N), *7720* (W--2780656); *Woytkowski 7246* (W--2453309). BRAZIL: Acre: *Forero, Coêlho, & Farias 6344* (Ac, N). Mato Grosso: *Maguire, Murça Pires, Maguire, & Silva 56867*

(Ld). Rondônia: Forero & Wrigley 7106 (Ld, N), 7134 (Ac, N). BOLIVIA: Cochabamba: Collector undetermined 154 (W—2428142). El Beni: H. H. Rusby 932 (Ws), 933 (Ws); Troll 2725 (Mu). Pando: Prance, Forero, Wrigley, Ramos, & Farias 6224 (Ac, N), 6477 (Ld, N). CULTIVATED: Brazil: Ducke s.n. [Belém, 25-8-1941] (Ca—91426). Peru: Scolnik 1176 (N).

PETREA NITIDULA Mold., Feddes Repert. Spec. Nov. 43: 168—170. 1938.

Additional bibliography: J. F. Macbr., Field Mus. Publ. Bot. 13 (5): 663 & 665—666. 1961; Mold., Phytologia 7: 440. 1961; Mold., Fifth Summ. 1: 142 & 169 (1971) and 2: 898. 1971; Soukup, Biota 11: 14. 1976; Mold., Phytologia 36: 35. 1977.

Recent collectors refer to this species as a vine, the inflorescences and calyx blue, and have encountered it along roadsides and in disturbed forests, flowering in October. They report for it the vernacular name, "flor de São José". The corollas are said to have been "blue" on Berg & al. P.18404 and "dark-blue" on Prance & al. 15858.

Additional citations: BRAZIL: Amazônas: Prance, Maas, Woolcott, Monteiro, & Ramos 15858 (N, Z). Mato Grosso: Berg, Steward, Ramos, Monteiro, & Lima P.18404 (Ld, N).

PETREA PERPLEXANS (Cockerell) MacGinitie

Additional synonymy: Petraea perplexans (Cockerell) MacGinitie apud R. Pearson, Anim. Pl. Cenoz. Era 33. 1964.

Additional bibliography: Mold., Phytologia 7: 441. 1961; R. Pearson, Anim. Pl. Cenoz. Era 33. 1964; Mold., Fifth Summ. 1: 376, 402, & 422 (1971) and 2: 596 & 898. 1971.

PETREA PERUVIANA Mold., Feddes Repert. Spec. Nov. 43: 206—208. 1938.

Additional bibliography: Buek, Gen. Spec. Syn. Candoll. 3: 228. 1858; Mold., Geogr. Distrib. Avicen. 22 & 24. 1939; Soukup, Biota 1: 180. 1956; J. F. Macbr., Field Mus. Publ. Bot. 13 (5): 663 & 666. 1960; Mold., Phytologia 7: 441—442. 1961; Soukup, Biota 5: 14. 1964; Mold., Résumé Suppl. 16: 5. 1968; Mold. in Menninger, Flow. Vines 338. 1970; Mold., Fifth Summ. 1: 119, 137, & 142 (1971) and 2: 596, 599, & 898. 1971; Soukup, Biota 11: 14. 1976.

Recent collectors describe this plant as a liana, to 7 m. long, climbing on small trees, the stems harshly scabrid, the leaves rigid, harshly scabrid, the fruit "shiny, whitish, surrounded by the silver-white expanded winged sepals", and have found it growing along trails, flowering in November and December, fruiting in February. The corollas are said to have been "blue" on Castañeda 3850 and "violet" on Castañeda 3929. Soukup reports the vernacular name, "senango sacha".

Macbride (1960) cites Klug 170 & 637 and Williams 690 & 8106 from Loreto and Meyen s.n. from Puno, Peru.

The Schunke Vigo 3682, distributed as P. peruviana, seems, rather, to be P. maynensis Huber.

Additional citations: COLOMBIA: Vaupés: Romero Castañeda 3850 (N), 3929 (N). PERU: Loreto: D. R. Simpson 739 (N)

PETREA PERUVIANA var. **ACUMINATA** Mold., Feddes Repert. Spec. Nov. 43: 208. 1938.

Bibliography: Mold., Feddes Repert. Spec. Nov. 43: 208. 1938; Mold., Geogr. Distrib. Avicen. 22 & 24. 1939; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 34, 35, & 97. 1942; Mold., Phytologia 2: 181 (1946) and 2: 500. 1948; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 70, 73, & 192. 1949; Mold., Résumé 80, 84, & 464. 1959; J. F. Macbr., Field Mus. Publ. Bot. 13 (5): 666. 1960; Mold., Résumé Suppl. 10: 2 (1964) and 16: 5. 1968; Mold., Fifth Summ. 1: 137 & 142 (1971) and 2: 898. 1971; Soukup, Biota 11: 14. 1976.

Recent collectors describe this plant as a liana, 1.2 m. long, the leaves very coriaceous and tough, the flowers either in axillary racemes or terminating side branches, and the calyx blue. They have found it growing in cutover woods, climbing medium-size trees, in primary and secondary forests, and in the lower canopy of 40-foot trees, at 110--800 m. altitude, flowering in January and September, fruiting in September.

The corollas are said to have been "blue" on Belshaw 3420 and on Cazalet & Pennington 7649, "purple" on Mexia 6498, and "lilac and purple" on Revilla 2115. Miss Mexia refers to the plant as "frequent"; Revilla encountered it "cerca a purma".

Macbride (1960) cites Mexia 6498 & s.n. and Williams 647 from Loreto, Peru.

Material has been misidentified and distributed in some herbaria as P. aspera Turcz. and P. volubilis L.

Additional citations: ECUADOR: Morona-Santiago: Sparre 19187 (S). Santiago-Zamora: Cazalet & Pennington 7649 (N, W--2406153). PERU: Loreto: Mexia 6498 (W--1691255); Revilla 2115 (N). San Martín: Belshaw 3420 (Ld, N, Z)

PETREA PUBESCENS Turcz., Bull. Soc. Imp. Nat. Mosc. 36 (2): 211--212. 1863.

Additional synonymy: Petrea pubeseens Turcz. ex Soukup, Biota 11: 14, sphalm. 1976.

Additional & emended bibliography: Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 478. 1894; Pittier, Supl. Pl. Usual. Venez. 55. 1939; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 2: 478 (1946) and imp. 3, 2: 478. 1960; J. F. Macbr., Field Mus. Publ. Bot. 13 (5): 663 & 665--667. 1960; Mold., Phytologia 7: 442. 1961; Mold., Résumé Suppl. 17: 3 & 7. 1968; Mold., Biol. Abstr. 50: 6338 (1969) and 50 (12): B.A.S.I.C. S.154. 1969; Mold., Phytologia 18: 72. 1969; Hocking, Excerpt. Bot. A.15: 422. 1970; Mold., Fifth Summ. 1: 119, 126, 137, 142, 169, & 366 (1971) and 2: 596, 599, & 898. 1971; Mold., Phytologia 25: 228, 234, & 242. 1973;

López-Palacios, Revist. Fac. Farm. Univ. Andes 14: 22 (1974) and 15: 66—69. 1974; Mold., Phytologia 34: 257. 1976; Soukup, Biota 11: 14. 1976; López-Palacios, Fl. Venez. Verb. 452, 454, 460—462, 476—480, 638, & 652, fig. 112. 1977; Mold., Phytologia 36: 45 (1977) and 42: 303, 304, 312, & 313. 1979.

Illustrations: López-Palacios, Fl. Venez. Verb. [477], fig. 112. 1977.

Recent collectors describe this plant as a small, rather columnar, deciduous tree, 4--8 m. tall, branched above the middle, or as a few-branched shrub, 1—5 m. tall, the trunk to 9 cm. in diameter, the leaves thick-subcoriaceous, deep-green and asperous above, rugose, the flowers abundant, the "bracts" violet, the calyx pale-blue, violet-blue, or lavender. They have found it growing on dry hills, at the edge of woods, in deciduous or tropophilous forests, and on mountain savannas with shrubby growth in the gullies, at 140—2320 m. altitude, flowering in January, March to June, August, September, and November. The corollas are said to have been "lavender" on *Gentry & al. 11010*, "purple" on *Aristeguieta 4674*, *Hutchison & Wright 3271*, and *Robertson & Austin 152*, "violet-blue" on *Davidse & al. 5599*, "blue-violet" on *Burkart 16485*, and "blue" on *García-Barriga 18167* & *18182*.

López-Palacios and his associates describe *P. pubescens* as an "arbolito inerme, decidue, 4—6 m. Hojas simples, opositi-decusadas, escabritas por la haz, verde oscuro por el haz, más claras por el envés. Flores grandes, vistosas, ametistinas. Cáliz y corola de color morado intense, salvo la garganta de la corola, cremosa por dentro, base del cáliz púrpura oscuro, glándulas, lóbulos púrpura pálido. Planta muy ornamental durante la floración. Frecuente a orillas de la carreta, vistoso, hermoso super floribundo, melífero". Aristeguieta refers to it as "muy llamativas", while Burkart asserts that it is "very decorative".

The vernacular names, "guamo macho" and "pluma de la reina", are reported for the species. Wurdack comments that *Hutchison & Wright 3271* matches *Lehmann 1872* in the United States National Herbarium at Washington.

Macbride (1960) cites only *Ule 9722* from Peru. López-Palacios cites from Venezuela the following collections: Barinas: *Bernardi 1224*. Lara: *R. T. Smith V.984*; *Steyermark 104926*; *Tamayo 3396*; *Trujillo 2747*. Mérida: *Funck & Schlim 1504*; *Hambury-Tracy 136*; *Ijjasz & Madriz 137*; *Jahn 906*; *Little 15567*; *Ruiz-Terán & López-Palacios 826*. Táchira: *Funck & Schlim 1504*; *García-Barriga 13314*; *Steyermark 98878*. Trujillo: *Quintero & Cavroz 1106*. In his 1975 work he comments about the *Funck & Schlim 1504* type collection: "El ejemplar del B.M. examinado por mí tiene una nota en rótulo, posiblemente no de mano de los colectores, que dice: 'New Granada, A. Amer.' y en el de G. se lee 'Merida-Salomón 400?' Según ésto, el tipo es indiscutiblemente de Venezuela, y si en verdad es de Mérida, Sería de San Cristóbal de Torondoy, de donde no conozco ningún otro registro de esta taxon ni consta que Funck

& Schlim hayan estado allí; pero puede ser también de San Cristóbal, Táchira, región de la que existen numerosos registros y en donde ciertamente estuvo Schlim."

He further notes: "Me parece difícil encontrar *P. pubescens* a alturas de 100 m. Para Venezuela los registros seguros están a alturas mayores de 1000 m. El registro de *Bernardi 1224* a los 300 m. es muy dudoso!"

He continues: "Tampoco la he visto en el Dto. Federal. El Dr. Moldenke cita para allá 2 ejemplares: *Golmer s.n.* (B) y *Bredemeyer s.n.* (V). El ejemplar de Golmer debió de haberse destruido en el incendio del herbario de Berlin; he examinado el de Bredemeyer, del herbario de Viena, que en realidad está rótula con el No. 16. Si ésta bien tiene la indicación de procedencia: 'Caracas', no creo que deba tomarse muy al pie de la letra, pues muchos colectores de aquel entonces incluian toda la provincia de Venezuela bajo el nombre de 'Caracas'."

Material of *P. pubescens* has been misidentified and distributed in some herbaria as *P. arborea* H.B.K. and *P. aspera* Turcz. On the other hand, the *Aristeguieta 1602* & *3864* and the *Aristeguieta & Agostini 4113*, cited by me in 1961 as *P. pubescens*, actually prove to be *P. glandulosa* Pittier.

Additional citations: COLOMBIA: Cundinamarca: *López-Palacios & Idrobo 3693* (N, Z). Huila: *Davidse, Gentry, & Llanos 5599* (Ld). Magdalena: *H. H. Smith 1521* (Mi, Ws). Norte de Santander: *Bruckmüller s.n.* [Nova Granada] (N). Tolima: *García-Barriga 18167* (W—2844141), *18182* (W—2844302). Valle del Cauca: *Holton 512* (Ms—30933); *Hutchison & Wright 3271* (Mu, N, S, Ws). VENEZUELA: Aragua: *Robertson & Austin 152* (E—2048449). Barinas: *Bernardi 1224* (Ve—50305). Guárico: *Aristeguieta 4674* (N, Ve). Lara: *Burkart 16551* (Ve); *Gentry, Morillo, & Morillo 11010* (W—2788958); *J. A. Steyermark 104926* (Mu, N); *Tamayo 3396* (Ve). Mérida: *Little 15567* (Ve—47014); *Ruiz-Terán & López-Figueiras 826* (N), *1989* (N). Táchira: *Steyermark, Dunsterville, & Dunsterville 98878* (Ac). Trujillo: *Oberwinkler & Oberwinkler 15144* (Mu). Yaracuy: *Burkart 16485* (Ve).

PETREA PUBESCENS f. **ALBICALYX** Mold.

This taxon is now regarded as a synonym of *P. glandulosa* Pittier, which see.

PETREA PUBESCENS var. **KLUGII** Mold., Feddes Reprt. Spec. Nov. 43: 172—173. 1938.

Synonymy: *Petrea pubeseens* var. *klugii* Mold. ex Soukup, Biota 11: 14, sphalm. 1976.

Additional bibliography: J. F. Macbr., Field Mus. Publ. Bot. 13 (5): 667. 1960; Mold., Phytologia 7: 442—443. 1961; Mold., Fifth Summ. 1: 137 & 142 (1971) and 2: 898. 1971; Soukup, Biota 11: 14. 1976; Mold., Phytologia 36: 45. 1977.

Macbride (1960) cites only *Klug* *4155* from San Martín, Peru.

PETREA RACEMOSA Nees

Additional & emended synonymy: *Peraea* *racemosa* Nees, Flora 4 (1): 300. 1821. *Petrea* *racemosa* Nees & Mart., Nov, Act. Soc. Nat. Cur. 11 (1): 72. 1823. *Petraea* *subserrata* Nees ex Cham., Linnaea 7: 368--369. 1832. *Petraea* *racemosa* Nees & Mart. ex Cham., Linnaea 7: 369 & 370. 1832. *Petrea* *subserrata* Cham. & Schlecht. ex Turcz., Bull. Soc. Imp. Nat. Mosc. 36 (2): 211 [as "*subserratae*"]. 1863; Mold., Prelim. Alph. List Inv. Names 35, in syn. 1940. *Petrea* *denticulata* Schau. ex M. Kunz, Anatom. Untersuch. Verb. 64. 1911. *Petraea* *sub-serrata* Cham. apud Sampaio, Bol. Mus. Nac. Rio Jan. 13: 231. 1937. *Petraea* *volubilis* Vell. apud Sampaio, Bol. Mus. Nac. Rio Jan. 13: 231, in syn. 1937 [not *P.* *volubilis* Gaertn., 1791, nor Haust., 1966, nor Jack, 1947, nor Jacq., 1832, nor L., 1763 & 1919, nor Schau., 1960, nor Willd., 1940, nor Woodr., 1906]. *Petraes* *volubilis* Vell. apud Sampaio, Bol. Mus. Nac. Rio Jan. 13: 287, in syn. 1937. *Petraea* *recemosa* Nees & Mart. ex Barroso, Rodriguesia 32: 71. 1957.

Additional & emended bibliography: Buek, Gen. Spec. Syn. Candoll. 3: 338. 1858; Bocq., Adansonia, ser. 1, 2: 99--101 & 135 (1862) and ser. 1, 3: 251, pl. 20. 1863; Bocq., Rév. Verbenac. 99--101, 135, & 251, pl. 20. 1863; Vesque, Ann. Sci. Nat. Paris, ser. 7, 1: 339. 1885; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 478. 1894; Peckolt, Bericht. Deutsch. Pharm. Gesel. 14: 476--477. 1904; M. Kunz, Anatom. Untersuch. Verb. 64--66. 1911; Crevost & Pételot, Bull. Econ. Indochin. 37: 1289. 1934; Sampaio, Bol. Mus. Nac. Rio Jan. 13: 231 & 287. 1937; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 2: 478. 1946; Pételot, Pl. Méd. Cambod. Laos Vietn. 2 [Archiv. Recherch. Agron. Past. Vietn. 18]: 258 (1953) and 4: 25, 145, & 200. 1954; Chittenden, Dict. Gard. 1534. 1956; Angely, Fl. Paran. 7: 12. 1957; Barroso, Rodriguesia 32: 71. 1957; Reitz, Sellowia 11: 76 & 121. 1959; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 2: 478. 1960; J. F. Macbr., Field Mus. Publ. Bot. 13 (5): 667. 1960; Angely, Fl. Paran. 17: 46. 1961; Mold., Phytologia 7: 443--445. 1961; Rizzini in Ferré, Simpos. Cerrado 113. 1962; Angely, Bibl. Veg. Paran. 207. 1964; Mold., Résumé Suppl. 11: 7. 1964; Angely, Fl. Anal. Paran., ed. 1, 578. 1965; Bernardi & Robert, Fleurs Tropic. 189--190, pl. 21. 1966; Mold., Résumé Suppl. 15: 21 (1967) and 16: 25. 1968; Farnsworth, Blomster, Quimby, & Schermerh., Lynn Index 6: 266. 1969; Mold. in Menninger, Flow. Vines 338. 1970; Angely, Fl. Anal. Fitogeogr. Est. S. Paulo, ed. 1, 4: 830, 831, & xiv, map 1376. 1971; Dwyer, Raymondiana 4: 71. 1971; Mold., Fifth Summ. 1: 169, 187, & 366 (1971) and 2: 594--599 & 898. 1971; López-Palacios, Pittiera 5: 47. 1973; López-Palacios, Revist. Fac. Farm. Univ. Andes 9 (13): 56. 1973; Mold., Phytologia 27: 368. 1973; Troncoso, Darwiniana 18: 367, 369, & 411. 1974; López-Palacios, Revist. Fac. Farm. Univ. Andes 15: 67. 1975; Mold., Phytologia 41: 450 (1979) and 42: 315. 1979.

Additional illustrations: Crevost & Pételot, Bull. Econ. Indochin. 37: opp. 1288. 1934; Bernardi & Robert, Fleurs Tropic. pl. 21 (in color). 1966.

Recent collectors describe this plant as a vine or liana, a semi-climbing or scandent shrub, or a tree to 3 m. tall, the leaves caducous, the inflorescence ornamental, with the pedicels and calyx blue. They have found it growing in capoeira, the borders of thickets, and along river edges, as well as in "orla matinha de galeria", flowering from September to November, fruiting in November. The corollas are said to have been "blue" on Héringer 11553 and Pereira 7161, "violet" on Hatschbach 24863 & 32638, Hatschbach & Kummrow 34824, and Sampaio 8232, and "rose" on Sidney & Onishi 996/227. Vernacular names reported are "cipó azul", "flor de S. Miguel", "flor-de-São-Miguel", "flor-de-viuva", "touca da viúva", "touca de viúva", "toucado de viuva", and "viuvinha".

Peckolt (1904) gives a detailed chemical analysis of the plant and reports the use of the leaves in Brazil as a diaphoretic and excitant.

Crevost & Pételot (1934) erroneously reduce P. kohautiana Presl to synonymy here and avers that P. racemosa is "cultivée dans tout le Vietnam comme plante d'ornament. - Originaire des Antilles [this applies only to the P. kohautiana which he regards as cospecific]. Nous ne lui connaissons aucun usage médicinal au Vietnam. D'après Hubert...les feuilles sont diaphorétiques et excitant. Les feuilles, en raison de ses aspérités silicifiées, sont parfois employées comme polissoirs, pour nettoyer les métaux, l'ivoire et la corne".

López-Palacios (1973) reports that some specimens of this species exhibit both opposite and ternate leaves. Chittenden (1956) calls it the "commonest species in gardens [in England], citing the illustration in Bot. Mag. pl. 628 and Lodd., Bot. Cab. pl. 736, "both as P. volubilis", the corollas said to be "violet, blue, or lilac".

Macbride photographed the type specimens of the synonymous P. denticulata Schrad. in Geneva as his type photograph number 7874 and a cotype of Petraea subserrata Cham. in Berlin as his type photograph number 17575.

The Angely (1971) work cited in the bibliography above is often cited by the incorrect titlepage date of "1970".

Barroso (1957) cites Brade 15096 "lote 15RB28.200" and reports the species from Rio de Janeiro, São Paulo, Minas Gerais, and Pará. Dwyer (1971) cites Woytkowski 5642 from Amazonas, Peru.

Material of P. racemosa has been misidentified and distributed in some herbaria as P. volubilis L. On the other hand, the Teixeira 2559 [Herb. Serg. Tavares 1513], distributed as P. racemosa, actually is P. blanchetiana Schau.

Additional citations: BRAZIL: Distrito Federal: Héringer 11553 (N, N). Goiás: Prance & Silva 59470 [L.S.143] (N, N, N, S); Sidney & Onishi 996/227 (Ld). Minas Gerais: A. Castellanos 24099

[Herb. Cent. Pesq. Florest. 3009] (Ac); Froés 33439 (S); E. Pereira 7161 [Herb. Brad. 23552] (Mu, N). Paraná: Dusén 10745 (Mu), 15874 (Mu); Hatschbach 24863 (N, W--2706731), 32638 (Ld). Pernambuco: Pickel 3112 (Mi). Rio de Janeiro: Martius s.n. [Macbride photos 7874] (N--photo, W--photo); Sampaio s.n. [Campos, VIII/1939] (Ja--45381, Ja). São Paulo: I. S. Gottsberger 16 [6] (Ld); Hatschbach & Kummrow 34824 (Ld); Santoro s.n. [Herb. Inst. Bot. S. Paulo 678] (W--1594549); Válio 47 (W--2369417). State undetermined: Sellow s.n. [Macbride photos 17575] (N--photo, W--photo). CULTIVATED: Brazil: Reitz 6255 (W--2402936); Reitz & Klein 11249 (W--2402937); Sampaio 8232 (Ja--45374, Ja), 8408 (Ja--45370). MOUNTED ILLUSTRATIONS: Schau. in Mart., Fl. Bras. 9: pl. 45, fig. 2. 1851 (N, Z).

PETREA RACEMOSA f. ALBA (Kuhlm.) Mold., Phytologia 41: 450. 1979.

Additional synonymy: Petrea racemosa var. alba Kuhlm. ex Mold., Phytologia 7: 445. 1961.

Bibliography: Kuhlm., Flores Bras. 2: 30. 1955; Mold., Résumé 104, 221, & 464. 1959; Angely, Fl. Paran. 16: 68 (1960) and 17: 46. 1961; Mold., Phytologia 7: 445. 1961; Angely, Fl. Anal. Paran., ed. 1, 578. 1965; Mold., Fifth Summ. 1: 169 & 366 (1971) and 2: 898. 1971; Mold., Phytologia 41: 450. 1979.

PETREA RIPARIA Mold., Feddes Repert. Spec. Nov. 43: 194--195. 1938.

Additional bibliography: Mold., Phytologia 7: 445. 1961; Mold., Fifth Summ. 1: 169 (1971) and 2: 898. 1971; López-Palacios, Revist. Fac. Farm. Univ. Andes 17: 48. 1976; Mold., Phytologia 34: 256 & 259. 1976.

Recent collectors describe this plant as a vine climbing on trees, 2 m. long, a shrub 2--3 m. tall, or a "parasita", and have found it in flower in March, April, and October. The flowers are said to have been "dark-lilac" on Oliveira 4211, "light-purple" on López-Palacios 3928, "vermelha-amareladas, muito atraentes" on Fróes 25053, and "rose, ovary yellow" on Raimundo S.P.1131.

López-Palacios (1976) cites only his no. 3928 from Colombia.

Additional citations: COLOMBIA: Santander: López-Palacios 3928 (Ld). BRAZIL: Amazônas: Fróes 25053 (N). Bahia: Raimundo S.P. 1131 (N). Pará: E. Oliveira 4211 (N).

PETREA RIVULARIS Mold., Feddes Repert. Spec. Nov. 43: 191--192. 1938.

Additional bibliography: Mold., Phytologia 7: 445. 1961; Mold., Fifth Summ. 1: 130 (1971) and 2: 898. 1971; Mold., Phytologia 23: 418. 1972; López-Palacios, Revist. Fac. Farm. Univ. Andes 17: 48. 1976.

Recent collectors describe this plant as a liana, the calyx white to pale-green, and have encountered it on terra firme, flowering in July and August. López-Palacios describes it as an "arbolito de 5--7 m x 10--12 cm de diámetro, flores violáceo claro, notoriamente bracteadas". He cites (1976) only his no. 3655 "que aunque colection en Marco, al otre lado de la frontera con el Brasil, puede hallarse también en Leticia, Amazonas".

Additional citations: BRAZIL: Amazônas: López-Palacios 3655 (N, Z); Prance, Maas, Atchley, Steward, Woolcott, Coêlho, Monteiro, Pinheiro, & Ramos 14640 (N).

PETREA ROTUNDA Potbury, Carnegie Inst. Wash. Publ. 465: 79, pl. 14, fig. 3. 1935.

Synonymy: Petrea? orbicularis Gilmore ex Mold., Feddes Repert. Spec. Nov. 43: 17, in syn. 1938. Petraea rotunda Potbury ex R. Pearson, Anim. Pl. Cenoz. Era 30. 1964.

Bibliography: Potbury, Carnegie Inst. Wash. Publ. 465: 79, pl. 14, fig. 3. 1935; Mold., Feddes Repert. Spec. Nov. 43: 17--18. 1938; Mold., Geogr. Distrib. Avicen. 41. 1939; Mold., Prelim. List Inv. Names 35. 1940; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 75 & 97. 1941; Mold., Alph. List Inv. Names 35. 1942; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 166 & 192. 1949; LaMotte, Geol. Soc. Am. Mem. 51: [Cat. Cenoz. Pl. N. Am.] 246. 1952; Mold., Résumé 226, 332, & 464. 1959; R. Pearson, Anim. Pl. Cenoz. Era 30. 1964; Mold., Fifth Summ. 1: 376 (1971) and 2: 598 & 898. 1971.

Illustrations: Potbury, Carnegie Inst. Wash. Publ. 465: pl. 14, fig. 3. 1935.

PETREA RUGOSA H.B.K., Nov. Gen. Sp. Pl., ed. folio, 2: 228 [as "Petraea"]. 1817.

Additional synonymy: Petraea rugosa H.B.K., Nov. Gen. Sp. Pl., ed. folio, 2: 228. 1817. Petraea rugosa Humb. & Bonpl. apud Steud., Nom. Bot., ed. 1, 606. 1821. Petrea obtusifolia Benth. apud Schau. in A. DC., Prodr. 11: 619, in syn. 1847. Petrea rugosa var. rugosa [H.B.K.] ex Mold. in Woodson, Schery, & al., Ann. Mo. Bot. Gard. 60: 82. 1973.

Additional & emended bibliography: H.B.K., Nov. Gen. Sp. Pl., ed. folio, 2: 228 (1817) and ed. quart., 2: 282. 1818; Sweet, Hort. Brit., ed. 1, 1: 323. 1826; G. Don in Loud., Hort. Brit., ed. 1, 247. 1830; Sweet, Hort. Brit., ed. 2, 417. 1830; Cham., Linnaea 7: 369 & 370. 1832; G. Don in Loud., Hort. Brit., ed. 2, 247. 1832; Loud., Hort. Brit., ed. 2, 551. 1832; G. Don in Loud., Hort. Brit., ed. 3, 247. 1839; Sweet, Hort. Brit., ed. 3, 551. 1839; Schau., Linnaea 20: 482. 1847; Buek, Gen. Spec. Syn. Candoll. 3: 338. 1858; Bocq., Adansonia, ser. 1, 3: [Rev. Verbenac.] 251. 1863; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 478. 1894; Barnhart, Bull. Torrey Bot. Club 29: 590. 1902; Knuth, Feddes Repert. Spec. Nov. Beih. 43: [Init. Fl. Venez.] 605. 1927; MAHA Mag. 10: 56. 1940; Robledo, Lecc. Bot. 2: 499. 1940; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 2: 478 (1946) and imp. 3, 2: 478. 1960; Mold., Phytologia 7: 445--446. 1961; Corner & Watanabe, Illustr. Guide Trop. Pl. 764. 1969; El-Gazzar & Wats., New Phytol. 69: 456, 483, & 485. 1970; Mold., Fifth Summ. 1: 119, 126, & 367 (1971) and 2: 596--598, 767, & 898. 1971; Mold. in Woodson, Schery, & al., Ann. Mo. Bot. Gard. 60: 82--83 & 147. 1973; El-Gazzar, Egypt. Journ. Bot. 17: 75. 1974; Gibbs, Chemotax. Flow. Pl. 3: 1754. 1974; López-Palacios, Pittieria 6: 13 & 28. 1974; López-Palacios, Revist. Fac. Farm. Univ. Andes 15: 69--70. 1975; Kunkel, Excerpt. Bot. A.26: 416. 1976; Mold., Phytologia 34: 256 & 270 (1976) and 36: 40. 1977; López-Palacios, Fl. Venez. Verb. 652. 1977; Mold., Phytologia 41: 450. 1979.

Additional illustrations: Corner & Watanabe, Illustr. Guide Trop. Pl. 764. 1969.

Recent collectors describe this plant as a scandent or virgate shrub, 1--4 m. tall, the leaves stiff and hard, very rough and harsh, bullate, the inflorescence very showy, and the calyx purple. They have encountered it on open shrubby slopes and dry sandy ridges fully exposed to the sun, at altitudes of 80--1400 m., flowering in February, May, and July to September, fruiting in July. The corollas are said to have been "bright-blue" on Haught 2103, "purple-blue" on López-Palacios 3867, "blue-purple" on López-Palacios & Idrobo 3838, "light-purple" on López-Palacios & Idrobo 3703, and "purple with pale center" on Barclay & al. 3461, while Corner & Watanabe (1969) describe them as "violet-blue".

Vernacular names reported for the species are "azulina", "azulino carrasposo", "azulito", "chaparrito", "chicharrón", "copo morado", "mamoncillo", "mayadena", "pavita", "pluma de la reina", "plumilla", "plumito", "rough-leaved petrea", and "sombrerito".

Macbride photographed the type specimen of P. rugosa at Paris as his type photograph number 39477. López-Palacios, after careful study of this type and other relevant material, as well as field work, thinks that it was not collected at Caracas, as stated by Schauer (1847), but, rather, at Honda in Tolima, Colombia. In fact, he definitely excludes the species from the native Venezuelan flora. Sweet (1826) asserts that it was introduced into cultivation in England in 1824 from "Caracas". Knuth (1927) also still lists the type Humboldt & Bonpland collection as from Caracas.

The revised Humboldt, Bonpland, & Kunth dates for the original publication of the name, P. rugosa, were verified by Barnhart (1902).

Gibbs (1974) reports syringin absent from the stems of this species and a negative result with the HCl/methanol test.

Material of P. rugosa has been misidentified and distributed in some herbaria as P. volubilis L. On the other hand, the Holton 512, distributed as P. rugosa, actually is P. pubescens Turcz.

Additional citations: COLOMBIA: Antioquia: F. A. Barkley 38C494 (Z). Caldas: Haught 2103 (W--1742367); Uribe Uribe 6442 (N). Córdoba: López-Palacios 3867 (N, Tu). Cundinamarca: Barclay, Juajibioy, & Gama 346 (W--2702185). Huila: L. A. Bermúdez 34935 (Ca-44399). Magdalena: Purdie s.n. (Pd). Tolima: Dryander 2303 (Bm);

Humboldt & *Bonpland s.n.* [Macbride photos 39477] (N--photo of type, N--photo of isotype, P--type, P--isotype, W--photo of type, Z--photo of type, Z--photo of isotype). Valle del Cauca: *López-Palacios* & *Idrobo 3703* (Ac, N), *3838* (Ld). Department undetermined: *Mutis 448* (W--1562713), *899* (W--1562714), *914* (W--1562715), *4183* (W--1562716), *4428* (W--1562718).

PETREA RUGOSA f. **CASTA** (Mold.) Mold., Phytologia 41: 450. 1979.

Synonymy: *Petrea rugosa* var. *casta* Mold., Feddes Repert. Spec. Nov. 43: 48. 1938. *Petrea arborea* var. *alba* Hort. ex Mold., Feddes Repert. Spec. Nov. 43: 48, in syn. 1938.

Bibliography: Mold., Feddes Repert. Spec. Nov. 43: 48. 1938; Mold., Geogr. Distrib. Avicen. 39. 1939; Mold., Prelim. List Inv. Names 34. 1940; Mold., Alph. List Inv. Names 35. 1942; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 74 & 97 (1942) and ed. 2, 162 & 192. 1949; Mold., Résumé 221, 232, & 469. 1959; Mold., Fifth Summ. 1: 367 (1971) and 2: 597 & 898. 1971; Mold. in Woodson, Schery, & al., Ann. Mo. Bot. Gard. 60: 83 & 147. 1973; Mold., Phytologia 34: 256 & 270 (1976), 36: 40 (1977), and 41: 450. 1979.

Recent collectors describe this plant as a shrub, 1--3.5 m. tall, the calyx pure white. The corolla is also said to have been "white" on *López-Palacios* & *Idrobo 3704*, but "blanca con tinta lila" on their *no. 3831*.

Additional citations: COLOMBIA: Cauca: *López-Palacios* & *Idrobo 3831* (N, Z). Valle del Cauca: *López-Palacios 3704* (Ld). CULTIVATED: Colombia: *López-Palacios 4033* (Ld).

PETREA SCABERRIMA Mold., Feddes Repert. Spec. Nov. 43: 177--179. 1938.

Additional bibliography: Mold., Phytologia 7: 446. 1961; Mold., Fifth Summ. 1: 119 (1971) and 2: 898. 1971.

PETREA SWALLENI Mold., Feddes Repert. Spec. Nov. 43: 192--194. 1938.

Additional bibliography: Mold., Phytologia 7: 446. 1961; Mold., Fifth Summ. 1: 169 (1971) and 2: 898. 1971.

PETREA VOLUBILIS L., Sp. Pl., ed. 1, imp. 1, 2: 626. 1753.

Additional & emended synonymy: *Petraea* (*volubilis?*) *mexicana* Schiede ex Cham., Linnaea 7: 367. 1832. *?Petroea volubilis* Hort. ex Neumann, Ann. Fl. Pom. 1837/1838 254--255, pl. 32. 1838; Grindal, Everyday Gard. India, ed. 16, 40 & 81. 1960. *Petrea subserrata* Bárcena apud Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 478. 1894 [not *P. subserrata* Cham., 1832]. *Stachytarpheta volubilis* Solereder, Syst. Anat. Dicot. 712. 1899. *Petraea volubilis* Woodr. apud Cooke, Fl. Pres. Bomb., ed. 3, 437, in syn. 1906. *Stachytarpheta volubilis* Vesque apud D. H. Scott in Solereder, Syst. Anat. Dicot. [transl. Boodle & Fritsch] 1: 630, hyponym. 1908. *Petrea adiliaea* Goyena, Fl. Nicarag. 566. 1911. *Petrea* *guranensis* Cham. ex Mold., Feddes Repert. Spec. Nov. 43: 33, in syn. 1938. *Petrea staphylea* ex Mold., Feddes Repert. Spec. Nov. 43: 33, in syn. 1938. *Petrea volubulis* L. ex Rao, Journ. Indian Bot. Soc. 31: [297], sphalm. 1952. *Petrea arborescens* Pesman, Meet Fls. Mex. 266. 1962. *Petraea vulubilis* Jacq. ex Datta, Handb. Syst. Bot. 182. 1965. *Petraea volubilis* Haust. ex Datta & Majumdar, Bull. Bot. Soc. Beng. 20: 102. 1966. *Petrae volubis* Anon., Brit. Honduras postage stamp Minkus 281. 1972. *Petrae volubilis* Anon. ex Mold., Phytologia 25: 242, in syn. 1973. *Petrae volubis* Hatcher in Scott, Stand. Post. Stamp Cat. 133 (1): 212. 1976.

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Recent collectors describe this species as a large or small, woody, ornamental vine or strong, high-climbing liana reaching to the treetops, often to 7 m. tall, or sometimes a tall undershrub, 1--2 m. tall, or even a tree, 10--13 m. tall, profusely flowering, the stems scandent, clambering, or twining, the leaves rough-surfaced and harsh, the calyx papery, persistent for 1--2 months, blue, light- or sky-blue, pale lavender-blue, purplish-blue, pale blue-purple, or lavender, usually much paler than the corolla, in fruit enlarging and becoming greenish, the corolla early deciduous, leaving the persistent usually light-blue calyx with the developing fruit.

The corollas are described as having been "blue" on Breedlove 9016, Dorantes Lopez 520, Gimate L. 911, King 4307, Lundell 17938, MacDougall 598S, H.279, & H.357, Moldenke & al. 28131, Nairne (1894), Neale 5174, and Sumithraarachchi & Sumithraarachchi DBS. 77, "light-blue" on Troll 279, "pale-blue" on D'Arcy 5927, "dark-blue" on Foster 780 and Hansen & al. 1759, "purplish-blue" on Moldenke & al. 28344, "gray-blue" on Brumbach 8325, "dark-blue or blue-violet" on Burger & Stolze 5190, "bluish-purple" on Lundell 16883, "blue-lavender" on Lundell 15637, "lavender" on Liesner & Dwyer 1498, "lavender to blue" on Kelly 201, "purple" on Dickson 1466, Dilmy s.n., McVaugh 22468, and Ventura A. 1003, "violet" on Chavelas P. & Pérez J. ES.805, Held & Van Rhijn FC.88, Molina R. 20794, Nafday 171, and Williams (1949), and "purple, lower lobe with prominent white spot" on Bunting & Licht 649.

Recent collectors have encountered this plant in thickets and secondgrowth, along roadsides, on dry mountainsides and limestone outcrops, in remoral covering ancient ruins and in roadside jungle forests, in limestone soil in disturbed tropical rainforest remnants on steep hilltops and in tropical deciduous forests, in remnant stands of tall wet forest, in the open sun on mountains, in secondary semi-dry forests and low deciduous forests, among primary riparian vegetation, in "orilla de arroyo", and in "bosque perturbado por potrero, suelo arcilloso muy rocoso", at altitudes of 40--1000 meters, flowering from December to July, fruiting in February, March, June, and July. King reports it only "occasional" in San Luis Potosí, Mexico, while both Gimate and Ventura refer to it as "abundant" in Hidalgo and Puebla. Brumbach reports it as escaped in thickets on Captiva Island, Florida.

Quick asserts that the "flower is like a violet", but this is hardly an accurate description! Graf (1963) speaks of the corollas as "violet" in color and the calyx as "lilac-blue". Maheshwari (1963) notes: "Flowers blue or pale-violet, star-like, in terminal, long racemes. Calyx petaloid, rigid.....A handsome plant when in flower. Grown in gardens [in Delhi, India] along walls, pergolas and poles for its blossoms borne in elegant, wreath-like clusters", flowering there from October to April, and cites his no. 526.

The anonymous author of the "Guide to Some East African Trees" (undated) describes the species as a "Pretty tropical American twining shrub flowering twice a year. Flowers are violet and heliotrope. It has many pendulous branches and curious brittle papery leaves. Found in all parts of East Africa except for the very driest parts and the highest altitudes." Parker (1924) points out that "The brightly colored calyx is the most conspicuous portion of the flower and remains showy long after the fall of the corolla", asserting that in the Punjab [India] it flowers in April. Trelease (1967) describes and illustrates the twigs, pith, leaf-scars, and buds as seen in the dormant season and comments that "Though its foliage and flowers are very different, the purple-wreath produces something of the effect of a wisteria when in bloom, the flowers being borne in long hanging clusters. In tropical countries it is frequent as a covering of tree-trunks and hanging from the eaves of houses."

Ghouse and his associates (1976) report microscopic examination of microtome sections of various plant parts of P. volubilis reveal the abundance of stone-cells in every organ. "The abundance of these cells makes the plant very hard, tough and inaccessible for sectioning".

Nair & Rehm (1962) describe the pollen as 3-zonicolpate, spheroidal (diameter 49 mu; range 46—53 mu), the colpi small (7 x 3.5 mu), the ends acute, tenuimarginate, the exine 2.8 mu thick, granulate. Cave (1964) and Sharma (1963) report the chromosome number as 2x = 34. Shah & Unnikrishnan (1969) found axillary bud track connections related to the vascular strand entering the "axillary leaf".

Puff (1978) reports on the structure of the unicellular, heavily silicified leaf trichomes which account for the sandpaper-like texture of the leaves. "The hairs consist of a disc-like base (in mature leaves frequently located in a shallow depression of the epidermis, and therefore usually not easily recognizable) and a conical, sharp tip in the center (previously considered to be the whole hair). The development of these hairs is described, and observations are included about distribution and structure of the other types of nonglandular and glandular trichomes on the leaf blades of P. volubilis."

Griffith & Hyland (1966) list P. volubilis as cultivated in Maryland -- Plant Introduction no. 256311, collection no. S.632 from Queensland, Australia — the "flowers lavender-blue, profuse". Read informs us that in Florida is blooms several times a year. Rzedowski (1963) calls it "an abundant liana" in Mexico. McVaugh refers to it as occasional in deciduous forests in Oaxaca, growing in association with Bursera, Ceiba, Swietenia, and legumes. Kruse speaks of it as a "trepadora leñosa, grande, de flores azules muy vistosas. Se cultiva en los jardines [Guerrero, Mexico]. Su encuentra con frecuencia en una ladera pedregosa cubierta de rocas calizas cristalinas y suoles con pH. 7.5." Pesman (1962) asserts that it blooms three times a year and is one of the "handsomest of all Central American trees". Molina (1974) found it in cultivation in Honduras, Miller (1935) reports it cultivated in the Barbados Islands where it flowers 3 or 4 times a year, the "flowers lasting ten days". Mitchell (1967) found it in cultivation in the Bahama Islands. Alain (1974) records it from Oriente, Las Villas, and Havana, Cuba. Fosberg (1976) reports it as cultivated on St. Croix island, but his record is probably a misidentification of P. kohautiana Presl.

Smith (1978) reports P. volubilis from Lara, Venezuela. Esteva (1969) reports it both cultivated and escaped in that country. LeCointe (1947) says that in Brazil it is "Especial para ornamento de colunas". Loudon (1832) and Sweet (1826) assert that it was introduced into cultivation in England from Veracruz in 1733; as P. stapelsiae Paxt. from "S. Am." in 1824. Chittenden (1956) says P. volubilis has been in cultivation in England "since 1731". Nielsen (1965) avers that it was introduced into west Africa "from So. Am." Lind & Tallantire (1962) record it from cultivation in Uganda; Williams (1949) found it cultivated on Zanzibar and Pemba islands, where it flowers "several times a year". Gledhill (1962) reports it cultivated in Sierra Leone. I have personally seen it in parks in Cairo, Egypt, in 1974. Jafri & Ghafoor, in a personal communication to me, say that it is "sometimes cultivated in our gardens [in Pakistan] for its beautiful, showy, stellate flowers" and that it blooms there from March to May. Voigt (1845) list it as cultivated in India. Patel (1968) reports it cultivated in gardens in Melghat, India, where it flowers in March and April. Srinivasan & Agarwal (1963) list is from gardens in Lahore, while Santapau (1967) reports it from Saurashtra.

Woodrow (1910) says of this plant: "It thrives especially if planted out on the northern side of a house at 2,000 feet altitude; blooms during February to March, and is propagated by layers". Bor & Raizada (1954) give its flowering period is March to April [in India], but "Sometimes with a second flush in October. It does not fruit in this country." Srivastava (1976) describes it as "A very beautiful plant while in blossoms. Cultivated in gardens along walls and poles [in Gorakupur, India]", flowering there from October to April, citing his no. 833. Sharma (1975) found it cultivated in the Punjab. Voigt (1845) claims that it was introduced to Indian gardens in 1841. It is now cultivated in Bihar & Orissa according to Haines (1922) and Maheshwari (1975). Datta & Majumdar (1966) describe it as a "Climbing garden shrub [in India]. Flowers stellate, blue-purple. Flowering from January to March." Grindal (1960) comments that it "blends well with Bouginvillaea" in Indian gardens. Nath (1960) found it cultivated in Burma. Chevalier (1919) says that in Vietnam it blooms from June to December. Tingle (1967) reports it cultivated in Hong Kong. MacDaniels found it "commonly cultivated" in the Philippine Islands.

Steiner (1952) asserts that it is best propagated by cuttings and by layering, and that its growing season in the Philippines starts in January. Hallier (1918) collected it from cultivated plants on Luzon (H. Hallier C.120a) and Java (H. Hallier C.120). Backer & Bakhuizen (1965) inform us that in Java it is "a very common ornamental.

Smith & Tejada describe the plant as a straggling shrub recumbent on shrubs and small trees -- their no. 4526 is voucher for plant samples used in the U. S. Department of Agriculture Cancer Chemotherapy National Service Center's anti-tumor screening program.

Breedlove found it growing in black soil with limestone outcrops in lightly grazed regenerating areas with some shrubs and tree-suckers. Nairne (1894) refers to it as a "very handsome climber". Stewart (1972) calls it "a large climber from Tropical America with large purplish blue persistent calyces." Kuck & Tongg (1955) report that in their area it flowers "periodically, the spring ones best". Mattoon (1958) lists only two sources where plants may be secured by horticulturists. MacMillan (1962) calls it "one of the most beautiful of flowering plants" and says that usually it flowers twice a year in the tropics. Greensill (1966) tells us that it "prefers partial shade under high trees, can be allowed to twine, otherwise prune". Smiley (1960) asserts that it flowers in the "spring or summer, rarely anytime". Pancho describes it as a "climbing woody ornamental vine, flowers bluish in hanging clusters to a foot long at branch-tips, each flower with a bluish-lavender spreading star-shaped calyx which is persistent".

Menninger (1962) notes that Standley & Record refer to this species as P. arborea (a misidentification) when they speak of "a large woody vine.....One of the handsomest of all Central American plants because of the abundance of blue flowers, the color depending chiefly on the calyx lobes which retain their color for a long time". Dakers (1962) notes that "Although it is not often seen P. volubilis is a very lovely plant, usually treated as a climber, for a heated greenhouse. It will grow 20—30 ft. tall and so it is not really suitable for a small greenhouse. The star-like flowers appear in April and May in long trusses and the colour is lilac-blue; unfortunately, the flowers are not long lived. A greenhouse with a minimum temperature in winter of 50° is needed and it is best to grow the plants in a border of really good, well drained soil -- a special bed can be made with John Ihnes Potting Compost No. 3. Plants need plenty of water in summer, but much less in winter and light shade should be given when the sun is bright."

O'Gorman (1961) notes that "The calyx spreads open while the corolla is still a round bud in the center, and it remains after the corolla has fallen so that, at first glance, the vine seems to bear two kinds of flowers. The blooms appear in early spring." Brilmayer (1962) adds that "It can top 30 ft. in tropical climates, but is not overpowering in a ... greenhouse. With favorable conditions it could be outstanding, spilling its flower sprays down in sunny windows. Give [it] warmth, highest possible humidity (spraying the leathery leaves is helpful); rich, light soil kept constantly moist; and full sun except in midsummer. It can't stand cold or dryness of air or soil. If necessary, prune after flowering, but only lightly to thin and shape. Propagated by stem cuttings or seeds." Encke (1960) adds that "Während des Winters sollte die Nachttemperatur nicht über 15° [C.], besser sogar etwas darunter liegen".

Vernacular names reported for *P. volubilis*, in addition to those previously recorded in these notes, are "bejuco de caballo", "blue jasmine", "blue petrea", "bòng xanh", "cacalacaxíhuitl", "capitan lila", "chaparro", "cipó azul", "climbing petraea", "coamecate azul", "colación", "coroa de viúva", "corona de la reina", "cowtongue", "cual mecate", "cualmecate", "cuero de sapo", "dây bông xanh", "desconocido", "fleur de papier" [because of the papery calyx], "flor azul", "flor de papel", "flor de Santa Maria", "flor de Sao Miguel", "flor de viuda", "flor de viúva", "grinalda de viúva", "hoa tía", "hoja chigüe", "jasmine azul", "kudirai valuppu", "lei-poni-pekelea", "lengua de vaca", "opptzimin", "opp-tzimin", "papel de lija", "pascueza de venado", "petrea", "purple petrea", "purple wreath", "purplewreath petra", "purplewreath retrea", "purpurkranz", "queens wreath", "queen's wreath", "raspasombrero", "raspa-sombrero", "sand paper-vine", "sandpaper vine", "Santa Rita", "soltero", "spislákat juki", "Stapelia-like petraea", "tháthub", "totopostillo", "touca de viúva", "toucado", "toucado de viúva", "viuvinha" [a name also applied to the genus *Cinnamomum*], "yochopptzimin", and "yoch-opp-tzimin" [=a horse (or tapir) crackling (or bursting of something dry or hollow)].

Hubert (1921) and Crevost & Pételot (1934) report that *P. volubilis* is employed medicinally as a diaphoretic and expectorant. The two latter authors mistakenly reduce *P. kohautiana* Presl, *P. retusa* Presl, *P. serrata* Presl, and *P. volubilis* Vell. to synonymy here. The species is said also to be used medicinally by the Totonac Amerinds in Mexico. Gibbs (1974) found syringin doubtfully present in the stems, cyanogenesis absent from the leaves, and the HCl/methanol test results negative.

Wheeler s.n. [Winter Haven, Fla., Apr. 20, 1924] and *Herb. Bishop Mus. s.n.*, cited below, have labels that do not specifically indicate that the source plants were cultivated, but I am assuming that they were, although in both regions it is often difficult to determine if a given individual plant was planted by man in that spot or escaped there by natural means.

Walker 8074 bears a label reading "tree, fls. creamy-white, with red centers, called 'cacao' in Vietnam" -- I assume this to be a case of mixed labels.

Mound & Halsey (1978) report P. volubilis as one of the hosts for the whitefly, Trialeurodes floridensis (Quaint.) Quaint. & Bak.

The here revised dates of publication for the Humboldt, Bonpland & Kunth names involved in the synonymy here are based on Barnhart (1902). The Angely (1971) reference in the bibliography is often cited as "1970", the erroneous titlepage date. It should be noted that the Stachytarpheta volubilis credited to Vesque by Scott (1908) does not occur in the Vesque work to which it is cited. Gibson (1970) fails to recognize f. albiflora Standl. or var. pubescens Mold. as deserving nomenclatural recognition under Petrea volubilis, relegating these name to the synonymy of the typical form of the species. The Petraea mexicana Willd., cited in the above synonymy, is based on Herb. Willd. 11490 in the Berlin herbarium, now destroyed.

Goyena (1911) describes his P. adiliaea, which I place in synonymy here only tentatively, not having seen the type material, as follows: "Nuestra especie denominada Hoja chígüe de hoja pequeña, tiene las hojas, á veces verticiladas por á 3, los racimos son terminales y sus brazos dispuestos: 2 laterales seguidos de otro á un solo lado; los peciolos están acomplañados de una bracteíta lanceolado-subulado y parecen artículados con el cáliz, las divisiones calicinales exteriores así como los dientes de cáliz interior azul-claros, la corola erguida, enrodado-bilabiada, exerta, de color violaso, cuyo labio inferior lleva una mancha circular amarillento-blanquecina hacia la base, la denominarémos, si resultase especie nueva, P. Adiliaea, en honor de doña Adilia Trejos, esposa del Dr. Julián Irías, quien ordenó la publicación de esta obra, en su calidad de Ministro de Fomento del Gobierno del General Zelaya."

Roys (1931) and Loesener (1912) call what appears to be P. volubilis by the name, P. arborea H.B.K., an error widely copied in herbaria. Crevost & Pételot (1934) designated it as P. subserrata Cham. On the other hand, the "Petrea volubilis L." of D'Arcy (1967), cultivated on the island of Tortola, and the "Petraea volubilis Jacq." of Richard (1792) probably refer to P. kohautiana Presl.

Loesener (1912) cites Seler 1777 from Oaxaca, Mexicom while Macbride (1960) cites Soukup 2903 from Peru [probably cultivated]. Jafri & Ghafoor, in a personal communication to me, cite from Pakistan: Said Qureshi s.n., Said Zaibun & Nuzhat s.n., Shamim s.n., R. R. Stewart s.n., and Sultanul Abedin 9796. Knuth (1927) cites Pittier 8855 from Carabobo, Venezuela.

Material of P. volubilis has been widely misidentified and distributed in herbaria as P. arborea H.B.K., P. arborea var. pubescens Mold., P. aspera Turcz., Petraea arborea H.B.K., and even as Ceanothus azureus Desf. in the Rhamnaceae. On the other hand, Field Mus. Econ. Pl. 611127, distributed as P. volubilis, actually is P. arborea H.B.K., while Croat 4858, Ducke 9303, Lewis, Dwyer, Elias, & Solís 195, Pittier 11769, and Skog 1205 are P. aspera Turcz.; Mexia 6498 is P. peruviana var. acuminata Mold.; Dusén 10745 & 15874 and Sampaio 8408 are P. racemosa Nees; Mutis 4428 is P. rugosa H.B.K.; Breedlove 9016, Gifford & Totten s.n. [January 1, 1941], Jerabek s.n. [Balboa Park, Jan. 1945] & s.n. [Pacific Beach, April 1945], Kellerman 7738, Laughlin 178, Mell s.n. [near Campeche, Feb. 1945], H. E. Moore 2536, C. V. Morton 7080, R. W. Read X-1-55, Rzedowski 7346, and Ventura A. 3218 are P. volubilis var. pubescens Mold.; and R. M. King 4337 is Carpodiptera ameliae Lundell in the Tiliaceae.

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BAY ISLANDS: Roatán: Molina R. 20794 (N, W--2751983). NICARAGUA: Zelaya: Bunting & Licht 649 (N, W--2542893). COSTA RICA: Alajuela: Burger & Stolze 5190 (N). PANAMA: Barro Colorado Island: R. Foster 780 (Mi). CUBA: Las Villas: J. G. Jack 4249 (Pd). ECUADOR: Guayas: Valverde 77 (N). INDIA: Maharashtra: Nafday 171 (Ba). INDOCHINA: Vietnam: E. H. Walker 8074 (W--2395330). PHILIPPINE ISLANDS: Luzon: Pancho 3078 (Ws). HAWAIIAN ISLANDS: Oahu: Judd, Bryan, & Neal s.n. [Sept. 25, 1937] (N). CULTIVATED: Bangladesh: Zeysuddin 159 (Kh). Florida: Lawrence 123 (Ba); R. W. Read s.n. [X-1.55] (Ba). Hawaiian Islands: R. S. Cowan s.n. [Aug. 1944] (Ba); F. R. Fosberg 9384 (Bi); Herb. Bishop Mus. s.n. (Bi); Judd, Bryan, & Neal s.n. [Sept. 25, 1937] (Bi); J. F. Rock 2613 (Bi). Java: Dilmy s.n. [Herb. Bogor. Bot. Gard. XI.C.29] (Ba). Massachusetts: W. H. Hodge s.n. [April 1948] (Ma—34196). Mexico: Von Schrenk s.n. [Mar. 1, 1933] (E--1035698). Missouri: D'Arcy 5927 (Ld). Mozambique: Hornby 4107 (Ul). Pakistan: Qureshi s.n. [27. 2.1966] (Kh); Qureshi, Zaibunisa, & Nuzhat s.n. [25.3.1969] (Kh). Philippine Islands: MacDaniels 26 (Ba); Quisumbing s.n. [Philip. Nat. Herb. 4355] (Ba). Puerto Rico: Quick s.n. [23 March 1926] (Mi). Sri Lanka: Moldenke, Moldenke, Dassanayake, & Jayasuriya 28344 (Ld, Pd, W--2764543); Moldenke, Moldenke, & Jayasuriya 28131 (Ac, Gz, Kh, Ld, Pd, W--2764556); Sumithraarachchi & Sumithraarachchi DBS.77 (W--2803408). MOUNTED ILLUSTRATIONS: H. N. Moldenke color slide 305 (Z).

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Synonymy: Petrea arborea f. albiflora Standl., Field Mus. Publ. Bot. 11: 140. 1932. Petrea volubilis var. albiflora (Standl.) Mold., Revist. Sudam. Bot. 5: 2. 1937. Petraea arborea f. albiflora Standl. apud Fedde & Schust., Justs Bot. Jahresber. 60 (2): 574. 1941. Petrea volubilis alba Mold. in Menninger, Flow. Vines pl. 191. 1970. Petrea volubilis var. albiflora Mold., Phytologia 26: 375, in syn. 1973.

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[to be continued]

ON THE OCCURRENCE OF CONTIGUOUS STOMATA IN TMESIPTERIS

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While demonstrating the epidermal cells of a Tmesipteris leaf to Botany Students at Kuwait University last year I came across a pair of laterally contiguous stomata (Fig. 1). Contiguous stomata have been recorded in a few pteridophytic genera but, as far as I am aware, this represents the first record of such stomata in the genus Tmesipteris.

The specimen fragment from which the leaf was obtained had been imported earlier by the Botany Department of Kuwait University for educational purposes. Informations concerning its locality, date of collection, name of collector, and even name of the species are unfortunately not available. Professor Lacey kindly provided me with a specimen of T. tannensis for comparison.

The ground epidermal cells and stomata are similar in shape and size in both specimens. But the two plants differ markedly in the shape and size of their leaves. Those of T. tannensis are broadly lanceolate, broadest near base, and measure about 1.5 cm in length and 0.6 cm in width while those of the other specimen are narrowly lingulate, broadest above middle, measuring about 2.8 cm long and 0.4 cm wide. T.vieillardi is known to possess narrow leaves (Sporne, 1975) whereas T.lanceolata has leaves that may reach 3 cm in length (Sykes, 1908). However, differences in leaf form would not warrant precise identification since as stated by Sykes (1908) different leaf forms may be found on the same plant.

The stomata of the concerned specimen (Fig. 1) are oriented in the direction of the long axis of the ground epidermal cells; parallel to the long axis of the leaf. They fall in the same range of size as estimates given for the stomata of T. tannensis by Zimmermann (1927). They are also similar to stomata of other related (or usually considered as related) living and fossil plants as Psilotum, Hornea (=Horneophyton), Rhynia (Zimmermann, 1927) and Nothia (El-Saadawi and Lacey, 1979).

The manner in which the two contiguous stomata of Tmesipteris are connected is described as lateral, for the stomata are arranged side by side. Other forms of connection of contiguous stomata are also recognized in pteridophytes, e.g. polar or superimposed; when the stomata are connected end to end (Pant and Khare, 1969).

When the number of contiguous stomata is only two they are variously referred to in literature as 'twin stomata' (Inamdar, 1970) or'paired stomata' (Singh et al., 1974). However, the term 'contiguous stomata' which is widely used in literature, is more appropriate since it applies to such types of connected stomata regardless of their number which may reach six (Kropfitsch, 1951). The term 'Les stomates associés' and its English equivalent 'associated stomata' have been used, by Chappet and Guyot (1969) and El-Gazzar and Badawi (1975) respectively, in the same sense of contiguous stomata.

Literature on contiguous stomata in pteridophytes is meagre. So far, they have been recorded in only four genera namely; Equisetum, Equisetaceae (Pant and Kidwai, 1968); Ophioglossum and Helminthostachys, Ophioglossaceae (Pant and Khare, 1969; Inamdar, 1970); Blechnum, Polypodiaceae (Inamdar et al., 1971). The first three genera together with Tmesipteris are eusporangiate pteridophytes while Blechnum only belongs to the leptosporangiate ferns. Contiguous stomata were found on different organs : stems of Equisetum, leaves of Helminthostachys, Blechnum, and Tmesipteris, and leaves and spikes of Ophioglossum. The number of contiguous stomata is usually two or three.

Literature on contiguous stomata in angiosperms is, on the other hand, considerable. But there is no need, in this respect, except to say that contiguous stomata have been recorded in members of many dicotyledonous and several monocotyledonous families, and that they occur on different vegetative and floral organs and their number ranges from two to four (and up to six under the effect of an external agent), Kropfitsch (1951); Dehnel (1961); Pant and Kidwai (1964, 1966); Chappet and Guyot (1969); Inamdar (1969); Gopal and Shah (1970) ; Shah and Gopal (1971).

In addition to naturally occurring contiguous stomata Literature includes also reference to the occurrence of induced contiguous stomata. The external stimulant may be a fungus (Gertz, 1919), a virus (Weber and Kenda, 1952) or a chemical agent (Kropfitsch, 1951).

Polyploidy has been suggested by Inamdar *et al*. (1969) as a possible cause (among several other alternatives) for the development of aberrent patterns of stomata.

Since the present find is, so far, the only record of contiguous stomata in *Tmesipteris* and knowing that it is only recorded once in a single specimen, it becomes clear that it does not represent a specific feature but an abnormality provoked by an external factor. However, owing to the small amount of material examined here, this conclusion may be incorrect. Polyploidy should perhaps be thought of as a possible cause since the occurrence of tetraploid *Tmesipteris* sporophytes is well known (Sporne, 1975). This, however, necessitates further thorough investigation of fresh specimens of *Tmesipteris* species especially where living material is available.

Acknowledgements

I wish to thank Prof. W. S. Lacey (of Wales University, Bangor, U. K.) for kindly providing me with a specimen of *T. tannensis* (collected on 4.12.1961, from New Zealand, by Dr. G.

Scott). I thank Mr. Sayed Zaki for technical assistance with the same specimen. Thanks are also due to Kuwait University for library and photographic facilities offered.

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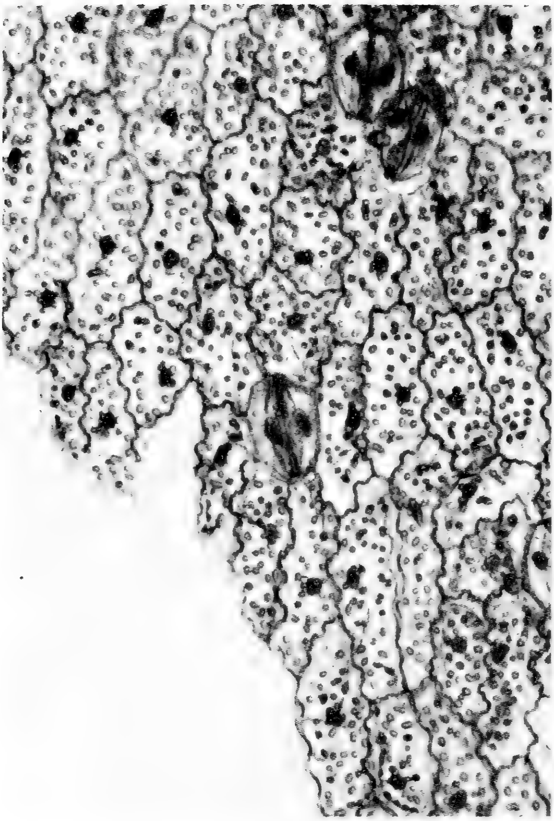

Fig. 1. A strip of epidermis of leaf of Tmesipteris sp. showing a single pair of contiguous stomata and one solitary stoma. x 170.

BOOK REVIEWS

Alma L. Moldenke

"APPLIED AND FUNDAMENTAL ASPECTS OF PLANT CELL, TISSUE, AND ORGAN CULTURE" edited by J. Reinert & Y. P. S. Bajaj, xviii & 803 pp., 167 fig., 260 b/w photo & 57 tab. Springer-Verlag, Heidelberg, D-1000 Berlin 33 & New York, N. Y. 10010. 1977. $83.60.

This is a very detailed, carefully prepared, highly valuable and very expensive book "covering the major lines of current research in the subject with the main emphasis on developments relevant to agriculture, forestry, horticulture and industry" and is the only modern comprehensive treatment available to date. The 48 contributors to this study are all specialists in their respective fields. The 7 chapters present the modern problems and techniques with their proportionate success and applications available now and those prognosed for the future. They include (1) Regeneration of plants as in cloning, meristem production of orchids, (2) Haploids as in monoploid production by chromosome elimination, anther culture, (3) Cytology, Cytogenetics as in triploid plants from endosperm, in vitro pollination and fertilization, (4) Protoplasts, Somatic Hybridization and Genetic Engineering as in DNA, chloroplast and bacterial uptake and transfer of genes controlling N_2-fixation, (5) Tissue Culture and Plant Pathology as in virus-free plants from infected stock, (6) Cell Culture and Secondary Products, as in possible pharmaceutical production of increased flavonoids, isoprenoids, etc., and (7) A Miscellany of isozymes, radiation of cells and protoplasts, cryobiology, and plant cell cultures and gene banks. Advanced students, teachers, research scientists in many laboratories throughout the world will appreciate the coverage and organization of this study and will need its information.

"BIOLOGICAL INSECT PEST SUPPRESSION" by Harry C. Coppel & James W. Mertins, xiii & 314 pp., 33 b/w photo, 13 fig. & 1 tab. Springer-Verlag, Berlin, Heidelberg, & New York, N. Y. 10010. 1977. $29.60.

The authors of this "Advanced Series in Agricultural Sciences Vol. 4" consider this topic to embrace "the use or encouragement, by man, of living organisms or their products for the population reduction of pest insects" and stress the need for specialists in this field to "take an active part in formulating resource management decisions......[even though] the nuts and bolts of this important decision-making apparatus have yet to be assembled, but they will be". This is an excellent text probing the techniques, with pros and cons, of the basic biological problems in more selective methods of control than excessive insecticide spraying. The release of cobalt sterile male screwworm flies has controlled that cattle pest in Florida. Use of predators, pathogens, environment modification, genetic manipulation, hormones, pheromones, antifeedants, etc. are all considered. There is a very detailed bibliography provided.

"GREENHOUSE MANAGEMENT" by Joe J. Hanan, Winfred D. Holley & Kenneth L. Goldsberry, xiv & 530 pp., 283 b/w fig. incl. many photo, & 101 tab. Springer-Verlag, Heidelberg, D-1000 Berlin 33 & New York, N. Y. 10010. 1978. $47.00.

Much of the newer writing on greenhouses has been about construction and maintenance for study and/or hobby purposes, but this text is a seriously technical one planned for training people in various phases of the management field for the greenhouse production of certain fruits and vegetables, tobacco, cut flowers and ornamentals as a successful business endeavor. I am not aware of any other text at so modern, practical and thorough a level. There are treatments of all kinds of light, temperature control, water, soils and nutrition, pollution, insect and disease control, chemical growth regulation, construction, business management and marketing. This book is No. 5 in the "Advanced Series in Agricultural Sciences".

"NEW NATURAL PRODUCTS AND PLANT DRUGS WITH PHARMACOLOGICAL, BIOLOGICAL OR THERAPEUTIC ACTIVITY" edited by H. Wagner & P. Wolff, xi & 286 pp., 152 b/w fig. & 31 tab. Springer-Verlag, Heidelberg, D-1000 Berlin 33 & New York, N. Y. 10010. 1977. $30.90.

These are proceedings neatly photo-offset printed from the First International Congress on Medicinal Research, Section A, held at the University of Munich in September 1976, which hold that "those concerned with new drug development must initiate major programs to explore higher plants for biologically active structures that up to now have eluded the imagination of the synthetic chemist". There are papers about plants and antitumor, antibiotic, cytotoxic substances as well as the terpenoids, saponins, ergot alkaloids and neolignans. The importance of taxonomically checked voucher specimens safely esconced in recognized herbaria is stressed.

"PLANT TISSUE CULTURE AND ITS BIO-TECHNOLOGICAL APPLICATION" edited by W. Barz, E. Reinhard & M. H. Zenk, xv & 419 pp., 196 b/w fig. incl. 78 microphoto. & 28 tab. Springer-Verlag, Heidelberg, D-1000 Berlin 33, & New York, N. Y. 10010. 1977. $38.80.

These proceedings are also neatly photo-offset printed from the First International Congress on Medicinal Plant Research, Section B, held at the University of Munich in September 1976, "introducing cell culture systems for medicinal compound production" since the "increasing difficulties in securing an ample supply of medicinal plants because of a drastic decrease in plant resources due to human disturbances of the natural environment, ruthless exploitation, increasing labor cost, and technical and/or economic difficulties in cultivating wild plants". The 35 papers include such topics as: Cardiac Glycosides in Cell Cultures of *Digitalis*, Characterization of Biochemical Nutrients, Steroids in Plant Cell Tissues, Freeze-Preservation of Plant Cell Cultures. Radio-immuno-Screening Methods for Secondary Plant Products, Somatic Cell Hybridization, etc.

Index to authors in Volume Forty-two

Index to supra-specific scientific names in Volume Forty-two

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