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STUDIES IN AMERICAN ORCHIDS X*

LESLIE A. GARAY

In preparing the final manuscript of the Orchid Flora of Colombia and Ecuador a number of correlated material from the neighboring countries had to be investigated. These studies which cannot directly be incorporated into the main text of the "Flora", are presented here. Number IX of this series was published in Botanical Museum Leaflets, 24: 299-304, 1973.

Habenaria linguicruris Rchb.f., Bonpl. 2: 10, 1854.
Type: Venezuela; Caracas, WAGENER 96! (W).
Syn.: *Habenaria Ernstii* Schltr., Fedde, Rep. Beih. 6: 26, 1919.
Type: Venezuela; Caracas, ERNST *s.n.*! (AMES).

A comparison of the holotypes of *H. linguicruris* and *H. Ernstii* with one another has shown them to be conspecific.

Porphyrostachys parviflora (C. Schweinf.) Garay, *stat. nov.*
Basionym: *Stenoptera pilifera var. parviflora* C. Schweinf. in Bot. Mus. Leafl. Harv. Univ. 9: 222, 1941.
Syn.: *Stenoptera parviflora* (C. Schweinf.) C. Schweinf. in Fieldiana Bot. 33: 4, 1970.
Type: Peru; Huanuco, Llata, MACBRIDE & FEATHERSTONE 2301! (F).

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The plants of the genus *Porphyrostachys* may be separated from *Stenoptera* in that the flowers have a column with a long, decurrent foot to which the lip is adnate; lateral sepals are also decurrent on the ovary. These characters are absent in *Stenoptera*.

Psilochilus carinatus Garay, *sp. nov.*

Terrestris, erecta, usque ad 30 cm. alta; caulibus ascendentibus, pluriarticulatis, primum vaginatis, deinde laxe paucifoliatis; foliis ovato-ellipticis, acutis vel subacuminatis, basi rotundatis, breviter petiolatis, usque ad 9.5 cm. longis, 4 cm. latis; inflorescentia terminali, pauciflora; bracteis distichis, ovato-lanceolatis, usque ad 1.5 cm. longis, sursum decrescentibus; floribus succedaneis; sepalo postico lineari-oblongo, acuto, dorsaliter in medio carinato-incrassato, usque ad 21 mm. longo, 3.5 mm. lato; sepalis lateralibus falcato-linearibus, acutis, dorsaliter subcarinatis, usque ad 18 mm. longis, 3.5 mm. latis; petalis tenuibus, falcato-oblanceolatis, acutis, usque ad 18 mm. longis, 3 mm. latis; labello longe unguiculato, deinde cuneato-trilobo, lobis lateralibus oblique triangularibus, lobo intermedio antico, subquadrato-rotundato, antice truncato, margine eroso-denticulato, disco in medio bicarinato, carina tertia in ungue, usque ad 17 mm. longo, 7 mm. lato; columna gracili, arcuata, alis subtruncato-denticulatis, usque ad 15 mm. longa; ovario cylindrico, breviter pedicellato, usque ad 15 mm. longo.

Colombia: Sierra Nevada de Santa Marta, PURDIE *s.n.*! type! (K); Fusagasugá, HOLTON *s.n.*! (K).

Palmorchis colombiana Garay, *sp. nov.*

Herba terrestris, elata, pars quae adest, 40 cm. longa; radicibus nondum notis; caulibus supra foliosis; foliis satis tenuibus, ellipticis, acutis vel abrupte acuminatis, basi longe petiolatis; lamina usque ad 20 cm. longa, 7.5 cm. lata; petiolo usque ad 10 cm. longo; inflorescentiis satis gracilibus, remote plurivaginatis, supra subdense plurifloris, usque ad 12 cm. longis; bracteis lanceolatis, acuminatis, usque ad 10 mm. longis; floribus albidis, succedaneis; sepalo postico lineari-ligulato, obtusiusculo, usque ad 12 mm. longo, 2 mm. lato; sepalis lateralibus oblique falcato-oblanceolatis, obtusis, usque ad 10 mm. longis, 2.5 mm. latis; petalis oblanceolato-dolabriformibus, obtusis, usque ad 11.5 mm. longis, 3 mm. latis; labello basin lineari-conduplicato, puberulo, deinde trapezoideo, utrinque obtusangulo, antice tridentato, lacinia mediana carnosa; toto labello usque ad 10 mm. longo; 7 mm. lato; columna gracili, antice villosa, usque ad 10 mm. longa; ovario pedicellato satis gracili, usque ad 10 mm. longo.

Colombia: Dept. El Valle, Río Calima, Quebrada de La Brea, 30-40 m. alt., SCHULTES & VILLARREAL 7370! (AMES), type!

Psilochilus physurifolius (Rchb. f.) Løjtnant in Bot. Notiser 130: 168, 1977.

Basionym: *Pogonia physurifolia* Rchb.f. in Nederl. Kruidk. 4: 324, 1858.

Type: British Guiana, without precise locality, SCHOMBURGK *s.n.*! (K).

Through the courtesy of Dr. Peter Taylor, Curator of the Orchid Herbarium at Kew, I was able to examine the type-specimen of *Pogonia physurifolia*. The dissection of one of the glued-down flowers revealed a triandrous condition of the column. As a matter of fact, all details of the flower agree remarkably with those collected by BROADWAY *s.n.*! in Grenada, the latter which was identified and illustrated by Ames as *Psilochilus macrophyllus* (Lindl.) Ames. — See Ames, Orchidaceae 7: 45, Pl. 110, 1922. — The lip in *P. macrophyllus* differs in its different proportions and its short claw; *P. Maderoi* (Schltr.) Schltr. has a distinct keel on the long claw. The Ecuadorian material published as *P. physurifolius* is based on a wrong determination; its correct disposition will be given in the currently published Orchids of Ecuador.

Triphora Ravenii (L.O. Wms.) Garay, *comb. nov.*

Basionym: *Pogonia Ravenii* L. O. Wms. in Fieldiana, Bot. 32: 200, 1970.

Type: Costa Rica; 6 km. S. of San Vito de Java, RAVEN 21837! (F).

An examination of the holotype clearly shows that this species is a member of the genus *Triphora* and closely related to *T. amazonica* Schltr.

Pseudocentrum Purdii Garay, *sp. nov.*

Terrestris, erecta, usque ad 65 cm. alta; radicibus fasciculatis, carnosis, pilosis; foliis basilaribus, rosulatis, longe petiolatis, petiolis canaliculatis, usque ad 13 cm. longis, laminis oblique ellipticis vel ovato-ellipticis, abrupte acuminatis, herbaceis, usque ad 18 cm. longis, 6.5 cm. latis; scapo erecto, vaginato, supra racemoso; racemo cylindrico, satis dense multifloro, usque ad 16 cm. longo; bracteis ovato-lanceolatis, acuminatis, 1.5 cm. longis, 0.5 cm. latis; floribus extus villosis; sepalo postico ovato, subacuminato, usque ad 6 mm. longo, 2 mm. lato; sepalis lateralibus connatis, apice liberis, oblique ovato-falcatis, 4 mm. longis, 3 mm. latis, deinde cylindraceo-canaliculatis, usque ad 2 cm. longis; petalis linearibus, acuminatis, usque ad 4 mm. longis, 1 mm. latis; labello sessili, 3-lobo, lobis lateralibus linearibus, 3 mm. longis, parallelis, deinde abrupte in lobum intermedium, conduplicatum, linearem, apice inflatum, decurrentibus, infra apicem lobulo fornicato donato, toto labello usque ad 18 mm. longo; ovario gracili, cylindrico, satis dense villoso, usque ad 11 mm. longo.

Colombia: Dept. de la Guajira, Mont del Agua, Molina, Río Hacha, Hacha, Purdie *s.n.*! (K).

Sobralia Fenzliana Rchb.f. in Bot. Zeit. 10: 714, 1852.

Type: Panama; Chiriqui, Warscewicz 48! (W).

Syn.: *Sobralia panamensis* Schltr. in Fedde, Rep. Beih. 17: 11, 1922.

Type: Panama; Gatun Lake, Powell 21! (AMES)

At the time Schlechter described *S. Powellii,* the type of *S. Fenzliana* was not available to him, judging from an *ex char.* determination of a drawing he sent to Professor Ames. An examination of the holotype of both species confirms their conspecificity. Recently I have seen material of this species also from Colombia and Ecuador.

Sobralia luteola Rolfe in Kew Bull. 199, 1898.
Type: Tropical America: flowered in cultivation by RALLI *s.n.*! (K).
Syn.: *Sobralia pleiantha* Schltr. in Fedde, Rep. 3: 79, 1906.
Type: Costa Rica: Boruca, PITTIER 3855! (AMES).

The rather short, distichous inflorescence with imbricating bracts and the production of flowers in a rapid succession are the distinguishing features of this species. An examination of both holotypes confirms them to be conspecific.

Sobralia Powellii Schltr. in Fedde, Rep. Beih. 17: 11, 1922.
Type: Panama: near Gatun Lake, POWELL 2! (AMES).

Sobralia Powellii has been treated as a synonym of *S. leucoxantha* Rchb.f. by all contemporary students of American orchids. An examination of the type of *S. leucoxantha,* however, clearly indicates that both species are amply distinct, not only in vegetative aspects, but also in size and structure of the flowers. The original mix-up is most probably due to the misidentification of Plate 7058 in the BOTANICAL MAGAZINE. Ironically, most of the true *S. leucoxantha* specimens in herbaria are misidentified as *S. macra* Schltr., which, however, is not a synonym of *S. leucoxantha.* I have seen material also from Costa Rica, Colombia and Ecuador.

Sobralia Warscewiczii Rchb.f. in Bot. Zeit. 10: 714, 1852.
Type: Panama; Chiriqui, WARSCEWICZ 8! (W).
Syn.: *Sobralia Amparoae* Schltr. in Fedde, Rep. Beih. 19: 8, 1923.
Type: Costa Rica; from cultivation, TONDUZ 51! (AMES).
Sobralia Hawkesii Heller in Phytologia 14: 16, 1966.
Type: Nicaragua; Dept. Granada, Volcán Mombacho, HELLER & HAWKES 3025 (F).

An examination of the types of *S. Warscewiczii* and *S. Amparoae* and a comparison of them with the published illustration of *S. Hawkesii* indicates that all three species are conspecific with one another.

Elleanthus Presl, Rel. Haenk. 1: 97, 1827.

Sepals free, rarely spreading; dorsal sepal concave; lateral sepals basally connivent, gibbose. Petals free, usually thinner in texture. Lip longer than sepals, concave with a flared apex, basally cymbiform, excavate or gibbous with one or two distinct corpuscles or calli. Column erect, footless but with oblique base, winged above. Stigmata confluent into one, prominent under the triangular rostellum. Anther incumbent. Pollinia 8, in unequal massulae. Erect or branching shrublike plants with fibrous roots. Stem erect, ascending or decumbent, cane-like, leafy. Leaves distichous, rigid, plicate, sessile on arpophyllaceous, adpressed leaf-sheath. Inflorescence terminal, racemose or subcapitate, commonly rather dense and many-flowered, rarely lax and few-flowered. Bracts conspicuous, but not foliaceous. Flowers rather small, but attractively colored.

Lectotype: *Elleanthus lancifolius* Presl [Britton & Wilson in Sci. Surv. Porto Rico 5, pt. 2: 203, 1924].

Approximately 70 species in tropical America and West Indies.

KEY TO SECTIONS

1. Rachis shortened into a tightly packed, subglobose head; column with a prominent, infrastigmatic protuberance forming a distinct mentum .... Sect. **Cephalelyna**
1a. Rachis elongate, densely or loosely spicate; column without an infrastigmatic mentum, at most angular-protuberant 2
2. Inflorescence lateral .... Sect. **Laterales**
2a. Inflorescence terminal 3
3. Flowers and bracts in an all-sided spike or secund 4
3a. Flowers and bracts in a distichous to bifarious spike, either approximate, imbricate or remote on a flexuous to strongly fractiflex raceme . 7
4. Calli of lip freely exposed in basal cavity 5
4a. Calli of lip partially hidden behind a transverse membrane covering the entrance to basal cavity in part .... Sect. **Hymenophora**
5. Calli of lip tightly approximate or confluent in fresh condition, variously sulcate in middle, especially when dried, centrally affixed to didymous cavity .... Sect. **Calelyna**
5a. Calli of lip free from one another and distinctly separated, each located either at the center or at the base of their respective cavities 6
6. Column with a biauriculate clinandrium; lateral sepals more or less connate .... Sect. **Otiophora**

6a. Column with an exauriculate clinandrium; lateral sepals free from one another .... Sect. **Stachydelyna**
7. Base of lip subglobose, didymous-saccate; calli inserted basally or centrally in cavity .... Sect. **Chloidelyna**
7a. Base of lip conical, subcalcarate-saccate, not didymous; calli inserted on sides of cavity .... Sect. **Elleanthus**

Elleanthus Sect. **Cephalelyna** (Rchb.f.) Rchb.f. in Walp. Ann. 6: 474, 1862.

Basionym: *Evelyna* Sect. *Cephalelyna* Rchb.f. in Bot. Zeit. 10: 709, 1852.

Lectotype: *Evelyna casapensis* Rchb.f. *in hoc loco.*

Inflorescence terminal, capitate; rachis shortened into a tightly packed, subglobose head; column with a prominent, infrastigmatic mentum.

This section is the most difficult as well as the most misunderstood in the genus due to the superficial resemblance of its members to one another. Since I did not find a correct treatment in any of the floristic works pertaining to this group of plants, a short synopsis with key to all species is provided here:

KEY TO SPECIES

1. Lip ovate; petals linear-filiform, 1-nerved; infrastigmatic protuberance of column with a median, recurved digit .... **E. Killipii**
1a. Lip cuneate-flabellate to more or less orbicular; petals wider, several-nerved; infrastigmatic protuberance of column without a median, recurved digit 2
2. Lip from a concave or saccate base cuneate-flabellate 3
2a. Lip from a concave or saccate base orbicular to suborbicular 7
3. Infrastigmatic protuberance papillose-hirsute 4
3a. Infrastigmatic protuberance glabrous 6
4. Lateral sepals oblong-ligulate, acute; petals entire 5
4a. Lateral sepals obliquely ovate-lanceolate, acuminate, petals erose-denticulate .... **E. Glomera**
5. Stem slender; bracts ovate; lip from a saccate base transversely elliptic-flabellate with erose-dentate margin, retuse in front .... **E. capitatus**
5a. Stem stout; bracts elliptic; lip from a concave base obovate-flabellate with entire margin, bilobed in front. .... **E. Sodiroi**
6. Sepals more or less connate at base; lip deeply excised in middle .. .. **E. Hookeranus**
6a. Sepals free to base; lip slightly retuse in front .. **E. sphaerocephalus**

7. Infrastigmatic protuberance short, poorly developed, obscurely papillose; bracts lanceolate, long-acuminate .... **E. cynarocephalus**

7a. Infrastigmatic protuberance elongate, well-developed, glabrous; bracts ovate-lanceolate, shortly acuminate 8

8. Petals as wide as the sepals; lip emarginate in front with a median apicule ....**E. cephalotus**

8a. Petals narrower than sepals; lip emarginate to bilobed in front without a median apicule 9

9. Lateral sepals 3-nerved; lip coarsely lacerate-fimbriate to lacerate-dentate along margin ....**E. brasiliensis**

9a. Lateral sepals 5- to 7-nerved; lip minutely erose-denticulate along margin ....**E. casapensis**

ENUMERATION OF SPECIES

Elleanthus brasiliensis (Lindl.) Rchb.f. in Walp. Ann. 6: 478, 1862.

Basionym: *Evelyna brasiliensis* Lindl. in Hook., Lond. Journ. Bot. 2: 661, 1843.

Type: Brazil; Organ Mountains, GARDNER 642 (K).

The specimen in the Lindley herbarium is collected by GARDNER 673! (K-L) which I examined. It is at variance with Lindley's drawing on the same sheet where the lip is shown as having broadly triangular apiculate apex. However, Lindley at the time of original publication did not describe any floral details.

Elleanthus capitatus (Poepp. & Endl.) Rchb.f. in Walp. Ann. 6: 475, 1862.

Basionym: *Evelyna capitata* Poepp. & Endl., Nov. Gen. ac Sp. Pl. 1: 32, 1836.

Type: Peru; near Cuchero, POEPPIG *s.n.*! (W).

Syn.: *Evelyna cephalophora* Rchb.f. in Bot. Zeit. 10: 709, 1852.

Elleanthus cephalophorus (Rchb.f.) Rchb.f. in Walp. Ann. 6: 476, 1862.

Type: Peru; near Cuchero, POEPPIG 1638! (W).

The very slender plants have rather small heads. *Elleanthus cephalophorus* on one of the herbarium sheets has been annotated by Reichenbach himself in 1885 to be conspecific with *E. capitatus*.

Elleanthus casapensis (Rchb.f.) Rchb.f. in Walp. Ann. 6: 475, 1862.

Basionym: *Evelyna casapensis* Rchb.f. in Bot. Zeit. 10: 709, 1852.

Type: Peru; Casapi, MATTHEWS 1891! (W).

This is the most common species in the Andes from Colombia to Peru. The leaves are abruptly constricted below the apex into a long-acuminate tip.

Elleanthus cephalotus Garay & Sweet in Journ. Arnold Arb. 53: 390, 1972.

Basionym: *Bletia capitata* R. Br. in Aiton, Hort. Kew. ed. 2, 5: 206, 1813.

Syn.: *Elleanthus capitatus* (R. Br.) Rchb.f. ex Cogn. in Urban, Symb. Antill. 6: 561, 1910, not (Poepp. & Endl.) Rchb.f., 1862.

Type: West Indies (probably Jamaica), without precise locality. Introduced by SIR JOSEPH BANKS *s.n.*! in 1795 and flowered at Kew Gardens Aug. 15, 1796! (BM).

This species is apparently restricted to the West Indian Islands. It may be distinguished from all other members in this section by the broad petals which are of the same width as the sepals. A good illustration as well as a description is given in the *Orchids of Jamaica* by Fawcett and Rendle.

Elleanthus cynarocephalus (Rchb.f.) Rchb.f., Walp. Ann. 6: 476, 1862.

Basionym: *Evelyna cynarocephala* Rchb.f., Bonpl. 4: 216, 1856.

Syn: *Epidendrum capitatum* Sessé & Mociño, Fl. Mex., ed. 2, 202, 1894.

Type: Mexico, Mt. Tuxtla, SESSÉ & MOCIÑO *s.n.*! (Herb. Pavón) (G).

Terrestrial plants, up to 50 cm. tall. Stem erect, leafy, completely enclosed by striate leaf-sheaths. Leaves elliptic-lanceolate, long-acuminate, ribbed, up to 18 cm. long and 3.5 cm. wide. Inflorescence terminal, sessile, capitate. Bracts congested, ovate-lanceolate to lanceolate, acuminate, up to 6 cm. long, decreasing inwards. Flowers rose-colored. Dorsal sepal oblong-ligulate, obtuse, 3-nerved, up to 11 mm. long and 3 mm. wide; lateral sepals connate for 3 mm. at base, together cymbiform; free portion linear-oblong, obliquely acute, each up to 11 mm. long and 3 mm. wide. Petals linear-oblong, rounded at apex, erose-denticulate above, 3-nerved, up to 10 mm. long and 2 mm. wide. Lip suborbicular, lightly excised in front with wavy and obscurely denticulate margin, slightly gibbose at base, provided with a pair of small ovoid calli, up to 12 mm. long and wide. Column winged, more or less sigmoid with a prominent chin. Ovary cylindric, ribbed, sessile, up to 15 mm. long.

Since Reichenbach did not describe the floral details a new description is given here, prepared from the type. There are 3 specimens in existence. The type is in Geneva, a duplicate of it in the Reichenbach Herbarium in Vienna, while the third, with the original handwritten label, once part of the Lambert Herbarium, is in the British Museum of Natural History. A good illustration is to be found in Hamer, *Las Orquideas de El Salvador* 1: 157, 1974, where it is called *Elleanthus cephalotus*. The basally connate sepals are unique in the section.

Elleanthus Glomera Garay, *nom. nov.*

Basionym: *Glomera brasiliensis* Barb. Rodr., Gen. et Sp. Orch. Nov. 1: 147, 1877.

Type: Brazil; Prov. S. Paulo, near Santos, MOSÉN 3485 (S).

An examination of Rodrigues's original drawings of floral details of *Glomera brasiliensis*, now in the Library of the Orchid Herbarium of Oakes Ames, has convinced me that this species is sufficiently distinct from the *E. brasiliensis*.

Elleanthus Hookeranus (Barb. Rodr.) Garay, *comb. nov.*

Basionym: *Evelyna Hookerana Barb. Rodr.*, Gen. et Sp. Orch. Nov. 2: 166, 1881.

Syn.: *Elleanthus brasiliensis var. Hookeranus* (Barb. Rodr.) Cogn. in Mart., Fl. Bras. 3(5): 327, 1901.

Lectotype: Brazil; Prov. Rio de Janeiro, Serra d'Estrella, BARBOSA RODRIGUES *s.n.* No specimen known to exist; Rodrigues's original drawing in the Library of the Orchid Herbarium of Oakes Ames is selected here for holotype! (AMES)

Elleanthus Killipii Garay, *sp. nov.*

Plantae elatae, usque ad 80 cm. altae; radicibus fasciculatis, flexuosis, carnosis; caulibus erectis, primum vaginatis deinde multifoliatis; foliis lanceolatis, acuminatis, base cuneatis, subtus 5-7 nerviis, usque ad 23 cm. longis, 4 cm. latis; inflorescentia terminali, capitata, dense pluriflora, ca. 2.5 cm. diametienti; bracteis ovato-lanceolatis, acuminatis, usque ad 2 cm. longis; floribus pallide purpureis; sepalo postico oblongo-ligulato, acuto, basin extus sparse furfuraceo, usque ad 11.5 mm. longo, 3 mm. lato; sepalis lateralibus oblique oblongo-ligulatis, acutis vel subacuminatis, basi excavatis, extus sparse furfuraceis, usque ad 13 mm. longis, 3 mm. latis; petalis lineari-filiformibus, acuminatis, uninerviis, usque ad 11 mm. longis, 1 mm. latis; labello concavo, basi saccato, intus callis vel corpusculis 2, ovoideis, antice evanescentibus ornato, deinde in laminam ovatam, antice tridenticulatam expanso, margine minutissime erosulo, toto labello usque ad 12 mm. longo, 10 mm. lato; columna suberecta, tabula infrastigmatica 3-lobo intermedio pubescenti, recurva, usque ad 7 mm. longa; ovario cylindrico, pubescenti, usque ad 9 mm. longo.

Colombia: Dept. El Valle, Buenaventura, coastal thickets, 10 m. alt., KILLIP 11760! type! (AMES), KILLIP 5215! (AMES, US).

Elleanthus Killipii is readily distinguishable from the other species in the Section *Cephalelyna* by the shape of the ovate lip and the linear-filiform, 1-nerved petals.

Elleanthus Sodiroi Schltr. in Fedde, Rep. 14: 387, 1916.

Type: Ecuador; Pichincha near Quito, SODIRO 38! (BR).

So far this species is known only from Ecuador. An outstanding field character is the entire margin to the obovate-flabellate lip.

Elleanthus sphaerocephalus Schltr. in Fedde, Rep. Beih. 27: 17, 1924.

Type: Colombia; Dept. Nariño, Pasto, HOPP 33.

This species is now known from Venezuela to Bolivia. As a matter of fact, it is illustrated in Dunsterville & Garay, VENEZUELAN ORCHIDS 4: 70, 1966 under the name of *E. capitatus.*

Elleanthus Sect. **Laterales** Garay *sect. nov.*

Type: *Elleanthus lateralis* Garay (in press).

Inflorescentia lateralis, spicata; columna sub fovea stigmatica ut plurimum angulata, nunquam mentum formantia.

Elleanthus Sect. **Hymenophora** Garay, *sect. nov.*

Type: *Evelyna hymenophora* Rchb.f.

Inflorescentia terminalis, spicata; flores quaquaversae; columna sub fovea stigmatica angulata; calli labelli pro maxima parte post membranum foveae inclusi.

Elleanthus Sect. **Calelyna** (Rchb.f.) Benth. & Hook., Gen. Pl. 3: 522, 1883.

Basionym: *Evelyna* Subg. *Calelyna* Rchb.f. in Bot. Zeit. 10: 708, 1852.

Syn.: *Elleanthus* Subg. *Calelyna* (Rchb.f.) Rchb.f. in Walp. Ann 6: 473, 1862.

Lectotype: *Evelyna myrosmatis* Rchb.f. *in hoc loco.*

Inflorescence terminal, spicate; flowers quaquaversal; column angulate; calli of lip freely exposed in basal cavity, tightly approximate or confluent in fresh condition, variously sulcate in middle when dry.

Elleanthus Sect. **Otiophora** Garay, *sect. nov.*

Type: *Elleanthus Caroli* Schltr.

Inflorescentia terminalis, spicata; flores quaquaversae; sepala lateralia plus minusve connata; columna sub fovea stigmatica angulata; clinandrium biauriculatum.

Elleanthus Sect. **Stachydelyna** (Rchb.f.) Rchb.f. in Walp. Ann. 6: 476, 1862.

Basionym: *Evelyna* Sect. *Stachydelyna* Rchb.f. in Bot. Zeit 10: 709, 1852.

Lectotype: *Evelyna Lindenii* Rchb.f. *in hoc loco.*

Inflorescence terminal, spicate; lateral sepals free; flowers all-sided; column angulate; clinandrium exauriculate.

Elleanthus Sect. **Chloidelyna** (Rchb.f.) Garay, *comb. nov.*

Basionym: Evelyna Subsect. *Chloidelyna* Rchb.f. in Bot. Zeit. 10: 709, 1852.

Syn.: *Elleanthus* Subsect. *Chloidelyna* (Rchb.f.) Rchb.f. in Walp. Ann. 6: 476, 1862.

Type: *Evelyna graminifolia* Poepp. & Endl.

Inflorescence terminal, spicate; flowers distichous; column angulate; base of lip subglobose, didymous, saccate; calli free, inserted basally or centrally in cavity.

Elleanthus confusus Garay, *sp. nov.*

Plantae fruticosae, ramosae, supra metrales; caulibus erectis, strictis, infra vaginatis, supra paucifoliatis; ramis abbreviatis, supra 3-, 4-foliatis, usque ad 12 cm longis; foliis coriaceis, subplicatis, lanceolatis, subacuminatis, usque ad 7 cm. longis, 1.5 cm. latis; inflorescentia terminali, sessili, laxe pauciflora, usque ad 3.5 cm. longa; rhachide sinuoso-fractiflexa; bracteis ovato-cucullatis, acutis, rigidis, lepidotis, usque ad 12 mm. longis; floribus satis tenuibus, albidis, pallide roseo-suffusis, glabris; sepalo postico anguste ovato, concave obtuso, plus minusve mucronato, usque ad 8 mm. longo, 3 mm. lato; sepalis lateralibus oblique ovato-oblongis, concavis, acutis, apice dorsaliter carinatis, usque ad 8.5 mm. longis, 3.5 mm. latis; petalis cuneato-spathulatis, obtusis, margine sub apice utrinque denticulatis, usque ad 9 mm. longis, 4 mm. latis; labello in circuitu subrotundo, basi globoso-saccato, intus callis 2, parallelis ornato, lamina antice biloba, margine irregulariter lacerato-dentata, disco ante saccum transverse incrassato; toto labello usque ad 10 mm. longo latoque; columna arcuatoclavata, alata, juxta rostellum auriculata, usque ad 5 mm. longa; ovario cylindrico, furfuraceo.

Venezuela: EDO. ARAGUA; Rancho Grande, DUNSTERVILLE 533! — EDO. BOLIVAR; Cerro Venamo, STEYERMARK & DUNSTERVILLE 92507! Type! (AMES); Chimantá Massif, STEYERMARK 75735! (AMES, F, NY).

This new species was illustrated in Venezuelan Orchids 2: 100, 1961 as *E. virgatus* (Rchb.f.) C. Schweinf., and in Lasser, Flora de Venezuela 15(1): 226, 1970 as *E. kermesinus* (Lindl.) Rchb.f. It differs from the former in the coriaceous bracts and the differently proportioned lip; from the latter in dissimilar floral segments and the shape of the column.

Elleanthus Sect. **Elleanthus**

Lectotype: *Elleanthus lancifolius* Presl

Syn.: *Elleanthus* Sect. *Virgatae* Garay in Orquideologia 4: 15, 1969.

Type: *Sertifera virgata* Rchb.f.

Inflorescence terminal, spicate; flowers distichous; column angulate; base of lip conical, subcalcarate-saccate, not didymous, calli inserted on sides of cavity.

Elleanthus formosus Garay, *sp. nov.*

Plantae, erectae, verosimiliter ramosae, partes quae adsunt usque ad 15 cm. longae; caulibus erectis, infra vaginatis, supra 2- 4-foliatis; foliis satis coriaceis, plicatis, auguste lanceolato-ellipticis, subacuminatis, basin cuneatis, usque ad 10 cm. longis, 1.5 cm. latis; inflorescentia terminali, sessili, usque ad 7 cm. longa; rhachide filiformi, valde fractiflexa, laxe 4-, 6-flora; bracteis cymbiformibus, scariosis, usque ad 2 cm. longis, sursum decrescentibus; floribus illis E. virgatis semillimis sed multo majoribus; sepalo postico elliptico, apice rotundato, in medio breviter mucronato, usque ad 11 mm. longo, 4 mm. lato; sepalis lateralibus oblique ovatis, rotundatis, breviter mucronatis, usque ad 12 mm. longis, 5 mm. latis; petalis e cuneata basi obovatis apice, rotundatis, usque ad 11 mm. longis, 4 mm. latis; labello saccato, intus callis vel corpusculis lateraliter insertis ornato, lamina in ambitu suborbiculari, antice valde biloba, margine crenulata, disco longitudinaliter incrassato in medio, toto labello 17 mm. longo, 12 mm. lato; columna cylindrica, usque ad 7 mm. longa; ovario cylindrico, obscure alato, usque ad 7 mm. longo.

Colombia: DEPT. NARIÑO, on road Barbacoas-Tuqueres, SCHMIDTCHEN *s.n.*! Type! (W).

Cybebus Garay, *gen. nov.*

Etymology: Greek *Kybebos* = stooping, with head bent, in reference to the rectangularly bent flowers.

Sepala inter se breviter in tubum cylindricum, arcuatum connata, deinde libera, arcuato-patentia. Petala sepalo postico conniventia. Labellum horizontale, naviculare. Columna rectangulariter arcuata, dimidio superiore porrecta, libera, dimidio inferiore sepalis connata, et cum eis pedem elongatum, arcuatum formans; clinandrium amplum; rostellum transversum, 3-lobum, lobo intermedio lineari-triangulo; stigmata 2, sub rostello confluentia.

Herbae terrestres elatae, grandiflorae; radicibus fasciculatis tuberosis; foliis basilaribus, plurimis, petiolatis; scapo erecto, vaginato, supra laxe paucifloro; bracteis prominentibus, ovariis longioribus; floribus speciosis, magnis; ovario cylindrico, sessili.

Type: *Cybebus grandis* Garay

Species singula, adhuc nota, Colombiana.

This new genus is closest to *Mesadenus* Schltr. in the structure of the rostellum and in the general appearance of the flowers. The rectangularly arcuate column with a long foot, and the tubulose base of the sepals readily differentiate this genus from the other members of the *Spiranthes* alliance.

Cybebus grandis Garay, *sp. nov.*

Terrestris, erecta, usque ad 50 cm. alta; radicibus fasciculatis, tuberosis, villosis; foliis basilaribus, plurimis, in specimine nostro 5-nis, petiolatis; petiolis canaliculatis, basin imbricantibus, usque ad 10 cm. longis; laminis oblique ovato-ellipticis, acutis, basi acuto-cuneatis, usque ad 12 cm. longis, 5.5 cm. latis; scapo erecto, plurivaginato, infra glabro, supra puberulo, tertia parte superiori laxe paucifloro; bracteis lineari-lanceolatis, acuminatis, ovariis duplo superantibus, usque ad 5.5 cm. longis; floribus speciosis, extus puberulis; sepalis inter se in tubum arcuato-cylindricum breviter connatis, deinde liberis, arcuato-patentibus; sepalo postico anguste lanceolato-elliptico, acuminato, usque ad 35 + 5 mm. longo, 7 mm. lato; sepalis lateralibus lineari-lanceolatis, acuminatis, usque ad 35 + 5 mm. longis, 5 mm. latis; petalis e cuneata basi falcato-dolabriformibus, acuminatis, omnino glabris, usque ad 35 + 5 mm. longis, 7 mm. latis; labello porrecto, naviculari, apice recurvo, basi biauriculato-sagittato, usque ad 35 mm. longo, 10 mm. lato; columna arcuata, facie puberula, usque ad 18 mm. longa; rostello prominenti, 3-lobo, 2 mm. longo, 3 mm. lato; ovario cylindrico, puberulo, torto, usque ad 3.5 cm. longo.

Colombia: Depto. del Cauca, near lake El Tambo, Munchique, K. Von Sneidern 731! type! (S).

Cyclopogon Presl, Rel. Haenk. 1: 93, t.13, f-1, 1827.

Etymology: *Kyklos* = circle and *pogon* = tail [i.e., of fire], with divided ends, in reference to the (reddish?) sepals which arise in a circle from a tube, like tails of fire with divided ends.

Type: *Cyclopogon ovalifolium* Presl.

The diagnostic features of the genus *Cyclopogon* for the past 125 years have been completely misunderstood. *Cyclopogon* was generally regarded a synonym of *Spiranthes* since 1840, when Lindley transferred it in his Genera and Species of Orchidaceous Plants. In 1920, Schlechter reinstated it in his study of the *Spiranthianae*, with a rather detailed generic circumscription. Unfortunately both of these students of orchidology overlooked the fact that Haenke's illustrations show a peculiar character, albeit not mentioned in the original description, namely, the sepals are connate with one another to form a distinct sepaline tube.

Recently I have seen several collections from Ecuador and Peru referable to *C. ovalifolium* which I intended to describe as a new genus, based on the fusion of the sepals. Once I became aware of the characters of the true *Cyclopogon*, I requested the type from Prague, and an examination of it confirmed my interpretation. *Cyclopogon* is closest to the genus *Gamosepalum*, but in the latter genus the column in the flowers is adnate dorsally to the sepals.

It must be emphasized that the circumscription given by Schlechter for *Cyclopogon* is no longer tenable. Fortunately, for Schlechter's concept the generic name, *Beadlea* Small is available. Appropriate transfers are being made in the new generic revision of the *Spiranthinae* by Dr. Pabst and me.

The following amplified descriptions are prepared from the type-material and from the additional material at hand. The genus is monotypic.

Sepals similar, basally connate into a cylindric tube, above free. Petals connivent with dorsal sepal, basally for a short distance adnate to column. Lip broadly unguiculate, sagittate-auriculate, the claw adnate to sepaline tube. Column free, elongate, slender, cylindric, pubescent in front, basally produced into a short, somewhat descending foot; stigmata 2, approximately touching each other; rostellum elongate, ligulate, truncate or obscurely excised; anther in the descending clinandrium dorsal, erect, 2-celled. Ovary sessile. Terrestrial plants with fleshy, fasciculate, villose roots. Leaves basal, many, petiolate. Scape slender, several-sheathed, spicate above. Bracts linear-setaceous. Flowers small.

Cyclopogon ovalifolium Presl, Rel. Haenk. 1: 93, 1827.

Syn.: *Spiranthes Preslii* Lindl., Gen. and Sp. Orch. Pl. 470, 1840.

Gyrostachys ovalifolia (Presl) O. Ktze., Rev. Gen. Pl. 2: 664, 1891.

Type: Peru; Prov. Huánuco, HAENKE *s.n.*! (PR).

Terrestrial plants, up to 35 cm. tall. Roots fasciculate, rather thick, fleshy, villose. Leaves basal, up to 5, petiolate; blade obliquely elliptic to ovate-elliptic, acute, basally rounded or abruptly cuneate, up to 7.5 cm. long and 4 cm. wide, commonly smaller; petiole slender, canaliculate, up to 5 cm. long. Scape erect, slender, loosely several-sheathed, terminated by a one-sided spike; spike cylindric, subdensely many-flowered, very variable in length, 4 to 14 cm. long. Bracts linear to linear-setaceous, up to 15 mm. long. Flowers small, tubular, greenish or brownish green. Sepals similar, linear-ligulate, obtuse, basally connate into a distinct, cylindrical tube which is 2.5 to 3.5 mm. long, including the tube up to 8.5 mm. long and 1.5 mm. wide. Petals linear-subspathulate, rounded, up to 8 mm. long and 1 mm. wide. Lip unguiculate, sagittate-auriculate at base, the auricles flat and more or less rounded; blade linear-oblong, constricted at one-fourth from apex producing a transversely elliptic, terminal lobe; disc pubescent; whole lip up to 8.5 mm. long and 3 mm. wide in front. Column slender, up to 6 mm. long. Ovary sessile, glabrous, cylindric, up to 4 mm. long.

Ecuador: IMBARBURA: along trail to Río Chalguayaco, below Magnolia, lower Intag Valley, DREW E-587! (AMES). — PICHINCHA: on western side of Cerro Pichincha, JAMESON 38! (K-L). — PASTAZA: in the vicinity of Colonia Játiva, ca. 12 km. from Mera, H. LUGO 98! (AMES, GB). — **Peru:** HUÁNUCO, HAENKE *s.n.*! (PR). — SAN MARTIN, Roque, MELIN 111! (S).

Sauroglossum andinum (Hauman) Garay, *stat. nov.*

Basionym: *Spiranthes nitida var. andina* Hauman in Anal. Soc. Cienc. Argent. 90: 123, 1921.

Lectotype: Argentina; Prov. Catamarca, Rodeo, CASTILLON 2042!, *in hoc loco*.

In general appearance the plants of *S. andinum* are very similar to *S. distans* Lindl. ex Garay, but the floral segments, especially the shape of lip, are amply distinct from one another.

Sauroglossum aurantiacum (C. Schweinf.) Garay, *stat. nov.*

Basionym: *Spiranthes Weberbaueri* var. *aurantiaca* C. Schweinf. in Bot. Mus. Leaf. Harv. Univ. 15: 7, 1951.

Type: Peru; Prov. Urubamba, Piri, VARGAS 5935! (AMES).

In general appearance the plants are like those of *S. longiflorum* (Schltr.) Garay (*comb. nov.* in press); in floral detail they are reminiscent of *S. elatum* Lindl.

Sauroglossum corymbosum (Lindl.) Garay, *comb. nov.*

Basionym: *Synassa corymobsa* Lindl. in Bot. Reg. 19: sub t. 1618, 1833.

Syn: *Pelexia corymbosa (Lindl.) Lindl.*, Gen. and Sp. Orch. Pl. 482, 1840.

Synassa dilatata Lindl. ex Krzl. in Engl., Bot. Jahrb. 54, Beibl. 117: 19, 1916, *sphalm.*

Spiranthes subumbellata C. Schweinf. in Bot. Mus. Leafl. Harv. Univ. 10: 31, 1941.

Type: Peru; without precise locality, PAVÓN *s.n.*! (K-L).

A point-by-point comparison of the characters I have observed in the dissected flowers of the type-specimens of *Synassa corymbosa* Lindl. and *Sauroglossum elatum* Lindl. failed to disclose any criteria by which the two species could be kept apart generically.

Sauroglossum distans Lindl. ex Garay, *sp. nov.*

Terrestris, erecta, usque ad 60 cm. alta; foliis basilaribus, ellipticis vel obovato-ellipticis, basin versus subpetiolato-angustatis, acutis, usque ad 13 cm. longis, 3.3 cm. latis; scapo erecto, primum vaginis imbricatis obtecto, supra laxe multifloro; bracteis lanceolatis, acuminatis, usque ad 2 cm. longis, sursum decrescentibus; floribus extus pubescentibus; sepalo postico lineari-oblongo, concavo, acuto, usque ad 10 mm. longo, 2 mm. lato; sepalis lateralibus oblique lineari-oblanceolatis, acutis, usque ad 12 mm. longis, 2 mm. latis; petalis e lineari basi oblanceolatis, acutis, basi decurrentibus, usque ad 10 mm. longis, 1.2 mm. latis; labello e linari basi spathulato, lamina plus minusve rhomboidea, margine subcrenulata, disco basin obscure bicalloso, in medio laminae linea incrassata ornato; toto labello usque ad 13 mm. longo, 4 mm. lato; columna gracili, glabra, usque ad 8 mm. longa; ovario fusiformi, puberulo, brevissime pedicellato, usque ad 10 mm. longo. — *Sauroglossum distans* Lindl. *nomen nudum* in Ann. Mag. Nat. Hist. ser. 3, 1: 334, 1856.

Bolivia: without precise locality, BRIDGES *s.n.!* type! (K).

Hapalorchis lineatus (Lindl.) Schltr. in Beih. Bot. Centralbl. 37(2): 363, 1920.

Basionym: *Spiranthes lineata* Lindl., Gen. and Sp. Orch. Pl. 471, 1840.

Syn.: *Gyrostachys lineata* (Lindl.) O. Ktze., Rev. Gen. Pl. 2: 664, 1891.

Cyclopogon lineatus (Lindl.) Pabst in Bradea 1: 466, 1975.

Lectotype: Brazil; São Paulo, MARTIUS *s.n.*! (M), *in hoc loco.*

Sauroglossum monophyllum Griseb., Symb. Fl. Argent. 339, 1879.

Type: Argentina; Prov. Oran, LORENTZ & HIERONYMUS 286 (CORD).

Sauroglossum tenue Lindl. in Ann. Mag. Nat. Hist. ser. 3, 1: 334, 1856.

Spiranthes tenuis (Lindl.) Benth. ex Fawc., Fl. Pl. Jam. 40, 1893, not Lindl. 1840.

Spiranthes Fawcettii Cogn. in Fedde. Rep. 7: 123, 1909.

Hapalorchis tenuis (Lindl.) Schltr. in Beih. Bot. Centralbl. 37 (2): 363, 1920.

Type: Cuba; Monte Verde, WRIGHT 622! (K-L).

Spiranthes amabilis Ames, Sched. Orch. 2: 8, 1923.

Type: Guatamala; Dept. Alta Verapaz, Cobán, TUERCKHEIM II-1787! (US).

Cyclopogon stenoglossus Pabst in Bradea 1: 468, 1975.

Type: Brazil; Minas Gerais, near Caxambu, WELTER 188! (HB).

While reviewing the genus *Hapalorchis* for the Flora of Ecuador, it became apparent that Lindley included two different species under the original description of *Spiranthes lineata*. He examined Martius' collection which is mostly in fruit and included with it a drawing by Descourtilz prepared in the field. Since a specimen always takes precedence over drawings when available, the Martius collection must be regarded as the lectotype for the species. I have studied this collection and it shows an autogamous plant in which the pollinia wrap themselves around the rostellum. Consequently, when the flowers are dissected, the rostellum always becomes ruptured and torn, showing a 3-dentate clinandrium. The situation is the same in the type-collections of *Sauroglossum tenue*, *Spiranthes amabilis* and *Cyclopogon stenoglossus*. It is rather obvious that we are dealing with a rather widespread species with very little internal variation. On the other hand, the Descourtilz drawing represents a distinct, outcrossing species which is limited in distribution to southern Brazil. For those plants I propose the name *Hapalorchis Lindleyanus*.

Hapalorchis Lindleyanus Garay, *sp. nov.*

Terrestris erecta, usque ad 30 cm. alta; radicibus crassis, villosis; foliis plurimis, petiolatis, petiolis canaliculatis, gracilibus, base vaginatis, usque ad 3 cm. longis; laminis ovatis, acutis, basi rotundatis, usque ad 4.5 cm. longis, 2 cm. latis; pedunculo erecto, vaginifero, supra laxe paucifloro; bracteis ovato-cucullatis, longe acuminatis, usque ad 1.5 cm. longis, sursum decrescentibus; floribus satis tenuibus, extus basin sparse pubescentibus, secundis; sepalo postico lineari-oblongo, concavo, apiculato, usque ad 8 mm. longo, 2 mm. lato; sepalis lateralibus porrectis, oblongo-linearibus, acutis, usque ad 8 mm. longis, 1.2 mm. latis; petalis lineari-spathulatis, subacuminatis, margine superiore subcrenulatis, usque ad 8 mm. longis, 1.3 mm. latis; labello ima basi excavato, lamina primum subquadrata, deinde in lobum reniformem expansa, disco in centro pubescenti, basin margine incrassata, antice lineis ternis valde discoloribus ornata; toto labello usque ad 7 mm. longo, 5 mm. lato; columna usque ad 5 mm. longa; ovario ovoideo, pubescenti, usque ad 8 mm. longo.

Brazil: Therezopolis, Rio, M. & R. Foster 1005! type! (AMES).

As I stated above, the specimens referable to this rather common species have always been confused with *H. lineatus* from which it differs in having larger floral segments and dissimilar lip.

Pelexia Hameri Garay, *sp. nov.*

Terrestris, gracilis, usque ad 30 cm. alta; radicibus fasciculatis, tuberosis, villosis; foliis basilaribus, ut videtur 2, sub anthesin jam emarcidis, ovatis, obtusis vel subacutis, distincte breviter petiolatis, petiolis inclusis usque ad 5 cm. longis, 1.8 cm. latis; scapo gracili, plurivaginato, puberulo, supra laxe multifloro, spicato; bracteis ovato-lanceolatis, acuminatis, usque ad 9 mm. longis; floribus viridi-albidis, extus sparse pubescentibus; sepalo postico anguste ovato-lanceolato vel ovato-elliptico, obtuso, usque ad 3.8 mm. longo, 1 mm. lato; sepalis lateralibus oblongo-ligulatis, obtusis, usque ad 4 mm. longis, 1.2 mm. latis, basin oblique saccatis, sacco 2 mm. longo; petalis sepalo postico conniventibus, e cuneata basi oblique lineari-dolabri formibus, obtusis, usque ad 4 mm. longis, 1 mm. latis, labello unguiculato, basi lineari-falcato sagittato, lamina conduplicata, lineari-oblonga, apice abrupte in lobum reniformem expansa, margine repanda; disco basin lobi terminali papilloso-incrassato; toto labello 5.5 mm. longo, 3 mm. lato; columna infundibuliformi, 2 mm. longa, basi in pedem decurrentem, 2 mm. longam producta; ovario arcuato-fusiformi, puberulo, sessili, usque ad 6 mm. longo.

El Salvador: in the gardens of Doña Hertha Freund in San Benito, San Salvador, HAMER 613! type! (AMES).

The plants are reminiscent of weak specimens of *P. Schaffneri* (Rchb.f.) Schltr., but the flowers are very different. This smallest-flowered *Pelexia* is dedicated to Mr. Fritz Hamer, whose lavishly illustrated, two-volume work on the Orchids of El Salvador is one of the most outstanding contributions to our knowledge of the orchids of Central America.

Sarcoglottis Lehmannii Garay, *sp. nov.*

Terrestris, elata, usque ad 30 cm. alta; radicibus fasciculatis, crassis, villosis; foliis rosulatis, petiolatis; petiolis canaliculatis, usque ad 6 cm. longis, laminis late ellipticis, utrinque obtusis vel subacutis, usque ad 16 cm. longis, 6 cm. latis; scapo erecto, vaginis acuminatissimis, imbricatibusque obtecto, supra laxe racemoso, paucifloro; bracteis ovato-lanceolatis, acuminatissimis, usque ad 2.5 cm. longis; floribus, parvulis, extus dense pubescentibus; sepalo postico anguste elliptico, acuto, usque ad 12 mm. longo, 3 mm. lato; sepalis lateralibus ovario longe decurrentibus, oblique lanceolatis, subacuminatis, usque ad 10 + 18 mm. longis, 3 mm. latis; petalis e cuneata basi oblique anguste falcato-ellipticis, acutis, margine minute ciliolatis, usque ad 11 mm. longis, 2 mm. latis; labello dimidio basali anguste lineari, deinde in laminam ovatam, canaliculatam, intus sparse pubescentem expanso, apice lobulo cordiformi, acuminatissimo, recurvo producto, basi auriculis filiformibus, 4 mm. longis donato, toto labello usque ad 25 mm. longo, 4 mm. lato; rostello 2.5 mm. longo; ovario cylindrico, pubescenti, usque ad 15 mm. longo.

Colombia: DEPT. CAUCA, Timbiqui, LEHMANN *s.n.*! type. [H.K. 1263] (K).

Buchtienia rosea Garay, *sp. nov.*

Terrestris, elata, usque ad 120 cm. alta; radicibus fasciculatis, carnosis, villosis; foliis basilaribus, ut videtur duis, longe petiolatis, petiolis canaliculatis, robustiusculis, usque ad 29 cm. longis, laminis late ellipticis, subacutis vel obtusis, basi subcordato-cuneatis, usque ad 23 cm. longis, 13 cm. latis; scapo erecto, primum vaginato, deinde laxe racemoso; racemo cylindrico, multifloro, usque ad 35 cm. longo; bracteis lineari-lanceolatis, anguste acuminatis, usque ad 2 cm. longis, sursum decrescentibus; floribus carnosis, roseis; sepalo postico anguste elliptico, acuto, extus sparse puberulo, usque ad 9 mm. longo, 3 mm. lato; sepalis lateralibus oblique ovato-lanceolatis, subacuminatis, extus sparse puberulis, usque ad 12 mm. longis, 3 mm. latis; petalis oblique falcato-ellipticis, utrinque attenuatis, acutis, usque ad 9 mm. longis, 2 mm. latis; labello e basi subquadrato aequaliter cuneato-trilobo, lobis lateralibus, oblongis, apice rotundatis, lobo intermedio triangulari, obtuso, 2 mm. longo, disco basin marginaliter incrassato; toto labello 7 mm. longo, 6 mm. lato; ovario cylindrico, pubescenti, usque ad 11 cm. longo.

Peru: Dept. Cuzco, on road from Mistiana to Keros, VARGAS 7381! type! (AMES).

It differs from *B. boliviensis* Schltr. in the color of the flowers, in the not long-acuminate sepals and the differently proportioned lip which is equally 3-lobed in front with a very short midlobe.

Eltroplectris pauciflora (Poepp. & Endl.) Garay, *comb. nov.*
Basionym: *Pelexia pauciflora* Poepp. & Endl., Nov. Gen. ac Sp. Pl. 2: 17, t. 124, 1837.
Syn.: *Physurus pauciflorus* (Poepp. & Endl.) Lindl., Gen. and Sp. Orch. Pl. 504, 1840.
Erythrodes pauciflora (Poepp. & Endl.) Ames, Orchid. 7: 75, 1922.
Type: Brazil; Prov. Amazonas, Rio Negro, around Ega, POEPPIG *s.n.*! (W).

It is difficult to understand why this plant was treated as a member of the genus *Physurus* or *Erythrodes* by former students of orchidology. The plants have neither rhizome nor cauline leaves, nor have the lips a distinct spur. An examination of the type undoubtedly places it in the genus *Eltroplectris*, and its closest relative is another Brazilian species, namely, *E. longicornu* (Cogn.) Pabst.

Platythelys peruviana Garay, *sp. nov.*
Terrestris, parvula, usque ad 12.5 cm. alta; rhizomate ascendenti, pluriarticulato; caulibus gracilibus, infra vaginatis, supra laxe paucifoliatis; foliis lineari-lanceolatis, acuminatis, basi rotundatis, breviter petiolatis, petiolo incluso usque ad 3.5 cm. longis, 0.6 cm. latis; inflorescentia terminali, abbreviata, pauciflora, usque ad 2.2 cm. longa; pedunculo 1.5 cm. longo; floribus satis parvulis; sepal postico anguste ovato, obtuso, concavo, usque ad 3.5 mm. longo, 1.2 mm. lato; sepalis lateralibus oblique oblongo-ligulatis, obtusis, usque ad 3.5 mm. longis, 1.2 mm. latis; petalis cuneato-oblanceolatis, acutis vel subacuminatis, usque ad 3 mm. longis, 0.5 mm. latis; labello calcarato, calcare cylindrico, usque ad 3 mm. longo, lamina bipartita: hypochilio valde concavo, antice emarginato, epichilio late cordato-reniformi, acuminato, utrinque rotundato, toto labello 3 mm. longo, 1.5 mm. lato; ovario arcuato-cylindrico, glabro, usque ad 6 mm. longo.

Peru: Dept. Junín, Chanchamayo Valley, SCHUNCKE 569! type! (F).

Specimens of this species have been reported in the literature erroneously as *Erythrodes querceticola* (Lindl.) Ames.

Stelis trigoniflora (Sw.) Garay, *comb. nov.*

Basionym: *Epidendrum trigoniflorum* Sw., Nov. Gen. & Sp. Pl., Prodr. 125, 1788, excluding synomyms.

Syn.: *Stelis ophioglossoides* Auct. not Sw. in Schrad., Journ. Bot. 2 (4): 239,1800.

When Swartz described *Epidendrum trigoniflorum*, he based his description on his own collection from Jamaica. He also prepared detailed drawings of it for inclusion in his Icones Plantarum Incognitarum, t. 49, but they remained unpublished. Under *Epidendrum trigoniflorum* Swartz cited in synonymy the plate of *Epidendrum ophioglossoides*, t. 133, f. 2, which Jacquin published in 1763. In 1791, in his Observationes Botanicae, p. 332, under *E. ophioglossoides* Swartz remarks: "Plantae *Plumieri* & *Jacquini* certe distinctae. . . . JACQUINI . . . ad *E. trigoniflorum* (Prodr. p. 125) pertinet, affirmante planta Ipsius in Museo BANKSIANO servata." I have examined the Jacquin material and it is specifically different from *Epidendrum trigoniflorum*, while the Plumier material is a true *Pleurothallis*.

Although convinced that the Plumier and Jacquin illustrations and material were different from one another, in 1800, in proposing the genus *Stelis*, Swartz united them under *Stelis ophioglossoides* under which name the error persisted until recently (See Garay & Sweet in Journ. Arnold Arb. 53: 391 and 528, 1972). I have recently noticed that Turton has already separated *Epidendrum ophioglossoides* Jacq. and *Epidendrum trigoniflorum* Sw. as two distinct species in his Vegetable Kingdom 2: 1508 and 1511, 1806.

Octomeria truncata Hoffmsgg., Preis. Verz. Orch. 26, 1842.

Type: Brazil; Rio de Janeiro, HOFFMANSEGG *s.n.*! (W).

Syn.: *Octomeria lobulosa* Rchb.f. in Hamb. Gartenz. 14: 215, 1858.

Type: Brazil; without precise locality, cult. SCHILLER *s.n.*! (W).

It is difficult to understand why Reichenbach described *O. lobulosa* when the actual type-material of *O. truncata*, both drawings and specimens were in his possession since 1840. Morphologically the specimens and flowers of both species are indistinguishable.

Epidendrum tropidioides Garay, *sp. nov.*

Plantae procurrentes, valde ramosae; caulibus primum vaginantibus, supra paucifoliatis, compressis; foliis lanceolato-oblongis, acutis vel subacuminatis, basi caulem amplectentibus, usque ad 20 cm. longis, 2.2 cm. latis; inflorescentiis terminalibus, arcuatis; pedunculo prominenti, compresso, alato, usque ad 13 cm. longo, apice ramoso; ramis racemosis, arcuatis, usque ad 15 cm. longis; bracteis distichis, ovato-cucullatis, acutis, usque ad 1.5 cm. longis, illis Tropidiis in mentem revocantibus; floribus satis firmis, magnis, pallide viridis, extus purpureo-striatis; sepalo postico anguste lanceolato, acuto, usque ad 2.2 cm. longo, 5 mm. lato; sepalis lateralibus dorsali simillimis sed paulo angustioribus; petalis e cuneata basi rhombeo-spathulatis; acutis, margine interiore sublobatis, usque ad 2.2 cm. longis, 9 mm. latis; labello in ambitu cuneato-obovato, antice trilobo, lobis lateralibus brevibus, rotundatis, lobo intermedio antico, suborbiculari, acuto, margine erosulo; disco supra basin bicarinato, toto labello 2.2 cm. longo, 8 mm. lato; columna humili, clinandrio urceolato, usque ad 8 mm. longo; ovario cylindrico, glabro, usque ad 1.5 cm. longo.

Colombia: DEPT. PUTUMAYO, 5 km. N.E. of Sibundoy, BRISTOL 388! type! (AMES).

Chondrorhyncha stenioides Garay, *sp. nov.*

Epiphytica, caespitosa, humilis, usque ad 15 cm. alta; radicibus carnosis, leviter flexuosis, glabris; caulibus nullis; foliis ad 3, distichis, obovato-oblanceolatis, acutis, satis tenuibus, basi cuneatis et vaginis conduplicatis articulatis, usque ad 13 cm. longis, 3 cm. latis, in exsiccatione angustioribus;

pedunculo laterali, gracili, unifloro, usque ad 3 cm. longo; bractea ovato-cucullata vel infundibuliformi, usque ad 7 mm. longa; floribus satis magnis, apertis, albidis vel viridi-albidis, labello intus obscure purpureo-maculato; sepalo positco valde concavo-cucullato, in ambitu subrotundo-elliptico, obtuso, usque ad 20 mm. longo, 16 mm. lato; sepalis lateralibus patentibus, ovato-ellipticis, basin versus excavatis, obtusis, usque ad 24 mm. longis, 10 mm. latis; petalis cum sepalo postico conniventibus, oblique late ellipticis, obtusis, usque ad 20 mm. longis, 12 mm. latis; labello valde carnoso, complicato, in ambitu triangulo, lobis lateralibus inter se subquadratis, replicatis, deinde in lobo terminali, rhynchophoro, tubuloso continuis, disco a basi usque ad medium carina sigmoidea decoro, in medio callo denticulato, transverso ornato, toto labello usque ad 13 mm. longo, 10 mm. lato; columna cylindrica, usque ad 9 mm. alta, basi in pedem, 8 mm. longam producta; polliniis 4, inaequalibus, obpyriformibus; ovario costato, glabro, usque ad 12 mm. longo.

Ecuador: Prov. Pastaza, at confluence of Río Verde and Río Pastaza, STACY *s.n.*! type! (AMES).

The flowers of these plants closely resemble those of *Stenia pallida*, having in common the general configuration of the lip. The method of adnation of the lip to the column-foot, the structure of the pollinia are those of the genus *Chondrorhyncha*. This new species is perhaps closest to *C. guttata* (Rchb.f.) Garay from Peru from which it differs in having larger flowers without any spots, and differently proportioned floral parts.

Chondrorhyncha guttata (Rchb.f.) Garay, *comb. nov.*

Basionym: *Stenia guttata* Rchb.f. in Gard. Chron. n.s. 14: 134, 1880.

Type: Peru; without precise locality, DAVIS *s.n.*! (W).

I have seen about seven different collections of this rare species, all from Tingo Maria, Muña and San Martin regions of Peru. The narrower floral segments of the strongly maculate flowers readily differentiate it from *C. stenioides* Garay.

Maxillaria pardalina Garay, *nom. nov.*

Basionym: *Maxillaria pantherina* Rchb.f. in Bonpl. 3: 239, 1855, not Hoffmsgg. 1844.

Type: Ecuador; Andes [of Quito] JAMESON 761! (W).

Since the specific epithet "pantherina" is preoccupied by a Brazilian species, the Andean plants require a new name.

Although *Maxillaria pantherina* Rchb.f. has been reduced to a synonym of *M. platpetala* Ruíz & Pav. by Brieger and Hunt in 1969, their judgment is based on a single specimen in the Lindley Herbarium. They assumed it to be an isotype of *M. platypetala,* overlooking the fact that Lindley clearly stated in his Genera and Species of Orchidaceous Plants, p. 143, 1832, that his only specimen was donated to him by Hooker and it was collected by Hall in Ecuador. When Reichenbach described his *M. pantherina,* he was aware of Lindley's interpretation of *M. platypetala,* for he clearly says "*Maxillariam platypetalam nisi Ruízianam tamen Lindleyanam non novi, quae nonnullis nobis quadrare videtur. Cum tamen cel. auctor procurrentem dicat simillimam platypetalae, haec longe certe distat.*"

It seems advisable to repeat Hoffmannsegg's original description for it is very inaccessible; some of its peculiar terminology is explained in parentheses:

Maxillaria pantherina Hoffmsegg. — Plantae insidentes, nutricariae (pseudobulbose with fasciculate roots), nutricio sterili (leafbearing pseudobulb) pyramidali sulcato-costato, foliis binis oblongis et linearibus, inflorescentia laterali, pedunculis (sub-) binis bracteatis, indumentis (bracts) conformibus, oblongis, acuminatis, sulphureo-pomaceis, petalis sepalis ⅓ brevioribus dimidio angustioribus, labello 3-lobo albido, circa marginem maculis irregulariter sparsis atropurpureis. Ibid. (Rio de Janeiro). — Judging from the rather poor drawing by Hoffmansegg, *M. pantherina* most probably is identical with *M. marginata* (Lindl.) Fenzl.

Osmoglossum candidum (Linden & André) Garay, *comb. nov.*

Basionym: *Odontoglossum candidum* Linden & André in Ill. Hortic. 22: 58, 1875.

Type: Colombia: DEPT. CAUCA, without precise locality, LINDEN *s.n.*

The genus *Osmoglossum* is new to Colombia, and plants must be exceedingly rare, for I have not yet seen a specimen collected in the wild. It appears to be close to *O. Egertonii* (Lindl.) Schltr., but differs in the pandurate lip and the fimbriate column-wings.

Osmoglossum panduratum Garay, *sp. nov.*

Epiphytica, usque ad 50 cm. alta; rhizomate repenti, valida; pseudobulbis approximatis, anguste ovoideis, compressis, 2-foliatis, usque ad 9 cm. longis, 3 cm. latis; foliis oblongo-linearibus, loratis, acutis, usque ad 42 cm. longis, 1.5 cm. latis; inflorescentiis erectis vel suberectis, laxe paucifloris, usque ad 30 cm. longis; pedunculis ancipitibus, paucivaginatis; bracteis lineari-lanceolatis pedicellis aequilongis, usque ad 1 cm. longis; floribus niveis, columna pallide rosea, callo aurantiaco, brunneo-punctato; sepalo postico lanceolato-elliptico, abrupte acuminato, 14 mm. longo, 5 mm. lato; sepalis lateralibus tertiam partem basalem inter se connatis, oblique oblongo-lanceolatis, abrupte acuminatis, 14 mm. longis, 4 mm. latis; petalis late ellipticis, obtusis vel subacutis, 15 mm. longis, 8 mm. latis; labello sessili, pandurato, a medio replicato, basi truncato, antice ovato, abrupte acuto, disco callo W-formi, valde carnoso a basi usque ad medium ornato, explanato 13 mm. longo, 8 mm. lato; columna generis, clinandrio denticulato; ovario cum pedicello geniculato.

Ecuador: without precise locality. Imported and grown by JOHN STACY *s.n.*! type! (AMES).

This new species is closely related to *O. pulchellum* differing from it in its much smaller flowers, and in the shape of the lip. In *O. pulchellum* the constriction of the lip is in front of callus, the terminal lobe is larger than the basal part, subquadrate to subrotund, truncate in front and the callus occupies ⅓ of the disc of lip. In our plants the constriction of the lip is on the sides of callus, the terminal lobe is smaller than the basal part, ovate, abruptly subacute and the callus occupies ½ of the disc of the lip.

Miltonia flava Lindl. in Gard. Chron. 475, July 15, 1848; Baxt. in Loudon, Hort. Brit. Suppl. 3: 589, 1850.

Type: Brazil, without precise locality, LODDIGES *s.n.*! (K-L).

Syn.: *Odontoglossum anceps* Kl. in Allgem. Gartenzeit. 19: 250, 1851.

Miltonia anceps (Kl.) Lindl., Folia Orch. Miltonia 3, 1853.

Oncidium anceps (Kl.) Rchb.f. in Walp. Ann. 6: 758, 1863.

Type: Brazil; without precise locality, ALLARDT *s.n.*

Miltonia flava has always been an enigmatic species and is still in want of rediscovery. It is known to me only through specimens in the Lindley and Reichenbach Herbaria. The specimen itself is a document of a strange historical background.

Introduced from Brazil by Loddiges around 1843, it flowered but once when it was sent to Lindley for naming. Lindley prepared a fine drawing in color from the already withering flower which is mounted together with the specimen in his herbarium, and annotated by his hand as *Miltonia flava.* At that time Lindley must have also prepared a description, which, however, was not published until July 15, 1848 in the GARDENERS' CHRONICLE, and then anonymously. Baxter, however, not only reported it in Loudon's HORTUS BRITANNICUS Suppl. 3: 589, 1850, but also attributed the name to Lindley. Yet for reasons unknown Lindley, as well as Reichenbach, completely ignored the publication of *Miltonia flava.* In 1853, curiously enough, while writing the pages for his FOLIA ORCHIDACEA, Lindley annotated his specimen of *Miltonia flava* as *Miltonia anceps* and has described it under that latter name without any reference to the earlier publication. Since the original description of *Milton flava* is not readily available, it is repeated here:

"Sp. Char. — Flower-stalk one-flowered, with equitant carinate sheaths. Sepals linear, lanceolate, flat, acuminate. Petals of the same form, but twice as broad. Lip panduriform, slightly hairy, with a cordate-ovate end, and near the base an elevated ridge, which reaches half way down the lip and divides at the point into two short plates. Column with a deep, purple, white-edged, toothed hood, and short triangular wings.

"A rather pretty Brazilian Orchid, from Messrs. Loddiges.

We have only seen a single flower, beginning to wither. It was of a yellow colour, not unlike in size and colour that of Miltonia stellata, from which it differs in having an elevated plate passing down the middle, narrower sepals, and a flat panduriform lip. It is No. 1595 of Messrs. Loddiges' Catalogue."

Odontoglossum heterosepalum (Rchb.f.) Garay, *stat nov.*
Basionym: *Odontoglossum angustatum var. heterosepalum* Rchb.f. in Linnaea 22: 850, 1850.

An examination of the holotype, FUNCK & SCHLIM 1242! (W) collected in Merida convinces me that Reichenbach's variety constitutes a distinct species. It is hard to understand why Reichenbach called this a variety of *O. angustatum* Lindl. While his statement added to the description explains a familiarity with the excessive natural variation observable within species of *Odontoglossum*, the variation pattern of *O. heterosepalum* cannot be accommodated within the pattern of variation of the southern *O. angustatum*.

PLATE 1

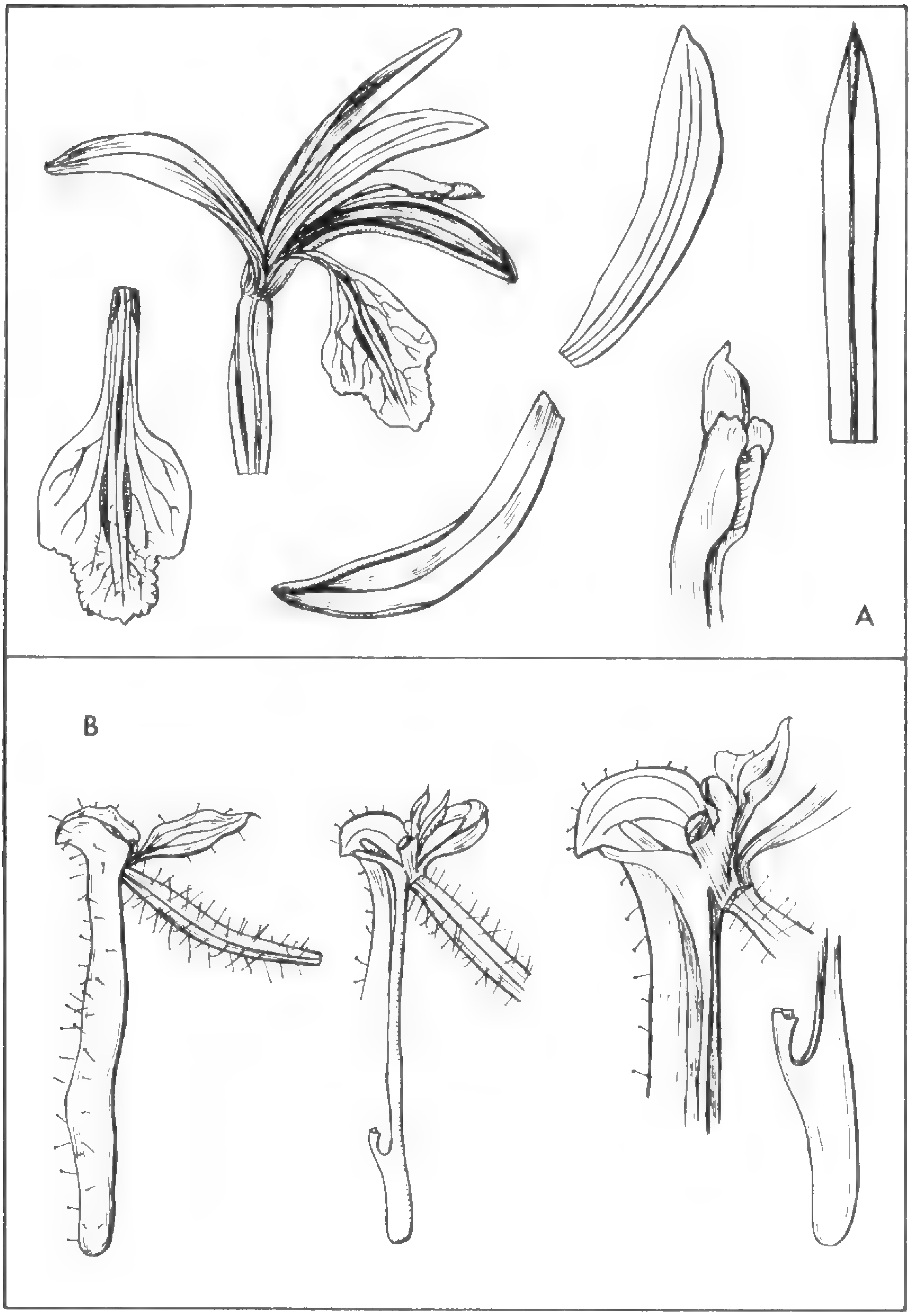

Plate 1. A. **Psilochilus carinatus** Garay. B. **Pseudocentrum Purdii** Garay

PLATE 2

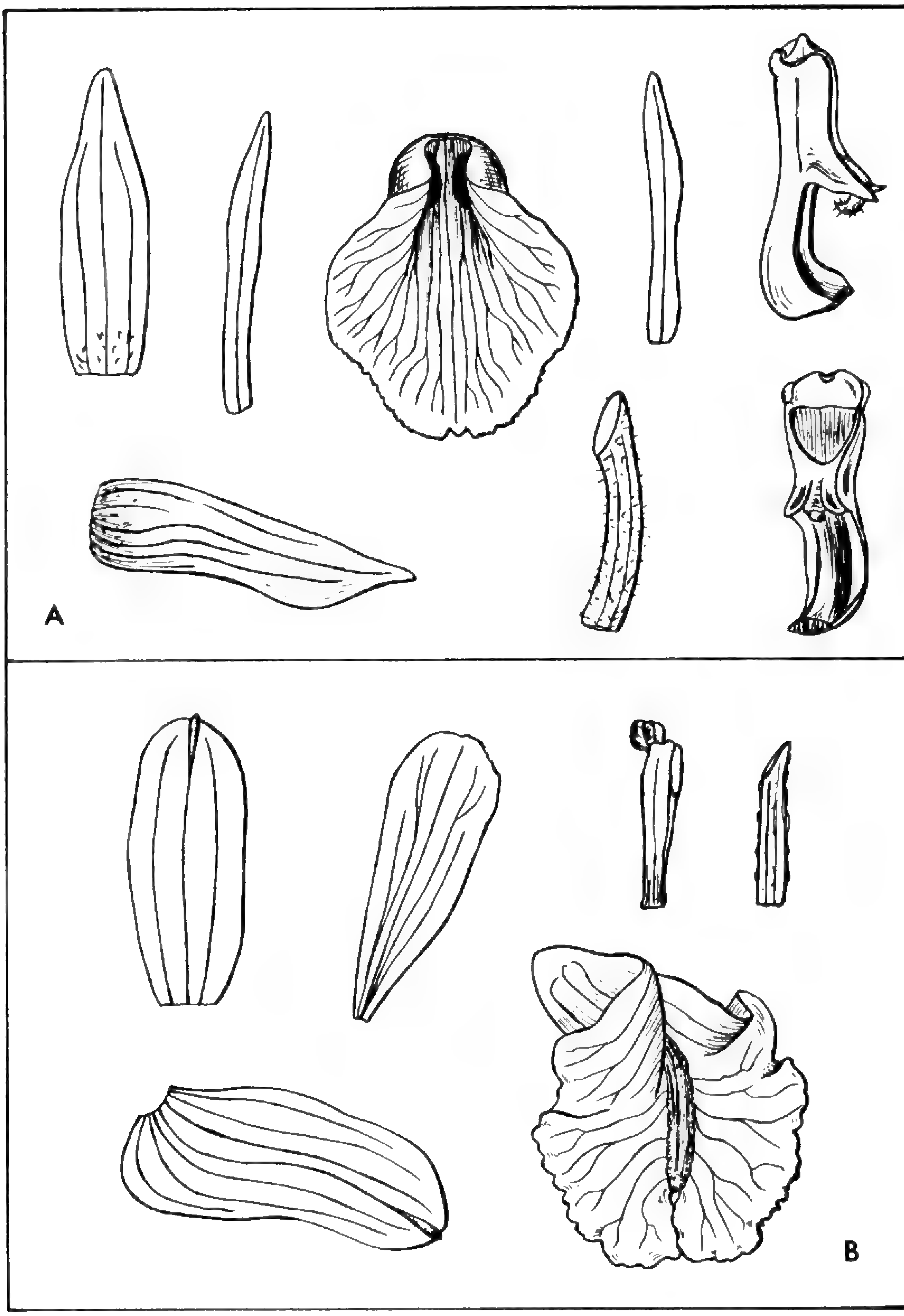

Plate 2. A. **Elleanthus Killipii** Garay. B. **Elleanthus formosus** Garay.

PLATE 3

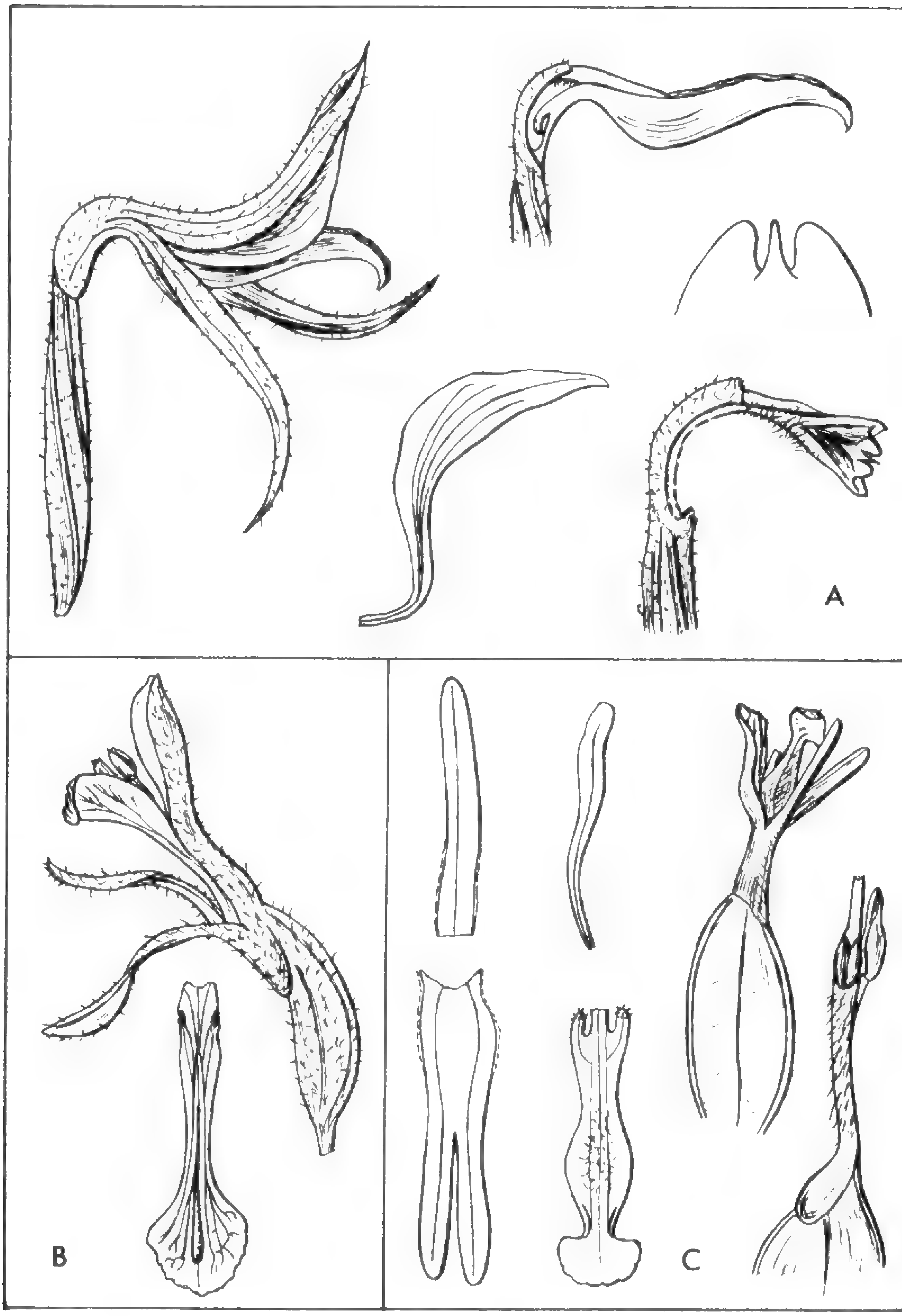

Plate 3. A. **Cybebus grandis** Garay. B. **Sauroglossum distans** Lindl. ex Garay. C. **Cyclopogon ovalifolium** Presl.

PLATE 4

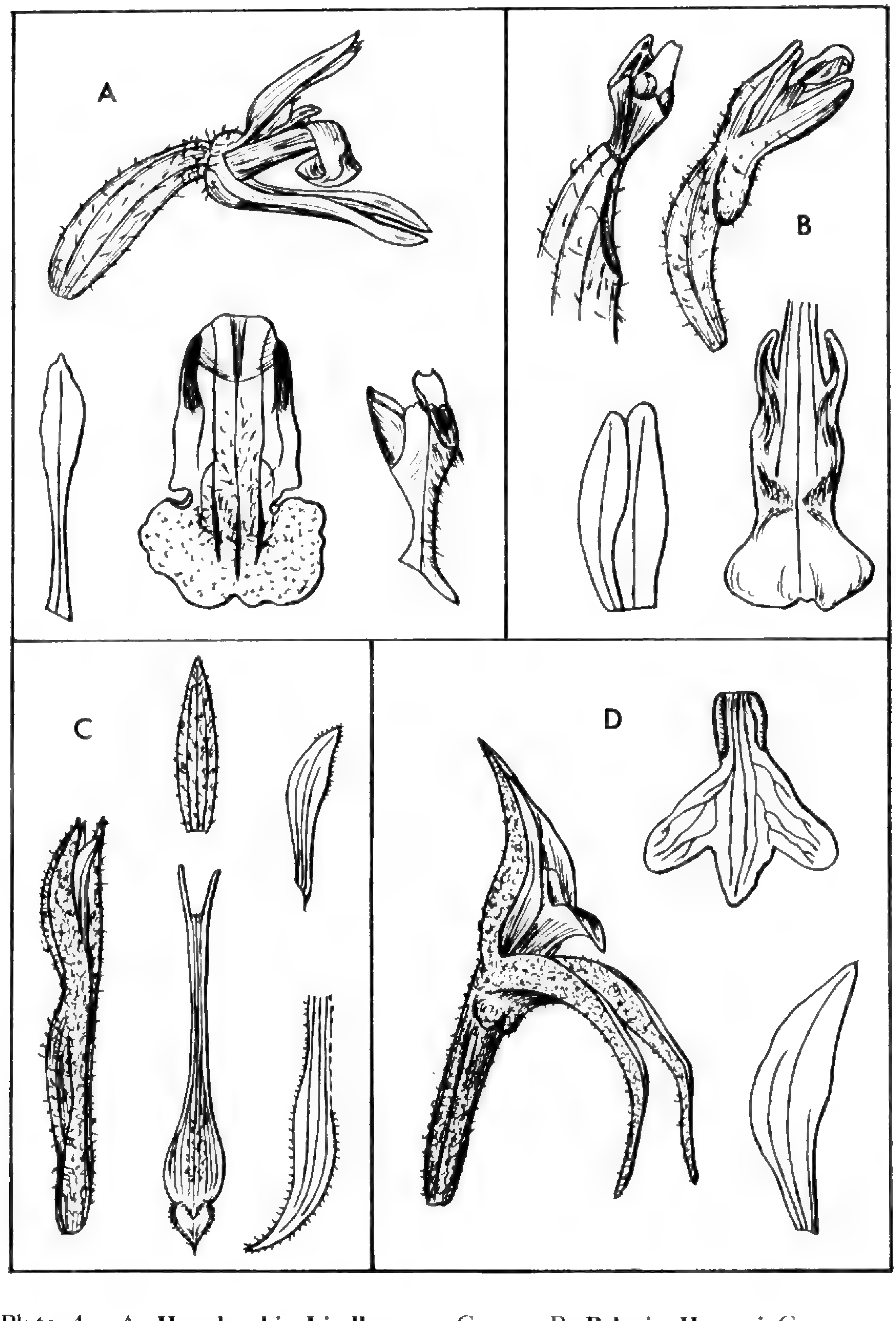

Plate 4. A. **Hapalorchis Lindleyanus** Garay. B. **Pelexia Hameri** Garay. C. **Sarcoglottis Lehmannii** Garay. D. **Buchtienia rosea** Garay.

PLATE 5

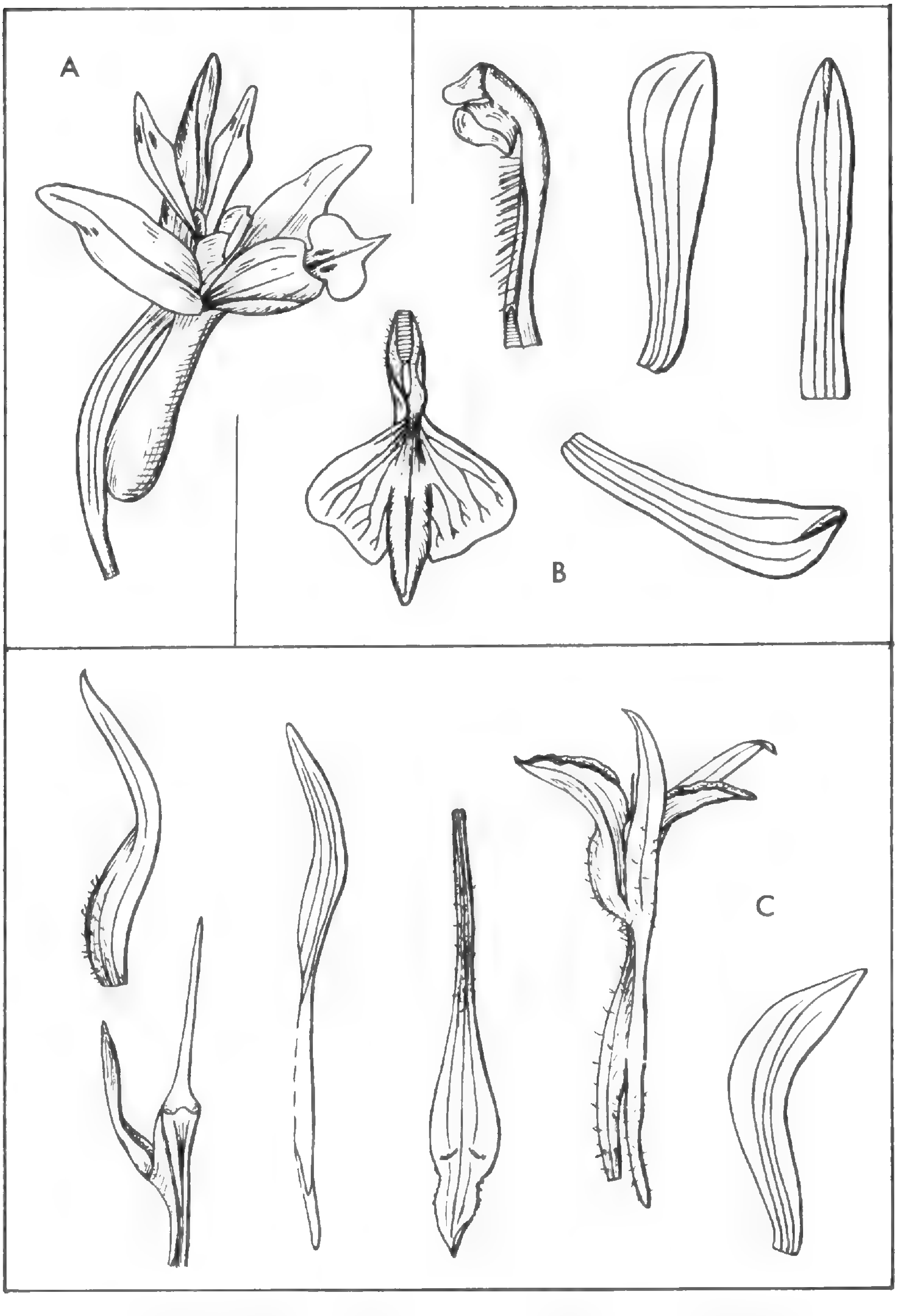

Plate 5. A. **Platythelys peruviana** Garay. B. **Palmorchis colombiana Garay.** C. **Eltroplectris pauciflora** (Poepp. & Endl.) Garay.

PLATE 6

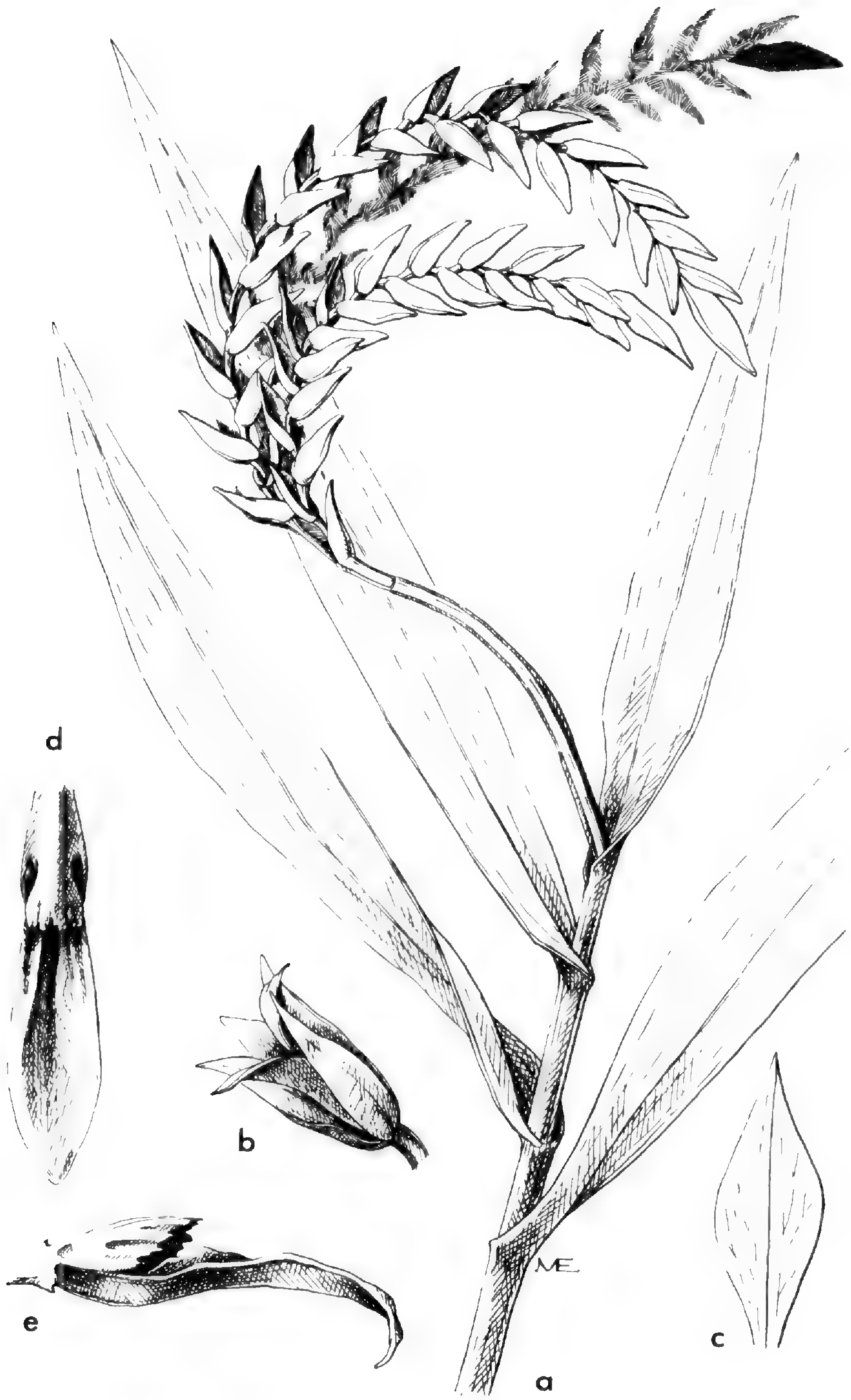

Plate 6. **Epidendrum tropidioides** Garay.

PLATE 7

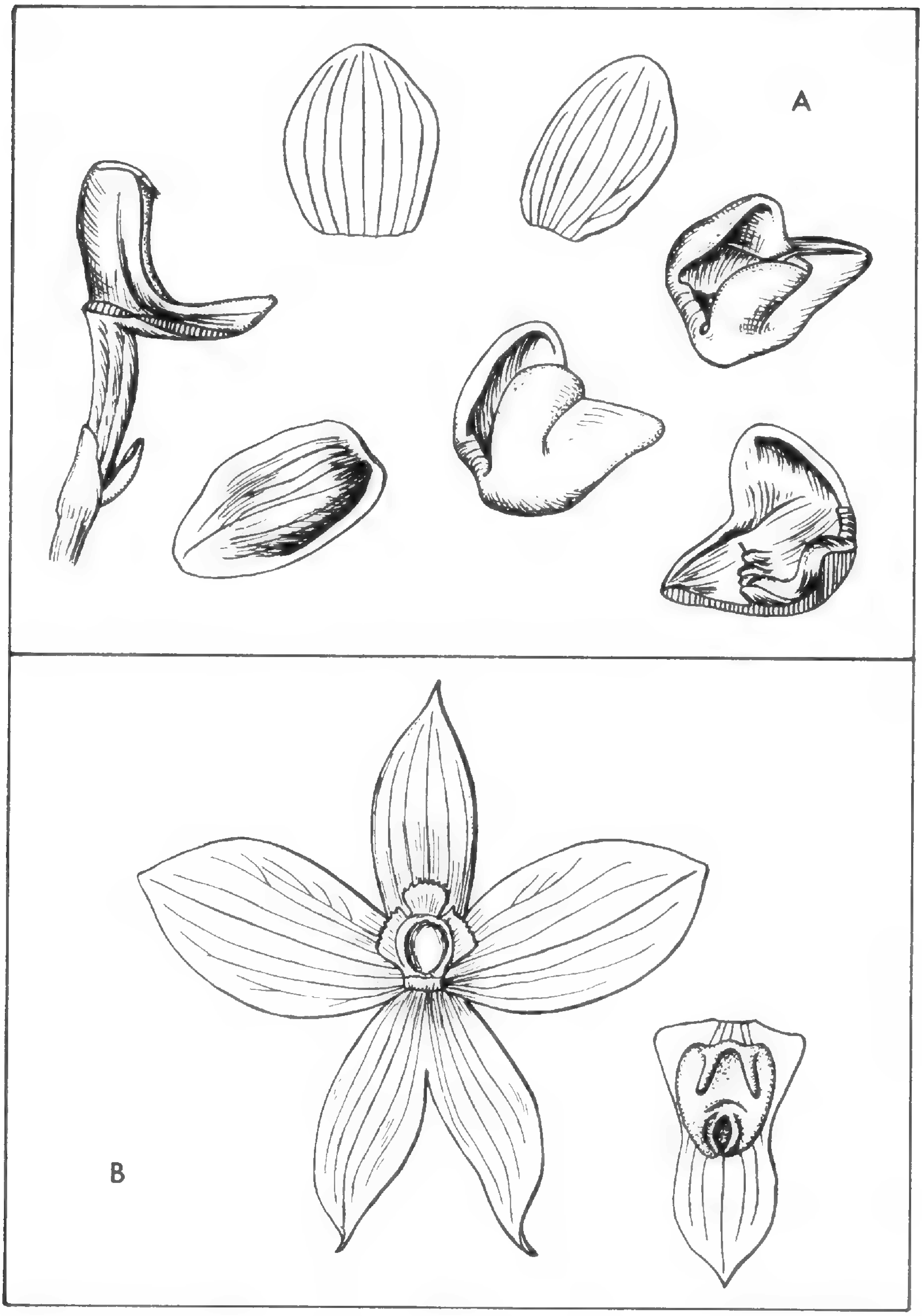

Plate 7. A. **Chondrorhyncha stenioides** Garay. B. **Osmoglossum panduratum** Garay.

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REVISION OF THE GENUS MASDEVALLIA - I.

HERMAN R. SWEET

The members of the genus *Masdevallia* have been in constant demand during recent years. The genus is comprised of some 400 species, most of which are poorly known, and those in cultivation frequently misidentified. Several years ago I started a complete revision of the genus, and this paper is the first step towards its finalization.

In 1925 Kränzlin published a monograph of the genus *Masdevallia* which in reality was an updated version of THE GENUS MASDEVALLIA by Miss Florence H. Woolward, originally published in 1896. The best part of Kränzlin's monograph is his principal division of the genus into 14 sections. Here Kränzlin demonstrated again, just as he had done with the genus *Oncidium*, his ability to recognize natural groups. At the same time he raised havoc with the assignment of individual species into sections, a pattern quite uniform in all of his monographic studies.

The first section taken up in this series is *Triotosiphon* proposed by Schlechter in 1922, but overlooked by Kränzlin. It was chosen purposely for it clearly reflects the taxonomic status of the genus as a whole. Some of the species now assigned to this section have been transferred to the genus *Physosiphon*. Admittedly, the technical distinction between *Masdevallia* and *Physosiphon* rests primarily in the calliferous petals in *Masdevallia*; this particular character also differentiates *Masdevallia* from the other genera of *Pleurothallidinae*.

Because of the great similarity in gross morphology that often exists among species belonging to the same section, it became mandatory to dissect and draw every type specimen in order to understand the true characters of their morphology.

When Schlechter chose the sectional name *Triotosiphon* — translated as a tube having three ears — he emphasized the nature of the flat but free sepaline lobes. Yet I believe that the emphasis should be on the dorsally ventricose tube which at once separates it from the Section *Tubulosae*.

The Section *Triotosiphon* contains eight species of which six are new to science. Surprisingly I have seen no material from Colombia or Peru, yet plants have been reported from Venezuela, Ecuador and Bolivia.

Section Triotosiphon (Schltr.) Sweet, *comb. nov.*

Basionym: *Masdevallia* subgen. *Triotosiphon* Schltr. in Fedde, Rep. Beih. 10: 42, 1922.

Type: **Masdevallia Bangii** Schltr.

Small, epiphytic plants, densely caespitose. Roots filiform, flexuous, glabrous. Secondary stem very short, completely enclosed by tubular, imbricating sheaths. Leaves coriaceous, very narrow. Inflorescence very slender, one-flowered. Flowers rather small, yellow. Sepals connate into a dorsally ventricose tube, suberect to arcuate, terminated by 3, free lobes; lobes fleshy, more or less spreading, ear-like, hence the sectional name, ecaudate. Petals, lip and column typical for the genus.

KEY TO SPECIES

1. Lip distinctly 3-lobed 2
1a. Lip entire 4
2. Sepaline lobes ovate, obtuse; petals acute; lateral lobes of lip falcate-triangular . . . . **M. trioon**
2a. Sepaline lobes lanceolate to narrowly ovate-lanceolate, acute; petals subtruncate, apiculate 3
3. Lateral lobes of lip obliquely triangular, obtuse; terminal lobe of lip ovate-rhombic; 3-dentate; disc glabrous . . . . **M. Bangii**
3a. Lateral lobes of lip semi-elliptic; terminal lobe of lip cuneate-subquadrate, erose-denticulate; disc at junction of terminal and lateral lobes on each side with an obliquely inserted, semilunate callus . . . . **M. Lansbergii**
4. Flowers arcuately curved; sepaline lobes triangular-lanceolate, sub-acuminate; petals spathulate; lip with a pair of low ridges 5
4a. Flowers suberect; sepaline lobes ovate-lanceolate to linear-oblong, acute to obtuse; petals linear-oblong; lip without ridges 6
5. Sepaline lobes 8 mm. long; ridges of lip glabrous . . . **M. kyphonantha**
5a. Sepaline lobes 4 mm. long; ridges of lip pubescent . **M. pseudominuta**
6. Petals linear with a longitudinal, keel-like callus 7

6a. Petals dolabriform with globose calli; sepaline lobes 5 mm. long .... **M. gnoma**
7. Sepaline lobes 5 mm. long; petals with a rounded, obscurely erose apex; lip pandurate .... **M. irapana**
7a. Sepaline lobes 10 mm. long; petals with a subtruncate apex, apiculate in middle; lip linear .... **M. venezuelana**

Masdevallia Bangii Schltr. in Fedde, Rep. Beih. 10: 41, 1922.

Syn.: *Physiphon Bangii* (Schltr.) Garay in Can. Journ. Bot. 34: 249, 1956.

Type: Bolivia; La Paz; Coroico, Ungas, BANG 2424! (AMES).

Epiphytic, caespitose plants, up to 5 cm. tall. Roots fasciculate, flexuous, glabrous. Secondary stem approximate, very thin, up to 2 mm. long, one-leaved. Leaves fleshy, erect, linear-oblanceolate, obtuse, gradually tapering toward the base, up to 5 cm. long and 3 mm. wide. Inflorescence erect, filiform, one-flowered, commonly shorter than the leaves, up to 2 cm. long. Bracts tubular, much shorter than the petiole, up to 4 mm. long. Flowers delicate, yellowish. Sepals connate into a narrow, dorsally ventricose tube, up to 8 mm. in length, free at apex; lobes lanceolate to narrowly ovate-lanceolate, distinctly carinate dorsally, acute, up to 3 mm. long and 1 mm. wide. Petals obliquely linear-oblong, subtruncate at apex, minutely apiculate in the center, very obscurely callose toward base along anterior margin, up to 2.2 mm. long and 0.6 mm. wide. Lip rather fleshy, from a cordate, oblong-cuneate base 3-lobed; lateral lobes obliquely triangular, obtuse; terminal lobe ovate-rhombic, distinctly 3-dentate at apex, up to 2.2 mm. long and 1 mm. wide. Column short with a three-lobed clinandrium, up to 2 mm. long. Ovary fusiform, articulate with the pedicel, up to 10 mm. long.

Bolivia: La Paz; Coroico, Yungas, BANG 2424! (AMES, US).

Masdevallia gnoma, Sweet, *sp. nov.*

Type: Ecuador; Prov. Napo, vicinity of Papallacta, STACY *s.n.*! (AMES).

Epiphytica, minuta, usque ad 2.5 cm. alta; radicibus fasciculatis, flexuosis, glabris; caulibus secundariis vix ullis, vaginis 2, alte amplectentibus omnino obtectis; foliis carnosis, lineari-oblanceolatis, acutis, basin versus sensim angustatis, usque ad 2 cm. longis, 2 mm. latis; inflorescentia capillari, uniflora, usque ad 1 cm. longa; floribus suberectis, parvis, luteis vel luteo-viridibus; bracteis tubulosis, usque ad 2 mm. longis; sepalis tubulosis, dorsaliter ventricosis, usque ad 5 mm. longis, lobis liberis, ovato-lanceolatis, acutis, usque ad 4.5 mm. longis, 1 mm. latis; petalis inaequaliter dolabriformibus, apice truncatis, in medio prominenter apiculatis, lamina antice expansa, globoso-callosa, usque ad 2 mm. longis, 0.5 mm. latis; labello oblongo-ligulato, antice subtruncato, margine erosulo; disco lamellis triangulis ornato; toto labello usque ad 2.2 mm. longo, 0.8 mm. lato; columna abbreviata, clavata, usque ad 2 mm. longa; ovario cylindrico, usque ad 2.5 mm. longo.

Epiphytic, minute plants, up to 2.5 cm. tall. Roots fasciculate, flexuous, glabrous. Secondary stem very short, completely enclosed by two loose-fitting, scarious sheaths, up to 2 mm. long. Leaves fleshy, linear-oblanceolate, acute, tapering toward the base, up to 2 cm. long and 2 mm. wide. Inflorescence slender, one-flowered, up to 1 cm. long. Flowers suberect, small, greenish yellow to yellow. Bracts tubulose, up to 2 mm. long. Sepals connate into a dorsally ventricose tube, 5 mm. long, free portions ovate-lanceolate, acute, up to 4.5 mm. long and 1 mm. wide. Petals unequally dolabriform, truncate with a prominent, median apicule, the anteriorly expanded blade with a globose callus, up to 2 mm. long and 0.5 mm. wide. Lip oblong-ligulate, subtruncate in front with an erose margin; disc with a pair of elevated triangular lamellae; whole lip up to 2.2 mm. long and 0.8 mm. wide. Column short, clavate, up to 2 mm. long. Ovary cylindric, up to 2.5 mm. long.

Ecuador: Prov. Napo; vicinity of Papallacta, STACY *s.n.*! (AMES).

Masdevallia irapana Sweet, sp. nov.

Type: Venezuela; Sucre, Peninsula de Paria, N.E. of Irapa, STEYERMARK 95079! (AMES).

Epiphytica, delicatula, caespitosa, usque ad 4 cm. alta; radicibus fasciculatis, filiformibus, glabris; caulibus secundariis abbreviatis, vaginis tubulosis, atro-brunneis omnino obtectis, usque ad 5 mm. longis; foliis lineari-oblanceolatis, obtusis, carnosis; basin versus sensim subpetiolatis, usque ad 5 cm. longis, 4 mm. latis; pedunculo filiformi, unifloro, usque ad 15 mm. longo; bracteis tubulosis, 1 mm. longis; floribus minutis, flavis vel aurantiacis; sepalis tubulosis, dorsaliter ventricosis, usque ad 5 mm. longis; lobis liberis oblongo-ellipticis, obtusis, usque ad 5 mm. longis, 1.4 mm. latis; petalis lineari-oblongis, sub apice paulisper constrictis, apice rotundatis, obscure erosis, margine anteriore callo lineari ornata, usque ad 2 mm. longis, 0.3 mm. latis; labello pandurato, dimidio basilari carnoso, subquadrato, concavo, dimidio anteriori e cuneata basi subrotondo, margine erosulo, toto labello usque ad 3 mm. longo, 1.5 mm. lato; columna abbreviata, usque ad 2 mm. longa; ovario cylindrico, usque ad 1 mm. longo.

Epiphytic, delicate, caespitose plants, up to 4 cm. tall. Roots fasciculate, filiform, glabrous. Secondary stem short, completely enclosed by imbricating, tubular, brown-purple sheaths, up to 5 mm. long. Leaves linear-oblanceolate, obtuse, tapering to a petiolate base, up to 5 cm. long and 4 mm. wide. Peduncle very short, slender, up to 15 mm. long, one-flowered. Bracts tubular, up to 1 mm. long. Flowers small, yellow to orange in color. Sepals united into a dorsally ventricose tube, up to 5 mm. long, free parts narrowly oblong-elliptic, obtuse, up to 5 mm. long and 1.4 mm. wide. Petals linear-oblong, somewhat constricted below the rounded, obscurely erose apex, the anterior margin with a short, linear, longitudinal thickening, up to 2 mm. long and 0.3 mm. wide. Lip pandurate; basal part subquadrate thickened, concave; apical part from a cuneate base subrotund with an erose margin, up to 3 mm. long and 1.5 mm. wide. Column short, up to 2 mm. long. Ovary cylindric, up to 1 mm. long.

Venezuela: Sucre, Peninsula de Paria, N.E. of Irapa, STEYERMARK 95079! (AMES, VEN).

Masevallia Lansbergii Rchb.f. in Nederl. Kruidk. Arch. 4: 317, 1858.

Syn.: *Physosiphon Lansbergii* (Rchb.f.) L.O. Wms. in Bot. Mus. Leafl. Harv. Univ. 7: 197, 1939.

Type: Venezuela; Caracas, LANSBERG 4! (W).

Epiphytic caespitose plants, up to 7 cm. tall. Roots fasciculate, glabrous. Secondary stem very short, completely enclosed by two tubular sheaths, up to 5 mm. long. Leaves linear-spathulate, obtuse, gradually tapering to base, subpetiolate, up to 7 cm. long and 6 mm. wide, commonly smaller. Peduncle filiform, one-flowered, up to 5 cm. long. Bracts tubular, up to 4 mm. long. Flowers small, yellow. Sepals connate into a dorsally ventricose tube, up to 8 mm. long, free part linear-oblong, acute, up to 8 mm. long and 1.5 mm. wide. Petals linear-oblong, truncate at apex with a small apiculum in middle, slightly tapering toward base, the anterior margin with a small, subglobose callosity above the base, up to 2.5 mm. long and 0.5 mm. wide. Lip 3-lobed, lateral lobes semi-elliptic; terminal lobe cuneate-subquadrate, with an obtuse, subtruncate, erose-denticulate apex, at the junction of the terminal lobe and lateral lobes on each side provided with an obliquely inserted, semi-lunate callus; whole lip up to 3 mm. long and 1 mm. wide. Column short with a distinct foot, cylindric, up to 2 mm. long. Ovary cylindric, up to 2 mm. long.

Venezuela: Caracas, LANSBERG 4! (W); Tovar, FENDLER 1369! (AMES)

Masdevallia kyphonantha, Sweet, *sp. nov.*

Type: Venezuela; Estado Yaracuy; 7 km. N. of Salom, STEYERMARK 106263! (AMES).

Epiphytica, caespitosa, usque ad 5 cm. alta; radicibus fasciculatis, flexuosis, glabris; caulibus secundariis approximatis, valde abbreviatis, vaginis 2, ample tubulosis omnino obtectis, usque ad 4 mm. longis; foliis carnosis, lineari-oblongis, paulisper basin versus attenuatis, obtusis, usque ad 5 cm. longis, 2 mm. latis; inflorescentia capillari, uniflora, usque ad 2.5 cm. longa; bracteis tubulosis, usque ad 4 mm. longis; floribus albidis; sepalis tubulosis, dorsaliter ventricosis, arcuatis, inde nomen, usque ad 18 mm. longis, lobis liberis, lanceolato-triangularibus, subacuminatis, usque ad 8 mm. longis, 3 mm. latis; petalis oblique spathulatis, apice rotundatis, minute mucronatis, margine anteriore in medio callo globoso ornata, usque ad 3.5 mm. longis, 1.2 mm. latis; labello oblongo-ligulato, antice rotundato vel subtruncato, erosulo, disco longitudinaliter bicarinato, usque ad 5 mm. longo, 2 mm. lato; columna paululo arcuata, subclavata, usque ad 3.5 mm. longa; ovario cylindrico, usque ad 5 mm. longo.

Epiphytic, caespitose plants, up to 5 cm. tall. Roots fasciculate, flexuous, glabrous. Secondary stem approximate, very short, completely enclosed by two, loose-fitting, tubular sheaths, up to 4 mm. long. Leaves fleshy, linear-oblong, somewhat tapering toward the base, obtuse, up to 5 cm. long and 2 mm. wide. Inflorescence very slender, one-flowered, up to 2.5 cm. long. Bracts tubular, as long as the pedicels, up to 4 mm. long. Flowers whitish. Sepals connate into a dorsally ventricose, arcuately curved tube, hence the name, up to 18 mm. long, the free portions lanceolate-triangular, subacuminate, up to 8 mm. long and 3 mm. wide. Petals obliquely spathulate, rounded at apex, minutely mucronate, with an obscurely globose callus near the middle of the anterior margin, up to 3.5 mm. long and 1.2 mm. wide. Lip oblong-ligulate, rounded to subtruncate in front with an erose margin; disc provided with a pair of elevated, longitudinal ridges, up to 5 mm. long and 2 mm. wide. Column slightly arcuate, subclavate, up to 3.5 mm. long. Ovary cylindric, up to 5 mm. long.

Venezuela: Estado Yaracuy; 7 km. N. of Salom, STEYERMARK 106263! (AMES, VEN).

Masdevallia pseudominuta, Sweet, *sp. nov.*

Type: Venezuela; Curimagua, Sierra de San Luís, GARCIA *s.n.* sub DUNSTERVILLE 538! (AMES).

Epiphytica, caespitosa, usque ad 3 cm. alta; radicibus filiformibus, flexuosis, glabris; caulibus secundariis valde abbreviatis, seu vix ullis, vaginis imbricantibus, tubulosis obtectis; foliis carnosis, lineari-oblanceolatis, usque ad 3 cm. longis, 2 mm. latis; pedunculo gracili, unifloro, usque ad 2 cm. longo; bracteis tubulosis, usque ad 3.5 mm. longis; floribus luteis; sepalis tubulosis, dorsaliter ventricosis, arcuatis, 6 mm. longis, lobis liberis, triangulari-lanceolatis, subacuminatis, usque ad 5 mm. longis, 1 mm. latis; petalis oblique spathulatis, obtusis, obscure apiculatis, margine anteriore in medio obscure subglobosa, usque ad 2 mm. longis, 0.8 mm. latis; labello lineari-oblongo, subtruncato, disco longitudinaliter bicarinato, carinis puberulentibus, usque ad 2.5 mm. longo, 0.8 mm. lato; columna abbreviata, clavata, usque ad 2 mm. longa; ovario cylindrico, usque ad 2 mm. longo.

Epiphytic, small, caespitose plants, up to 3 cm. tall. Roots filiform, flexuous, glabrous. Secondary stem short, completely enclosed by imbricating, tubular sheaths. Leaves fleshy, linear-oblanceolate, up to 3 cm. long and 2 mm. wide. Peduncle slender, one-flowered, up to 2 cm. long. Bracts tubular, up to 3.5 mm. long. Flowers yellow. Sepals are united into a dorsally ventricose, somewhat arcuately curved tube 6 mm. in length, free portions spreading, triangular-lanceolate, subacuminate, up to 5 mm. long and 1 mm. wide. Petals obliquely spathulate, obtuse, obscurely apiculate with an obscurely subglobose callus near the middle of the anterior lobe, up to 2 mm. long and 0.8 mm. wide. Lip linear-oblong, subtruncate in front with a pair of longitudinal, puberulent ridges, up to 2.5 mm. long and 0.8 mm. wide. Column short, clavate, up to 2 mm. long. Ovary cylindric, up to 2 mm. long.

Venezuela: Curimagua, Sierra de San Luís, GARCIA *s.n.* sub DUNSTERVILLE 538! (AMES).

Masdevallia trioon Sweet, *sp. nov.*

Type: Ecuador; Condor, FISKE *s.n.*! (AMES)

Epiphytica, perpusilla, caespitosa, usque ad 4 cm. alta; radicibus filiformibus, flexuosis, glabris; caulibus secundariis vix ullis, vaginis tubulosis, 2, omnino obtectis, usque ad 2 mm. longis; foliis lineari-spathulatis, obtusis, basin versus angustatis, usque ad 4 cm. longis, 3 mm. latis; pedunculo filiformi, unifloro, usque ad 1.5 cm. longo; bracteis tubulosis, usque ad 3 mm. longis; floribus luteis; sepalis dorsaliter ventricosis, usque ad 6 mm. longis, lobis liberis patentibus, ovatis, obtusis, inde nomen, usque ad 2 mm. longis, 1.6 mm. latis; petalis e cuneata basi oblongo-ellipticis, acutis, margine anteriori callo globoso decora, usque ad 3 mm. longis, 1 mm. latis; labello e cuneato-subquadrata basi 3-lobo, lobis lateralibus falcato-triangularibus, lobo terminali rectangulariter-oblongo, recurvo, margine integro, toto labello, usque ad 3 mm. longo, 1 mm. lato; columna erecta, usque ad 3.5 mm. longa; ovario cylindrico, usque ad 3.5 mm. longo.

Epiphytic, small, caespitose plants, up to 4 cm. tall. Roots filiform, flexuous, glabrous. Secondary stem hardly any, completely enclosed by two tubular sheaths, up to 2 mm. long. Leaves linear-spathulate, obtuse, tapering to base, up to 4 cm. long and 3 mm. wide. Peduncle filiform, one-flowered, up to 1.5 cm. long. Bracts tubular, up to 3 mm. long. Flowers yellow. Sepals united into a dorsally ventricose, inflated tube, up to 6 mm. long, free lobes spreading, ovate, obtuse, up to 2 mm. long and 1.6 mm. wide. Petals from a cuneate base oblong-elliptic, acute, along anterior margin below middle provided with a small, globose callus, up to 3 mm. long and 1 mm. wide. Lip from a cuneate-subquadrate base 3-lobed; lateral lobes falcate-triangular; midlobe rectangular-oblong, recurved with entire margin; whole lip up to 3 mm. long and 1 mm. wide. Column erect with a short foot, up to 3.5 mm. long. Ovary cylindric, up to 3.5 mm. long.

Ecuador: Condor, FISKE *s.n.*! (AMES).

Masdevallia venezuelana Sweet, *sp. nov.*

Type: Venezuela; Rancho Grande, PITTIER 13966! (AMES).

Epiphytica, caespitosa, usque ad 10 cm. alta; radicibus fasciculatis, filiformibus, flexuosis, glabris; caulibus secundariis abbreviatis, vaginis tubulosis omnino obtectis, usque ad 6 mm. longis; foliis carnosis, oblanceolato-spathulatis, obtusis, basin versus in petiolo angustatis, usque ad 6 cm. longis, 8 mm. latis, vulgo minoribus; pedunculo gracili, unifloro, usque ad 8 cm. longo; bracteis tubulosis, pedicellis aequilongis, usque ad 5 mm. longis; floribus citrinis vel aurantiacis, satis magnis; sepalis dorsaliter ventricosis, 10 mm. longis, lobis liberis lineari-oblongis, obtusis vel rotundatis, usque ad 10 mm. longis, 2 mm. latis; petalis hyalinis, linearibus, apicem versus paululo dilatatis, subtruncatis, in medio apiculatis, margine anteriori callo cariniformi ornata, usque ad 3 mm. longis, 0.5 mm. latis;

labello luteo, lineari, parte basali carnosa, excavata, in medio marginis in disco decurrentibus, parte apicali membranacea, oblongo-lineari, apice erosa, toto labello usque ad 3.5 mm. longo, 1 mm. lato; columna erecta, cylindrica, usque ad 2 mm. longa, ovario cylindrico, sulcato, usque ad 2 mm. longo.

Epiphytic, caespitose plants, up to 10 cm. tall. Roots fasciculate, filiform, glabrous. Secondary stem short, completely enclosed by tubular sheaths, up to 6 mm. long. Leaves fleshy, oblanceolate-spathulate, obtuse, tapering to a distinct petiole, up to 6 cm. long and 8 mm. wide, commonly smaller. Peduncle slender, one-flowered, up to 8 cm. long. Bracts tubular, as long as the pedicel, up to 5 mm. long. Flowers lemon-yellow to golden yellow, large for the section. Sepals connate into a dorsally ventricose tube, 10 mm. in length, free parts linear-oblong, obtuse to rounded at apex, up to 10 mm. long and 2 mm. wide. Petals hyaline, linear, somewhat expanded at apex, subtruncate, apiculate in middle, the anterior margin with a long, fleshy keel, up to 3 mm. long and 0.5 mm. wide. Lip yellow, linear, basal half fleshy, excavate, with the margins decurved in middle onto the disc; apical half membranaceous, oblong-linear with erose apex, up to 3.5 mm. long and 1 mm. wide. Column erect, cylindric, with a distinct foot, up to 2 mm. long. Ovary cylindric, sulcate, up to 2 mm. long.

Venezuela: Rancho Grande PITTIER 13966! (AMES, US), DUNSTERVILLE 528! (AMES), STEYERMARK 89793! (AMES, VEN), PITTIER 11820! (AMES, G, US).

PLATE 8

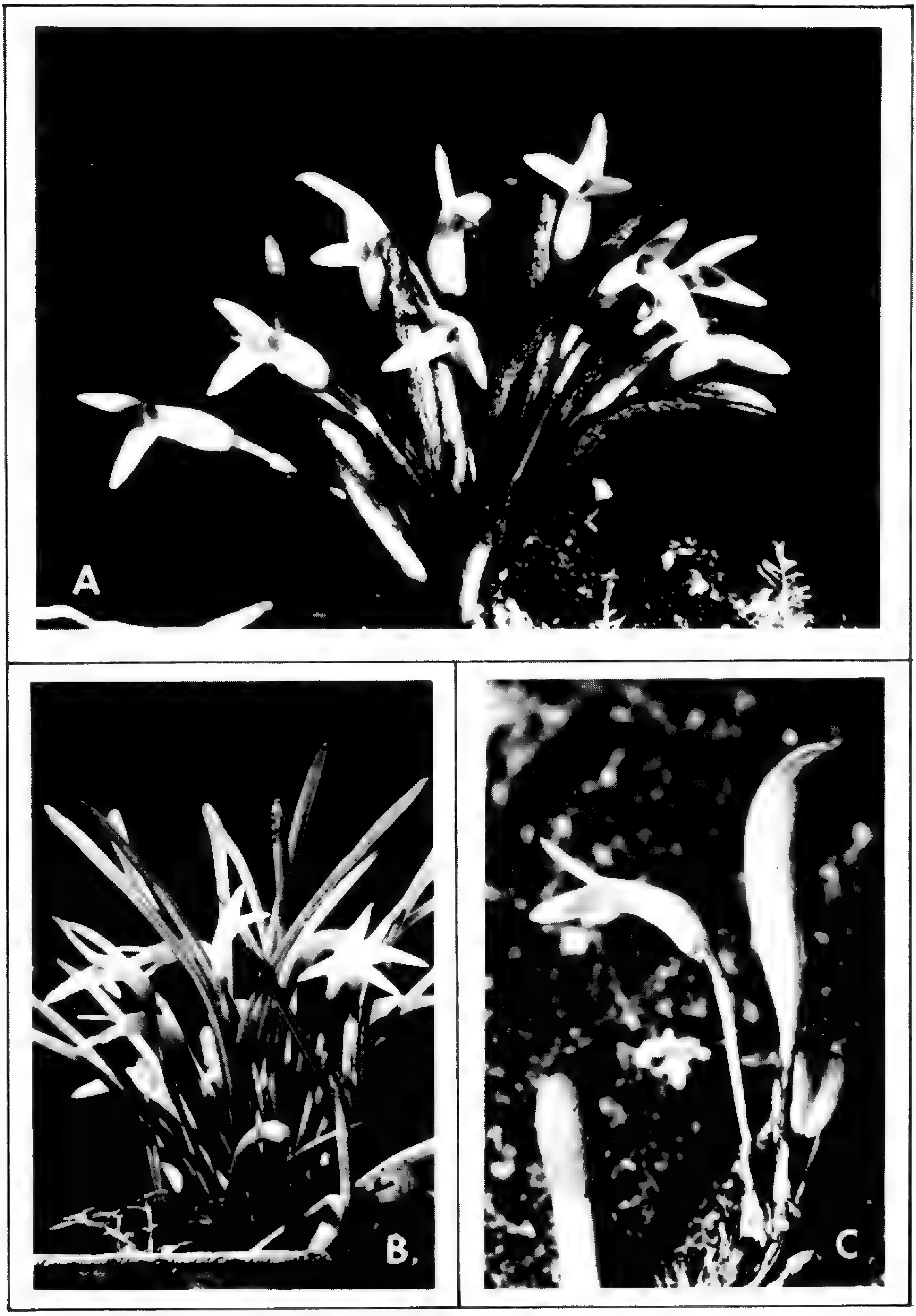

Plate 8. A. **Masdevallia gnoma** Sweet. B. **Masdevallia kyphonantha** Sweet. C. **Masdevallia pseudominuta** Sweet.

PLATE 9

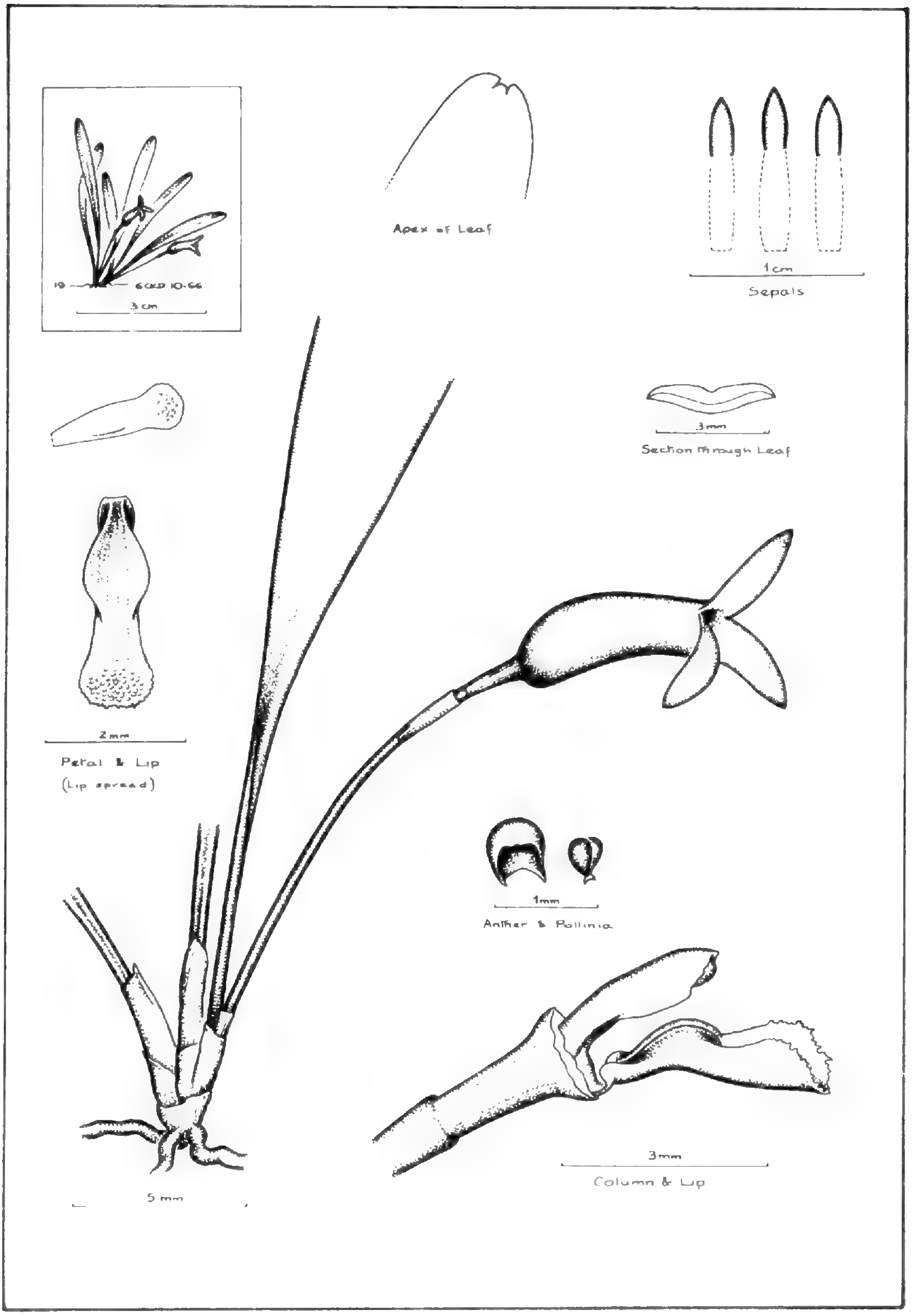

Plate 9. **Masdevallia irapana** Sweet.

PLATE 10

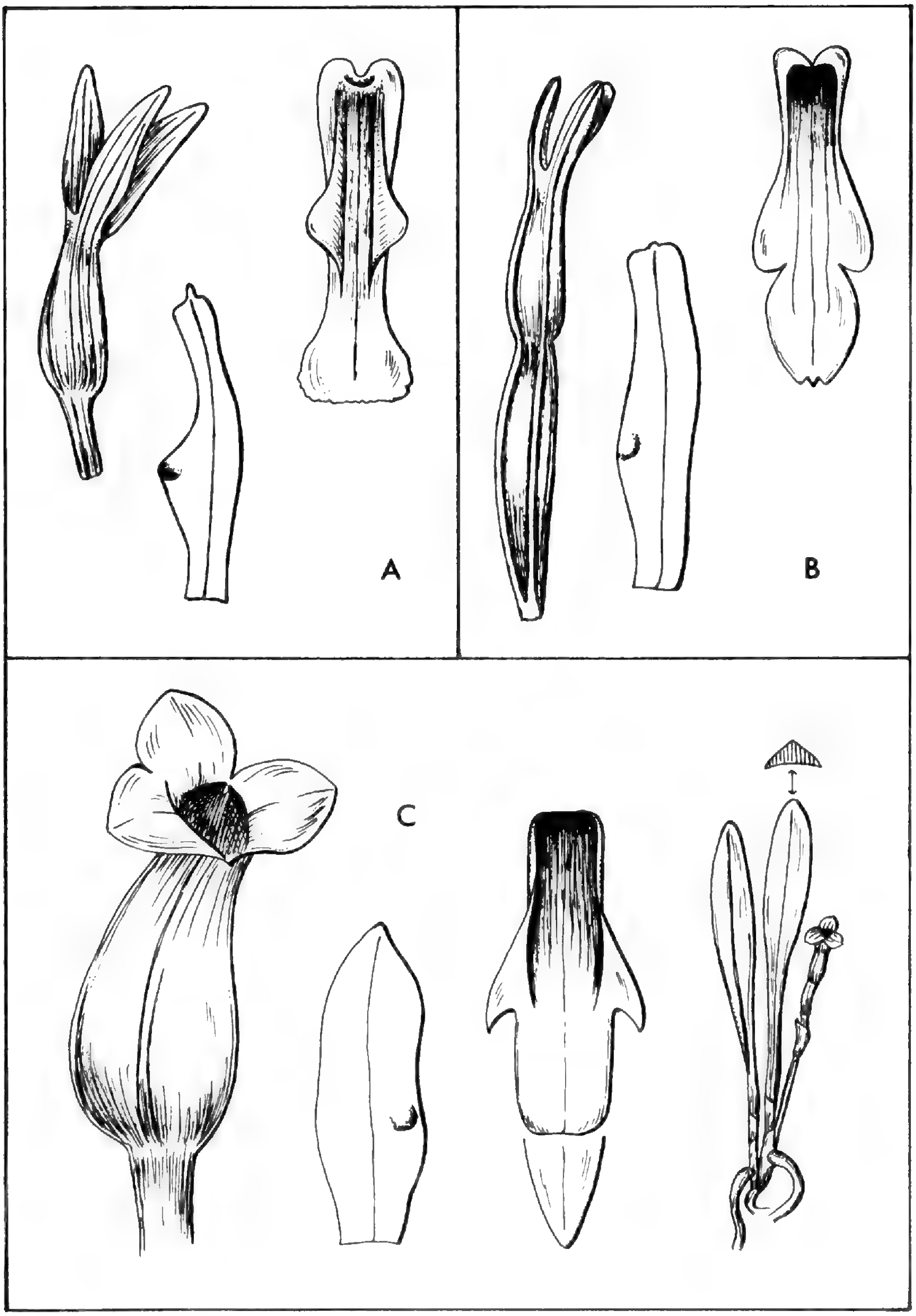

Plate 10. **Masdevallia gnoma** Sweet. B. **Masdevallia Bangii** Schltr., C. **Masdevallia trioon** Sweet.

PLATE 11

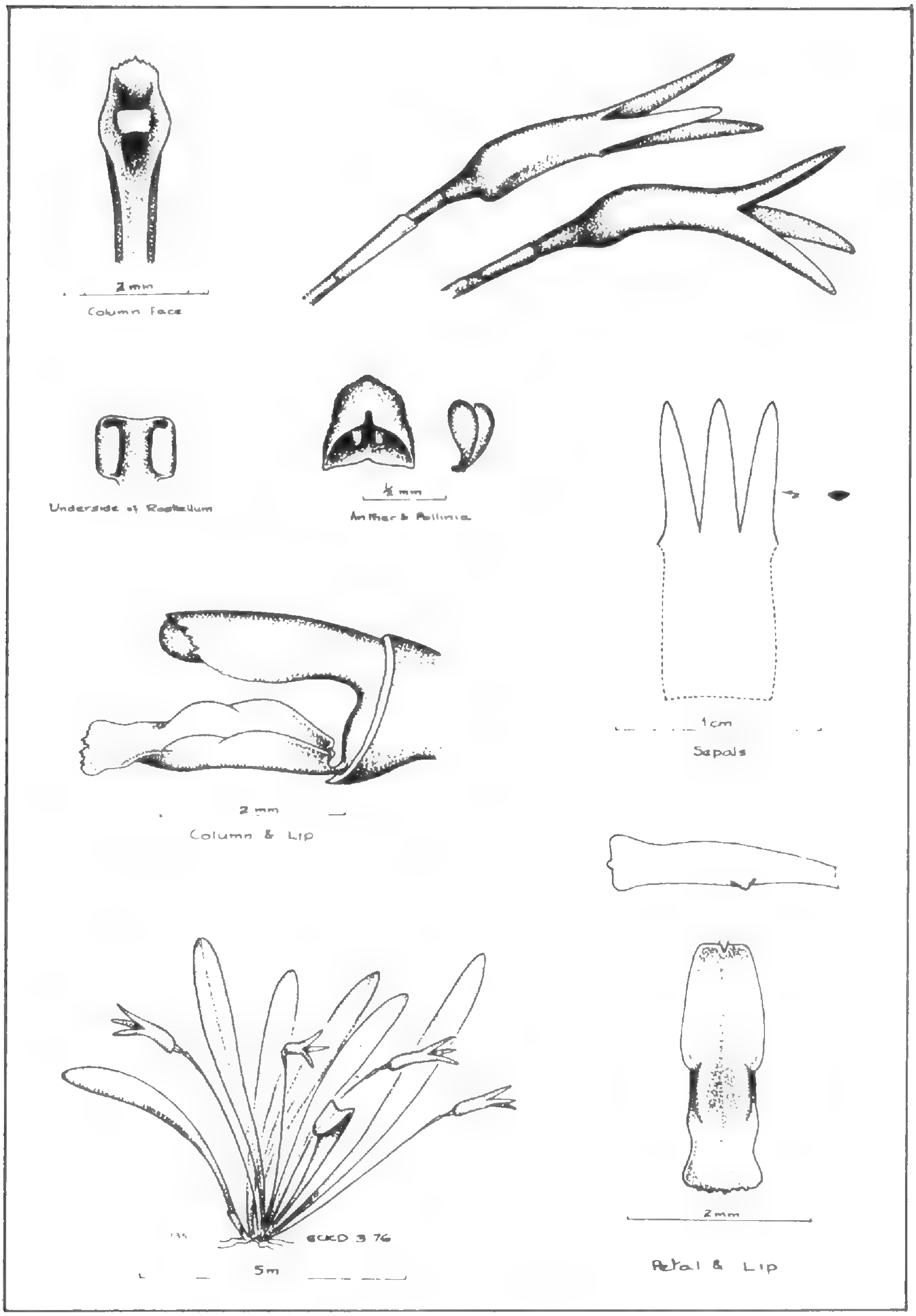

Plate 11. **Masdevallia Lansbergii** Rchb.f.

PLATE 12

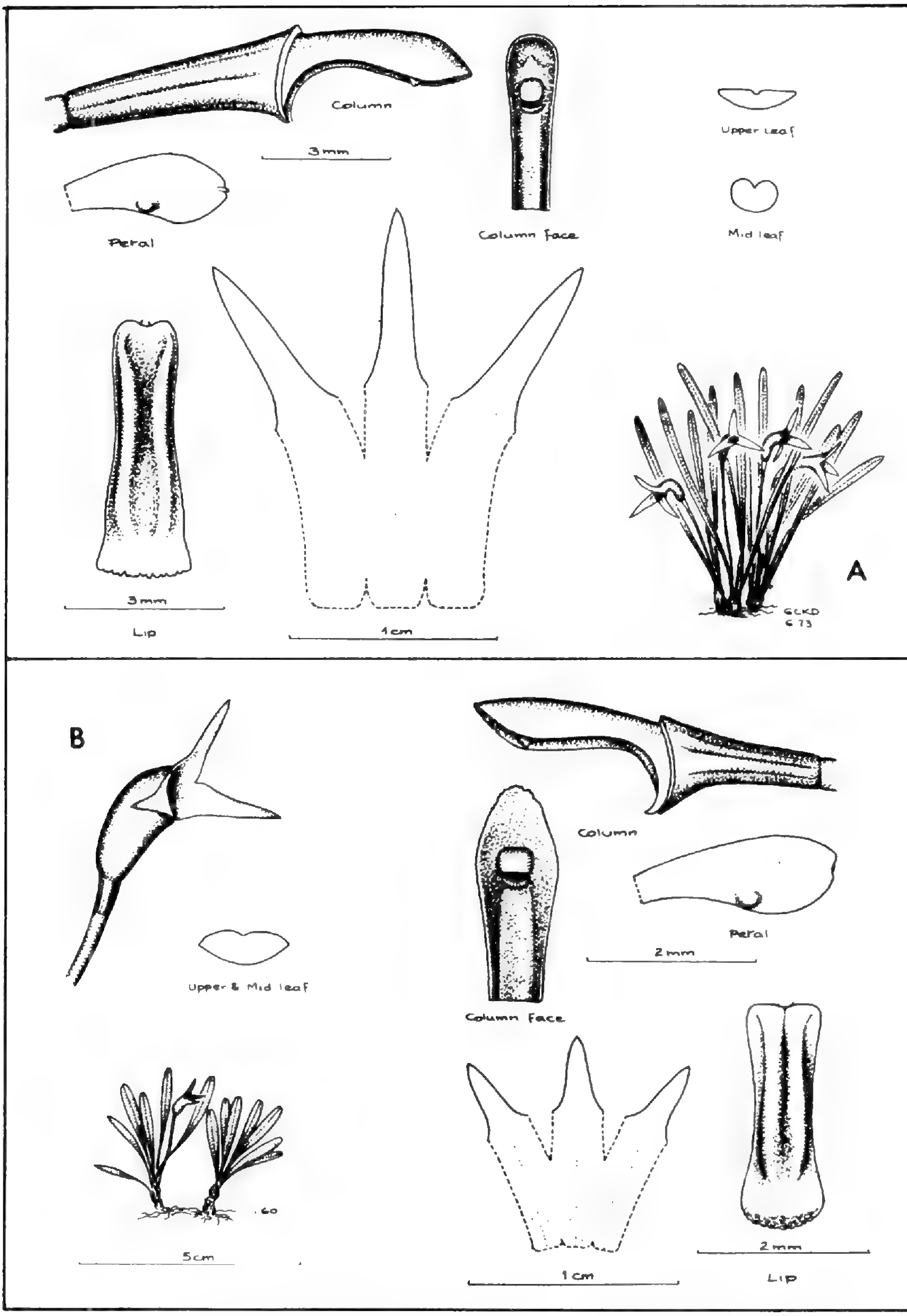

Plate 12. A. **Masdevallia kyphonantha** Sweet. B. **Masdevallia pseudominuta** Sweet.

PLATE 13

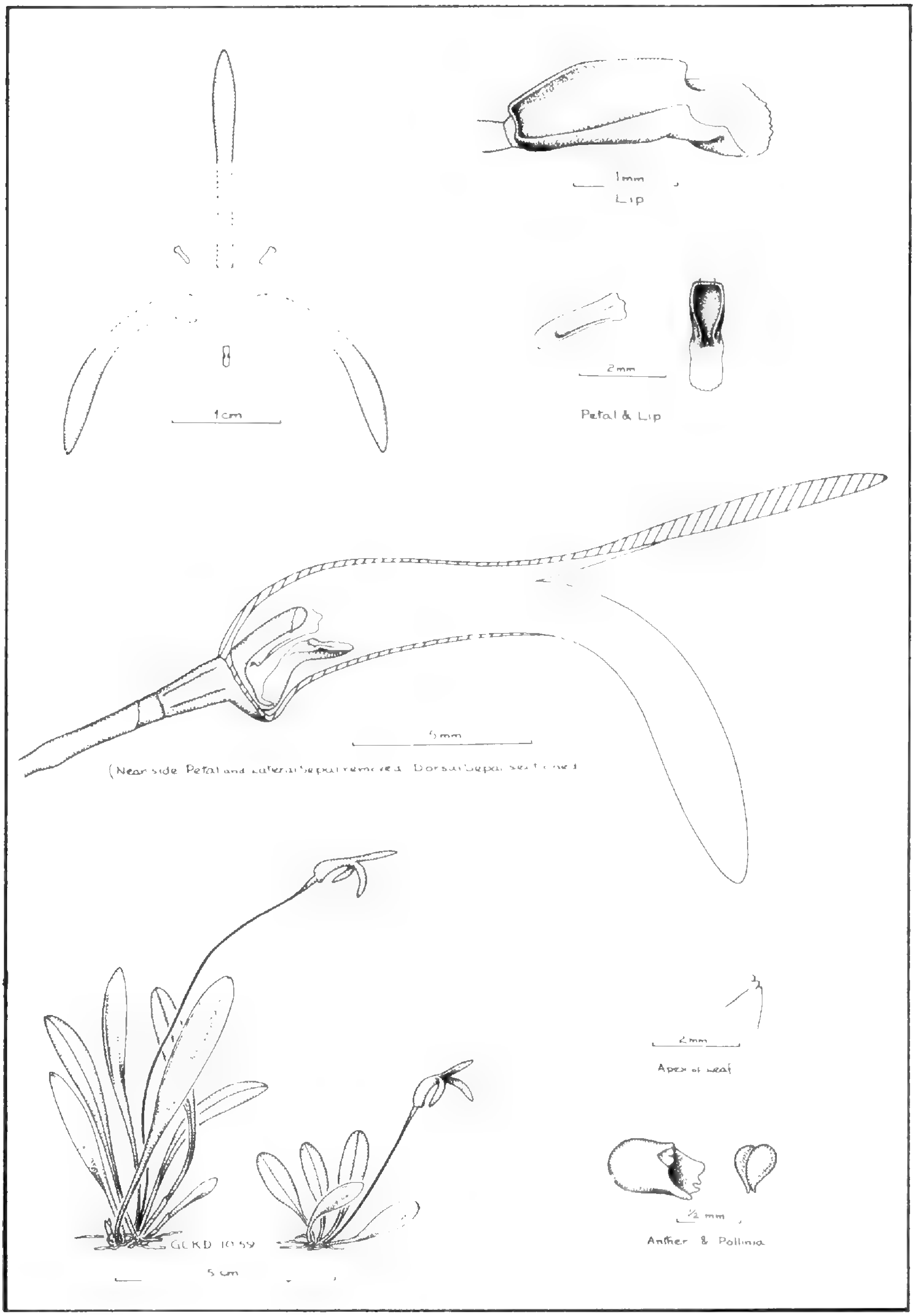

Plate 13. **Masdevallia venezuelana** Sweet.

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STUDIES IN THE GENUS ONCIDIUM — II SECTION SERPENTIA

John E. Stacy

As I have stated in the first paper of this series, the various sections of *Oncidium* will be handled in a random sequence, mostly dictated by existing needs for clarification of cultivated material.

The Section *Serpentia* was established by Garay in 1970 in his review of the genus *Oncidium*. The group of plants comprising this section had already been brought together by Kränzlin in 1922 as a subsection notwithstanding the lack of any phyletic or genetic proximity with the rest of the Section *Varicosa* to which it was attached.

The outstanding characteristic of this section is the remarkable habit of the plants. The inflorescences which may be compared with those of *O. volvox, O. acinaceum, O. Schilleranum* to mention a few, often develop adventitious plantlets in lieu of flowers. The result is a twining habit which, without closer scrutiny, appears to have plants situated distantly on thin rhizomes or stolons. The true nature of these plants was first recognized by Dr. Rodrigues in Costa Rica, who together with Dr. Daniels, give an excellent discussion on the morphology of these plants in Orquideologia 7: 79-84, 1972.

Although the Section Serpentia contains only a handful of species, the individual members are still poorly known, most probably due to the great similarity in their vegetative growth. The type-species, *O. globuliferum*, for a long time remained unknown, but it is available for study now in the Paris herbarium. When Reichenbach first examined Humboldt's material he hastily united his own *O. Scansor* with it. Yet both plants are amply distinct from one another as will be shown later. To make matters worse, Reichenbach described a new variety of *O. globuliferum* from Costa Rica which was indeed different from his concept of *O. Scansor*.

Perhaps the greatest mystery in this group of plants is *O. serpens* Lindl. Lindley based his description on a single dried specimen without actually examining the lip for details. Since the type-specimen had only a single flower very nicely pressed, an examination of it without boiling it first, gave rise to a wrong description of its shape and the nature of its callus. Through the courtesy of Dr. Peter Taylor of the Orchid Herbarium, Royal Botanic Gardens, Kew, I have studied the type-specimen and I find it identical with *O. trachycaulon* Schltr. and *O. Sancti-Pauli* Krzl.

While the plants of the species mentioned above all have smooth peduncles without nodes which twine about branches, *Oncidium Harlingii*, a newly discovered species, exhibits a very different habit. The plants are epiphytic on *Selaginella* growing on the ground, its peduncles are upright and jointed. The species is endemic in Ecuador and its distribution is limited in the area of Gualaceo to General Plaza where it has been collected on three different occasions in association with *Odontoglossum crinitum*.

Section Serpentia (Krzl.) Garay in Taxon 19: 455, 1970.
Type: *Oncidium serpens* Lindl.

The flowers are medium to large for the plant and range from 2 to 5 cm. vertically, yellow in color with reddish brown maculations on the sepals, petals and base of lip. The sepals and petals are clawed, spreading; the petals somewhat wider than the sepals. The lip is most conspicuous, usually with small basal lobes; the midlobe is emarginate, transversely reniform, solid-colored except at the base, with a variously tuberculate crest. The column is short, auriculate, and thickened below the stigma; the rostellum is short.

The plants are small, epiphytic, with remotely-spaced pseudobulbs on slender, wiry, twining or erect inflorescences. The mature pseudobulbs are monophyllous, rarely longer than 3 cm., round to ovate, slightly compressed, enclosed by distichously imbricating, leafy sheaths. The secondary inflorescence is short, emerging from the axils of the sheaths, frequently from less developed pseudobulbs, usually single-flowered or rarely few-flowered on a fractiflex rachis. The leaves are oblong-ovate, acute or rounded at apex and with a conduplicate petiole.

KEY TO SPECIES

1. Inflorescence many-jointed, covered with adpressed, chartaceous sheaths; petals larger than sepals .... **O. Harlingii**
1a. Inflorescence without joints or sheaths; petals more or less similar to sepals 2
2. Leaves rounded at apex; column wings quadrate, entire; clinandrium marginate, low 3
2a. Leaves pointed at apex; column wings serrate; clinandrium strongly cucullate .... **O. serpens**
3. Midlobe of lip sessile, overlapping lateral sepals .... **O. Scansor**
3a. Midlobe of lip produced from an elongate isthmus, exposing lateral sepals .... **O. globuliferum**

SYSTEMATICS OF SPECIES

Oncidium globuliferum H.B.K., Nov. Gen. et Sp. Pl. 1: 347, 1816.

Type: Colombia; Dept. Cauca, near Lake Timbio, Humboldt 2072! (P).

Syn.: *Oncidium convolvulaceum* Lindl. in Lindl. & Paxt., Fl. Gard. 1: 102, 1850.

Type: Venezuela; without precise locality, Funck & Schlim 1444! (K-L).

Oncidium globuliferum var. costaricense Rchb.f. in Gard. Chron. 1678, 1871.

Type: Costa Rica; without precise locality, Zahn 149! (W).

Oncidium Wercklei Schltr. in Fedde, Rep. Beih. 19: 68, 1923.

Type: Costa Rica; San Jeronimo, Wercklé 46! (AMES).

Observation: Sepals up to 15 mm. long, 5 mm. wide, obovate-oblong, slightly clawed at the base; lateral sepals free and slightly narrower. Petals subsimilar, up to 15 mm. long and 6 mm. wide. Lip is conspicuous, 3-lobed; basal lobes small, suborbicular; midlobe from a prominent isthmus transversely reniform, emarginate, up to 3.5 cm. wide and 2.8 cm. long including the base. Pseudobulbs somewhat compressed, round to ovate, spaced remotely on slender, wiry growths. Peduncle either lateral from base of pseudobulb or from developing plantlet, usually single-flowered but specimens have been seen with several-flowered, fractiflex rachis; the largest pseudobulb up to 3.5 cm. long with a leaf up to 10 cm. long.

DISTRIBUTION: Costa Rica south to Bolivia.

Oncidium Harlingii Stacy, *sp. nov.*

Type: Ecuador; Gualaceo 30 K. West of Limón, growing on ground among moss at 2300 m., HARLING 12835! (GB).

Epiphytica, erecta, simplici vel ramosa; pedunculis, teretibus, satis rigidis, multi-articulatis, vaginis ad-pressis, jam emarcidis, internodiis sesquipollicaris subaequilongis vestiti; pseudobulbis valde distantibus, leviter compressis, ovoideo-lenticularibus, vaginis distichis, foliiferis omnino obtectis, unifoliatis, usque ad 2 cm. altis; foliis in exsiccatione satis papyraceis, ovato-lanceolatis, acutis vel subacuminatis, basin plus-minusuve petiolatis, petiolo usque ad 1.5 cm. longo incluso usque ad 11 cm. longis, 2.5 cm. latis; inflorescentiis abbreviatis, 1-3 floris; bracteis cucullato-lanceolatis, acuminatis, ovariis pedicellatis brevioribus; floribus conspicuis; sepalo postico obovato-elliptico, obtuso, paulo convexo, usque ad 8 mm. longo, 5 mm. lato; sepalis lateralibus inter se breviter connatis, patulis, ovato-oblongis, acutis, usque ad 10 mm. longis, 4 mm. latis; petalis quam sepalis multo majoribus, ovato-ellipticis obtusis vel rotundatis, usque ad 12 mm. longis, 7 mm. latis; labello sessili, basin utrinque auriculato, subrotundo, deinde in laminam transverse reniformem, antice emarginatam seu bilobam expanso; disco basin callo triquetro, tota superficie minutissime muricato ornato; toto labello 26 mm. longo, 30 mm. lato, basin 11 mm. lato; columna humili, juxta stigma auriculata, auriculis oblique subquadratis; ovario pedicellato cylindrico, usque ad 2 cm. longo.

Observation: *O. Harlingii* is readily separated from the other species belonging to this section by the rather straight and erect growths with adpressed sheaths at the many nodes and by the triquetrous callus at the base of the lip. The dorsal sepal is obovate, obtuse, up to 8 mm. long and 5 mm. wide; the lateral sepals are shortly connate, spreading, ovate-oblong, up to 10 mm. long and 4 mm. wide. The petals are ovate elliptic, obtuse or rounded, up to 12 mm. long and 7 mm. wide. The lip is sessile, auriculate at the base with subrotund lobes, up to 11 mm. across; the midlobe is transverse-reniform, emarginate at the apex, up to 2.6 cm. long and 3 cm. wide; the callus is small, triquetrous, with minute superficial processes along the margins. The column is short with obliquely subquadrate auricles on either side of the stigma.

DISTRIBUTION: Endemic in southern Ecuador.

Oncidium Scansor Rchb.f. in Linnaea 22: 844, 1850.
Type: Venezuela; Prov. Merida at 2000 m., Funck & Schlim 1022! (W).

Observation: *O. Scansor* is readily separated from *O. globuliferum* by the midlobe of lip being sessile; the lateral lobes are small and together form a somewhat saggitate base. The lip is up to 3.8 cm. long and 5 cm. wide, up to 15 mm. across the lateral lobes; the flat basal portion of the callus is pubescent. The dorsal sepal is elliptic-oblong, acute, up to 16 mm. long and 6 mm. wide; the lateral sepals are similar and slightly oblique, up to 17 mm. long and 5 mm. wide. The petals are obovate, up to 18 mm. long and 7 mm. wide. The column wings are subquadrate.

DISTRIBUTION: Venezuela, Colombia.

ILLUSTRATION: Dusnterville & Garay, Venez. Orch. Ill. 2: 249, 1961 as *O. globuliferum*.

Oncidium serpens Lindl., Gen. and Sp. Orch. Pl. 204, 1833.
Type: Ecuador; Prov. Esmeraldas, Patacocha, at 1900 m., Hall 4! (K).
Syn.: *Oncidium trachycaulon* Schltr. in Fedde, Rep. Beih. 7: 191, 1920.

Type: Colombia; Dept. Cauca, Madero, *s.n.*

Observation: The plants of this species are readily separated from *O. Harlingii* by the absence of sheaths and nodes along the growths. The lip of the flower is longer than wide, and in the type-flower it is more or less oblong-pandurate with an auriculate base. It measures up to 12 mm. long and 8 mm. across the midlobe, but may be somewhat wider. The callus, as reconstructed from the type-specimen, is tuberculate and it is difficult to explain Lindley's interpretation of it being bilamellate. The sepals and petals are clawed, elliptic-obovate, up to 11 mm. long and 5 mm. wide; the petals are less prominently clawed. The column is up to 5 mm. long with small, quadrate, serrated wings; the clinandrium is conspicuously cucullate, truncate. The pedicellate ovary is up to 18 mm. long and the floral bracts are up to 4 mm. long. The leaves are ovate, acute, up to 5 cm. long and 1.5 cm. wide. The somewhat compressed pseudobulbs are oblong-ovate and rarely more than 2.5 cm. long. The inflorescence is usually several-flowered.

Distribution: Colombia, Ecuador.

ACKNOWLEDGMENTS

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PLATE 14

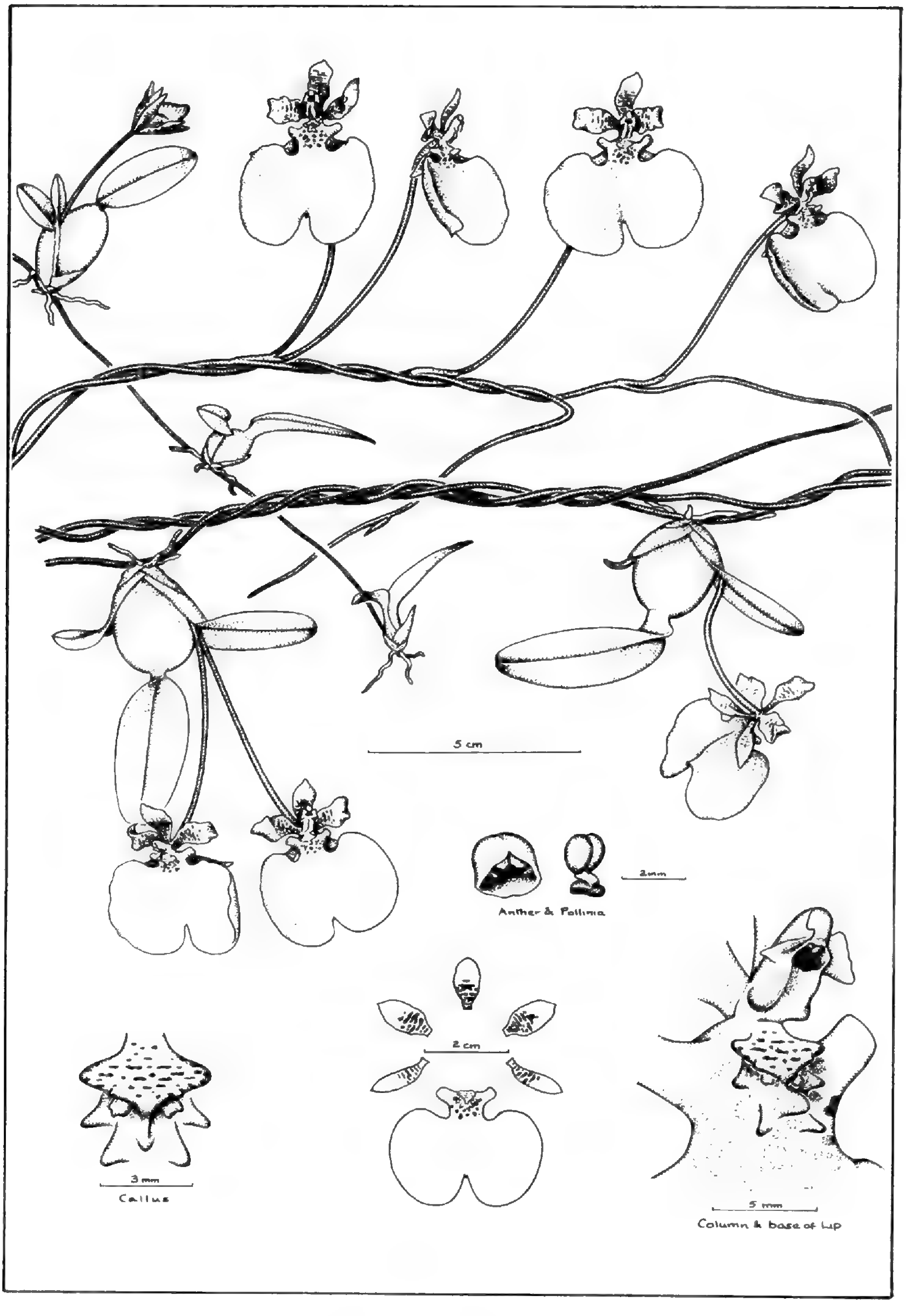

Plate 14. **Oncidium Scansor** Rchb.f.

PLATE 15

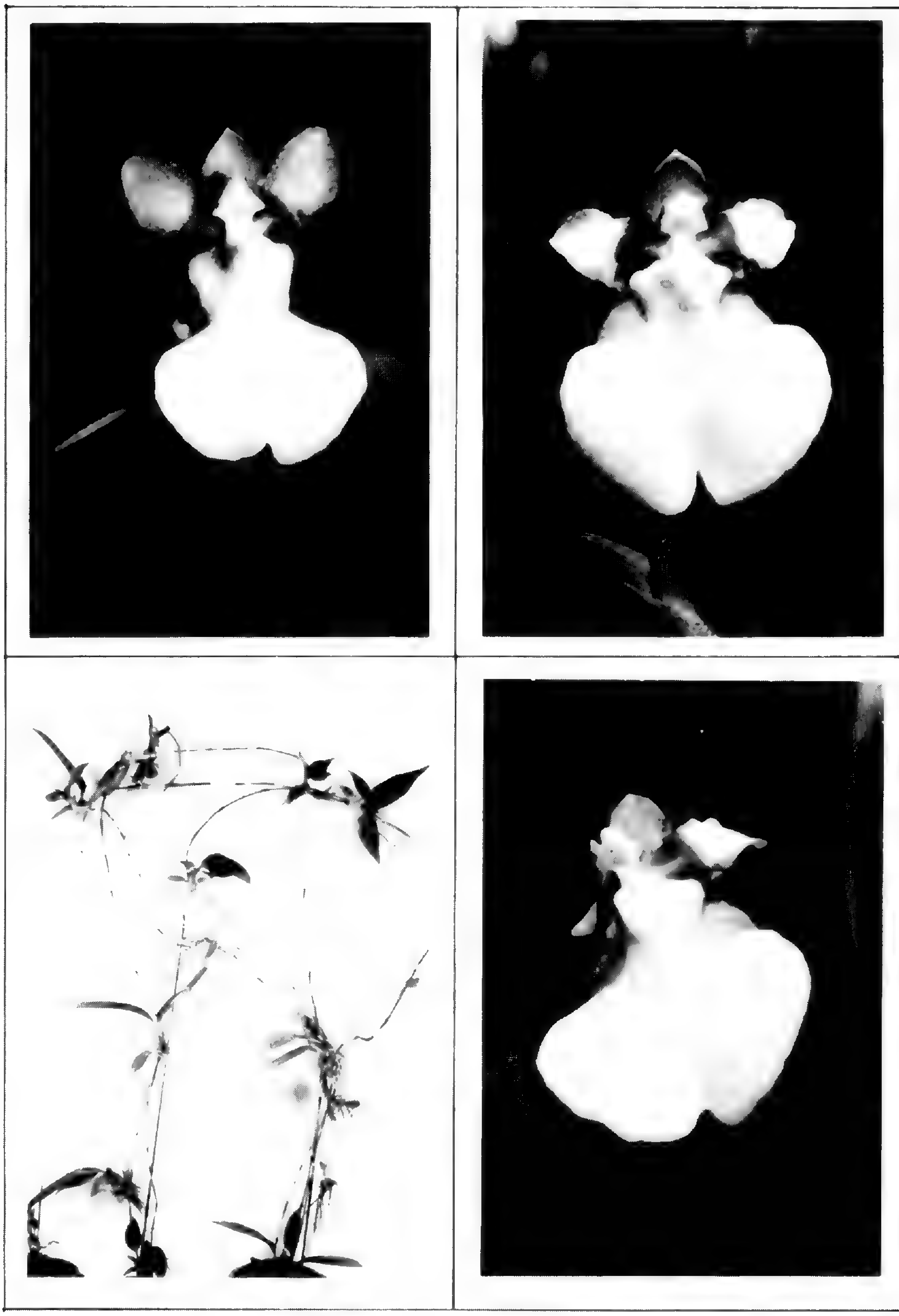

Plate 15. **Oncidium Harlingii** Stacy

PLATE 16

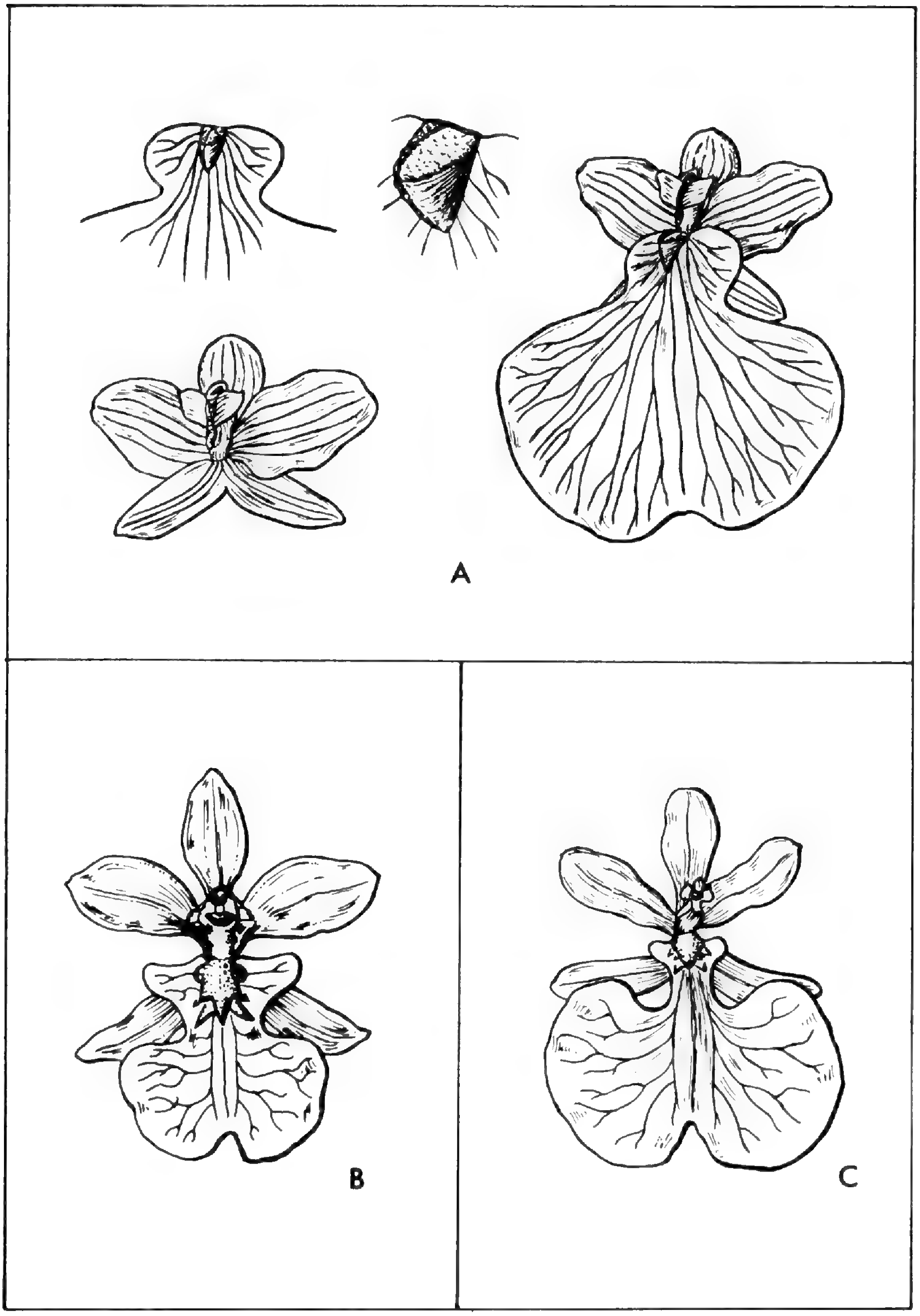

Plate 16. A. **Oncidium Harlingii** Stacy. B. **Oncidium serpens** Lindl. C. **Oncidium globuliferum** H.B.K.

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BIBLIOGRAPHY OF PRECAMBRIAN PALEONTOLOGY AND PALEOBIOLOGY

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This bibliography was started in 1968 while the first author was a graduate student at Harvard University, and has been carried on as a continuing project since that time, primarily at the University of California, Santa Barbara. Since the literature in this relatively new, but rapidly expanding area of paleontology is growing at an increasing rate, it was decided to make the bibliography available at this time to all workers in this and related fields.

In selecting the references, an effort was made to exclude material which is purely, or largely, geochemical in context, and to avoid overlap with the comprehensive bibliography on "Chemical Evolution and the Origin of Life". The latter has been published in *Space Life Sciences 2* (1970): 225-295; *3* (1973): 293-304; *4* (1973): 309-328; and in *Origins of Life 5* (1974): 507-527; *6* (1975): 285-300; *7* (1976): 75-85; *8* (1977): 59-65.

An effort has been made also to avoid duplication insofar as possible, of references which are indexed in the volume *Stromatolites* (edited by M.R. Walter, Elsevier, 1976), which contains a comprehensive bibliography of published work on stromatolites, both Precambrian and Phanerozoic.

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De Plantis Toxicariis e Mundo Novo Tropicale Commentationes XXIII

NOTES ON BIODYNAMIC PLANTS OF ABORIGINAL USE IN THE NORTHWESTERN AMAZONIA

RICHARD EVANS SCHULTES

This article continues a series of notes on plants employed in the rich ethnopharmacopeas of the Indians of the Amazon Valley — mainly in Colombian, Ecuadorian and Peruvian territories. The primary purpose of this series is manifestly to call to the attention of phytochemical and pharmacological research specialists the hitherto neglected but extensive knowledge of biodynamic plants amongst the aboriginal populations of these regions — a knowledge destined to disappear rapidly in the face of threatening or even presently active acculturation.

Some of the notes in the following pages have come from my own ethnobotanical studies in the northwest Amazon from 1941 to the present. I have, however, drawn also upon the field research of colleagues, especially upon the studies of my former student, Dr. Homer V. Pinkley, amongst the Kofán Indians of Ecuador and Colombia and upon the rich store of knowledge of my Colombian colleague, Prof. Hernando García-Barriga of the Instituto de Ciencias Naturales, Universidad Nacional, Bogotá, Colombia. I have further incorporated into these notes several of the preliminary results of the Alpha-Helix Amazon Expedition 1976-77, Phase VII, dedicated to Ethnopharmacological Studies of the Flora and Fauna of the

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Pebas Region of the Peruvian Amazon, and I have freely quoted from the final report (unpublished) of this expedition.

I am pleased to acknowledge the collaboration of my Colombian colleagues, Prof. Alvaro Fernández-Pérez and Dr. Enrique Forero of the Herbario Nacional de Colombia, and of Prof. Oscar Tovar of the Universidad Nacional Mayor de San Marcos, Lima, as well as the specialists who have identified many of the voucher specimens.

The notes in the following pages are arranged in accordance with the Engler & Prantl system. Voucher specimens cited are deposited in the Economic Herbarium of Oakes Ames, Botanical Museum of Harvard University, the Gray Herbarium of Harvard University, the Herbario Nacional de Colombia in Bogotá, the Herbario del Museo de Historia Natural, Lima or in several of these institutions.

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Haemodoraceae

Schiekia orinocensis *(HBK.) Meissner*, Pl. Vasc. Gen. Comm. (1842) 300.

Colombia: Comisaría del Vaupés, Río Vaupés, Cerro de Mitú. "On granite rocks. Flowers deep yellow." September 7, 1951. *R.E. Schultes et I. Cabrera 13898.* — Río Vaupés, between Mitú and Javareté. May 14-24, 1953. *R.E. Schultes et I. Cabrera 1927.* — Río Vaupés, Mitú and vicinity, Urania. "Flowers orange. Roots red-orange. On bare granite slope." September 27 - October 20, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24325.*

The Kubeo medicine men on the Río Kuduyarí administer a tea made of the crushed leaves and roots when they treat a condition described as "shaking all over".

Nothing apparently is known of the chemistry of *Schiekia*.

Amaryllidaceae

Eucharis amazonica *Linden* in Illustr. Hort. 28 (1881) 30.

ECUADOR: Dureno, Río Aguarico, Napo. "Cultivated in village; also grows in forest not far from rivers." February 7, 1966. *H.V. Pinkley 105.*

The whole plant (including the bulb) is boiled and steeped to prepare an emetic tea. Pinkley reports that the Kofáns, who call the plant *kon-si-ahipa-cho,* believe that this decoction enables them to attain greater accuracy in using the blow gun.

Apparently no chemical investigations of *Eucharis* have been published.

ARACEAE

Anthurium crassinervium *(Jacq.) Schott* var. **caatingae** *R.E. Schultes var. nov.*

A *Anthurio crassinervio* principaliter foliis chartaceis (non firme coriaceis), anguste lanceolatis, spathae spadicisque colore differt.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. At base of Cerro de Mitú. "Spathe grey-purple. Spadix purple. In white sand". September 27 - October 20, 1966. *R. E. Schultes, R. F. Raffauf et D. Soejarto 24202* (TYPUS in Herb. Gray).

A warm decoction made of the leaves of this coriaceous variety is employed by the Kubeo Indians of the region of Mitú as an ear wash to relieve a condition due probably to fungal infection.

ZINGIBERACEAE

Costus amazonicus *(Loes.) Macbride* in Field Mus. Publ. Bot. 11 (1931) 13.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, Cerro Isibukuri. Flowers pale pink. Bracts green, slightly red at base on both surfaces. Height 10 feet. Taiwano name = *nā-ka'.* March 8, 1951. *R.E. Schultes et I. Cabrera 13263.*

Costus erythrocoryne *K. Schumann* in Engler, Pflanzenr. Zingib. (1904) 410.

COLOMBIA: Comisarí del Vaupés. Same locality. "Bracts all deep scarlet on both surfaces. Flowers red. Height 6 feet. Kabuyarí name = *wa'-roo-nĕ.* Taiwano name = *ña-ka'.* March 8, 1951. *R. E. Schultes et I. Cabrera 13262.*

Both of these species are similarly employed by the Taiwano and Kabuyarí Indians of the Río Kananarí: the leaves are dried and pulverized, and the powder is snuffed into the nostrils to staunch persistent nose-bleeding, a condition frequent among aging individuals.

Hedychium coronarium *Koernicke* in Retzius, Obs. 3 (1783) 73.

COLOMBIA: Comisaría del Vaupés, Río Kuduyarí, Cerro Yapobodá. "Flowers white, fragrance of narcissus. Plant 6 feet tall." October 1, 1951. *R.E. Schultes et I. Cabrera 14188.*

The Kubeos take a decoction of the root to relieve pains in the chest and arms. Their name of the plant is *ma-tsĕ'-kö-ra.*

ORCHIDACEAE

Dichaea muricata *(Sw.) Lindley*, Gen. and Sp. Orch. Pl. (1833) 209.

ECUADOR: Dureno, Río Aguarico, Napo. October 20, 1966. *H.V. Pinkley 526.*

A wash is prepared from this orchid by the Kofáns for treating eye infections. The Kofán name is *shahasi-sehĕ'-pa.*

Psygmorchis pusilla *(L.) Dodson et Dressler* in Phytologia 24 (1972) 288.

Oncidium pusillum (L.) Reichenbach fil. in Walp. Ann. Bot. Syst. 6 (1863) 714.

ECUADOR: Dureno, Río Aguarico, Napo. December 20, 1965. *H.V. Pinkley 11.*

The Kofán Indians, who call this epiphyte *atiipa-kashaikie-si-sehĕ'-pa,* treat lacerations with a wash prepared by boiling the plant in water.

MORACEAE

Brosimum utile *(HBK.) Pittier* var. **ovalifolium** *(Ducke) C.C. Berg* in Act. Bot. Neerl. 19 (1970) 328.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Jinogojé. "Tree 40 feet tall. 1 foot in diameter." June 15, 1952. *R.E. Schultes et I. Cabrera 16735.*

The bark of this tree is extensively employed for making clothing, especially uniforms for dancing. The latex, taken cautiously, is considered a tonic.

The latex is employed medicinally in parts of Colombia in the belief that it cures asthma and other pulmonary and bronchial ailments. (García-Barriga: *Flora Medicinal de Colombia* 1 (1974) 241).

The Makunas call the tree *wa-só-gee;* the Makus, *bawn'-tĕg;* the Yukunas, *ma-ree-m'a.*

Coussapoa cinnamomea *Cuatrecasas* in Caldasia 7 (1956) 288.

COLOMBIA: Comisaría del Amazonas, Trapecio Amazónica, Río Loretoyacu. October, 1945. *R.E. Schultes 6693.* — Same locality. September 1946. *R.E. Schultes et G. Black 8269.*

The Tikuna Indians of the Trapecio Amazónico formerly employed leaves and fruit of *Coussapoa cinnamomea*, pounded and mixed with mud, as a fish poison.

Coussapoa magnifolia *Trécul* var. **glabrescens** *Cuatrecasas var. nov.*

Differt a var. *magnifolia* typica, foliis supra leavibus glaberrimis vel spasissim pilis, subtus tandum pilis tenuibus adpressis sparsis praeditis; stipulis subglabris; ramulis inflorescentiae minutissime hirtulis.

BRAZIL: Estado do Amazones, Rio Negro, between Uaupés (São Gabriel) and São Felipe. October, 1947. *R. E. Schultes et J. Murça Pires 8976* (spec. masc.) — COLOMBIA: Comisaría del Vaupés, Río Vaupés, Raudal del Yuruparí, quartzitic base. "Tree 50 feet tall" November 1951. *R. E. Schultes et I. Cabrera 1958* (spec. fem.) (TYPUS in U.S.Nat. Herb.)

Coussapoa orthoneura *Standley* in Field Mus. Publ. Bot 17 (1937) 165.

BRAZIL: Estado do Amazonas, Rio Tikié, Taracuá. January 28 - February 9, 1948. *R.E. Schultes et F. López 9685.* — COLOMBIA: Comisaría del Amazonas, Río Apaporis, Soratama. "Gigantic tree 70 feet tall. Fruit yellow. Piunave = *koom-ka'.*" August 27, 1951. *R.E. Schultes et I. Cabrera 13774.* — Comisaría del Vaupés, Río Apaporis, Raudal de Jerijerimo, "Small tree. Fruit red. On rock savannah cliff." February 14, 1952. *R. E. Schultes et I. Cabrera 15324.* — Río Vaupés, Raudal de Tatú. "Flowers yellow. Small tree, 60 feet. Hanging over cataract". October 10, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24379.*

The Puinave Indians chew the fruits to cure mouth sores.

The leaves of *Schultes, Raffauf et Soejarto 24379* gave a positive test for alkaloids with Dragendorff reagent.

Coussapoa trinervia *Spruce ex Mildbread* in Notizbl. 10 (1928) 416.

COLOMBIA: Comisaría del Amazonas, Río Apaporis, Soratama. "Tree. Fruit green. Flood-forest". Aug. 16, 1951. *R.E. Schultes et I. Cabrera 13589.*

The Indians of the Río Apaporis frequently chew the hard, astringent fruits to treat sores of the tongue and mouth.

Helicostylis scabra *(Macbride) C.C. Berg* in Act. Bot. Neerl. 18 (1969) 464.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Raudal Yayacopi (La Playa). "Ernormous tree. Latex white. Fruit green, edible." February 18, 1952. *R.E. Schultes et I. Cabrera 15466.*

The Puinave Indians call this tree *han-shee-má;* the Makús, *meé-o.* The latex is applied to abrasions of the skin in the belief that it prevents infection.

Poulsenia armata *(Miq.) Standley* in Trop. Woods, no. 3 (1933) 4.

COLOMBIA: Comisaría del Putumayo, Río Sucumbíos, Santa Rosa. April 7-8, 1942. *R.E. Schultes 3617.*

The Kofán Indians employ the bark in the manufacture of cloth for clothing and bedding.

Pourouma Schultesii *Cuatrecasas* in Caldasia 7 (1956) 303.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Jinogojé. September 25, 1952. *R.E. Schultes et I. Cabrera 17615.*

The Indians of the lowermost Río Piraparaná burn the bark of this tree and apply the ashes to running sores and ulcers.

The Puinave name is *muñ.*

Pseudolmedia laevigata *Trécul* in Ann. Sci. Nat., ser. 3, 8 (1847) 131.

COLOMBIA: Comisaría del Amazonas, Río Apaporis, Soratama. "Fruit red, soft. Small tree." February 4, 1952. *R.E. Schultes et I. Cabrera 15147.*

The fruits of this tree are said by the Indians of the Río Apaporis to be toxic.

Cyanogenesis has been reported from *Pseudolmedia* (Gibbs, R.D.: *Chemotaxonomy of Flowering Plants* 3 (1974) 1818).

Myristicaceae

Virola albidiflora *Ducke* in Journ. Wash. Acad. Sci. 26 (1936) 259

Colombia: Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. "Small tree. Flowers yellow." September 8, 1951. *R.E. Schultes et I. Cabrrea 13974.*

The Kubeos call this tree *po-ham-bo'-raek;* the Tukanos, *sĕ-nĕ-'no.* Both peoples employ the fresh bark resin in treating skin sores.

There appears to be a rather generalized use of the bark resin of various species of *Virola* to alleviate or cure fungal infections of the skin and to hasten the healing of wounds (Schultes and Holmstedt in *Lloydia* 34 (1971) 61-78).

Connaraceae

Rourea cuspidata *Bentham et Baker* var. **densiflora** *(Steyermark) Forero* in Mem. N. Y. Bot. Gard. 26 (1976) 48.

Colombia: Comisaría del Amazonas, Trapecio Amazónico, Loretoyacu River. October 1945. *R.E. Schultes 6684.* Same lonality. *R.E. Schultes et G.A. Black 8305.* September 1946. — Río Amazonas, La Victoria. August 30, 1939. *L. Williams 2963.*

The Tikunas of the region of Leticia, Colombia, indicate that this species is toxic, but they no longer have a use for it.

Forero (*loc. cit.,* 28) reports that the seeds and roots of some species of *Rourea* have been used as dog poisons, source of the Brazilian vernacular name *mata-cachorro.*

Rourea glabra *Humboldt, Bonpland et Kunth,* Nov. Gen. et Sp. 7 (1825) 41.

A decoction of *Rourea glabra* is said to be employed as a medicine for sore throat (Forero: *loc. cit.,* 28).

Leguminosae

Tachigalia cavipes *(Spruce ex Benth.) Macbride* in Field Mus. Publ. Bot. 13, pt. 3 (1943) 127.

Colombia: Comisaría del Vaupés, Mitú. December 18, 1939. *E. Pérez-Arbeláez et J. Cuatrecasas 6738.* — Río Kubiyú, Guranhudá. June 30, 1958. *H. García-Barriga, R.E. Schultes et H. Blohm 16061.* — Río Kananarí. Cerro

Isibukuri, 250 m. - 700 m. November 29-30, 1951. *H. García-Barriga 13779.* — Río Piraparaná. Loma Buc-chia. August 28-31, 1952. *H. García-Barriga 14286* — Río Piraparaná, middle course. January 9, 1952. *R.E. Schultes et I. Cabrera 17137.* — Río Vaupés, below mouth of Río Kubiyú, March 26, 1970. *D. Soejarto et T.E. Lockwood 2430.* — Right tributary of Río Macú-Paraná, upland forest. "Ingredient of *we-wit-kat-ku* ("no children medicine") of Bara-Makú. June 1-8, 1970. *P. Silverwood - Cope 10.* — Río Vaupés, about 1 km. below Mitú. "Tree 12 m. tall, spreading, inundated; leaves silvery green with a swollen rachis at first pair of leaflets housing extremely ferocious ants; flowers with calyx pale green, corolla yellow." July 3, 1976. *J.L. Zarucchi 1810A.* "Tree 15 m. tall, spreading, at edge of river, inundated. Leaves silvery white beneath; leaves with swollen rachis at the first leaflet pair, which house ants (these being the fiercest ants encountered by the collector in the Vaupés). Flowers bright yellow, showy". June 25, 1976. *J.L. Zarucchi et M. Balick 1746.*

A common plant along the banks of the rivers in the Colombian Vaupés, *Tachigalia cavipes* has a number of medicinal uses in the native ethnopharmacopeia. A tea of the leaves is widely valued in the Colombian Vaupés as a febrifuge. Bark of the stem is employed as an emetic and as a medicine when the intestinal system has been "poisoned" by ingestion of tainted fish. When the powdered leaves are mixed with the pulverized leaves of a species of *Combretum*, they are employed as a body insect-repellant. According to Zarucchi *(Zarucchi et Balick 1746)*, the "bark is macerated to make a preparation used to clean bad cuts and wounds; also, the bark is powdered and used to 'dry up' cancres of the mouth and lips from over-use of coca".

The Kubeo Indians dry and powder the leaves to mix with fariña (flour of *Manihot esculenta)* when there is blood in the stool.

The Makú Indians who live near the Barasana tribe along the Río Makú-Paraná apparently employ *Tachigalia cavipes* as an antifertility agent.

Tachigalia paniculata *Aublet* var. **comosa** *Dwyer* in Ann. Mo. Bot. Gard. 41 (1954) 240.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. September 1946, *R.E. Schultes 8266.* Same locality. September 1946, *R.E. Schultes et H. García-Barriga 8360.* — Comisaría del Vaupés, Río Apaporis, Jinogojé. September 3-11, 1952. *H. García-Barriga 14418.*

The Tikuna Indians of the Leticia area of Colombia utilize the seeds of *Tachigalia paniculata* as a medicine, preparing a strong emetic by boiling them in water.

Tachigalia ptychophysca *Spruce ex Bentham* in Martius, Fl. Brasil. 15, pt. 2 (1876) 229.

COLOMBIA: Comisaría del Vaupés, Raudal de Jerijerimo and vicinity. July 7, 1951. *R.E. Schultes et I. Cabrera 12955.*

This species of *Tachigalia* is reputed to be valuable as an aphrodisiac: the unripe pods are boiled and eaten. *Schultes et Cabrera 12955* represents apparently the second collection of this very characteristic species of *Tachigalia*. It is the first from Colombia. The type was collected by Spruce *(Spruce 2022)* at Ipanoré on the Rio Uaupés in Brazil.

EUPHORBIACEAE

Hevea brasiliensis *(Willd ex Juss.) Mueller-Argoviensis* in Linnaea 34 (1865) 204.

PERU: Departamento de Loreto, Provincia Maynas, Río Ampiyacu, Pebas and vicinity. "Tree 25 m. tall in secondary forest. Isolated." April 23, 1977. *T. Plowman, R.E. Schultes et O. Tovar* (Alpha-Helix Amazon Expedition, 1976-1977, Phase VII) *6995.*

Hevea guianensis *Aublet,* Hist. Plant. Guian. Franç. 2 (1775) 871.

PERU: Departamento de Loreto, Provincia Maynas, Río Ampiyacu. Pucu Urquillo and vicinity (near Pebas). "Tree 60 ft. tall, 10 inches diameter. Bark smooth, tan-grey. Latex cream." April 28, 1977. *T. Plowman, R.E. Schultes et O. Tovar* (Alpha-Helix Amazon Expedition, 1976-1977, Phase VII) *7125.*

In view of the report in the literature (Raffauf, R. F, *A Handbook of Alkaloids and Alkaloid-containing Plants* (1970)) of several alkaloids from the rubber tree, *Hevea brasiliensis* (presumably from cultivated material collected in Malaysia), Phase VII of the Alpha-Helix Amazon Expedition 1976-1977 carried out analyses of the two species, *H. brasiliensis* and *H. guianensis,* growing in the region of Pebas, Peru, under natural conditions. Both species were found to be alkaloid-negative.

Micrandra Spruceana *(Baill.) R.E. Schultes* in Bot. Mus. Leafl., Harvard Univ. 15 (1952) 217.

PERU: Departamento de Loreto, Provincia Maynas, Río Ampiyacu, Puca Urquillo and vicinity. "Tree 65 m. tall with large buttresses, forming interwoven props at base. Growing in upland primary forest. Latex white, sparse. Fruit green. Seeds brilliant, smooth, red-brown." April 22, 1977. *T. Plowman, R.E. Schultes et O. Tovar 6951.* — Pebas and vicinity. Trail north from town. "Fruits and seeds found on ground under large buttressed tree in chacara." April 10, 1977. *T. Plowman, R. E. Schultes et O. Tovar* (Alpha-Helix Amazon Expedition 1976-1977, Phase VII) *6735.*

Notwithstanding intensive study of *Micrandra* (including *Cunuria*) over a large area of the northwest Amazon, I have not encountered a medicinal use of the plant, until recent research amongst the Witotos and Boras now residing in the vicinity of Pebas in Amazonian Peru. Both Indian tribes employ the sparse latex of this tree, which they recognize as "cousin" of *Hevea*, known by the Peruvian name of *conoco*, for treating sores of the gums and mucous membranes of the mouth and to staunch the flow of blood following severance of the umbilical cord. Upon questioning, the Indians assured me that not any latex—*i.e.*, latex from *Hevea* (which is locally much more abundant) and from the numerous moraceous trees of the area — would serve the same purpose, since they were more caustic and failed to effect rapid congealment of the blood.

STERCULIACEAE

Theobroma grandiflorum *(Willd.) K. Schumann* in Martius, Fl. Bras. 12, pt. 3 (1886) 76, t. 17.

COLOMBIA: Comisaría del Amazonas, Río Amazonas, near mouth of Río Loretoyacu and Puerto Nariño. "Tree. Cultivated. Leaves pale beneath. Staminodes deep red. Alkaloid-negative." September 13-15, 1966. *R.E. Schultes, R.P. Raffauf et D. Soejarto 24165.*

PERU: Departamento de Loreto, Río Amazonas, Iquitos. Fruit purchased in market. May 7, 1977. *T. Plowman, R.E. Schultes et O. Tovar 7301.*

During Phase VII of the Alpha-Helix Amazon Expedition 1976-1977, an examination of the seeds of *Theobroma grandiflorum* — the *cupuassú* of Brazil — was carried out. Gas chromatography - mass spectrometry indicated a single compound which was identified as tetramethyluric acid, probably a new alkaloid.

In view of this analysis, it is of interest that a spot test with Dragendorff reagent on *Theobroma grandiflorum* leaves

(Schultes, Raffauf et Soejarto 24165) gave a negative result for alkaloids.

Theobroma subincanum *Martius* in Buchner, Repert. Pharm. 35 (1830) 23.

BRAZIL: Estado do Amazonas, Rio Purús, Rio Apitua, vicinity of Jamamadí Indian village. Forest on terra firma. "Tree, 15 m. x 15 cm. diameter. Bark used in snuff. The bark is stripped, burnt and the ash mixed with tobacco (13929) to produce a narcotic snuff. *Cowadimani*." July 1, 1971. *G.T. Prance et al. 13933.* — Same locality and date. "Seedlings of tree cultivated by Jamamadí Indians as an alternative to Theobroma *(13933)* in making their narcotic snuff. Bark is burned and the ashes are added to tobacco *(13928)*". *Cupiú. G.T. Prance et al. 13939.* — Rio Cunhuá at Deni Indian village. "Forest beside stream. Tree, 12 m. x 15 cm. diameter. The bark ash used as an ingredient of Deni Indian snuff; the fruit eaten by Deni Indians. *Mapanaha* (Deni), *cupuí* (Port.)". November 29, 1970. *G.T. Prance et al. 16515.* — Rio Purús, Jamamadí Mission Station, 30 km. west of Labrea. Forest on terra firma. "Treelet, 3 m. tall. Bark ash mixed with tobacco leaves as components of Jamamadí snuff. *Shina* (Jamamadí)". June 28, 1974. *D.G. Campbell et al. P21258.*

COLOMBIA: Comisaría del Vaupés, Río Piraparaná. "Cultivated tree. Bark pounded and burned to mix with tobacco and yakee snuff." August 24, 1952. *R.E. Schultes et I. Cabrera 17005.*

There may well be a reason for the choice of bark of this species of *Theobroma* for the alkaline ash mixture in tobacco and *Virola* snuffs over such a wide area of the Amazon. The Indians of the Río Piraparaná region of the Colombian Vaupés prefer this ash to mix with the dried and powdered *Virola* resin. Natives in other parts of the Colombian Amazon (*e.g.*, the Yukunas of the Río Miritiparaná) use it to make ashes for tobacco-snuff. The several reports by Prance and his collaborators are based on specimens from the Rio Purús of Brazil, an area some 600 air-miles from the Colombian locality cited above and from totally unrelated Indians. There are likewise reports, but without voucher specimens, of the employment of the bark-ashes of *Theobroma* for this purpose from numerous other Amazonian localities.

THYMELAEACEAE

Schoenobiblus peruvianus *Standley* in Field Mus. Publ. Bot. 6 (1936) 169.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. October, 1946.

R.E. Schultes et H. García-Barriga 8418. — Comisaría del Putumayo, Río Guamüés, Santa Rosa. September 6, 1966. *H.V. Pinkley 436.* — Río San Miguel (Sucumbíos), Santa Rosa. November 30, 1966. *H.V. Pinkley 565.*

Among the Tikuna Indians of the Leticia area of Colombia, the dried leaves of this shrub are powdered and made into a poultice to help the healing process in cases of persistent and infected cuts or wounds. The Tikunas know the plant as *ka-we ´-rĕ-ta. Schoenobiblus peruvianus* is utilized by the Kofán Indians in preparing a kind of curare (Schultes in Bot. Mus. Leafl., Harvard Univ. 13 (1949) 285; *Pinkley 565*) and as a fish poison *(Pinkley 436)*. Chemical studies of *Schoenobiblus* apparently have not been published.

UMBELLIFERAE

Niphogeton ternatus *(Willd. ex R. et S.) Mathias et Constance* in Univ. Cal. Publ. Bot. 23 (1951) 409.

COLOMBIA: Comisaría del Putumayo, road from Sibundoy to Pasto, between La María and Páramo de San Antonio. Alt. 2900-3180 m. "Tea of leaves used for colic in Sibundoy Valley." June 1, 1946. *R.E. Schultes et M. Villarreal 7814.*

This plant is highly esteemed by the Kamsá Indians of Sibundoy for the treatment of digestive disorders. A decoction of the leaves is taken. There appears to have been no phytochemical study pointing to active principles in this species.

STYRACACEAE

Styrax Tessmannii *Perkins* in Notizbl. 10 (1928) 459.

COLOMBIA: Comisaría del Amazonas, Río Apaporis, Soratama. March 26, 1952. *R.E. Schultes et I. Cabrera 16047.* — Trapecio Amazónico, Río Amazonas, Río Loretoyacu. *R.E. Schultes 7144.*

The leaves of *Styrax Tessmannii* are commonly applied crushed to fungal infections between the toes. This use is common amongst several tribes of the middle Río Apaporis.

Styrax yapobodensis *(J. Idrobo et R.E. Schultes) Steyermark* in Fieldiana 28 (1953) 492.

COLOMBIA: Comisaría del Vaupés, Río Kuduyarí, Yapobodá. "Golden pubescence on under side of leaf. Height 15 feet. Flowers white." October 5-6, 1951. *R.E. Schultes et I. Cabrera 14394.* – Same locality. "Small treelet up to 8 feet." April 1953. *R.E. Schultes et I. Cabrera 20012.* — Río Kubiyú, Cerro Kañendá. Savannah. "Bush. Height 9 feet. Under part of leaf sordid. Flowers white; anthers yellow". November 10, 1952. *R.E. Schultes et I. Cabrera 18311.*

The Kubeo Indians crush the leaves of this small shrub to apply to warts.

POTALIACEAE

Potalia Amara *Aublet*, Hist. Plant. Guian. Franç. 1 (1775) 394, t. 151.

BRAZIL: Estado do Amazonas, Rio Uneiuxí, Makú Indian village, 300 km. above mouth. "Forest on terra firma. Treelet, 3 m. tall. Root bark scraped, mixed with Menispermaceae *15560* as ingredient for Makú snake-bite cure. *Awuibiden: aw* = snake (Makú)". October 23, 1971. *G.T. Prance, P.J.M. Maas, D.B. Woolcott, O.P. Monteiro et J.F. Ramos 15559.*

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. "*Martiguaje*". September 16, 1939. *J. Cuatrecasas 6852.* — Same locality. September 8, 1951. *R.E. Schultes et I. Cabrera 13972.* — Comisaría del Amazonas, Río Apaporis, Soratama. "Shrub 2 m. tall. Flowers yellowish green. Leaves paler green beneath, dark green above. Puinave name = *chin-wee'*. Growing in flood forest". August 27, 1951. *R.E. Schultes et I. Cabrera 13726.* — Comisaría del Vaupés, Río Vaupés, Cerro de Mitú. "Flowers yellow. Used against snake-bite. Height 5 ft. *Martiguaje*". August 20, 1960. *R.E. Schultes 22718.*

PERU: Departamento de Loreto, Provincia Maynas. Mishuyacu, road to Quistococha, near Iquitos. "*Curarina*". October 15, 1965. *J. Torres 109.* — Río Napo, Negro Urco. "*Curarina* (sp.); *cu' yacono' -le.* Treelet, 2 m.". August 27, 1966. *R.T. Martin et C.A. Lau-Cam 1312.* — Millpa Canio. "*Curarina-sacha*". March 26, 1968. *F. Tina et M. Tello* (Amazon Natural Drug Co.) *2074.* — Provincia Mariscal Cáceres, Tocache Nuevo. "*Curarina-sacha.* Los nativos tomen las hojas en infusion para picadura de viboras". November 10, 1969. *J. Schunke V. 3610.* — Río Yaguasyacu, affluent of Río Ampuyacu. Brillo Nuevo and vicinity. "Bora = *okaji-kahpuu.* Fresh leaves chopped with water. Taken internally for snake-bite or against any poisonous animal *(raya, isula).* Calms the body and eliminates pain". April 12, 1977. *T. Plowman, R.E. Schultes et O. Tovar* (Alpha-Helix Amazon Expedition 1976-1977, Phase VII) *6803.* — Same locality. "Unbranched treelet, 4 m. tall, in disturbed upland forest. Leaves coriaceous, shiny. Rhachis and inflorescence yellow. Fruit green. Alkaloid-negative". April 15, 1977. *T. Plowman, R.E. Schultes et O. Tovar 6895.*

It is obvious that in the northwest Amazon *Potalia Amara* is considered a valuable and very versatile remedy. The Makú Indians of Brazil mix the bark scrapings with the bark of a menispermaceous plant to treat snake-bite. The several tribes of the Colombian Vaupés likewise consider it efficaceous for snake-bite. This same use prevails also in Amazonian Peru and Brazil.

Although the plant has a wide reputation as a treatment for snake-bite, the Indians of the Vaupés in Colombia appear to value it primarily in infusion as an emetic to be used in cases of food poisoning, frequent during tribal festivals. The Bora Indians in Peru take the leaves finely chopped in water "to calm the body and eliminate pain", not only in the case of snake-bite, but for the stings of the tail of the fresh water skate *(raya)* and of large, poisonous ants *(isula)*.

It is difficult to understand the paucity of chemical investigation of a plant ethnopharmacologically so important over so wide an area. Fresh material *(Plowman, Schultes et Tovar 6803)* was chemically examined on the Alpha-Helix Amazon Expedition 1976-1977: "Only squalene and methyl esters of fatty acids were found . . . No alkaloids were present". Squalene is widely distributed in plants, known from 14 families of higher plants and from yeasts.

Known as *temblador* in Venezuela, an infusion of the bark is employed as a laxative *(L. Williams 14352)*. In the western Amazon of Brazil, where the plant is called *anabí* and *pao de cobra* ("snake plant"), *Potalia Amara* is recognized as toxic. The leaves and shoots are made into a bitter infusion employed in treating syphilis, and a decoction of the leaves is used as a wash for eye infections. A tea of the leaves is emetic in large doses and is taken to empty the stomach of tainted cassava flour. Folk medicine in Brazil maintains that the root is valuable in treating snake-bite (Le Cointe, P.: *Amazonia Brasileira* 3 (1943) 20.

In Peru, *Potalia Amara* is known as *sacha-mangua* (L. Williams in Field Mus. Nat. Hist. Bot. Ser. 15 (1936) 418), *curarina* and *curarina-sacha* ("*curanina*" is a name widely employed in Hispanic America for snake-bite potions). The most widely known term for the plant in Colombia is *martiguaje*. One of the Brazilian names, *pao de cobra*, referes to the widespread esteem that the plant enjoys as an antidote for snake venom.

It would appear that a plant of such varied therapeutic uses should be the subject of intense phytochemical study.

Cyphomandra crassifolia *(Ort.) Macbride* in Publ. Field Mus. Nat. Hist., Bot. 8 (1930) 112.

COLOMBIA: Comisaría del Putumayo, Río Sucumbíos, Conejo and vicinity. Altitude 300 m. "Bush. Flowers green, anthers white. Fruits round, green, hard." April 2-5, 1942. *R.E. Schultes 3652.* – Puerto Ospina and vicinity. March 25-26, 1953. *R.E. Schultes et I. Cabrera 18979.* — Comisaría del Amazonas, Río Amazonas, Leticia. September 20, 1945. *R.E. Schultes 6541.* — Comisaría del Vaupés, Río Apaporis, Soratama. August 17, 1951. *R.E. Schultes et I. Cabrera 13044.* — Río Vaupés, Mitú and vicinity. September 7, 1951. *R.E. Schultes et I. Cabrera 13903.*

The Kofán Indians employ the leaves of *Cyphomandra crassifolia* for dying clay pots black. A tea of the leaves is used by the Indians in the Mitú region to expel intestinal parasites.

Scopoletin has been isolated from *Cyphomandra* (Hegenauer, R.: *Chemotaxonomie der Pflanzen* 6 (1973) 418. Tannins and tetraterpenes have likewise been reported from the genus (Gibbs *loc. cit.*, 3 (19746 1762-1765).

Cyphomandra dolichorachis *Bitter* in Fedde Rep. 17 (1921) 350.

COLOMBIA: Comisaría del Putumayo, Sibundoy. Altitude 2225-2300 m. May 29, 1946. *R.E. Schultes et M. Villarreal 7650.*

The Kamsá Indian medicine men employ a decoction of the leaves as a vermifuge.

Cyphomandra endopogon *Bitter* in Engler, Jahrb. 54, Beibl. 119 (1916) 16.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. August 19, 1964. *A. Fernández-Pérez 6863.* — Same locality. "Small tree to 6 m. tall in secondary growth. Heliophile. Corolla green; stamens white at anthesis. Fruit a berry, ovoid, yellow at maturity. Whole plant gives strong narcotic odor". January 28 - February 7, 1969. *T. Plowman, T. Lockwood, H. Kennedy et R.E. Schultes 2332.*

A spot test with Dragendorff reagent indicated that this species *(Fernández 6863)* is weakly alkaloidal.

Juanulloa ochracea *Cuatrecasas* in Brittonia 10 (1958) 148.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Raudal Yayacopi (La Playa) "Bush. Flowers green. Epiphyte (?)." February 16, 1952. *R.E.*

Schultes et I. Cabrera 15412. — Comisaría del Putumayo, Río Putumayo, Puerto Ospina. "Bush 15 feet tall. Flowers yellowish; bracts orange. Leaves crassulent." March 23-26, 1953. *R.E. Schultes et I. Cabrera 18960.* — Comisaría del Caquetá, Río Caquetá, Floresta, c. 15 km. down from Puerto Limón. "Climbing epiphyte shrub on fallen tree, 3 m. tall. Calyx red; corolla yellow. Leaves coriaceous." December 20, 1968. *T. Plowman 2176.*

The inhabitants in the vicinity of Puerto Limón, who call this plant *ayahuasca*, employ the leaves and the trunk to treat wounds. The vernacular name — commonly applied to an hallucinogenic plant *(Banisteriopsis Caapi)* and a preparation from it — suggests its possible use as an intoxicant (Schultes in Bot. Mus. Leafl., Harvard Univ. 23 (1972) 140).

The alkaloid parquine has been reported from this genus (Raffauf, *loc. cit.*)

Markea coccinea *L.C. Richard* in Act. Soc. Hist. Nat. Paris 1 (1792) 107.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Raudal de Jerijerimo. July 8, 1951. *R.E. Schultes et I. Cabrera 13441.* — Río Pacoa. "Vine. Flowers red." February 7-12, 1952. *R.E. Schultes et I. Cabrera 15251.* — Río Apaporis, Soratama. "Medium sized treelet. Flowers white." January 1952. *R.E. Schultes et I. Cabrera 19846.* — Río Vaupés, between Mitú and Javareté, Cerro de Tipiaca. "Climber. Flowers vermillion-orange." May 14-15, 1953. *R.E. Schultes et I. Cabrera 19305.*

The Desano Indians, who call the plant *see-nan-da*´, apply a decoction of the leaves of this relatively rare species to treat conjuctivitis and other eye affections.

Nothing apparently is known of the chemistry of *Markea.*

Solanum albidum *Dunal*, Hist. Solan. (1813) 206.

PERU: Departamento de Loreto, Pucallpa. Altitude 200 m. "In low forest. Flowers lilac. Plant 2-3 m. Vulgar name: *mullaca*. Las hojas las utilizan los indios Shipibos para labado vaginal en enfusion. El tronco tiene espinas." November 20, 1965. *J. Schunke V. 1014.*

An infusion of the leaves is reported as a vaginal wash amongst the Shipibo Indians of Peru.

Solanum apaporanum *R.E. Schultes* in Bot. Mus. Leafl., Harvard Univ. 13 (1949) 292.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. "Vine. Spines on stem. Flowers white. Fruit orange. Alkaloid-positive." September 27 - October 20, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24300.*

The abundant fruits of *Solanum apaporanum* are dried and powdered by the Kubeo Indians who apply the dust to the body at night as an insect repellant.

A Dragendorff reagent spot test on fresh material indicated that this species is alkaloid positive.

Solanum campaniforme *Roemer et Schultes*, Syst. 4 (1819) 662.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. "Small tree, 10 feet tall. Petals deep blue; fruits green. In secondary growth. Alkaloid-positive." September 27 - October 20, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24292.*

Desano Indians boil the leaves to make a strong infusion in which they bathe feet badly infected with *niguas* or sand-fleas before extracting the egg-sacs with spines.

A spot test with Dragendorff reagent indicated the presence of alkaloids in the leaves.

Solanum jamaicense *Miller*, Gard. Dict., ed. 8 (1768) no. 17.

COLOMBIA: Comisaría del Amazonas, Leticia and vicinity. "Flowers white. Shrub." August - September, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24098.*

An alkaloid test with Dragendorff reagent indicated that this species is doubtfully alkaloidal.

Solanum mammosum *Linnaeus*, Sp. Pl. (1753) 187.

COLOMBIA: Comisaría del Putumayo, Río Putumayo, between Puerto Asís and Puerto Ospina. "Dooryard; not planted. Shrub 1.75 m. Corolla purple. Fruit bright yellow, pulp white, seeds reddish brown. Fruit used as a cockroach poison. *Cocona, cucunu, resgalgal, chufchu.*" May 16, 1963. *M.L. Bristol 1011.* — Region of Mocoa, camino viejo Pepino - Mocoa. Altitude 500-800 m. "*Regargar.* Sirve para matar las cucarachas." August 28, 1963. *P. Juajibioy Chindoy 266.*

ECUADOR: Napo, Dureno, Río Aguarico. February 28, 1966. "Kofán = *koko'-no-cho.*" *H.V. Pinkley 172.*

PERU: Departamento de Loreto, Río Napo, Negro Urca. "Cultivated shrub. *Cocona venenosa.*" August 16, 1966. *R.T. Martin et C.A. Lau - Cam 1288.*

The efficacy of the powdered fruit as a specific poison for cockroaches is widely recognized, but use of the plant for this purpose seems nowhere to be more extensive than in the westernmost parts of the Amazon amongst the Indians of Colombia, Ecuador and Peru.

The collection *Pinkley 172* reports an interesting use of this toxic plant: "As a pacifier for small children."

Solanum subinerme *Jacquin*, Enum. Pl. Carib. (1760) 15.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. "Height 4-5 feet. Flowers blue-purple. Weed." September 27 - October 20, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24244.*

A spot test in the field with Dragendorff reagent indicated that this species is alklaoid-positive.

Solanum Topiro *Humboldt et Bonpland in* Dunal, Sol. Gen. Aff. Sym. (1816) 10.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, between Ríos Kananarí and Pacoa. "Flowers greenish, anthers yellow. Bush. Fruit green, turning orange. Kubeo = *bĕ-ta'-ka;* Taiwano = *dĕ-twa';* Tatuya = *da-twa'*. Cultiivated." September 1, 1951. *R.E. Schultes et I. Cabrera 13842.*

The small seeds of this edible fruit are often dried and pulverized for medicinal use: amongst the Taiwano, the powder is kept and added to powder to *Erythroxylon Coca* when the mucous membranes and tongue become irritated from overuse of coca.

Solanum verbascifolium *Linnaeus*, Sp. Pl. (1753) 184.

COLOMBIA: Comisaría del Amazonas, Río Amazonas, near mouth of Río Loretoyacu and Puerto Nariño. "Bush, 8 feet. Flowers white or pale violet. Alkaloid-positive." September 13-15, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24123.* — Comisaría del Vaupés, Mitú and vicinity. "Herb up to 3 feet. Flowers white, leaves used for washing. Leaves asperous, causing rash and itching. In secondary growth." September 27 - October 20, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24228.*

This bushy species has long been employed in the Vaupés as one of the most easily available plants for washing clothes. It is not cultivated but is found growing spontaneously in every house site or *Manihot* field. The asperous leaves cause rashes and itching if handled over a long period.

The leaves give a positive test for alkaloid with Dragendorff reagent. They undoubtedly have a high concentration also of saponins.

Isertia rosea *Spruce* in Martius, Fl. Bras. 6, pt. 6 (1889) 284.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, Cachivera de Palito. July 25, 1951. *R.E. Schultes et I. Cabrera 13148.*

The Taiwano Indians of the Río Kananarí value a decoction prepared from the leaves of this plant as an effective febrifuge. It is taken hot in quantity every several hours to reduce fever by stimulating perspiration.

Pagamea coriacea *Spruce ex Bentham* in Journ. Linn. Soc. 1 (1857) 110.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Raudal de Jerijerimo. March, 1951. *R.E. Schultes 12108.* — Same locality. June 13, 1951, *R.E. Schultes et I. Cabrera 12467;* January 21, 1952, *R.E. Schultes et I. Cabrera 14953;* March 15, 1952, *R.E. Schultes et I. Cabrera 15931.* — Río Karurú, Mesa de Yambi, Savannah Goo-ran-hoo-da', April 15-16, 1953, *R.E. Schultes et I. Cabrera 19169.*

The Indians in the region of Raudal de Jerijerimo on the Río Apaporis value this plant as a very efficaceous remedy for reestablishment of the ability to walk following attacks which, in age, appear to deprive Indians from free use of the legs. The causes of this curious disease (which is not uncommon) are unknown.

The bark of the young branches is scraped and, in the fresh condition, is boiled into a decoction, which must be drunk over a period of two or three weeks. Administration of this tea is reputed to result in strong stimulation of the afflicted patient and sometimes in ability to regain use of the legs.

Pagamea macrophylla *Spruce ex Bentham* in Journ. Linn. Soc. 1 (1857) 110.

COLOMBIA: Comisaría del Vaupés, Río Piraparaná, Caño Paca. September 18, 1952. *R.E. Schultes et I. Cabrera 17581.*

The leaves of *Pagamea macrophylla* are sought by medicine men of the Makuna tribe. They are dried, pulverized and aspirated as a powder during diviniation ceremonies. There is no indication, however, that they have hallucinogenic properties. The Makú name of this plant in the Río Piraparaná is *ma-ha-shu'-kĕ-ma*.

Retiniphyllum concolor *(Spruce ex Benth.) Mueller-Argoviensis* in Martius, Fl. Bras. 6, pt. 5 (1881) 8.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Raudal de Jerijerimo. March 1951. *R.E. Schultes 12110.* — Río Guainía, Puerto Colombia. October 31 - November 2, 1952. *R.E. Schultes, R.E.D. Baker et I. Cabrera 18156* — Río Negro, San Felipe. "Bush. Fruit red. Flowers green-white." November 2, 1952. *R.E. Schultes, R.E.D. Baker et I. Cabrera 18244.* — Río Guainía, Caño del Caribe. "Fruit red." November 2, 1952. *R.E. Schultes, R.E.D. Baker et I. Cabrera 18255.*

This species of *Retiniphyllum* in the northwest Amazon is believed to have antituberculous properties. The leaves are burned, and the aromatic smoke is allowed to permeat the part of the round house where the patient resides. It is thought to have purifying and therapeutic effects.

Retiniphyllum pilosum *(Spruce ex Benth.) Mueller-Argoviensis* in Martius Fl. Bras. 6, pt. 5 (1881) 7.

BRAZIL: Estado do Amazonas, Rio Negro, Jucabí (at mouth of Rio Curicuriarí). "Bush. Flowers white. Fruit red." January 17, 1948. *R.E. Schultes et F. López 9633.*

COLOMBIA: Comisaría del Vaupés, Río Guainía, Puerto Colombia (opposite Maroa). "Bush 4-5 feet. Fruit red." October 31 - November 2, 1952. *R.E. Schultes, R.E.D. Baker et I. Cabrera 18155.* — Río Guainía, Raudal del Sapo, below Puerto Colombia. October 31 - November 2, 1952. *R.E. Schultes, R.E.D. Baker et I. Cabrera 18202.* — Same locality and date. *R.E. Schultes, R.E.D. Baker et I. Cabrera 18237.*

The natives who live along the Río Guainía dry the fruit of *Retiniphyllum pilosum* for medicinal use during the year as an anthelmintic.

Retiniphyllum Schomburgkii *Mueller-Argoviensis* in Martius, Fl. Bras. 6, pt. 5 (1881) 12.

COLOMBIA: Comisaría del Vaupés, Río Negro, San Felipe. October 31 - November 2, 1952. *R.E. Schultes, R.E.D. Baker et I. Cabrera 17997.*

The fruits of *Retiniphyllum Schomburgkii* are considered to be effective as a vermifuge amongst the Indians of the upper Río Negro area and the Río Guainía.

Retiniphyllum speciosum *(Bentham) Mueller-Argoviensis* in Martius, Fl. Bras. 6, pt. 5 (1881) 10.

BRAZIL: Estado do Amazonas, Rio Uaupés, Serra Wabeesee, below Bela Vista. November 17, 1947. *R.E. Schultes et J. Murça Pires 9139.*

COLOMBIA: Comisaría del Vaupés, Río Negro, San Felipe. "Small tree or large bush. Fruit red. Flowers white and red." December 12, 1947. *R.E. Schultes et F. López 9327.*

The fruit of *Retiniphyllum speciosum* is considered by the Kuripakos of the Río Negro to be an efficient vermifuge when eaten in quantity.

Retiniphyllum truncatum *Mueller-Argoviensis* in Martius, Fl. Bras. 6, pt. 5 (1881) 11.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Raudal de Jerijerimo. "Fruit red, edible. Small bush." January 13, 1951. *R.E. Schultes et I. Cabrera 12464.* — Same locality. "Bush up to 5 feet tall. Leaves and petioles sticky when slightly dried. Flowers white. Floral axis bright red." March 1951. *R.E. Schultes 12111.* — Same locality. June 13, 1951. *R.E. Schultes et I. Cabrera 12453.* — Same locality. "Bush, 4 feet tall. Flowers white, red at centre. Fruit scarlet." September 16, 1951. *R.E. Schultes et I. Cabrera 14009.* — Same locality. November 27, 1951. *R.E. Schultes et I. Cabrera 14628.* — Río Guainía, Puerto Colombia. October 31 - November 2, 1952. *R.E. Schultes, R.E.D. Baker et I. Cabrera 18170* — Río Kubiyú, Cerra Kañendś. November 10, 1952. *R.E. Schultes et I. Cabrera 18366.* — Río Paraná Pichuna. June 1953. *Schultes et Cabrera 19943.* — Comisaría del Amazonas, Río Caquetá, La Pedrera, Cerro de La Pedrera. October 2, 1952. *R.E. Schultes et I. Cabrera 17681.*

The Taiwanos, who live near the Raudal de Jerijerimo, value the resin of this bush for treating hemorrhoids and other causes of rectal bleeding, applying the resin to the affected area with the finger over a period of several days. The resin must be taken from the fresh plant. The Taiwano name for *Retiniphyllum truncatum* is *bov-fee'*.

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COCAINE IN BLOOD OF COCA CHEWERS

B. HOLMSTEDT*, J.-E. LINDGREN*, L. RIVIER**, AND T. PLOWMAN***

Although the non-medical use of cocaine, either by sniffing or injection, is considered harmful by many medical authorities, there still is controversy as to whether the chewing of coca leaves, as practised by South American Indians, is detrimental or not. Experimental evidence on coca chewing gathered scientifically in the field has not previously been substantiated by measurements of blood levels of cocaine.

During Phase VII of the Alpha-Helix Amazon Expedition 1976-1977, we had occasion to study two methods of administration of coca leaves and to determine the amount of cocaine in blood versus time by an unequivocal method of analysis. Whole coca leaves (*Erythroxylum Coca* Lam.) were obtained from Pisac, Department of Cuzco, Peru. Coca powder (pulverized leaves of *E. Coca* mixed with *Cecropia* leaf ash) was prepared by Witoto Indians of the Río Ampiyacu, Department of Loreto, Peru, according to the custom of the region.

Coca leaves and powder (5-10 g.) were taken orally by human subjects in the same way that South American natives do. The cocaine, as measured by mass fragmentography, persisted in the plasma for more than seven hours and reached concentrations from 10 to 150 ng/ml at 0.38 to 1.95 hours. Half-lives of the elimination of cocaine have been calculated ranging from 1.0 to 1.9 hours. The absorption half-lives ranged from 0.2 to 0.6 hours (see Table 1).

The stimulating effect obtained seems to be well correlated

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TABLE I

Pharmacokinetic Data on Coca-Chewing

Subject	Amount of plant material (g)	Amount of cocaine (mg)	k_a (h^{-1})	$t_{1/2}$ (h)	C_{max} (ng/ml)	t_p (h)	k_{el} (h^{-1})	$t`_{12}$ (h)
BH	(powder) n.d.	n.d.	4.42	0.16	24	0.38	0.40	1.72
OT	(powder) 10	24	1.19	0.58	59	1.45	0.43	1.62
JEL	(powder) 7	16.8	1.18	0.59	11	1.00	0.58	1.19
TP	(powder) 20	48	1.14	0.61	139	1.03	0.73	0.95
OT	(leaves) 4.4	21	1.15	0.60	149	1.05	0.60	1.22
TP	(leaves) 6.4	30.7	1.68	0.41	78	1.95	0.37	1.86

k_a : Absorption rate constant
k_{el} : Elimination rate constant
$t_{1/2}$: Absorption half-life
$t`_{1/2}$: Elimination half-life
C_{max} : Maximum cocaine concentration in the plasma
t_p : Time at which maximum concentration of cocaine occurred in the plasma
n.d. : Not determined

with the rising concentrations of cocaine in the blood. The shape of the curves fits with the subjective effects reported. The differences in stimulation between using whole coca leaves or coca powder and taking cocaine by local application in the nose or by intravenous injections seems to be essentially a difference in means of administration and dosage. There is, consequently, no reason to believe that the stimulating effect achieved by the use of either coca leaves or powder is not due to cocaine.

An extended report on this experimental project, of which the present article is an abstract, will be published in the *Journal of Ethnopharmacology*.

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CHROMOSOME NUMBERS IN NEOTROPICAL *ERYTHROXYLUM* (ERYTHROXYLACEAE)

T. PLOWMAN [1], L. RUDENBERG[2], AND C.W. GREENE[2]

The genus *Erythroxylum* includes some 200 species, the great majority of which are found in the American tropics. Within this genus are found several economically important plants, most notably *E. Coca* Lam. and *E. novogranatense* (Morris) Hieron. These two closely related species native to South America are extensively cultivated as the sole source of the alkaloid cocaine. Numerous cultivars and local races of these species occur in the Amazon and Andes, the result of at least 6000 years of coca cultivation. The variation and evolution of coca under domestication has been little studied in recent years and little is known about the cytogenetics and breeding relationships of this important crop.

As part of a multidisciplinary project on coca, we have conducted a preliminary cytological study on *Erythroxylum* species. Until now, there have been no published chromosome counts with voucher specimens of any neotropical *Erythroxylum;* nor are any vouchered counts known for the cultivated species. Species of *Erythroxylum* are notoriously difficult to distinguish morphologically, and much confusion exists in the taxonomic placement of many species. It is therefore essential that herbarium vouchers accompany all chromosome studies and that chemical analyses carried out on the genus to insure present and future identifications.

Five chromosome counts of *Erythroxylum* species have been published in the past. These are summarized in Table One. Only one of these counts (*E. Kunthianum* Wall.) bears a voucher specimen. The correct identity of the two plants determined as *E. Coca* is especially open to question. Several

[1]Botanical Museum of Harvard University.
[2]Gray Herbarium, Harvard University.

related species, both wild and cultivated, are frequently misidentified as *E. Coca*.

Materials and Methods

Mitotic counts were made from root tip meristems from greenhouse reared plants, pretreated in 0.004 M 8-hydroxyquinoline at 15°C. for 3 hours (Tijo & Levan, 1950). Root tips were then rinsed in distilled water, stained 1/2 hour in 1% acetic orcein: 1 N HC1 (9:1) with gentle heating, and squashed in 45% acetic acid.

Meiotic studies were conducted with flower buds fixed and stored in Carnoy's solution (ethanol: acetic acid, 3:1). Tissue stored in Carnoy's for up to 4 years provided adequately preserved material for study. Microsporocytes were squashed and stained in acetocarmine. Photographs were taken with a Zeiss oil immersion lens under phase illumination. Herbarium vouchers are preserved at the Economic Herbarium of Oakes Ames (ECON).

Results and Discussion

Chromosome numbers are summarized in Table Two. All counts showed 2n = 24 or n = 12, in agreement with earlier published counts for *Erythroxylum*. It would seem that n = 12 is the base number for the genus. Some chromosomal irregularities, including chromosome bridges, were observed in microsporocytes of *E. Coca (Plowman 6165, 6183)*. A more detailed investigation of additional material will be necessary for a better understanding of these features. So far as is known, all the species investigated here appear to be normal, sexual species.

Cytological examination of preserved buds of *Erythroxylum havanense* Jacq. *(Plowman & Davis 3563)*, *E. Ulei* O.E. Schulz *(Plowman 6189)* and *E. areolatum* L. *(Kress s.n.)* proved unrewarding. The smallest buds (ca. 0.5 mm. diameter) showed pollen already formed. Furthermore, preserved material of these wild species was difficult to work with because of tissue hardness, preventing good squash-preparations. In the future, better results may be obtained by special pretreatment of buds or by examining root tips when material is available.

It is clear that much remains to be done in the cytology of *Erythroxylum*. The study of cytogenetics has been essential in determining the origin and evolution of numerous cultivated plants. *Erythroxylum* should be no exception. Of initial, primary importance is an investigation of karyotypes and chromosomal behavior in the main cultivated forms of *E. coca* and *E. novogranatense*, as well as in related wild species.

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TABLE ONE: PREVIOUSLY PUBLISHED CHROMOSOME NUMBERS IN *ERYTHROXYLUM*

SPECIES	CHROMOSOME NUMBER	LOCALITY AND VOUCHER	REFERENCE
E. Coca Lam.	2n = 24	Not given	Heitz (1929)
E. Coca Lam.	2n = 24	Not given	Janaki Ammal in Darlington & Janaki Ammal (1945)
E. emarginatum Thonn.	2n − 24	West Africa	Mangenot & Mangenot (1958, 1962)
E. Kunthianum Wall.	n = 12	India: Khasia and Jaintia Hills, Shillong. *Mehra & Khosla 1904* (PAN)	Mehra & Khosla (1969)
E. Mannii Oliv.	2n = 24	West Africa	Mangenot & Mangenot (1958, 1962)

TABLE TWO: NEW CHROMOSOME NUMBERS IN *ERYTHROXYLUM*

SPECIES	CHROMOSOME NUMBER	LOCALITY AND VOUCHER
E. Coca Lam.	n = 12	U.S.A.: cultivated, Cambridge, Massachusetts. *Plowman 6122* (Grown from seed collected in Peru: Dept. Ayacucho. San Francisco. *Plowman & Jacobs 4711*).
E. Coca Lam.	n = 12	U.S.A.: cultivated, Cambridge, Massachusetts. *Plowman 6165*. (Grown from seed collected in Peru: Dept. Ayacucho. San Francisco. *Plowman & Jacobs 4711*).
E. Coca Lam.	n = 12	U.S.A.: cultivated, Cambridge, Massachusetts. *Plowman 6183*. (Grown from cuttings collected in Colombia: Dept. Vaupés. Río Kubiyú. *E.W. Davis* 20).
E. novogranatense (Morris) Hieron.	n = 12	Colombia: Dept. Cesar. Sierra Nevada de Santa marta. Sogrome. *Plowman & Davis 3685*.
E. novogranatense (Morris) Hieron.	n = 12	U.S.A.: cultivated, Cambridge, Massachusetts. *Plowman 6180*. (Grown from cuttings collected in Colombia: Dept. Huila. San Agustín. *Plowman & Davis 4152*).
E. novogranatense (Morris) Hieron.	2n = 24	U.S.A.: cultivated, Cambridge, Massachusetts. *Plowman 6275*. (Grown from seed collected at Fairchild Tropical Garden, Miami, Florida. *Plowman 3500*).
E. novogranatense var. *truxillense* (Rusby) E. Machado	2n = 24	U.S.A.: cultivated, Cambridge, Massachusetts. *Plowman 6250*. (Grown from seed collected in Peru: Dept. La Libertad. Simbal. *Plowman 5620*)
E. orinocense HBK.	2n = 24	Colombia: Dept. Cesar: Sierra Nevada de Santa Marta. Atánquez. *Plowman & Davis 3600*.

Explanation of Plate

Plate 17. Fig. 1-6. 1. Microsporocyte of *Erythroxylum Coca*, *Plowman 6183*. X 1000.

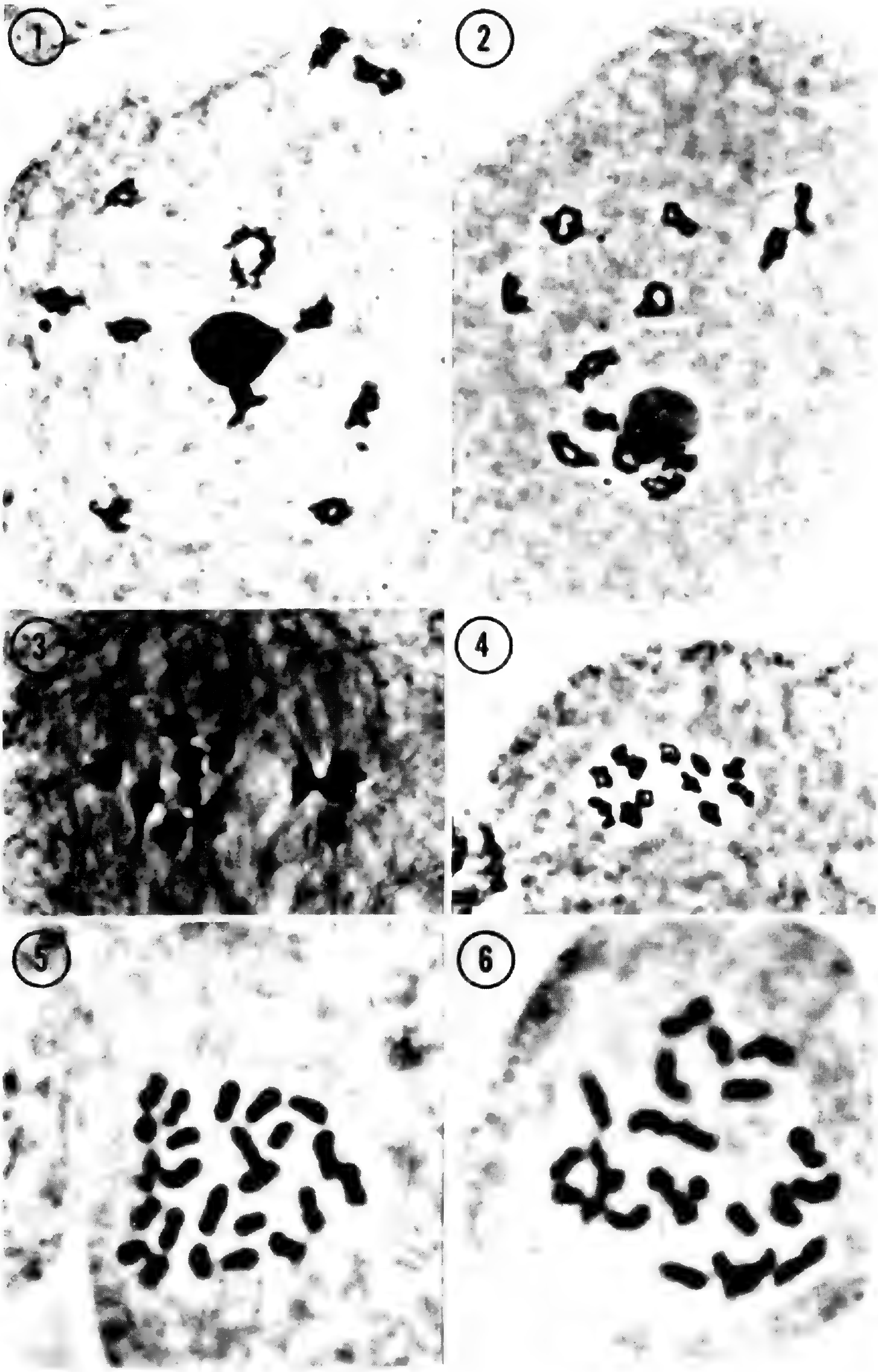
2. Microsporocyte of *Erythroxylum Coca*, *Plowman 6165*. X 1000.

3. Microsporocyte of *Erythroxylum novogranatense*, *Plowman 3685*. X 1300.

4. Microsporocyte of *Erythroxylum novogranatense*, *Plowman 6180*. X 1300.

5. Root tip cell of *Erythroxylum novogranatense*, *Plowman 6275*. X 2800.

6. Root tip cell of *Erythroxylum novogranatense* var. *truxillense*, *Plowman 6250*. X 2900.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BOTANICAL MUSEUM LEAFLETS
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SOMA BROUGHT UP-TO-DATE*

R. GORDON WASSON

Already a decade has passed since the publication of the English edition of our *SOMA: Divine Mushroom of Immortality*. *SOMA* first made its bow to the world in an expensive *de luxe* format. That edition is exhausted and copies are quoted in the auction markets for rare books at a considerable advance in price. The hard cover edition is also exhausted. Of the paperback edition there has been a succession of printings. It sells steadily, especially in university centers of the English-speaking world.

When I undertook to study the Soma enigma, I approached it from outside the Sanskrit discipline, from ethnobotany. After all, if a plant is to be identified, why not turn to botany? And if the plant, when its juice was ingested, inspired its devotees with glowing rapture and adoration, why not have recourse to someone conversant with plant hallucinogens? The West has known the ṚgVeda for more than a century. The Vedists have failed to identify the Soma plant, if indeed they ever made any effort to do so: of such effort I have found no serious trace, however strange this may seem to non-Vedists.

Naturally I needed a Vedist to work with me. My first stroke of good fortune was to win the enthusiastic cooperation of a young and brilliant Sanskrit scholar, Wendy Doniger O'Flaherty, who holds doctorates in Sanskrit and Indian Studies from Harvard and Oxford Universities and

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who has lately become Professor of the History of Religions and Indian Studies at the University of Chicago. She is the author of Part II of our *SOMA*, 'The Post-Vedic History of the Soma Plant'.

My method was to study Louis Renou's translation of the ṚgVeda, as far as he had gone before his death, especially but by no means exclusively Mandala IX, as well as all his essays and commentary on the Vedic text. I also found richly rewarding (1) Abel Bergaigne's three volumes on *La Religion Védique*, packed full as they were with brilliant *aperçus*, even prophetic in some instances, although he never suspected that a mushroom could be the answer to the identity of Soma, and (2) *L'Agniṣṭoma* of W. Caland and V. Henry, in which they give a slow-motion picture, as it were, of the Soma sacrifice. There were giants in the land in those early days of Vedic studies. My transatlantic correspondence with Dr. O'Flaherty was voluminous, as we constantly exchanged ideas and I raised questions with her.

Early in my inquires it seemed to me that a mushroom was the answer to many passages in the Vedic text and was contradicted by none. I went over the ground again and again and explored further and further. The result was that I accumulated many texts, each supporting my mushroom surmise, and I found none contradicting it. Not one of my passages could be considered proof — far from it — but the accumulation of many such passages would carry increasing conviction. Here is the technique of overlapping circles and ellipses, which is a commonplace in the natural sciences. To this day Darwin's theory of the Origin of Species has not been conclusively proved, but the accumulation of evidence in its favor has been overwhelming and convincing: no one of consequence challenges it. When we published our *SOMA* I waited with bated breath for fear a text from the ṚgVeda would be produced incompatible with our mushroom hypothesis: none has been offered. Instead, some Vedic and Sanskrit scholars have produced most helpful, even startling, support.

The beauty of our case is that our evidence is linked in *parallel* and not in *series*, and one or another of our separate arguments can be shot down and yet our overall conclusions will hold good.

Of primary interest to the readers of the French edition is the public reception that the book has had from leading scholars in the Sanskrit world, especially those competent in the ṚgVeda. This reception has been conspicuously marked by silence: so far as I know, there have been only three full-dress reviews by leading Vedic scholars, two unfavorable and one favorable. To each of the unfavorable reviews I have published a detailed reply.

But that silence extends only to the printed word. The discussions among Sanskritists and especially Vedic scholars were for a while lively. Beyond the confines of those limited disciplines, among botanists, anthropologists, indologists, sinologues, students of religion, etc., etc., the references to our mushroom surmise in lectures, discussions, and publications have been steady and, so far as I have knowledge, all laudatory. But these people are not Vedists.

For generations the Vedic and Sanskrit fraternities have been an ingrown community: the outside world of scholarship and science has largely left them to themselves to till their rich gardens in peace, and in turn they have largely ignored that world. I hear tell of fratricidal infighting in the Sanskrit family, but however that may be, they are unaccustomed to invasion from the outside and many do not welcome intruders: they close their ranks when the watchman cries 'Stranger!' In Vedic time the Brahmans were the exclusive custodians of the Secrets of Soma: today some of the Vedic scholars occupying exalted chairs seem to have replaced the Brahmans in their attitude of superior exclusivity, though of course these Vedic scholars are not possessed of the Secrets.

In *SOMA* a Vedist and ethnomycologist, working as a team, think we may have found the answer to the Soma enigma. As I shall show shortly, invaluable support for our position has been forthcoming from those scholars whose minds are open to new ideas.

There are problems in the humane letters as well as science that do not lend themselves to final answers. In our *SOMA* we advanced with all modesty a thesis pointing to an identification of the Soma plant. We marshalled evidence favoring (not proving) this identification and hoped that the evidence was enough to interest specialists and to encourage them to look further.

When Darwin announced his theory of evolution, there were those Biblical scholars who took the position that if his theories challenged the literal truth of the Bible he must be wrong and the Bible was of course (so they said) right. External evidence on the Bible has revolutionized conceptions of it in the past century and the ṚgVeda is no more immune to detached study than the Bible. As compared with the theory of evolution, the controversy over Soma in the ṚgVeda is the same *en petit, en très petit*. There is a category of Indo-Iranian exegete who lives immured in his enclave, unfamiliar with the outside world. Fortunately not all Indo-Iranian scholars are of that breed. We must remember, however, that exegetes, useful — indeed indispensable — as they are, are often at the end of the line when it comes to assessing great poetry.

Some of the most rewarding years of my life I have spent under the spell of the line of seminal Vedic and Sanskrit scholars whom I have already mentioned: Bergaigne, and Caland and Henry, and Renou, as well as many other figures of comparable stature in the English-speaking world. That succession of learned and intuitive scholars seems, at least momentarily, to have fallen off somewhat, with Renou's tragic death and the death of the R.P. Jean de Menasce, O.P. My conversations with Renou in his Paris home and his country place in Normandy, the letter that Menasce wrote me from his death-bed, make me certain that had they lived, whether they agreed or disagreed with me, the breadth of their understanding would have been inspiring, their pronouncements discriminating and helpful. They would have grasped the possibilities that lay in interdisciplinary exchanges — long overdue — for Vedic studies. No one could ever say that they possessed constipated mentalities.

FRESH EVIDENCE

A. The Putka of the Santal

At an early stage of our mycological inquiries the late Georg Morgenstierne, the distinguished Norwegian scholar specializing in the babel of tongues spoken in Nuristan, drew my attention to an oddity of the language spoken by the Santal, a tribe numbering some millions living in scattered villages of Orissa and Bihar in India. Their language is neither Indo-European nor Dravidian: in India it heads a third much smaller family called Munda. A trait of these languages is that they possess no genders: Munda speakers know not our masculine, feminine, neuter categories. For them all creatures and objects are either animate, possessing a soul, or inanimate, devoid of soul. The division between the two seems to us somewhat arbitrary, enshrining conceptions that prevailed long long ago. Thus the sun, moon, stars were and are conceived of as animate. On the other hand the whole of the vegetable kingdom is inanimate — with one exception, *a single species of mushroom* called 'putka'*. What was this mushroom and why was it animate?

In 1965 I visited the Santal Parganas (as they are called) in Bihar, in and around Dumka. I questioned as many of the older people as I could. Mrs. A.E. Stronstad, the wife of the Norwegian missionary, most graciously was serving as my interpreter. I found the Santal an endearing people, gentle, eager to help, obviously candid. None of them that I spoke with knew either English or Hindi. The Santal are, unlike the Hindus, mycophiles. My best informant was an elderly woman, Ludgi Marndi. She told me there was one mushroom that caused inebriation. Was it the *putka*? No, definitely not. What was the *putka*? We were in January and none were around at that time of year. Why was it animate? No one knew: apparently the reason had been lost in the depths of the past. A few informants pointed out hesitatingly that *putka* abounded in the sacred grove of *sarjom* trees growing near every village. (Santal *sarjom* = Hindi *sal* = *Shorea robusta*) Was this perhaps the

*'Mushroom' in French is *champignon*, but unlike 'mushroom' in English, *champignon* embraces the whole fungal world even to the microscopic species. As this paper was to be translated into French, 'mushroom' in it embraces ascomycetes as well as basidiomycetes.

reason? But the *sarjom* trees themselves were not animate, and *putka* grew abundantly elsewhere: how then could that be the reason? No answer.

Just as I was about the leave the Santal country I engaged Ludgi Marndi in one final talk. We went over the same ground. Suddenly she leaned forward and in a whisper made a most curious remark, which she said was her guess as to why the *putka* were animate: the *putka* must be eaten on the very day they are gathered, 'for within twenty-four hours they will stink like a cadaver'. She was whispering. She was so earnest that I wrote down in my journal at once what she had said. But I confess that it meant nothing to me.

In 1967 the mycologist Roger Heim, then directeur of the Muséum National d'Histoire Naturelle and former Président of the Académie des Sciences, and I, he from Paris and I from New York, journeyed to the Santal villages of Orissa and Bihar. We went in July. We found *putka* growing in abundance and Heim identified them. They were fungi without inebriating potency. The Santal gathered these hypogenous fungi just as they were appearing on the surface, little dark-brown globular mushrooms. We questioned villagers along our whole route but no one could tell us why these mushrooms were animate. When we published our paper on our trip in *Les Cahiers du Pacifique* #14, in September 1970, we offered that baffling sentence of Ludgi's to our readers, though it still meant nothing to us.

It meant nothing to us until the April-June 1975 issue of the *Journal of the American Oriental Society (JAOS)* came out. Then it developed that her remark meant everything to us. That *JAOS* paper explained 1) Ludgi's baffling remark, 2) why the *putka* were animate, 3) and the etymology of *putka*. It fortified even further, some say immeasurably, the thesis that we had presented in *SOMA: Divine Mushroom of Immortality*.

The paper in the *JAOS* was written by Stella Kramrisch. She has spent 27 years in India as Professor of Indian Art at the University of Calcutta. She also taught concurrently at the Courtauld Institute, London University. From there she had gone to the University of Pennsylvania as Professor of South Asian Art. She was and is now the Curator of Indian and Himalayan Art in the Philadelphia Museum of Art and Professor of Indian Art at the Institute of Fine Arts of New York University.

P.O. Bodding in the preface to his five volume *Santal Dictionary* (Oslo, 1929-1936, I:xiv) had drawn attention to a noteworthy fact:

> Strangely enough, the Santals use some pure Sanskrit words, which, so far as I know, are not heard in present day Hindi.

He might have added that, at least in the instance we are considering, the word has disappeared from *all* Sanskrit vernaculars. Professor Kramrisch wins a rich accolade for discovering that Santal *putka* was a loan word from Sanskrit, *pūtika*, a plant heretofore unidentified. She had read our paper in the *Cahiers du Pacifique*, and saw immediately that *putka* was simply the Sanskrit *pūtika*. It is cognate with our word 'putrid', and the stench of the *putka* lives up to its Sanskrit name. The *pūtika* was mixed with the clay that went into the ceremonial making of the Māhāvīra pot. Its offensiveness was turned into fragrance when the pot, held by tongs, was fired in the course of the rite. It was the earliest surrogate for Soma. No one had ever known what plant it was. Not even Bodding had hit on its identity. In our *SOMA* Dr. O'Flaherty had mentioned *pūtika* four times but I failed to link it with the *putka:* Stella Kramrisch in the *JAOS* had identified it with finality. Professor Kramrisch wrote:

> The identification of *Pūtika*, the Soma surrogate, supplies strong evidence that Soma indeed was a mushroom. *Pūtika* integrated into the Mahavira pot played its part in the mystery of the Pravargya sacrifice. That putka-mushrooms should be known, to this day, as 'endowed with a soul' witnesses amongst the Santal of Eastern India a memory of the numinous emanating from the indigenous Indian Soma substitute . . . . (Vol. 95:2, p. 230 col. 2)
>
> A gap of more than two and a half millennia, a transfer from Aryan priestly symbolism to tribal belief, the tribe adopting a Sanskrit name with but little change into its own language, the survival of this name in a Munda language, in a region at a considerable distance to the east from the ancient center of Brahmanical sacrifices, all this did not impair the ongoing myth of *Pūtika*. This species is known to the Santal as 'endowed with a soul'. It is distinct from other mushrooms, from all the vegetable kingdom, as being numinous. The odor of sanctity clings to this

> mushroom, however pejorative its telling name . . . . (p. 233 col. 2)
>
> The mantle of King Soma had fallen on this notable mushroom, which inherits the glory of Soma for whom it is a surrogate. Its heyday is in the Pravargya ritual. Then the mushroom is lost to us in a millennial darkness from which, miraculously, it emerges 'endowed with a soul', amongst the aboriginal Santal of Eastern India in our own day. . . . (p. 235 col. 2)

How amazing it is that through a concatenation of happenstances we are able, here in 1978, to define the precise species of the plant *pūtika*, which the Aryans, perhaps 3000 years ago, adopted as a surrogate from Soma! Preserved as in a time capsule in the Santal country and called in the Santal language *putka*, for 3000 years it waited to be discovered and its meaning made known by Roger Heim, Directeur of the Muséum National d'Histoire Naturelle, by the Austrian-born art historian, Stella Kramrisch, and by the ethnomycologist Gordon Wasson, two of us working as a team, Heim and Wasson seeking the reason why *putka*, alone in the vegetable kingdom, was animate and not finding the answer, not until Kramrisch revealed it to them, on the strength of evidence we had gathered but had failed to understand! According to the laws of Manu, mushrooms have been forbidden for thousands of years to Hindus of the twice-born castes. This makes it all the more significant that a mushroom was at one time the Holy of Holies.

The late R.C. Zaehner, a distinguished scholar in the Indo-Iranian field and a professor in Oxford, in his review of our *SOMA* in *The Times Literary Supplement*, 22-5-1969, gave as the main argument against my mushroom theory the fact that when Soma came to be abandoned other mushrooms were never the substitutes. He did not live long enough to learn that the primary surrogate, the *pūtika*, was a mushroom.

Manfred Mayrhofer in his *Concise Etymological Sanskrit Dictionary* presented two identical words that he spelled *pūtikah:* 1) 'foul, stinking', and 2) 'a species of plant serving as a substitute for the Soma plant'. Fortunately, in his "Additions and Corrections' at the end of Vol 3, he was able to cite Professor Kramrisch's paper and thus reconcile and unite in one word what he had presented as homonyms.

B. The Color of Soma.

We said in *SOMA* that *hári* in the ṚgVeda meant red when that color word was applied to Soma, which we think was *A. muscaria*, a mushroom that throughout Eurasia, when mature, is almost always an intense and striking red. John Brough says: 'I have been unable to find any evidence that any shade of red is included in the colour-range denoted by hári', and winds up his discussion by declaring that 'red is absolutely excluded'.

Scholars know that to arrive at the value of color words in texts 3000 and more years old calls for intense linguistic research, citation by citation, pinpointing as close as possible the time and place of each citation, and the study of other overlapping color words, and of cognate color words in surrounding languages, *etc., etc.* In Brough's discussion of *hári* there is none of this, only his *ipse dixit*.

Sir Harold W. Bailey, Brough's predecessor in the chair in Cambridge that Brough now holds, undertook a study of the meaning of *ZAR*, cognate in Khotan Saka to Vedic *hári*. His findings appeared in a collection of learned papers: *Mémorial: Jean de Menasce*, published in 1974 as #185 by the Fondation Culturelle Iranienne. I will quote only one sentence of his conclusions:

> Important for the Irano-Indian period is the corresponding Old Indian vocabulary. Here *hári-, harít-, hárita-* has the same wide range from red through orange to yellow and green. (p. 372)

Bailey mentions neither Brough nor me.

C. The Etymology of 'Soma'

'Soma' has been known in the West for almost two centuries and has been a focus of scholarly attention for most of that time. Yet Indic scholars including Brough have docilely accepted the 'etymology' that the Brahmans have given it and say that *so-* is the Vedic *su-*, meaning the 'pressed thing', from the liturgical act in the Soma sacrifice when the plants were noisily pounded with stones on hide-covered boards. As Bailey said in 1971 in Tokyo, this is 'a poor kind of way to designate a sacrificial plant of great potency'. Indeed, the plant must have had a name before the liturgy was devised, but then we are to suppose that that name was utterly lost, and the plant came to have no name at all! Is this conceivable? But in the Brahman world etymologies were creatures of word-play, puns, poetic fancy.

Bailey has suggested an alternative etymology, which he has presented briefly in three publications, listed below. Instead of *so-ma-*, he would break the word thus: *som-a-* and then it would be linked with the Indo-European root for 'fungus', of which German *Schwamm*, Latin *fungus*, Greek *spongia* are just a few examples in Europe. Many Vedic and Sanskrit scholars display a low flash-point when this fungal theme is broached. Why this is so is baffling. It has been suggested to me that a spiritual osmosis from the Brahmans is the explanation, for converts are proverbially more Papist than the Pope. I prefer to think that as I was the first to suggest a mushroom, they may resent the irruption of an outsider into their domain. Let them be cautious: Bailey's suggestions have a way of turning out right in the end. After all, the Law of Parsimony has its place here: as between two unproved etymologies, the plausible one has an immense advantage over the one that strains credibility.

Bailey presented this etymology orally at Canberra, at the 28th International Congress of Orientalists in January 1971. He next developed the theme in the Memoirs of the Research Department of Toyo Bunko (The Oriental Library), No. 29, Tokyo, in 1971, pp 8 and 15. He discussed it again in his paper, 'A Half-Century of Irano-Indian Studies', which he read as an informal lecture after he was awarded the Triennial Gold Medal of the Royal Asiatic Society on 13 April 1972 and which was published in the Society's *Journal* No 2, 1972, p 105. He returned to the theme in his contribution to *Mithraic Studies*, edited by John R. Hinnells and published by Manchester University Press in 1975, p 19, ftnt 38.

D. Aja Ekapad

Through oversight I failed to include in our *SOMA* a discussion of *Aja Ekapād*, the designation of a deity mentioned six times in the ṚgVeda, always in hymns to the Vi'svadevas. This name means, as Abel Bergaigne pointed out and everyone agrees, *non-né unipède* 'not-born singlefoot'. There has been much scholarship expended on this name for a god: the 'Not-born Singlefoot', but no one has seen how perfectly it fits a mushroom. A mushroom is *unipède*: to this day every German child still learns at his mother's knee the riddle:

. . . .
Sag' wer mag das Männlein sein
Das da steht auf einem Bein?

Children: Glückpilz! Fliegenpilz!

Less familiar to us urbanized westerners, living divorced the land and unfamiliar with the elementary facts of nature that our ancestors well knew, is *non-né*. All plants are born of seed, *except mushrooms*. They are *non-né*. The spores of a mushroom are too small for the eye to see: they require a microscope. Mushrooms were, as Early Man saw it, miraculously conceived, by the lightningbolt of the Almighty in mother earth softened by the rain. There is a verse in the ṚgVeda that says Parjanya, the god of Thunder, was the father of Soma, and according to another verse, 'the gods, those fathers with a commanding glance, laid the Somic germ'. In *Aja Ekapād* we have the perfect binomial for a mushroom!

Aja Ekapād is accompanied in five citations by another divinity, Ahi Budhnya, the serpent of the depths, a chthonic being who invariably guards the holy plant throughout Asia. That *Aja Ekapād* is another name for Soma, perhaps already archaic in Vedic times, finds support in ṚgVeda X 65.13, where the epithet proper to Soma, 'Mainstay of the Sky', is applied to him. In ṚgVeda X 82.6 *Aja* appears, not now linked to *Ekapād,* but to the navel, *nabni*, also endlessly applied to Soma, and thus two seemingly disparate metaphors are reconciled in the divine mushroom, both proper to Soma.

Here is Renou's translation of the second half of the verse we are discussing, X 82.6:

> Dans le nombril du Non-né (est) fixé le Un (comme les rais sur la roue), en lequel tous les êtres se tiennent-depuis-toujours.

> In the navel of the Not-born (is) fixed the One (like the spokes on the wheel), in which all beings stand from all time.

He has interpolated — clearly indicated by the parentheses — 'like the spokes on the wheels. Where did Renou get these words or the idea that they contain? Obviously he did not invent this gloss. Dr. O'Flaherty has sought the source in the obvious places and has not found it. Perhaps it occurs in the other Vedas or the Brahmanas. It might prove of vital interest, for the gills of a mushroom make one think of the spokes of a wheel; attached to the stipe as to the navel.

I will end this esssay on a lighter note.

One aspect of our *SOMA* that was utterly repugnant even to my friends and supporters in Europe and America was my discussion of Soma-urine. Without exception they were horrified by the thought of drinking urine, and filled with disbelief. This surprised me as I had thought we in this generation had overcome our parochial squeamishness. In my *Rejoinder* to Brough I handled this topic with special care, citing contemporary evidence to indicate that urine drinking goes on to this day in India and I think in most of the world's population. Early Man, probably everywhere, recognized that in urine he possessed an aseptic fluid useful for wounds, serving also in religious observances, and perhaps wholesome for ingestion.

In the fall of 1977 Morarji Desai, Prime Minister of India, made known to the world that he drinks his own urine every day, for his health's sake. Little did the Prime Minister know how this innocent announcement would affect the post and the telephone calls of Gordon Wasson in Danbury, Connecticut. All sorts of people, friends and even strangers, got in touch with me to congratulate me. One Sanskrit scholar, a friend, said that now the last barrier to my Soma theory was demolished! Another man, engaged in the public relations business, a stranger who scarcely knew me, asked me how I had contrived such an interview. What a coup! Did I have a personal contact with the Prime Minister, or know someone who knew him? Alas, I could claim no credit.

WASSON'S *SOMA:* IMPORTANT REVIEWS AND PERTINENT COMMENTARY

Bailey, H.W.: (1) 'The Range of the Colour *ZAR* in Khotan Saka Texts', *Mémorial: Jean de Menasce*, Fondation Culturelle Iranienne, Louvain, 1974; pp. 369-374; our quotation is from p. 372.
(2) 'Trends in Iranian Studies', *Memoirs of the Research Department of the Toyo Bunko* (The Oriental Library) No. 29, Tokyo, The Toyo Bunko; see pp. 8 and 15.
(3) 'A Half-Century of Irano-Indian Studies', *Journal of the Royal Asiatic Society*, 1972:2, pp. 99-110; see p. 105.
(4) 'The second stratum of the Indo-Iranian gods', *Mithraic Studies*, edited by John R. Hinnells, Manchester University Press, 1975; see ftnt. 38.

Brough, John: 'Soma and *Amanita Muscaria*', *BSOAS*, 34:2, 331-362. Review Article.

Gershevitch, Ilya: 'An Iranianist's View of the Soma Controversy', *Mémorial: Jean de Menasce*, Fondation Culturelle Iranienne, Louvain, 1974; pp. 45-75.

Heim, Roger, and R.G. Wasson: 'Les Putka des Santals Champignons doués d'une âme.' Cahiers du Pacifique N⁰ 14, Sept. 1970; pp. 60-85, 11 planches hors texte, 6 en couleur. The Ludgi Marndi citation is on p. 65.

Ingalls, Daniel H.H.: (1) *The New York Times*, Sunday Book Review Section, 5 Sept. 1971.
(2) *JAOS*, 91:2, 1971.

Kramrisch, Stella: 'The Mahāvīra Vessel and the Plant Pūtika', *JAOS* 95:2, April-June 1975, 222-235.

Kuiper, F.B.J.: *Indo-Iranian Journal*, 12:4, 1970, pp. 279-285. Review Article.

La Barre, Weston: *American Anthropologist*, Vol. 72, 1970, 368-373. Review Article.

Lévi-Strauss, Claude: 'Les champignons dans la culture: A propos d'un livre de M. R.-G. Wasson', *L'Homme, Vol. X, Cahier 1, 1970, pp. 5-16. Review Article.*

Schultes, Richard Evans: *Journal of Psychedelic Drugs*, Vol. 3:2, Spring 1973. Review.

Wasson, R.G. (1) 'Soma: Comments Inspired by Professor Kuiper's Review', *Indo-Iranian Journal*, 12:4, 1970, pp. 286-298. This article appeared in the same issue immediately after the Kuiper review.
(2) 'Soma of the Rig Veda: what was it?', *JAOS*, 91:2, April-June 1971. This paper was republished later by the American Oriental Society in their Essay Series, No. 7, along with Daniel Ingalls's review that had appeared with it in the *JAOS*.
(3) 'Soma and the Fly-Agaric: Mr. Wasson's Rejoinder to Professor Brough', with Introduction by Richard Evans Schultes. Published by the Botanical Museum of Harvard University, Cambridge, Mass. 1972.

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DE PLANTIS TOXICARIIS E MUNDO NOVO TROPICALE COMMENTATIONES XXIII

ETHNOPHARMACOLOGICAL NOTES FROM NORTHERN SOUTH AMERICA

Richard Evans Schultes

Increasing evidence indicates that the indigenous population of the northwesternmost part of the Amazon Valley possesses an almost unsurpassed wealth of knowledge of biodynamic plants. There are few parts of the world where native people display such a basic understanding of plants of use as poisons, narcotics or medicines.

Until recently, this corner of the great hylea has not been in danger from penetration by outside civilization. How long this happy state of affairs will continue is open to doubt.

In order to preserve some of this native folk lore, I have been publishing a series of articles summarizing some of the ethnopharmacological information which my students and I have collected in field work from 1941 to the present.

Most of the following notes pertain to the wealth of ethnopharmacological knowledge of Indians of the northwestern Amazon — primarily in Colombian territory, but occasionally from adjacent parts of Brazil, Ecuador and Peru.

Voucher specimens cited are preserved in several herbaria: the Economic Herbarium of Oakes Ames and the Gray Herbarium of Harvard University, the New York Botanical Garden, the Herbario Nacional de Colombia (Bogotá) and the Instituto Nacional de Pesquisas da Amazonia (Manáos).

The families are arranged in accordance with the Engler and Prantl system, and the genera are alphabetically enumerated under their respective families.

Lycopodiaceae

Lycopodium cernuum *Linnaeus*, Sp.Pl. (1753)1103.

COLOMBIA: Comisaría del Amazonas, Río Amazonas, vicinity of Leticia. August 29 - September 12, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24038.*

A Dragendorff spot-test for alkaloids was positive for this common species of *Lycopodium*.

Alkaloids have recently been detected in about a dozen species of Lycopodiaceae. Nicotine and quinolizidine bases account for most of the lycopodiaceous alkaloids (Tyler, V.E.: Lloydia 24(1961)58).

PIPERACEAE

Peperomia macrostachya *(Vahl.) Dietrich* var. **nematostachya** *(Link.) Trelease et Yuncker,* Piperac. N. S. Am. 2(1950)661.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, Cerro Isibukuri. "Epiphyte". March 8, 1951. *R.E. Schultes et I. Cabrera 13260.* — Río Vaupés, Mitú and vicinity. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24178.*

The leaves of this climbing epiphyte are boiled, and the resulting tea is taken by elderly members of the Taiwano tribe to relieve difficulty in urinating. It is said also to be an effective febrifuge.

A Dragendorff spot test for alkaloids *(Schultes, Raffauf et Soejarto 24178)* was negative.

Piper hostmannianum *(Miq.) C. DeCandolle* in DeCandolle Prodr. 16, pt.1(1869)287.

COLOMBIA: Comisaría del Amazonas, Río Amazonas, vicinity of Leticia. "Small bush. Leaves aromatic." August 29 - September 12, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24018.*

In the Leticia region, a poultice of the crushed leaves is applied to warts in the belief that this hastens their disappearance. The plant is known as *cordoncillo*, a name applied to many species of *Piper* in reference to the inflorescence (*cordoncillo* = "shoe string").

Piper interitum *Trelease ex Macbride* in Field Mus. Publ. Bot. 18, No. 357(1936)176.

PERU: Departamento del Loreto, Zapote, Alto Río Purús. "Tree about 10 meters high. Lowland forest". October 15, 1968. *L.Rivier 21.*

The dried leaves and roots are pulverized and used as a substitute for tobacco snuff. The Kulina Indian name is *tetsi*.

Pothomorphe umbellata *(L.) Miquel,* Comm. Phyt. (1840)36.

COLOMBIA: Comisaría del Putumayo, Río Guamües, San Antonio. "Secondary growth. Herb 5-6 feet." September 5, 1966. *H.V. Pinkley 421.*

The Kofán Indians prepare an arrow poison of this plant alone (the bark of the lower stem and root is scraped and boiled) or mixed with other plant ingredients, especially for hunting monkeys and wild pigs. The Kofán name is *a-nama-he se-hé-pa*.

This species has been employed as a strong diuretic in Brazil (Peckholt, T.: Pharm. Rundschau 12(1894)240,285), but there appears to be no chemical constituent which would make the bark active as an ingredient of curare.

MYRICACEAE

Myrica parvifolia *Bentham,* Pl. Hartw. (1846)251.

COLOMBIA: Departamento de Cundinamarca, Bogotá, Cerro above La Cita. May 10, 1946. *R.E. Schultes 7111.*

Bundles of the leaves and stems of this shrub are burned in huts in the cool, humid highlands around Bogotá for the aromatic smoke which is believed to relieve congestion casued by the frequent pulmonary troubles of these people.

POLYGONACEAE

Rumex obtusifolius *Linnaeus,* Sp. Pl. (1753)335.

COLOMBIA: Comisaría del Putumayo, Valle de Sibundoy, Sibundoy. Alt. 2225-2300 m. May 29, 1946. *R.E. Schultes et M. Villarreal 7610.* — Same locality. "*Lengua de vaca*". February 20, 1963. *P.J. Chindoy B. 97.* — Same locality. "Garden and waste places, very frequent. One or two most persistent, most frequent weeds in valley". April 1, 1963. *M.L. Bristol 704.* — Same locality. "*Lengua de vaca.* Open pasture; infrequent." May 8, 1963. *M.L. Bristol 969.*

The Kamsá Indians of Sibundoy employed the roots of *Rumex obtusifolius* in decoction as a strong laxative.

The roots contain 1,8-dihydroxynaphthaline (Hesse, O.: Ann. Chem. 305 (1896)291).

Menispermaceae

Curarea tecunarum *Barneby et Krukoff* in Mem. N.Y. Bot. Gard. 22(2)1971)12.

Brazil: Estado do Amazonas, Rio Cunhuá, Deni Indian village. November 28, 1971. *G.T. Prance, R.J.M. Maas, D. Woolcott et al. 16453.*

Colombia: Comisaría del Putumayo, Río Guamües, Salvador. "Arrow poison" August - September 1963. *C. Naranjo et G. Wiederhold 16.* – Comisaría del Vaupés, Río Macaya, vicinity of Cachivera del Diablo. "Said to have been used formerly by Karijona Indians in arrow poisons. Vine. Fruits yellow, very bitter." May 1943. *R.E. Schultes 5526.* — Río Macú-Paraná, lowland forest. "Root scrapings are used in preparing arrow poison mixture by Bara-Makú. *Awa-puh'* (species of monkey root). June 1-8, 1970. *P. Silverwood - Cope 23.*

Curarea tecunarum is well recognized as one of the principal sources of an especially strong curare in the northwestern Amazon. Its use as a contraceptive, however, is not widely known. According to *Prance, Maas, Woolcott et al. 16453*, the stem is crushed and placed in water, stirred and taken as a contraceptive by the Deni Indians.

Telitoxicum peruvianum *Moldenke* in Brittonia 3(1938)45.

Colombia: Comisaría del Vaupés, Río Piraparaná, Caño Teemeeña, (Lobo Igarapé). "Small tree. Fruit dark green. Barasana: *bo-dé-mee-see*". September 10, 1952. *R.E. Schultes et I. Cabrera 17340.*

The Makuna Indians value *Telitoxicum peruvianum* as an important ingredient of the curare that formerly was prepared by medicine men of the Río Piraparaná. The Barasana believe that application of crushed leaves to ulcers and similar infections aids in cleansing the wounds.

Annonaceae

Anaxagorea sp.

Ecuador: Napo, Río Aguarico, Dureno. "Tree." December 12, 1955. *H.V.*

Pinkley 16. — Same locality. "Small tree, 6 - 8 feet." October 19, 1966. *H.V. Pinkley 522.*

The bark of the root of this treelet is an ingredient of curare amongst the Kofáns. The Kofán name is *ko-yo-vi-fá-nti.*

Cyanogenesis is reported from a Philippine species of *Anaxagorea* (Hegnauer, R.: *Chemotaxonomie der Pflanzen* 3(1964)121)

Guatteria Duckeana *R.E. Fries* in Acta Horti Berg. 12 (1939) 468.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Cachivera de Tatú. "Tree 45 feet. Flowers green." October 20, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24377.*

All parts of this plant tested very positive for alkaloids with Dragendorff reagent.

Guatteria dura *R.E. Fries* in Acta Horti Berg. 12(1939)499.

COLOMBIA: Comisaría del Vaupés, Río Kuduyarí. "Tree 18 feet. Flowers yellow-green, cauliflorous." October 10, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24391.*

The bark tested highly positive for alkaloids, the leaves slightly positive, with Dragendorff reagent.

Unonopsis veneficiorum *(Mart.) R.E. Fries* in Acta Horti Berg. 12(1937)238.

COLOMBIA: Comisaría del Vaupés, right tributary of Río Macú-paraná. June 1-8, 1970. *P. Silverwood-Cope 11.*

This plant is reported to be an ingredient of a contraceptive formula of the Bora-Makú who inhabit the region of the Río Piraparaná in the Colombian Vaupés. The name of the medicinal preparation in Makú is *wĕ-wit-kat-ku* ("no children medicine").

Unonopsis veneficiorum has long been known as an ingredient of a type of curare in the northwestern Amazon. The plant is alkaloidal (Hegnauer, R.: *Chemotaxonomie der Pflanzen* 3(1964)118).

Xylopia amazonica *R.E. Fries* in Acta Horti Berg. 12(1939)562.

COLOMBIA: Comisaría del Amazonas. Río Apaporis, Soratama. "Large tree. Flowers white. High land." September 28, 1951. *R.E. Schultes et I. Cabrera 14146.*

Xylopia amazonica is valued by the Indians of the Río Apaporis in the form of a tea to induce sleep. The leaves and stems are employed. Alkaloids, polyphenols, and essential oils have been reported from *Xylopia* (Hegnauer, R.: *Chemotaxonomie der Pflanzen* 3(1964)118, 120).

Xylopia Benthamii *R.E. Fries* in Kgl. Sv. Vet.-Akad. Handl. 34, No. 5(1900)35.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, Cerro Isibukuri. Alt. 2500 feet. "Small tree. Pods white and red. Forest on slope near summit." December 4, 1951. *R.E. Schultes et I. Cabrera 14751.*

According to the Taiwanos of the Río Kananarí, a tea of this plant is administered as a tranquilizer to people who have experienced a great fright.

MYRISTICACEAE

Osteophloem platyspermum *(Poepp.) Warburg* in Nova Acta Acad. C. L. C. G. Nat. Cur. 68(1897)162.

BRAZIL: Estado do Amazonas, basin of Rio Negro, Rio Uniciuxí, Makú Indian village 300 km. above mouth. "Forest on terra firma. Tree. 25m. x 40 cm. diameter. Flowers green. Sap drunk by Makú as cure for coughs and colds. Makú = *tugnebanpe*." October 23, 1971. *G.T. Prance, R.J.M. Maas, D.B. Woolcott et al. 15571.* — Rio Negro, vicinity of Manáos, Reserva Ducke. April 11 - 14, 1972. *R.E. Schultes et W. Rodrigues 26126a.*

The Makú drink the sap as a "cure for coughs and colds." Labourers in the Reserva Ducke near Manáos burn the leaves and inhale the smoke to relieve asthmatic conditions.

Chemical studies of *Osteophloem* apparently have not been effected.

LEGUMINOSAE

Acosmium nitens *(Vog.) Yakovlev* in Notes Roy. Bot. Gard. Edinb. 29(1969)353.

BRAZIL: Estado do Amazonas, Rio Negro, Tapurucuara. "Flowers white. Small tree. Bark very alkaloid-positive; petiole and leaf negative." July 5 - August 12, 1967. *R.E. Schultes 24550* (Alpha-Helix Amazon Expedition 1967).

The bark of this tree was indicated as an ingredient of curare made in former times by the Tukano Indians.

Heterostemon mimosoides Desfontaines in Mem. Mus. Paris 4(1818)248.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. "Small tree or bush. Flowers purple. Alkaloid-negative." September 27 - October 20, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24171.*

The flowers are said formerly to have been pulverized and used for flavouring chicha.

OXALIDACEAE

Oxalis lotoides *Humboldt, Bonpland et Kunth*, Nov. Gen. et Sp. 5(1821)187.

COLOMBIA: Comisaría del Putumayo, Valle de Sibundoy, Sibundoy. Alt. 2225-2399 m. May 29, 1946. *R.E. Schultes et M. Villarreal 7607.*

The Kamsá Indians prepare a tea of this plant which is taken as a gargle to relieve chest and throat pains.

It is perhaps significant that the leaves of another species of this genus, the Amazonian *Oxalis Martiana* Zucc., are prepared in the form of a gargle to relieve pains of angina (Le-Cointe: *A Amazonia Brasileira* 3(1943)108).

Leucoanthocyanines have been reported from some species of *Oxalis* (Bate-Smith, E.C.: Journ. Linn. Soc. London (Botany) 58(1962)95-173).

VOCHYSIACEAE

Qualea acuminata *Spruce ex Warming* in Martius, Fl. Bras. 13, pt. 2(1882)40.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. "Small tree. Flowers white and pink." September 27 - October 20, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24177.*

This plant tests alkaloid-negative with Dragendorff reagent. A tea of the bark is valued as a taenifuge in the Mitú area.

The chemistry of *Qualea* is unknown.

EUPHORBIACEAE

Croton glabellus *Linnaeus*, Syst. Ed. X(1758)1275.

COLOMBIA: Comisaría del Amazonas, near mouth of Río Loretoyacu and Puerto Nariño. "Fruit green. Small tree." September 13-15, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24149.*

Witoto Indians living in the vicinity of Leticia crush leaves of this tree to poultice infected cuts and sores.

Croton glabellus has been reported to be alkaloid-positive (Haynes, L.J. et K.L. Stuart: Journ. Chem. Soc. 1963 (1963) 1784, 1789).

Croton palanostigma *Klotzsch* in Hooker Lond. Journ. Bot. 2 (1843) 48.

BRAZIL: Estado do Amazonas, vicinity of Manáos, Reserva Ducke. "Small tree. Flowers white". April 11 - 14, 1972. *R.E. Schultes et W. Rodrigues 26124Ia.*

The sap of this tree is applied to ulcers and boils to reduce pain.

Mabea nitida *Spruce ex Bentham* in Hooker Kew Journ. 6 (1854) 367.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. "Tree 20 feet. Fruit rusty. Alkaloid-negative." September 27 - October 20, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24170.*

The oil extracted from the seeds was, according to Kubeo informants, formerly rubbed into the scalp to prevent or delay loss of hair.

BOMBACACEAE

Bombax globosum *Aublet*, Pl. Guian. Fr. 2 (1775) 701.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, Cerro Isibukuri. "Large tree, 60 - 70 feet tall. Flowers yellow-white, petals yellow towards tip." September 29, 1951. *R.E. Schultes et I. Cabrera 14700.*

The Taiwano Indians, who know this tree as *ka-ne-weé-re*, gathered the "wool" from the ripened fruits for use, mixed with latex or resin from a number of plants, to apply to cuts, open sores or ulcers as a kind of protection during healing.

Sterculiaceae

Herrania Camargoana *R.E. Schultes* in Bot. Mus. Leafl., Harvard Univ. 14(1950)120.

Brazil: Estado do Amazonas, Rio Cauaburí, Maturacá. "Single slender trunk. Height 20 ft. In flood forest. Fruit brownish red with fleshy pseudospines at junction of ribs and cross ridges. Alkaloid-negative." July 5 - August 12, 1967. *R.E. Schultes 24572* (Alpha-Helix Amazon Expedition, 1967).

The bitter seeds of *Herrania Camargoana* are pulverized and employed as a condiment on game-meat by the Waika Indians of the Rio Cauaburí in northwestern Brazil.

Guttiferae

Caraipa parvielliptica *Cuatrescasas* in Rev. Acad. Col. Cienc. 8, No. 29 (1950)64.

Colombia: Comisaría del Vaupés, Río Kananarí, Cerro Isibukuri. "Bush along rill." April 12, 1951. *R.E. Schultes et I. Cabrera 14738.* – Comisaría del Amazonas, Río Apaporis, Soratama. "Height 60 feet." March 26, 1952. *R.E. Schultes et I. Cabrera 16070.* — Río Miritiparaná. "Small tree. Yukuna: *seé-na*." May 8, 1952. *R.E. Schultes et I. Cabrera 16460.*

The Yukunas apply the sap of *Caraipa parvielliptica* to sores of the mucous membrane of the mouth. In Brazil, the sap of *C. paraensis* Huber and *C. grandifolia* Martius is similarly employed for herpes, mange and itches (LeCointe: *A Amazonia Brasileira* 3(1934)424).

Several species of *Caraipa* have been reported to contain a high content of resins which are useful in treating a variety of skin diseases. A highly toxic vermifugal constituent has been found in the seeds (Freise, F.W.: Apoth. Zeit. 44(1929)1481).

Symphonia globulifera *Linnaeus filius,* Suppl. (1781)302.

COLOMBIA: Comisaría del Amazonas, Río Apaporis, Soratama. "Flowers red. Height 75 feet." December 14, 1951. *R.E. Schultes et I. Cabrera 14904.*

The bark of this tree, source of a very useful resinous latex, is said by the Indians of the middle Río Apaporis to be very effective, when burned to ashes and applied to recalcitrant ulcers of the abdomen and legs, in rapidly drying the infection.

Vismia ferruginea *Humboldt, Bonpland et Kunth,* Nov. Gen. et Sp. 5(1821)141.

BRAZIL: Estado do Amazonas, Manáos, Flores. "Flowers greenish white. Common bush in scrub growth." July 5 - August 12, 1967. *R.E. Schultes 24594* (Alpha-Helix Amazon Expedition 1967).

The resinous exudate of this bush is commonly applied to sores of the skin in the region of Manáos.

FLACOURTIACEAE

Banara guianensis *Aublet,* Pl. Guian. Fr. (1775)548.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. "Bushy tree, common on river bank. Flowers green-yellow." September 27 - October 20, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24176.*

A spot test with Dragendorff reagent gave a doubtful positive result for alkaloids.

Mayna longifolia *Poeppig et Endlicher,* Nov. Gen. et Sp. 3 (1845) 64.

COLOMBIA: Comisaría del Amazonas, Río Miritiparaná, Caño Guacoyá. "Fruit cauline, greenish white." April 25, 1952. *R.E. Schultes et Cabrera 16285.*

The seeds of this shrub are crushed and boiled in water to make a tea to provoke vomiting in cases of serious food poisoning, especially from tainted fish. The tea must, however, be used with caution, since it is reputedly toxic, causing extreme dizziness, profuse sweating and uncontrollable trembling.

The plant is well known by all Indians of the area. The

Makuna call it *oo-too-mee-ko*; the Miraña, *do-ro-hĕ*; the Tanimuka, *ya-poo-moo-ho*; the Yukuna, *ka-sá-ra* ("beetle tree").

Mayna toxica *R.E. Schultes* in Rhodora 65(1963)16, t. 10.

COLOMBIA: Comisarí del Amazonas, Río Caquetá, La Pedrera and vicinity, Quebrada Tonina. On high land. "Small tree, 20 feet tall. Flowers white." October 5, 1952. *R.E. Schultes et I. Cabrera 17731.*

The Miraña Indians of the La Pedrera region assert that formerly the bark of seeds of this tree were given to dogs as a poison. The same uses have hitherto been reported (Schultes, R.E. in Rhodora loc. cit.) from the Vaupés and for other Indian tribes. It was then indicated that: "The fact that at least two species — *Mayna muricida* and *M. toxica* — are similarly employed for their toxic properties by Indians in far-separated parts of the Colombian Amazon suggests that an investigation into the chemical constituents of this genus might be of interest."

Ryania angustifolia *(Turcz.) Monachino* in Lloydia 12(1949)21.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Mitú and vicinity. "Small tree in secondary growth. Flowers white. Leaves and twigs: alkaloid doubtful. Bark: alkaloid negative." September 27 - October 20, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24175.*

The root, although not used, is considered poisonous by the Kubeo Indians.

One species, *Ryania dentata* Miq., has been reported as an ingredient of an arrow poison in Colombia (Mezey, K.: Rev. Acad. Col. Cienc. Exact. Fis. Nat. 7(1947)319.

Sundry species of *Ryania* are recognized in South America as poisonous. The toxicity is due presumably to a glycoside (Merz, K.W.: Arch. Pharm. 268(1930)592; Nakarai, S. et T. Sano: Arch. Pharm. 272(1943)1).

COMBRETACEAE

Combretum Cacoucia *Exell* in Kew Bull. 1931(1931)469.

BRAZIL: Estado do Para, Utinga, Belém. "*Rabo de arara.* Extensive liana.

Acrid water in stem. Flowers red, said to be poisonous." September 1947. *R.E. Schultes 8668.*

There are numerous reports, similar to the folk report from Belém do Pará connected with this collection, that the flowers of *Combretum Cacoucia* are toxic. There is apparently no chemical evidence to sustain this assertion, yet the number of reports is such that the problem bears serious study.

Caffeine and tannins have been reported from the genus *Combretum* (Gibbs R.D.: *Chemotaxonomy of Flowering Plants* 3 (1974) 1478).

Solanaceae

Saracha procumbens *(Cav.) Ruíz et Pavón,* Fl. Peruv. 2 (1799) 43.

Colombia: Comisaría del Putumayo, Valle de Sibundoy, Sibundoy and vicinity. Alt. 2225-2300 m. May 29, 1946. *R.E. Schultes et M. Villarreal 7615.* — Same locality. August 22, 1963. *M.L. Bristol 1328.*

According to Bristol, the Kamsá Indian name of this garden plant, the fruit of which is edible, is *chuftanguemesha*. A tea of the whole plant is drunk as a diuretic and febrifuge *(Schultes et Villarreal 7615).*

Bignoniaceae

Pseudocalymma alliaceum *(Lam.) Sandwith* in Rec. Trav. Bot. Neerl. 34(1937)210.

Colombia: Comisaría del Amazonas, Río Amazonas, Leticia. Alt. 100 M. "Arbusto de 1.5 m., esteril. Olor fuerte aliaceo. Alcaloides: positivo. Nombre vulgar: *sacha-ajo*." October 8, 1961. *J.M. Idrobo 4687.*

Although this plant is alkaloid-positive with a Dragendorff test, the whole plant, crushed and made into a tea, is taken frequently to relieve pulmonary ailments.

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FOSSIL POLLEN AND THE ORIGIN OF CORN

ANCIENT POLLEN FROM DEEP CORES IN MEXICO SHOWS THE ANCESTOR OF CORN TO BE CORN AND NOT ITS RELATIVE, TEOSINTE.

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UMESH C. BANERJEE***

There are currently two main schools of thought on the question of corn's origin: one, a 19th century concept, considers teosinte, corn's closest relative, to be its ancestor; the other, a more recent one, maintains that the ancestor of cultivated corn was a wild corn, now probably extinct.

The teosinte theorists argue that since the majority of cultivated species have extant wild ancestral forms, corn must also have its wild counterpart and does so in teosinte (*1*), a species that is widely distributed in parts of Mexico and Central America and which has, for more than a century, been recognized as corn's closest relative (*2*). This school also relies strongly on certain parts of the cytogenetic evidence (*3*), and this particular evidence is indeed impressive. Corn and teosinte have the same chromosome number, hybridize freely, the hybrids are usually highly fertile, the pairing of the parental chromosomes in the hybrids is virtually complete and — perhaps most important — crossing over between them is

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essentially the same as it is in pure corn (*4*). All of these circumstances combine to make the teosinte theory much more plausible than it was in the nineteenth century.

The teosinte school concedes that the archaeological evidence presently available lends little support to the teosinte theory but regards this evidence as being outweighed by the cytogenetic evidence. It suggests that supporting archaeological evidence is lacking because the early stages in teosinte's domestication occurred in open campsites where cultural remains have not been preserved (*5, 7*).

On the question of the fossil pollen discovered in Mexico, the teosinte school is distinctly ambivalent. On the one hand it says that this evidence is not to be taken seriously or the data are confusing and ambiguous and they do not solve the problem of the origin of corn (*5*). On the other hand the school asserts that because of the relevance of the fossil pollen to the validity of the teosinte hypothesis it requires rigorous examination (*6*). That examination results in the rather conflicting conclusions that the fossil pollen is not large enough to be reliably distinguished from teosinte, but is too large to be the pollen of a primitive wild corn (*19, 1, 20*). Finally the school explains the fossil pollen as contamination occurring during the core-sampling operation (*1*).

The corn theorists, including the present authors, agree that cultivated corn undoubtedly had an ancestral form and hold that this was a wild corn, probably now rendered extinct initially because of repeated hybridization with cultivated corn once the practice of agriculture began, and later by the depredations of Old-World grazing animals, horses, cows, burros, sheep and goats introduced by the Spaniards and other colonists. This school sees corn differing from teosinte in numerous genetic, morphological, taxonomic and evolutionary characteristics (*8, 9*), and regards the genetic evidence, considered as a whole, as showing teosinte differing from corn not by a few genes (*1*), but by genes or blocks of genes on virtually all of its chromosomes (*8*). This school regards the archaeological evidence as critical and the paleobotanical evidence involving the fossil pollen as virtually conclusive (*10, 13*).

It is the authenticity of the fossil pollen that we wish especially to consider here. Other kinds of evidence bearing on the problem are treated in detail elsewhere (*8*, *9*). Suffice it to say here that contrary to a recently published drawing showing an Indian cultivating teosinte (*11*), there is presently no evidence of any kind, archaeological, ethnological, linguistic, ideographic, pictorial or historical, to show that teosinte was ever cultivated as a crop by the American Indians.

DISCOVERY OF THE FOSSIL POLLEN

The discovery of the fossil pollen in question was the result of meticulous studies of palynological samples from cores taken at the Bellas Artes site in Mexico City in preparation for the construction of Mexico's first skyscraper, a 43-story building. (Fig. 1.) These cores were obtained from Dr. Leonardo

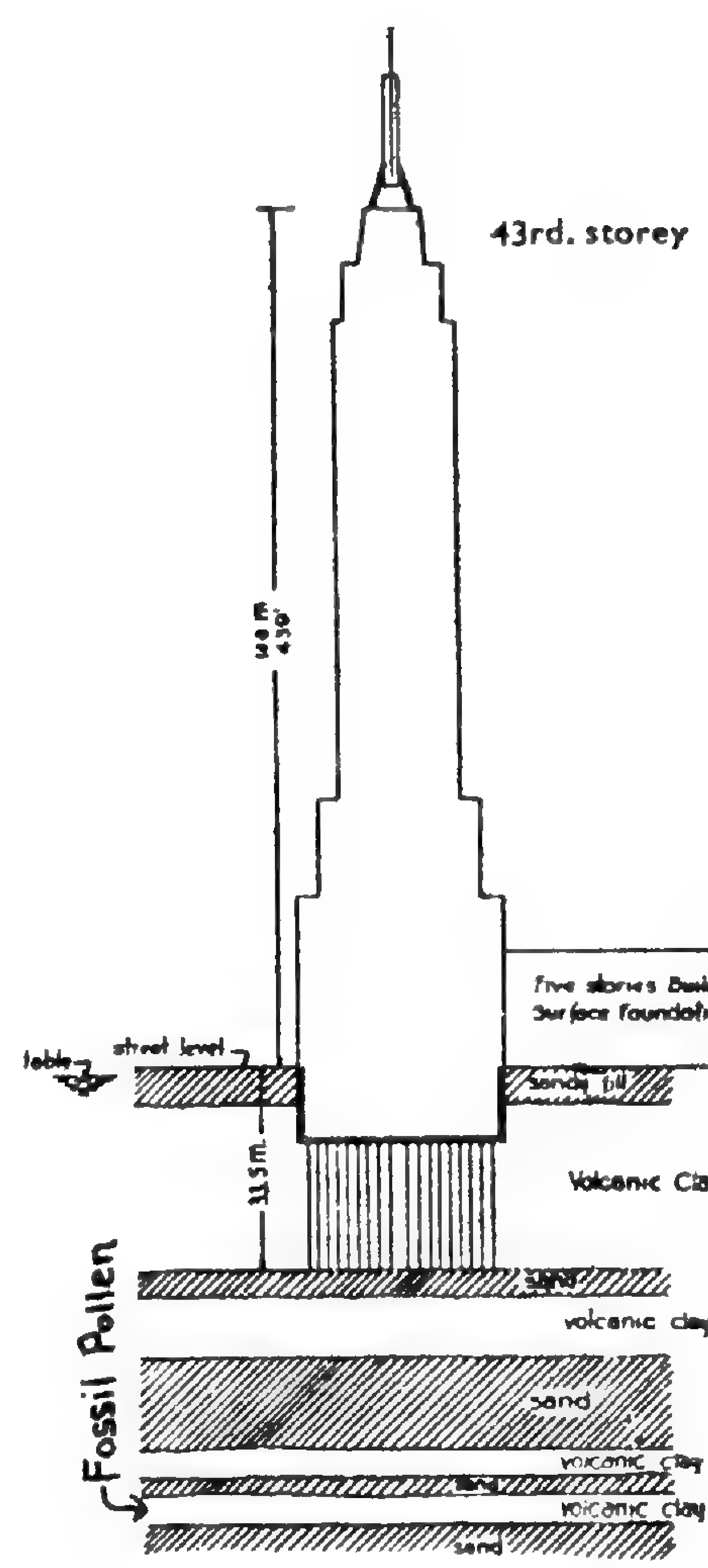

Fig. 1. Fossil pollen, identified as corn pollen, was discovered in core samples taken at depths of 69.3 - 70.5 meters in preparation for Mexico's first skyscraper. An arrow indicates the level of volcanic clay in which the pollen occurred. After Zeevaert (*28*). Depending on the criteria used, this level is variously dated at 25 to 80 thousand years ago. It contains no cultural remains.

Zeevaert, the engineer in charge of the core sampling, by Professor Paul Sears of Yale University for palynological studies to chart climatic changes as they might be revealed by changes in frequencies of pollen of various species especially of pines indicating a drier, cooler period; oak and alder a warmer, moister one and fir a cooler, moister one (*12*). In analyzing the pollen found in the cores, Sears' associate, Mrs. Kathryn Clisby, observed in the lower levels of the profile, 69.3 - 70.5 meters, a number of indubitable grass pollen grains that seemed too large to be identified as those of ordinary grasses. Thinking that these might be the pollen grains of teosinte, Sears and Clisby obtained from Mangelsdorf pollen of several varieties of teosinte. When it became apparent that some of the fossil pollen grains were larger than those of teosinte, Sears, Clisby and Mangelsdorf agreed that these might be pollen grains of corn and decided to send the cores to Elso S. Barghoorn, a paleobotanist at Harvard, for further study. Barghoorn and his then graduate student Margaret Wolfe made an intensive study of the fossil grains, macerating out additional ones from the core centers to eliminate possible surface contamination and comparing them in size and also in the ratio of the pore diameter to the long axis with pollen of fourteen varieties of modern corn, three of teosinte and eight of *Tripsacum*, a more distant relative of corn which, like teosinte, occurs widely in Mexico.

The results of these comparisons show that, although there is an overlapping in size frequencies between the pollen grains of corn and those of teosinte, some of the fossil pollen grains are much too large to be classified as teosinte. We (*13*) concluded that the large fossil pollen grains were almost certainly those of a wild maize once growing in the Valley of Mexico, well before the beginnings of agriculture in Middle America, and this essentially established two important facts:

1. Corn is an American plant and not one of Asiatic origin.
2. The ancestral form of cultivated corn was corn and not teosinte.

The conclusion with respect to corn's American origin seems to have been generally accepted. At least no recent articles arguing for an Asiatic orign of corn have come to our attention.

The second conclusion, that the ancestor of cultivated corn is corn, was also generally accepted, at least for a period, especially when it proved to be quite consistent with archaeological remains of corn, most notably the oldest of these, uncovered by Richard MacNeish in the Tehuacan Valley of Mexico (*14*). Many students of corn thought that the long and sometimes acrimoniously debated problem of the origin of corn had finally been solved.

In the late sixties the old, now long-dormant theory that the ancestor of corn is teosinte was rather suddenly revived. Most prominent in its revival was George Beadle, a Nobel Laureate in Physiology and Medicine and a retired University Chancellor, who, in an interesting personal account, tells his reasons for reviving the theory (*3*).

Beadle was soon joined by others, including Walton Galinat, who believed that the evidence from morphological characteristics which he was then studying outweighed the evidence from fossil pollen or the archaeological remains in which he had participated in describing and publishing (*14*, *23*).

The new devotees of the revived teosinte theory were generally not initially deterred by the archaeological evidence which by this time was considerable — or the evidence from the fossil pollen, both of which were neither consistent nor compatible with the concept of corn as a domesticated teosinte. Realizing, however, that the evidence of the fossil pollen was widely accepted by botanists and archaeologists and could not be ignored, they tended to dismiss it by relying on Kurtz *et al.* (*15*). These authors measured pollen from corn plants grown under a variety of environmental conditions, a treatment which resulted in considerable variation in the axis/pore ratio, a measurement which Barghoorn *et al.* had earlier employed as one means of distinguishing the pollen of corn from that of teosinte. Kurtz *et al.* concluded that axis/pore ratio alone is not adequate for making this distinction. The teosinte theory advocates have, with remarkable unanimity, cited or even quoted Kurtz *et al.* as raising serious doubts about the identification of the fossil pollen (*1*, *6*, *16*) but with equal unanimity have overlooked or ignored the statement set forth rather conspicuously in these authors' summary that their data "do not refute the findings of Barghoorn *et al.*" and that five of the fossil pollen grains studied by Barghoorn *et al.* "are sufficiently large in both axis length and pore diameter as well as axis/pore ratio to be classified as maize with a high degree of reliability."

IDENTIFICATION OF THE FOSSIL POLLEN

The problem of identifying the fossil pollen is one of comparing it with the pollen of corn and its two American relatives teosinte and *Tripsacum*. There are no other native grasses with which the fossil pollen might be identified. Distinguishing the fossil pollen from that of *Tripsacum* is not difficult since there is little overlapping in size, only the largest grains of *Tripsacum* being within the range of the smallest grains of corn. Also the pattern of spinules on the exines of *Tripsacum* grains, as revealed by the scanning electron microscope, is quite different from that in corn. In *Tripsacum* the spinules occur in clusters; in corn they are regularly distributed as they are also in teosinte (*17*, *18*).

Since the pollen of corn can not be distinguished from teosinte pollen by their spinule patterns which are quite similar, the only criterion for making a distinction is one of size. It has been asserted that size is not a taxonomic character. This is not strictly true. The principal difference between popcorn and flint corn, for example, is in the size of their kernals. Size of structures is often included as a part of taxonomic descriptions.

In certain instances there is no difficulty in distinguishing corn and teosinte pollen by size alone. For example, in a recent publication (*18*), the photographs of pollen of Guerrero teosinte and Confite Morocho corn show the corn pollen to be only slightly larger than the teosinte pollen. But when the corn pollen is enlarged to the same magnification, x 1692, as the teosinte pollen it proves to be half again as long as the teosinte pollen with about twice the volume.

Although individual grains of corn pollen cannot always, as was possible in this case, be distinguished from individual grains of teosinte, populations of pollen grains can usually be distinguished. A comparison of the frequency distributions of 200 archaeological grains of pollen from the Bat Cave site in New Mexico with 200 grains of pollen from a teosinte growing in the Valley of Mexico shows some overlapping (*19*). In the region of overlap the grains of corn and teosinte cannot be distinguished. But 59 percent of the Bat Cave pollen grains are larger than the largest teosinte grains. Distinguishing these from the teosinte grains is no problem.

The population of the fossil pollen grains from the Bellas Artes site is clearly different from any population of teosinte grains with which it has been compared. There are, as Kurtz *et al.* have stated, at least five pollen grains, 36 percent of the total, too large to be identified as teosinte pollen.

The teosinte theorists now argue that the fossil pollen grains, earlier considered to be too small to be reliably distinguished from teosinte grains, are too large to be those of a primitive corn (*1*, *5*). This argument is based on a correlation showing a relationship between length of ear and pollen size (*20*). The length of the ear determines to a considerable extent the length of the styles, commonly called "silks", that the pollen tubes must travel to reach the ovules and effect fertilization.

Since the ears of a primitive wild corn are assumed to have been small, the earliest intact cobs from San Marcos Cave in the Tehuacan Valley vary in length from 19 - 25 mm (*14*), it is concluded that the pollen of such a corn must have been correspondingly small. This does not necessarily follow. Actually the correlation mentioned above, although statistically significant, is strongly influenced by two races, Jala and Huesillo, that have unusually long ears and unusually large pollen. The correlation among the remaining eight races included in the study is by no means so strong and there are notable exceptions. The highly evolved Mexican race Vandeño, for example, has pollen grains of about the same size, 83.9 microns, as those of the primitive Mexican popcorn race Nal-Tel, 81.2 microns, although its ears are more than twice as long as Nal-Tel, 17.2 and 7.9 cm, respectively.

SIGNIFICANCE OF THE LARGE POLLEN

It is the large pollen of the primitive popcorn that seems to us to be especially significant and to require explanation. The length of the mature ear is only one factor in determining the length of the styles that the pollen tubes must travel to reach the ovules. Equally important is the extent to which the husks protrude beyond the tips of the ears which they enclose. The senior author has frequently been impressed by the fact that among the early archaeological remains the husks are considerably longer, on the average, than the longest cobs of the same level. This first came to attention in the archaeological remains turned up in the first Bat Cave expedition. The only husk found in the lower levels of the cave is quite long, 24.5 cm, more than twice the length of the longest intact cob, 10.3 cm. The authors (*21*) concluded that the husk must have been an involucre of leaf sheaths subtending and surrounding the base of an ear but not tightly enclosing it.

The real nature of this long husk became apparent with a study of the specimens from the second Bat Cave expedition (*22*). These led to the conclusion that the long husk found in the first expedition may have enclosed, not a single ear, but a pair of ears, upper and lower, each with its own shorter husk system (Fig. 2). If the silks of the lower ear became exposed to pollination only when they reached the terminus of the outer husk system they would have been about 23 cm long. This is longer than any of the ears in the correlation study reported above except the giant ears of the races Jala and Huesillo, but is about the length of the longest silks of the race Vandeño, when allowance is made for the husks extending several inches beyond the tip of the ear as they do in most varieties. Thus the fact that the highly-evolved race Vandeño has the same pollen size as the primitive popcorn race, Nal-Tel becomes explicable.

The two-eared husk system may also explain the two-ranked, four-rowed cob found in the lower level of San Marcos cave. The teosinte advocates regard this as evidence of the evolution of the early Tehuacan corn from teosinte. A more simple and obvious explanation is that this cob represents a lower secondary ear in a two-eared husk system. Lower sec-

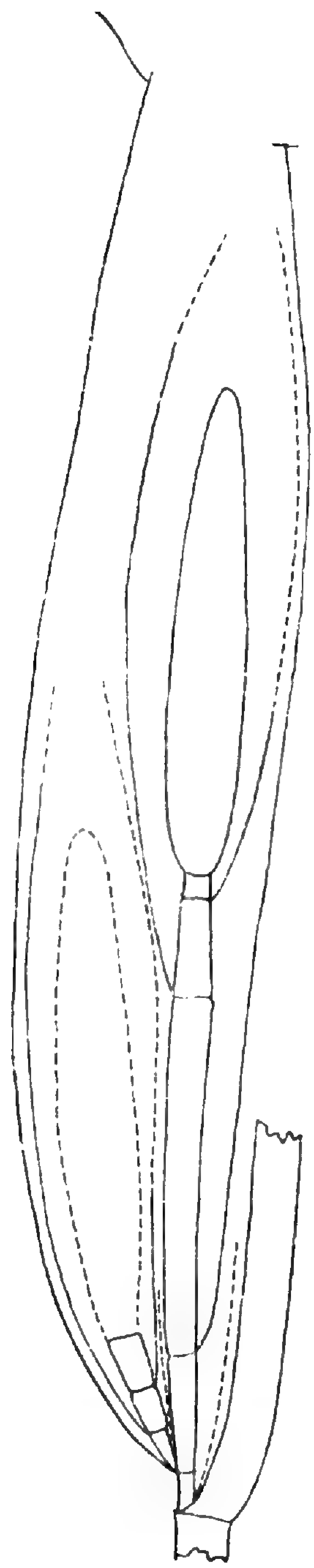

Fig. 2. Archaeological evidence shows that primitive corn may sometimes have borne two ears, an upper and a lower, in the same husk system. To reach the terminal opening of the outer husks the styles — "silks" — attached to the basal ovules of the lower ear would have to be quite long and the pollen grains effecting fertilization quite large. This wild corn may have been "preadapted" to evolve under domestication in the direction of producing long single ears. Teosinte does not have this preadaptation. Solid lines represent actual parts; broken lines artist's reconstruction. Drawn by Julián Cámara-Hernández (*22*). 1/2 actual size.

ondary ears, even in modern corn varieties, are often two-ranked and four-rowed.

Husk systems similar to the one described from Bat Cave and illustrated in Fig. 2, have also been found in the remains from San Marcos Cave in Tehuacan and the Huarmey Site in Peru (*23*, *24*).

Primitive corn as we now conceive of it with its large pollen may thus be recognized as a classic example of what some students of the dynamics of domestication, notably Vavilov and Hawkes (*25*), regard as "preadaptation."* These authors stress the fact that primitive ancestral forms of successul cultivated plants already possessed tendencies which induced man to cultivate them. Corn had its share of these especially in its easily harvested and threshed grain, and its conspicuous response to man's ministrations: freedom from competition with other vegetation and increased soil fertility. Early cultivators, although perhaps noting corn's large pollen grains, just visible to the naked eye, could scarcely have been aware of their significance. But it was its large pollen grains that gave corn the ability to evolve in the direction of producing larger and larger ears. If ever there was a wild species preadapted to domestication, corn is perhaps the prime example of this condition. Teosinte does not have this preadaptation; it could not have evolved in this direction without a series of mutations involving pollen size.

POSSIBILITY OF CONTAMINATION

One recent explanation of the fossil pollen is that it represents contamination (*1*), either from modern pollen at the upper levels being carried to a lower one during the sampling or from pollen in the air when the sampling was being done. To explain the fossil pollen as contamination is, of course, to assume that it is indeed corn pollen.

That pollen in the 1 - 3 meter level could be carried down to the 69.2 - 70.5 meter level leaving no contamination at intervening levels seems quite improbable, if not impossible, in view of the precision of the equipment and the techniques employed in

*Further reading has shown us that the idea of preadaptation as presented by these authors, is new only as it applies to evolution under domestication. Simpson in his book, *Tempo and Mode in Evolution* (Columbia University Press, 1944) discusses at length the concept as it applies to evolution in nature. Students of corn's evolution, including the senior author of the present article, have perhaps been remiss in not recognizing the phenomenon of preadaptation as an important factor in corn's amazingly rapid evolution under domestication. Included among corn's preadaptive characteristics is its ability to hybridize and exchange genes with its relatives, teosinte and *Tripsacum*. Teosinte lacks this characteristic, since, if it is cultivated corn's only ancestor, it had no wild corn, *Zea Mays*, with which to hybridize and its does not, even under ideal experimental conditions, hybridize successfully with *Tripsacum*.

the core sampling. The possibility of contamination by atmospheric pollen appears to be equally remote.

The Bellas Artes site is centrally located in greater Mexico City, one of the largest metropolitan areas in this hemisphere. It is many miles removed in all directions from the nearest corn-growing areas. We do not know exactly how far corn pollen can be carried by the wind but compared to the pollen of some other species, pines for example, it is relatively heavy. Agronomists and seed producers maintaining the purity of breeding lots of corn allow about one thousand feet of isolation if the contaminating pollen comes from the windward side, less if physical barriers to air flow are present (*26*). During the time of year that corn pollen would be shedding in Mexico City, if corn were there, the air is relatively still, indeed so much so that industrial pollution not carried away by the wind has become a major problem.

An experiment performed for another purpose by a Harvard graduate student, Ramana Tantravahi, may have a bearing on the question of how far corn pollen can travel with the wind. In order to effect the hybridization of teosinte with *Tripsacum* on a large scale, Tantravahi grew emasculated plants of teosinte adjacent to pollen-shedding plants of *Tripsacum* in a small garden surrounded by University buildings in Cambridge. To test the effectiveness of the emasculation of teosinte and to detect contamination by corn pollen from any source he also grew in the garden a row of emasculated corn plants. When the ears of these were examined at the end of the season, not a single kernal was found (*27*), although there were extensive plantings of corn in the market-gardening area near the Waltham Field Station about six miles due west of Harvard University. The winds during the corn-pollen-shedding season are prevailingly from the west. These observations suggest that corn pollen cannot ordinarily be carried as far as six miles.

The possibility that there was corn pollen in the air at the Bellas Artes site when the soil sampling occurred is quite remote. Almost equally remote is the possibility that such pollen, if actually there, could have contaminated the core samples.

The core sampling at the Bellas Artes site that revealed the fossil pollen is not an ordinary drilling operation involving repeated pouring of water or drilling mud into the hole, thus providing abundant opportunities for contamination. Core sampling in preparation for the construction of a skyscraper is an operation of considerable precision — one that is especially designed to yield undisturbed samples. Essentially it involves a series of tubes driven through the soil at successive levels. As the tubes are removed, they are immediately sealed at both ends with a special wax and are sent to the laboratory for various analyses. Engineers familiar with the problems of soil mechanics who have examined the data in Dr. Zeevaert's article in *Geotechnique* (*28*) describe his operation as "extraordinarily careful and meticulous."

Dr. Zeevaert himself seems quite certain that the cores in which the fossil pollen was found are undisturbed samples. In a letter of October 17, 1973, to Barghoorn, he wrote:

> Indeed the sampling of the material was performed with a special sampler to obtain undisturbed samples of the soil, useful to determine the natural compressibility and sheer strength properties of the materials. Therefore, the samples taken were not disturbed or contaminated, they were 'undisturbed samples' used in soil mechanics to determine the 'in situ' mechanical properties of the materials. Therefore, you can be sure that the investigations made on these samples concerning the fossil maize pollen are reliable.

We are inclined to accept Dr. Zeevaert's statement as factual. We are pleased to note, in passing, that Dr. Zeevaert has recently been elected a foreign member of the United States National Academy of Engineering.

Finally the fossil pollen itself demonstrates that it is not the product of modern contamination. It does so in this way: it is one of the standard palynological techniques to prepare pollen for electron microscope studies by a treatment known as acetolysis (glacial acetic acid and concentrated sulfuric acid, 9:1). This treatment is described in detail by Banerjee (*29*). Suffice it to say here that corn pollen when fresh resembles in shape an inflated basketball; when dry the shape of a deflated ball. Pollen from extant corn plants is restored to its original inflated shape when subjected to the acetolysis treatment (Plate 18A). But the pollen from the Bellas Artes does not respond as does modern pollen to this treatment (Plate 18D). This is true also of certain other ancient pollen. Pollen from Coxcatlan Cave in the Tehuacan Valley dated at *ca.* 1900 years failed to expand completely with the acetolysis treatment (Plate 18C). On the other hand pollen from the same cave at *ca.* 1600 years expanded almost like modern pollen (Plate 18B). Apparently as the chemical constituents of the pollen grains change with age certain of them lose their ability to react with the chemicals introduced by the acetolysis treatment (Plate 18C). What these constituents might be is a question beyond the scope of this discussion. The important point here is to recognize the fact that ancient pollen grains differ from modern ones in their capacity to respond to certain chemical treatments. The loss of this capacity seems to begin at about 2000 years; we do not know at what age it is completely lost. Pollen from the Huarmey site in Peru, dated at 3600-4000 years (*20*) is only slightly more collapsed than the pollen shown in Plate 18C dated at 1900 years (*29*).

The failure of the Bellas Artes pollen to respond to the acetolysis treatment combined with the fact that opportunities for contamination, discussed above, are minimal, if not actually nonexistent, has persuaded us that this pollen is indeed ancient and not the product of modern contamination. Having previously satisfied ourselves that the pollen has been correctly identified as corn pollen, we can now only conclude that the fossil pollen is authentic and if so, it is more than highly probable that the ancestor of cultivated corn was corn and not teosinte.

IMPLICATIONS FOR CORN IMPROVEMENT

Eliminating teosinte as the ancestor of corn does not mean, however, that it has had no role in the evolution of cultivated corn. On the contrary, archaeological remains are consistent in showing that although the earliest corn may have been pure corn, later corn is the product of hybridization with teosinte. And the hybridization still continues (*30*).

To the puzzled onlooker the distinction between recognizing teosinte as *an* ancestor of modern corn while vigorously denying it to be *the* ancestor may seem to be no more than an exercise in semantics. From the standpoint of theoretical genetics and practical plant breeding, however, it is much more than that. If teosinte is *the* ancestor of corn and the only one, then modern corn contains only one stream of germplasm. But if the ultimate ancestor of corn was corn, as the fossil pollen and the archaeological remains show, and modern corn is the product of repeated introgression from teosinte, then two distinct streams are involved and modern corn, although a diploid, has some of the attributes of an allopolyploid (*8*). In this respect it is comparable to the allopolyploid cereals like bread wheat, one of the world's most productive food plants, the product of hybridizing three species, two of which have never been recognized as worthy of cultivation and a third, einkorn, which being generally quite unproductive, is but little grown.

The interactions of these two streams of germplasm, corn's and teosinte's, has produced profound effects, including genetic recombination, heterosis — hybrid vigor — and mutagenesis (*31*). These, combined with corn's preadaptation to changes in ear length, by virtue of its large pollen, have resulted in the explosive evolution (*23*) illustrated in Plate 19. It is doubtful if such rapid evolution could have occurred were teosinte the only ancestor of corn. Then the hybridization of cultivated corn, originating from teosinte, with its ancestor, teosinte would have produced a minimum of genetic recombination and heterosis and probably no mutagenesis, and any increase in ear length would have been inhibited by teosinte's lack of preadaptation because of its small pollen.

To the practical plant breeder the difference in the two theories may determine the most promising methods of employing genes from teosinte. Shall he hybridize corn directly with teosinte or shall he hybridize strains of one race of corn containing teosinte germplasm with strains of another race containing a somewhat different combination of teosinte genes? In both strains the teosinte genes or blocks of genes will have been absorbed into the corn genotype by the natural selection of modifying genes that suppress the undesirable characters of teosinte and allow the desirable ones to be expressed. The genotype of modern corn may well be a constellation on a grand scale of DNA recombinants.

So far little progress in corn breeding has been made by hybridizing corn directly with teosinte but phenomonal results have been obtained by combining strains that are the product of past introgression from teosinte as shown by anatomical and genetic studies (*32*).

The average yields of corn in the United States have increased from 26 bushels per acre in 1929 to 95 bushels in 1972. This progress has involved the bringing together by empirical methods of strains of germplasm from diverse sources, much of it originally from teosinte. There are many races of corn not yet employed in hybrid corn breeding (*33*). Recognizing the potential value of these for breeding opens new possibilities for improvement that may render corn, this nation's basic food plant, still more important on the world scene as one of not more than about twelve species of cultivated plants, each one a unique biological system, that quite literally stand between mankind and starvation.

SUMMARY

Fossil pollen discovered in core samples from a depth of 69.3 - 70.5 meters in preparation for the construction of Mexico's first skyscraper has been identified as the pollen of a primitive wild corn. Its authenticity seems now to be well established since the possibility that the pollen represents modern contamination is shown to be remote. The authors conclude that the ancestor of cultivated corn was a wild corn and not its closest relative, teosinte, and that this may have important implications for corn's genetic improvement and its role in meeting the world food problem.

POSTSCRIPT

Two important events occurred while this paper was in proof. An article by Iltis *et al.* (appearing in *Science*, Jan. 12, 1979) announced the discovery in Mexico of a diploid perennial teosinte. As senior author of the present article, I recognized this as a significant discovery and I wrote Iltis at once congratulating him. I failed, however, to recognize the full significance of the discovery. It remained for H. Garrison Wilkes, the author of the book, *Teosinte: the Closest Relative of Maize* (*2*), presently in India, to point out in a letter to me, dated Jan. 17, that this discovery may be the key piece in the puzzle, a so-called "missing link" in corn's genealogy. Wilkes assumes, correctly I think, that hybridization between the diploid perennial teosinte and a wild annual corn could have produced all of the known annual races of teosinte. This assumption is to a large extent testable.

I am urging Wilkes to publish this concept and its implications as soon as possible, and I am hoping that this postscript will serve to establish his priority for an imaginative and important new idea. The relevance of our present article to this new concept is obvious.

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PLATE 18

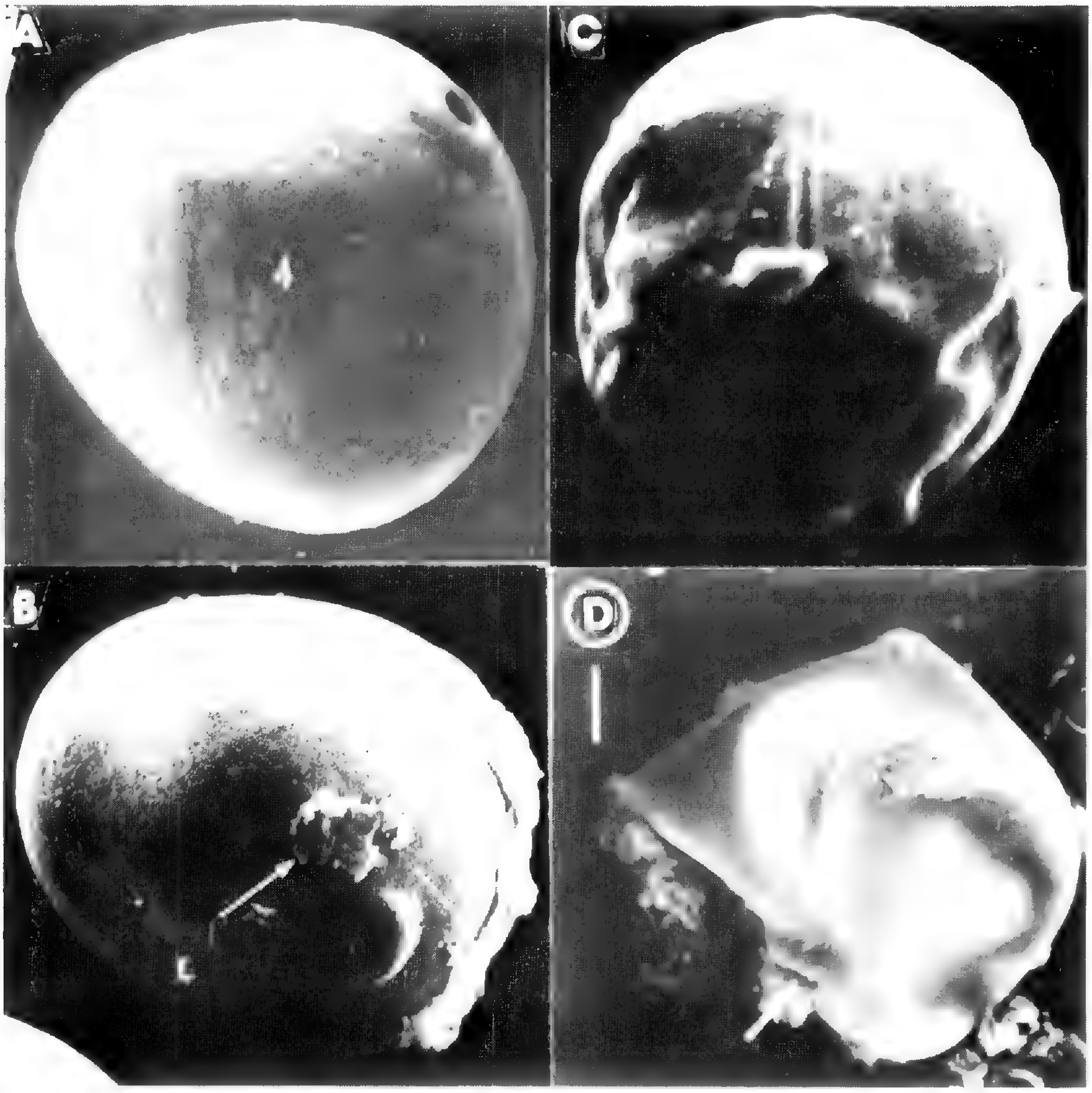

Plate 18. The effect of the acetolysis treatment on restoring pollen to its original shape. A. Modern pollen grain of the Mexican popcorn race Polomero Toluqueño, fully expanded after treatment; B. Archaeological pollen grain from the Tehuacan site, Mexico *ca* 1600 years old, expanded; C. Pollen grain *ca* 1900 years old from the same site, slightly collapsed; D. Fossil pollen grain from the Bellas Artes site, Mexico, completely collapsed, showing that it is ancient and does not represent contamination of the core samples.

PLATE 19

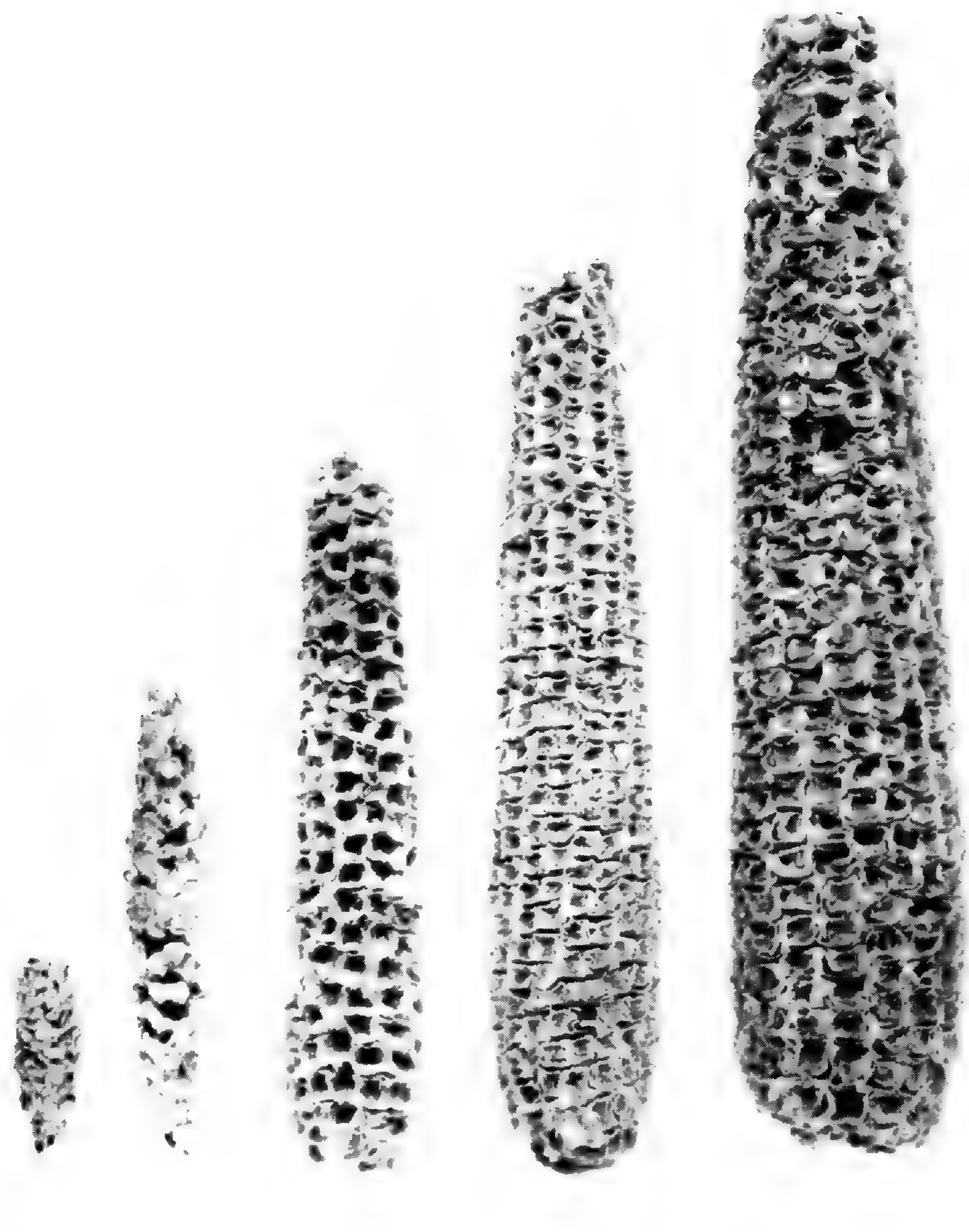

Plate 19. Evolution in ear length in 6500 years in the Tehuacan Valley, Mexico. The approximate ages of the cobs from left to right are 7000, 5300, 2200, 450 and 450 years respectively (*23*). This evolution, rapid as compared to that of other cultivated plants, is partly the product of wild corn's preadaptation to domestication by virtue of its large pollen as revealed by the fossil remains from the Bellas Artes site, Mexico.

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EFFECTS OF FIELD PRESERVATION ON THE FLAVONOID CONTENT OF *JESSENIA BATAUA*

GILLIAN A. COOPER-DRIVER* AND MICHAEL J. BALICK**

As a preface to a chemotaxonomic investigation on the *Jessenia-Oenocarpus* complex (Palmae), it seemed desirable to determine how specimens of plants collected in the field in the wet tropics should be best preserved for future chemical investigation.

Up to 30-40 years ago, most collected plant material was dried by placing it in a conventional press with frequent change of blotters to absorb moisture from the specimens, the entire process taking about a week (1). However, in the wet tropics much of the material was damaged by insects or micro-organisms before drying was complete, rendering the specimen of little value for taxonomic purposes. The artificial drying of such specimens by the use of field stoves or even electric bulbs overcame these problems, but collectors could not easily transport such equipment to remote study areas. Thus, the use of chemical preservatives was introduced to treat plants collected in the field and to prevent them from deterioration by insects or by rotting, until they could be dried at a base facility. Schultes (2) suggested a formalin (40% formaldehyde) and water mixture of approximately 1:5 to avoid the spoilage of most plant materials. Moore (3) recommended using a 1% aqueous solution of hydroxyquinoline sulfate, while Hodge (4) cited the use of an ethanol mixture, noting also that the use of

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potable spirits worked quite well if nothing else was available.

Although it is certain that such methods are useful for the adequate preservation of plant specimens for classical taxonomic purposes, it appeared likely to us that specimens preserved in such ways might have suffered a change in their chemistry. For example, formaldehyde is known to react with many aromatic compounds, while treatment with aqueous alcohols (ethanol and methanol) is the method of choice for extracting a wide variety of secondary compounds, used in chemotaxonomic studies, from plant tissues. Consequently, the use of such methods of preservation might make it difficult to properly survey the many different classes of such compounds which have been used for systematic purposes (5). Flavonoids, for example, as well as related phenolics, might be severely affected. These are probably the most useful class of secondary plant constituents for chemotaxonomic purposes because of their widespread distribution, diversity of structure, and relative ease of identification using simple apparatus (6).

Since the flavonoids have previously been shown to be useful in the taxonomy of the Monocotyledonae, including the Palmae (7), they would appear to be a useful group of compounds to throw light on specific problems relating to the taxonomy of the *Jessenia-Oenocarpus* complex. Since most of the material studied grows in the Amazon Valley, however, many miles from any centers of civilization, it was decided to determine whether the use of plant preservatives in the field would affect subsequent analysis of the material for flavonoid compounds. Preservative treatments similar to those that might be used in the field were, therefore, investigated under laboratory conditions, and the results are presented here.

The plants of *Jessenia Bataua* (Mart.) Burret used in this study were grown from a population of seeds collected from a single tree in Tukunaré, near Mitú, Comisaría del Vaupés, Colombia, in July of 1976. The seeds were germinated, planted in soil and grown under controlled conditions in a phytotron for one year, until the plants were 20 cm. high. Pinnae were removed and subjected to the following treatments in order to simulate the procedures that have been used previously in the field (2,4): 1. sun dried; 2. dried in an herbarium oven at 105°F; 3. soaked in water; 4. soaked in 95% ethanol; 5. soaked in white rum (86 proof, ca. 44% ethanol); 6. soaked in an FAA mixture (ethanol 90%: glacial acetic acid 5%: formalin 5%); 7. soaked in formalin (100% formalin, ca. 40% formaldehyde) and water in a 1:1 mixture; 8. soaked in formalin alone.

The material for treatments 3-8 was stored in the dark for four weeks at room temperature, and the leaves were then removed from the solutions and air dried. The solutions were kept in a refrigerator.

Two samples of dried leaves from each of the eight treatments described above were finely macerated, extracted with boiling 80% methanol, and the solution concentrated and made up to a final volume of 10 ml. The ultra-violet spectrum (220-400 nm) of the methanol extract (suitably diluted) was determined and the amount of phenolic compounds calculated, using caffeic acid (a cinnamic acid) and rutin (quercetin 3-0-rhamnoglucoside, a flavonol) as standards. Identical amounts of the methanol extracts were also examined by 2-dimensional chromatography, using the solvent systems n-butanol-acetic acid-water 6:1:2 (BAW) followed by 5% aqueous acetic acid (HOAc).

The solutions in which the leaves had been soaked were concentrated to a standard volume and subjected to 2-dimensional chromatography by the procedure described above.

The amount of phenolic compounds remaining in the leaf material following these various treatments is shown in Table 1.

TABLE 1

Treatment	phenols* mgm/gm dry wt.
1. Sun dried	12.5
2. Herbarium dried	11.5
3. Water	3.0
4. 95% Ethanol	2.4
5. White rum	2.4
6. FAA	0.9
7. Formalin-water 1:1	1.8
8. Formalin	1.6

*as caffeic acid

Two dimensional chromatography of the sun dried *Jessenia Bataua* leaf material gave the following pattern of major phenolic compounds. (Figure 1)

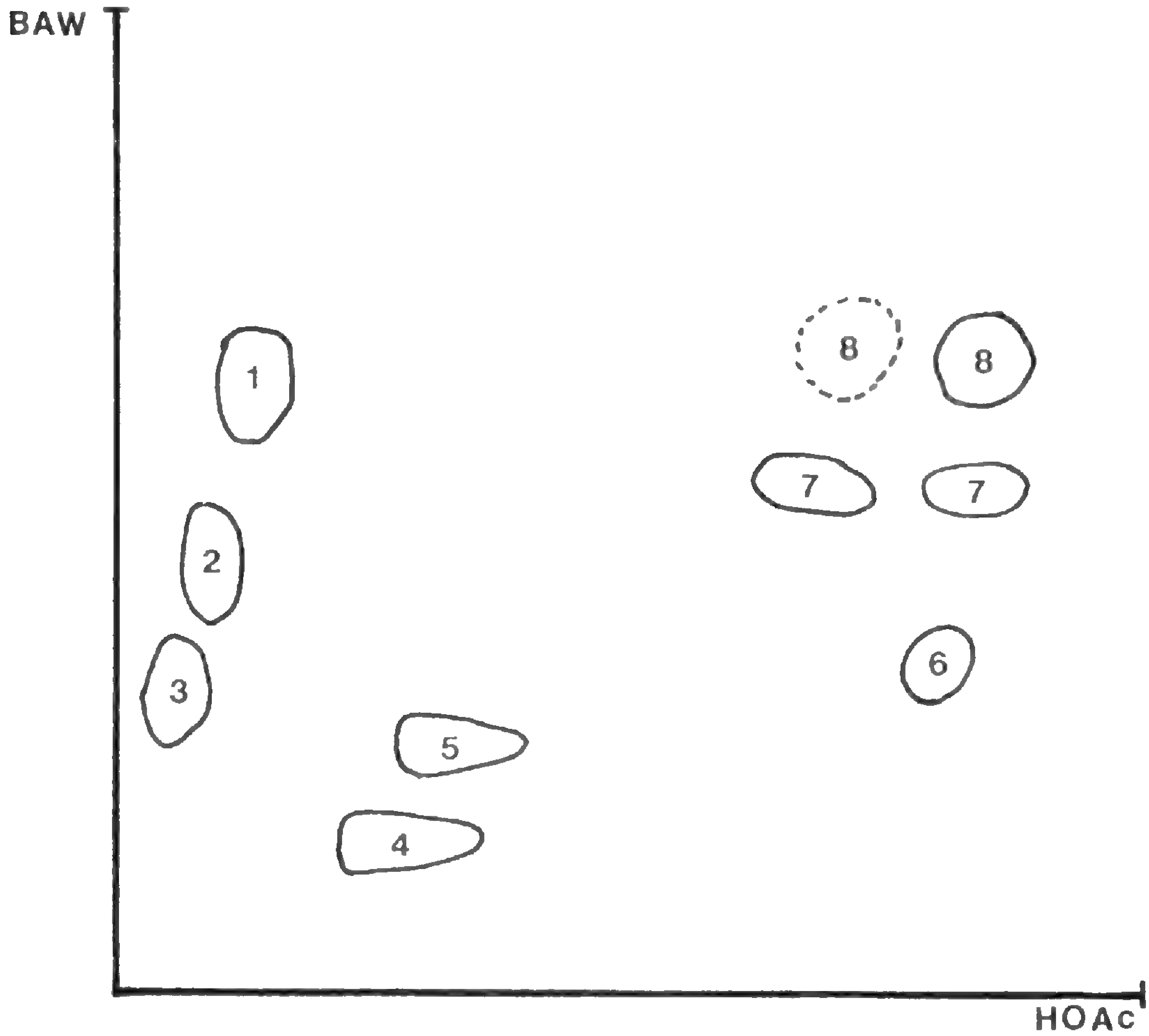

FIGURE 1. 2-dimensional chromatogram of ultra-violet fluorescent spots of flavonoids and related compounds in *Jessenia Bataua*.

From their fluorescence under ultra-violet light and their position on the chromatogram, it is believed that compounds 1-3 are flavonol glycosides; 4-5 flavone glycosides; 6 an unknown cinnamic acid and, compounds 7-8 isomeric forms of caffeic acid and p-coumaric acid derivatives respectively. Further investigations on the identity of these compounds is at present underway.

The 2-dimensional paper chromatograms showed that the following compounds were present in the various leaf extracts (Table 2).

The 2-dimensional paper chromatograms of the solutions in which the leaves had been soaked showed that the following compounds had been extracted from the leaves and were present in the solution (Table 3).

TABLE 2

Treatment		Phenolic compounds present							
		1	2	3	4	5	6	7	8
1.	Sun dried	++	++	++	++	++	++	++	++
2.	Herbarium dried	++	++	++	++	++	++	++	++
3.	Water	+	+	+	+	+	+	+	+
4.	95% Ethanol	tr	tr	tr	tr	tr	tr	tr	tr
5.	White rum	tr	tr	tr	tr	tr	tr	tr	tr
6.	FAA	–	–	–	–	–	–	–	–
7.	Formalin-water 1:1	–	–	–	–	–	–	–	–
8.	Formalin	–	–	–	–	–	–	–	–

(++ = very positive; + = positive; tr = trace; – = negative)

TABLE 3

Treatment		Phenolic compounds present							
		1	2	3	4	5	6	7	8
3.	Water	+	+	+	+	+	+	+	+
4.	95% Ethanol	++	++	++	++	++	++	++	++
5.	White rum	++	++	++	++	++	++	++	++
6.	FAA	+	+	+	+	+	+	+	+
7.	Formalin-water 1:1	–	–	–	–	–	–	–	–
8.	Formalin	–	–	–	–	–	–	–	–

As we expected, there is no doubt from the above results (Tables 1-3) that, if plant material is to be subjected to chemotaxonomic investigation for flavonoids or closely related phenolic compounds, the material must be preserved only by sun drying or by subsequent artificial drying. Soaking in preservatives containing 95% ethanol, white rum and FAA results in changes of cell permeability and consequent leakage of phenolic material into the solution (Table 3). Preservatives containing formaldehyde in high concentration (nos. 7 & 8), which cross link with proteins, carbohydrates and phenolic compounds to give insoluble precipitates, show no free phenolic compounds either in methanolic leaf extracts or in the solutions themselves. Water affects the concentration of the phenolics in the leaf less, but it is not a good preservative because of its lack of fungicidal or bacteriocidal properties. Therefore, care should be taken when using tropical herbarium material, since, in many cases, the nature of their treatment after collection is unknown.

On the basis of these results, ways of treating of *Jessenia Bataua* for subsequent chemical analysis can be rated as follows: (Table 4; highest rating is 1)

TABLE 4

Treatment	*Rating*
Sun dried Herbarium dried	1
Water	2
95% Ethanol White rum	3
Formalin-water 1:1 Formalin	4
FAA	5

Based on our preliminary experiments, the following suggestions can be made:

First: All herbarium material should be plainly marked on the label as to whether it has been chemically treated in the field and if so for how long and in what way. If specimens have been treated they are occasionally so marked, but rarely is it indicated that specimens were merely sun dried or herbarium dried. This lack of information reduces the value of these specimens as potentially useful samples for chemical study.

Second: With the increasing use of chemotaxonomy as one of the tools for systematics, at least 10 gms. and preferably 50 gms. of leaf material (or flowering material, or both depending on the plant) should, whenever possible, be collected, sun or 'blotter' dried separately, and affixed in an air tight bag to the original specimen for later chemotaxonomic use. This is especially urgent for tropical material, since the habitats listed on herbarium sheets often no longer exist. As flavonoids have been identified in herbarium specimens over 100 years old, there is little problem of subsequent shortage! A few hours of extra field effort in caring for this material might then help towards solving taxonomic problems which could arise in the future, especially during expeditions of "salvage botany", collecting from important localities due to be destroyed by colonization or programs of "development through destruction".

Obviously, further studies are needed on the use of preservatives covering the entire range of tropical material, including monocotyledyons and dicotyledons, ferns and lower plants, as has in part been done by Giannasi for temperate plants (pers. comm.). With chemotaxonomy less an experimental subject and coming of age as a valid systematic tool, our field methods must be readjusted to provide a source of reliable material for the future investigator. Thus, the use of this material will, it is hoped, serve in our attempt to understand the complex and dynamic biological order of the tropics.

ACKNOWLEDGMENTS

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PLATE 20

Plate 20. *Jessenia Bataua (Mart.) Burret* in a swampy habitat near Manáus, Brazil. - Photograph by M.J. Balick.

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DE PLANTIS TOXICARIIS E MUNDO NOVO TROPICALE COMMENTATIONES XXV

BIODYNAMIC ACANTHACEOUS PLANTS OF THE NORTHWEST AMAZON

Richard Evans Schultes

Continuing a series of articles to call attention to ethnopharmacologically important plants of the northwest Amazon, I herewith present notes on uses of several acanthaceous species which, during my field work in Colombia from 1941 through 1954, I encountered in the local native pharmacopoeias.

Most of the collections were identified by the late Dr. Emery C. Leonard of the Smithsonian Institution and have been cited in his *The Acanthaceae of Colombia* in Contributions of the United States National Herbarium 31. pt. 3 (1953).

Little is known of the phytochemistry of the Acanthaceae. Traces of an alkaloid have been found in *Justicia gendarussa* L. (Hegnauer, R.: *Chemotaxonomie der Pflanzen* 3(1964)46). Saponines have been reported from Aphelandra, Justicia, Mendoncia and Sanchezia; tannins from Aphelandra and Sanchezia; and cyanogenesis from *Aphelandra aurantiaca*, *Fittonia Verschaffeltii*, *Justicia carnea* and *Sanchezia nobilis*. (Gibbs, R.D.: *Chemotaxonomy of Flowering Plants* 3(1974) 1774-1775).

Specimens of the collections cited are preserved in the United States National Herbarium; the Gray Herbarium or the Economic Herbarium of Oakes Ames at Harvard University; and the Herbario Nacional de Colombia in Bogotá.

Aphelandra aurantiaca *(Schiedw.) Lindley* in Bot Reg. 31 (1845) t.12.

Colombia: Comisaría del Amazonas, Trapecio Amazónico, Río Loretoyacu "Herb. Flowers vermillion". October 20-30, 1945. *R.E. Schultes 6630.*

The root bark of *Aphelandra aurantiaca* is considered by the Tikuna Indians of the Trapecio Amazónico to have strong properties when administered in a warm decoction to alleviate progressive deafness due to old age. The decoction is dropped into the ears.

Aphelandra pilosa *Leonard* in Contrib. U. S. Nat. Herb. 31 (1951) 209.

COLOMBIA: Comisaría del Vaupés, Río Guainía. "Flowers scarlet". November 17, 1952. *R.E. Schultes, R.E.D. Baker et I. Cabrera 18455.*

A cold poultice of the crushed leaves of *Aphelandra pilosa* is applied by the Kuripako Indians of the Río Guainía to relieve swellings of the throat, due probably to chronic inflamation of the amygdalae.

Fittonia argyroneura *E. Coemans* in Fl. des Serres 15 (1865) 103.

ECUADOR: Napo, Río Aguarico, Dureno. "Primary forest". December 21, 1965. *H. Pinkley 15.*

According to the collector, this small plant, which the Kofán Indians call *minakóro - sé - hé - pa*, is made into a tea which is used to rinse out the mouth to relieve toothache.

Fittonia Verschaffeltii *(Lem.) E. Coemans* in Fl. des Serres 15 (1865) 186).

COLOMBIA: Comisaría del Putumayo, Río Sucumbíos, Quebrada Conejo, April 2-5, 1942. *R.E. Schultes 3480.*

The Kofán Indians, who call this herb *mee-ná-ku-ru*, state that it is used medicinally to alleviate a condition probably allied to chronic nephritis. A tea of the leaves is drunk three or four times a day when there is difficulty or pain in urination, usually in elderly members of the tribe. The decoction is also taken for sore throat and as a febrifuge.

Justicia Blackei *Leonard* in Contrib. U. S. Nat. Herb. 31 (1951) 508.

COLOMBIA: Comisaría del Amazonas, Trapecio Amazónico, Río Loretoyacu. "Herb. Flowers white and purple." September 1946. *R.E. Schultes et G.A. Black 8317.*

The Tikuna Indians of the Trapecio Amazónico, who know this plant as *kē-rḗ-ma*, valued the leaves in infusion to relieve a condition which seems to be due to chronic sinusitis. The tea is gargled and drunk. The Tikunas appear to be especially prone to sinus-related affections in the wet season.

Justicia Cabrerae *Leonard* in Contrib. U. S. Nat. Herb. 31 (1951) 566.

COLOMBIA: Comisaría del Amazonas, Río Pacoa and Río Kananarí. "Flowers white." June 20, 1951. *R.E. Schultes et I. Cabrera 12701.*

The roots of *Justicia Cabrerae* are esteemed by the Makuna Indians as the basis of a remedy for skin affections, probably of a fungal origin, of the crotch. The powdered root is mixed with lard from boars and rubbed repeatedly on the affected area. The Makuna refer to the plant as *mee-kee-ñá-ta-ree.*

Justicia chlorastachya *Leonard* in Contrib. U. S. Nat. Herb. 31 (1951) 495.

COLOMBIA: Comisaría del Amazonas, Río Apaporis, Soratama. June 20, 1951. *R.E. Schultes et I. Cabrera 12703.*

The pulverized roots of this plant are employed in the same manner as those of *Justicia Cabrerae*. The Makuna name is the same.

Justicia comata *(L.) Lamarck* Encycl. 1(1785)632.

COLOMBIA: Comisaría del Amazonas, Río Hamacayacu, between Amazon and Putumayo watersheds. "Herb. Flowers white, violet-spotted." September, 1946. *R.E. Schultes 8248.*

The Tikuna Indians gather the plants of *Justicia comata*, dry the leaves and pulverize them. Not only are the powders employed as perfumes, but they are believed to be efficaceous insect repellants when dusted on the body.

Justicia ideogenes *Leonard* in Contrib. U. S. Nat. Herb. 31 (1951) 622.

COLOMBIA: Comisaría del Putumayo, Río Sucumbíos, Quebrada Conejo. April 2-5, 1942. *R.E. Schultes 3538*.

Justicia ideogenes is one of the Kofán Indian remedies for a condition leading to a palsy-like trembling, usually associated with age. The whole plant is boiled in water, and the drink is poured warm with friction over the lower arms and the feet. The Kofán name of *J. ideogenes* is *mee-rē-ká-sē-pa* and *chu-rú-ko-pu*.

Justicia pectoralis *Jacquin*, Enum. Pl. Carib. (1760) 11.

BRAZIL: Territorio do Roraima, Posto Mucajaí, Rio Mucajaí. "Secondary forest by airstrip. Herb. Petals blue, stamens white." March 21, 1971. *G.T. Prance, W.C. Steward, J.F. Ramos et O.P. Monteiro 111 74*.

According to the collectors, this plant is "used by Indians for hallucinogenic & snuff". It is called by the Uaicá-Mucajaí *paxararok*.

Justicia pectoralis *Jacquin* var. **stenophylla** *Leonard* in Contrib. U. S. Nat. Herb. 31(1951)615.

BRAZIL: Estado do Amazonas, Rio Cauaburí, Maturacá. Waika=*mashihiri*. July 5 - August 12, 1967. *R.E. Schultes 24573* (Alpha-Helix Amazon Expendition, 1967)

Territorio do Roraima, Rio Tototobí, Waika village of Wayhana-oo-thle. August 6, 1967. *R.E. Schultes 24627* (Alpha-Helix Amazon Expedition, 1967).

Justicia pectoralis var. *stenophylla* is extensively cultivated in Waika villages. The leaves are dried, pulverized and added to the powdered "resin" of *Virola theiodora* (Spr. ex Benth.) Warb. in the preparation of the hallucinogenic snuff known in the region as *epena* or *nyakwana* (Schultes, R.E. and B. Holmstedt: Rhodora 70(1968)113-160).

It is possible, even probable, that this plant — as well as other species of Justica — may be used alone, without admixture, by various groups of the Waika in Brazil and Venezuela as the source of an hallucinogenic snuff (Schultes, R.E. in Efron, D. [Ed.] *Ethnopharmacologic Search for Psychoactive Drugs* (1967) 303; Chagnon, N., P. Le Quesne and J. Cook: Acta Cient. Venez. 21(1970)186-193).

It is clear that much more field work must be carried out before the whole picture of the importance of Justicia in hallucinogenic preparations is available.

Chemical studies of Justicia are still incipient. Reports of the presence of tryptamines need corroboration (Schules, R.E.: Ann. Rev. Pl.Physiol. 21(1970) 571-594; Schultes, R.E. and A. Hofmann, *The Botany and Chemistry of Hallucinogens* (1973) 192).

Justicia Schultesii *Leonard* in Contrib. U. S. Nat. Herb. 31 (1951) 545.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, Cerro Isibukuri. August 4, 1951. *R.E. Schultes et I. Cabrera 13222.*

Justicia Schultesii is used by the Makuna Indians in the same way and for the same purposes as *J. Cabrerae.*

Mendoncia aspera *(Ruíz et Pav.) Nees* in DeCandolle Prodr. 11 (1847) 51.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, Cerro Isibukuri. August 3, 1951. *R.E. Schultes et I. Cabrera 13259.* — Río Apaporis, Soratama. August 24, 1951. *R.E. Schultes et I. Cabrera 13710.*

The root of *Mendoncia aspera* is employed, crushed and thrown into still water as a fish poison by the Taiwano Indians (Schultes, R.E.: Lloydia 29(1966)302).

Ruellia colorata *Baillon* in Bull. Mens. Soc. Linn. Paris 2 (1890) 853.

COLOMBIA: Comisaría del Putumayo, Río Sucumbíos, Quebrada Conejo. "Large bush. Bracts fiery red, flowers red-orange. Used as ornament in nose, ears, wrists." April 2-5, 1942. *R.E. Schultes 3507.*

The Kofán Indians employ the root of *Ruellia colorata* as a vermifuge and vomitive. The roots are pounded into a paste which is simply kneaded in cold water. The Kofán name is *see-tu-ku-t̄-hē-ta.* In the Brazilian Amazon, the root of *Ruellia geminiflora* HBK. is considered a vomitive (LeCointe, P.: A Amazonia Brasileira 3(1934)205).

Sanchezia thinophila *Leonard* in Bot. Mus. Leafl. Harvard Univ. 16(1953)94.

COLOMBIA: Comisaría del Amazonas, Trapecio Amazónico, Río Loretoyacu. October 20-30, 1945. *R.E. Schultes 6607*. — Puerto Nariño, near mouth of Río Loretoyacu. September 13-15, 1966. *R.E. Schultes, R.F. Raffauf et D. Soejarto 24121*.

The Tikuna Indians of the Trapecio Amazónico prepare a decoction of the inflorescences of *Sanchezia thinophila* which is used as a wash to bathe the heads of girls who undergo the ritual adolescent initiating ceremony so characteristic of this tribe. The hair is forcefully pulled out, leading to profuse bleeding.

It is possible that this use is related to a kind of "Doctrine of Signatures" connection with the large, showy, blood-red bracts of the plant.

Little is known of the chemistry of Sanchezia. No biodynamic constituents have been reported for the genus, but may have a high tannin content. The leaves of *Schultes, Raffauf et Soejarto 24121* were alkaloid-negative with Dragendorff reagent.

Teliostachya lanceolata *Nees* var. **crispa** *Nees* in Martius, Fl. Bras. 9(1847)72.

PERU: Departamento de Loreto, Iquitos and vincinity. "*Toé negra*. Cultivated. Flowers white with violet. 0.5 - 1 m. in height." July 15, 1967. *R. Martin, T. Plowman et C. Lau - Cam 1638*.

The Kokama Indians use this plant as an hallucinogen and as an admixture in a narcotis preparation. Teliostachya seems not to have been phytochemically investigated.

PLATE 21

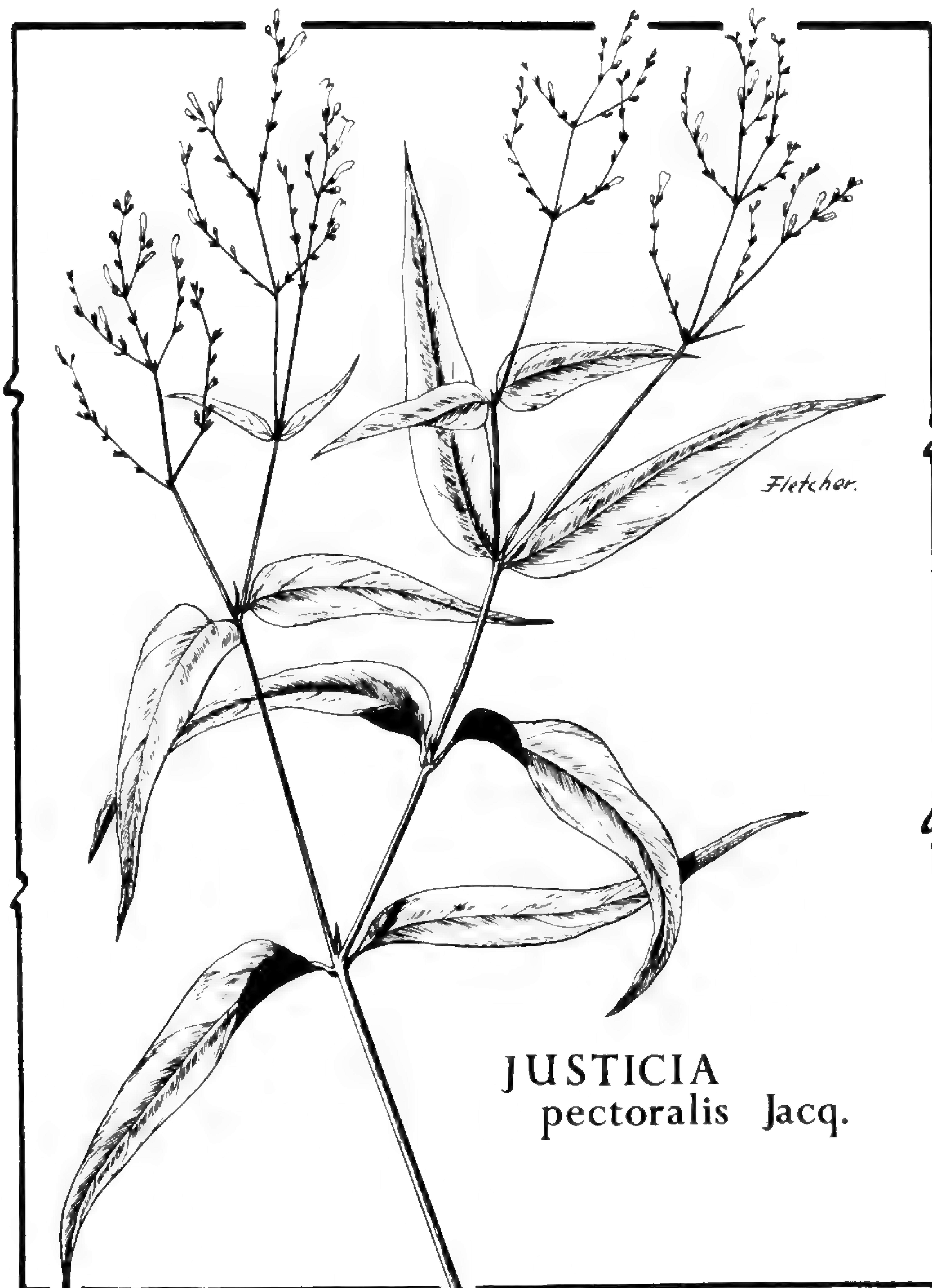

Plate 21. *Justicia pectoralis* Jacq.

PLATE 22

Plate 22. *Justicia pectoralis* var. *stenophylla* Leonard.

PLATE 23

Plate 23. *Mendoncia aspera* (Ruíz et Pav.) Nees.

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A NEGLECTED MAYAN GALACTAGOGUE
IXBUT *(EUPHORBIA LANCIFOLIA)*

FREDERIC ROSENGARTEN, JR.*

A potentially important medicinal plant — indigenous to Guatemala, Belice and Honduras — is the perennial herb *Euphorbia lancifolia* Schlecht., commonly known as "ixbut" in Guatemala and El Salvador, and less well known as "hierba lechera" in southern Mexico. It is a member of the spurge family (Euphorbiaceae).

According to Black's Medical Dictionary: "Galactagogues are drugs which increase the flow of milk in nursing women. The normal stimulus of an infant's lips is the most powerful agent in producing milk, and a mother who has little or no milk should nevertheless hold the infant to the breast. Good food and the hormone, prolactin, from the pituitary gland increase the quantity and improve the quality of milk."(1)

Traditional Guatemalan folklore claims that ixbut (rhymes with "wish-boot"), taken as an herbal tea, will stimulate lactation and increase the flow of mother's milk in postpartum women. A modern report in the *Flora of Guatemala* (2) states: "It is said to double the quantity of milk given by cows that eat it. An infusion or decoction of it often is given to nursing women to increase their flow of milk, and it is claimed that it will cause the milk to flow after it has ceased normally, or even in women who have not given birth to a child."

In this connection, one still hears countless tales about the

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wondrous powers of ixbut as a galactagogue, some of which border on the sensational: for example, there are numerous claims that aged grandmothers, or even great-grandmothers, after taking ixbut, have been able to suckle newlyborn infants through their withered breasts when the young mothers died in child birth.

An even more curious incident involving ixbut was reported in a Guatemalan newspaper in November 1952 (3): during the late 1890's, a Guatemalan physician, Dr. Pedro Molina F., was at his home near Flores, Petén. One afternoon, he received a message that he was urgently needed by a woman in labor. By the time he arrived at the isolated, humble, native hut, he managed to save the life of the baby girl, but the mother died. Dr. Molina thereupon asked the feeble great-grandfather, who appeared to be at least ninety years old, what woman was going to nurse the infant. This venerable progenitor replied that no woman was around, but no woman was in fact needed since he himself would be the wet nurse; he was going to drink a tea of the medicinal herb ixbut which would enable him to provide milk for his new great-granddaughter. The physician objected and reluctantly departed. Six days later, Dr. Molina returned to check on the condition of the baby: he found the old man boiling ixbut leaves in a pot of water; for five days he had been drinking the infusion, but he complained that his swollen breasts hurt him when the infant suckled. The physician examined the great-grandfather's breasts which indeed were enlarged like the teats of a perfect wet nurse and were exuding a milky juice that tasted like mother's milk. The baby was thriving.

I know of one authentic case: in 1963, Señorita Bertha García, a teacher in the dietary and anthropological service of the Institute of Nutrition of Central America and Panama (INCAP), was on a dietary survey with an INCAP technical, nutritional team in the village of Santa Cruz Balanyá, Departamento de Chimaltanango, when she met a 45-year-old Indian woman who was nursing a small 14-month-old baby. The woman's sister had recently died in child birth, and since the family was so poor they couldn't afford to buy milk or any other food for the infant — this woman, who had one son of twenty-five, and had not nursed a baby for a quarter of a century, took it upon herself to nurse her infant nephew. So she started to take a tea made from ixbut leaves, three times a day — and took it for several months. Señorita García was skeptical: upon request, the mature, nursing aunt exposed her breast, which indeed contained an abundant supply of milk.

The word "ixbut" had its origin in the early Mayan languages of the Pokom group (4) — then gradually spread to the quiché and mam tongues of Guatemala (5). "Ix" meant woman; while "but" stood for an increase in the flow or volume of water. Hence the implication that the plant ixbut increased the volume of liquid (i.e., milk) in women (4).

Euphorbia lancifolia *Schlechtendal* in Linnaea 7 (1832) 143.

This herb was described by D. F. L. von Schlechtendal on the basis of material collected in a shady forest at Misantla, Mexico, approximately 60 miles northwest of Vera Cruz, in early 1829, by the German collector Christian Julius Wilhelm Schiede.

The original description by Schlechtendal follows:

> 36. *E. lancifolia* n. sp.: herbacea carnosula glabra alternifolia, inflorescentia dichotoma terminali. Caulis articulatus, articulis longitudine eximie diversis, glaberrimus, laevis, in statu sicco striis elevatis notatus teres. Folia alterna breviter petiolata late lanceolata aut rhombeo-lanceolata, basi acute apice vero acutissime acuminata, superficie obscurius viridi glabra, pagina infera dilutiori glaucescente pilisque minutis albis adpressis oculo armato tantum in conspectum venientibus adspersa, integerrima, margine paululum inflexo, majora 3¼—3¾ p. longa, 17—19 l. in medio lata, petiolo 4—5 lineari. Flores in apicibus caulis terminalem et ex ultimis axillis axillares cymas efformant dichotomas, paucifloras abortu florum v. ramulorum lateralium, inferiori in sua parte bracteis parvis lanceolatis acutis 1½ lin. longis oppositis viduis saepe obsessas. Involucrum campanulato-turbinatum 4-fidum, laciniis exterioribus inaequalibus (3 majoribus quarta) erectis (an semper?) semirotundis inferne bilabiatis, labiis angustis lacinia brevioribus, laciniis interioribus alternis minoribus tenerioribus apice laciniatis. Stamina s. flores masculi more generis et flos centralis pedicellatus, dein elongatus nutans, ovario dense breviter piloso. Fructus non vidimus nec juniores. — In sylvis umbrosis Misantlae. Mart.

A contemporary description, published by Standley and Steyermark in *Flora of Guatemala* (2) follows:

> "A perennial herb, somewhat fleshy and succulent, the stems terete, pale greenish, glabrous or nearly so, ascending or procumbent or prostrate, sometimes greatly elongate, as much as 2 meters long or more, and subscandent; leaves alternate, on very short, stout petioles, mostly rhombic-lanceolate and 5-9 cm. long, acute or acuminate, acute at the base, entire, green and glabrous above, pale beneath and inconspicuously and sparsely pilosulous or glabrate, the lateral nerves obsolete; involucres in small, almost naked, terminal cymes, campanulate-turbinate, 4-lobate, glabrous, the lobes obovate, fimbriate, the glands transverse-ovate, the appendage semiorbicular, crenulate, white or whitish."

The range of *Euphorbia lancifolia* is now known to include southeastern Mexico, Guatemala, Belice, El Salvador and Honduras. It seems to be most abundantly represented in Guatemala where it has been recorded from Alta Verapaz, Escuintla, Petén, Izabal, Santa Rosa, Suchitepequez, Retalhuleu, Guatemala, Sacatepequez, Quezaltenango, San Marcos, Quiché and Huehuetenango. It prefers damp thickets, occasionally growing, however, in pine forests or in open fields. Ixbut may be found at many different elevations: at 1,000 feet or less on the warm lowland areas of the Pacific coast in the Departments of Escuintla, Suchitepequez and Retalhuleu — to areas up to 5,800 feet and sometimes higher in the Departments of Quezaltenango, San Marcos and the Alta Verapaz, in the cool highlands.

The vernacular names of *Euphorbia lancifolia* have been reported as *ixbut* and *sapillo* (2), but the plant is usually known throughout Guatemala, and even beyond the borders of the country, as *ixbut*. It was introduced to Cuba, where the name has been recorded as *isbut*.

Ixbut may have originated in the warm, humid drainage basin of the region known today as the Departamento del Petén, Guatemala — possibly near San Benito, southwest of Lake Petén Itzá (6). (See map, Plate 28)

Ixbut plants may be readily multiplied by root cuttings. In the Cobán region (Alta Verapaz), ixbut is often cultivated as a medicinal herb near villages, so it will be readily available as a galactagogue.

Standley and Steyermark (2) report: "Rather curiously, it is claimed in Cobán that the plants often cause the death of cattle and horses eating them, and this may be the result of the inherent properties of the seeds."

I have never heard reports during my field work in Guatemala that would indicate toxicity in *Euphorbia lancifolia;* nor in my discussions with local physicians has any such danger been expressed. It should be emphasized that the leaves and branchlets of ixbut, not the seeds, should be utilized. Furthermore, the seed, which is minute, apparently is not used by the native population. It is probable that the report about the death of horses and cattle is the result of a confusion of ixbut with another plant, possibly another species of *Euphorbia,* which genus does have toxic species.

Roys points out (7) that in ancient Maya medicine, in the "Ritual of the Bacabs," the Maya doctors believed in curing like with like: a vine that looked like a serpent was considered a fitting cure for snake bites; a yellow fruit was given as medicine to cure jaundice; red plants or fruits were prescribed for patients who vomited blood or suffered from dysentery. Since ixbut contained an abundant, sticky, milky sap, which exuded from its broken stems and leaves, it was fitting that it may have been recommended to increase milk flow in nursing mothers.

Erwin P. Dieseldorff, a German naturalist who settled in the Cobán region of Guatemala during the latter part of the nineteenth century, included ixbut in a booklet which he wrote on medicinal plants of the Alta Verapaz (10). He described it as a prevalent herb growing especially well in damp areas. The dark green ixbut leaves, containing a milky latex, should be cooked in water together with their tender branchlets to prepare an herbal tea, to be used as a galactagogue.

In March 1971, the Instituto Indigenista Nacional de Guatemala published a bulletin (9) concerning popular medicine in rural areas of Guatemala. The medicinal plant ixbut is mentioned several times in this report, especially to increase lactation in postpartum nursing mothers. It was listed as a popular folk remedy in Cobán and Chamelco, in the zone of Kekchí; and in San Cristobal Verapaz and Tamahú in the zone of Pocomchí.

Usually it is recommended that the ixbut leaves be boiled in water; the liquid allowed to cool; sugar added, and the drink consumed three times a day. In Tamahú, it is likewise suggested that fresh ixbut leaves be eaten, uncooked, like a salad.

In another portion of this same report, fresh ixbut leaves are recommended as a cure for sexual impotence, in the village of San Cristobal Verapaz.

By 1945, *Euphorbia lancifolia* had been introduced to Cuba (8), where it was recommended as a galactagogue. Just as in Guatemala, it was reported in Cuba that "isbut" could increase lactation up to 100% in nursing mothers.

In 1949, Dr. Manuel Serrano, a botanist, chemist and pioneer in the serious testing and utilization of ixbut in Guatemala, reported on a series of controlled tests that had been carried out on a group of nursing mothers at or near the General Hospital in Guatemala City — in collaboration with Merck & Co., Inc. (11). Of the 86 postpartum women tested, 54 showed an abundant increase in the production of milk after taking ixbut. In some cases, mothers who during earlier parturitions had been unable to nurse, were able to do so effectively after drinking an herbal tea of ixbut for several days. In one case, following a Caesarean section, the milk secretion had been almost nonexistent: 48 hours after the administration of ixbut, however, the lactic secretion increased to such an extent that not only was the child thoroughly satisfied, but the excess of mother's milk soaked the sheets during the night.

The results of the ixbut tests were carefully checked by Dr. Serrano. The duration of the therapy was usually from 3 to 5 days. The parts of the ixbut plant utilized were those above the ground, i.e., the stems, leaves and flowers — but not the roots. The average dose of ixbut given to the women: 5 leaves or 5 sections of stem (about 5 grams) were brewed to make a cup of herbal tea; then 6 cups of ixbut tea were given daily to each patient.

The chemical analysis of the mothers' milk carried out before and after the intake of ixbut showed that the quality of the milk did not undergo any notable change in its composition, even though the ixbut may have excited additional secretion.

Dr. Serrano cautioned that the ixbut tea should not be allowed to ferment: when it turns yellow, it should be discarded since it might cause diarrhea.

Time magazine published an article in 1949 (12) entitled "Milkweed," in a section devoted to Medicine. It described some of Dr. Manuel Serrano's experiments with ixbut in Guatemala: controlled testing of 1,800 women who had experienced trouble in nursing their babies indicated that 50% could not nurse at all without ixbut; 35% who could nurse only a little showed notable improvement after taking ixbut; while 15% did not benefit from ixbut.

Dr. Serrano pointed out to *Time* that he was convinced that ixbut increased milk flow — actually milk, and not water. The active principle in ixbut that caused the increase in lactation had not been isolated in 1949. (Today, thirty years later, it still has not been determined just what this active principle may be.) Dr. Serrano in 1949 ruled out the milk-producing hormone *prolactin:* while prolactin did not enable his wife to nurse her four babies, ixbut did.

Between 1949 and 1951, the late Dr. Efrén C. del Pozo of Mexico City, former Secretary General of the Unión de Universidades de America Latina, carried out considerable research on ixbut in collaboration with Merck & Co., Inc., both in Mexico City and in Guatemala City (13).

During 1949, Dr. del Pozo's first testing was made at the Centro Materno Infantil Ávila Camacho in Mexico City on 21 nursing women. The ixbut plant material had been shipped by Air Cargo from Guatemala City and was thus from 4 to 7 days old. During 1950, Dr. del Pozo carried out further research at the Mexico City Penitentiary: 14 lactating mothers were tested; 11 were given ixbut, while 3 were left as controls. In 1951, a third series of tests involving ixbut took place in Guatemala City under Dr. del Pozo's direction, at the Maternidad de Guarderías Infantiles, on 22 nursing women and 3 non-lactating women.

On the whole, the results of Dr. del Pozo's experiments on the effect of ixbut were inconclusive and somewhat negative, even though in some nursing mothers a variable increase of lactation was noted following treatment with an aqueous extract of ixbut; average dose approximately 750 cc., a 10% infusion, daily for 25 days.

Dr. del Pozo made the following observations following three years of research on ixbut:

(1) For an accurate evaluation of any galactagogue such as ixbut, a long control period is necessary, since short term trials are unreliable;

(2) As a result of his studies, Dr. del Pozo concluded that ixbut does not induce lactation in non-lactating women — despite popular, folkloric claims in Guatemala to the contrary.

(3) Ixbut does not produce breast pain or congestion in lactating women between the second and fourteenth month of lactation;

(4) Ixbut does not produce any appreciable change in breast volume or in the mammary glands of nursing mothers;

(5) The active principle (if any) of ixbut does not seem to be unstable. Very fresh plant material administered in Guatemala did not show higher activity than material several days old. This fact is also contrary to popular belief in Guatemala;

(6) Ixbut seems to have higher activity as a galactagogue in Guatemala during the month of November, i.e., in the early part of the dry season in Guatemala City shortly before the plant blossoms;

(7) On the whole, in the opinion of Dr. del Pozo, the lactogenic properties of ixbut have been considerably exaggerated — not only in the case of women, but also when he carried out ixbut tests on postpartum female cats;

(8) Dr. del Pozo, however, pointed out that the striking effects of ixbut reported in Guatemala by lay people cannot be totally denied on the basis of his testings. The Guatemalan claims refer mainly to ixbut used during the first days after delivery when lactation is started; while his tests were designed usually to explore lactagogue effects from two to fourteen months after childbirth;

(9) Furthermore, Dr. del Pozo personally knew of the case of a woman in Mexico City who had to feed artificially two of her previous children for lack of natural milk. When she received infusions of fresh ixbut, she was able to breastfeed her third child with a remarkable increase of the volume of milk.

During 1952, Merck & Co., Inc. discontinued its research on ixbut. It was felt that although ixbut may have some effects as a galactagogue during the first days of lactation, these results were highly irregular and difficult to prove.

Ixbut has been used, off and on, for many years to supplement cattle feed in Guatemala (4). In 1894, Fermin Rosal noted that his own cows in Cuyotenengo, on the Pacific coast of Guatemala, were not producing anywhere nearly as much milk as the cows on the neighboring hacienda which were being fed ixbut.

In 1911, Eduardo Saravia Castillo elaborated a Guatemalan product called "GALAC-LATEX" as a supplement for cattle feed, in which ixbut was the principal ingredient. This galactagogue was apparently successful for a few years, but it is no longer produced.

In June 1927, Professor Guillermo Gándara carried out an experiment in La Ceiba, El Salvador, concerning the effect of ixbut on milk production in cows (14). The poorest producer was selected from 8 milch cows. This cow had been producing on the average 2 bottles of milk (each bottle roughly 3/4 liter) daily. For 5 consecutive days the cow was given, as a dietary supplement, an infusion of ixbut — 250 grams per liter of water; then normal forage for 3 days; then 3 days more of the dietary supplement of ixbut. At the end of 11 days, this cow had tripled its production of milk from 2 bottles to 6 bottles per day.

In 1947, J. Ignacio Aguilar noted in southeastern Mexico that ixbut would increase milk yields in cows, when mixed with other cattle forage (15). He recommended mixing ixbut in small quantities — about 1.5 grams ixbut leaves per kilo of the cow's weight — in an aqueous solution to supplement other cattle feed in order to provide a balanced diet for dairy cows. He observed, however, that too much ixbut should not be fed to the cows: for a few days milk yields would increase substantially, but then gradually decrease as the animals' physical condition deteriorated, possibly due to overstrain and exhaustion.

According to Aguilar, ixbut is a galactagogue par excellence for dairy cows, superior to alfalfa and other tropical, leguminous forage plants. Ixbut is extremely vigorous and more resistant to plant diseases than alfalfa. For best results, ixbut should be planted in warm, shady, protected areas where there is constant humidity. It is readily propagated by root cuttings; it should be planted in rows 35 centimeters apart, with approximately 25 centimeters between the plants in the rows. After two years, under favorable conditions, an average of 25 tons of green ixbut forage may be harvested per hectare per year; with two cuttings in the rainy season and one in the dry season. Each time the forage is cut, new growth is stimulated. If cared for properly, an ixbut pasture should last 15 to 20 years.

In a laboratory analysis, Aguilar (15) found that ixbut leaves *(Euphorbia lancifolia)* contained 7.46 per cent protein, as compared to 4.72 per cent for alfalfa *(Medicago sativa)*.

In 1949, Dr. Manuel Serrano (11), in collaboration with Merck & Co., Inc., investigated the effect of ixbut on the milk production of 6 goats in Guatemala City. The goats were given a 5% aqueous infusion of fresh ixbut plant material daily, for a period of 4 days. No signs of toxicity were noted. A modest increase in goat's milk production was observed in each case.

During 1949, tests were made of the insecticidal properties of 78 species of plants from tropical America used as fish poisons, insecticides or drugs (16). Through several years, roots, stems, leaves, flowers and seeds were collected and tested at the Puerto Rico Agricultural Experiment Station, Mayaguez, Puerto Rico, to determine the toxicity of the materials to insects.

Five species were found to be highly toxic; 30 species partially toxic; while 43 species, including ixbut *(Euphorbia lancifolia)* were found to be non-toxic to insects.

In 1957 (17), Squibb, Braham and Scrimshaw carried out experiments on the utilization of the carotenoids of ixbut *(Euphorbia lancifolia)*, teosinte *(Euchlaena mexicana)*, yellow bamboo leaves *(Bambusa vulgaris)* and green bamboo leaves *(Bambusa ventricosa)*, by New Hampshire chicks over a 5-week feeding period. The carotene content and vitamin A activity of dehydrated forage meals prepared from these ingredients were studied. It was found that ixbut contained the highest carotene content of the four forages and maintained the highest serum levels of vitamin A. The dehydrated meals prevented mortality and permitted good weight gains.

The chemical composition of these dehydrated forage meals was as follows:

Ingredients	Ixbut	Yellow bamboo leaves	Green bamboo leaves	Teosinte
Ash, gm.%	9.8	21.3	19.7	12.5
Calcium, mg.%	1,519	—	—	1,163
Iron, mg.%	53.3	13.4	8.0	147.6
Phosphorus, mg.%	400	86	86	320
Moisture, gm.%	9.2	8.6	6.6	4.0
Ether extract, gm.%	5.9	2.5	2.3	3.1
Crude fiber, gm.%	16.2	21.7	24.4	21.6
Nitrogen, gm.%	1.90	1.61	1.55	1.20
Carotene, mg.%	15.05	12.32	8.61	8.28
Vitamin C, mg.%	73	6	8	38
Vitamin B_2, mg.%	0.66	0.90	0.65	0.57
Vitamin B_1, mg.%	0.04	0.10	0.16	0.10
Niacin, mg.%	4.22	2.54	3.10	3.32

The following chromatographic analyses of dried ixbut leaves from Guatemala City, Guatemala, were reported by the chemical research laboratory of SISA Incorporated of Cambridge, Massachusetts, on August 21, 1979:

EXTRACTION OF *EUPHORBIA LANCIFOLIA* (IXBUT)

In order partially to characterize some of the principles of *Euphorbia lancifolia*, an extract of dried ixbut leaves was prepared and the extract subjected to gas-liquid chromatography (figure 1) and high pressure liquid chromatography (figure 2).

The gas-liquid chromatographic analytical method separates the components of the extract primarily on the basis of their volatility with the most volatile materials appearing first.

The high pressure liquid chromatographic analytical method separates the components primarily on the basis of polarity. With a "reverse phase" column of the type used here, the more polar components appear early on the chart.

Since in both of these methods each peak on the chart corresponds to at least one component in the mixture, the results shown in figure 1 and figure 2 indicate that the extract contains a large number of components. These components have not been identified but the results indicate that these methods, particularly the high pressure liquid chromatographic method, could be used to separate some of the components in quantities large enough for further chemical and biological characterization. The analytical scans are, in effect, the signature of ixbut in chromatography under the stated conditions, for future reference.

PROCEDURE

A 5.0 g sample of dried leaves of *Euphorbia lancifolia* was homogenized briefly with 100 ml of ethanol in a blender. The mixture was transferred to a Soxlet apparatus and extracted at reflux with 250 ml of 95% ethanol. These extraction conditions were chosen to approximate the use of the plant by boiling the leaves in water to give an herbal tea.

The ethanolic extract was subjected to gas liquid (glc) and high pressure liquid (hplc) chromatographic analyses.

The glc analysis was carried out on a 6ft x 1/8 inch stainless steel column of 2% OV-17 on 100/120 mesh Supelcoport using a Varian 1400 instrument equipped with a temperature programmed run from 100°C to 340°C at 20°/min. temperature rise. The glc scan for this run is shown in figure 1.

The hplc analysis was done on a 30 cm x 3.9 mm "reverse phase" column of μ Bondapak C_{18} using a Water ALC 200 instrument with an ultraviolet (254 nm) detector. A satisfactory analysis was obtained using acetonitrile as the mobile phase. The hplc scan for this run is shown in figure 2.

According to Dr. Juan José Urrutia, Chief, Nutrition and Infection program of the INCAP, ixbut is rarely used at the present time as a galactagogue in Guatemala City. On the whole, the pure Indian in the rural areas of Guatemala produces more milk for breast feeding than the urbane mother of white or mixed racial background in the city.

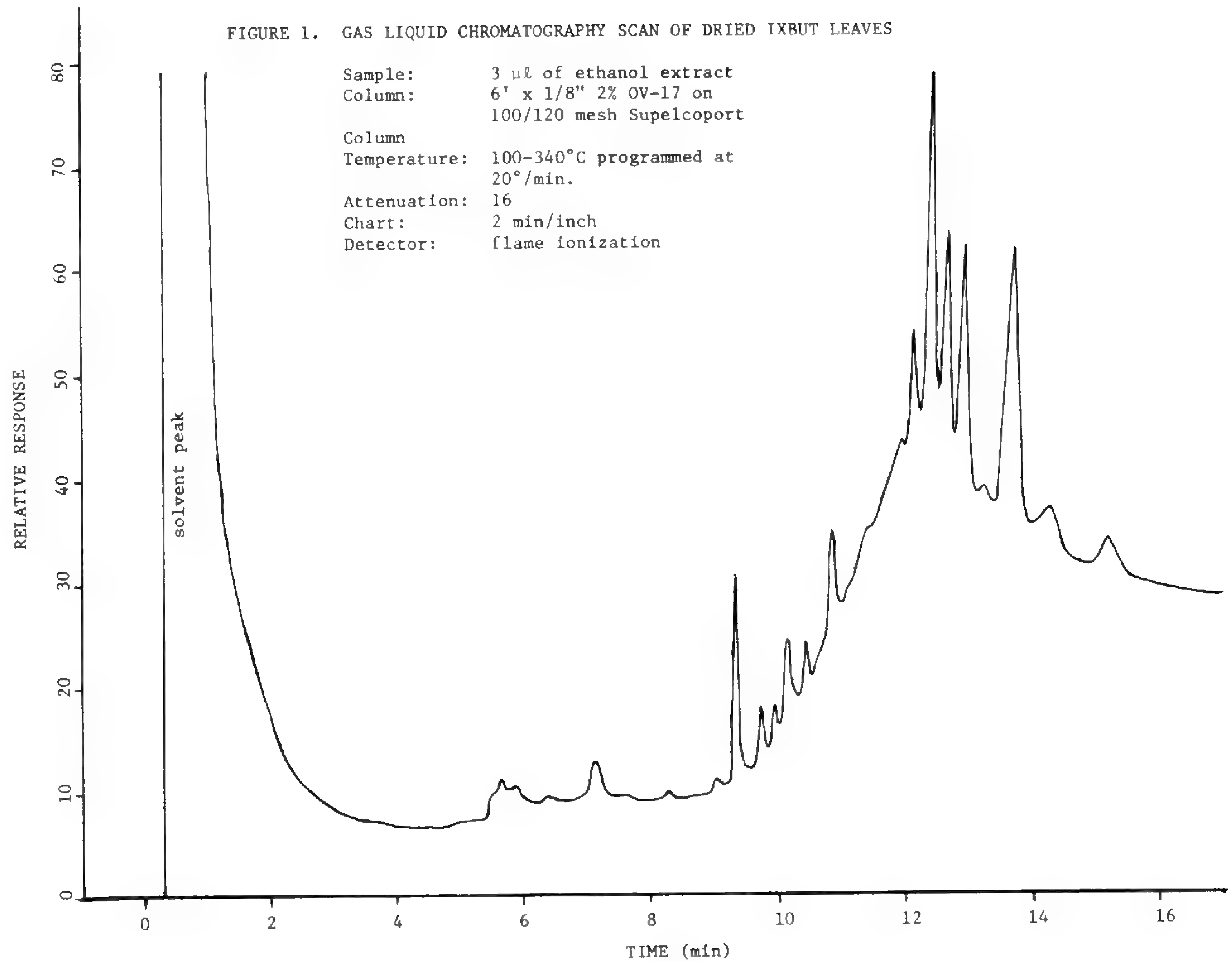

FIGURE 1. GAS LIQUID CHROMATOGRAPHY SCAN OF DRIED IXBUT LEAVES

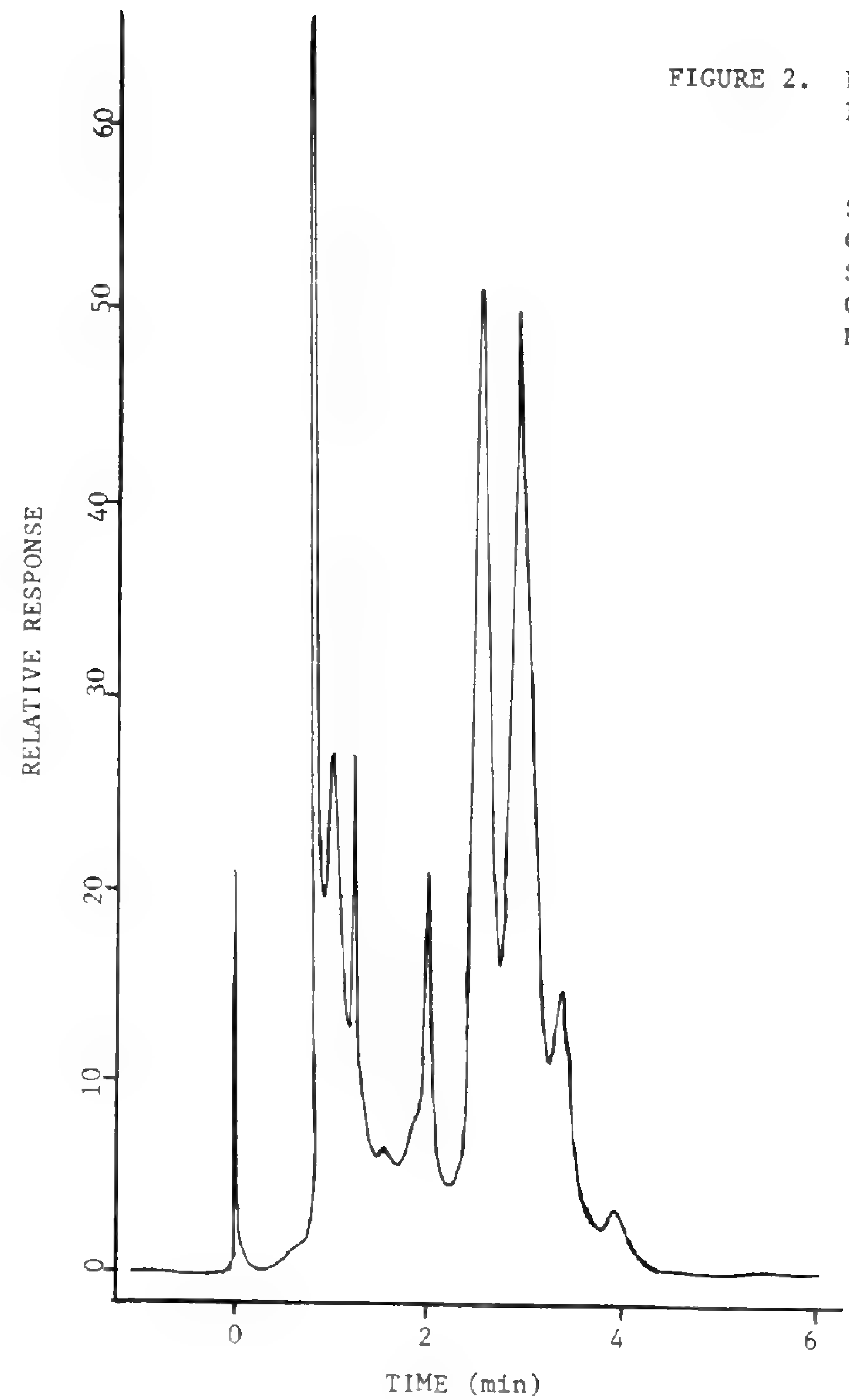

FIGURE 2. HIGH PRESSURE LIQUID CHROMATOGRAPHY SCAN OF DRIED IXBUT LEAVES

Sample:	25 μℓ Ethanol extract
Column:	30 cm x 2.9 mm μ Bonapak C_{18}
Solvent:	acetonitrile 4 ml/min
Chart:	2 min/inch
Detector:	ultraviolet absorption (254 nm)

In remote regions of Guatemala, the Indian women today still utilize ixbut, but only when they have trouble producing breast milk, especially during the first 3 days postpartum. In these far-off localities, the baby has no other food or water, and depends on his mother's milk for both, during a period of 2 months or longer.

In Guatemala City, on the other hand, the urbane women are no longer interested in ixbut; they can obtain other foods for the baby such as powdered milk, bottled milk, eggs and vegetables.

Dr. Juan José Hurtado V., a specialist in pediatric medicine in Guatemala City, concurs that ixbut is used much less in Guatemala in 1979 than it was 30 years ago when he was a resident intern. In those days, Dr. Hurtado heard a great deal about the merits of ixbut as a galactagogue: midwives frequently recommended it. In fact, when Dr. Hurtado was born in Guatemala City in 1926, his mother took an infusion of ixbut leaves three times a day for several days and was able to breast-feed him. At that time, ixbut was a "fashionable" medicinal herb, readily available in several local markets. At the present time, it is vitually impossible to find ixbut in any market in or near Guatemala City. According to Dr. Manuel Serrano, ixbut is still sold in small quantities, from time to time, in the more remote, indigenous markets of San Felipe Retalhuleu, Cobán and Colomba.

Dr. Hurtado categorizes ixbut as a non-toxic, beneficial, medicinal herb, rarely used or even mentioned today in Guatemala City.

The American Academy of Pediatrics and the Canadian Pediatric Society have recently issued a joint statement to encourage all physicians to recommend breast-feeding (18). The "breast is best" movement is apparently gaining in popularity. *The Harvard Medical School Health Letter* stresses the critical role of breast feeding in preventing gastroenteritis in infants in developing countries. Respiratory infections, meningitis and other overwhelming infections are less frequent among breast-fed infants.

Mrs. Dina Nathusius is one of the Guatemalan leaders of La Leche League International, Inc., of Franklin Park, Illinois —

a group interested in fomenting natural nursing of babies through breast-feeding. Mrs. Nathusius points out that in the local Guatemalan chapter of La Leche League, young mothers are advised it is perfectly allright to take ixbut if they want to, just as their mothers and grandmothers used to many years ago, since it is not toxic and might indeed help them psychologically — by giving them confidence, by relaxing them and so helping them to nurse their babies. Some young mothers have indeed informed Mrs. Nathusius that ixbut has aided them to breast-feed their babies. Mrs. Nathusiu confirms, however, that very little ixbut is utilized at the present time in Guatemala in comparison to two generations ago.

In *Maternity Nursing* (19), it is emphasized that worry and emotional tension have an adverse effect on lactation in the nursing mother. Perhaps, as Mrs. Nathusius suggests above, ixbut itself may at times be beneficial as a tranquilizer — due to its soothing, relaxing effect upon those postpartum mothers who have confidence in its power as a tried and true galactagogue.

In 1950 (13), Dr. Efrén del Pozo, in fact, found in experiments of his own as a Mexican physician, that intravenous injections of ixbut caused a fall of blood pressure and a marked slowing of the heart, in tests carried out on lactating women in the Mexico City Penitentiary.

Dr. Lewis H. Sarett, Senior Vice President, Science and Technology, of Merck & Co., Inc., has the following comments to make about ixbut: to date the active principle of this galactagogue has not been isolated; if found, it would consist probably of pure crystals resulting from a chemical fractionation of the fresh plant material.

It is a long and costly process now to introduce a new drug. The problems following Thalidomide during the late 1950's and early 1960's led to the Kefauver-Harris amendments of the Pure Food and Drug laws in 1962 — designed to prevent a recurrence of the Thalidomide tragedy in any new drug.

Although there is a trend towards a greater utilization of products of nature, there are much longer delays in gaining Food and Drug Administration approval for their use. For example, even if ixbut, let us say, should prove to be an effective galactagogue for dairy cows, the F. D. A. might take a dim view of adding a drug orally to cattle feed which would show up in milk for human consumption — unless it were completely metabolized in the liver or in the intestinal tract.

In order to gain approval of drug regulatory agencies in most countries, it would be necessary to measure the level of the product (ixbut) and its metabolites in milk. An adequate safety ratio would have to be determined: all major metabolic products should be checked to determine their toxicoligical effects on at least two species of animals, with the drug adminstered over a period of several years. Extreme caution would be necessary.

CONCLUSION

Ixbut, *Euphorbia lancifolia*, is a potentially important, natural galactagogue of Central American origin, worthy of further chemical and pharmacological study.

This medicinal herb has been used for centuries in Guatemala, in Maya medicine, to increase the flow of milk in postpartum, lactating mothers. If used in moderation, it seems to have no toxic side effects in humans.

Ixbut, when mixed with cattle fodder, is reputed to have increased milk yields in cows.

Since the active principle of ixbut has never been isolated, considerable research would be necessary before any valid conclusions could be drawn concerning its future importance in medicine or in the dairy industry.

The voucher collection of leaves of *Euphorbia lancifolia* upon which this article is based (Frederic Rosengarten, Jr. *s. n.*, July 10, 1979, Guatemala City, Guatemala) has been deposited in the Botanical Museum of Harvard University.

ACKNOWLEDGMENTS

I wish gratefully to acknowledge the valued cooperation and orientation of Dr. Manuel Serrano, Universidades

Guatemala-Alemania, Quezaltenango, Guatemala, who provided me with much pertinent information concerning the folklore and other ethnobotanical data available on ixbut, as well as several relevant photographs.

I also wish to express my appreciation to the following persons who have provided assistance to me during the preparation of this article: to Dr. Richard Evans Schultes for his thoughtful editorial guidance; to Dr. Lewis J. Sarett and Mrs. Martha Windholz of Merck & Co., Inc., Rahway, New Jersey; to the late Dr. Efrén C. del Pozo of Mexico City; to Dr. Elfriede de Pöll, Lic. Mario Dary Rivera and Prof. José Esteban Jimenez Ochoa of the Botanical Garden, Guatemala City; to Dr. Juan José Hurtado V. of Guatemala City; to Dr. Juan José Urrutia and Señorita Bertha García of the INCAP, Guatemala City; to Dr. Norman R. Farnswoth of the University of Illinois at the Medical Center, Chicago; and to Mr. Franz J. Ippisch, Mrs. George-Ann Mellen and Mrs. Dina Nathusius of Guatemala City.

ILLUSTRATIONS: Plates 24, 25, 27, 30 and 31 by A. Gutt; plate 26 from *Las Plantas Medicinales del Departamento de Alta Verapaz*, by Erwin P. Dieseldorff, 1940; plates 28 and 29 by Elmer W. Smith; plates 32, 33, 34 and 35 by Dr. Manuel Serrano.

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(18) *The Harvard Medical School Health Letter.* February, 1979. Vol. IV, No. 4. 3.
(19) Reeder, Sharon R., Mastroianni, Luigi, Jr., Martin, Leonide L. and Fitzpatrick, Elise. *Maternity Nursing.* Thirteenth edition. J. B. Lippincott Company, Philadelphia. 362.

PLATE 24

Plate 24. The rank, much-branched, perennial herb, ixbut — 7 years old. Botanical Garden, Guatemala City.

PLATE 25

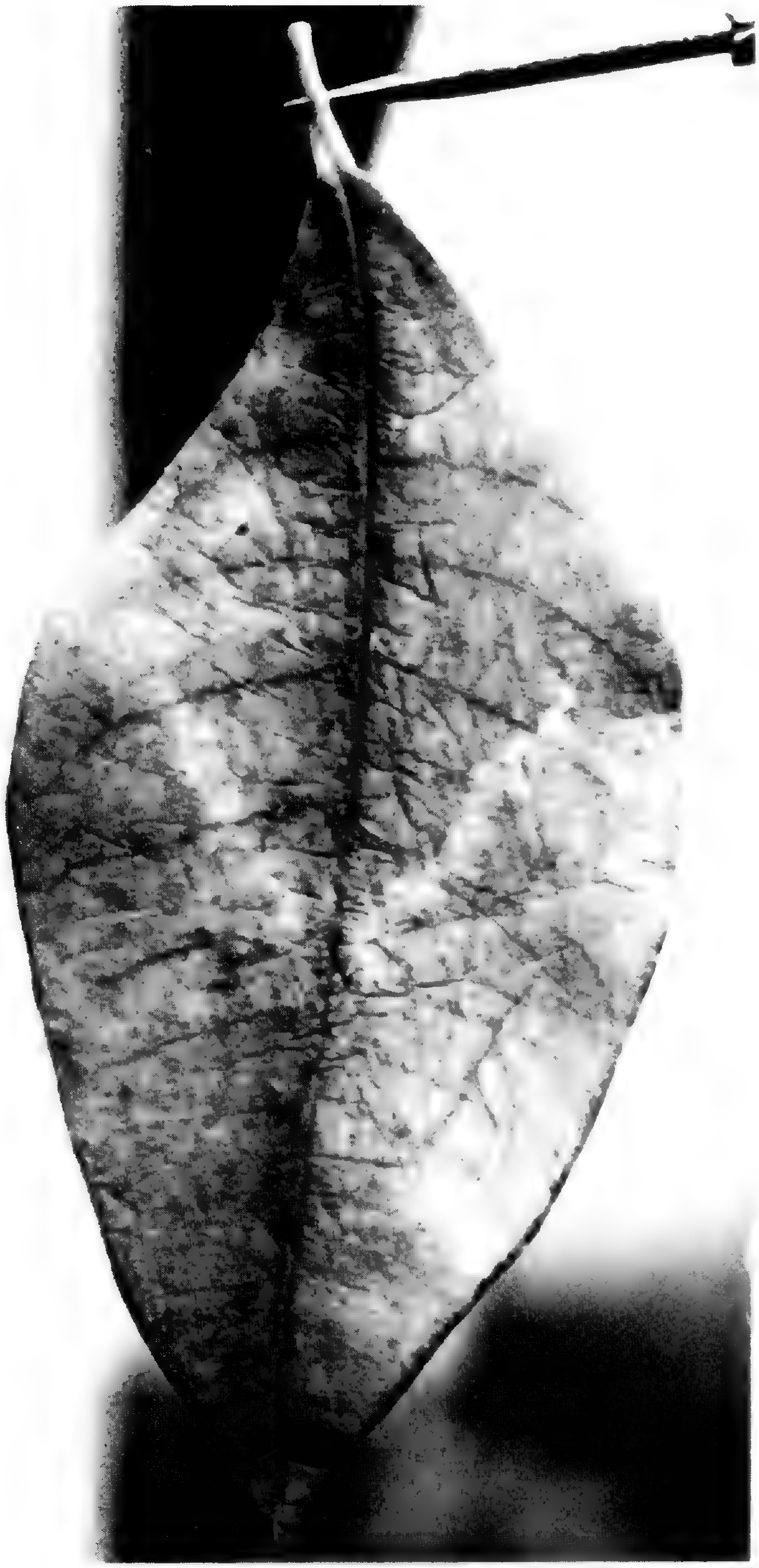


Plate 25. The rhombic-lanceolate, dark green ixbut leaf, 5 to 9 cm. long, is usually characterized when fresh by a unique white "V", stretching from midrib to margin.

PLATE 26

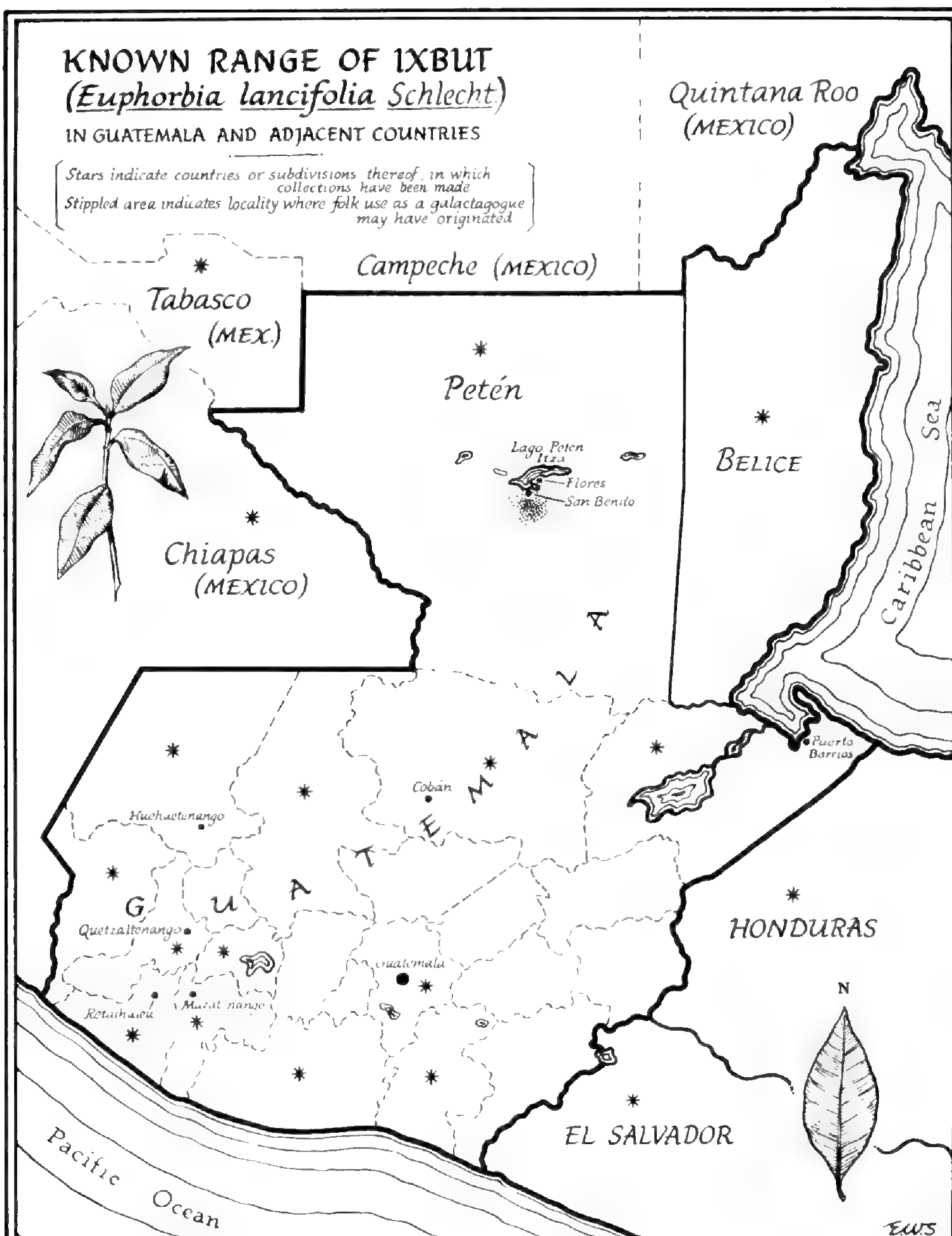
Ixbut

Plate 26. Drawing of ixbut from Erwin P. Dieseldorff's *Las Plantas Medicinales del Departamento de Alta Verapaz.* Note the typical V-markings on the leaves.

PLATE 27

Plate 27. Ixbut in the Botanical Garden, Guatemala City. The leaves contain a milky latex, possibly the source of the active galactagogue principle.

PLATE 28


KNOWN RANGE OF IXBUT
(Euphorbia lancifolia Schlecht)
IN GUATEMALA AND ADJACENT COUNTRIES
Stars indicate countries or subdivisions thereof, in which collections have been made
Stippled area indicates locality where folk use as a galactagogue may have originated
Quintana Roo (MEXICO)
Campeche (MEXICO)
Tabasco (MEX.)
Petén
Lago Peten Itza
Flores
San Benito
BELICE
Caribbean Sea
Chiapas (MEXICO)
GUATEMALA
Cobán
Huehuetenango
Quetzaltenango
Puerto Barrios
HONDURAS
N
EL SALVADOR
Pacific Ocean
EWS

EXPLANATION OF PLATE 29

(1) Flowering stems, about one half natural size.
(2) Root system with nodules, about one half natural size.
(3) Inflorescence (cyathium), showing nectar glands, the four fimbriate lobes of the cup, and the single, pendent, developing female flower, about seven times natural size.
(4) One segment of the dried dehiscent seed capsule, about six times natural size.
(5) Fresh seed, about six times natural size.

Botanical Illustration by E. W. Smith

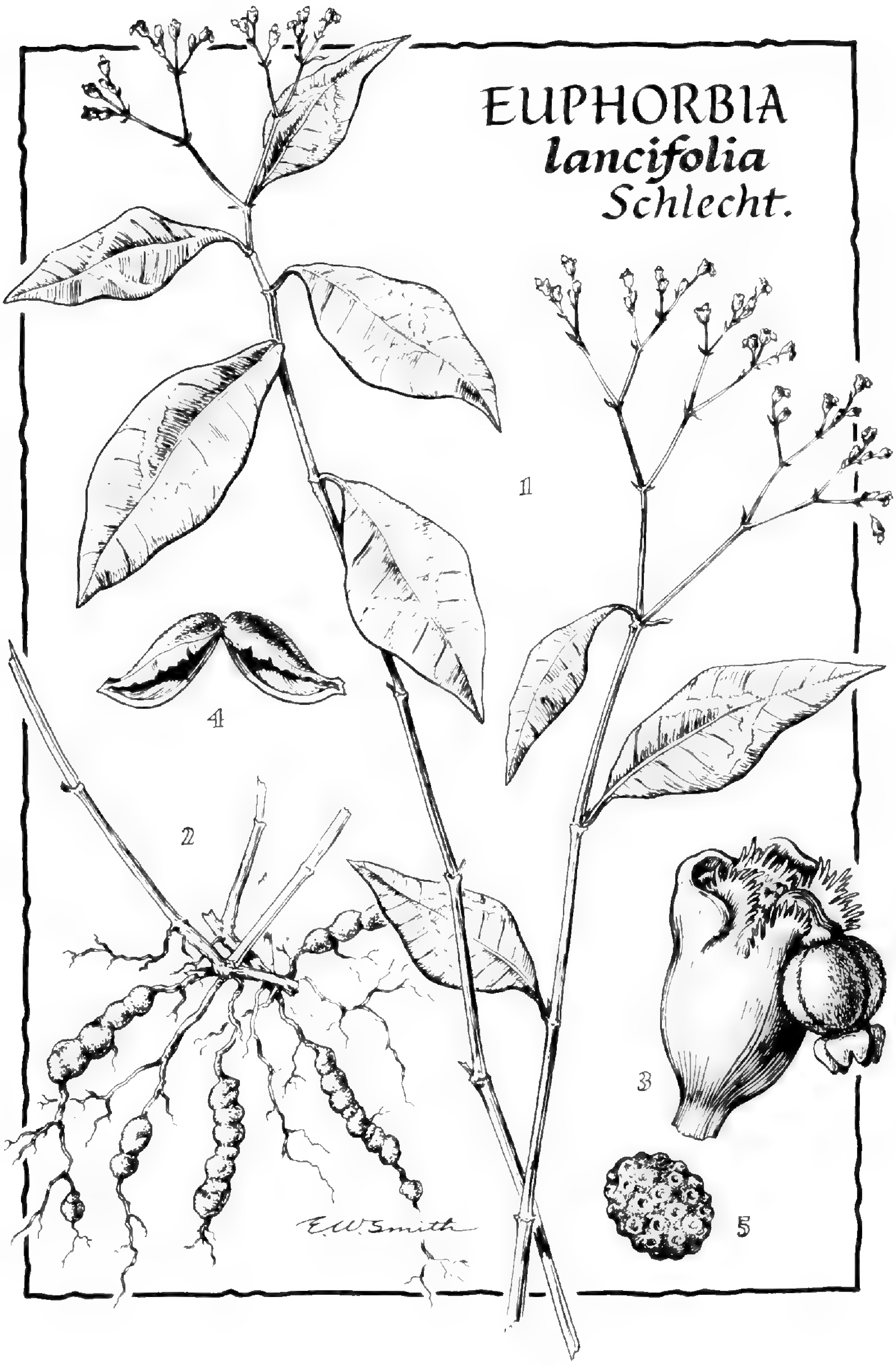

EUPHORBIA
lancifolia
Schlecht.
1
2
3
4
5
E.W. Smith

PLATE 30

Plate 30. Ixbut in the Botanical Garden, Guatemala City.

PLATE 31

Plate 31. Close-up view of root system of ixbut.

PLATE 32

Plate 32. An 18-year old, postpartum, Indian mother selects ixbut leaves for brewing in her herbal tea. Quezaltenango, Guatemala.

PLATE 33

Plate 33. The traditional Guatemalan Indian preparation of ixbut tea: brew about 5 grams (5 fresh, macerated ixbut leaves) in 250 cc. of boiling water; allow to cool; add sugar as desired.

PLATE 34

Plate 34. Dosage of ixbut herbal tea, traditionally recommended in Guatemala: 6 cups daily for 3 to 5 days to promote lactation. (Daily dose of 30 grams of ixbut in infusion.)

PLATE 35

Plate 35. 24 hours after this young Indian mother had taken ixbut tea, she was able successfully to breast-feed her baby.

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EVOLUTION OF THE IDENTIFICATION OF THE MAJOR SOUTH AMERICAN NARCOTIC PLANTS

RICHARD EVANS SCHULTES[1,2]

There are usually two events to consider in the identification of a narcotic: 1) the first description or reference to its use in the literature or some other evidence — such as archaeological — of its use; and 2) the earliest botanical collection or identifiable illustration definitely associating the plant with its utilization as an inebriant.

It should be then at once obvious that the basic step in our understanding of any hallucinogen or other psychoactive plant must necessarily rest upon a correct identification. Clearly no chemical or pharmacological studies can be carried out on a sound basis, until certainty concerning the vegetal source be established; and anthropological or sociological investigations likewise must suffer from lack of full and accurate botanical determination of the source plant. The exact Latin binomial, ideally backed up with a voucher specimen filed away in a recognized botanical institution, is almost always essential to progress in understanding any drug.

Contrary to widespread belief, the botanical identification of medicinal, toxic and narcotic plants is not an easy task. Often frustratingly slow, it frequently demands years of field work. Sometimes — though fortunately not often — aboriginal users oppose study by outsiders of their sacred plants. More frequently, however, obfuscation resulting from careless, hasty or incompetantly gathered or interpreted data by well meaning but untrained investigators clouds the issues for many years. There are sundry instances where, even today, we are beset with doubts about the true and complete source of hallucinogenic preparations.

[1]Delivered at the conference *Hallucinogens in Native American Shamanism and Modern Life*, San Francisco, California, September 30, 1978.

[2]Paul C. Mangelsdorf Professor of Natural Sciences, Harvard University; Director, Botanical Museum of Harvard University.

The apparently wide use of vegetal additives to alter the effects, strength and duration of the activity of some of the principal plant components of biodynamic drinks, snuffs and chews is still in a very preliminary stage of investigation. It promises to disclose a rich understanding of often hidden plant properties on the part of the South American aborigines.

In view of the present state of our knowledge, then, it may be advantageous to review the steps in identifying a number of the major psychotropic plants currently used in South America and to look at what little we know about some of the additives employed in a few of the hallucinogenic preparations.

ERYTHROXYLACEAE

Erythroxylon* *P. Brown*

Coca must be rated as the most important and culturally significant narcotic of South America. It likewise is the psychoactive plant that, of the New World flora, has played the greatest role in Western medicine. Yet our understanding of the source plant or plants has been woefully inadequate. Recent studies are beginning finally to clarify some of the botanical and ethnobotanical mysteries surrounding coca and its aboriginal use.

The chewing of coca — practiced by millions of Indians in the Andes and in the western Amazon — represents probably the oldest use of a narcotic in South America. The oldest archaeological records of coca-chewing date from at least 3000 B.C. Figurines of this remote date demonstrating the pouched cheeks of coca-chewers have been discovered in sites of the Valdivia Culture of coastal Ecuador (Lathrap, 1979). This discovery represents the earliest known specimen of a continuous series of Ecuadorian figurines showing coca-chewing, primarily in the northern highland area of the country.

Actual pre-Incan coca leaves have been found in a grave site located along the coastal area of Peru, with a radio carbon dating of 1314 B.C. (Lanning, 1967).

*This generic epithet is often spelled *Erythroxylum* and it has been suggested that *Erythroxylum* is nomenclaturally correct (Plowman, 1976). In this non-taxonomic article, I prefer to employ the more widely used and more familiar *Erythroxylon*.

The first writer to discuss coca use appears to be Monardes in 1577. An English translation of his writing appeared in 1596 under the title *Joyfull Newes out of the New-found World* (Frampton, 1596).

The first voucher botanical specimens of coca were collected in Provincia Sica Sica in the Ungas region of Bolivia by the French botanist Joseph de Jussieu in 1749. The species *Erythroxylon Coca* was described in 1786 by the French naturalist Jean Baptiste Lamarck. There are three duplicate types of this species preserved in the herbarium of the Jardin des Plantes in Paris, together with illustrations made by Jussieu.

It has long been widely believed that there is in reality only one species of *Erythroxylon* cultivated and employed as a narcotic. As in the case of *Cannabis* — where many botanists now recognize three, not one, species — recent intensive research has established the fact that two cultivated species are involved in coca use: *E. Coca* and *E. novogranatense* (Morris) Hieron. (Plowman, per. comm.).

Although *Erythroxylon Coca* has been botanically known since 1786, a precise understanding of the taxonomy of this group of plants has, as a result of intensive field work, been available only in very recent times due primarily to the investigations of Timothy C. Plowman.

Species indicated in the foregoing discussion:

Erythroxylon Coca Lamarck, Encycl. 2 (1786) 393.
Erythroxylon novogranatense (Morris) Hieronymus in Engler, Bot. Jahrb. 20, Beibl. 49 (1895) 35.

Myristicaceae

Virola *Aublet*

One of the most important — yet most recently identified — of the South American hallucinogens is that prepared from a blood-red resin-like exudate of the inner bark of the myristicaceous *Virola*. It is most commonly employed as a snuff and has various names, differing according to tribe and locality. The best known names, however, are *yakee* and *yato* in Colombia, *paricá, epena* or *nyakwana* in Brazil (Schultes, 1954a, 1954b).

Although used in the western Amazon generally, *Virola* as a narcotic is most intensely utilized in the northwesternmost part of Brazil, adjacent parts of Colombia and the Orinoco headwater areas of Venezuela: a region where Spruce concentrated several years of his field research, and where he devoted special attention to the diversity of species of *Virola;* yet he failed to discover this interesting native use of the genus.

It seems that the first mention of the snuff is that of the German ethnologist Theodor Koch-Grünberg who, in 1923, referred to an intoxicating powder called *hakudufha* prepared from a tree-bark by the Yekwana Indians of the Orinoco (Koch-Grünberg, 1923). "This is a magical snuff", he wrote, "exclusively used by witch doctors and prepared from the bark of a certain tree which, when pounded up is boiled in a small eathenware pot, until all the water has evaporated and a sediment remains at the bottom of the pot. This sediment is toasted in the pot over a slight fire and is then finely powdered with the blade of a knife. Then the sorcerer blows a little of the powder through a reed . . . into the air. Next, he snuffs, whilst, with the same reed, he absorbs the powder into each nostril successively. The hakudufha obviously has a strongly stimulating effect, for immediately the witch doctor begins singing and yelling wildly, all the while pitching the upper part of his body backwards and forwards."

Koch-Grünberg did not authenticate this discovery with botanical material, but there would appear to be little doubt that his description applies to *Virola*-snuff.

The earliest botanical association of an inebriating snuff with the Myristicaceae or Nutmeg Family appeared in 1938. The Brazilian botanist Adolpho Ducke indicated that the "Indians of the upper Rio Negro use the dried leaves of this species [*Virola theiodora*] and of *V. cuspidata* in making a snuff powder that they call *paricá*" (Ducke, 1938). A year later, in writing about the leguminous tree *Anadenanthera peregrina*, the seeds of which are the source of yopo-snuff, he elaborated as follows: "Martius and other writers attribute to this species the source of the narcotic paricá employed by certain Amazonian Indians

. . . . Notwithstanding, according to information which I obtained from the natives themselves in two localities in the upper Rio Negro, the *paricá*-powder comes from the leaves of species of *Virola* . . ." (Ducke, 1939). It is now known with certainty that the leaves are not used, but Ducke's reports represent apparently the earliest identification of this narcotic powder with the correct genus of trees.

It was not until 1954, however, that the preparation of the snuff was described in detail and specifically identified on the basis of voucher botanical material. During my ethnobotanical studies in Amazonian Colombia, I encountered the Indians of the Vaupés region preparing a brownish snuff taken for ceremonial inebriation only by witch doctors for diagnosis and treatment of disease, prophecy and divination and for a variety of other magical purposes. It was prepared from the inner bark of *Virola calophylla* (Spr.) Warb. or *V. calophylloidea* Markgraf (Schultes, 1954a, 1954b). Later field work indicated that *V. elongata* (Benth.) Warb. is likewise a source of the drug (Prance, 1970, 1978; Brewer-Carias and Steyermark, 1976).

Gradually, studies established the fact that the most intense use of *Virola*-snuff occurs amongst the large group of Indian subtribes known collectively as the Waikas, inhabiting the upper reaches of the Orinoco and the northern tributaries of the Rio Negro of Venezuela and Brazil, respectively. These Indians refer to the snuff usually as *epena, ebene* or *nyakwana*.

The main source of the powder amongst the Waikas is *Virola theiodora* (Spr. ex Benth.) Warb., as established by voucher specimens which Bo Holmstedt and I collected from two different groups of these Indians in Brazil in 1967 (Schultes and Holmstedt, 1968). Other species have been indicated by Ettore Biocca for the same region (Biocca, 1966), but it seems that botanical material upon which corroboration of these identifications can be based is no longer available if, indeed, it ever was collected: the other species that he reports are *V. calophylloidea, V. cuspidata,* (Benth.) Warb. and *V. rufula* (Mart. ex DC.) Warb. Since these species do give positive alkaloid reactions to spot tests in the field, it is possible that they are actually used as the basis of narcotic preparations.

Subsequent to the discovery of the use of *Virola* in preparing a snuff, it was learned that the Witoto Indians of Colombia and their neighbours, the Boras and Muinanes, employ the red exudate of several species of *Virola* to make pellets which are ingested to induce intoxication (Schultes, 1969). In 1969, the use of *V. theiodora* for this purpose was first reported from the Witotos of the Río Karaparaná of Colombia, but these Indians indicated that several other species might also be so utilized (Schultes and Swain, 1976). In 1976, with Holmstedt and Plowman, I learned that the Witotos and Boras of adjacent parts of the Peruvian Amazon do indeed employ several species for this purpose. *V. elongata, V. loretensis* A.C.Sm., *V. Pavonis* (DC.) A.C. Sm. and *V. surinamensis* (Rol.) Warb. (Schultes, Swain and Plowman, 1977). Of extreme interest was the report that the Boras apparently employ the myristicaceous *Iryanthera macrophylla* (Benth.) Warb. as the basis of one of these hallucinogenic preparations.

There is one group of very primitive, nomadic Makú Indians in the Río Piraparaná of Colombia, who drink the resin of *Virola elongata* directly with no preparation in order to induce the intoxication. This observation, based on voucher specimens, was made by the British anthropologist Peter Silverwood-Cope in 1969. There are, likewise, vague suggestions written on herbarium material collected by the American botanist Julian Steyermark in 1964, that witch doctors in Venezuela smoke the inner, dried bark of *V. sebifera* Aubl. for curing fevers or to drive away evil spirits. Both *V. elongata* and *V. sebifera* are alkaloidal, and these reports, consequently, may be based in actual effects of the plants as used.

Species indicated in the foregoing discussion:

Iryanthera macrophylla (Spruce) Warburg in Nov. Act. Nat. Cur. 68 (1897) 155.
Virola calophylla Warburg in Nov. Act. Nat. Cur. 68 (1897) 231.
Virola calophylloidea Markgraf in Fedde Repert. 19 (1923) 24.
Virola cuspidata (Benth.) Warburg in Nov. Act. Nat. Cur. 68 (1897) 176.
Virola elongata (Benth.) Warburg in Nov. Act. Nat. Cur. 68 (1897) 178.
Virola loretensis A.C. Smith in Bull. Torrey Bot. Club 60 (1933) 95.
Virola Pavonis (A.DC.) A.C. Smith in Brittonia 2 (1937) 504.
Virola rufula (Mart. ex DC.) Warburg in Nov. Act. Nat. Cur. 68 (1897) 181.
Virola theiodora (Spr. ex Benth.) Warburg in Nov. Act. Nat. Cur. 68 (1897) 187.
Virola surinamensis (Rol.) Warburg in Nov. Act. Nat. Cur. 68 (1897) 208.

Anadenanthera *Spegazzini*

Historically, the most important South American hallucinogenic snuff is *yopo* or *niopo*, now used almost exclusively in the Orinoco basin of Colombia and Venezuela.

The earliest report of what undoubtedly must have been this snuff dates from observations made in 1496 (Safford, 1916). The Taino Indians of Hispaniola called the snuff *cohoba*. They inhaled it to communicate with the spirit world. It was, according to an early writer, ". . . so strong that those who take it lose consciousness; when the stupefying action begins to wane, the arms and legs become loose and the head droops . . . and almost immediately they believe that they see the room turn upside-down and men walking with their heads downwards." Because of the almost complete disappearance of Indians from the Caribbean, the use of the cohoba snuff no longer exists in the Antilles. For many years, cohoba was thought to have been tobacco-snuff, in spite of the clearly very different effects noted in this earliest observation.

In 1916, the American ethnobotanist William E. Safford definitely identified the cohoba of the West Indies as the same intoxicating snuff as yopo of the Orinoco (Safford, 1916). Pointing out that the intoxication caused by yopo of the Orinoco was very similar to that described for cohoba, Safford suggested that the two must be one snuff under different names. He reasoned that, since the West Indian islands were populated by several invasions of Indians from northern South America, the custom of using this snuff — as well as the source plant itself — had been introduced to the Caribbean Islands from the Orinoco basin. The pattern of distribution of this tree in the West Indies does indeed suggest that it is an introduction.

The snuff was mentioned by the early Jesuit explore of the Orinoco region, José Gumilla, in his book *El Orinoco Ilustrado* of 1741.

The earliest botanical report of yopo appears to be that of the German naturalist-explorer Baron Alexander von Humboldt who, in 1801, identified the source as *Acacia Niopo* — an early name for the plant now known as *Anadenanthera peregrina*

(L.) Speg. (Humboldt, 1819). In 1819, he reported that the Maypure Indians of the Orinoco, whom he had seen prepare the drug eighteen years earlier, softened and kneaded the beans of this leguminous tree into small cakes with cassava flour (*Manihot esculenta* Cranz.) and lime from snails; these cakes were the supply of snuff when it was desired. Von Humboldt erroneously reported that ". . . it is not to be believed that the *Niopo acacia* pods are the chief cause of the stimulating effects of the snuff" but that ". . . these effects are due to the freshly calcined lime." The botanist K. S. Kunth, who worked with Humboldt, reported in 1825 the following concerning this plant: "Ex seminibus tritis calci vivae admixtis fit tabacum nobilisque Indi otomacos et guajibos utuntur" (Kunth, 1825).

It was the British plant-explorer Richard Spruce, however, who offered the earliest detailed report on the narcotic, basing it on field studies amongst the Guahibos of the Orinoco of Colombia and Venezuela in 1851 (Spruce, 1908). He collected not only voucher herbarium specimens of *Anadenanthera peregrina* but material of the pods and beans for chemical study and ample ethnological material connected with the preparation and use of yopo — material still preserved at the Royal Botanic Gardens, Kew. It is interesting to note that the seeds collected in 1851 for chemical study were not analyzed for more than a century and that their analysis was published only in 1977 (Schultes, Holmstedt, Lindgren and Rivier, 1977).

It is believed that another species of *Anadenanthera* – *A. colubrina* (Vell.) Brenan — was formerly employed in preparing an intoxicating snuff known as *vilca* or *huilca* in southern Peru and Bolivia and *cébil* in northern Argentina. This species of *Anadenanthera* has the same active principles — tryptamines — as the closely related *A. peregrina* of the Orinoco and could have been the source of an inebriating preparation. The evidence, however, is wholly circumstantial and rather weak. No voucher material has ever been connected with the preparation of an hallucinogenic snuff in southern South America, and, of course the Indians who formerly prepared vilca and cébil have long since disappeared (Altschul, 1967). Recent studies have, however, discovered the hallucinogenic smoking of *A. colubrina* amongst Indians of the northwest of Argentina (Califano, 1976).

At the present time, the use of *Anadenanthera peregrina* in elaborating yopo is restricted apparently to the Orinoco Valley and adjacent regions. There are snuffs prepared and employed in other areas of tropical South America which have been attributed to *A. peregrina*, although, due to the limited distribution of this species and lack of voucher specimens, there are serious doubts that these snuffs are, in reality, derived from this legume. It may possibly be that a century ago, the distribution of *A. peregrina*, as a result of Indian cultivation of the tree, could have been somewhat wider.

One example of the confusion resulting from incomplete botanical identification of drugs — or lack of it — are the maps prepared for anthropological use, in which great areas of South America are blacked in as regions where snuff from *Anadenanthera peregrina* is employed — even in vast expanses where it is known that the plant does not occur (Cooper, 1949; Lathrap, 1975). There are a number of other psychoactive snuffs used in South America — especially *tobacco, rapé dos indios, coca, epena* and *koribo* — yet, because of its greater historical importance, yopo has immediately come to the fore in anthropological literature as the major narcotic snuff.

Species indicated in the foregoing discussion:

Anadenanthera colubrina (Vell.) Brenan in Kew Bull. 1955, 2 (1955) 182.
Anadenanthera colubrina (Vell.) Brenan *var Cebil* (Griseb.) Altschul in Contrib. Gray Herb. Harvard Univ. 193 (1964) 53.
Anadenanthera peregrina (L.) Spegazzini in Physis 6 (1923) 313.
Anadenanthera peregrina (L.) Spegazzini *var. falcata* (Benth.) Altschul in Contrib. Gray Herb. Harvard Univ. 193 (1964) 50.

Mimosa *Linnaeus*

Here we still have real problems in precise identification, and it may be too late to solve them.

Although the use of *vinho de jurema*, an intoxicating drink once important in aboriginal cultures in northeastern Brazil, has apparently become extinct, this narcotic preparation was formerly a major hallucinogen. It was the basis, for example, of the *ajuca* ceremony of the Pankararú Indians and was employed also amongst the Karirí, Tusha, Fulnio, Guegue, Acroa, Pimentiera, Atanaye and other tribes now totally disappeared or fully acculturated. Furthermore, the magico-religious use of this Indian narcotic apparently early entered some of the Afro-American rituals in eastern Brazil.

An early — and probably reliable — report by the Brazilian writer Caminhoa, quoted by the Brazilian botanist Mello Morais in 1881, referred to the hallucinogenic effects of jurema. He stated that medicine men experienced "fantastic and agreeable dreams" following its ingestion (Mello Morais, 1881).

Another early report by the Brazilian missionary José Monteiro de Noronha suggested in 1768 that the use of jurema may once have been much wider (Noronha, 1768). Another early Brazilian report maintained in 1843 that, among the Amanajoz Indians of the Río Negro in western Amazonia, warriors, strong young men and old women singers took a narcotic drink from the root of a certain tree called *jurema*. Still another Brazilian missionary — the Jesuit João Daniel — stated that a number of Amazonian tribes used jurema. These three reports are most certainly erroneous and confused, since they all were probably second-hand, and one of them obviously confused jurema with yopo-snuff and coca powder, both of which are used only in the Orinoco and western Amazon regions.

Jurema does not occur in the rain-forested Amazon. The plant or plants yielding vinho de jurema are native only in the xerophytic caatinga vegetation of the States of Pernambuco and Paraíba. While it is true — as has been pointed out — that certain tribes (e.g., the Amanajó) migrated to various points in the Amazon from northeastern Brazil in the late 1700's, the major question remains unanswered: where could these Indians have found jurema roots in their new and very different environment? In a weak defense of the early and probably erroneous reports, we might mention the slight possibility that the term jurema referred to a number of different psychoactive plants and that these early migrant Indians applied the term to plants in their new home with properties similar to those of the jurema that they had known.

Jurema means "intoxicating drink" in Tupi-Guaraní and, therefore, was applied probably in a wide sense by the peoples who used the term.

It was only in 1873 that botanical studies on jurema began with the work of the Brazilian botanist Aruda Cámara who reported several plants as jurema. A bush known as *jurema branca*, which he identified as "*Mimosa Jurema alba*" was "used as a narcotic". *Jurema prêta*, which he referred to *Acacia Jurema* Mart., grew, he stated, only in the driest areas of the caatingas and sertões, describing it as a large plant from which "the natives prepare a drink which brings on an enchantment, transporting them heaven".

Later, in 1881, Mello Morais wrote more extensively on the botanical aspects of jurema. He reported that the "country folk cure fatigue and with the bark of this tree" and that "the Indians extract from jurema a certain kind of intoxicating wine with delightful effects; to make it, they strip off the bark and, after boiling it for 24 hours, they add honey to counteract the astringency of the inebriating drink which is kept for later use." Mello Morais identified the source as a new species of *Mimosa* which he described and called *M. Jurema*. It is obvious then that his observations were based on botanical specimens.

In 1946, the Brazilian biochemist Oswaldo Gonçalves de Lima collected material of the several juremas in northeastern Brazil. The material was identified by Adolpho Ducke. Jurema prêta, he found, was *Mimosa nigra* Huber and *M. hostilis* (Mart.) Benth. It was the roots of the latter — *M. hostilis* — that yielded the "miraculous drink" consumed ritually in the ajuca ceremony. Jurema branca, used as a stupefacient, is *M. verrucosa* Benth. and other closely allied species.

From this authentically identified material of *Mimosa hostilis*, Gonçalves de Lima isolated an alkaloid which he called nigerine (Gonçalves, 1946). The compound was later shown to be identical with N,N-dimethyltryptamine.

With the knowledge that the active principal of jurema is N,N-dimethyltryptamine, there arises a further and still univestigated problem. This chemical constituent is believed not to be active when taken orally, unless it is accompanied by a monoamine oxidase inhibitor. No such inhibitor has been reported from the roots of *Mimosa hostilis*. Is there one present in minute amounts which has not yet been detected? Or perchance did the Indians employ as additives parts of other plants which contain a monoamine oxidase inhibitor? There are here indicated several courses of investigation: 1) chemical examination with modern sophisticated techniques of the roots of *M. hostilis*, an abundant shrub now of relatively easy access; and, 2) if it still be possible, ethnobotanical field work in northeastern Brazil in the hope that there are still living in the hinterlands a few elderly Indians knowledgable about the preparation of vinho de jurema.

Species indicated in the foregoing discussion:

Mimosa hostilis (*Mart.*) *Bentham* in Trans. Linn. Soc. 30 (1875) 415.
Mimosa verrucosa *Bentham* in Hooker Journ. Bot. 4 (1842) 390.

Mapighiaceae

Banisteriopsis *C.B. Robinson et Small*

Undoubtedly the most widely used and probably culturally the most important South American hallucinogen is the drink variously known as *ayahuasca, caapi, natema, pindé* or *yajé*. Employed in the western half of the Amazon Valley in Bolivia, Brazil, Colombia, Ecuador and Peru, in the uppermost reaches of the Orinoco in Colombia and Venezuela and even, in sporadic localities, on the Pacific slope of the Colombian and Ecuadorian Andes, the drug understandably varies significantly in its preparation from locality to locality and even from tribe to tribe (Naranjo, 1970).

Made basically from the bark of lianas of the Malpighiaceae, the major ingredient is either *Banisteriopsis Caapi* or *B. inebrians*, the bark of which contains three β-carboline alkaloids. Other malpighiaceous plants in this and other genera have, however, on occasion been indicated as sources of the hallucinogenic drink: *B. Cabrerana* Cuatr., *B. Martiniana* (Juss.)

Cuatr. var. *laevis* Cuatr., *B. quitensis*, Ndz. *Mascagnia glandulifera* Cuatr., *Tetrapteris methystica* R. E. Schult., *T. mucronata* Cav. (Schultes, 1957; Friedberg, 1965; Schultes, 1975; Cuatrecasas, 1958).

The study of the botany and chemistry of this narcotic have been complicated by the discovery that many other plants in sundry families are frequently employed as additives, primarily to alter the effects of the drug. Botanical investigations have been made more difficult by the lack of taxonomic understanding of the Malpighiaceae until recently and chemical analyses have suffered from both this lack of botanical precision and from the usual absence of voucher specimens on which exact identification of the vegetal material might be authenticated.

The earliest report of ayahuasca appears to be that of the Ecuadorian geographer Manuel Villavicencio who, in 1858 stated, without citing botanical material, that the source of the drug, was a vine employed by the Záparo, Angatero, Mazán and other tribes of the Río Napo (Villavicencio, 1858).

Seven years earlier, however, in 1851, Spruce had discovered Tukanoan Indians along the Rio Uaupés of Amazonian Brazil using a liana known as caapi, but his observations were not published until later (Spruce, 1874, 1908). He precisely identified caapi as a new malpighiaceous species, which he named *Banisteria Caapi*. Recent botanical studies have shown that the concept is more correctly accommodated in the related genus *Banisteriopsis*. Spruce made an ample collection of the liana in full flower — specimens taken from the same vine from which the drink was prepared. He was so far ahead of his time, actually, that he collected stems for chemical analysis — material that was not chemically studied until 1969 (Schultes, Holmstedt and Lindgren, 1969).

Later, in 1853, Spruce met with the use of caapi amongst the Guahibos of the Orinoco where, he reported, the Indians "not only drink an infusion, like those of the Uaupés, but also chew the dried stem" (Spruce, 1908). Again, in 1857, he encountered the Záparos of Ecuador taking ayahuasca, and he considered it to be "the identical species of the Uaupés, but under a different name" (Spruce, 1908).

In the century that followed Spruce's remarkable work, many explorers, botanists and others — von Martius, Orton, Crévaux, Koch-Grünberg, to name only a few — referred to ayahuasca, caapi, or yajé, usually quite casually and without citing botanical material: stating merely that the drug came from "a jungle liana" (Schultes, 1957; Friedberg, 1965).

Of outstanding interest was the work in 1922 of Rusby in Bolivia. Rusby vouchered all of his collections of drug plants, but we have been unable to locate a specimen of *Banisteriopsis* in his material (Rusby, 1923). Another contribution of major importance was the publication in 1931 by the American botanist Conrad V. Morton of the detailed field notes made by the famous Peruvian botanical collector Guilielmo Klug in the Colombian Putumayo (Morton, 1931). The second of the two major sources of the hallucinogenic drink, *Banisteriopsis inebrians*, was based on Klug's collection. Similarly, the collections of the Russian botanists Varanof and Juzepezuk in the Caquetá area of Colombia in 1925-26 added valuable data based upon botanical material (Schultes, 1957). The field work of the Colombian botanist Hernando García-Barriga has added appreciably to our knowledge (García-Barriga, 1958). In 1957, I published a review of the then known sources of the hallucinogen, incorporating my own field studies in the Colombian Amazon with a review of the literature that had grown up on the problem (Schultes, 1957). This was followed in 1965 by an exceptionally complete ethnobotanical survey of the drug by the French ethnobotanist Claudine Friedberg, who had carried out field work in Peru (Friedberg, 1965). In the meantime, the taxonomist José Cuatrecasas of the Smithsonian Institution had provided, for the first time, a firm basis for classification of ethnobotanical and phytochemical problems with his monograph of the Malpighiaceae of Colombia, published in 1958 (Cuatrecasas, 1958).

But serious complications early arose in attempts to identify the hallucinogen. In 1890, a missionary confused the tree-species of *Datura* or *Brugmansia* employed by the Jívaro with their malpighiaceous narcotic — a confusion that quickly entered the pharmacological and chemical literature. Unfortunately, it has persisted. And at one time, yajé was attributed even to the Aristolochiaceae (Rouhier, 1924)!

Then there arose, primarily from uncritical interpretation of Spruce's field notes, an extraordinary presumption that gained very wide acceptance in the literature: it presumed that, although ayahuasca and caapi were derived from *Banisteriopsis*, yajé referred to the apocynaceous *Prestonia amazonica* (Benth.) Macbr. Although this suggestion has been thoroughly discredited (Schultes and Raffauf, 1960), it persists in the popular and, unfortunately, even in the technical literature. It is responsible for much of the confusion in chemical and pharmacological studies. Spruce, in his field notes, suggested that the Indians of the Vaupés sometimes added a plant, which he felt might have been what the Indians called *caapi-pinima* ("painted caapi"): he noted that it looked like the apocynaceous plant that he had collected earlier in the central Amazon and which was described as a new species: *Haemadictyon amazonicum* Benth. ex Muell.-Arg., now known as *Prestonia amazonica* (Spruce, 1908). This tentative observation was later uncritically interpreted by a French researcher who had never been in the field as a flat assertion and was so published (Reinberg, 1921). *Prestonia amazonica*, collected but once in over 125 years, is known only from a locality nearly 1500 miles from the Uaupés; with all of the now known admixtures used with the drink, there is no question that the local additive to which Spruce referred could not have been *Prestonia amazonica*, especially since so many botanists and ethnologists have worked in the region where Spruce collected and have not found a species of *Prestonia* employed for this hallucinogenic purpose.

It is now definitely known that the major constituents of ayahuasca, caapi and yajé are species of *Banisteriopsis*. There remains, however, the colossal task of elucidating the many additives which Amazonian Indians put with the hallucinogen (Schultes, 1972). These additives or admixtures may be very localized — even to a single medicine man — or they may be widely utilized. There is, in many instances, good reason to assume that they drastically alter or strengthen the effects of *B. Caapi* or *B. inebrians* alone.

The Siona of Colombia add what is probably *Brugmansia suaveolens* (H. et B. ex Willd.) Bercht. et Presl., in itself an hallucinogen. Their neighbors, the Inganos, add the amaranthaceous *Alternanthera Lehmannii.* The Kofán and Jívaro tribes value the solanaceous *Brunfelsia* as an admixture. Makuna medicine men in the Colombian Vaupés add a few crushed leaves of the apocynaceous *Malouetia Tamaquarina* A.DC. Tobacco is occasionally used as an admixture (Schultes, 1957). Several lianas, without identification, are said to be added, but it has not been possible to identify them for lack of specimens. A very thorough field and laboratory study of plant additives to ayahuasca by the Swiss biochemist Laurent Rivier and the Swedish chemist Jan-Erik Lindgren has disclosed the use of at least two dozen plants, including ferns and several cactuses (Rivier and Lindgren, 1972).

Recently, two of the many admixtures have attracted special attention, because phytochemical investigation of botanically vouchered material has substantiated folk uses. More often than not, specialists have explained away indigenous uses of plants as being grounded in superstition. These two admixtures in question are *Banisteriopsis Rushyana* (Ndz.) Morton and *Psychotria viridis* R. et P. The leaves — not the bark — of both plants are used, apparently never together, however, as admixtures.

In 1965, the French chemist M. J. Poisson reported that the leaves of *Banisteriopsis Rushyana* contained relatively high concentrations of N,N-dimethyltryptamine (Poisson, 1965). This discovery, corroborated by several later investigators (Agurell, Holmstedt and Lindgren, 1968; der Marderosian et al., 1968) was the first report of a tryptamine in the Malpighiaceae. There were also minor tryptamines present, as well as traces of β-carbolines. The leaves of *B. Rushyana*, known in Colombia and Ecuador as *oco-yajé*, are said to heighten and lengthen the visual hallucinations of the intoxication. It is now clear that there is a chemical basis for this use: the resulting drink, containing the β-carboline alkaloids of *B. Caapi* and *B. Rushyana* — both hallucinogenic indole derivitives — is, in effect, far more potent.

More recent field work has indicated the use as additives in widely separated parts of the Amazon of the leaves of several species of Psychotria — especially *P. viridis* (der Marderosian, 1970). This additive, which is apparently far more commonly utilized than *Banisteriopsis Rusbyana*, likewise has been found to contain N,N-dimethyltryptamine — the first indication of this typtamine in the Rubiaceae.

Several writers — notably Spruce and Koch-Grünberg — mentioned more than one kind of caapi in the basin of the Rio Uaupés of Colombia and Brazil. In 1948, I witnessed the preparation and experimented with a caapi prepared from a different malpighiaceous plant amongst the nomadic Makú Indians of the Rio Tikié, in northwesternmost Brazil. Specimens of the liana, from the bark of which a cold water infusion was made, represented an undescribed species of the genus *Tetrapteris*, closely allied to *Banisteriopsis*, which I described and named *T. methystica* (Schultes, 1954c). It is worth considering the possibility that this species is the second "kind" of caapi mentioned by Spruce and Koch-Grünberg, and it might be that the name *caapi-pinima* ("painted caapi") reported by both of these investigators alludes not to coloured leaves but to the unusual yellowish hue of the drink in contrast to the normal dark brown colour of the hallucinogen prepared from the species of *Banisteriopsis*.

Much field and laboratory research must be carried out before a complete understanding of the ayahuasca-caapi-yajé complex is available. It is disconcerting that the rapidity of acculturation throughout the Amazon Valley may soon bring about the loss of much of the knowledge of plant uses amongst the Indians. It will then be too late to retrieve extremely valuable information.

Species indicated in the foregoing discussion:

Banisteriopsis Caapi (Spr. ex. Griseb.) Morton in Journ. Wash. Acad. Sci. 21 (1931) 485.
Banisteriopsis Cabrerana Cuatrecasas in Webbia 23, pt. 1 (1958) 493.
Banisteriopsis inebrians Morton in Journ. Wash. Acad. Sci. 21 (1931) 485.
Banisteriopsis Martiniana (Juss.) Cuatrecasas var. laevis Cuatrecasas in Webbia 13 (1958) 502.
Banisteriopsis quitensis Niedenzu in Lect. Lyc. Brunsberg (1900-01):10 (1900) Malpigh. 427.
Banisteriopsis Rusbyana (Ndz.) Morton in Journ. Wash. Acad. Sci. 21 (1931) 487.
Mascagnia glandulifera Cuatrecasas in Webbia 13 (1958) 365.

Tetrapteris methystica R.E. Schultes in Bot. Mus. Leafl., Harvard Univ. 16 (1954) 202.
Tetrapteris mucronata Cavanilles, Diss. 9 (1790) 434, t. 262.

SOLANACEAE

Latua *Philippi*

There is an unusual and rare spiny shrub or small tree — apparently a strict endemic of the coastal mountains of central Chile — which has long been used as a virulently toxic plant capable of producing delirium, hallucinations and, occasionally, permanent insanity. The genus is monotypic, consisting of a single species: *Latua pubiflora* (Griseb.) Baillon.

Although the identification of this hallucinogen has been available for more than a century, little, until recently, has been known of its use and properties.

Latua pubiflora was first described by the German botanist August H.R. Griesbach in 1854 as a species of *Lycioplesium*. Later, in 1858, the Chilean botanist R. A. Philippi described the plant as representing a new genus, *Latua*, giving it the name *Latua venenosa* (Philippi, 1858). It was not until 1888 that the French taxonomist Henri E. Baillon made the correct combination, assigning the currently accepted name of *Latua pubiflora*.

The narcotic use of *Latua pubiflora* — known locally as *latué* or *árbol de los brujos* ("sorcerers' tree") — was first associated with the plant in 1858 by Philippi: ". . . the native Indians posses a secret to madden a person by means of a vegetable poison". He related several cases of intentional and accidental intoxication (Philippi, 1858).

A few collections of *Latua pubiflora* have been made during the past 120 years, but a thorough survey of the plant, and its use, following extensive field work, has only recently been published (Plowman, Gyllenhaal and Lindgren, 1971). The occurrence and use of latué is still a closely guarded secret surrounded by superstition, as it is utilized in magico-medical rites by shamans and sorcerers.

Species indicated in the foregoing discussion:

Latua pubiflora (Griseb.) Baillon, Hist. Plant. 9 (1888) 334.

Conclusion

A few closing words may bring into relief several salient points of interest.

1) There is no doubt — whether or not supporting archaeological or early literature evidence be available — that the indigenous use of all of the major psychoactive drugs of South America indicates great age.

2) For coca, archaeological material puts its use back at least as far as 3000 BC — 5000 years ago. Actual authenticated botanical identification came about in 1749 — 229 years ago.

3) The earliest literature reference to yopo-snuff is apparently 482 years old — made in 1496. The source plant was not botanically determined until 1801.

4) For the hallucinogenic preparations made from *Virola*, the first literature reference seems to be one published in 1923. The actual source plants, however, were not identified specifically on the basis of botanical material until 1954.

5) A description of the use and effects of ayahuasca appeared in the literature in 1858, although the same drug, under the name caapi, had been botanically collected, named and described, but not published, in 1851.

6) The Chilean árbol de los brujos or latué was discovered and botanically identified in 1854, but the narcotic use of the species was indicated only in 1858.

7) The earliest literature reference to jurema dates from the late 1700's. Botanical identification began in 1873 and was substantiated only in 1946.

These observations indicate how much basic botanical work has been accomplished during the past century. This century has been marked by ever increasing acculturation and even disappearance of native cultures in South America. There are sundry minor yet extremely interesting hallucinogens and narcotics — half a dozen of them reported only during the last 10 or 15 years — of which we know next to nothing. It behooves ethnobotanists and enthnopharmacological investigators to study these psychoactive plants, their use and their significance in aboriginal societies before the race with acculturation or extinction of indigenous cultures is forever lost.

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PLATE 36

mode de nutrition. Nous n'apprendrons jamais à digérer des terres et à les assimiler; mais, depuis que les grands travaux de MM. Gay-Lussac et Thénard nous ont fait connoître que de légères différences de proportions d'oxigène, d'hydrogène et de carbone caractérisent seules le bois le plus dur et la matière amylacée, comment nier que la chimie ne puisse réussir un jour à convertir en substance alimentaire ces énormes masses végétales, ces tissus à fibres endurcies qui composent le tronc des arbres de nos forêts? Pour qu'une telle découverte fût importante, elle devroit être fondée sur des procédés simples et peu coûteux : mais dans cette supposition, qui ne paroît guère probable, elle changeroit l'organisation des corps politiques, le prix du travail, la distribution de la population sur le globe. En rendant l'homme plus indépendant, elle tendroit à dissoudre les liens de la société, à sapper les bases de l'industrie et de la civilisation.

Le petit village d'Uruana est plus difficile à gouverner que la plupart des autres missions. Les Otomaques sont un peuple inquiet, bruyant, effréné dans ses passions. Ils n'aiment pas seulement avec excès les liqueurs fermentées de manioc et de maïs et le vin de palmier; ils se mettent aussi dans un état particulier d'ivresse, on pourroit presque dire de démence, par l'usage de la poudre de *niopo* [1]. Ils cueillent les longues gousses d'une Mimosacée que nous avons fait connoître sous le nom d'*Acacia Niopo* [2]; ils les mettent en morceaux, les humectent et les font fermenter. Lorsque les graines amollies commencent à noircir, ils les pétrissent comme une pâte; et, après y avoir mêlé de la farine de manioc et de la chaux tirée de la coquille d'une Ampullaire, ils exposent toute la masse à un feu très-vif sur un gril de bois dur. La pâte durcie prend la forme de petits gâteaux. Lorsqu'on veut s'en servir, on la réduit en une poudre fine qu'on place sur un plat de 5 ou 6 pouces de largeur. L'Otomaque tient ce plat, qui a un manche, dans sa main droite, tandis qu'il aspire le *niopo* par le nez à travers un os fourchu d'oiseau dont les deux extrémités aboutissent aux narines. L'os, sans lequel l'Otomaque ne croiroit pas pouvoir prendre cette espèce de tabac en poudre, a 7 pouces de longueur : il m'a paru être le tarse d'un grand Échassier. J'ai envoyé le *niopo* et tout ce singulier appareil à M. de Fourcroy à Paris. Le *niopo* est si excitant que les plus petites portions font éternuer violemment ceux

[1] En maypure, *nupa*; les missionnaires disent *ñopo*.

[2] C'est un Acacia à feuilles très-délicates, et non un Inga, comme a dit par mégarde M. *Willdenow* (*Spec. Plant.*, Tom. IV, Pl. II, p. 1027). Une autre espèce de Mimosacée que nous avons rapportée (le *Chiga* des Otomaques et le *Sipa* des Maypures) donne des graines dont la farine est mangée à Uruana comme du manioc. C'est de cette farine que l'on prépare le *pain de chiga* qui est commun à Cunaviche et sur les bords du Bas-Orénoque. Le *Chiga* est une espèce d'*Inga*, et je ne connois point d'autre Mimosacée qui supplée aux Céréales.

Plate 36. Von Humboldt's identification of the source of the narcotic snuff *niopo* of the Otomac Indians.

16. Jahrgang. № 33. 13. August 1858.

BOTANISCHE ZEITUNG.

Redaction: *Hugo von Mohl.* — *D. F. L. von Schlechtendal.*

Latua Ph., ein neues Genus der Solanaceen.

Von

Prof. Dr. **R. A. Philippi** in Santjago.

Bereits vor sechs Jahren erfuhr ich in der Provinz Valdivia, dass die dortigen Indianer das Geheimniss besässen, vermittelst eines vegetabilischen Giftes die Menschen verrückt zu machen, und zwar auf längere oder kürzere Zeit, je nach der Stärke der Gabe dieses Giftes, dass sie die Sache aber als ein grosses Geheimniss behandelten. Dem Pater Romualdo, Missionär in Daglipulli, gelang es zu erfahren, dass die Pflanze ein hoher Strauch sei, *Latúe* heisse, hie und da im Urwalde des Kustengebirges wachse, und endlich auch einen Zweig zu erhalten. Dieser war jedoch ohne Blätter, indem der Indier, welcher ihn brachte, unstreitig glaubte, der Pater wollte denselben haben, um seine giftigen Eigenschaften, welche hauptsachlich in der Rinde sitzen, zu erforschen. Später erfuhr ich von Herrn Juan Renous Näheres über den *Latúe*. Der Strauch sei dem *Tayu* oder *Palo Santo*, *Flotowia diacanthoides*, im Wuchse, in den Dornen und Blättern überaus ähnlich, die Bluthe sei aber wie von der Gestalt und Grösse der von *Sarmienta repens* R. et P. (einer Gesneriacee, welche zwischen den Moosen und Farrnkräutern der Stämme und grösseren Aeste kriechend und durch ihre scharlachrothen Blumen damit lebhaft contrastirend zu den schönsten Zierden der Wälder des südlichen Chiles gehört). Von der Frucht wusste mir Herr Renous nichts zu sagen, wohl aber theilte mir derselbe mehrere Fälle von absichtlichen und unfreiwilligen Vergiftungen mit. Letztere sind um so leichter, als der Strauch, wie eben gesagt, dem *Tayu* so sehr ähnlich ist, dessen Rinde äusserlich und innerlich in Gestalt eines Dekoktes für ein vortreffliches Mittel gegen Quetschungen, Erschutterungen durch Fall, Hufschläge u. s. w. gilt. So theilte er mir unter andern folgenden Fall mit, der kurzlich passirt war Einer seiner Holzarbeiter hatte einen heftigen Schlag mit dem stumpfen Ende einer Axt erhalten, und ging in den Wald, um sich dagegen Rinde von *Tayu* zu holen, ergriff aber statt dessen *Latúe* und trank die Abkochung von diesem Gift. Fast unmittelbar darauf wurde er verrückt und lief in die Wälder, wo er erst nach Ablauf von drei Tagen in bewusstlosem Zustande gefunden wurde. Einige Tage genügten zwar, ihn wieder herzustellen, allein er behielt Monate lang heftige Kopfschmerzen. Eben so giftig wie die Rinde sind die Fruchte, welche durch ihre Farbe und Grösse einige Aehnlichkeit mit jungen Aepfeln haben. Ein Paar Leute, welche auf dem Wege von Osorno nach Moullin, wo demnach die *Latúe* auch wachsen muss, sich verleiten liessen, ein Paar Fruchte zu essen, kamen fast ohne Bewusstsein und ganz verstort an letzterem Orte an. Leider habe ich nichts Näheres über die Symptome erfahren, welche der Genuss der *Latúe* hervorbringt, und über die Gegenmittel, welche die Indianer anwenden, um die übeln Folgen der Vergiftung zu beseitigen.

Meine Begierde, eine so merkwürdige Pflanze kennen zu lernen, war natürlich sehr gross, und ich sparte keine Mühe, mir Exemplare derselben mit Blüthen und Frucht zu verschaffen, aber lange waren meine Anstrengungen vergehens. Im Jahre 1854 fand Herr C. Ocsenius am Ufer des Riobueno oder Trumao zwischen den Orten los Juntas und Trinidad einen ihm unbekannten Strauch in Blüthe, brach

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Plate 37. The report by Philippi of the toxic nature of *Latua* (1858).

PLATE 38

(20)

2) *Inermes.*

30. A. Guachapele. †

A. inermis; foliis bipinnatis; pinnis 4 - 5 - jugis; foliolis 5 - 6 - jugis, obovatis vel subelliptico - oblongis, membranaceis, utrinque pubescentibus; glandula in medio petioli interque summum pinnarum par; floribus axillaribus, capitatis, monadelphis; leguminibus linearibus, longe rostratis. (*VI. p.* 281.)

Guachapele *Guayaquilensium*.

Crescit in sylvis, prope Guayaquil Quitensium. ♄ *Floret Martio.*

Lignum ad construendum aptissimum.

Acaciæ Lebbeck valde affinis.

31. A. pectinata. †

A. inermis; foliis bipinnatis, eglandulosis; pinnis sub 15-jugis; foliolis 50 - 60 - jugis, linearibus, obtusis, submucronatis, dimidiato - subhastatis, uninerviis, subcoriaceis, supra glabris, nitidis, subtus sericeo-pubescentibus. (*VI. p.* 282.)

Inga pectinata. *Willd. Sp. pl.* 4. *p.* 1126.

Crescit ad ripam fluminis Cassiquiares. (*Missiones del Alto Orinoco.*) ♄ *Floret Majo.*

An vere hujus generis ?

32. A. Niopo. †

A. inermis; foliis bipinnatis; pinnis sub 23 - jugis; foliolis 50 - 70 - jugis, linearibus, subfalcatis, acutis, obsolete uninerviis, membranaceis, glabris, ciliatis; glandula supra basim petioli et inter summum pinnarum par; leguminibus linearibus, rostratis. (*VI. p.* 282.)

A. Niopo. *Humb. Relat. hist. II. p.* 620 — 623.

Inga Niopo. *Willd. Sp. pl.* 4. *p.* 1027.

Niopo *incolarum*.

Crescit prope Maypures, Atures, etc. (*Missiones del Orinoco.*) ♄ *Fructificat Majo.*

Ex seminibus tritis calci vivæ admixtis fit tabacum nobile quo Indi Otomacos et Guajibos dicti utuntur. (Humb. Relat. hist. II. p. 620.)

Plate 38. Kunth's report of the source of the snuff known as *niopo*. Synopsis Plantarum . . . of 1825.

PLATE 39

Jurema. (*Mimosa jurema.*) — Arvore de mediana grandeza, que vegeta em terrenos fracos e seccos.

USOS MEDICINAES

A entre-casca da jurema serve em cozimento, para lavar feridas. A casca da raiz, serve para curar as diarrhéas, tomado o cozimento em clyster.

Os sertanejos, curam o cansaço, e a cachexia, com a casca d'esta arvore.

Os indios extrahem da jurema, certa especie de vinho, que embriaga, com transporte delicioso; e para este fim, tiram a casca, poem-n'a em infusão, por 24 horas, coam depois a infusão, ajuntam-lhe mel de abelhas, para corrigir o gosto adstringente d'essa embriagante bebida, e guardam-n'a para o uso.

Os sertanejos empregam a entre-casca da jurema, como fortificante do apparelho uterino.

Jurubeba. (*Solanum paniculatum.*)—Planta, de grandeza mediana, tendo as folhas largas, e todas ellas semeadas de espinhos. E' mui conhecida na Bahia, Sergipe, Alagoas e Pernambuco, onde vegeta em abundancia. Esta planta é mui estimada por suas virtudes medicinaes.

USOS MEDICINAES

A raiz cozida, e dada a beber, cura as gonorrhéas, combatendo ao mesmo tempo o virus syphilitico. A fructa, que é amarga, é grande remedio para as aposthemas internas; bem como servem-se do sumo bebido, e posto externamente nas contusões, pela manhã, e á noite, misturado com agua. E', além d'isso, estomacal, e um precioso desobstruente do figado.

O padre-mestre José Bonifacio Bezerra de Mello (meu professor de latim), constantemente comia, cómo regalo,a fructa da jurubeba.

Jussara ou assahy. (Alagoas.)—Especie de coqueiro, mui abundante nas Alagoas.

USOS NA INDUSTRIA

A industria póde obter d'esta planta, optimo vinho.

Jussara.—Especie de capim, cuja folha imita ao capim *Sapé*, e deita flôr amarella.

Plate 39. The report of *jurema* made by Mello Morais in 1881 in his *Phytographia ou Botanica Brasiliera.*

PLATE 40

No pasaremos en silencio una de las cosas que á nuestro modo de ver llamará la atencion, i es un bejuco del cual hacen uso los Zaparos, Santa Marias, Mazanes i Angutéros

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para adivinar, prever i contestar con acierto en los casos difíciles, ya sea para dar respuestas oportunas á los embajadores de las otras tribus cuando se trata de hacer la guerra, ya para descubrir los planes del enemigo por medio de esta mágica bebida i tomar las disposiciones convenientes para el ataque i defensa, ya en caso de enfermedad de un pariente para averiguar cual *brujo* lo tiene en ese estado, ya para hacer una visita amistosa á otras tribus, ya cuando les llega gente estraña como viajeros, ya, en fin, para cerciorarse del amor de sus mugeres. La operacion consiste en lo siguiente: toman un bejuco llamado *Aya huasca* (bejuco de muerto ó almas) del cual hacen un lijero cocimiento i lo bebe el indio que debe dar las respuestas ó arreglar los planes i muchas veces lo beben todos los indios que forman el congreso: esta bebida es narcótica, como debe suponerse, i á pocos momentos empieza á producir los mas raros fenómenos. Su accion parece dirijirse á escitar el sistema nervioso; todos los sentidos se avivan i todas las facultades se despiertan; sienten vahidos i rodeos de cabeza, luego la sensacion de elevarse al aire i comenzar un viaje aéreo; el poseido empieza á ver en los primeros momentos las imájenes mas deliciosas, conforme á sus ideas i conocimientos: los salvajes dicen que ven lagos deliciosos, bosques cubiertos de frutas, aves lindísimas que les comunican lo que ellos desean saber de agradable i favorable, i otras bellezas relativas á su vida salvaje. Pasado este momento empiezan á ver fieras terribles dispuestas á desgarrarlos, les falta el vuelo i bajan á tierra á combatir con las fieras quienes les comunican todas las desgracias i desventuras que les aguarda; en este momento

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se levanta el salvaje que estaba como en estupor i procura tomar las armas, insulta á sus mayores amigos que lo contienen á la fuerza dentro de la hamaca, hasta que se duerma, lo que no tarda mucho en suceder. Yo, por mí, sé decir que cuando he tomado el *Ayahuasca* he sentido rodeos de cabeza, luego un viaje aéreo en el que recuerdo percibia las prespectivas mas deliciosas, grandes ciudades, elevadas torres, hermosos parques i otros objetos bellísimos; luego me figuraba abandonado en un bosque i acometido de algunas fieras, de las que me defendia; en seguida tenia sensacion fuerte de sueño del que recordaba con dolor i pesadez de cabeza i algunas veces mal estar general. El salvaje toma el *Ayahuasca* muchas veces por placer pero necesita de personas robustas que estén cerca para sujetarlo fuertemente en una hamaca; por que si se le dejara en libertad i se apoderara de cualquiera arma, tal vez no escaparia con vida ninguno de los circunstantes: tales son la furia i las bravatas que dice á los espectros malignos. Pasado el último sueño recoje los recuerdos que tuvo cuando veia las visiones, i segun sus supersticiones arregla las determinaciones que debe tomar. El *Ayahuasca* no se permite á los muy jóvenes ni á las mugeres: los efectos de esta bebida no son inferiores á los que hace la composicion de ópio, de la cual se sirven los orientales en Asia para engolfarse en agradables ilusiones.

Plate 40. Villavicencio's description of the use of *ayahuasca* in Ecuador (1858)

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THE CORRECT NAME FOR SIBERIAN GINSENG

DJAJA D. SOEJARTO[1,2] AND NORMAN R. FARNSWORTH[1]

"Siberian Ginseng" is a vernacular name associated with an araliaceous plant and its product, which is now imported primarily from the Soviet Union and marketed in health food stores here in the U.S.A., Europe and elsewhere. The product is prepared from the roots of *Eleutherococcus senticosus* (Rupr. & Maxim.) Maxim., which is commonly referred to as "Devil's Shrub", "Touch-me-not", "Prickly Eleutherococc", "Eleutherococc", and "Siberian Ginseng". This species grows in Eastern Siberia, Sakhalin Island, Japan, South Korea, Manchuria, and the Chinese Provinces of Shansi and Hopei. A taxonomic description of *E. senticosus* is provided by Poyarkova (1973).

It is interesting to note that *E. senticosus* is not mentioned to any extent in the early Oriental medical writings as having useful properties. However, extracts of the roots of *E. senticosus* have been studied extensively in the Soviet Union for about 25 years; more than 200 scientific periodicals can be found on *in vitro, in vivo,* and *in situ* effects, as well as scores of papers reporting results of human studies. These studies have been pioneered by Brekhman (1969, 1970), Dardymov (1976) and their co-workers, and are continuing. The major effects attributed to extracts of *E. senticosus* roots relate to an anti-stress phenomenon, called by Russian workers "an adaptogenic effect", the mechanism for which remains unclear.

Since this plant is an important item of commerce, and because a great deal of confusion seems to be apparent in the herb industry relative to the priority of the binomial *Eleutherococcus senticosus* over *Acanthopanax senticosus* (or *vice*

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versa), we undertook a study to clarify the taxonomic and nomenclatural position of this taxon.

The genus *Eleutherococcus*[3] was established by Maximowicz in 1859 with *E. senticosus* as the type species, on the basis of plant specimens collected from Amur and Ussuri (Siberia). Previously, this plant was known to Ruprecht and Maximowicz as *Hedera senticosa* Rupr. & Maxim. (1857), but later Maximowicz recognized it as belonging to a new taxon, for which he introduced the name *Eleutherococcus*, and re-named the plant *Eleutherococcus senticosus* (Rupr. & Maxim.) Maxim.

The genus *Acanthopanax*[4] was established by Miquel in 1863, when he raised the subgenus *Acanthopanax* Decne. & Pl., of the genus *Panax* L., into a generic status. A new taxon, *Acanthopanax spinosum* Miq., accompanied the generic description.

In 1898, Harms merged *Eleutherococcus* into the genus *Acanthopanax*, and the name of our plant became *Acanthopanax senticosus* (Rupr. & Maxim.) Harms. After 1898, some authors continued to use the binomial *E. senticosus* (e.g., Nakai, 1924; Liou, 1959; including the references cited therein), while others used *A. senticosus* (e.g., Schneider, 1912; Harms & Rehder, 1916; Rehder, 1922; Li, 1942).

The union of the genera by Harms demonstrates that a close taxonomic relationship exists. Subsequently, Harms treated members of *Eleutherococcus* under the Section *Eleutherococcus* of the genus *Acanthopanax*, whereas members of *Acanthopanax* were treated under the Section *Euacanthopanax*. The creation of these two Sections within the genus clearly indicates that Harms did recognize the differences that separate the two plant groups.

In 1924, Nakai re-instated the generic status of *Eleutherococcus*, but in 1942, Li treated *Eleutherococcus* again under *Acanthopanax*, as did Harms (1898). In 1950, once again, the genus *Eleutherococcus* was re-instated in the Flora of the U.S.S.R. (Poyarkova, 1973).

After studying specimens belonging to *Eleutherococcus* and

[3]From the Greek *eleutheros* = free, and *coccon* = seed.

[4]From the Greek *akanthos* = thorn or spine, and *Panax* = name of genus.

Acanthopanax[5], and analyzing the published original descriptions of the same, we came to the conclusion that the major features that separate the two taxa are as follows:

> **Eleutherococcus:** Flower pedicels not jointed, flowers in solitary umbels, ovary 5-loculed and 5-styled (rarely 3-6), fruits globose or acute with 5 seeds (rarely 3-6).
>
> **Acanthopanax:** Flower pedicels jointed, flowers in racemose or paniculate umbels, ovary 2-loculed and 2-styled (rarely 3-loculed and 3-styled), fruits flat or compressed, with 2 (rarely 3) seeds.

Basically, these are criteria used by Bentham & Hooker f. (1867) in maintaining the separation of *Eleutherococcus* from *Acanthopanax* at the generic level. It is also worthwhile to note that Nakai (1924) emphasized the differences that separate these two taxa in the number of styles and the number of cells (locules) of the ovary, as well as in the shape of the fruits. The presence or absence of articulation in the flower pedicels, according to Nakai (1924) is not an important character, since this phenomenon is seen only in dried specimens, caused by the unequal shrinking of the parenchyma cells.

We feel that the criteria defined above are strong enough to separate the two taxa at the generic level. Union of the taxa results in a heterogeneous group taxonomically, as Li (1942) has admitted. Li further states that this "genus [*Acanthopanax, s.l.*] is heterogeneous and may ultimately require certain segregations" (1942: 6). On the basis of the present evidence, we recognize the genus *Eleutherococcus* (with about 15 species) as distinct from *Acanthopanax* (with about 25 species).

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As a consequence, the correct name for "Siberian Ginseng" should be *Eleutherococcus senticosus* (Rupr. & Maxim.) Maxim. The binomial *Acanthopanax senticosus* (Rupr. & Maxim.) Harms is thus relegated to synonymy.

The legitimacy of *Eleutherococcus senticosus* does not change, even if *Eleutherococcus* and *Acanthopanax* are united. When Harms (1898) merged *Eleutherococcus* with *Acanthopanax*, the name *Eleutherococcus* should have been retained, in accordance with the law of priority. Article *57.1* of the International Code of Botanical Nomenclature (Stafleu, 1978) states: "When two or more taxa of the same rank are united, the oldest legitimate name or (for taxa below the rank of genus) the oldest legitimate epithet is retained . . ." As such, *Acanthopanax* (Miq.) Harms is illegitimate, and so is *A. senticosus* (Rupr. & Maxim.) Harms.

Finally, it is our opinion that only critical studies covering the entire taxonomic and geographic ranges of *Eleutherococcus* and *Acanthopanax* will enable one to judge correctly, if union of these two taxa is warranted.

Eleutherococcus senticosus (Rupr. & Maxim.) Maxim., Mém. Présent. Acad. Impér. Sci. St.-Pétersb. Ser. 6c, 9: 132. 1859; Nakai, J. Arnold Arbor. 5: 10. 1924; Poyarkova *in* Shishkin, Fl. USSR 16: 17. 1973.

Hedera senticosa Rupr. & Maxim., Bull. Phys.-Math. Acad. Impér. Sci. St.-Pétersb. 15: 134. 1857.

Acanthopanax senticosus (Rupr. & Maxim.) Harms *in* Engler & Prantl, Natürl. Pflz. Fam. 3(8): 50. 1898; Li, Sargentia 2: 71. 1942.

Acanthopanax eleutherococcus Makino, Bot. Mag. Tokyo 12: 19. 1898. (*Fide* Nakai, 1924; Li, 1942; Poyarkova, 1973).

Eleutherococcus koreanus Nakai, Fl. Sylv. Koreana 15:32. 1926. (*Fide* Nakai, 1924; Li, 1942; Poyarkova, 1973).

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